

Medical Terminology

7TH EDITION

AN ILLUSTRATED
GUIDE



Barbara Janson Cohen
Ann DePetris



Wolters Kluwer
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Dedications

I am most grateful to Ann DePetris, a skilled and knowledgeable contributor to this text. Ann has shown a great commitment to the development of this revision, always willing to share the work and bringing her clinical expertise to the project. Thanks, Ann, for being a great and generous coworker. It's to you that I dedicate this edition of the book.

Barbara Cohen

To some very special people in my life—my husband Michael, son Paul, daughter Marie, and her husband Bobby. This wouldn't have been possible without all of your loving patience and unconditional support. And to Barbara Cohen—the uniqueness and high standards reflected in *Medical Terminology: An Illustrated Guide*, are the direct result of your unbelievable dedication and skills. You are a remarkable author and educator, and a true mentor. Barbara, it has been an honor and pleasure to work with you on this seventh edition. It's to all of you I dedicate my contributions to this edition.

Ann DePetris

Preface

Knowledge of medical terminology is fundamental to a wide variety of health care fields. This book is designed to satisfy the basic learning requirements needed to practice in any health career setting. In the course of your training and future careers, you will need to learn thousands of new terms. The job might be overwhelming if not for learning the skills of dividing the words into their component parts. These roots, suffixes, and prefixes appear over and over in different terms but retain the same meanings. Knowing these meanings will help you define and remember a host of words. This process is like using a set of building blocks to assemble different structures. Using a more scientific example, it's like using the four bases in DNA to code for all the amino acids needed to make proteins.

After the introductory sections, each chapter begins with an illustrated overview of a specific body system with definitions of the key terms related to that system. Tables of word parts and exercises on using them follow. Turning to the abnormal, a section on diseases and treatments is included, followed by definitions of relevant key terms. The section of supplementary terms includes words and phrases that are “good to know” if time allows or if someone is particularly interested in that specialty. The sequence of the systems chapters differs slightly from that found in

traditional anatomy and physiology books. The organization emphasizes their clinical importance, starting with the cardiovascular, respiratory, and digestive systems and continuing with systems treated in more specialized fields, such as the urinary, reproductive, and musculoskeletal systems. The chapters can be taken out of order once the introductory units are completed.

We have tried to make this book easy to use and full of reinforcing drills. We have also included many phonetic pronunciations so you can recognize technical terms when they are spoken and can comfortably use them yourself. The online student learning resources offer many additional activities and an audio glossary. Each chapter opens with a short case study. Some of the words and abbreviations in these studies will be unfamiliar at the start, but return to the opening study after you have completed the chapter, and hopefully, it should make more sense.

You are probably at the beginning of a long journey to gain accomplishment in your chosen field. We hope that this book will aid you in that endeavor and provide a basis on which to build your career.

Barbara Cohen and Ann DePetrìs

Acknowledgments

In our constant quest to improve the quality of *Medical Terminology: An Illustrated Guide*, we rely on the advice and talents of many people. First, we want to acknowledge the observant instructors and students who take the time to suggest improvements in the text. Also we thank the reviewers, who make many valuable suggestions for revisions. The clinicians who contributed current information in their respective fields include: Margaret O. Burr, BS, RVT, RDMS; Michael DePetrìs, R. Ph.; Paul DePetrìs, BS; Mary Green, PA-C; Nancy Gurzick, RDH, BS, MA; Marie Howard, PT, DPT; Robert Howard, DO; Bonnie L. Lehman BSN, MS, CNM; Christine Licari, RD; Pamela Morgan, OTR/L;

Christina Olkowski, MT (ASCP); Donna Robertson, RNC, MSA; Anne Tobin, RN, MSN, ACNP; and Terese A. Trost MA, RT. The information they shared will help guide students through various career paths. Thanks to you all.

As always, we are grateful to the dedicated staff of Lippincott Williams & Wilkins; especially for this edition, Staci Wolfson, Product Manager, who worked on every aspect of the book and its ancillaries; and David Troy, Executive Editor, who oversaw this project from start to finish.

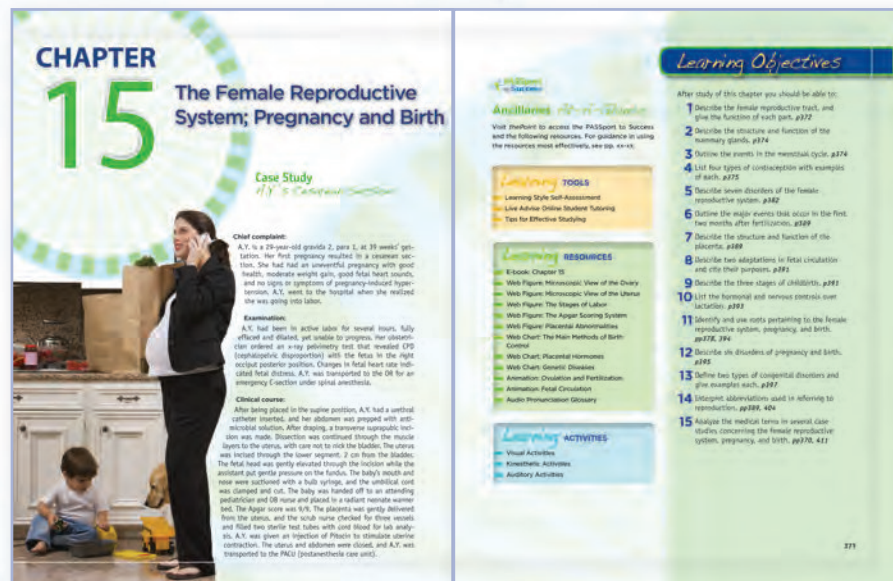
Barbara Cohen
Ann DePetrìs

User's Guide

Medical Terminology: An Illustrated Guide, 7th edition, was created and developed to help you master the language of medicine. The tools and features in the text will help you work through the material presented. Please take a few moments to look through this User's Guide, which will introduce you to the features that will enhance your learning experience.

Chapter Contents, Objectives, and Pretests

Chapter Opening Case Studies and Objectives help you identify learning goals and familiarize yourself with the materials covered in the chapter. **Chapter Pretests** quiz students on previous knowledge at the beginning of each chapter. Students should take each Chapter Pretest before starting the chapter and again after completing the chapter in order to measure progress.



Detailed Illustrations

Illustrations: Detailed, full-color drawings and photographs illuminate the chapters. These include clinical photographs and tissue micrographs. The many figures amplify and clarify the text and are particularly helpful for visual learners.

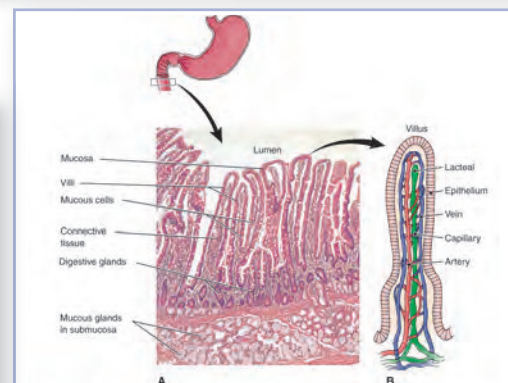
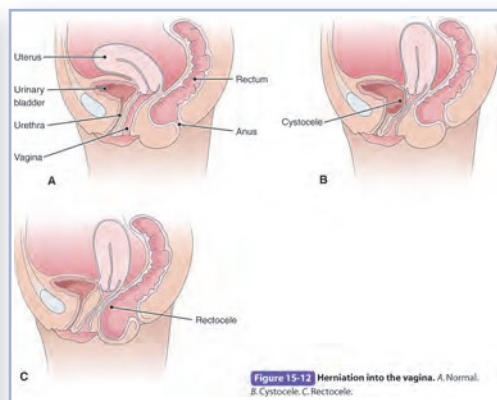
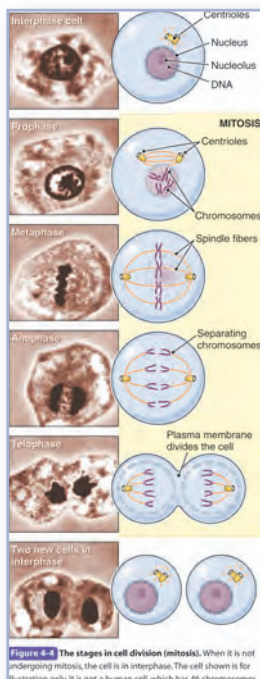
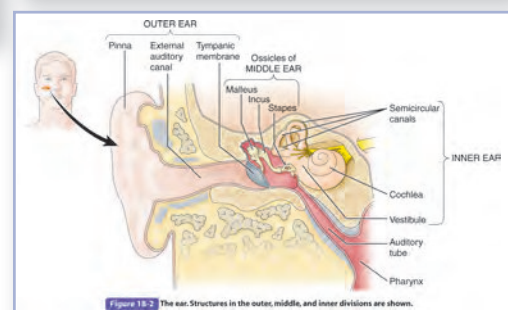


Figure 12-4 Intestinal villi. A. Microscopic view of the small intestine showing villi and glands that secrete mucus and digestive juices. The lumen is the central opening. B. An intestinal villus. Each villus has blood vessels and a lacteal (lymphatic capillary) for nutrient absorption.



Feature Boxes

FEATURE BOXES CALL OUT IMPORTANT INFORMATION

Focus on Words boxes provide historical or other interesting information on select terms within a chapter.

Box 2-1 *Focus on Words*

Meaningful Suffixes

Suffixes sometimes take on a color of their own as they are added to different words. The suffix *-thion* is taken from the name of the Greek town Marathon, from which news of a battle victory was carried by a long-distance runner. It has been attached to various words to mean a contest of great endurance. We have bike-a-thons, dance-a-thons, telethons, and even major charity fundraisers called thon-a-thons.

The adjective ending *-ish* is used, as in *boyish* or *childish*, to suggest traces of certain characteristics. People tack it onto words to indicate that they are estimates, not right on target, as in *forty-ish* or *blue-ish*. A vague time for a lunch appointment could be *noon-ish*.

In science and medicine, the ending *-tech* is used to imply high technology, as in the company name Genentech, and *-pure* may be added to inspire confidence, as in the naming of the Multi-Pure water filter. The ending *-mate* suggests helping, as in *helpmate*, defined in the dictionary as a helpful companion, more specifically, a wife, or sometimes, a husband. The medical device HeartMate is a pump used to assist a damaged heart.

Clinical Perspectives boxes focus on body processing as well as techniques used in clinical settings.

Box 10-6 *Clinical Perspectives*

Use of Reticulocytes in Diagnosis

As erythrocytes mature in the red bone marrow, they go through a series of stages in which they lose their nuclei and most other organelles, maximizing the space available for hemoglobin. In one of the last stages of development, small numbers of ribosomes and some rough endoplasmic reticulum remain in the cell and appear as a network, or reticulum, when stained. Cells at this stage are called reticulocytes. Reticulocytes leave the red bone marrow and enter the bloodstream, where they become fully mature erythrocytes in about 24 to 48 hours. The average number of red cells maturing through the reticulocyte stage at any given time is about 1 to 2 percent. Changes in these numbers can be used in diagnosing certain blood disorders.

When erythrocytes are lost or destroyed, as from chronic bleeding or some form of hemolytic anemia, red cell production is "stepped up" to compensate for the loss. Greater numbers of reticulocytes are then released into the blood before reaching full maturity, and counts increase to above normal. On the other hand, a decrease in the number of circulating reticulocytes suggests a problem with red cell production, as in cases of deficiency anemias or suppression of bone marrow activity.

Mature erythrocyte

Reticulocytes

Health Professions boxes focus on a variety of health careers, showing how the knowledge of medical terminology is applied in real-world careers.

Box 13-3 *Health Professions*

Hemodialysis Technician

A hemodialysis technician, also called a renal technician or a nephrology technician, specializes in the safe and effective delivery of renal dialysis therapy to patients suffering from kidney failure. Before treatment begins, the technician prepares the dialysis solutions and ensures that the dialysis machine is clean, sterile, and in proper working order. The technician measures and records the patient's weight, temperature, and vital signs, inserts a catheter into the patient's arm, and connects the dialysis machine to it. During dialysis, the technician monitors the patient for adverse reactions and guards against any equipment malfunction. After the treatment is completed, the technician again measures and records the patient's weight, temperature, and vital signs. To perform these duties, hemodialysis technicians need thorough scientific and clinical training. Most technicians in the United States receive their training from a college or technical school, and many states require that the technician be certified.

Hemodialysis technicians work in a variety of settings, such as hospitals, clinics, and patients' homes. As populations age, the incidence of kidney disease is expected to rise, as will the need for hemodialysis. For more information about this career, contact the National Association of Nephrology Technicians at www.dialysistech.net.

For Your Reference boxes provide supplemental information for terms within a chapter.

Box 21-2 *For Your Reference*

Types of Skin Lesions

LESION	DESCRIPTION
bul <i>BUL-a</i>	raised, fluid-filled lesion larger than a vesicle (plural: bullae)
fissure <i>FISH-ur</i>	crack or break in the skin
macule <i>MAK-ul</i>	flat, colored spot
nodule <i>NOD-ul</i>	solid, raised lesion larger than a papule; often indicative of systemic disease
papule <i>PAP-ul</i>	small, circular, raised lesion at the surface of the skin
plaque <i>plak</i>	superficial, flat, or slightly raised differentiated patch more than 1 cm in diameter
pustule <i>PUS-tul</i>	raised lesion containing pus; often in a hair follicle or sweat pore
ulcer <i>UL-ser</i>	lesion resulting from destruction of the skin and perhaps subcutaneous tissue
vesicle <i>VES-i-kul</i>	small, fluid-filled, raised lesion; a blister or bleb
wheel <i>wel</i>	smooth, rounded, slightly raised area often associated with itching; seen in urticaria (hives), such as that resulting from allergy

Word Part Tables

DETAILED TABLES

Present roots, prefixes, and suffixes covered in each chapter in an easy-to-reference format (with examples of their use in medical terminology).

Word Part Knowledge aids in the learning and understanding of common terminology.

Table 19-1 Roots for Bones and Joints			
Root	Meaning	Example	Definition of Example
oste/o	bone	osteopenia os-tē-ō-PĒ-nē-ā	deficiency of bone tissue
myel/o	bone marrow; also, spinal cord	myeloid Mĭ-e-loyd	pertaining to or resembling bone marrow
chondr/o	cartilage	chondroblast KON-drō-blast	a cartilage-forming cell
arthr/o	joint	arthrosis ar-THRŌ-sis	joint; condition affecting a joint
synov/i	synovial fluid, joint, or membrane	asynovia a-sĭn-Ō-vē-ā	lack of synovial fluid
burs/o	bursa	peribursal per-i-BER-sal	around a bursa

Exercises

Exercises are designed to test your knowledge before you move to the next learning topic that follows each table.

EXERCISE 19-1	
Fill in the blanks:	
1. Osteolysis (os-tē-OL-i-sis) is destruction of _____	_____
2. Myelogenous (mĭ-e-LOJ-e-nus) means originating in _____	_____
3. Arthrodesis (ar-THRŌD-e-sis) is fusion of a(n) _____	_____
4. A chondroma (kōn-DRŌ-mā) is a tumor of _____	_____
5. A bursolith (BUR-sŏ-lith) is a stone in a(n) _____	_____
Define the following words:	
6. osteoid (OS-tē-oyd) _____	_____
7. myelopoiesis (mĭ-e-lŏ-pŏy-E-ŏs) _____	_____
8. chondromalacia (kōn-drŏ-mā-LĀ-shē-ā) _____	_____
9. arthrocentesis (ar-thrŏ-sen-TE-sis) _____	_____
10. bursitis (bur-Sĭ-tis) _____	_____
11. synovial (sĭ-NŌ-vē-əl) _____	_____
Write words for the following definitions:	
12. inflammation of bone and bone marrow	_____
13. a bone-forming cell	_____

Term Tables

Key Terms include the most commonly used terms.

Terminology	Key Terms
Normal Structure and Function	
agranulocyte A-gran-ŭ-lŏ-sĭt	A white blood cell that does not have visible granules in its cytoplasm. Agranulocytes include lymphocytes and monocytes. (see Fig. 10-4)
albumin al-Bŭ-mĭn	A simple protein found in blood plasma
antibody AN-tĭ-bŏd-ĭ	A protein produced in response to and interacting specifically with an antigen
antigen AN-tĭ-jen	A substance that induces the formation of an antibody
B cell	A lymphocyte that matures in lymphoid tissue and is active in producing antibodies; B lymphocyte (Lĭm-fŏ-sĭt)
band cell	An immature neutrophil with a nucleus in the shape of a band; also called a stab cell. Band cell counts are used to trace infections and other diseases. (see Fig. 10-4)
basophil BA-sŏ-fĭl	A granular leukocyte that stains strongly with basic dyes; active in allergic reactions
blood blud	The fluid that circulates in the cardiovascular system (roots: hem/o, hemāt/o)
coagulation kŏ-ŏ-g-ŭ-LĀ-shun	Blood clotting
cross-matching	Testing the comparability of donor and recipient blood in preparation for a transfusion. Donor red cells are mixed with recipient serum to look for an immunologic reaction. Similar tests are done on tissues before transplantation
electrolyte e-LEK-trŏ-lĭt	A substance that separates into charged particles (ions) in solution; a salt. Term also applied to ions in body fluids
eosinophil ē-ŏ-SĬN-ŏ-fĭl	A granular leukocyte that stains strongly with acidic dyes; active in allergic reactions and defense against parasites

Supplementary Terms list more specialized terms.

Terminology Supplementary Terms	
Normal Structure and Function	
agglutination <i>a-glu-ti-NA-shun</i>	The clumping of cells or particles in the presence of specific antibodies
bilirubin <i>bil-i-RO-hin</i>	A pigment derived from the breakdown of hemoglobin. It is eliminated by the liver in bile
complement <i>COM-ple-ment</i>	A group of plasma enzymes that interacts with antibodies
corpuscle <i>KOR-pus-l</i>	A small mass or body. A blood corpuscle is a blood cell
hemopoietic stem cell <i>he-mo-poy-E-tik</i>	A primitive bone marrow cell that gives rise to all varieties of blood cells
heparin <i>HEP-a-rin</i>	A substance found throughout the body that inhibits blood coagulation; an anticoagulant
plasmin <i>PLAZ-min</i>	An enzyme that dissolves clots; also called <i>fibrinolysin</i>
thrombin <i>THROM-bin</i>	The enzyme derived from prothrombin that converts fibrinogen to fibrin
Symptoms and Conditions	
agranulocytosis <i>a-gran-u-lo-si-TO-sis</i>	A condition involving a decrease in the number of granulocytes in the blood; also called <i>granulocytopenia</i>
erythrocytosis <i>e-rit-ro-si-TO-sis</i>	Increase in the number of red cells in the blood; may be normal, such as to compensate for life at high altitudes, or abnormal, such as in cases of pulmonary or cardiac disease
Fanconi syndrome <i>fan-KO-ne</i>	Congenital aplastic anemia that appears between birth and 10 years of age; may be hereditary or caused by damage before birth, as by a virus
graft versus host reaction <i>(GVHR)</i>	An immunologic reaction of transplanted lymphocytes against tissues of the host; a common complication of bone marrow transplantation
hairy cell leukemia	A form of leukemia in which cells have filaments, making them look "hairy"
hematoma <i>he-ma-TO-ma</i>	A localized collection of blood, usually clotted, caused by a break in a blood vessel

Abbreviations are listed for common terms.

Terminology Abbreviations			
Ab	Antibody	ITP	Idiopathic thrombocytopenic purpura
Ag	Antigen, also silver	lytes	Electrolytes
AIDS	Acquired immunodeficiency syndrome	MCH	Mean corpuscular hemoglobin
ALL	Acute lymphoblastic (lymphocytic) leukemia	MCHC	Mean corpuscular hemoglobin concentration
AML	Acute myeloblastic (myelogenous) leukemia	mcl.	Microliter
APTT	Activated partial thromboplastin time	mcm.	Micrometer
BT	Bleeding time	MCV	Mean corpuscular volume
CBC	Complete blood count	MDS	Myelodysplastic syndrome
CGL	Chronic granulocytic leukemia	mEq	Milliequivalent
CLL	Chronic lymphocytic leukemia	NHL	Non-Hodgkin lymphoma
CML	Chronic myelogenous leukemia	PCV	Packed cell volume
crit	Hematocrit	pH	Scale for measuring hydrogen ion concentration (acidity or alkalinity)
DIC	Disseminated intravascular coagulation	Ph	Philadelphia chromosome
Diff	Differential count	PMN	Polymorphonuclear (neutrophil)
EBV	Epstein-Barr virus	poly	Neutrophil
ELISA	Enzyme-linked immunosorbent assay	polymorph	Neutrophil
EPO, EP	Erythropoietin	PT	Prothrombin time; pro time
ESR	Erythrocyte sedimentation rate	PTT	Partial thromboplastin time
FFP	Fresh frozen plasma	RBC	Red blood cell; red blood (cell) count
Hb, Hgb	Hemoglobin	seg	Neutrophil
Hct, H_v	Hematocrit	SLE	Systemic lupus erythematosus
HDN	Hemolytic disease of the newborn	T(C)T	Thrombin (clotting) time
HIV	Human immunodeficiency virus	TTP	Thrombotic thrombocytopenic purpura
IF	Intrinsic factor	vWF	von Willebrand factor
Ig	Immunoglobulin	WBC	White blood cell; white blood (cell) count

Chapter Review Exercises

Chapter Review Exercises are designed to test your knowledge of the chapter material and appear at the end of each chapter.

Chapter Review

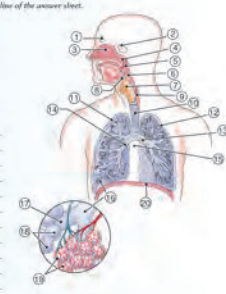
Labeling Exercise

THE RESPIRATORY SYSTEM

Write the name of each numbered part on the corresponding line of the answer sheet.

Alveolar duct
Alveoli
Capillaries
Diaphragm
Epiglottis
Esophagus
Frontal sinus
Laryngopharynx
Larynx and vocal cords
Left bronchus

Left lung
Mediastinum
Nostril cavity
Nasopharynx
Oropharynx
Right lung
Right bronchus
Sigmoidal sinus
Terminal bronchiole
Trachea



1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

11. _____

12. _____

13. _____

14. _____

15. _____

16. _____

17. _____

18. _____

19. _____

20. _____

Terminology

TERMINOLOGY

Match the following terms and write the appropriate letter to the left of each number:

1. compliance
2. surfactant
3. apnea
4. aspiration
5. mediastinum
6. atelectasis
7. emphysema
8. hyperventilation
9. hypoxemia
10. pertussis

a. accidental inhalation of foreign material into the lungs
b. space between the lungs
c. substance that reduces surface tension
d. a measure of how easily the lungs expand
e. expectoration
f. pulmonary disease with destruction of alveoli
g. increased carbon dioxide in the blood
h. decreased rate and depth of breathing
i. whooping cough
j. incomplete expansion of lung tissue

11. CR
12. RSV
13. PCP
14. CRP
15. BCG

a. virus that causes respiratory disease in young children
b. tuberculosis vaccine
c. hereditary disease that affects collagen
d. pneumonia seen in compromised patients
e. childhood vaccine

Supplementary Terms

16. atelectasis
17. atelectasis
18. apnea
19. asthma
20. expectoration
21. atelectasis
22. Croup-Sinus
23. rales
24. pneumonia (bacterial)
25. orthopnea

a. suffocation
b. respiration
c. systemic depression in oxygen
d. bronchi, bronchial respiratory sound
e. agent that helps remove bronchial secretions
f. irregular respiratory wave in normally ill patients
g. device used to measure air flow
h. acute rhinitis
i. pertaining to an upright position
j. abnormal chest sounds

Using Your Knowledge

26. The trachea branches into two main bronchi for the lungs of _____.

27. The gas produced in the tissues and exhaled in respiration is _____.

28. The pharynx serves as a passageway for _____.

29. The double membrane that covers the lungs and lines the thoracic cavity is the _____.

30. The small air sacs in the lungs through which gases are exchanged between the atmosphere and the blood are the _____.

31. The trachea divides into a right and a left primary _____.

32. A pneumonic virus is one that invades the _____.

33. The term *acid-fast bacillus* (AFB) is commonly applied to the organism that causes _____.

Case Studies and Case Study Questions

Case Studies and **Case Study Questions** in every chapter present terminology in the context of a medical report. These are an excellent review tool as they test your cumulative knowledge of medical terminology, and put terminology into a real-world context.

Additional Case Studies

Case Study 18-1: Audiology Report

S.R., a 55-year-old male, reported decreased hearing sensitivity in his left ear for the past three years. In addition to hearing loss, he was experiencing tinnitus and aural fullness. Pure-tone test results revealed normal hearing sensitivity for the right ear and a moderate sensorineural hearing loss in the left ear. Speech thresholds were appropriate for the degree of hearing loss noted. Word recognition was excellent for the right ear but poor for the left ear when the signal was present at a suprathreshold level. Tympanograms were characterized by

Case Study 18-2: Phacoemulsification with Intraocular Lens Implant

W.S., a 68-year-old woman, was scheduled for surgery for a cataract and relief from "floaters," which she had noticed in her visual field since her surgery for a retinal detachment the previous year. She reported to the ambulatory surgery center an hour before her scheduled procedure. Before transfer to the operating room, she spoke with her ophthalmologist and reviewed the surgical plan. Her right eye was identified as the operative eye, and it was marked with a "yes" and the surgeon's initials on the lid. She was given anesthetic drops in the right eye and an intravenous bolus of 2.0 mg of midazolam (Versed).

In the OR, W.S. and her operative eye were again identified by the surgeon, anesthesiologist, and nurse. After anesthesia and skin prep were achieved, the eye was prepared and draped in sterile sheets. An operating microscope with video system was positioned over her eye. A 5-0 silk suture was placed through the superior rectus muscle to retract the eye. A lid speculum

normal shape, amplitude, and peak pressure profiles bilaterally. The contralateral acoustic reflex was normal for the right ear but absent for the left ear at the frequencies tested (500 to 4,000 Hz). The ipsilateral acoustic reflex was present with the probe in the right ear and absent with the probe in the left ear. Brainstem auditory evoked potentials (BAEPs) were within normal range for the right ear. No repeatable response was observed from the left ear. A subsequent MRI showed a 1-cm acoustic neuroma.

was placed to open the eye. A minimal conjunctival peritomy was performed, and hemostasis was achieved with wet-field cautery. The anterior chamber was entered at the 12 o'clock position. A capsulotomy was performed after Masket was placed in the anterior chamber. Phacoemulsification was carried out without difficulty. The remaining cortex was removed by irrigation and aspiration.

An intraocular lens (IOL) was placed into the posterior chamber. Miotic was injected to achieve pupillary dilation, and the wound was closed with one 10-0 suture. Self-conjunctival Celestone and Garamycin were injected. The lid speculum and retraction suture were removed. After application of Enoxon and Bacthran ointments, the eye was patched, and a shield was applied. W.S. left the OR in good condition and was discharged to home four hours later.

Part III Body Systems

Write terms from the case studies with the following meanings:

7. record obtained by tympanometry

8. pertaining to or perceived by the ear

9. above a minimum level

10. pertaining to sound or hearing

11. perception of sounds, such as ringing or tinkling in the ear

12. physician who specializes in conditions of the eye

13. generic drug name for Versed

14. within the eye

15. abnormal contraction of the pupil

16. below the conjunctiva

Abbreviations. Define the following abbreviations:

17. Hz

18. BAEP

19. IOL

Case Study Questions

Multiple choice. Select the best answer and write the letter of your choice to the left of each number:

1. The study of hearing is termed:

a. otoscopy
b. audiometry
c. light spectrum
d. otology
e. audiology

4. Another name for an acoustic neuroma is:

a. muscular degeneration
b. acoustic neuroma
c. auditory glioma
d. eighth cranial (vestibular)
e. acoustic glioma

2. Sensorineural hearing loss may result from:

a. damage to the second cranial nerve
b. otitis media
c. otitis externa
d. damage to the eighth cranial nerve
e. stapedectomy

3. The term that means "on the same side" is:

a. contralateral
b. bilateral
c. distal
d. ventral
e. ipsilateral

5. Ultrasound destruction and aspiration of the lens is called:

a. cataractomy
b. phacoemulsification
c. vitrectomy
d. radial keratotomy
e. refraction

6. The term *akinesia* means:

a. movement
b. lack of sensation
c. washing
d. lack of movement
e. tactile

Flashcard Starter Set

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4. Print and read your own personal learning styles report to better understand how to study most effectively and efficiently.

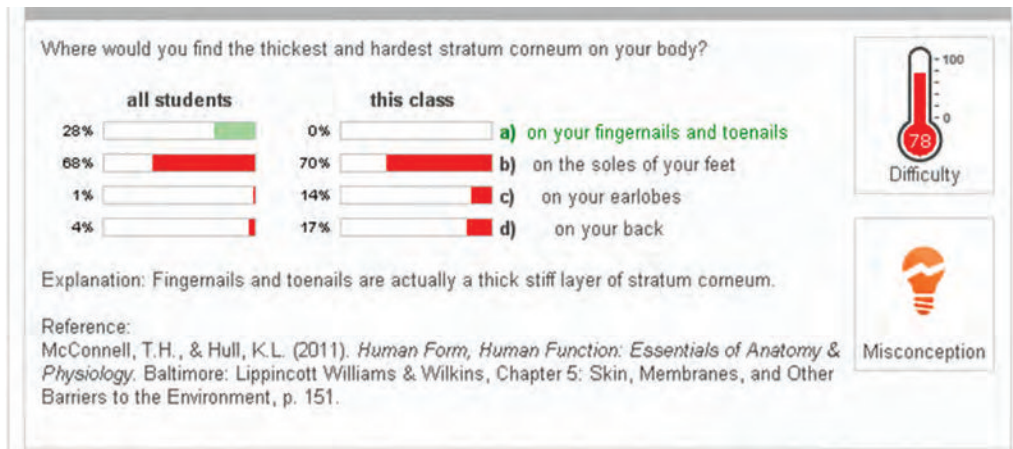
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- Listen & Label and Look & Label
- Word Building
- Zooming In
- Pronounce It
- Spell It
- Sound It
- Hangman
- Crossword Puzzles
- Quiz Show
- Concentration
- Case Studies and Case Study Questions
- Dictionary and Audio Glossary application
- Flashcards and Flashcard Generator applications
- Animations
- Audio Drills (which allow for chapter audio files to be downloaded as MP3 files)
- Chapter Quizzes

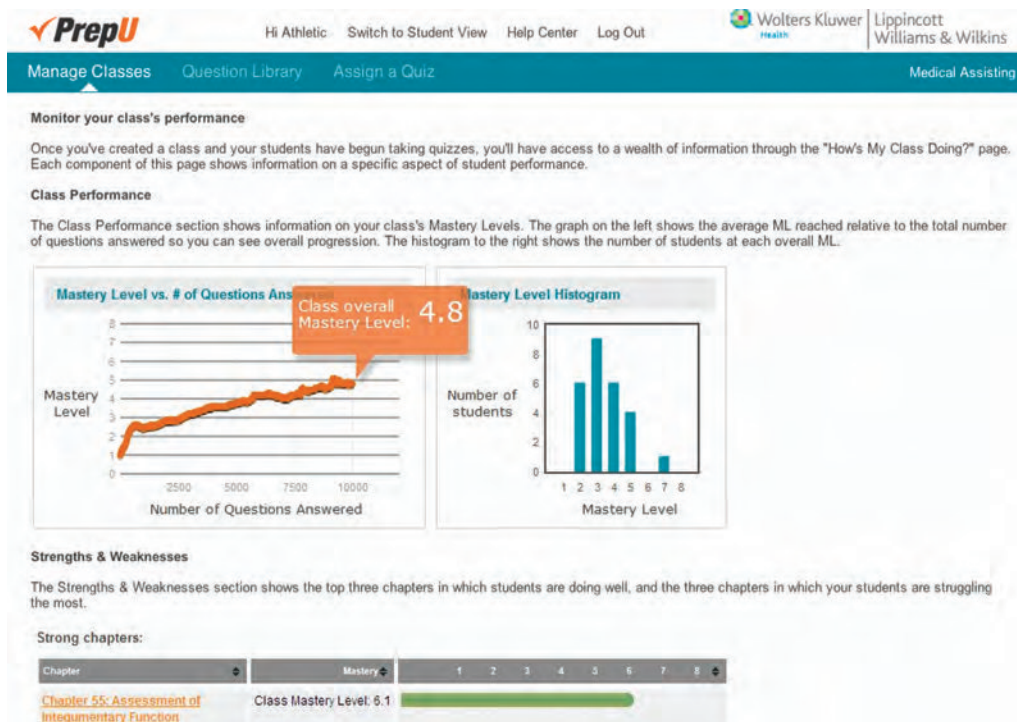


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PrepU uses repetitive and adaptive quizzing to build mastery of medical terminology concepts, helping students to learn more while giving instructors the data they need to monitor each student's progress, strengths, and weaknesses. The hundreds of questions in PrepU offer students the chance to drill themselves on medical terminology and support their review and retention of the information they've learned. Each question not only provides an explanation for the correct answer, but also references the text page for the student to review the source material. PrepU for *Medical Terminology* challenges students with questions and activities that coincide with the materials they've learned in the text and gives students a proven tool to learn medical terminology more effectively. For instructors, PrepU provides tools to identify areas and topics of student misconception; instructors can use these rich course data to assess students' learning and better target their in-class activities and discussions, while collecting data that are useful for accreditation.



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PrepU works! PrepU works, and not just because we say so. PrepU efficacy is *backed by data*:

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To see a video explanation of PrepU, go to http://download.lww.com/wolterskluwer_vitalstream_com/mktg/prepuvid/prepupromo01.html.

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PART

I

Introduction to Medical Terminology

CHAPTER 1 Concepts of Medical Terminology

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CHAPTER 4 Cells, Tissues, and Organs

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CHAPTER

1

Concepts of Medical Terminology

Case Study

J.V.'s Digestive Problems

Chief complaint:

J.V., a 22-year-old college student, visited the university health clinic and stated he had a four-month history of a burning pain in the middle of his chest. He notices it more at night and has difficulty sleeping because of the pain. He also states that the pain seems to occur more frequently following late-night college gatherings where pizza, spicy chicken wings, and beer are served.

Examination:

Well-nourished 22-year-old male c/o epigastric pain no longer relieved by antacids; orthopnea—currently sleeping with three pillows; occasional dysphagia; ETOH consumption is six to eight beers per week; nonsmoker; no neurological, musculoskeletal, genitourinary, or respiratory deficits. Referred to a gastroenterologist for ↑ acid production and gastroesophageal reflux disease (GERD).

Clinical course:

The gastroenterologist saw J.V. and ordered an upper GI. Results demonstrated reflux disease, and J.V. underwent a gastroscopy. Results showed no evidence of bleeding, ulcerations, or strictures. The student was given educational material on GERD, including dietary recommendations. He was started on Prevacid and will be reevaluated in six months.

In this chapter, you learn about how medical words are constructed and also learn about the use of abbreviations and other types of shorthand in medical writing. Later in the chapter, we revisit J.V. and see how he is progressing under treatment.



Ancillaries *At-A-Glance*

Visit *thePoint* to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii–xvi.

Learning TOOLS

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning RESOURCES

- E-Book: Chapter 1
- Web Chart: “Do Not Use” Abbreviations and Symbols
- Audio Pronunciation Glossary

Learning ACTIVITIES

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After study of this chapter, you should be able to:

- 1 Explain the purpose of medical terminology. *p4*
- 2 Name the languages from which most medical word parts are derived. *p4*
- 3 Define the terms *root*, *suffix*, and *prefix*. *p4*
- 4 Explain what combining forms are and why they are used. *p6*
- 5 Pronounce words according to the pronunciation guide used in this text. *p7*
- 6 List three features of medical dictionaries. *p9*
- 7 Identify medical words and abbreviations in case studies to review concepts of medical terminology. *pp2, 13*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|--|---|
| <p>_____ 1. The main part of a word is called the:</p> <ul style="list-style-type: none"> a. origin b. prefix c. root d. extension <p>_____ 2. A word part at the beginning of a word is a:</p> <ul style="list-style-type: none"> a. prefix b. combining form c. preview d. root <p>_____ 3. A word part at the end of a word is the:</p> <ul style="list-style-type: none"> a. vowel b. adjective c. insertion d. suffix <p>_____ 4. The adjective form of <i>thorax</i>, meaning “chest,” is:</p> <ul style="list-style-type: none"> a. thoracic b. thoraxal c. thorous d. thoral | <p>_____ 5. The <i>ch</i> in the word <i>chemistry</i> is pronounced like the letter:</p> <ul style="list-style-type: none"> a. s b. h c. k d. f <p>_____ 6. The <i>ps</i> in the word <i>psychology</i> is pronounced like the letter:</p> <ul style="list-style-type: none"> a. p b. s c. j d. k <p>_____ 7. The word below that has a hard g is:</p> <ul style="list-style-type: none"> a. grasp b. gem c. page d. judge <p>_____ 8. The symbol ↓ means:</p> <ul style="list-style-type: none"> a. start b. turn c. decrease d. left |
|--|---|

Medical terminology is a special vocabulary used by health care professionals for effective and accurate communication. Every health-related field requires an understanding of medical terminology, and this book highlights selected health care occupations in special boxes (see **Box 1-1**). Because it is based mainly on Greek and Latin words, medical terminology is consistent and uniform throughout the world. It is also efficient; although some of the terms are long, they often reduce an entire phrase to a single word. The one word *gastroduodenostomy*, for example, stands for “a communication between the stomach and the first part of the small intestine” (**Fig. 1-1**). The part *gastr* means stomach; *duoden* stands for the duodenum, the first part of the small intestine; and *ostomy* means a communication.

The medical vocabulary is vast, and learning it may seem like learning the entire vocabulary of a foreign language. Moreover, like the jargon that arises in all changing fields, it is always expanding. Think of the terms that have been added to our vocabulary with the development of computers, such as software, search engines, e-mail, chatrooms, and blogs. The task may seem overwhelming, but

there are methods to aid in learning and remembering words and even to help make informed guesses about unfamiliar words. Most medical terms can be divided into component parts—roots, prefixes, and suffixes—that maintain the same meaning whenever they appear. By learning these meanings, you can analyze and remember many words.

Word Parts

Word components fall into three categories:

1. The **root** is the fundamental unit of each medical word. It establishes the basic meaning of the word and is the part to which modifying word parts are added.
2. A **suffix** is a short word part or series of parts added at the end of a root to modify its meaning. This book indicates suffixes by a dash before the suffix, such as *-itis* (inflammation).
3. A **prefix** is a short word part added before a root to modify its meaning. This book indicates prefixes by a dash after the prefix, such as *pre-* (before).

Box 1-1



Health Professions

1

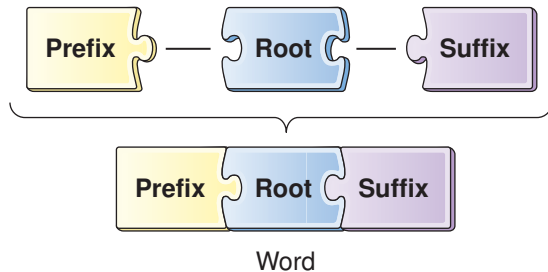
Health Information Technicians

Every time a patient receives medical treatment, information is added to the patient's medical record, which includes data about symptoms, medical history, test results, diagnoses, and treatment. Health information technicians organize and manage these records, working closely with physicians, nurses, and other health professionals to ensure that they provide a complete and accurate basis for quality patient care.

Accurate medical records are essential for administrative purposes. Health information technicians assign a code to each diagnosis and procedure a patient receives, and this information is used for accurate patient billing. In addition, health information technicians analyze medical records to reveal trends in

health and disease. This research can be used to improve patient care, manage costs, and help establish new medical treatments.

To read and interpret medical records, health information technicians need a thorough background in medical terminology. Most of these technicians work in hospitals and long-term care facilities. Others may work in medical clinics, government agencies, insurance companies, and consulting firms. Because of the growing need for medical care, health information technology is projected to be one of the fastest growing careers in the United States. For more information about this profession, contact the American Health Information Management Association at www.ahima.org.



Words are formed from roots, suffixes, and prefixes.

The simple word *learn* can be used as a root to illustrate. If we add the suffix *-er* to form *learner*, we have “one who learns.” If we add the prefix *re-* to form *relearn*, we have “to learn again.”

Not all roots are complete words. In fact, most medical roots are derived from other languages and are meant to be

used in combinations. The Greek word *kardia*, for example, meaning “heart,” gives us the root *cardi*. The Latin word *pulmo*, meaning “lung,” gives us the root *pulm*. In a few instances, both the Greek and Latin roots are used for the same structure. We find both the Greek root *nephr* and the Latin root *ren* used in words pertaining to the kidney (Fig. 1-2).

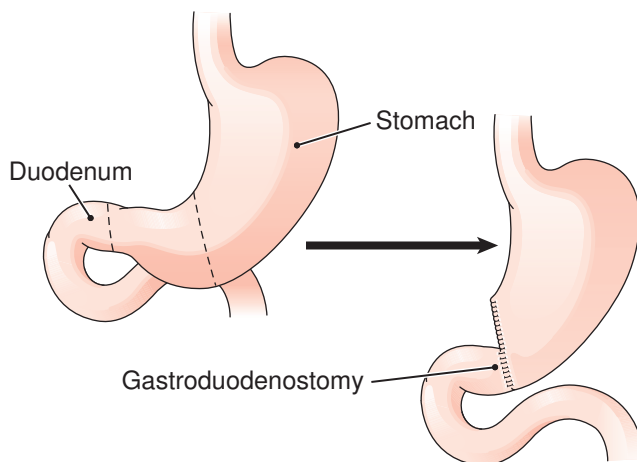


Figure 1-1 Gastroduodenostomy. A communication (-stomy) between the stomach (gastr) and the first part of the small intestine, or duodenum (duoden).

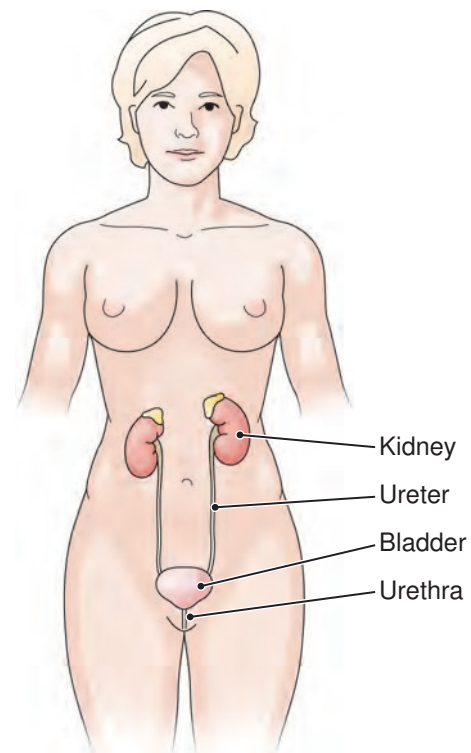


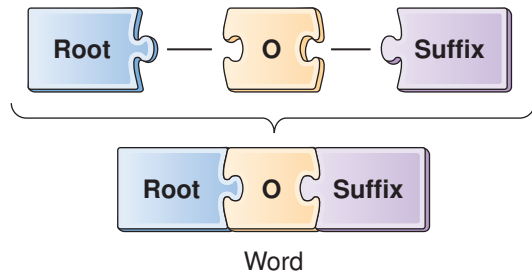
Figure 1-2 Structures named with more than one word root. Medical terminology uses both the Greek root *nephr* and the Latin root *ren* for the kidney, an organ of the urinary system.

Note that the same root may have different meanings in different fields of study, just as the words *spam*, *menu*, *browser*, *surfing*, and *cookie* have different meanings in common vocabulary other than in “computerese.” The root *myel* means “marrow” and may apply to either the bone marrow or the spinal cord. The root *scler* means “hard” but may also apply to the white of the eye. *Cyst* means “a filled sac or pouch” but also refers specifically to the urinary bladder. You will sometimes have to consider the context of a word before assigning its meaning. Health information technicians must be skilled in the use of medical language, as described in **Box 1-1**.

Compound words contain more than one root. The words *eyeball*, *bedpan*, *frostbite*, and *wheelchair* are examples. Some examples of compound medical words are *cardiovascular* (pertaining to the heart and blood vessels), *urogenital* (pertaining to the urinary and reproductive systems), and *lymphocyte* (a white blood cell found in the lymphatic system).

COMBINING FORMS

When a suffix or another root beginning with a consonant is added to a root, a vowel is inserted between the root and the next word part to aid in pronunciation. This combining vowel is usually an *o*, as seen in the previous example of gastroduodenostomy, but may occasionally be *a*, *e*, or *i*.

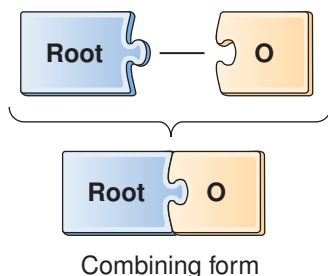


A combining vowel may be added between a root and a word part that follows.

Thus, when the suffix *-logy*, meaning “study of,” is added to the root *neur*, meaning “nerve or nervous system,” a combining vowel is added:

neur + o + logy = neurology (study of the nervous system)

Roots shown with a combining vowel are called **combining forms**.



A root with a combining vowel is called a combining form.

This text gives roots with their most common combining vowels added after a slash and refers to them simply as roots, as in *neur/o*.

A combining vowel usually is not used if the ending begins with a vowel. For example, the root *neur* is combined with the suffix *-itis*, meaning “inflammation of,” in this way:

neur + itis = neuritis (inflammation of a nerve)

This rule has some exceptions, particularly when they affect pronunciation or meaning, and you will observe these as you work.

WORD DERIVATIONS

As mentioned, most medical word parts come from Greek (G.) and Latin (L.). The original words and their meanings are included in this text only occasionally. They are interesting, however, and may aid in learning. For example, *muscle* comes from a Latin word that means “mouse” because the movement of a muscle under the skin was thought to resemble the scampering of a mouse.

The coccyx, the tail end of the spine, is named for the cuckoo because it was thought to resemble the cuckoo’s bill (**Fig. 1-3**). For those interested in the derivations of medical words, a good medical dictionary will provide this information.

WORDS ENDING IN *x*

When you add a suffix to a word ending in *x*, the *x* is changed to a *g* or a *c*. If there is a consonant before the *x*, such as *yx* or *nx*, the *x* is changed to a *g*. For example, *pharynx* (throat) becomes *pharyngeal* (*fa-RIN-jē-al*), to mean “pertaining to the throat;” *coccyx* (terminal portion of the spine) becomes *coccygeal* (*kok-SIJ-e-al*), to mean “pertaining to the coccyx.”

If a vowel comes before the *x*, such as *ax* or *ix*, you change the *x* to a *c*. Thus, *thorax* (chest) becomes *thoracic* (*thō-RAS-ik*) to mean “pertaining to the chest” and *cervix* (neck) becomes *cervical* (*SER-vi-kal*) to mean “pertaining to a neck.”

SUFFIXES BEGINNING WITH *rh*

When you add a suffix beginning with *rh* to a root, the *r* is doubled. For example:

hem/o (blood) + -rhage (bursting forth) = hemorrhage
(a bursting forth of blood)

men/o (menses) + -rhea (flow, discharge) = menorrhea
(menstrual flow)

Pronunciation

This text provides phonetic pronunciations at every opportunity, even in the answer keys. The PASSport to Success on the Web resource, *thePoint*, has a large audio pronunciation

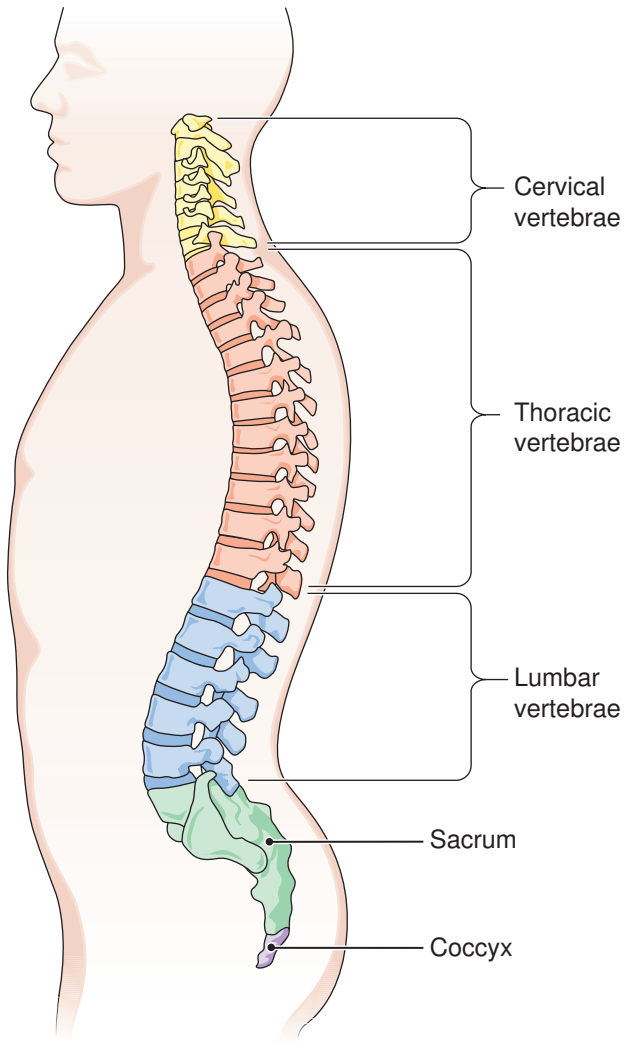


Figure 1-3 Word derivations. The coccyx of the spine is named by its resemblance to the bill of a cuckoo.

dictionary. Take advantage of these aids. Repeat each word aloud as you learn to recognize it in print or hear it in the Student Resources. The following pronunciation guidelines apply throughout the text.

A vowel (a, e, i, o, u) gets a short pronunciation if it has no pronunciation mark over it, such as

a as in hat
e as in met
i as in bin
o as in not
u as in run

A short line over the vowel gives it a long pronunciation:

ā as in say
ē as in tea
ī as in lie
ō as in hose
ū as in sue

The accented syllable in each word is shown with capital letters, as in *AK-sent*.

Be aware that word parts may change in pronunciation when they are combined in different ways. Note also that accepted pronunciations may vary from place to place. Only one pronunciation for each word is given here, but be prepared for differences, as noted in **Box 1-2**.

SOFT AND HARD *c* AND *g*

- A soft *c*, as in *racer*, will be written in pronunciations as *s* (*RĀ-ser*).
- A hard *c*, as in *candy*, will be written as *k* (*KAN-dē*).
- A soft *g*, as in *page*, will be written as *j* (*pāj*).
- A hard *g*, as in *grow*, will be written as *g* (*grō*).

Box 1-2



Focus on Words

Pronunciations

When pronunciations are included in a text, it is sometimes difficult for authors to know which pronunciation of a term to use. Pronunciations may vary from country to country and even in different regions of the same country. Think how easy it is to distinguish a Southern accent and one from the Midwest or Northeast United States. The general rule is to use the most common pronunciation or to list that pronunciation first if more than one is given.

The word *gynecology* is usually pronounced with a hard *g* in the United States, but in many areas, a soft *g* is used, as in *jīn-e-KOL-ō-jē*. Words pertaining to the cerebrum (largest part of the brain) may have an accent on different syllables.

The adjective is usually pronounced with the accent on the second syllable (*se-RĒ-bral*), but in cerebrum (*SER-ē-brum*) and cerebrospinal (*ser-e-brō-SPI-nal*), the accented syllable differs.

The name for the first part of the small intestine (duodenum) is often pronounced *dū-ō-DĒ-num*, although the pronunciation *dū-O-de-num* is also acceptable. And the scientific term for the navel, umbilicus, is usually pronounced with the accent on the second syllable as *um-BIL-i-kus*, but *um-bi-LĪ-kus* is also used. When extreme, some alternative pronunciations can sound like a foreign language. The word we pronounce as *SKEL-e-tal* is pronounced in some other English-speaking countries as *ske-LE-tal*.

SILENT LETTERS AND UNUSUAL PRONUNCIATIONS

A silent letter or unusual pronunciation can be a problem, especially if it appears at the start of a word that you are trying to look up in the dictionary. See **Box 1-3** for some examples.

The combinations in **Box 1-3** may be pronounced differently when they appear within a word, as in *diagnosis* (*dī-ag-NŌ-sis*), meaning determination of the cause of disease, in which the *g* is pronounced; *apnea* (*AP-nē-a*), meaning cessation of breathing, in which the *p* is pronounced; *nephrop-tosis* (*nef-rop-TŌ-sis*), meaning dropping of the kidney, in which the *p* is pronounced.



Go to the Audio Pronunciation Glossary on *thePoint* to hear medical terms pronounced.

LEARNING STYLES

The term “learning styles” describes how people differ in the senses they most depend on to learn. Visual learners want to see a word in print. They like diagrams, charts, and pictures. Auditory learners need to hear words pronounced. They like to talk over what they have learned and profit from listening again to recorded lessons. Tactile

learners use touch, such as writing out answers or retyping notes. They like to follow demonstrations to learn a new skill. You can evaluate your own learning style with an inventory on the Student Resources on *thePoint*. Exercises on the PASSport to Success are coded as to the learning styles they support.

Of course, we use all of our senses to some degree in learning, and the more channels we use, the more likely it is that we will absorb and remember new information. This text, in combination with the student resources, calls on multiple senses to aid learning: seeing new words in print, writing out answers, using flashcards, listening to pronunciations, and completing exercises on the computer. Unlike the fashion magazines that use perfumed ads to sell products, the olfactory sense has not yet been incorporated into textbooks. Perhaps someday student resources will have a smell feature!

Abbreviations

Shortened words or initials can save time in writing medical reports and case histories. We commonly use TV for television, Jr. for junior, F for Fahrenheit temperature readings, UV for ultraviolet, and Dr. for doctor. A few of the many medical abbreviations are mL for the metric measurement, milliliter; dB for decibels, units of sound intensity; CA for cancer; hgb for hemoglobin; and ECG for electrocardiogram.

Box 1-3

For Your Reference

Silent Letters and Unusual Pronunciations

LETTER(S)	PRONUNCIATION	EXAMPLE	DEFINITION OF EXAMPLE
ch	k	chemical <i>KEM-i-kal</i>	pertaining to the elements and their interactions (root <i>chem/o</i> means “chemical”)
dys	dis	dysfunction <i>dis-FUNK-shun</i>	difficult or abnormal (dys-) function
eu	u	euphoria <i>ū-FOR-ē-a</i>	exaggerated feeling of well-being (<i>eu-</i> means “true” or “good”)
gn	n	gnathic <i>NATH-ik</i>	pertaining to the jaw (gnath/o)
ph	f	phantom <i>FAN-tom</i>	illusion or imaginary image
pn	n	pneumonia <i>nū-MŌ-nē-a</i>	inflammation of the lungs (pneumon/o)
ps	s	pseudonym <i>SŪ-dō-nim</i>	false name (-nym)
pt	t	ptosis <i>TŌ-sis</i>	dropping, downward displacement
rh	r	rhinoplasty <i>Rī-nō-plas-tē</i>	plastic repair of the nose (rhin/o)
x	z	xiphoid <i>Zī-foyd</i>	pertaining to cartilage attached to the sternum (from Greek <i>xiphos</i> , meaning “sword”)

PHRASE ABBREVIATIONS

An **acronym** is an abbreviation formed from the first letter of each word in a phrase. Some everyday acronyms are ASAP (as soon as possible), ATM (automated teller machine), and a computer's RAM (random access memory). Acronyms have become popular for saving time and space in naming objects, organizations, and procedures. They abound in the names of government agencies: FDA (Food and Drug Administration), USDA (United States Department of Agriculture), and NIH (National Institutes of Health). Some medical acronyms are BP for blood pressure, MRI for magnetic resonance imaging, AIDS for acquired immunodeficiency syndrome, CNS for the central nervous system, and RN for registered nurse. Acronyms and abbreviations that appear in a chapter are listed and defined at the end of that chapter. Appendix 2 is a more complete list of commonly used abbreviations and acronyms with their meanings. An abbreviation dictionary is also helpful.

SYMBOLS

Symbols are commonly used as shorthand in case histories. Some examples are ① and ② for left and right and ↑ and ↓ for increase and decrease. A list of common symbols appears in Chapter 7 and in Appendix 1.

Symbols and abbreviations can save time, but they can also cause confusion if they are not universally understood. Usage varies in different institutions, and the same abbreviation may have different meanings in different fields. For example, the acronym CRF can mean chronic renal failure or case report form; MS can represent mitral stenosis or multiple sclerosis. Again, as with roots having multiple meanings, if the acronym is not defined, its interpretation depends on its context.

Some abbreviations and symbols are subject to error and should never be used. These appear in “Do Not Use” lists published by organizations that promote patient safety, such as the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and the Institute for Safe Medical Practices (ISMP). Most institutions have a

policy manual that details the accepted abbreviations for that facility. Only the most commonly used symbols and abbreviations are given here.



See the Student Resources on *thePoint* for a chart of selected “Do Not Use” abbreviations and the Web addresses of organizations that publish these guidelines.

Medical Dictionaries

With few exceptions, you can do all the exercises in this book without the aid of a dictionary, but medical dictionaries are valuable references for everyone in health-related fields. These include not only complete, unabridged versions, but also easy-to-carry short versions and dictionaries of medical acronyms and abbreviations. Many of these dictionaries are also available on CD, on the internet, and also as applications for smartphones. Dictionaries give information on meanings, pronunciation, synonyms, derivations, and related terms. Those dictionaries intended for nursing and allied health professions include more complete clinical information, with notes on patient care.

Dictionaries vary in organization; in some, almost all terms are entered as nouns, such as disease, syndrome, procedure, or test. Those with a more clinical approach enter some terms according to their first word, which may be an adjective or proper name, for example, biomedical engineering, Cushing disease, and wind chill factor. This format makes it easier to look up some terms. All dictionaries have directions on how to use the book and interpret the entries, as shown in Appendix 9, taken from *Stedman's Medical Dictionary*, 28th ed.

In addition to information on individual terms and phrases, medical dictionaries have useful appendices on measurements, clinical tests, drugs, diagnosis, body structure, information resources, and other topics.

Terminology

Key Terms

acronym <i>AK-rō-nim</i>	An abbreviation formed from the first letter of each word in a phrase
combining form <i>kom-BĪ-ning</i>	A word root combined with a vowel that links the root with another word part, such as a suffix or another root. Combining forms are shown with a slash between the root and the vowel, as in <i>neur/o</i>
compound word <i>KOM-pownd</i>	A word that contains more than one root
prefix <i>PRĒ-fix</i>	A word part added before a root to modify its meaning
root <i>rūt</i>	The fundamental unit of a word
suffix <i>SU-fix</i>	A word part added to the end of a root to modify its meaning

J.V.'s Case Study Follow-Up

J.V. was scheduled for a gastroscopy as an outpatient procedure. The gastroenterologist was able to visualize the esophagus and the inside of the stomach. The area around the esophageal sphincter was a normal pink in color and showed no signs of esophagitis or ulceration. J.V. was started

on a proton pump inhibitor to reduce stomach acid and was advised to limit his intake of spicy foods and alcohol. At his follow-up appointment, he reported no repeat episodes of epigastric pain.

Chapter Review

Fill in the blanks:

1. A word part that always comes after a root is a(n) _____.
2. A root with a vowel added to aid in pronunciation is called a(n) _____.
3. Combine the word parts *dia-*, meaning “through,” and *-rhea*, meaning “flow,” to form a word meaning “passage of fluid stool” _____.
4. The abbreviation ETOH means (refer to Appendix 2) _____.
5. Use the flashcards at the back of the book to find that the word part *-al*, as in *neurological*, is one of several suffixes that mean _____.
6. Combine the root *cardi*, meaning “heart,” with the suffix *-logy*, meaning “study of,” to form a word meaning “study of the heart” _____.
7. Use Appendix 3 to find that the suffix in *gastroscopy*, seen in J.V.’s opening case study, means _____.
8. Appendix 1 shows that the symbol ↑ means _____.

MULTIPLE CHOICE

Select the best answer and write the letter of your choice to the left of each number.

- | | |
|---|--|
| <p>_____ 9. <i>Epi-</i> in the term <i>epigastric</i> is a:</p> <ul style="list-style-type: none">a. word rootb. prefixc. suffixd. combining form | <p>_____ 13. The combining form for <i>thorax</i> (chest):</p> <ul style="list-style-type: none">a. thorax/ob. thor/oc. thorac/od. thori/o |
| <p>_____ 10. The <i>-pnea</i> in the term <i>orthopnea</i> is a:</p> <ul style="list-style-type: none">a. rootb. prefixc. derivationd. suffix | <p>_____ 14. In J.V.’s case study, the term GERD represents a(n):</p> <ul style="list-style-type: none">a. combining formb. acronymc. prefixd. suffix |
| <p>_____ 11. The term <i>musculoskeletal</i> is a(n):</p> <ul style="list-style-type: none">a. abbreviationb. word rootc. combining formd. compound word | <p>_____ 15. In the case study, the <i>ph</i> in dysphagia is pronounced as:</p> <ul style="list-style-type: none">a. fb. pc. hd. s |
| <p>_____ 12. The adjective for <i>larynx</i> is:</p> <ul style="list-style-type: none">a. larynxicb. laryngealc. larynald. largeal | |

Pronounce the following words:

16. dyslexia
17. rheumatism
18. pneumatic
19. chemist
20. pharmacy

12 Part I Introduction to Medical Terminology

Pronounce the following phonetic forms and write the words they represent:

21. KAR-dē-ak _____
22. HĪ-drō-jen _____
23. OK-ū-lar _____
24. IN-ter-fās _____
25. rū-MAT-ik _____

WORD BUILDING

Write words for the following definitions using the word parts provided. A combining vowel is included. Each word part can be used more than once.

-itis -logy -ptosis nephr -o- gastr cardi neur

26. Inflammation of the stomach _____
27. Study of the nervous system _____
28. Dropping of the kidney _____
29. Study of the kidney _____
30. Inflammation of a nerve _____
31. Downward displacement of the heart _____

WORD ANALYSIS

Define each of the following words and give the meaning of the word parts in each. Use a dictionary if necessary.

32. dysmenorrhea (dis-men-ō-RĒ-a) _____
 - a. dys _____
 - b. men/o _____
 - c. -rhea _____
33. cardiologist (kar-dē-OL-ō-jist) _____
 - a. cardi/o _____
 - b. -log/o _____
 - c. -ist _____
34. nephritis (nef-RĪ-tis) _____
 - a. nephr/o _____
 - b. -itis _____
35. renogastric (rē-nō-GAS-trik) _____
 - a. ren/o _____
 - b. gastr/o _____
 - c. -ic _____



For more learning activities, see Chapter 1 of the Student Resources on *thePoint*.

Additional Case Study

1

J.S.'s Arthritic Knees

Chief complaint:

J.S., a 68-YO male, presents to his family doctor c/o bilateral knee discomfort that worsens prior to a heavy rainstorm. He states that his "arthritis" is not getting any better. He has been taking NSAIDs but is not obtaining relief at this point. His family physician referred him to an orthopedic surgeon for further evaluation.

Past medical history:

J.S. was quite active in sports in high school and college. He tore his ACL while playing soccer during his junior year in college, at which time he retired from intercollegiate athletics.

His only other physical complaints involve stiffness in his right shoulder, which he attributes to pitching while playing baseball in high school.

Current medications:

NSAIDs prn for arthritic pain; Lipitor 10mg for mild hyperlipidemia

X-rays:

Bilateral knee x-rays revealed moderate degenerative changes with joint space narrowing in the left knee; severe degenerative changes and joint space narrowing in the right knee.

Case Study Questions

Multiple choice. Select the best answer and write the letter of your choice to the left of each number:

- | | |
|---|--|
| <p>_____ 1. The <i>bi-</i> in the word <i>bilateral</i> is a:</p> <ul style="list-style-type: none"> a. suffix b. root c. prefix d. combining form <p>_____ 2. The <i>-itis</i> in the word <i>arthritis</i> is a:</p> <ul style="list-style-type: none"> a. root b. prefix c. derivation d. suffix | <p>_____ 3. <i>Arthr/o</i> is a(n):</p> <ul style="list-style-type: none"> a. combining form b. acronym c. prefix d. suffix <p>_____ 4. The AI in the abbreviation NSAID means (See Appendix 2):</p> <ul style="list-style-type: none"> a. antacid b. antiinflammatory c. antiinfectious d. after incident |
|---|--|

Fill in the blanks:

- | | |
|---|--|
| <p>5. Use Appendix 2 to find what the abbreviation <i>ACL</i> means.</p> <p>_____</p> <p>6. Use Appendix 2 to find what the abbreviation <i>c/o</i> means.</p> <p>_____</p> <p>7. Use the flashcards for Chapter 3 at the back of this book to find the meaning of the prefix <i>hyper-</i>.</p> <p>_____</p> <p>8. Use Appendix 2 to find what the abbreviation <i>prn</i> means.</p> <p>_____</p> | <p>9. Use Appendices 5, 6, and 7 to look up the meanings of the word parts in <i>hyperlipidemia</i>.</p> <p>a. hyper- _____</p> <p>b. lip/o _____</p> <p>c. -emia _____</p> <p>10. Use Appendix 3 to find the meaning for the root words in <i>orthopedic</i>.</p> <p>a. orth/o _____</p> <p>b. ped/o _____</p> <p>11. Use the flashcards for Chapter 5 at the back of this book to find the meaning of the prefix <i>inter-</i>.</p> <p>_____</p> |
|---|--|

CHAPTER

2

Suffixes

Case Study

R.F.'s Encounter with a Cerebral Aneurysm

Chief complaint:

R.F., a 42-year-old woman, has been complaining of atypical headaches for the past few weeks. She experienced vomiting with one of the headaches that she could not attribute to the flu or something she had eaten. She does not have a history of migraines. R.F. had an appointment with a neurologist, who referred her to the neurosurgery clinic for evaluation of a possible cerebral hemorrhage.

Examination:

Patient is a 42-YO female c/o sudden and severe headaches over the past three to four weeks; one headache was accompanied with vomiting. Patient admits to recent photophobia and intermittent blurred vision. She has a history of venous thrombi following an emergency hip surgery for a fracture she suffered two years ago when she was in an automobile accident. Multiple vertebrae and her pelvis were also fractured. No other complications postaccident noted. Hypertensive with a BP of 154/86; neurological and physical examination is otherwise normal. Diagnoses: cerebral aneurysm and hypertension.

Clinical course:

The neurologist ordered a CT scan that revealed a small saccular aneurysm measuring 4 mm near the circle of Willis, the arterial pathway supplying the brain. R.F. was scheduled for a craniotomy and surgical insertion of a clip around the neck of the aneurysm to control bleeding and offer protection from rebleeding.

An aneurysm (*AN-yū-rism*) is a bulge in a weakened arterial wall that can rupture and cause damage. An aneurysm is illustrated later in this chapter when we learn more about R.F.'s medical care. There is more information on aneurysms and their potential effects in Chapters 9 and 17.





Ancillaries *At-A-Glance*

Visit *thePoint* to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii–xvi.

Learning TOOLS

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning RESOURCES

- eBook Chapter 2
- Audio Pronunciation Glossary

Learning ACTIVITIES

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After study of this chapter, you should be able to:

- 1 Define a suffix. *p16*
- 2 Give examples of how suffixes are used to convert terms into nouns, adjectives, and plurals. *p16*
- 3 Recognize and apply some general noun, adjective, and plural suffixes used in medical terminology. *p17*
- 4 Analyze the suffixes used in case studies. *pp14, 29*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|---|--|
| <p>_____ 1. The suffix in the word <i>learning</i> is:</p> <p>a. learn
b. ng
c. ing
d. earn</p> | <p>_____ 4. The suffix <i>-oid</i> means:</p> <p>a. excess
b. origin
c. resembling
d. paired</p> |
| <p>_____ 2. The suffixes <i>-ism</i>, <i>-ia</i>, and <i>-ist</i> are found in:</p> <p>a. verbs
b. adjectives
c. adverbs
d. nouns</p> | <p>_____ 5. The plural of <i>fungus</i> is:</p> <p>a. fungi
b. fungal
c. fungae
d. funga</p> |
| <p>_____ 3. The suffixes <i>-ic</i>, <i>-ous</i>, <i>-al</i>, and <i>-ile</i> are found in:</p> <p>a. adjectives
b. nouns
c. verbs
d. roots</p> | <p>_____ 6. The singular of <i>ova</i> (eggs) is:</p> <p>a. ovi
b. ovae
c. ovum
d. ovas</p> |

A suffix is a word ending that modifies a root. A suffix may indicate that the word is a noun or an adjective and often determines how the definition of the word will begin (**Box 2-1**). For example, using the root *myello*, meaning “bone marrow,” the adjective ending *-oid* forms the word *myeloid*, which means “like or pertaining to bone marrow.” The ending *-oma* forms *myeloma*, which is a tumor of the bone marrow. Adding another root, *gen*, which represents genesis or origin, and the adjective ending *-ous* forms the word *myelogenous*, meaning “originating in bone marrow.”

The suffixes given in this chapter are general ones that are used throughout medical terminology. They include endings that form:

- Nouns: a person, place, or thing
- Adjectives: words that modify nouns
- Plurals: endings that convert single nouns to multiples

Additional suffixes will be presented in later chapters as they pertain to disease states, medical treatments, or specific body systems.

Box 2-1



Focus on Words

Meaningful Suffixes

Suffixes sometimes take on a color of their own as they are added to different words. The suffix *-thon* is taken from the name of the Greek town Marathon, from which news of a battle victory was carried by a long-distance runner. It has been attached to various words to mean a contest of great endurance. We have bike-a-thons, dance-a-thons, telethons, and even major charity fundraisers called thon-a-thons.

The adjective ending *-ish* is used, as in *boyish* or *childish*, to suggest traces of certain characteristics. People tack it onto words to indicate that they are estimates, not right on target,

as in *forty-ish* or *blue-ish*. A vague time for a lunch appointment could be *noon-ish*.

In science and medicine, the ending *-tech* is used to imply high technology, as in the company name Genentech, and *-pure* may be added to inspire confidence, as in the naming of the Multi-Pure water filter. The ending *-mate* suggests helping, as in *helpmate*, defined in the dictionary as a helpful companion, more specifically, a wife, or sometimes, a husband. The medical device HeartMate is a pump used to assist a damaged heart.

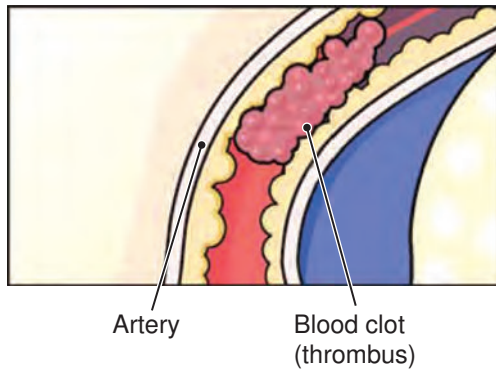


Figure 2-1 Thrombosis. This term refers to having a blood clot (thrombus) in a vessel. The word *thrombosis* has the noun suffix *-sis*, meaning “condition of.”

Noun Suffixes

The following general suffixes convert roots into nouns. **Table 2-1** has suffixes that represent different conditions. Note that the ending *-sis* may appear with different combining vowels as *-osis*, *-iasis*, *-esis*, or *-asis*. The first two of these denote an abnormal condition.

Table 2-2 has endings that convert roots into medical specialties or specialists. The suffix *-logy* applies to many fields other than medicine. It contains the root *log/o* taken from the Greek word *logos*, which means “word,” and generally means a field of study. Some examples are biology, archeology, terminology, and technology, as in medical technology, described in **Box 2-2**. Terms with this ending are also used to identify an institutional department or a specialty, as in cardiology, dermatology, radiology, and others.

Table 2-1 Suffixes that Mean “Condition of”

Suffix	Example	Definition of Example
-ia	dementia dē-MEN-shē-a	loss of (de-) intellectual function (from L. <i>mentis</i> : mind)
-ism	racism RĀ-sizm	discrimination based on race
-sis	thrombosis throm-BŌ-sis	having a blood clot (thrombus) in a vessel (Fig. 2-1)
-y	atony AT-ō-nē	lack (a-) of muscle tone

EXERCISE 2-1

Write the suffix that means “condition of” in the following words. Remember to use the phonetics to pronounce each word as you work through the exercises.

1. phobia (unfounded fear; from G. *phobos*: fear)
FŌ-bē-a

_____ -ia

2. psoriasis (skin disease)
sō-RĪ-a-sis

3. egotism (exaggerated self-importance; from *ego*: self)
Ē-gō-tizm

4. dystrophy (changes due to lack of nourishment; root: *troph/o*)
DIS-trō-fē

5. anesthesia (loss of sensation; root: *esthesi/o*) (**Fig. 2-2**)
an-es-THĒ-zē-a

6. parasitism (infection with parasites or behaving as a parasite)
PAR-a-sit-izm

7. stenosis (narrowing of a canal)
ste-NŌ-sis

(Continued)

EXERCISE 2-1 (Continued)

8. tetany (sustained muscle contraction)
TET-a-nē
9. diuresis (increased urination; root: ur/o)
dī-ū-RE-sis

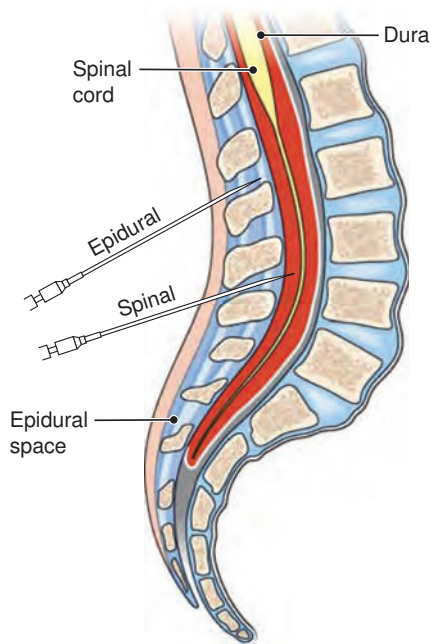


Figure 2-2 Injection sites for anesthesia. The word *anesthesia* uses the noun suffix *-ia*, meaning “condition of.” The dura is a layer of the meninges, the membranes that cover the brain and spinal cord. One who administers anesthesia is an anesthetist or anesthesiologist.



Figure 2-3 Pediatrics is the care and treatment of children. The ending *-ics* indicates a medical specialty. In this photo, a pediatrician, one who practices pediatrics, is testing an infant’s reflexes. The root *ped/o* means “child.”

Table 2-2 Suffixes for Medical Specialties

Suffix	Meaning	Example	Definition of Example
-ian	specialist in a field of study	physician <i>fī-ZISH-un</i>	practitioner of medicine (from root <i>physi/o</i> , meaning “nature”)
-iatrics	medical specialty	pediatrics <i>pē-dē-AT-riks</i>	care and treatment of children (<i>ped/o</i>) (Fig. 2-3)
-iatry	medical specialty	psychiatry <i>sī-KĪ-a-trē</i>	study and treatment of mental (<i>psych/o</i>) disorders
-ics	medical specialty	orthopedics <i>or-thō-PĒ-diks</i>	study and treatment of the skeleton and joints (from root <i>ped/o</i> , meaning “child,” and prefix <i>ortho</i> , meaning “straight”)
-ist	specialist in a field of study	podiatrist <i>pō-DĪ-a-trist</i>	one who studies and treats the foot (<i>pod/o</i>)
-logy	study of	physiology <i>fīz-ē-OL-ō-jē</i>	study of function in a living organism (from root <i>physi/o</i> , meaning “nature”)

EXERCISE 2-2

Write the suffix in the following words that means “study of,” “medical specialty,” or “specialist in a field of study.”

1. cardiologist (specialist in the study and treatment of the heart; root: cardi/o) *kar-dē-OL-ō-jist*
2. neurology (the study of the nervous system; root: neur/o) *nū-ROL-ō-jē*
3. geriatrics (study and treatment of the aged; root: ger/e) (Fig. 2-4) *jer-ē-AT-riks*
4. dermatology (study and treatment of the skin, or derma) *der-ma-TOL-ō-jē*
5. optician (one who makes and fits corrective lenses for the eyes; root: opt/o) *op-TISH-an*
6. anesthetist (one who administers anesthesia) (see Fig. 2-2) *a-NES-the-tist*

Write a word for a specialist in the following fields:

7. anatomy (study of body structure) *a-NAT-ō-mē*
8. pediatrics (care and treatment of children; root: ped/o) *pē-dē-AT-riks* (see Fig. 2-3)
9. radiology (use of radiation in diagnosis and treatment) *rā-dē-OL-ō-jē*
10. psychology (study of the mind; root: psych/o) *sī-KOL-ō-jē*
11. technology (practical application of science) *tek-NOL-ō-jē*
12. obstetrics (medical specialty concerning pregnancy and birth) *ob-STET-riks*

Box 2-2



Health Professions

Medical Laboratory Technology

The field of medical laboratory technology includes a wide range of clinical sciences. The people who perform laboratory testing for the medical profession may follow either of two career paths. Clinical laboratory scientists (CLS), also called medical technologists (MT), require a bachelor's degree. Clinical laboratory technicians, also known as medical laboratory technicians, may practice with an associate's degree. They may have more limited responsibilities and work under closer supervision than CLSs. Both training programs require internships in a laboratory following graduation.

According to the American Society of Clinical Pathology (ASCP), these health care professionals perform a variety of tasks from simple premarital blood tests to more complex tests for diseases, including HIV/AIDS, diabetes, and cancer. They examine specimens of human blood and tissue microscopically to look for microorganisms, such as bacteria and parasites, or cancerous cells.

They may match blood for transfusions and test blood for chemicals, drugs, and other substances. Physicians rely on the information they provide to determine a diagnosis and formulate a treatment plan for their patients. In addition, these laboratory professionals may evaluate test results; develop and modify laboratory procedures; and establish and monitor programs to ensure the accuracy of tests.

In the course of their work, they operate valuable equipment, including computers and precision instruments, such as high-powered microscopes and cell counters. Therefore, they must be proficient with instrumentation and electronic technology as well as science. Careers in medical laboratory sciences require completion of a CLS or medical technician program accredited by the National Accrediting Agency of Clinical Laboratory Science (NAA-CLS).



Figure 2-4 Geriatrics is the care and treatment of the aged. A specialist in this field, a geriatrician, is shown.

The two endings *-iatrics* and *-iatry* contain the root *-iatr/o*, based on a Greek word for healing and meaning “physician” or “medical treatment.”

Adjective Suffixes

The suffixes below are all adjective endings that mean “pertaining to,” “like,” or “resembling” (**Table 2-3**). There are no rules for which ending to use for a given noun. Familiarity comes with practice. When necessary, tips on proper usage are given in the text.

Note that for words ending with the suffix *-sis*, the first *s* is changed to a *t* before adding *-ic* to form the adjective, as in genetic, pertaining to genesis (origin); psychotic, pertaining to psychosis (a mental disorder); or diuretic, pertaining to diuresis (increased urination).

Table 2-3

Suffixes that Mean “Pertaining to,” “Like,” or “Resembling”

Suffix	Example	Definition of Example
-ac	cardiac KAR-dē-ak	pertaining to the heart
-al	vocal VO-kal	pertaining to the voice
-ar	nuclear NŪ-klē-ar	pertaining to a nucleus
-ary	salivary SAL-i-var-ē	pertaining to saliva
-form	muciform MŪ-si-form	like or resembling mucus
-ic	anatomic an-a-TOM-ik	pertaining to anatomy (Fig. 2-5)
-ical (ic + al)	electrical ē-LEK-tri-kal	pertaining to electricity
-ile	virile VIR-il	pertaining to the male, masculine
-oid	lymphoid LIM-foyd	pertaining to the lymphatic system
-ory	circulatory SIR-kū-la-tor-ē	pertaining to circulation
-ous	cutaneous kū-TĀ-nē-us	pertaining to the skin (from L. <i>cutis</i> : skin)

EXERCISE 2-3

Identify the suffix meaning “pertaining to,” “like,” or “resembling” in the following words:

1. dietary (pertaining to the diet) _____ -ary
DĪ-e-tar-ē
2. neuronal (pertaining to a nerve cell, or neuron) (Fig. 2-6) _____
NŪ-rō-nal
3. metric (pertaining to a meter or measurement; root metr/o means “measure”) _____
ME-trik
4. venous (pertaining to a vein; root: ven/o) _____
VĒ-nus
5. epileptiform (like or resembling epilepsy) _____
ep-i-LEP-ti-form
6. toxoid (like or resembling a toxin, or poison) _____
TOK-soyd
7. topical (pertaining to a surface) _____
TOP-i-kal
8. febrile (pertaining to fever) _____
FEB-ril
9. neurotic (pertaining to neurosis, a mental disorder) _____
nū-ROT-ik
10. surgical (pertaining to surgery) _____
SUR-ji-kal
11. muscular (pertaining to a muscle) _____
MUS-kū-lar
12. urinary (pertaining to urine; root: ur/o) _____
Ū-ri-nar-ē
13. respiratory (pertaining to respiration) _____
RES-pi-ra-tor-ē
14. pelvic (pertaining to the pelvis) (Fig. 2-7) _____
PEL-vik
15. saccular (pouch-like, resembling a small sac) _____
SAK-ū-lar

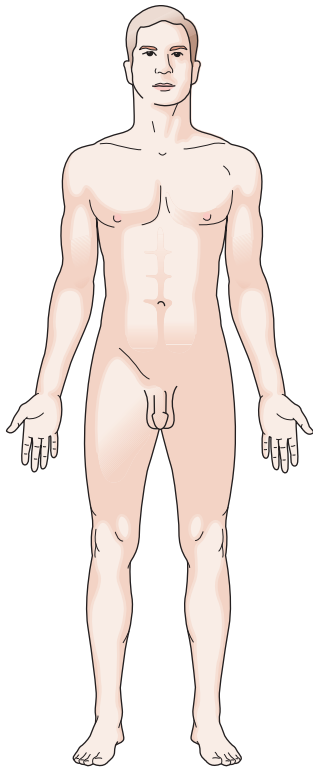


Figure 2-5 The anatomic position. This posture is standard in the study of anatomy. A person in this position is facing forward with arms at the side and palms forward (anterior). The adjective suffix *-ic* means “pertaining to.”

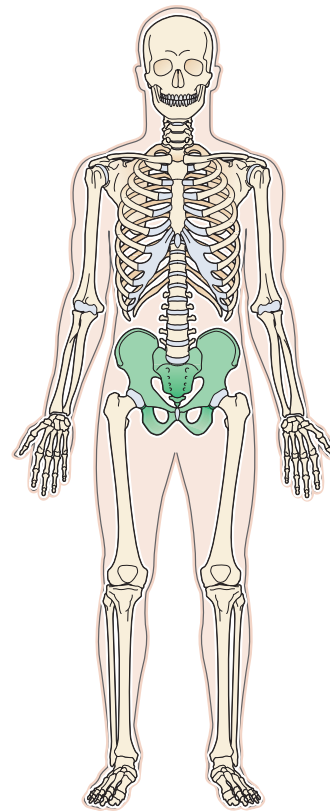
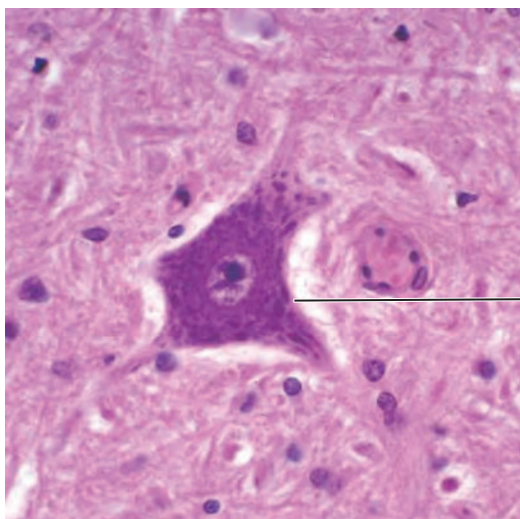


Figure 2-7 The pelvis is the bony hip girdle. The adjective form of pelvis is *pelvic*.

Forming Plurals

Many medical words have special plural forms based on the ending of the word. **Table 2-4** gives some general

rules for the formation of plurals along with examples. The plural endings listed in column two are substituted for the word endings in column one. Note that both singular endings *-on* and *-um* change to *-a* for the plural. You have to learn which singular ending to use for specific words when converting a plural word ending in *-a* to the singular.



Neuron

Figure 2-6 A neuron is a nerve cell. The adjective form of *neuron* is *neuronal*.

SOME EXCEPTIONS TO THE RULES

There are exceptions to the rules given for forming plurals, some of which will appear in later chapters. For example, the plural of *sinus* (space) is *sinuses*, the plural of *virus* is *viruses*, and *serums* (thin fluids) is sometimes used instead of *sera*. An *-es* ending may be added to words ending in *-ex* or *-ix* to form a plural, as in *appendixes*, *apexes*, and *indexes*.

Some incorrect plural forms are in common usage, for example, *stigmas* instead of *stigmata*, *referendums* instead of *referenda*, *stadiums* instead of *stadia*. Often people use *phalange* instead of *phalanx* as the singular of *phalanges*. Words ending in *-oma*, meaning “tumor,” should be changed to *-omata*, but most people just add an *s* to form the plural. For example, the plural of *carcinoma* (a type of cancer) should be *carcinomata*, but *carcinomas* is commonly used.

Table 2-4 Plural Endings

Word Ending	Plural Ending	Singular Example	Plural Example
a	ae	vertebra (bone of the spine) <i>VER-te-bra</i>	vertebrae (Fig. 2-8) <i>VER-te-brē</i>
en	ina	lumen (central opening) <i>LŪ-men</i>	lumina (Fig. 2-9) <i>LŪ-min-a</i>
ex, ix, yx	ices	matrix (background substance; mold) <i>MĀ-triks</i>	matrices <i>MĀ-tri-sēz</i>
is	es	diagnosis (determination of a disease or defect) <i>dī-ag-NŌ-sis</i>	diagnoses <i>dī-ag-NŌ-sēz</i>
ma	mata	stigma (mark or scar) <i>STIG-ma</i>	stigmata <i>stig-MAT-a</i>
nx (anx, inx, ynx)	nges	phalanx (bone of finger or toe) <i>fa-LANKS</i>	phalanges (Fig. 2-10) <i>fa-LAN-jēz</i>
on	a	ganglion (mass of nervous tissue) <i>GANG-lē-on</i>	ganglia <i>GANG-lē-a</i>
um	a	serum (thin fluid) <i>SĒ-rum</i>	sera <i>SĒ-ra</i>
us	i	thrombus (see Fig. 2-1) <i>THROM-bus</i>	thrombi <i>THROM-bī</i>

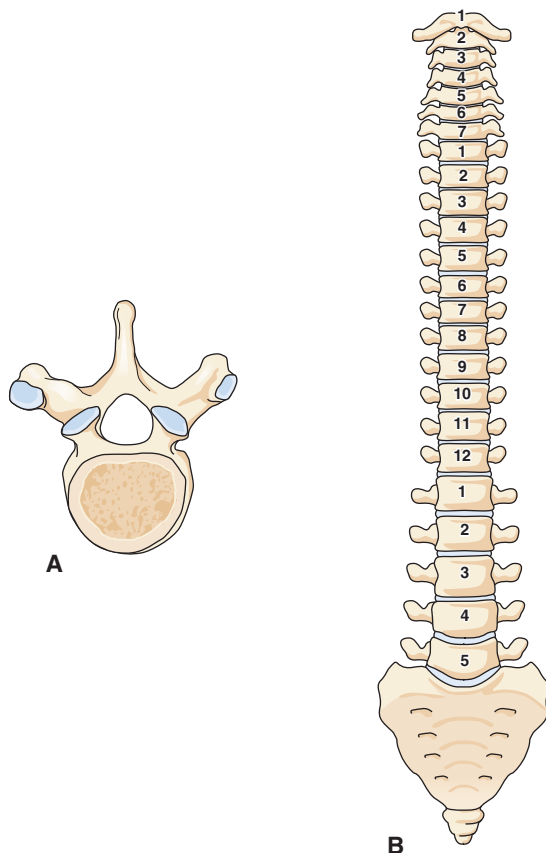


Figure 2-8 **Bones of the spine.** Each bone of the spine is a vertebra (**A**). The spinal column is made of 26 vertebrae (**B**).

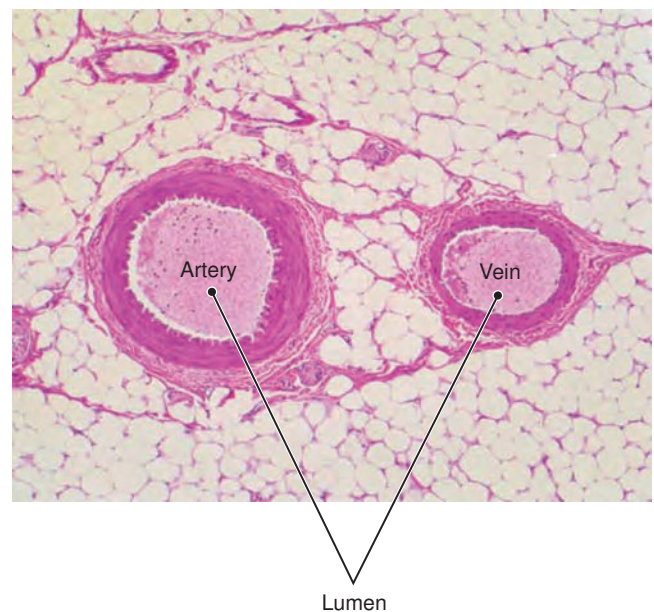


Figure 2-9 **A lumen is the central opening of an organ or vessel.** Two blood vessels are shown, an artery and a vein. The plural of lumen is *lumina*.

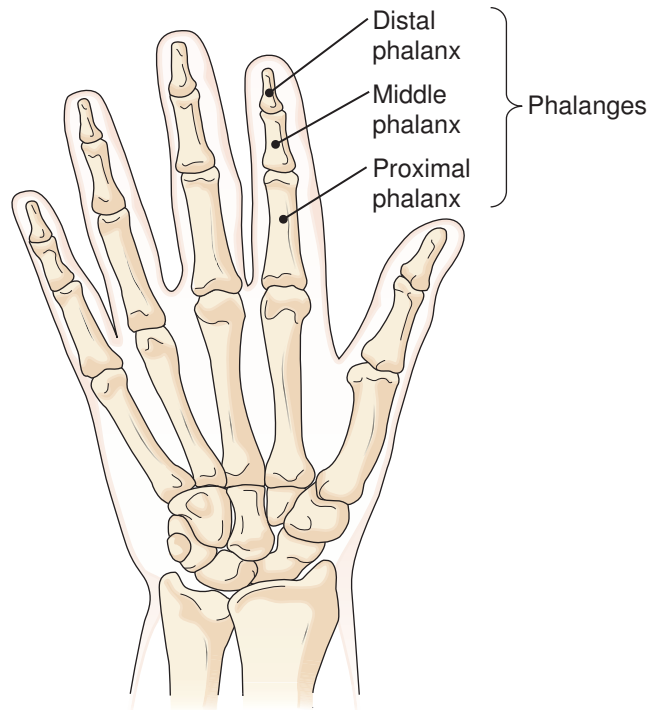


Figure 2-10 Bones of the right hand, anterior view. Each bone of a finger or toe is a phalanx. Each hand has 15 phalanges.

EXERCISE 2-4

Write the plural form of the following words. The word ending is underlined in each.

- | | |
|---|----------------|
| 1. patell <u>a</u> (kneecap)
<i>pa-TEL-a</i> | _____ patellae |
| 2. phenomen <u>on</u> (occurrence or perception)
<i>fe-NOM-e-non</i> | _____ |
| 3. oment <u>um</u> (abdominal membrane)
<i>ō-MEN-tum</i> | _____ |
| 4. prognos <u>is</u> (prediction of disease outcome)
<i>prog-NŌ-sis</i> | _____ |
| 5. ap <u>ex</u> (tip or peak)
<i>A-peks</i> | _____ |
| 6. ov <u>um</u> (female reproductive cell; egg)
<i>Ō-vum</i> | _____ |
| 7. spermatozo <u>on</u> (male reproductive cell; sperm cell)
<i>sper-ma-tō-ZŌ-on</i> | _____ |
| 8. menin <u>x</u> (membrane around the brain and spinal cord)
<i>ME-ninks</i> | _____ |
| 9. embol <u>us</u> (blockage in a vessel)
<i>EM-bō-lus</i> | _____ |

EXERCISE 2-4 (Continued)

Write the singular form of the following words. The word ending is underlined in each.

10. protozoa (single-celled animals)
prō-tō-ZŌ-a

11. appendices (things added)
a-PEN-di-sēz

12. adenomata (tumors of glands)
ad-e-NŌ-ma-ta

13. fungi (simple, nongreen plants)
FUN-jī

14. pelves (cup-shaped cavities)
PEL-vēz

15. foramina (openings, passageways)
fō-RAM-i-na

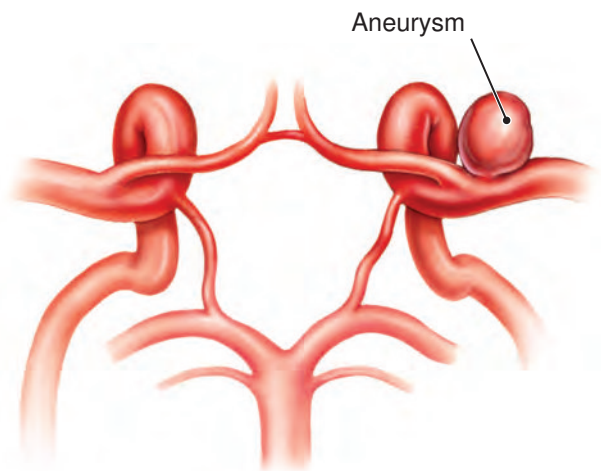
16. curricula (series of courses)
kur-RIK-ū-la

17. indices (directories, lists)
IN-di-sēz

18. alveoli (small sacs)
al-VE-ō-lī

R.F.'s Postoperative Follow-Up

R.F. underwent a craniotomy in which a special clip was placed around the neck of the aneurysm. She was closely observed for postoperative neurological deficits, including vascular spasm, a serious possible complication. She tolerated the procedure well with no complications.



Circle of Willis

Chapter Review

Identify the suffix that means “condition of” in the following words:

1. alcoholism (*AL-kō-hol-izm*) (alcohol dependence) _____
2. insomnia (*in-SOM-nē-a*) (inability to sleep; root: somn/o) _____
3. acidosis (*as-i-DŌ-sis*) (acid body condition) _____
4. dysentery (*DIS-en-ter-ē*) (intestinal disorder; root: enter/o) _____
5. psychosis (*sī-KŌ-sis*) (disorder of the mind) _____
6. anemia (*a-NĒ-mē-a*) (lack of blood or hemoglobin; root: hem/o) _____

Give the suffix in the following words that means “specialty” or “specialist”:

7. psychiatry (*sī-Kī-a-trē*) _____
8. orthopedics (*or-thō-PĒ-diks*) _____
9. anesthesiologist (*an-es-thē-zē-OL-ō-jist*) _____
10. technician (*tek-NISH-un*) _____
11. anatomist (*a-NAT-ō-mist*) _____
12. obstetrician (*ob-ste-TRISH-un*) _____

Give the name of a specialist in the following fields:

13. pediatrics (*pē-dē-A-triks*) _____
14. dermatology (*der-ma-TOL-ō-jē*) _____
15. physiology (*fīz-ē-OL-ō-jē*) _____
16. gynecology (*gī-ne-KOL-ō-jē*) _____

Identify the adjective suffix in the following words that means “pertaining to,” “like,” or “resembling”:

17. pelvic (*PEL-vik*) _____
18. arterial (*ar-TĒ-rē-al*) _____
19. anxious (*ANG-shus*) _____
20. fibroid (*FĪ-broyd*) _____
21. vascular (*VAS-kū-lar*) _____
22. oral (*OR-al*) _____
23. basic (*BĀ-sik*) _____
24. binary (*BĪ-nar-ē*) _____
25. skeletal (*SKEL-e-tal*) _____
26. rheumatoid (*RŪ-ma-toyd*) _____

27. febrile (*FEB-ril*) _____
28. surgical (*SUR-ji-kal*) _____
29. circular (*SIR-kū-lar*) _____
30. exploratory (*ek-SPLOR-a-tor-ē*) _____

Write the plural for the following words. Each word ending is underlined.

31. gingiva (gums) _____
JIN-ji-va
32. testis (male reproductive organ) _____
TEST-is
33. ganglion (mass of nervous tissue) _____
GANG-lē-on
34. lumenu (central opening) _____
LŪ-men
35. locus (place) _____
LŌ-kus
36. criterion (standard) _____
kri-TIR-ē-on
37. larynx (voice box) _____
LAR-inks
38. vena (vein) _____
VE-na
39. nucleus (center; core) _____
NŪ-klē-us

Write the singular form for the following words. Each word ending is underlined.

40. thrombi (blood clots) _____
THROM-bī
41. vertebrae (bones of the spine) _____
VER-te-brē
42. bacteria (type of microorganism) _____
bak-TĒ-rē-a
43. alveoli (air sacs) _____
al-VE-ō-lī
44. apices (high points, tips) _____
A-pi-sēz
45. foramina (openings) _____
fō-RAM-i-na
46. diagnoses (identifications of disease) _____
di-ag-NŌ-sēz
47. carcinomata (cancers) _____
kar-si-NŌ-ma-ta

WORD BUILDING

Write a word for the following definitions using the word parts provided. Each may be used more than once.

-ist -ic parasit -ism -y log -o-

- 48. pertaining to parasites _____
- 49. one who studies parasites _____
- 50. a condition of having parasites _____
- 51. study of parasites _____

WORD ANALYSIS

Define each of the following words and give the meaning of the word parts in each. Use a dictionary if necessary.

- 52. geriatrician (*jer-ē-a-TRI-shun*) _____
 - a. ger/e _____
 - b.iatr/o _____
 - c. -ic _____
 - d. -ian _____
- 53. anesthesia _____
 - a. an- _____
 - b. esthesi/o _____
 - c. -ia _____
- 54. photophobia (*fō-tō-FŌ-bē-a*) _____
 - a. phot/o _____
 - b. phob (from Greek *phobos*) _____
 - c. -ia _____



For more learning activities, see Chapter 2 of the Student Resources on *thePoint*.

Additional Case Study

2

C.R.'s Job-Related Breathing Problems

Chief complaint:

C.R., a 54-YO woman, has been having difficulty breathing (dyspnea) that was originally attributed to a left upper lobe (LUL) pneumonia. She was treated with an antibiotic, and after no improvement was noted in her breathing, C.R. had a follow-up chest x-ray that revealed a small LUL pneumothorax. She was referred to the respiratory clinic and saw Dr. Williams, a pulmonologist.

Past medical history:

C.R. has a history of smoking a pack a day for 30 years and stopped two years ago. She noticed an improvement in her breathing and tired less easily after she quit. About one month ago, she complained of general malaise, dyspnea, and a productive cough; she was expectorating pus-containing (purulent) sputum and was febrile. The chest radiograph and sputum cultures indicate that her symptoms had progressed into a bronchopneumonia with pulmonary edema complicated

by a small pneumothorax in the left upper lobe. A small mass was identified in the left lobe. Also noted, C.R. is a hairstylist as well as a manicurist and recently went back to work in a small beauty salon. She has complained that the fumes from the hair chemicals and nail products affect her breathing.

Clinical course:

Dr. Williams performed a bronchoscopic examination. He took a biopsy of the mass and the results were negative. Sputum cultures were taken to determine the spectrum of action of an appropriate antibiotic. A respiratory therapist measured the patient's respiratory volumes and recorded any changes. The patient was told to drink plenty of liquids, get proper rest, and refrain from working for one week. She was told to wear a mask when she returned to work, avoid unventilated areas in the salon, and avoid the chemical fumes as much as possible. She is to return to the clinic in one month for follow-up.

Case Study Questions

Multiple choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|---|---|
| <p>_____ 1. The <i>gh</i> in the terms cough and radiograph is pronounced as:</p> <ul style="list-style-type: none">a. gb. hc. fd. s <p>_____ 2. The <i>pn</i> in the term bronchopneumonia is pronounced as:</p> <ul style="list-style-type: none">a. pb. nc. fd. s <p>_____ 3. Which of the following is a compound word?</p> <ul style="list-style-type: none">a. pulmonaryb. pneumothoraxc. respiratoryd. antibiotic | <p>_____ 4. The suffix that means "condition of" in <i>pneumonia</i> is:</p> <ul style="list-style-type: none">a. -niab. -moniac. -iad. -onia <p>_____ 5. The plural of <i>spectrum</i> is:</p> <ul style="list-style-type: none">a. spectrab. spectriac. spectrinad. spectrums |
|---|---|

6. Find four words in the case study with a suffix that means “specialist in a field:”

1. _____
2. _____
3. _____
4. _____

7. Find five words in the case study with suffixes that mean “pertaining to, like, or resembling,” and write both the suffix and the word that contains it.

Suffix	Word
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____

CHAPTER

3

Prefixes

Case Study

T.S.'s Diving Accident and Spinal Cord Injury

Chief complaint:

A 14-year-old male, T.S., was transported to the emergency room after diving into a shallow backyard cement pool. He c/o severe head and neck pain and has minimal movement of his arms. He is not able to move his legs.

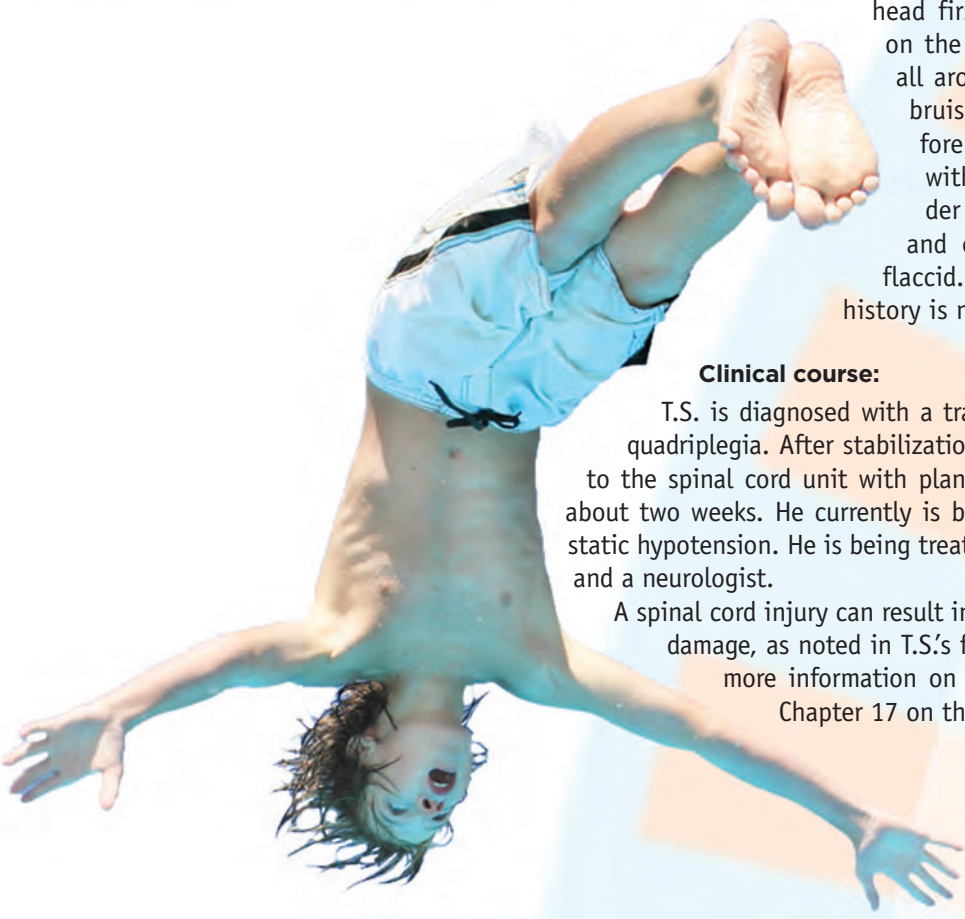
Examination:

A well-nourished 14-year-old male is awake and oriented, initially hypotensive and bradycardic, but vital signs are stabilizing. He reports being at a backyard pool party for his friend's birthday and remembers diving into the pool head first. The next thing he recalls is waking up on the deck of the pool with his friends standing all around him. He has a large erythematous and bruised area centered on the upper part of the forehead. T.S. has full head and neck movement with good muscle strength. He has good shoulder movement and is able to flex his elbows and extend his wrists. His legs are flexic and flaccid. He has no finger movement. Past medical history is noncontributory.

Clinical course:

T.S. is diagnosed with a transected C6 vertebra potentially resulting in quadriplegia. After stabilization of the cervical fracture, he was transferred to the spinal cord unit with plans to move him to the rehabilitation unit in about two weeks. He currently is being monitored for hyperthermia and orthostatic hypotension. He is being treated by his primary physician, a neurosurgeon, and a neurologist.

A spinal cord injury can result in psychological as well as permanent physical damage, as noted in T.S.'s follow-up study later in this chapter. There is more information on the spinal cord and mental disturbances in Chapter 17 on the nervous system.





Ancillaries *At-A-Glance*

Visit *thePoint* to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii–xvi.

Learning TOOLS

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning RESOURCES

- E-book: Chapter 3
- Audio Pronunciation Glossary

Learning ACTIVITIES

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After study of this chapter, you should be able to:

- 1 Define a prefix and explain how prefixes are used. *p34*
- 2 Identify and define some of the prefixes used in medical terminology. *p36*
- 3 Use prefixes to form words used in medical terminology. *p37*
- 4 Analyze the prefixes used in case studies. *pp32, 50*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|--|---|
| <p>_____ 1. A word prefix appears:</p> <ul style="list-style-type: none"> a. in the middle of the word b. after a suffix c. at the end of the word d. at the beginning of the word | <p>_____ 5. The prefixes <i>mono-</i>, <i>tri-</i>, and <i>multi-</i> all refer to:</p> <ul style="list-style-type: none"> a. size b. number c. location d. shape |
| <p>_____ 2. The prefix in the words <i>prefix</i> and <i>pretest</i> means:</p> <ul style="list-style-type: none"> a. before b. final c. fixed d. superior | <p>_____ 6. The prefixes <i>leuk/o-</i>, <i>melan/o-</i>, and <i>erythr/o-</i> all refer to:</p> <ul style="list-style-type: none"> a. dimensions b. area c. abnormalities d. color |
| <p>_____ 3. The prefix in the word <i>microscopic</i> is:</p> <ul style="list-style-type: none"> a. mic- b. scop- c. micro- d. pic- | <p>_____ 7. The opposite of hyperglycemia (high blood sugar) is:</p> <ul style="list-style-type: none"> a. hyperglucemia b. hypoglycemia c. hypogalcemia d. hyperglycemic |
| <p>_____ 4. The suffix in the word <i>microscopic</i> is:</p> <ul style="list-style-type: none"> a. -ic b. -scop c. -micro d. -ros | <p>_____ 8. The opposite of postnatal (after birth) is:</p> <ul style="list-style-type: none"> a. perinatal b. prenatural c. prenatal d. postpartum |

A prefix is a short word part added before a word or word root to modify its meaning. For example, the word *lateral* means “side.” Adding the prefix *uni-*, meaning “one,” forms *unilateral*, which means “affecting or involving one side.” Adding the prefix *contra-*, meaning “against or opposite,” forms *contralateral*, which refers to an opposite side. The term *equilateral* means “having equal sides.” Prefixes in this book are followed by hyphens to show that word parts are added to the prefix to form a word.

This chapter introduces most of the prefixes used in medical terminology in **Tables 3-1 to 3-8**. Although the list is long, almost all of the prefixes you will need to work through this book are presented here. Some additional

prefixes, including those related to disease, are given in several later chapters. The meanings of many of the prefixes in this chapter are familiar to you from words that are already in your vocabulary, as shown in **Box 3-1**. You may not know all the words in the exercises, but make your best guess. The words in the tables are given as examples of usage. Almost all of them reappear in other chapters. If you forget a prefix as you work, you may refer to this chapter or to the alphabetical lists of word parts and their meanings in Appendices 3 and 4. Appendix 7 lists prefixes only.

All medical personnel are familiar with these prefixes. To learn about one popular field, nursing, see **Box 3-2**.

Box 3-1



Focus on Words

Prefix Shorthand

Many prefixes catch on rapidly as a form of shorthand. In everyday life, the prefix *e-* for electronic has spread to words such as e-mail, e-commerce, e-zine, e-waste, and others. *X-* for extreme appears in X-games and other X-sports.

The prefix *nan/o* means “one billionth” but is used more generally in terms related to very small particles, such as nanotechnology. It also appears in the names of lotions and cosmetics that have ultrafine particles (nanoparticles) among their ingredients. *Steri-* implies sterility, or at least cleanliness. It is used for naming Steri-Strip bandages and for other protective medical products and cleaning materials.

The prefix *endo-* in the names of many surgical instruments signifies new endoscopic instruments that are longer and thinner and have smaller working tips to be used in areas where there is minimal access. Some examples are endoscissors, endosuture, endocautery, and endosnare.

Health care products designed for specific age groups are also encoded by prefixes. *Geri-*, pertaining to old age, as in geriatrics, appears in geri-chair, geri-pads, geri-jacket, and the patent medicine Geritol, among others. *Pedi-* or *pedia-*, meaning “child,” is found in the names pedi-cath, pedi-dose, pedi-set (instruments), and Pedialyte, a product used for children to replace fluid and electrolytes.

Box 3-2



Health Professions

Registered Nurse

Careers in nursing are the most diverse of all health care occupations and have the greatest number of practitioners. About 60 percent of nursing jobs are in hospitals, but other sites include offices, clinics, hospices, homes, and private companies. Within these settings, nurses may concentrate on particular specialties, such as emergency or critical care, surgery, psychiatry, and pediatric (child) or geriatric (elderly) care. Registered nurses (RNs) usually engage in direct patient contact, but they also educate patients and their families about medical conditions, give advice and emotional support, keep patient records, help with diagnostic testing, manage research trials, and provide follow-up and rehabilitative care. On a wider scale, they may work in industry, correction facilities, and schools. They may also work in public health, run health screening or immunization centers, or manage blood drives.

The three possible educational pathways that lead to a nursing career are a four-year bachelor's degree (BSN), a two- to three-year associate degree (ADN) from a community or junior college, or a two- to three-year diploma from a hospital nursing program. Whereas the majority of nurses graduate from an accredited ADN or BSN program, there are still a limited number of hospital diploma programs that prepare students for a nursing career. Courses include liberal

arts, sciences, behavioral sciences, and nursing. All programs include supervised clinical training in a health care facility. All graduates must pass a national examination, the NCLEX-RN, to obtain a license to practice.

Many people start their careers as practical nurses or nurse's aides and then return to school for an RN degree. Others may begin with an associate degree or diploma and then enroll in a bachelor's degree program while working and receiving tuition reimbursement from an employer. There are also accelerated programs for those with degrees in other fields who wish to switch into nursing.

RNs who want to advance further in their careers and work more independently can train as nurse anesthetists, nurse midwives, clinical nurse specialists, or nurse practitioners (who can provide primary care and in some states, prescribe medications). Careers as nursing educators and administrators also require advanced training. The job outlook for nursing is extremely good, especially in medically underserved areas and in home health care. Sources of information on nursing careers include the National League for Nursing at www.nln.org, the American Association of Colleges of Nursing at www.aacn.nche.edu, and the American Nurses Association at <http://nursingworld.org>.

Table 3-1 Prefixes for Numbers*

Prefix	Meaning	Example	Definition of Example
prim/i-	first	primary <i>PRĪ-mar-ē</i>	first
mon/o-	one	monocular <i>mon-OK-ŭ-lar</i>	having one eyepiece or affecting one eye
uni-	one	unite <i>ŭ-NĪT</i>	form into one part
hemi-	half, one side	hemisphere <i>HEM-i-sfēr</i>	one half of a rounded structure (Fig. 3-1)
semi-	half, partial	semipermeable <i>sem-ē-PER-mē-a-bl</i>	partially permeable (capable of being penetrated)
bi-	two, twice	binary <i>BĪ-nar-ē</i>	made up of two parts
di-	two, twice	diatomic <i>dī-a-TOM-ik</i>	having two atoms
dipl/o-	double	diplococci <i>dip-lō-KOK-sī</i>	round bacteria (cocci) that grow in groups of two
tri-	three	tricuspid <i>tri-KUS-pid</i>	having three points or cusps (Fig. 3-2)
quadr/i-	four	quadruplet <i>kwa-DRŪP-let</i>	one of four babies born together
tetra-	four	tetralogy <i>tet-RAL-ō-jē</i>	a group of four
multi-	many	multicellular <i>mul-tī-SEL-ŭ-lar</i>	consisting of many cells (Fig. 3-3)
poly-	many, much	polymorphous <i>pol-ē-MOR-fus</i>	having many forms (morph/o)

*Prefixes pertaining to the metric system are in Appendix 8-2.

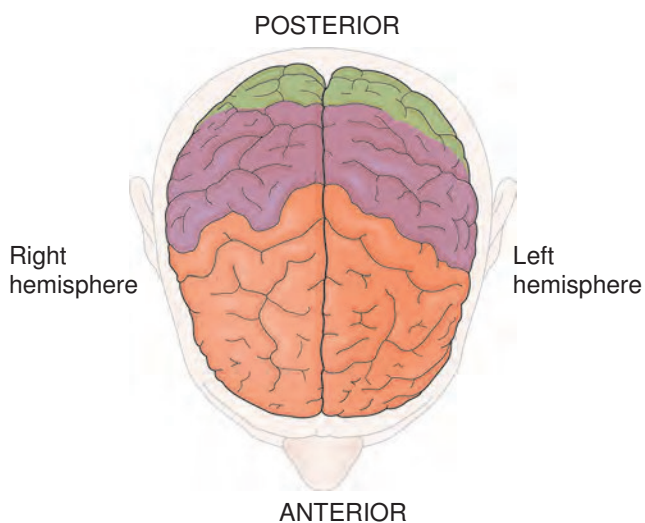


Figure 3-1 Brain hemispheres. Each half of the brain is a hemisphere. The prefix *hemi-* means half or one side.

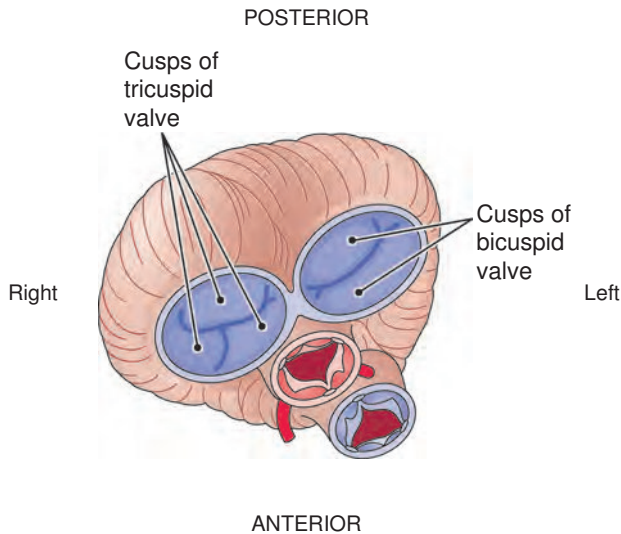


Figure 3-2 Heart valves. The valve on the heart's right side, the tricuspid, has three cusps (flaps); the valve on the heart's left side, the bicuspid, has two cusps. The prefixes *bi-* and *tri-* indicate number.

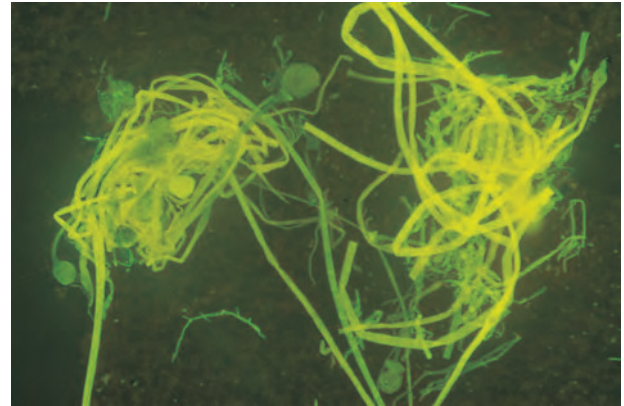


Figure 3-3 A multicellular organism. This fungus has more than one cell. It is a simple multicellular organism.

Common Prefixes

EXERCISE 3-1

Fill in the blanks. Use the phonetics to pronounce each word as you work through the exercises.

- Place the following prefixes in order of increasing numbers:
a. tri- b. uni- c. tetra- d. bi- _____
- A binocular (*bī-NOK-ū-lar*) microscope has _____ eyepieces.
- A quadruped (*KWAD-rū-ped*) animal walks on _____ feet (ped/o).
- The term unilateral (*ū-ni-LAT-e-ral*) refers to _____ side (later/o).
- The term semilunar (*sem-ē-LŪ-nar*) means shaped like a _____ moon.
- A diploid (*DIP-loyd*) organism has _____ sets of chromosomes (-ploid).
- A tetrad (*TET-rad*) has _____ components.
- A tripod (*TRĪ-pod*) has _____ legs.
- Monophonic sound has _____ channel.

Give a prefix that is similar in meaning to each of the following:

- di- _____
- poly- _____
- hemi- _____
- mon/o- _____

Table 3-2 Prefixes for Colors

Prefix	Meaning	Example	Definition of Example
cyan/o-	blue	cyanosis <i>sī-a-NŌ-sis</i>	bluish discoloration of the skin due to lack of oxygen (Fig. 3-4)
erythr/o-	red	erythrocyte <i>e-RITH-rō-sīt</i>	red blood cell (-cyte)
leuk/o-	white, colorless	leukemia <i>lū-KĒ-mē-a</i>	cancer of white blood cells
melan/o-	black, dark	melanin <i>MEL-a-nin</i>	the dark pigment that colors the hair and skin
xanth/o-	yellow	xanthoma <i>zan-THŌ-ma</i>	yellow growth (-oma) on the skin



Figure 3-4 Cyanosis, a bluish discoloration. This abnormal coloration is seen in the toenails and toes, as compared to the normal coloration of the fingertips. The prefix *cyan/o-* means “blue.”

EXERCISE 3-2

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|--|---------------------------------------|
| _____ 1. melanocyte (<i>MEL-a-nō-sīt</i>) | a. pertaining to bluish discoloration |
| _____ 2. xanthoderma (<i>zan-thō-DER-ma</i>) | b. redness of the skin |
| _____ 3. cyanotic (<i>sī-a-NŌ-tik</i>) | c. yellow coloration of the skin |
| _____ 4. erythema (<i>e-ri-THĒ-ma</i>) | d. cell that produces dark pigment |
| _____ 5. leukocyte (<i>LŪ-kō-sīt</i>) | e. white blood cell |

Table 3-3 Negative Prefixes

Prefix	Meaning	Example	Definition of Example
a-, an-	not, without, lack of, absence	anhydrous <i>an-Hĭ-drus</i>	lacking water (hydr/o)
anti-	against	antiseptic <i>an-ti-SEP-tik</i>	agent used to prevent infection (sepsis)
contra-	against, opposite, opposed	contraindicated <i>kon-tra-IN-dĭ-kā-ted</i>	against recommendations, not advisable
de-	down, without, removal, loss	decalcify <i>dē-KAL-si-fĭ</i>	remove calcium (calc/i) from
dis-	absence, removal, separation	dissect <i>di-SEKT</i>	to separate tissues for anatomical study
in-*, im- (used before b, m, p)	not	incontinent <i>in-KON-ti-nent</i>	not able to contain or control discharge of excretions
non-	not	noncontributory <i>non-kon-TRIB-ŭ-tor-ē</i>	not significant, not adding information to a medical diagnosis
un-	not	uncoordinated <i>un-kō-OR-dĭ-nā-ted</i>	not working together, not coordinated

*May also mean “in” or “into” as in inject, inhale.

EXERCISE 3-3

Identify and define the prefix in the following words:

	Prefix	Meaning of Prefix
1. aseptic	a-	not, without, lack of, absence
2. antidote	_____	_____
3. amnesia	_____	_____
4. disintegrate	_____	_____
5. contraception	_____	_____
6. inadequate	_____	_____
7. depilatory	_____	_____
8. nonconductor	_____	_____

Add a prefix to form the negative of the following words:

9. conscious	_____	unconscious
10. significant	_____	_____
11. infect	_____	_____
12. usual	_____	_____
13. specific	_____	_____
14. congestant	_____	_____
15. compatible	_____	_____

Table 3-4 Prefixes for Direction

Prefix	Meaning	Example	Definition of Example
ab-	away from	abduct <i>ab-DUKT</i>	to move away from the midline (Fig. 3-5)
ad-	toward, near	adduct <i>ad-DUKT</i>	to move toward the midline (Fig. 3-5)
dia-	through	diarrhea <i>dī-a-RĒ-a</i>	frequent discharge of fluid fecal matter
per-	through	percutaneous <i>per-kū-TĀ-nē-us</i>	through the skin
trans-	through	transected <i>tran-SEKT-ed</i>	cut (sectioned) through or across

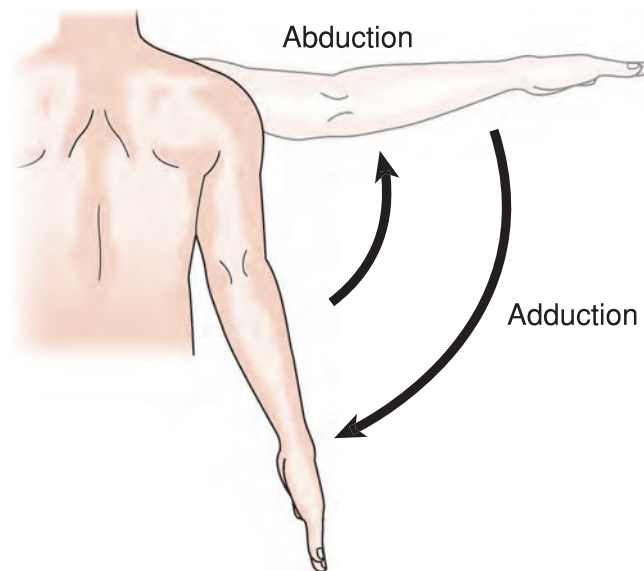


Figure 3-5 Abduction and adduction. The prefix *ab-* means “away from;” the arm is moved away from the body in abduction. The prefix *ad-* means “toward;” the arm is moved toward the body in adduction.

EXERCISE 3-4

Identify and define the prefix in the following words:

	Prefix	Meaning of Prefix
1. dialysis	<u>dia-</u>	<u>through</u>
2. percolate	<u> </u>	<u> </u>
3. adjacent	<u> </u>	<u> </u>
4. absent	<u> </u>	<u> </u>
5. diameter	<u> </u>	<u> </u>
6. transport	<u> </u>	<u> </u>

Table 3-5 Prefixes for Degree

Prefix	Meaning	Example	Definition of Example
hyper-	over, excess, abnormally high, increased	hyperthermia <i>hī-per-THER-mē-a</i>	high body temperature
hypo-*	under, below, abnormally low, decreased	hyposecretion <i>hī-pō-sē-KRĒ-shun</i>	underproduction of a substance
olig/o-	few, scanty	oligospermia <i>ol-i-gō-SPER-mē-a</i>	abnormally low number of sperm cells in semen
pan-	all	pandemic <i>pan-DEM-ik</i>	disease affecting an entire population
super-*	above, excess	supernumerary <i>su-per-NŪ-mer-ar-ē</i>	in excess number

*May also indicate position, as in hypodermic, superficial.

EXERCISE 3-5

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|--|---|
| _____ 1. hypotensive (<i>hī-pō-TEN-siv</i>) | a. excess breathing |
| _____ 2. oligodontia (<i>ol-i-gō-DON-shē-a</i>) | b. something written above |
| _____ 3. panplegia (<i>pan-PLĒ-jē-a</i>) | c. having low blood pressure |
| _____ 4. superscript (<i>SŪ-per-skript</i>) | d. total paralysis |
| _____ 5. hyperventilation (<i>hī-per-ven-ti-LĀ-shun</i>) | e. less than the normal number of teeth |

Table 3-6 Prefixes for Size and Comparison

Prefix	Meaning	Example	Definition of Example
equi-	equal, same	equilibrium <i>ē-kwi-LIB-rē-um</i>	a state of balance, state in which conditions remain the same
eu-	true, good, easy, normal	euthanasia <i>ū-tha-NĀ-zē-a</i>	easy or painless death (thanat/o)
hetero-	other, different, unequal	heterogeneous <i>het-er-ō-JĒ-nē-us</i>	composed of different materials, not uniform
homo-, homeo-	same, unchanging	homograft <i>HŌ-mō-graft</i>	tissue transplanted to another of the same species
iso-	equal, same	isocellular <i>i-sō-SEL-ū-lar</i>	composed of similar cells
macro-	large, abnormally large	macroscopic <i>mak-rō-SKOP-ik</i>	large enough to be seen without a microscope
mega-*, megalo-	large, abnormally large	megacolon <i>meg-a-KŌ-lon</i>	enlargement of the colon

(Continued)

Table 3-6 Prefixes for Size and Comparison (*Continued*)

Prefix	Meaning	Example	Definition of Example
micro-*	small	microcyte <i>MI-krō-sīt</i>	very small cell (-cyte)
neo-	new	neonate <i>NE-ō-nāt</i>	a newborn infant (Fig. 3-6)
normo-	normal	normovolemia <i>nor-mō-vol-Ē-mē-a</i>	normal blood volume
ortho-	straight, correct, upright	orthodontics <i>or-thō-DON-tiks</i>	branch of dentistry concerned with correction and straightening of the teeth (odont/o)
poikilo-	varied, irregular	poikilothermic <i>poy-ki-lō-THER-mik</i>	having variable body temperature (therm/o)
pseudo-	false	pseudoplegia <i>sū-dō-PLĒ-jē-a</i>	false paralysis (-plegia)
re-	again, back	reflux <i>RE-flux</i>	backward flow

*Mega- also means 1 million, as in megahertz. Micro- also means 1 millionth, as in microsecond.



Figure 3-6 A neonate or newborn. The prefix *neo-* means “new.”

EXERCISE 3-6

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|---|--|
| _____ 1. isograft (<i>Ī-sō-graft</i>) | a. having a constant body temperature |
| _____ 2. orthotic (<i>or-THOT-ik</i>) | b. irregular, mottled condition of the skin |
| _____ 3. pseudoreaction (<i>sū-dō-rē-AK-shun</i>) | c. false response |
| _____ 4. poikiloderma (<i>poy-kil-ō-DER-ma</i>) | d. tissue transplanted between identical individuals |
| _____ 5. homothermic (<i>hō-mō-THER-mik</i>) | e. straightening or correcting deformity |

Identify and define the prefix in the following words:

	Prefix	Meaning of Prefix
6. homeostasis	homeo-	same, unchanging
7. equivalent	_____	_____
8. orthopedics	_____	_____
9. rehabilitation	_____	_____
10. euthyroidism	_____	_____
11. neocortex	_____	_____
12. megabladder	_____	_____
13. isometric	_____	_____
14. normothermic	_____	_____

Write the opposite of the following words:

- | | |
|---|-------|
| 15. homogeneous (of uniform composition)
<i>hō-mō-JĒ-nē-us</i> | _____ |
| 16. macroscopic (large enough to see with the naked eye)
<i>ma-krō-SKOP-ik</i> | _____ |

Table 3-7

Prefixes for Time and/or Position

Prefix	Meaning	Example	Definition of Example
ante-	before	antenatal <i>an-te-NĀ-tal</i>	before birth (nat/i)
pre-	before, in front of	premature <i>prē-ma-CHUR</i>	occurring before the proper time
pro-	before, in front of	prodrome <i>PRŌ-drōm</i>	symptom that precedes a disease
post-	after, behind	postnasal <i>pōst-NĀ-sal</i>	behind the nose (nas/o)

EXERCISE 3-7

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|--|-----------------------------------|
| _____ 1. postmortem (<i>pōst-MOR-tem</i>) | a. to occur before another event |
| _____ 2. antedate (<i>AN-te-dāt</i>) | b. ancestor, one who comes before |
| _____ 3. progenitor (<i>prō-JEN-i-tor</i>) | c. before birth (parturition) |
| _____ 4. prepartum (<i>prē-PAR-tum</i>) | d. throwing or extending forward |
| _____ 5. projectile (<i>prō-JEK-tīl</i>) | e. occurring after death |

Identify and define the prefix in the following words:

	Prefix	Meaning of Prefix
6. prediction (<i>prē-DIK-shun</i>)	pre-	before, in front of
7. postmenopausal (<i>pōst-men-ō-PAW-zal</i>)	_____	_____
8. procedure (<i>prō-SĒD-ūr</i>)	_____	_____
9. predisposing (<i>prē-dis-PŌ-zing</i>)	_____	_____
10. antepartum (<i>an-ti-PAR-tum</i>)	_____	_____

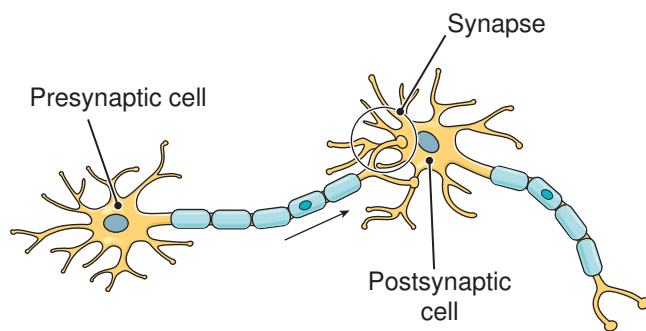


Figure 3-7 A synapse. Nerve cells come together at a synapse, as shown by the prefix *syn-*. The presynaptic cell is located before (prefix *pre-*) the synapse; the postsynaptic cell is located after (prefix *post-*) the synapse.

Table 3-8 Prefixes for Position

Prefix	Meaning	Example	Definition of Example
dextr/o-	right	dextrogastria <i>deks-trō-GAS-trē-a</i>	displacement of the stomach (gastr/o) to the right
sinistr/o-	left	sinistromanual <i>sin-is-trō-MAN-ū-al</i>	left-handed
ec-, ecto-	out, outside	ectopic <i>ek-TOP-ik</i>	out of normal position
ex/o-	away from, outside	excise <i>ek-SĪZ</i>	to cut out
end/o-	in, within	endoderm <i>EN-dō-derm</i>	inner layer of a developing embryo
mes/o-	middle	mesencephalon <i>mes-en-SEF-a-lon</i>	middle portion of the brain (encephalon), midbrain
syn-, sym- (used before b, m, p)	together	synapse <i>SIN-aps</i>	a junction between two nerve cells (Fig. 3-7)
tel/e-, tel/o-	end	telophase <i>TEL-ō-fāz</i>	the last stage of cell division (mitosis)

EXERCISE 3-8

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|---|---|
| _____ 1. mesoderm (<i>MES-ō-derm</i>) | a. displacement of the heart to the left |
| _____ 2. symbiosis (<i>sim-bī-Ō-sis</i>) | b. device for viewing the inside of a structure |
| _____ 3. sinistocardia (<i>sin-is-trō-KAR-dē-a</i>) | c. two organisms living together |
| _____ 4. endoscope (<i>EN-dō-skōp</i>) | d. endbrain |
| _____ 5. telencephalon (<i>tel-en-SEF-a-lon</i>) | e. middle layer of a developing embryo |

Identify and define the prefix in the following words:

	Prefix	Meaning of Prefix
6. sympathetic (<i>sim-pa-THET-ik</i>)	<u>sym-</u>	<u>together</u>
7. extract (<i>EKS-tract</i>)	<u> </u>	<u> </u>
8. ectoparasite (<i>ek-tō-PAR-a-sīt</i>)	<u> </u>	<u> </u>
9. syndrome (<i>SIN-drōm</i>)	<u> </u>	<u> </u>
10. endotoxin (<i>en-dō-TOX-in</i>)	<u> </u>	<u> </u>

Write the opposite of the following words:

11. exogenous (outside the organism)
eks-OJ-e-nus _____
12. dextromanual (right handed)
deks-trō-MAN-ū-al _____
13. ectoderm (outermost layer of the embryo)
EK-tō-derm _____

T.S.'s Therapy

From the hospital, T.S. was transferred to a rehabilitation center for further evaluation and therapy. At this point in his recovery, he was unable to move his legs and had limited movement of his arms. He is participating in a plan of care with physical and occupational therapy and is working on performing basic activities of daily living. Within therapy, he

is practicing wheelchair functional operations, transfers, and safe propulsions. The goal is to progress toward independence within his home lifestyle and regain status as an active member in his school and community. Despite the support and encouragement of his family and many friends, he remains slightly depressed and fearful of his future.

Chapter Review

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|-----------------------|---|
| _____ 1. primitive | a. one half or one side of the chest |
| _____ 2. biceps | b. having two forms |
| _____ 3. unify | c. a muscle with two parts |
| _____ 4. dimorphous | d. combine into one part |
| _____ 5. hemithorax | e. occurring first in time |
| _____ 6. erythematous | a. cell with yellow color |
| _____ 7. melanoma | b. having a bluish discoloration |
| _____ 8. xanthocyte | c. darkly pigmented tumor |
| _____ 9. cyanotic | d. red in color |
| _____ 10. leukocyte | e. white blood cell |
| _____ 11. telophase | a. total paralysis |
| _____ 12. mesoderm | b. first stage of cell division |
| _____ 13. panplegia | c. double vision |
| _____ 14. prophase | d. middle layer of tissue |
| _____ 15. diplopia | e. final stage of cell division |

Match each of the following prefixes with its meaning:

- | | |
|--------------------|-----------------------------|
| _____ 16. poikilo- | a. good, true, easy |
| _____ 17. eu- | b. straight, correct |
| _____ 18. ortho- | c. false |
| _____ 19. pseudo- | d. few, scanty |
| _____ 20. oligo- | e. varied, irregular |

Fill in the blanks:

21. A monacle has _____ lens(es).
22. A triplet is one of _____ babies born together.
23. Sinistrad means toward the _____.
24. A disaccharide is a sugar composed of _____ subunits.
25. A contralateral structure is located on the side _____ to a given point.
26. A tetralogy is composed of _____ part(s).
27. The term in T.S.'s case study that describes his lack of reflexes is _____.

Identify and define the prefix in the following words:

- | | <i>Prefix</i> | <i>Meaning of Prefix</i> |
|-----------------|---------------|--------------------------|
| 28. hyperactive | _____ | _____ |
| 29. transfer | _____ | _____ |

30. distant	_____	_____
31. posttraumatic	_____	_____
32. regurgitate	_____	_____
33. extend	_____	_____
34. adhere	_____	_____
35. unusual	_____	_____
36. ectoderm	_____	_____
37. detoxify	_____	_____
38. semisolid	_____	_____
39. premenstrual	_____	_____
40. perforate	_____	_____
41. dialysis (<i>dī-AL-i-sis</i>)	_____	_____
42. antibody	_____	_____
43. microsurgery	_____	_____
44. disease	_____	_____
45. endoparasite	_____	_____
46. symbiotic (<i>sim-bī-OT-ik</i>)	_____	_____
47. prognosis (<i>prog-NŌ-sis</i>)	_____	_____
48. insignificant	_____	_____

TRUE-FALSE

Examine the following statements. If the statement is true, write T in the first blank. If the statement is false, write F in the first blank and correct the statement by replacing the underlined word in the second blank.

	True or False	Correct Answer
49. Immune cells are primed by their <u>first</u> exposure to a disease organism.	T	_____
50. A unicellular organism is composed of <u>10</u> cells.	F	one
51. To bisect is to cut into <u>two</u> parts.	_____	_____
52. A tetrad has <u>five</u> parts.	_____	_____
53. In Latin, the oculus dexter is the <u>left</u> eye.	_____	_____
54. A triceps muscle has <u>six</u> parts.	_____	_____
55. A polygraph measures <u>many</u> physiologic responses.	_____	_____
56. In T.S.'s case study, quadriplegia refers to paralysis of <u>four</u> limbs.	_____	_____
57. T.S.'s orthostatic hypotension would occur when he is <u>upright</u> .	_____	_____

OPPOSITES

Write a word that means the opposite of each of the following:

58. humidify _____
59. abduct _____
60. permeable _____
61. heterogeneous _____
62. exotoxin _____
63. microscopic _____
64. hyperventilation _____
65. postsynaptic _____
66. septic _____

SYNONYMS

Write a word that means the same as each of the following:

67. supersensitivity _____
68. megalocyte (extremely large red blood cell) _____
69. antenatal _____
70. isolateral (having equal sides) _____

WORD BUILDING

Write words for the following definitions using the word parts provided. Each may be used more than once.

mon/o -al dextr/o end/o cardi cyt -ic ecto micro -ia

71. Pertaining to a very small cell _____
72. A condition in which the heart is outside its normal position _____
73. Pertaining to a cell with a single nucleus _____
74. Condition in which the heart is displaced to the right _____
75. Pertaining to the innermost layer of the heart _____
76. Pertaining to a very large cell _____
77. Condition in which the heart is extremely small _____

WORD ANALYSIS

Define each of the following words and give the meaning of the word parts in each. Use a dictionary if necessary.

78. isometric _____
- a. iso- _____
 - b. metr/o _____
 - c. -ic _____
79. symbiosis _____
- a. sym- _____
 - b. bio _____
 - c. -sis _____
80. monoclonal _____
- a. mon/o _____
 - b. clon(e) _____
 - c. al _____



For more learning activities, see Chapter 3 of the Student Resources on *thePoint*.

Additional Case Studies

Case Study 3-1: Displaced Fracture of the Femoral Neck

While walking home from the train station, M.A., a 72-YO woman with preexisting osteoporosis, tripped over a broken curb and fell. In the emergency department, she was assessed for severe pain in and swelling and bruising of her right thigh. A radiograph showed a fracture at the neck of the right femur (thigh bone) (**Fig. 3-8**). M.A. was prepared for surgery and given a preoperative injection of an analgesic to relieve her pain. During surgery, she was given spinal anesthesia and positioned on an operating room table, with her right hip elevated on a small pillow. Intravenous antibiotics were given before the incision was made. Her right hip was repaired with a bipolar hemiarthroplasty (joint reconstruction). Postoperative care included maintaining the right hip in abduction, fluid replacement, physical therapy, and attention to signs of tissue degeneration and possible dislocation.

Case Study 3-2: Urinary Tract Infection

Chief complaint:

D.S. recently noticed some blood in her urine, and at the same time, she was experiencing some pain when she urinated. She thought she might have a fever and generally felt tired. She was not sleeping well since she frequently had to get up during the night to use the bathroom. She decided to make an appointment to see her primary care physician.

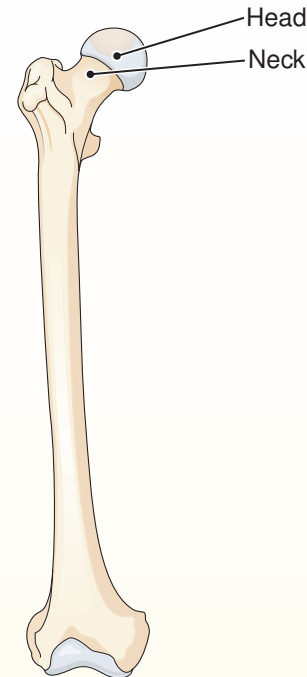
Past medical history:

A 33-YO female non-smoker, two children, monogamous relationship, is a triathlete, and is in excellent health. Has a history of occasional urinary tract infections, about one to two times a year. Presents now with dysuria (painful urination), hematuria (blood in the urine), and nocturia (nighttime urination).

Case Study Questions

Identify and define the prefixes in the following words:

1. preexisting
2. analgesic, anesthesia
3. dislocation
4. replacement
5. bipolar
6. hemiarthroplasty



Anterior view

Figure 3-8 The right femur (thigh bone). The femoral neck is the fracture site in Case Study 3-1.

Clinical course:

Urine analysis report showed cloudy urine with a large number of leukocytes and erythrocytes indicating a urinary tract infection. D.S. was given an antibiotic and told to increase her fluid intake. If symptoms persist beyond one week, D.S. is to return to the office.

Prefix	Meaning of Prefix
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

- | | | |
|-----------------|-------|-------|
| 7. degeneration | _____ | _____ |
| 8. antibiotic | _____ | _____ |
| 9. erythrocyte | _____ | _____ |
| 10. primary | _____ | _____ |

Fill in the blanks:

11. The suffixes in the words osteoporosis and anesthesia mean _____.
12. The suffixes in the words intravenous, femoral, and analgesic mean _____.
13. In a monogamous relationship, each person has _____ partner.
14. A triathlete competes in an event with _____ activities, such as swimming, bicycling, and running.

Find a word in the case histories that describes:

15. The time period before surgery _____
16. The time period after surgery _____
17. A position away from the midline of the body _____
18. Another name for a white blood cell _____

CHAPTER

4

Cells, Tissues, and Organs

Case Study

R.S.'s Self-Diagnosis

Chief complaint:

R.S. is a second-year medical student who, until recently, has done well in school. Lately, he finds that he is always tired and unable to focus in class. He decides to self-diagnose and begins with a review of systems (ROS). He notes that he is not having any cardiovascular, lymphatic, or respiratory system symptoms, such as tissue swelling, coughing, or shortness of breath. He also has not noticed any changes in urinary system functions. He realizes that he has gained some weight recently and has also been a little constipated but has no other problems with his digestive system. He rules out anything concerning his musculoskeletal system because he has no muscle cramps, joint pain, or weakness. He thinks his skin is drier than usual. He worries that this is an integumentary system sign of hypothyroidism and becomes concerned about his endocrine system function. Unable to perform any imaging studies or lab tests on his own, he makes an appointment to see a campus health services physician.

Examination:

R.S. tells the doctor he feels he has a metabolic disorder. He thinks he might have an adenoma, a glandular tumor that is disrupting homeostasis, his normal metabolic state. The doctor takes a complete history and orders various blood tests to assist with the diagnosis. He completes a physical examination that reveals no abnormalities.

Clinical course:

The blood glucose levels, complete blood count (CBC), and thyroid function tests are all normal. Nothing in the tests indicates anything physically wrong with the patient. There is no indication that any further cytologic or histologic tests are necessary. The doctor tells R.S. that he is sleep-deprived from all his studying and that his weight gain can be explained by his poor food choices in the university cafeteria. In addition, the doctor advises R.S. to schedule some exercise into his daily routine. Lastly, he reminds R.S. that although he is studying to be a doctor, self-diagnosis at this point in his career could be inaccurate and could cause undue anxiety.





Ancillaries *At-A-Glance*

Visit *thePoint* to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii–xvi.

Learning TOOLS

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning RESOURCES

- E-book: Chapter 4
- Animation: The Cell Cycle and Mitosis
- Audio Pronunciation Glossary

Learning ACTIVITIES

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After study of this chapter, you should be able to:

- 1** List the simplest to the most complex levels of a living organism. *p54*
- 2** Describe and locate the main parts of a cell. *p54*
- 3** Name and give the functions of the four basic types of tissues in the body. *p55*
- 4** Define basic terms pertaining to the structure and function of body tissues. *p62*
- 5** Recognize and use prefixes, roots, and suffixes pertaining to cells, tissues, and organs. *p63*
- 6** Analyze medical words in case studies pertaining to cells, tissues, and organs. *pp52, 72*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|---|---|
| <p>_____ 1. The root that means “cell” is:</p> <p style="margin-left: 20px;">a. spher</p> <p style="margin-left: 20px;">b. cyt</p> <p style="margin-left: 20px;">c. fibr</p> <p style="margin-left: 20px;">d. gen</p> | <p>_____ 5. A compound that speeds the rate of a metabolic reaction is a(n):</p> <p style="margin-left: 20px;">a. gene</p> <p style="margin-left: 20px;">b. salt</p> <p style="margin-left: 20px;">c. enzyme</p> <p style="margin-left: 20px;">d. mineral</p> |
| <p>_____ 2. The root that means “tissue” is:</p> <p style="margin-left: 20px;">a. hist</p> <p style="margin-left: 20px;">b. cellul</p> <p style="margin-left: 20px;">c. cyst</p> <p style="margin-left: 20px;">d. hem</p> | <p>_____ 6. The substance that makes up the cell’s genetic material is:</p> <p style="margin-left: 20px;">a. DNA</p> <p style="margin-left: 20px;">b. protein</p> <p style="margin-left: 20px;">c. acid</p> <p style="margin-left: 20px;">d. base</p> |
| <p>_____ 3. The control center of the cell is the:</p> <p style="margin-left: 20px;">a. membrane</p> <p style="margin-left: 20px;">b. ribosome</p> <p style="margin-left: 20px;">c. virus</p> <p style="margin-left: 20px;">d. nucleus</p> | <p>_____ 7. Chemicals: cells: tissues: _____: systems: organism. What belongs in the blank?</p> <p style="margin-left: 20px;">a. organs</p> <p style="margin-left: 20px;">b. genes</p> <p style="margin-left: 20px;">c. enzymes</p> <p style="margin-left: 20px;">d. nuclei</p> |
| <p>_____ 4. The process of body cell division is called:</p> <p style="margin-left: 20px;">a. separation</p> <p style="margin-left: 20px;">b. segregation</p> <p style="margin-left: 20px;">c. mitosis</p> <p style="margin-left: 20px;">d. gestation</p> | <p>_____ 8. The root <i>morph/o</i> means:</p> <p style="margin-left: 20px;">a. reproduction</p> <p style="margin-left: 20px;">b. fat</p> <p style="margin-left: 20px;">c. form</p> <p style="margin-left: 20px;">d. balance</p> |

Body Organization

All organisms are built from simple to more complex levels (**Fig. 4-1**). Chemicals form the materials that make up cells, which are the body’s structural and functional units. Groups of cells working together make up **tissues**, which in turn make up the **organs**, which have specialized functions. Organs become components of the various systems, which together comprise the whole organism. This chapter discusses the terminology related to cells, tissues, and organs, leading to the study of all the organ systems in Part 3.

The Cell

The **cell** is the basic unit of living organisms (**Fig. 4-2**). Cells accomplish all the activities and produce all the components of the body. They carry out **metabolism**, the sum of all the body’s physical and chemical activities. They provide the energy for metabolic reactions in the form of the chemical **ATP** (adenosine triphosphate), commonly described as

the energy compound of the cell. The main categories of organic compounds contained in cells are:

- **Proteins**, which include the **enzymes**, some hormones, and structural materials
- **Carbohydrates**, which include sugars and starches. The main carbohydrate is the sugar **glucose**, which circulates in the blood to provide energy for the cells.
- **Lipids**, which include fats. Some hormones are derived from lipids, and adipose (fat) tissue is designed to store lipids.

Within the **cytoplasm** that fills the cell are subunits called **organelles**, each with a specific function (**see Fig. 4-2**). The main cell structures are named and described in **Box 4-1**. Diseases may affect specific parts of cells. Cystic fibrosis and diabetes, for example, involve the plasma membrane. Other disorders originate with mitochondria, the endoplasmic reticulum (ER), lysosomes, or peroxisomes (**Box 4-2**).

The **nucleus** is the control region of the cell. It contains the **chromosomes**, which carry genetic information

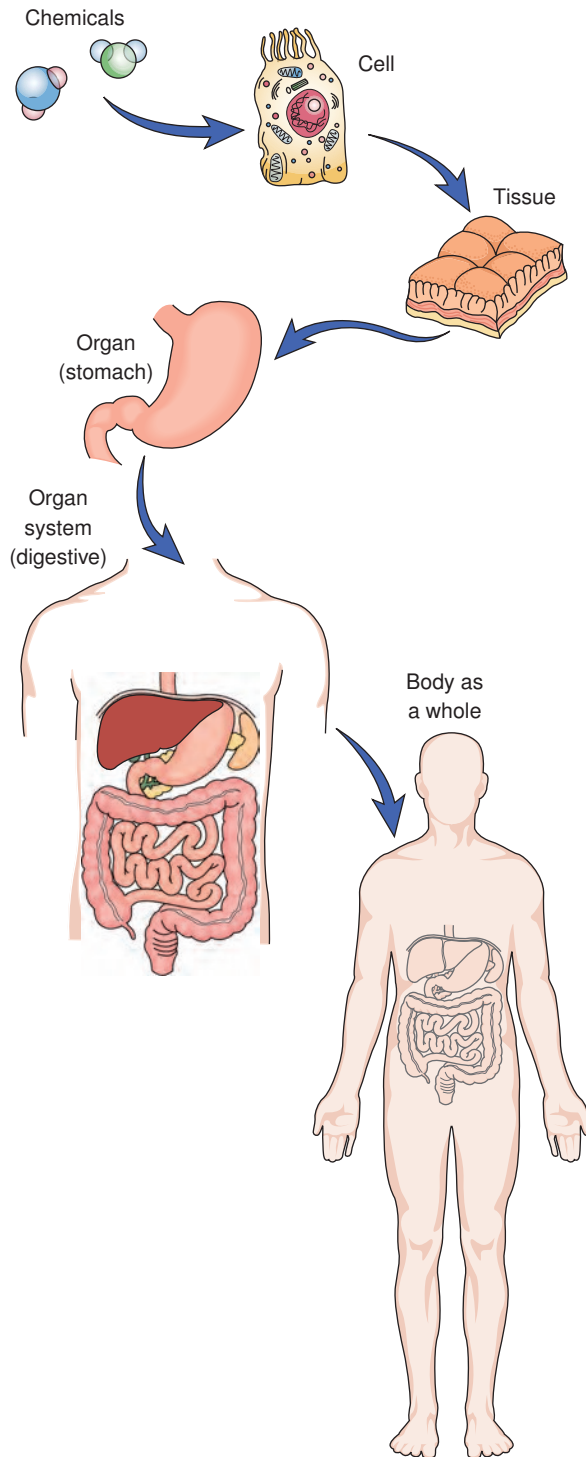


Figure 4-1 Levels of organization. The organ shown is the stomach, which is part of the digestive system.

(Fig. 4-3). Each human cell, aside from the reproductive (sex) cells, contains 46 chromosomes. These thread-like structures are composed of a complex organic substance, DNA (deoxyribonucleic acid), which is organized into separate units called **genes**. Genes control the formation of proteins, most particularly enzymes, the catalysts needed to speed the rate of metabolic reactions. To help manufacture

proteins, the cells use a compound called **RNA (ribonucleic acid)**, which is chemically related to DNA. Changes (mutations) in the genes or chromosomes are the source of hereditary diseases, as described in Chapter 15.

When a body cell divides by the process of **mitosis**, the chromosomes are doubled and then equally distributed to the two daughter cells. The stages in mitosis are shown in **Figure 4-4**. When a cell is not dividing, it remains in a stage called **interphase**. In cancer, cells multiply without control causing cellular overgrowth and tumors. Reproductive cells (eggs and sperm) divide by a related process, **meiosis**, that halves the chromosomes in preparation for fertilization. The role of meiosis in reproduction is further explained in Chapter 14.

The study of cells is **cytology** (*sī-TOL-ō-jē*), based on the root *cyt/o*, meaning “cell.” **Box 4-3** has career information in the field of cytology.



See the animation “The Cell Cycle and Mitosis” in the Student Resources on thePoint.

Tissues

Cells are organized into four basic types of tissues that perform specific functions:

- Epithelial (*ep-i-THĒ-lē-al*) tissue covers and protects body structures and lines organs, vessels, and cavities (Fig. 4-5). Simple epithelium, composed of cells in a single layer, functions to absorb substances from one system to another, as in the respiratory and digestive tracts. Stratified epithelium, with cells in multiple layers, protects deeper tissues, as in the mouth and vagina. Most of the active cells in glands are epithelial cells. Glands are described in more detail in Chapter 16.
- Connective tissue supports and binds body structures (Fig. 4-6). It contains fibers and other nonliving material between the cells. Included in this category are blood (Chapter 10), adipose (fat) tissue, cartilage, and bone (Chapter 19).
- Muscle tissue (root: *my/o*) contracts to produce movement (Fig. 4-7). There are three types of muscle tissue:
 - Skeletal muscle moves the skeleton. It has visible cross-bands, or striations, that are involved in contraction. Because it is under conscious control, it is also called voluntary muscle. Skeletal muscle is discussed in greater detail in Chapter 20.
 - Cardiac muscle forms the heart. It functions without conscious control and is described as involuntary. Chapter 9 describes the heart and its actions.
 - Smooth or visceral muscle forms the walls of the abdominal organs; it is also involuntary. Many

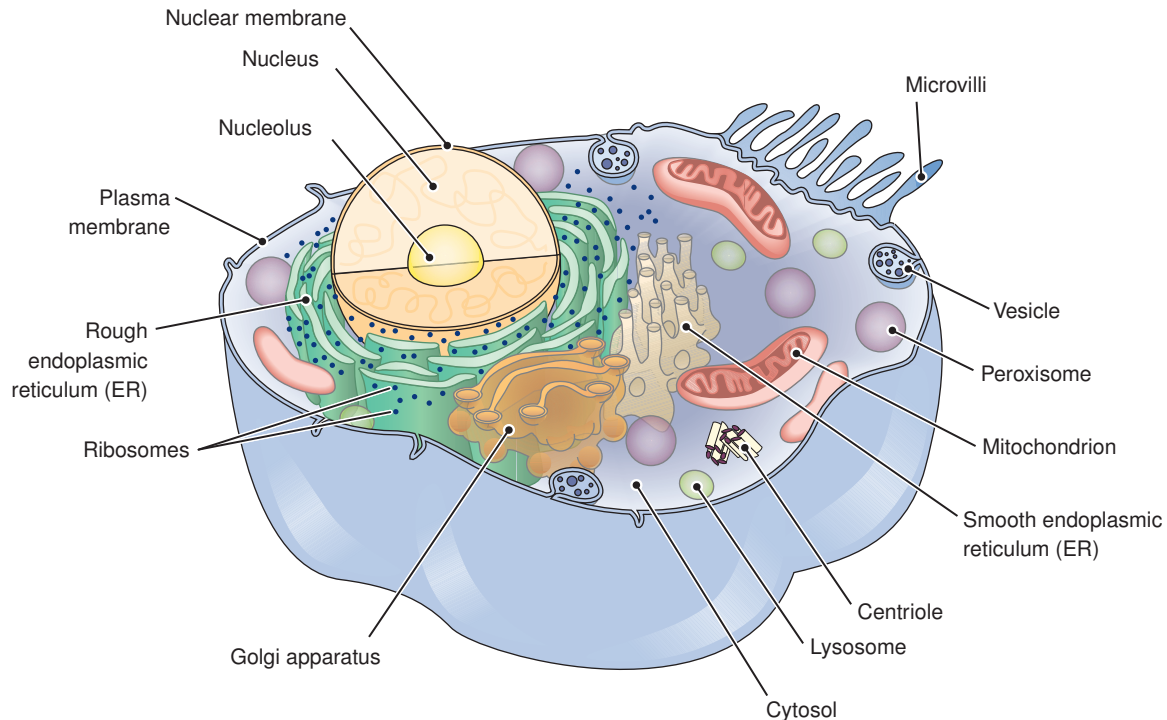


Figure 4-2 Generalized animal cell, sectional view. The main organelles are shown.

Box 4-1

For Your Reference

Cell Structures

NAME	DESCRIPTION	FUNCTION
plasma membrane (PLAZ-ma)	outer layer of the cell, composed mainly of lipids and proteins	encloses the cell contents; regulates what enters and leaves the cell; participates in many activities, such as growth, reproduction, and interactions between cells
microvilli (mī-krō-VIL-ī)	short extensions of the cell membrane	absorb materials into the cell
nucleus (NŪ-klē-us)	large, dark-staining organelle near the center of the cell, composed of DNA and proteins	contains the chromosomes, the hereditary units that direct all cellular activities
nucleolus (nū-KLĒ-ō-lus)	small body in the nucleus; composed of RNA, DNA, and protein	makes ribosomes
cytoplasm (SĪ-tō-plazm)	colloidal suspension that fills the cell from the nuclear membrane to the plasma membrane	site of many cellular activities. Consists of cytosol and organelles
cytosol (SĪ-tō-sol)	the fluid portion of the cytoplasm	surrounds the organelles

Cell Structures (Continued)

NAME	DESCRIPTION	FUNCTION
endoplasmic reticulum (ER) (<i>en-dō-PLAZ-mik re-TIK-ū-lum</i>)	network of membranes within the cytoplasm. Rough ER has ribosomes attached to it; smooth ER does not.	rough ER sorts proteins and forms them into more complex compounds. Smooth ER is involved with lipid synthesis.
ribosomes (<i>RĪ-bō-sōmz</i>)	small bodies free in the cytoplasm or attached to the ER, composed of RNA and protein	manufacture proteins
mitochondria (<i>mī-tō-KON-drē-a</i>)	large organelles with folded membranes inside	convert energy from nutrients into ATP
Golgi apparatus (<i>GŌL-jē</i>)	layers of membranes	makes compounds containing proteins, sorts and prepares these compounds for transport to other parts of the cell or out of the cell
lysosomes (<i>LĪ-sō-sōmz</i>)	small sacs of digestive enzymes	digest substances within the cell
peroxisomes (<i>per-OKS-i-sōmz</i>)	membrane-enclosed organelles containing enzymes	break down harmful substances
vesicles (<i>VES-i-klz</i>)	small membrane-bound sacs in the cytoplasm	store materials and move materials into or out of the cell in bulk
centrioles (<i>SEN-trē-ōlz</i>)	rod-shaped bodies (usually two) near the nucleus	help separate the chromosomes during cell division
surface projections	structures that extend from the cell	move the cell or the fluids around the cell
cilia (<i>SIL-ē-a</i>)	short, hair-like projections from the cell	move the fluids around the cell
flagellum (<i>fla-JEL-um</i>)	long, whip-like extension from the cell	moves the cell

Box 4-2



Clinical Perspectives

Cell Organelles and Disease

Two organelles that play a vital role in cellular disposal and recycling may also be involved in disease. Lysosomes contain enzymes that break down carbohydrates, lipids, proteins, and nucleic acids to safely recycle cellular structures. Lysosomes may also digest the cell itself as a normal part of development. Cells that are no longer needed “self-destruct” by releasing lysosomal enzymes into their own cytoplasm. In Tay-Sachs disease, the lysosomes in nerve cells lack an enzyme that breaks down certain kinds of lipids. These lipids build up inside the cells, causing malfunction that leads to brain injury, blindness, and death.

Peroxisomes resemble lysosomes but contain different kinds of enzymes. They break down toxic substances that enter the cell, such as drugs and alcohol, as well as harmful

byproducts of normal metabolism. Disease may result if lysosomes or peroxisomes destroy cells in error. This may occur in cases of autoimmune diseases, in which the body develops an immune response to its own cells. The joint disease rheumatoid arthritis is one such example.

Mitochondria, because they may have been separate organisms early in evolution, have their own DNA. Mutations (changes) in their DNA or in the nuclear DNA that controls their activity can disrupt ATP production and damage organs throughout the body. These mitochondrial disorders are difficult to diagnose because they cause a variety of symptoms and have been confused with epilepsy, cerebral palsy, and multiple sclerosis.



Figure 4-3 Human chromosomes. There are 46 chromosomes in each human cell, except the sex cells (egg and sperm).

organs described in later chapters on the systems have walls made of smooth muscle. The walls of ducts and blood vessels also are composed mainly of smooth muscle.

- Nervous tissue (root: *neur/o*) makes up the brain, spinal cord, and nerves (**Fig. 4-8**). It coordinates and controls body responses by the transmission of electrical impulses. The basic cell in nervous tissue is the neuron, or nerve cell. The nervous system and senses are discussed in Chapters 17 and 18.

MEMBRANES

A **membrane** (*MEM-brān*) is a simple, very thin, and pliable sheet of tissue. Membranes may cover an organ, line a cavity, or separate one structure from another. Some secrete special substances. Mucous membranes secrete **mucus**, a thick fluid that lubricates surfaces and protects underlying tissue, as in the lining of the digestive tract and respiratory passages. Serous membranes, which secrete a thin, watery fluid, line body cavities and cover organs. These include the membranes around the heart and lungs. Fibrous membranes cover and support organs, as found around the bones, the brain, and spinal cord.

The study of tissues is **histology** (*his-TOL-ō-jē*), based on the root *hist/o*, meaning “tissue.” **Box 4-4** describes some terms used in histology.

Organs and Organ Systems

Tissues are arranged into organs, which serve specific functions, and organs, in turn, are grouped into systems. **Figure 4-9** shows the organs of the digestive system as

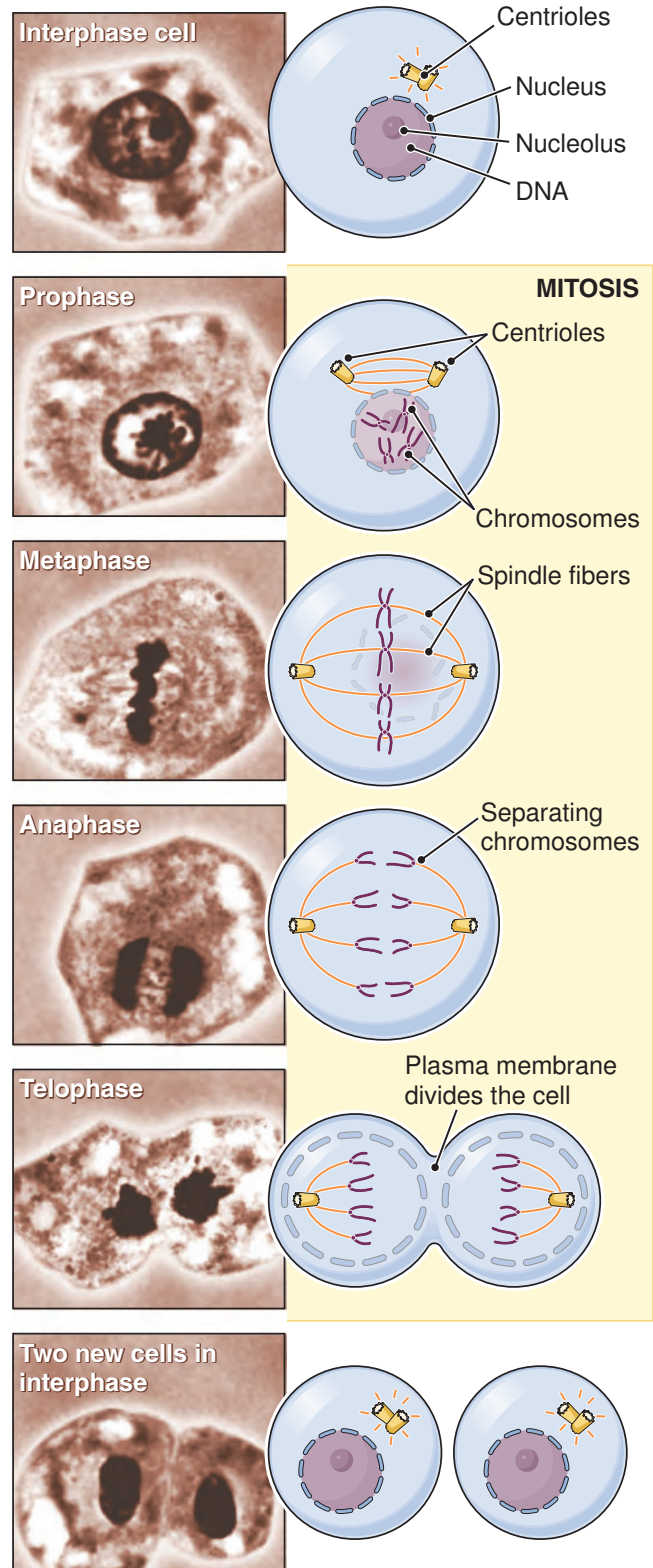


Figure 4-4 The stages in cell division (mitosis). When it is not undergoing mitosis, the cell is in interphase. The cell shown is for illustration only. It is not a human cell, which has 46 chromosomes.

Box 4-3



Health Professions

4

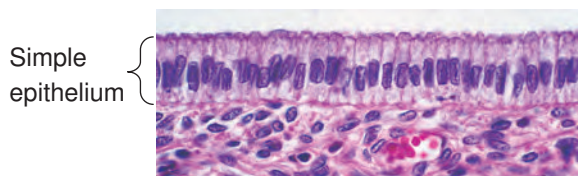
Cytotechnologist

Cytotechnology is the laboratory study of cells. Cytotechnologists work with pathologists to diagnose cancer, infections, and other diseases based on cellular changes. This profession developed initially for the study of Pap smears, used in the diagnosis of cervical cancer but has since expanded to include analysis of specimens from many other body sites, such as glands, lymph nodes, organs, and body cavities. In addition to direct microscopic study, the work of cytotechnologists also now includes molecular analysis and immunologic chemistry, often involving complex automated and computerized instruments.

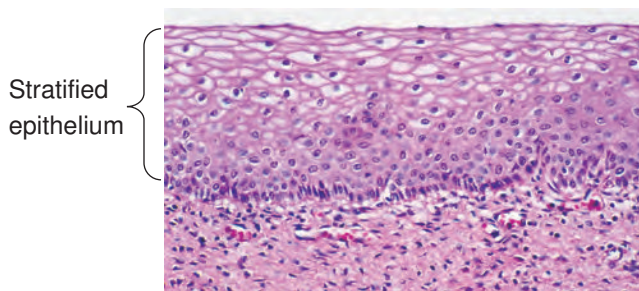
Someone interested in a cytotechnology career should be meticulous and independent and should possess a high degree of responsibility. Preparation for this field requires a bachelor's degree with courses in anatomy, chemistry, microbiology, histology, and mathematics plus specialized laboratory training. Those interested in a supervisory, management, or teaching position need an advanced degree and three to five years of professional experience. The American Society for Cytotechnology develops practice standards, monitors regulatory issues, evaluates new technologies, and provides educational opportunities for the profession. Their website is <http://www.asct.com>.

an example. Grouped according to functions, the body systems are:

- Circulation:
 - Cardiovascular system, consisting of the heart and blood vessels
 - Lymphatic system, organs, and vessels that aid circulation and help protect the body from foreign materials



A



B

Figure 4-5 Epithelial tissue. The cells in simple epithelium (A) are in a single layer and absorb materials from one system to another. The cells in stratified epithelium (B) are in multiple layers and protect deeper tissues.

- Nutrition and fluid balance:
 - Respiratory system, which obtains the oxygen needed for metabolism and eliminates carbon dioxide, a byproduct of metabolism.
 - Digestive system, which takes in, breaks down, and absorbs nutrients and eliminates undigested waste
 - Urinary system, which eliminates soluble waste and balances the volume and composition of body fluids
- Production of offspring:
 - The male and female reproductive systems
- Coordination and control:
 - Nervous system, consisting of the brain, spinal cord, and nerves, and including the sensory system. This system receives and processes stimuli and directs responses.
 - Endocrine system, consisting of individual glands that produce hormones
- Body structure and movement:
 - Skeletal system, the bones and joints
 - Muscular system, which moves the skeleton and makes up organs. The muscular system and skeleton protect vital organs.
- Body covering:
 - The integumentary system, which includes the skin and its associated structures, such as hair, sweat glands, and oil glands. This system functions in protection and also helps to regulate body temperature.

Each of the body systems is discussed in Part 3. Bear in mind, however, that the body functions as a whole; no system is independent of the others. They work together to maintain the body's state of internal stability, termed **homeostasis**.

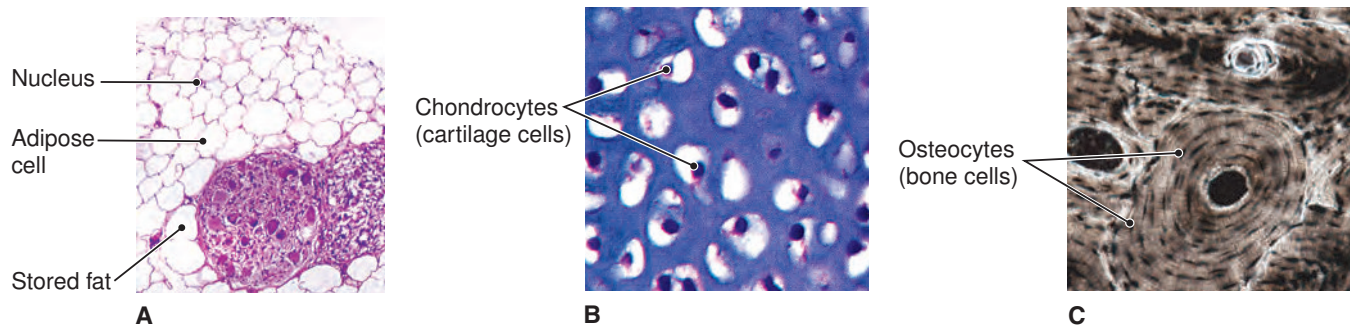


Figure 4-6 Connective tissue. Examples of connective tissue are adipose tissue (A), which stores fat; cartilage (B), which is used for protection and reinforcement; and bone (C), which makes up the skeleton.

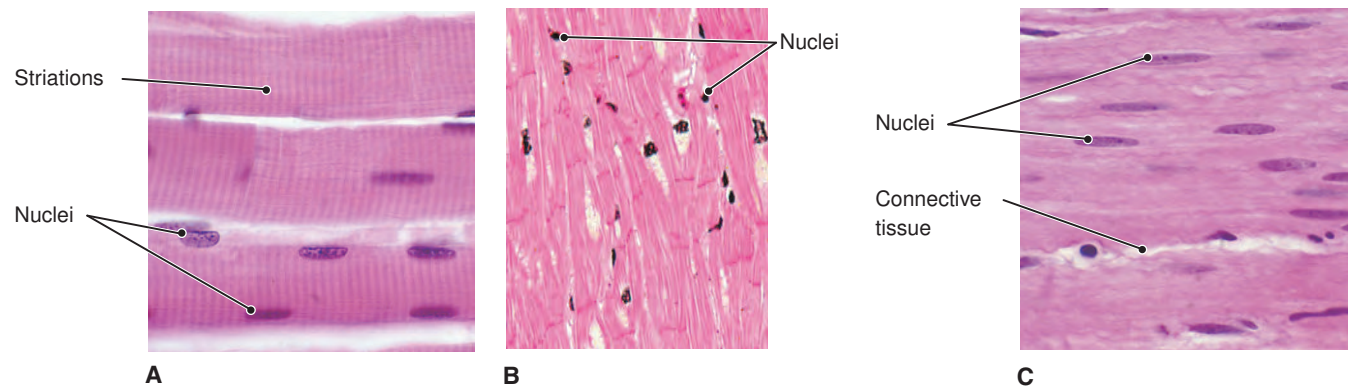


Figure 4-7 Muscle tissue. Skeletal muscle (A) moves the skeleton. It has visible bands (striations) that produce contraction. Cardiac muscle (B) makes up the wall of the heart. Smooth muscle (C) makes up the walls of hollow organs, ducts, and vessels.

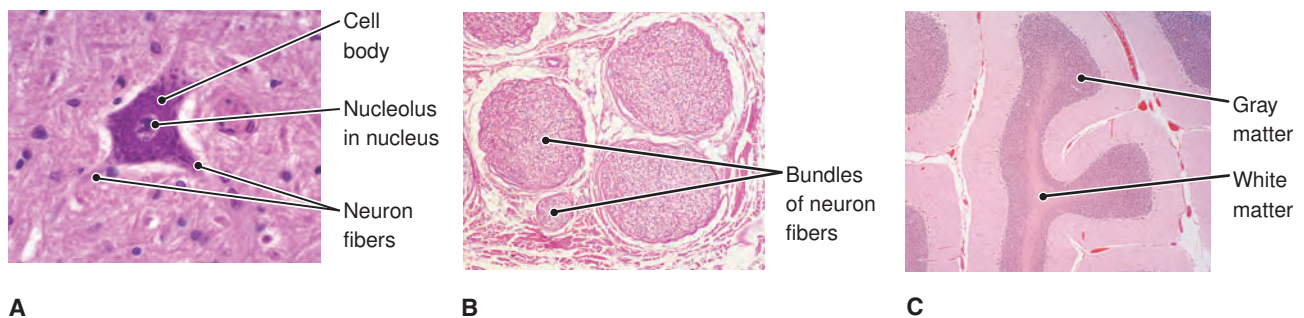


Figure 4-8 Nervous tissue. The functional cell of the nervous system is the neuron (A). Neuron fibers join to form nerves (B). Nervous tissue also makes up the spinal cord and brain (C), where it is divided into gray matter and white matter.

Box 4-4



Clinical Perspectives

4

Laboratory Study of Tissues

Biopsy is the removal and examination of living tissue to determine a diagnosis. The term is also applied to the specimen itself. *Biopsy* comes from the Greek word *bios*, meaning "life," plus *opsis*, meaning "vision." Together they mean the visualization of living tissue.

Some other terms that apply to cells and tissues come from Latin. *In vivo* means "in the living body," as contrasted with *in vitro*, which literally means "in glass," and refers to

procedures and experiments done in the laboratory, as compared to studies done in living organisms. *In situ* means "in its original place" and is used to refer to tumors that have not spread.

In toto means "whole" or "completely," as in referring to a structure or organ removed totally from the body. *Postmortem* literally means "after death," as in referring to an autopsy performed to determine the cause of death.

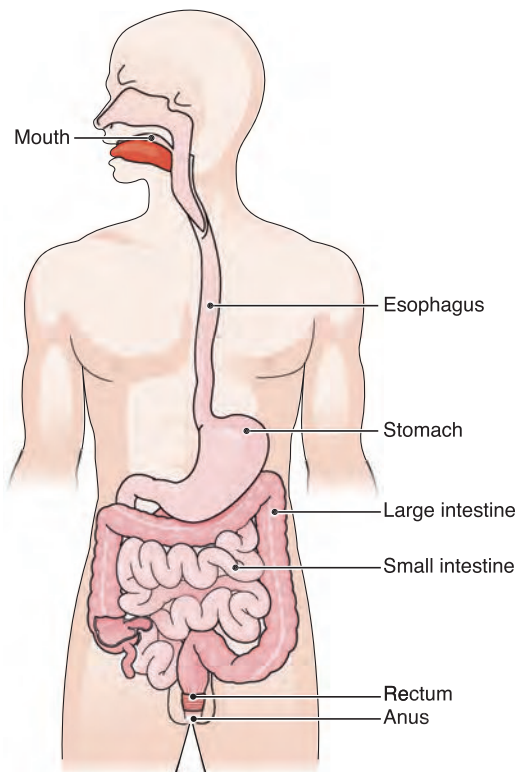


Figure 4-9 Organs of the digestive tract. Other organs and glands contribute to digestion, as described in Chapter 12.

Terminology

Key Terms

ATP	The energy compound of the cell that stores energy needed for cell activities; adenosine triphosphate (<i>a-DEN-ō-sēn trī-FOS-fāt</i>)
carbohydrate <i>kar-bō-HĪ-drāt</i>	The category of organic compounds that includes sugars and starches
cell <i>sel</i>	The basic structural and functional unit of the living organism, a microscopic unit that combines with other cells to form tissues (root: <i>cyt/o</i>)
chromosome <i>KRŌ-mō-sōm</i>	A thread-like body in a cell's nucleus that contains genetic information
cytology <i>sī-TOL-ō-jē</i>	Study of cells
cytoplasm <i>SĪ-tō-plāzm</i>	The fluid that fills a cell and holds the organelles
DNA	The genetic compound of the cell, makes up the genes; deoxyribonucleic (<i>dē-ok-sē-rī-bō-nū-KLĒ-ik</i>) acid
enzyme <i>EN-zīm</i>	An organic substance that speeds the rate of a metabolic reaction
gene <i>jēn</i>	A hereditary unit composed of DNA and combined with other genes to form the chromosomes
glucose <i>GLŪ-kōs</i>	A simple sugar that circulates in the blood, the main energy source for metabolism (roots: <i>gluc/o</i> , <i>glyc/o</i>)
histology <i>his-TOL-ō-jē</i>	Study of tissues
homeostasis <i>hō-mē-ō-STĀ-sis</i>	A steady state, a condition of internal stability and constancy
lipid <i>LIP-id</i>	A category of organic compounds that includes fats (root: <i>lip/o</i>)
membrane <i>MEM-brān</i>	A simple, very thin, and pliable sheet of tissue that might cover an organ, line a cavity, or separate structures
metabolism <i>me-TA-bō-līzm</i>	The sum of all the physical and chemical reactions that occur within an organism
mitosis <i>mī-TŌ-sis</i>	Cell division
mucus <i>MŪ-kus</i>	A thick fluid secreted by cells in membranes and glands that lubricates and protects tissues (roots: <i>muc/o</i> , <i>myx/o</i>); the adjective is <i>mucous</i> .
nucleus <i>NŪ-klē-us</i>	The cell's control center; directs all cellular activities based on the information contained in its chromosomes (roots: <i>nucle/o</i> , <i>kary/o</i>)
organ <i>OR-gan</i>	A part of the body with a specific function, a component of a body system
organelle <i>OR-ga-nel</i>	A specialized structure in the cytoplasm of a cell
protein <i>PRŌ-tēn</i>	A category of organic compounds that includes structural materials, enzymes, and some hormones

Terminology

Key Terms (Continued)

RNA

An organic compound involved in the manufacture of proteins within cells; ribonucleic (*rī-bō-nū-KLĒ-ik*) acid

tissue

TISH-ū

A group of cells that acts together for a specific purpose (roots: hist/o, histi/o)

Word Parts Pertaining to Cells, Tissues, and Organs

See **Tables 4-1 to 4-3**.



Go to the audio pronunciation glossary in the Student Resources on thePoint to hear these terms pronounced.

Table 4-1

Roots for Cells and Tissues

Root	Meaning	Example	Definition of Example
morph/o	form	polymorphous <i>pol-ē-MOR-fus</i>	having many forms
cyt/o, -cyte	cell	cytologist <i>sī-TOL-ō-jist</i>	one who studies cells
nucle/o	nucleus	nuclear <i>NŪ-klē-ar</i>	pertaining to a nucleus
kary/o	nucleus	karyotype <i>KAR-ē-ō-tīp</i>	picture of a cell's chromosomes organized according to size (Fig. 4-10)
hist/o, histi/o	tissue	histocompatibility <i>his-tō-kom-pat-i-BIL-i-tē</i>	tissue similarity that permits transplantation
fibr/o	fiber	fibrosis <i>fī-BRŌ-sis</i>	abnormal formation of fibrous tissue
reticul/o	network	reticulum <i>re-TIK-ū-lum</i>	a network
aden/o	gland	adenoma <i>ad-e-NŌ-ma</i>	tumor (-oma) of a gland
papill/o	nipple	papilla <i>pa-PIL-a</i>	projection that resembles a nipple
myx/o	mucus	myxadenitis <i>mīks-ad-e-NĪ-tis</i>	inflammation (-itis) of a mucus-secreting gland
muc/o	mucus, mucous membrane	mucorrhea <i>mū-kō-RĒ-a</i>	increased flow (-rhea) of mucus
somat/o, -some	body, small body	chromosome <i>KRŌ-mō-sōm</i>	small body that takes up color (dye) (chrom/o)



Figure 4-10 Human karyotype. The 46 chromosomes are in 23 pairs arranged according to size. The XY sex chromosomes, the 23rd pair at the lower right, indicate that the cell is from a male; a female cell has XX sex chromosomes.

EXERCISE 4-1

Fill in the blanks. Use the phonetics to pronounce the words in the exercises.

1. Cytogenesis is the formation (genesis) of _____.
2. A fibril (*FĪ-bril*) is a small _____.
3. A histologist (*his-TOL-ō-jist*) studies _____.
4. A dimorphic (*dī-MOR-fik*) organism has two _____.
5. Karyomegaly (*kar-ē-ō-MEG-a-lē*) is enlargement (-megaly) of the _____.
6. Nucleoplasm is the substance that fills the _____.
7. Adenitis (*ad-e-NĪ-tis*) is inflammation (-itis) of a(n) _____.
8. A papillary (*PAP-i-lar-ē*) structure resembles a(n) _____.
9. A myxoma (*mik-SŌ-ma*) is a tumor of tissue that secretes _____.
10. A reticulocyte (*re-TIK-ū-lō-sīt*) is a cell that contains a(n) _____.
11. The term *mucosa* (*mu-KŌ-sa*) is used to describe a membrane that secretes _____.
12. Somatotropin (*sō-ma-tō-TRŌ-pin*), also called growth hormone, has a general stimulating effect on the _____.

Use the suffix -logy to build a word with each of the following meanings:

13. The study of form _____
14. The study of cells _____
15. The study of tissues _____

Table 4-2 Roots for Cell Activity

Root	Meaning	Example	Definition of Example
blast/o, -blast	immature cell, productive cell, embryonic cell	histioblast <i>HIS-tē-ō-blast</i>	a tissue-forming cell
gen	origin, formation	karyogenesis <i>kar-ē-ō-JEN-e-sis</i>	formation of a nucleus
phag/o	eat, ingest	autophagy <i>aw-TOF-a-jē</i>	self (auto)-destruction of a cell's organelles
phil	attract, absorb	basophilic <i>bā-sō-FIL-ik</i>	attracting basic stain
plas	formation, molding, development	hyperplasia <i>hī-per-PLĀ-zē-a</i>	overdevelopment of an organ or tissue
trop	act on, affect	chronotropic <i>kron-o-TROP-ik</i>	affecting rate or timing (chron/o)
troph/o	feeding, growth, nourishment	atrophy <i>A-trō-fē</i>	tissue wasting

The roots in **Table 4-2** are often combined with a simple noun suffix (*-in*, *-y*, or *-ia*) or an adjective suffix (*-ic*) and used as word endings. Such combined forms that routinely

appear as word endings are simply described and used as suffixes in this book. Examples from the above list are *-trophy*, *-plasia*, *-tropin*, *-philic*, and *-genic*.

EXERCISE 4-2

Match the following terms in the following sets and write the appropriate letter to the left of each number:

- | | |
|---|--|
| _____ 1. phagocyte (<i>FAG-ō-sīt</i>) | a. overdevelopment of tissue |
| _____ 2. histogenesis (<i>his-tō-JEN-e-sis</i>) | b. study of heredity |
| _____ 3. leukoblast (<i>LŪ-kō-blast</i>) | c. formation of tissue |
| _____ 4. genetics (<i>je-NET-iks</i>) | d. cell that ingests waste |
| _____ 5. hypertrophy (<i>hī-PER-trō-fē</i>) | e. immature white blood cell |
| _____ 6. neoplasia (<i>nē-ō-PLĀ-jē-a</i>) | a. attracting color |
| _____ 7. gonadotropin (<i>gon-a-dō-TRŌ-pin</i>) | b. pertaining to the body |
| _____ 8. aplasia (<i>a-PLĀ-jē-a</i>) | c. substance that acts on the sex glands |
| _____ 9. somatic (<i>sō-MAT-ik</i>) | d. new formation of tissue |
| _____ 10. chromophilic (<i>krō-mō-FIL-ik</i>) | e. lack of development |

Identify and define the root in the following words:

	Root	Meaning of Root
_____ 11. genesis (<i>JEN-e-sis</i>)	_____	_____
_____ 12. esophagus (<i>e-SOF-a-gus</i>)	_____	_____
_____ 13. normoblast (<i>NOR-mō-blast</i>)	_____	_____
_____ 14. aplastic (<i>a-PLAS-tik</i>)	_____	_____
_____ 15. dystrophy (<i>DIS-trō-fē</i>)	_____	_____

Table 4-3 Suffixes and Roots for Body Chemistry

Word Part	Meaning	Example	Definition of Example
Suffixes			
-ase	enzyme	lipase <i>LĪ-pās</i>	enzyme that digests fat (lipid)
-ose	sugar	lactose <i>LAK-tōs</i>	milk sugar
Roots			
hydr/o	water, fluid	hydration <i>hī-DRĀ-shun</i>	addition of water, relative amount of water present
gluc/o	glucose	glucogenesis <i>glū-kō-JEN-e-sis</i>	production of glucose
glyc/o	sugar, glucose	normoglycemia <i>nor-mō-glī-SĒ-mē-a</i>	normal blood sugar level
sacchar/o	sugar	polysaccharide <i>pol-ē-SAK-a-rīd</i>	compound containing many simple sugars
amyl/o	starch	amyloid <i>AM-i-loyd</i>	resembling starch
lip/o	lipid, fat	lipophilic <i>lip-ō-FIL-ik</i>	attracting or absorbing lipids
adip/o	fat	adiposuria <i>ad-i-pō-SŪR-ē-a</i>	presence of fat in the urine (ur/o)
steat/o	fatty	steatorrhea <i>stē-a-tō-RĒ-a</i>	discharge (-rhea) of fatty stools
prote/o	protein	protease <i>PRŌ-tē-ās</i>	enzyme that digests protein

EXERCISE 4-3**Fill in the blanks:**

1. A disaccharide (*dī-SAK-a-rīd*) is a compound that contains two _____.
2. The ending *-ose* indicates that fructose is a(n) _____.
3. Hydrophobia (*hī-drō-FŌ-bē-a*) is an aversion (-phobia) to _____.
4. Amylase (*AM-i-lās*) is an enzyme that digests _____.
5. Liposuction (*LIP-ō-suk-shun*) is the surgical removal of _____.
6. A glucocorticoid (*glū-kō-KOR-ti-koyd*) is a hormone that controls the metabolism of _____.
7. An adipocyte (*AD-i-pō-sīt*) is a cell that stores _____.

Identify and define the root in the following words:

	Root	Meaning of Root
8. asteatosis (<i>as-tē-a-TŌ-sis</i>)	_____	_____
9. lipoma (<i>lī-PŌ-ma</i>)	_____	_____
10. hyperglycemia (<i>hī-per-glī-SĒ-mē-a</i>)	_____	_____
11. glycolytic (<i>glū-kō-LIT-ik</i>)	_____	_____

Terminology**Supplementary Terms**

amino acids <i>a-MĒ-nō</i>	The nitrogen-containing compounds that make up proteins
anabolism <i>a-NAB-ō-lizm</i>	The type of metabolism in which body substances are made; the building phase of metabolism
catabolism <i>ka-TAB-ō-lizm</i>	The type of metabolism in which substances are broken down for energy and simple compounds
collagen <i>KOL-a-jen</i>	A fibrous protein found in connective tissue
cortex <i>KOR-tex</i>	The outer region of an organ
glycogen <i>GLI-kō-jen</i>	A complex sugar compound stored in liver and muscles and broken down into glucose when needed for energy
interstitial <i>in-ter-STISH-al</i>	Between parts, such as the spaces between cells in a tissue
medulla <i>me-DUL-la</i>	The inner region of an organ, marrow (root: medull/o)
parenchyma <i>par-EN-ki-ma</i>	The functional tissue of an organ
parietal <i>pa-RI-e-tal</i>	Pertaining to a wall, describes a membrane that lines a body cavity
soma <i>SŌ-ma</i>	The body
stem cell	An immature cell that has the capacity to develop into any of a variety of different cell types, a precursor cell
visceral <i>VIS-er-al</i>	Pertaining to the internal organs, describes a membrane on the surface of an organ

R.S.'s Return to Class Schedule

Following his appointment, R.S. decided to accept his doctor's advice. He started preparing at least two meals a day at home and often boxed a lunch to eat during the day on campus. The more nutritious meals provided him greater energy; he no longer felt sluggish. He visited the

university gym to work out at least two to three times a week for 20 minutes and hoped to increase that time when his schedule permitted. Finally, he recognized that a little knowledge is a dangerous thing and that it is not smart to try and diagnose oneself.

Chapter Review

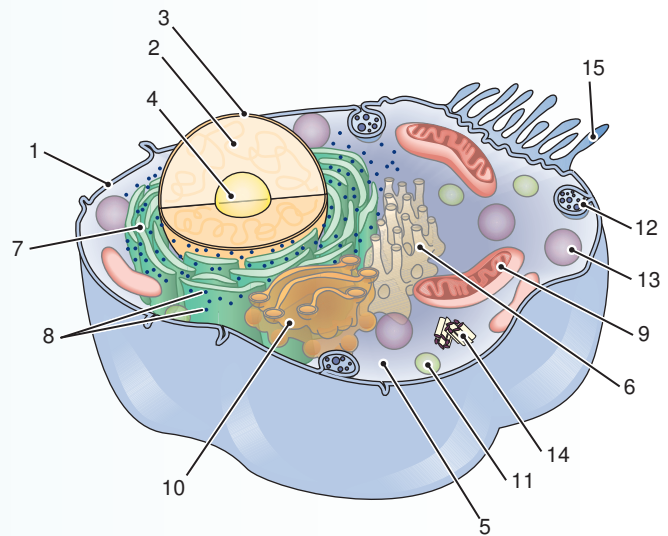
Labeling Exercise

DIAGRAM OF A TYPICAL ANIMAL CELL

Write the name of each numbered part on the corresponding line of the answer sheet.

Centriole	Nucleus
Cytosol	Peroxisome
Golgi apparatus	Plasma membrane
Lysosome	Ribosomes
Microvilli	Rough ER
Mitochondrion	Smooth ER
Nuclear membrane	Vesicle
Nucleolus	

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____



Terminology

MATCHING

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|----------------------|---|
| _____ 1. cytoplasm | a. small cellular body containing digestive enzymes |
| _____ 2. DNA | b. material that holds the cellular organelles |
| _____ 3. nucleoplasm | c. energy compound of the cells |
| _____ 4. lysosome | d. genetic material |
| _____ 5. ATP | e. material that fills the nucleus |

- _____ 6. mitosis
- _____ 7. ribosomes
- _____ 8. mitochondria
- _____ 9. blastocyte
- _____ 10. liposomes
- _____ 11. reticular
- _____ 12. adenoid
- _____ 13. fibroma
- _____ 14. megakaryocyte
- _____ 15. chromosome
- _____ 16. autotroph
- _____ 17. papilliform
- _____ 18. cytogenesis
- _____ 19. atrophy
- _____ 20. somatic
- _____ 21. fibroplasia
- _____ 22. hypoplasia
- _____ 23. dysphagia
- _____ 24. amorphous
- _____ 25. lipolysis
- _____ 26. glucosuria
- _____ 27. proteolytic
- _____ 28. adiposuria
- _____ 29. polysaccharide
- _____ 30. hydrotherapy
- a. immature cell
- b. organelles that produce ATP
- c. organelles that contain RNA
- d. small bodies that store fat
- e. cell division
- a. resembling a gland
- b. fibrous tumor
- c. cell with a very large nucleus
- d. pertaining to a network
- e. structure that contains genes
- a. resembling a nipple
- b. wasting of tissue
- c. formation of cells
- d. pertaining to the body
- e. organism that can manufacture its own food
- a. difficulty in eating
- b. dissolving of fat
- c. underdevelopment of an organ or tissue
- d. formation of fibrous tissue
- e. having no specific form
- a. presence of fat in the urine
- b. presence of glucose in the urine
- c. treatment using water
- d. compound composed of many simple sugars
- e. destroying or dissolving protein

Supplementary Terms

- _____ 31. amino acid
- _____ 32. collagen
- _____ 33. glycogen
- _____ 34. cortex
- _____ 35. catabolism
- a. outer region of an organ
- b. building block of protein
- c. fibrous protein in connective tissue
- d. complex sugar stored in liver and muscles
- e. breakdown phase of metabolism

Fill in the blanks:

- 36. All the activities of a cell makes up its _____.
- 37. The four basic tissue types are _____.
- 38. The study of tissues is called _____.
- 39. The system that includes the skin and its structures is the _____.
- 40. The systems involved in circulation are the cardiovascular system and the _____.
- 41. The simple sugar that is the main energy source for metabolism is _____.
- 42. The control center of the cell is the _____.
- 43. An organic compound that speeds the rate of metabolic reactions is a(n) _____.

44. A cytotoxic substance is poisonous or damaging to _____.
45. The term *dehydration* refers to a loss or deficiency of _____.
46. The study of form and structure is called _____.
47. A myxocyte is found in tissue that secretes _____.

TRUE-FALSE

Examine the following statements. If the statement is true, write T in the first blank. If the statement is false, write F in the first blank, and correct the statement by replacing the underlined word in the second blank.

	True or False	Correct Answer
48. An adipocyte is a cell that stores <u>proteins</u> .	_____	_____
49. Hydrophobia is an aversion to <u>fats</u> .	_____	_____
50. A megakaryocyte is a cell with a large <u>nucleus</u> .	_____	_____
51. There are <u>46</u> chromosomes in each human cell, aside from the reproductive cells.	_____	_____
52. A whip-like extension of a cell is a <u>flagellum</u> .	_____	_____

WORD BUILDING

Write a word for each of the following definitions using the word parts provided. Each may be used more than once.

-oid amyl/o muc/o aden/o -ase lip/o leuk/o histi/o blast

53. Like or resembling a gland _____
54. Immature white blood cell _____
55. Enzyme that digests fat _____
56. Resembling mucus _____
57. Cell that gives rise to tissue _____
58. Enzyme that digests starch _____
59. Resembling starch _____

WORD ANALYSIS

Define each of the following words and give the meaning of the word parts in each. Use a dictionary if necessary.

60. homeostasis (*hō-mē-ō-STĀ-sis*) _____
- a. homeo _____
- b. stat (from Greek *states*) _____
- c. -sis _____
61. somatotropic (*sō-ma-tō-TROP-ik*) _____
- a. somat/o _____
- b. trop/o _____
- c. -ic _____

62. autophagy (*aw-TOF-a-jē*) _____
- a. auto _____
 - b. phag/o _____
 - c. -y _____
63. asteatosis (*as-tē-a-TŌ-sis*) _____
- a. a- _____
 - b. steat/o _____
 - c. -sis _____



For more learning activities, see Chapter 4 of the Student Resources on *thePoint*.

Additional Case Studies

Case Study 4-1: Hematology Laboratory Studies

J.E. had a blood test as required for a preoperative anesthesia assessment in preparation for scheduled plastic surgery on her breasts. The report read as follows:

Complete blood count (CBC) and differential:

Red blood cell (RBC) count—4.5 million/mcL

Hemoglobin (Hgb)—12.6 g/dL

Hematocrit (Hct)—38 percent

White blood cell (WBC) count—8,500/mcL

Neutrophils—58 percent

Lymphocytes—34 percent

Monocytes—6 percent

Eosinophils—1.5 percent

Basophils—0.5 percent

Platelet count—200,000/mcL

Prothrombin time (PT)—11.5 seconds

Partial thromboplastin time (PTT)—65 seconds

Blood glucose—84 mg/dL

The surgeon reviewed these results and concluded that they were within normal limits (WNL).

Case Study 4-2: Needle Aspiration of Thyroid Tumor

Chief complaint:

D.S., a 65-YO male, noticed a lump on the side of his neck and went to see his physician. He has a history of prostate cancer and had a prostatectomy four years ago. Bilateral lymph node dissection revealed no metastasis. His physician referred him to a surgeon for evaluation of a nodule on the thyroid gland.

Examination:

Dr. Thompson, a general surgeon, examined D.S. and recommended a needle aspiration of the thyroid gland. The

ultrasound-guided fine needle aspiration revealed atypical cells with abundant cytoplasm and prominent nuclei but no metastasis. However, the nuclei showed some morphologic changes. Histologic slides of the left thyroid showed clusters of epithelial cells associated with lymphocytes suggestive of lymphocytic thyroiditis.

Clinical course:

D.S. underwent a total thyroidectomy and is healing well. A follow-up CT scan of the neck and chest showed no additional nodules or indications of metastatic disease.

Case Study Questions

Multiple choice. Select the best answer and write the letter of your choice to the left of each number.

- _____ 1. J.E.'s blood test results were within normal limits. She could be described as being in a state of:
- dysplasia
 - homeostasis
 - hematophilia
 - myogenesis

- _____ 2. The suffix in glucose indicates that this compound is a(n):
- enzyme
 - protein
 - sugar
 - fat

- _____ 3. The suffix in *prostatectomy* and *thyroidectomy* means:
- inflammation
 - removal or excision
 - incision into
 - study of

- _____ 4. The singular form of *nuclei* is:
- nucleus
 - nucleoli
 - nuclear
 - nucleum

Identify and give the meaning of the prefixes in the following words:

	Prefix	Meaning of Prefix
5. monocytes	_____	_____
6. prothrombin	_____	_____
7. atypical	_____	_____
8. bilateral	_____	_____
9. dissection	_____	_____

Find words in the case studies for the following:

10. Three words that contain a root that means *attract, absorb* _____

11. Two words with a root that means *formation, molding, development* _____

12. A word with a root that means *form* _____

13. A word with a root that means *tissue* _____

14. Four words that contain a root that means *cell* _____

CHAPTER

5

Body Structure

Case Study

B.K.'s Stomach Ache

Chief complaint:

It was summer vacation, and B.K. and his older brother were hosting a lemonade stand in front of their home. Late in the afternoon, B.K., a 4-year-old male, appeared agitated and complained to his mother that he had a stomach ache. His mother recalled that she had given him a peanut butter and jelly sandwich and an apple for lunch earlier in the day. He had had no problems eating his lunch. Later in the day, she saw her son curled up on the couch crying and holding his stomach, and she decided to take him to the after-hours clinic where the child's pediatrician was on staff.

Examination:

Dr. Davies, B.K.'s pediatrician, had known the boy since he was a newborn. B.K.'s parents made certain that their son had physical examinations on a regular basis. His immunizations were current, and aside from a few earaches and colds, B.K. was a healthy young boy. Upon arrival in the clinic, the office medical assistant recorded that B.K.'s vital signs were within normal limits. Dr. Davies then saw the patient and had him lie supine on the examination table. He performed a cephalocaudal assessment. The only abnormality causing concern was the abdominal pain B.K. said he was experiencing.

Dr. Davies asked B.K. to show him where it hurt the most. The boy first pointed to the left upper quadrant of his abdomen and then, somewhat confused, pointed to his right lower quadrant. The medical assistant returned and drew some blood for laboratory studies, which later showed normal results. Dr. Davies then ordered an abdominal x-ray.

Clinical course:

The x-ray revealed that B.K. had swallowed a nickel and a penny. The boy then confessed that he was trying to hide the money from his brother, so he had swallowed the coins. Dr. Davies explained to B.K. and his mother that he expected no serious complications and that the coins should be expelled in the next 24 hours or so.

In this chapter, we learn about body regions and orientations and become familiar with some of the terms health care professionals use to pinpoint exact locations on and within the body.



Ancillaries *At-A-Glance*

Visit *thePoint* to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii–xvi.

Learning **TOOLS**

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning **RESOURCES**

- E-book: Chapter 5
- Web Figure: Abdominal Regions
- Web Figure: Abdominal Quadrants
- Web Figure: Body Positions
- Web Chart: Directional Terms
- Web Chart: Structures in Abdominal Quadrants
- Audio Pronunciation Glossary

Learning **ACTIVITIES**

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After study of this chapter, you should be able to:

- 1 Define the main directional terms used in anatomy. *p76*
- 2 Describe division of the body along three different planes. *p76*
- 3 Locate the dorsal and ventral body cavities. *p76*
- 4 Locate and name the nine divisions of the abdomen. *p77*
- 5 Locate and name the four quadrants of the abdomen. *p79*
- 6 Describe the main body positions used in medical practice. *p79*
- 7 Define basic terms describing body structure. *p82*
- 8 Recognize and use roots pertaining to body regions. *p83*
- 9 Recognize and use prefixes pertaining to position and direction. *p84*
- 10 Identify medical words and abbreviations pertaining to body structure in case studies. *pp74, 93*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|--|---|
| <p>_____ 1. In humans, <i>ventral</i> is another term for:</p> <ul style="list-style-type: none"> a. lateral b. central c. posterior d. anterior | <p>_____ 5. The root <i>cephal/o</i> refers to the:</p> <ul style="list-style-type: none"> a. spine b. head c. chest d. lungs |
| <p>_____ 2. A plane that divides the body into left and right parts is a:</p> <ul style="list-style-type: none"> a. coronal plane b. sagittal plane c. transverse plane d. frontal plane | <p>_____ 6. The root <i>brachi/o</i> refers to the:</p> <ul style="list-style-type: none"> a. head b. spinal cord c. leg d. arm |
| <p>_____ 3. The scientific name for the chest cavity is:</p> <ul style="list-style-type: none"> a. cervical cavity b. thoracic cavity c. dorsal cavity d. pelvic cavity | <p>_____ 7. The prefix <i>peri-</i> means:</p> <ul style="list-style-type: none"> a. under b. around c. above d. within |
| <p>_____ 4. The brain and spinal cord are in what cavity?</p> <ul style="list-style-type: none"> a. dorsal cavity b. abdominal cavity c. thoracic cavity d. ventral cavity | <p>_____ 8. The prefix <i>juxta-</i> means:</p> <ul style="list-style-type: none"> a. near b. below c. away from d. medical |

All health care fields require knowledge of body directions and orientations. Physicians, surgeons, nurses, occupational therapists, and physical therapists, for example, must be thoroughly familiar with the terms used to describe body locations and positions. Radiologic technologists must be able to position a person and direct x-rays to obtain suitable images for diagnosis, as noted in **Box 5-1**.

Directional Terms

In describing the location or direction of a given point in the body, it is always assumed that the subject is in the **anatomic position**, that is, upright, with face front, arms at the sides with palms forward and feet parallel, as shown in **Figure 5-1**. In this stance, the terms illustrated in **Figure 5-1** and listed in **Box 5-2** are used to designate relative position.

Figure 5-2 illustrates planes of section, that is, directions in which the body can be cut. A **frontal plane**, also called a coronal plane, is made at right angles to the midline and divides the body into anterior and posterior parts. A **sagittal** (*SAJ-i-tal*) plane passes from front to back and divides the body into right and left portions. If the plane passes through the midline, it is a midsagittal or medial plane. A **transverse plane** passes horizontally, dividing the body into superior and inferior parts.

Body Cavities

Internal organs are located within dorsal and ventral cavities (**Fig. 5-3**). The dorsal cavity contains the brain in the **cranial cavity** and the spinal cord in the **spinal cavity** (canal). The uppermost ventral space, the **thoracic cavity**, is separated from the **abdominal cavity** by the **diaphragm**, a muscle used in breathing. There is no anatomic separation between the abdominal cavity and the **pelvic cavity**, which together make up the **abdominopelvic cavity**. The large membrane that lines the abdominopelvic



Visit the Student Resources on thePoint for an expanded list of directional terms with examples of their uses.

Box 5-1



Health Professions

5

Radiologic Technologist

Radiologic technologists help in the diagnosis of medical disorders by taking x-ray images (radiographs) of the body. They must prepare patients for radiologic procedures, place patients in appropriate positions, and then adjust equipment to the correct angles, heights, and settings for taking the x-ray image. They must position the image receptors correctly and after exposure, remove and process the images. They are also required to keep patient records and maintain equipment. Radiologic technologists must minimize radiation hazards by using protective equipment for themselves and patients and by delivering the minimum possible amount of radiation. They wear badges to monitor radiation levels and keep records of their exposure.

Specialists in the field may be employed for more complex procedures, such as computerized tomography (CT) or magnetic resonance imaging (MRI), as described in later chapters. They may also administer materials, such as contrast media, to aid in imaging and diagnosis.

The majority of radiologic technologists work in hospitals, but they may also be employed in physicians' offices, diagnostic imaging centers (e.g., doing mammograms), and outpatient care centers. Beginning in 2015, radiologic technologists must possess a minimum of an associate's degree to qualify for professional certification. A higher degree is necessary for a supervisory or teaching position. The Joint Review Committee on Education in Radiologic Technology accredits most of the education programs. The American Registry of Radiologic Technologists (ARRT) offers a national certification examination in radiography as well as in other imaging technologies (CT, MRI, nuclear medicine, etc.). ARRT certification is required for employment as a radiologic technologist in most U.S. states. Job opportunities in this field are currently good. The American Society of Radiologic Technologists has information on this career at www.asrt.org.

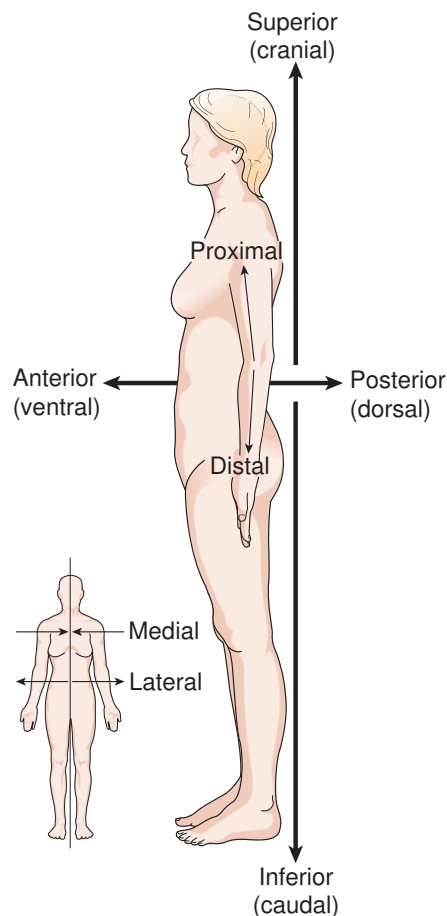


Figure 5-1 Directional terms.

cavity and covers the organs within it is the **peritoneum** (*per-i-tō-NĒ-um*).

Abdominal Regions

For orientation, the abdomen can be divided by imaginary lines into nine regions—three medial regions and six lateral regions (**Fig. 5-4**). The sections down the midline are the:

- epigastric (*ep-i-GAS-trik*) region, located above the stomach
- umbilical (*um-BIL-i-kal*) region, named for the umbilicus, or navel
- hypogastric (*hī-pō-GAS-trik*) region, located below the stomach

The lateral regions have the same name on the left and right sides (**Box 5-3**). They are the:

- hypochondriac (*hī-pō-KON-drē-ak*) regions, right and left, named for their positions near the ribs, specifically near the cartilages (root: chondr/o) of the ribs
- lumbar (*LUM-bar*) regions, right and left, which are located near the small of the back (lumbar region of the spine)
- iliac (*IL-ē-ak*) regions, right and left, named for the upper bone of the hip, the ilium. These regions are also called the inguinal (*ING-gwi-nal*) regions, with reference to the groin.

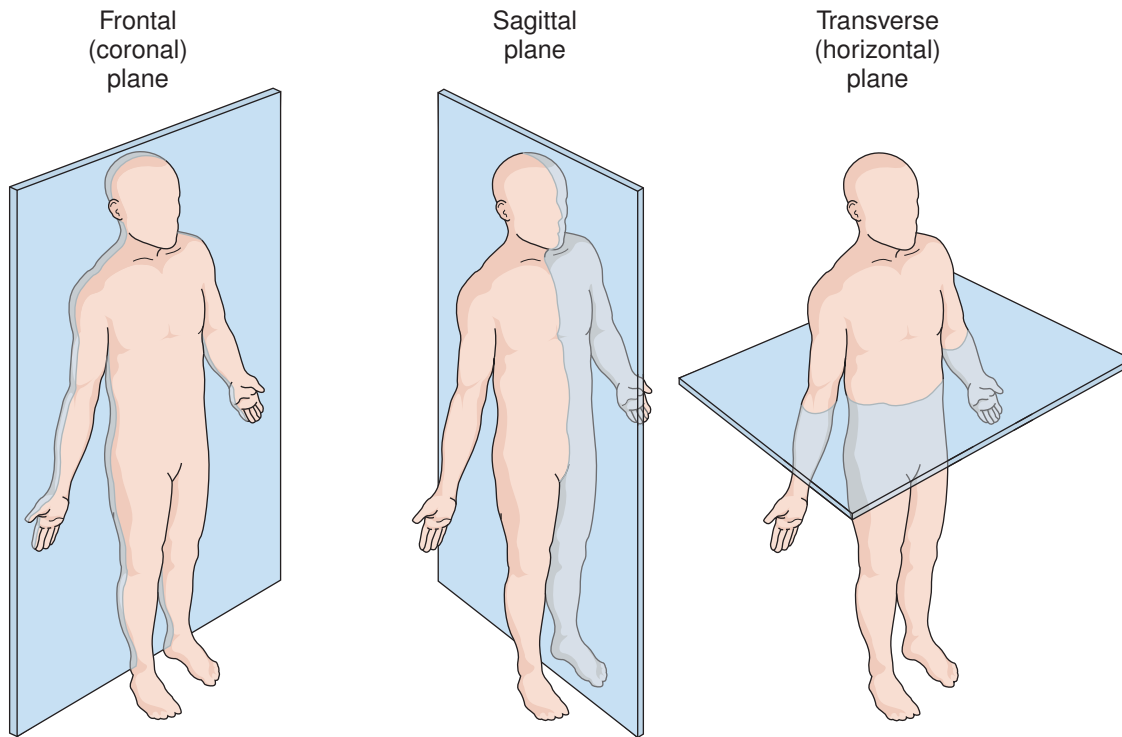


Figure 5-2 Planes of division.

Box 5-2

For Your Reference

Anatomic Directions

TERM	DEFINITION
anterior (ventral)	toward or at the front (belly) of the body
posterior (dorsal)	toward or at the back (dorsum) of the body
medial	toward the midline of the body
lateral	toward the side of the body
proximal	nearer to the point of attachment or to a given reference point
distal	farther from the point of attachment or from a given reference point
superior	above, in a higher position
inferior	below, in a lower position
cranial (cephalad)	toward the head
caudal	toward the lower end of the spine (Latin <i>cauda</i> means "tail"); in humans, in an inferior direction
superficial (external)	closer to the surface of the body
deep (internal)	closer to the center of the body

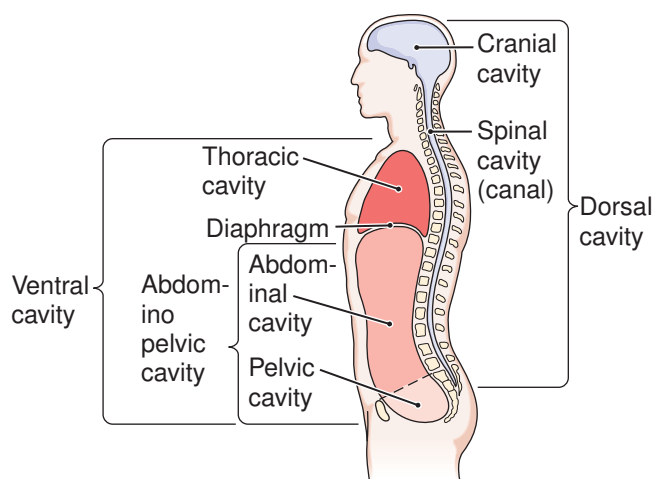


Figure 5-3 Body cavities, lateral view. Shown are the dorsal and ventral cavities with their subdivisions.

More simply, but less precisely, the abdomen can be divided into four sections by a single vertical line and a single horizontal line that intersect at the umbilicus (navel) (**Fig. 5-5**). The sections are the right upper quadrant (RUQ), left upper quadrant (LUQ), right lower quadrant (RLQ), and left lower quadrant (LLQ).

Additional terms for body regions are shown in **Figures 5-6 and 5-7**. You may need to refer to these illustrations as you work through the book.

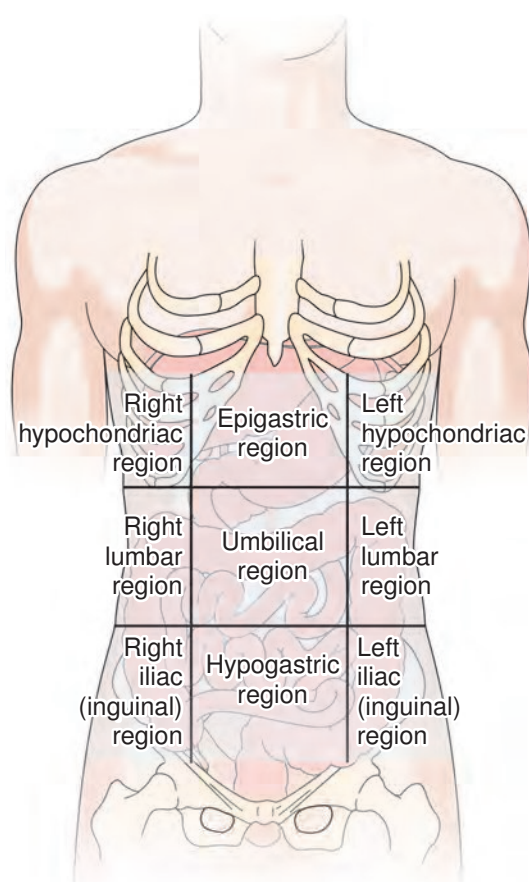


Figure 5-4 The nine regions of the abdomen.

Positions

In addition to the anatomic position, there are other standard positions in which the body is placed for special purposes, such as examination, tests, surgery, or fluid drainage. The most common of these positions and some of their uses are described in **Box 5-4**.



The regions of the abdomen and some of these body positions are illustrated in the Student Resources on *thePoint*.

Box 5-3



Focus on Words

Cutting the Job in Half

A beginning student in medical science may be surprised by the vast number of names and terms that he or she is required to learn. This responsibility is lightened somewhat by the fact that we are bilaterally symmetrical; that is, aside from some internal organs such as the liver, spleen, stomach, pancreas, and intestine, nearly everything on the right side can be found on the left as well. The skeleton can figuratively be split down the center, with equal structures on both sides of the midline. Many blood vessels and nerves are paired. This cuts the learning in half.

In addition, many of the blood vessels and nerves in a region have the same name. The radial artery, radial vein, and radial nerve are parallel, and all are located along the radius of the forearm. Vessels are commonly named for the organ they supply: the hepatic artery and vein of the liver, the pulmonary artery and vein of the lungs, and the renal artery and vein of the kidney.

No one could say that the learning of medical terminology is a snap, but it could be harder!

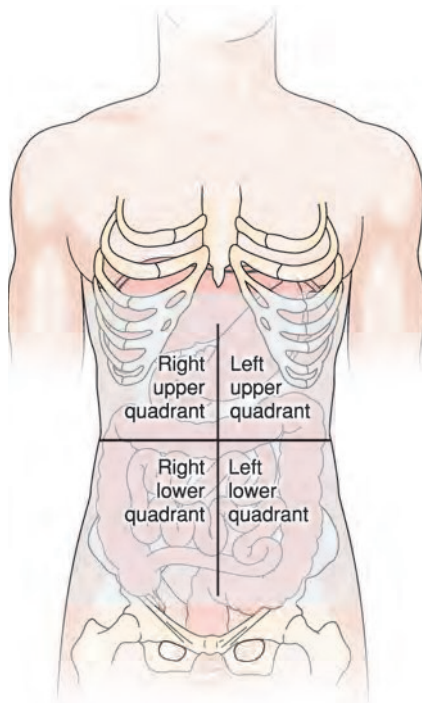


Figure 5-5 Quadrants of the abdomen. Some organs within the quadrants are indicated.

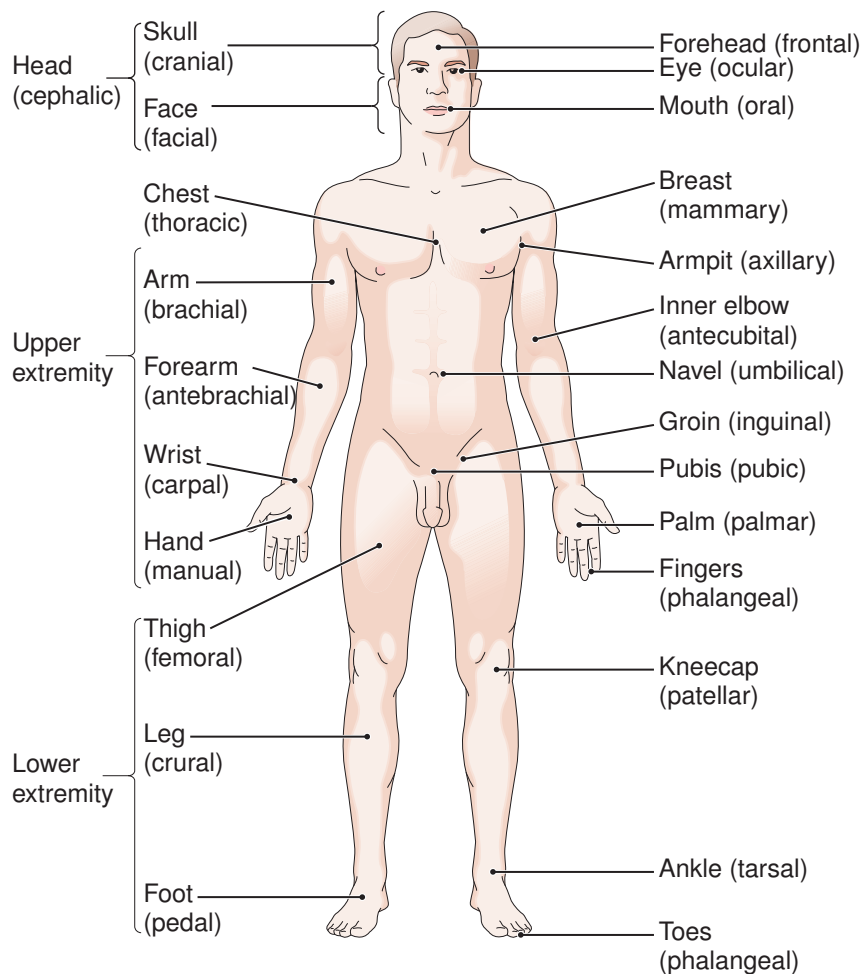


Figure 5-6 Common terms for body regions, anterior view. Anatomic adjectives for regions are in parentheses.

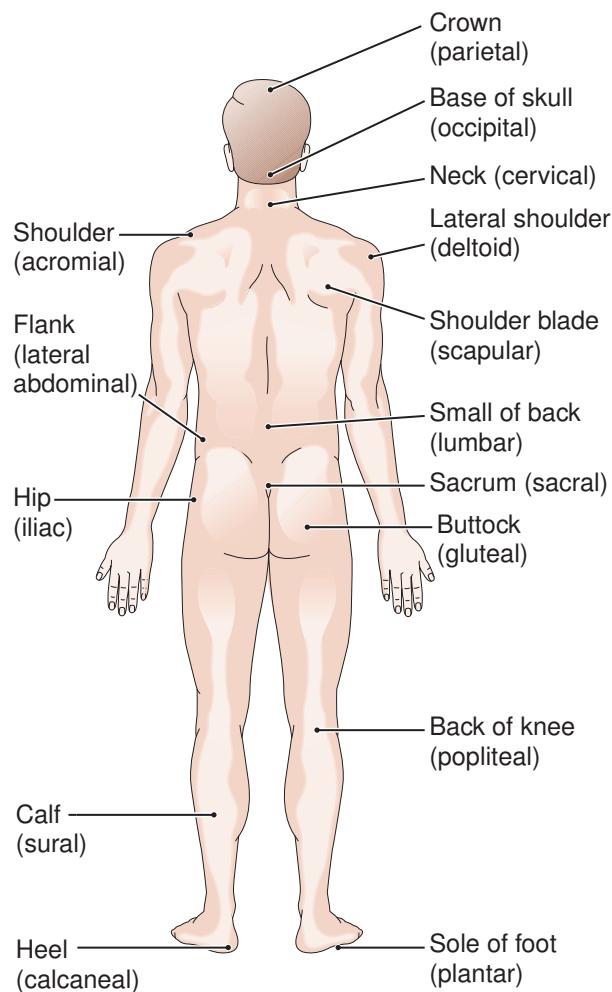


Figure 5-7 Common terms for body regions, posterior view. Anatomic adjectives for regions are in parentheses.

Box 5-4

For Your Reference

Body Positions

POSITION	DESCRIPTION
anatomic position <i>an-a-TOM-ik</i>	standing erect, facing forward, arms at sides, palms forward, legs parallel, toes pointed forward; used for descriptions and studies of the body
decubitus position <i>dē-KŪ-bi-tus</i>	lying down, specifically according to the part of the body resting on a flat surface, as in left or right lateral decubitus, or dorsal or ventral decubitus
dorsal recumbent position <i>rē-KUM-bent</i>	on back, with legs bent and separated, feet flat; used for obstetrics and gynecology
Fowler position	on back, head of bed raised about 18 inches, knees elevated; used to ease breathing and for drainage
jackknife position <i>JAK-nīf</i>	on back with shoulders elevated, legs flexed and thighs at right angles to the abdomen; used to introduce a tube into the urethra
knee-chest position	on knees, head and upper chest on table, arms crossed above head; used in gynecology and obstetrics and for flushing the intestine

(Continued)

Body Positions (*Continued*)

POSITION	DESCRIPTION
lateral recumbent position	on the side with one leg flexed, arm position may vary
lithotomy position <i>li-THOT-ō-mē</i>	on back, legs flexed on abdomen, thighs apart; used for gynecologic and urologic surgery
prone	lying face down
Sims position	on left side, right leg drawn up high and forward, left arm along back, chest forward resting on bed; used for kidney and uterine surgery, colon examination, and enemas
supine* <i>SŪ-pīn</i>	lying face up
Trendelenburg position <i>tren-DEL-en-berg</i>	on back with head lowered by tilting bed back at 45-degree angle; used for pelvic and abdominal surgery, treatment of shock

*To remember the difference between prone and supine, look for the word *up* in supine.

Terminology Key Terms

abdominal cavity <i>ab-DOM-i-nal</i>	The large ventral cavity below the diaphragm and above the pelvic cavity
abdominopelvic cavity <i>ab-dom-i-nō-PEL-vik</i>	The large ventral cavity between the diaphragm and pelvis that includes the abdominal and pelvic cavities
anatomic position <i>an-a-TOM-ik</i>	Standard position for anatomic studies, in which the body is erect and facing forward, the arms are at the sides with palms forward, and the feet are parallel
cranial cavity <i>KRĀ-nē-al</i>	The dorsal cavity that contains the brain
diaphragm <i>DĪ-a-fram</i>	The muscle that separates the thoracic from the abdominal cavity
frontal (coronal) plane <i>ko-RŌN-al</i>	Plane of section that separates the body into anterior (front) and posterior (back) portions
pelvic cavity <i>PEL-vik</i>	The ventral cavity that is below the abdominal cavity
peritoneum <i>per-i-tō-NĒ-um</i>	The large serous membrane that lines the abdominopelvic cavity and covers the organs within it
sagittal plane <i>SAJ-i-tal</i>	Plane that divides the body into right and left portions
spinal cavity (canal) <i>SPI-nal</i>	Dorsal cavity that contains the spinal cord
thoracic cavity <i>thō-RAS-ik</i>	The ventral cavity above the diaphragm, the chest cavity
transverse (horizontal) plane <i>trans-VERS</i>	Plane that divides the body into superior (upper) and inferior (lower) portions



Go to the Audio Pronunciation Glossary in the Student Resources on *thePoint* to hear these terms pronounced.

Word Parts Pertaining to Body Structure

Tables 5-1 to 5-3.

5

Table 5-1 Roots for Regions of the Head and Trunk

Root	Meaning	Example	Definition of Example
cephal/o	head	megacephaly <i>meg-a-SEF-a-lē</i>	abnormal largeness of the head
cervic/o	neck	cervicofacial <i>ser-vi-kō-FĀ-shal</i>	pertaining to the neck and face
thorac/o	chest, thorax	thoracotomy <i>thō-ra-KOT-ō-mē</i>	incision (-tomy) into the chest
abdomin/o	abdomen	intra-abdominal <i>in-tra-ab-DOM-i-nal</i>	within the abdomen
celi/o	abdomen	celiocentesis <i>sē-lē-ō-sen-TĒ-sis</i>	surgical puncture (centesis) of the abdomen
lapar/o	abdominal wall	laparoscope <i>LAP-a-rō-skōp</i>	instrument (-scope) for viewing the peritoneal cavity through the abdominal wall
lumb/o	lumbar region, lower back	thoracolumbar <i>thō-rak-ō-LUM-bar</i>	pertaining to the chest and lumbar region
periton, peritone/o	peritoneum	peritoneal <i>per-i-tō-NĒ-al</i>	pertaining to the peritoneum

EXERCISE 5-1

Write the adjective for each of the following definitions. The correct suffix is given in parentheses.

- Pertaining to (-al) the abdomen _____ abdominal
- Pertaining to (-ic) the head _____
- Pertaining to (-al) the neck _____
- Pertaining to the chest (-ic) _____
- Pertaining to (-ar) the lower back _____

Fill in the blanks:

- Peritonitis (*per-i-tō-NĪ-tis*) is inflammation (-itis) of the _____.
- The adjective celiac (*SĒ-lē-ak*) pertains to the _____.
- In B.K.s opening case study, the doctor's cephalocaudal examination began at his _____.
- A laparotomy (*lap-a-ROT-ō-mē*) is an incision through the _____.

Table 5-2 Roots for the Extremities

Root	Meaning	Example	Definition of Example
acro	extremity, end	acrocyanosis <i>ak-rō-sī-a-NŌ-sis</i>	bluish discoloration of the extremities
brachi/o	arm	antebrachium <i>an-tē-BRĀ-kē-um</i>	forearm
dactyl/o	finger, toe	polydactyly <i>pol-ē-DAK-tīl-ē</i>	having more than the normal number of fingers or toes
ped/o	foot	pedometer <i>pe-DOM-e-ter</i>	instrument that measures footsteps
pod/o	foot	podiatric <i>pō-dē-AT-rik</i>	pertaining to study and treatment of the foot

EXERCISE 5-2**Fill in the blanks:**

1. Acrokinesia (*ak-rō-kī-NĒ-sē-a*) is excess motion (-kinesia) of the _____.
2. Animals that brachiate (*BRĀ-kē-āt*), such as monkeys, swing from place to place using their _____.
3. A dactylospasm (*DAK-tīl-ō-spazm*) is a spasm (cramp) of a(n) _____.
4. The term brachiocephalic (*brā-kē-ō-se-FAL-ik*) refers to the _____.
5. Sinistropedal (*si-nis-trō-PĒ-dal*) refers to the use of the left _____.

Table 5-3 Prefixes for Position and Direction

Prefix	Meaning	Example	Definition of Example
circum-	around	circumoral <i>ser-kum-OR-al</i>	around the mouth
peri-	around	periorbital <i>per-ē-OR-bit-al</i>	around the orbit (eye socket)
intra-	in, within	intravascular <i>in-tra-VAS-kū-lar</i>	within a vessel (vascul/o)
epi-	on, over	epithelial <i>ep-i-THĒ-lē-al</i>	referring to epithelium, tissue that covers surfaces
extra-	outside	extrathoracic <i>eks-tra-thō-RAS-ik</i>	outside the thorax
infra-*	below	infrascapular <i>in-fra-SKAP-ū-lar</i>	below the scapula (shoulder blade)
sub-*	below, under	sublingual <i>sub-LING-gwal</i>	under the tongue (lingu/o)
inter-	between	intercostal <i>in-ter-KOS-tal</i>	between the ribs (cost/o)

Table 5-3 Prefixes for Position and Direction (*Continued*)

Prefix	Meaning	Example	Definition of Example
juxta-	near, beside	juxtaposition <i>juks-ta-pō-ZI-shun</i>	a location near or beside another structure
para-	near, beside	parasagittal <i>par-a-SAJ-i-tal</i>	near or beside a sagittal plane
retro-	behind, backward	retrouterine <i>re-trō-Ū-ter-in</i>	behind the uterus
supra-	above	suprapatellar <i>su-pra-pa-TEL-ar</i>	above the patella (kneecap)

*Also indicates degree.

EXERCISE 5-3

Synonyms. Write a word that means the same as each of the following:

- perioral _____ circumoral _____
- subscapular _____
- perivascular _____
- infracostal _____
- circumorbital _____

Opposites. Write a word that means the opposite of each of the following:

- infrapatellar _____ suprapatellar _____
- intracellular _____
- subscapular _____
- extrathoracic _____

Define the following words:

- paranasal (*par-a-NĀ-zal*) _____
- retroperitoneal (*re-trō-per-i-tō-NĒ-al*) _____
- supraabdominal (*sū-pra-ab-DOM-i-nal*) _____
- intrauterine (*in-tra-Ū-ter-in*) _____

Refer to Figures 5-6 and 5-7 to define the following terms:

- periumbilical (*per-ē-um-BIL-i-kal*) _____
- intergluteal (*in-ter-GLŪ-tē-al*) _____
- epitarsal (*ep-i-TAR-sal*) _____
- intraocular (*in-tra-OK-ū-lar*) _____
- parasacral (*par-a-SĀ-kral*) _____

Terminology**Supplementary Terms**

digit <i>DIJ-it</i>	A finger or toe (adjective: digital)
epigastrium <i>ep-i-GAS-trē-um</i>	The epigastric region
fundus <i>FUN-dus</i>	The base or body of a hollow organ, the area of an organ farthest from its opening
hypochondrium <i>hī-pō-KON-drē-um</i>	The hypochondriac region (left or right)
lumen <i>LŪ-men</i>	The central opening within a tube or hollow organ
meatus <i>mē-Ā-tus</i>	A passage or opening
orifice <i>OR-i-fis</i>	The opening of a cavity
os	Mouth, any body opening
septum <i>SEP-tum</i>	A wall dividing two cavities
sinus <i>SĪ-nus</i>	A cavity, as within a bone
sphincter <i>SFINK-ter</i>	A circular muscle that regulates an opening



Go to the Audio Pronunciation Glossary in the Student Resources on *thePoint* to hear these terms pronounced.

Terminology**Abbreviations**

LLQ	Left lower quadrant
LUQ	Left upper quadrant
RLQ	Right lower quadrant
RUQ	Right upper quadrant

Outcome of B.K.'s Case

Teased by his brother, but reassured by the doctor, B.K. spent a quiet afternoon and evening and slept through the night. In the morning, he went into the bathroom and had a bowel

movement. Examination of his stool showed that the coins had been expelled, and B.K. felt much better. Following this experience, B.K. deposited his earnings in his piggy bank.

Chapter Review

LABELING EXERCISE

DIRECTIONAL TERMS

Write the name of each numbered part on the corresponding line of the answer sheet.

Anterior (ventral)

Distal

Inferior (caudal)

Lateral

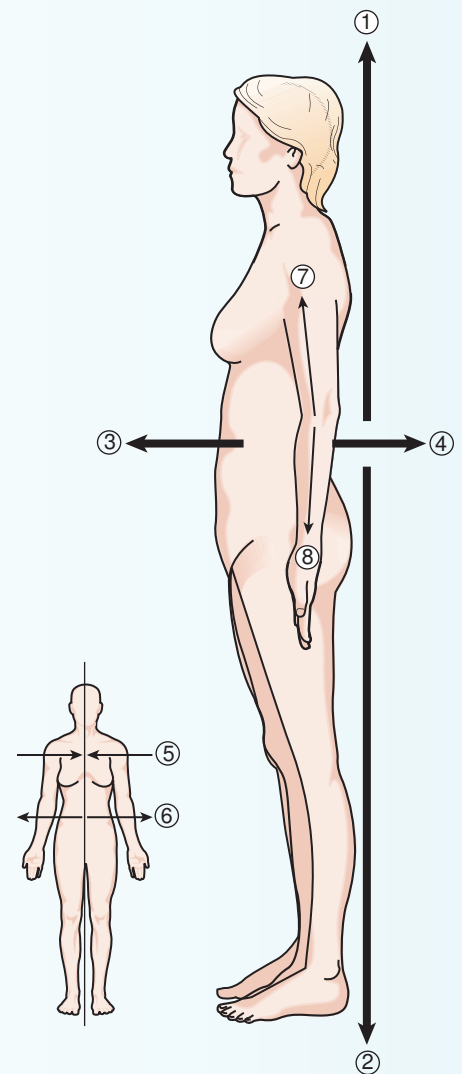
Medial

Posterior (dorsal)

Proximal

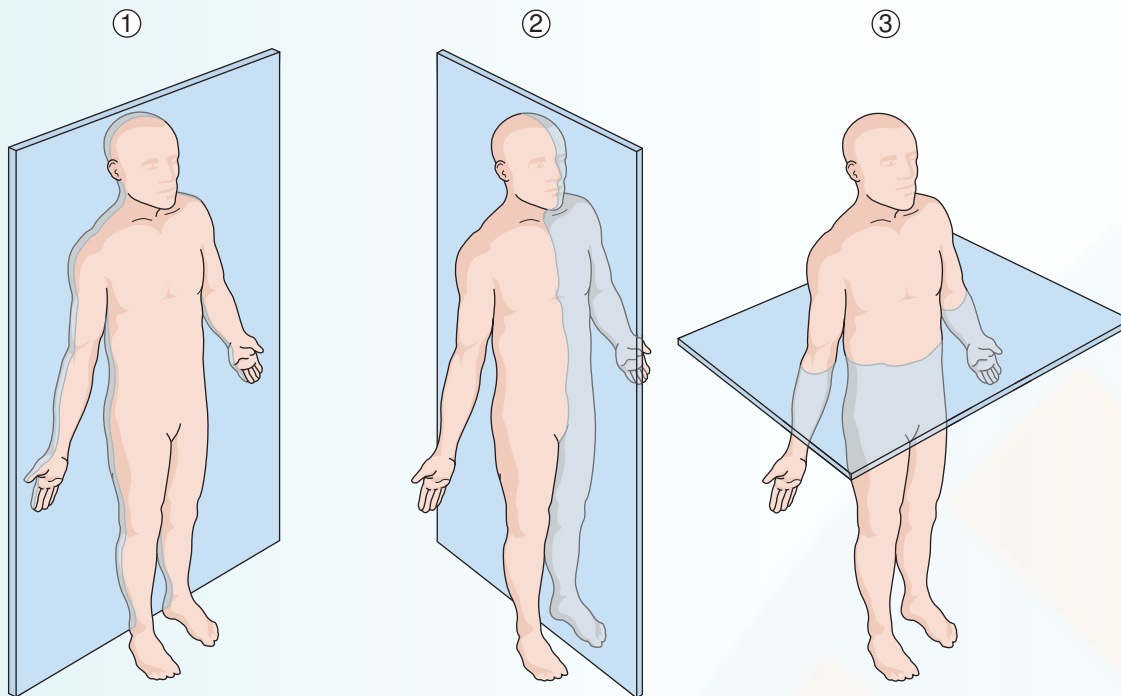
Superior (cranial)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____



PLANES OF DIVISION

Write the name of each numbered part on the corresponding line of the answer sheet.



Frontal (coronal) plane Transverse (horizontal) plane
Sagittal plane

1. _____

2. _____

3. _____

BODY CAVITIES, LATERAL VIEW

Write the name of each numbered part on the corresponding line of the answer sheet.

Abdominal cavity Pelvic cavity
Abdominopelvic cavity Spinal cavity (canal)
Cranial cavity Thoracic cavity
Dorsal cavity Ventral cavity
Diaphragm

1. _____

2. _____

3. _____

4. _____

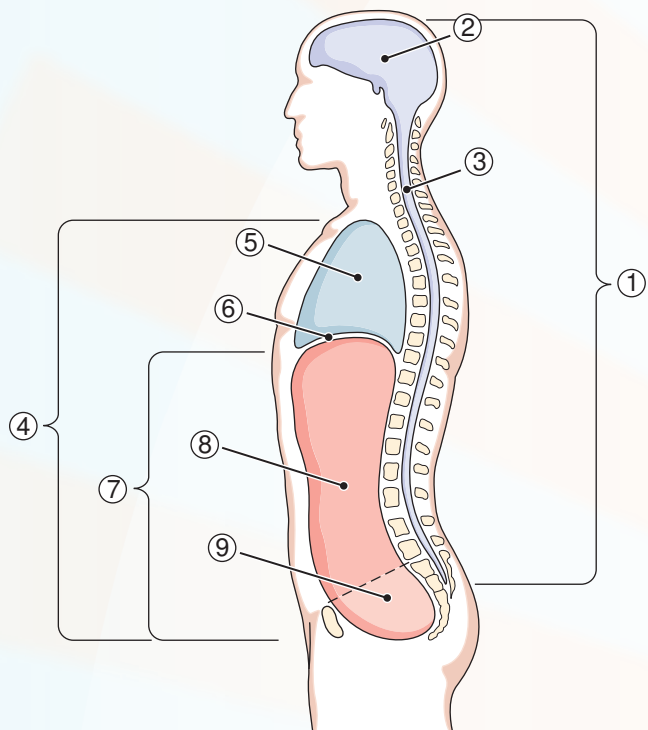
5. _____

6. _____

7. _____

8. _____

9. _____



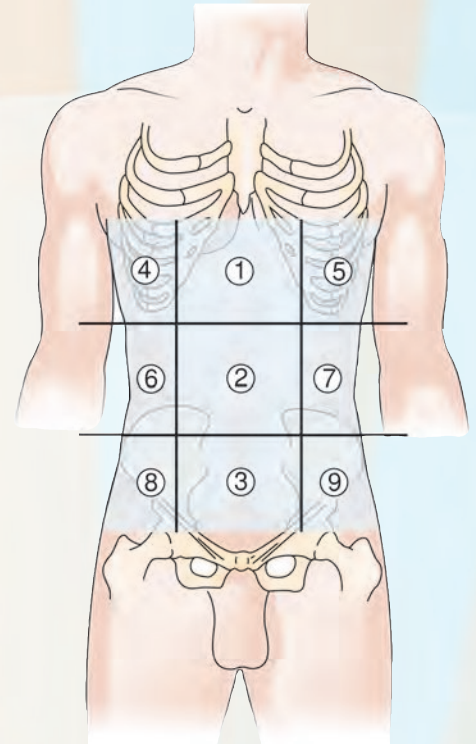
THE NINE REGIONS OF THE ABDOMEN

Write the name of each numbered part on the corresponding line of the answer sheet.

Epigastric region
Hypogastric region
Left hypochondriac region
Left iliac (inguinal) region
Left lumbar region

Right hypochondriac region
Right iliac (inguinal) region
Right lumbar region
Umbilical region

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____



TERMINOLOGY

MATCHING

Match the following terms and write the appropriate letter to the left of each number.

- | | |
|-------------------------|---|
| _____ 1. cephalad | a. surgical puncture of the chest |
| _____ 2. acrodermatitis | b. skin inflammation of the extremities |
| _____ 3. laparoscopy | c. pertaining to the right foot |
| _____ 4. dextropedal | d. examination through the abdominal wall |
| _____ 5. thoracentesis | e. toward the head |
| _____ 6. microcephaly | a. circular cut |
| _____ 7. celiotomy | b. excessive size of the feet |
| _____ 8. macropodia | c. outer layer of the skin |
| _____ 9. epidermis | d. abnormal smallness of the head |
| _____ 10. circumcision | e. incision of the abdomen |

Supplementary Terms

- | | |
|---------------------|--|
| _____ 11. septum | a. central opening of a tube |
| _____ 12. fundus | b. circular muscle that regulates an opening |
| _____ 13. lumen | c. dividing wall |
| _____ 14. sphincter | d. cavity, as in a bone |
| _____ 15. sinus | e. base of a hollow organ |

TRUE-FALSE

Examine each of the following statements. If the statement is true, write T in the first blank. If the statement is false, write F in the first blank and correct the statement by replacing the underlined word in the second blank.

	True or False	Correct Answer
16. The cranial and spinal cavities are the <u>ventral</u> body cavities.	F	dorsal
17. A <u>midsagittal plane</u> divides the body into equal right and left parts.		
18. The wrist is <u>distal</u> to the elbow.		
19. A <u>transverse plane</u> divides the body into anterior and posterior parts.		
20. The abdominal cavity is <u>inferior</u> to the thoracic cavity.		
21. The hypogastric region is <u>superior</u> to the umbilical region.		
22. When B.K. in the opening case study was lying in the supine position, he was lying <u>face down</u> .		
23. The left hypochondriac region is in the <u>LUQ</u> .		

ADJECTIVES

Name the part of the body referred to in the following adjectives:

24. lumbar	
25. carpal	
26. popliteal	
27. occipital	
28. phalangeal	
29. cervical	
30. celiac	
31. brachial	

Define the following words:

32. perioral	
33. suprapubic	
34. infraumbilical	
35. intercostal	
36. sublingual	
37. retroperitoneal	
38. bipedal	

SYNONYMS

Write a word that means the same as each of the following:

39. posterior	
40. circumocular	
41. submammary	
42. ventral	

OPPOSITES

Write a word that means the opposite of each of the following:

43. microcephaly _____

44. deep _____

45. proximal _____

46. subscapular _____

47. extracellular _____

48. superior _____

ELIMINATIONS

In each of the sets below, underline the word that does not fit in with the rest and explain the reason for your choice:

49. thoracic cavity — spinal cavity — pelvic cavity — abdominal cavity — abdominopelvic cavity

50. umbilical region — hypochondriac region — epigastric region — cervical region — iliac region

51. jackknife — supine — sagittal — decubitus — prone

52. lumb/o — dactyl/o — brachi/o — acro — pod/o

WORD BUILDING

Write a word for each of the following definitions using the word parts provided.

spasm cephal -o- dactyl extra- -ic infra- syn- thorac a- intra- -y poly-

53. within the head _____

54. below the chest _____

55. outside the chest _____

56. condition of having extra fingers or toes _____

57. fusion of the fingers or toes _____

58. pertaining to the head and chest _____

59. absence of a finger or toe _____

60. cramp of a finger or toe _____

61. absence of a head _____

WORD ANALYSIS

Define each of the words below and give the meaning of the word parts in each. Use a dictionary if necessary.

62. mesocephalic (*mes-ō-se-FAL-ik*) _____

a. mes/o _____

b. cephal/o _____

c. -ic _____

63. acrocyanosis (*ak-rō-sī-a-NŌ-sis*) _____
- a. acro _____
 - b. cyan/o _____
 - c. -sis _____
64. antebrachial (*an-tē-BRĀ-kē-al*) _____
- a. ante- _____
 - b. brachi/o _____
 - c. -al _____
65. epigastric (*ep-i-GAS-trik*) _____
- a. epi- _____
 - b. gastr/o _____
 - c. -ic _____



For more learning activities, see Chapter 5 of the Student Resources on *thePoint*.

Additional Case Studies

5

Case Study 5-1: Emergency Care

During a triathlon, paramedics responded to a scene with multiple patients involved in a serious bicycle accident. B.R., a 20-YO woman, lost control of her bike while descending a hill at approximately 40 mph. As she fell, two other cyclists collided with her, sending all three crashing to the ground.

At the scene, B.R. reported pain in her head, back, chest, and leg. She also had numbness and tingling in her legs and feet. Other injuries included a cut on her face and on her right arm and an obvious deformity to both her shoulder and knee. She had slight difficulty breathing.

The paramedic did a rapid cephalocaudal assessment and immobilized B.R.'s neck in a cervical collar. She was secured on a backboard and given oxygen. After her bleeding was controlled and her injured extremities were immobilized, she was transported to the nearest emergency department.

During transport, the paramedic in charge radioed ahead to provide a prehospital report to the charge nurse. His report included the following information: occipital and frontal head

pain; laceration to right temple, superior, and anterior to right ear; lumbar pain; bilateral thoracic pain on inspiration at midclavicular line on the right and midaxillary line on the left; dull aching pain of the posterior proximal right thigh; bilateral paresthesia (numbness and tingling) of distal lower legs circumferentially; varus (knock-knee) adduction deformity of left knee; and posterior displacement deformity of left shoulder.

At the hospital, the emergency department physician ordered radiographs for B.R. Before the procedure, the radiology technologist positioned a lead gonadal shield centered on the midsagittal line above B.R.'s symphysis pubis to protect her ovaries from unnecessary irradiation by the primary beam. The technologist knew that gonadal shielding is important for female patients undergoing imaging of the lumbar spine, sacroiliac joints, acetabula, pelvis, and kidneys. Shields should not be used for any examination in which an acute abdominal condition is suspected.

Case Study 5-2: Medical Assistant in Training

P.K. is a student in a local medical assistant training program. She was beginning her clinical rotations and was scheduled in a busy outpatient clinic. During the first week, she was assigned to follow a clinical medical assistant (CMA) who was prepping patients for examination by the physician. One of the goals for the week was to learn about body positioning for the various examinations.

The first day, P.K. assisted the CMA with a patient who came in for a gynecologic exam. After the physician completed the history, he asked P.K. and the medical assistant to help the patient into a lithotomy position.

The next morning, an elderly patient with suspected pneumonia who came in was escorted to an examination room. She

was lying on her back on the examination table waiting for the physician. P.K. placed the patient into a Fowler position to aid the patient's breathing.

Later that afternoon, P.K. heard the CMA call for assistance with a patient whose blood pressure was lower than normal. P.K. walked in, and the patient had already been placed into a Trendelenburg position.

The next day, a patient came in to have some stitches or sutures removed. The patient previously had a cyst removed from his lumbar region. P.K. assisted the patient into a prone position in preparation for the nurse clinician to remove the sutures.

By the end of the week, P.K. felt comfortable with positioning patients for the various physical examinations.

Case Study Questions

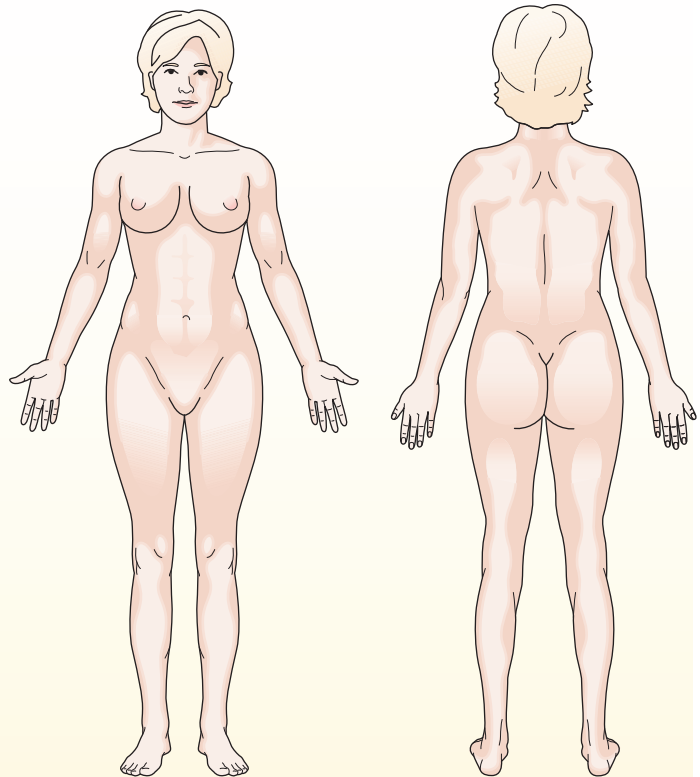
Multiple choice. Referring to case study 5-1, select the best answer and write the letter of your choice to the left of each number.

- | | |
|---|---|
| <p>_____ 1. The term for the time span between injury and admission to the emergency department is:</p> <ul style="list-style-type: none"> a. preoperative b. prehospital c. pre-emergency d. pretrauma e. intrainjury | <p>_____ 3. The victim's injured extremities were immobilized before transport. Immobilized means:</p> <ul style="list-style-type: none"> a. abducted as far as possible b. internally rotated and flexed c. adducted so that the limbs are crossed d. rotated externally e. held in place to prevent movement |
| <p>_____ 2. A cephalocaudal assessment goes from_____.</p> <ul style="list-style-type: none"> a. stem to stern b. front to back c. head to toe d. side to side e. skin to bone | <p>_____ 4. A cervical collar was placed on the victim to stabilize and immobilize the_____.</p> <ul style="list-style-type: none"> a. uterus b. shoulders c. chin d. neck e. pelvis |

- _____ 5. The singular form of acetabula is:
- acetyl
 - acetabulum
 - acetabia
 - acetab
 - acetabulae

Draw or shade the appropriate area(s) on one or both diagrams for each question pertaining to case study.

- Draw dots over the areas of the victim's occipital and frontal head pain.
- Draw a dash (—) over the area of the right temporal laceration—superior and anterior to the right ear.
- Crosshatch the area of lumbar pain.
- Place an X over the area of thoracic pain at the anterior left midaxillary line.
- Draw a star at the area of the pain on the right proximal posterior thigh.
- Shade the area of the bilateral paresthesia of the distal lower legs, circumferentially.
- Draw an arrow to show the direction of the varus adduction of the left knee.
- Draw an arrow to show the direction of the posterior displacement of the left shoulder.
- Draw a fig leaf to show the gonadal shield on the midsagittal line above the symphysis pubis.
- Draw a circle around the area of the sacroiliac joints.



Referring to case study 5-2:

- | | |
|---|---|
| <p>_____ 16. The patient was placed in a Fowler position to:</p> <ol style="list-style-type: none"> aid breathing perform urologic surgery treat shock examine the colon palpate the vertebrae | <p>_____ 17. The lumbar region refers to the:</p> <ol style="list-style-type: none"> upper arm lower abdomen chest lateral abdomen small of the back |
|---|---|

Describe the following positions:

- lithotomy _____
- Trendelenburg _____
- prone _____



PART



Disease and Treatment

CHAPTER 6 Disease

CHAPTER 7 Diagnosis and Treatment;
Surgery

CHAPTER 8 Drugs

CHAPTER

6

Disease

Case Study

Infected on an African Safari

Chief complaint:

J.N., a 56-year-old female, was on a month-long safari vacation with her husband in South Africa. During the last week of the trip, she began to experience a low-grade fever, abdominal cramping, and foul-smelling diarrhea. She returned home and promptly saw her internist.

Examination

The internist took a history, and J.N. recounted the events leading up to the acute onset of abdominal spasms and other intestinal symptoms. She explained that she and her husband went on an African safari and visited some pretty remote areas. Sanitation was a concern of hers, and she was careful to consume only bottled beverages. J.N. did admit though that she tried some of the native cuisine in the high mountain villages.

The internist ordered the following laboratory tests: complete blood count (CBC), liver enzymes, and a stool specimen. The stool specimen was checked for protozoa, helminths such as hookworm, and other parasites that may have been endemic to the region in which J.N. and her husband had traveled. The CBC showed an elevated white blood count (WBC), and the stool specimen was positive for the protozoan *Giardia lamblia*. No indications of hepatitis nor any other signs of pathology were noted.

Clinical course:

J.N.'s internist explained the results of the tests and said that she most likely contracted the illness from contaminated water in the mountain villages she visited. He prescribed the drug, Tindamax, also known as tinidazole, and told her to take the medicine on an empty stomach. He cautioned her about transmitting the infection. Lastly, he reinforced strict personal hygiene and instructed her to wash her hands meticulously after having a bowel movement. She was to notify the office if symptoms persisted.

In this chapter, we learn about different categories of diseases, including infectious diseases, such as the protozoal disease J.N. contracted. We also discuss how the body responds to disease and learn about word parts contained in disease terminology. Diseases often require medical intervention, such as drug treatment, as in J.N.'s case. Medical treatment in general is the subject of Chapter 7, and drugs are specifically discussed in Chapter 8.

Ancillaries *At-A-Glance*

Visit *thePoint* to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii-xvi.

Learning **TOOLS**

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning **RESOURCES**

- E-book: Chapter 6
- Web Figure: Modes of Disease Transmission
- Web Figure: Chain of Events in Inflammation
- Web Chart: Disease Terminology
- Web Chart: Common Routes of Disease Transmission
- Animation: Acute Inflammation
- Audio Pronunciation Glossary

Learning **ACTIVITIES**

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After study of this chapter, you should be able to:

- 1** List the major categories of diseases. *p98*
- 2** Compare the common types of infectious organisms and list some diseases caused by each. *p99*
- 3** Describe the common responses to disease. *p100*
- 4** Define and give examples of neoplasia. *p103*
- 5** Define the major terms pertaining to diseases. *p104*
- 6** Identify and use word parts pertaining to diseases. *p106*
- 7** Analyze the disease terminology in several case studies. *pp96, 118*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|--|---|
| <p>_____ 1. Any organism so small that it can only be seen with a microscope is a:</p> <ul style="list-style-type: none"> a. miniorganism b. macroorganism c. microcell d. microorganism | <p>_____ 5. Single-celled animals, as a group, are called:</p> <ul style="list-style-type: none"> a. algae b. mold c. protozoa d. vibrios |
| <p>_____ 2. A disease that has a sudden and severe onset is described as:</p> <ul style="list-style-type: none"> a. chronic b. mild c. acute d. infectious | <p>_____ 6. Heat, pain, redness, and swelling are the characteristic signs of:</p> <ul style="list-style-type: none"> a. immunity b. fever c. inflammation d. healing |
| <p>_____ 3. Abnormal and uncontrolled growth of tissue is termed:</p> <ul style="list-style-type: none"> a. anemia b. neoplasia c. parasitism d. toxicity | <p>_____ 7. White blood cells engulf foreign organisms by the process of:</p> <ul style="list-style-type: none"> a. phagocytosis b. egestion c. ejection d. dysphagia |
| <p>_____ 4. Round bacteria are called:</p> <ul style="list-style-type: none"> a. cocci b. yeasts c. fungi d. bacilli | <p>_____ 8. The sum of all body defenses against infectious disease is termed:</p> <ul style="list-style-type: none"> a. pyosis b. complementation c. secretion d. immunity |

A disease is any disorder of normal body function. Diseases can be grouped into a number of different but often overlapping categories.

Types of Diseases

- Infectious diseases—caused by certain harmful **microorganisms** and other **parasites** that live at the expense of another organism. Any disease-causing agent is described as a **pathogen**.
- Degenerative diseases—resulting from wear and tear, aging, or **trauma** (injury) that can result in a **lesion** (wound) and perhaps **necrosis** (death of tissue). Common examples include arthritis, cardiovascular problems, and certain respiratory disorders such as emphysema. Structural malformations such as congenital malformations, **prolapse** (dropping), or **hernia** (rupture) may also result in degenerative changes.
- Neoplasia—abnormal and uncontrolled growth of tissue.
- Immune disorders—this category includes failures of the immune system, allergies, and autoimmune diseases, in which the body makes antibodies to its own tissues. (Immune disorders receive more detailed discussion in Chapter 10.)
- Metabolic disorders—resulting from lack of enzymes or other factors needed for cellular functions. Many hereditary disorders fall into this category. Malnutrition caused by inadequate intake of nutrients or inability of the body to absorb and use nutrients also upsets metabolism. (Metabolic disorders are discussed in more detail in Chapter 12, and hereditary disorders are discussed in Chapter 15.)
- Hormonal disorders—caused by underproduction or overproduction of hormones or by inability of the hormones to function properly. One example is diabetes mellitus. (Chapter 16 has more detail on hormonal disorders.)
- Mental and emotional disorders—disorders that affect the mind and adaptation of an individual to his or her environment. (Chapter 17 has further discussion on behavioral disorders.)

Box 6-1



Focus on Words

Name That Disease

Diseases get their names in a variety of ways. Some are named for the places where they were first found, such as Lyme disease for Lyme, Connecticut; West Nile disease and Rift Valley fever for places in Africa; and hantavirus fever for a river in Korea. Others are named for the people who first described them, such as Cooley anemia; Crohn disease, an inflammatory bowel disease; and Hodgkin disease of the lymphatic system.

Many diseases are named on the basis of the symptoms they cause. Tuberculosis causes small lesions known as tubercles in the lungs and other tissues. Skin anthrax produces lesions that turn black, and its name comes from the same

root as anthracite coal. In sickle cell anemia, red blood cells become distorted into a crescent shape when they give up oxygen. Having lost their smooth, round form, the cells jumble together, blocking small blood vessels and depriving tissues of oxygen.

Bubonic plague causes painful and enlarged lymph nodes called buboes. Lupus erythematosus, a systemic autoimmune disorder, is named for the Latin term for wolf, because the red rash that may form on the faces of people with this disease gives them a wolf-like appearance. Yellow fever, scarlet fever, and rubella (German measles) are named for colors associated with the pathology of these diseases.

Some methods for naming diseases are described in **Box 6-1**.

The cause of a disease is its **etiology** (*ē-tē-OL-ō-jē*), although many diseases have multiple interacting causes. An **acute** disease is sudden and severe and of short duration. A **chronic** disease is of long duration and progresses slowly. One health profession that deals with the immediate effects of acute disease is the emergency medical technician (EMT) (**Box 6-2**).



PASSport
to Success

See the Student Resources on *thePoint* for a complete list of disease terminology.

Infectious Diseases

Infectious diseases are caused by viruses, bacteria, fungi (yeasts and molds), protozoa (single-celled animals), and worms (helminths) (**Box 6-3**). Infecting organisms can enter the body through several routes or portals of entry, including damaged skin, the respiratory tract, digestive system, and the urinary and reproductive tracts. An infected person's bodily discharges may contain organisms that spread infection through the air, food, water, or direct contact. Microorganisms often produce disease by means of the **toxins** (poisons) they release. The presence of harmful microorganisms or their toxins in the body is termed **sepsis**.

Box 6-2



Health Professions

Emergency Medical Technicians

Emergency medical technicians (EMTs) are the first health professionals to arrive at the scene of an automobile accident, heart attack, or other emergency situation. EMTs must assess and respond rapidly to a medical crisis, taking a medical history, performing a physical examination, stabilizing the patient, and, if necessary, transporting the patient to the nearest medical facility.

To perform their lifesaving duties, EMTs need extensive training, including a thorough understanding of anatomy and physiology. EMTs must know how to use specialized equipment, such as backboards to immobilize injuries, electrocardiographs to monitor heart activity, and defibrillators to treat cardiac arrest; they must also be proficient

at giving intravenous fluids, oxygen, and certain lifesaving medications. At medical facilities, EMTs work closely with physicians and nurses, reporting on histories, physical examinations, and measures taken to stabilize the patient. Most EMTs receive their training from college or technical schools and must be certified in the state where they are employed.

As the American population ages and becomes concentrated in urban centers, the rate of accidents and other emergencies is expected to rise. Thus, the need for EMTs remains high. For more information about this career, contact the National Association of Emergency Medical Technicians at <http://www.naemt.org>.

Box 6-3

For Your Reference

Common Infectious Organisms

TYPE OF ORGANISM	DESCRIPTION	EXAMPLES OF DISEASES CAUSED
bacteria <i>bak-TĒ-rē-a</i>	simple microscopic organisms that are widespread throughout the world, some can produce disease; singular: bacterium (<i>bak-TĒ-rē-um</i>)	
cocci <i>KOK-sī</i>	round bacteria; may be in clusters (staphylococci), chains (streptococci), and other formations; singular, coccus (<i>KOK-us</i>)	pneumonia, rheumatic fever, food poisoning, septicemia, urinary tract infections, gonorrhea
bacilli <i>ba-SIL-ī</i>	rod-shaped bacteria; singular, bacillus (<i>ba-SIL-us</i>)	typhoid, dysentery, salmonellosis, tuberculosis, botulism, tetanus
vibrios <i>VIB-rē-ōz</i>	short curved rods	cholera, gastroenteritis
spirochetes <i>SPI-rō-kētz</i>	corkscrew-shaped bacteria that move with a twisting motion	Lyme disease, syphilis, Vincent disease
chlamydia <i>kla-MID-ē-a</i>	extremely small bacteria with complex life cycles that grow in living cells, but unlike viruses, are susceptible to antibiotics	conjunctivitis, trachoma, pelvic inflammatory disease (PID), and other sexually transmitted infections (STIs)
rickettsia <i>ri-KET-sē-a</i>	extremely small bacteria that grow in living cells but are susceptible to antibiotics	typhus, Rocky Mountain spotted fever
viruses <i>VĪ-rus-es</i>	submicroscopic infectious agents that can live and reproduce only within living cells	colds, herpes, hepatitis, measles, varicella (chickenpox), influenza, AIDS
fungi <i>FUN-jī</i>	simple, nongreen plants, some of which are parasitic; includes yeasts and molds; singular, fungus (<i>FUN-gus</i>)	candidiasis, skin infections (tinea, ringworm), valley fever
protozoa <i>prō-tō-ZŌ-a</i>	single-celled animals; singular, protozoon (<i>prō-tō-ZŌ-on</i>)	dysentery, <i>Trichomonas</i> infection, malaria
helminths <i>HEL-minths</i>	worms	trichinosis; infestations with roundworms, pinworms, hookworms

BACTERIA

In shape, bacteria are:

- Round, or cocci, shown in [Figure 6-1](#)
- Rod-shaped, or bacilli, shown in [Figure 6-2](#)
- Curved, including vibrios and spirochetes, shown in [Figure 6-3](#)

Bacteria may be named according to their shape and also by the arrangements they form (see [Fig. 6-1](#)). They are also described according to the dyes they take up when stained in the laboratory. The most common laboratory bacterial stain is the **Gram stain**, with which gram-positive organisms stain purple and gram-negative organisms stain red (see [Fig. 6-1](#)).

Chlamydia and rickettsia are two bacterial groups that are smaller than typical bacteria and can grow only within living host cells (see [Box 6-3](#)).



See a figure and chart on the transmission of infectious diseases in the Student Resources on *thePoint*.

Responses to Disease

INFLAMMATION

A common response to infection and to other forms of disease is **inflammation**. When cells are injured, they release chemicals that allow blood cells and fluids to move into the tissues. This inflow of blood results in the four signs of inflammation:

- Heat
- Pain
- Redness
- Swelling

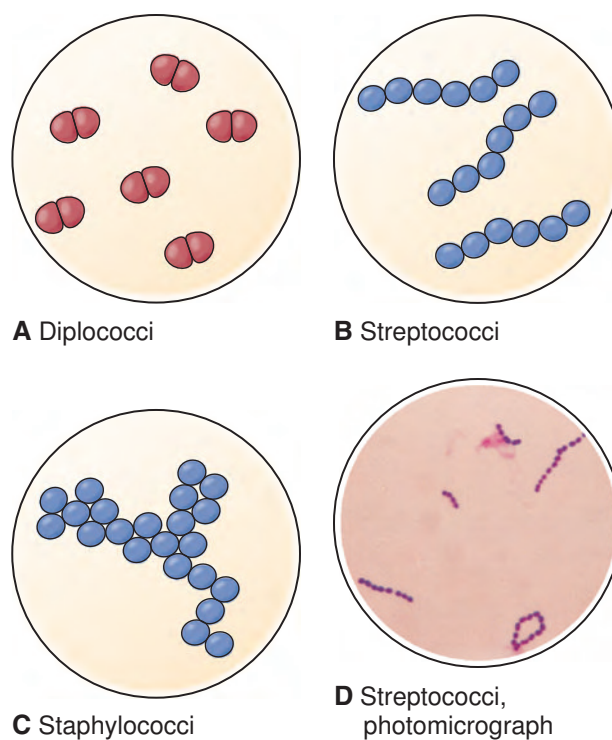


Figure 6-1 Cocci, round bacteria, Gram stained. A. Cells growing in pairs, diplococci. B. Cells in chains, streptococci. C. Cells in clusters, staphylococci. D. Streptococci viewed under a microscope in a photomicrograph. Gram-positive cells are purple; gram-negative cells are red.

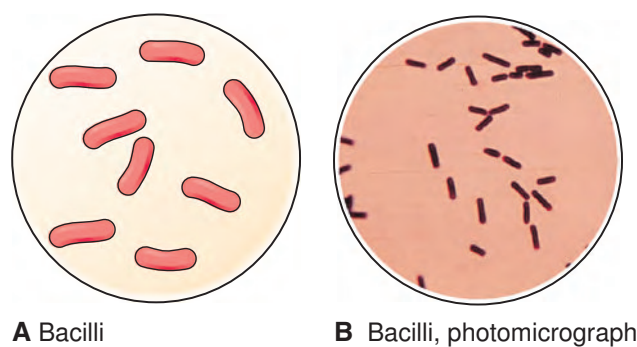
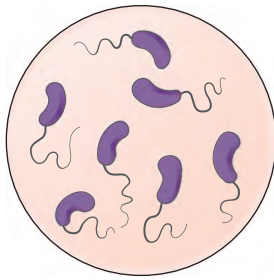
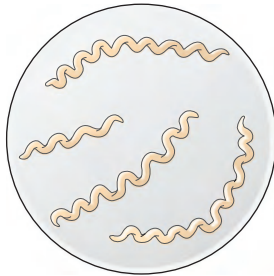


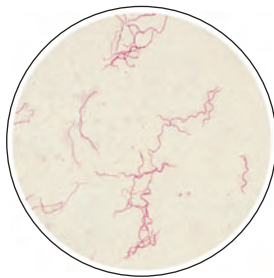
Figure 6-2 Bacilli, rod-shaped bacteria. A. Drawing of bacilli. B. Photomicrograph of bacilli.



A Vibrios



B Spirochetes



C Spirochetes, photomicrograph

Figure 6-3 Curved bacteria. A. Vibrios are short curved rods. B. Spirochetes are spiral shaped. C. Spirochetes shown in a photomicrograph.

The suffix *-itis* indicates inflammation, as in appendicitis (inflammation of the appendix) and tonsillitis (inflammation of the tonsils).

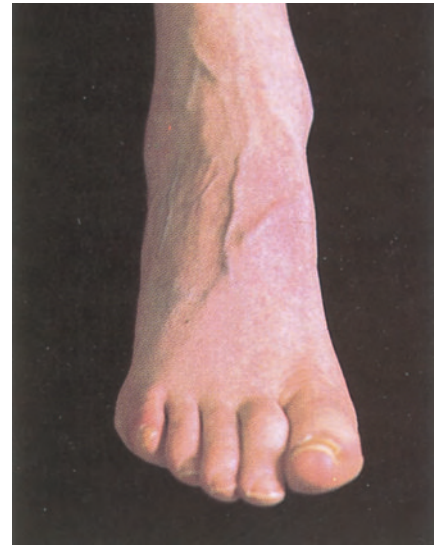
Inflammation is one possible cause of **edema**, a swelling or accumulation of fluid in the tissues (**Fig. 6-4**). Other causes of edema include fluid blockage, heart failure, and imbalance in body fluid composition, as described in later chapters.



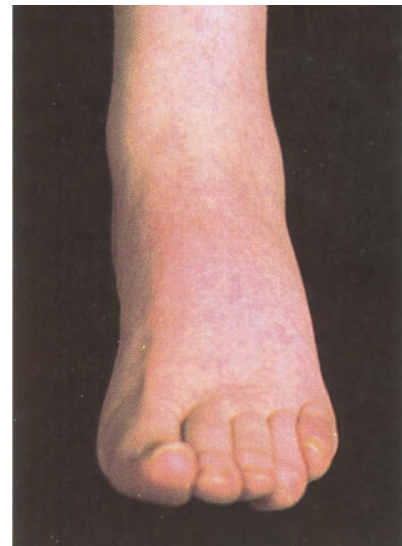
See the animation "Acute Inflammation" in the Student Resources on thePoint.

PHAGOCYTOSIS

The body uses **phagocytosis** to get rid of invading microorganisms, damaged cells, and other types of harmful debris.



A



B

Figure 6-4 Edema. A. A normal foot showing veins, tendons, and bones. B. Edema (swelling) obscures surface features.

Certain white blood cells are capable of engulfing these materials and destroying them internally (**Fig. 6-5**). Phagocytic cells are found circulating in the blood, in the tissues, and in the lymphatic system (see Chapters 9 and 10). The remains of phagocytosis consist of fluid and white blood cells; this mixture is called **pus**.

IMMUNITY

Immunity refers to all our defenses against infectious disease. Inflammation and phagocytosis are examples of inborn or innate protective mechanisms, which are based on a person's genetic makeup and do not require any previous

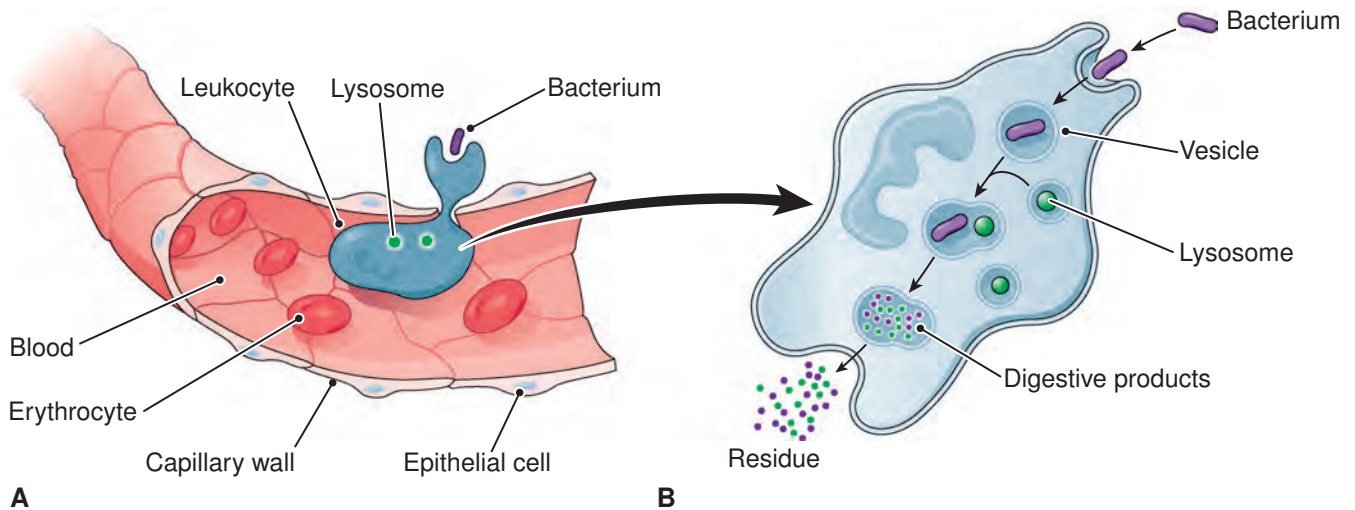


Figure 6-5 Phagocytosis. A. A phagocytic white blood cell squeezes through a capillary wall to engulf a bacterium. B. Lysosomal enzymes destroy the bacterium, and the waste products are eliminated.

exposure to a disease organism. Other defenses that fall into this category are mechanical barriers, such as intact skin and mucous membranes, as well as body secretions, such as stomach acid and enzymes in saliva and tears.

Immunity that we develop during life from exposure to disease organisms is termed *acquired immunity*, or adaptive immunity. This type of immunity is specific for particular diseases encountered by natural exposure or by the administration of vaccines (see Chapter 10). The system responsible for adaptive immunity consists of cells in the blood, lymphatic system, and other tissues. These cells recognize different foreign invaders and get rid of them by direct attack and by producing circulating antibodies that immobilize and help destroy them. The immune system also monitors the body continuously for abnormal and malfunctioning cells, such as cancer cells. The immune system may overreact to produce allergies and may react to one's own tissues to cause autoimmune diseases.

Neoplasia

As noted earlier, a **neoplasm** is an abnormal and uncontrolled growth of tissue—a tumor or growth. A **benign** neoplasm does not spread, that is, undergo **metastasis** to other tissues, although it may cause damage at the site where it grows. An invasive neoplasm that can metastasize to other tissues is termed **malignant** and is commonly called **cancer**. A malignant tumor that involves epithelial tissue is a **carcinoma**. If the tumor arises in glandular epithelium, it is an adenocarcinoma (the root *aden/o* means “gland”); a cancer of pigmented epithelial cells (melanocytes) is a melanoma. A neoplasm that involves connective tissue or muscle is a **sarcoma**. Cancers of the blood, lymphatic system, and nervous system are classified according to the cell

types involved and other clinical features. Further descriptions of these cancers appear in Chapters 10 and 17.

Often mistaken for a malignancy is a **cyst**, a sac or pouch filled with fluid or semisolid material that is abnormal but not cancerous (**Fig. 6-6**). Common sites for cyst formation are the breasts, the skin's sebaceous glands, and the ovaries. Causes of cyst formation include infection or blockage of a duct.

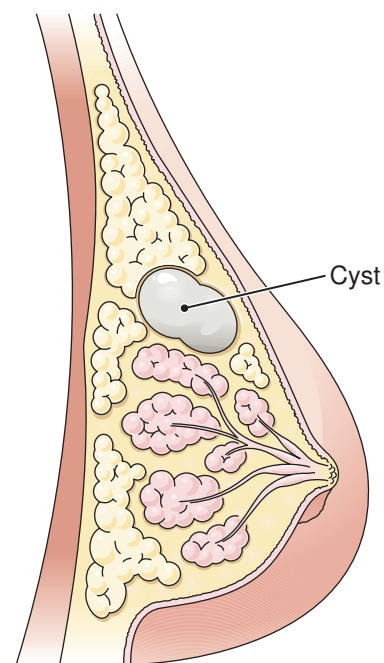


Figure 6-6 Cyst in the breast.

Terminology Key Terms

acute <i>a-KŪT</i>	Sudden, severe; having a short course
benign <i>bē-NĪN</i>	Not recurrent or malignant, favorable for recovery, describing a tumor that does not spread (metastasize) to other tissues
carcinoma <i>kar-si-NŌ-ma</i>	A malignant neoplasm composed of epithelial cells (from Greek root <i>carcino</i> , meaning “crab”) (adjective: <i>carcinomatous</i>)
chronic <i>KRON-ik</i>	Of long duration, progressing slowly
cyst <i>sist</i>	An abnormal filled sac or pouch (see Fig. 6-6). Used as a root meaning a normal bladder or sac, such as the urinary bladder or gallbladder (root: <i>cyst/o</i>)
edema <i>e-DĒ-ma</i>	Accumulation of fluid in the tissues, swelling; adjective: <i>edematous</i> (<i>e-DĒ-ma-tus</i>) (see Fig. 6-4)
etiology <i>ē-tē-OL-ō-jē</i>	The cause of a disease
Gram stain	A laboratory staining procedure that divides bacteria into two groups: gram-positive, which stain purple, and gram-negative, which stain red (see Fig. 6-1)
hernia <i>HER-nē-a</i>	Protrusion of an organ through an abnormal opening, a rupture (Fig. 6-7)
inflammation <i>in-fla-MĀ-shun</i>	A localized response to tissue injury characterized by heat, pain, redness, and swelling
lesion <i>LĒ-zhun</i>	A distinct area of damaged tissue, an injury or wound
malignant <i>ma-LIG-nant</i>	Growing worse, harmful, tending to cause death, describing an invasive tumor that can spread (metastasize) to other tissues
metastasis <i>me-TAS-ta-sis</i>	Spread from one part of the body to another, characteristic of cancer. Verb is <i>metastasize</i> (<i>me-TAS-ta-sīz</i>), adjective: <i>metastatic</i> (<i>met-a-STAT-ik</i>)
microorganism <i>mī-krō-OR-gan-izm</i>	An organism too small to be seen without the aid of a microscope
necrosis <i>ne-KRŌ-sis</i>	Death of tissue (root <i>necr/o</i> means “death”); adjective: <i>necrotic</i> (<i>ne-KROT-ik</i>)
neoplasm <i>NĒ-ō-plazm</i>	An abnormal and uncontrolled growth of tissue, namely, a tumor; may be benign or malignant. From prefix <i>neo-</i> meaning “new” and root <i>plasm</i> meaning “formation.” The root <i>onc/o</i> and the suffix <i>-oma</i> refer to neoplasms
parasite <i>PAR-a-sīt</i>	An organism that grows on or in another organism (the host), causing damage to it
pathogen <i>PATH-ō-jen</i>	An organism capable of causing disease (root <i>path/o</i> means “disease”)
phagocytosis <i>fag-ō-sī-TŌ-sis</i>	The ingestion of organisms, such as invading bacteria or small particles of waste material by a cell (root <i>phag/o</i> means “to eat”). The phagocytic cell, or phagocyte, then destroys the ingested material (see Fig. 6-5)
prolapse <i>PRŌ-laps</i>	A dropping or downward displacement of an organ or part, ptosis

Terminology

Key Terms *(Continued)*

pus	A product of inflammation consisting of fluid and white blood cells (root: py/o)
sarcoma <i>sar-KŌ-ma</i>	A malignant neoplasm arising from connective tissue (from Greek root sarco, meaning “flesh”); adjective: sarcomatous
sepsis <i>SEP-sis</i>	The presence of harmful microorganisms or their toxins in the blood or other tissues; adjective: septic
toxin <i>TOKS-in</i>	A poison; adjective: toxic (roots: tox/o, toxic/o)
trauma <i>TRAW-ma</i>	A physical or psychological wound or injury

See also **Box 6-3** on infectious organisms.



Go to the Audio Pronunciation Glossary in the Student Resources on thePoint to hear these terms pronounced.

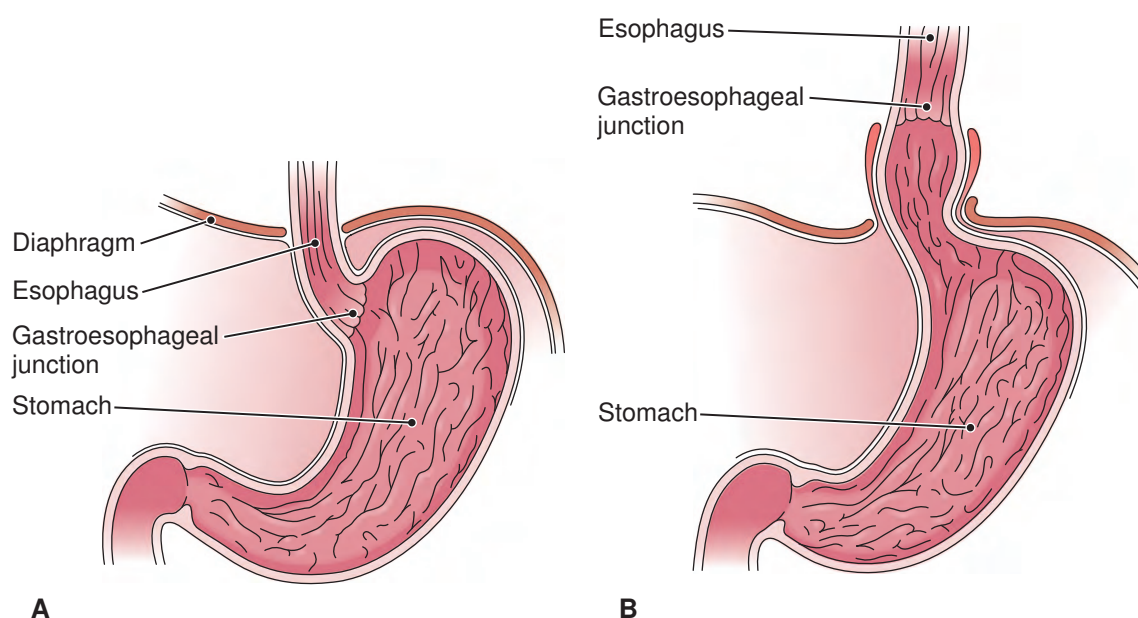


Figure 6-7 Hernia (A) A normal stomach. (B) Hiatal hernia. The stomach protrudes through the diaphragm into the thoracic cavity, raising the level of the junction between the esophagus and the stomach.

Word Parts Pertaining to Disease

See Tables 6-1 to 6-5.

Table 6-1 Roots for Disease

Root	Meaning	Example	Definition of Example
alg/o, algi/o, algesi/o	pain	algisia al-JĒ-zē-a	condition of having pain
carcin/o	cancer, carcinoma	carcinoid KAR-si-noyd	resembling a carcinoma
cyst/o	filled sac or pouch, cyst, bladder	cystic SIS-tik	pertaining to or having cysts
lith	calculus, stone	lithiasis lith-Ī-a-sis	stone formation
onc/o	tumor	oncogenic on-kō-JEN-ik	causing a tumor
path/o	disease	pathogen PATH-ō-jen	organism that produces disease
py/o	pus	pyocyst PI-ō-sist	cyst filled with pus
pyr/o, pyret/o	fever, fire	pyrexia pī-REK-sē-a	fever
scler/o	hard	sclerosis skle-RŌ-sis	hardening of tissue
tox/o, toxic/o	poison	endotoxin en-dō-TOK-sin	toxin within bacterial cells

EXERCISE 6-1

Identify and define the root in each of the following words:

	Root	Meaning of Root
1. antipyretic <i>an-tē-pī-RET-ik</i>	_____	_____
2. pathology <i>pa-THOL-ō-jē</i>	_____	_____
3. empyema <i>em-pī-Ē-ma</i>	_____	_____
4. intoxicate <i>in-TOK-si-kāt</i>	_____	_____

Fill in the blanks:

- A carcinogen (*kar-SIN-ō-jen*) is a substance that causes _____.
- Pyoderma (*pī-ō-DER-ma*) is a skin disease associated with _____.

EXERCISE 6-1 (Continued)

7. A pyrogenic (*pī-rō-JEN-ik*) agent induces _____.
8. The term *pathogenic* (*path-ō-JEN-ik*) means producing _____.
9. A urolith (*Ū-rō-lith*) is a(n) _____ in the urinary tract (*ur/o*).
10. An exotoxin (*ek-sō-TOK-sin*) is a(n) _____ secreted by bacterial cells.
11. Arteriosclerosis (*ar-tē-rē-ō-skle-RŌ-sis*) is a(n) _____ of the arteries.
12. An algesimeter (*al-je-SIM-e-ter*) is used to measure sensitivity to _____.
13. An oncogene (*ON-kō-jēn*) is a gene that causes a(n) _____.

Table 6-2 Prefixes for Disease

Prefix	Meaning	Example	Definition of Example
brady-	slow	bradypnea <i>brad-ip-NĒ-a</i>	slow breathing (-pnea) rate
dys-	abnormal, painful, difficult	dysplasia <i>dis-PLĀ-jē-a</i>	abnormal development (plas) of tissue
mal-	bad, poor	malabsorption <i>mal-ab-SŌRP-shun</i>	poor absorption of nutrients
pachy-	thick	pachycephaly <i>pak-i-SEF-a-lē</i>	abnormal thickness of the skull
tachy-	rapid	tachycardia <i>tak-i-KAR-dē-a</i>	rapid heart (cardi/o) rate
xero-	dry	xeroderma <i>zē-rō-DER-ma</i>	dryness of the skin

EXERCISE 6-2

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|--|--------------------------------------|
| _____ 1. dystrophy (<i>DIS-trō-fē</i>) | a. abnormal thickness of the fingers |
| _____ 2. pachydactyly (<i>pak-ē-DAK-til-ē</i>) | b. abnormal nourishment of tissue |
| _____ 3. tachypnea (<i>tak-IP-nē-a</i>) | c. difficulty in swallowing |
| _____ 4. bradycardia (<i>brad-i-KAR-dē-a</i>) | d. rapid breathing |
| _____ 5. dysphagia (<i>dis-FĀ-jē-a</i>) | e. slow heart rate |

Identify and define the prefix in each of the following words:

	Prefix	Meaning of Prefix
_____ 6. xerosis (<i>zē-RŌ-sis</i>)	_____	_____
_____ 7. dysentery (<i>DIS-en-ter-ē</i>)	_____	_____
_____ 8. maladjustment (<i>mal-ad-JUST-ment</i>)	_____	_____

Table 6-3 Suffixes for Disease

Suffix	Meaning	Example	Definition of Example
-algia, -algnesia	pain	neuralgia <i>nū-RAL-jē-a</i>	pain in a nerve (neur/o)
-cele	hernia, localized dilation	gastrocele <i>GAS-trō-sēl</i>	hernia of the stomach (gastr/o)
-clasis, -clasia	breaking	karyoclasia <i>kar-ē-OK-la-sis</i>	breaking of a nucleus (kary/o)
-itis	inflammation	cystitis <i>sis-TĪ-tis</i>	inflammation of the urinary bladder (cyst/o)
-megaly	enlargement	hepatomegaly <i>hep-a-tō-MEG-a-lē</i>	enlargement of the liver (hepat/o)
-odynia	pain	urodynia <i>ū-rō-DIN-ē-a</i>	pain on urination (ur/o)
-oma*	tumor	lipoma <i>lī-PŌ-ma</i>	tumor of fat cells
-pathy	any disease of	nephropathy <i>nef-ROP-a-thē</i>	any disease of the kidney (nephro)
-rhage†, -rhagia†	bursting forth, profuse flow, hemorrhage	hemorrhage <i>HEM-or-ij</i>	profuse flow of blood
-rhea†	flow, discharge	pyorrhea <i>pī-ō-RĒ-a</i>	discharge of pus
-rhexis†	rupture	amniorrhexis <i>am-nē-ō-REK-sis</i>	rupture of the amniotic sac (bag of waters)
-schisis	fissure, splitting	retinoschisis <i>ret-i-NOS-ki-sis</i>	splitting of the retina of the eye

*Plurals: -omas, -omata.

†Remember to double the r when adding this suffix to a root.

EXERCISE 6-3**Match the following terms and write the appropriate letter to the left of each number:**

- | | |
|--|--------------------------------------|
| _____ 1. adipocle (<i>AD-i-pō-sēl</i>) | a. tumor of immature cells |
| _____ 2. blastoma (<i>blas-TŌ-ma</i>) | b. fissure of the chest |
| _____ 3. thoracoschisis (<i>thō-ra-KOS-ki-sis</i>) | c. breaking of a bone |
| _____ 4. melanoma (<i>mel-a-NŌ-ma</i>) | d. hernia containing fat |
| _____ 5. osteoclasia (<i>os-tē-OK-la-sis</i>) | e. tumor of pigmented cells |
| _____ 6. analgesia (<i>an-al-JĒ-zē-a</i>) | a. local dilatation containing fluid |
| _____ 7. hydrocele (<i>HĪ-drō-sēl</i>) | b. pain in a gland |
| _____ 8. menorrhagia (<i>men-ō-RĀ-jē-a</i>) | c. absence of pain |
| _____ 9. adenodynia (<i>ad-e-nō-DIN-ē-a</i>) | d. profuse menstrual flow |
| _____ 10. hepatorrhexis (<i>hep-a-tō-REK-sis</i>) | e. rupture of the liver |

EXERCISE 6-3 (Continued)

The root *my/o* means “muscle.” Define the following terms:

11. myalgia (*mī-AL-jē-a*) _____ pain in a muscle
12. myopathy (*mī-OP-a-thē*) _____
13. myorrhexis (*mī-ō-REK-sis*) _____
14. myodynia (*mī-ō-DIN-ē-a*) _____
15. myoma (*mī-Ō-ma*) _____

Some words pertaining to disease are used as suffixes in compound words (see Table 6-4). As previously noted, the term *suffix* is used in this book to mean any word part that

consistently appears at the end of words. This may be a simple suffix (such as -y, -ia, -ic), a word, or a root-suffix combination, such as -megaly, -rhagia, -pathy.

Table 6-4 Words for Disease Used as Suffixes

Word	Meaning	Example	Definition of Example
dilation*, dilatation*	expansion, widening	vasodilation <i>vas-ō-dī-LĀ-shun</i>	widening of blood vessels (vas/o)
ectasia, ectasis	dilation, dilatation, distension	gastrectasia <i>gas-trek-TĀ-sē-a</i>	dilatation of the stomach (gastr/o)
edema	accumulation of fluid, swelling	cephaledema <i>sef-al-e-DE-ma</i>	swelling of the head
lysis*	separation, loosening, dissolving, destruction	dialysis <i>dī-AL-i-sis</i>	separation of substances by passage through (dia-) a membrane
malacia	softening	craniomalacia <i>krā-nē-ō-ma-LĀ-shē-a</i>	softening of the skull (crani/o)
necrosis	death of tissue	osteonecrosis <i>os-tē-ō-ne-KRŌ-sis</i>	death of bone (oste/o) tissue
ptosis	dropping, downward displacement, prolapse	blepharoptosis <i>blef-e-rop-TŌ-sis</i>	dropping or drooping of the eyelid (blephar/o; Fig. 6-8)
sclerosis	hardening	phlebosclerosis <i>fleb-ō-skle-RŌ-sis</i>	hardening of veins (phleb/o)
spasm	sudden contraction, cramp	arteriospasm <i>ar-TĒR-ē-ō-spazm</i>	spasm of an artery
stasis*	suppression, stoppage	menostasis <i>men-OS-ta-sis</i>	suppression of menstrual (men/o) flow
stenosis	narrowing, constriction	bronchostenosis <i>brong-kō-ste-NŌ-sis</i>	narrowing of a bronchus (air passageway)
toxin	poison	nephrotoxin <i>nef-rō-TOK-sin</i>	substance poisonous or harmful for the kidneys

*May also refer to treatment.

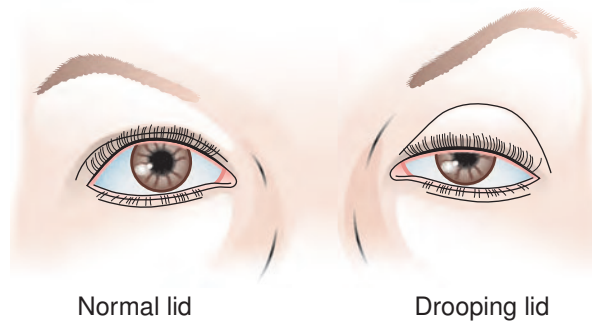


Figure 6-8 Blepharoptosis (dropping or drooping of the eye-lid). Ptosis means a downward displacement.

EXERCISE 6-4

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|--|-------------------------------|
| _____ 1. myolysis (<i>mī-OL-i-sis</i>) | a. destruction of blood cells |
| _____ 2. osteomalacia (<i>os-tē-ō-ma-LĀ-shē-a</i>) | b. death of heart tissue |
| _____ 3. cardioneclerosis (<i>kar-dē-ō-ne-KRŌ-sis</i>) | c. stoppage of blood flow |
| _____ 4. hemolysis (<i>hē-MOL-i-sis</i>) | d. softening of a bone |
| _____ 5. hemostasis (<i>hē-mō-STĀ-sis</i>) | e. dissolving of muscle |

The root *splen/o* means “spleen.” Define the following words:

6. splenomalacia (*splē-nō-ma-LĀ-shē-a*) _____
7. splenoptosis (*splē-nop-TŌ-sis*) _____
8. splenotoxin (*splē-nō-TOK-sin*) _____

Table 6-5

Prefixes and Roots for Infectious Diseases

Word Part	Meaning	Example	Definition of Example
Prefixes			
staphyl/o	grape-like cluster	staphylococcus <i>staf-i-lō-KOK-us</i>	a round bacterium that forms clusters
strept/o	twisted chain	streptobacillus <i>strep-tō-ba-SIL-us</i>	a rod-shaped bacterium that forms chains
Roots			
bacill/i, bacill/o	bacillus	bacilluria <i>bas-i-LŪ-rē-a</i>	bacilli in the urine (-uria)
bacteri/o	bacterium	bacteriostatic <i>bak-tēr-ē-ō-STAT-ik</i>	stopping (stasis) the growth of bacteria
myc/o	fungus, mold	mycotic <i>mī-KOT-ik</i>	pertaining to a fungus
vir/o	virus	viremia <i>vī-RĒ-mē-a</i>	presence of viruses in the blood (-emia)

EXERCISE 6-5

Fill in the blanks:

1. A bactericidal (*bak-tēr-i-SĪ-dal*) agent kills _____.
2. A mycosis (*mī-KŌ-sis*) is any disease caused by a(n) _____.
3. The term bacillary (*BAS-il-a-rē*) means pertaining to _____.
4. The prefix *staphyl/o-* means _____.
5. The prefix *strept/o-* means _____.

Use the suffix *-logy* to write a word that means the same as each of the following:

6. Study of fungi _____
7. Study of viruses _____
8. Study of bacteria _____

Terminology

Supplementary Terms

acid-fast stain	A laboratory staining procedure used mainly to identify the tuberculosis (TB) organism
communicable <i>ko-MŪN-i-ka-bl</i>	Capable of passing from one person to another, such as an infectious disease
endemic <i>en-DEM-ik</i>	Occurring at a low level but continuously in a given region, such as the common cold (from <i>en-</i> , meaning “in” and Greek <i>demos</i> , meaning “people”)
epidemic <i>ep-i-DEM-ik</i>	Affecting many people in a given region at the same time, a disease that breaks out in a large proportion of a population at a given time
exacerbation <i>eks-zas-er-BĀ-shun</i>	Worsening of disease, increase in severity of a disease or its symptoms
iatrogenic <i>i-at-rō-JEN-ik</i>	Caused by the effects of treatment (from Greek root <i>iatro-</i> , meaning “physician”)
idiopathic <i>id-ē-ō-PATH-ik</i>	Having no known cause (root <i>idio</i> means “self-originating”)
in situ <i>in SĪ-tū</i>	Localized, noninvasive (literally “in position”); said of tumors that do not spread, such as carcinoma in situ (CIS)
normal flora <i>FLŌ-ra</i>	The microorganisms that normally live on or in the body. These organisms are generally harmless and are often beneficial, but they can cause disease under special circumstances, such as injury or failure of the immune system
nosocomial <i>nos-ō-KŌ-mē-al</i>	Describing an infection acquired in a hospital (root <i>nos/o</i> means “disease,” and <i>comial</i> refers to a hospital). Such infections can be a serious problem, especially if they are resistant to antibiotics; for example, there are now strains of methicillin-resistant <i>Staphylococcus aureus</i> (MRSA) and vancomycin-resistant <i>S. aureus</i> (VRSA), which cause dangerous infections in hospital settings
opportunistic <i>op-por-tū-NIS-tik</i>	Describing an infection that occurs because of a host’s poor or altered condition
pandemic <i>pan-DEM-ik</i>	Describing a disease that is prevalent throughout an entire region or the world. AIDS is now pandemic in certain regions of the world

(Continued)

Terminology

Supplementary Terms (Continued)

remission <i>rē-MISH-un</i>	A lessening of disease symptoms, the period during which such lessening occurs
septicemia <i>sep-ti-SE-mē-a</i>	Presence of pathogenic bacteria in the blood, blood poisoning
systemic <i>sis-TEM-ik</i>	Pertaining to the whole body
Manifestations of Disease	
abscess <i>AB-ses</i>	A localized collection of pus
adhesion <i>ad-HE-zhun</i>	A uniting of two surfaces or parts that may normally be separated
anaplasia <i>a-na-PLĀ-jē-a</i>	Lack of normal differentiation, as shown by cancer cells
ascites <i>a-SĪ-tēz</i>	Accumulation of fluid in the peritoneal cavity
cellulitis <i>sel-ū-LĪ-tis</i>	A spreading inflammation of tissue
effusion <i>e-FŪ-zhun</i>	Escape of fluid into a cavity or other body part
exudate <i>EKS-ū-dāt</i>	Material that escapes from blood vessels as a result of tissue injury
fissure <i>FISH-ur</i>	A groove or split
fistula <i>FIS-tū-la</i>	An abnormal passage between two organs or from an organ to the surface of the body
gangrene <i>GANG-grēn</i>	Death of tissue, usually caused by lack of blood supply; may be associated with bacterial infection and decomposition
hyperplasia <i>hī-per-PLĀ-jē-a</i>	Excessive growth of normal cells in normal arrangement
hypertrophy <i>hī-PER-trō-fē</i>	An increase in the size of an organ without increase in the number of cells; may result from an increase in activity, as in muscles
induration <i>in-dū-RĀ-shun</i>	Hardening, an abnormally hard spot or place
metaplasia <i>met-a-PLĀ-jē-a</i>	Conversion of cells to a form that is not normal for that tissue (prefix <i>meta-</i> means “change”)
polyp <i>POL-ip</i>	A tumor attached by a thin stalk
purulent <i>PUR-ū-lent</i>	Forming or containing pus
suppuration <i>sup-ū-RĀ-shun</i>	Pus formation



Go to the Audio Pronunciation Glossary in the Student Resources on *thePoint* to hear these terms pronounced.

Terminology Abbreviations**AF** Acid fast**CA, Ca** Cancer**CIS** Carcinoma in situ**FUO** Fever of unknown origin**Gm+** Gram-positive**Gm⁻** Gram-negative**MRSA** Methicillin-resistant *Staphylococcus aureus***Staph** *Staphylococcus***Strep** *Streptococcus***VRSA** Vancomycin-resistant *Staphylococcus aureus*

J.N.'s Follow-Up

J.N. took the full course of drug therapy and her symptoms subsided. She brought in a stool specimen to her follow-up office visit. Test results were negative for the offending pathogen.

Chapter Review

MATCHING

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|-------------------------|--|
| _____ 1. adenocarcinoma | a. pertaining to profuse flow of blood |
| _____ 2. neuroma | b. cancer of glandular tissue |
| _____ 3. gastromegaly | c. tumor of a nerve |
| _____ 4. encephalitis | d. enlargement of the stomach |
| _____ 5. hemorrhagic | e. inflammation of the brain |
| _____ 6. sclerotic | a. stone formation |
| _____ 7. oncolysis | b. dry |
| _____ 8. analgesia | c. destruction of a tumor |
| _____ 9. xerotic | d. absence of pain |
| _____ 10. lithiasis | e. hardened |
| _____ 11. dactyledema | a. swelling of the fingers or toes |
| _____ 12. apyrexia | b. thickness of the skin |
| _____ 13. pachyderma | c. discharge of pus |
| _____ 14. dysphagia | d. difficulty in swallowing |
| _____ 15. pyorrhea | e. absence of fever |
| _____ 16. nephroptosis | a. local wound or injury |
| _____ 17. hemostasis | b. stoppage of blood flow |
| _____ 18. carcinoid | c. dilatation |
| _____ 19. lesion | d. resembling cancer |
| _____ 20. ectasia | e. dropping of the kidney |
| _____ 21. spasm | a. any disease of a gland |
| _____ 22. cardiorrhesis | b. hardening of a vein |
| _____ 23. venosclerosis | c. like a poison |
| _____ 24. toxoid | d. sudden contraction or cramp |
| _____ 25. adenopathy | e. rupture of the heart |

Supplementary Terms

- | | |
|------------------------|-----------------------------------|
| _____ 26. abscess | a. abnormal passageway |
| _____ 27. adhesion | b. escape of fluid into a cavity |
| _____ 28. fistula | c. tumor attached by a thin stalk |
| _____ 29. polyp | d. localized collection of pus |
| _____ 30. effusion | e. union of two surfaces or parts |
| _____ 31. idiopathic | a. worsening |
| _____ 32. purulent | b. having no known cause |
| _____ 33. ascites | c. acquired in a hospital |
| _____ 34. nosocomial | d. forming or containing pus |
| _____ 35. exacerbation | e. fluid in the abdominal cavity |

FILL IN THE BLANKS

36. Heat, pain, redness, and swelling are the four major signs of _____.
37. Any abnormal and uncontrolled growth of tissue, whether benign or malignant, is called a(n) _____.
38. The spreading of cancer to other parts of the body is the process of _____.
39. Protrusion of an organ through an abnormal opening is a(n) _____.
40. Toxicology is the study of _____.
41. Death of tissue is called _____.
42. An oncoprotein is a protein associated with a(n) _____.
43. Referring to J.N.'s opening case study, the suffix and its meaning in the word *diarrhea* is _____.
44. The singular of *protozoa* is _____.
45. The common name for a helminth is a(n) _____.

DEFINITIONS

Use the suffix *-genesis* to write words with the following meanings:

46. Formation of cancer _____ carcinogenesis
47. Formation of pus _____
48. Origin of any disease _____
49. Formation of a tumor _____

The root *bronch/o* pertains to a bronchus, an air passageway in the lungs. Add a suffix to this root to form words with the following meanings:

50. Sudden contraction of a bronchus _____
51. Inflammation of a bronchus _____
52. Narrowing of a bronchus _____
53. Excessive flow or discharge from a bronchus _____

Use the root *oste/o*, meaning "bone," to form words with the following meanings:

54. Death of bone tissue _____
55. Softening of a bone _____
56. Breaking of a bone _____
57. Tumor of a bone _____
58. Destruction of bone tissue _____

TRUE-FALSE

Examine the following statements. If the statement is true, write T in the first blank. If the statement is false, write F in the first blank and correct the statement by replacing the underlined word in the second blank.

	True or False	Correct Answer
59. A mycosis is an infection with a <u>fungus</u> .	_____	_____
60. Round bacteria in chains are <u>staphylococci</u> .	_____	_____
61. A sudden disease of short duration is <u>chronic</u> .	_____	_____
62. A tumor that does not metastasize is termed <u>benign</u> .	_____	_____
63. A slower than normal heart rate is <u>tachycardia</u> .	_____	_____
64. A tumor of connective tissue is classified as a <u>sarcoma</u> .	_____	_____

ELIMINATIONS

In each of the sets below, underline the word that does not fit in with the rest and explain the reason for your choice:

65. cocci — helminths — chlamydia — bacilli — vibrios

66. neoplasm — tumor — carcinoma — pathogen — oncology

67. septicemic — endemic — metastatic — opportunistic — epidemic

WORD BUILDING

Use the word parts given to build words for the following definitions.

tox pyr gen o py -oma -y path nephro -logy -ic

- | | |
|-------------------------------|-------|
| 68. poisonous for the kidney | _____ |
| 69. producing pus | _____ |
| 70. tumor of the kidney | _____ |
| 71. study of disease | _____ |
| 72. producing fever | _____ |
| 73. study of the kidney | _____ |
| 74. producing disease | _____ |
| 75. any disease of the kidney | _____ |
| 76. producing kidney tissue | _____ |

WORD ANALYSIS

Define the following words and give the meaning of the word parts in each. Use a dictionary if necessary.

77. antipyretic (*an-tē-pī-RET-ik*) _____
- a. anti- _____
- b. pyret/o _____
- c. -ic _____

78. arteriosclerosis (*ar-tē-rē-ō-skle-RŌ-sis*) _____
- a. arterio/o _____
 - b. scler/o _____
 - c. -sis _____
79. phagocytosis (*fag-ō-sīt-TŌ-sis*) _____
- a. phag/o _____
 - b. cyt/o _____
 - c. -sis _____
80. hyperplasia (*hī-per-PLĀ-zē-a*) _____
- a. hyper- _____
 - b. plas _____
 - c. -ia _____



For more learning activities, see Chapter 10 of the Student Resources on *thePoint*.

Additional Case Studies

Case Study 6-1: HIV Infection and Tuberculosis

T.H., a 48-YO man, was an admitted intravenous (IV) drug user and occasionally abused alcohol. Over four weeks, he had experienced fever, night sweats, malaise, a cough, and a 10-pound weight loss. He was also concerned about several discolored lesions that had erupted weeks before on his arms and legs.

T.H. made an appointment with a physician assistant (PA) at the neighborhood clinic. On examination, the PA noted bilateral anterior cervical and axillary lymphadenopathy and pyrexia. T.H.'s temperature was 102.2°F. The PA sent T.H. to the hospital for further studies.

T.H.'s chest radiograph (x-ray image) showed paratracheal adenopathy and bilateral interstitial infiltrates, suspicious of tuberculosis (TB). His blood study results were positive for human immunodeficiency virus (HIV) and showed a low lymphocyte count. Sputum and bronchoscopic lavage (washing) fluid were positive for an acid-fast bacillus (AFB); a PPD (purified protein derivative) skin test result was also positive. Based on these findings, T.H. was diagnosed with HIV, TB, and Kaposi sarcoma related to past IV drug abuse.

Case Study 6-2: Endocarditis

D.A., a 37-YO man, sought treatment after experiencing several days of high fever and generalized weakness on return from his vacation. D.A.'s family doctor suspected cardiac involvement because of D.A.'s history of rheumatic fever. The doctor was concerned because D.A.'s brother had died of acute malignant hyperpyrexia during surgery at the age of 12. D.A. was referred

to a cardiologist, who scheduled an electrocardiogram (ECG) and a transesophageal echocardiogram (TEE).

D.A. was admitted to the hospital with subacute bacterial endocarditis (SBE) and placed on high-dose IV antibiotics and bed rest. He had also developed a heart murmur, which was diagnosed as idiopathic hypertrophic subaortic stenosis (IHSS).

Case Study Questions

Multiple choice. Select the best answer and write the letter of your choice to the left of each number:

- _____ 1. The cervical region is the region of the:
 - a. heart
 - b. uterus
 - c. neck
 - d. leg
 - e. head
- _____ 2. In referring to tissues, the term *interstitial* means:
 - a. around cells
 - b. under cells
 - c. between cells
 - d. through cells
 - e. within cells
- _____ 3. The term *axillary* refers to the:
 - a. bladder
 - b. abdomen
 - c. wrist
 - d. armpit
 - e. groin
- _____ 4. The term *pyrexia* refers to a:
 - a. fever
 - b. stone
 - c. tumor
 - d. spasm
 - e. poison
- _____ 5. Paraesophageal and paratracheal refer to a position _____ the esophagus and trachea.
 - a. under
 - b. superior to
 - c. near
 - d. in between
 - e. within
- _____ 6. The endocardium is the tissue lining the heart's chambers. Endocarditis refers to a(n) _____ of this lining.
 - a. narrowing
 - b. inflammation
 - c. overgrowth of tissue
 - d. cancerous growth
 - e. thinning
- _____ 7. D.A.'s heart murmur was caused by a stenosis, or _____ of the heart's aortic valve.
 - a. narrowing
 - b. inflammation
 - c. overgrowth
 - d. cancer
 - e. thinning
- _____ 8. The term for a condition or disease of unknown etiology is:
 - a. stenosis
 - b. hypertrophic
 - c. chronic
 - d. acute
 - e. idiopathic

Fill in the blanks:

9. Adenopathy is any disease of a(n) _____.
10. Tuberculosis is caused by a bacterium that is rod-shaped, thus described as a(n) _____.
11. A malignant neoplasm arising from muscle or connective tissue is a(n) _____.
12. A potentially fatal disease condition characterized by a very high fever is called _____.

Give the meaning of the following abbreviations:

13. HIV _____
14. PPD _____
15. ECG _____
16. AFB _____

CHAPTER

7

Diagnosis and Treatment; Surgery

Case Study

M.L.'s Rollerblading Mishap

Chief complaint:

M.L., an active 59-year-old woman, was rollerblading early one morning. When attempting to avoid some loose gravel, she fell, injuring her right wrist and knee. She immediately experienced pain in her wrist and knee and noticed that her knee was swelling. She was able to use her cell phone and call her husband who came and took her to a nearby emergency room.

Examination:

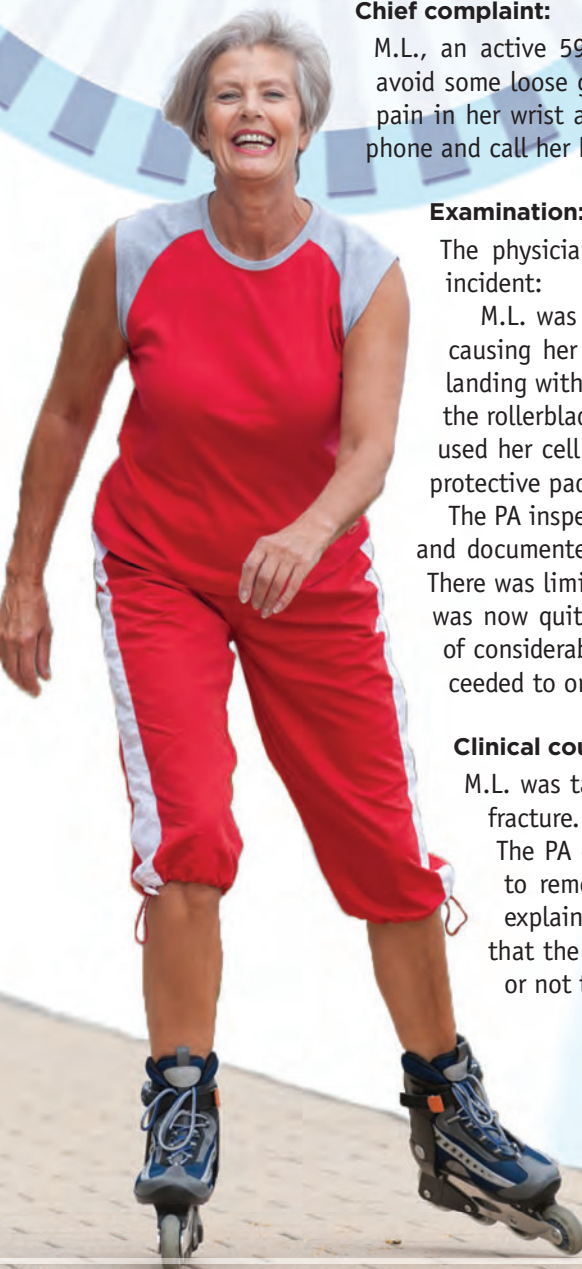
The physician's assistant (PA) in the emergency room obtained the following Hx of the incident:

M.L. was rollerblading on a path early that morning and skated into some loose gravel, causing her to fall forward. She attempted to break the fall with her arms and ended up landing with her right hand and knee bearing the impact of the fall. She was able to take off the rollerblades and, favoring her right leg, make her way over to a nearby bench, where she used her cell phone to contact her husband for help. M.L. was not wearing a helmet or any protective pads on her knees, elbows, or wrists.

The PA inspected the wrist, which was deformed and edematous. She palpated the wrist area and documented that M.L. complained of pain, weakness, and slight tingling in the fingers. There was limited range of motion (ROM) of the fingers. Next, the PA examined the knee that was now quite swollen. M.L. could not bear much weight on the right leg and complained of considerable pain. The PA explained the prognosis to M.L. and her husband and then proceeded to order some diagnostic tests.

Clinical course:

M.L. was taken to the radiology department, where an x-ray of the right wrist revealed a fracture. An MRI was ordered for the knee and showed no fractures or ligament tears. The PA explained to the patient that she might need to have an arthrocentesis, a tap to remove fluid in the knee joint, which would relieve some of the pain. She also explained that an endoscopic exam of the joint, an arthroscopy, might be required but that the orthopedic surgeon who had already been consulted would determine whether or not this procedure was necessary.



Ancillaries *At-A-Glance*

Visit *thePoint* to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii-xvi.

Learning **TOOLS**

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning **RESOURCES**

- E-book: Chapter 7
- Web Figure: Sonogram
- Web Figure: Echocardiogram
- Web Figure: Electrocardiogram
- Web Figure: Electroencephalogram
- Audio Pronunciation Glossary

Learning **ACTIVITIES**

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After study of this chapter, you should be able to:

- 1** List the main components of a patient history. *p122*
- 2** Describe the main methods used in patient examination. *p122*
- 3** Name and describe nine imaging techniques. *p124*
- 4** Name possible forms of treatment. *p125*
- 5** Describe theories of alternative and complementary medicine and some healing practices used in these fields. *p128*
- 6** Describe staging and grading as they apply to cancer. *p129*
- 7** Define basic terms pertaining to medical examination, diagnosis, and treatment. *p130*
- 8** Identify and use the roots and suffixes pertaining to diagnosis and surgery. *p132*
- 9** Interpret symbols and abbreviations used in diagnosis and treatment. *p138*
- 10** Analyze medical terms related to diagnosis and treatment in case studies. *pp120, 144*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|---|--|
| <p>_____ 1. Determination of a disease's nature and cause is called:</p> <ul style="list-style-type: none"> a. prognosis b. diagnosis c. titration d. admission | <p>_____ 4. Removal of tissue for microscopic study is a(n):</p> <ul style="list-style-type: none"> a. biopsy b. aeration c. endoscopy d. CT scan |
| <p>_____ 2. Measurements of the basic functions needed to maintain life, such as breathing and pulse, together are called:</p> <ul style="list-style-type: none"> a. respiration b. health signs c. vital signs d. etiology | <p>_____ 5. An appendectomy is:</p> <ul style="list-style-type: none"> a. therapy of the appendix b. measurement of the appendix c. imaging of the appendix d. surgical removal of the appendix |
| <p>_____ 3. A simple device for listening to sounds within the body is a:</p> <ul style="list-style-type: none"> a. cystoscope b. speculum c. barometer d. stethoscope | <p>_____ 6. A tracheotomy is:</p> <ul style="list-style-type: none"> a. surgical incision of the trachea b. placement of a tracheal tube c. removal of a tracheal tube d. removal of the trachea |

Medical care begins with assessing a disorder using information gathered from the patient and a variety of testing and examination methods. Based on these results, a course of treatment is recommended that may include surgery.

Diagnosis

Medical **diagnosis**, the determination of the nature and cause of an illness, begins with a patient history. This includes a history of the present illness with a description of **symptoms** (evidence of disease), a past medical history, and a family and a social history.

A physical examination, which includes a review of all systems and observation of any **signs** of illness, follows the history taking. Practitioners use the following techniques in performing physicals:

- **Inspection:** visual examination
- **Palpation:** touching the surface of the body with the hands or fingers (**Fig. 7-1**)



Figure 7-1 Palpation. The practitioner touches the body surface with the hands or fingers.



Figure 7-2 Percussion. The practitioner taps the body to evaluate tissues.

- **Percussion:** tapping the body to evaluate tissue according to the sounds produced (**Fig. 7-2**)
- **Auscultation:** listening to body sounds with a **stethoscope** (**Fig. 7-3**)

Vital signs (VS) are also recorded for comparison with normal ranges. VS are measurements that reflect basic functions necessary to maintain life and include:

- Temperature (T)
- Pulse rate, measured in beats per minute (bpm) (**Fig. 7-4**). Pulse rate normally corresponds to the heart rate (HR), the number of times the heart beats per minute.
- Respiration rate (R), measured in breaths per minute
- Blood pressure (BP), measured in millimeters of mercury (mm Hg) and recorded when the heart is contracting (systolic pressure) and relaxing (diastolic pressure) (**Fig. 7-5**). An examiner typically uses a stethoscope



Figure 7-4 Pulse rate. The practitioner palpates an artery to measure pulse rate in beats per minute.

and a blood pressure cuff, or **sphygmomanometer** (*sfig-mō-ma-NOM-e-ter*), to measure blood pressure. Newer devices that read blood pressure directly and give digital readings are also in use. Chapter 9 has more information on blood pressure.

Additional tools used in physical examinations include the **ophthalmoscope** (**Fig. 7-6A**), for examination of the eyes; the **otoscope** (**see Fig. 7-6B**), for examination of the ears; and hammers for testing reflexes.

The skin, hair, and nails provide easily observable indications of a person's state of health. Skin features such as color, texture, thickness, and presence of lesions (local injuries) are noted throughout the course of the physical examination. Chapter 21 contains a discussion of the skin and skin diseases.

Diagnosis is further aided by laboratory test results. These may include tests on blood, urine, and other body



Figure 7-3 Auscultation. The practitioner uses a stethoscope to listen to body sounds.



Figure 7-5 Blood pressure. The practitioner uses a blood pressure cuff (sphygmomanometer) and a stethoscope to measure systolic and diastolic pressures.

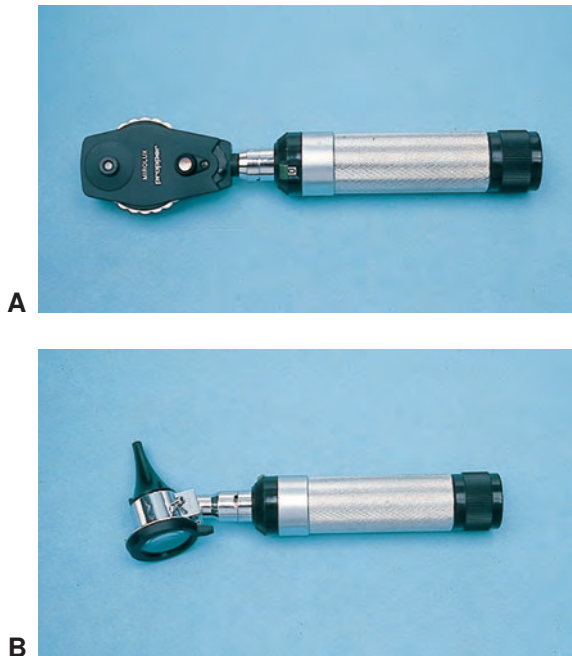


Figure 7-6 Examination tools. A. Ophthalmoscope for eye examination. B. Otoscope for ear examination.

fluids and the identification of infectious organisms. Additional tests may include study of the electrical activity of tissues such as the brain and heart, examination of body cavities by means of an **endoscope** (Fig. 7-7), and imaging techniques. **Biopsy** is the removal of tissue for microscopic examination. Biopsy specimens can be obtained by:

- Needle withdrawal (aspiration) of fluid, as from the chest or from a cyst
- A small punch, as of the skin

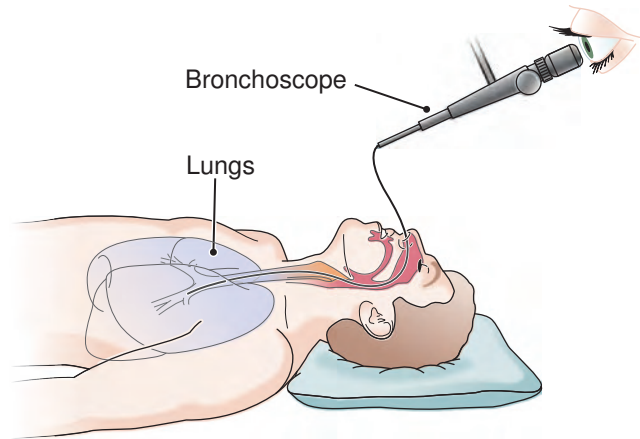


Figure 7-7 Endoscope. A bronchoscope is a type of endoscope used to examine the respiratory bronchi.

- Endoscopy, as from the respiratory or digestive tract
- Surgical removal, as of a tumor or node

When new tests appear, as in all other areas of health sciences, new terminology is added to the medical vocabulary (see Box 7-1).

IMAGING TECHNIQUES

Imaging techniques employ various types of energy to produce visual images of the body. The most fundamental imaging method is **radiography** (Fig. 7-8), which uses x-rays to produce an image (radiograph) on film or to produce a digital image that can be viewed on a monitor. Radiography is the preferred method for imaging dense tissues, such as bone. Some soft-tissue structures can be demonstrated as well, but a contrast medium, such as a barium mixture, may be needed to enhance visualization. Other forms of energy used to produce diagnostic

Box 7-1



Focus on Words

Terminology Evolves with Medical Science

The science of medicine never stands still, nor does its terminology. One can never say that his or her work in learning medical terminology is complete because vocabulary is constantly being added as new diagnoses, treatments, and technologies are discovered or developed.

Fifty years ago, gene therapy, genetic engineering, in vitro fertilization, cloning, and stem cell research were unknown to the public. PET scans, MRI, DNA fingerprinting, radioimmunoassay, bone density scans for identifying osteoporosis, and other

diagnostic techniques were not in use. Some of the new categories of drugs, such as statins for reducing cholesterol, antiviral agents, histamine antagonists for treating ulcers, ACE inhibitors for treating hypertension, and breast cancer preventives, were undiscovered. The genes associated with certain forms of cancer and with certain hereditary abnormalities had yet to be isolated.

Each of these advances brings new terminology into use. Anyone who wants to keep current with medical terminology has a lifetime of learning ahead.



Figure 7-8 Radiography. The action of x-rays on sensitized film produced this image (radiograph) of a normal right hand.

images include sound waves, radioactive isotopes, radio waves, and magnetic fields. See **Box 7-2** for a description of the most commonly used imaging methods and **Box 7-3** for a summary of these and other imaging techniques in use.

Treatment

If diagnosis so indicates, treatment, also termed **therapy**, is begun. This may consist of counseling, drugs, surgery, radiation, physical therapy, occupational therapy, psychiatric treatment, or some combination of these. See Chapter 8 for a discussion of drugs and their actions. **Palliative** therapy is treatment that provides relief but is not intended as a cure. Terminally ill patients, for example, may receive treatment that eases pain and provides comfort but is not expected to change the outcome of the disease. During diagnosis and throughout the course of treatment, a patient is evaluated to establish a **prognosis**—that is, a prediction of the disease's outcome.

SURGERY

Surgery is a method for treating disease or injury by manual operations. Surgery may be done through an existing body opening, but usually it involves cutting or puncturing tissue with a sharp instrument in the process of **incision**. See **Box 7-4** for descriptions of surgical instruments and **Figure 7-11** for pictures of surgical instruments. Surgery usually requires some form of **anesthesia** to dull or eliminate pain. After surgery, incisions must be closed for proper healing. Traditionally, surgeons have used stitches or **sutures** to close wounds, but today they also use adhesive strips, staples, and skin glue.

Many types of operations are now performed with a **laser**, an intense beam of light. Some procedures require

Box 7-2



Clinical Perspectives

Medical Imaging

Three imaging techniques that have revolutionized medicine are radiography, computed tomography (CT), and magnetic resonance imaging (MRI). With them, physicians today can “see” inside the body without making a single cut.

The oldest technique is radiography (*rā-dē-OG-ra-fē*), in which a machine beams x-rays (a form of radiation) through the body onto a piece of film. The resulting image is called a radiograph. Dark areas indicate where the beam passed through the body and exposed the film, whereas light areas show where the beam did not pass through. Dense tissues (bone, teeth) absorb most of the x-rays, preventing them from exposing the film. For this reason, radiography is commonly used to visualize bone fractures and tooth decay as well as abnormally dense tissues like tumors. Radiography does not provide clear images of soft tissues because most of the beam passes through and exposes the film, but contrast media can help make structures like blood vessels and hollow organs more visible. For example, barium sulfate (which absorbs x-rays) coats the digestive tract when ingested.

During a CT scan, a machine revolves around the patient, beaming x-rays through the body onto a detector. The detector takes numerous images of the beam and a computer assembles them into transverse sections, or “slices.” Unlike conventional radiography, CT produces clear images of soft structures such as the brain, liver, and lungs. It is commonly used to visualize brain injuries and tumors and even blood vessels when used with contrast media.

MRI uses a strong magnetic field and radio waves. The patient undergoing MRI lies inside a chamber within a very powerful magnet. The molecules in the patient's soft tissues align with the magnetic field inside the chamber. When radio waves hit the soft tissue, the aligned molecules emit energy that the MRI machine detects, and a computer converts these signals into an image. MRI produces even clearer images of soft tissue than does CT and can create detailed views of blood vessels without contrast media. MRI can visualize brain injuries and tumors that might be missed using CT.

Box 7-3

For Your Reference



Imaging Techniques

METHOD	DESCRIPTION
cineradiography <i>sin-e-rā-dē-OG-ra-fē</i>	making of a motion picture of successive images appearing on a fluoroscopic screen
computed tomography (CT, CT scan) <i>tō-MOG-ra-fē</i>	use of a computer to generate an image from a large number of x-rays passed at different angles through the body; a three-dimensional image of a cross section of the body is obtained; reveals more about soft tissues than does simple radiography (Fig. 7-9A)
fluoroscopy <i>flōr-OS-kō-pē</i>	use of x-rays to examine deep structures; the shadows cast by x-rays passed through the body are observed on a fluorescent screen; the device used is called a fluoroscope
magnetic resonance imaging (MRI)	production of images through the use of a magnetic field and radio waves; the characteristics of soft tissue are revealed by differences in molecular properties; eliminates the need for x-rays and contrast media (see Fig. 7-9B)
positron emission tomography (PET)	production of sectional body images by administration of a natural substance, such as glucose, labeled with a positron-emitting isotope; the rays subsequently emitted are interpreted by a computer to show the internal distribution of the substance administered; PET has been used to follow blood flow through an organ and to measure metabolic activity within an organ, such as the brain, under different conditions
radiography <i>rā-dē-OG-ra-fē</i>	use of x-rays passed through the body to make a visual record (radiograph) of internal structures either on specially sensitized film or digitally. Also called roentgenography (<i>rent-ge-NOG-ra-fē</i>) after the developer of the technique
scintigraphy <i>sin-TIG-ra-fē</i>	imaging the radioactivity distribution in tissues after internal administration of a radioactive substance (radionuclide); the images are obtained with a scintillation camera; the record produced is a scintiscan (<i>SIN-ti-skan</i>) and usually specifies the part examined or the isotope used for the test, as in bone scan, gallium scan
single-photon emission computed tomography (SPECT)	scintigraphic technique that permits visualization of a radioisotope's cross-sectional distribution
ultrasonography <i>ul-tra-son-OG-ra-fē</i>	generation of a visual image from the echoes of high-frequency sound waves traveling back from different tissues; also called sonography (<i>so-NOG-ra-fē</i>) and echography (<i>ek-OG-ra-fē</i>) (Fig. 7-10)

destruction of tissue by a harmful agent, such as by heat or a chemical, in the process of **cautery** or cauterization. Surgeons are now increasingly using computer-assisted robotic surgery for certain procedures. In this type of operation, the surgeon uses robotic instruments manipulated remotely or by a computer. These operations can be less invasive than standard surgeries and result in less bleeding. The method has been used mainly for urogenital procedures, some joint replacement, correction of certain heart abnormalities, and gallbladder removal.

Some of the purposes of surgery include:

- **Treatment:** For **excision** (cutting out) of diseased or abnormal tissue, such as a tumor or an inflamed appendix. Surgical methods are also used to repair wounds or injuries, as in skin grafting for burns or for realigning broken bones. Surgical methods are used to correct circulatory problems and to return structures to their normal positions, as in raising a prolapsed organ, such as the urinary bladder, in a surgical **fixa-tion** procedure.
- **Diagnosis:** To remove tissue for laboratory study in a biopsy, as previously described. Exploratory surgery to investigate the cause of symptoms is performed less frequently now because of advances in noninvasive diagnostic and imaging techniques.
- **Restoration:** Surgery may compensate for lost function, as when a section of the intestine is redirected in a colostomy, a tube is inserted to allow breathing in a tracheostomy, a feeding tube is inserted, or an organ is transplanted. Surgeons may perform plastic

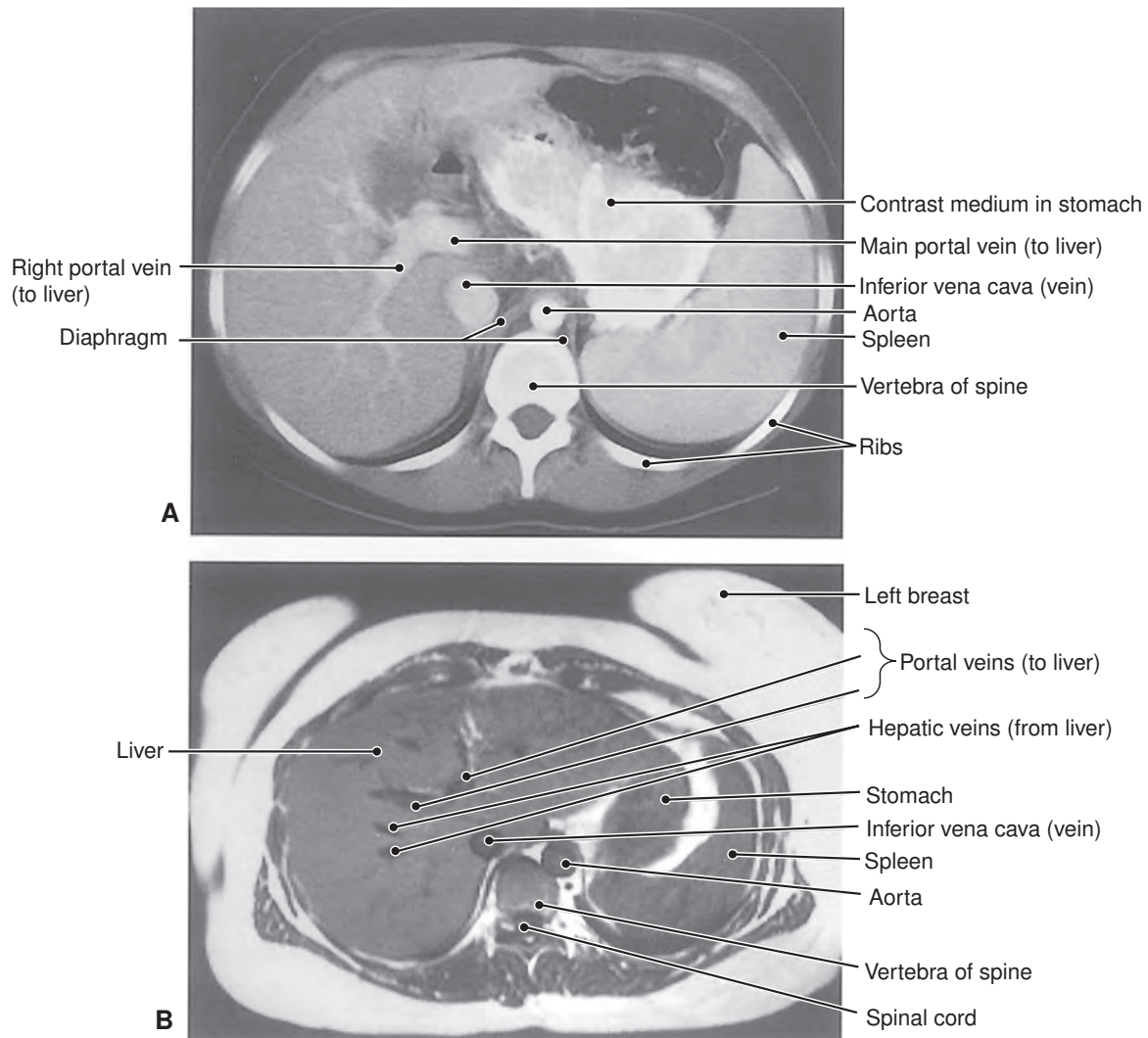


Figure 7-9 Imaging techniques. Shown are cross sections through the liver and spleen. A. Computed tomography (CT). B. Magnetic resonance imaging (MRI).



Figure 7-10 Ultrasonography. The practitioner is using ultrasound to monitor pregnancy.

or reconstructive surgery to accommodate a prosthesis (substitute part), to restore proper appearance, or for cosmetic reasons.

- **Relief:** Palliative surgery relieves pain or discomfort, as by cutting the nerve supply to an organ or reducing the size of a tumor to relieve pressure.

Surgery may be done in an emergency or urgent situation under conditions of acute danger, as in traumatic injury or severe blockage. Other procedures, such as cataract removal from the eye, may be planned when convenient. Elective or optional surgery would not cause serious consequences if delayed or not done.

Over time, surgery has extended beyond the classic operating room of a hospital to other hospital areas and to private surgical facilities where people can be treated within one day as outpatients. Preoperative care is given

Box 7-4

For Your Reference



Surgical Instruments

INSTRUMENT	DESCRIPTION
bougie <i>BOO-zhē</i>	slender, flexible instrument for exploring and dilating tubes
cannula <i>KAN-ū-la</i>	tube enclosing a trocar (see below) that allows escape of fluid or air after removal of the trocar
clamp	instrument used to compress tissue
curet (curette) <i>KŪ-ret</i>	spoon-shaped instrument for removing material from the wall of a cavity or other surface (see Fig. 7-11)
elevator <i>EL-e-vā-tor</i>	instrument for lifting tissue or bone
forceps <i>FOR-seps</i>	instrument for holding or extracting (see Fig. 7-11)
Gigli saw <i>JĒ-ylĕ</i>	flexible wire saw
hemostat <i>HĒ-mō-stat</i>	small clamp for stopping blood flow from a vessel (see Fig. 7-11)
rasp	surgical file
retractor <i>rē-TRAK-tor</i>	instrument used to maintain exposure by separating a wound and holding back organs or tissues (see Fig. 7-11)
rongeur <i>ron-ZHUR</i>	gouge forceps
scalpel <i>SKAL-pel</i>	surgical knife with a sharp blade (see Fig. 7-11)
scissors <i>SIZ-ors</i>	a cutting instrument with two opposing blades
sound <i>sownd</i>	instrument for exploring a cavity or canal (see Fig. 7-11)
trocar <i>TRŌ-kar</i>	sharp pointed instrument contained in a cannula used to puncture a cavity

before surgery and includes examination, obtaining the patient's informed consent for the procedure, and preadmission testing. Postoperative care includes recovery from anesthesia, follow-up evaluations, and instructions for home care.

Box 7-5 describes some aspects of careers in surgical technology.

Alternative and Complementary Medicine

During the past century, the leading causes of death in industrialized countries have gradually shifted from infectious diseases to chronic diseases of the cardiovascular and respiratory systems and cancer. In addition to advancing

age, life habits and the environment greatly influence these conditions. As a result, many people have begun to consider healing practices from other philosophies and cultures as alternatives and complements to conventional Western medicine. Some of these philosophies include **osteopathy**, **naturopathy**, **homeopathy**, and **chiropractic**. Techniques of **acupuncture**, **biofeedback**, **massage**, and **meditation** may also be used, as well as herbal remedies (see Chapter 8) and nutritional counseling on diet, vitamins, and minerals. Complementary and alternative therapies emphasize maintaining health rather than treating disease and allowing the body the opportunity to heal itself. These ideas fit into the concept of **holistic health care**, which promotes treating an individual as a whole with emotional, social, and spiritual needs in addition to physical needs and encouraging people to be involved in their own health maintenance.

The U.S. government has established the National Center for Complementary and Alternative Medicine (NCCAM) within the National Institutes of Health (NIH) to study these therapies.

Cancer

Methods used in the diagnosis of cancer include physical examination, biopsy, imaging techniques, and laboratory tests for abnormalities, or “markers,” associated with specific types of malignancies. Some cancer markers are by-products, such as enzymes, hormones, and cellular proteins, that are abnormal or are produced in abnormal amounts. Researchers have also linked specific genetic mutations to certain forms of cancer.

Oncologists (cancer specialists) use two methods, **grading** and **staging**, to classify cancers, to select and evaluate therapy, and to estimate disease outcome. Grading is based on histologic (tissue) changes observed in tumor cells when they are examined microscopically. Grades increase from I to IV with increasing cellular abnormality.

Staging is a procedure for establishing the clinical extent of tumor spread, both at the original site and in other parts of the body (metastases). The TNM system is commonly used. These letters stand for primary tumor (T), regional lymph nodes (N), and distant metastases (M). Evaluation in these categories varies for each type of tumor. Based on TNM results, a stage ranging in severity from I to IV is assigned. Cancers of the blood, lymphatic system, and nervous system are evaluated by different standards.

The most widely used methods for treatment of cancer are surgery, radiation therapy, and **chemotherapy** (treatment with chemicals). Newer methods of **immunotherapy** use substances that stimulate the immune system as a whole or vaccines prepared specifically against a tumor. Hormone therapy may also be effective against certain types of tumors. When no active signs of the disease remain, the cancer is said to be in **remission**.

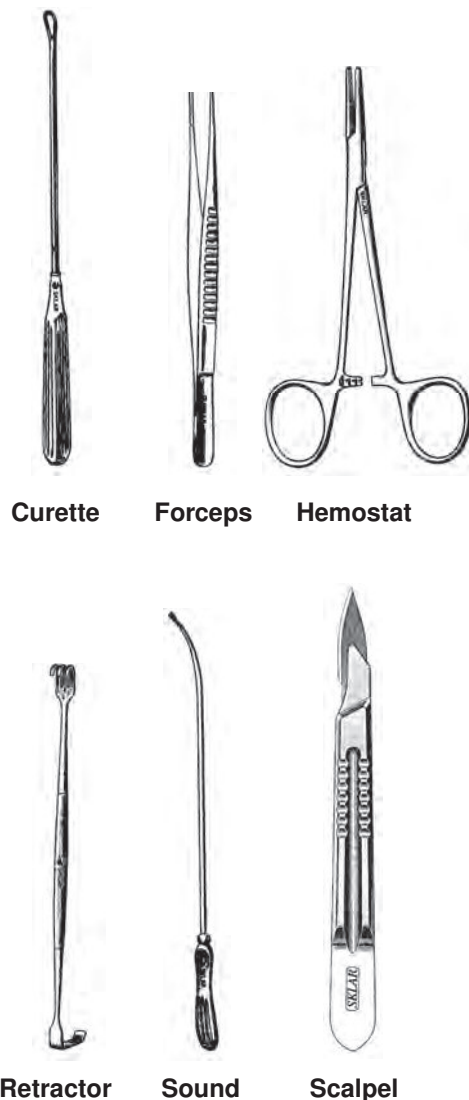


Figure 7-11 Surgical instruments.

Box 7-5



Health Professions

Surgical Technology

Surgical technologists, also known as operating room technicians, prepare for and assist with surgical procedures under the supervision of surgeons and nurses. They prepare the operating room, surgical instruments, and equipment. They help the surgical team to scrub and put on gowns, gloves, and masks. They also prepare patients for surgery, helping to position them on the table and draping them with sterile linens. During an operation, surgical technologists hand instruments and other materials to the surgeon, maintain supplies, and operate special equipment. Finally, they help count materials

to be sure that all have been removed from the patient at the conclusion of surgery, and they assist in suturing. They also take responsibility for specimens removed for laboratory testing. The job requires stamina, manual dexterity, and quick reaction time.

A career in surgical technology requires training in a surgical technology program and certification. Preparation for this training should include courses in basic sciences, math, and computer applications. The Association of Surgical Technologists at www.ast.org has additional information on this career.

Terminology

Key Terms

anesthesia <i>an-es-THĒ-zē-a</i>	Loss of the ability to feel pain, as by administration of a drug
auscultation <i>aws-kul-TĀ-shun</i>	Listening for sounds within the body, usually within the chest or abdomen (see Fig. 7-3)
biopsy <i>BĪ-op-sē</i>	Removal of a small amount of tissue for microscopic examination
cautery <i>KAW-ter-ē</i>	Destruction of tissue by a damaging agent, such as a harmful chemical, heat, or electric current (electrocautery); cauterization
chemotherapy <i>kē-mō-THER-a-pē</i>	Use of chemicals to treat disease. The term is often applied specifically to the treatment of cancer with chemicals.
diagnosis <i>di-ag-NŌ-sis</i>	The process of determining the cause and nature of an illness
endoscope <i>EN-dō-skōp</i>	An instrument for examining the inside of an organ or cavity through a body opening or small incision; most endoscopes use fiber optics for viewing (see Fig. 7-7)
excision <i>ek-SIZH-un</i>	Removal by cutting (suffix: -ectomy)
fixation <i>fik-SĀ-shun</i>	Holding or fastening a structure in a firm position (suffix: -pexy)
grading <i>GRĀ-ding</i>	A method for evaluating a tumor based on microscopic examination of the cells
immunotherapy <i>im-ū-nō-THER-a-pē</i>	Treatment that involves stimulation or suppression of the immune system, either specifically or nonspecifically
incision <i>in-SIZH-un</i>	A cut, as for surgery; also the act of cutting (suffix: -tomy)
inspection <i>in-SPEK-shun</i>	Visual examination of the body
laser <i>LĀ-zer</i>	A device that transforms light into a beam of intense heat and power; used for surgery and diagnosis
ophthalmoscope <i>of-THAL-mō-skōp</i>	An instrument for examining the interior of the eye (see Fig. 7-6A)
otoscope <i>Ō-tō-skōp</i>	Instrument used to examine the ears (see Fig. 7-6B)
palliative <i>PAL-ē-a-tiv</i>	Providing relief but not cure; a treatment that provides such relief
palpation <i>pal-PĀ-shun</i>	Examining by placing the hands or fingers on the surface of the body to determine characteristics such as texture, temperature, movement, and consistency (see Fig. 7-1)
percussion <i>per-KUSH-un</i>	Tapping the body lightly but sharply to assess the condition of the underlying tissue by the sounds obtained (see Fig. 7-2)
prognosis <i>prog-NŌ-sis</i>	Prediction of a disease's course and outcome
radiography <i>rā-dē-OG-ra-fē</i>	Use of x-rays passed through the body to make a visual record (radiograph) of internal structures either on specially sensitized film or digitally; roentgenography (<i>rent-ge-NOG-ra-fē</i>)

Terminology**Key Terms** (Continued)

remission <i>rē-MISH-un</i>	Lessening of disease symptoms; the period during which this decrease occurs or the period when no sign of a disease exists
sign <i>sīn</i>	Objective evidence of disease that can be observed or tested; examples are fever, rash, high blood pressure, and blood or urine abnormalities; an objective symptom
sphygmomanometer <i>sfig-mō-ma-NOM-e-ter</i>	Blood pressure apparatus or blood pressure cuff; pressure is read in millimeters of mercury (mm Hg) when the heart is contracting (systolic pressure) and when the heart is relaxing (diastolic pressure) and is reported as systolic/diastolic (see Fig. 7-5)
staging <i>STĀ-jīng</i>	The process of classifying malignant tumors for diagnosis, treatment, and prognosis
stethoscope <i>STETH-ō-skōp</i>	An instrument used for listening to sounds produced within the body (from the Greek root <i>steth/o</i> , meaning “chest”) (see Fig. 7-3)
surgery <i>SUR-jer-ē</i>	A method for treating disease or injury by manual operations
suture <i>SŪ-chur</i>	To unite parts by stitching them together; also the thread or other material used in that process or the seam formed by surgical stitching (suffix: -rhaphy)
symptom <i>SIM-tum</i>	Any evidence of disease; sometimes limited to subjective evidence of disease as experienced by the individual, such as pain, dizziness, and weakness
therapy <i>THER-a-pē</i>	Treatment, intervention
vital signs	Measurements that reflect basic functions necessary to maintain life

Alternative and Complementary Medicine

acupuncture <i>AK-ū-punk-chur</i>	An ancient Chinese method of inserting thin needles into the body at specific points to relieve pain, induce anesthesia, or promote healing; similar effects can be obtained by using firm finger pressure at the surface of the body in the technique of <i>acupressure</i>
biofeedback <i>bī-ō-FĒD-bak</i>	A method for learning control of involuntary physiologic responses by using electronic devices to monitor bodily changes and feeding this information back to a person
chiropractic <i>kī-rō-PRAK-tik</i>	A science that stresses the condition of the nervous system in diagnosis and treatment of disease; often, the spine is manipulated to correct misalignment. Most patients consult for musculoskeletal pain and headaches (from Greek <i>cheir</i> , meaning “hand”).
holistic health care <i>hō-LIS-tik</i>	Practice of treating a person as a whole entity with physical, emotional, social, and spiritual needs. It stresses comprehensive care, involvement in one’s own care, and the maintenance of good health rather than the treatment of disease.
homeopathy <i>hō-mē-OP-a-thē</i>	A philosophy of treating disease by administering drugs in highly diluted form along with promoting healthy life habits and a healthy environment (from <i>home/o</i> , meaning “same,” and <i>path/o</i> , meaning “disease”)
massage <i>ma-SAHJ</i>	Manipulation of the body or portion of the body to calm, relieve tension, increase circulation, and stimulate muscles
meditation <i>med-i-TĀ-shun</i>	Process of clearing the mind by concentrating on the inner self while controlling breathing and perhaps repeating a word or phrase (mantra)
naturopathy <i>nā-chur-OP-a-thē</i>	A therapeutic philosophy of helping people heal themselves by developing healthy lifestyles; naturopaths may use some of the methods of conventional medicine (from <i>nature</i> and <i>path/o</i> , meaning “disease”)

(Continued)

Terminology**Key Terms** (Continued)**osteopathy***os-tē-OP-a-thē*

A system of therapy based on the theory that the body can overcome disease when it has normal structure, a favorable environment, and proper nutrition. Osteopaths use standard medical practices for diagnosis and treatment but stress the identification and correction of faulty body structure (from *oste/o*, meaning “bone,” and *path/o*, meaning “disease”).



Go to the Audio Pronunciation Glossary in the Student Resources on *thePoint* to hear these terms pronounced.

Word Parts Pertaining to Diagnosis and Treatment

See **Tables 7-1 to 7-3**.

Table 7-1**Roots for Physical Forces**

Root	Meaning	Example	Definition of Example
aer/o	air, gas	aerobic <i>ār-Ō-bik</i>	pertaining to or requiring air (oxygen)
bar/o	pressure	barometer <i>ba-ROM-e-ter</i>	instrument used to measure pressure
chrom/o, chromat/o	color, stain	chromatic <i>krō-MAT-ik</i>	having color
chron/o	time	chronologic <i>kron-ō-LOJ-ik</i>	arranged according to the time of occurrence
cry/o	cold	cryoprobe <i>KRĭ-ō-prōb</i>	instrument used to apply extreme cold
electr/o	electricity	electrolysis <i>ē-lek-TROL-i-sis</i>	decomposition of a substance by means of electric current
erg/o	work	synergistic <i>sin-er-JIS-tik</i>	working together with increased effect, such as certain drugs in combination
phon/o	sound, voice	phonograph <i>FŌ-nō-graf</i>	instrument used to reproduce sound
phot/o	light	photoreaction <i>fō-tō-rē-AK-shun</i>	response to light
radi/o	radiation, x-ray	radiology <i>rā-dē-OL-ō-jē</i>	study and use of radiation
son/o	sound	sonogram <i>SON-ō-gram</i>	record obtained by use of ultrasound
therm/o	heat, temperature	hypothermia <i>hī-pō-THER-mē-a</i>	abnormally low body temperature

EXERCISE 7-1

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|---|-------------------------------------|
| _____ 1. radioactive (<i>rā-dē-ō-AK-tiv</i>) | a. attracting color (stain) |
| _____ 2. chromophilic (<i>krō-mō-FIL-ik</i>) | b. abnormally high body temperature |
| _____ 3. synchrony (<i>SIN-krō-nē</i>) | c. pertaining to increased pressure |
| _____ 4. hyperthermia (<i>hī-per-THER-mē-a</i>) | d. occurrence at the same time |
| _____ 5. hyperbaric (<i>hī-per-BAR-ik</i>) | e. giving off radiation |

Identify and define the root in each of the following words:

	Root	Meaning of Root
6. ultrasonic (<i>ul-tra-SON-ik</i>)	<u>son/o</u>	<u>sound</u>
7. anaerobic (<i>an-er-Ō-bik</i>)	_____	_____
8. exergonic (<i>eks-er-GON-ik</i>)	_____	_____
9. homeothermic (<i>hō-mē-ō-THER-mik</i>)	_____	_____
10. chronic (<i>KRON-ik</i>)	_____	_____
11. achromatic (<i>ak-rō-MAT-ik</i>)	_____	_____

Fill in the blanks:

12. Barotrauma (*bar-ō-TRAW-ma*) is injury caused by _____.
13. Cryotherapy (*krī-ō-THER-a-pē*) is treatment using _____.
14. A photograph (*FŌ-tō-graf*) is an image produced by means of _____.
15. The term electroconvulsive (*ē-lek-trō-con-VUL-siv*) means causing convulsions by means of _____.
16. Phonetics (*fō-NET-iks*) is the study of _____.

Table 7-2 Suffixes for Diagnosis

Suffix	Meaning	Example	Definition of Example
-graph	instrument for recording data	polygraph <i>POL-ē-graf</i>	instrument used to record many physiologic responses simultaneously; lie detector
-graphy	act of recording data*	echography <i>ek-OG-ra-fē</i>	recording data obtained by ultrasound
-gram†	a record of data	electrocardiogram <i>e-lek-trō-KAR-dē-ō-gram</i>	record of the heart's electrical activity
-meter	instrument for measuring	calorimeter <i>kal-ō-RIM-e-ter</i>	instrument for measuring the caloric energy of food
-metry	measurement of	audiometry <i>aw-dē-OM-e-trē</i>	measurement of hearing (audi/o); root <i>metr/o</i> means "measure"

(Continued)

Table 7-2 Suffixes for Diagnosis (*Continued*)

Suffix	Meaning	Example	Definition of Example
-scope	instrument for viewing or examining	bronchoscope BRONG-kō-skōp	instrument for examining the bronchi (breathing passages) (see Fig. 7-7)
-scopy	examination of	celioscopy sē-lē-OS-kō-pē	examination of the abdominal cavity (celi/o)

*This ending is often used to mean not only the recording of data but also the evaluation and interpretation of the data.

†An image prepared simply using x-rays is called a radiograph. When special techniques are used to image an organ or region with x-rays, the ending -gram is used with the root for that area, as in urogram (urinary tract), angiogram (blood vessels), and mammogram (breast).

EXERCISE 7-2

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|---|--|
| _____ 1. microscope (<i>MĪ-krō-skōp</i>) | a. instrument for examining very small objects |
| _____ 2. sonogram (<i>SON-ō-gram</i>) | b. instrument for measuring temperature |
| _____ 3. thermometer (<i>ther-MOM-e-ter</i>) | c. measurement of work done |
| _____ 4. laparoscopy (<i>lap-a-ROS-kō-pē</i>) | d. a record of sound |
| _____ 5. ergometry (<i>er-GOM-e-trē</i>) | e. examination of the abdomen |
| _____ 6. audiometer (<i>aw-dē-OM-e-ter</i>) | a. a record of sound |
| _____ 7. phonogram (<i>FŌ-nō-gram</i>) | b. instrument for measuring time |
| _____ 8. endoscope (<i>EN-dō-skōp</i>) | c. instrument for viewing the inside of a cavity or organ |
| _____ 9. electroencephalograph
(<i>e-lek-trō-en-SEF-a-lō-graf</i>) | d. instrument used to measure hearing |
| _____ 10. chronometer (<i>kron-OM-e-ter</i>) | e. instrument used to record the brain's electrical activity |



See examples of diagnostic records in the Student Resources on thePoint.

Table 7-3 Suffixes for Surgery

Suffix	Meaning	Example	Definition of Example
-centesis	puncture, tap	thoracentesis (<i>thor-a-sen-TĒ-sis</i>)	puncture of the chest (thorac/o)
-desis	binding, fusion	pleurodesis <i>plū-ROD-e-sis</i>	binding of the pleura (membranes around the lungs)
-ectomy	excision, surgical removal	hepatectomy <i>hep-a-TEK-tō-mē</i>	excision of liver tissue (hepat/o)
-pexy	surgical fixation	hysteropexy <i>HIS-ter-ō-pek-sē</i>	surgical fixation of the uterus (hyster/o)

Table 7-3 Suffixes for Surgery (*Continued*)

Suffix	Meaning	Example	Definition of Example
-plasty	plastic repair, plastic surgery, reconstruction	rhinoplasty RĪ-nō-plas-tē	plastic surgery of the nose (rhin/o)
-rhaphy	surgical repair, suture	herniorrhaphy her-nē-OR-a-fē	surgical repair of a hernia (herni/o)
-stomy	surgical creation of an opening	tracheostomy trā-kē-OS-tō-mē	creation of an opening into the trachea (trache/o)
-tome	instrument for incising (cutting)	microtome MĪ-krō-tōm	instrument for cutting thin sections of tissue for microscopic study
-tomy	incision, cutting	laparotomy lap-a-ROT-ō-mē	surgical incision of the abdomen (lapar/o)
-tripsy	crushing	neurotripsy nū-rō-TRIP-sē	crushing of a nerve (neur/o)

EXERCISE 7-3

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|--|-------------------------------------|
| _____ 1. gastropexy (<i>gas-trō-PEK-sē</i>) | a. crushing of a stone |
| _____ 2. mammoplasty (<i>MAM-ō-plas-tē</i>) | b. surgical fixation of the stomach |
| _____ 3. adenectomy (<i>ad-e-NEK-tō-mē</i>) | c. puncture of the abdomen |
| _____ 4. lithotripsy (<i>LITH-ō-trip-sē</i>) | d. excision of a gland |
| _____ 5. celiocentesis (<i>sē-lē-ō-sen-TE-sis</i>) | e. plastic surgery of the breast |

The root *cyst/o* means “urinary bladder.” Use this root to write a word that means each of the following:

6. Incision into the bladder _____ cystotomy
7. Surgical repair of the bladder _____
8. Creation of an opening into the bladder _____
9. Surgical fixation of the bladder _____
10. Plastic repair of the bladder _____

The root *arthr/o* means “joint.” Use this root to write a word that means each of the following:

11. Puncture of a joint _____ arthrocentesis
12. Instrument for incising a joint _____
13. Fusion of a joint _____
14. Plastic repair of a joint _____
15. Incision of a joint _____

Write a word for each of the following definitions using the roots given:

16. Incision into the trachea (trache/o) _____
17. Surgical repair of the stomach (gastr/o) _____
18. Creation of an opening into the colon (col/o) _____

Terminology Supplementary Terms

Symptoms

clubbing <i>KLUB-ing</i>	Enlargement of the ends of the fingers and toes because of soft-tissue growth of the nails; seen in a variety of diseases, especially lung and heart diseases (Fig. 7-12)
colic <i>KOL-ik</i>	Acute abdominal pain associated with smooth-muscle spasms
cyanosis <i>sī-a-NŌ-sis</i>	Bluish discoloration of the skin due to lack of oxygen
diaphoresis <i>dī-a-fō-RĒ-sis</i>	Profuse sweating
malaise <i>ma-LAZ</i>	A feeling of discomfort or uneasiness, often indicative of infection or other disease (from French, meaning “discomfort,” using the prefix <i>mal-</i> , meaning “bad”)
nocturnal <i>nok-TUR-nal</i>	Pertaining to or occurring at night (roots <i>noct/i</i> and <i>nyct/o</i> mean “night”)
pallor <i>PAL-or</i>	Paleness, lack of color
prodrome <i>PRŌ-drōm</i>	A symptom indicating an approaching disease
sequela <i>se-KWEL-a</i>	A lasting effect of a disease (plural: sequelae)
syncope <i>SIN-kō-pē</i>	A temporary loss of consciousness because of inadequate blood flow to the brain, fainting

Diagnosis

alpha-fetoprotein (AFP) <i>AL-fa fē-tō-PRŌ-tēn</i>	A fetal protein that appears in the blood of adults with certain types of cancer
bruit <i>brwē</i>	A sound, usually abnormal, heard in auscultation
facies <i>FĀ-shē-ēz</i>	The expression or appearance of the face
febrile <i>FEB-ril</i>	Pertaining to fever
nuclear medicine	The branch of medicine concerned with the use of radioactive substances (radionuclides) for diagnosis, therapy, and research
radiology <i>rā-dē-OL-ō-jē</i>	The branch of medicine that uses radiation, such as x-rays, in the diagnosis and treatment of disease; a specialist in this field is a radiologist
radionuclide <i>rā-dē-ō-NŪ-klīd</i>	A substance that gives off radiation; used for diagnosis and treatment; also called radioisotope or radiopharmaceutical
speculum <i>SPEK-ū-lum</i>	An instrument for examining a canal (Fig. 7-13)
syndrome <i>SIN-drōm</i>	A group of signs and symptoms that together characterize a disease condition

Treatment

catheter <i>KATH-e-ter</i>	A thin tube that can be passed into the body; used to remove fluids from or introduce fluids into a body cavity (Fig. 7-14)
--------------------------------------	--

Terminology

Supplementary Terms (Continued)

clysis*KLĪ-sis*

The introduction of fluid into the body, other than orally, as into the rectum or abdominal cavity; also refers to the solution thus used

irrigation*ir-i-GĀ-shun*

Flushing of a tube, cavity, or area with a fluid (see Fig. 7-14)

lavage*la-VAJ*

The washing out of a cavity, irrigation

normal saline (NS)*SĀ-lēn*

A salt (NaCl) solution compatible with living cells, also called physiologic saline solution (PSS)

paracentesis*par-a-sen-TĒ-sis*

Puncture of a cavity for removal of fluid

prophylaxis*prō-fi-LAK-sis*

Prevention of disease

Surgery**drain**

Device for allowing matter to escape from a wound or cavity; common types include Penrose (cigarette), T-tube, Jackson-Pratt (J-P), and Hemovac

ligature*LIG-a-chur*

A tie or bandage, the process of binding or tying (also called ligation)

resection*rē-SEK-shun*

Partial excision of a structure

stapling*STĀ-pling*

In surgery, the joining of tissue by using wire staples that are pushed through the tissue and then bent

surgeon*SUR-jun*

A physician who specializes in surgery



Go to the Audio Pronunciation Glossary in the Student Resources on thePoint to hear these terms pronounced.

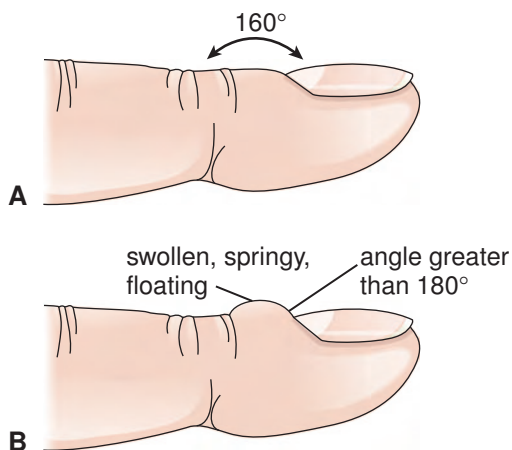


Figure 7-12 Clubbing. A. Normal. B. Clubbing; the end of the finger is enlarged because of soft-tissue growth around the nail.

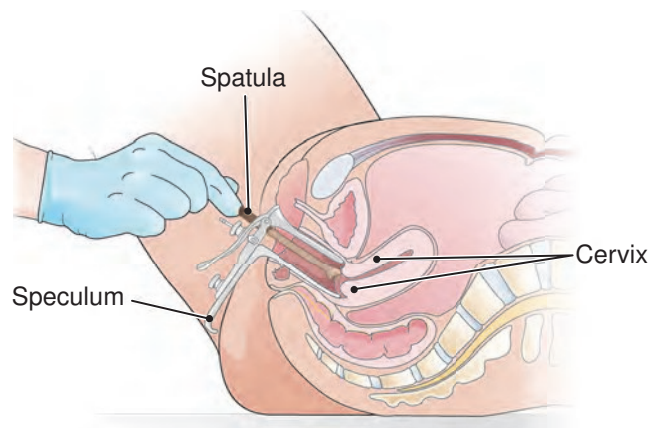


Figure 7-13 A vaginal speculum. This instrument is used to examine the vagina and cervix and to obtain a cervical sample for testing.

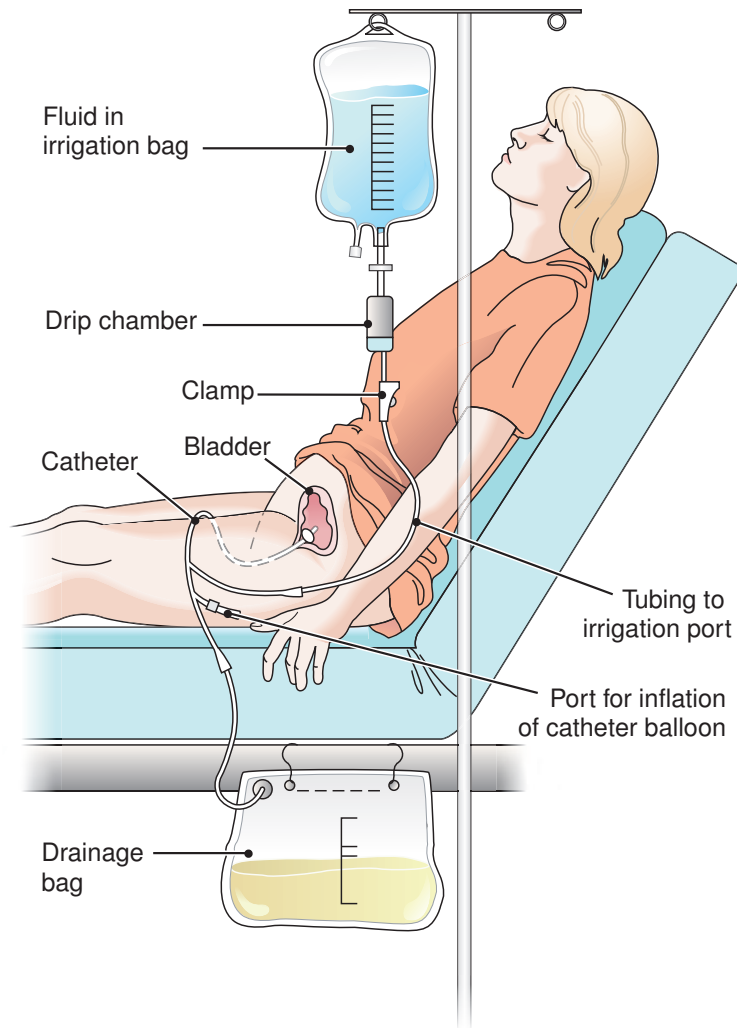


Figure 7-14 Continuous bladder irrigation using a catheter.

Terminology Symbols

1°	primary
2°	secondary (to)
Δ	change
ℒ	left
℞	right
↑	increase(d)
↓	decrease(d)
♂	male
♀	female

°	degree
^	above
v	below
=	equal to
≠	not equal to
±	doubtful, slight
~	approximately
×	times
#	number, pound

Terminology Abbreviations

History and Physical Examination

ADL	Activities of daily living
BP	Blood pressure
bpm	Beats per minute
C	Celsius (centigrade)
CC	Chief complaint
c/o, co	Complains (complaining) of
EOMI	Extraocular muscles intact
ETOH	Alcohol (ethyl alcohol)
F	Fahrenheit
HEENT	Head, eyes, ears, nose, and throat
HIPAA	Health Insurance Portability and Accountability Act
h/o	History of
H & P	History and physical
HPI	History of present illness
HR	Heart rate
Hx	History
I & O	Intake and output
IPPA	Inspection, palpation, percussion, auscultation
IVDA	Intravenous drug abuse
NAD	No apparent distress
NKDA	No known drug allergies
P	Pulse
PE	Physical examination
PE(R) RLA	Pupils equal (regular) react to light and accommodation
PMH	Past medical history
pt	Patient
R	Respiration
R/O	Rule out
ROS	Review of systems
T	Temperature
TPR	Temperature, pulse, respiration
VS	Vital signs
WD	Well developed
WNL	Within normal limits
w/o	Without
YO, y/o	Years old, year-old

Diagnosis and Treatment

ABC	Aspiration biopsy cytology
AFP	Alpha-fetoprotein
BS	Bowel sounds, breath sounds
bx	Biopsy
CAM	Complementary and alternative medicine
Ci	Curie (unit of radioactivity)
C & S	Culture and (drug) sensitivity (of bacteria)
CT	Computed tomography
D/C, dc	Discontinue
Dx	Diagnosis
EBL	Estimated blood loss
ICU	Intensive care unit
I & D	Incision and drainage
MET	Metastasis
MRI	Magnetic resonance imaging
NCCAM	National Center for Complementary and Alternative Medicine
NS, N/S	Normal saline
PCA	Patient-controlled analgesia
PET	Positron emission tomography
PICC	Peripherally inserted central catheter
postop	Postoperative
preop	Preoperative
PSS	Physiologic saline solution
RATx	Radiation therapy
Rx	Drug, prescription, therapy
SPECT	Single-photon emission computed tomography
TNM	(Primary) tumor, (regional lymph) nodes, (distant) metastases

Views for Radiography

AP	Anteroposterior
LL	Left lateral
PA	Posteroanterior
RL	Right lateral

(Continued)

Terminology Abbreviations *(Continued)*

Orders

AMA	Against medical advice	NPO	Nothing by mouth (Latin, <i>non per os</i>)
AMB	Ambulatory	OOB	Out of bed
BRP	Bathroom privileges	QNS	Quantity not sufficient
CBR	Complete bed rest	QS	Quantity sufficient
DNR	Do not resuscitate	STAT	Immediately
KVO	Keep vein open	TKO	To keep open

Drug-related abbreviations are located in Chapter 8.

M.L.'s Injury Follow-Up

M.L. was seen by the orthopedic surgeon, who reduced her wrist fracture and applied a short arm cast. She was scheduled for an arthrocentesis to remove fluid from the right knee. Following the procedure, M.L. was discharged and sent home with instructions to rest and to keep the right wrist and leg

elevated. She was directed to take an antiinflammatory medication (NSAID) for the inflammation and pain. It was recommended that in the future M.L. wear protective padding when she rollerblades.

Chapter Review

MATCHING

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|-----------------------|---|
| _____ 1. electrolyte | a. evidence of disease |
| _____ 2. staging | b. classification of malignant tumors |
| _____ 3. symptom | c. substance that conducts electric current |
| _____ 4. syndrome | d. to unite parts by stitching them together |
| _____ 5. suture | e. a group of symptoms that characterizes a disease |
| _____ 6. cautery | a. removal of tissue for microscopic study |
| _____ 7. scintiscan | b. pain caused by cold |
| _____ 8. cryalgnesia | c. destruction of tissue with a damaging agent |
| _____ 9. vasotripsy | d. image obtained with a radionuclide |
| _____ 10. biopsy | e. crushing of a vessel |
| _____ 11. ergometer | a. instrument used to cut bone |
| _____ 12. osteotome | b. organism that produces color |
| _____ 13. acupuncture | c. instrument to measure work output |
| _____ 14. biofeedback | d. method for controlling involuntary responses |
| _____ 15. chromogen | e. treatment by insertion of thin needles |

Supplementary Terms

- | | |
|-----------------------|--|
| _____ 16. sequelae | a. enlargement of the ends of the fingers and toes |
| _____ 17. prophylaxis | b. lasting effects of disease |
| _____ 18. clubbing | c. prevention of disease |
| _____ 19. prodrome | d. partial excision |
| _____ 20. resection | e. symptom indicating an approaching disease |
| _____ 21. catheter | a. thin tube |
| _____ 22. colic | b. feeling of discomfort |
| _____ 23. diaphoresis | c. acute abdominal pain |
| _____ 24. malaise | d. washing out of a cavity |
| _____ 25. lavage | e. profuse sweating |

WORD ROOTS

Identify and define the root in each of the following words:

	Root	Meaning of Root
26. achromatous	_____	_____
27. ultrasonic	_____	_____
28. radiology	_____	_____
29. thermal	_____	_____
30. allergy	_____	_____
31. chronology	_____	_____
32. anaerobic	_____	_____

FILL IN THE BLANKS

33. Photochromic eyeglass lenses change color in response to _____.
34. Plastic repair of the bladder is called _____.
35. Fusion of a joint is _____.
36. Surgical creation of an opening in the trachea is a(n) _____.
37. Another word for treatment is _____.
38. The PA in M.L.'s case evaluated her wrist by touching it. The term for this examination technique is _____.
39. Following her examination, the PA predicted the outcome of M.L.'s injuries; that is, she gave a(n) _____.
40. Referring to M.L.'s opening case study, the adjective form of *diagnosis* is _____.
41. In the same case study, the adjective form of edema is _____.

Use the root -hepat/o, meaning "liver," to write a word for each of the following:

42. Incision of the liver _____.
43. Excision of liver tissue _____.
44. Surgical fixation of the liver _____.
45. Surgical repair of the liver _____.

TRUE-FALSE

Examine the following statements. If the statement is true, write T in the first blank. If the statement is false, write F in the first blank and correct the statement by replacing the underlined word in the second blank.

	True or False	Correct Answer
46. Adenectomy is surgical removal of a <u>gland</u> .	_____	_____
47. An image produced by x-rays is a <u>radiogram</u> .	_____	_____
48. An otoscope is used to examine the <u>ear</u> .	_____	_____
49. A baroreceptor is sensitive to <u>temperature</u> .	_____	_____
50. An echogram is produced by <u>ultrasound</u> .	_____	_____
51. Arthroscopy is endoscopic examination of a <u>joint</u> .	_____	_____

ELIMINATIONS

In each of the sets below, underline the word that does not fit in with the rest and explain the reason for your choice.

52. percussion — inspection — palpation — remission — auscultation

53. ophthalmoscope — sphygmomanometer — stethoscope — syncope — endoscope

54. curette — forceps — speculum — scalpel — hemostat

55. TNM — MRI — PET — CT — SPECT

ABBREVIATIONS

Write the meaning of the following abbreviations used in M.L.'s opening case study:

56. PA _____
57. MRI _____
58. Hx _____

59. ROM _____
60. NSAID _____

WORD BUILDING

Write words for the following definitions using the word parts provided.

lith/o -rhaphe neur/o -tripsy -tome r -pexy -scopy cyst/o

61. Instrument used to incise a nerve _____
62. Endoscopic examination of the bladder _____
63. Bladder stone _____
64. Surgical repair of a nerve _____
65. Crushing of a stone _____
66. Surgical fixation of the bladder _____
67. Surgical repair of the bladder _____
68. Crushing of a nerve _____
69. Instrument used to incise the bladder _____

WORD ANALYSIS

Define each of the following words and give the meaning of the word parts in each. Use a dictionary if necessary.

70. isochromatophilic (*ī-sō-krō-mat-ō-FIL-ik*) _____
- a. iso- _____
- b. chromat/o _____
- c. phil _____
- d. -ic _____
71. synchronous (*SIN-krō-nus*) _____
- a. syn- _____
- b. chron/o _____
- c. -ous _____
72. asymmetric (*ā-sim-ET-rik*) _____
- a. a- _____
- b. sym- _____
- c. metr/o _____
- d. -ic _____
73. chromogenesis (*krō-mō-JEN-e-sis*) _____
- a. chrom/o _____
- b. gen/e _____
- c. -sis _____

Additional Case Studies

Case Study 7-1: Comprehensive History and Physical

C.F., a 46-YO married Asian woman, works as an office manager for an insurance company. This morning, she had a follow-up visit with her oncologist and was sent to the hospital for immediate admission for possible recurrence or sequelae of her ovarian cancer. She is alert, articulate, and a reliable reporter.

CC: C.F. presents with mild, low, aching pelvic pain and low abdominal fullness. She states, "I feel like I have cramps and am bloated. Sometimes I'm so tired I cannot do my work without a short nap."

HPI: C.F. has been in remission for 14 months from aggressively treated ovarian carcinoma. She presents with mild abdominal distention and tenderness on deep palpation of the lower pelvis. C.F. claims a feeling of fullness in the lower abdomen, loss of appetite, and inability to sleep through the night. She is afraid that her cancer was not cured. Sometimes her heart races and she cannot catch her breath, but with two children in college, she cannot afford to miss work.

MEDS: Therapeutic vitamin \times 1/day. Valium 5 mg every 6 hours (q6h) as needed (prn) for anxiety. Benadryl 25 mg at bedtime (hs) prn for insomnia. Echinacea tea 3 cups/day to prevent colds or flu. *Ginkgo biloba* 3 cups/day for energy.

ALLERGIES: NKDA, no food allergies

PMH: C.F. was diagnosed with ovarian CA four years ago and treated with surgery, radiation, and chemotherapy. A total abdominal hysterectomy (removal of the uterus) with bilateral removal of the oviducts and ovaries was performed. At the time of surgery, the pelvic lymph nodes tested negative for disease. Chemotherapy and radiation therapy occurred after surgical recovery. C.F. has been well and capable of full ADL until four weeks ago. Childhood history is unremarkable, with normal childhood diseases, including measles, mumps, and chicken pox. C.F. was born and raised in this country. She has no other adult diseases, surgery, or injuries.

CURRENT HEALTH Hx: Denies tobacco, ETOH, or recreational drugs or substances. She exercises three to five times per week with aerobic exercise class and treadmill. She is a vegetarian and drinks one to five cups of green tea per day. Immunizations are up to date, unsure of last tetanus booster. Recent negative mammogram and negative TB test (PPD).

FAMILY Hx: Both parents alive and well. Maternal aunt died of "stomach tumor" at age 37.

TPR & BP & PAIN: 37C-96-22 126/72 in no acute distress.

HEENT: WNL. Mesocephalic; fundi benign; PERRLA; uncorrected 20/20 vision; mouth clear; good dental health; neck supple w/o rigidity, thyromegaly, or cervical lymphadenopathy; trachea midline. No carotid bruits.

LUNGS: All lobes clear to auscultation and percussion.

HEART: Rate 96 bpm, regular; no murmurs, gallops, or rubs.

BREASTS: Symmetrical, w/o masses or discharge.

ABDOMEN: Skin intact with healed suprapubic midline surgical incision and a symmetrical area of discoloration and dermal thickness from radiation therapy. Bowel sounds active and normal. Suprapubic tenderness on palpation. No hepatosplenomegaly. Absence of inguinal lymph nodes on palpation. Kidneys palpable. Rectal exam WNL. Hemoccult test (stool test for blood) result negative.

GU: Unremarkable. Surgical menopause.

MUSCULOSKELETAL: WNL. No weakness, limitation of mobility, joint pain, stiffness, or edema.

NEUROLOGIC: All reflexes intact. No syncope, paralysis, numbness.

DIAGNOSTIC IMPRESSION: Possible recurrence of ovarian CA, ascites.

TREATMENT PLAN: Send blood for CA-125 (genetic marker for ovarian cancer). Schedule abdominal paracentesis and second-look diagnostic laparoscopy with biopsy and tissue staging. D/C all herbal supplements.

Case Study 7-2: Diagnostic Laparoscopy

For a laparoscopy, C.F. was given general anesthesia and her trachea was intubated. She was placed in lithotomy position with arms abducted. Her abdomen was insufflated with carbon dioxide (CO₂) through a thin needle placed below the umbilicus. Three trocar punctures were made to insert the telescope with camera and the cutting and grasping instruments. Biopsies were taken of several pelvic lymph nodes and sent to the

pathology laboratory. There were many adhesions from prior surgery, which were lysed to mobilize her organs and enhance visualization. A loop of small bowel, which had adhered to the anterior abdominal wall, had been punctured when the trocar was introduced. The surgeon repaired the defect with an endoscopic stapler and irrigated the abdomen with 3 L of NS mixed with antibiotic solution.

Case Study Questions

Write the word from the case study that completes each of the following statements:

1. Secondary conditions, complications, or lasting effects of C.F.'s cancer would be called _____.
2. Examination by listening to body sounds with a stethoscope is called _____.
3. The size and shape of C.F.'s head was described as _____.

4. A collection of abdominal fluid (ascites) is drained by a cavity puncture and drainage procedure called a(n) _____.
5. Removal of tissue for microscopic examination is _____.
6. A surgical procedure in which an endoscope is inserted through the abdominal wall to visualize the abdominal cavity and determine the cause of a disorder is a(n) _____.
7. For her examination, C.F. was placed in a supine position with knees bent. This position is used for gynecologic and urologic surgery and is called the _____.

Multiple choice. Select the best answer and write the letter of your choice to the left of each number:

- _____ 8. C.F.'s cancer was in a state of apparent cure with no active signs of disease. This state is called:
 - a. exacerbation
 - b. syndrome
 - c. remission
 - d. sequelae
 - e. tumor staging
- _____ 9. The abbreviation NKDA refers to allergies to:
 - a. lactose
 - b. wheat
 - c. eggs
 - d. drugs
 - e. dust
- _____ 10. C.F. claimed that her heart races and she cannot catch her breath. The terms for these conditions are, respectively:
 - a. tachypnea and dyspnea
 - b. tachycardia and dyspnea
 - c. dyspnea and tachycardia
 - d. tachycardia and bradypnea
 - e. bradycardia and tachypulmono
- _____ 11. Syncope is:
 - a. fainting
 - b. nosebleed
 - c. inflammation
 - d. palpitations
 - e. anxiety
- _____ 12. Hepatosplenomegaly means:
 - a. removal of the liver and spleen
 - b. prolapse of the heart and spleen
 - c. hemorrhage of the liver and spleen
 - d. enlargement of the liver and spleen
 - e. surgical repair of the kidney and liver
- _____ 13. C.F.'s abdominal cavity and organs were bound with fibrous tissue bands, which had to be lysed during surgery. These attachments are called:
 - a. prodromes
 - b. sequelae
 - c. adhesions
 - d. ascites
 - e. fibroids
- _____ 14. The accidental puncture of the intestine was not an expected outcome of surgery. It was an incident that occurred despite attempts to protect her from harm. The term for this type of disorder is (see Chapter 6):
 - a. iatrogenic
 - b. nosocomial
 - c. idiopathic
 - d. etiologic
 - e. surgical misadventure

Give the meaning of each of the following abbreviations:

15. HPI _____
16. CA _____
17. TPR _____
18. ADL _____
19. bpm _____
20. WNL _____
21. D/C _____
22. NS _____

CHAPTER

8

Drugs

Case Study

P.L.'s Cardiac Disease and Crisis

Chief complaint:

P.L. was having chest pain and had taken two nitroglycerin tablets without relief. Her family called an ambulance, and she was brought to the emergency room with chest pain that radiated down her arm, dyspnea, and syncope.

Examination:

While P.L. was being admitted to the emergency room, her family provided a history to the triage nurse. They related that P.L. has a four-year history of heart disease. Her routine medications included Lanoxin to slow and strengthen her heart-beat, Inderal to support her heart rhythm, Lipitor to decrease her cholesterol, Catapres to lower her hypertension, nitroglycerin prn for chest pain, HydroDIURIL to eliminate fluid and decrease the heart's workload, Diabinese for her diabetes, and Coumadin to prevent blood clots. She also took Tagamet for her stomach ulcer and several OTC preparations, including an herbal sleeping potion that she mixed in tea and Metamucil mixed in orange juice every morning for her bowels. Her family indicated that P.L. also took a number of other herbal and OTC medications, but they were unable to recall their names.

While P.L. was having a 12-lead ECG, her blood pressure dropped, and her heart rate deteriorated into a full cardiac arrest.

Clinical course:

Immediate resuscitation was instituted with cardiopulmonary resuscitation (CPR), defibrillation, and a bolus of IV epinephrine. Between shocks, she was given a bolus of lidocaine and a bolus of diltiazem plus repeated doses of epinephrine every five minutes. P.L. did not respond to resuscitation, and she was pronounced dead 55 minutes after arrival to the emergency room.



Ancillaries *At-A-Glance*

Visit *thePoint* to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii-xvi.

Learning **TOOLS**

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning **RESOURCES**

- E-book: Chapter 8
- Web Figure: Sublingual Absorption of Drugs
- Web Figure: Intradermal Injection Sites
- Web Figure: Subcutaneous Injection Sites
- Web Figure: Intramuscular Injection Sites
- Audio Pronunciation Glossary

Learning **ACTIVITIES**

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After study of this chapter, you should be able to

- 1** Explain the difference between over-the-counter and prescription drugs. *p148*
- 2** List three potential adverse side effects of drugs. *p148*
- 3** Explain two ways in which drugs can interact. *p148*
- 4** Explain the difference between the generic name and the brand name of a drug. *p149*
- 5** List several drug references. *p149*
- 6** Describe five safety issues related to the use of herbal medicines. *p149*
- 7** Define basic terms related to drugs and their actions *p150*
- 8** Identify and use word parts pertaining to drugs. *p151*
- 9** Define abbreviations related to drugs and their uses *p153*
- 10** Recognize the major categories of drugs and how they act. *p154*
- 11** List some common herbal medicines and how they act. *p157*
- 12** List common routes for drug administration. *p158*
- 13** List standard forms in which liquid and solid drugs are prepared. *p160*
- 14** Analyze the terminology related to drugs in several case studies. *pp146, 169*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|--|---|
| <p>_____ 1. The federal agency that approves drugs for sale is the:</p> <ul style="list-style-type: none"> a. Food and Drug Administration b. U.S. Department of Agriculture c. Department of Health and Human Services d. Occupational Safety and Health Administration | <p>_____ 5. An analgesic is a drug used for:</p> <ul style="list-style-type: none"> a. fractures b. water retention c. coma d. pain |
| <p>_____ 2. A reason for not using a specific drug is a:</p> <ul style="list-style-type: none"> a. prescription b. prognosis c. counterpurpose d. contraindication | <p>_____ 6. An antihypertensive drug affects:</p> <ul style="list-style-type: none"> a. blood pressure b. diet c. growth d. ovulation |
| <p>_____ 3. A manufacturer's registered name for a drug is its:</p> <ul style="list-style-type: none"> a. chemical name b. generic name c. brand name d. over-the-counter name | <p>_____ 7. The solvent in an aqueous solution is:</p> <ul style="list-style-type: none"> a. acid b. water c. salt d. base |
| <p>_____ 4. The word root for drug or medicine is:</p> <ul style="list-style-type: none"> a. pharm b. scop c. log d. lapar | <p>_____ 8. The abbreviation prn means:</p> <ul style="list-style-type: none"> a. as needed b. once a day c. each night d. before meals |

Drugs

A **drug** is a substance that alters body function. Traditionally, drugs have been derived from natural plant, animal, and mineral sources. Today, most are manufactured synthetically by pharmaceutical companies. A few, such as certain hormones and enzymes, have been produced by genetic engineering.

Many drugs, described as over-the-counter (OTC) drugs, are available without a signed order, or **prescription** (Rx). Others require a health care provider's prescription for use.

Responsibility for the safety and **efficacy** of all drugs sold in the United States lies with the Federal Food and Drug Administration (FDA), which must approve all drugs before they are sold.

ADVERSE DRUG EFFECTS

An unintended effect of a drug or other form of treatment is a **side effect**. Most drugs have potential adverse side effects that must be evaluated before they are prescribed. In

addition, there may be **contraindications**, or reasons not to use a particular drug for a specific individual based on that person's medical conditions, current medications, sensitivity, or family history. While a patient is under treatment, it is important to be alert for signs of adverse effects such as digestive upset, changes in the blood, or signs of allergy, such as hives or skin rashes. **Anaphylaxis** is an immediate and severe allergic reaction that may be caused by a drug. It can lead to life-threatening respiratory distress and circulatory collapse.

Because drugs given in combination may interact, the prescriber must know of any drugs the patient is taking before prescribing another. In some cases, a combination may result in **synergy** or **potentiation**, meaning that the drugs together have a greater effect than either of the drugs acting alone. In other cases, one drug may act as an **antagonist** of another, interfering with its action. Drugs may also react adversely with certain foods or substances used socially, such as alcohol and tobacco.

Drugs that act on the central nervous system may lead to psychological or physical **substance dependence**, in which a person has a chronic or compulsive need for a

Box 8-1



Focus on Words

Where Do Drugs Get Their Names?

Drug names are derived in a variety of ways. Some are named for their origins. Adrenaline, for example, is named for its source, the adrenal gland. Even its generic name, epinephrine, informs us that it comes from the gland that is above (epi-) the kidney (nephro). Pitocin, a drug used to induce labor, is named for its source, the pituitary gland, combined with the chemical name of the hormone, oxytocin. Botox, currently injected into the skin for cosmetic removal of wrinkles, is the toxin from the organism that causes botulism, a type of food poisoning. Aspirin (an antiinflammatory agent), Taxol (an antitumor agent), digitalis (used to treat heart failure), and atropine (a smooth-muscle relaxant) are all named for the

plants from which they come. For example, aspirin is named for the blossoms of *Spiraea*, from which it is derived. Taxol comes from a yew (evergreen) of the genus *Taxus*. Digitalis is from purple foxglove, genus *Digitalis*. Atropine comes from the plant *Atropa belladonna*.

Some names tell us about the drug or its actions. The name for Humulin, a form of insulin made by genetic engineering, points out that this is human insulin and not a hormone from animal sources. Lomotil reduces intestinal motility and is used to treat diarrhea. The name *Belladonna* is from Italian and means “fair lady,” because this drug dilates the pupils of the eyes, making women appear more beautiful.

drug regardless of its bad effects. With repeated use, a drug **tolerance** may develop, whereby a constant dose has less effect, and the dose must be increased to produce the original response. Cessation of the drug then leads to symptoms of substance **withdrawal**, a state that results from a drug's removal or dose reduction. Certain symptoms are associated with withdrawal from specific drugs.

DRUG NAMES

Drugs may be cited by either their generic or their **brand names**. (Box 8-1 has information on drug naming.) The **generic name** is usually a simple version of the chemical name for the drug and is not capitalized. The brand name (trade name, proprietary name) is a registered trademark of the manufacturer and is written with an initial capital letter. For example, Tylenol is the brand name for the analgesic compound acetaminophen; the antidepressant Prozac is fluoxetine. A brand name is protected by a patent; only the company that holds the patent can produce and sell that drug under its brand name until the patent expires. Box 8-3, which appears later in this chapter, has many more examples of generic and brand names. Note that the same drug may be marketed by different companies under different brand names. Both Motrin and Advil, for example, are the generic antiinflammatory agent ibuprofen.

DRUG INFORMATION

In the United States, the standard for drug information is the *United States Pharmacopeia* (USP). This reference is published by a national committee of pharmacologists and other scientists. It contains formulas for drugs sold in the United States; standards for testing the strength, quality, and purity of drugs; and standards for the preparation

and dispensing of drugs. The American Society of Health System Pharmacists (ASHP) publishes extensive drug information, and the *Physicians' Desk Reference*, published yearly by Thomson Healthcare, contains information supplied by drug manufacturers. An enormous amount of drug information is available online through the Web sites for these publications and others. Another excellent source of up-to-date information on drugs is a community or hospital pharmacist. See Box 8-2 for information on careers in pharmacy.

Herbal Medicines

For hundreds of years, people have used plants to treat diseases, a practice described as herbal medicine or **phyto-medicine**. Many people in industrialized countries are now turning to herbal products as alternatives or complements to conventional medicines. Although plants are the source of many conventional drugs, pharmaceutical companies usually purify, measure, and often modify or synthesize the active ingredients in these plants rather than presenting them in their natural states.

Some issues have arisen with the increased use of herbal medicines, including questions about their purity, safety, concentration, and efficacy. Another issue is drug interactions. Health care providers should ask about the use of herbal remedies when taking a patient's drug history, and patients should report any herbal medicines they take when under treatment. The FDA does not test or regulate herbal medicines, and there are no requirements to report adverse effects. There are, however, restrictions on the health claims that can be made by the manufacturers of herbal medicines. The U.S. government has established the Office of Dietary Supplements (ODS) to support and coordinate research in this field.

Box 8-2



Health Professions

Pharmacists and Pharmacy Technicians

Medications are chemicals designed to treat illness and improve quality of life. The role of pharmacists and pharmacy technicians is to ensure that patients receive the correct medications and the education they need to use them effectively and derive their intended health benefits.

As key members of the health care team, pharmacists need strong clinical backgrounds with a thorough understanding of chemistry, anatomy, and physiology. Some pharmacists work in a community or retail environment; others are employed in hospitals. Different positions require different responsibilities. All pharmacists dispense prescription medications, monitor patients' responses to them, and also educate patients about their appropriate use. Hospital pharmacists also accompany physicians on their rounds and manage drug therapies by ordering and monitoring laboratory results and

adjusting medication dosages as needed. Pharmacists share their expertise with other health professionals and participate in clinical research on drugs and their effects.

Pharmacy technicians assist pharmacists with their duties. Their training also requires a thorough background in basic sciences. State rules and regulations vary, but pharmacy technicians may perform many of the tasks related to dispensing medications, such as preparing drugs and packaging them with appropriate labels and instructions for use.

Job prospects for pharmacists and pharmacy technicians are promising because of the growing need for health care. In fact, pharmacy is projected to be one of the fastest growing careers in the United States. For more information about careers in pharmacy, contact the American Association of Colleges of Pharmacy at www.aacp.org.

Terminology

Key Terms

anaphylaxis <i>an-a-fi-LAK-sis</i>	An extreme allergic reaction that can lead to respiratory distress, circulatory collapse, and death
antagonist <i>an-TAG-o-nist</i>	A substance that interferes with or opposes the action of a drug
brand name	The trade or proprietary name of a drug, a registered trademark of the manufacturer; written with an initial capital letter
contraindication <i>kon-tra-in-di-KĀ-shun</i>	A factor that makes the use of a drug undesirable or dangerous
drug	A substance that alters body function
efficacy <i>EF-i-ka-sē</i>	The power to produce a specific result; effectiveness
generic name <i>je-NER-ik</i>	The nonproprietary name of a drug; that is, a name that is not privately owned or trademarked; usually a simplified version of the chemical name; not capitalized
phytomedicine <i>fit-tō-MED-i-sin</i>	Another name for herbal medicine (root <i>phyt/o</i> meaning “plant”)
potentiation <i>pō-ten-shē-Ā-shun</i>	Increased potency created by two drugs acting together
prescription (Rx) <i>prē-SKRIP-shun</i>	Written and signed order for a drug with directions for its administration
side effect	A result of drug therapy or other therapy that is unrelated to or an extension of its intended effect; usually applies to an undesirable effect of treatment
substance dependence	A condition that may result from chronic use of a drug, in which a person has a chronic or compulsive need for a drug regardless of its adverse effects; dependence may be psychological or physical

Terminology

Key Terms (Continued)

synergy <i>SIN-er-jē</i>	Combined action of two or more drugs working together to produce an effect greater than any of the drugs could produce when acting alone; also called synergism (<i>SIN-er-jizm</i>); adjective: synergistic (<i>sin-er-JIS-tik</i>)
tolerance	A condition in which chronic use of a drug results in loss of effectiveness and the dose must be increased to produce the original response
withdrawal	A condition that results from abrupt cessation or reduction of a drug that has been used regularly



Go to the Audio Pronunciation Glossary in the Student Resources on thePoint to hear these terms pronounced.

Table 8-1

Word Parts Pertaining to Drugs

	Meaning	Example	Definition of Example
Suffixes			
-lytic (adjective of lysis)	dissolving, reducing, loosening	thrombolytic <i>throm-bō-LIT-ik</i>	agent that dissolves a blood clot (thrombus)
-mimetic	mimicking, simulating	sympathomimetic <i>sim-pa-thō-mi-MET-ik</i>	mimicking the effects of the sympathetic nervous system
-tropic	acting on	psychotropic <i>sī-kō-TROP-ik</i>	acting on the mind (psych/o)
Prefixes			
anti-	against	antiemetic <i>an-tē-e-MET-ik</i>	drug that prevents vomiting (emesis)
contra-	against, opposite, opposed	contraceptive <i>kon-tra-SEP-tiv</i>	preventing conception
counter-	against, opposed	countertransport <i>kown-ter-TRANS-port</i>	movement in an opposite direction
Roots			
alg/o, algi/o, algesi/o	pain	algesia <i>al-JĒ-zē-a</i>	sense of pain
chem/o	chemical	chemotherapy <i>kē-mō-THER-a-pē</i>	treatment with drugs
hypn/o	sleep	hypnosis <i>hip-NŌ-sis</i>	induced state of sleep
narc/o	stupor	narcotic <i>nar-KOT-ik</i>	agent that induces a state of stupor with decreased sensation
pharm, pharmac/o	drug, medicine	pharmacy <i>FAR-ma-sē</i>	the science of preparing and dispensing drugs, or the place where these activities occur

(Continued)

Table 8-1 Word Parts Pertaining to Drugs (*Continued*)

	Meaning	Example	Definition of Example
pyr/o, pyret/o	fever	antipyretic <i>an-ti-pī-RET-ik</i>	counteracting fever
tox/o, toxic/o	poison, toxin	toxicity <i>tok-SIS-i-tē</i>	state of being poisonous
vas/o	vessel	vasodilation <i>vas-ō-dī-LĀ-shun</i>	widening of a vessel

EXERCISE 8-1

Identify and define the suffix in each of the following words:

	Suffix	Meaning of Suffix
1. anxiolytic (<i>ang-zī-ō-LIT-ik</i>)	_____	_____
2. chronotropic (<i>kron-ō-TROP-ik</i>)	_____	_____
3. parasympathomimetic (<i>par-a-sim-pa-thō-mi-MET-ik</i>)	_____	_____

Using the prefixes listed in Table 8-1, write the opposite of each of the following words:

4. inflammatory _____
5. indicated _____
6. septic _____
7. act _____
8. toxin _____
9. pyretic _____

Identify and define the root in each of the following words:

	Root	Meaning of Root
10. hypnotic (<i>hip-NOT-ik</i>)	_____	_____
11. toxicology (<i>tok-si-KOL-ō-jē</i>)	_____	_____
12. analgesia (<i>an-al-JĒ-zē-a</i>)	_____	_____
13. chemistry (<i>KEM-is-trē</i>)	_____	_____
14. narcosis (<i>nar-KŌ-sis</i>)	_____	_____

Define each of the following words:

15. vasoconstriction (*vā-sō-kon-STRIK-shun*) _____
16. pharmacology (*far-ma-KOL-ō-jē*) _____
17. mucolytic (*mū-kō-LIT-ik*) _____
18. gonadotropic (*gō-nad-ō-TROP-ik*) _____

Terminology Abbreviations

Drugs and Drug Formulations

APAP	Acetaminophen
ASA	Acetylsalicylic acid (aspirin)
ASHP	American Society of Health System Pharmacists
cap	Capsule
elix	Elixir
FDA	Food and Drug Administration
INH	Isoniazid (antituberculosis drug)
MED(s)	Medicine(s), medication(s)
NSAID(s)	Nonsteroidal antiinflammatory drug(s)
ODS	Office of Dietary Supplements
OTC	Over-the-counter
PDR	<i>Physicians' Desk Reference</i>
Rx	Prescription
supp	Suppository
susp	Suspension
tab	Tablet
tinct	Tincture
ung	Ointment
USP	<i>United States Pharmacopeia</i>

Dosages and Directions

ā	Before (Latin, <i>ante</i>)
āā	Of each (Greek, <i>ana</i>)
ac	Before meals (Latin, <i>ante cibum</i>)
ad lib	As desired (Latin, <i>ad libitum</i>)
aq	Water (Latin, <i>aqua</i>)
bid, b.i.d.	Twice a day (Latin, <i>bis in die</i>)
ċ	With (Latin, <i>cum</i>)
DAW	Dispense as written

D/C, dc	Discontinue
DS	Double strength
hs	At bedtime (Latin, <i>hora somni</i>)
ID	Intradermal(ly)
IM	Intramuscular(ly)
IU	International unit
IV	Intravenous(ly)
LA	Long-acting
mcg	Microgram
mg	Milligram
mL	Milliliter
p	After, post
pc	After meals (Latin, <i>post cibum</i>)
po, PO	By mouth (Latin, <i>per os</i>)
pp	Postprandial (after a meal)
prn	As needed (Latin, <i>pro re nata</i>)
qam	Every morning (Latin, <i>quaque ante meridiem</i>)
qh	Every hour (Latin, <i>quaque hora</i>)
q ____ h	Every ____ hours
qid, q.i.d.	Four times a day (Latin, <i>quater in die</i>)
ś	Without (Latin, <i>sine</i>)
SA	Sustained action
SC, SQ, subcut	Subcutaneous(ly)
SL	sublingual(ly)
SR	Sustained release
śś	Half (Latin, <i>semis</i>)
tid, t.i.d.	Three times per day (Latin, <i>ter in die</i>)
U	Unit(s)
x	Times

Drug Reference Information

So far, this chapter has been an overview of drugs and the terminology for drugs and drug usage. The next section of the chapter contains informational boxes that you

can examine now and refer to again as you work through Part 3 of the text. **Box 8-3** outlines the major categories of drugs and cites examples by both generic and brand names. **Box 8-4** lists some common herbal medicines and their uses. **Boxes 8-5** through **8-7** have information on routes of administration, drug preparations, and injectable drugs (**Figs. 8-1 to 8-6**).

Box 8-3

For Your Reference



Common Drugs and Their Actions

CATEGORY	ACTIONS; APPLICATIONS	GENERIC NAME	BRAND NAME(S)
adrenergics <i>ad-ren-ER-jiks</i> (sympathomimetics <i>[sim-pa-thō-mi-MET-iks]</i>)	Mimic the action of the sympathetic nervous system, which responds to stress; used to treat bronchospasms, allergic reactions, hypotension	epinephrine phenylephrine pseudoephedrine dopamine	Bronkaid Neo-Synephrine Sudafed Intropin
analgesics <i>an-al-JĒ-siks</i>	Alleviate pain		
narcotics <i>nar-KO-tiks</i>	Decreases pain sensation in central nervous system; chronic use may lead to physical dependence	codeine morphine meperidine oxycodone	Demerol Percodan, Percocet
nonnarcotics <i>non-nar-KO-tiks</i>	Acts peripherally to inhibit prostaglandins (local hormones); they may also be antiinflammatory and antipyretic (reduce fever). Cox-2 inhibitors limit an enzyme that causes inflammation without affecting a related enzyme that protects the stomach lining	aspirin (acetylsalicylic acid; ASA) acetaminophen (APAP) ibuprofen celecoxib (Cox-2 inhibitor)	Tylenol Motrin, Advil Celebrex
anesthetics <i>an-es-THET-iks</i>	Reduce or eliminate sensation (esthesi/o)	local: lidocaine bupivacaine general: nitrous oxide midazolam thiopental	Xylocaine Marcaine Versed Pentothal
anticoagulants <i>an-ti-kō-AG-ū-lants</i>	Prevent coagulation and formation of blood clots	heparin warfarin	Coumadin
anticonvulsants <i>an-ti-kon-VUL-sants</i>	Suppress or reduce the number and/or intensity of seizures	phenobarbital phenytoin carbamazepine valproic acid	Dilantin Tegretol Depakene
antidiabetics <i>an-ti-dī-a-BET-iks</i>	Prevent or alleviate diabetes	insulin glyburide acarbose glipizide	Humulin (injected) Diabeta Precose Glucotrol
antiemetics <i>an-tē-e-MET-iks</i>	Relieve symptoms of nausea and prevent vomiting (emesis)	ondansetron dimenhydrinate prochlorperazine scopolamine promethazine	Zofran Dramamine Compazine TRANSDERM-SCÖP Phenergan
antihistamines <i>an-ti-HIS-ta-mēnz</i>	Prevent responses mediated by histamine: allergic and inflammatory reactions	diphenhydramine fexofenadine loratadine cetirizine	Benadryl Allegra Claritin Zyrtec
antihypertensives <i>an-ti-hī-per-TEN-sivs</i>	Lower blood pressure by reducing cardiac output, dilating vessels, or promoting excretion of water by the kidneys. ACE inhibitors block production of a substance that raises blood pressure. See also calcium-channel blockers and beta-blockers under cardiac drugs; diuretics	amlodipine atenolol clonidine prazosin minoxidil captopril enalapril	Norvasc Tenormin Catapres Minipress Loniten Capoten Vasotec

Common Drugs and Their Actions (*Continued*)

CATEGORY	ACTIONS; APPLICATIONS	GENERIC NAME	BRAND NAME(S)
antiinflammatory drugs <i>an-tē-in-FLAM-a-tō-rē</i>	Counteract inflammation and swelling		
corticosteroids <i>kor-ti-kō-STER-oyds</i>	Hormones from the cortex of the adrenal gland; used for allergy, respiratory and blood diseases, injury, and malignancy; suppress the immune system	dexamethasone cortisone prednisone hydrocortisone fluticasone	Decadron Cortone Deltasone Hydrocortone, Cortef Flonase
nonsteroidal antiinflammatory drugs (NSAIDs) <i>non-ster-OYD-al</i>	Reduce inflammation and pain by interfering with synthesis of prostaglandins; also antipyretic	aspirin ibuprofen indomethacin naproxen celecoxib	Motrin, Advil Indocin Naprosyn, Aleve Celebrex
antiinfective agents	Kill or prevent the growth of infectious organisms		
antibacterials <i>an-ti-bak-TĒ-rē-als</i>	Effective against bacteria	amoxicillin penicillin V erythromycin	Polymox Pen-Vee K Erythrocin
antibiotics <i>an-ti-bī-OT-iks</i>		vancomycin gentamicin cephalexin tetracycline ciprofloxacin (for ulcer-causing <i>Helicobacter pylori</i>) isoniazid (INH) (tuberculosis)	Vancocin Garamycin Keflex Achromycin Cipro Nydrizid
antifungals <i>an-ti-FUNG-gals</i>	Effective against fungi	amphotericin B miconazole nystatin	Fungizone Monistat Nilstat
antiparasitics <i>an-ti-par-a-SIT-iks</i>	Effective against parasites: protozoa, worms	iodoquinol (amebae) quinacrine	Yodoxin Atabrine
antivirals <i>an-ti-VI-rals</i>	Effective against viruses	acyclovir zanamivir (influenza) zidovudine (HIV) indinavir (HIV protease inhibitor)	Zovirax Relenza Retrovir Crixivan
antineoplastics <i>an-ti-nē-ō-PLAS-tiks</i>	Destroy cancer cells; they are toxic for all cells but have greater effect on cells that are actively growing and dividing; hormones and hormone inhibitors also are used to slow tumor growth	cyclophosphamide doxorubicin methotrexate vincristine tamoxifen (estrogen inhibitor)	Cytosan Adriamycin Folex Oncovin Nolvadex
cardiac drugs <i>KAR-dē-ak</i>	Act on the heart		
antiarrhythmics <i>an-tē-a-RITH-miks</i>	Correct or prevent abnormalities of heart rhythm	quinidine lidocaine digoxin	Quinidex Xylocaine Lanoxin
beta-adrenergic blockers (beta-blockers) <i>bā-ta-ad-ren-ER-jik</i>	Inhibit sympathetic nervous system; reduce rate and force of heart contractions	propranolol metoprolol atenolol	Inderal Toprol-XL Tenormin
calcium-channel blockers <i>KAL-sē-um</i>	dilate coronary arteries, slow heart rate, reduce contractions	diltiazem nifedipine verapamil	Cardizem Procardia Covera

(Continued)

Common Drugs and Their Actions (*Continued*)

CATEGORY	ACTIONS; APPLICATIONS	GENERIC NAME	BRAND NAME(S)
hypolipidemics <i>hī-pō-lip-i-DĖ-miks</i>	lower cholesterol in patients with high serum levels that cannot be controlled with diet alone; hypocholesterolemics, statins	lovastatin pravastatin atorvastatin simvastatin	Mevacor Pravachol Lipitor Zocor
nitrates <i>NĪ-trätz</i>	dilate coronary arteries and reduce heart's workload by lowering blood pressure and reducing venous return	nitroglycerin isosorbide	Nitrostat Isordil
antianginal agents <i>an-ti-AN-ji-nal</i>			
CNS stimulants	stimulate the central nervous system	methylphenidate amphetamine (chronic use may lead to drug dependence)	Ritalin Adderall, Dexedrine
diuretics <i>dī-ū-RET-iks</i>	promote excretion of water, sodium, and other electrolytes by the kidneys; used to reduce edema and blood pressure. Loop diuretics act on the kidney tubules (see Chapters 9 and 13)	furosemide ethacrynic acid mannitol hydrochlorothiazide (HCTZ) triamterene + HCTZ	Lasix Edecrin Osmitrol HydroDIURIL Dyazide
gastrointestinal drugs <i>gas-trō-in-TES-tin-al</i>	act on the digestive tract		
antidiarrheals <i>an-ti-dī-a-RĒ-als</i>	treat or prevent diarrhea by reducing intestinal motility or absorbing irritants and soothing the intestinal lining	diphenoxylate loperamide attapulgate atropine	Lomotil Imodium Kaopectate
histamine H ₂ antagonists <i>HIS-ta-mēn</i>	decrease stomach acid secretion by interfering with the action of histamine at H ₂ receptors; used to treat ulcers and other gastrointestinal problems	famotidine ranitidine	Pepcid Zantac
laxatives <i>LAK-sa-tivs</i>	promote elimination from the large intestine; types include: stimulants hyperosmotics (retain water) stool softeners bulk-forming agents	bisacodyl lactulose docusate psyllium	Dulcolax Constilac, Chronulac Colace, Surfak Metamucil
proton pump inhibitors <i>PRŌ-ton</i>	reduce stomach acidity by blocking transport of hydrogen ions (protons) into the stomach	esomeprazole lansoprazole omeprazole	Nexium Prevacid Prilosec
muscle relaxants <i>rē-LAK-sants</i>	depress nervous system stimulation of skeletal muscles; used to control muscle spasms and pain	baclofen carisoprodol methocarbamol	Lioresal Soma Robaxin
psychotropics <i>sī-kō-TROP-iks</i>	affect the mind, altering mental activity, mental state, or behavior		
anxiety agents <i>an-tē-ang-ZĪ-e-tē</i>	reduce or dispel anxiety; tranquilizers; anxiolytic agents	lorazepam chlordiazepoxide diazepam hydroxyzine alprazolam buspirone	Ativan Librium Valium Atarax Xanax BuSpar
antidepressants <i>an-ti-dē-PRES-sants</i>	relieve depression by raising brain levels of neurotransmitters (chemicals active in the nervous system)	amitriptyline imipramine fluoxetine paroxetine sertraline	Elavil Tofranil Prozac Paxil Zoloft

Common Drugs and Their Actions (Continued)

CATEGORY	ACTIONS; APPLICATIONS	GENERIC NAME	BRAND NAME(S)
antipsychotics <i>an-ti-si-KOT-iks</i>	act on nervous system to relieve symptoms of psychoses	chlorpromazine haloperidol risperidone olanzapine	Thorazine Haldol Risperdal Zyprexa
respiratory drugs	act on the respiratory system		
antitussives <i>an-ti-TUS-sivs</i>	suppress coughing	dextromethorphan	Benlyn DM
asthma maintenance drugs	used for prevention of asthma attacks and chronic treatment of asthma;	fluticasone	Flovent
bronchodilators <i>brong-kō-dī-LĀ-tors</i>	prevent or eliminate spasm of the bronchi (breathing tubes) by relaxing bronchial smooth muscle; used to treat asthma attacks and bronchitis	montelukast albuterol epinephrine metaproterenol	Singulair Proventil Sus-Phrine Alupent
expectorants <i>ek-SPEK-tō-rants</i>	induce productive coughing to eliminate respiratory secretions	guaifenesin	Robitussin
mucolytics <i>mū-kō-LIT-iks</i>	loosen mucus to promote its elimination	acetylcysteine	Mucomyst
sedatives/hypnotics <i>SED-a-tivs/hip-NOT-iks</i>	induce relaxation and sleep; lower (sedative) doses promote relaxation leading to sleep; higher (hypnotic) doses induce sleep; antianxiety agents also used	phenobarbital zolpidem	Ambien

Box 8-4

For Your Reference

Therapeutic Uses of Herbal Medicines

NAME	PART USED	THERAPEUTIC USES
aloe <i>AL-ō</i>	leaf	treatment of burns and minor skin irritations
black cohosh <i>KŌ-hosh</i>	root	reduction of menopausal hot flashes
chamomile <i>KAM-ō-mil</i>	flower	antiinflammatory, gastrointestinal antispasmodic, sedative
echinacea <i>e-ki-NĀ-shē-a</i>	all	may reduce severity and duration of colds, may stimulate the immune system, used topically for wound healing
evening primrose oil <i>PRIM-rōz</i>	seed	source of essential fatty acids important for the health of the cardiovascular system; treatment of premenstrual syndrome (PMS), rheumatoid arthritis, skin disorders
flax	seed	source of fatty acids important in maintaining proper lipids (e.g., cholesterol) in the blood
ginger <i>JIN-jer</i>	root	relief of nausea and motion sickness, treatment of colds and sore throat
ginkgo <i>GING-kō</i>	leaf	improves blood circulation in and function of the brain, improves memory, used to treat dementia, antianxiety agent, protects the nervous system

(Continued)

Therapeutic Uses of Herbal Medicines (*Continued*)

NAME	PART USED	THERAPEUTIC USES
ginseng <i>JIN-seng</i>	root	stress reduction, lowers blood cholesterol and blood sugar
green tea	leaf	antioxidant, acts against cancer of the gastrointestinal tract and skin, oral antimicrobial agent, reduces dental caries
kava <i>KA-va</i>	root	antianxiety agent, sedative
milk thistle <i>thisl</i>	seeds	protects the liver against toxins, antioxidant
saw palmetto <i>pal-MET-ō</i>	berries	used to treat benign prostatic hyperplasia (BPH)
slippery elm	bark	as lozenge for throat irritation, for gastrointestinal irritation and upset, protects irritated skin
soy	bean	rich source of nutrients; protective estrogenic effects in menopausal symptoms, osteoporosis, cardiovascular disease, cancer prevention
St. John wort	flower	treatment of anxiety and depression, has antibacterial and antiviral properties (note: this product can interact with a variety of drugs)
tea tree oil	leaf	antimicrobial; used to heal cuts, skin infections, burns
valerian <i>va-LĒ-rē-an</i>	root	sedative, sleep aid

Box 8-5

For Your Reference

Routes of Drug Administration

ROUTE	DESCRIPTION
BY ABSORPTION	
absorption <i>ab-SORP-shun</i>	drug taken into the circulation through the digestive tract or by transfer across another membrane
inhalation <i>in-ha-LĀ-shun</i>	administration through the respiratory system, as by breathing in an aerosol or nebulizer spray
instillation <i>in-stil-LĀ-shun</i>	liquid is dropped or poured slowly into a body cavity or on the surface of the body, such as into the ear or onto the conjunctiva of the eye (Fig. 8-2)
oral <i>OR-al</i>	given by mouth; per os (po)
rectal <i>REK-tal</i>	administered by rectal suppository or enema
sublingual (SL) <i>sub-LING-gwal</i>	administered under the tongue
topical <i>TOP-i-kal</i>	applied to the surface of the skin
transdermal <i>trans-DER-mal</i>	absorbed through the skin, as from a patch placed on the surface of the skin

Routes of Drug Administration (*Continued*)

ROUTE	DESCRIPTION
BY INJECTION	
injection <i>in-JEK-shun</i>	administered by a needle and syringe (Fig. 8-3); described as parenteral (<i>pa-REN-ter-al</i>) routes of administration
epidural <i>ep-i-DUR-al</i>	injected into the space between the meninges (membranes around the spinal cord) and the spine
hypodermoclysis <i>hī-pō-der-MOK-li-sis</i>	administration of a solution by subcutaneous infusion. Useful for fluid delivery as an alternative for intravenous infusion
intra dermal (ID) <i>in-tra-DER-mal</i>	injected into the skin
intramuscular (IM) <i>in-tra-MUS-kū-lar</i>	injected into a muscle
intravenous (IV) <i>in-tra-VĒ-nus</i>	injected into a vein
spinal (intrathecal) <i>in-tra-THĒ-kal</i>	injected through the meninges into the spinal fluid
subcutaneous (SC) <i>sub-kū-TĀ-nē-us</i>	injected beneath the skin; hypodermic



See illustrations of various drug administration routes in the Student Resources on thePoint.



Figure 8-1 Inhalation of a drug. The patient is using a metered-dose inhaler for drug administration.

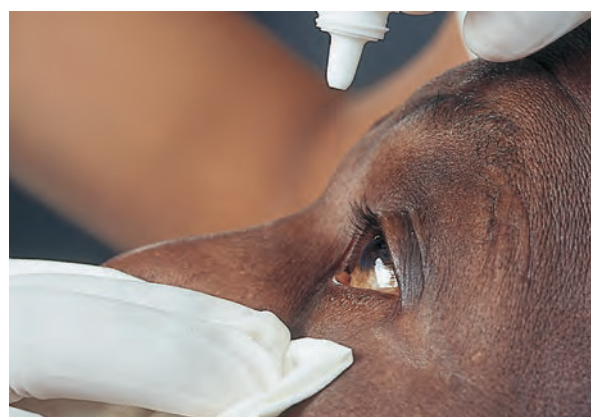


Figure 8-2 Instillation of a drug. A practitioner pulls down the lower lid to administer eye drops into the lower conjunctival sac.

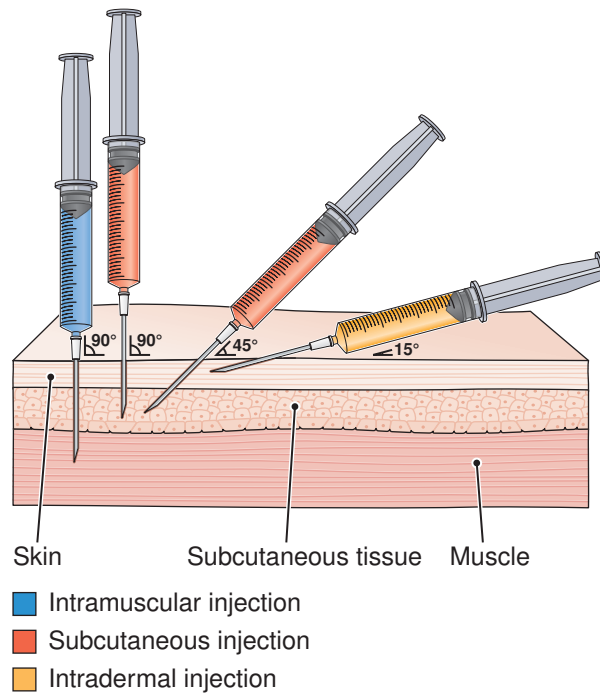


Figure 8-3 Injection. Comparison of the angles of insertion for intramuscular, subcutaneous, and intradermal injections.

Box 8-6

For Your Reference

Drug Preparations

FORM	DESCRIPTION
LIQUID	
aerosol <i>AR-o-sol</i>	solution dispersed as a mist to be inhaled
aqueous solution <i>AK-wē-us</i>	substance dissolved in water
elixir (elix) <i>ē-LIK-sar</i>	a clear, pleasantly flavored and sweetened hydroalcoholic liquid intended for oral use
emulsion <i>ē-MUL-shun</i>	a mixture in which one liquid is dispersed but not dissolved in another liquid
lotion <i>LŌ-shun</i>	solution prepared for topical use
suspension (susp) <i>sus-PEN-shun</i>	fine particles dispersed in a liquid, must be shaken before use
tincture (tinct) <i>TINK-chur</i>	substance dissolved in an alcoholic solution

Drug Preparations (*Continued*)

FORM	DESCRIPTION
SEMISOLID	
cream <i>krēm</i>	a semisolid emulsion used topically
ointment (ung) <i>OYNT-ment</i>	drug in a base that keeps it in contact with the skin
SOLID	
capsule (cap) <i>KAP-sŭl</i>	material in a gelatin container that dissolves easily in the stomach
lozenge <i>LOZ-enj</i>	a pleasant-tasting medicated tablet or disk to be dissolved in the mouth, such as a cough drop
suppository (supp) <i>su-POZ-i-tor-ē</i>	substance mixed and molded with a base that melts easily when inserted into a body opening
tablet (tab) <i>TAB-let</i>	a solid dosage form containing a drug in a pure state or mixed with a nonactive ingredient and prepared by compression or molding, also called a pill

Box 8-7

For Your Reference

Terms Pertaining to Injectable Drugs

TERM	MEANING
ampule <i>AM-pŭl</i>	a small sealed glass or plastic container used for sterile intravenous solutions (Fig. 8-4)
bolus <i>BŌ-lus</i>	a concentrated amount of a diagnostic or therapeutic substance given rapidly intravenously
catheter <i>KATH-e-ter</i>	a thin tube that can be passed into a body cavity, organ, or vessel (Fig. 8-6)
syringe <i>sir-INJ</i>	an instrument for injecting fluid (Fig. 8-5) (see also Fig. 8-4)
vial <i>Vī-al</i>	a small glass or plastic container (see Fig. 8-4)



Figure 8-4 Injectable drug containers. An ampule (**top left**), a vial (**top right**), and a syringe (**bottom**) are shown.

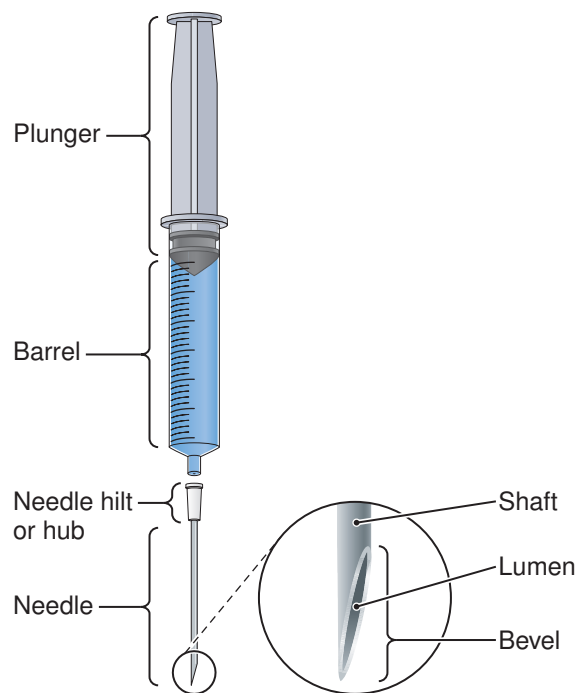


Figure 8-5 Parts of a needle and syringe.

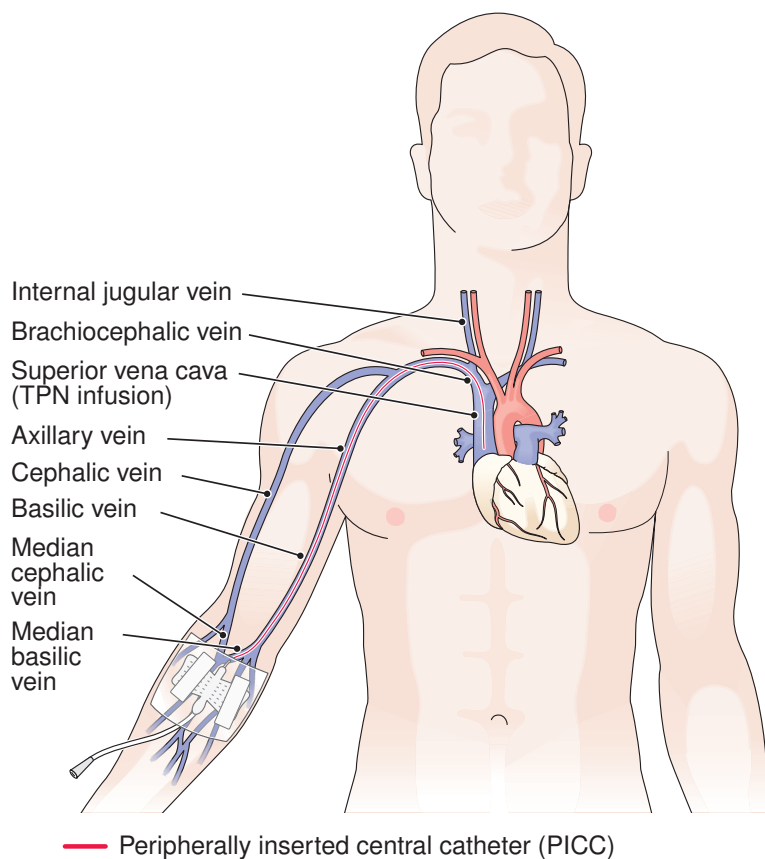


Figure 8-6 Catheter. Shown is placement of a peripherally inserted central catheter (PICC).

Following Up on P.L.'s Death

As the emergency room physician was documenting the course of events in P.L.'s death, he reviewed the patient's history and details provided by the family. He wondered if the patient routinely consumed any other OTC and herbal medications

and thought about what potentiating effects the various drug combinations may have had. On the death certificate, her primary cause of death was listed as cardiac arrest. Multiple secondary diagnoses were listed, including polypharmacy.

Chapter Review

MATCHING

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|-------------------------|---|
| _____ 1. potentiation | a. promoting excretion of water |
| _____ 2. antiemetic | b. flowing in an opposite direction |
| _____ 3. countercurrent | c. agent that prevents vomiting |
| _____ 4. hyperpyrexia | d. combined drug action to greater effect |
| _____ 5. diuretic | e. abnormally high body temperature |
| _____ 6. efficacy | a. sympathomimetic |
| _____ 7. adrenergic | b. affecting timing |
| _____ 8. vasomotor | c. extreme allergic reaction |
| _____ 9. chronotropic | d. effectiveness |
| _____ 10. anaphylaxis | e. pertaining to vessel movement |
| _____ 11. ASA | a. without |
| _____ 12. ad lib | b. as desired |
| _____ 13. aq | c. aspirin |
| _____ 14. \bar{s} | d. three times a day |
| _____ 15. tid | e. water |
| _____ 16. green tea | a. antimicrobial |
| _____ 17. aloe | b. source of fatty acids |
| _____ 18. ginger root | c. used to treat burns, irritation |
| _____ 19. tea tree oil | d. antioxidant |
| _____ 20. flax seed | e. relieves nausea |

MULTIPLE CHOICE

Select the best answer and write the letter of your choice to the left of each number.

- _____ 21. Another term for brand name is:
- indicated name
 - generic name
 - prescription name
 - chemical name
 - trade name
- _____ 22. A drug that is administered topically is:
- swallowed
 - injected
 - applied to the skin
 - placed under the tongue
 - inserted with a catheter

_____ 23. Drug administration by injection is described as:

- a. partial
- b. instilled
- c. encapsulated
- d. nebulized
- e. parenteral

_____ 24. An ampule is a(n):

- a. concentrated amount given rapidly
- b. mist to be inhaled
- c. tablet to dissolve in the mouth
- d. small sealed container
- e. alcoholic solution

_____ 25. A hypolipidemic drug

- a. lowers cholesterol
- b. increases urination
- c. fights infection
- d. reduces inflammation
- e. diminishes sensation

_____ 26. Another term for hypodermic is:

- a. intrathecal
- b. spinal
- c. epidural
- d. subcutaneous
- e. aqueous

_____ 27. NSAIDs are used to treat:

- a. inflammation
- b. convulsions
- c. nausea
- d. hypertension
- e. diabetes

_____ 28. Proton pump inhibitors

- a. relieve depression
- b. relax muscle spasms
- c. are used to treat asthma
- d. are used to administer drugs
- e. reduce stomach acidity

- _____ **29.** P.L.'s nitroglycerine in the opening case study is ordered: prn SL. This means:
- a.** as needed, under the tongue
 - b.** at bedtime, under the tongue
 - c.** as needed, on the skin
 - d.** by mouth, on the skin
 - e.** by mouth, under the skin
- _____ **30.** P.L. took several OTC preparations. OTC means:
- a.** on the cutaneous
 - b.** off the cuff
 - c.** over the counter
 - d.** do not need a prescription
 - e.** c and d
- _____ **31.** P.L.'s herbal sleeping potion was mixed into tea and taken at bedtime. The dissolved mixture is called a(n) _____ and is taken at _____.
- a.** elixir/QAM
 - b.** emulsion/bid
 - c.** suspension/hs
 - d.** aqueous solution/hs
 - e.** aqueous solution/QAM
- _____ **32.** During P.L.'s resuscitation, epinephrine was given in an IV bolus. This means it was administered:
- a.** intrathecally in a continuous drip
 - b.** parenterally in a topical solution
 - c.** intravenously in a continuous drip
 - d.** intravenously in a rapid concentrated dose
 - e.** intrathecally in a rapid concentrated dose
- _____ **33.** P.L. had a secondary diagnosis of polypharmacy. This means that she:
- a.** used more than one drug store
 - b.** had polyps
 - c.** used more prescription than OTC drugs
 - d.** had a toxic dose
 - e.** used many different drugs

FILL IN THE BLANKS

- 34.** An analgesic is used to treat _____.
- 35.** An intravenous injection is given into a(n) _____.
- 36.** When a drug has lost its effect at a constant dose, the patient has developed _____.
- 37.** Phytomedicine is the practice of treating with _____.
- 38.** A transdermal route of administration is through the _____.

39. A toxicologist is one who studies _____.
40. The study of drugs and their actions is called _____.
41. An antipyretic drug counteracts _____.
42. With reference to drug interactions, another term for synergy is _____.

ELIMINATIONS

In each of the sets below, underline the word that does not fit in with the rest and explain the reason for your choice.

43. antitussive — histamine H₂ antagonist — expectorant — mucolytic — bronchodilator
- _____

44. solution — elixir — tincture — emulsion — tablet
- _____

45. antineoplastics — nitrates — antiarrhythmics — calcium-channel blockers — beta-blockers
- _____

46. anesthetic — analgesic — narcotic — adrenergic — sedative
- _____

DEFINITIONS

Define each of the following words:

47. bronchodilation _____
48. anxiolytic _____
49. psychotropic _____

OPPOSITES

Write a word that means the opposite of each of the following:

50. convulsant _____
51. vasoconstriction _____
52. balance _____
53. toxin _____
54. indicated _____
55. coagulant _____

ABBREVIATIONS

Define each of the following abbreviations:

56. USP _____
57. IU _____
58. Rx _____
59. FDA _____
60. D/C _____

WORD BUILDING

Write a word for each of the following definitions using the word parts given.

narc/o -lytic thromb/o muc/o toxic/o -sis anxi/o hypn/o

61. an induced sleep-like state _____

62. reducing anxiety _____

63. condition caused by poisoning _____

64. dissolving a blood clot _____

65. condition of having a blood clot _____

66. a state of stupor _____

67. dissolving mucus _____

WORD ANALYSIS

Define each of the following words, and give the meaning of the word parts in each. Use a dictionary if necessary.

68. hypodermoclysis (*hī-pō-der-MOK-li-sis*) _____

a. hypo- _____

b. derm/o _____

c. clysis _____

69. adrenergic (*ad-ren-ER-jik*) _____

a. adren/o _____

b. erg/o _____

c. -ic _____

70. pharmacokinetic (*far-ma-kō-ki-NET-ik*) _____

a. pharmac/o _____

b. kinet/o _____

c. -ic _____



For more learning activities, see Chapter 8 of the Student Resources on *thePoint*.

Additional Case Studies

Case Study 8-1: Inflammatory Bowel Disease

A.E., a 19-YO college student, was diagnosed at the age of 13 with Crohn disease, a chronic inflammatory disease that can affect the entire gastrointestinal tract from mouth to anus. A.E.'s disease is limited to his large bowel. During a nine-month period of disease exacerbation characterized by severe cramping and bloody stools, he took oral corticosteroids (prednisone) to reduce the inflammatory response. He experienced many of the drug's side effects, but has been in remission for four years. Currently, A.E.'s condition is managed on drugs that reduce inflammation by suppressing the immune response. He takes

Pentasa (mesalamine) 250 mg 4 caps po bid Pentasa is of the 5-ASA (acetylsalicylic acid or aspirin) group of antiinflammatory agents, which work topically on the inner surface of the bowel. It has an enteric coating, which dissolves in the bowel environment. He also takes 6-mercaptopurine (Purinethol) 75 mg PO daily and a therapeutic vitamin with breakfast. A.E. may take acetaminophen for pain but must avoid NSAIDs, which will irritate the intestinal mucosa (inner lining) and cause a flare-up of the disease.

Case Study 8-2: Asthma

E.N., a 20-YO woman with asthma, visited the preadmission testing unit one week before her cosmetic surgery to meet with the nurse and anesthesiologist. Her current meds included several bronchodilators, which she takes by mouth and by inhalation, and a tranquilizer that she takes when needed for nervousness. She sometimes receives inhalation treatments with Mucomyst, a mucolytic agent. On E.N.'s preoperative note, the nurse wrote:

Theo-Dur 1 cap 200 mg tid
Flovent inhaler 1 spray (50 mcg each nostril b.i.d.)
Ativan (lorazepam) 1 mg po bid
Albuterol metered-dose inhaler 2 puffs (180 mcg) prn q4–6h for bronchospasm and before exercise

E.N. stated that she has difficulty with her asthma when she is anxious and when she exercises. She also admitted to occasional use of marijuana and ecstasy, a hallucinogen and mood-altering illegal recreational drug. The anesthesiologist wrote an order for lorazepam 4 mg IV one hour preop. The plastic surgeon recommended several herbal products to complement her surgery and her recovery. He ordered a high-potency vitamin 3 tabs with breakfast and dinner to support tissue health and healing. He also prescribed bromelain, an enzyme from pineapple, to decrease inflammation, 1 500 mg cap po qid three days before surgery and postoperatively for two weeks. Arnica montana was prescribed to decrease discomfort, swelling, and bruising; 3 tabs sublingual t.i.d. the evening after surgery and for the following 10 days.

CASE STUDY QUESTIONS

Multiple choice. Select the best answer and write the letter of your choice to the left of each number.

- _____ 1. A.E. takes several drugs to prevent or act against his inflammatory response. These agents are described as:
 - a. contrainflammatory
 - b. counterinflammatory
 - c. antiinflammatory
 - d. proinflammatory
 - e. hypoinflammatory
- _____ 2. A.E. presented with several untoward results or risks from the corticosteroid therapy. These sequelae are called:
 - a. contraindications
 - b. side effects
 - c. antagonistic effects
 - d. exacerbations
 - e. synergy states
- _____ 3. A.E. takes four 250-mg capsules of Pentasa po bid. How many capsules does he take in one day?
 - a. 2,000
 - b. 1,000
 - c. 4
 - d. 8
 - e. 12
- _____ 4. A.E. must avoid NSAIDs because, in cases of inflammatory bowel disease, these drugs are:
 - a. contraindicated
 - b. indicated
 - c. complementary
 - d. synergistic
 - e. prescriptive

- _____ 5. E.N. used a mucolytic drug when needed. This drug's action is to:
- increase secretions
 - decrease spasm
 - calm anxiety
 - decrease mucus secretions
 - simulate mucus
- _____ 6. E.N.'s Flovent inhaler is indicated as 1 spray of 50 mcg in each nostril bid. How many micrograms (mcg) does she get in one day?
- 100 mcg
 - 200 mcg
 - 250 mcg
 - 500 mcg
 - 5,000 mcg
- _____ 7. The Ativan that E.N. takes for nervousness is a(n) _____ drug.
- anxiolytic
 - potentiating
 - antiemetic
 - analgesic
 - bronchodilator
- _____ 8. The anesthesiologist ordered lorazepam (Ativan) to be given IV preop to decrease anxiety and to smooth E.N.'s anesthesia induction. The complementary way that lorazepam and anesthesia work together is called:
- antagonistic
 - complementary medicine
 - parasympathomimetic
 - tolerance
 - synergy
- _____ 9. Bromelain and Arnica montana are herbal products that can be described as all of the following except:
- phytopharmaceutical
 - alternative
 - herbal
 - complementary
 - chronotropic
- _____ 10. Arnica montana was prescribed 3 tabs SL tid. How many tablets would E.N. take in one day?
- 6
 - 9
 - 12
 - 21
 - 33
- _____ 11. Flovent is administered as an inhalant. The form in which the drug is prepared is called a(n):
- emulsion
 - elixir
 - aerosol
 - suspension
 - unguent

Define each of the following abbreviations:

12. po _____
13. mg _____
14. NSAIDs _____
15. mcg _____
16. IV _____



PART

III

Body Systems

- CHAPTER 9** Circulation: The Cardiovascular and Lymphatic Systems
- CHAPTER 10** Blood and Immunity
- CHAPTER 11** The Respiratory System
- CHAPTER 12** The Digestive System
- CHAPTER 13** The Urinary System
- CHAPTER 14** The Male Reproductive System
- CHAPTER 15** The Female Reproductive System; Pregnancy and Birth
- CHAPTER 16** The Endocrine System
- CHAPTER 17** The Nervous System and Behavioral Disorders
- CHAPTER 18** The Senses
- CHAPTER 19** The Skeleton
- CHAPTER 20** The Muscular System
- CHAPTER 21** The Skin

CHAPTER

9

Circulation: The Cardiovascular and Lymphatic Systems

Case Study

C.L.'s Arrhythmia during Army Boot Camp

Chief complaint:

C.L., a 19-year-old man recently enlisted into the army, successfully passed the army physicals and reported to Fort Knox for basic training. The first two weeks were uneventful as C.L. became acclimated to the vigorous daily schedules of army life. As the physical training progressed, the platoon would go on long runs in full gear. C.L. passed out during two of the long runs. The first time he was taken to the infirmary, where he was examined, was cleared, and returned to duty. With the second incident, he was put on a sick leave and sent home for additional follow-up.

Examination:

When C.L. came home, his family took him to see his primary care physician, who referred him to a cardiologist. C.L. explained to the physician that on some of the long, rigorous runs with full gear he would become short of breath and feel his heart start to race. He would then become dizzy and pass out. When he woke up, he'd be lying on the ground with his sergeant standing over him.

The physician ordered some lab tests and also a Holter monitor that C.L. was to wear for a month. He explained to C.L. and his family that he suspected an abnormal heart beat caused the fainting spells. The monitor would record any arrhythmias that occurred during the month. He told C.L. to maintain normal activities, and the monitor would detect any abnormalities that might occur.

Clinical course:

At the conclusion of the month, C.L. saw the cardiologist again. The results of the Holter monitor indicated that he had an abnormal heart rhythm known as atrial fibrillation. The physician explained the two methods of treatment for the condition: a medical approach using anticoagulants to prevent blood clots and medication to slow the heart rate, and a surgical procedure called an ablation. It was decided after reviewing the test results and discussion with family on the pros and cons of the various treatment options that a pulmonary vein catheter ablation was the treatment of choice for C.L.





Ancillaries *At-A-Glance*

Visit thePoint to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii–xvi.

Learning TOOLS

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning RESOURCES

- E-book: Chapter 9
- Web Figure: Pathway of Blood through the Heart
- Web Figure: Evolution of Atherosclerosis
- Web Figure: Clinical Picture of Acute Myocardial Infarction
- Web Chart: Lymphoid Tissue
- Animation: Blood Circulation
- Animation: Cardiac Cycle
- Animation: Hypertension
- Animation: Heart Failure
- Audio Pronunciation Glossary

Learning ACTIVITIES

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After study of this chapter you should be able to:

- 1 Describe the structure of the heart. *p174*
- 2 Trace the path of blood flow through the heart. *p175*
- 3 Trace the path of electrical conduction through the heart. *p177*
- 4 Identify the components of an electrocardiogram. *p178*
- 5 Differentiate among arteries, arterioles, capillaries, venules, and veins. *p178*
- 6 Explain blood pressure and describe how blood pressure is measured. *p179*
- 7 Identify and use the roots pertaining to the cardiovascular and lymphatic systems. *pp183, 197*
- 8 Describe the main disorders that affect the cardiovascular and lymphatic systems. *pp185, 198*
- 9 Define medical terms pertaining to the cardiovascular and lymphatic systems. *pp191, 198*
- 10 List the functions and components of the lymphatic system. *p195*
- 11 Interpret medical abbreviations referring to circulation. *p203*
- 12 Analyze medical terms in case studies involving circulation. *pp172, 212*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|---|---|
| <p>_____ 1. The cardiovascular system includes the heart and:
 a. lungs
 b. blood vessels
 c. digestive organs
 d. endocrine system</p> | <p>_____ 5. The tonsils, spleen, thymus, and nodes are part of the:
 a. digestive system
 b. endocrine system
 c. epicardium
 d. lymphatic system</p> |
| <p>_____ 2. The thick, muscular layer of the heart wall is the:
 a. endocardium
 b. valve
 c. myocardium
 d. apex</p> | <p>_____ 6. The medical term for a “heart attack” is:
 a. myocardial infarction
 b. cerebrovascular accident
 c. aneurysm
 d. pneumonia</p> |
| <p>_____ 3. The lower chambers of the heart are the:
 a. ventricles
 b. atria
 c. base
 d. systole</p> | <p>_____ 7. The accumulation of fatty deposits in the lining of a vessel is called:
 a. obesity
 b. atherosclerosis
 c. stent
 d. angiogenesis</p> |
| <p>_____ 4. A vessel that carries blood away from the heart is a(n):
 a. vein
 b. chamber
 c. lymph node
 d. artery</p> | <p>_____ 8. Phlebitis is inflammation of a:
 a. blood cell
 b. vein
 c. heart
 d. nerve</p> |

Blood circulates throughout the body in the **cardiovascular system**, which consists of the **heart** and the **blood vessels** (Fig. 9-1). This system forms a continuous circuit that delivers oxygen and nutrients to all cells and carries away waste products. The lymphatic system also functions in circulation. Its vessels drain fluid and proteins left in the tissues and return them to the bloodstream. The lymphatic system plays a part in immunity and in the digestive process as well, as explained in Chapters 10 and 12. This chapter discusses the circulatory system in detail, in both its normal and clinical aspects, and then proceeds to study the lymphatic system.

The Heart

The heart is located between the lungs, with its point, or **apex**, directed toward the inferior and left (Fig. 9-2). The wall of the heart consists of three layers, all named with the root *cardi*, meaning “heart.” Moving from the innermost to the outermost layer, these are the:

1. **Endocardium**—a thin membrane that lines the chambers and valves (the prefix *endo-* means “within”).

2. **Myocardium**—the thick muscle layer that makes up most of the heart wall (the root *my/o* means “muscle”).
3. **Epicardium**—a thin membrane that covers the heart (the prefix *epi-* means “on”).

A fibrous sac, the **pericardium**, contains the heart and anchors it to surrounding structures, such as the sternum (breastbone) and diaphragm (the prefix *peri-* means “around”).

Each of the heart’s upper receiving chambers is an **atrium** (plural: atria). Each of the lower pumping chambers is a **ventricle** (plural: ventricles). The chambers of the heart are divided by walls, each of which is called a **septum**. The interventricular septum separates the two ventricles; the interatrial septum divides the two atria. There is also a septum between the atrium and ventricle on each side.

The heart pumps blood through two circuits. The right side pumps blood to the lungs to be oxygenated through the **pulmonary circuit**. The left side pumps to the remainder of the body through the **systemic circuit** (see Fig. 9-1).

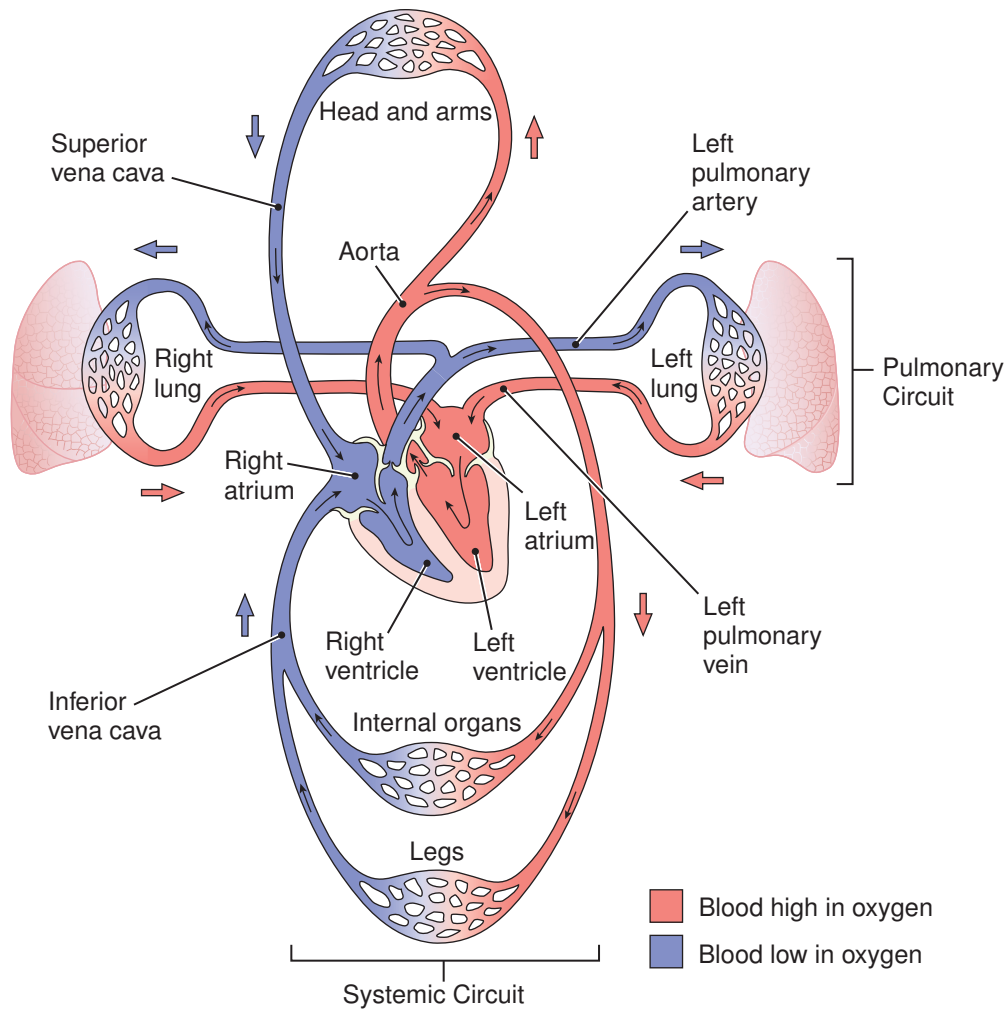


Figure 9-1 The cardiovascular system. The pulmonary circuit carries blood to and from the lungs; the systemic circuit carries blood to and from all other parts of the body.

BLOOD FLOW THROUGH THE HEART

The pathway of blood through the heart is shown by the arrows in **Figure 9-2**. The sequence is as follows:

1. The right atrium receives blood low in oxygen from all body tissues through the **superior vena cava** and the **inferior vena cava**.
2. The blood then enters the right ventricle and is pumped to the lungs through the **pulmonary artery**.
3. Blood returns from the lungs high in oxygen and enters the left atrium through the **pulmonary veins**.
4. Blood enters the left ventricle and is forcefully pumped into the **aorta** to be distributed to all tissues.

One-way valves in the heart keep blood moving in a forward direction. The valves between the atrium and ventricle on each side are the **atrioventricular (AV) valves** (see **Fig. 9-2**). The valve between the right atrium and ventricle

is the **right AV valve**, also known as the **tricuspid valve** because it has three cusps (flaps). The valve between the left atrium and ventricle is the **left AV valve**, which is a **bicuspid valve** with two cusps; it is often called the **mitral valve** (so named because it resembles a bishop's miter).

The valves leading into the pulmonary artery and the aorta have three cusps. Each cusp is shaped like a half-moon, so these valves are described as **semilunar valves** (*lunar* refers to the moon). The valve at the entrance to the pulmonary artery is specifically named the **pulmonary valve**; the valve at the entrance to the aorta is the **aortic valve**.



See the Student Resources on thePoint for a figure on the pathway of blood through the heart and the animations "Blood Circulation" and "Cardiac Cycle."

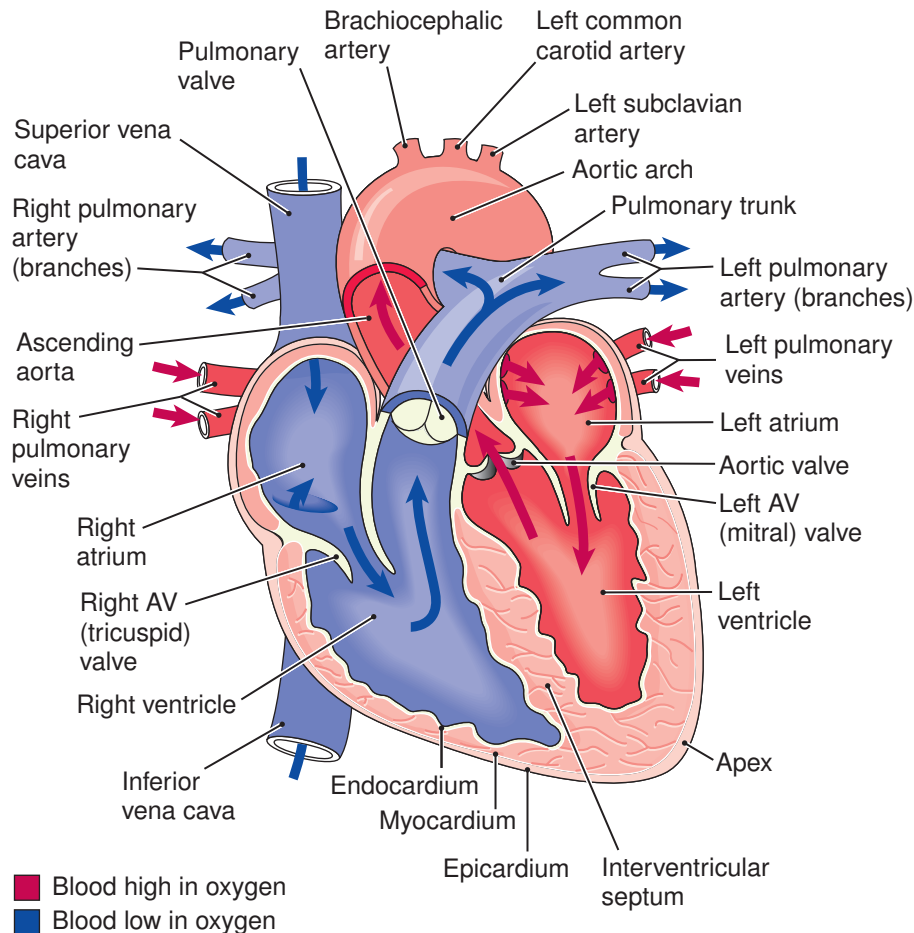


Figure 9-2 The heart and great vessels. AV stands for atrioventricular.

Heart sounds are produced as the heart functions. The loudest of these, the familiar lub and dup that can be heard through the chest wall, are produced by alternate closings of the valves. The first heart sound (S_1) is heard when the valves between the chambers close. The second heart sound (S_2) is produced when the valves leading into the aorta and pulmonary artery close. Any sound made as the heart functions normally is termed a **functional murmur**. (The word *murmur* used alone with regard to the heart describes an abnormal sound.)

THE HEARTBEAT

Each contraction of the heart, termed **systole** (*SIS-tō-lē*), is followed by a relaxation phase, **diastole** (*dī-AS-tō-lē*), during which the chambers fill. Each time the heart beats, both atria contract, and immediately thereafter both ventricles contract. The number of times the heart contracts per minute is the **heart rate**. The wave of increased pressure produced in the vessels each time the ventricles contract is the **pulse**. Pulse rate is usually counted by palpating a peripheral artery, such as the radial artery at the wrist or the carotid artery in the neck (see Fig. 7-4).

Cardiac contractions are stimulated by a built-in system that regularly transmits electrical impulses through the heart. The components of this conduction system are shown in Figure 9-3. In the sequence of action, they include the:

1. **Sinoatrial (SA) node**, located in the upper right atrium and called the *pacemaker* because it sets the rate of the heartbeat.
2. **Atrioventricular (AV) node**, located at the bottom of the right atrium near the ventricle. Internodal fibers between the SA and AV nodes carry stimulation throughout both atria.
3. **AV bundle (bundle of His)** at the top of the interventricular septum.
4. **Left and right bundle branches**, which travel along the left and right sides of the septum.
5. **Purkinje (pur-KIN-jē) fibers**, which carry stimulation throughout the walls of the ventricles (see information on naming in Box 9-1).

Although the heart itself generates the heartbeat, factors such as nervous system stimulation, hormones, and drugs can influence the rate and the force of contractions.

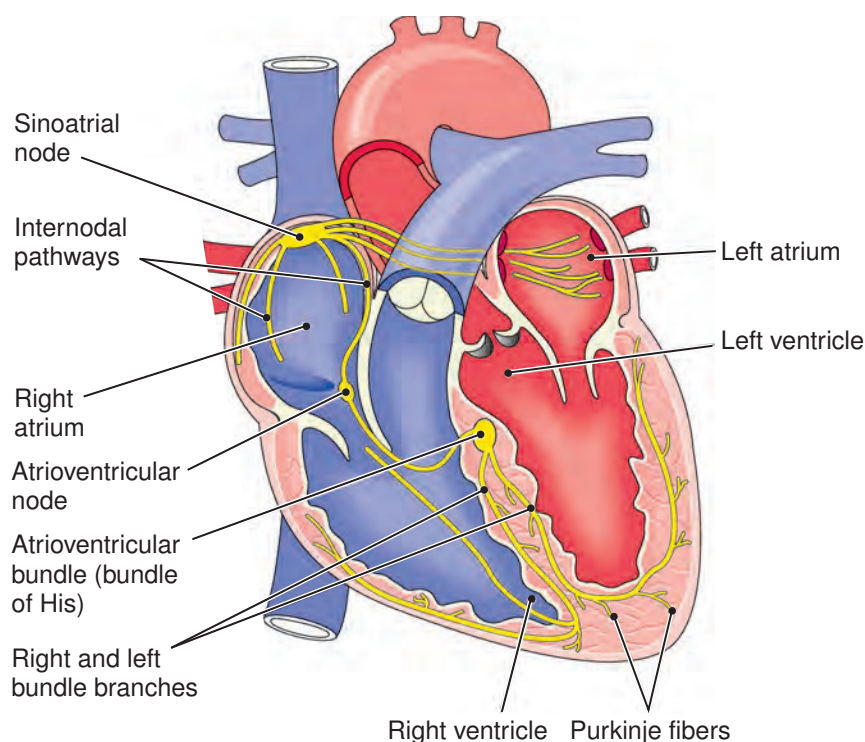


Figure 9-3 The heart's electrical conduction system. Impulses travel from the sinoatrial (SA) node to the atrioventricular (AV) node, then to the atrioventricular bundle, bundle branches, and Purkinje fibers. Internodal pathways carry impulses throughout the atria.

Box 9-1



Focus on Words

Name That Structure

An eponym (*EP-o-nim*) is a name that is based on the name of a person, usually the one who discovered a particular structure, disease, principle, or procedure. Everyday examples are graham cracker, Ferris wheel, and boycott. In the heart, the bundle of His and Purkinje fibers are part of that organ's electrical conduction system. Korotkoff sounds are heard in the vessels when taking blood pressure. Cardiovascular disorders named for people include the tetralogy of Fallot, a combination of four congenital heart defects; Raynaud disease of small vessels; and the cardiac arrhythmia known as Wolff-Parkinson-White syndrome. In treatment, Doppler echocardiography is named for a physicist of the 19th century. The Holter monitor and the Swan-Ganz catheter give honors to their developers.

In other systems, the islets of Langerhans are cell clusters in the pancreas that secrete insulin. The graafian follicle in the ovary surrounds a mature egg cell. The eustachian tube connects the middle ear to the throat.

Many disease names are eponymic: Parkinson and Alzheimer, which affect the brain; Graves, a disorder of the

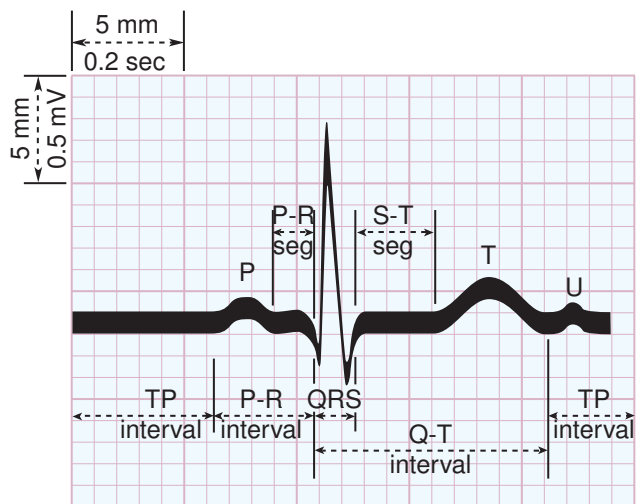
thyroid; Addison and Cushing, involving the adrenal cortex; and Down syndrome, a hereditary disorder. The genus and species names of microorganisms often are based on the names of their discoverers, *Escherichia*, *Salmonella*, *Pasteurella*, and *Rickettsia* to name a few.

Many reagents, instruments, and procedures are named for their developers too. The original name for a radiograph was roentgenograph (*RENT-jen-ō-graf*), named for Wilhelm Roentgen, discoverer of x-rays. A curie is a measure of radiation, derived from the name of Marie Curie, a co-discoverer of radioactivity.

Although eponyms give honor to physicians and scientists of the past, they do not convey any information and may be more difficult to learn. There is a trend to replace these names with more descriptive ones; for example, auditory tube instead of eustachian tube, mature ovarian follicle for graafian follicle, pancreatic islets for islets of Langerhans, and trisomy 21 for Down syndrome.



A



B

Figure 9-4 Electrocardiography (ECG). A. ECG tracing showing a normal sinus rhythm. B. Components of a normal ECG tracing. Shown are the P, QRS, T, and U waves, which represent electrical activity in different parts of the heart. Intervals measure from one wave to the next; segments are smaller components of the tracing.

Electrocardiography

Electrocardiography (ECG) measures the heart's electrical activity as it functions (Fig. 9-4). Electrodes (leads) placed on the body's surface detect the electrical signals, which are then amplified and recorded as a tracing. A normal, or **sinus rhythm**, which originates at the SA node, is shown in Figure 9-4A. Figure 9-4B shows the letters assigned to individual components of one complete cycle:

1. The P wave represents electrical change, or **depolarization**, of the atrial muscles.
2. The QRS component shows depolarization of the ventricles.
3. The T wave shows return, or **repolarization**, of the ventricles to their resting state. Atrial repolarization is hidden by the QRS wave.
4. The small U wave, if present, follows the T wave. It is of uncertain origin.

An *interval* measures the distance from one wave to the next; a *segment* is a smaller component of the tracing. Many heart disorders, some of which are described later in the chapter, appear as abnormalities in ECG components.

The Vascular System

The vascular system consists of:

1. **Arteries** that carry blood away from the heart (Fig. 9-5)
2. **Arterioles**, vessels smaller than arteries that lead into the capillaries
3. **Capillaries**, the smallest vessels, through which exchanges take place between the blood and the tissues
4. **Venules**, small vessels that receive blood from the capillaries and drain into the veins
5. **Veins** that carry blood back to the heart (Fig. 9-6)

All arteries, except the pulmonary artery (and the umbilical artery in the fetus), carry highly oxygenated blood. They are thick-walled, elastic vessels that carry blood under high pressure. All veins, except the pulmonary vein (and the umbilical vein in the fetus), carry blood low in oxygen. Veins have thinner, less elastic walls and tend to give way under pressure. Like the heart, veins have one-way valves that keep blood flowing forward.

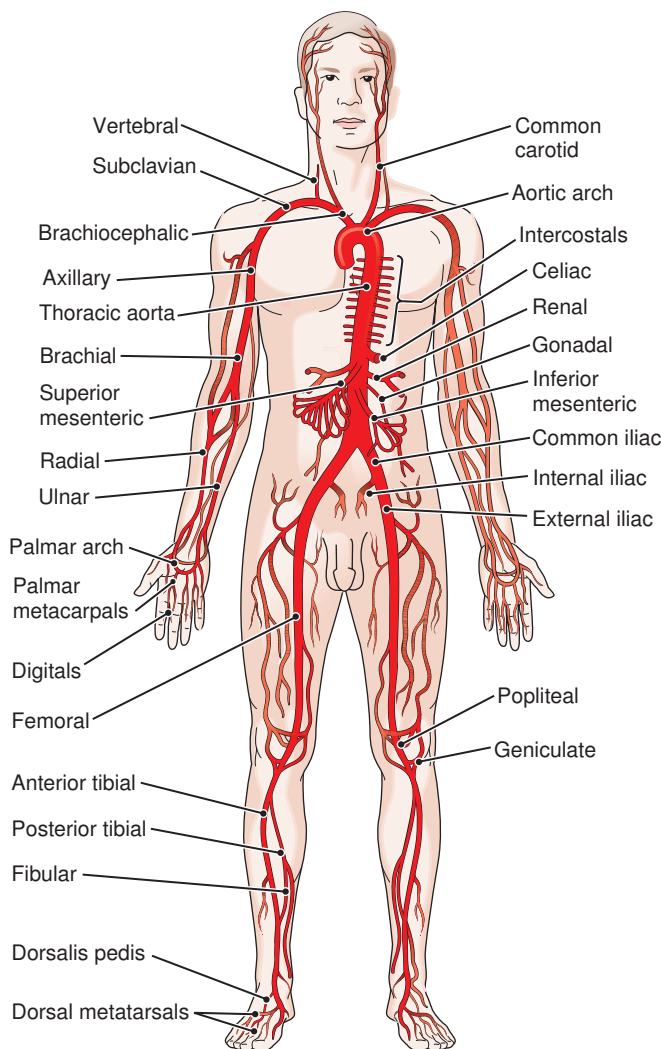


Figure 9-5 Principal systemic arteries.

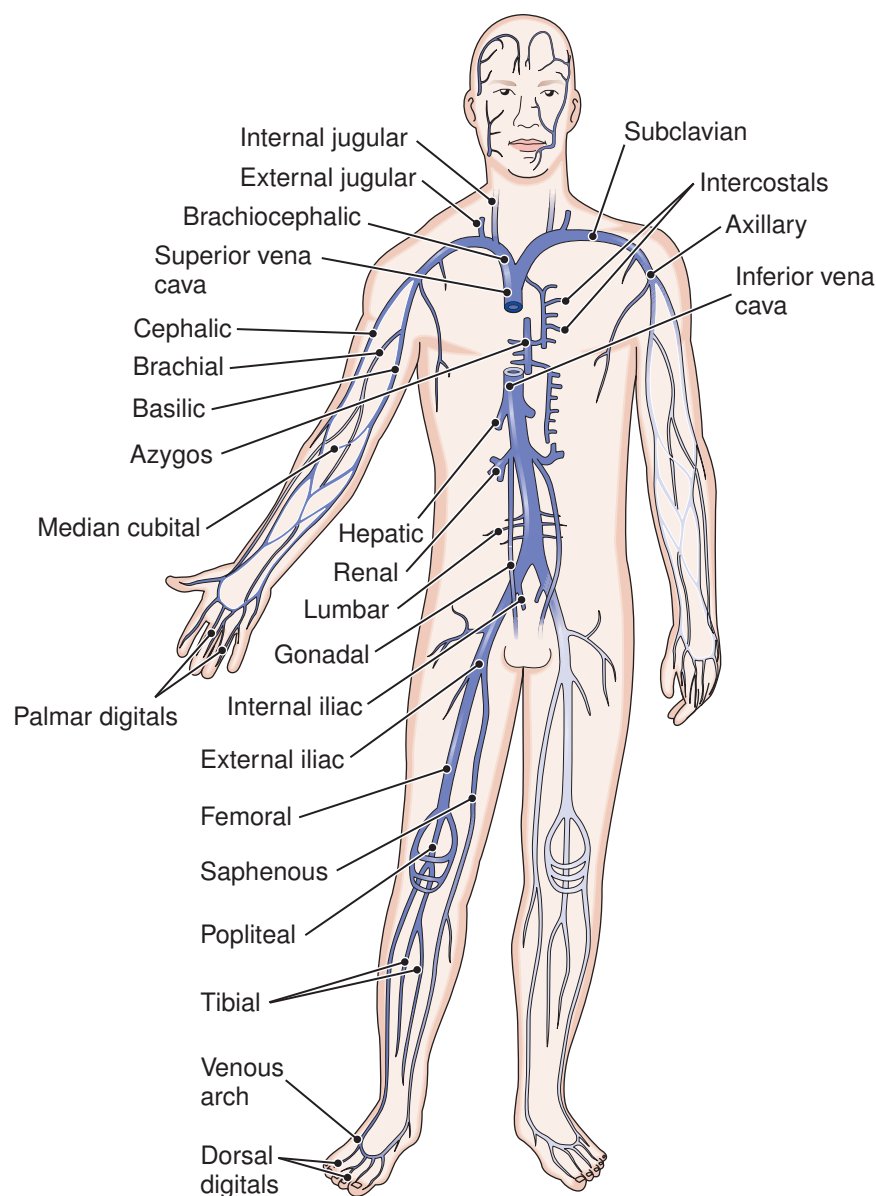


Figure 9-6 Principal systemic veins.

Nervous system stimulation can cause the diameter of a vessel to increase (vasodilation) or decrease (vasoconstriction). These changes alter blood flow to the tissues and affect blood pressure.

Blood Pressure

Blood pressure (BP) is the force exerted by blood against the wall of a blood vessel. It falls as the blood travels away from the heart and is influenced by a variety of factors, including cardiac output, vessel diameters, and total blood volume. Vasoconstriction increases blood pressure in a vessel; vasodilation decreases pressure.

Blood pressure is commonly measured in a large artery with an inflatable cuff (Fig. 9-7) known as a blood pressure cuff or blood pressure apparatus, but technically

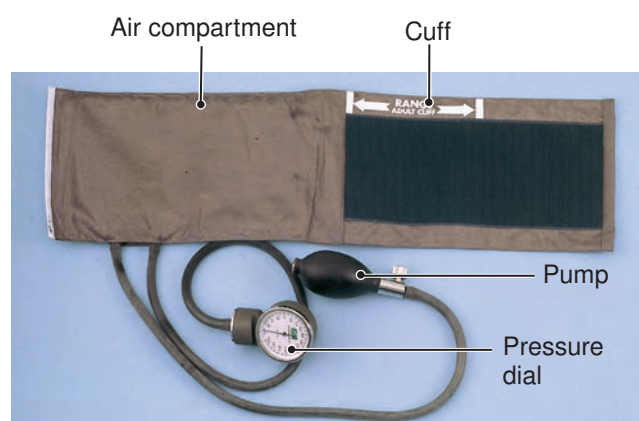


Figure 9-7 Blood pressure cuff (sphygmomanometer). Shown are the cuff, the bulb for inflating the cuff, and the manometer for measuring pressure.

Box 9-2



Clinical Perspectives

Cardiac Catheterization: Measuring Blood Pressure from Within

Because arterial blood pressure decreases as blood flows farther away from the heart, measurement of blood pressure with a simple inflatable cuff around the arm is only a reflection of the pressure in the heart and pulmonary arteries. Precise measurement of pressure in these parts of the cardiovascular system is useful in diagnosing certain cardiac and pulmonary disorders.

More accurate readings can be obtained using a catheter (thin tube) inserted directly into the heart and large vessels. One type commonly used is the pulmonary artery catheter (also known as the Swan-Ganz catheter), which has an inflatable balloon at the tip. This device is threaded into the right side of the heart through a large vein. Typically, the right internal jugular vein is used because it is the shortest

and most direct route to the heart, but the subclavian and femoral veins may also be used. The catheter's position in the heart is confirmed by a chest x-ray, and when appropriately positioned, the atrial and ventricular blood pressures are recorded. As the catheter continues into the pulmonary artery, pressure in this vessel is readable. When the balloon is inflated, the catheter becomes wedged in a branch of the pulmonary artery, blocking blood flow. The reading obtained is called the pulmonary capillary wedge pressure (PCWP). It gives information on pressure in the heart's left side and on resistance in the lungs. Combined with other tests, cardiac catheterization can be used to diagnose cardiac and pulmonary disorders such as shock, pericarditis, congenital heart disease, and heart failure.

called a **sphygmomanometer**. The examiner inflates the cuff to stop blood flow in a vessel. He or she then uses a stethoscope to listen for blood flow in the vessel as the pressure is slowly released (see Fig. 7-5). The blood pressure reading includes both systolic pressure, measured while the heart is contracting, and diastolic pressure, measured when the heart relaxes. These are reported

as systolic then diastolic separated by a slash, such as 120/80. Pressure is expressed as millimeters of mercury (mm Hg)—that is, the height to which the pressure can push a column of mercury in a tube. Blood pressure is a valuable diagnostic measurement that is easily obtained. (See Box 9-2 for more information on blood pressure measurement.)

Terminology

Key Terms

Cardiovascular System

Normal Structure and Function

aorta <i>ā-OR-ta</i>	The largest artery. It receives blood from the left ventricle and branches to all parts of the body (root: aort/o)
aortic valve <i>ā-OR-tik</i>	The valve at the entrance to the aorta
apex <i>Ā-peks</i>	The point of a cone-shaped structure (adjective: apical). The apex of the heart is formed by the left ventricle and is pointed toward the inferior and left
artery <i>AR-te-rē</i>	A vessel that carries blood away from the heart. All except the pulmonary and umbilical arteries carry oxygenated blood (roots: arter, arteri/o)
arteriole <i>ar-TĒ-rē-ōl</i>	A small vessel that carries blood from the arteries into the capillaries (root: arteriol/o)
atrioventricular (AV) node <i>ā-trē-ō-ven-TRIK-ū-lar</i>	A small mass in the lower septum of the right atrium that passes impulses from the sinoatrial (SA) node toward the ventricles
atrioventricular (AV) valve	A valve between the atrium and ventricle on the right and left sides of the heart. The right AV valve is the tricuspid valve; the left is the mitral valve

Terminology

Key Terms (Continued)

9

atrium <i>Ā-trē-um</i>	An entrance chamber, one of the two upper receiving chambers of the heart (root: atri/o)
AV bundle	A band of fibers that transmits impulses from the atrioventricular (AV) node to the top of the interventricular septum. It divides into the right and left bundle branches, which descend along the two sides of the septum; the bundle of His
blood pressure	The force exerted by blood against the wall of a vessel
bundle branches	Branches of the AV bundle that divide to the right and left sides of the interventricular septum
capillary <i>KAP-i-lar-ē</i>	A microscopic blood vessel through which materials are exchanged between the blood and the tissues
cardiovascular system <i>kar-dē-ō-VAS-kū-lar</i>	The part of the circulatory system that consists of the heart and the blood vessels
depolarization <i>dē-pō-lar-i-ZĀ-shun</i>	A change in electrical charge from the resting state in nerves or muscles
diastole <i>dī-AS-tō-lē</i>	The relaxation phase of the heartbeat cycle; adjective: diastolic
electrocardiography (ECG) <i>ē-lek-trō-kar-dē-OG-ra-fē</i>	Study of the electrical activity of the heart as detected by electrodes (leads) placed on the surface of the body. Also abbreviated EKG from the German <i>elektrokardiography</i>
endocardium <i>en-dō-KAR-dē-um</i>	The thin membrane that lines the chambers of the heart and covers the valves
epicardium <i>ep-i-KAR-dē-um</i>	The thin outermost layer of the heart wall
functional murmur	Any sound produced as the heart functions normally
heart <i>hart</i>	The muscular organ with four chambers that contracts rhythmically to propel blood through vessels to all parts of the body (root: cardi/o)
heart rate	The number of times the heart contracts per minute; recorded as beats per minute (bpm)
heart sounds	Sounds produced as the heart functions. The two loudest sounds are produced by alternate closing of the valves and are designated S ₁ and S ₂
inferior vena cava <i>VĒ-na KĀ-va</i>	The large inferior vein that brings blood low in oxygen back to the right atrium of the heart from the lower body
left AV valve	The valve between the left atrium and the left ventricle; the mitral valve or bicuspid valve
mitral valve <i>MI-tral</i>	The valve between the left atrium and the left ventricle; the left AV valve or bicuspid valve
myocardium <i>mī-ō-KAR-dē-um</i>	The thick middle layer of the heart wall composed of cardiac muscle
pericardium <i>per-i-KAR-dē-um</i>	The fibrous sac that surrounds the heart
pulmonary artery <i>PUL-mō-nār-ē</i>	The vessel that carries blood from the right side of the heart to the lungs

(Continued)

Terminology**Key Terms** *(Continued)*

pulmonary circuit <i>SER-kit</i>	The system of vessels that carries blood from the right side of the heart to the lungs to be oxygenated and then back to the left side of the heart
pulmonary veins	The vessels that carry blood from the lungs to the left side of the heart
pulmonary valve	The valve at the entrance to the pulmonary artery
pulse <i>puls</i>	The wave of increased pressure produced in the vessels each time the ventricles contract
Purkinje fibers <i>pur-KIN-jē</i>	The terminal fibers of the cardiac conducting system. They carry impulses through the walls of the ventricles
repolarization <i>rē-pō-lar-i-ZĀ-shun</i>	A return of electrical charge to the resting state in nerves or muscles
right AV valve	The valve between the right atrium and right ventricle; the tricuspid valve
septum <i>SEP-tum</i>	A wall dividing two cavities, such as two chambers of the heart
sinus rhythm <i>SĪ-nus RITH-um</i>	Normal heart rhythm
sinoatrial (SA) node <i>sī-nō-Ā-trē-al</i>	A small mass in the upper part of the right atrium that initiates the impulse for each heartbeat; the pacemaker
sphygmomanometer <i>sfig-mō-man-OM-e-ter</i>	An instrument for determining arterial blood pressure (root <i>sphygm/o</i> means “pulse”); blood pressure apparatus or cuff
superior vena cava <i>VĒ-na KĀ-va</i>	The large superior vein that brings blood low in oxygen back to the right atrium from the upper body
systemic circuit <i>sis-TEM-ik SER-kit</i>	The system of vessels that carries oxygenated blood from the left side of the heart to all tissues except the lungs and returns deoxygenated blood to the right side of the heart
systole <i>SIS-tō-lē</i>	The contraction phase of the heartbeat cycle; adjective: systolic
valve <i>valv</i>	A structure that keeps fluid flowing in a forward direction (roots: <i>valv/o</i> , <i>valvul/o</i>)
vein <i>vān</i>	A vessel that carries blood back to the heart. All except the pulmonary and umbilical veins carry blood low in oxygen (roots: <i>ven/o</i> , <i>phleb/o</i>)
ventricle <i>VEN-trik-l</i>	A small cavity. One of the two lower pumping chambers of the heart (root: <i>ventricul/o</i>)
venule <i>VEN-ūl</i>	A small vessel that carries blood from the capillaries to the veins
vessel <i>VES-el</i>	A tube or duct to transport fluid (roots: <i>angi/o</i> , <i>vas/o</i> , <i>vascul/o</i>)



Go to the Audio Pronunciation Glossary in the Student Resources on *thePoint* to hear these terms pronounced.

Roots Pertaining to the Cardiovascular System

See **Tables 9-1** and **9-2**.

Table 9-1 Roots for the Heart

Root	Meaning	Example	Definition of Example
cardi/o	heart	cardiomyopathy* <i>kar-dē-ō-mī-OP-a-thē</i>	any disease of the heart muscle
atri/o	atrium	atriotomy <i>ā-trē-OT-ō-mē</i>	surgical incision of an atrium
ventricul/o	cavity, ventricle	supraventricular <i>sū-pra-ven-TRIK-ū-lar</i>	above a ventricle
valv/o, valvul/o	valve	valvulotome <i>VAL-vū-lō-tōm</i>	instrument for incising a valve

*Preferred over myocardiopathy.

9

EXERCISE 9-1

Fill in the blanks:

- The word *cardiogenic* (*kar-dē-ō-GEN-ik*) means originating in the _____.
- Interatrial (*in-ter-Ā-trē-al*) means between the _____.
- Ventriculotomy (*ven-trik-ū-LOT-ō-mē*) means surgical incision of a(n) _____.
- A valvuloplasty (*val-vū-lō-PLAS-tē*) is plastic repair of a(n) _____.

Write the adjective for the following definitions. The proper suffix is given for each.

- Pertaining to the heart (-ac) _____
- Pertaining to the myocardium (-al; ending differs from adjective ending for the heart) _____
- Pertaining to an atrium (-al) _____
- Pertaining to a valve (-ar) _____
- Pertaining to a ventricle (-ar) _____
- Pertaining to the pericardium (-al) _____

Following the example, write a word for the following definitions pertaining to the tissues of the heart:

- Inflammation of the heart's lining (usually at a valve) _____ endocarditis
- Inflammation of the heart muscle _____
- Inflammation of the fibrous sac around the heart _____

(Continued)

EXERCISE 9-1 (Continued)

Write a word for the following definitions:

14. Pertaining to an atrium and a ventricle _____
15. Between (inter-) the ventricles _____
16. Study (-logy) of the heart _____
17. Surgical incision of a valve _____
18. Enlargement (-megaly) of the heart _____

Table 9-2 Roots for the Blood Vessels

Root	Meaning	Example	Definition of Example
angi/o*	vessel	angiography an-jē-OG-ra-fē	x-ray imaging of a vessel
vas/o, vascul/o	vessel, duct	vasospasm VĀ-sō-spazm	sudden contraction of a vessel
arter/o, arteri/o	artery	endarterial end-ar-TĒ-rē-al	within an artery
arteriol/o	arteriole	arteriolar ar-tē-rē-Ō-lar	pertaining to an arteriole
aort/o	aorta	aortoptosis ā-or-top-TŌ-sis	downward displacement of the aorta
ven/o, ven/i	vein	venous VĒ-nus	pertaining to a vein
phleb/o	vein	phlebotomy fle-BOT-ō-mē	incision of a vein to withdraw blood

*The root *angi/o* usually refers to a blood vessel but is used for other types of vessels as well. *Hemangi/o* refers specifically to a blood vessel.

EXERCISE 9-2

Fill in the blanks:

1. Vasoconstriction (*vas-ō-kon-STRĪK-shun*) means narrowing of a(n) _____.
2. Endarterectomy (*end-ar-ter-EK-tō-mē*) is removal of the inner lining of a(n) _____.
3. Arteriolitis (*ar-tē-rē-ō-LĪ-tis*) is inflammation of a(n) _____.
4. Angioedema (*an-jē-ō-e-DE-ma*) is localized swelling caused by changes in _____.
5. Aortostenosis (*ā-or-tō-ste-NŌ-sis*) is narrowing of the _____.
6. Phlebectasia (*fleb-ek-TĀ-zē-a*) is dilatation of a(n) _____.
7. The term *microvascular* (*mī-krō-VAS-kū-lar*) means pertaining to small _____.

EXERCISE 9-2 (Continued)

Define the following words:

8. cardiovascular (*kar-dē-ō-VAS-kū-lar*) _____
9. intraaortic (*in-tra-ā-OR-tik*) _____
10. angiitis (*an-jē-Ī-tis*) (note spelling); also angitis or vasculitis _____
11. arteriorrhexis (*ar-tē-rē-ō-REK-sis*) _____
12. phlebitis (*fleb-Ī-tis*) _____

Use the ending **-gram** to form a word for a radiograph of the following:

13. vessels (use angi/o) _____
14. aorta _____
15. veins _____

Use the root **angi/o** to write words with the following meanings:

16. Formation (-genesis) of a vessel _____
17. Dilatation (-ectasis) of a vessel _____
18. Any disease (-pathy) of a vessel _____
19. Plastic repair (-plasty) of a vessel _____

Use the appropriate root to write words with the following meanings:

20. Within (intra-) a vein _____
21. Incision of an artery _____
22. Excision of a vein _____
23. Hardening (-sclerosis) of the aorta _____

Clinical Aspects of the Cardiovascular System

ATHEROSCLEROSIS

The accumulation of fatty deposits within the lining of an artery is termed **atherosclerosis** (Fig. 9-8). This type of deposit, called **plaque** (*plak*), begins to form when a vessel receives tiny injuries, usually at a point of branching. Plaques gradually thicken and harden with fibrous material, cells, and other deposits, restricting the vessel's lumen (opening) and reducing blood flow to the tissues, a condition known as **ischemia** (*is-KĒ-mē-a*). A major risk factor for the development of atherosclerosis is **dyslipidemia**, abnormally high levels or imbalance in **lipoproteins** that are carried in the blood, especially high levels of cholesterol-containing, low-density lipoproteins (LDLs). Other risk factors for atherosclerosis include smoking, high blood pressure, poor diet, inactivity, stress, and a family history of the disorder. Atherosclerosis may involve any arteries, but most of its effects are seen in the coronary vessels of the heart, the

aorta, the carotid arteries in the neck, and vessels in the brain. The techniques described later for treating coronary artery disease (CAD) are used for these other vessels as well.

Atherosclerosis is the most common form of a more general condition known as **arteriosclerosis** in which vessel walls harden from any cause. In addition to plaque, calcium salts and scar tissue may contribute to arterial wall thickening, with a narrowing of the lumen and loss of elasticity.

THROMBOSIS AND EMBOLISM

Atherosclerosis predisposes a person to **thrombosis**, the formation of a blood clot within a vessel (see Fig. 9-8). The clot, called a **thrombus**, interrupts blood flow to the tissues supplied by that vessel, resulting in necrosis (tissue death). Blockage of a vessel by a thrombus or other mass carried in the bloodstream is **embolism**, and the mass itself is called an **embolus**. Usually, the mass is a blood clot that breaks loose from a vessel's wall, but it may also be air (as from injection or trauma), fat (as from marrow released after a bone break), bacteria, or other solid materials. Often a venous thrombus will travel through the heart and then lodge in an artery of the lungs, resulting in a life-threatening pulmonary

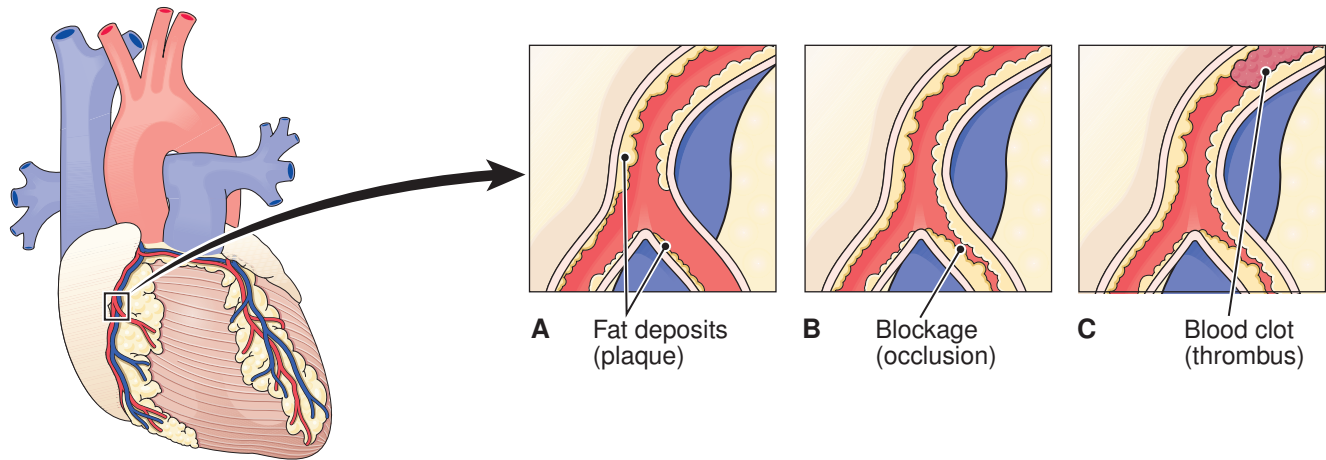


Figure 9-8 **Coronary atherosclerosis.** A. Fat deposits (plaque) narrow an artery, leading to ischemia (lack of blood supply). B. Plaque causes blockage (occlusion) of a vessel. C. Formation of a blood clot (thrombus) in a vessel leads to myocardial infarction (MI).

embolism. An embolus from a carotid artery often blocks a cerebral vessel, causing a **cerebrovascular accident (CVA)**, commonly called **stroke** (see Chapter 17).

ANEURYSM

An arterial wall weakened by atherosclerosis, malformation, injury, or other changes may balloon out, forming an **aneurysm**. If an aneurysm ruptures, hemorrhage results. Rupture of a cerebral artery is another cause of stroke. The abdominal aorta and carotid arteries are also common aneurysm sites. In a **dissecting aneurysm (Fig. 9-9)**, blood hemorrhages into the arterial wall's thick middle layer, separating the muscle as it spreads and sometimes rupturing the vessel. The aorta is most commonly involved. It may be possible to repair a dissecting aneurysm surgically with a graft.

HYPERTENSION

High blood pressure, or **hypertension (HTN)**, is a contributing factor in all of the conditions described above. In simple terms, HTN is defined as a systolic pressure greater than 140 mmHg or a diastolic pressure greater than 90 mmHg. HTN causes the left ventricle to enlarge (hypertrophy) as a result of increased work. Some cases of HTN are secondary to other disorders, such as kidney malfunction or endocrine disturbance, but most of the time, the causes are unknown, a condition described as primary, or essential, HTN.

Changes in diet and life habits are the first line of defense in controlling HTN. Drugs that are used include diuretics to eliminate fluids, vasodilators to relax the blood vessels, and drugs that prevent the formation or action of angiotensin, a substance in the blood that normally acts to increase blood pressure (see Chapter 13).

HEART DISEASE

Coronary Artery Disease

Coronary artery disease (CAD) results from atherosclerosis in the vessels that supply blood to the heart muscle. It is a leading cause of death in industrialized countries (see Fig. 9-8). An early sign of CAD is the type of chest pain known as **angina pectoris**. This is a feeling of constriction around the heart or pain that may radiate to the left arm or shoulder, usually brought on by exertion. Often there is anxiety, **diaphoresis** (profuse sweating), and **dyspnea** (difficulty in breathing). CAD is diagnosed by ECG, **stress tests**, **echocardiography**, and **coronary angiography**. This invasive x-ray imaging method requires injection of a dye into the coronary arteries by means of a catheter threaded through

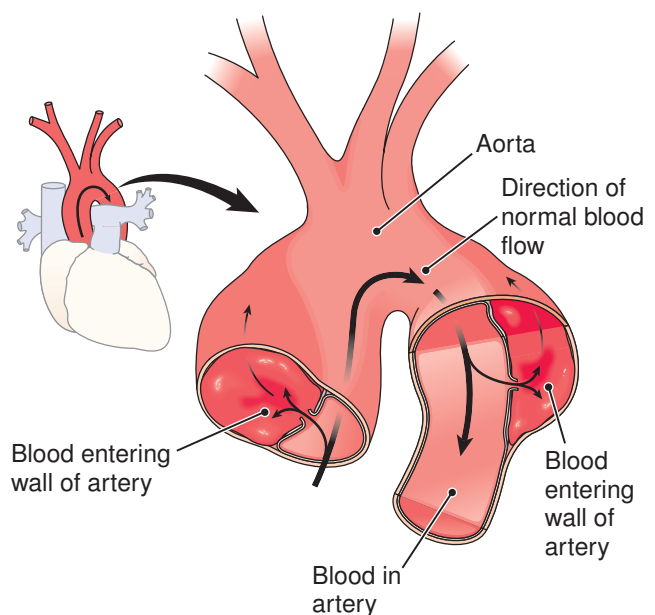


Figure 9-9 **Dissecting aortic aneurysm.** Blood separates the layers of the arterial wall.



See the Student Resources on *thePoint* for a figure on the evolution of atherosclerosis and to view the animation "Hypertension."

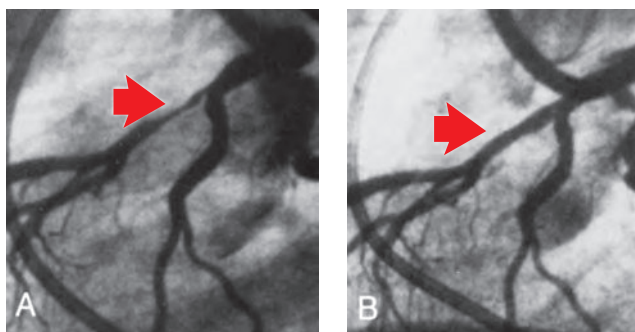


Figure 9-10 Coronary angiography. Coronary vessels are imaged after administration of a dye during cardiac catheterization. *A.* Angiography shows narrowing in the mid-left anterior descending (LAD) artery (*arrow*). *B.* The same vessel after angioplasty, a procedure to distend narrowed vessels. Note the improved blood flow through the artery distal to the repair.

blood vessels into the heart (**Fig. 9-10**). Coronary CT angiography (CTA) is a noninvasive procedure that can be used in the diagnosis of heart disease. It employs computed tomography scans following injection of a small amount of dye into the arm. A **coronary calcium scan** (heart scan) reveals vessel-narrowing calcium deposits in the coronary

arterial walls. Researchers have also found that a substance called **C-reactive protein (CRP)** is associated with poor cardiovascular health. This protein is produced during systemic inflammation, which may contribute to atherosclerosis. CRP levels can indicate cardiovascular disease and predict its outcome (prognosis). A more specific test for heart attack risk is the more accurate hs-CRP (high-sensitivity CRP) test.

CAD is treated by control of exercise and diet and by drug therapy and surgical intervention when appropriate. Drugs, such as nitroglycerin, may be used to dilate coronary vessels. Other drugs may be used to regulate the heartbeat, strengthen the force of heart contraction, lower cholesterol, or prevent blood clot formation.

Patients with severe CAD may be candidates for **angioplasty**, surgical dilatation of the blocked vessel by means of a balloon catheter, a procedure technically called **percutaneous transluminal coronary angioplasty (PTCA)** (**Figs. 9-10 and 9-11**). Angioplasty may include placement of a **stent**, a small mesh tube, to keep the vessel open (**Fig. 9-12**). Stents prevent recoil of the vessel and are available in different versions. The basic type is the bare metal stent; another is the drug-eluting stent, which releases drugs to prevent vascular restenosis. The newest form of stent is a completely bioabsorbable device that is gradually metabolized and absorbed into the body.

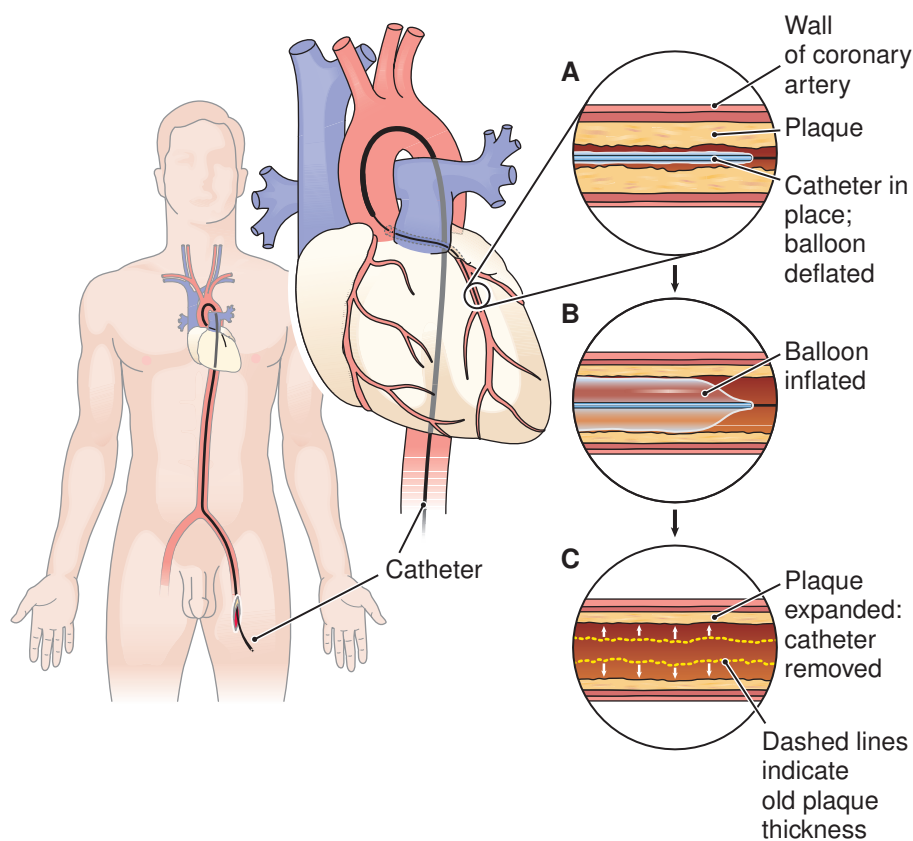


Figure 9-11 Coronary angioplasty (PTCA). *A.* A guide catheter is threaded into the coronary artery. *B.* A balloon catheter is inserted through the occlusion. *C.* The balloon is inflated and deflated until plaque is flattened and the vessel is opened.

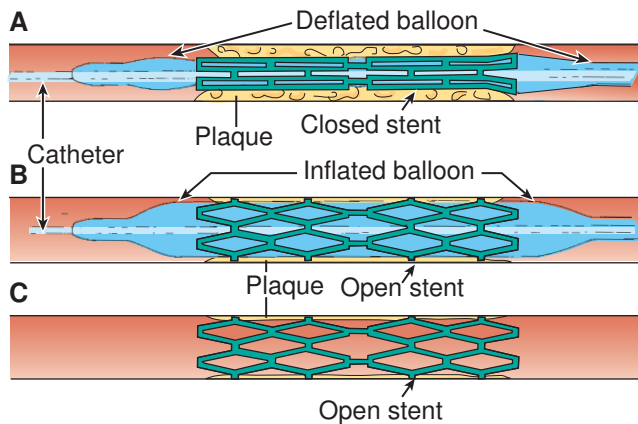


Figure 9-12 Arterial stent. A. Stent closed, before balloon inflation. B. Stent open, balloon inflated; stent will remain expanded after balloon is deflated and removed. C. Stent open, balloon removed.

If further intervention is required, surgeons can bypass the blocked vessel or vessels with a vascular graft (**Fig. 9-13**). In this procedure, known as a **coronary artery bypass graft (CABG)**, another vessel or a piece of another vessel, usually the left internal mammary artery or part of

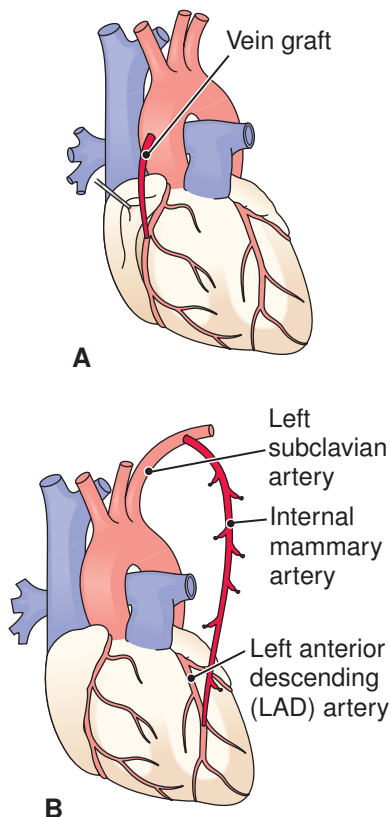


Figure 9-13 Coronary artery bypass graft (CABG). A. A segment of the saphenous vein carries blood from the aorta to a part of the right coronary artery that is distal to an occlusion. B. The mammary artery is used to bypass an obstruction in the left anterior descending (LAD) coronary artery.

the leg's saphenous vein, is grafted to carry blood from the aorta to a point past the coronary vessel obstruction.

Myocardial Infarction

Degenerative changes in the arteries predispose a person to thrombosis and sudden coronary artery **occlusion** (obstruction). The resultant area of myocardial necrosis is termed an **infarct** (**Fig. 9-14**), and the process is known as **myocardial infarction (MI)**, the “heart attack” that may cause sudden death. Symptoms of MI include pain over the heart (precordial pain) or upper part of the abdomen (epigastric pain) that may extend to the jaw or arms, pallor (paleness), diaphoresis, nausea, fatigue, anxiety, and dyspnea. There may be a burning sensation similar to indigestion or heartburn. In women, because degenerative changes more commonly affect multiple small vessels rather than the major coronary pathways, MI symptoms are often more long term and are more subtle and diffuse than the intense chest pain that is more typical in men.

MI is diagnosed by ECG and assays for specific substances in the blood. Creatine kinase (CK) is an enzyme normal to muscle cells. It is released in increased amounts when muscle tissue is injured. The form of CK specific to cardiac muscle cells is **creatine kinase MB (CK-MB)**. **Troponin (Tn)** is a protein that regulates contraction in muscle cells. Increased serum levels, particularly the forms TnT and TnI, indicate MI.

Patient outcome is based on the degree of damage and the speed of treatment to dissolve the clot and to reestablish normal blood flow and heart rhythm.

Arrhythmia

Arrhythmia is any irregularity of heart rhythm, such as an altered heart rate, extra beats, or a change in the pattern

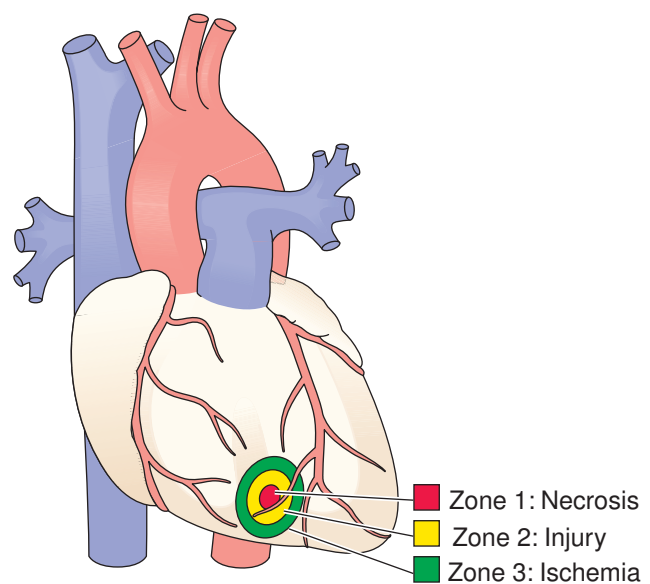


Figure 9-14 Myocardial infarction (MI). A blood clot (thrombus) causes a zone of necrosis (tissue death). Surrounding tissue suffers from lack of blood supply (ischemia).

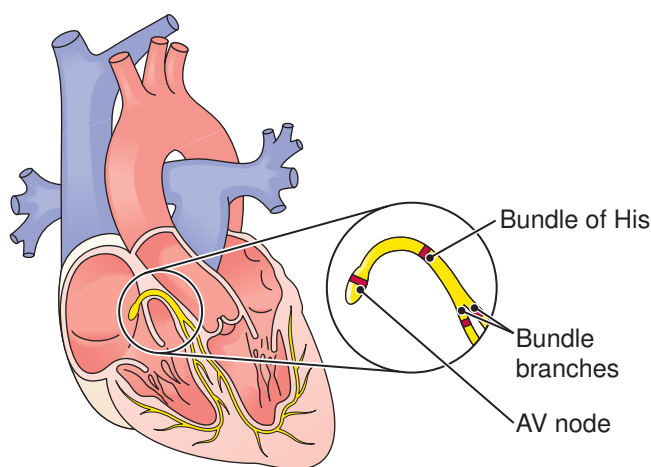


Figure 9-15 Potential sites for heart block in the atrioventricular (AV) portion of the heart's conduction system.

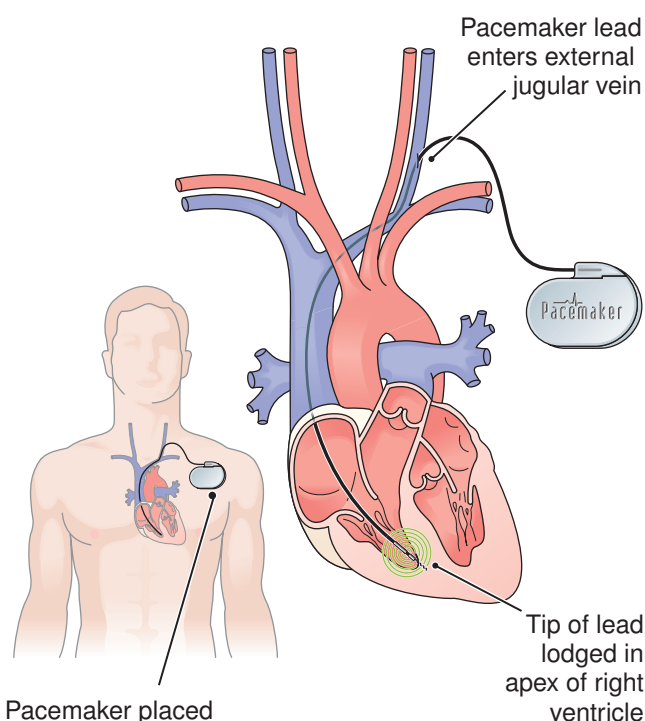
of the beat. **Bradycardia** is a slower-than-average rate, and **tachycardia** is a higher-than-average rate.

Damage to cardiac tissue, as by MI, may result in **heart block**, an interruption in the heart's electrical conduction system resulting in arrhythmia (**Fig. 9-15**). Heart block is classified in order of increasing severity as first-, second-, or third-degree heart block. Block in a bundle branch is designated as a left or right bundle branch block (BBB).

If, for any reason, the SA node is not generating a normal heartbeat or there is heart block, an **artificial pacemaker** may be implanted to regulate the beat (**Fig. 9-16**). Usually, the pacemaker is inserted under the skin below the clavicle, and leads are threaded through veins into one or both of the right chambers. Some pacemakers act only when the heart is not functioning on its own, and others adjust to the need for a change in heart rate based on activity.

MI is also a common cause of **fibrillation**, an extremely rapid, ineffective heartbeat, especially dangerous when it affects the ventricles. (C.L. in the opening case study had atrial fibrillation.) **Cardioversion** is the general term for restoration of a normal heart rhythm, either by drugs or application of electric current. Hospital personnel use external chest “paddles” for emergency electrical **defibrillation**. In addition to **cardiopulmonary resuscitation** (CPR), automated external defibrillators (AEDs) can help save lives when available for high-risk patients or in public places, such as malls, schools, churches, aircraft, and sports venues. The AED detects fatal arrhythmia and automatically delivers a correct preprogrammed shock. An implantable cardioverter defibrillator (ICD), applied much like a pacemaker, detects potential fibrillation and automatically shocks the heart to restore normal rhythm.

A newer approach to the treatment of heart rhythm irregularities is cardiac **ablation**, destruction of that portion of the conduction pathway that is involved in the arrhythmia. Electrode catheter ablation uses high-frequency sound waves, freezing (cryoablation), or electrical energy delivered through an intravascular catheter to ablate a defect in the conduction pathway.



Pacemaker placed beneath skin in pectoral region

Figure 9-16 Placement of a pacemaker. The lead is placed in an atrium or ventricle, usually on the right side. A dual-chamber pacemaker has leads in both chambers.

Heart Failure

The general term **heart failure** refers to any condition in which the heart fails to empty effectively. The resulting increased pressure in the venous system leads to **edema**, justifying the description **congestive heart failure** (CHF). Left-side failure results in pulmonary edema with breathing difficulties (dyspnea); right-side failure causes peripheral edema with tissue swelling, especially in the legs, along with weight gain from fluid retention. Other symptoms of CHF are **cyanosis** and **syncope** (fainting).

Heart failure is treated with rest, drugs to strengthen heart contractions, diuretics to eliminate fluid, and restriction of salt in the diet.



See the Student Resources on *thePoint* for a clinical picture of acute myocardial infarction and to view the animation “Heart Failure.”

Heart failure is one cause of **shock**, a severe disturbance in the circulatory system resulting in inadequate blood delivery to the tissues. Shock is classified according to cause as:

- Cardiogenic shock, caused by heart failure
- Hypovolemic shock, caused by loss of blood volume
- Septic shock, caused by bacterial infection
- Anaphylactic shock, caused by severe allergic reaction

Congenital Heart Disease

A congenital defect is any defect that is present at birth. The most common type of congenital heart defect is a **septal defect**, a hole in the septum (wall) that separates the atria or the septum that separates the ventricles (Fig. 9-17). An atrial septal defect often results from persistence of an opening, the foramen ovale, that allows blood to bypass the lungs in fetal circulation. A septal defect permits blood to shunt from the left to the right side of the heart and return to the lungs instead of flowing out to the body. The heart has to

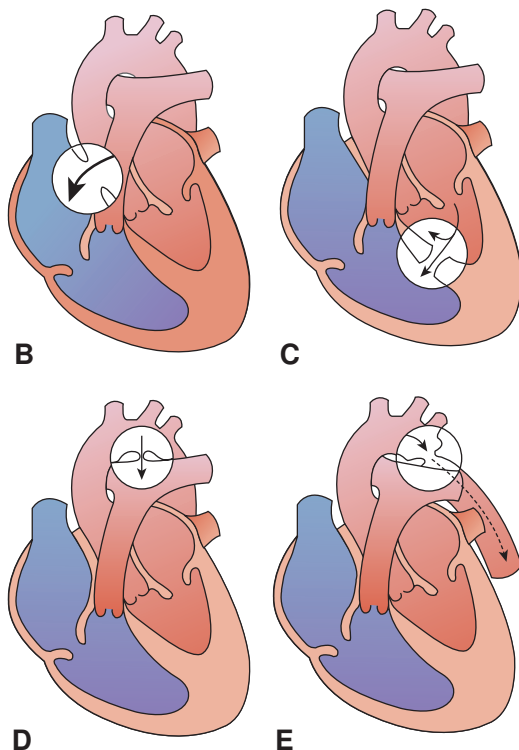
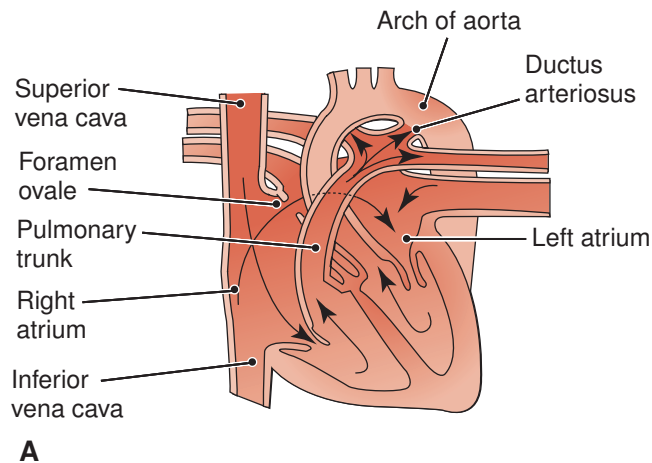


Figure 9-17 Congenital heart defects. A. Normal fetal heart showing the foramen ovale and ductus arteriosus. B. Persistence of the foramen ovale results in an atrial septal defect. C. A ventricular septal defect. D. Persistence of the ductus arteriosus (patent ductus arteriosus) forces blood back into the pulmonary artery. E. Coarctation of the aorta restricts outward blood flow in the aorta.

work harder to meet the tissues' oxygen needs. Symptoms of septal defect include cyanosis (leading to the description "blue baby"), syncope, and **clubbing** of the fingers.

Another congenital defect that results from persistence of a fetal modification is **patent ductus arteriosus** (see Fig. 9-17D). In this case, a small bypass between the pulmonary artery and the aorta fails to close at birth. Blood then can flow from the aorta to the pulmonary artery and return to the lungs.

Heart valve malformation is another type of congenital heart defect. Failure of a valve to open or close properly is evidenced by a **murmur**, an abnormal sound heard as the heart cycles. A localized aortic narrowing, or **coarctation of the aorta**, is a congenital defect that restricts blood flow through that vessel (see Fig. 9-17E). Most of the congenital defects described can be corrected surgically.

Rheumatic Heart Disease

In **rheumatic heart disease**, infection with a specific type of *Streptococcus* sets up an immune reaction that ultimately damages the heart valves. The infection usually begins as a "strep throat," and most often the mitral valve is involved. Scar tissue fuses the valve's leaflets, causing a narrowing or **stenosis** that interferes with proper function. People with rheumatic heart disease are subject to repeated valvular infections and may need to take antibiotics prophylactically (preventively) before invasive medical or dental procedures. Severe cases of rheumatic heart disease may require surgical correction or even valve replacement. The incidence of rheumatic heart disease has declined with the use of antibiotics.

DISORDERS OF THE VEINS

A breakdown in the valves of the veins in combination with a chronic dilatation of these vessels results in **varicose veins** (Fig. 9-18). These appear twisted and swollen under the skin,



Figure 9-18 Varicose veins.

most commonly in the legs. Contributing factors include heredity, obesity, prolonged standing, and pregnancy, which increase pressure in the pelvic veins. Varicosities can impede blood flow and lead to edema, thrombosis, hemorrhage, or ulceration. Treatment includes the wearing of elastic stockings and, in some cases, surgical removal of the varicose veins, after which collateral circulation is naturally established. A varicose vein in the rectum or anal canal is referred to as a **hemorrhoid**.

Phlebitis is any inflammation of the veins and may be caused by infection, injury, poor circulation, or damage to

valves in the veins. Such inflammation typically initiates blood clot formation, resulting in **thrombophlebitis**. Any veins are subject to thrombophlebitis, but the more serious condition involves the deep veins as opposed to the superficial veins, in the condition termed **deep vein thrombosis (DVT)**. The most common sites for DVT are the deep leg veins, causing serious reduction in venous drainage from these areas.

Vascular technologists obtain information on the blood vessels and circulation to aid in diagnosis. **See Box 9-3** for information on this career.

Box 9-3



Health Professions

Vascular Technologists

Vascular technologists perform noninvasive diagnostic studies to evaluate the blood vessels (arteries and veins) in the head, neck, extremities, and abdomen. These studies help physicians diagnose vascular disorders. They obtain two-dimensional images of the blood vessels using ultrasound and measure the velocity and direction of blood flow using Doppler ultrasound. Other instrumentation is used to measure blood pressure, changes in blood volume, and the blood's oxygen saturation.

Most vascular technologists work in hospitals, where they prepare patients for tests, take clinical histories, perform limited physical examinations, carry out diagnostic tests, and report results. They may also work in offices, clinics, or laboratories. Although most of their patients are elderly, vascular studies may be required on pediatric patients, adolescents, or young adults.

Unlike early workers in this field who were often trained on the job, vascular technologists today complete a two- or four-year educational program accredited by the Commission on Accreditation of Allied Health Education Programs (CAAHEP). Certification specific to vascular technology is available from the American Registry for Diagnostic Medical Sonography at www.ardms.org and from other organizations. Certification requires appropriate education, clinical experience, examination, and continuing education. Certification will be a requirement of all vascular technologists working in IAC (Intersocietal Accreditation Commission) accredited vascular laboratories beginning in 2017. Additional information on this career is available from the Society for Vascular Ultrasound at www.svunet.org.

9

Terminology

Key Terms

Cardiovascular Disorders

aneurysm <i>AN-ū-rizm</i>	A localized abnormal dilation of a blood vessel, usually an artery, caused by weakness of the vessel wall; may eventually burst
angina pectoris <i>an-JĪ-na PEK-tō-ris</i>	A feeling of constriction around the heart or pain that may radiate to the left arm or shoulder, usually brought on by exertion; caused by insufficient blood supply to the heart
arrhythmia <i>a-RITH-mē-a</i>	Any abnormality in the rate or rhythm of the heartbeat (literally “without rhythm;” note doubled r). Also called <i>dysrhythmia</i>
arteriosclerosis <i>ar-tēr-ē-ō-skler-Ō-sis</i>	Hardening (sclerosis) of the arteries, with loss of capacity and loss of elasticity, as from fatty deposits (plaque), deposit of calcium salts, or scar tissue formation
atherosclerosis <i>ath-er-ō-skler-Ō-sis</i>	The development of fatty, fibrous patches (plaques) in the lining of arteries, causing narrowing of the lumen and hardening of the vessel wall. The most common form of arteriosclerosis is hardening of the arteries. The root <i>ather/o</i> means “porridge” or “gruel”

(Continued)

Terminology

Key Terms (Continued)

bradycardia <i>brad-ē-KAR-dē-a</i>	A slow heart rate, of less than 60 bpm
cerebrovascular accident (CVA) <i>ser-e-brō-VAS-kū-lar</i>	Sudden damage to the brain resulting from reduction of blood flow. Causes include atherosclerosis, embolism, thrombosis, or hemorrhage from a ruptured aneurysm; commonly called stroke
clubbing <i>KLUB-ing</i>	Enlargement of the ends of the fingers and toes caused by growth of the soft tissue around the nails (see Fig. 7-12). Seen in a variety of diseases in which there is poor peripheral circulation
coarctation of the aorta <i>kō-ark-TĀ-shun</i>	Localized narrowing of the aorta with restriction of blood flow (see Fig. 9-17E)
C-reactive protein (CRP)	Protein produced during systemic inflammation, which may contribute to atherosclerosis; high CRP levels can indicate cardiovascular disease and its prognosis
cyanosis <i>sī-a-NŌ-sis</i>	Bluish discoloration of the skin caused by lack of oxygen (see Fig. 3-4)
deep vein thrombosis (DVT)	Thrombophlebitis involving the deep veins
diaphoresis <i>dī-a-fō-RĒ-sis</i>	Profuse sweating
dissecting aneurysm	An aneurysm in which blood enters the arterial wall and separates the layers. Usually involves the aorta (see Fig. 9-9)
dyslipidemia <i>dis-lip-i-DE-mē-a</i>	Disorder in serum lipid levels, which is an important factor in development of atherosclerosis. Includes hyperlipidemia (high lipids), hypercholesterolemia (high cholesterol), and hypertriglyceridemia (high triglycerides)
dyspnea <i>DISP-nē-a</i>	Difficult or labored breathing (-pnea)
edema <i>e-DE-ma</i>	Swelling of body tissues caused by the presence of excess fluid (see Fig. 6-4). Causes include cardiovascular disturbances, kidney failure, inflammation, and malnutrition
embolism <i>EM-bō-lizm</i>	Obstruction of a blood vessel by a blood clot or other matter carried in the circulation
embolus <i>EM-bō-lus</i>	A mass carried in the circulation. Usually a blood clot, but also may be air, fat, bacteria, or other solid matter from within or from outside the body
fibrillation <i>fi-bri-LĀ-shun</i>	Spontaneous, quivering, and ineffectual contraction of muscle fibers, as in the atria or the ventricles
heart block	An interference in the electrical conduction system of the heart resulting in arrhythmia (see Fig. 9-15)
heart failure	A condition caused by the inability of the heart to maintain adequate blood circulation
hemorrhoid <i>HEM-ō-royd</i>	A varicose vein in the rectum
hypertension <i>hī-per-TEN-shun</i>	A condition of higher-than-normal blood pressure. Essential (primary, idiopathic) hypertension has no known cause
infarct <i>in-FARKT</i>	An area of localized tissue necrosis (death) resulting from a blockage or a narrowing of the artery that supplies the area
ischemia <i>is-KĒ-mē-a</i>	Local deficiency of blood supply caused by circulatory obstruction (root: hem/o)
murmur	An abnormal heart sound

Terminology

Key Terms (Continued)

myocardial infarction (MI) <i>mī-ō-KAR-dē-al in-FARK-shun</i>	Localized necrosis (death) of cardiac muscle tissue resulting from blockage or narrowing of the coronary artery that supplies that area. Myocardial infarction is usually caused by formation of a thrombus (clot) in a vessel (see Fig. 9-14)
occlusion <i>ō-KLŪ-zhun</i>	A closing off or obstruction, as of a vessel
patent ductus arteriosus <i>PĀ-tent DUK-tus ar-tēr-ē-O-sus</i>	Persistence of the ductus arteriosus after birth. The ductus arteriosus is a vessel that connects the pulmonary artery to the descending aorta in the fetus to bypass the lungs (see Fig. 9-17D)
phlebitis <i>flē-BĪ-tis</i>	Inflammation of a vein
plaque <i>plak</i>	A patch. With regard to the cardiovascular system, a deposit of fatty material and other substances on a vessel wall that impedes blood flow and may block the vessel; atheromatous plaque
rheumatic heart disease <i>rū-MAT-ik</i>	Damage to heart valves after infection with a type of <i>Streptococcus</i> (group A hemolytic <i>Streptococcus</i>). The antibodies produced in response to the infection produce valvular scarring usually involving the mitral valve
septal defect <i>SEP-tal</i>	An opening in the septum between the atria or ventricles; a common cause is persistence of the foramen ovale (<i>for-Ā-men ō-VAL-ē</i>), an opening between the atria that bypasses the lungs in fetal circulation (see Fig. 9-17B and C)
shock	Circulatory failure resulting in an inadequate blood supply to the tissues. Cardiogenic shock is caused by heart failure; hypovolemic shock is caused by a loss of blood volume; septic shock is caused by bacterial infection
stenosis <i>ste-NŌ-sis</i>	Constriction or narrowing of an opening
stroke	See <i>cerebrovascular accident</i>
syncope <i>SIN-kō-pē</i>	A temporary loss of consciousness caused by inadequate blood flow to the brain; fainting
tachycardia <i>tak-i-KAR-dē-a</i>	An abnormally rapid heart rate, usually over 100 bpm
thrombophlebitis <i>throm-bō-flē-BĪ-tis</i>	Inflammation of a vein associated with formation of a blood clot
thrombosis <i>throm-BŌ-sis</i>	Development of a blood clot within a vessel
thrombus <i>THROM-bus</i>	A blood clot that forms within a blood vessel (root: thromb/o)
varicose vein <i>VAR-i-kōs</i>	A twisted and swollen vein resulting from breakdown of the valves, pooling of blood, and chronic dilatation of the vessel (root: varic/o); also called varix (<i>VAR-iks</i>) or varicosity (<i>var-i-KOS-i-tē</i>) (see Fig. 9-18)

Diagnosis and Treatment

ablation <i>ab-LĀ-shun</i>	Removal or destruction. In cardiac ablation, a catheter is used to destroy a portion of the heart's conduction pathway to correct an arrhythmia
angioplasty <i>AN-jē-ō-plas-tē</i>	A procedure that reopens a narrowed vessel and restores blood flow. Commonly accomplished by surgically removing plaque, inflating a balloon within the vessel, or installing a device (stent) to keep the vessel open (see Figs. 9-10 through 9-12)

(Continued)

Terminology

Key Terms (Continued)

artificial pacemaker	A battery-operated device that generates electrical impulses to regulate the heartbeat. It may be external or implanted, may be designed to respond to need, and may have the capacity to prevent tachycardia (see Fig. 9-16)
cardiopulmonary resuscitation (CPR) <i>rē-sus-i-TĀ-shun</i>	Restoration of cardiac output and pulmonary ventilation after cardiac arrest using artificial respiration and chest compression or cardiac massage
cardioversion <i>KAR-dē-ō-ver-zhun</i>	Correction of an abnormal cardiac rhythm. May be accomplished pharmacologically, with antiarrhythmic drugs, or by application of electric current (see defibrillation)
coronary angiography <i>an-jē-OG-ra-fē</i>	Radiographic study of the coronary arteries after introduction of an opaque dye by means of a catheter threaded through blood vessels into the heart (see Fig. 9-10)
coronary artery bypass graft (CABG)	Surgical creation of a shunt to bypass a blocked coronary artery. The aorta is connected to a point past the obstruction with another vessel or a piece of another vessel, usually the left internal mammary artery or part of the leg's saphenous vein (see Fig. 9-13)
coronary calcium scan (heart scan)	Method for visualizing vessel-narrowing calcium deposits in coronary arteries. Useful for diagnosing coronary artery disease in people at moderate risk or those who have undiagnosed chest pain
creatine kinase MB (CK-MB) <i>KRĒ-a-tin KĪ-nāz</i>	Enzyme released in increased amounts from cardiac muscle cells following myocardial infarction (MI). Serum assays help diagnose MI and determine the extent of muscle damage
CT angiography (CTA)	Computed tomography scan used to visualize vessels in the heart and other organs. Requires only a small amount of dye injected into the arm. Can rule out blocked coronary arteries that may cause a myocardial infarction (heart attack) in people with chest pain or abnormal stress tests
defibrillation <i>dē-fib-ri-LĀ-shun</i>	Use of an electronic device (defibrillator) to stop fibrillation by delivering a brief electric shock to the heart. The shock may be delivered to the surface of the chest, as by an automated external defibrillator (AED), or directly into the heart through wire leads, using an implantable cardioverter defibrillator (ICD)
echocardiography <i>ek-ō-kar-dē-OG-ra-fē</i>	A noninvasive method that uses ultrasound to visualize internal cardiac structures
lipoprotein <i>lip-ō-PRŌ-tēn</i>	A compound of protein with lipid. Lipoproteins are classified according to density as very low-density (VLDL), low-density (LDL), and high-density (HDL). Relatively higher levels of HDLs have been correlated with cardiovascular health
percutaneous transluminal coronary angioplasty (PTCA)	Dilatation of a sclerotic blood vessel by means of a balloon catheter inserted into the vessel and then inflated to flatten plaque against the arterial wall (see Fig. 9-11)
stent	A small metal device in the shape of a coil or slotted tube that is placed inside an artery to keep the vessel open after balloon angioplasty (see Fig. 9-12)
stress test	Evaluation of physical fitness by continuous ECG monitoring during exercise. In a thallium stress test, a radioactive isotope of thallium is administered to trace blood flow through the heart during exercise
troponin (Tn) <i>TRŌ-pō-nin</i>	A protein in muscle cells that regulates contraction. Increased serum levels, primarily in the forms TnT and TnI, indicate recent myocardial infarction (MI)

The Lymphatic System

The **lymphatic system** is a widely distributed system with multiple functions (Fig. 9-19). Its role in circulation is to return excess fluid and proteins from the tissues to the bloodstream. Blind-ended lymphatic capillaries pick up these materials in the tissues and carry them into larger vessels (Fig. 9-20). The fluid carried in the lymphatic system is called **lymph**. Lymph drains from the lower part of the body

and the upper left side into the **thoracic duct** (left lymphatic duct), which travels upward through the chest and empties into the left subclavian vein near the heart (see Fig. 9-19). The **right lymphatic duct** drains the body's upper right side and empties into the right subclavian vein.

Another major function of the lymphatic system is to protect the body from impurities and invading microorganisms (see discussion of immunity in Chapter 10). Along the path of the lymphatic vessels are small masses of lymphoid

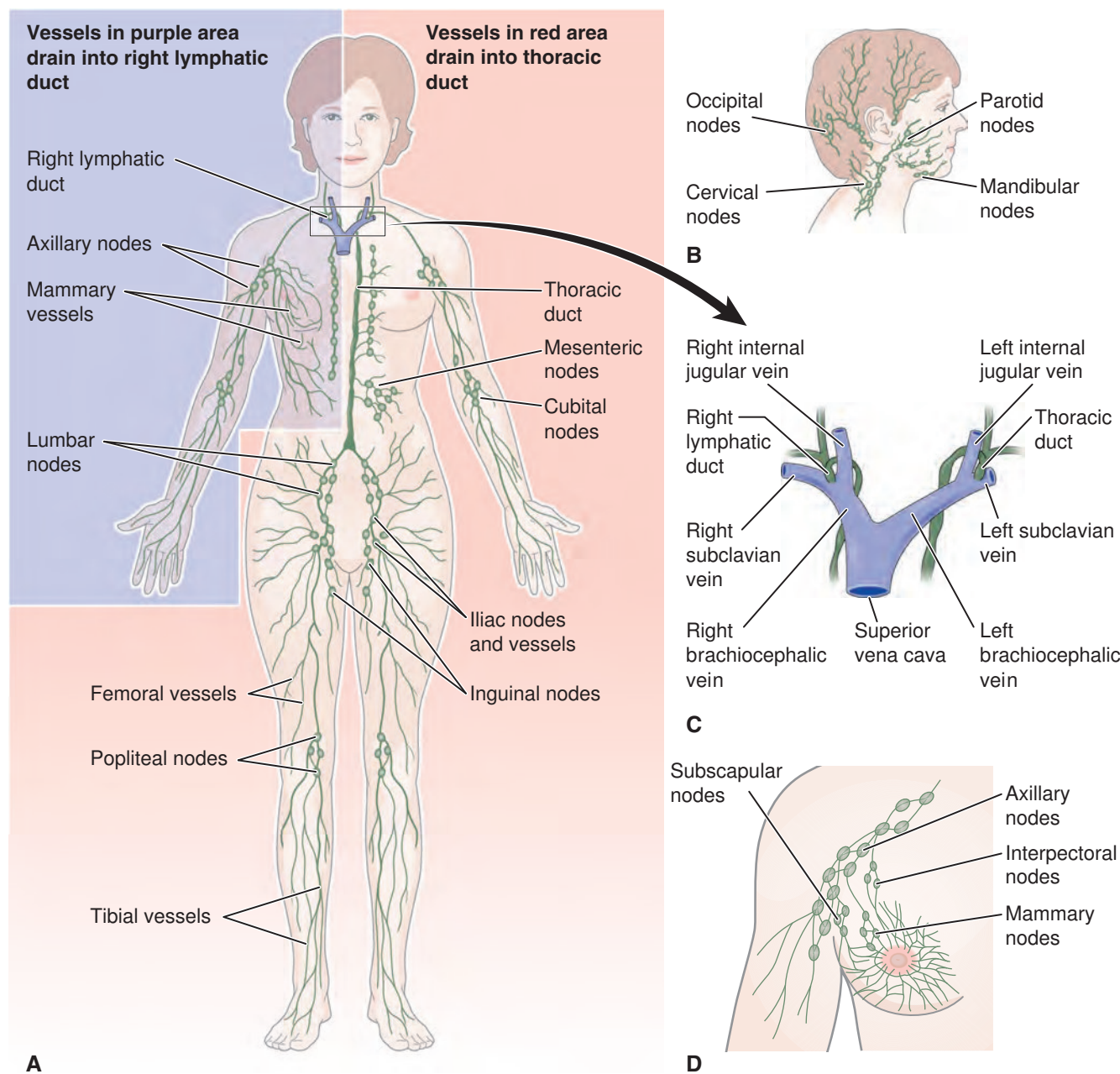


Figure 9-19 Lymphatic system. A. Lymphatic vessels drain almost every area of the body. Lymph nodes are distributed along the path of the vessels. Areas draining into the right lymphatic duct are shown in *purple*; areas draining into the thoracic duct are shown in *red*. B. Lymph nodes and vessels of the head. C. Drainage of the right lymphatic duct and thoracic duct into the subclavian veins. D. Lymph nodes and vessels of the breast, mammary glands, and surrounding areas.

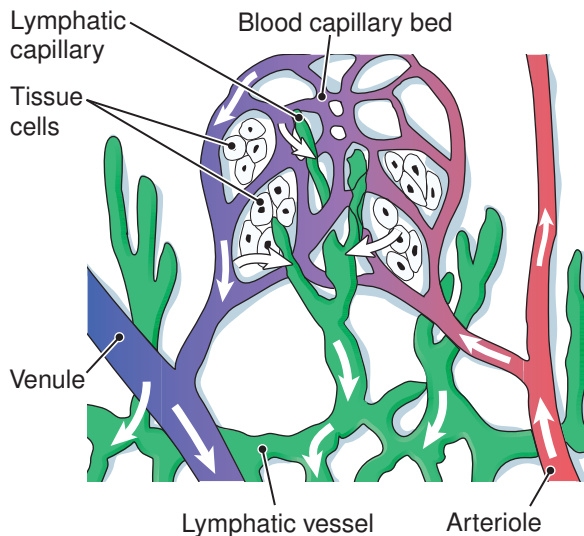


Figure 9-20 Lymphatic drainage in the tissues. Lymphatic capillaries pick up fluid and proteins left in the tissues and carry them back to the bloodstream.

tissue, the **lymph nodes** (Fig. 9-21). Their function is to filter the lymph as it passes through. They are concentrated in the cervical (neck), axillary (armpit), mediastinal (chest), and inguinal (groin) regions. Other protective organs and tissues of the lymphatic system include the:

- **Tonsils**, located in the throat (pharynx). They filter inhaled or swallowed materials and aid in immunity early in life. The tonsils are further discussed in Chapter 11.
- **Thymus** in the chest, above the heart. It processes and stimulates lymphocytes active in immunity.
- **Spleen** in the upper left region of the abdomen. It filters blood and destroys old red blood cells.
- **Appendix**, attached to the large intestine. It may aid in the development of immunity.
- **Peyer patches**, in the lining of the intestine. They help protect against invading microorganisms.

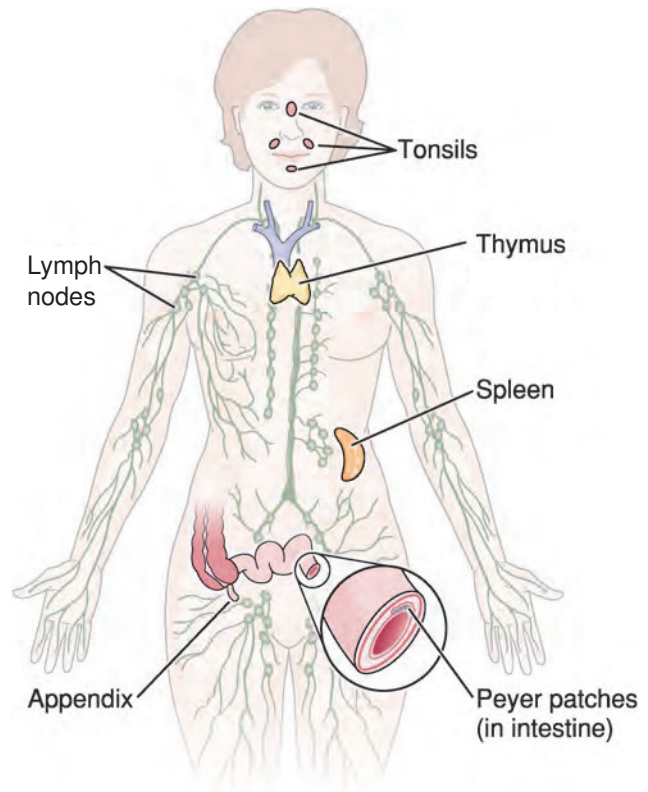


Figure 9-21 Location of lymphoid tissue.



See the Student Resources on *thePoint* for a chart summarizing lymphoid tissue.

A final function of the lymphatic system is to absorb digested fats from the small intestine (see Chapter 12). These fats are then added to the blood with the lymph that drains from the thoracic duct.

Terminology

Key Terms

Lymphatic System

Normal Structure and Function

appendix <i>a-PEN-diks</i>	A small, finger-like mass of lymphoid tissue attached to the first part of the large intestine
lymph <i>limf</i>	The thin, plasma-like fluid that drains from the tissues and is transported in lymphatic vessels (root: lymph/o)
lymph node	A small mass of lymphoid tissue along the path of a lymphatic vessel that filters lymph (root: lymphaden/o)

Terminology

Key Terms (Continued)

lymphatic system <i>lim-FAT-ik</i>	The system that drains fluid and proteins from the tissues and returns them to the bloodstream. This system also participates in immunity and aids in absorption of fats from the digestive tract
Peyer patches <i>PI-er</i>	Aggregates of lymphoid tissue in the lining of the intestine
right lymphatic duct	The lymphatic duct that drains fluid from the body's upper right side
spleen	A large reddish-brown organ in the upper left region of the abdomen. It filters blood and destroys old red blood cells (root: splen/o)
thoracic duct	The lymphatic duct that drains fluid from the upper left side of the body and all of the lower body; left lymphatic duct
thymus <i>THI-mus</i>	A lymphoid organ in the upper part of the chest beneath the sternum. It functions in immunity (root: thym/o)
tonsils <i>TON-silz</i>	Small masses of lymphoid tissue located in regions of the throat (pharynx)



Go to the Audio Pronunciation Glossary in the Student Resources on *thePoint* to hear these terms pronounced.

9

Roots Pertaining to the Lymphatic System

See **Table 9-3**.

Table 9-3

Roots for the Lymphatic System

Root	Meaning	Example	Definition of Example
lymph/o	lymph, lymphatic system	lymphoid <i>LIM-foyd</i>	resembling lymph or lymphatic tissue
lymphaden/o	lymph node	lymphadenitis <i>lim-fad-e-NI-tis</i>	inflammation of a lymph node
lymphangi/o	lymphatic vessel	lymphangiogram <i>lim-FAN-jē-ō-gram</i>	x-ray image of lymphatic vessels
splen/o	spleen	splenalgia <i>splē-NAL-jē-a</i>	pain in the spleen
thym/o	thymus	athymia <i>a-THI-mē-a</i>	absence of the thymus
tonsil/o	tonsil	tonsillar <i>TON-sil-ar</i>	pertaining to a tonsil

EXERCISE 9-3

Fill in the blanks:

1. Lymphedema (*limf-e-DĒ-ma*) means swelling caused by obstruction of the flow of _____.
2. Lymphadenectomy (*lim-fad-e-NEK-tō-mē*) is surgical removal of a(n) _____.
3. A lymphangioma (*lim-fan-jē-Ō-ma*) is a tumor of _____.
4. The adjective *splenic* (*SPLEN-ik*) means pertaining to the _____.
5. Thymectomy (*thī-MEK-tō-mē*) is surgical removal of the _____.
6. Tonsillopathy (*ton-sil-OP-a-thē*) is any disease of the _____.

Identify and define the root in the following words:

	Root	Meaning of Root
7. lymphangial (<i>lim-FAN-jē-al</i>)	lymphangi/o	lymphatic vessel
8. perisplenitis (<i>per-i-splē-NĪ-tis</i>)	_____	_____
9. lymphadenography (<i>lim-fad-e-NOG-ra-fē</i>)	_____	_____
10. tonsillectomy (<i>ton-sil-EK-tō-mē</i>)	_____	_____
11. hypothyroidism (<i>hī-pō-THĪ-mizm</i>)	_____	_____

Use the appropriate root to write words with the following meanings:

12. Inflammation of lymphatic vessels _____
13. A tumor (-oma) of lymphatic tissue _____
14. Any disease (-pathy) of the lymph nodes _____
15. Enlargement (-megaly) of the spleen _____
16. Pertaining to (-ic) the thymus _____
17. Inflammation of a tonsil _____

Clinical Aspects of the Lymphatic System

Changes in the lymphatic system are often related to infection and may consist of inflammation and enlargement of the nodes, called **lymphadenitis**, or inflammation of the

vessels, called **lymphangitis**. Obstruction of lymphatic vessels because of surgical excision or infection results in tissue swelling, or **lymphedema** (see Box 9-4). Any neoplastic disease involving lymph nodes is termed **lymphoma**. These neoplastic disorders affect the white cells found in the lymphatic system, and they are discussed more fully in Chapter 10.

Terminology

Key Clinical Terms

Lymphatic Disorders

lymphadenitis <i>lim-fad-e-NĪ-tis</i>	Inflammation and enlargement of lymph nodes, usually as a result of infection
lymphangitis <i>lim-fan-JĪ-tis</i>	Inflammation of lymphatic vessels as a result of bacterial infection. Appears as painful red streaks under the skin (also spelled <i>lymphangiitis</i>) (Fig. 9-22)

Terminology

Key Clinical Terms *(Continued)*

lymphedema
lim-fe-DE-ma

Swelling of tissues with lymph caused by obstruction or excision of lymphatic vessels
(see Box 9-4)

lymphoma
lim-FŌ-ma

Any neoplastic disease of lymphoid tissue

Box 9-4



Clinical Perspectives

Lymphedema: When Lymph Stops Flowing

Fluid balance in the body requires appropriate distribution of fluid among the cardiovascular system, lymphatic system, and the tissues. Edema occurs when the balance is tipped toward excess fluid in the tissues. Often, edema is due to heart failure. However, blockage of lymphatic vessels (with resulting fluid accumulation in the tissues) can cause another form of edema, called lymphedema. The clinical hallmark of lymphedema is chronic swelling of an arm or leg, whereas heart failure usually causes swelling of both legs.

Lymphedema may be either primary or secondary. Primary lymphedema is a rare congenital condition caused by abnormal development of lymphatic vessels. Secondary lymphedema, or acquired lymphedema, can develop as a result of trauma to a limb, surgery, radiation therapy, or infection of the lymphatic vessels (lymphangitis). One of the most common causes of lymphedema is the removal of axillary

lymph nodes during mastectomy, which disrupts lymph flow from the adjacent arm. Lymphedema may also occur following prostate surgery.

Therapies that encourage the flow of fluid through the lymphatic vessels are useful in treating lymphedema. These therapies may include elevation of the affected limb, manual lymphatic drainage through massage, light exercise, and firm wrapping of the limb to apply compression. In addition, changes in daily habits can lessen the effects of lymphedema. For example, further blockage of lymph drainage can be prevented by wearing loose clothing and jewelry, carrying a purse or handbag on the unaffected arm, and not crossing the legs when sitting. Lymphangitis requires the use of appropriate antibiotics. Prompt treatment is necessary because in addition to swelling, other complications include poor wound healing, skin ulcers, and increased risk of infection.

9

Figure 9-22 Lymphangitis. Lymphangitis is inflammation of lymphatic vessels. Note the linear red streak proximal to a skin infection.



Terminology Supplementary Terms

Normal Structure and Function

apical pulse <i>AP-i-kal</i>	Pulse felt or heard over the heart's apex. It is measured in the fifth left intercostal space (between the ribs) about 8 to 9 cm from the midline
cardiac output	The amount of blood pumped from the right or left ventricle per minute
Korotkoff sounds <i>ko-ROT-kof</i>	Arterial sounds heard with a stethoscope during determination of blood pressure with a cuff
perfusion <i>per-FŪ-zhun</i>	The passage of fluid, such as blood, through an organ or tissue
precordium <i>prē-KOR-dē-um</i>	The anterior region over the heart and the lower part of the thorax; adjective: precordial
pulse pressure	The difference between systolic and diastolic pressure
stroke volume	The amount of blood ejected by the left ventricle with each beat
Valsalva maneuver <i>val-SAL-va</i>	Bearing down, as in childbirth or defecation, by attempting to exhale forcefully with the nose and throat closed. This action has an effect on the cardiovascular system

Symptoms and Conditions

bruit <i>brwē</i>	An abnormal sound heard in auscultation
cardiac tamponade <i>tam-pon-ĀD</i>	Pathologic accumulation of fluid in the pericardial sac. May result from pericarditis or injury to the heart or great vessels
ectopic beat <i>ek-TOP-ik</i>	A heartbeat that originates from some part of the heart other than the SA node
extrasystole <i>eks-tra-SIS-tō-lē</i>	Premature heart contraction that occurs separately from the normal beat and originates from a part of the heart other than the SA node
flutter	Very rapid (200 to 300 bpm) but regular contractions, as in the atria or the ventricles
hypotension <i>hī-po-TEN-shun</i>	A condition of lower-than-normal blood pressure
intermittent claudication <i>claw-di-KĀ-shun</i>	Pain in a muscle during exercise caused by inadequate blood supply. The pain disappears with rest
mitral valve prolapse	Movement of the mitral valve cusps into the left atrium when the ventricles contract
occlusive vascular disease	Arteriosclerotic disease of the vessels, usually peripheral vessels
palpitation <i>pal-pi-TĀ-shun</i>	A sensation of abnormally rapid or irregular heartbeat
pitting edema	Edema that retains the impression of a finger pressed firmly into the skin (Fig. 9-23)
polyarteritis nodosa <i>nō-DŌ-sa</i>	Potentially fatal collagen disease causing inflammation of small visceral arteries. Symptoms depend on the organ affected
Raynaud disease <i>rā-NŌ</i>	A disorder characterized by abnormal constriction of peripheral vessels in the arms and legs on exposure to cold
regurgitation <i>rē-gur-ji-TĀ-shun</i>	A backward flow, such as the backflow of blood through a defective valve
stasis <i>STĀ-sis</i>	Stoppage of normal flow, as of blood or urine. Blood stasis may lead to dermatitis and ulcer formation
subacute bacterial endocarditis (SBE)	Bacterial growth in a heart or valves previously damaged by rheumatic fever
tetralogy of Fallot <i>fal-Ō</i>	A combination of four congenital heart abnormalities: pulmonary artery stenosis, interventricular septal defect, displacement of the aorta to the right, and right ventricular hypertrophy

Terminology

Supplementary Terms (Continued)

9

thromboangiitis obliterans	Inflammation and thrombus formation resulting in occlusion of small vessels, especially in the legs. Most common in young men and correlated with heavy smoking. Thrombotic occlusion of leg vessels may lead to gangrene of the feet. Patients show a hypersensitivity to tobacco. Also called <i>Buerger disease</i>
vegetation	Irregular bacterial outgrowths on the heart valves; associated with rheumatic fever
Wolff-Parkinson-White syndrome (WPW)	A cardiac arrhythmia consisting of tachycardia and a premature ventricular beat caused by an alternative conduction pathway
Diagnosis	
cardiac catheterization	Passage of a catheter into the heart through a vessel to inject a contrast medium for imaging, diagnosis, obtaining samples, or measuring pressure
central venous pressure (CVP)	Pressure in the superior vena cava
cineangiocardiology <i>sin-e-an-jē-ō-kar-dē-OG-ra-fē</i>	The photographic recording of fluoroscopic images of the heart and large vessels using motion picture techniques
Doppler echocardiography	An imaging method used to study the rate and pattern of blood flow
Holter monitor	A portable device that can record from 24 hours to one month of an individual's ECG readings during normal activity
homocysteine <i>hō-mō-SIS-tē-ēn</i>	An amino acid in the blood that at higher-than-normal levels is associated with increased risk of cardiovascular disease
phlebotomist <i>fle-BOT-ō-mist</i>	Technician who specializes in drawing blood
phonocardiography <i>fō-nō-kar-dē-OG-ra-fē</i>	Electronic recording of heart sounds
plethysmography <i>ple-thiz-MOG-ra-fē</i>	Measurement of changes in the size of a part based on the amount of blood contained in or passing through it. Impedance plethysmography measures changes in electrical resistance and is used in the diagnosis of deep vein thrombosis
pulmonary capillary wedge pressure (PCWP)	Pressure measured by a catheter in a branch of the pulmonary artery. It is an indirect measure of pressure in the left atrium (see Box 9-2)
radionuclide heart scan	Imaging of the heart after injection of a radioactive isotope. The PYP (pyrophosphate) scan using technetium-99m (^{99m} Tc) is used to test for myocardial infarction because the isotope is taken up by damaged tissue. The MUGA (multigated acquisition) scan gives information on heart function
Swan-Ganz catheter	A cardiac catheter with a balloon at the tip that is used to measure pulmonary arterial pressure. It is flow guided through a vein into the right side of the heart and then into the pulmonary artery
transesophageal echocardiography (TEE)	Use of an ultrasound transducer placed endoscopically into the esophagus to obtain images of the heart
triglycerides <i>trī-GLIS-er-idz</i>	Simple fats that circulate in the bloodstream
ventriculography <i>ven-trik-ū-LOG-ra-fē</i>	X-ray study of the heart's ventricles after introduction of an opaque dye by means of a catheter
Treatment and Surgical Procedures	
atherectomy <i>ath-er-EK-tō-mē</i>	Removal of atheromatous plaque from the lining of a vessel. May be done by open surgery or through the vessel's lumen
commissurotomy <i>kom-i-shur-OT-ō-mē</i>	Surgical incision of a scarred mitral valve to increase the size of the valvular opening

(Continued)

Terminology**Supplementary Terms** *(Continued)*

embolectomy <i>em-bō-LEK-tō-mē</i>	Surgical removal of an embolus
intraaortic balloon pump (IABP)	A mechanical assist device that consists of an inflatable balloon pump inserted through the femoral artery into the thoracic aorta. It inflates during diastole to improve coronary circulation and deflates before systole to allow blood ejection from the heart
left ventricular assist device (LVAD)	A pump that takes over the left ventricle's function in delivering blood into the systemic circuit. These devices are used to assist patients awaiting heart transplantation or those who are recovering from heart failure
Drugs	
angiotensin-converting enzyme (ACE) inhibitor	A drug that lowers blood pressure by blocking the formation of angiotensin II, a substance that normally acts to increase blood pressure
angiotensin receptor blocker (ARB)	A drug that blocks tissue receptors for angiotensin II; angiotensin II receptor antagonist
antiarrhythmic agent	A drug that regulates the rate and rhythm of the heartbeat
beta-adrenergic blocking agent	Drug that decreases the rate and strength of heart contractions; beta-blocker
calcium-channel blocker	Drug that controls the rate and force of heart contraction by regulating calcium entrance into the cells
digitalis <i>dij-i-TAL-is</i>	A drug that slows and strengthens heart muscle contractions
diuretic <i>dī-ū-RET-ik</i>	Drug that eliminates fluid by increasing the kidneys' output of urine. Lowered blood volume decreases the heart's workload
hypolipidemic agent <i>hī-pō-lip-i-DE-mik</i>	Drug that lowers serum cholesterol
lidocaine <i>LĪ-dō-kān</i>	A local anesthetic that is used intravenously to treat cardiac arrhythmias
loop diuretic	Drug that increases urine output by inhibiting electrolyte reabsorption in the kidney nephrons (loops) (see Chapter 13)
nitroglycerin <i>nī-trō-GLIS-er-in</i>	A drug used in the treatment of angina pectoris to dilate coronary vessels
statins	Drugs that act to lower lipids in the blood. The drug names end with <i>-statin</i> , such as lovastatin, pravastatin, atorvastatin
streptokinase (SK) <i>strep-tō-KĪ-nās</i>	An enzyme used to dissolve blood clots
tissue plasminogen activator (tPA)	A drug used to dissolve blood clots. It activates production of a substance (plasmin) in the blood that normally dissolves clots.
vasodilator <i>vas-ō-dī-LĀ-tor</i>	A drug that widens blood vessels and improves blood flow

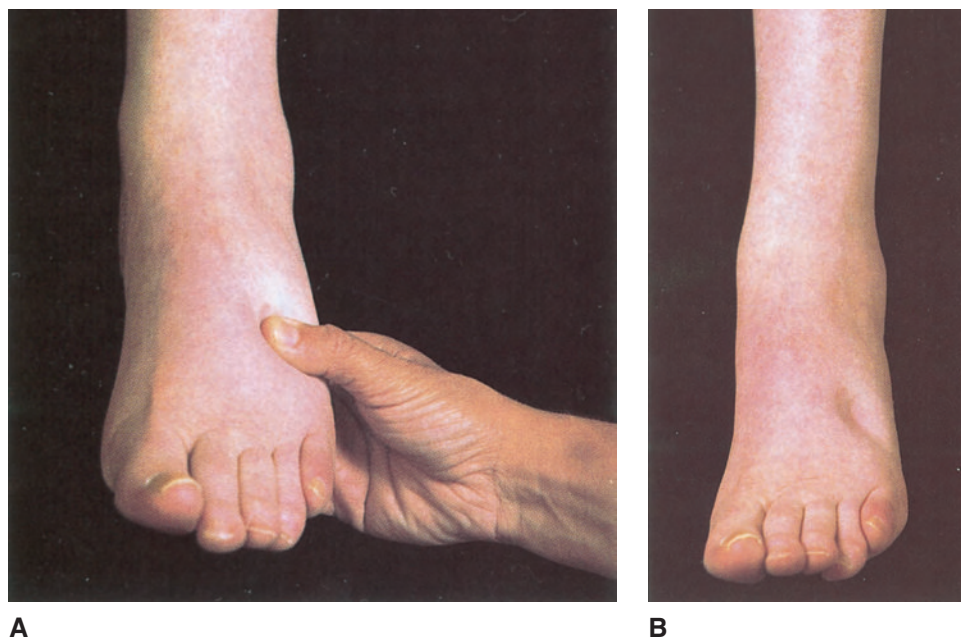


Figure 9-23 Pitting edema. When the skin is pressed firmly with the finger (A), a pit remains after the finger is removed (B).

Terminology

Abbreviations

ACE	Angiotensin-converting enzyme	CK-MB	Creatine kinase MB
AED	Automated external defibrillator	CPR	Cardiopulmonary resuscitation
AF	Atrial fibrillation	CRP	C-reactive protein
AMI	Acute myocardial infarction	CTA	Computed tomography angiography
APC	Atrial premature complex	CVA	Cerebrovascular accident
AR	Aortic regurgitation	CVD	Cardiovascular disease
ARB	Angiotensin receptor blocker	CVI	Chronic venous insufficiency
AS	Aortic stenosis; arteriosclerosis	CVP	Central venous pressure
ASCVD	Arteriosclerotic cardiovascular disease	DOE	Dyspnea on exertion
ASD	Atrial septal defect	DVT	Deep vein thrombosis
ASHD	Arteriosclerotic heart disease	ECG (EKG)	Electrocardiogram, electrocardiography
AT	Atrial tachycardia	HDL	High-density lipoprotein
AV	Atrioventricular	hs-CRP	High-sensitivity C-reactive protein (test)
BBB	Bundle branch block (left or right)	HTN	Hypertension
BP	Blood pressure	IABP	Intraaortic balloon pump
bpm	Beats per minute	ICD	Implantable cardioverter defibrillator
CABG	Coronary artery bypass graft	IVCD	Intraventricular conduction delay
CAD	Coronary artery disease	JVP	Jugular venous pulse
CCU	Coronary/cardiac care unit	LAD	Left anterior descending (coronary artery)
CHD	Coronary heart disease		
CHF	Congestive heart failure		

(Continued)

Terminology Abbreviations *(Continued)*

LAHB	Left anterior hemiblock	PTCA	Percutaneous transluminal coronary angioplasty
LDL	Low-density lipoprotein	PVC	Premature ventricular contraction
LV	Left ventricle	PVD	Peripheral vascular disease
LVAD	Left ventricular assist device	PYP	Pyrophosphate (scan)
LVEDP	Left ventricular end-diastolic pressure	S₁	First heart sound
LVH	Left ventricular hypertrophy	S₂	Second heart sound
MI	Myocardial infarction	SA	Sinoatrial
mm Hg	Millimeters of mercury	SBE	Subacute bacterial endocarditis
MR	Mitral regurgitation, reflux	SK	Streptokinase
MS	Mitral stenosis	SVT	Supraventricular tachycardia
MUGA	Multigated acquisition (scan)	^{99m}Tc	Technetium-99m
MVP	Mitral valve prolapse	TEE	Transesophageal echocardiography
MVR	Mitral valve replacement	Tn	Troponin
NSR	Normal sinus rhythm	tPA	Tissue plasminogen activator
P	Pulse	VAD	Ventricular assist device
PAC	Premature atrial contraction	VF, v fib	Ventricular fibrillation
PAP	Pulmonary arterial pressure	VLDL	Very-low-density lipoprotein
PCI	Percutaneous coronary intervention	VPC	Ventricular premature complex
PCWP	Pulmonary capillary wedge pressure	VSD	Ventricular septal defect
PMI	Point of maximal impulse	VT	Ventricular tachycardia
PSVT	Paroxysmal supraventricular tachycardia	VTE	Venous thromboembolism
		WPW	Wolff-Parkinson-White syndrome

C.L.'s Follow-Up

C.L. underwent a successful ablation procedure without any complications, and he has not had a recurrence of the atrial fibrillation. C.L.'s preexisting heart condition prohibited him

from performing required duties in the army, so he was not able to return to boot camp. He was released from the service and returned to civilian life.

Chapter Review

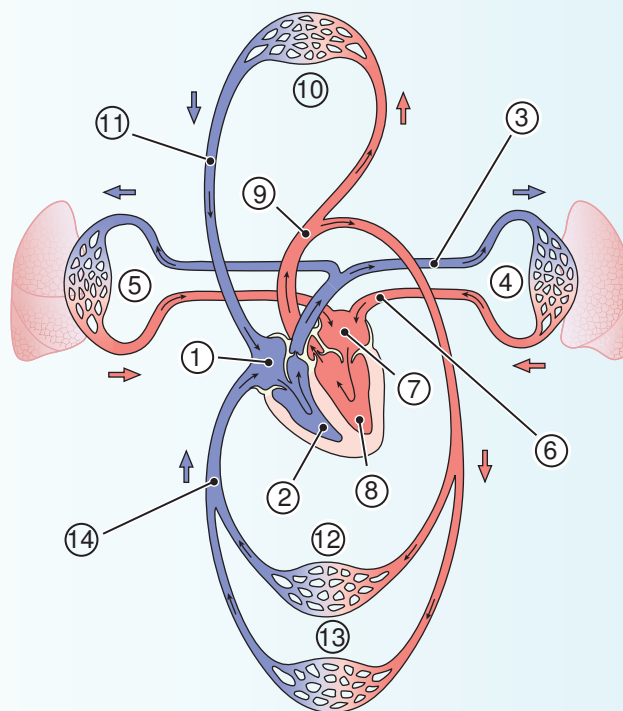
Labeling Exercise

THE CARDIOVASCULAR SYSTEM

Write the name of each numbered part on the corresponding line of the answer sheet:

Aorta	Left pulmonary vein
Head and arms	Left ventricle
Inferior vena cava	Legs
Internal organs	Right atrium
Left atrium	Right lung
Left lung	Right ventricle
Left pulmonary artery	Superior vena cava

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____



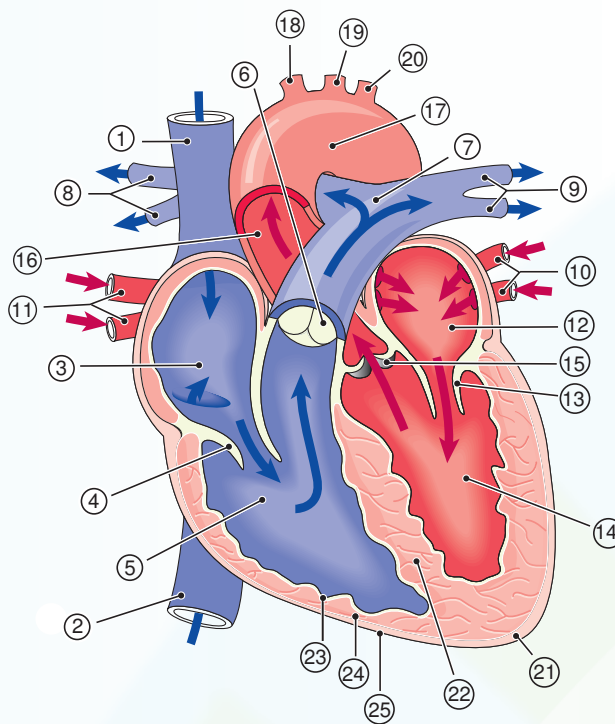
■ Blood high in oxygen
■ Blood low in oxygen

THE HEART AND GREAT VESSELS

Write the name of each numbered part on the corresponding line of the answer sheet.

Aortic arch	Left pulmonary veins
Aortic valve	Left subclavian artery
Apex	Left ventricle
Ascending aorta	Myocardium
Brachiocephalic artery	Pulmonary artery
Endocardium	Pulmonary valve
Epicardium	Right atrium
Inferior vena cava	Right AV (tricuspid) valve
Interventricular septum	Right pulmonary artery (branches)
Left atrium	Right pulmonary veins
Left AV (mitral) valve	Right ventricle
Left common carotid artery	Superior vena cava
Left pulmonary artery (branches)	

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____



■ Blood high in oxygen
■ Blood low in oxygen

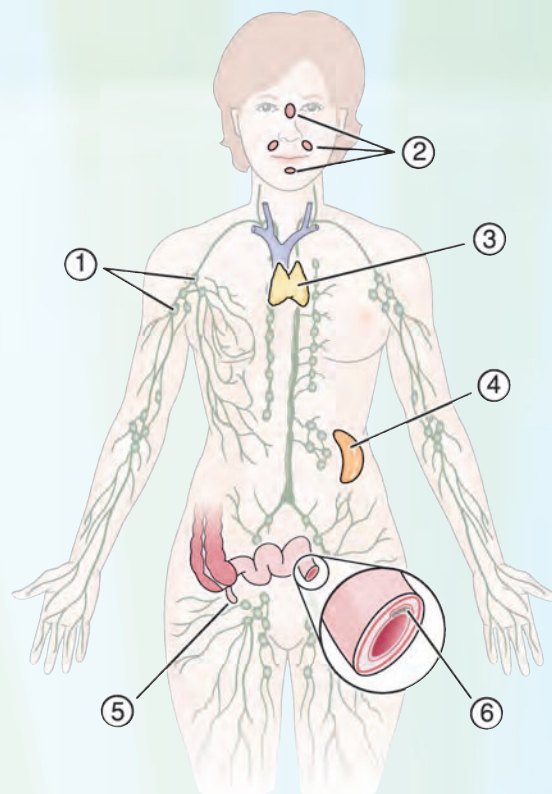
18. _____
19. _____
20. _____
21. _____
22. _____
23. _____
24. _____
25. _____

LOCATION OF LYMPHOID TISSUE

Write the name of each numbered part on the corresponding line of the answer sheet:

Appendix	Spleen
Lymph nodes	Thymus
Peyer patches (in intestine)	Tonsils

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____



Terminology

MATCHING

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|---------------------------|---|
| _____ 1. valve | a. vessel that empties into the right atrium |
| _____ 2. vena cava | b. fibrous sac around the heart |
| _____ 3. apex | c. structure that keeps fluid moving forward |
| _____ 4. pericardium | d. central opening of a vessel |
| _____ 5. lumen | e. lower, pointed region of the heart |
| _____ 6. thrombosis | a. ineffective quivering of muscle |
| _____ 7. myocarditis | b. formation of a blood clot in a vessel |
| _____ 8. infarction | c. inflammation of the heart muscle |
| _____ 9. fibrillation | d. local deficiency of blood |
| _____ 10. ischemia | e. local death of tissue |
| _____ 11. atherosclerosis | a. twisted and swollen vessel |
| _____ 12. varix | b. blockage |
| _____ 13. occlusion | c. absence of a heartbeat |
| _____ 14. asystole | d. localized dilatation of a vessel |
| _____ 15. aneurysm | e. accumulation of fatty deposits |

- | | |
|----------------|---|
| _____ 16. VT | a. stroke |
| _____ 17. CVA | b. a type of blood lipid |
| _____ 18. HTN | c. rapid beat in the heart's lower chambers |
| _____ 19. HDL | d. high blood pressure |
| _____ 20. CABG | e. surgery to bypass a blocked vessel |

Supplementary Terms

- | | |
|-------------------------|---------------------------------------|
| _____ 21. diuretic | a. removal of plaque |
| _____ 22. regurgitation | b. drug that increases urinary output |
| _____ 23. streptokinase | c. premature contraction |
| _____ 24. atherectomy | d. drug used to dissolve blood clots |
| _____ 25. extrasystole | e. backward flow |

FILL IN THE BLANKS

26. Each upper receiving chamber of the heart is a(n) _____.
27. The microscopic vessels through which materials are exchanged between the blood and the tissues are the _____.
28. The heart muscle is the _____.
29. The largest artery is the _____.
30. A sinus rhythm originates in the _____.
31. Blood returning to the heart from the systemic circuit enters the chamber called the _____.
32. The term *varicoid* pertains to a(n) _____.
33. The lymphoid organ in the chest is the _____.
34. A phlebotomist (*fle-BOT-ō-mist*) is one who drains blood from a(n) _____.
35. At its termination in the abdomen, the aorta divides into the right and left (see Fig. 9-5) _____.
36. The large artery in the neck that supplies blood to the brain is the (see Fig. 9-5) _____.
37. The large vein that drains the lower body and empties into the heart is the (see Fig. 9-6) _____.
38. The right lymphatic duct and the thoracic duct drain into vessels called the (see Fig. 9-19) _____.
39. In C.L.'s case study, the device he wore to record his heart rhythm is called a(n) _____.
40. The abnormal heart rhythm that prevented C.L. from completing basic training is termed _____.
41. The catheterization technique used to correct C.L.'s arrhythmia is termed cardiac _____.

TRUE-FALSE

Examine the following statements. If the statement is true, write T in the first blank. If the statement is false, write F in the first blank and correct the statement by replacing the underlined word in the second blank.

- | | True or False | Correct Answer |
|--|---------------|----------------|
| 42. The left AV valve is the <u>mitral</u> valve. | _____ | _____ |
| 43. The <u>systemic circuit</u> pumps blood to the lungs. | _____ | _____ |
| 44. An <u>artery</u> is a vessel that carries blood back to the heart. | _____ | _____ |
| 45. <u>Diastole</u> is the relaxation phase of the heart cycle. | _____ | _____ |

46. The right ventricle pumps blood into the aorta.
47. Blood returning from the lungs to the heart enters the left atrium.
48. The pulmonary vein carries blood to the lungs.
49. The brachial artery supplies blood to the leg.
50. Peyer patches are in the intestine.
51. Bradycardia is a lower-than-average heart rate.
52. A beta-adrenergic blocking agent slows the heart rate.

ELIMINATIONS

In each of the sets below, underline the word that does not fit in with the rest and explain the reason for your choice:

53. SA node — Purkinje fibers — apex — AV node — AV bundle

54. murmur — systolic — sphygmomanometer — mm Hg — diastolic

55. U — S₁ — QRS — T — P

56. thymus — spleen — cusp — tonsil — Peyer patches

DEFINITIONS

Define the following terms:

57. Avascular (*ā-VAS-kū-lar*)

58. Atriotomy (*ā-trē-OT-ō-mē*)

59. Splenectomy (*splē-NEK-tō-mē*)

60. Supraventricular (*sū-pra-ven-TRIK-ū-lar*)

61. Phlebectasis (*fleb-EK-ta-sis*)

Write words for the following definitions:

62. Physician who specializes in study and treatment of the heart

63. Suture (-rhaply) of an artery

64. Surgical fixation (-pexy) of the spleen

65. An instrument (-tome) for incising a valve

66. Stoppage (-stasis) of lymph flow

67. Excision of a lymph node

Use the root aort/o to write words with the following meanings:

68. Downward displacement (-ptosis) of the aorta _____
69. Narrowing (-stenosis) of the aorta _____
70. Radiograph (-gram) of the aorta _____
71. Before or in front of (pre-) the aorta _____

ADJECTIVES

Write the adjective form of the following words:

72. atrium _____
73. thymus _____
74. vein _____
75. septum _____
76. sclerosis _____
77. spleen _____

PLURALS

Write the plural form of the following words:

78. thrombus _____
79. varix _____
80. stenosis _____
81. septum _____

ABBREVIATIONS

Write the meaning of the following abbreviations as they apply to the cardiovascular system:

82. AED _____
83. LVAD _____
84. DVT _____
85. VF _____
86. BBB _____
87. PCTA _____

WORD BUILDING

Write words for the following definitions using the word parts given.

-pathy lymph/o -oma angi/o -itis aden/o plasty

88. inflammation of a vessel _____
89. any disease of a lymph node _____
90. neoplasm involving the lymphatic system _____

- 91. plastic repair of a vessel _____
- 92. inflammation of a lymphatic vessel _____
- 93. any disease of a vessel _____
- 94. inflammation of a lymph node _____
- 95. neoplasm of a lymph node _____
- 96. tumor involving vessels _____

WORD ANALYSIS

Define the following words and give the meaning of the word parts in each. Use a dictionary if necessary.

- 97. Phonocardiography (*fō-nō-kar-dē-OG-ra-fē*) _____
 - a. phon/o _____
 - b. cardi/o _____
 - c. -graphy _____
- 98. Endarterectomy (*end-ar-ter-EK-tō-mē*) _____
 - a. end/o- _____
 - b. arteri/o _____
 - c. ecto- _____
 - d. -tomy _____
- 99. Telangiectasia (*tel-an-jē-ek-TĀ-zē-a*)- _____
 - a. tel- _____
 - b. angi/o _____
 - c. -ectasia _____
- 100. Lymphangiophlebitis (*lim-fan-jē-ō-flē-BĪ-tis*) _____
 - a. lymph/o _____
 - b. angi/o _____
 - c. phleb/o _____
 - d. -itis _____

Additional Case Studies

Case Study 9-1: PTCA and Echocardiogram

A.L., a 68-YO woman, was admitted to the CCU with chest pain, dyspnea, diaphoresis, syncope, and nausea. She had taken three sublingual doses of nitroglycerin tablets within a 10-minute time span without relief before dialing 911. A previous stress test and thallium uptake scan suggested cardiac disease.

Her family history was significant for cardiovascular disease. Her father died at the age of 62 of an acute myocardial infarction. Her mother had bilateral carotid endarterectomies and a femoral-popliteal bypass procedure and died at the age of 72 of congestive heart failure. A.L.'s older sister died from a ruptured aortic aneurysm at the age of 65. A.L.'s ECG on admission showed tachycardia with a rate of 126 bpm with inverted T waves. A murmur was heard at S₁. Her skin color was dusky to cyanotic on her

lips and fingertips. Her admitting diagnosis was possible coronary artery disease, acute myocardial infarction, and valvular disease.

Cardiac catheterization with balloon angioplasty (PTCA) was performed the next day. Significant stenosis of the left anterior descending coronary artery was shown and treated with angioplasty and stent placement. Left ventricular function was normal.

Echocardiography, two days later, showed normal-sized left and enlarged right ventricular cavities. The mitral valve had normal amplitude of motion. The anterior and posterior leaflets moved in opposite directions during diastole. There was a late systolic prolapse of the mitral leaflet at rest. The left atrium was enlarged. The impression of the study was mitral prolapse with regurgitation. Surgery was recommended.

Case Study 9-2: Mitral Valve Replacement Operative Report

A.L. was transferred to the operating room, placed in a supine position, and given general endotracheal anesthesia. The surgeon entered her pericardium longitudinally through a median sternotomy and found that her heart was enlarged, with a dilated right ventricle. The left atrium was dilated. Preoperative transesophageal echocardiography revealed severe mitral regurgitation with severe posterior and anterior prolapse. Extracorporeal circulation was established. The aorta was cross-clamped, and cardioplegic solution (to stop the heartbeat) was given into the aortic root intermittently for myocardial protection.

The left atrium was entered via the interatrial groove on the right, exposing the mitral valve. The middle scallop of the posterior leaflet was resected. The remaining leaflets were removed to the areas of the commissures and preserved for the sliding plasty. The elongated chordae were shortened to

better anchor the valve cusps. The surgeon slid the posterior leaflet across the midline and sutured it in place. A No. 30 annuloplasty ring was sutured in place with interrupted No. 2-0 Dacron suture. The valve was tested by inflating the ventricle with NSS and proved to be competent. The left atrium was closed with continuous No. 4-0 Prolene suture. Air was removed from the heart. The cross-clamp was removed. Cardiac action resumed with normal sinus rhythm. After a period of cardiac recovery and attainment of normothermia, cardiopulmonary bypass was discontinued.

Protamine was given to counteract the heparin. Pacer wires were placed in the right atrium and ventricle. Silicone catheters were placed in the pleural and substernal spaces. The sternum and soft tissue wound was closed. A.L. recovered from her surgery and was discharged six days later.

Case Study Questions

Write the word or phrase from the case study that means each of the following:

1. The state of profuse perspiration _____
2. Under the tongue _____
3. Test of cardiac function during physical exertion _____
4. Pertaining to both the heart and blood vessels _____
5. Excision of the inner lining along with atherosclerotic plaque from an artery (plural) _____
6. An abnormal heart sound _____
7. Bluish discoloration of the skin due to lack of oxygen _____
8. The noun form of stenotic _____
9. Between the atria _____
10. Below the sternum _____

Multiple choice. Select the best answer and write the letter of your choice to the left of each number:

- | | |
|---|--|
| _____ 11. The word transluminal means: | _____ 15. Sternotomy is: |
| a. across a wall | a. incision into the sternum |
| b. between branches | b. removal of the sternum |
| c. through an outer layer | c. narrowing of the sternum |
| d. through a central opening | d. plastic repair of the sternum |
| e. across a valve | e. surgical fixation of the sternum |
| _____ 12. The term that means backflow, as of blood, is: | _____ 16. Extracorporeal circulation occurs: |
| a. infarction | a. within the brain |
| b. regurgitation | b. within the pericardium |
| c. amplitude | c. within the body |
| d. prolapse | d. in the legs |
| e. tourniquet | e. outside the body |
| _____ 13. The term for a narrowing of the bicuspid valve is: | _____ 17. Protamine was given to counteract the action of the heparin. This drug action is described as: |
| a. atrial prolapse | a. antagonistic |
| b. pulmonic stenosis | b. synergy |
| c. mitral stenosis | c. potentiating |
| d. mitral prolapse | d. simulation |
| e. atrial stenosis | e. addiction |
| _____ 14. Blowout of a dilated segment of the main artery is: | |
| a. left anterior diastole | |
| b. peritoneal infarction | |
| c. coarctation of the aorta | |
| d. cardiac tamponade | |
| e. ruptured aortic aneurysm | |

Abbreviations. Define the following abbreviations:

18. CCU _____
19. AMI _____
20. CAD _____
21. LAD _____
22. CHF _____
23. TEE _____
24. MVR _____

CHAPTER 10

Blood and Immunity

Case Study

*Nurse Anesthetist M.R.
with Latex Allergy*

Chief complaint:

M.R., a 36-year-old certified registered nurse anesthetist (CRNA), was noticing when she removed her gloves following cases in the OR that her hands had a red patchy rash. They began to itch after a few minutes of donning the gloves, so she figured she might have developed an allergy to the latex in the gloves. When she began to have a runny nose and itchy swollen eyes, she was worried and sought medical advice from her primary care physician who referred her to an allergist.

Examination:

The allergist examined M.R.'s hands and observed a localized red crusty rash that stopped at the wrists. There were a few blisters spread over the hand region. Along with the examination, a history indicated M.R. had noticed the contact dermatitis for a while when she wore powdered latex gloves in the OR, and she more recently noted generalized allergic symptoms during surgical cases. During the most recent case, she became tachycardic and hypotensive and experienced urticaria, rhinitis, and bronchospasm when she was in contact with or in proximity to latex. She had one frightening episode of anaphylaxis.

Clinical course:

M.R. was diagnosed with a type I hypersensitivity, IgE T cell-mediated latex allergy, as shown by both immunologic and skin-prick tests. Although M.R. is a CRNA, she was educated on the course of latex allergies. She was reminded that there is no cure and that the only way to prevent an allergic reaction is to avoid coming into contact with latex.

This chapter describes the composition and characteristics of blood, the life-sustaining fluid that circulates throughout the body. A discussion of immunity is included because many components of the immune system are carried in the blood. M.R.'s case of allergy is an example of immunologic hyperactivity. Some allergic symptoms, such as tachycardia and hypotension, were described in Chapter 9 on circulation. Others, such as rhinitis and bronchospasm, appear in the next chapter on the respiratory system.



Ancillaries *At-A-Glance*

Visit *thePoint* to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii–xvi.

Learning TOOLS

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning RESOURCES

- E-book: Chapter 10
- Web Figure: Hematopoiesis
- Web Chart: Childhood Immunizations
- Web Animation: Hemostasis
- Web Animation: Immune Response
- Audio Pronunciation Glossary

Learning ACTIVITIES

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After study of this chapter you should be able to:

- 1 Describe the composition of the blood plasma. *p216*
- 2 Describe and give the functions of the three types of blood cells. *p217*
- 3 Differentiate the five different types of leukocytes. *p217*
- 4 Explain the basis of blood types. *p218*
- 5 Define immunity, and list the possible sources of immunity. *p220*
- 6 Identify and use roots and suffixes pertaining to the blood and immunity. *p224*
- 7 Identify and use roots pertaining to blood chemistry. *p227*
- 8 List and describe three major disorders of the blood. *p228*
- 9 Describe the major tests used to study blood. *pp228, 230*
- 10 List and describe three major disorders of the immune system. *p232*
- 11 Interpret abbreviations used in blood studies. *p238*
- 12 Analyze medical terms in several case studies involving the blood. *pp214, 244*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- _____ 1. Erythrocyte is the scientific name for a:
 - a. white blood cell
 - b. lymphocyte
 - c. red blood cell
 - d. muscle cell
- _____ 2. Platelets, or thrombocytes, are involved in:
 - a. inflammation
 - b. digestion
 - c. immunity
 - d. blood clotting
- _____ 3. The white blood cells active in immunity are the:
 - a. hematids
 - b. lymphocytes
 - c. adipose cells
 - d. chondrocytes
- _____ 4. Substances produced by immune cells that counteract microorganisms and other foreign materials are called:
 - a. antibodies
 - b. antigens
 - c. anticoagulants
 - d. Rh factors
- _____ 5. A deficiency of hemoglobin results in the disorder called:
 - a. hypertension
 - b. chromatosis
 - c. anemia
 - d. hemophilia
- _____ 6. A neoplastic overgrowth of white blood cells is called:
 - a. anemia
 - b. leukemia
 - c. fibrosis
 - d. cystitis

Blood is the fluid that circulates through the vessels, bringing oxygen and nourishment to all cells and carrying away carbon dioxide and other waste products. The **blood** also distributes body heat and carries special substances, such as antibodies and hormones. Certain blood cells are a major component of the immune system, which protects against disease. This chapter thus includes a discussion of the immune system.

Blood

The total adult blood volume is about 5 L (5.2 quarts). Whole blood can be divided into two main components: the liquid portion, or **plasma** (55 percent), and **formed elements**, more commonly known as blood cells (45 percent) (**Fig. 10-1**).

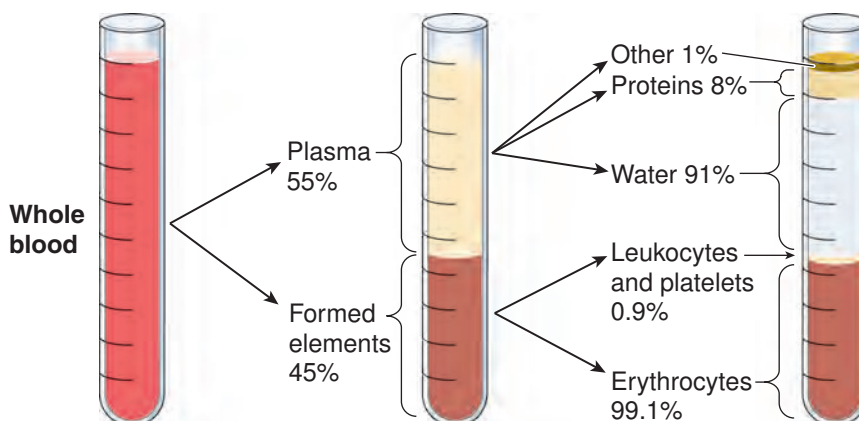


Figure 10-1 Composition of whole blood. Percentages show the relative proportions of the different components of plasma and formed elements.

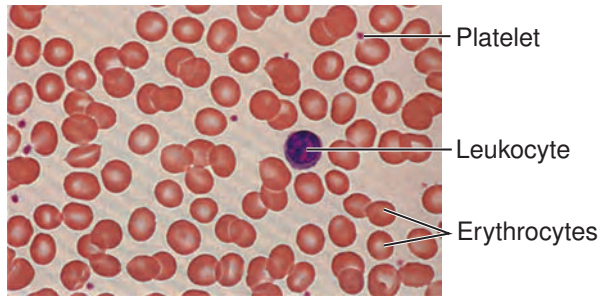


Figure 10-2 Blood cells. When viewed under a microscope, all three types of formed elements are visible.

BLOOD PLASMA

Plasma is about 90 percent water. The remaining 10 percent contains nutrients, **electrolytes** (dissolved salts), gases, **albumin** (a protein), clotting factors, antibodies, wastes, enzymes, and hormones. Laboratories test for a multitude of these substances in blood chemistry tests. The pH (relative acidity) of the plasma remains steady at about 7.4.

BLOOD CELLS

The blood cells (**Fig. 10-2**) include **erythrocytes**, or red blood cells (RBCs); **leukocytes**, or white blood cells (WBCs); and **platelets**, also called **thrombocytes**. All blood cells are produced in red bone marrow. Some WBCs multiply in lymphoid tissue as well. For Your Reference **Box 10-1** summarizes the different types of blood cells; **Box 10-2** discusses time-saving acronyms, such as RBC and WBC.

Erythrocytes

The major function of erythrocytes is to carry oxygen to cells. This oxygen is bound to an iron-containing pigment

in the cells called **hemoglobin**. Erythrocytes are small, disk-shaped cells with no nuclei (**Fig. 10-3**). Their concentration of about 5 million per microliter (mcL) of blood makes them by far the most numerous of the blood cells. The hemoglobin that they carry averages 15 g/dL (100 mL) of blood. An RBC gradually wears out and dies in about 120 days, so these cells must be constantly replaced. Production of red cells in the bone marrow is regulated by the hormone **erythropoietin (EPO)**, which is made in the kidneys.

Leukocytes

WBCs all show prominent nuclei when stained. They total about 5,000 to 10,000/mcL, but their number may increase during infection. There are five types of leukocytes that vary in their relative percentages and in their functions. The different types are identified by the size and appearance of the nucleus, by their staining properties, and by whether or not they show visible granules in the cytoplasm when stained. The five types are illustrated and compared in **Box 10-3**. Classified as granulocytes or agranulocytes, they are as follows:

- **Granulocytes**, or granular leukocytes, have visible granules in the cytoplasm when stained. A granulocyte has a segmented nucleus. There are three types of granulocytes, named for the kind of stain (dye) the granules take up:
 - **Neutrophils** stain weakly with both acidic and basic dyes.
 - **Eosinophils** stain strongly with acidic dyes.
 - **Basophils** stain strongly with basic dyes.
- **Agranulocytes** do not show visible granules when stained. An agranulocyte's nucleus is large and

Box 10-1

For Your Reference

Blood Cells

CELL TYPE	NUMBER PER MICROLITER OF BLOOD	DESCRIPTION	FUNCTION
Erythrocyte (red blood cell)	5 million	Tiny (7 mcm diameter), biconcave disk without nucleus (anuclear)	Carries oxygen bound to hemoglobin; also carries some carbon dioxide and buffers blood
Leukocyte (white blood cell)	5,000 to 10,000	Larger than red cell with prominent nucleus that may be segmented (granulocyte) or unsegmented (agranulocyte); types vary in staining properties	Immunity. Protects against pathogens and destroys foreign matter and debris. Located in blood, tissues, and lymphatic system
Platelet (thrombocyte)	150,000 to 450,000	Fragment of large cell (megakaryocyte)	Hemostasis. Forms a platelet plug and starts blood clotting (coagulation)

Box 10-2



Focus on Words

Acronyms

Acronyms are abbreviations that use the first letters of the words in a name or phrase. They have become very popular because they save time and space in writing as the number and complexity of technical terms increases. Some examples that apply to studies of the blood are CBC (complete blood count) and RBC and WBC for red and white blood cells. Some other common acronyms are CNS (central nervous system or clinical nurse specialist), ECG (electrocardiogram) NIH (National Institutes of Health), and STI (sexually transmitted infection).

If the acronym has vowels and lends itself to pronunciation, it may be used as a word in itself, such as AIDS (acquired immunodeficiency syndrome); ELISA (enzyme-linked

immunosorbent assay); JAMA (*Journal of the American Medical Association*); NSAID (nonsteroidal antiinflammatory drug), pronounced “en-sayd;” and CABG (coronary artery bypass graft), which inevitably becomes “cabbage.” Few people even know that LASER is an acronym that means “light amplification by stimulated emission of radiation.”

An acronym is usually introduced the first time a phrase appears in an article and is then used without explanation. If you have spent time searching back through an article in frustration for the meaning of an acronym, you probably wish, as does this author, that all the acronyms used and their meanings would be listed at the beginning of each article.

either round or curved. There are two types of agranulocytes:

- **Lymphocytes** are the smaller agranulocytes.
- **Monocytes** are the largest of all the WBCs.

WBCs protect against foreign substances. Some engulf foreign material by the process of **phagocytosis** (see Fig. 6-5); others have different functions in the immune system. In diagnosis, it is important to know not only the total number of leukocytes but also the relative number of each type, because these numbers can change in different disease conditions. Laboratories report these numbers as a differential count (Diff), which is part of a complete blood count (CBC).

The most numerous WBCs, neutrophils, are called *polymorphs* because of the various shapes of their nuclei. They are also referred to as *segs*, *polys*, or *PMNs* (*polymorphonuclear leukocytes*). A **band cell**, also called a *stab cell*, is an immature neutrophil with a solid curved nucleus (Fig. 10-4). Large numbers of band cells in the blood indicate an active infection.

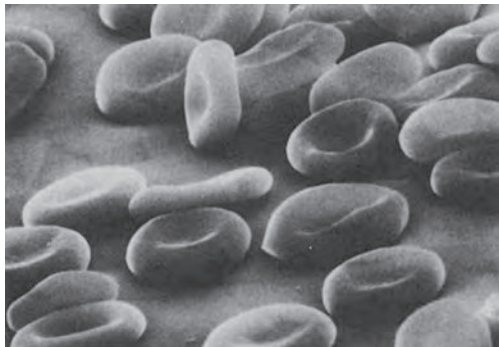


Figure 10-3 Erythrocytes (red blood cells). The cells are seen under a scanning electron microscope, which gives a three-dimensional view.

Platelets

The blood platelets (thrombocytes) are not complete cells, but fragments of large cells named **megakaryocytes**, which form in bone marrow (Fig. 10-5). They number from 200,000 to 400,000/mcL of blood. Platelets are important in **hemostasis**, the prevention of blood loss, which includes the process of blood clotting, or **coagulation**.



See the figure on hematopoiesis (formation of blood cells) and the animation “Hemostasis” in the Student Resources on thePoint.

When a vessel is injured, platelets stick together to form a plug at the site. Substances released from the platelets and from damaged tissue then interact with clotting factors in the plasma to produce a wound-sealing clot. Clotting factors are inactive in the blood until an injury occurs. To protect against unwanted clot formation, 12 factors must interact before blood coagulates. The final reaction is the conversion of **fibrinogen** to threads of **fibrin** that trap blood cells and plasma to produce the clot (Fig. 10-6). The plasma that remains after blood coagulates is **serum**.

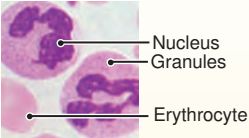
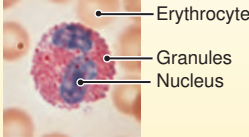
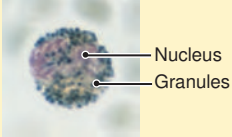
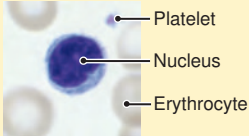
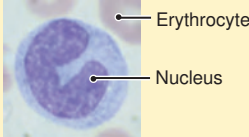
BLOOD TYPES

Genetically inherited proteins on the surface of RBCs determine blood type. More than 20 groups of these proteins have now been identified, but the most familiar are the ABO and Rh blood groups. The ABO system includes types A, B, AB, and O. The Rh types are Rh positive (Rh⁺) and Rh negative (Rh⁻). Blood is typed by mixing samples separately with different prepared antisera. Red cells in the sample will agglutinate (clump) with the antiserum that corresponds to the blood’s type, as shown in Figure 10-7 for the ABO system.

Box 10-3

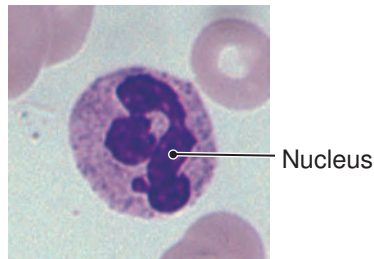
For Your Reference

Leukocytes (White Blood Cells)

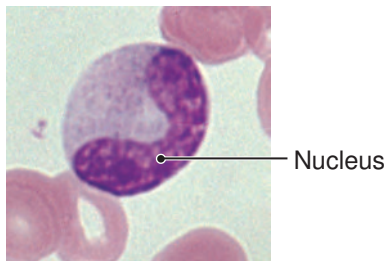
CELLS	RELATIVE PERCENTAGE (ADULT)	FUNCTION
GRANULOCYTES		
neutrophils <i>NU-trō-fils</i>	54 to 62 percent	phagocytosis
 <p>A Neutrophil</p>		
eosinophils <i>ē-ō-SIN-ō-fils</i>	1 to 3 percent	allergic reactions; defense against parasites
 <p>B Eosinophil</p>		
basophils <i>BĀ-sō-fils</i>	less than 1 percent	allergic reactions
 <p>C Basophil</p>		
AGRANULOCYTES		
lymphocytes <i>LIM-fō-sitz</i>	25 to 38 percent	Immunity (T cells and B cells)
 <p>D Lymphocyte</p>		
monocytes <i>MON-ō-sitz</i>	3 to 7 percent	phagocytosis
 <p>E Monocyte</p>		

In giving blood transfusions, it is important to use blood that is the same type as the recipient's blood or a type to which the recipient will not have an immune reaction. In an emergency, type O, Rh-negative blood can be used because these red cells will not induce an immune

response. When there is time, laboratories perform more complete tests for compatibility that take additional blood proteins into account. In this process of **cross-matching**, donor red cells are mixed with recipient serum to test for a reaction.



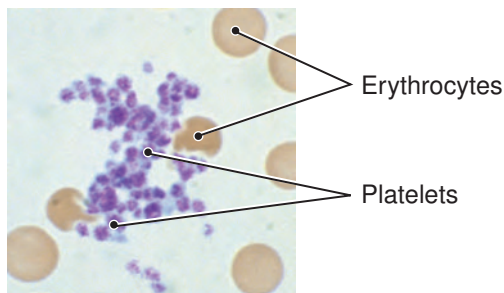
A Mature neutrophil



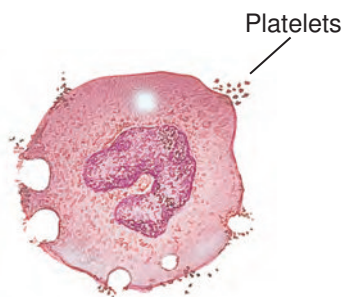
B Band cell (immature neutrophil)

Figure 10-4 Band cell. A. A mature neutrophil. B. A band cell, or stab cell, is an immature neutrophil with a thick curved nucleus.

Whole blood may be used to replace a large volume of blood lost, but in most cases requiring blood transfusion, a blood fraction, such as packed red cells, platelets, plasma, or specific clotting factors, is administered.



A Platelets



B Megakaryocyte

Figure 10-5 Platelets (thrombocytes). A. Platelets seen in a blood smear under the microscope. B. A megakaryocyte releases platelets.

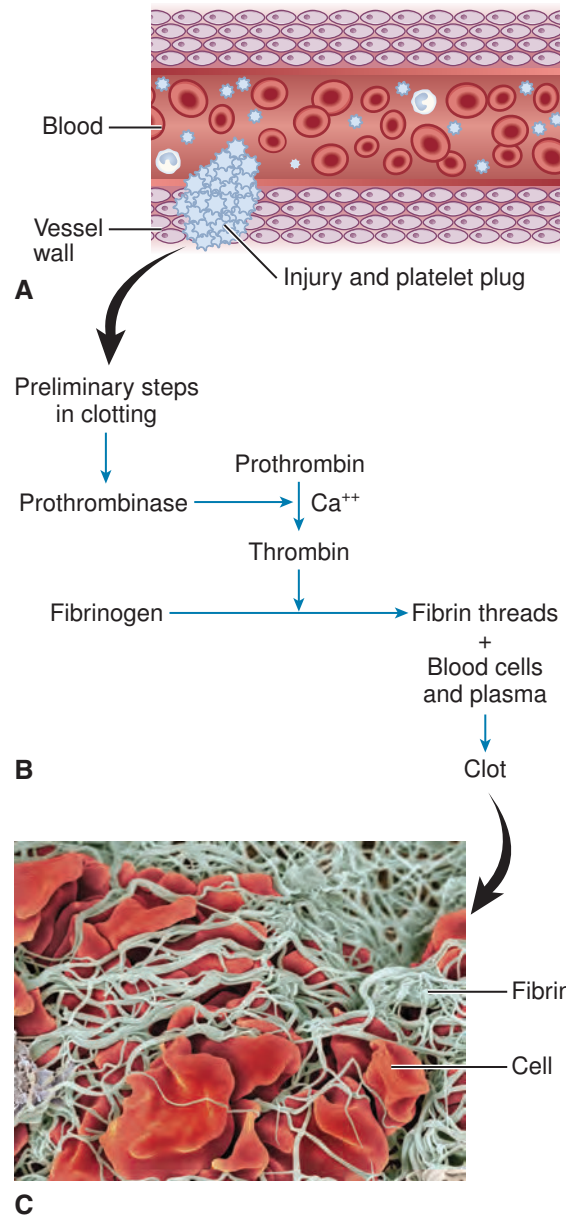


Figure 10-6 Blood clotting (coagulation). Blood coagulation involves a complex series of reactions that leads to formation of fibrin threads. The fibrin traps blood cells to form a clot. A. Substances released from damaged tissue start the clotting process. B. The final steps in formation of fibrin. One of these steps requires calcium (Ca^{2+}). C. Microscopic view of blood cells trapped in fibrin.

Immunity

Immunity is protection against disease. It includes defenses against harmful microorganisms, their products, or any other foreign substance. These defenses may be inborn or acquired during life (Fig. 10-8).

NONSPECIFIC IMMUNITY

Nonspecific defense mechanisms protect against any invading organism or harmful foreign substance, not any

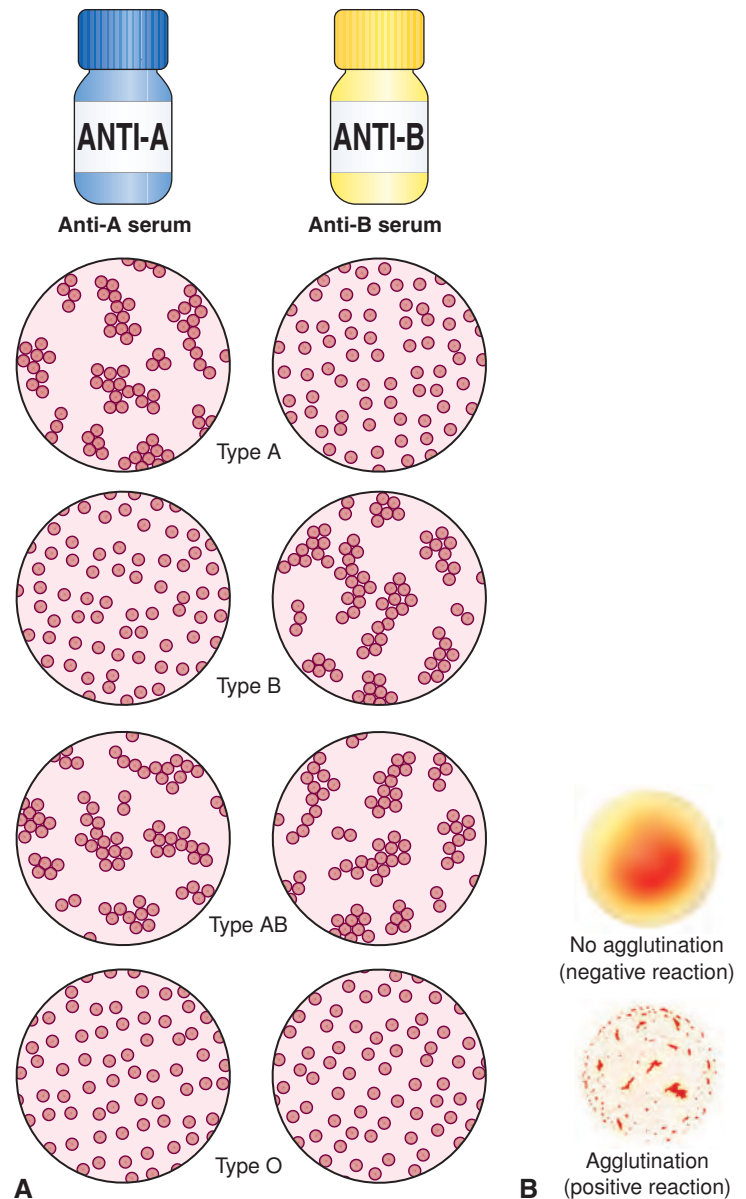


Figure 10-7 Blood typing. Blood type is determined by mixing samples separately with antisera prepared against the different red cell antigens. Clumping (agglutination) with an antiserum indicates the presence of the corresponding antigen. **A.** Labels at the top of each column denote the kind of antiserum added to the blood samples. Anti-A serum agglutinates red cells in type A blood, but anti-B serum does not. Anti-B serum agglutinates red cells in type B blood, but anti-A serum does not. Both sera agglutinate type AB blood cells, and neither serum agglutinates type O blood. **B.** Photographs of blood typing reactions.

particular one. These defenses are inborn, or *innate*, and are based on an individual's inherited genetic makeup. Most of these protections are physical barriers or chemical defenses and include the following:

- Unbroken skin, which acts as a barrier
- Cilia, tiny cell projections that sweep impurities out of the body, as in the respiratory tract
- Mucus that traps foreign material
- Bactericidal body secretions, as found in tears, the skin, the digestive tract, and the reproductive tract
- Reflexes, such as coughing and sneezing, which expel impurities
- Lymphoid tissue, which filters impurities from blood and lymph, as described in Chapter 9
- Phagocytes—cells that attack, ingest, and destroy foreign organisms

SPECIFIC IMMUNITY

Specific or *adaptive* immunity is acquired during life and is directed toward a particular disease organism or other foreign substance. Protection against measles, for example, will not protect against chickenpox or any other disease.

The specific immune response involves complex interactions between components of the lymphatic system and the blood. Any foreign particle, but mainly proteins, may act as an **antigen**, a substance that provokes an immune response. This response comes from two types of lymphocytes that circulate in the blood and lymphatic system:

- **T cells** (T lymphocytes) mature in the thymus. They are capable of attacking a foreign cell directly, producing *cell-mediated immunity*. **Macrophages**, descendants of monocytes, are important in the function of T cells.

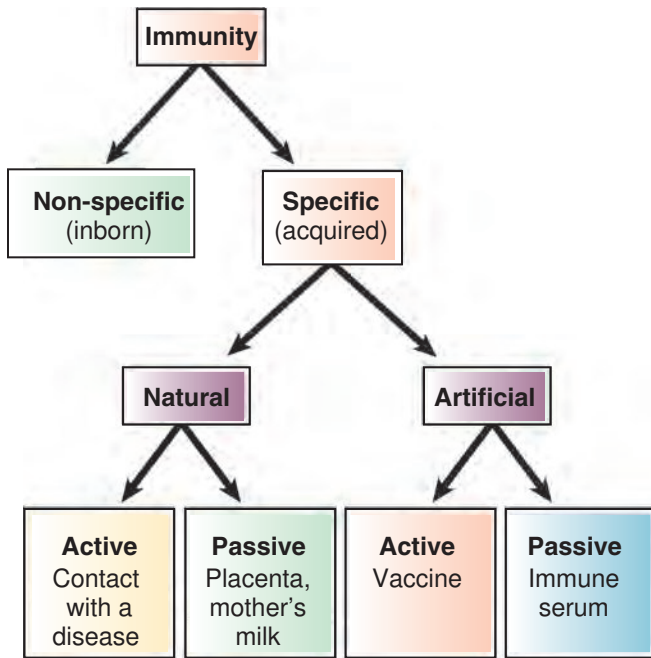


Figure 10-8 Types of immunity.

Macrophages take in and process foreign antigens. A T cell is activated when it contacts an antigen on a macrophage's surface in combination with some of the body's own proteins.

- **B cells** (B lymphocytes) mature in bone marrow. When they meet a foreign antigen, they multiply rapidly and mature into **plasma cells**. These cells produce **antibodies**, also called **immunoglobulins (Ig)**, that inactivate antigens (Fig. 10-9). Antibodies remain in the blood, often providing long-term immunity to the specific organism against which they were formed. Antibody-based immunity is referred to as *humoral immunity*.

Types of Specific Immunity

Specific immunity may be acquired either naturally or artificially (see Fig. 10-8). In addition, each avenue for acquiring such immunity may be either active or passive. In active immunity, a person makes his or her own antibodies in response to contact with an antigen. In passive immunity, an antibody, known as an immune serum, is transferred from an outside source. Immune sera may come from other people or from immunized animals. The portion of the blood plasma that contains antibodies is the **gamma globulin** fraction. The types of specific immunity are:

- **Natural specific immunity**
 - Active—from contact with a disease organism or other foreign antigen
 - Passive—by transfer of antibodies from a mother to her fetus through the placenta or through the mother's milk

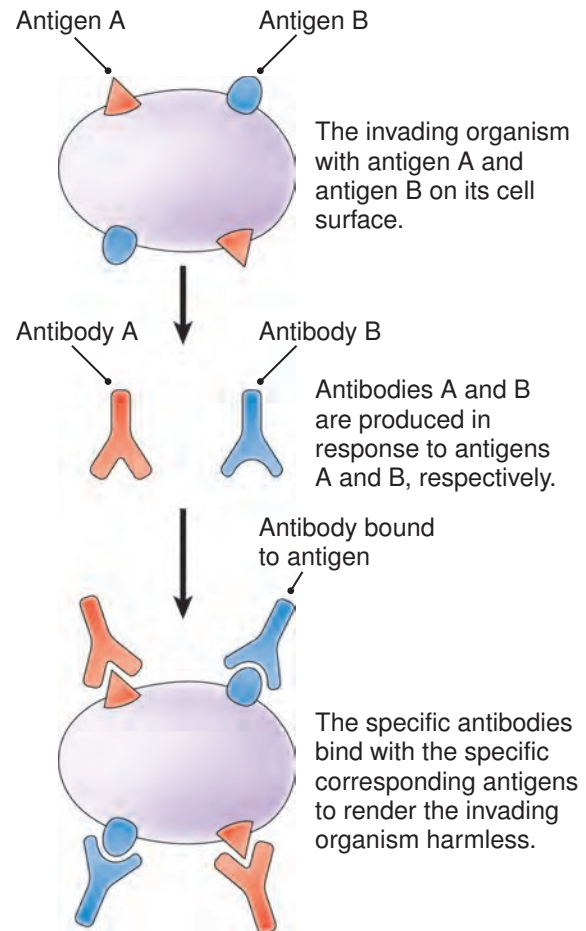


Figure 10-9 The antigen-antibody reaction. Antibodies produced by immune cells bind with specific antigens to aid in their inactivation and elimination.

- **Artificial specific immunity**
 - Active—by administration of a vaccine, which may be a killed or weakened organism, part of an organism, or an altered toxin (toxoid)
 - Passive—by administration of an immune serum obtained from other people or animals



See the chart on childhood immunizations and the animation “Immune Response” in the Student Resources on thePoint.

Immunology has long been a very active area of research. The above description is only the barest outline of the events that are known to occur in the immune response, and there is much still to be discovered. Some of the areas of research include autoimmune diseases, in which an individual produces antibodies to his or her own body tissues; hereditary and acquired immunodeficiency diseases; the relationship between cancer and immunity; and the development of techniques for avoiding rejection of transplanted tissue.

Normal Structure and Function

agranulocyte <i>Ā-gran-ū-lō-sīt</i>	A white blood cell that does not have visible granules in its cytoplasm. Agranulocytes include lymphocytes and monocytes (see Box 10-3)
albumin <i>al-BŪ-min</i>	A simple protein found in blood plasma
antibody <i>AN-ti-bod-ē</i>	A protein produced in response to and interacting specifically with an antigen
antigen <i>AN-ti-jen</i>	A substance that induces the formation of an antibody
B cell	A lymphocyte that matures in lymphoid tissue and is active in producing antibodies; B lymphocyte (<i>LIM-fō-sīt</i>)
band cell	An immature neutrophil with a nucleus in the shape of a band; also called a stab cell. Band cell counts are used to trace infections and other diseases (see Fig. 10-4)
basophil <i>BĀ-sō-fil</i>	A granular leukocyte that stains strongly with basic dyes; active in allergic reactions
blood <i>blud</i>	The fluid that circulates in the cardiovascular system (roots: hem/o, hemat/o)
coagulation <i>kō-ag-ū-LĀ-shun</i>	Blood clotting
cross-matching	Testing the compatibility of donor and recipient blood in preparation for a transfusion. Donor red cells are mixed with recipient serum to look for an immunologic reaction. Similar tests are done on tissues before transplantation
electrolyte <i>ē-LEK-trō-līt</i>	A substance that separates into charged particles (ions) in solution; a salt. Term also applied to ions in body fluids
eosinophil <i>ē-ō-SIN-ō-fil</i>	A granular leukocyte that stains strongly with acidic dyes; active in allergic reactions and defense against parasites
erythrocyte <i>e-RITH-rō-sīt</i>	A red blood cell (roots: erythr/o, erythrocyt/o) (see Figs. 10-2 and 10-3)
erythropoietin (EPO) <i>e-rith-rō-POY-e-tin</i>	A hormone produced in the kidneys that stimulates red blood cell production in the bone marrow. This hormone is now made by genetic engineering for clinical use
fibrin <i>FĪ-brin</i>	The protein that forms a clot in the blood coagulation process
fibrinogen <i>fī-BRIN-ō-jen</i>	The inactive precursor of fibrin
formed elements	The cellular components of blood
gamma globulin <i>GLOB-ū-lin</i>	The fraction of the blood plasma that contains antibodies; given for passive transfer of immunity
granulocyte <i>GRAN-ū-lō-sīt</i>	A white blood cell that has visible granules in its cytoplasm. Granulocytes include neutrophils, basophils, and eosinophils (see Box 10-3)
hemoglobin (Hb, Hgb) <i>HĒ-mō-glō-bin</i>	The iron-containing pigment in red blood cells that transports oxygen
hemostasis <i>hē-mō-STĀ-sis</i>	The stoppage of bleeding
immunity	The state of being protected against a disease (root: immun/o)
immunoglobulin (Ig) <i>im-ū-nō-GLOB-ū-lin</i>	An antibody. Immunoglobulins fall into five classes, each abbreviated with a capital letter: IgG, IgM, IgA, IgD, IgE

(Continued)

Terminology

Key Terms *(Continued)*

leukocyte <i>LŪ-kō-sīt</i>	A white blood cell (roots: leuk/o, leukocyt/o)
lymphocyte <i>LIM-fō-sīt</i>	An agranular leukocyte active in immunity (T and B cells); found in both the blood and in lymphoid tissue (roots: lymph/o, lymphocyt/o)
megakaryocyte <i>meg-a-KAR-ē-ō-sīt</i>	A large bone marrow cell that fragments to release platelets
macrophage <i>MAK-rō-faj</i>	A phagocytic cell derived from a monocyte; usually located within the tissues. Macrophages process antigens for T cells
monocyte <i>MON-ō-sīt</i>	An agranular phagocytic leukocyte
neutrophil <i>NŪ-trō-fil</i>	A granular leukocyte that stains weakly with both acidic and basic dyes. The most numerous of the white blood cells. A type of phagocyte
phagocytosis <i>fag-ō-sīt-TŌ-sis</i>	The engulfing of foreign material by white blood cells
plasma <i>PLAZ-ma</i>	The liquid portion of the blood
plasma cell	A mature form of a B cell that produces antibodies
platelet <i>PLĀT-let</i>	A formed element of the blood that is active in hemostasis; a thrombocyte (root: thrombocyt/o)
serum <i>SĒR-um</i>	The fraction of the plasma that remains after blood coagulation; it is the equivalent of plasma without its clotting factors (plural: sera, serums)
T cell	A lymphocyte that matures in the thymus and attacks foreign cells directly; T lymphocyte
thrombocyte <i>THROM-bō-sīt</i>	A blood platelet (root: thrombocyt/o)



Go to the Audio Pronunciation Glossary in the Student Resources on *thePoint* to hear these terms pronounced.

Word Parts Pertaining to Blood and Immunity

See **Tables 10-1 to 10-3**.

Table 10-1 Suffixes for Blood

Suffix	Meaning	Example	Definition of Example
-emia,* -hemia	condition of blood	polycythemia <i>pol-ē-sī-THĒ-mē-a</i>	increase of cells (cyt) in the blood
-penia	decrease in, deficiency of	cytopenia <i>sī-tō-PĒ-nē-a</i>	deficiency of cells in the blood
-poiesis	formation, production	hemopoiesis <i>hē-mō-poy-Ē-sis</i>	production of blood cells

*A shortened form of the root hem plus the suffix -ia.

EXERCISE 10-1**Define the following terms:**

1. hyperalbuminemia (*hī-per-al-bū-mi-NE-mē-a*) _____ excess albumin in the blood
2. hypoproteinemia (*hī-pō-prō-tēn-Ē-mē-a*) _____
3. leukocytopenia (*lū-kō-sī-tō-PĒ-nē-a*) _____
4. erythropoiesis (*e-rith-rō-poy-Ē-sis*) _____
5. toxemia (*tok-SĒ-mē-a*) _____
6. bacteremia (*bak-ter-Ē-mē-a*) _____
7. thrombocytopenia (*throm-bō-sī-tō-PĒ-nē-a*) _____

Use the suffix -emia to write words for the following definitions:

8. Presence of pus in the blood _____
9. Presence of viruses in the blood _____
10. Presence of excess white cells (leuk/o) in the blood _____

10

Many of the words relating to blood cells can be formed either with or without including the root *cyt/o*, as in erythropenia or erythrocytopenia, leukopoiesis or

leukocytopenia. The remaining types of blood cells are designated by easily recognized roots such as *agranulocyt/o*, *monocyt/o*, *granul/o*, and so on (see Table 10-2).

Table 10-2 Roots for Blood and Immunity

Root	Meaning	Example	Definition of Example
myel/o	bone marrow	myelogenous <i>mī-e-LOJ-e-nus</i>	originating in bone marrow
hem/o, hemat/o	blood	hemopathy <i>hē-MOP-a-thē</i>	any disorder of blood
erythr/o, erythrocyt/o	red blood cell	erythroblast <i>e-RITH-rō-blast</i>	immature red blood cell
leuk/o, leukocyt/o	white blood cell	leukocytosis <i>lū-kō-sī-TŌ-sis</i>	increase in the number of leukocytes in the blood
lymph/o, lymphocyt/o	lymphocyte	lymphocytic <i>lim-fō-SĪT-ik</i>	pertaining to lymphocytes
thromb/o	blood clot	thrombolytic <i>throm-bō-LIT-ik</i>	dissolving a blood clot
thrombocyt/o	platelet, thrombocyte	thrombopoiesis <i>throm-bō-poy-Ē-sis</i>	formation of platelets
immun/o	immunity, immune system	immunization <i>im-ū-ni-ZĀ-shun</i>	production of immunity

EXERCISE 10-2

Identify and define the root in the following words:

	Root	Meaning of Root
1. hematology (<i>hē-ma-TOL-ō-jē</i>)	_____	_____
2. panmyeloid (<i>pan-MĪ-e-loyd</i>)	_____	_____
3. prothrombin (<i>prō-THROM-bin</i>)	_____	_____
4. preimmunization (<i>prē-im-ū-ni-ZĀ-shun</i>)	_____	_____
5. ischemia (<i>is-KĒ-mē-a</i>)	_____	_____

Fill in the blanks:

6. Hemorrhage is a profuse flow (-rhage) of _____.
7. Myelofibrosis (*mi-e-lō-fī-BRO-sis*) is formation of fibrous tissue in _____.
8. Erythroclasis (*er-i-THROK-la-sis*) is the breaking (-clasis) of _____.
9. An immunocyte (*im-ū-nō-SĪT*) is a cell active in _____.
10. The term thrombocythemia (*throm-bō-sī-THĒ-mē-a*) refers to a blood increase in the number of _____.
11. Leukopoiesis (*lū-kō-poy-Ē-sis*) refers to the production of _____.
12. A hemocytometer (*hē-mō-sī-TOM-e-ter*) is a device for counting _____.
13. Lymphokines (*LIM-fō-kīnz*) are chemicals active in immunity that are produced by _____.
14. A hematoma (*hē-ma-TŌ-ma*) is a swelling caused by collection of _____.

Write a word for the following definitions:

15. Immature lymphocyte _____
16. Tumor of bone marrow _____
17. Decrease in red blood cells _____
18. Dissolving (-lysis) of a blood clot _____
19. Formation (-poiesis) of bone marrow _____

The suffix **-osis** added to a root for a type of cell means an increase in that type of cell in the blood. Use this suffix to write a word that means each of the following:

20. Increase in granulocytes in the blood _____ granulocytosis
21. Increase in lymphocytes in the blood _____
22. Increase in red blood cells _____
23. Increase in monocytes in the blood _____
24. Increase in platelets in the blood _____

Table 10-3 Roots for Blood Chemistry

Root	Meaning	Example	Definition of Example
azot/o	nitrogenous compounds	azoturia āz-ō-TŪ-rē-a	increased nitrogenous compounds in the urine (-uria)
calc/i	calcium (symbol Ca)	calcification kal-si-fī-KĀ-shun	deposition of calcium salts
ferr/o, ferr/i	iron (symbol Fe)	ferrous FER-ous	pertaining to or containing iron
sider/o	iron	sideroderma sid-er-ō-DER-ma	deposition of iron into the skin
kali	potassium (symbol K)	hyperkalemia* hī-per-ka-LĒ-mē-a	excess of potassium in the blood
natri	sodium (symbol Na)	natriuresis nā-trē-ū-RĒ-sis	excretion of sodium in the urine (ur/o)
ox/y	oxygen (symbol O)	hypoxia hī-POK-sē-a	deficiency of oxygen in the tissues

*The i in the root is dropped.

EXERCISE 10-3**Fill in the blanks:**

1. A sideroblast (*SID-er-ō-blast*) is an immature cell containing _____.
2. The term *hypokalemia* (*hī-pō-ka-LĒ-mē-a*) refers to a blood deficiency of _____.
3. The bacterial species *Azotobacter* is named for its ability to metabolize _____.
4. Hypoxemia (*hī-pok-SĒ-mē-a*) is a blood deficiency of _____.
5. Ferritin (*FER-i-tin*) is a compound that contains _____.
6. A calcareous (*kal-KAR-ē-us*) substance contains _____.

Use the suffix -emia to form words with the following meanings:

7. Presence of potassium in the blood _____
8. Presence of nitrogenous compounds in the blood _____
9. Presence of sodium in the blood _____
10. Presence of calcium in the blood _____

Box 10-4

For Your Reference



Common Blood Tests

TEST	ABBREVIATION	DESCRIPTION
red blood cell count	RBC	number of red blood cells per microliter of blood
white blood cell count	WBC	number of white blood cells per microliter of blood
differential count	Diff	relative percentage of the different types of leukocytes
hematocrit (Fig. 10-10)	Ht, Hct, crit	relative percentage of packed red cells in a given volume of blood
packed cell volume	PCV	hematocrit
hemoglobin	Hb, Hgb	amount of hemoglobin in g/dL (100 mL) of blood
mean corpuscular volume	MCV	volume of an average red cell
mean corpuscular hemoglobin	MCH	average weight of hemoglobin in red cells
mean corpuscular hemoglobin concentration	MCHC	average concentration of hemoglobin in red blood cells
erythrocyte sedimentation rate	ESR	rate of erythrocyte settling per unit of time; used to detect infection or inflammation
complete blood count	CBC	series of tests including cell counts, hematocrit, hemoglobin, and cell volume measurements

Clinical Aspects of Blood

ANEMIA

Anemia is defined as an abnormally low amount of hemoglobin in the blood. Anemia may result from too few RBCs or from cells that are too small (microcytic) or have too

little hemoglobin (hypochromic). Key tests in diagnosing anemia are blood counts, mean corpuscular volume (MCV), and mean corpuscular hemoglobin concentration (MCHC). (For Your Reference Box 10-4 describes these and other blood tests. Box 10-5 has information on careers in hematology.)

The general symptoms of anemia include fatigue, shortness of breath, heart palpitations, pallor, and irritability.

Box 10-5



Health Professions

Careers in Hematology

Hematologists are physicians and other scientists who specialize in the study of blood and blood diseases. In medical practice, hematology is often combined with the study and treatment of blood cancers as the specialty of hematology–oncology.

Other health care professionals who work in hematology perform different roles depending upon their academic preparation (see Box 2-2). These careers include medical technologists, medical technicians, and phlebotomists, who are employed in hospitals, clinics, outpatient laboratories, and private offices.

Medical technologists and technicians may specialize in various clinical settings, such as blood banks and microbiology and chemistry laboratories. Each of these positions requires an advanced skill set and working knowledge of electronic equipment, instrumentation, and computers. Those working in hematology test blood for abnormalities or infections and may do cross-matching for transfusions. They examine blood cells for signs of cancer and other diseases. They must be familiar with laboratory safety policies and procedures and

must exercise appropriate precautions when working with body fluids and tissues. For information on careers in medical laboratory technology, contact the American Society for Clinical Laboratory Science at <http://www.ascls.org>.

A phlebotomist is a health care professional who draws blood for testing, transfusions, or research. Phlebotomists work in hospitals, laboratories, private physicians' offices, clinics, and blood banks. They often draw blood from a vein (venipuncture), but may also draw it from an artery or by skin puncture, such as a finger or heel stick. Phlebotomists must be trained in sterile techniques and safety precautions to prevent the spread of infectious diseases. They must take specimens without harming the patient or interfering with medical care and must accurately label and transport specimens to the proper laboratory. Educational requirements vary among states. Often, in-house training with certification by the National Phlebotomy Association is acceptable (www.nationalphlebotomy.org).

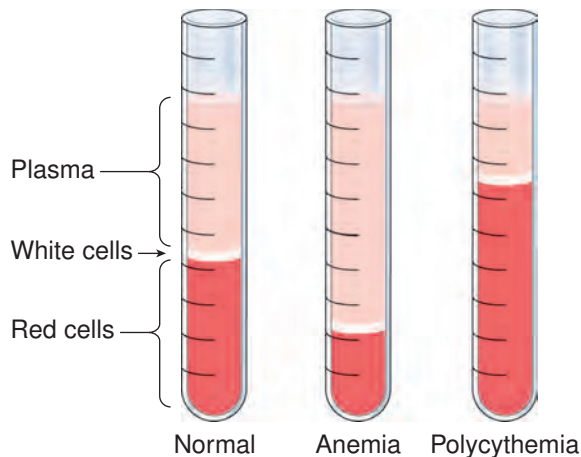


Figure 10-10 Hematocrit. The tube on the left shows a normal hematocrit. The middle tube shows that the percentage of red blood cells is low, indicating anemia. The tube on the right shows an excessively high percentage of red blood cells, as seen in polycythemia.

There are many different types of anemia, some of which are caused by faulty production of red cells and others by loss or destruction of red cells.

Anemia Due to Impaired Production of Red Cells

- **Aplastic anemia** results from bone marrow destruction and affects all blood cells (pancytopenia). It may be caused by drugs, toxins, viruses, radiation, or bone marrow cancer. Aplastic anemia has a high mortality rate but has been treated successfully with bone marrow transplantation.
- **Nutritional anemia** may result from a deficiency of vitamin B₁₂ or folic acid, B vitamins needed for RBC development. Most commonly, it is caused by a deficiency of iron, needed to make hemoglobin (Fig. 10-11). Folic acid deficiency commonly appears in those with poor diet, in pregnant and lactating women, and in

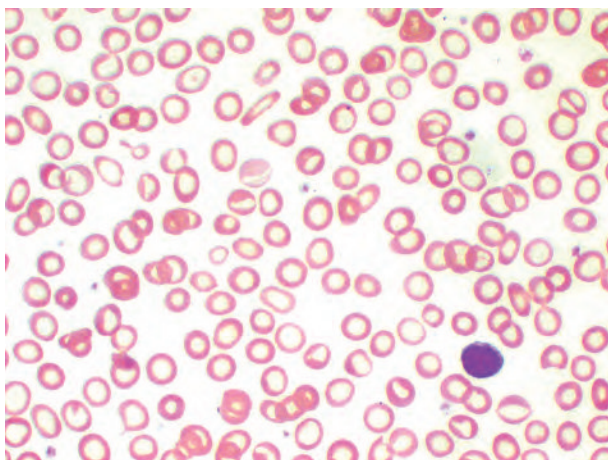


Figure 10-11 Iron deficiency anemia. Red cells are small (microcytic) and are lacking in hemoglobin (hypochromic).

those who abuse alcohol. Iron deficiency anemia results from poor diet, poor iron absorption, or blood loss. Both folic acid deficiency and iron deficiency respond to dietary supplementation.

- **Pernicious anemia** is a specific form of B₁₂ deficiency. It results from the lack of **intrinsic factor** (IF), a substance produced in the stomach that aids in the intestinal absorption of B₁₂. Pernicious anemia must be treated with regular B₁₂ injections.
- In **sideroblastic anemia**, there is adequate iron available, but the iron is not used properly to manufacture hemoglobin. This disorder may be hereditary or acquired, as by exposure to toxins or drugs. It may also be secondary to another disease. The excess iron precipitates out in immature red cells (normoblasts).

Anemia Due to Loss or Destruction of Red Cells

- **Hemorrhagic anemia** results from blood loss. This may be a sudden loss, as from injury, or loss from chronic internal bleeding, as from the digestive tract in cases of ulcers or cancer.
- **Thalassemia** is a hereditary disease that appears mostly in Mediterranean populations. A genetic mutation causes abnormal hemoglobin production and **hemolysis** (destruction) of red cells. Thalassemia is designated as α (alpha) or β (beta), according to the part of the hemoglobin molecule affected. Severe β thalassemia is also called **Cooley anemia** or *thalassemia major*.
- In **sickle cell anemia**, a mutation alters the hemoglobin molecule so that it precipitates (settles out) when it gives up oxygen, distorting the RBCs into a crescent shape (Fig. 10-12). The altered cells block small blood vessels and deprive tissues of oxygen, an episode termed *sickle cell crisis*. The misshapen cells are also readily destroyed (hemolyzed). The disease predominates in black populations. Genetic carriers of the defect, those with one normal and one abnormal gene, show *sickle cell trait*. They usually have no symptoms, except when oxygen is low, such as at high altitudes. They can, however, pass the defective gene



Figure 10-12 A blood smear in sickle cell anemia. Abnormal cells take on a crescent (sickle) shape when they give up oxygen.

Box 10-6



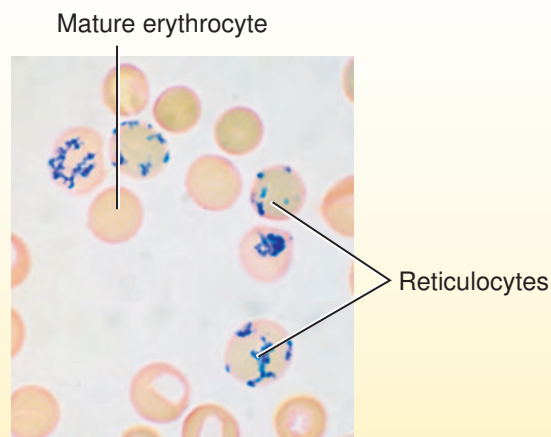
Clinical Perspectives

Use of Reticulocytes in Diagnosis

As erythrocytes mature in the red bone marrow, they go through a series of stages in which they lose their nuclei and most other organelles, maximizing the space available for hemoglobin. In one of the last stages of development, small numbers of ribosomes and some rough endoplasmic reticulum remain in the cell and appear as a network, or reticulum, when stained. Cells at this stage are called *reticulocytes*. Reticulocytes leave the red bone marrow and enter the bloodstream, where they become fully mature erythrocytes in about 24 to 48 hours. The average number of red cells maturing through the reticulocyte stage at any given time is about 1 to 2 percent. Changes in these numbers can be used in diagnosing certain blood disorders.

When erythrocytes are lost or destroyed, as from chronic bleeding or some form of hemolytic anemia, red cell production is “stepped up” to compensate for the loss. Greater numbers of reticulocytes are then released into the blood before reaching full maturity, and counts increase to above normal. On the other hand, a decrease in the number of circulating

reticulocytes suggests a problem with red cell production, as in cases of deficiency anemias or suppression of bone marrow activity.



to offspring. Sickle cell anemia, as well as many other genetic diseases, can be diagnosed in carriers and in a fetus before birth.

Reticulocyte counts are useful in diagnosing the causes of anemia. Reticulocytes are immature RBCs that normally appear as a small percentage of the total erythrocytes. An increase in the reticulocyte count indicates increased red cell formation, as in response to hemorrhage or cell destruction. A decrease in reticulocytes indicates a failure in red cell

production, as caused by nutritional deficiency or aplastic anemia (see Box 10-6).

COAGULATION DISORDERS

The most common cause of coagulation problems is a deficiency in the number of circulating platelets, a condition termed **thrombocytopenia**. Possible causes include aplastic anemia, infections, bone marrow cancer, and agents

Box 10-7

For Your Reference



Coagulation Tests

TEST	ABBREVIATION	DESCRIPTION
Activated partial thromboplastin time	APTT	Measures time required for clot formation; used to evaluate clotting factors and monitor heparin therapy
Bleeding time	BT	Measures capacity of platelets to stop bleeding after a standard skin incision
Partial thromboplastin time	PTT	Evaluates clotting factors; similar to APTT, but less sensitive
Prothrombin time	PT, pro time	Indirectly measures prothrombin; used to monitor anticoagulant therapy; also called Quick test
Thrombin time (thrombin clotting time)	TT (TCT)	Measures how quickly a clot forms

that destroy bone marrow, such as x-rays or certain drugs. This disorder results in bleeding into the skin and mucous membranes, variously described as **petechiae** (pinpoint spots), **ecchymoses** (bruises), and **purpura** (purple lesions).

In **disseminated intravascular coagulation (DIC)**, there is widespread clotting in the vessels, which obstructs circulation to the tissues. This is followed by diffuse hemorrhages as clotting factors are removed and the coagulation process is impaired. DIC may result from a variety of causes, including infection, cancer, hemorrhage, injury, and **allergy**.

Hemophilia is a hereditary deficiency of a specific clotting factor. It is a genetically sex-linked disease that is passed from mother to son. There is bleeding into the tissues, especially into the joints (hemarthrosis). Hemophilia must be treated with transfusions of the necessary clotting factor.

For Your Reference **Box 10-7** on page 232 lists tests done for these and other coagulation disorders.

NEOPLASMS

Leukemia is a neoplasm of WBCs. The rapidly dividing but incompetent white cells accumulate in the tissues and crowd out the other blood cells. The symptoms of leukemia include anemia, fatigue, easy bleeding, **splenomegaly**, and sometimes hepatomegaly (enlargement of the liver). The causes of leukemia are unknown but may include exposure to radiation or harmful chemicals, hereditary factors, and perhaps viral infection.

The two main categories of leukemia are determined by origin and the cells involved:

- Myelogenous leukemia originates in the bone marrow and involves mainly the granular leukocytes.
- Lymphocytic leukemia affects B cells and the lymphatic system, causing **lymphadenopathy** (lymph node disease) and adverse effects on the immune system.

Leukemias are further differentiated as acute or chronic based on clinical progress. Acute leukemia is the most

common form of cancer in young children. The acute forms are:

- Acute myeloblastic (myelogenous) leukemia (AML). The prognosis in AML is poor for both children and adults.
- Acute lymphoblastic (lymphocytic) leukemia (ALL). With treatment, the ALL remission rate is high.

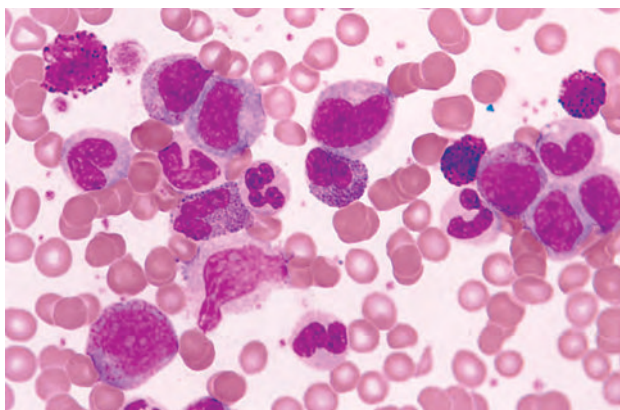
The chronic forms of leukemia are:

- Chronic myelogenous leukemia, also called chronic granulocytic leukemia, affects young to middle-aged adults (**Fig 10.13A**). Most cases show the **Philadelphia chromosome (Ph)**, an inherited anomaly in which part of chromosome 22 shifts to chromosome 9.
- Chronic lymphocytic leukemia (CLL) appears mostly in the elderly and is the most slowly growing form of the disease (**see Fig. 10-13B**).

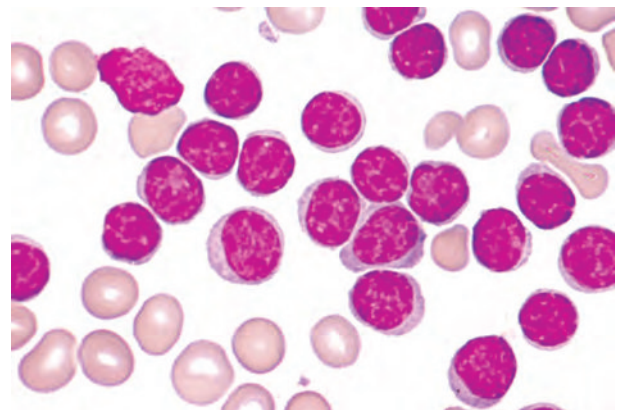
Leukemia treatment includes chemotherapy, radiation therapy, and bone marrow transplantation. One advance in transplantation is the use of umbilical cord blood to replace blood-forming cells in bone marrow. This blood is more readily available than bone marrow and does not have to match as closely to avoid rejection.

Hodgkin disease is a disease of the lymphatic system that may spread to other tissues. It begins with enlarged but painless lymph nodes in the cervical (neck) region and then progresses to other nodes. A feature of Hodgkin disease is giant cells in the lymph nodes called **Reed-Sternberg cells** (**Fig. 10-14**). Symptoms include fever, night sweats, weight loss, and skin itching (pruritus). Persons of any age may be affected, but the disease predominates in young adults and those over age 50. Most cases can be cured with radiation and chemotherapy.

Non-Hodgkin lymphoma (NHL) is also a malignant enlargement of lymph nodes but does not show Reed-Sternberg cells. It is more common than Hodgkin disease



A



B

Figure 10-13 Leukemia. Leukemia is a malignant overgrowth of white cells originating in the bone marrow (myelogenous) or lymphatic system (lymphocytic). **A.** Chronic myelogenous leukemia showing overproduction of all categories of white cells. **B.** Chronic lymphocytic leukemia showing numerous lymphocytes.

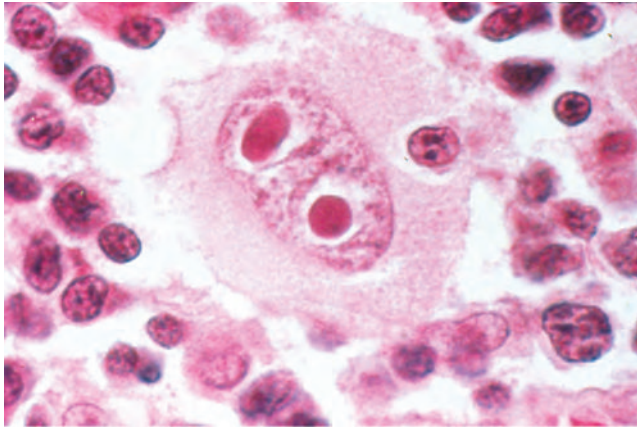


Figure 10-14 **Reed-Sternberg cell.** These cells are typical of Hodgkin disease.

and has a higher mortality rate. Cases vary in severity and prognosis. It is most prevalent in the older adult population and in those with AIDS and other forms of immunodeficiency. NHL involves the T or B lymphocytes, and some cases may be related to infection with certain viruses. It requires systemic chemotherapy and sometimes bone marrow transplantation.

Multiple myeloma is a cancer of the blood-forming cells in bone marrow, mainly the plasma cells that produce antibodies. The disease causes anemia, bone pain, and bone weakening. Patients have a greater susceptibility to infection because of immunodeficiency. Abnormally high levels of calcium and protein in the blood often lead to kidney failure. Multiple myeloma is treated with radiation and chemotherapy, but the prognosis is generally poor.

Clinical Aspects of Immunity

HYPERSENSITIVITY

Hypersensitivity is a harmful overreaction of the immune system, commonly known as allergy. In cases of allergy, a person is more sensitive to a particular antigen than the average individual. Common **allergens** are pollen, animal dander, dust, and foods, but there are many more. A seasonal allergy to inhaled pollens is commonly called “hay fever.” Responses may include itching, redness, or tearing of the eyes (conjunctivitis), skin rash, asthma, runny nose (rhinitis), sneezing, **urticaria** (hives), and **angioedema**, a reaction similar to hives but involving deeper layers of tissue.

An **anaphylactic reaction** is a severe generalized allergic response that can rapidly lead to death as a result of shock and respiratory distress. It must be treated by immediate

administration of **epinephrine** (adrenaline) and maintenance of open airways. Oxygen, antihistamines, and corticosteroids may also be given. Common causes of anaphylaxis are drugs, especially penicillin and other antibiotics, vaccines, diagnostic chemicals, foods, and insect venom.

A **delayed hypersensitivity reaction** involves T cells and takes at least 12 hours to develop. A common example is the reaction to contact with plant irritants such as those of poison ivy and poison oak.

IMMUNODEFICIENCY

The term **immunodeficiency** refers to any failure in the immune system. This may be congenital (present at birth) or acquired and may involve any components of the system. The deficiency may vary in severity but is always evidenced by an increased susceptibility to disease.

AIDS (**acquired immunodeficiency syndrome**) is acquired by infection with **HIV** (**human immunodeficiency virus**), which attacks certain T cells. These cells have a specific surface attachment site, the CD4 receptor, for the virus. HIV is spread by sexual contact, use of contaminated needles, blood transfusions, and passage from an infected mother to her fetus. It leaves the host susceptible to opportunistic infections such as pneumonia caused by the fungus *Pneumocystis jiroveci*; thrush, an oral fungal infection caused by *Candida albicans*; and infection with *Cryptosporidium*, a protozoon that causes cramps and diarrhea. It also predisposes the patient to **Kaposi sarcoma**, a once-rare form of skin cancer. AIDS may also induce autoimmunity or attack the nervous system.

AIDS is diagnosed and monitored by **CD4+ T lymphocyte counts**, a measure of cells with the HIV receptor. A count of less than 200/mcL of blood signifies severe immunodeficiency. HIV antibody levels and direct viral blood counts are also used to track the disease’s course. At present there is no vaccine or cure for AIDS, but drugs can delay its progress.

AUTOIMMUNE DISEASES

A disorder that results from an immune response to one’s own tissues is classified as an **autoimmune disease**. The cause may be a failure in the immune system or a reaction to body cells that have been slightly altered by mutation or disease. The list of diseases that are believed to be caused, at least in part, by autoimmunity is long. Some, such as **systemic lupus erythematosus** (SLE), **systemic sclerosis** (scleroderma), and **Sjögren syndrome**, affect tissues in multiple systems. Others target more specific organs or systems. Examples are pernicious anemia, rheumatoid arthritis, Graves disease (of the thyroid), myasthenia gravis (a muscle disease), fibromyalgia syndrome (a musculoskeletal disorder), rheumatic heart disease, and glomerulonephritis (a kidney disease). These diseases are discussed in more detail in other chapters.

Terminology

Key Terms

Disorders

AIDS (acquired immunodeficiency syndrome)	Immune system failure caused by infection with HIV (human immunodeficiency virus). The virus infects certain T cells and thus interferes with immunity
allergen <i>AL-er-jen</i>	A substance that causes an allergic response
allergy <i>AL-er-jē</i>	Hypersensitivity
anaphylactic reaction <i>an-a-fi-LAK-tik</i>	An exaggerated allergic reaction to a foreign substance (root <i>phylaxis</i> means “protection”). It may lead to death caused by circulatory collapse, and respiratory distress if untreated. Also called <i>anaphylaxis</i>
anemia <i>a-NĒ-mē-a</i>	A deficiency in the amount of hemoglobin in the blood; may result from blood loss, malnutrition, a hereditary defect, environmental factors, and other causes (see Figs. 10-11 and 10-12)
angioedema <i>an-jē-ō-e-DE-ma</i>	A localized edema with large hives (wheals) similar to urticaria but involving deeper layers of the skin and subcutaneous tissue
aplastic anemia <i>ā-PLAS-tik</i>	Anemia caused by bone marrow failure resulting in deficient blood cell production, especially of red cells; pancytopenia
autoimmune disease <i>aw-tō-i-MŪN</i>	A condition in which the immune system produces antibodies against an individual's own tissues (prefix <i>auto</i> means “self”)
Cooley anemia	A form of thalassemia (hereditary anemia) that affects production of the β (beta) hemoglobin chain; thalassemia major
delayed hypersensitivity reaction	An allergic reaction involving T cells that takes at least 12 hours to develop. Examples are various types of contact dermatitis, such as poison ivy or poison oak; the tuberculin reaction (test for TB); and rejections of transplanted tissue
disseminated intravascular coagulation (DIC)	Widespread clot formation in the microscopic vessels; may be followed by bleeding caused by depletion of clotting factors
ecchymosis <i>ek-i-MŌ-sis</i>	A collection of blood under the skin caused by leakage from small vessels (root <i>chym</i> means “juice”)
hemolysis <i>hē-MOL-i-sis</i>	The rupture of red blood cells and the release of hemoglobin (adjective: hemolytic)
hemophilia <i>hē-mō-FIL-ē-a</i>	A hereditary blood disease caused by lack of a clotting factor and resulting in abnormal bleeding
hemorrhagic anemia <i>hem-ō-RAJ-ik</i>	Anemia that results from blood loss, as from an injury or internal bleeding
HIV (human immunodeficiency virus)	The virus that causes AIDS
Hodgkin disease	A neoplastic disease of unknown cause that involves the lymph nodes, spleen, liver, and other tissues; characterized by the presence of giant Reed-Sternberg cells (see Fig. 10-14)
hypersensitivity	An immunologic reaction to a substance that is harmless to most people; allergy
immunodeficiency <i>im-ū-nō-dē-FISH-en-sē</i>	A congenital or acquired failure of the immune system to protect against disease
intrinsic factor	A substance produced in the stomach that aids in the intestinal absorption of vitamin B ₁₂ , necessary for the manufacture of red blood cells. Lack of intrinsic factor causes pernicious anemia
Kaposi sarcoma <i>KAP-ō-sē</i>	Cancerous lesion of the skin and other tissues, seen most often in patients with AIDS

(Continued)

Terminology

Key Terms (Continued)

leukemia <i>lū-KĒ-mē-a</i>	Malignant overgrowth of immature white blood cells; may be chronic or acute; may affect bone marrow (myelogenous leukemia) or lymphoid tissue (lymphocytic leukemia)
lymphadenopathy <i>lim-fad-e-NOP-a-thē</i>	Any disease of the lymph nodes
multiple myeloma <i>mī-e-LŌ-ma</i>	A tumor of the blood-forming tissue in bone marrow
non-Hodgkin lymphoma (NHL)	A widespread malignant disease of lymph nodes that involves lymphocytes. It differs from Hodgkin disease in that giant Reed-Sternberg cells are absent
nutritional anemia <i>nū-TRISH-un-al</i>	Anemia resulting from a dietary deficiency, usually of iron, vitamin B ₁₂ , or folic acid
Philadelphia chromosome (Ph)	An abnormal chromosome found in the cells of most individuals with chronic granulocytic (myelogenous) leukemia
pernicious anemia <i>per-NISH-us</i>	Anemia caused by failure of the stomach to produce intrinsic factor, a substance needed for the absorption of vitamin B ₁₂ . This vitamin is required for the formation of erythrocytes
petechiae <i>pē-TĒ-kē-ē</i>	Pinpoint, flat, purplish-red spots caused by bleeding within the skin or mucous membrane (singular: petechia)
purpura <i>PUR-pū-ra</i>	A condition characterized by hemorrhages into the skin, mucous membranes, internal organs, and other tissues (from Greek word meaning “purple”). Thrombocytopenic purpura is caused by a deficiency of platelets
sickle cell anemia <i>SIK-l</i>	A hereditary anemia caused by the presence of abnormal hemoglobin. Red blood cells become sickle shaped when they give up oxygen and interfere with normal blood flow to the tissues (see Fig. 10-12). Most common in black populations of West African descent
sideroblastic anemia <i>sid-e-rō-BLAS-tik</i>	Anemia caused by inability to use available iron to manufacture hemoglobin. The excess iron precipitates in normoblasts (developing red blood cells)
Sjögren syndrome <i>SHŌ-gren</i>	An autoimmune disease involving dysfunction of the exocrine glands and affecting secretion of tears, saliva, and other body fluids. Deficiency leads to dry mouth, tooth decay, corneal damage, eye infections, and difficulty in swallowing
splenomegaly <i>splē-nō-MEG-a-lē</i>	Enlargement of the spleen
systemic lupus erythematosus <i>LŪ-pus er-i-thē-ma-TŌ-sus</i>	Inflammatory connective tissue disease affecting the skin and multiple organs. Patients are sensitive to light and may have a red butterfly-shaped rash over the nose and cheeks
systemic sclerosis	A diffuse connective tissue disease that may involve any system causing inflammation, degeneration, and fibrosis. Also called scleroderma because it causes thickening of the skin
thalassemia <i>thal-a-SĒ-mē-a</i>	A group of hereditary anemias mostly found in populations of Mediterranean descent (the name comes from the Greek word for “sea”)
thrombocytopenia <i>throm-bō-sī-tō-PE-nē-a</i>	A deficiency of thrombocytes (platelets) in the blood
urticaria <i>ur-ti-KAR-ē-a</i>	A skin reaction consisting of round, raised eruptions (wheals) with itching; hives
Diagnosis and Treatment	
adrenaline <i>a-DREN-a-lin</i>	See epinephrine

Terminology

Key Terms (Continued)

CD4+ T lymphocyte count	A count of the T cells that have the CD4 receptors for the AIDS virus (HIV). A count of less than 200/mcL of blood signifies severe immunodeficiency
epinephrine <i>ep-i-NEF-rin</i>	A powerful stimulant produced by the adrenal gland and sympathetic nervous system. Activates the cardiovascular, respiratory, and other systems needed to meet stress. Used as a drug to treat severe allergic reactions and shock. Also called adrenaline
reticulocyte counts <i>rē-TIK-ū-lō-sīt</i>	Blood counts of reticulocytes, a type of immature red blood cell; reticulocyte counts are useful in diagnosis to indicate the rate of erythrocyte formation (see Box 10-6)
Reed-Sternberg cells <i>rēd SHTERN-berg</i>	Giant cells that are characteristic of Hodgkin disease. They usually have two large nuclei and are surrounded by a halo (see Fig. 10-14)

Terminology

Supplementary Terms

Normal Structure and Function

agglutination <i>a-glū-ti-NĀ-shun</i>	The clumping of cells or particles in the presence of specific antibodies
bilirubin <i>bil-i-RŪ-bin</i>	A pigment derived from the breakdown of hemoglobin. It is eliminated by the liver in bile
complement <i>COM-ple-ment</i>	A group of plasma enzymes that interacts with antibodies
corpuscle <i>KOR-pus-l</i>	A small mass or body. A blood corpuscle is a blood cell
hemopoietic stem cell <i>hē-mō-poy-E-tik</i>	A primitive bone marrow cell that gives rise to all varieties of blood cells
heparin <i>HEP-a-rin</i>	A substance found throughout the body that inhibits blood coagulation; an anticoagulant
plasmin <i>PLAZ-min</i>	An enzyme that dissolves clots; also called <i>fibrinolysin</i>
thrombin <i>THROM-bin</i>	The enzyme derived from prothrombin that converts fibrinogen to fibrin

Symptoms and Conditions

agranulocytosis <i>ā-gran-ū-lō-sī-TŌ-sis</i>	A condition involving a decrease in the number of granulocytes in the blood; also called <i>granulocytopenia</i>
erythrocytosis <i>e-rith-rō-sī-TŌ-sis</i>	Increase in the number of red cells in the blood; may be normal, such as to compensate for life at high altitudes, or abnormal, such as in cases of pulmonary or cardiac disease
Fanconi syndrome <i>fan-KŌ-nē</i>	Congenital aplastic anemia that appears between birth and 10 years of age; may be hereditary or caused by damage before birth, as by a virus
graft versus host reaction (GVHR)	An immunologic reaction of transplanted lymphocytes against tissues of the host; a common complication of bone marrow transplantation
hairy cell leukemia	A form of leukemia in which cells have filaments, making them look “hairy”
hematoma <i>hē-ma-TŌ-ma</i>	A localized collection of blood, usually clotted, caused by a break in a blood vessel

(Continued)

hemolytic disease of the newborn (HDN)	Disease that results from incompatibility between the blood of a mother and her fetus, usually involving Rh factor. An Rh-negative mother produces antibody to an Rh-positive fetus that, in later pregnancies, will destroy the red cells of an Rh-positive fetus. The problem is usually avoided by treating the mother with antibodies to remove the Rh antigen; erythroblastosis fetalis
hemosiderosis <i>hē-mō-sid-er-Ō-sis</i>	A condition involving the deposition of an iron-containing pigment (hemosiderin) mainly in the liver and the spleen. The pigment comes from hemoglobin released from disintegrated red blood cells
idiopathic thrombocytopenic purpura (ITP)	A clotting disorder caused by destruction of platelets that usually follows a viral illness. Causes petechiae and hemorrhages into the skin and mucous membranes
infectious mononucleosis <i>mon-ō-nū-klē-Ō-sis</i>	An acute infectious disease caused by Epstein-Barr virus (EBV). Characterized by fever, weakness, lymphadenopathy, hepatosplenomegaly, and atypical lymphocytes (resembling monocytes) (Fig. 10-15)
lymphocytosis <i>lim-fō-sī-TŌ-sis</i>	An increase in the number of circulating lymphocytes
myelodysplastic syndrome <i>mī-e-lō-dis-PLAS-tik</i>	Bone marrow dysfunction resulting in anemia and deficiency of neutrophils and platelets. May develop in time into leukemia; preleukemia
myelofibrosis <i>mī-e-lō-fī-BRŌ-sis</i>	Condition in which bone marrow is replaced with fibrous tissue
neutropenia <i>nū-trō-PĒ-nē-a</i>	A decrease in the number of neutrophils with increased susceptibility to infection. Causes include drugs, irradiation, and infection. May be a side effect of treatment for malignancy
pancytopenia <i>pan-sī-tō-PĒ-nē-a</i>	A decrease in all cells of the blood, as in aplastic anemia
polycythemia <i>pol-ē-sī-THĒ-mē-a</i>	Any condition in which there is a relative increase in the percent of red blood cells in whole blood. May result from excessive production of red cells because of oxygen lack, as caused by high altitudes, breathing obstruction, heart failure, or certain forms of poisoning. Apparent polycythemia results from concentration of the blood, as by dehydration
polycythemia vera <i>pol-ē-sī-THĒ-mē-a VĒ-ra</i>	A condition in which overactive bone marrow produces too many red blood cells. These interfere with circulation and promote thrombosis and hemorrhage. Treated by blood removal. Also called <i>erythremia</i> , <i>Vaquez-Osler disease</i>
septicemia <i>sep-ti-SĒ-mē-a</i>	Presence of microorganisms in the blood
spherocytic anemia <i>sfēr-ō-SIT-ik</i>	Hereditary anemia in which red blood cells are round instead of disk shaped and rupture (hemolyze) excessively
thrombotic thrombocytopenic purpura (TTP)	An often fatal disorder in which multiple clots form in blood vessels
von Willebrand disease	A hereditary bleeding disease caused by lack of von Willebrand factor, a substance necessary for blood clotting
Diagnosis (see also Boxes 10-4 and 10-7)	
Bence Jones protein	A protein that appears in the urine of patients with multiple myeloma
Coombs test	A test for detection of antibodies to red blood cells such as appear in cases of autoimmune hemolytic anemias
electrophoresis <i>ē-lek-trō-fo-RĒ-sis</i>	Separation of particles in a liquid by application of an electrical field; used to separate components of blood
ELISA	Enzyme-linked immunosorbent assay. A highly sensitive immunologic test used to diagnose HIV infection, hepatitis, and Lyme disease, among others
monoclonal antibody <i>mon-ō-KLŌ-nal</i>	A pure antibody produced in the laboratory; used for diagnosis and treatment
pH	A scale that measures the relative acidity or alkalinity of a solution. Represents the amount of hydrogen ion in the solution

Terminology

Supplementary Terms (Continued)

Schilling test <i>SHIL-ing</i>	Test used to determine absorption of vitamin B ₁₂ by measuring excretion of radioactive B ₁₂ in the urine. Used to distinguish pernicious from nutritional anemia
seroconversion <i>sĕ-rō-con-VER-zhun</i>	The appearance of antibodies in the serum in response to a disease or an immunization
Western blot assay	A very sensitive test used to detect small amounts of antibodies in the blood
Wright stain	A commonly used blood stain. Figure 10-2 shows blood cells stained with Wright stain
Treatment	
anticoagulant <i>an-ti-kō-AG-ū-lant</i>	An agent that prevents or delays blood coagulation
antihistamine <i>an-ti-HIS-ta-mĕn</i>	A drug that counteracts the effects of histamine and is used to treat allergic reactions
apheresis <i>af-e-RĒ-sis</i>	A procedure in which blood is withdrawn, a portion is separated and retained, and the remainder is returned to the donor. Apheresis may be used as a suffix with a root meaning the fraction retained, such as plasmapheresis, leukapheresis
autologous blood <i>aw-TOL-ō-gus</i>	A person's own blood. May be donated in advance of surgery and transfused if needed
cryoprecipitate <i>krī-ō-prĕ-SIP-i-tāt</i>	A sediment obtained by cooling. The fraction obtained by freezing blood plasma contains clotting factors
desensitization <i>dĕ-sen-si-ti-ZĀ-shun</i>	Treatment of allergy by small injections of the offending allergen. This causes an increase of antibody to destroy the antigen rapidly on contact
homologous blood <i>hō-MOL-ō-gus</i>	Blood from animals of the same species, such as human blood used for transfusion from one person to another. Blood used for transfusions must be compatible with the recipient's blood
immunosuppression <i>im-ū-nō-sū-PRESH-un</i>	Depression of the immune response. May be correlated with disease but also may be induced therapeutically to prevent rejection in cases of tissue transplantation
protease inhibitor <i>PRŌ-tē-ās</i>	An anti-HIV drug that acts by inhibiting an enzyme the virus needs to multiply



Go to the Audio Pronunciation Glossary in the Student Resources on *thePoint* to hear these terms pronounced.

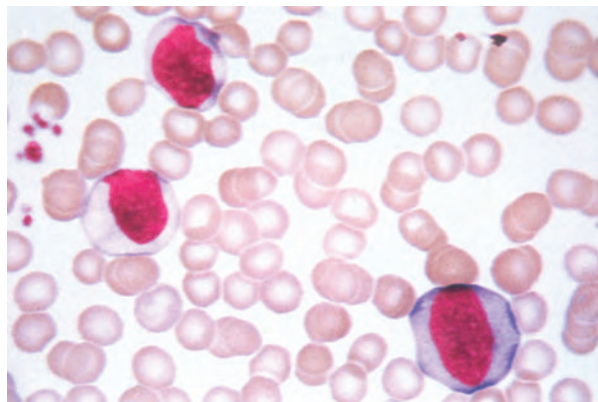


Figure 10-15 Infectious mononucleosis. Atypical lymphocytes characterize this viral disease.

Terminology Abbreviations

Ab	Antibody	ITP	Idiopathic thrombocytopenic purpura
Ag	Antigen, also silver	lytes	Electrolytes
AIDS	Acquired immunodeficiency syndrome	MCH	Mean corpuscular hemoglobin
ALL	Acute lymphoblastic (lymphocytic) leukemia	MCHC	Mean corpuscular hemoglobin concentration
AML	Acute myeloblastic (myelogenous) leukemia	mcl	Microliter
APTT	Activated partial thromboplastin time	mcm	Micrometer
BT	Bleeding time	MCV	Mean corpuscular volume
CBC	Complete blood count	MDS	Myelodysplastic syndrome
CGL	Chronic granulocytic leukemia	mEq	Milliequivalent
CLL	Chronic lymphocytic leukemia	NHL	Non-Hodgkin lymphoma
CML	Chronic myelogenous leukemia	PCV	Packed cell volume
crit	Hematocrit	pH	Scale for measuring hydrogen ion concentration (acidity or alkalinity)
DIC	Disseminated intravascular coagulation	Ph	Philadelphia chromosome
Diff	Differential count	PMN	Polymorphonuclear (neutrophil)
EBV	Epstein-Barr virus	poly	Neutrophil
ELISA	Enzyme-linked immunosorbent assay	polymorph	Neutrophil
EPO, EP	Erythropoietin	PT	Prothrombin time; pro time
ESR	Erythrocyte sedimentation rate	PTT	Partial thromboplastin time
FFP	Fresh frozen plasma	RBC	Red blood cell; red blood (cell) count
Hb, Hgb	Hemoglobin	seg	Neutrophil
Hct, Ht	Hematocrit	SLE	Systemic lupus erythematosus
HDN	Hemolytic disease of the newborn	T(C)T	Thrombin (clotting) time
HIV	Human immunodeficiency virus	TTP	Thrombotic thrombocytopenic purpura
IF	Intrinsic factor	vWF	von Willebrand factor
Ig	Immunoglobulin	WBC	White blood cell; white blood (cell) count

M.R.'s Case Study Follow-Up

M.R. avoids all contact with any natural rubber latex in her home and at work. She can work only in a pediatric OR, as they are latex-free because many children with congenital disorders are allergic to latex. She wears a medical alert

bracelet, uses a bronchodilator inhaler at the first symptom of bronchospasm, and carries a syringe of epinephrine at all times.

Chapter Review

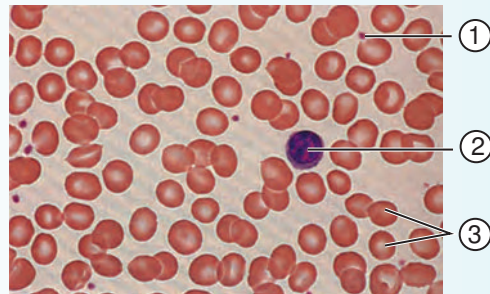
Labeling Exercise

BLOOD CELLS

Write the name of each numbered part on the corresponding line of the answer sheet.

Erythrocyte
Leukocyte
Platelet

1. _____
2. _____
3. _____



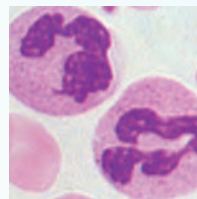
LEUKOCYTES (WHITE BLOOD CELLS)

Write the name of each numbered part on the corresponding line of the answer sheet.

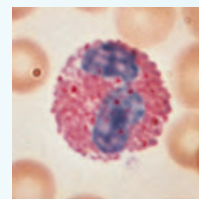
Basophil Monocyte
Eosinophil Neutrophil
Lymphocyte

1. _____
2. _____
3. _____
4. _____
5. _____

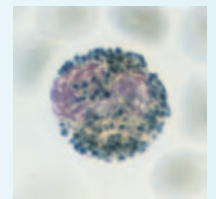
Leukocytes (white blood cells)



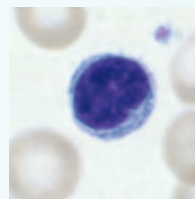
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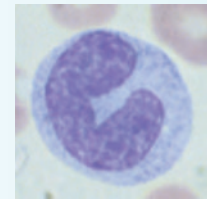
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3



4



5

Terminology

MATCHING

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|----------------------------|--|
| _____ 1. hemolysis | a. substance active in blood clotting |
| _____ 2. prothrombin | b. cell that produces platelets |
| _____ 3. antibody | c. destruction of red blood cells |
| _____ 4. megakaryocyte | d. able to dissolve a blood clot |
| _____ 5. thrombolytic | e. substance active in an immune response |
| _____ 6. calcitonin | a. pertaining to iron |
| _____ 7. natriuresis | b. hormone involved in the metabolism of calcium |
| _____ 8. ferric | c. urinary excretion of sodium |
| _____ 9. siderosis | d. urinary excretion of nitrogenous compounds |
| _____ 10. azoturia | e. condition involving iron deposits |
| _____ 11. thalassemia | a. allergy |
| _____ 12. purpura | b. hereditary form of anemia |
| _____ 13. hypersensitivity | c. stoppage of blood flow |
| _____ 14. hemophilia | d. hereditary clotting disorder |
| _____ 15. hemostasis | e. bleeding into the tissues |
| _____ 16. pH | a. hematocrit |
| _____ 17. HIV | b. scale for measuring acidity or alkalinity |
| _____ 18. ALL | c. laboratory test of blood |
| _____ 19. PCV | d. a form of leukemia |
| _____ 20. CBC | e. virus that causes an immunodeficiency disease |

Supplementary Terms

- | | |
|---------------------------|---|
| _____ 21. electrophoresis | a. separation of blood and use of components |
| _____ 22. heparin | b. pigment that comes from hemoglobin |
| _____ 23. apheresis | c. anticoagulant |
| _____ 24. ELISA | d. method for separating components of a solution |
| _____ 25. bilirubin | e. sensitive immunologic test |

FILL IN THE BLANKS

26. The engulfing of foreign material by white cells is called _____.
27. The iron-containing pigment in red blood cells that carries oxygen is called _____.
28. A substance that separates into ions in solution is a(n) _____.
29. The cell fragments active in blood clotting are the _____.
30. A hemocytometer is used to count _____.
31. Oxyhemoglobin is hemoglobin combined with _____.
32. A hematoma is a localized collection of _____.
33. A disorder involving lack of hemoglobin in the blood is _____.
34. A myeloma is a neoplasm that involves the _____.
35. The abbreviation Ig means _____.

MULTIPLE CHOICE

Referring to M.R.'s opening case study, select the best answer and write the letter of your choice to the left of each number.

- _____ 36. The natural latex protein in latex gloves may act as a(n):
 a. antibody
 b. allergen
 c. purpura
 d. immunocyte
- _____ 37. Urticaria is commonly called:
 a. rhinitis
 b. dermatitis
 c. hives
 d. congenital
- _____ 38. The cells involved in a T cell-mediated allergic response are:
 a. basophils
 b. monocytes
 c. lymphocytes
 d. B cells
- _____ 39. Anaphylaxis, a life-threatening physiological response, is an extreme form of:
 a. remission
 b. hypersensitivity
 c. hemostasis
 d. homeostasis
- _____ 40. The common name for epinephrine is:
 a. heparin
 b. antihistamine
 c. cortisone
 d. adrenaline

TRUE-FALSE

Examine the following statements. If the statement is true, write T in the first blank. If the statement is false, write F in the first blank and correct the statement by replacing the underlined word in the second blank.

	True or False	Correct Answer
41. A platelet is also called a <u>monocyte</u> .	_____	_____
42. A plasma cell produces <u>antibodies</u> .	_____	_____
43. The liquid that remains after blood coagulates is called <u>serum</u> .	_____	_____
44. Blood that does not react with either A or B antiserum is <u>type O</u> .	_____	_____
45. A band cell is an immature <u>monocyte</u> .	_____	_____
46. The root kali- pertains to <u>potassium</u> .	_____	_____

DEFINITIONS

The suffixes -ia, -osis, and -hemia all denote an increase in the type of cell indicated by the word root. Define the following terms:

47. leukocytosis (*lū-kō-sī-TŌ-sis*) _____
48. eosinophilia (*ē-ō-sin-ō-FIL-ē-a*) _____
49. erythrocytosis (*e-rith-rō-sī-TŌ-sis*) _____
50. thrombocythemia (*throm-bō-sī-THĒ-mē-a*) _____
51. neutrophilia (*nū-trō-FIL-ē-a*) _____
52. monocytosis (*mon-ō-sī-TŌ-sis*) _____

Write a word for each of the following:

53. An immature red blood cell _____
54. A decrease in the number of platelets (thrombocytes) in the blood _____

55. Presence of pus in the blood _____
56. Specialist in the study of immunity _____
57. Profuse flow of blood _____

Define each of the following:

58. viremia _____
59. neutropenia _____
60. myelotoxin _____
61. autoimmunity _____
62. hypoxemia _____

ADJECTIVES

Use the ending -ic to write the adjective form of the following words:

63. septicemia _____
64. lymphocyte _____
65. basophil _____
66. hemolysis _____
67. thrombosis _____
68. leukemia _____

ELIMINATIONS

In each of the sets below, underline the word that does not fit in with the rest and explain the reason for your choice:

69. fibrin — thrombin — thrombolysis — prothrombin — fibrinogen

70. Diff — Hct — MCV — EPO — MCH

71. eosinophil — reticulocyte — monocyte — basophil — lymphocyte

72. allergy — hypersensitivity — gamma globulin — urticaria — anaphylaxis

WORD BUILDING

Write a word for the following definitions using the word parts given.

-penia -blast leuk/o -oid -poiesis myel/o gen- -emia -ic -oma cyt/o

73. pertaining to a white blood cell _____
74. an immature white blood cell _____
75. pertaining to bone marrow _____
76. originating in bone marrow _____
77. an immature bone marrow cell _____
78. neoplastic overgrowth of white cells in the blood _____

79. deficiency of white cells in the blood
80. cancer of bone marrow
81. formation of white blood cells
82. pertaining to bone marrow cells

WORD ANALYSIS

Define the following words, and give the meaning of the word parts in each. Use a dictionary if necessary.

83. Pancytopenia (*pan-sī-tō-PĒ-nē-a*) _____
- a. pan- _____
- b. cyt/o _____
- c. -penia _____
84. Polycythemia (*pol-ē-sī-THE-mē-a*) _____
- a. poly- _____
- b. cyt/o _____
- c. hem/o _____
- d. -ia _____
85. Anisochromia (*an-ī-sō-KRŌ-mē-a*) _____
- a. an- _____
- b. iso- _____
- c. chrom/o _____
- d. -ia _____
86. myelodysplastic (*mī-e-lō-dis-PLAS-tic*) _____
- a. myel/o _____
- b. dys- _____
- c. plast(y) _____
- d. -ic _____



For more learning activities, see Chapter 10 of the Student Resources on *thePoint*.

Additional Case Studies

Case Study 10-1: Blood Replacement

C.L., a 16-YO girl, sustained a ruptured liver when she hit a tree while sledding. Emergency surgery was needed to stop the internal bleeding. During surgery, the ruptured segment of the liver was removed, and the laceration was sutured with a heavy, absorbable suture on a large smooth needle. Before surgery, her hemoglobin was 10.2 g/dL, but the reading decreased to 7.6 g/dL before hemostasis was attained. Cell salvage, or autotransfusion, was set up. In this procedure, the free blood was suctioned from her abdomen and mixed with an anticoagulant (heparin). The RBCs were washed in a sterile centrifuge with NS and transfused back to her through tubing fitted with a filter. She also received six units of homologous, leukocyte-reduced

whole blood, five units of fresh frozen plasma, and two units of platelets. During the surgery, the CRNA repeatedly tested her Hgb and Hct as well as prothrombin time and partial thromboplastin time to monitor her clotting mechanisms.

C.L. is B positive. Fortunately, there was enough B-positive blood in the hospital blood bank for her surgery. The lab informed her surgeon that they had two units of B-negative and six units of O-negative blood, which she could have received safely if she needed more blood during the night. However, her hemoglobin level increased to 12 g/dL, and she was stable during her recovery. She was monitored for DIC and pulmonary emboli.

Case Study 10-2: Myelofibrosis

A.Y., a 52-YO kindergarten teacher, had myelofibrosis that had been in remission for 25 years. She had seen her hematologist regularly and had had routine blood testing since the age of 27. After several weeks of fatigue, idiopathic joint and muscle aching, weakness, and a frightening episode of syncope, she saw her hematologist for evaluation. Her hemoglobin was 9.0 g/dL and her hematocrit was 29 percent. Concerned that she was having an exacerbation, her doctor scheduled a bone marrow aspiration, and the results were positive for myelofibrosis.

A.Y. went through a six-month therapy regimen of iron supplements in the form of ferrous sulfate tablets and received weekly vitamin B₁₂ injections. Interferon was given every other week in addition to erythropoiesis therapy, which was

unsuccessful. She was treated for presumed aplastic anemia. During treatment, splenomegaly developed, which compromised her abdominal organs and pulmonary function. She continued to lose weight, and her hemoglobin dropped as low as 6.0 g/dL. Weekly transfusions of packed RBCs did not improve her hemoglobin and hematocrit.

After a regimen of high-dose chemotherapy to shrink the fibers in her bone marrow and a splenectomy, A.Y. received a stem cell transplant. The stem cells were obtained from blood donated by her brother, who was a perfect immunologic match. After a six-month period of recovery in a protected environment, required because of her immunocompromised state, A.Y. returned home and has been free of disease symptoms for over one year.

Case Study Questions

Multiple choice. Select the best answer and write the letter of your choice to the left of each number:

- _____ 1. The removal of part of the liver is called:
 - a. partial hepatectomy
 - b. hepatomegaly
 - c. resection of the liver
 - d. a and b
 - e. a and c
- _____ 2. The unit for hemoglobin measurement (g/dL) means:
 - a. grams in decimal point
 - b. grains in a decathlon
 - c. drops in 50 mL
 - d. grams in 100 mL
 - e. grains in deciliter
- _____ 3. Heparin, an anticoagulant, is a drug that:
 - a. increases the rate of blood clotting
 - b. takes the place of fibrin
 - c. supports thrombin
 - d. interferes with blood clotting
 - e. makes blood thinner than water
- _____ 4. The RBCs were washed with NS. This means: the _____ were washed with _____.
 - a. reticulocytes, heparin
 - b. red blood cells, nutritional solution
 - c. erythrocytes, normal saline
 - d. reticulocytes, normal solution
 - e. red blood cells, heparin
- _____ 5. Autotransfusion is transfusion of autologous blood, that is, the patient's own blood. Homologous blood is taken from:
 - a. another human
 - b. synthetic chemicals
 - c. plasma with clotting factors
 - d. an animal with similar antibodies as humans
 - e. IV fluid with electrolytes

- _____ 6. Patients who lose significant amounts of blood may lose clotting ability. Effective therapy in such cases would be replacement of:
- IV solution with electrolytes
 - iron supplements
 - platelets
 - heparin
 - packed RBCs
- _____ 7. C.L.'s blood type is B positive. The best blood for her to receive is:
- positive
 - negative
 - AB positive
 - B negative
 - B positive
- _____ 8. Myelofibrosis, like aplastic anemia, is a disease in which there is:
- overgrowth of RBCs
 - destruction of the bone marrow
 - dangerously high hemoglobin and hematocrit
 - absence of bone marrow
 - lymphatic tissue in the bone marrow
- _____ 9. Erythropoiesis is:
- production of blood
 - production of red cells
 - production of plasma
 - destruction of white cells
 - destruction of platelets
- _____ 10. The "ferrous" in ferrous sulfate represents:
- electrolytes
 - RBCs
 - iron
 - oxygen
 - B vitamins
- _____ 11. Hemoglobin and hematocrit values pertain to:
- leukocytes
 - immune response
 - granulocytes
 - red blood cells
 - fibrinogen
- _____ 12. Splenomegaly is:
- prolapse of the spleen
 - movement of the spleen
 - enlargement of the lymph glands
 - destruction of the bone marrow
 - enlargement of the spleen
- _____ 13. The stem cells A.Y. received were expected to develop into new:
- spleen cells
 - bone marrow cells
 - hemoglobin
 - abdominal organs
 - cartilage
- _____ 14. A.Y.'s health was compromised because the high-dose chemotherapy caused:
- immunodeficiency
 - electrolyte imbalance
 - anoxia
 - Rh incompatibility
 - autoimmunity

Define the following abbreviations:

15. Hgb _____
16. Hct _____
17. FFP _____
18. PT _____
19. PTT _____
20. DIC _____

CHAPTER 11

The Respiratory System

Case Study

Preoperative Respiratory Testing for A.D., a Young Girl with Asthma

Chief complaint:

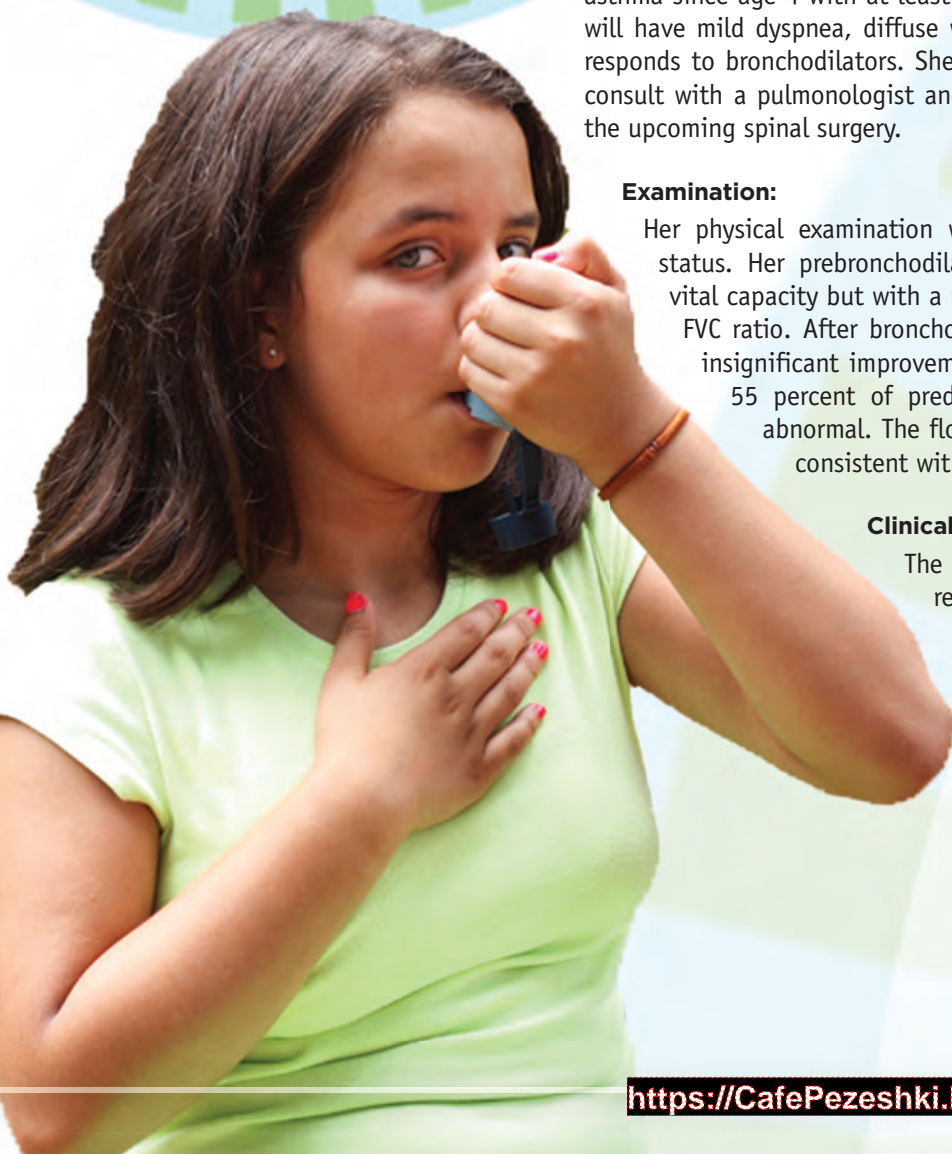
A.D., a 13-year-old girl, was seen in the preadmission testing unit in preparation for her elective spinal surgery for scoliosis. She has a history of mild asthma since age 4 with at least one attack per week. In an acute attack, she will have mild dyspnea, diffuse wheezing, yet an adequate air exchange that responds to bronchodilators. She was sent to pulmonary health services for a consult with a pulmonologist and pulmonary function studies to clear her for the upcoming spinal surgery.

Examination:

Her physical examination was unremarkable except for her respiratory status. Her prebronchodilator spirometry showed a mild reduction in vital capacity but with a moderate to severe decrease in FEV_1 and FEV_1/FVC ratio. After bronchodilator administration, there was a mild but insignificant improvement in FEV_1 . The postbronchodilator FEV_1 was 55 percent of predicted value and was considered moderately abnormal. The flow volume loops and spirographic curves were consistent with airflow obstruction.

Clinical course:

The anesthesiologist reviewed the pulmonologist's report. A.D.'s respiratory status was compromised for the surgical procedure and would require medical intervention prior to going to the OR. When the FEV_1 was acceptable, he spoke with A.D. and the family and explained her respiratory status would be closely monitored during and after surgery. Additional medications would be needed to maintain optimal airflow and oxygenation.





Ancillaries *At-A-Glance*

Visit *thePoint* to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii–xvi.

Learning TOOLS

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning RESOURCES

- E-book: Chapter 11
- Web Figure: Principal Muscles of Breathing and Lateral Chest
- Web Figure: Respiratory Infections
- Web Figure: Effects of Smoking
- Animation: Pulmonary Ventilation
- Animation: Oxygen Transport
- Animation: Carbon Dioxide Exchange
- Animation: Asthma
- Audio Pronunciation Glossary

Learning ACTIVITIES

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After study of this chapter you should be able to:

- 1 Compare external and internal gas exchange. *p248*
- 2 Describe and give the functions of the structures in the respiratory tract. *p248*
- 3 Describe the mechanism of breathing, including the roles of the diaphragm and phrenic nerve. *p252*
- 4 Explain how oxygen and carbon dioxide are carried in the blood. *p253*
- 5 Identify and use word parts pertaining to the respiratory system. *p255*
- 6 Discuss nine disorders of the respiratory system. *p257*
- 7 Name three types of organisms that can infect the respiratory system and give examples of each. *p258*
- 8 List and define 10 volumes and capacities commonly used to measure pulmonary function. *p263*
- 9 Interpret abbreviations commonly used with reference to the respiratory system. *p270*
- 10 Analyze medical terms in case studies pertaining to respiration. *pp246, 278*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|--|---|
| <p>_____ 1. The gas that is supplied to tissues by the respiratory system is:</p> <ul style="list-style-type: none"> a. oxygen b. neon c. sulfur d. carbon dioxide | <p>_____ 5. The tubes that carry air from the trachea into the lungs are the:</p> <ul style="list-style-type: none"> a. arteries b. nares c. veins d. bronchi |
| <p>_____ 2. The gas that is eliminated by the respiratory system is:</p> <ul style="list-style-type: none"> a. chlorine b. carbon dioxide c. hydrogen d. fluoride | <p>_____ 6. The dome-shaped muscle under the lungs is the:</p> <ul style="list-style-type: none"> a. palate b. diaphragm c. hiatus d. esophagus |
| <p>_____ 3. The air sacs through which gases are exchanged in the lungs are the:</p> <ul style="list-style-type: none"> a. trachea b. alveoli c. bursae d. bronchi | <p>_____ 7. The membrane around the lungs is the:</p> <ul style="list-style-type: none"> a. peritoneum b. mucosa c. pleura d. mediastinum |
| <p>_____ 4. The structure that holds the vocal cords is the:</p> <ul style="list-style-type: none"> a. larynx b. tongue c. uvula d. tonsils | <p>_____ 8. A term for inflammation of the lungs is:</p> <ul style="list-style-type: none"> a. pneumonia b. bronchitis c. pleuritis d. laryngitis |

The main function of the respiratory system is to provide **oxygen** to body cells for energy metabolism and to eliminate **carbon dioxide**, a byproduct of metabolism. Because these gases must be carried to and from the cells in the blood, the respiratory system works closely with the cardiovascular system to accomplish gas exchange (**Fig. 11-1**). This activity has two phases:

- External gas exchange occurs between the outside atmosphere and the blood.
- Internal gas exchange occurs between the blood and the tissues.

External exchange takes place in the **lungs**, located in the thoracic cavity. The remainder of the respiratory tract consists of a series of passageways that conduct air to and from the lungs. No gas exchange occurs in these regions. Refer to **Figure 11-2** as you read the following description of the respiratory tract.

Upper Respiratory Passageways

The upper respiratory passageways consist of the **nose** and **pharynx** (throat). Air can also be exchanged through the mouth, but there are fewer mechanisms for cleansing the air taken in by this route.

THE NOSE

Air enters through the nose, where it is warmed, filtered, and moistened as it passes over the hair-covered mucous membranes of the nasal cavity. Cilia—microscopic hair-like projections from the cells that line the nose—sweep dirt and foreign material toward the throat for elimination. Material that is eliminated from the respiratory tract by coughing or clearing the throat is called **sputum**. Receptors for the sense of smell are located within bony side projections of the nasal cavity called **turbinate bones** or conchae.

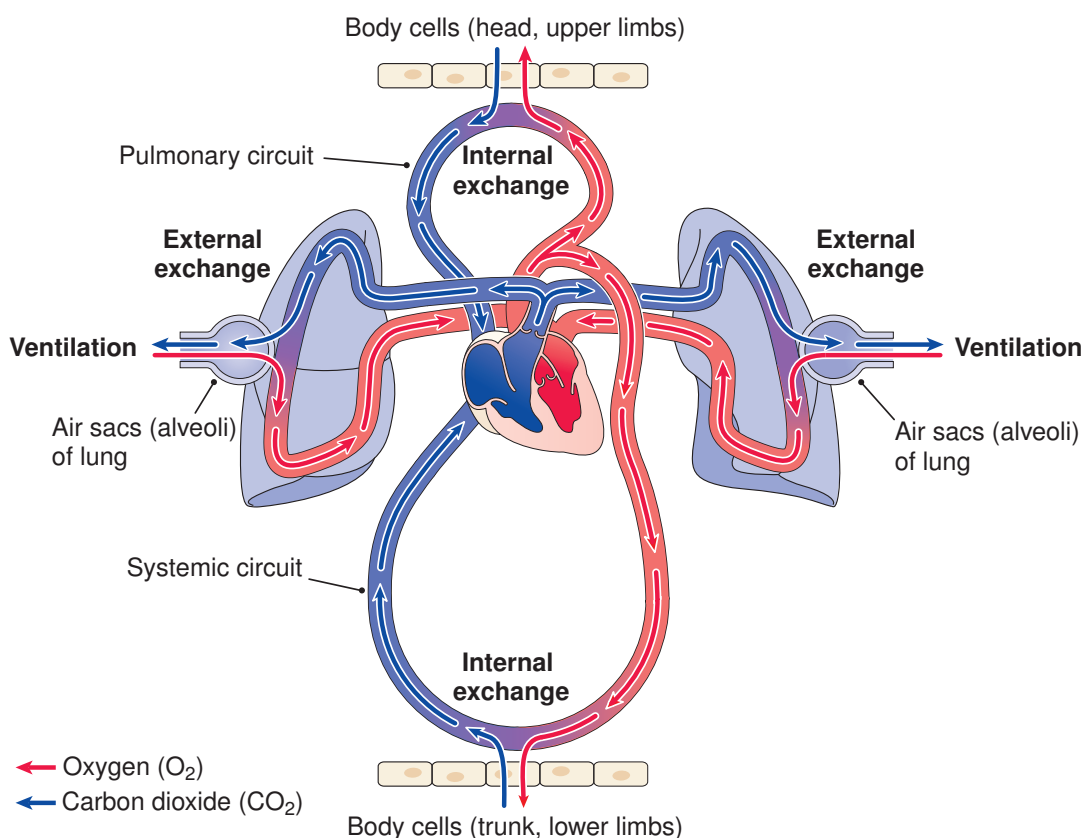


Figure 11-1 Respiration. In ventilation, gases are moved into and out of the lungs. In external exchange, gases move between the air sacs (alveoli) of the lungs and the blood. In internal exchange, gases move between the blood and body cells. The circulation transports gases in the blood.

In the bones of the skull and face near the nose are air-filled cavities lined with mucous membrane that drain into the nasal cavity. These chambers lighten the bones and provide resonance for speech production. These cavities, called **sinuses**, are named specifically for the bones in which they are located, such as the frontal, sphenoidal, ethmoidal, and maxillary sinuses. Together, because they are near the nose, these cavities are referred to as the paranasal sinuses. **Figure 11-2** shows the location of the frontal and sphenoidal sinuses.

THE PHARYNX

Inhaled air passes into the throat, or pharynx, where it mixes with air that enters through the mouth and also with food destined for the digestive tract. The pharynx is divided into three regions, which are shown in **Figure 11-2**:

- The nasopharynx is the superior portion located behind the nasal cavity.
- The oropharynx is the middle portion located behind the mouth.
- The laryngopharynx is the inferior portion located behind the larynx.

The tonsils, lymphoid tissue described in Chapter 9, are in the region of the pharynx (**Fig. 11-3**):

- The **palatine tonsils** are on either side of the soft palate in the oropharynx.
- The single pharyngeal tonsil, commonly known as the **adenoids**, is in the nasopharynx.
- The lingual tonsils are small mounds of lymphoid tissue at the posterior of the tongue.

Opinions on the advisability of removing the tonsils have changed over time, as described in **Box 11-1**.

Lower Respiratory Passageways and Lungs

Air moves from the pharynx into the larynx, commonly called the voice box, because it contains the **vocal cords**. The larynx is at the top of the **trachea**, commonly called the windpipe, which conducts air into the bronchial system toward the lungs.

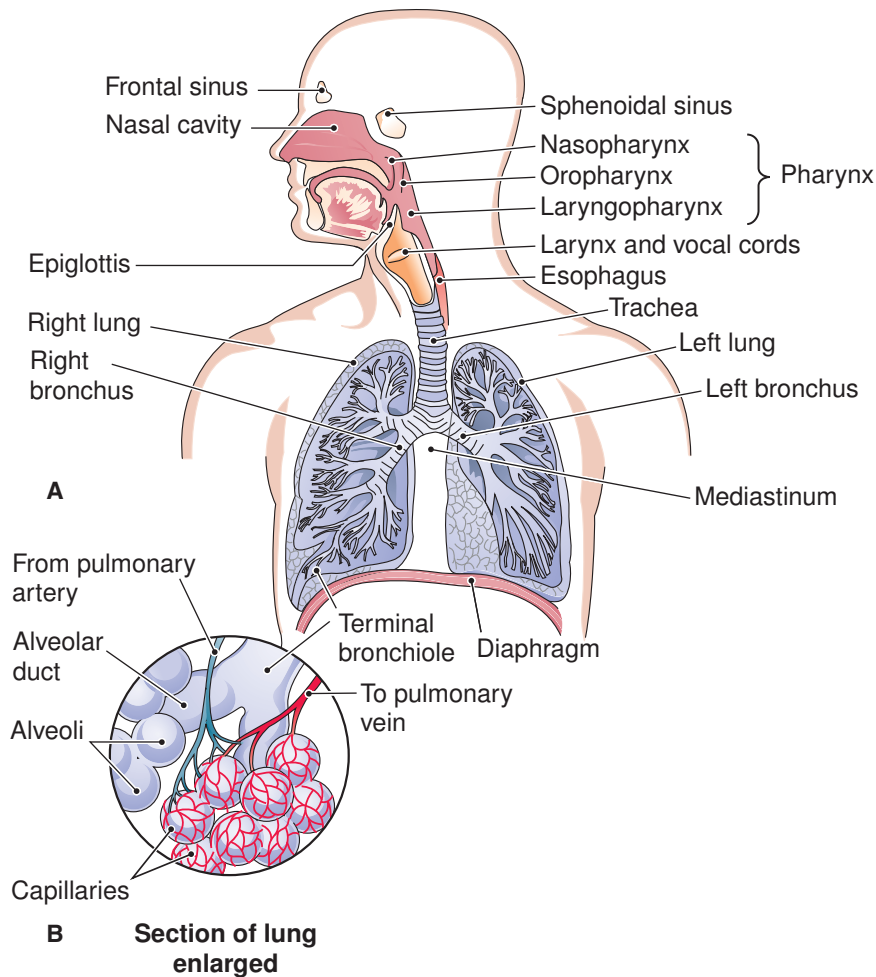


Figure 11-2 The respiratory system. *A.* Overview. *B.* Enlarged section of lung tissue showing the relationship between the alveoli (air sacs) and the blood capillaries.

THE LARYNX

The larynx is shaped by nine cartilages, the most prominent of which is the anterior thyroid cartilage that forms the “Adam’s apple” (Fig. 11-4). The small leaf-shaped cartilage

at the top of the larynx is the **epiglottis**. When one swallows, the epiglottis covers the opening of the larynx and helps to prevent food from entering the respiratory tract.

The larynx contains the vocal cords, folds of tissue that are important in speech production (Fig. 11-5). Vibrations produced by air passing over the vocal cords form the basis for voice production, although portions of the throat and mouth are needed for proper speech articulation. The opening between the vocal cords is the **glottis** (the epiglottis is above the glottis).

THE TRACHEA

The trachea is a tube reinforced with C-shaped rings of cartilage to prevent its collapse (you can feel these rings if you press your fingers gently against the front of your throat). Cilia in the trachea’s lining move impurities up toward the throat, where they can be eliminated by swallowing or by **expectoration**, coughing them up.

The trachea is contained in a region known as the **mediastinum**, which consists of the space between the lungs together with the organs contained in this space (see Fig. 11-2). In addition to the trachea, the mediastinum contains the heart, esophagus, large vessels, and other tissues.

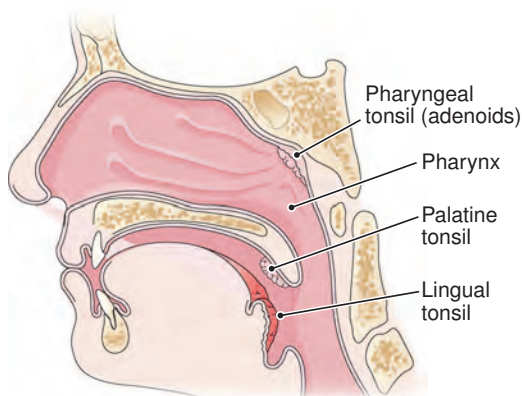


Figure 11-3 The tonsils. All of the tonsils are located in the vicinity of the pharynx (throat).

Box 11-1



Clinical Perspectives

Tonsillectomy: A Procedure Reconsidered

Tonsillitis, a bacterial infection of the tonsils, is a common childhood illness. In years past, surgical removal of the infected tonsils was a standard procedure, as tonsillectomy was thought to prevent severe infections like strep throat. Because tonsils were thought to have little function, surgeons often removed infected tonsils—even healthy tonsils, in order to prevent tonsillitis later. With the discovery that tonsils play an important immune function, the number of tonsillectomies performed in the United States dropped dramatically, reaching an all-time low in the 1980s.

Today, although many cases of tonsillitis are successfully treated with appropriate antibiotics, tonsillectomy is becoming more frequent; in fact, it is the second most common surgical procedure among American children. Surgery is considered if an infection recurs or if enlarged tonsils make

swallowing or breathing difficult. Many tonsillectomies are performed in children to treat obstructive sleep apnea, a condition in which the child stops breathing for a few seconds at a time during sleep. Recent studies suggest that tonsillectomy may also be beneficial for children suffering from otitis media (middle ear infection), because bacteria infecting the tonsils may travel to this region of the ear.

Most tonsillectomies are performed by electrocautery, a technique that uses an electrical current to burn the tonsils away from the throat. Now that this operation is becoming more common, surgeons are developing new techniques. For example, coblation tonsillectomy uses radio waves to break down tonsillar tissue. Studies suggest that this procedure results in a faster recovery, fewer complications, and decreased postoperative pain compared with electrocautery.

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THE BRONCHIAL SYSTEM

At its lower end, the trachea divides into a right and a left primary **bronchus**; these enter the lungs. The right bronchus is shorter and wider; it divides into three secondary bronchi in the right lung. The left bronchus divides into two branches that supply the left lung. Further divisions produce an increasing number of smaller tubes that supply air to smaller subdivisions of lung tissue. As the air passageways progress through the lungs, the cartilage in the walls gradually disappears and is replaced by smooth (involuntary) muscle.

The smallest of the conducting tubes, the **bronchioles**, carry air into the microscopic air sacs, the **alveoli**, through

which gases are exchanged between the lungs and the blood. It is through the ultrathin walls of the alveoli and their surrounding capillaries that oxygen diffuses into the blood and carbon dioxide diffuses out of the blood for elimination (see Fig. 11-2).

THE LUNGS

The cone-shaped lungs occupy the major portion of the thoracic cavity. The right lung is larger and divided into three lobes. The left lung, which is smaller to accommodate the heart, is divided into two lobes. The lobes are further subdivided to correspond to divisions of the bronchial network.

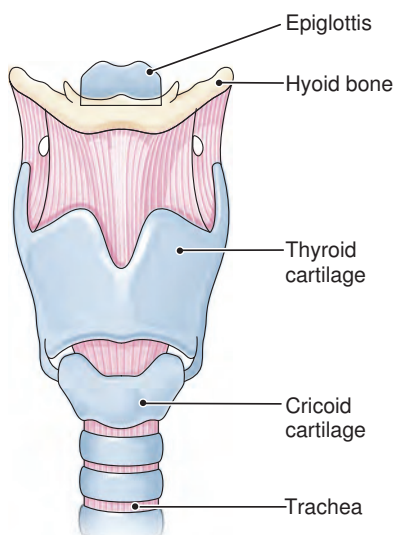


Figure 11-4 The larynx, anterior view.

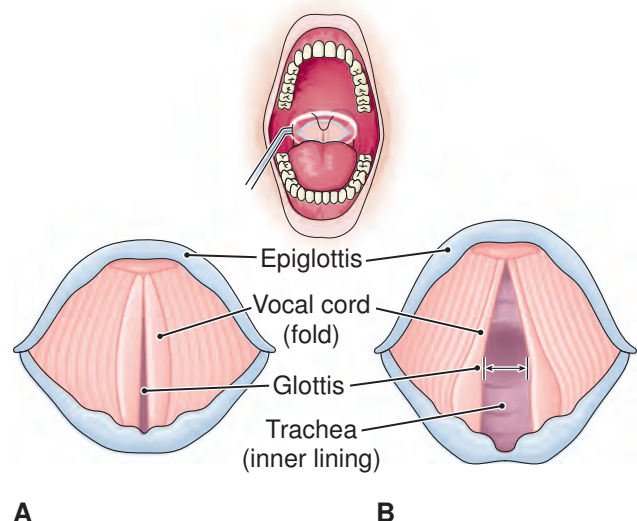


Figure 11-5 The vocal cords, superior view. A. The glottis in closed position. B. The glottis in open position.

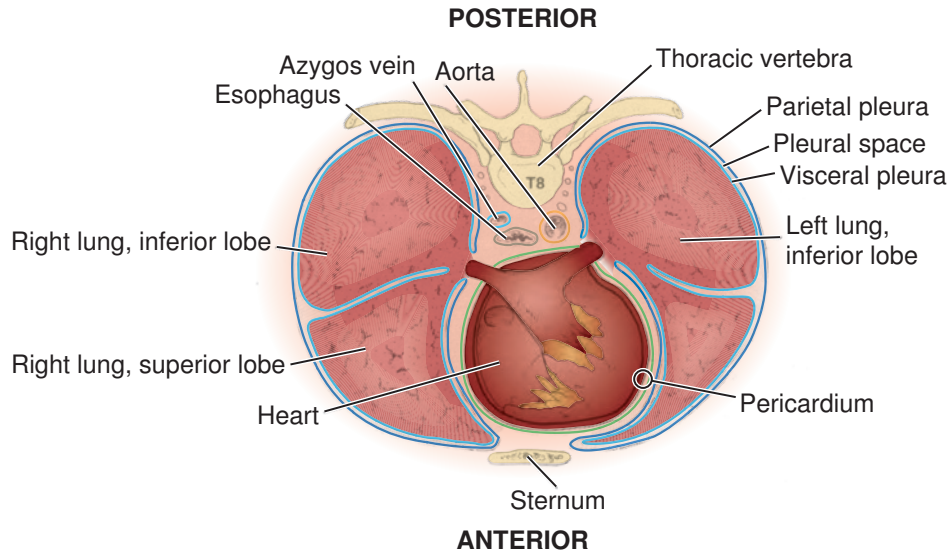


Figure 11-6 The pleura. A transverse section through the lungs shows the parietal and visceral layers of the pleura as well as structures in the mediastinum.

A double membrane, the **pleura**, covers the lungs and lines the thoracic cavity (**Fig. 11-6**). There are two pleural layers:

- The parietal pleura, the outer layer, is attached to the wall of the thoracic cavity.
- The visceral pleura, the inner layer, is attached to the surface of the lungs.

The very narrow, fluid-filled space between the two layers is the **pleural space**. The moist pleural membranes slide easily over each other within the chest cavity, allowing the lungs to expand during breathing.

Breathing

Air is moved into and out of the lungs by the process of breathing, technically called **pulmonary ventilation**. This consists of a steady cycle of **inspiration** (inhalation) and **expiration** (exhalation), separated by a period of rest. Breathing is normally regulated unconsciously by centers in the brainstem. These centers adjust the rate and rhythm of breathing according to changes in the blood's composition, especially the concentration of carbon dioxide.



See the figure on the principal muscles of breathing and the animation “Pulmonary Ventilation” in the Student Resources on thePoint.

INSPIRATION

The breathing cycle begins when the **phrenic nerve** stimulates the **diaphragm** to contract and flatten, enlarging the chest cavity. At the same time, external intercostal

muscles between the ribs elevate and expand the rib cage. A resulting decrease in pressure within the thorax causes air to flow into the lungs (**Fig. 11-7**). Muscles of the neck and thorax are used in addition for forceful inhalation.

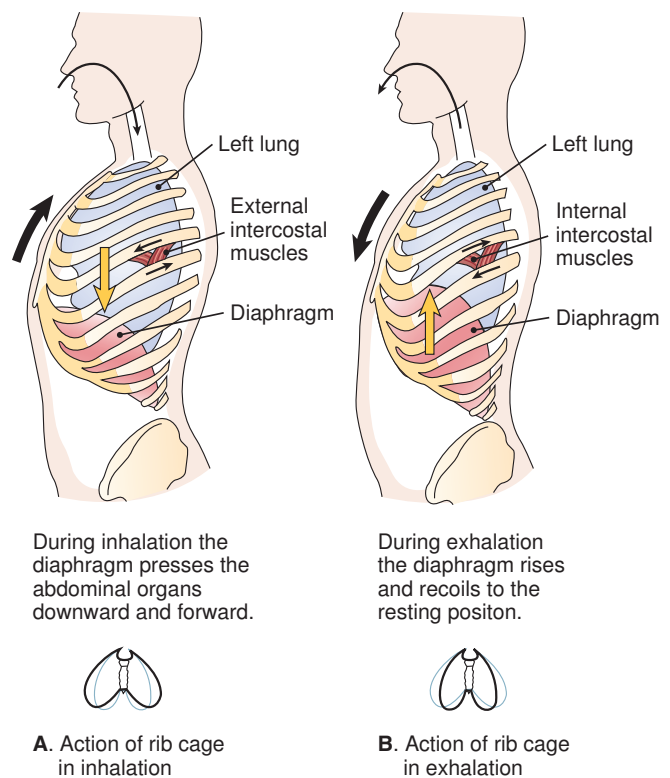


Figure 11-7 Pulmonary ventilation. A. In inhalation, the diaphragm lowers, and the external intercostals elevate the rib cage. B. In exhalation, the diaphragm rises, and the internal intercostals draw the ribs downward.

The measure of how easily the lungs expand under pressure is **compliance**. Fluid produced in the lungs, known as **surfactant**, aids in compliance by reducing surface tension within the alveoli.

EXPIRATION

Expiration occurs as the breathing muscles relax and the elastic lungs spring back to their original size. Increased pressure in the smaller thorax forces air out of the lungs. In forceful exhalation, the internal intercostal muscles contract to lower the rib cage, and the abdominal muscles contract, pressing internal organs upward against the diaphragm.

Gas Transport

Oxygen is carried in the blood bound to **hemoglobin** in red blood cells. The oxygen is released to the cells as needed. Carbon dioxide is carried in several ways but is mostly converted to **carbonic acid**. The amount of carbon dioxide that is exhaled is important in regulating the blood's acidity or alkalinity, based on the amount of carbonic acid that is formed. Dangerous shifts in blood pH can result from exhalation of too much or too little carbon dioxide.



See the animations “Oxygen Transport” and “Carbon Dioxide Exchange” in the Student Resources on thePoint.

Terminology

Key Terms

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Normal Structure and Function

adenoids <i>AD-e-noyds</i>	Lymphoid tissue located in the nasopharynx; the pharyngeal tonsils
alveoli <i>al-VE-ō-lī</i>	The tiny air sacs in the lungs through which gases are exchanged between the atmosphere and the blood in respiration (singular: alveolus). An alveolus, in general, is a small hollow or cavity; the term also applies to the bony socket for a tooth
bronchiole <i>BRONG-kē-ōl</i>	One of the smaller subdivisions of the bronchial tubes (root: bronchiol)
bronchus <i>BRONG-kus</i>	One of the larger air passageways in the lungs. The bronchi begin as two branches of the trachea and then subdivide within the lungs (plural: bronchi) (root: bronch)
carbon dioxide (CO₂)	A gas produced by energy metabolism in cells and eliminated through the lungs
carbonic acid <i>kar-BON-ik</i>	An acid formed when carbon dioxide dissolves in water; H ₂ CO ₃
compliance <i>kom-PLĪ-ans</i>	A measure of how easily the lungs expand under pressure. Compliance is reduced in many types of respiratory disorders
diaphragm <i>DĪ-a-fragm</i>	The dome-shaped muscle under the lungs that flattens during inspiration (root: phren/o)
epiglottis <i>ep-i-GLOT-is</i>	A leaf-shaped cartilage that covers the larynx during swallowing to prevent food from entering the trachea
expectoration <i>ek-spek-to-RĀ-shun</i>	The act of coughing up material from the respiratory tract; also the material thus released; sputum
expiration <i>ek-spi-RĀ-shun</i>	The act of breathing out or expelling air from the lungs; exhalation
glottis <i>GLOT-is</i>	The opening between the vocal cords
hemoglobin <i>HĒ-mō-glō-bin</i>	The iron-containing pigment in red blood cells that transports oxygen

(Continued)

Terminology

Key Terms (Continued)

inspiration <i>in-spi-RĀ-shun</i>	The act of drawing air into the lungs; inhalation
larynx <i>LAR-inks</i>	The enlarged, superior portion of the trachea that contains the vocal cords (root: laryng/o)
lung	A cone-shaped, spongy respiratory organ contained within the thorax (roots: pneum, pulm)
mediastinum <i>mē-dē-as-TĪ-num</i>	The space between the lungs together with the organs contained in this space
nose <i>nōz</i>	The organ of the face used for breathing and for housing receptors for the sense of smell; includes an external portion and an internal nasal cavity (roots: nas/o, rhin/o)
oxygen (O₂) <i>OK-si-jen</i>	The gas needed by cells to release energy from food during metabolism
palatine tonsils <i>PAL-a-tĭn</i>	The paired masses of lymphoid tissue located on either side of the oropharynx; usually meant when the term <i>tonsils</i> is used alone
pharynx <i>FAR-inks</i>	The throat; a common passageway for food entering the esophagus and air entering the larynx (root: pharyng/o)
phrenic nerve <i>FREN-ik</i>	The nerve that activates the diaphragm (root: phrenic/o)
pleura <i>PLŪR-a</i>	A double-layered membrane that lines the thoracic cavity (parietal pleura) and covers the lungs (visceral pleura) (root: pleur/o)
pleural space	The thin, fluid-filled space between the two layers of the pleura; pleural cavity
pulmonary ventilation <i>PUL-mō-nār-ē ven-ti-LĀ-shun</i>	The movement of air into and out of the lungs
sinus <i>SĪ-nus</i>	A cavity or channel; the paranasal sinuses are located near the nose and drain into the nasal cavity
sputum <i>SPŪ-tum</i>	The substance released by coughing or clearing the throat; expectoration. It may contain a variety of material from the respiratory tract
surfactant <i>sur-FAK-tant</i>	A substance that decreases surface tension within the alveoli and eases lung expansion
trachea <i>TRĀ-kē-a</i>	The air passageway that extends from the larynx to the bronchi (root: trache/o)
turbinate bones <i>TUR-bi-nāt</i>	The bony projections in the nasal cavity that contain receptors for the sense of smell. Also called conchae (<i>KON-kē</i>); singular: concha (<i>KON-ka</i>)
vocal cords <i>VŌ-kal</i>	Membranous folds on either side of the larynx that are important in speech production. Also called vocal folds



Go to the Audio Pronunciation Glossary in the Student Resources on thePoint to hear these terms pronounced.

Word Parts Pertaining to the Respiratory System

See **Tables 11-1 to 11-3.**

Table 11-1 Suffixes for Respiration

Suffix	Meaning	Example	Definition of Example
-pnea	breathing	orthopnea or-THOP-nē-a	breathing difficulty that is relieved by assuming an upright (ortho-) position
-oxia*	level of oxygen	hypoxia hi-POK-sē-a	decreased amount of oxygen in the tissues
-capnia*	level of carbon dioxide	hypercapnia hi-per-KAP-nē-a	increased carbon dioxide in the tissues
-phonia	voice	dysphonia dis-FŌ-nē-a	difficulty in speaking

*When referring to levels of oxygen and carbon dioxide in the blood, the suffix *-emia* is used, as in hypoxemia, hypercapnemia.

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EXERCISE 11-1

Use the suffix *-pnea* to form words with the following meanings:

- lack of breathing _____ apnea
- painful or difficult breathing _____
- easy, normal (eu-) breathing _____
- slow (brady-) rate of breathing _____

Use the ending *-pneic* to write the adjective form of the above words:

- _____
- _____
- _____
- _____

Use the suffixes in Table 11-1 to write a word for each of the following definitions:

- lack of voice _____
- decreased carbon dioxide in the tissues _____
- lack of (an-) oxygen in the tissues _____
- normal levels of carbon dioxide in the tissues _____

Table 11-2 Roots for the Respiratory Passageways

Root	Meaning	Example	Definition of Example
nas/o	nose	intranasal <i>in-tra-NĀ-zal</i>	within the nose
rhin/o	nose	rhinoplasty <i>RĪ-nō-plas-tē</i>	plastic repair of the nose
pharyng/o*	pharynx	pharyngeal <i>fa-RIN-jē-al</i>	pertaining to the pharynx
laryng/o*	larynx	laryngospasm <i>la-RIN-gō-spazm</i>	spasm (sudden contraction) of the larynx
trache/o	trachea	tracheotomy <i>TRĀ-kē-ō-tōm</i>	instrument used to incise the trachea
bronch/o, bronch/i	bronchus	bronchogenic <i>brong-kō-GEN-ik</i>	originating in a bronchus
bronchiol	bronchiole	bronchiolectasis <i>brong-kē-ō-LEK-ta-sis</i>	dilatation of the bronchioles

*An *e* is added to the root before the adjective ending *-al*.

EXERCISE 11-2

Write words for the following definitions:

- discharge from the nose _____ rhinorrhea
- pertaining to the larynx (see *pharynx* in Table 11-2) _____
- inflammation of the pharynx _____
- endoscopic examination of the larynx _____
- plastic repair of the pharynx _____
- surgical incision of the trachea _____
- narrowing of a bronchus _____
- inflammation of the bronchioles _____

Define the following words (note the adjectival endings):

- nasopharyngeal (*nā-zō-fa-RIN-jē-al*) _____
- endotracheal (*en-dō-TRĀ-kē-al*) _____
- peribronchial (*per-i-BRONG-kē-al*) _____
- paranasal (*par-a-NĀ-zal*) _____
- bronchiolar (*brong-KĒ-ō-lar*) _____
- bronchiectasis (*brong-kē-EK-ta-sis*) _____

Table 11-3 Roots for the Lungs and Breathing

Root	Meaning	Example	Definition of Example
phren/o	diaphragm	phrenic FREN-ik	pertaining to the diaphragm
phrenic/o	phrenic nerve	phrenicectomy fren-i-SEK-tō-mē	partial excision of the phrenic nerve
pleur/o	pleura	pleurodesis plū-ROD-e-sis	fusion of the pleura
pulm/o, pulmon/o	lung	extrapulmonary EKS-tra-pul-mō-ner-ē	outside the lungs
pneumon/o	lung	pneumonitis nū-mō-NĪ-tis	inflammation of the lung; pneumonia
pneum/o, pneumat/o	air, gas; also respiration, lung	pneumothorax nū-mō-THŌ-raks	presence of air in the thorax (pleural space)
spir/o	breathing	spirometer spī-ROM-e-ter	instrument for measuring breathing volumes

EXERCISE 11-3**Define the following words:**

1. pleuralgia (*plū-RAL-jē-a*) _____
2. intrapulmonary (*in-tra-PUL-mō-ner-ē*) _____
3. pneumonectomy (*nū-mō-NEK-tō-mē*) _____
4. pneumoplasty (*NŪ-mō-plas-tē*) _____
5. pulmonology (*pul-mō-NOL-ō-jē*) _____
6. apnea (*a-NŪ-mē-a*) _____
7. phrenicotomy (*fren-i-KOT-ō-mē*) _____

Write words for the following definitions:

8. within the pleura _____
9. above the diaphragm _____
10. surgical puncture of the pleural space _____
11. any disease of the lungs (pneumon/o) _____
12. crushing of the phrenic nerve _____
13. record of breathing volumes _____

Clinical Aspects of the Respiratory System

Any disorder that causes resistance to air flow through the respiratory tract or that limits chest expansion will affect pulmonary function. These disorders may involve the respiratory system directly, such as infection, injury, allergy, **aspiration** (inhalation) of foreign bodies, or cancer; they may

also originate in other systems, such as in the skeletal, muscular, cardiovascular, or nervous systems.

As noted above, changes in ventilation can affect the blood's pH (acidity or alkalinity). If too much carbon dioxide is exhaled by **hyperventilation**, the blood tends to become too alkaline, a condition termed **alkalosis**. If too little carbon dioxide is exhaled as a result of **hypoventilation**, the blood tends to become too acidic, a condition termed **acidosis**.

INFECTIONS

A variety of organisms infect the respiratory system. For your reference, some of these organisms are listed along with the diseases they cause in **Box 11-2**. Childhood immunizations have dramatically reduced the incidence of some infectious respiratory diseases, such as **diphtheria** and **pertussis** (the “D” and “P” in the DTaP vaccine; the “T” is for tetanus). Selected infectious diseases are described in greater detail below.



See the figure on respiratory infections in the Student Resources on thePoint.

Pneumonia

Pneumonia is caused by many different microorganisms, usually bacteria or viruses. Bacterial agents are most commonly *Streptococcus pneumoniae* and *Klebsiella pneumoniae*. Viral pneumonia is more diffuse and is commonly caused by influenza virus, adenovirus, and, in young children, respiratory syncytial virus (RSV). There are two forms of pneumonia (**Fig. 11-8**):

- Bronchopneumonia (bronchial pneumonia) begins in terminal bronchioles that become clogged with exudate and form consolidated (solidified) patches.
- Lobar pneumonia, an acute disease, involves one or more lobes of the lung.

Box 11-2

For Your Reference

Organisms That Infect the Respiratory System

ORGANISM	DISEASE
BACTERIA	
Streptococcus pneumoniae <i>strep-tō-KOK-us nū-MŌ-nē-ē</i>	Most common cause of pneumonia; streptococcal pneumonia
Haemophilus influenzae <i>hē-MOF-i-lus in-flū-EN-zē</i>	Pneumonia, especially in debilitated patients
Klebsiella pneumoniae <i>kleb-sē-EL-a nū-MŌ-nē-ē</i>	Pneumonia in elderly and debilitated patients
Mycoplasma pneumoniae <i>mī-kō-PLAZ-ma nū-MŌ-nē-ē</i>	Mild pneumonia, usually in young adults and children; “walking pneumonia”
Legionella pneumophila <i>lē-ju-NEL-la nū-MO-fi-la</i>	Legionellosis (Legionnaire disease); respiratory disease spread through water sources, such as air conditioners, pools, humidifiers
Chlamydia psittaci <i>kla-MID-ē-a SI-ta-sē</i>	Psittacosis (ornithosis); carried by birds
Streptococcus pyogenes <i>strep-tō-KOK-us pī-OJ-e-nēz</i>	“Strep throat,” scarlet fever
Mycobacterium tuberculosis <i>mī-kō-bak-TĒR-ē-um tū-ber-kū-LŌ-sis</i>	Tuberculosis
Bordetella pertussis <i>bōr-de-TEL-a per-TUS-sis</i>	Pertussis (whooping cough)
Corynebacterium diphtheriae <i>kō-RĪ-nē-bak-tēr-ē-um dif-THĒ-rē-ē</i>	Diphtheria
VIRUSES	
Rhinoviruses <i>RĪ-nō-vī-rus-es</i>	Major cause of common cold; also caused by coronaviruses, adenoviruses, and others
Influenzavirus <i>in-flū-EN-za-vī-rus</i>	Influenza
Respiratory syncytial virus (RSV) <i>sin-SISH-al</i>	Common cause of respiratory disease in infants
SARS coronavirus <i>kō-RŌ-na-vī-rus</i>	Severe acute respiratory syndrome; highly infectious disease that appeared in 2003 and spreads from small mammals to humans
Hantavirus <i>HAN-ta-vī-rus</i>	Hantavirus pulmonary syndrome (HPS); spread by inhalation of virus released from dried rodent droppings

Organisms That Infect the Respiratory System (Continued)

ORGANISM	DISEASE
FUNGI	
Histoplasma capsulatum <i>his-tō-PLAS-ma kap-sū-LĀT-um</i>	Histoplasmosis; spread by airborne spores
Coccidioides immitis <i>kok-sid-ē-OY-dēz IM-i-tis</i>	Coccidioidomycosis (valley fever, San Joaquin fever); found in dry, alkaline soils
Blastomyces dermatitidis <i>blas-tō-Mĭ-sēz der-ma-TIT-i-dis</i>	Blastomycosis; rare but often fatal fungal disease
Pneumocystis jiroveci (formerly carinii) <i>nū-mō-SIS-tis jir-ō-VE-sē</i>	<i>Pneumocystis</i> pneumonia (PCP); seen in immunocompromised hosts

Pneumonia can usually be treated successfully in otherwise healthy people, but in debilitated patients, it is a leading cause of death. Immunocompromised patients, such as those with AIDS, are often subject to a form of fungal pneumonia called *Pneumocystis* pneumonia (PCP).

The term *pneumonia* is also applied to noninfectious lung inflammation, such as that caused by **asthma**, allergy, or inhalation of irritants. In these cases, however, the more general term **pneumonitis** is often used.

Tuberculosis

The incidence of **tuberculosis (TB)** has increased in recent years, along with the increase of AIDS and the appearance of antibiotic resistance in the causative organism, *Mycobacterium tuberculosis* (MTB). (This organism, because of its staining properties, is also referred to as AFB, meaning *acid-fast bacillus*.) The name *tuberculosis* comes from the small lesions, or tubercles, that characterize the infection. The tubercles can liquefy in the center and then rupture to release bacteria into the bloodstream. Generalized TB is known as *miliary tuberculosis* because of the many tubercles that are the size of millet seeds in infected tissue (**Fig. 11-9**).

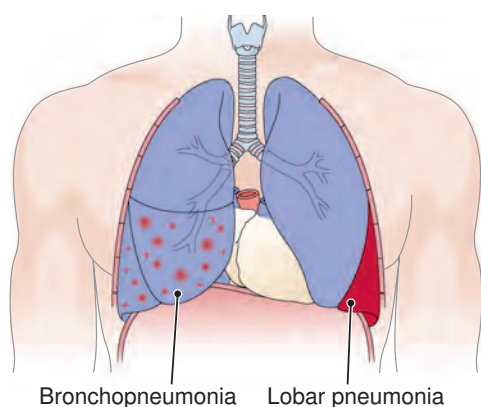


Figure 11-8 Pneumonia. In bronchopneumonia (right lung), patchy areas of consolidation occur. In lobar pneumonia (left lung), an entire lobe is consolidated.

TB symptoms include fever, weight loss, weakness, cough, and **hemoptysis**, the coughing up of blood-containing sputum. Accumulation of exudate in the alveoli may result in consolidation of lung tissue. Active TB is diagnosed by chest x-ray and laboratory culture of sputum samples to isolate, stain, and identify any causative organisms. If found, the organisms can be tested for drug susceptibility. These laboratory studies can take up to eight weeks, as the TB organism is very slow-growing, so clinicians also use several quick tests to identify tuberculosis infections. These include:

- The **tuberculin test**, a skin test, also known as a Mantoux (*man-TOO*) test. The test material, tuberculin, is made from byproducts of the tuberculosis organism. PPD (purified protein derivative) is the form of tuberculin commonly used. In 48 to 72 hours after tuberculin is injected below the skin, a hard, raised lump appears if a person has been infected with the TB organism. This test does not distinguish active from inactive cases.
- IGRA, a rapid blood test to diagnose TB. This is an immunologic test with the full name interferon-gamma

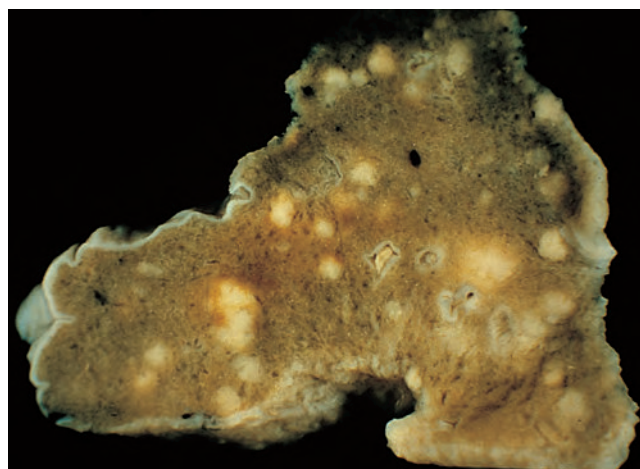


Figure 11-9 Tuberculosis. The cut surface of the lung reveals numerous white nodules in miliary (generalized) tuberculosis.

release assay. It is used to confirm results of a negative skin test in people at high risk of having TB.

- NAA, a sputum test that can confirm a positive TB diagnosis within 24 hours. The full name is nucleic acid amplification test.

BCG vaccine is used worldwide to help to prevent TB; it is not used routinely in the United States because the incidence of TB in this country is relatively low and also because it invalidates the tuberculin test. The bacillus (B) used for the vaccine is named for Calmette (C) and Guérin (G), discoverers of this avirulent mycobacterium strain.

Influenza

Influenza (“flu”) is a viral respiratory disease associated with chills, fever, headaches, muscular aches, and cold-like symptoms. It usually resolves in several days, but severe forms of influenza have caused fatal pandemics, most recently in 1918, 1957, and 1968. The virus can mutate readily and spread among animals, such as birds or pigs, and humans.

Because influenza viruses change so rapidly, scientists must prepare vaccines against the strains most likely to cause an epidemic in any given year. The virus strains are grouped into categories A to C, with A the most severe and C the least. They are further designated H and N with numbers, such as H3N2 and H5N1. The “H” and “N” represent surface proteins that the virus uses to infect a host.

Medical personnel combat influenza with vaccines, isolation of infected populations, destruction of infected animals, and antiviral medications.

Common Cold

More than 200 viruses are known to cause the common cold. About one half of these are rhinoviruses, and the others include adenoviruses and coronaviruses. The symptoms, known to all, are sneezing; **acute rhinitis**, which is inflammation of the nasal passageways with copious secretion of watery mucus; tearing of the eyes; and congestion. The infection may spread from the nose and throat to the sinuses, middle ear, and lower respiratory tract.

Cold viruses are mostly spread by airborne virus-filled droplets released by an infected person’s coughs and sneezes. Frequent hand washing and not touching one’s hands to any part of the face are good preventive measures.

The disorder usually resolves in about a week. Because colds are caused by viruses, antibiotics do not cure them. Rest, fluid intake, symptomatic treatment, and time work best. The large variety of cold viruses and their frequent mutation have prevented the development of an effective vaccine.

Box 11-3 has some history on terminology related to respiratory infections and other disorders.

EMPHYSEMA

Emphysema is a chronic disease associated with overexpansion and destruction of the alveoli (**Fig. 11-10A**). Common causes are exposure to cigarette smoke and other forms of pollution as well as chronic infection. Emphysema is the main disorder included under the heading of **chronic obstructive pulmonary disease (COPD)** (also called **COLD**, chronic obstructive lung disease). Other conditions included in this category are asthma, **bronchiectasis**, and chronic **bronchitis** (see **Fig. 11-10B**).

ASTHMA

Asthma attacks result from narrowing of the bronchial tubes. This constriction, along with edema (swelling) of the bronchial linings, inflammation, and mucus accumulation, results in wheezing, extreme **dyspnea** (difficulty in breathing), and **cyanosis**.

Asthma is most common in children. Although its causes are uncertain, a main factor is irritation caused by allergy. Heredity may also play a role. Treatment of asthma includes:

- removal of allergens
- administration of bronchodilators to widen the airways
- administration of corticosteroids to reduce inflammation

Box 11-3



Focus on Words

Don't Breathe a Word

Some laypersons' terms for respiratory symptoms and conditions are so old-fashioned and quaint that you might see them today only in Victorian novels. **Catarrh** (*ka-TAR*) is an old word for an upper respiratory infection with much mucus production. **Quinsy** (*KWIN-zē*) referred to a sore throat or tonsillar abscess. **Consumption** was tuberculosis, and **dropsy** referred to generalized edema. The **grippe** (*grip*) meant influenza, which we more often abbreviate as “flu.”

Some unscientific words are still in use. These include whooping cough for pertussis, croup for laryngeal spasm, cold sore or fever blister for a herpes lesion, and phlegm for sputum.

Many people use informal terms instead of scientific words to describe their symptoms. Health professionals should be familiar with the slang or colloquialisms that patients might use so that they can better communicate with them.

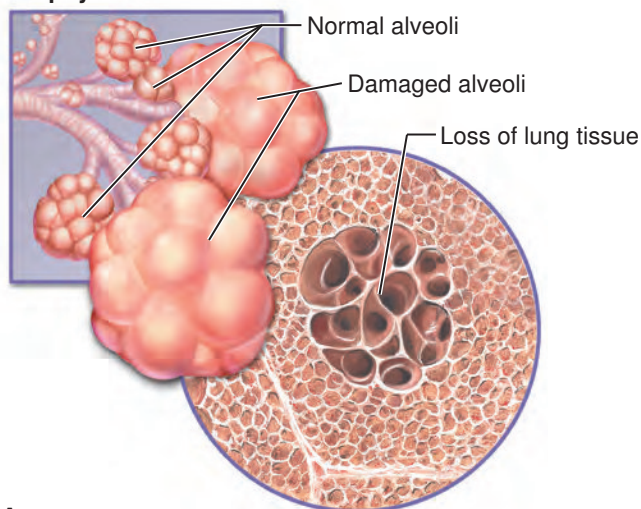
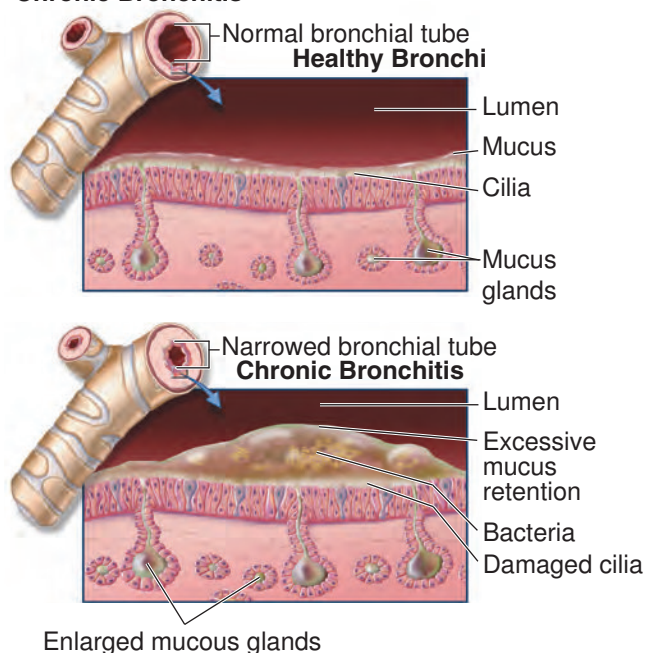
Emphysema**A****Chronic Bronchitis****B**

Figure 11-10 Types of chronic obstructive pulmonary disease (COPD). A. Emphysema results in dilation and destruction of alveoli. B. Chronic bronchitis involves airway inflammation, damage to cilia, and excess mucus secretion.



See the figure on the effects of smoking and the animation “Asthma” in the Student Resources on *thePoint*.

PNEUMOCONIOSIS

Chronic irritation and inflammation caused by dust inhalation is termed **pneumoconiosis**. This is an occupational hazard seen mainly in people working in mining and stone working industries. Different forms of pneumoconiosis are named for the specific type of dust inhaled: silicosis (silica or quartz), anthracosis (coal dust), asbestosis (asbestos fibers).

Although the term *pneumoconiosis* is limited to conditions caused by inhalation of inorganic dust, lung irritation may also result from inhalation of organic dusts, such as textile or grain dusts.

LUNG CANCER

Lung cancer is the leading cause of cancer-related deaths in both men and women. The incidence of lung cancer has increased steadily over the past 50 years, especially in women. Cigarette smoking is a major risk factor in this as well as other types of cancer. The most common form of lung cancer is squamous carcinoma, originating in the lining of the bronchi (bronchogenic). Lung cancer usually cannot be detected early, and it metastasizes rapidly. The overall long-term survival rate is low.

Methods used to diagnose lung cancer include radiographic studies, computed tomography (CT) scans, and

sputum examination for cancer cells. Physicians can use a **bronchoscope** to examine the airways and to collect tissue samples for study. They may also take samples by surgical or needle biopsies.

RESPIRATORY DISTRESS SYNDROME

Respiratory distress syndrome (RDS) of the newborn occurs in premature infants and is the most common cause of death in this group. It results from a lack of lung surfactant, which reduces compliance. **Acute respiratory distress syndrome (ARDS)**, also known as *shock lung*, may result from trauma, allergic reactions, infection, and other causes. It involves edema that can lead to respiratory failure and death if untreated.

CYSTIC FIBROSIS

Cystic fibrosis (CF) is the most common fatal hereditary disease among white children. The flawed gene that causes CF affects glandular secretions by altering chloride transport across cell membranes. Thickening of bronchial secretions leads to infection and other respiratory disorders. Other mucus-secreting glands, sweat glands, and the pancreas are also involved, causing electrolyte imbalance and digestive disturbances.

CF is diagnosed by the increased amounts of sodium and chloride in the sweat. Geneticists also can identify the gene that causes CF by DNA analysis. There is no cure at present for CF. Patients are treated to relieve their symptoms, as by postural drainage, aerosol mists, bronchodilators, antibiotics, and mucolytic (mucus-dissolving) agents.

SUDDEN INFANT DEATH SYNDROME

Sudden infant death syndrome (SIDS), also called “crib death,” is the unexplained death of a seemingly healthy infant under one year of age. Death usually occurs during sleep, leaving no signs of its cause. Neither autopsy nor careful investigation of family history and circumstances of death provides any clues.

Certain maternal conditions during pregnancy are associated with an increased risk of SIDS, although none is a sure predictor. These include cigarette smoking, age under 20, low weight gain, anemia, illegal drug use, and reproductive or urinary tract infections.

Some practices that have reduced the incidence of SIDS are:

- Place the baby on his or her back (supine) for sleep (“back to sleep”).
- Keep the baby in a smoke-free environment.
- Use a firm, flat baby mattress.
- Don’t overheat the baby.

PLEURAL DISORDERS

Pleurisy, also called **pleuritis**, is an inflammation of the pleura, usually associated with infection. Pain is the common symptom of pleurisy. Because this pain is intensified by breathing or coughing as the inflamed membranes move, breathing becomes rapid and shallow. Analgesics and antiinflammatory drugs are used to treat the symptoms of pleurisy.

As a result of injury, infection, or weakness in the pleural membrane, substances may accumulate between the layers of the pleura. When air or gas collects in this space, the condition is termed **pneumothorax** (Fig. 11-11). Compression may cause collapse of the lung, termed **atelectasis**.

In **pleural effusion**, other materials accumulate in the pleural space (Fig. 11-12). Depending on the substance involved, these are described as **empyema** (pus), also termed **pyothorax**; **hemothorax** (blood); or **hydrothorax** (fluid).

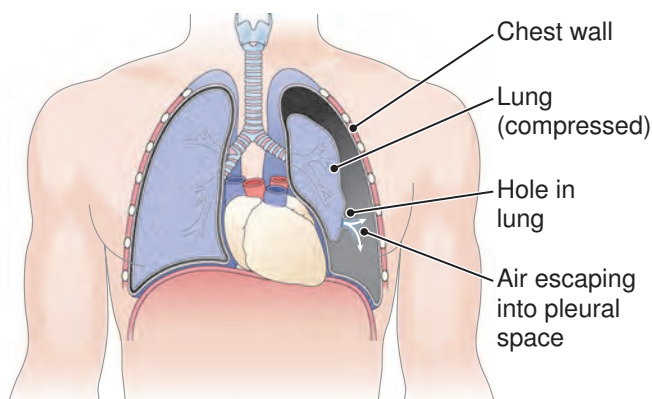


Figure 11-11 Pneumothorax. Injury to lung tissue allows air to leak into the pleural space and put pressure on the lung.

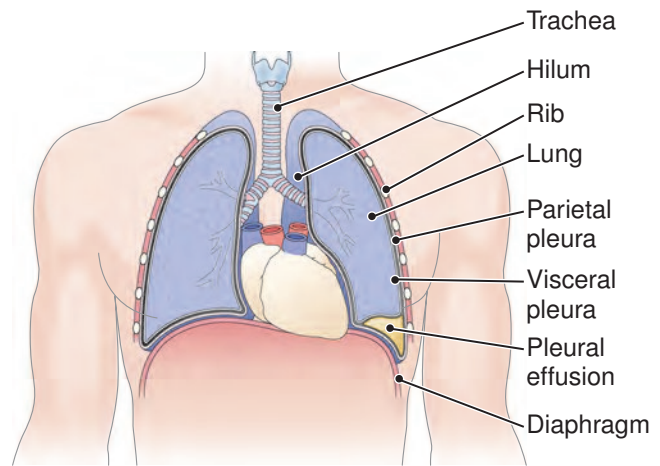


Figure 11-12 Pleural effusion. An abnormal volume of fluid collects in the pleural space.

Causes of these conditions include injury, infection, heart failure, and pulmonary embolism. **Thoracentesis**, needle puncture of the chest to remove fluids (Fig. 11-13), or fusion of the pleural membranes (pleurodesis) may be required. A chest tube may be inserted to remove air and fluid from the pleural space.

DIAGNOSIS OF RESPIRATORY DISORDERS

In addition to chest radiographs, CT scans, and magnetic resonance imaging (MRI) scans, methods for diagnosing respiratory disorders include **lung scans**, bronchoscopy, and tests of pleural fluid removed by thoracentesis. **Arterial blood gases (ABGs)** are used to evaluate gas exchange in the lungs by measuring carbon dioxide, oxygen, bicarbonate, and pH in an arterial blood sample. **Pulse oximetry** is routinely used

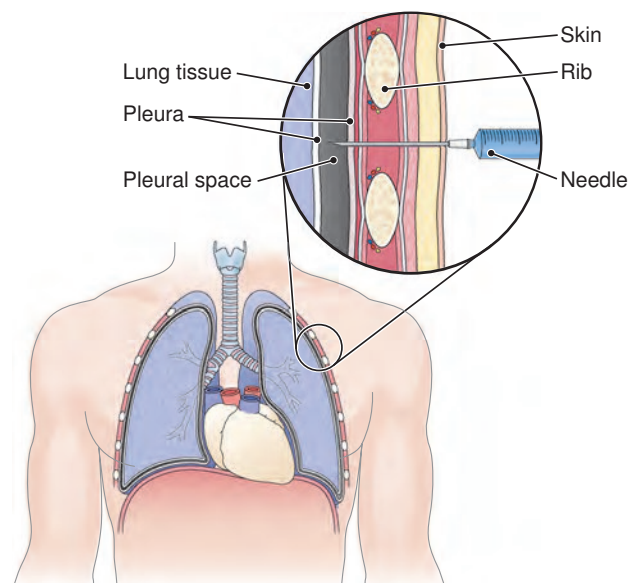


Figure 11-13 Thoracentesis. A needle is inserted into the pleural space.

to measure the oxygen saturation of arterial blood by means of an oximeter, a simple device placed on a thin part of the body, usually the finger or the ear (**Fig. 11-14**).

Pulmonary function tests are used to assess breathing, usually by means of a **spirometer**. They measure the volumes of air that can be moved into or out of the lungs with different degrees of effort. Often used to monitor treatment in cases of allergy, asthma, emphysema, and other respiratory conditions, they are also used to measure progress in smoking cessation. The main volumes and capacities measured in these tests are summarized in **Box 11-4** and illustrated in **Figure 11-15**. A capacity is the sum of two or more volumes.

See **Box 11-5** for information on respiratory therapists, who perform many of these tests.



Figure 11-14 Pulse oximetry. The oximeter measures the oxygen saturation of arterial blood.

Box 11-4

For Your Reference

Volumes and Capacities (Sums of Volumes) Used in Pulmonary Function Tests

VOLUME OR CAPACITY	DEFINITION
tidal volume (TV)	amount of air breathed into or out of the lungs in quiet, relaxed breathing
residual volume (RV)	amount of air that remains in the lungs after maximum exhalation
expiratory reserve volume (ERV)	amount of air that can be exhaled after a normal exhalation
inspiratory reserve volume (IRV)	amount of air that can be inhaled above a normal inspiration
total lung capacity (TLC)	total amount of air that can be contained in the lungs after maximum inhalation
inspiratory capacity (IC)	amount of air that can be inhaled after normal exhalation
vital capacity (VC)	amount of air that can be expelled from the lungs by maximum exhalation after maximum inhalation
functional residual capacity (FRC)	amount of air remaining in the lungs after normal exhalation
forced expiratory volume (FEV)	volume of gas exhaled with maximum force within a given interval of time; the time interval is shown as a subscript, such as FEV ₁ (one second) and FEV ₃ (three seconds)
forced vital capacity (FVC)	the volume of gas exhaled as rapidly and completely as possible after a complete inhalation

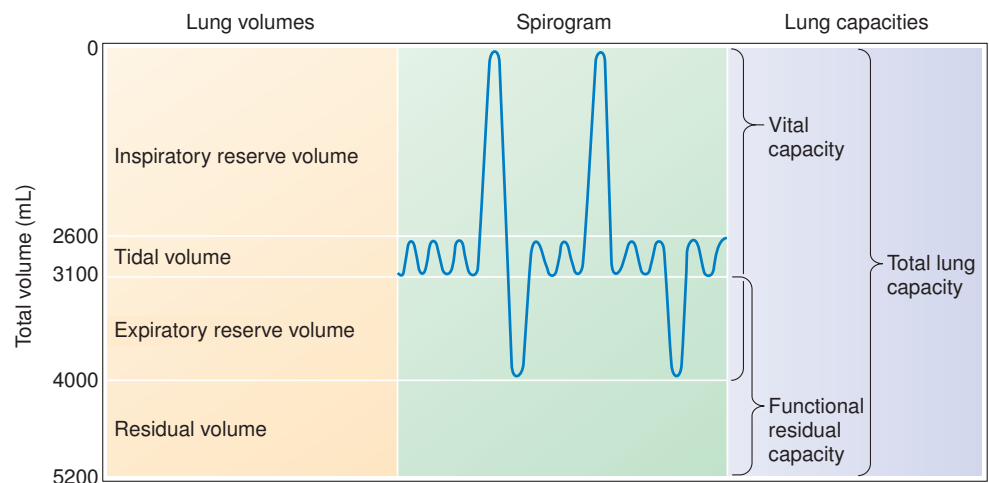


Figure 11-15 A spirogram. A spirometer produces a tracing of lung volumes and capacities (sums of volumes).

Box 11-5



Health Professions

Careers in Respiratory Therapy

Respiratory therapists and respiratory therapy technicians specialize in evaluating and treating breathing disorders. Respiratory therapists evaluate the severity of their patients' conditions by taking complete histories and testing respiratory function with specialized equipment. Based on their findings, and in consultation with a physician, therapists design and implement individualized treatment plans, which may include oxygen therapy and chest physiotherapy. They also educate patients on the use of ventilators and other medical devices. Respiratory therapy technicians assist in carrying out evaluations and treatments.

To perform their duties, both types of practitioners need a thorough scientific background. Most respiratory therapists in the United States receive their training from an accredited college or university and take a national licensing exam. Respiratory therapists and technicians work in a variety of settings, such as hospitals, nursing-care facilities, and private clinics. For additional information about careers in respiratory therapy, visit the American Association for Respiratory Care at www.aarc.org.

Terminology

Key Terms

Disorders

acidosis <i>as-i-DŌ-sis</i>	Abnormal acidity of body fluids. Respiratory acidosis is caused by abnormally high carbon dioxide levels
acute respiratory distress syndrome (ARDS)	Pulmonary edema that can lead rapidly to fatal respiratory failure; causes include trauma, aspiration into the lungs, viral pneumonia, and drug reactions; shock lung
acute rhinitis <i>rī-NĪ-tis</i>	Inflammation of the nasal mucosa with sneezing, tearing, and profuse secretion of watery mucus, as seen in the common cold
alkalosis <i>al-ka-LŌ-sis</i>	Abnormal alkalinity of body fluids. Respiratory alkalosis is caused by abnormally low carbon dioxide levels
aspiration <i>as-pi-RĀ-shun</i>	The accidental inhalation of food or other foreign material into the lungs. Also means the withdrawal of fluid from a cavity by suction
asthma <i>AZ-ma</i>	A disease characterized by dyspnea and wheezing caused by spasm of the bronchial tubes or swelling of their mucous membranes
atelectasis <i>at-e-LEK-ta-sis</i>	Incomplete expansion of a lung or part of a lung; lung collapse. May be present at birth (as in respiratory distress syndrome) or be caused by bronchial obstruction or compression of lung tissue (prefix <i>atello</i> means “imperfect”)
bronchiectasis <i>brong-kē-EK-ta-sis</i>	Chronic dilatation of a bronchus or bronchi
bronchitis <i>brong-KĪ-tis</i>	Inflammation of a bronchus
chronic obstructive pulmonary disease (COPD)	Any of a group of chronic, progressive, and debilitating respiratory diseases, which includes emphysema, asthma, bronchitis, and bronchiectasis
cyanosis <i>sī-a-NŌ-sis</i>	Bluish discoloration of the skin caused by lack of oxygen in the blood (adjective: cyanotic) (see Fig. 3-4)
cystic fibrosis (CF) <i>SIS-tik fī-BRŌ-sis</i>	An inherited disease that affects the pancreas, respiratory system, and sweat glands. Characterized by mucus accumulation in the bronchi causing obstruction and leading to infection
diphtheria <i>dif-THER-ē-a</i>	Acute infectious disease, usually limited to the upper respiratory tract, characterized by the formation of a surface pseudomembrane composed of cells and coagulated material

Terminology

Key Terms (Continued)

dyspnea <i>disp-NE-a</i>	Difficult or labored breathing, sometimes with pain; “air hunger”
emphysema <i>em-fi-SE-ma</i>	A chronic pulmonary disease characterized by enlargement and destruction of the alveoli
empyema <i>em-pī-Ē-ma</i>	Accumulation of pus in a body cavity, especially the pleural space; pyothorax
hemoptysis <i>hē-MOP-ti-sis</i>	The spitting of blood from the mouth or respiratory tract (<i>ptysis</i> means “spitting”)
hemothorax <i>hē-mō-THOR-aks</i>	Presence of blood in the pleural space
hydrothorax <i>hī-drō-THOR-aks</i>	Presence of fluid in the pleural space
hyperventilation <i>hī-per-ven-ti-LĀ-shun</i>	Increased rate and depth of breathing; increase in the amount of air entering the alveoli
hypoventilation <i>hī-pō-ven-ti-LĀ-shun</i>	Decreased rate and depth of breathing; decrease in the amount of air entering the alveoli
influenza <i>in-flū-EN-za</i>	An acute, contagious respiratory infection causing fever, chills, headache, and muscle pain; “flu”
pertussis <i>per-TUS-is</i>	An acute, infectious disease characterized by a cough ending in a whooping inspiration; whooping cough
pleural effusion <i>PLŪR-al e-FŪ-zhun</i>	Accumulation of fluid in the pleural space. The fluid may contain blood (hemothorax) or pus (pyothorax or empyema)
pleurisy <i>PLŪR-i-sē</i>	Inflammation of the pleura; pleuritis. A symptom of pleurisy is sharp pain on breathing
pneumoconiosis <i>nū-mō-kō-nē-Ō-sis</i>	Disease of the respiratory tract caused by inhalation of dust particles. Named more specifically by the type of dust inhaled, such as silicosis, anthracosis, asbestosis
pneumonia <i>nū-MŌ-nē-a</i>	Inflammation of the lungs generally caused by infection. May involve the bronchioles and alveoli (bronchopneumonia) or one or more lobes of the lung (lobar pneumonia)
pneumonitis <i>nū-mō-NĪ-tis</i>	Inflammation of the lungs; may be caused by infection, asthma, allergy, or inhalation of irritants
pneumothorax <i>nū-mō-THOR-aks</i>	Accumulation of air or gas in the pleural space. May result from injury or disease or may be produced artificially to collapse a lung
pyothorax <i>pī-ō-THOR-aks</i>	Accumulation of pus in the pleural space; empyema
respiratory distress syndrome (RDS)	A respiratory disorder that affects premature infants born without enough surfactant in the lungs. It is treated with respiratory support and surfactant administration
sudden infant death syndrome (SIDS)	The sudden and unexplained death of an apparently healthy infant; crib death
tuberculosis <i>tū-ber-kū-LŌ-sis</i>	An infectious disease caused by the tubercle bacillus, <i>Mycobacterium tuberculosis</i> . Often involves the lungs but may involve other parts of the body as well. Miliary (<i>MIL-ē-ar-ē</i>) tuberculosis is an acute generalized form of the disease with formation of minute tubercles that resemble millet seeds

(Continued)

Terminology**Key Terms** (Continued)**Diagnosis**

arterial blood gases (ABGs)	The concentrations of gases, specifically oxygen and carbon dioxide, in arterial blood. Reported as the partial pressure (P) of the gas in arterial (a) blood, such as PaO ₂ or PaCO ₂ . These measurements are important in measuring acid–base balance
bronchoscope <i>BRONG-kō-skōp</i>	An endoscope used to examine the tracheobronchial passageways. Also allows access for tissue biopsy or removal of a foreign object (see Fig. 7-7)
lung scan	Study based on the accumulation of radioactive isotopes in lung tissue. A <i>ventilation scan</i> measures ventilation after inhalation of radioactive material. A <i>perfusion scan</i> measures blood supply to the lungs after injection of radioactive material. Also called a pulmonary scintiscan
pulse oximetry <i>ok-SIM-e-trē</i>	Determination of the oxygen saturation of arterial blood by means of a photoelectric apparatus (oximeter), usually placed on the finger or the ear; reported as SpO ₂ in percent (see Fig. 11-14)
pulmonary function tests	Tests done to assess breathing, usually by spirometry
spirometer <i>spī-ROM-e-ter</i>	An apparatus used to measure breathing volumes and capacities; record of test is a spirogram (see Fig. 11-15)
thoracentesis <i>thor-a-sen-TĒ-sis</i>	Surgical puncture of the chest for removal of air or fluids, such as may accumulate after surgery or as a result of injury, infection, or cardiovascular problems. Also called thoracocentesis (see Fig. 11-13)
tuberculin test <i>tū-BER-kū-lin</i>	A skin test for tuberculosis. Tuberculin (PPD), the test material made from products of the tuberculosis organism, is injected below the skin. A hard, raised lump appearing within 48 to 72 hours indicates an active or inactive TB infection. Also called the Mantoux (<i>man-TOO</i>) test

Terminology**Supplementary Terms****Normal Structure and Function**

carina <i>ka-RĪ-na</i>	A projection of the lowest tracheal cartilage that forms a ridge between the two bronchi. Used as a landmark for endoscopy. Any ridge or ridge-like structure (from a Latin word that means “keel”)
hilum <i>HĪ-lum</i>	An anatomic depression in an organ where vessels and nerves enter
nares <i>NĀ-rēz</i>	The external openings of the nose; the nostrils (singular: naris)
nasal septum	The partition that divides the nasal cavity into two parts (root <i>sept/o</i> means “septum”)

Symptoms and Conditions

anoxia <i>an-OK-sē-a</i>	Lack or absence of oxygen in the tissues; often used incorrectly to mean hypoxia
asphyxia <i>as-FIK-sē-a</i>	Condition caused by inadequate intake of oxygen; suffocation (literally “lack of pulse”)
Biot respirations <i>bē-Ō</i>	Deep, fast breathing interrupted by sudden pauses; seen in spinal meningitis and other central nervous system disorders

Terminology**Supplementary Terms** *(Continued)*

bronchospasm <i>BRONG-kō-spazm</i>	Narrowing of the bronchi caused by smooth muscle spasms; common in cases of asthma and bronchitis
Cheyne-Stokes respiration <i>chān stōks</i>	A repeating cycle of gradually increased and then decreased respiration followed by a period of apnea; caused by depression of the breathing centers in the brainstem; seen in cases of coma and in terminally ill patients
cor pulmonale <i>kor pul-mō-NĀ-lē</i>	Enlargement of the heart's right ventricle caused by disease of the lungs or pulmonary blood vessels
coryza <i>kō-RĪ-za</i>	Acute inflammation of the nasal passages with profuse nasal discharge; acute rhinitis
croup <i>krūp</i>	A childhood disease usually caused by a viral infection that involves upper airway inflammation and obstruction. Croup is characterized by a barking cough, difficulty breathing, and laryngeal spasm
deviated septum	A shifted nasal septum; may require surgical correction
epiglottitis <i>ep-i-glo-TĪ-tis</i>	Inflammation of the epiglottis that may lead to upper airway obstruction. Commonly seen in croup (also spelled epiglottiditis)
epistaxis <i>ep-i-STAK-sis</i>	Hemorrhage from the nose; nosebleed (Greek <i>-staxis</i> means “dripping”)
fremitus <i>FREM-i-tus</i>	A vibration, especially as felt through the chest wall on palpation
Kussmaul respiration <i>KOOS-mawl</i>	Rapid and deep gasping respiration without pause; characteristic of severe acidosis
pleural friction rub	A sound heard on auscultation that is produced by the rubbing together of the two pleural layers; a common sign of pleurisy
rales <i>rahlz</i>	Abnormal chest sounds heard when air enters small airways or alveoli containing fluid; usually heard during inspiration; singular: rale (<i>rahl</i>). Also called crackles
rhonchi <i>RONG-kī</i>	Abnormal chest sounds produced in airways with accumulated fluids; more noticeable during expiration (singular: rhonchus)
stridor <i>STRĪ-dor</i>	A harsh, high-pitched sound caused by obstruction of an upper air passageway
tussis <i>TUS-is</i>	A cough. An antitussive drug is one that relieves or prevents coughing
wheeze	A whistling or sighing sound caused by narrowing of a respiratory passageway
Disorders	
byssinosis <i>bis-i-NŌ-sis</i>	Obstructive airway disease caused by reaction to the dust in unprocessed plant fibers
sleep apnea <i>AP-nē-a</i>	Intermittent periods of breathing cessation during sleep. Central sleep apnea arises from failure of the brainstem to stimulate breathing. Obstructive sleep apnea results from airway obstruction during deep sleep, as from obesity or enlarged tonsils
small cell carcinoma	A highly malignant type of bronchial tumor involving small, undifferentiated cells; “oat cell” carcinoma

(Continued)

Terminology Supplementary Terms *(Continued)*

Diagnosis

mediastinoscopy <i>mē-dē-as-ti-NOS-kō-pē</i>	Examination of the mediastinum by means of an endoscope inserted through an incision above the sternum
plethysmograph <i>ple-THIZ-mō-graf</i>	An instrument that measures changes in gas volume and pressure during respiration
pneumotachometer <i>nū-mō-tak-OM-e-ter</i>	A device for measuring air flow
thoracoscopy <i>thor-a-KOS-kō-pē</i>	Examination of the pleural cavity through an endoscope; pleuroscopy

Treatment

aerosol therapy	Treatment by inhalation of a drug or water in spray form
continuous positive airway pressure (CPAP)	Use of a mechanical respirator to maintain pressure throughout the respiratory cycle in a patient who is breathing spontaneously
extubation	Removal of a previously inserted tube
intermittent positive pressure breathing (IPPB)	Use of a ventilator to inflate the lungs at intervals under positive pressure during inhalation
intermittent positive pressure ventilation (IPPV)	Use of a mechanical ventilator to force air into the lungs while allowing for passive exhalation
nasal cannula <i>KAN-ū-la</i>	A two-pronged plastic device inserted into the nostrils for delivery of oxygen (Fig. 11-16)
orthopneic position <i>or-thop-NE-ik</i>	An upright or semiupright position that aids breathing
positive end-expiratory pressure (PEEP)	Use of a mechanical ventilator to increase the volume of gas in the lungs at the end of exhalation, thus improving gas exchange
postural drainage <i>POS-tū-ral</i>	Use of body position to drain secretions from the lungs by gravity. The patient is placed so that secretions will move passively into the larger airways for elimination
thoracic gas volume (TGV, V_{TG})	The volume of gas in the thoracic cavity calculated from measurements made with a body plethysmograph

Surgery

adenoidectomy <i>ad-e-noyd-EK-tō-mē</i>	Surgical removal of the adenoids
intubation <i>in-tū-BĀ-shun</i>	Insertion of a tube into a hollow organ, such as into the larynx or trachea for entrance of air (Fig. 11-17). Patients may be intubated during surgery for administration of anesthesia or to maintain an airway. Endotracheal intubation may be used as an emergency measure when airways are blocked
lobectomy <i>lō-BEK-tō-mē</i>	Surgical removal of a lobe of the lung or of another organ
pneumoplasty <i>NŪ-mō-plas-tē</i>	Plastic surgery of the lung. In reduction pneumoplasty, nonfunctional portions of the lung are removed, as in cases of advanced emphysema
tracheotomy <i>trā-kē-OT-ō-mē</i>	Incision of the trachea through the neck, usually to establish an airway in cases of tracheal obstruction
tracheostomy <i>trā-kē-OS-tō-mē</i>	Surgical creation of an opening into the trachea to form an airway or to prepare for the insertion of a tube for ventilation (Fig. 11-18); also the opening thus created

Terminology Supplementary Terms *(Continued)*

Drugs

antihistamine <i>an-ti-HIS-ta-mēn</i>	Agent that prevents responses mediated by histamine, such as allergic and inflammatory reactions
antitussive <i>an-ti-TUS-iv</i>	Drug that prevents or relieves coughing
asthma maintenance drug	Agent used to prevent asthma attacks and for chronic treatment of asthma
bronchodilator <i>brong-kō-DĪ-lā-tor</i>	Drug that relieves bronchial spasm and widens the bronchi
corticosteroid <i>kor-ti-kō-STĒR-oyd</i>	Hormone from the adrenal cortex; used to reduce inflammation
decongestant <i>dē-kon-JES-tant</i>	Agent that reduces congestion or swelling
expectorant <i>ek-SPEK-tō-rant</i>	Agent that aids in removal of bronchopulmonary secretions
isoniazid (INH) <i>ī-sō-NĪ-a-zid</i>	Drug used to treat tuberculosis
leukotriene antagonist <i>lū-kō-TRĪ-ēn</i>	Drug that prevents or reduces inflammation by inhibiting leukotrienes, substances made in white blood cells that promote inflammation; they also constrict the bronchi and increase mucus production; used in asthma treatment
mucolytic <i>mū-kō-LIT-ik</i>	Agent that loosens mucus to aid in its removal
rifampin (rifampicin) <i>(RIF-am-pin)</i>	Drug used to treat tuberculosis

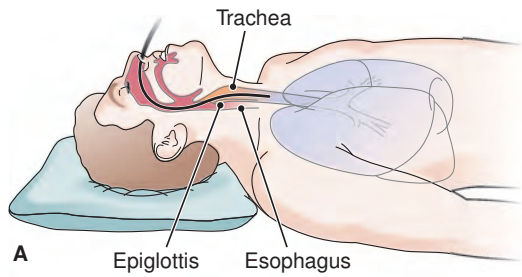


Go to the Audio Pronunciation Glossary in the Student Resources on thePoint to hear these terms pronounced.



Figure 11-16 A nasal cannula.

Intranasal intubation



Oral intubation

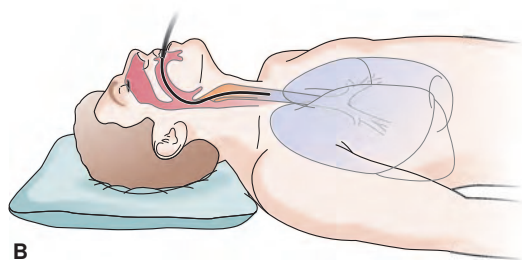


Figure 11-17 Endotracheal intubation. A. Nasal endotracheal catheter in proper position. B. Oral endotracheal intubation.

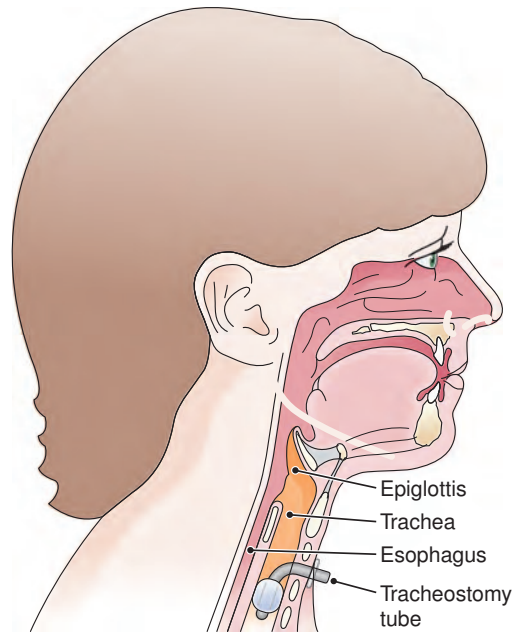


Figure 11-18 A tracheostomy tube in place.

Terminology

Abbreviations

ABG(s)	Arterial blood gas(es)
AFB	Acid-fast bacillus (usually <i>Mycobacterium tuberculosis</i>)
ARDS	Acute respiratory distress syndrome; shock lung
ARF	Acute respiratory failure
BCG	Bacillus Calmette-Guérin (tuberculosis vaccine)
BS	Breath sounds
C	Compliance
CF	Cystic fibrosis
CO₂	Carbon dioxide
COLD	Chronic obstructive lung disease
COPD	Chronic obstructive pulmonary disease
CPAP	Continuous positive airway pressure
CXR	Chest radiograph, chest x-ray
DTaP	Diphtheria, tetanus, pertussis (vaccine)
ERV	Expiratory reserve volume
FEV	Forced expiratory volume

FRC	Functional residual capacity
FVC	Forced vital capacity
HPS	<i>Hantavirus</i> pulmonary syndrome
IC	Inspiratory capacity
IGRA	Interferon-gamma release assay (test for TB)
INH	Isoniazid
IPPB	Intermittent positive pressure breathing
IPPV	Intermittent positive pressure ventilation
IRV	Inspiratory reserve volume
LLL	Left lower lobe (of lung)
LUL	Left upper lobe (of lung)
MEFR	Maximal expiratory flow rate
MMFR	Maximum midexpiratory flow rate
NAA	Nucleic acid amplification (test) (for TB)
O₂	Oxygen
PaCO₂	Arterial partial pressure of carbon dioxide
PaO₂	Arterial partial pressure of oxygen
PCP	<i>Pneumocystis</i> pneumonia

Terminology Abbreviations *(Continued)*

PEEP	Positive end-expiratory pressure	RV	Residual volume
PEFR	Peak expiratory flow rate	SARS	Severe acute respiratory syndrome
PFT	Pulmonary function test(s)	SIDS	Sudden infant death syndrome
PIP	Peak inspiratory pressure	SpO₂	Oxygen percent saturation
PND	Paroxysmal nocturnal dyspnea	T & A	Tonsils and adenoids; tonsillectomy and adenoidectomy
PPD	Purified protein derivative (tuberculin)	TB	Tuberculosis
R	Respiration	TGV	Thoracic gas volume
RDS	Respiratory distress syndrome	TLC	Total lung capacity
RLL	Right lower lobe (of lung)	TV	Tidal volume
RML	Right middle lobe (of lung)	URI	Upper respiratory infection
RSV	Respiratory syncytial virus	VC	Vital capacity
RUL	Right upper lobe (of lung)	V_{TG}	Thoracic gas volume

A.D.'s Follow-Up to Surgery

A.D.'s surgery went well and there were no complications. The anesthesiologist closely monitored her respiratory status to make certain it was not compromised. He administered additional medications to maintain optimal airflow.

Postoperatively, A.D.'s asthma was kept under control. The postoperative spirometry was adequate. Her discharge instructions were to resume preoperative medications and to follow up with her pulmonologist if there were any problems.

Chapter Review

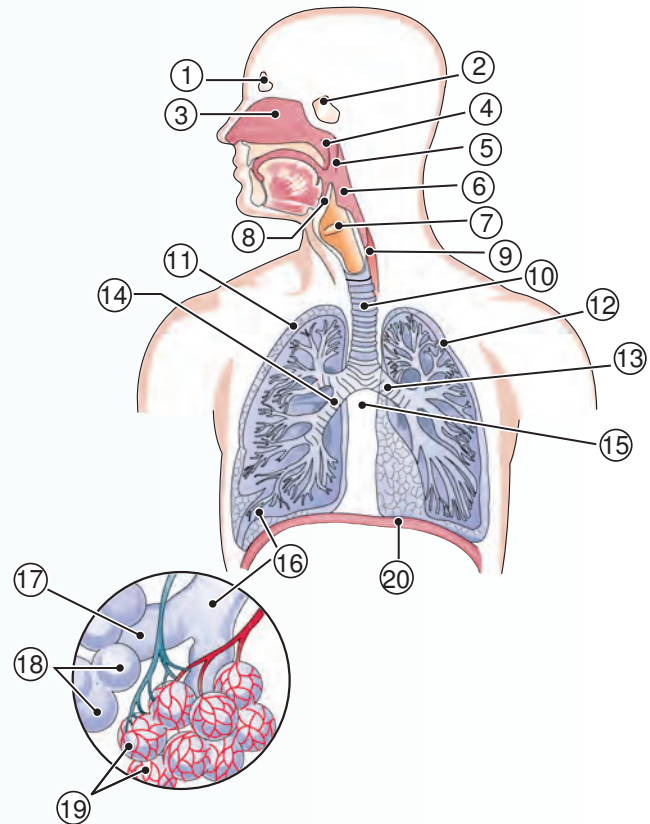
Labeling Exercise

THE RESPIRATORY SYSTEM

Write the name of each numbered part on the corresponding line of the answer sheet.

Alveolar duct	Left lung
Alveoli	Mediastinum
Capillaries	Nasal cavity
Diaphragm	Nasopharynx
Epiglottis	Oropharynx
Esophagus	Right bronchus
Frontal sinus	Right lung
Laryngopharynx	Sphenoidal sinus
Larynx and vocal cords	Terminal bronchiole
Left bronchus	Trachea

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____



Terminology

MATCHING

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|------------------------|---|
| _____ 1. compliance | a. accidental inhalation of foreign material into the lungs |
| _____ 2. surfactant | b. space between the lungs |
| _____ 3. sputum | c. substance that reduces surface tension |
| _____ 4. aspiration | d. a measure of how easily the lungs expand |
| _____ 5. mediastinum | e. expectoration |
| _____ 6. atelectasis | a. pulmonary disease with destruction of alveoli |
| _____ 7. emphysema | b. increased carbon dioxide in the blood |
| _____ 8. hypercapnemia | c. decreased rate and depth of breathing |
| _____ 9. hypopnea | d. whooping cough |
| _____ 10. pertussis | e. incomplete expansion of lung tissue |
| _____ 11. CF | a. virus that causes respiratory disease in young children |
| _____ 12. RSV | b. tuberculosis vaccine |
| _____ 13. PCP | c. hereditary disease that affects respiration |
| _____ 14. DTaP | d. pneumonia seen in compromised patients |
| _____ 15. BCG | e. childhood vaccine |

Supplementary Terms

- | | |
|----------------------------|--|
| _____ 16. stridor | a. suffocation |
| _____ 17. hilum | b. nosebleed |
| _____ 18. asphyxia | c. anatomic depression in an organ |
| _____ 19. epistaxis | d. harsh, high-pitched respiratory sound |
| _____ 20. expectorant | e. agent that helps remove bronchial secretions |
| _____ 21. coryza | a. irregular respiration seen in terminally ill patients |
| _____ 22. Cheyne-Stokes | b. device used to measure air flow |
| _____ 23. rales | c. acute rhinitis |
| _____ 24. pneumotachometer | d. pertaining to an upright position |
| _____ 25. orthopneic | e. abnormal chest sounds |

FILL IN THE BLANKS

26. The turbinate bones contain receptors for the sense of _____.
27. The gas produced in the tissues and exhaled in respiration is _____.
28. The phrenic nerve activates the _____.
29. The double membrane that covers the lungs and lines the thoracic cavity is the _____.
30. The small air sacs in the lungs through which gases are exchanged between the atmosphere and the blood are the _____.
31. The trachea divides into a right and a left primary _____.
32. A pneumotropic virus is one that invades the _____.
33. The term *acid-fast bacillus* (AFB) is commonly applied to the organism that causes _____.

34. The apparatus used to measure A.D.'s breathing volumes in the opening case study is called a(n) _____.

35. The amount of air that A.D. could expel from her lungs by maximum exhalation after maximum inhalation is termed the _____.

Supplementary Terms

36. A mucolytic agent dissolves _____.

37. An antitussive agent prevents _____.

38. The partition between the two portions of the nasal cavity is the nasal _____.

39. Intermittent periods of not breathing during sleep are termed sleep _____.

40. A.D. was given a drug to widen the bronchi. This type of drug is called a(n) _____.

TRUE-FALSE

Examine the following statements. If the statement is true, write T in the first blank. If the statement is false, write F in the first blank and correct the statement by replacing the underlined word in the second blank.

	True or False	Correct Answer
41. The pharynx is the <u>throat</u> .	_____	_____
42. The diaphragm flattens during <u>inhalation</u> .	_____	_____
43. The vocal cords are located in the <u>pharynx</u> .	_____	_____
44. The right lung has <u>two</u> lobes.	_____	_____
45. The opening between the vocal cords is the <u>glottis</u> .	_____	_____
46. The adenoids are in the <u>nasopharynx</u> .	_____	_____

DEFINITIONS

Write words for the following definitions:

47. incision of the phrenic nerve	_____
48. hernia of the pleura	_____
49. inflammation of the throat	_____
50. inflammation of the bronchioles	_____
51. creation of an opening into the trachea	_____

The word *thorax* (chest) is used as an ending in compound words that mean the accumulation of substances in the pleural space. Define the following terms:

52. pneumothorax _____	accumulation of air or gas in the pleural space
53. hemothorax _____	
54. pyothorax _____	
55. hydrothorax _____	

Define the following words:

56. bronchostenosis _____	
57. pleurodynia _____	

58. hypoxia _____
59. pneumonopathy _____
60. tachypnea _____
61. bronchiectasis _____
62. rhinoplasty _____
63. pharyngoxerosis _____

Identify and define the root in the following words:

	Root	Meaning of Root
64. respiration	_____	_____
65. pulmonologist	_____	_____
66. empyema	_____	_____
67. subphrenic	_____	_____
68. pneumatic	_____	_____

OPPOSITES

Write a word that means the opposite of the following:

69. intrapulmonary _____
70. hypocapnia _____
71. inspiration _____
72. tachypnea _____
73. extubation _____

ADJECTIVES

Write the adjective form of the following words:

74. pharynx _____
75. alveolus _____
76. nose _____
77. trachea _____
78. pleura _____
79. bronchus _____

PLURALS

Write the plural form of the following words:

80. naris _____
81. pleura _____
82. alveolus _____
83. concha _____
84. bronchus _____

ELIMINATIONS

In each of the sets below, underline the word that does not fit in with the rest and explain the reason for your choice:

85. turbinates — septum — nares — tonsil — conchae

86. sinus — thyroid cartilage — epiglottis — cricoid cartilage — vocal cords

87. diphtheria — tuberculosis — asthma — common cold — influenza

88. RUL — URI — LUL — LLL — RML

89. TLC — FRC — FEV — TV — RDS

WORD BUILDING

Write words for the following definitions using the word parts given.

-pnea -ia ox/i -metry phon/o hyper- dys- capn/o hypo- eu-

90. measurement of oxygen levels

91. normal, regular breathing

92. a low or weak voice

93. increased rate and depth of breathing

94. normal carbon dioxide levels

95. difficulty in breathing

96. low levels of oxygen in the tissues

97. difficulty in speaking

98. excess levels of carbon dioxide

99. excessive voice production

WORD ANALYSIS

Define the following words and give the meaning of the word parts in each. Use a dictionary if necessary.

100. pneumotachometer (*nū-mō-tak-OM-e-ter*)

a. pneum/o

b. tach/o

c. -meter

101. atelectasis (*at-e-LEK-ta-sis*)

a. atel/o-

b. -ectasis

102. pneumatocardia (*nū-ma-tō-KAR-dē-a*) _____
- a. pneumat/o _____
 - b. cardi _____
 - c. -ia _____
103. pneumoconiosis (*nū-mō-kō-nē-Ō-sis*) _____
- a. pneum/o _____
 - b. conio/o _____
 - c. -sis _____



For more learning activities, see Chapter 11 of the Student Resources on *thePoint*.

Additional Case Studies

Case Study 11-1: Giant Cell Sarcoma of the Lung

L.E., a 68-YO man, was admitted to the pulmonary unit with chest pain on inspiration, dyspnea, and diaphoresis. He had smoked one and a half packs of cigarettes per day for 52 years and had quit three months ago. L.E. was retired from the advertising industry and admitted to occasional alcohol use. He was treated for primary giant cell sarcoma of the left lung three years ago with a lobectomy of the left lung followed by radiation and chemotherapy.

Physical examination was unremarkable except for a thoracotomy scar in the left hemithorax, decreased breath sounds, and dullness to percussion of the left base. There was no hemoptysis. Chest and upper abdomen CT scan showed findings compatible with recurrent sarcoma of the left hemithorax. Abnormal mediastinal nodes were evident. A thoracentesis was attempted but did not yield fluid. L.E. was scheduled for a left thoracoscopy, mediastinoscopy, and biopsy.

Case Study 11-2: Terminal Dyspnea

N.A., a 76-YO woman, was in the ICU in the terminal stage of multisystem organ failure. She had been admitted to the hospital for bacterial pneumonia, which had not resolved with antibiotic therapy. She had a 20-year history of COPD. She was not conscious and was unable to breathe on her own. Her ABGs were abnormal, and she was diagnosed with refractory ARDS. The decision was made to support her breathing with endotracheal intubation and mechanical ventilation. After one week and several unsuccessful attempts to wean her from the ventilator, the pulmonologist suggested a permanent tracheostomy and discussed with the family the options of continuing or withdrawing life support. Her

physiologic status met the criteria of remote or no chance for recovery.

N.A.'s family discussed her condition and decided not to pursue aggressive life-sustaining therapies. N.A. was assigned DNR status. After the written orders were read and signed by the family, the endotracheal tube, feeding tube, pulse oximeter, and ECG electrodes were removed, and a morphine IV drip was started with prn boluses ordered to promote comfort and relieve pain. The family sat with her for many hours, providing comfort and support. After a while, they noticed that her breathing had become shallow with Cheyne-Stokes respirations. N.A. died quietly in the presence of her family and the hospital chaplain.

Case Study Questions

Multiple choice. Select the best answer and write the letter of your choice to the left of each number:

_____ 1. The root *pulmon*, as in *pulmonary*, means:

- a. chest
- b. air
- c. lung
- d. breath sound
- e. blood vessel

_____ 2. Hemoptysis is:

- a. drooping eyelids
- b. discoloration of skin
- c. blue nail beds
- d. spitting of blood
- e. acute leukemia

_____ 3. Dyspnea could NOT be described as:

- a. difficulty breathing
- b. eupnea
- c. air hunger
- d. orthopnea
- e. Cheyne-Stokes respirations

_____ 4. Pulse oximetry is used to measure:

- a. forced expiratory volume
- b. tidal volume
- c. end-tidal CO₂
- d. oxygen saturation of blood
- e. positive end-expiratory pressure

_____ 5. An endotracheal tube is placed:

- a. under the trachea
- b. beyond the carina
- c. within the bronchus
- d. around the airway
- e. within the trachea

Write words from the case histories with the following meanings:

6. Removal of a lobe

7. Profuse sweating

8. Surgical incision of the chest

9. Endoscopic examination of the chest cavity

10. Half of the chest

11. Endoscopic examination of the space between the lungs

12. Movement of air into and out of the lungs

Abbreviations. Define the following abbreviations:

13. COPD _____

14. ABG _____

15. ARDS _____

16. DNR _____

CHAPTER 12

The Digestive System

Case Study

B.F.'s Gastroesophageal Reflux Disease (GERD) and Erosive Esophagitis

Chief complaint:

B.F. is a 51-year-old African American businessman with complaints of epigastric pain. He has a 10-year history of heartburn that he notes has become worse over the last year. The heartburn occurs both after meals and at bedtime. His sleep has been interrupted by nighttime symptoms, and he feels generally fatigued. Intermittently he says he feels that things come back up into his throat, but he lacks clear signs of aspiration. He is aware that gastroesophageal reflux disease (GERD) is a chronic condition and may be associated with a risk for complications that include serious morbidity and mortality. Due to his required travel for business, he has put off making a doctor's appointment but realizes he needs to see his physician. The heartburn has increased in frequency (daily now) and severity, so he finally schedules an office visit.

Examination:

B.F. is seen by his primary care physician and describes his daily episodes of discomfort. B.F. is 6-foot-1 and weighs 230 pounds. The physician reviews a colonoscopy from last year with him that was normal. His blood pressure and other physical examination findings at this visit are within normal ranges. Results of a complete blood count, chemistry profile, and lipid profile are all within normal limits. He describes his self-medication by taking over-the-counter (OTC) drugs including antacids, histamine-2 receptor antagonists (H2 blockers), and the OTC proton pump inhibitor (PPI) omeprazole. The latter he notes helped "a little bit," but he discontinued use after two weeks, as noted in the packaging instructions. He has no history of smoking or alcohol abuse. He has an unremarkable past medical and family history.

Clinical course:

The physician explained to B.F. that he is experiencing classic esophageal symptoms that are highly specific to GERD, heartburn, and regurgitation. The physician also informed him that GERD might be associated with erosive esophagitis, which is best diagnosed on endoscopy via esophago-gastroduodenoscopy (EGD). Because B.F. is 51 and has been experiencing heartburn for more than 10 years with daily symptoms for the past year, he should be evaluated by endoscopy. He is referred for the procedure, but the appointment is not for seven weeks. He is prescribed a PPI and is instructed to return to the office in approximately four weeks while still on therapy for assessment of symptoms prior to his appointment.





Ancillaries *At-A-Glance*

Visit *thePoint* to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii–xvi.

Learning TOOLS

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning RESOURCES

- E-book: Chapter 12
- Web Figure: The Peritoneum
- Web Figure: The Salivary Glands and Ducts
- Web Figure: Pyloric Stenosis
- Web Figure: Complications of Ulcerative Colitis
- Web Figure: Diverticulosis and Diverticulitis
- Web Figure: Clinical Features of Cirrhosis
- Web Figure: Portal Hypertension
- Web Figure: Gallstones
- Animation: Enzymes
- Animation: Digestion
- Animation: The Liver in Health and Disease
- Audio Pronunciation Glossary

Learning ACTIVITIES

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After study of this chapter you should be able to:

- 1** Describe the organs of the digestive tract and give the function of each. *p282*
- 2** Describe the accessory organs and explain the role of each in digestion. *p286*
- 3** Identify and use the roots pertaining to the digestive system and accessory organs. *p289*
- 4** Describe the major disorders of the digestive system. *p293*
- 5** Define medical terms used in reference to the digestive system. *p299*
- 6** Interpret abbreviations used in referring to the gastrointestinal system. *p307*
- 7** Analyze the medical terms in case studies related to the digestive system. *pp280, 313*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|---|---|
| <p>_____ 1. An organic catalyst is a(n):
 a. sugar
 b. nucleic acid
 c. saliva
 d. enzyme</p> <p>_____ 2. The organ that carries food from the pharynx to the stomach is the:
 a. trachea
 b. larynx
 c. esophagus
 d. intestine</p> <p>_____ 3. The word root for the stomach is:
 a. gastr/o
 b. hepat/o
 c. ren/o
 d. cardi/o</p> <p>_____ 4. The word root <i>enter/o</i> refers to the:
 a. intestine
 b. heart
 c. kidney
 d. gallbladder</p> | <p>_____ 5. The wave-like action that moves substances through an organ is called:
 a. pulmonary
 b. peristalsis
 c. parotid
 d. mastication</p> <p>_____ 6. The process of moving digested nutrients from the intestine into the circulation is called:
 a. digestion
 b. egestion
 c. absorption
 d. lymphedema</p> <p>_____ 7. The organ that secretes bile is the:
 a. kidney
 b. spleen
 c. liver
 d. stomach</p> <p>_____ 8. Cholecystitis is inflammation of the:
 a. gallbladder
 b. throat
 c. diaphragm
 d. small intestine</p> |
|---|---|

The function of the digestive system is to prepare food for intake by body cells. Nutrients must be broken down by mechanical and chemical means into molecules that are small enough to be absorbed into circulation. Within cells, the nutrients are used for energy and for rebuilding vital cell components.

Digestion

Digestion takes place in the digestive tract proper, which extends from the **mouth** to the **anus** (**Fig. 12-1**). Peristalsis, wave-like contractions of the organ walls, moves food through the digestive tract and also moves undigested waste material out of the body. Also contributing to digestion are several accessory organs that release secretions into the digestive tract.

Enzymes are needed throughout the digestive process. These compounds are organic catalysts that speed the rate of food's chemical breakdown. The names of most enzymes can be recognized by the ending *-ase*.

The Digestive Tract

The digestive tract, also known as the alimentary canal or gastrointestinal (GI) tract, is essentially a long tube modified into separate organs with special functions (**see Fig. 12-1**). For Your Reference **Box 12-1** summarizes the activities of the digestive organs described below. A large serous membrane, the **peritoneum** (*per-i-tō-NE-um*), covers the organs in the abdominal cavity, supporting and separating them.



See the animations "Enzymes" and "Digestion" and a figure on the peritoneum in the Student Resources on thePoint.

THE MOUTH TO THE STOMACH

Digestion begins in the mouth (**Fig. 12-2**), also called the oral cavity. Here food is chewed into small bits by the teeth. There are 32 teeth in a complete adult set, including

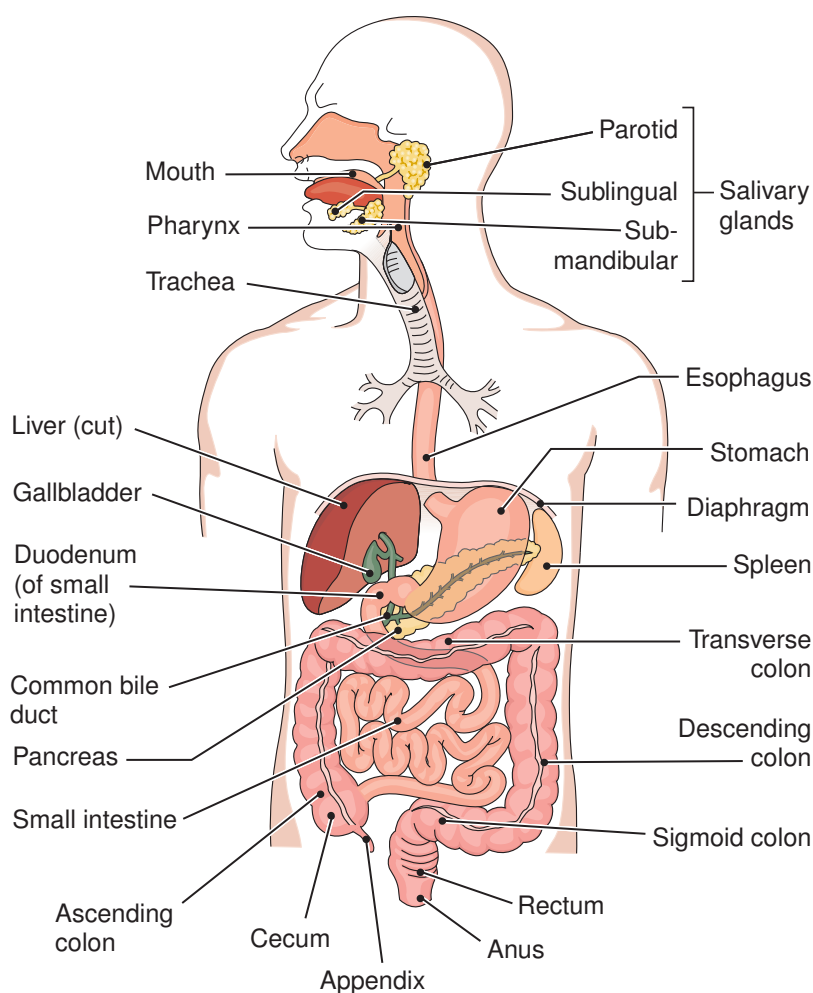


Figure 12-1 Digestive system. Some divisions of the small and large intestine are shown. The accessory organs are the salivary glands, liver, gallbladder, and pancreas. The trachea, diaphragm, and spleen are shown for reference.

Box 12-1

For Your Reference

Organs of the Digestive Tract

ORGAN	DIGESTIVE ACTIONS
Mouth	Used to bite and chew food. Mixes food with saliva, which contains salivary amylase, an enzyme that begins the digestion of starch. Shapes food into small portions, which the tongue pushes into the pharynx
Pharynx	Swallows food by reflex action and moves it into the esophagus
Esophagus	Moves food into the stomach by peristalsis
Stomach	Stores food; churns to mix food with water and digestive juices. Secretes protein-digesting hydrochloric acid (HCl) and the enzyme pepsin
Small intestine	Secretes enzymes. Receives secretions from the accessory organs, which digest and neutralize food. Site of most digestion and absorption of nutrients into the circulation
Large intestine	Forms, stores, and eliminates undigested waste material

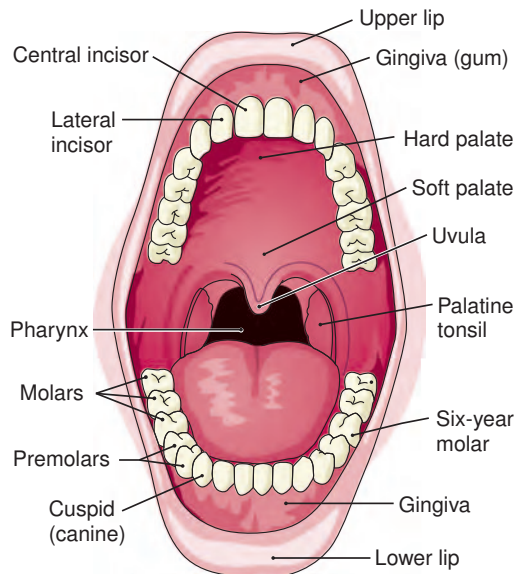


Figure 12-2 The mouth. The teeth, pharynx, tonsils, and other structures in the oral cavity are shown.

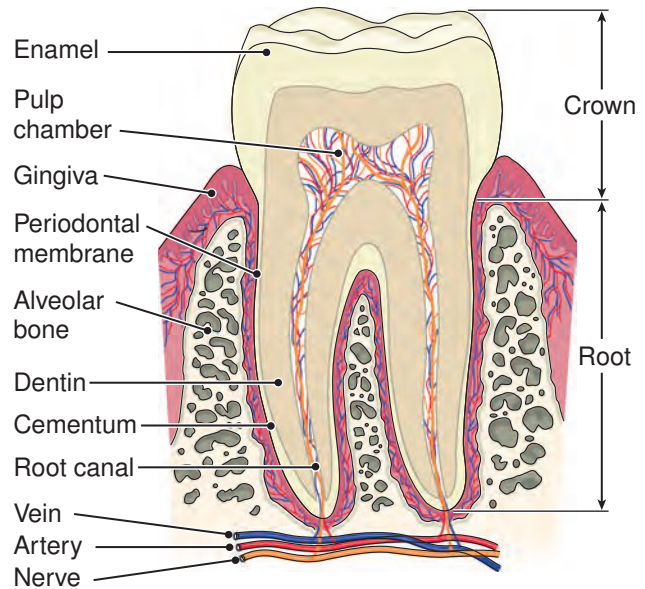


Figure 12-3 A molar tooth. The bony socket, gingiva, blood vessels, and nerve supply are shown as well as portions of the tooth.

incisors and canines to bite food and molars for grinding. The structural features of a molar tooth and its surrounding tissue are shown in [Figure 12-3](#). The **palate** is the roof of the mouth; the anterior portion (hard palate) is formed by bone, and the posterior part (soft palate) is made of soft tissue. The fleshy **uvula**, used in speech production, hangs from the soft palate. Dental hygienists help in care of the mouth and teeth. [Box 12-2](#) has information on careers in dental hygiene.

In the process of chewing, or **mastication**, the tongue, lips, cheeks, and palate also help to break up food and mix it with **saliva**, a secretion that moistens the food and begins starch digestion. The salivary glands ([see Fig. 12-1](#)) secrete saliva into the mouth and are considered to be accessory digestive organs.



For a more detailed picture of the salivary glands and ducts, visit the Student Resources on thePoint.

Portions of moistened food are moved toward the **pharynx** (throat), where swallowing reflexes push them into the **esophagus**. Peristalsis moves the food through the esophagus and into the **stomach**. At its distal end, where it joins the stomach, the esophagus has muscle tissue that contracts to keep stomach contents from refluxing (flowing backward). This **lower esophageal sphincter (LES)** is also called the “cardiac sphincter” because it lies above the cardia of the stomach, the region around its upper opening.

In the stomach, food is further broken down as it is churned and mixed with secretions containing the enzyme pepsin and powerful hydrochloric acid (HCl), both of which break down proteins. The partially digested food then passes through the stomach’s lower portion, the **pylorus**, into the **intestine**.

THE SMALL INTESTINE

Food leaving the stomach enters the **duodenum**, the first portion of the **small intestine**. As the food continues through the **jejunum** and **ileum**, the small intestine’s remaining sections, digestion is completed. (Ileum sounds like ilium, a large bone of the pelvis. For information on these and other homonyms, [see Box 12-3](#).) The digestive substances active in the small intestine include enzymes from the intestine itself and products from accessory organs that secrete into the duodenum.

The digested nutrients, including water, minerals, and vitamins, are absorbed into the circulation, aided by small projections in the intestinal lining called **villi** ([Fig. 12-4](#)). Each villus has blood capillaries to absorb nutrients into the bloodstream and lymphatic capillaries, or **lacteals**, to absorb small molecules of digested fats into the lymph. These fats join the blood when lymph flows into the bloodstream near the heart.

THE LARGE INTESTINE

Any food that has not been digested, along with water and digestive juices, passes into the **large intestine**. This part of the digestive tract begins in the lower right region

Box 12-2



Health Professions

Dental Hygienist

Dental hygienists focus primarily on dental health maintenance and preventive dental care. They examine patients' dentition and periodontium (supporting structures of the teeth); take radiographic images; and perform oral prophylaxis using hand and ultrasonic instruments to remove deposits, such as calculus, stains, and plaque. They may also apply fluorides to prevent caries. They work independently or along with a dentist to administer local anesthesia and nitrous oxide sedation and to do oral screenings, polish restorations, remove sutures, apply dental sealants, and perform periodontal procedures. Dental hygienists must be knowledgeable about safety concerning x-ray equipment, anesthesia, and infectious diseases. They wear safety glasses, surgical masks, and gloves to protect themselves and their patients. A major component of the dental hygienist's work is patient education for maintenance of good oral health. They may give instruction on nutrition and proper oral care, such as brushing, flossing, and the use of antimicrobial rinses.

Most dental hygiene programs award an associate degree; some offer bachelor's or master's degrees. The higher

degrees are required for research, teaching, or practice in public or school health facilities. The professional program requires one year of college-level prerequisite courses. The curriculum includes courses in radiography, dental anatomy, pharmacology, head and neck anatomy, and other health- and dental-related sciences. Additional material on the legal and ethical aspects of dental hygiene practice and extensive clinical training are included in the program. After graduation, dental hygienists must be licensed in their states by passing clinical and written examinations administered by the American Dental Association's (ADA) Joint Commission on National Dental Examinations.

Almost all hygienists work in dental offices. One advantage of this field is scheduling flexibility and the opportunity for part-time work. Job prospects are good; dental hygiene is among the fastest growing occupations. Benefits vary with place of employment. For additional information, contact the American Dental Hygienists' Association at www.adha.org.

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of the abdomen with a small pouch, the **cecum**, to which the **appendix** is attached. (The appendix does not aid in digestion, but contains lymphatic tissue and may function in immunity.) The large intestine continues as the **colon**, a name that is often used alone to mean the large intestine,

because the colon constitutes such a large portion of that organ. The colon travels upward along the right side of the abdomen as the ascending colon, crosses below the stomach as the transverse colon, and then continues down the left side of the abdomen as the descending colon. As food is

Box 12-3



Focus on Words

Homonyms

Homonyms are words that sound alike but have different meanings. One must know the context in which they are used in order to understand the intended meaning. For example, the ilium is the upper portion of the pelvis, but the ileum is the last portion of the small intestine. Different adjectives are preferred for each—iliac for the first and ileal for the second. The word *meiosis* refers to the type of cell division that halves the chromosomes to form the gametes, but *miosis* means abnormal contraction of the pupil. Both words come from the Greek word that means a decrease.

Similar-sounding names lead to some funny misspellings. The large bone of the upper arm is the humerus, but this bone is often written as "humorous." The vagus nerve (cranial nerve X) is named with a root that means "wander," as in the words vague and vagabond, because this nerve branches to many of the internal organs. Students often write the name

as if it had some relation to the famous gambling city in Nevada.

Homonyms may have a more serious side as well. Drug names may sound or look so similar that clinicians could confuse them, leading to dangerous potentially fatal complications. For example, one 50-year-old woman was hospitalized after she took Flomax, which is used to treat symptoms for an enlarged prostate instead of Volmax, which is used to relieve bronchospasm. Another example involved two drugs used to treat schizophrenia, clozapine and olanzapine; a young man was given the wrong drug and suffered severe complications. The FDA and the United States Adopted Names Council regulate sound-alike or look-alike drug names. The World Health Organization (WHO) has rejected many proposed names and has even changed drug names after they have been marketed when they have led to medication errors.

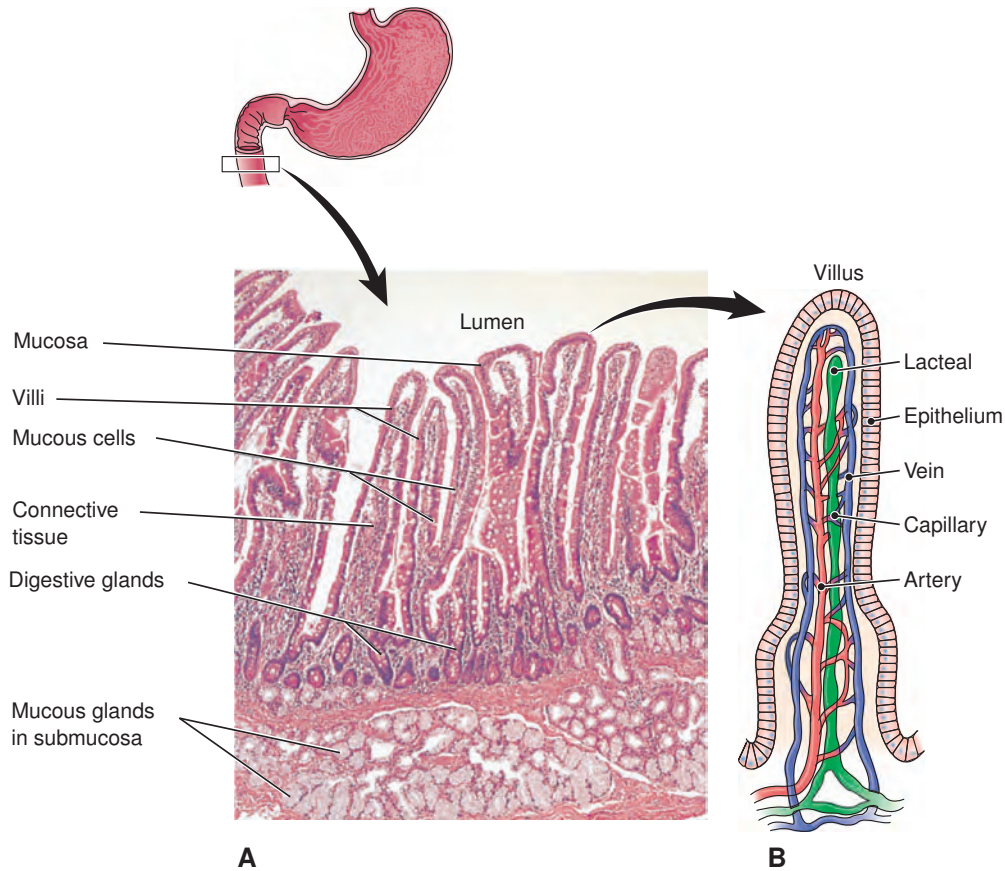


Figure 12-4 **Intestinal villi.** A. Microscopic view of the small intestine's lining showing villi and glands that secrete mucus and digestive juices. The lumen is the central opening. B. An intestinal villus. Each villus has blood vessels and a lacteal (lymphatic capillary) for nutrient absorption.

pushed through the colon, water is reabsorbed, and stool or feces is formed. This waste material passes into the S-shaped **sigmoid colon** and is stored in the **rectum** until eliminated through the anus.

The **pancreas** produces a mixture of digestive enzymes that is delivered into the duodenum through the pancreatic duct. It also secretes large amounts of bicarbonate, which neutralizes the strong stomach acid. For Your Reference **Box 12-4** summarizes the functions of the accessory organs.

The Accessory Organs

The salivary glands, which secrete into the mouth, are the first accessory organs to act on food. They secrete an enzyme (salivary amylase) that begins starch digestion. The remaining accessory organs are in the abdomen and secrete into the duodenum (**Fig. 12-5**). The **liver** is a large gland with many functions. A major activity is to process blood, removing toxins and converting nutrients into new compounds. A special circulatory pathway, the **hepatic portal system**, carries blood to the liver from the other abdominal organs. The liver functions in digestion by secreting **bile**, which emulsifies fats, that is, breaks them down into smaller units. The **gallbladder** stores bile until it is needed in digestion. The common hepatic duct from the liver and the cystic duct from the gallbladder merge to form the **common bile duct**, which empties into the duodenum.

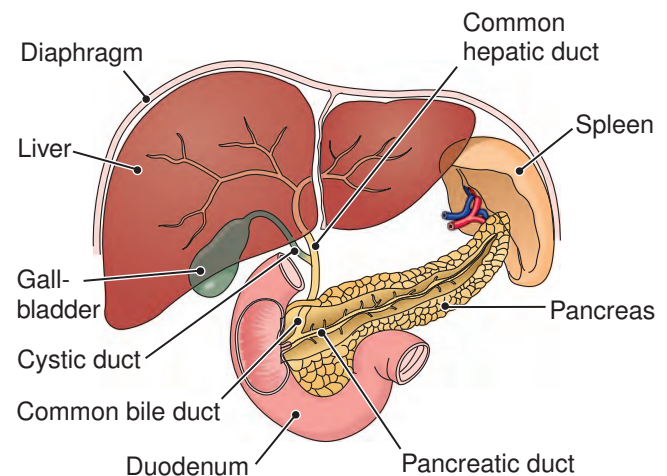


Figure 12-5 **Accessory organs of digestion.** The organs and ducts are shown. The diaphragm and spleen are shown for reference.

Box 12-4

For Your Reference



The Accessory Organs

ORGAN	DIGESTIVE ACTIONS
Salivary glands	Secrete saliva, which moistens food and contains salivary amylase, an enzyme that begins the digestion of starch
Liver	Secretes bile salts that break down (emulsify) fats
Gallbladder	Stores bile and releases it into the digestive tract when needed
Pancreas	Secretes a variety of digestive enzymes. Also secretes bicarbonate to neutralize stomach acid and water to dilute food

Terminology

Key Terms

12

Normal Structure and Function

anus <i>Ā-nus</i>	The distal opening of the digestive tract (root: an/o)
appendix <i>a-PEN-diks</i>	An appendage; usually means the narrow tube of lymphatic tissue attached to the cecum, the vermiform (worm-like) appendix
bile <i>bīl</i>	The fluid secreted by the liver that emulsifies fats and aids in their absorption (roots: chol/e, bili)
cecum <i>SĒ-kum</i>	A blind pouch at the beginning of the large intestine (root: cec/o)
colon <i>KŌ-lon</i>	The major portion of the large intestine; extends from the cecum to the rectum and is formed by ascending, transverse, and descending portions (roots: col/o, colon/o)
common bile duct	The duct that carries bile into the duodenum; formed by the union of the cystic duct and the common hepatic duct (root: choledoch/o)
duodenum <i>dū-ō-DĒ-num</i>	The first portion of the small intestine (root: duoden/o). Also pronounced <i>dū-OD-e-num</i>
enzyme <i>en-zīm</i>	An organic catalyst; speeds the rate of chemical reactions
esophagus <i>ē-SOF-a-gus</i>	The muscular tube that carries food from the pharynx to the stomach
feces <i>FĒ-sēz</i>	The waste material eliminated from the intestine (adjective: fecal); stool
gallbladder	A sac on the undersurface of the liver that stores bile (root: cholecyst/o)
hepatic portal system	A special circulatory pathway that brings blood directly from the abdominal organs to the liver for processing (also called simply the <i>portal system</i>). The vessel that enters the liver is the hepatic portal vein (portal vein)
ileum <i>IL-ē-um</i>	The terminal portion of the small intestine (root: ile/o)

(Continued)

Terminology**Key Terms** *(Continued)*

intestine <i>in-TES-tin</i>	The portion of the digestive tract between the stomach and the anus. It consists of the small and large intestines. It functions in digestion, absorption, and elimination of waste (root: enter/o). The bowel (<i>BOW-el</i>)
jejunum <i>je-JŪ-num</i>	The middle portion of the small intestine (root: jejun/o)
lacteal <i>lak-TĒL</i>	A lymphatic capillary in a villus of the small intestine. Lacteals absorb digested fats into the lymph
large intestine	The terminal portion of the digestive tract, consisting of the cecum, colon, rectum, and anus. It stores and eliminates undigested waste material (feces)
liver <i>LIV-er</i>	The large gland in the upper right abdomen. In addition to many other functions, it secretes bile needed for digestion and absorption of fats (root: hepat/o)
lower esophageal sphincter (LES) <i>ē-sof-a-JĒ-al SFINK-ter</i>	Muscle tissue at the distal end of the esophagus (gastroesophageal junction) that prevents stomach contents from refluxing into the esophagus. Also called the cardiac sphincter
mastication <i>mas-ti-KĀ-shun</i>	Chewing
mouth	The oral cavity; contains the tongue and teeth. Used to take in and chew food, mix it with saliva, and move it toward the throat to be swallowed
palate <i>PAL-at</i>	The roof of the mouth; the partition between the mouth and nasal cavity. Consists of an anterior portion formed by bone, the hard palate, and a posterior portion formed of tissue, the soft palate (root: palat/o)
pancreas <i>PAN-krē-as</i>	A large, elongated gland posterior to the stomach. It produces hormones that regulate sugar metabolism and also produces digestive enzymes (root: pancreat/o)
peristalsis <i>per-i-STAL-sis</i>	Wave-like contractions of an organ's walls; moves material through an organ or duct
peritoneum <i>per-i-tō-NĒ-um</i>	The large serous membrane that lines the abdominal cavity and supports the abdominal organs
pharynx <i>FAR-inks</i>	The throat; a common passageway for food entering the esophagus and air entering the larynx (root: pharyng/o)
pylorus <i>pī-LOR-us</i>	The stomach's distal opening into the duodenum (root: pylor/o). The opening is controlled by a ring of muscle, the pyloric sphincter
rectum <i>REK-tum</i>	The distal portion of the large intestine. It stores and eliminates undigested waste (roots: rect/o, proct/o)
saliva <i>sa-LĪ-va</i>	The clear secretion released into the mouth that moistens food and contains a starch-digesting enzyme (root: sial/o). Saliva is produced by three pairs of glands: the parotid, submandibular, and sublingual glands (see Fig. 12-1)
sigmoid colon	Distal S-shaped portion of the large intestine located between the descending colon and the rectum
small intestine	The portion of the intestine between the stomach and the large intestine; comprises the duodenum, jejunum, and ileum. Accessory organs secrete into the small intestine, and almost all digestion and absorption occur there
stomach <i>STUM-ak</i>	A muscular sac-like organ below the diaphragm that stores food and secretes juices that digest proteins (root: gastr/o)

Terminology**Key Terms** *(Continued)***uvula**
Ū-vū-la

The fleshy mass that hangs from the soft palate; aids in speech production (literally “little grape”) (root: uvul/o)

villi
VIL-ī

Tiny projections in the lining of the small intestine that absorb digested foods into the circulation (singular: villus)



Go to the Audio Pronunciation Glossary in the Student Resources on thePoint to hear these terms pronounced.

Roots Pertaining to the Digestive System

See **Tables 12-1 to 12-3**.

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Table 12-1**Roots for the Mouth**

Root	Meaning	Example	Definition of Example
bucc/o	cheek	buccoconversion <i>buk-kō-VER-zhun</i>	turning toward the cheek
dent/o, dent/i	tooth, teeth	edentulous <i>ē-DEN-tū-lus</i>	without teeth
odont/o	tooth, teeth	periodontics <i>per-ē-ō-DON-tiks</i>	dental specialty that deals with the study and treatment of the tissues around the teeth
gingiv/o	gum (gingiva)	gingivectomy <i>jin-ji-VEK-tō-mē</i>	excision of gum tissue
gloss/o	tongue	glossoplegia <i>glos-ō-PLĒ-jē-a</i>	paralysis (-plegia) of the tongue
lingu/o	tongue	orolingual <i>or-ō-LING-gwal</i>	pertaining to the mouth and tongue
gnath/o	jaw	prognathous <i>PROG-na-thus</i>	having a projecting jaw
labi/o	lip	labium <i>LĀ-bē-um</i>	lip or lip-like structure
or/o	mouth	circumoral <i>sir-kum-OR-al</i>	around the mouth
stoma, stomat/o	mouth	xerostomia <i>zē-rō-STŌ-mē-a</i>	dryness (xero-) of the mouth
palat/o	palate	palatine <i>PAL-a-tin</i>	pertaining to the palate (also palatal)
sial/o	saliva, salivary gland, salivary duct	sialogram <i>sī-AL-ō-gram</i>	radiograph of the salivary glands and ducts
uvul/o	uvula	uvulotome <i>Ū-vū-lō-tōm</i>	instrument (-tome) for incising the uvula

EXERCISE 12-1

Use the adjective suffix **-al** to write a word that has the same meaning as the following:

1. pertaining to the mouth _____ oral _____
2. pertaining to the lip _____
3. pertaining to the cheek _____
4. pertaining to the teeth _____
5. pertaining to the gums _____
6. pertaining to the tongue _____

Fill in the blanks:

7. The oropharynx is the part of the pharynx that is located behind the _____.
8. A dentifrice (*DEN-ti-fris*) is an agent used to clean the _____.
9. An orthodontist (*or-thō-DON-tist*) specializes in straightening (ortho-) of the _____.
10. Micrognathia (*mī-krō-NĀ-thē-a*) is excessive smallness of the _____.
11. Stomatoplasty (*STŌ-ma-tō-plas-tē*) is any plastic repair of the _____.
12. Hemiglossal (*hem-ī-GLOS-al*) means pertaining to one half of the _____.
13. A sialolith (*sī-AL-ō-lith*) is a stone formed in a _____ gland or duct.

Define the following words:

14. extrabuccal (*eks-tra-BUK-al*) _____
15. sublingual (*sub-LING-gwal*) _____
16. labiodental (*lā-bē-ō-DEN-tal*) _____
17. gingivitis (*jīn-jī-VĪ-tis*) _____
18. uvuloptosis (*ū-vū-lop-TŌ-sis*) _____
19. hypoglossal (*hī-pō-GLOS-al*) _____
20. palatorrhaphy (*pal-at-OR-a-fē*) _____

Table 12-2 Roots for the Digestive Tract (Except the Mouth)

Root	Meaning	Example	Definition of Example
esophag/o	esophagus	esophageal* ē-sof-a-JĒ-al	pertaining to the esophagus
gastr/o	stomach	gastroparesis gas-trō-pa-RĒ-sis	partial paralysis (paresis) of the stomach
pylor/o	pylorus	pyloroplasty pī-LOR-ō-plas-tē	plastic repair of the pylorus
enter/o	intestine	dysentery DIS-en-ter-ē	infectious disease of the intestine
duoden/o	duodenum	duodenostomy dū-ō-de-NOS-tō-mē	surgical creation of an opening into the duodenum

Table 12-2 Roots for the Digestive Tract (Except the Mouth) (*Continued*)

Root	Meaning	Example	Definition of Example
jejun/o	jejunum	jejunectomy <i>je-jū-NEK-tō-mē</i>	excision of the jejunum
ile/o	ileum	ileitis <i>il-ē-Ī-tis</i>	inflammation of the ileum
cec/o	cecum	cecoptosis <i>sē-kop-TŌ-sis</i>	downward displacement of the cecum
col/o, colon/o	colon	coloclysis <i>kō-lō-KLĪ-sis</i>	irrigation (-clysis) of the colon
sigmoid/o	sigmoid colon	sigmoidoscope <i>sig-MOY-dō-skōp</i>	an endoscope for examining the sigmoid colon
rect/o	rectum	rectocele <i>REK-tō-sēl</i>	hernia of the rectum
proct/o	rectum	proctopexy <i>PROK-tō-pek-sē</i>	surgical fixation of the rectum
an/o	anus	perianal <i>per-ē-Ā-nal</i>	around the anus

*Note addition of e before -al.

EXERCISE 12-2

Use the adjective suffix *-ic* to write a word for the following definitions:

1. pertaining to the stomach _____ gastric
2. pertaining to the intestine _____
3. pertaining to the pylorus _____
4. pertaining to the colon _____

Use the adjective suffix *-a/* to write a word for the following definitions:

5. pertaining to the duodenum _____ duodenal
6. pertaining to the jejunum _____
7. pertaining to the ileum _____
8. pertaining to the cecum _____
9. pertaining to the anus _____

Write a word for the following definitions:

10. pertaining to the stomach and esophagus _____
11. inflammation of the esophagus _____
12. surgical fixation of the stomach _____
13. study of the stomach and intestines _____
14. endoscopic examination of the duodenum _____
15. downward displacement of the pylorus _____

(Continued)

EXERCISE 12-2 (Continued)

16. surgical creation of an opening into the jejunum _____

17. excision of the ileum _____

18. pertaining to the anus and rectum _____

Use the root *col/o* to write a word for the following definitions:

19. inflammation of the colon _____

20. surgical creation of an opening into the colon _____

21. surgical fixation of the colon _____

22. surgical puncture of the colon _____

Use the root *colon/o* to write a word for the following definitions:

23. any disease of the colon _____

24. endoscopic examination of the colon _____

Two organs of the digestive tract or even two parts of the same organ may be surgically connected by a passage (anastomosis) after removal of damaged tissue. Such a procedure is named for the connected organs plus the ending *-stomy*. Use two roots plus the suffix *-stomy* to write a word for the following definitions:

25. surgical creation of a passage between the esophagus and stomach _____ esophagogastrostomy

26. surgical creation of a passage between the stomach and intestine _____

27. surgical creation of a passage between the stomach and the jejunum _____

28. surgical creation of a passage between the duodenum and the ileum _____

29. surgical creation of a passage between the sigmoid colon and the rectum (proct/o) _____

Table 12-3 Roots for the Accessory Organs

Root	Meaning	Example	Definition of Example
hepat/o	liver	hepatocyte HEP-a-tō-sīt	a liver cell
bili	bile	biliary BIL-ē-ar-ē	pertaining to the bile or bile ducts
chol/e, chol/o	bile, gall	cholestasis kō-lē-STĀ-sis	stoppage of bile flow
cholecyst/o	gallbladder	cholecystogram kō-lē-SIS-tō-gram	radiograph of the gallbladder
cholangi/o	bile duct	cholangioma kō-lan-jē-Ō-ma	cancer of the bile ducts
choledoch/o	common bile duct	choledochal KŌ-lē-dok-al	pertaining to the common bile duct
pancreat/o	pancreas	pancreatotropic pan-krē-at-ō-TROP-ik	acting on the pancreas

EXERCISE 12-3

Use the suffix **-ic** to write a word for the following definitions:

1. pertaining to the liver _____
2. pertaining to the gallbladder _____
3. pertaining to the pancreas _____

Use the suffix **-graphy** to write a word for the following definitions:

4. radiographic study of the pancreas _____
5. radiographic study of the bile ducts _____
6. radiographic study of the gallbladder _____
7. radiographic study of the liver _____

Use the suffix **-lithiasis** to write a word for the following definitions:

8. condition of having a stone in the common bile duct _____
9. condition of having a stone in the pancreas _____

Fill in the blanks:

10. Inflammation of the liver is called _____.
11. The word biligenesis (*bil-i-JEN-e-sis*) means the formation of _____.
12. A cholelith (*KŌ-lē-lith*) is a(n) _____.
13. Choledochotomy (*kō-led-ō-KOT-ō-mē*) is incision of the _____.
14. Cholecystorrhaphy (*kō-lē-sis-TOR-a-fē*) is suture of the _____.
15. Hepatomegaly (*hep-a-tō-MEG-a-lē*) is enlargement of the _____.
16. Cholangitis (*kō-lan-JĪ-tis*) is inflammation of a(n) _____.
17. Pancreatolysis (*pan-krē-a-TOL-i-sis*) is dissolving of the _____.

Clinical Aspects of the Digestive System

DIGESTIVE TRACT

Infection

A variety of organisms can infect the GI tract, from viruses and bacteria to protozoa and worms. In the mouth, bacterial infection contributes to tooth decay or **caries**. It may cause a mild gum infection (gingivitis) or more extensive involvement of the deeper tissues and bony support around the tooth (periodontitis). Infections of the stomach or intestine may produce short-lived upsets with **gastroenteritis**, **nausea**, **diarrhea**, and **emesis** (vomiting). Other infectious diseases of the GI tract, such as typhoid, cholera, and dysentery, are more serious, even fatal.

Appendicitis results from infection of the appendix, often secondary to its obstruction. Surgery is necessary to avoid rupture and **peritonitis**, infection of the peritoneal cavity.

Ulcers

An ulcer is a lesion of the skin or a mucous membrane marked by inflammation and tissue damage. Ulcers caused by the damaging action of gastric juices, also called peptic juices, on the lining of the GI tract are termed **peptic ulcers**. Most peptic ulcers appear in the first portion of the duodenum. The origins of such ulcers are not completely known, although infection with a bacterium, *Helicobacter pylori*, has been identified as a major cause. Heredity and stress may be factors, as well as chronic inflammation and exposure to damaging drugs, such as aspirin and other NSAIDs, or to irritants in food and drink.

Current ulcer treatment includes the administration of antibiotics to eliminate *H. pylori* infection and use of drugs

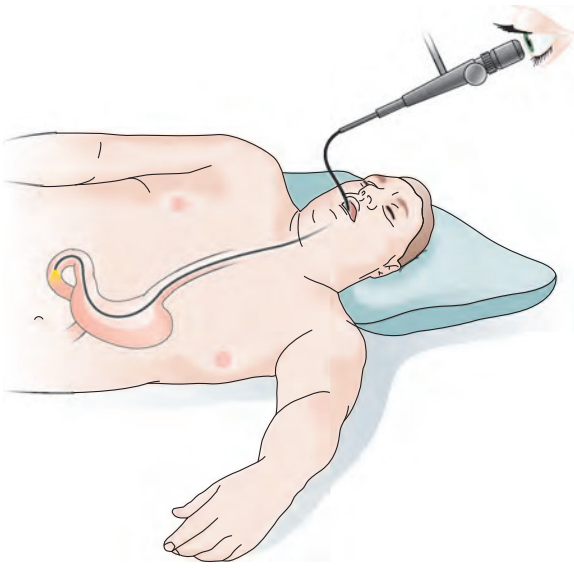


Figure 12-6 Endoscopy. A patient undergoing gastroscopy is shown.

that inhibit gastric acid secretion. Ulcers may lead to hemorrhage or to perforation of the digestive tract wall.

Ulcers can be diagnosed by **endoscopy** (Fig. 12-6, Box 12-5) and by radiographic study of the GI tract using a contrast medium, usually barium sulfate. A **barium study** can reveal a variety of GI disorders in addition to ulcers, including tumors and obstructions. A barium swallow is used for the study of the pharynx and esophagus; an upper GI series examines the esophagus, stomach, and small intestine.

Cancer

Cancer of the mouth generally involves the lips or tongue. Smoking is a major risk factor in these cases. **Leukoplakia**, white patches on mucous membranes, often results from smoking or other irritants and is an early sign of cancer in up to 25 percent of cases. The most common sites for GI tract cancer are the colon and rectum. Together, these colorectal cancers rank among the most frequent causes of cancer deaths in the United States in both men and women. A diet low in fiber and calcium and high in fat is a major risk factor in colorectal cancer. Heredity is also a factor, as is chronic inflammation of the colon (colitis). **Polyps** (growths) in the intestine often become cancerous and should be removed. Polyps can be identified and even removed by endoscopy.

One sign of colorectal cancer is bleeding into the intestine, which can be detected by testing the stool for blood. Because this blood may be present in very small amounts, it is described as **occult** (“hidden”) **blood**. Colorectal cancers are staged according to **Dukes classification**, ranging from A to C according to severity.

Examiners can observe the intestine’s interior with various endoscopes named for the specific area in which they are used, such as proctoscope (rectum), sigmoidoscope (sigmoid colon), and colonoscope (colon) (Fig. 12-7).

In some cases of cancer and for other reasons as well, it may be necessary to surgically remove a portion of the GI tract and create a **stoma** (opening) on the abdominal wall for elimination of waste. Such **ostomy surgery** (Fig. 12-8) is named for the organ involved, such as ileostomy (ileum) or colostomy (colon). When an **anastomosis** (connection) is formed between two organs of the tract, both organs are included in naming, such as gastroduodenostomy (stomach and duodenum) or coloproctostomy (colon and rectum).

Box 12-5



Clinical Perspectives

Endoscopy

Modern medicine has made great strides toward looking into the body without resorting to surgery. The endoscope, an instrument that is inserted through a body opening or small incision, has allowed the noninvasive examination of passageways, hollow organs, and body cavities. The first endoscopes were rigid-lighted telescopes that could be inserted only a short distance into the body. Today, physicians can navigate the twists and turns of the digestive tract using long fiberoptic endoscopes composed of flexible, light-transmitting bundles of glass or plastic.

Physicians can endoscopically detect structural abnormalities, ulcers, inflammation, and tumors in the GI tract. In addition, they use endoscopes to remove fluid or tissue samples for testing. Some surgery can even be done with an

endoscope, such as polyp removal from the colon or sphincter expansion. Endoscopy can also be used to examine and operate on joints (arthroscopy), the bladder (cystoscopy), respiratory passages (bronchoscopy), and the abdominal cavity (laparoscopy).

A “virtual colonoscopy” uses computerized x-rays to generate detailed images of the colon. This method can provide an adequate screening for most people, although a small percentage might then need a standard colonoscopy for further assessment or surgery. Capsular endoscopy, a recent technological advance, has made examination of the GI tract even easier. It uses a pill-sized camera that a patient can swallow! As the camera moves through the digestive tract, it transmits video images to a data recorder worn on the patient’s belt.

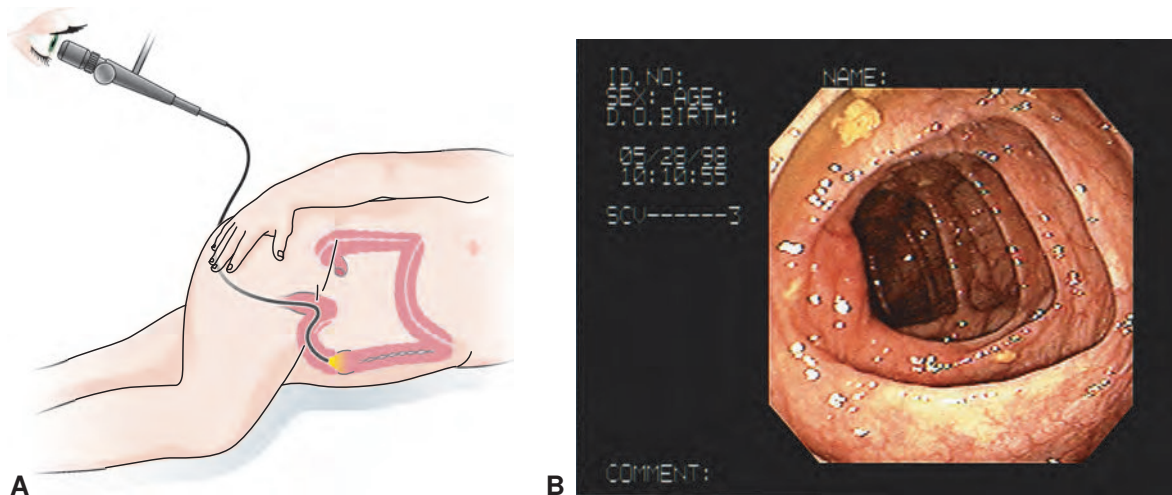


Figure 12-7 Colonoscopy. A. Sigmoidoscopy. The flexible fiberoptic endoscope is advanced past the proximal sigmoid colon and then into the descending colon. B. Endoscopic image of the cecum, the first portion of the large intestine.

Obstructions

A hernia is the protrusion of an organ through an abnormal opening. The most common type is an inguinal hernia, described in Chapter 14 (see Fig. 14-7). In a **hiatal hernia**, part of the stomach moves upward into the chest cavity through the space (hiatus) in the diaphragm through which the esophagus passes (see Fig. 6-7). Often this condition produces no symptoms, but it may result in chest pain, **dysphagia** (difficulty in swallowing), or reflux (backflow) of stomach contents into the esophagus.

In **pyloric stenosis**, the opening between the stomach and small intestine is too narrow. This usually occurs in infants and in boys more often than in girls. A sign of pyloric stenosis is projectile vomiting. Surgery may be needed to correct it.

Other types of obstruction include **intussusception** (Fig. 12-9), slipping of an intestinal segment into a part below it; **volvulus**, twisting of the intestine (see Fig. 12-9B); and **ileus**, intestinal obstruction often caused by lack of peristalsis.



See the figure on pyloric stenosis in the Student Resources on thePoint.

Hemorrhoids are varicose veins in the rectum associated with pain, bleeding, and, in some cases, rectal prolapse.

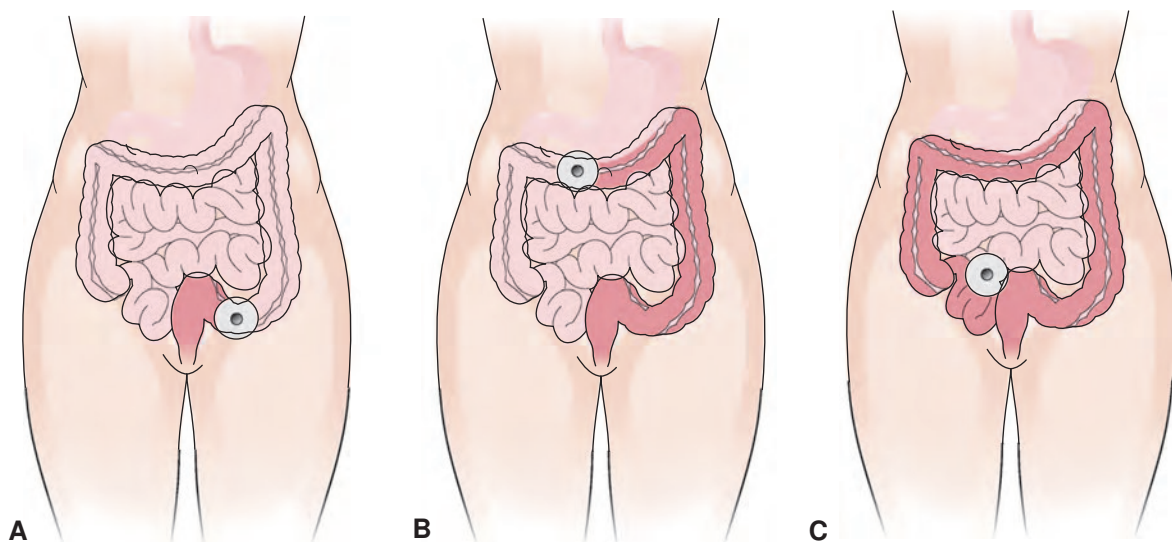


Figure 12-8 Ostomy surgery. Various locations are shown. The shaded portions represent the bowel sections that have been removed or are inactive. A. Sigmoid colostomy. B. Transverse colostomy. C. Ileostomy.

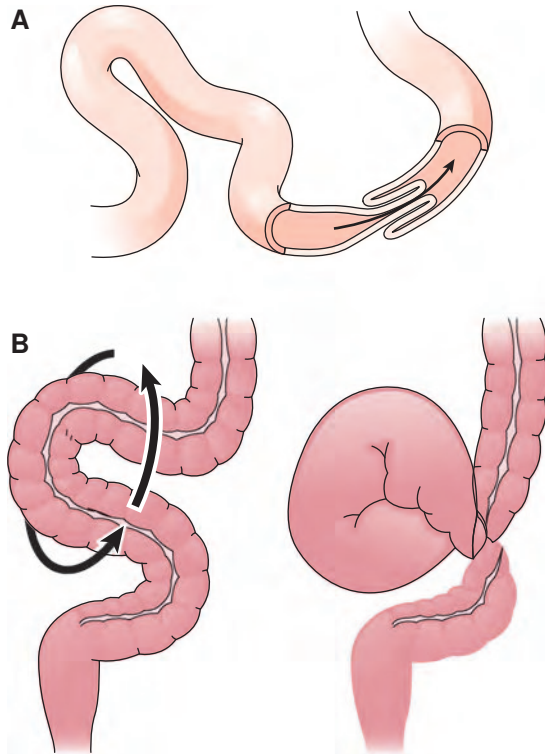


Figure 12-9 Intestinal obstruction. A. Intussusception. B. Volvulus, showing counterclockwise twist.

Gastroesophageal Reflux Disease

Gastroesophageal reflux disease (GERD) refers to reflux of gastric juices into the esophagus due to weakness at the gastroesophageal junction, specifically the LES (lower esophageal sphincter) (Fig. 12-10). These acidic secretions irritate the lining of the esophagus and even the throat and mouth if propelled upward by regurgitation. A GERD symptom commonly known as **heartburn**, an upward-radiating burning sensation

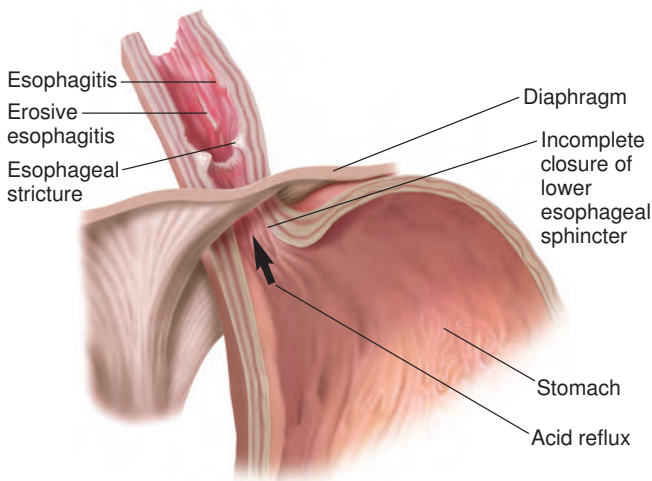


Figure 12-10 Gastroesophageal reflux disease (GERD). A weak LES allows acidic stomach contents to flow backward into the lower portion of the esophagus causing pain and irritation.

behind the sternum, does not involve the heart, but is experienced in the area near the heart (See B.F.'s opening case study).

GERD symptoms are more likely to occur when there is increased pressure in the stomach, such as after meals when the stomach is full, when one is lying or bending down, and with obesity and pregnancy. Hiatal hernia can also lead to GERD. Treatment includes weight reduction if needed; elevating the head of the bed 4 to 6 inches; avoidance of irritating foods; and drugs to reduce gastric acid secretion. Surgery to repair an incompetent LES might be needed.

Persistent reflux esophagitis may cause injury to the esophageal lining leading to **Barrett syndrome** or *Barrett esophagus*. In this condition, the esophageal mucosa is gradually replaced with epithelium resembling that of the stomach or intestines. Barrett esophagus frequently has no early symptoms, but possible complications include esophageal spasms, formation of scar tissue, esophageal strictures, and increased risk of cancer.

Inflammatory Intestinal Disease

Two similar diseases are included under the heading of inflammatory bowel disease (IBD):

- **Crohn disease** is a chronic inflammation of the intestinal wall, usually in the ileum and colon, causing pain, diarrhea, abscess, and often formation of an abnormal passageway, or **fistula**.
- **Ulcerative colitis** involves a continuous inflammation of the colon's lining that begins in the rectum and extends proximally (Fig. 12-11).

Both forms of IBD occur mainly in adolescents and young adults and show a hereditary pattern. They originate with an abnormal immunologic response, perhaps to the normal intestinal flora, along with autoimmunity. Treatment is with antiinflammatory agents, immunosuppressants, and frequently surgery to remove damaged portions of the colon.

Celiac disease is characterized by the inability to absorb foods containing gluten, a protein found in wheat and some



Figure 12-11 Ulcerative colitis. Prominent erythema and ulceration of the colon begin in the ascending colon and are most severe in the rectosigmoid area.

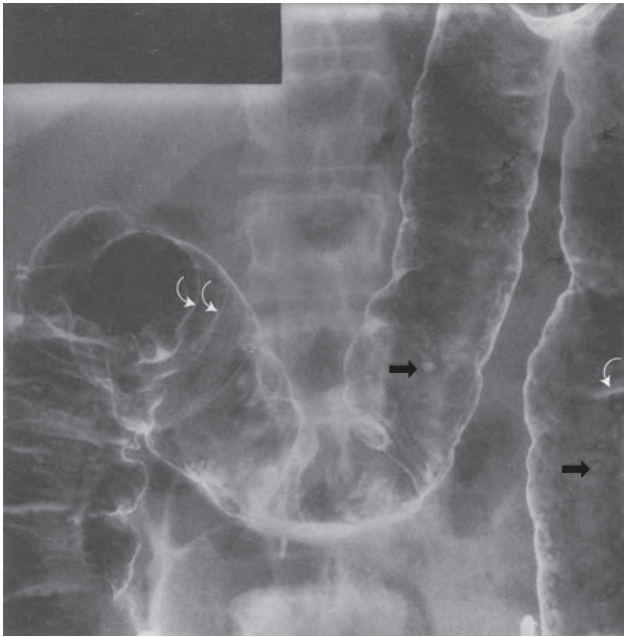


Figure 12-12 Lower gastrointestinal (GI) series. Barium enema shows lesions of enteritis (*straight arrows*) and thickened mucosa (*curved arrows*).

other grains. It affects the upper part of the small intestine and originates with an excess immune response to gluten. Mucosal inflammation diminishes the intestinal villi and interferes with absorption. Celiac disease is treated with a gluten-free diet.

Diverticulitis most commonly affects the colon. Diverticula are small pouches in the intestinal wall that commonly appear with age. The presence of these pouches is termed **diverticulosis**, which has been attributed to a diet low in fiber. Collection of waste and bacteria in these sacs leads to diverticulitis, which is accompanied by pain and sometimes bleeding. Diverticula can be seen by radiographic studies of the lower GI tract using barium as a contrast medium, a so-called barium enema (**Fig. 12-12**). Although there is no cure, diverticulitis is treated with a high-fiber diet, stool softeners, and drugs (antispasmodics) to reduce motility. Diverticular infections are treated with antibiotics.



See figures on the complications of ulcerative colitis and on diverticulosis and diverticulitis in the Student Resources on thePoint.

ACCESSORY ORGANS

Hepatitis

In the United States and other industrialized countries, **hepatitis** is most often caused by viral infection. More than five types of hepatitis viruses have now been identified. Vaccines are available for hepatitis A and hepatitis B.

- Hepatitis A virus (HAV) is the most common hepatitis virus. It is spread by fecal-oral contamination, often by food handlers, and in crowded, unsanitary conditions. It may also be acquired by eating contaminated food, especially seafood.
- Hepatitis B virus (HBV) is spread by blood and other body fluids. It may be transmitted sexually, by sharing injection needles, and by close interpersonal contact. Infected individuals may become carriers of the disease. Most patients recover, but the disease may be serious, even fatal, and may lead to liver cancer.
- Hepatitis C is spread through blood and blood products or by close contact with an infected person.
- Hepatitis D, the delta virus, is highly pathogenic but infects only those already infected with hepatitis B.
- Hepatitis E, like HAV, is spread by contaminated food and water. It has caused epidemics in Asia, Africa, and Mexico.

The name *hepatitis* simply means “inflammation of the liver,” but this disease also causes necrosis (death) of liver cells. Other infections as well as drugs and toxins may also cause hepatitis. Liver function tests performed on blood serum are important in diagnosis.

Jaundice, or **icterus**, is a symptom of hepatitis and other diseases of the liver and biliary system (**Fig. 12-13**). It appears as yellowness of the skin, whites of the eyes, and mucous membranes due to the presence of bile pigments, mainly **bilirubin**, in the blood.

Cirrhosis

Cirrhosis is a chronic liver disease characterized by **hepatomegaly**, **edema**, **ascites** (fluid in the abdomen), and jaundice. Disease progression leads to internal bleeding and brain damage caused by changes in the blood's composition. One complication of cirrhosis is **portal hypertension**, increased pressure in the hepatic portal system, the vessels that carry

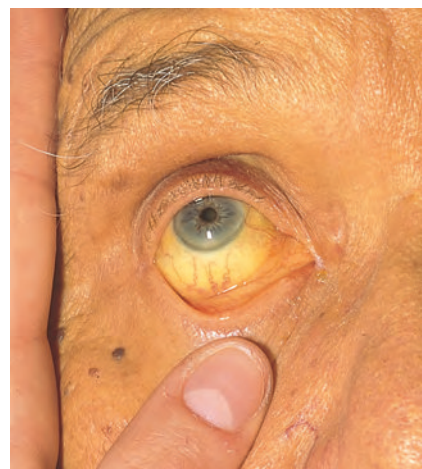


Figure 12-13 Jaundice. Yellowish discoloration due to bile pigments in the blood is seen in the eye.

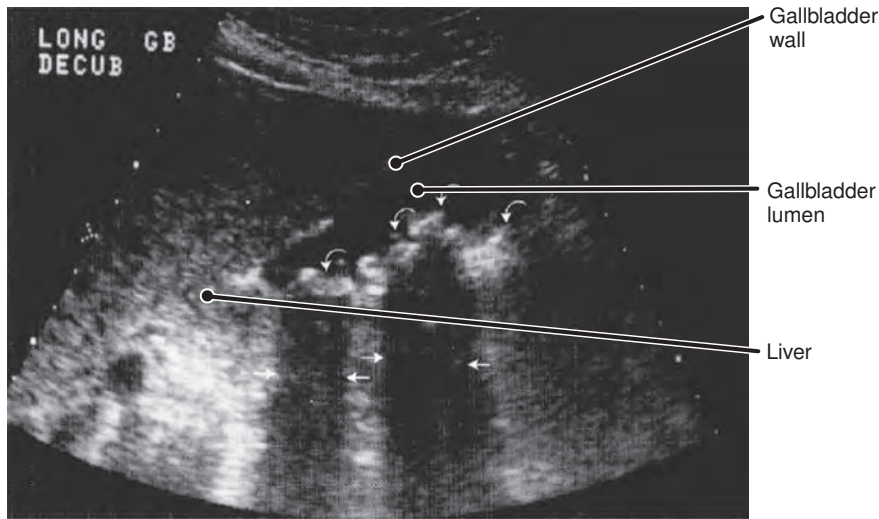


Figure 12-14 Cholelithiasis (gallstones).

Sonogram shows dense gallstones (*curved arrows*). Shadows appear (between the *straight arrows*) because the sound waves cannot penetrate the stones (calculi).

blood from the other abdominal organs to the liver. Portal hypertension causes **splenomegaly** and the formation of varices (varicose veins) in the distal esophagus with possible hemorrhage. The main cause of cirrhosis is the excess consumption of alcohol.



See the animation “The Liver in Health and Disease” and figures on the clinical features of cirrhosis and on portal hypertension in the Student Resources on *thePoint*.



See the figure on gallstones in the Student Resources on *thePoint*.

Gallstones

Cholelithiasis refers to the presence of stones in the gallbladder or bile ducts, which is usually associated with **cholecystitis**, inflammation of the gallbladder. Cholelithiasis is characterized by **biliary colic** (pain) in the right upper quadrant (RUQ), nausea, and vomiting.

Most gallstones are composed of cholesterol, an ingredient of bile. They form more commonly in women than in men and are promoted by conditions that increase estrogen, as this hormone raises the cholesterol level in bile. These predisposing conditions include pregnancy, use of oral contraceptives, and obesity. Oddly, the rapid weight loss that follows stomach reduction surgery to treat morbid obesity commonly leads to gallstones because of changes in bile production and cholesterol precipitation in the bile. Drugs may dissolve gallstones, but often the cure is removal of the gallbladder in a **cholecystectomy**. Originally, this procedure required an extensive incision, but now the gallbladder is almost always removed laparoscopically through a small abdominal slit. Following gallbladder removal, bile flows directly into the duodenum through the common bile duct.

Ultrasonography, radiography, and magnetic resonance imaging are used to diagnose gallstones (**Fig. 12-14**). Endoscopic retrograde cholangiopancreatography (ERCP) (**Fig. 12-15**) is a technique for viewing the pancreatic and bile ducts and for performing certain techniques to relieve

obstructions. Contrast medium is injected into the biliary system from the duodenum before imaging.

Pancreatitis

Pancreatitis, or inflammation of the pancreas, may result from alcohol abuse, drug toxicity, bile obstruction, infections, and other causes. Blood tests in acute pancreatitis show increased levels of the enzymes amylase and lipase. Glucose and bilirubin levels may also be elevated. Often the disease subsides with only symptomatic treatment.

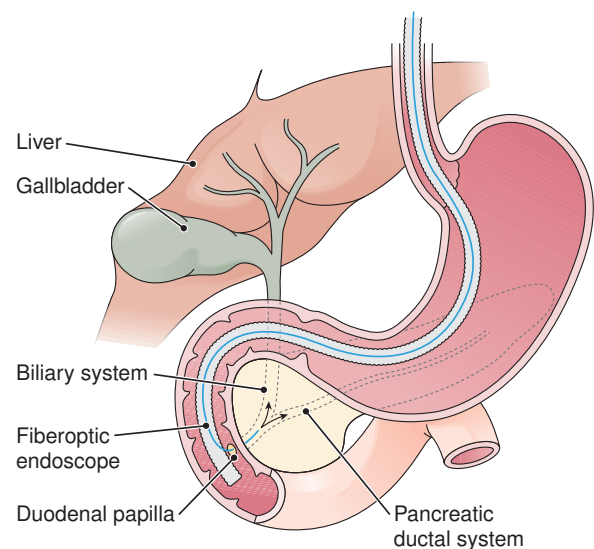


Figure 12-15 Endoscopic retrograde cholangiopancreatography (ERCP). A contrast medium is injected into the pancreatic and bile ducts in preparation for radiography.

Terminology

Key Terms

Disorders

appendicitis <i>a-pen-di-SĪ-tis</i>	Inflammation of the appendix
ascites <i>a-SĪ-tēz</i>	Accumulation of fluid in the abdominal cavity; a form of edema. May be caused by heart disease, lymphatic or venous obstruction, cirrhosis, or changes in blood plasma composition
Barrett syndrome <i>BA-ret</i>	Condition resulting from chronic esophagitis, as caused by gastroesophageal reflux disease. Inflammatory injury can lead to esophageal spasms, scarring, strictures, and increased risk of cancer. Also called Barrett esophagus
biliary colic <i>BIL-ē-ar-ē KOL-ik</i>	Acute abdominal pain caused by gallstones in the bile ducts
bilirubin <i>bil-i-RŪ-bin</i>	A pigment released in the breakdown of hemoglobin from red blood cells; mainly excreted by the liver in bile
caries <i>KAR-ēz</i>	Tooth decay
celiac disease <i>SĒ-lē-ak</i>	Inability to absorb foods containing gluten, a protein found in wheat and some other grains; caused by an excess immune response to gluten
cholecystitis <i>kō-lē-sis-TĪ-tis</i>	Inflammation of the gallbladder
cholelithiasis <i>kō-lē-li-THĪ-a-sis</i>	The condition of having stones in the gallbladder; also used to refer to stones in the common bile duct
cirrhosis <i>sir-RŌ-sis</i>	Chronic liver disease with degeneration of liver tissue
Crohn disease <i>krōn</i>	A chronic inflammatory disease of the gastrointestinal tract usually involving the ileum and colon
diarrhea <i>dī-a-RĒ-a</i>	The frequent passage of watery bowel movements
diverticulitis <i>dī-ver-tik-ū-LĪ-tis</i>	Inflammation of diverticula (small pouches) in the wall of the digestive tract, especially in the colon
diverticulosis <i>dī-ver-tik-ū-LŌ-sis</i>	The presence of diverticula, especially in the colon
dysphagia <i>dis-FĀ-jē-a</i>	Difficulty in swallowing
emesis <i>EM-e-sis</i>	Vomiting
fistula <i>FIS-tū-la</i>	An abnormal passageway between two organs or from an organ to the body surface, such as between the rectum and anus (anorectal fistula)
gastroenteritis <i>gas-trō-en-ter-Ī-tis</i>	Inflammation of the stomach and intestine
gastroesophageal reflux disease (GERD) <i>gas-trō-ē-sof-a-JĒ-al</i>	Condition caused by reflux of gastric juices into the esophagus resulting in heartburn, regurgitation, inflammation, and possible damage to the esophagus; caused by weakness of the lower esophageal sphincter (LES) (see Fig. 12-10)

(Continued)

Terminology

Key Terms (Continued)

heartburn <i>HART-burn</i>	A warm or burning sensation felt behind the sternum and radiating upward. Commonly associated with gastroesophageal reflux. Medical name is pyrosis (<i>pyr/o</i> means “heat”)
hemorrhoids <i>HEM-ō-roydz</i>	Varicose veins in the rectum associated with pain, bleeding, and sometimes rectal prolapse; piles
hepatitis <i>hep-a-TĪ-tis</i>	Inflammation of the liver; commonly caused by a viral infection
hepatomegaly <i>hep-a-tō-MEG-a-lē</i>	Enlargement of the liver
hiatal hernia <i>hī-Ā-tal</i>	A protrusion of the stomach through the opening (hiatus) in the diaphragm through which the esophagus passes (see Fig. 6-7)
icterus <i>IK-ter-us</i>	Jaundice
ileus <i>IL-ē-us</i>	Intestinal obstruction. May be caused by lack of peristalsis (adynamic, paralytic ileus) or by contraction (dynamic ileus). Intestinal matter and gas may be relieved by insertion of a drainage tube
intussusception <i>in-tu-su-SEP-shun</i>	Slipping of one intestinal segment into another part below it. Occurs mainly in male infants in the ileocecal region (see Fig. 12-9A). May be fatal if untreated for more than one day
jaundice <i>JAWN-dis</i>	A yellowish color of the skin, mucous membranes, and whites of the eye caused by bile pigments in the blood (from French <i>jaune</i> meaning “yellow”). The main pigment is bilirubin, a byproduct of erythrocyte destruction (see Fig. 12-13)
leukoplakia <i>lū-kō-PLĀ-kē-a</i>	White patches on mucous membranes, as on the tongue or cheeks, often resulting from smoking or other irritants; may be precancerous
nausea <i>NAW-zha</i>	An unpleasant sensation in the upper abdomen that often precedes vomiting. Typically occurs in digestive upset, motion sickness, and sometimes early pregnancy
occult blood <i>o-KULT</i>	Blood present in such small amounts that it can be detected only microscopically or chemically; in the feces, a sign of intestinal bleeding (<i>occult</i> means “hidden”)
pancreatitis <i>pan-krē-a-TĪ-tis</i>	Inflammation of the pancreas
peptic ulcer <i>PEP-tik UL-ser</i>	A lesion in the mucous membrane of the esophagus, stomach, or duodenum caused by the action of gastric juice
peritonitis <i>per-i-tō-NĪ-tis</i>	Inflammation of the peritoneum, the membrane that lines the abdominal cavity and covers the abdominal organs. May result from perforation of an ulcer, ruptured appendix, or reproductive tract infection, among other causes
polyp <i>POL-ip</i>	A tumor that grows on a stalk and bleeds easily
portal hypertension	An abnormal pressure increases in the hepatic portal system. May be caused by cirrhosis, infection, thrombosis, or a tumor
pyloric stenosis <i>pī-LOR-ik</i>	Narrowing of the opening between the stomach and the duodenum; pylorostenosis
regurgitation <i>rē-gur-ji-TĀ-shun</i>	A backward flowing, such as the backflow of undigested food
splenomegaly <i>splē-nō-MEG-a-lē</i>	Enlargement of the spleen

Terminology

Key Terms (Continued)

ulcerative colitis
UL-ser-a-tiv kō-LĪ-tis

Chronic ulceration of the rectum and colon; the cause is unknown, but may involve autoimmunity

volvulus
VOL-vū-lus

Twisting of the intestine resulting in obstruction. Usually involves the sigmoid colon and occurs most often in children and in the elderly. May be caused by congenital malformation, a foreign body, or adhesion. Failure to treat immediately may result in death (see Fig. 12-9B)

Diagnosis and Treatment

anastomosis
a-nas-to-MŌ-sis

A passage or communication between two vessels or organs. May be normal or pathologic or may be created surgically

barium study

Use of barium sulfate as a liquid contrast medium for fluoroscopic or radiographic study of the digestive tract. Can show obstruction, tumors, ulcers, hiatal hernia, and motility disorders, among other conditions

cholecystectomy
kō-lē-sis-TEK-tō-mē

Surgical removal of the gallbladder

Dukes classification

A system for staging colorectal cancer based on degree of bowel wall penetration and lymph node involvement; severity is graded from A to C

**endoscopic retrograde
cholangiopancreatography
(ERCP)**

A technique for viewing the pancreatic and bile ducts and for performing certain techniques to relieve obstructions. Contrast medium is injected into the biliary system from the duodenum before radiographs are taken (see Fig. 12-15)

endoscopy
en-DOS-kō-pē

Use of a fiberoptic endoscope for direct visual examination. GI studies include esophagogastroduodenoscopy, proctosigmoidoscopy (rectum and distal colon), and colonoscopy (all regions of the colon) (see Figs. 12-6 and 12-7)

ostomy
OS-tō-mē

An opening into the body; generally refers to an opening created for elimination of body waste. Also refers to the operation done to create such an opening (see stoma)

stoma
STŌ-ma

A surgically created opening to the body surface or between two organs (literally “mouth”) (see Fig. 12-8)



Go to the Audio Pronunciation Glossary in the Student Resources on thePoint to hear these words pronounced.

12

Terminology

Supplementary Terms

Normal Structure and Function

bolus
BŌ-lus

A mass, such as the rounded mass of food that is swallowed

cardia
KAR-dē-a

The part of the stomach near the esophagus, named for its closeness to the heart

chyme
kīm

The semiliquid partially digested food that moves from the stomach into the small intestine

(Continued)

Terminology Supplementary Terms *(Continued)*

defecation <i>def-e-KĀ-shun</i>	The evacuation of feces from the rectum
deglutition <i>deg-lū-TISH-un</i>	Swallowing
duodenal bulb <i>dū-ō-DĒ-nal</i>	The part of the duodenum near the pylorus; the first bend (flexure) of the duodenum
duodenal papilla <i>dū-ō-DĒ-nal pa-PIL-la</i>	The raised area where the common bile duct and pancreatic duct enter the duodenum (see Fig. 12-15); papilla of Vater (<i>FA-ter</i>)
greater omentum <i>ō-MEN-tum</i>	A fold of the peritoneum that extends from the stomach over the abdominal organs
hepatic flexure <i>he-PAT-ik FLEK-shur</i>	The right bend of the colon, forming the junction between the ascending colon and the transverse colon (see Fig. 12-1)
ileocecal valve <i>il-ē-ō-SĒ-kal</i>	A valve-like structure between the ileum of the small intestine and the cecum of the large intestine
mesentery <i>MES-en-ter-ē</i>	The portion of the peritoneum that folds over and supports the intestine
mesocolon <i>mes-ō-KŌ-lon</i>	The portion of the peritoneum that folds over and supports the colon
papilla of Vater	See duodenal papilla
rugae <i>RŪ-jē</i>	The large folds in the stomach's lining seen when the stomach is empty
sphincter of Oddi <i>OD-ē</i>	The muscular ring at the opening of the common bile duct into the duodenum
splenic flexure <i>SPLEN-ik FLEK-shur</i>	The left bend of the colon, forming the junction between the transverse colon and the descending colon (see Fig. 12-1)
Disorders	
achalasia <i>ak-a-LĀ-zē-a</i>	Failure of a smooth muscle to relax, especially the lower esophageal sphincter, so that food is retained in the esophagus
achlorhydria <i>ā-klor-HĪ-drē-a</i>	Lack of hydrochloric acid in the stomach; opposite is hyperchlorhydria
anorexia <i>an-ō-REK-sē-a</i>	Loss of appetite. Anorexia nervosa is a psychologically induced refusal or inability to eat (adjectives: anorectic, anorexic)
aphagia <i>a-FĀ-jē-a</i>	Inability to swallow or difficulty in swallowing; refusal or inability to eat
aphthous ulcer <i>AF-thus</i>	An ulcer in a mucous membrane, as in the mouth
bruxism <i>BRUK-sizm</i>	Clenching and grinding of the teeth, usually during sleep
bulimia <i>bū-LĒM-ē-a</i>	Excessive, insatiable appetite. A disorder characterized by overeating followed by induced vomiting, diarrhea, or fasting
cachexia <i>ka-KEK-sē-a</i>	Profound ill health, malnutrition, and wasting

Terminology**Supplementary Terms** (Continued)

12

cheilosis <i>kī-LŌ-sis</i>	Cracking at the corners of the mouth, often caused by B vitamin deficiency (root <i>cheillo</i> means “lip”)
cholestasis <i>kō-lē-STĀ-sis</i>	Stoppage of bile flow. Also pronounced <i>kō-LES-ta-sis</i>
constipation <i>con-sti-PĀ-shun</i>	Infrequency or difficulty in defecation and the passage of hard, dry feces
dyspepsia <i>dis-PEP-sē-a</i>	Poor or painful digestion
eructation <i>e-ruk-TĀ-shun</i>	Belching
familial adenomatous polyposis (FAP) <i>fa-MIL-ē-al ad-e-NŌ-ma-tus pol-i-PŌ-sis</i>	A heredity condition in which multiple polyps form in the colon and rectum, predisposing to colorectal cancer
flatulence <i>FLAT-ū-lens</i>	Condition of having gas or air in the GI tract
flatus <i>FLĀ-tus</i>	Gas or air in the gastrointestinal tract; gas or air expelled through the anus
hematemesis <i>hē-ma-TEM-e-sis</i>	Vomiting of blood
irritable bowel syndrome (IBS)	A chronic stress-related disease characterized by diarrhea, constipation, and pain associated with rhythmic intestinal contractions. Mucous colitis; spastic colon
megacolon <i>meg-a-KŌ-lon</i>	An extremely dilated colon. Usually congenital but may occur in acute ulcerative colitis
melenā <i>MEL-ē-na</i>	Black tarry feces resulting from blood in the intestines. Common in newborns. May also be a sign of gastrointestinal bleeding
obstipation <i>ob-sti-PĀ-shun</i>	Extreme constipation
pernicious anemia <i>per-NISH-us</i>	A form of anemia caused by the stomach’s failure to secrete intrinsic factor, a substance needed for the absorption of vitamin B ₁₂
pilonidal cyst <i>pī-lō-NĪ-dal</i>	A dermal cyst in the sacral region, usually at the top of the cleft between the buttocks. May become infected and begin to drain
thrush	Fungal infection of the mouth and/or throat caused by <i>Candida</i> ; appears as mucosal white patches or ulcers
Vincent disease <i>VIN-sent</i>	Severe gingivitis with necrosis associated with the bacterium <i>Treponema vincentii</i> ; necrotizing ulcerative gingivitis; trench mouth

Diagnosis and Treatment

appendectomy <i>ap-en-DEK-tō-mē</i>	Surgical removal of the appendix
bariatrics <i>bar-ē-AT-riks</i>	The branch of medicine concerned with prevention and control of obesity and associated diseases (from Greek <i>baros</i> , meaning “weight”)

(Continued)

Terminology

Supplementary Terms (Continued)

bariatric surgery	Surgery to reduce the size of the stomach and reduce nutrient absorption in the treatment of morbid obesity. Most common is gastric bypass surgery, which involves division of the stomach and anastomosis of its upper part to the small intestine (jejunum) (Fig. 12-16). Other methods are gastric stapling, partitioning of the stomach with rows of staples, and gastric banding, which involves laparoscopic placement of an adjustable loop (Lap-Band) that reduces stomach capacity
Billroth operations	Gastrectomy with anastomosis of the stomach to the duodenum (Billroth I) or to the jejunum (Billroth II) (Fig. 12-17)
gavage <i>ga-VAHZH</i>	Process of feeding through a nasogastric tube into the stomach
lavage <i>la-VAJ</i>	Washing out of a cavity; irrigation
manometry <i>man-OM-e-trē</i>	Measurement of pressure; pertaining to the GI tract, measurement of pressure in the portal system as a sign of obstruction
Murphy sign	Inability to take a deep breath when fingers are pressed firmly below the right arch of the ribs (below the liver). Signifies gallbladder disease
nasogastric (NG) tube <i>nā-zō-GAS-trik</i>	Tube that is passed through the nose into the stomach (Fig. 12-18). May be used for emptying the stomach, administering medication, giving liquids, or sampling stomach contents
parenteral hyperalimentation <i>pa-REN-ter-al</i>	Complete intravenous feeding for one who cannot take in food. Total parenteral nutrition (TPN)
percutaneous endoscopic gastrostomy (PEG) tube	Tube inserted into the stomach for long-term feeding (Fig. 12-19)
vagotomy <i>vā-GOT-ō-mē</i>	Interruption of vagal nerve impulses to reduce stomach secretions in the treatment of a gastric ulcer. Originally done surgically but may also be done with drugs
Drugs	
antacid <i>ant-AS-id</i>	Agent that counteracts acidity, usually gastric acidity
antidiarrheal <i>an-ti-dī-a-RĒ-al</i>	Drug that treats or prevents diarrhea by reducing intestinal motility or absorbing irritants and soothing the intestinal lining
antiemetic <i>an-tē-e-MET-ik</i>	Agent that relieves or prevents nausea and vomiting
antiflatulent <i>an-ti-FLAT-ū-lent</i>	Agent that prevents or relieves flatulence
antispasmodic <i>an-ti-spas-MOD-ik</i>	Agent that relieves spasm, usually of smooth muscle
emetic <i>e-MET-ik</i>	An agent that causes vomiting
histamine H₂ antagonist	Drug that decreases secretion of stomach acid by interfering with the action of histamine at H ₂ receptors. Used to treat ulcers and other gastrointestinal problems. H ₂ -receptor-blocking agent

Terminology

Supplementary Terms *(Continued)***laxative***LAK-sa-tiv*

Agent that promotes elimination from the large intestine. Types include stimulants, substances that retain water (hyperosmotics), stool softeners, and bulk-forming agents

proton pump inhibitor (PPI)

Agent that inhibits gastric acid secretion by blocking the transport of hydrogen ions (protons) into the stomach

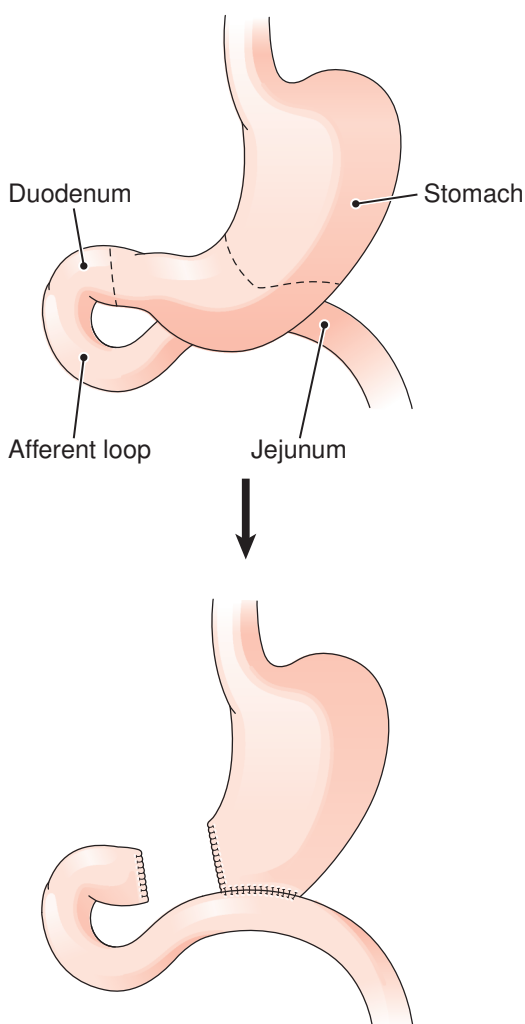


Figure 12-16 Gastric bypass. For treatment of morbid obesity, a small pouch is created in the stomach to limit food intake. The pouch is attached to the jejunum in a gastrojejunostomy to bypass the stomach and reduce nutrient absorption.

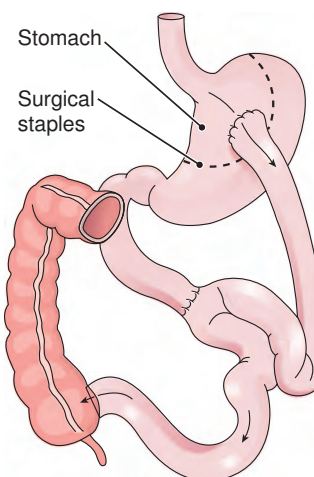


Figure 12-17 Gastrojejunostomy (Billroth II operation). The dotted lines show the portion removed.

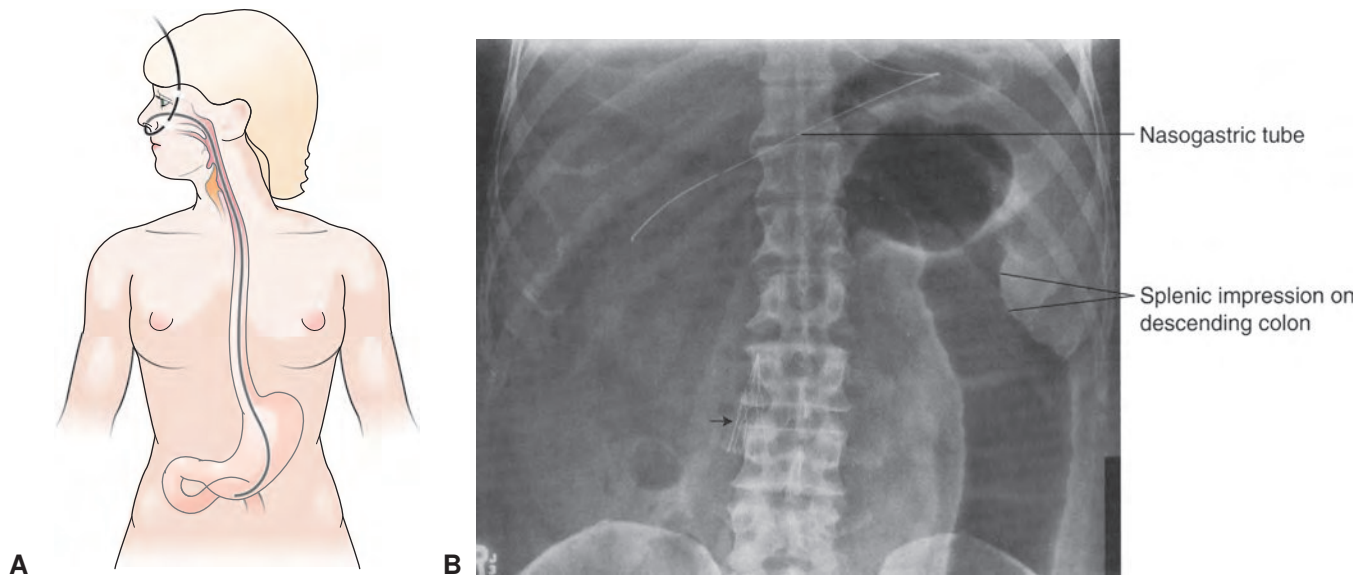


Figure 12-18 A nasogastric (NG) tube. A. Diagram showing an NG tube in place. B. Abdominal radiograph showing an NG tube. The filter (arrow) shown in the inferior vena cava is meant to trap emboli that might originate in the lower extremities and pelvis.

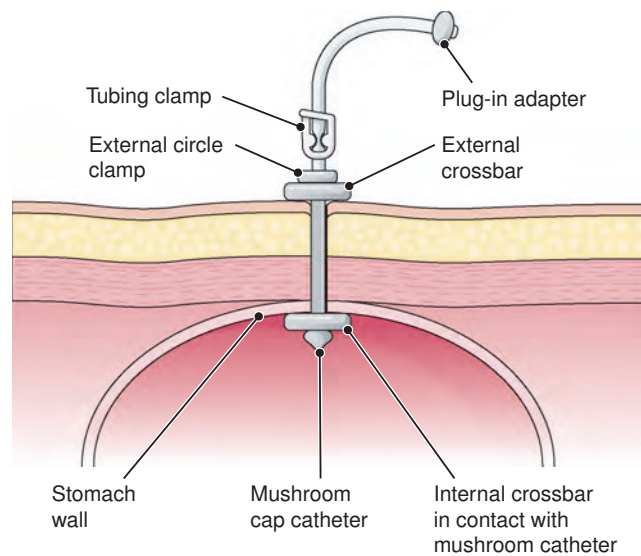


Figure 12-19 Percutaneous endoscopic gastrostomy (PEG) tube. The tube is shown in place in the stomach.

Terminology Abbreviations

BE	Barium enema (for radiographic study of the colon)	HEV	Hepatitis E virus
BM	Bowel movement	HCl	Hydrochloric acid
CBD	Common bile duct	IBD	Inflammatory bowel disease
EGD	Esophagogastroduodenoscopy	IBS	Irritable bowel syndrome
ERCP	Endoscopic retrograde cholangiopancreatography	LES	Lower esophageal sphincter
FAP	Familial adenomatous polyposis	NG	Nasogastric (tube)
GERD	Gastroesophageal reflux disease	N&V	Nausea and vomiting
GI	Gastrointestinal	N/V/D	Nausea, vomiting, and diarrhea
HAV	Hepatitis A virus	PONV	Postoperative nausea and vomiting
HBV	Hepatitis B virus	PPI	Proton pump inhibitor
HCV	Hepatitis C virus	TPN	Total parenteral nutrition
HDV	Hepatitis D virus	UGI	Upper gastrointestinal (radiograph series)

B.F.'s Follow-Up Study

When B.F. returns after four weeks for his follow-up appointment in primary care, he explains that he started feeling better so he stopped taking the medicine after three weeks. Now his symptoms have returned. They are waking him up at night, and he also now reports experiencing mild dysphagia. The physician explained that he must remain on his medication and emphasized how important it is that he goes to his endoscopy appointment. Results from this study indicate that B.F. does

indeed have moderate erosive esophagitis. There is a small hiatal hernia present as well.

B.F. is prescribed a PPI, 40 mg/day and encouraged to take it on a regular basis. He is counseled to decrease the fat in his meals, avoid lying down for at least two hours after meals, and limit alcohol intake. He returns six weeks later with marked improvement in compliance and total control of his symptoms. He is instructed to continue the PPI and to return in six months for reassessment.

Chapter Review

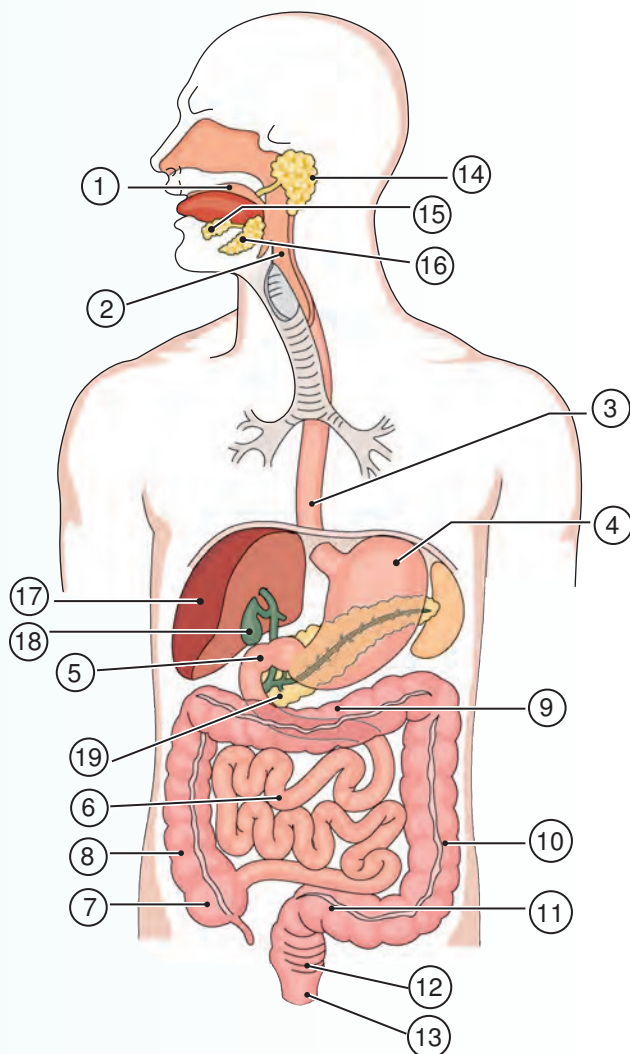
Labeling Exercise

THE DIGESTIVE SYSTEM

Write the name of each numbered part on the corresponding line of the answer sheet.

Anus	Parotid salivary gland
Ascending colon	Pharynx
Cecum	Rectum
Descending colon	Sigmoid colon
Duodenum (of small intestine)	Small intestine
Esophagus	Stomach
Gallbladder	Sublingual salivary gland
Liver	Submandibular salivary gland
Mouth	Transverse colon
Pancreas	

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____

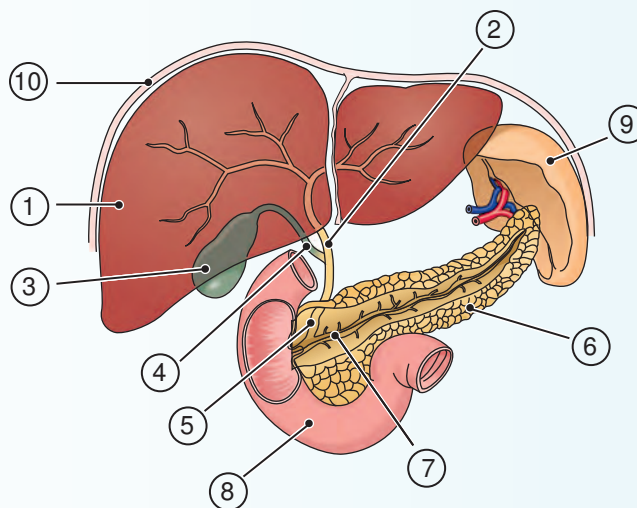


ACCESSORY ORGANS OF DIGESTION

Write the name of each numbered part on the corresponding line of the answer sheet.

Common bile duct	Gallbladder
Common hepatic duct	Liver
Cystic duct	Pancreas
Diaphragm	Pancreatic duct
Duodenum	Spleen

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____



Terminology

MATCHING

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|----------------------------|--|
| _____ 1. sublingual | a. lymphatic capillary |
| _____ 2. emetic | b. pertaining to the lip |
| _____ 3. labial | c. substance that induces vomiting |
| _____ 4. agnathia | d. hypoglossal |
| _____ 5. lacteal | e. absence of the jaw |
| _____ 6. icterus | a. terminal portion of the small intestine |
| _____ 7. colocentesis | b. wave-like muscular contractions |
| _____ 8. ileum | c. organic catalyst |
| _____ 9. peristalsis | d. surgical puncture of the colon |
| _____ 10. enzyme | e. jaundice |
| _____ 11. leukoplakia | a. a type of liver disease |
| _____ 12. cirrhosis | b. pertaining to the common bile duct |
| _____ 13. cholangiectasis | c. crushing of a biliary calculus |
| _____ 14. choledochal | d. dilatation of a bile duct |
| _____ 15. cholelithotripsy | e. white patches on a mucous membrane |

Supplementary Terms

- | | |
|-----------------------|---|
| _____ 16. eructation | a. part of the stomach near the esophagus |
| _____ 17. cardia | b. chewing |
| _____ 18. deglutition | c. belching |
| _____ 19. bolus | d. swallowing |
| _____ 20. mastication | e. a mass, as of food |

- | | |
|--------------------|------------------------------------|
| _____ 21. gavage | a. inability to eat |
| _____ 22. bruxism | b. partially digested food |
| _____ 23. aphagia | c. malnutrition and wasting |
| _____ 24. cachexia | d. feeding through a tube |
| _____ 25. chyme | e. tooth grinding |

FILL IN THE BLANKS

26. The large serous membrane that lines the abdominal cavity and supports the abdominal organs is the _____.
27. The hepatic portal system carries blood to the _____.
28. The organ that stores bile is the _____.
29. The blind pouch at the beginning of the colon is the _____.
30. Glossorrhaphy is suture of the _____.
31. The palatine tonsils are located on either side of the _____.
32. Dentin is the main substance of a(n) _____.
33. From its name you might guess that the buccinator muscle is in the _____.
34. An enterovirus is a virus that infects the _____.
35. The anticoagulant heparin is found throughout the body, but it is named for its presence in the _____.
36. The substance cholesterol is named for its chemical composition (sterol) and for its presence in _____.

Referring to B.F.'s opening case study:

37. Protrusion of the stomach through an opening in the diaphragm is termed a(n) _____.
38. Difficulty in swallowing is technically called _____.
39. The histamine-2 receptor antagonist used to treat B.F. reduces secretion of (see Chapter 8) _____.

DEFINITIONS

Write a word for the following definitions:

40. a dentist who specializes in treating the tissues around the teeth _____
41. surgical excision of the stomach _____
42. surgical repair of the palate _____
43. narrowing of the pylorus _____
44. inflammation of the pancreas _____
45. medical specialist who treats diseases of the stomach and intestine _____
46. surgical creation of an opening into the colon _____
47. surgical creation of a passage between the stomach and the duodenum _____
48. within (intra-) the liver _____

PLURALS

Write the plural form of the following words:

49. diverticulum _____
50. gingiva _____

51. calculus _____

52. anastomosis _____

TRUE-FALSE

Examine the following statements. If the statement is true, write T in the first blank. If the statement is false, write F in the first blank and correct the statement by replacing the underlined word in the second blank.

	True or False	Correct Answer
53. In the opening case study, B.F. is experiencing his epigastric pain in the region <u>below</u> the stomach.	_____	_____
54. The middle portion of the small intestine is the <u>duodenum</u> .	_____	_____
55. Polysialia is the excess secretion of <u>bile</u> .	_____	_____
56. The cystic duct carries bile to and from the <u>gallbladder</u> .	_____	_____
57. The appendix is attached to the <u>cecum</u> .	_____	_____
58. The common hepatic duct and the cystic duct merge to form the <u>common bile duct</u> .	_____	_____

ELIMINATIONS

In each of the sets below, underline the word that does not fit in with the rest and explain the reason for your choice:

59. gingiva — villus — palate — uvula — incisor

60. spleen — cecum — colon — rectum — anus

61. pancreas — gallbladder — liver — pylorus — salivary glands

62. diarrhea — emesis — nausea — regurgitation — amylase

ABBREVIATIONS

Write the meaning of the following abbreviations:

63. TPN _____

64. GERD _____

65. EGD _____

66. GI _____

67. HCl _____

68. PPI _____

69. PEG (tube) _____

70. HAV _____

WORD BUILDING

Write a word for the following definitions using the word parts provided.

-al cec/o r -pexy -cele proct/o -itis -rhaphy ile/o

71. inflammation of the cecum _____
72. suture of the rectum _____
73. fixation of the ileum _____
74. hernia of the rectum _____
75. pertaining to the ileum and cecum _____
76. fixation of the cecum _____
77. inflammation of the rectum _____
78. suture of the ileum _____
79. inflammation of the ileum _____

WORD ANALYSIS

Define each of the following words and give the meaning of the word parts in each. Use a dictionary if necessary.

80. myenteric (*mī-en-TER-ik*) _____
 - a. my/o _____
 - b. enter/o _____
 - c. -ic _____
81. cholescintigraphy (*kō-lē-sin-TIG-ra-fē*) _____
 - a. chole _____
 - b. scinti _____ spark (radiation)
 - c. -graphy _____
82. parenteral (*pa-REN-ter-al*) _____
 - a. par(a) _____
 - b. enter/o _____
 - c. -al _____



For more learning activities, see Chapter 12 of the Student Resources on *thePoint*.

Additional Case Studies

Case Study 12-1: Cholecystectomy

G.L., a 42-YO obese Caucasian woman, entered the hospital with nausea and vomiting, flatulence and eructation, a fever of 100.5°F, and continuous right upper quadrant (RUQ) and subscapular pain. Examination on admission showed rebound tenderness in the RUQ with a positive Murphy sign. Her skin, nails, and conjunctivae were yellowish, and she reported frequent clay-colored stools. Her leukocyte count was 16,000. An ERCP and ultrasound of the abdomen suggested many small stones in her gallbladder and possibly in the common bile duct. Her diagnosis was cholecystitis with cholelithiasis.

A laparoscopic cholecystectomy was attempted with an intraoperative cholangiogram and common bile duct exploration. Because of G.L.'s size and some unexpected bleeding, visualization was difficult, and the procedure was converted to an open approach. Small stones and granular sludge were irrigated from her common duct, and the gallbladder was removed. She had a T-tube inserted into the duct for bile drainage; this tube was removed on the second postoperative day. An NG tube in place before and during the surgery was also removed on Day 2. She was discharged on the fifth postoperative day with a prescription for prn pain medication.

Case Study 12-2: Colonoscopy with Biopsy

S.M., a 24-YO man, had a recent history of lower abdominal pain with frequent loose mucoid stools. He described symptoms of occasional dysphagia, dyspepsia, nausea, and aphthous ulcers of his tongue and buccal mucosa. A previous barium enema examination showed some irregularities in the sigmoid and rectal segments of his large bowel. Stool samples for culture, ova, and parasites were negative. His tentative diagnosis was irritable bowel syndrome. He followed a lactose-free, low-residue diet and took Imodium to reduce intestinal motility. His gastroenterologist recommended a colonoscopy. After a two-day regimen of a soft to clear liquid diet, laxatives, and an enema, the morning of the procedure, he reported to the

endoscopy unit. He was transported to the procedure room. ECG electrodes, a pulse oximeter sensor, and a blood pressure cuff were applied for monitoring, and an IV was inserted in S.M.'s right arm. An IV bolus of propofol was given, and S.M. was positioned on his left side. The colonoscope was gently inserted through the anal sphincter and advanced proximally.

The physician was able to advance past the ileocecal valve, examining the entire length of the colon. Ulcerated granulomatous lesions were seen throughout the colon with a concentration in the sigmoid segment. Many biopsy specimens were taken. The mucosa of the distal ileum was normal. Pathology examination of the biopsy samples was expected to establish a diagnosis of IBD.

Case Study Questions

Multiple choice. Select the best answer and write the letter of your choice to the left of each number:

- | | |
|--|---|
| _____ 1. Flatulence and eructation represent:
a. regurgitation of chyme
b. distention of the esophagus
c. passage of gas or air from the GI tract
d. muscular movement of the alimentary tract
e. sounds heard only by abdominal auscultation | _____ 4. The common duct is more properly called the:
a. common bile duct
b. common duodenal duct
c. unified cystic duct
d. joined bile duct
e. common digestive duct |
| _____ 2. Subscapular pain is experienced:
a. above the navel
b. below the shoulder blade
c. below the sternum
d. beside the shoulder blade
e. below the stomach | _____ 5. The Murphy sign is tested for:
a. under the ribs on the left
b. near the spleen
c. in the lower right abdomen
d. under the ribs on the right
e. in the lower left abdomen |
| _____ 3. Yellowish conjunctivae indicate:
a. emesis
b. regurgitation
c. inflammation
d. ptosis
e. jaundice | _____ 6. The NG tube is inserted through the _____ and terminates in the _____.
a. nose/stomach
b. nostril/gallbladder
c. glottis/nephron
d. anus/cecum
e. Nissen/glottis |

- _____ 7. Dysphagia and dyspepsia are difficulty or pain with:
- chewing and intestinal motility
 - speaking and motility
 - swallowing and digestion
 - breathing and absorption
 - swallowing and nutrition
- _____ 8. The buccal mucosa is in the:
- nostril, medial side
 - mouth, inside of the cheek
 - greater curvature of the stomach
 - lesser curvature near the duodenum
 - base of the tongue
- _____ 9. A gastroenterologist is a physician who specializes in study of:
- respiration and pathology
 - mouth and teeth
 - stomach, intestines, and related structures
 - musculoskeletal system
 - nutritional and weight loss diets
- _____ 10. The splenic and hepatic flexures are bends in the colon near the:
- liver and splanchnic vein
 - common bile duct and biliary tree
 - spleen and appendix
 - spleen and liver
 - mesenteric vessels and liver
- _____ 11. Intestinal motility refers to:
- chewing
 - peristalsis
 - absorption
 - antiemetics
 - ascites
- _____ 12. A colonoscopy is:
- a radiograph of the small intestine
 - an endoscopic study of the esophagus
 - an upper endoscopy with biopsy
 - a type of barium enema
 - an endoscopic examination of the large bowel
- _____ 13. The ileocecal valve is:
- part of a colonoscope
 - at the distal ileum
 - in the pylorus
 - at the proximal ileum
 - near the liver

Write the meaning of each of the following abbreviations:

14. ERCP _____
15. RUQ _____
16. NG _____
17. IBD _____

Give the word or words in the case studies with each of the following meanings:

18. presence of stones in the gallbladder _____
19. endoscopic surgery of the gallbladder _____
20. inflammation of the gallbladder _____
21. radiographic study of the gallbladder and biliary system _____
22. ring of muscle that regulates the distal opening of the colon _____
23. surgical excision of tissue for pathology examination _____

CHAPTER 13

The Urinary System

Case Study

E.O.'s Stress Incontinence

Chief complaint:

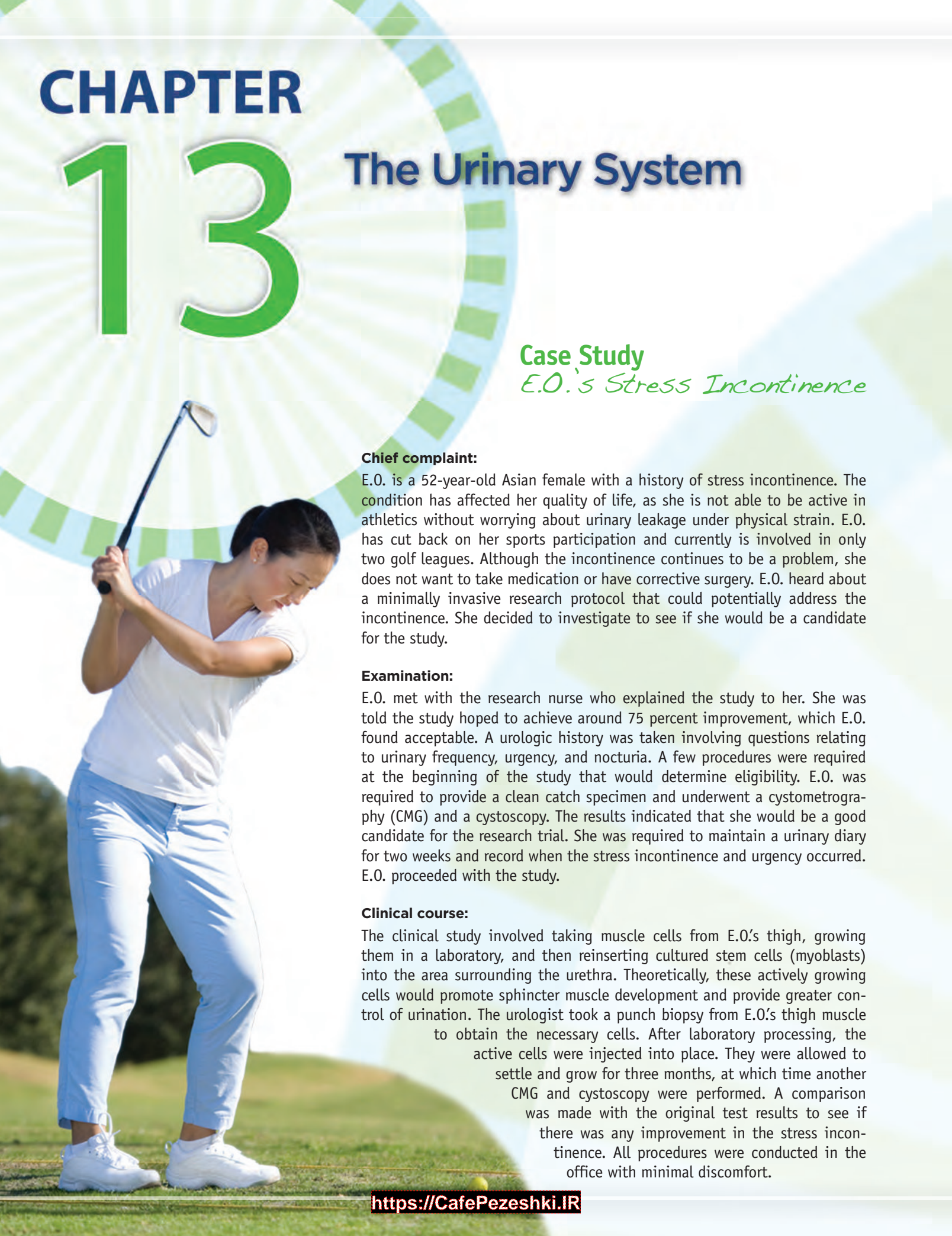
E.O. is a 52-year-old Asian female with a history of stress incontinence. The condition has affected her quality of life, as she is not able to be active in athletics without worrying about urinary leakage under physical strain. E.O. has cut back on her sports participation and currently is involved in only two golf leagues. Although the incontinence continues to be a problem, she does not want to take medication or have corrective surgery. E.O. heard about a minimally invasive research protocol that could potentially address the incontinence. She decided to investigate to see if she would be a candidate for the study.

Examination:

E.O. met with the research nurse who explained the study to her. She was told the study hoped to achieve around 75 percent improvement, which E.O. found acceptable. A urologic history was taken involving questions relating to urinary frequency, urgency, and nocturia. A few procedures were required at the beginning of the study that would determine eligibility. E.O. was required to provide a clean catch specimen and underwent a cystometrography (CMG) and a cystoscopy. The results indicated that she would be a good candidate for the research trial. She was required to maintain a urinary diary for two weeks and record when the stress incontinence and urgency occurred. E.O. proceeded with the study.

Clinical course:

The clinical study involved taking muscle cells from E.O.'s thigh, growing them in a laboratory, and then reinserting cultured stem cells (myoblasts) into the area surrounding the urethra. Theoretically, these actively growing cells would promote sphincter muscle development and provide greater control of urination. The urologist took a punch biopsy from E.O.'s thigh muscle to obtain the necessary cells. After laboratory processing, the active cells were injected into place. They were allowed to settle and grow for three months, at which time another CMG and cystoscopy were performed. A comparison was made with the original test results to see if there was any improvement in the stress incontinence. All procedures were conducted in the office with minimal discomfort.





Ancillaries *At-A-Glance*

Visit *thePoint* to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii–xvi.

Learning TOOLS

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning RESOURCES

- E-book: Chapter 13
- Web Figure: Urinary Obstruction, Reflux, and Infection
- Web Figure: Acute Pyelonephritis
- Web Figure: Hydronephrosis
- Web Chart: Role of Hormones in Electrolyte Balance
- Animation: Renal Function
- Audio Pronunciation Glossary

Learning ACTIVITIES

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After the study of this chapter, you should be able to:

- 1** Describe the functions of the urinary system. *p318*
- 2** Name and describe the organs of the urinary tract and cite the functions of each. *p318*
- 3** Identify the portions of the nephron. *p320*
- 4** Explain the relationship between the kidney and the blood circulation. *p320*
- 5** Describe the processes involved in urine formation. *p320*
- 6** Explain how urine is transported and released from the body. *p321*
- 7** Identify and use the roots pertaining to the urinary system. *p323*
- 8** Describe six major disorders of the urinary system. *p325*
- 9** Interpret abbreviations used in reference to the urinary system. *p335*
- 10** Analyze medical terms in case studies pertaining to the urinary system. *pp316, 343*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|---|---|
| <p>_____ 1. The organ that forms urine is the:</p> <ol style="list-style-type: none"> gallbladder cystic duct bladder kidney | <p>_____ 5. With reference to the urinary system, the root <i>cyst/o</i> means:</p> <ol style="list-style-type: none"> ureter urinary bladder urinary stasis kidney |
| <p>_____ 2. The tube that carries urine out of the body is the:</p> <ol style="list-style-type: none"> pylorus appendix urethra peristalsis | <p>_____ 6. Nephritis is inflammation of the:</p> <ol style="list-style-type: none"> liver intestine bladder kidney |
| <p>_____ 3. The hormone erythropoietin stimulates production of:</p> <ol style="list-style-type: none"> red blood cells platelets leukocytes saliva | <p>_____ 7. Separation of substances by passage through a membrane is termed:</p> <ol style="list-style-type: none"> centrifugation absorption degutition dialysis |
| <p>_____ 4. Micturition is the scientific term for:</p> <ol style="list-style-type: none"> urination digestion breathing retention | <p>_____ 8. A substance that promotes urinary output is a(n):</p> <ol style="list-style-type: none"> hypertensive diuretic channel blocker enzyme |

The urinary system excretes metabolic waste. In forming and eliminating urine, it also regulates the composition, volume, and acid-base balance (pH) of body fluids. In several ways, kidney activity affects the circulation. The urinary system is thus of critical importance in maintaining homeostasis, the state of internal balance. As shown in **Figure 13-1**, the urinary system consists of:

- Two kidneys, the organs that form urine
- Two ureters, which transport urine from the kidneys to the bladder
- The urinary bladder, which stores and eliminates urine
- The urethra, which carries urine out of the body

The Kidneys

The **kidneys** are the organs that form **urine** from substances filtered out of the blood. In addition to metabolic wastes, urine contains water and ions, so its formation is important in regulating the blood's volume and composition. In

addition, the kidneys produce two substances that act on the circulatory system:

- **Erythropoietin (EPO)**, a hormone that stimulates red blood cell production in the bone marrow.
- **Renin**, an enzyme that functions to raise blood pressure. It activates a blood component called **angiotensin**, which causes constriction of the blood vessels. The drugs known as ACE inhibitors (angiotensin-converting enzyme inhibitors) lower blood pressure by interfering with the production of angiotensin.

LOCATION AND STRUCTURE OF THE KIDNEYS

The kidneys are located behind the peritoneum in the lumbar region. On the top of each kidney rests an adrenal gland. The kidney is encased in a capsule of fibrous connective tissue overlaid with fat. An outermost layer of connective tissue supports the kidney and anchors it to the body wall.

If you look inside the kidney (**Fig. 13-2**), you will see that it has an outer region, the **renal cortex**, and an inner region, the **renal medulla** (see **Box 13-1**). The medulla is divided into

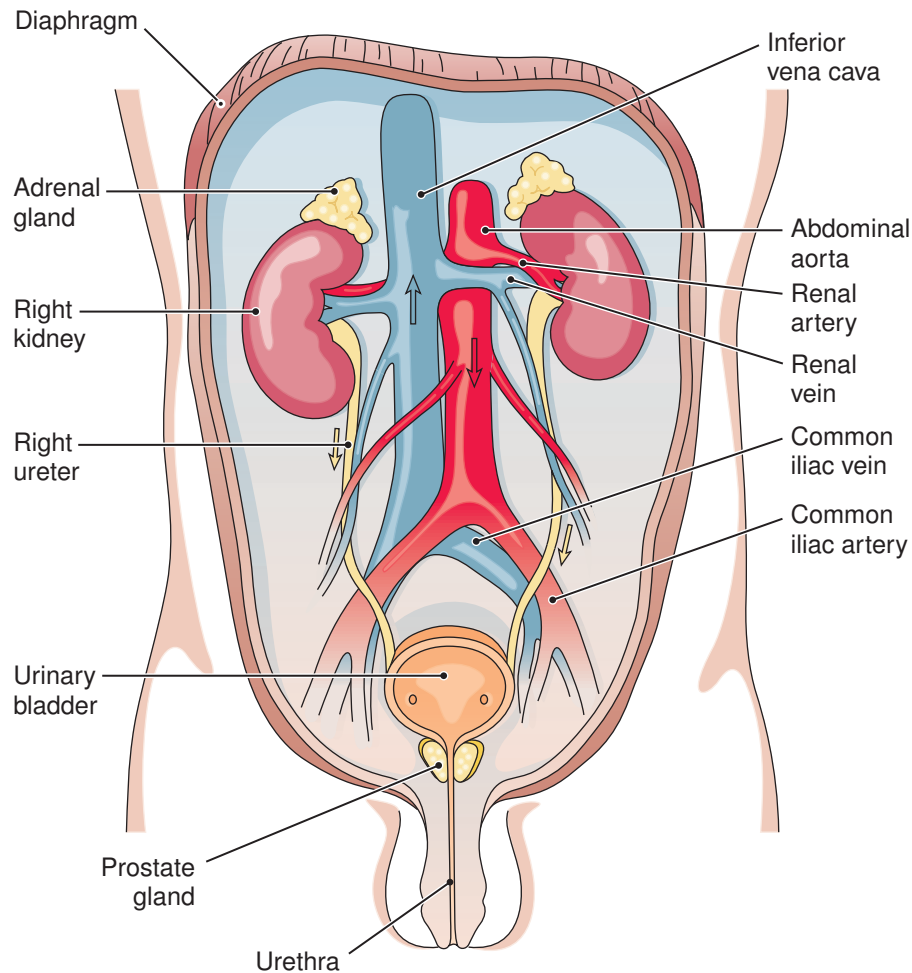


Figure 13-1 The male urinary system. The urinary system is shown along with nearby blood vessels and the adrenal glands.

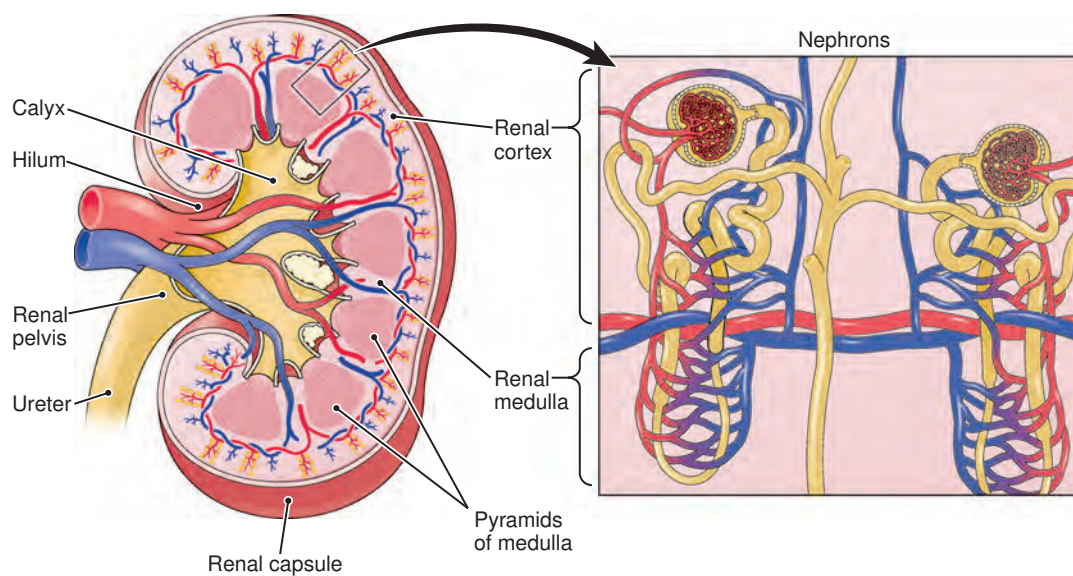


Figure 13-2 The kidney. (Left) A longitudinal section through the kidney shows its internal structure. The hilum is the point where blood vessels and ducts connect with the kidney. (Right) An enlarged diagram of nephrons. Each kidney contains more than 1 million nephrons.

Box 13-1



Focus on Words

Words That Serve Double Duty

Some words appear in more than one body system to represent different structures. The medulla of the kidney is the inner portion of the organ. Other organs, such as the adrenal gland, ovary, and lymph nodes, may also be divided into a central medulla and outer cortex. But *medulla* means “marrow,” and this term also applies to the bone marrow, to the spinal cord, and to the part of the brain that connects with the spinal cord, the medulla oblongata.

A ventricle is a chamber. There are ventricles in the brain and in the heart. The word *fundus* means the back part or

base of an organ. The uterus has a fundus, the upper rounded portion farthest from the cervix, as does the stomach. The fundus of the eye, examined for signs of diabetes and glaucoma, is the innermost layer, where the retina is located. A macula is a spot. There is a macula in the eye, which is the point of sharpest vision. There is also a macula in the ear, which contains receptors for equilibrium.

In interpreting medical terminology, it is often important to know the context in which a word is used.

triangular sections, the **renal pyramids**. These pyramids have a lined appearance because they are made up of the loops and collecting tubules of the **nephrons**, the kidney’s functional units. Each collecting tubule empties into a urine-collecting

area called a **calyx** (from the Latin word meaning “cup”). Several of the smaller minor calices merge to form a major calyx. The major calices then unite to form the **renal pelvis**, the upper funnel-shaped portion of the **ureter**.

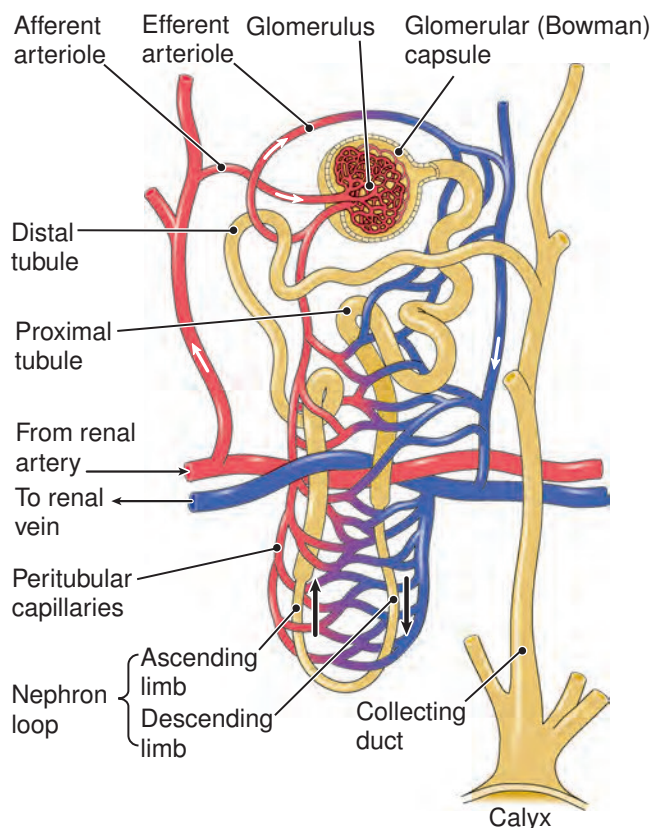


Figure 13-3 A nephron and its blood supply. The nephron regulates the proportion of water, waste, and other materials in urine according to the body’s constantly changing needs. A nephron consists of a glomerular capsule, convoluted tubules, the nephron loop (loop of Henle), and a collecting duct. Blood filtration occurs through the glomerulus in the glomerular capsule. Materials that enter the nephron can be returned to the blood through the surrounding peritubular capillaries.

THE NEPHRONS

The tiny working units of the kidneys are the nephrons (**Fig. 13-3**). Each of these microscopic structures is basically a single tubule coiled and folded into various shapes. The tubule begins with a cup-shaped **glomerular (Bowman) capsule**, which is part of the nephron’s blood-filtering device. The tubule then folds into the proximal tubule, straightens out to form the nephron loop (loop of Henle), coils again into the distal tubule, and then finally straightens out to form a collecting duct.

BLOOD SUPPLY TO THE KIDNEY

Blood enters the kidney through a renal artery, a short branch of the abdominal aorta. This vessel subdivides into smaller vessels as it branches throughout the kidney tissue, until finally blood is brought into the glomerular capsule and circulated through a cluster of capillaries, called a **glomerulus**, within the capsule.

Blood leaves the kidney by a series of vessels that finally merge to form the renal vein, which empties into the inferior vena cava.

Urine Formation

As blood flows through the glomerulus, blood pressure forces materials through the glomerular wall and through the wall of the glomerular capsule into the nephron. The fluid that enters the nephron, the **glomerular filtrate**, consists mainly of water, electrolytes, soluble wastes, nutrients, and toxins. The main waste material is **urea**, the nitrogenous (nitrogen-containing) byproduct of protein metabolism. The filtrate should not contain any cells or proteins, such as albumin.

The waste material and the toxins must be eliminated, but most of the water, electrolytes, and nutrients must be returned to the blood, or we would rapidly starve and dehydrate. This return process, termed **tubular reabsorption**, occurs through the peritubular capillaries that surround the nephron.

As the filtrate flows through the nephron, other processes further regulate its composition and pH. The filtrate's concentration is also adjusted under the effects of a pituitary hormone. **Antidiuretic hormone (ADH)** promotes reabsorption of water, thus concentrating the filtrate. The final filtrate, now called urine, flows into the collecting ducts to be eliminated. A **diuretic** is a substance that promotes increased urinary output or **diuresis**. Diuretic drugs are used in treating hypertension and heart failure to decrease fluid volume and reduce the heart's workload (see Chapter 9).



See the animation “Renal Function” and a chart on the role of hormones in electrolyte balance in the Student Resources on thePoint.

TRANSPORT AND REMOVAL OF URINE

Urine is drained from the renal pelvis and carried by the left and right ureters to the **urinary bladder** (Fig. 13-4), where it is stored. As the bladder fills, it expands upward from a stable triangle at its base. This triangle, the **trigone**, is marked by the ureteral openings and the urethral opening below (see Fig. 13-4). The trigone's stability prevents urine from refluxing into the ureters.

Fullness stimulates a reflex contraction of the bladder muscle and expulsion of urine through the **urethra**. The female urethra is short (4 cm [1.5 in.]) and carries only

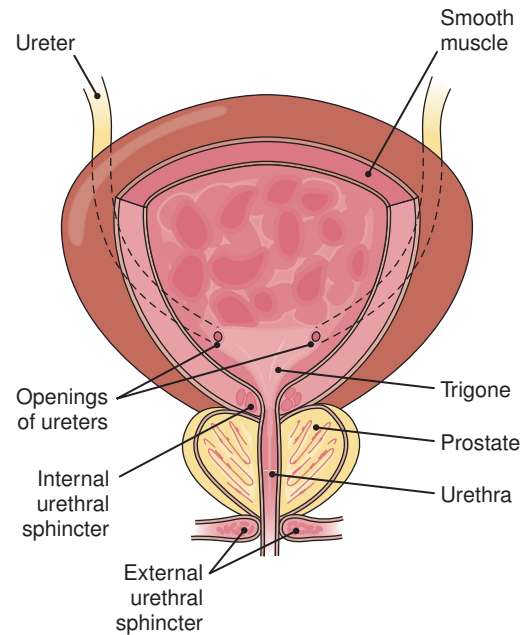


Figure 13-4 The urinary bladder. The interior of the male bladder is shown. The trigone is a triangular region in the bladder floor marked by the openings of the ureters and the urethra. The urethra travels through the prostate gland in the male.

urine. The male urethra is longer (20 cm [8 in.]) and carries both urine and semen.

The voiding (release) of urine, technically called **micturition** or **urination**, is regulated by two sphincters (circular muscles) that surround the urethra. The superior muscle, the internal urethral sphincter, is around the entrance to the urethra and functions involuntarily; the inferior muscle, the external urethral sphincter, is under conscious control. An inability to retain urine is termed *urinary incontinence*.

Terminology

Key Terms

Normal Structure and Function

antidiuretic hormone (ADH) <i>an-ti-dī-ū-RET-ik</i>	A hormone released from the pituitary gland that causes water reabsorption in the kidneys, thus concentrating the urine
angiotensin <i>an-jē-ō-TEN-sin</i>	A substance that increases blood pressure; activated in the blood by renin, an enzyme produced by the kidneys
calyx <i>KĀ-lik</i>	A cup-like cavity in the pelvis of the kidney; also calix (plural: calices) (roots: cali, calic)
diuresis <i>dī-ū-RE-sis</i>	Excretion of urine; usually meaning increased urinary excretion
diuretic <i>dī-ū-RET-ik</i>	A substance that increases the excretion of urine; pertaining to diuresis
erythropoietin (EPO) <i>e-rith-rō-POY-e-tin</i>	A hormone produced by the kidneys that stimulates red blood cell production in the bone marrow

(Continued)

Terminology

Key Terms (Continued)

glomerular capsule <i>glō-MER-ū-lar KAP-sūl</i>	The cup-shaped structure at the beginning of the nephron that surrounds the glomerulus and receives material filtered out of the blood; Bowman (<i>BŌ-man</i>) capsule
glomerular filtrate <i>glō-MER-ū-lar FIL-trāt</i>	The fluid and dissolved materials that filter out of the blood and enter the nephron through the glomerular capsule
glomerulus <i>glō-MER-ū-lus</i>	The cluster of capillaries within the glomerular capsule (plural: glomeruli) (root: glomerul/o)
kidney <i>KID-nē</i>	An organ of excretion (roots: ren/o, nephr/o); the two kidneys filter the blood and form urine, which contains metabolic waste products and other substances as needed to regulate the water, electrolyte, and pH balance of body fluids
micturition <i>mik-tū-RISH-un</i>	The voiding of urine; urination
nephron <i>NEF-ron</i>	A microscopic functional unit of the kidney; working with blood vessels, the nephron filters the blood and balances the composition of urine
renal cortex <i>RE-nal KOR-tex</i>	The kidney's outer portion; contains portions of the nephrons
renal medulla <i>me-DUL-la</i>	The kidney's inner portion; contains portions of the nephrons and ducts that transport urine toward the renal pelvis
renal pelvis <i>PEL-vis</i>	The expanded upper end of the ureter that receives urine from the kidney; Greek root <i>pyell/o</i> means "basin"
renal pyramid <i>PER-a-mid</i>	A triangular structure in the renal medulla; composed of the nephrons' loops and collecting ducts
renin <i>RE-nin</i>	An enzyme produced by the kidneys that activates angiotensin in the blood
trigone <i>TRĪ-gōn</i>	A triangle at the base of the bladder formed by the openings of the two ureters and the urethra (see Fig. 13-4)
tubular reabsorption <i>TŪB-ū-lar rē-ab-SORP-shun</i>	The return of substances from the glomerular filtrate to the blood through the peritubular capillaries
urea <i>ū-RE-a</i>	The main nitrogenous (nitrogen-containing) waste product in the urine
ureter <i>Ū-rē-ter</i>	The tube that carries urine from the kidney to the bladder (root: ureter/o)
urethra <i>ū-RE-thra</i>	The tube that carries urine from the bladder to the outside of the body (root: urethr/o)
urinary bladder <i>ū-ri-NAR-ē BLAD-der</i>	The organ that stores and eliminates urine excreted by the kidneys (roots: cyst/o, vesic/o)
urination <i>ū-ri-NĀ-shun</i>	The voiding of urine; micturition
urine <i>Ū-rin</i>	The fluid excreted by the kidneys. It consists of water, electrolytes, urea, other metabolic wastes, and pigments. A variety of other substances may appear in urine in cases of disease (root: ur/o)



Go to the Audio Pronunciation Glossary in the Student Resources on *thePoint* to hear these terms pronounced.

Roots Pertaining to the Urinary System

See **Tables 13-1 and 13-2.**

Table 13-1 Roots for the Kidney

Root	Meaning	Example	Definition of Example
ren/o	kidney	suprarenal <i>sū-pra-RĒ-nal</i>	above the kidney
nephr/o	kidney	nephrosis <i>nef-RŌ-sis</i>	any noninflammatory disease condition of the kidney
glomerul/o	glomerulus	juxtaglomerular <i>juks-ta-glō-MER-ū-lar</i>	near the glomerulus
pyel/o	renal pelvis	pyelectasis <i>pī-e-LEK-ta-sis</i>	dilatation of the renal pelvis
cali/o, calic/o	calyx	caliceal <i>kal-i-SĒ-al</i>	pertaining to a renal calyx (note addition of e); also spelled calyceal

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EXERCISE 13-1

Use the root **ren/o** to write a word for the following:

- behind (post-) the kidney _____ postrenal
- before or in front of (pre-) the kidney _____
- between the kidneys _____
- around the kidneys _____

Use the root **nephr/o** to write a word for the following:

- study of the kidney _____
- any disease of the kidney _____
- poisonous or toxic to the kidney _____
- softening of the kidney _____
- surgical removal of the kidney _____

Use the appropriate root to write a word for the following:

- inflammation of a glomerulus _____
- dilatation of a renal calyx _____
- plastic repair of the renal pelvis _____
- radiograph of the renal pelvis _____
- radiographic study (-graphy) of the kidney _____
- incision of a renal calyx _____
- hardening of a glomerulus _____
- inflammation of the renal pelvis and kidney _____

Table 13-2 Roots for the Urinary Tract (Except the Kidney)

Root	Meaning	Example	Definition of Example
ur/o	urine, urinary tract	urosepsis ŭ-ro-SEP-sis	generalized infection that originates in the urinary tract
urin/o	urine	nocturia nok-Tŭ-rē-a	urination during the night (noct/i)
ureter/o	ureter	ureterostenosis ŭ-rē-ter-ō-ste-NŌ-sis	narrowing of the ureter
cyst/o	urinary bladder	cystocele SIS-tō-sēl	hernia of the urinary bladder
vesic/o	urinary bladder	intravesical in-tra-VES-i-kal	within the urinary bladder
urethr/o	urethra	urethrotome ŭ-RE-thrō-tōm	instrument for incising the urethra

EXERCISE 13-2

Use the root *ur/o* to write a word for the following:

- study of the urinary tract _____
- radiography of the urinary tract _____
- a urinary calculus (stone) _____
- presence of urinary waste products in the blood _____

The root *ur/o* is used in the suffix *-uria*, which means “condition of urine or of urination.” Use *-uria* to write a word for the following:

- lack of urine _____ anuria
- painful or difficult urination _____
- formation of excess (poly-) urine _____
- presence of cells in the urine _____
- presence of blood (hemat/o) in the urine _____

The suffix *-uresis* means “urination.” Use *-uresis* to write a word for the following:

- increased excretion of urine _____ diuresis
- lack of urination _____
- excretion of sodium (natri-) in the urine _____
- excretion of potassium (kali-) in the urine _____

The adjective ending for the above words is *-uretic*, as in *diuretic* (pertaining to diuresis) and *natriuretic* (pertaining to the excretion of sodium in the urine).

Use the appropriate root to write a word for the following:

- surgical fixation of the urethra _____
- surgical creation of an opening in the ureter _____

EXERCISE 13-2 (Continued)

16. a ureteral calculus

17. endoscopic examination of the urethra

Use the root *cyst/o* to write a word for the following:

18. inflammation of the urinary bladder

19. surgical fixation of the urinary bladder

20. an instrument for examining the interior of the bladder

21. incision of the bladder

Use the root *vesic/o* to write a word for the following:

22. above the urinary bladder

23. pertaining to the urethra and bladder

Define the following terms:24. cystalgia (*sis-TAL-jē-a*)25. ureterotomy (*ū-rē-ter-OT-ō-mē*)26. transurethral (*trans-ū-RĒ-thral*)27. uropoiesis (*ū-rō-poy-Ē-sis*)

Clinical Aspects of the Urinary System

INFECTIONS

Organisms that infect the urinary tract generally enter through the urethra and ascend toward the bladder, producing **cystitis**. Untreated, the infection can ascend even further into the urinary tract. The infecting organisms are usually colon bacteria carried in feces, particularly *Escherichia coli*. Although urinary tract infections (UTIs) do occur in men, they appear more commonly in women because the female urethra is shorter than the male urethra and its opening is closer to the anus. Poor toilet habits and **urinary stasis** are contributing factors. In hospitals, UTIs may result from procedures involving the urinary system, especially **catheterization**, in which a tube is inserted into the bladder to withdraw urine (Fig. 13-5). Less frequently, UTIs originate in the blood and descend through the urinary system.

An infection that involves the kidney and renal pelvis is termed **pyelonephritis**. As in cystitis, signs of this condition include **dysuria**, painful or difficult urination, and the presence of bacteria and pus in the urine, **bacteriuria** and **pyuria**, respectively.

Urethritis is inflammation of the urethra, generally associated with sexually transmitted infections such as gonorrhea and chlamydial infections (see Chapter 14).



See the chart on urinary obstruction, reflux, and infection and the figure on acute pyelonephritis in the Student Resources on thePoint.

GLOMERULONEPHRITIS

Although the name simply means inflammation of the glomeruli and kidney, **glomerulonephritis** is a specific disorder that follows an immunologic reaction. It is usually a response to infection in another system, commonly a streptococcal infection of the respiratory tract or a skin infection. It may also accompany autoimmune diseases such as lupus erythematosus. The symptoms are hypertension, edema, and **oliguria**, the passage of small amounts of urine. This urine is highly concentrated. Because of damage to kidney tissue, blood and proteins escape into the nephrons, causing **hematuria**, blood in the urine, and **proteinuria**, protein in the urine. Blood cells may also form into small molds of the kidney tubule, called **casts**, which can be found in the urine. Most patients fully recover from glomerulonephritis, but in some cases, especially among the elderly, the disorder may lead to chronic renal failure (CRF) or end-stage renal disease (ESRD). In such cases, urea and other nitrogenous compounds accumulate in the blood, a condition termed **uremia**. These compounds affect the central nervous system, causing irritability, loss of appetite, stupor, and other symptoms. There is also electrolyte imbalance and **acidosis**.

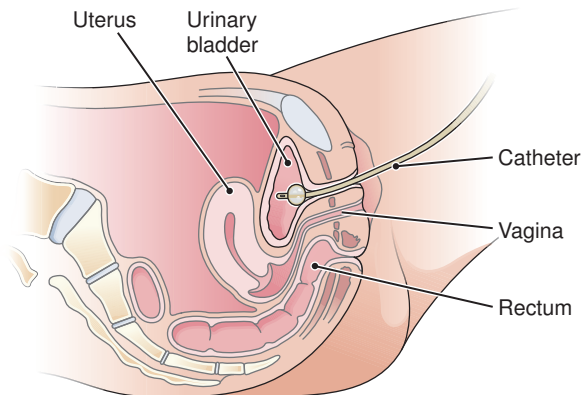


Figure 13-5 An indwelling (Foley) catheter. The catheter is shown in place in the female bladder.

NEPHROTIC SYNDROME

Glomerulonephritis is one cause of **nephrotic syndrome**, a disease in which the glomeruli become overly permeable and allow the loss of proteins. Other possible causes of nephrotic syndrome are renal vein thrombosis, diabetes, systemic lupus erythematosus, toxins, or any other condition that damages the glomeruli.

Nephrotic syndrome is marked by proteinuria and **hypoproteinemia**, low blood protein. The low plasma protein level affects capillary exchange and results in edema. There is also an increase in blood lipids, as the liver compensates for lost protein by releasing lipoproteins.

ACUTE RENAL FAILURE

Injury, shock, exposure to toxins, infections, and other renal disorders may cause damage to the nephrons, resulting in acute renal failure (ARF). There is rapid loss of

kidney function with oliguria and accumulation of nitrogenous wastes in the blood. Failure of the kidneys to eliminate potassium leads to hyperkalemia, along with other electrolyte imbalances and acidosis (see Box 13-2). When destruction (necrosis) of kidney tubules is involved, the condition may be referred to as acute tubular necrosis (ATN).

Renal failure may lead to a need for kidney **dialysis** or, ultimately, **renal transplantation**. Dialysis refers to the movement of substances across a semipermeable membrane; it is a method used to eliminate harmful or unnecessary substances from the body when the kidneys are impaired or have been removed (Fig. 13-6). Two approaches are used:

- In **hemodialysis**, blood is cleansed by passage over a membrane surrounded by fluid (dialysate) that draws out unwanted substances. Most people on hemodialysis are treated for four hours three times a week in a dialysis center. Some patients are able to use simpler machines at home for daily dialysis. Box 13-3 has information on careers in hemodialysis treatment.
- In **peritoneal dialysis**, fluid is introduced into the peritoneal cavity. The fluid, along with waste products, is periodically withdrawn and replaced (Fig. 13-7). Fluid may be exchanged at intervals throughout the day in continuous ambulatory peritoneal dialysis (CAPD) or during the night in continuous cyclic peritoneal dialysis (CCPD).

URINARY STONES

Urinary lithiasis (presence of stones) may be related to infection, irritation, diet, or hormone imbalances that lead to increased calcium in the blood. Most urinary calculi (stones) are made up of calcium salts, but they may be composed of

Box 13-2



Clinical Perspectives

Sodium and Potassium: Causes and Consequences of Imbalance

Sodium and potassium concentrations in body fluids are important measures of water and electrolyte balance. An excess of sodium in body fluids is termed **hypernatremia**, taken from the Latin name for sodium, *natrium*. This condition accompanies dehydration and severe vomiting and may cause hypertension, edema, convulsions, and coma. **Hyponatremia**, a sodium deficiency in body fluids, can come from water intoxication (overhydration), heart failure, kidney failure, cirrhosis of the liver, pH imbalance, or endocrine disorders. It can cause muscle weakness, hypotension, confusion, shock, convulsions, and coma.

The term **hyperkalemia** is taken from the Latin name for potassium, *kalium*. It refers to excess potassium in body fluids, which may result from kidney failure, dehydration, and other causes. Its signs and symptoms include nausea, vomiting, muscular weakness, and severe cardiac arrhythmias. **Hypokalemia**, or low potassium in body fluids, may result from taking diuretics that cause potassium to be lost along with water. It may also result from pH imbalance or secretion of too much aldosterone from the adrenal cortex, resulting in potassium excretion. Hypokalemia causes muscle fatigue, paralysis, confusion, hypoventilation, and cardiac arrhythmias.

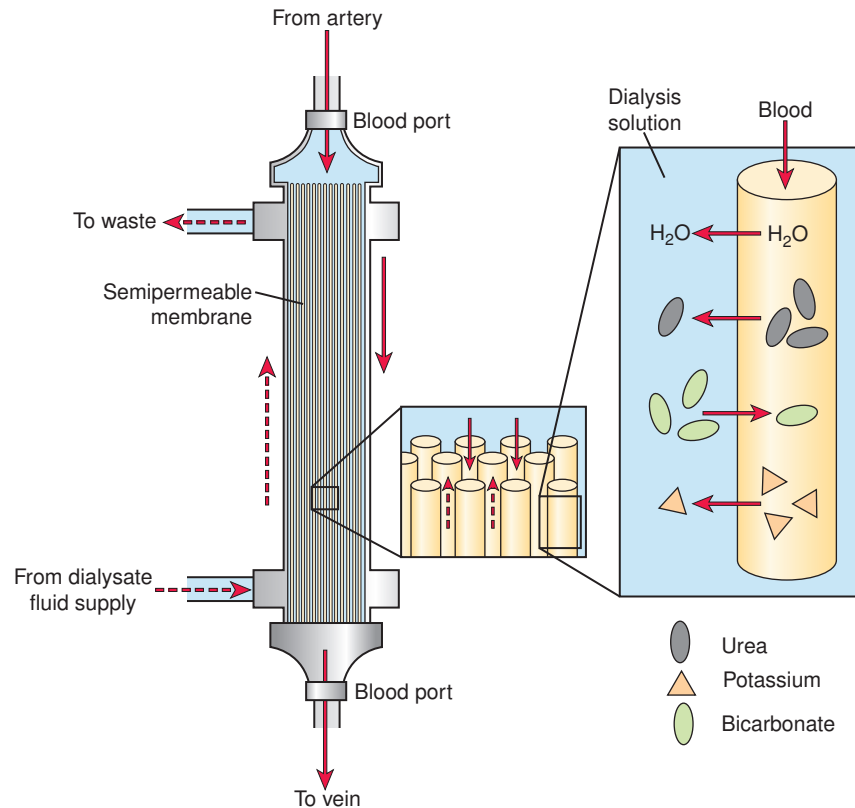


Figure 13-6 Hemodialysis. A semipermeable membrane separates the patient's blood from the dialysis solution. This membrane allows all the blood constituents except plasma proteins and blood cells to diffuse between the two compartments. Water, electrolytes, and other dissolved substances move from higher to lower concentration, removing waste materials, and restoring the blood's proper composition.

Box 13-3



Health Professions

Hemodialysis Technician

A hemodialysis technician, also called a renal technician or a nephrology technician, specializes in the safe and effective delivery of renal dialysis therapy to patients suffering from kidney failure. Before treatment begins, the technician prepares the dialysis solutions and ensures that the dialysis machine is clean, sterile, and in proper working order. The technician measures and records the patient's weight, temperature, and vital signs, inserts a catheter into the patient's arm, and connects the dialysis machine to it. During dialysis, the technician monitors the patient for adverse reactions and guards against any equipment malfunction. After the treatment is completed, the technician again measures and

records the patient's weight, temperature, and vital signs. To perform these duties, hemodialysis technicians need thorough scientific and clinical training. Most technicians in the United States receive their training from a college or technical school, and many states require that the technician be certified.

Hemodialysis technicians work in a variety of settings, such as hospitals, clinics, and patients' homes. As populations age, the incidence of kidney disease is expected to rise, as will the need for hemodialysis. For more information about this career, contact the National Association of Nephrology Technicians at www.dialysistech.net.

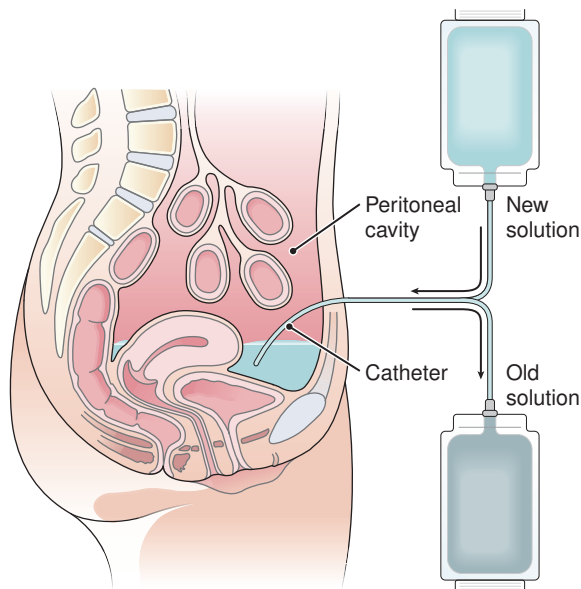


Figure 13-7 Peritoneal dialysis. The peritoneum, a semipermeable membrane richly supplied with small blood vessels, lines the peritoneal cavity. Waste products diffuse from the network of blood vessels into the dialysate in the peritoneal cavity.

other materials as well. Causes of stone formation include dehydration, infection, abnormal pH of urine, urinary stasis, and metabolic imbalances. The stones generally form in the kidney and may move to the bladder (Fig. 13-8). This results in great pain, termed **renal colic**, and obstruction that can promote infection and cause **hydronephrosis**, collection of urine in the renal pelvis.

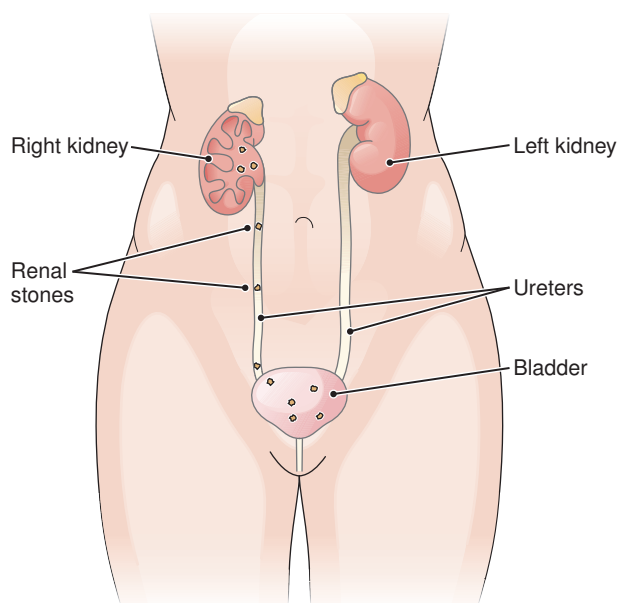


Figure 13-8 Calculus formation in the urinary tract. Various possible sites of calculus (stone) formation are shown.

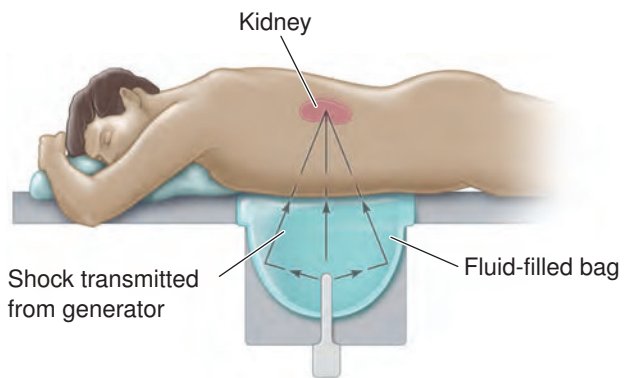


Figure 13-9 Lithotripsy. Shock waves are used to break kidney stones and allow for their passage. The procedure is called extracorporeal shock-wave lithotripsy (ESWL).



See the figure on hydronephrosis in the Student Resources on thePoint.

Because they are radiopaque, stones can usually be seen on simple radiographs of the abdomen. Stones may dissolve and pass out of the body on their own. If not, they may be removed surgically, in a **lithotomy**, or by endoscopy. External shock waves are used to crush stones in the urinary tract in a procedure called extracorporeal (outside the body) shock-wave **lithotripsy** (crushing of stones) (Fig. 13-9).

CANCER

Carcinoma of the bladder has been linked to occupational exposure to chemicals, parasitic infections, and cigarette smoking. A key symptom is sudden, painless hematuria. Often, the cancer can be seen by viewing the bladder lining with a **cystoscope** (Fig. 13-10). This instrument can also be used to biopsy tissue for study.

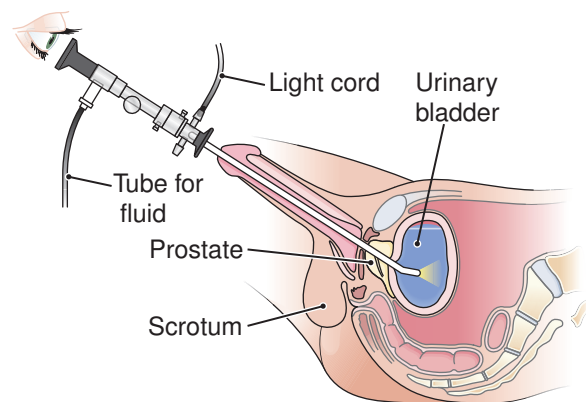


Figure 13-10 Cystoscopy. A lighted cystoscope is introduced through the urethra into the bladder of a male subject. Sterile fluid is used to inflate the bladder. Cystoscopes are used to examine the bladder, take biopsy specimens, and remove tumors.

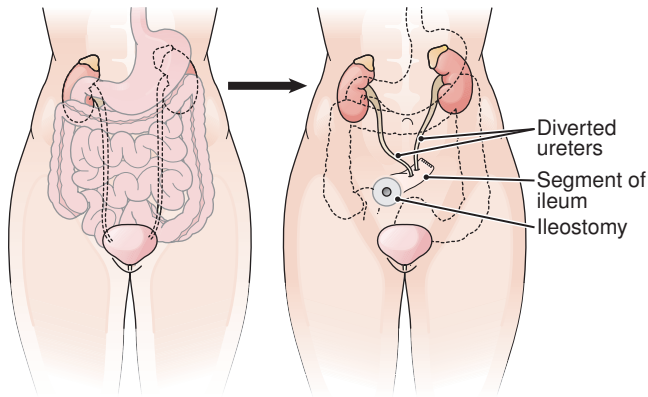


Figure 13-11 Ileal conduit. In this surgery, the ureters are vented to the body surface through the ileum when the bladder is removed or nonfunctional.

If treatment is not effective in permanently removing the tumor, a **cystectomy** (removal of the bladder) may be necessary. In this case, the ureters must be vented elsewhere, such as directly to the body surface through the

ileum in an **ileal conduit** (Fig. 13-11), or to some other portion of the intestine.

Cancer may also involve the kidney and renal pelvis. Additional means for diagnosing cancer and other urinary tract disorders include ultrasound, computed tomography scans, and radiographic studies such as **intravenous urography (IVU)** (Fig. 13-12), also called **intravenous pyelography (IVP)**, and **retrograde pyelography**.

URINALYSIS

Urinalysis (UA) is a simple and widely used method for diagnosing urinary tract disorders. It may also reveal disturbances in other systems when abnormal byproducts are eliminated in the urine. In a routine UA, the urine is grossly examined for color and turbidity (a sign that bacteria are present); **specific gravity (SG)** (a measure of concentration) and pH are recorded; tests are performed for chemical components such as glucose, ketones, and hemoglobin; and the urine is examined microscopically for cells, crystals, and casts. In more detailed tests, drugs, enzymes, hormones, and other metabolites may be analyzed, and bacterial cultures may be performed.

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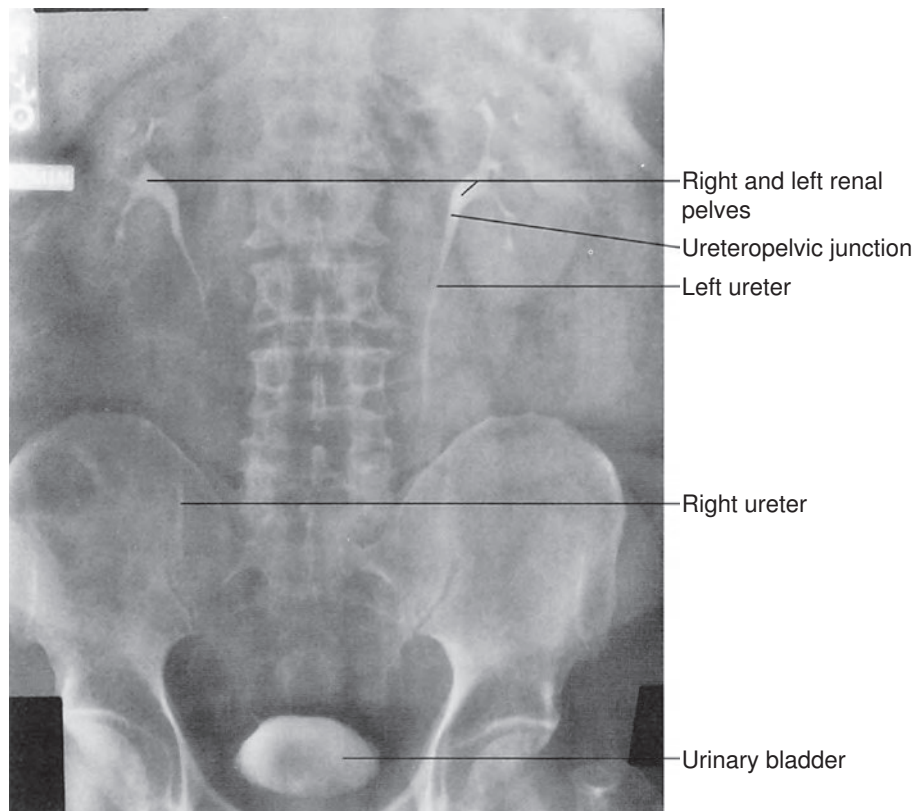


Figure 13-12 Intravenous urogram. The image shows the renal pelves, ureters, and urinary bladder.

Disorders

acidosis <i>as-i-DŌ-sis</i>	Excessive acidity of body fluids
bacteriuria <i>bak-tē-rē-Ū-rē-a</i>	Presence of bacteria in the urine
cast	A solid mold of a renal tubule found in the urine
cystitis <i>sis-TĪ-tis</i>	Inflammation of the urinary bladder, usually as a result of infection
dysuria <i>dis-Ū-rē-a</i>	Painful or difficult urination
glomerulonephritis <i>glō-mer-ū-lō-nef-RĪ-tis</i>	Inflammation of the kidney primarily involving the glomeruli. The acute form usually occurs after an infection elsewhere in the body; the chronic form varies in cause and usually leads to renal failure
hematuria <i>hē-mat-Ū-rē-a</i>	Presence of blood in the urine
hydronephrosis <i>hī-drō-nef-RŌ-sis</i>	Collection of urine in the renal pelvis caused by obstruction; results in distention and renal atrophy
hypokalemia <i>hī-pō-ka-LĒ-mē-a</i>	Deficiency of potassium in the blood
hyponatremia <i>hī-pō-na-TRĒ-mē-a</i>	Deficiency of sodium in the blood
hypoproteinemia <i>hī-pō-prō-tē-NĒ-mē-a</i>	Decreased amount of protein in the blood; may be caused by kidney damage resulting in protein loss
hyperkalemia	Excess amount of potassium in the blood
hypernatremia	Excess amount of sodium in the blood
nephrotic syndrome <i>nef-ROT-ik</i>	Condition that results from glomerular damage leading to loss of protein in the urine (proteinuria). There is low plasma protein (hypoproteinemia), edema, and increased blood lipids as the liver releases lipoproteins. Also called nephrosis
oliguria <i>ol-ig-Ū-rē-a</i>	Elimination of small amounts of urine
proteinuria <i>prō-tē-NŪ-rē-ā</i>	Presence of protein, mainly albumin, in the urine
pyelonephritis <i>pī-e-lō-ne-FRĪ-tis</i>	Inflammation of the renal pelvis and kidney, usually caused by infection
pyuria <i>pī-Ū-rē-a</i>	Presence of pus in the urine
renal colic <i>KOL-ik</i>	Radiating pain in the region of the kidney associated with the passage of a stone
uremia <i>ū-RĒ-mē-a</i>	Presence of toxic levels of urea and other nitrogenous substances in the blood as a result of renal insufficiency
urethritis <i>ū-rē-THRĪ-tis</i>	Inflammation of the urethra, usually due to infection
urinary stasis <i>STĀ-sis</i>	Stoppage of urine flow; urinary stagnation

Terminology

Key Terms (Continued)

Diagnosis and Treatment

catheterization <i>kath-e-ter-i-ZĀ-shun</i>	Introduction of a tube into a passage, such as through the urethra into the bladder for withdrawal of urine (see Fig. 13-5)
cystoscope <i>SIS-tō-skōp</i>	An instrument for examining the interior of the urinary bladder. Also used for removing foreign objects, for surgery, and for other forms of treatment
dialysis <i>dī-AL-i-sis</i>	Separation of substances by passage through a semipermeable membrane. Dialysis is used to rid the body of unwanted substances when the kidneys are impaired or missing. The two forms of dialysis are hemodialysis and peritoneal dialysis
hemodialysis <i>hē-mō-dī-AL-i-sis</i>	Removal of unwanted substances from the blood by passage through a semipermeable membrane (see Fig. 13-6)
intravenous pyelography (IVP) <i>pī-e-LOG-ra-fē</i>	Intravenous urography (see Fig. 13-12)
intravenous urography (IVU) <i>u-ROG-ra-fē</i>	Radiographic visualization of the urinary tract after intravenous administration of a contrast medium that is excreted in the urine; also called excretory urography or intravenous pyelography, although the latter is less accurate because the procedure shows more than just the renal pelvis
lithotripsy <i>LITH-ō-trip-sē</i>	Crushing of a stone (see Fig. 13-9)
peritoneal dialysis <i>per-i-tō-NĒ-al dī-AL-i-sis</i>	Removal of unwanted substances from the body by introduction of a dialyzing fluid into the peritoneal cavity followed by removal of the fluid (see Fig. 13-7)
retrograde pyelography <i>RET-rō-grād pī-e-LOG-ra-fē</i>	Pyelography in which the contrast medium is injected into the kidneys from below, by way of the ureters
specific gravity (SG)	The weight of a substance compared with the weight of an equal volume of water. The specific gravity of normal urine ranges from 1.015 to 1.025. This value may increase or decrease in disease
urinalysis (UA) <i>ū-rī-NAL-i-sis</i>	Laboratory study of the urine. Physical and chemical properties and microscopic appearance are included

Surgery

cystectomy <i>sis-TEK-tō-mē</i>	Surgical removal of all or part of the urinary bladder
ileal conduit <i>IL-ē-al KON-dū-it</i>	Diversion of urine by connection of the ureters to an isolated segment of the ileum. One end of the segment is sealed, and the other drains through an opening in the abdominal wall (see Fig. 13-11). A procedure used when the bladder is removed or nonfunctional. Also called ileal bladder
lithotomy <i>lith-OT-ō-mē</i>	Incision of an organ to remove a stone (calculus)
renal transplantation	Surgical implantation of a donor kidney into a patient



Go to the Audio Pronunciation Glossary in the Student Resources on thePoint to hear these words pronounced.

Terminology Supplementary Terms

Normal Structure and Function

aldosterone <i>al-DOS-ter-ōn</i>	A hormone secreted by the adrenal gland that regulates electrolyte excretion by the kidneys
clearance	The volume of plasma that the kidneys can clear of a substance per unit of time; renal plasma clearance
creatinine <i>krē-AT-in-in</i>	A nitrogenous byproduct of muscle metabolism. An increase in blood creatinine is a sign of renal failure
detrusor muscle <i>dē-TRŪ-sor</i>	The muscle in the bladder wall
glomerular filtration rate (GFR)	The amount of filtrate formed per minute by both kidneys
maximal transport capacity (T_m)	The maximum rate at which a given substance can be transported across the renal tubule; tubular maximum
renal corpuscle <i>KOR-pus-l</i>	The glomerular capsule and the glomerulus considered as a unit; the filtration device of the kidney

Symptoms and Conditions

anuresis <i>an-ū-RĒ-sis</i>	Lack of urination
anuria <i>an-Ū-rē-a</i>	Lack of urine formation
azotemia <i>az-ō-TĒ-mē-a</i>	Presence of increased nitrogenous waste, especially urea, in the blood
azoturia <i>az-ō-TŪ-rē-a</i>	Presence of increased nitrogenous compounds, especially urea, in the urine
cystocele <i>SIS-tō-sēl</i>	Herniation of the bladder into the vagina (see Fig. 15-12); vesicocoele
dehydration <i>dē-hī-DRĀ-shun</i>	Excessive loss of body fluids
diabetes insipidus <i>dr-a-BĒ-tēz in-SIP-id-us</i>	A condition caused by inadequate production of antidiuretic hormone, resulting in excessive excretion of dilute urine and extreme thirst
enuresis <i>en-ū-RĒ-sis</i>	Involuntary urination, usually at night; bed-wetting
epispadias <i>ep-i-SPĀ-dē-as</i>	A congenital condition in which the urethra opens on the dorsal surface of the penis as a groove or cleft; anaspadias
glycosuria <i>glī-kō-SŪ-rē-a</i>	Presence of glucose in the urine, as in cases of diabetes mellitus
horseshoe kidney	A congenital union of the lower poles of the kidneys, resulting in a horseshoe-shaped organ (Fig. 13-13)
hydroureter <i>hī-drō-ū-RĒ-ter</i>	Distention of the ureter with urine due to obstruction
hypospadias <i>hī-pō-SPĀ-dē-as</i>	A congenital condition in which the urethra opens on the undersurface of the penis or into the vagina (Fig. 13-14)

Terminology**Supplementary Terms** *(Continued)*

hypovolemia <i>hī-pō-vō-LĒ-mē-a</i>	A decrease in blood volume
neurogenic bladder <i>nū-rō-JEN-ik</i>	Any bladder dysfunction that results from a central nervous system lesion
nocturia <i>nok-TŪ-rē-a</i>	Excessive urination at night (<i>noct/o</i> means “night”)
polycystic kidney disease <i>pol-ē-SIS-tik</i>	A hereditary condition in which the kidneys are enlarged and contain many cysts (Fig. 13-15)
polydipsia <i>pol-ē-DIP-sē-a</i>	Excessive thirst
polyuria <i>pol-ē-Ū-rē-a</i>	Elimination of large amounts of urine, as in diabetes mellitus
retention of urine	Accumulation of urine in the bladder because of an inability to urinate
staghorn calculus	A kidney stone that fills the renal pelvis and calices to give a “staghorn” appearance (Fig. 13-16)
ureterocele <i>ū-RĒ-ter-ō-sēl</i>	A cyst-like dilation of the ureter near its opening into the bladder. Usually results from a congenital narrowing of the ureteral opening (Fig. 13-17)
urinary frequency	A need to urinate often without an increase in average output
urinary incontinence <i>in-KON-tin-ens</i>	Inability to retain urine; may originate with a neurologic disorder, trauma to the spinal cord, weakness of the pelvic muscles, urinary retention, or impaired bladder function. In urgency incontinence, an urge causes sudden urination before one has enough time to reach a bathroom. In stress incontinence, urine leaks during a forceful activity such as coughing, sneezing, or exercise
urinary urgency	Sudden need to urinate
water intoxication <i>in-tok-si-KĀ-shun</i>	Excess intake or retention of water with decrease in sodium concentration. May result from excess drinking, excess ADH, or replacement of a large amount of body fluid with pure water. Causes an imbalance in the cellular environment, with edema and other disturbances
Wilms tumor	A malignant kidney tumor that usually appears in children before the age of 5 years
Diagnosis	
anion gap <i>AN-ī-on</i>	A measure of electrolyte imbalance
blood urea nitrogen (BUN)	Nitrogen in the blood in the form of urea. An increase in BUN indicates an increase in nitrogenous waste products in the blood and renal failure
clean-catch specimen	A urine sample obtained after thorough cleansing of the urethral opening and collection in midstream to minimize the chance of contamination
cystometrography <i>sis-tō-me-TROG-ra-fē</i>	A study of bladder function in which the bladder is filled with fluid or air and the pressure exerted by the bladder muscle at varying degrees of filling is measured. The tracing recorded is a cystometrogram
protein electrophoresis (PEP)	Laboratory study of urinary proteins; used to diagnose multiple myeloma, systemic lupus erythematosus, and lymphoid tumor
urinometer <i>ū-ri-NOM-e-ter</i>	Device for measuring the specific gravity of urine

(Continued)

Terminology Supplementary Terms *(Continued)*

Treatment

indwelling Foley catheter A urinary tract catheter with a balloon at one end that prevents the catheter from leaving the bladder (see Fig. 13-5)

lithotrite
LITH-ō-trīt Instrument for crushing a bladder stone



Go to the Audio Pronunciation Glossary in the Student Resources on *thePoint* to hear these words pronounced.



Figure 13-13 Horseshoe kidney. The photograph shows the kidneys fused at the poles.

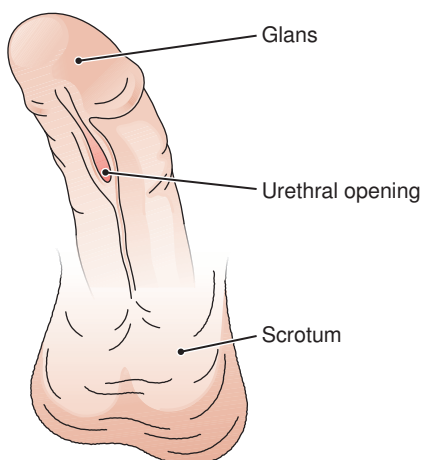


Figure 13-14 Hypospadias. The urethra is shown opening on the ventral surface of the penis.



Figure 13-15 Adult polycystic disease. The kidney is enlarged, and the active tissue is almost entirely replaced by cysts of varying size. (Left) Surface view. (Right) Longitudinal section.



Figure 13-16 Staghorn calculus. The kidney shows hydronephrosis and stones that are casts of the dilated calices.

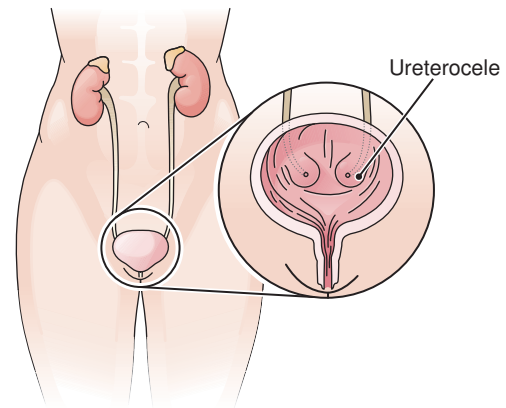


Figure 13-17 Ureterocele. The ureter bulges into the bladder. The resulting obstruction causes urine to reflux into the ureter (hydroureter) and renal pelvis (hydronephrosis).

Terminology

Abbreviations

ACE	Angiotensin-converting enzyme
ADH	Antidiuretic hormone
ARF	Acute renal failure
ATN	Acute tubular necrosis
BUN	Blood urea nitrogen
CAPD	Continuous ambulatory peritoneal dialysis
CCPD	Continuous cyclic peritoneal dialysis
CMG	Cystometrography; cystometrogram
CRF	Chronic renal failure
EPO	Erythropoietin
ESRD	End-stage renal disease
ESWL	Extracorporeal shock wave lithotripsy

GFR	Glomerular filtration rate
GU	Genitourinary
IVP	Intravenous pyelography
IVU	Intravenous urography
K	Potassium
KUB	Kidney-ureter-bladder (radiography)
Na	Sodium
PEP	Protein electrophoresis
SG	Specific gravity
Tm	Maximal transport capacity
UA	Urinalysis
UTI	Urinary tract infection

E.O.'s Follow-Up Study

E.O. had excellent results from the implanted autograft of muscle cells. There was no retention of urine, and the incontinence and urgency had all but disappeared. After a year, E.O.

continued to experience about a 95 percent success rate from her stress incontinence and had a much improved quality of life score.

Chapter Review

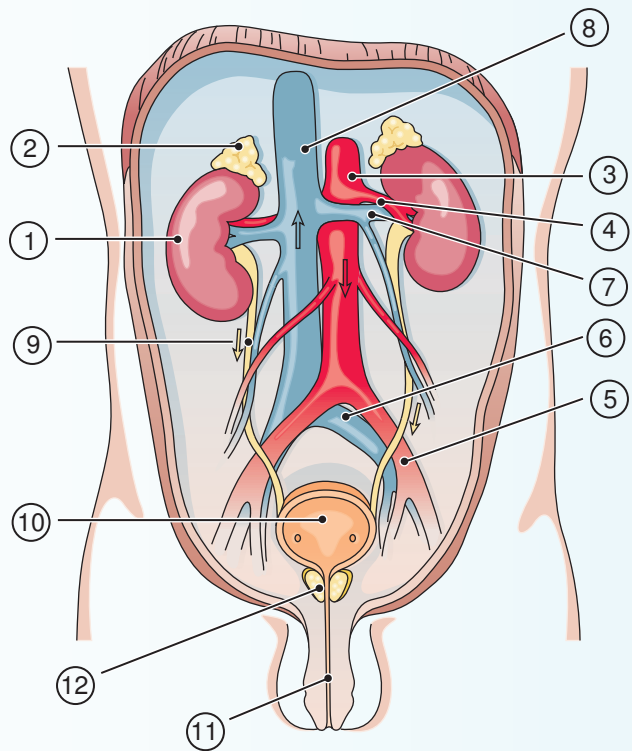
Labeling Exercise

URINARY SYSTEM

Write the name of each numbered part on the corresponding line of the answer sheet.

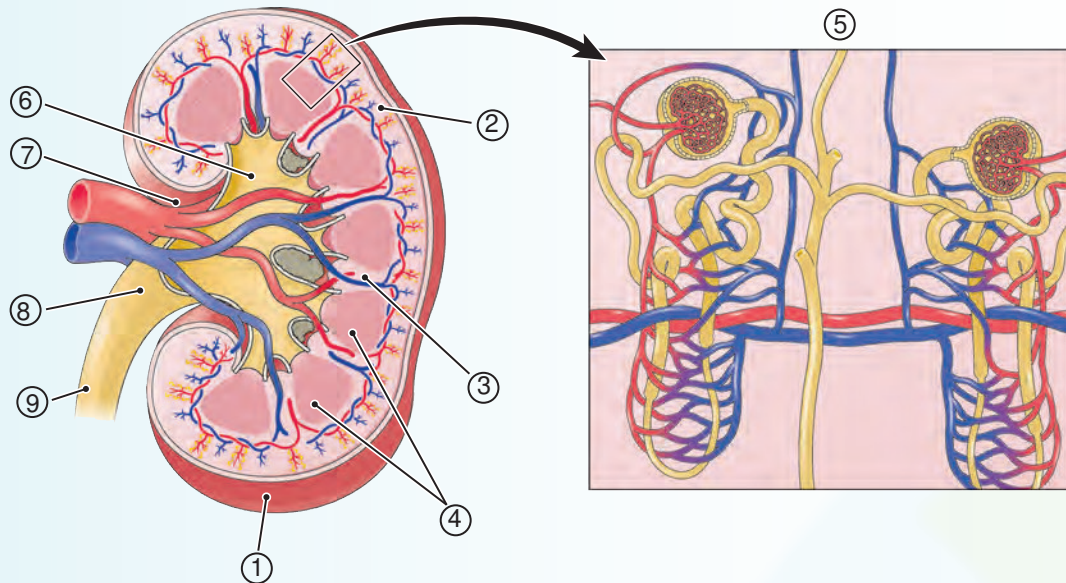
Abdominal aorta	Renal artery
Adrenal gland	Renal vein
Common iliac artery	Right kidney
Common iliac vein	Right ureter
Inferior vena cava	Urethra
Prostate gland	Urinary bladder

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____



THE KIDNEY

Write the name of each numbered part on the corresponding line of the answer sheet.



Calyx
Hilum
Nephrons
Pyramids of medulla
Renal capsule

Renal medulla
Renal pelvis
Renal cortex
Ureter

1. _____
2. _____
3. _____
4. _____
5. _____

6. _____
7. _____
8. _____
9. _____

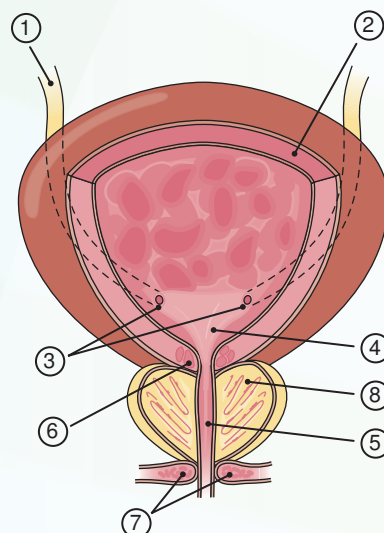
THE URINARY BLADDER

Write the name of each numbered part on the corresponding line of the answer sheet.

External urethral sphincter
Internal urethral sphincter
Openings of ureters
Prostate

Smooth muscle
Trigone
Ureter
Urethra

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____



Terminology

MATCHING

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|--------------------------|---|
| _____ 1. hematuria | a. abnormal color of urine |
| _____ 2. oliguria | b. pus in the urine |
| _____ 3. chromaturia | c. elimination of small amounts of urine |
| _____ 4. albuminuria | d. blood in the urine |
| _____ 5. pyuria | e. proteinuria |
| | |
| _____ 6. trigone | a. absence of a bladder |
| _____ 7. catheterization | b. stagnation, as of urine |
| _____ 8. stasis | c. deficiency of urine |
| _____ 9. acystia | d. triangle at the base of the bladder |
| _____ 10. uropenia | e. introduction of a tube |

Supplementary Terms

- | | |
|------------------------------|---|
| _____ 11. aldosterone | a. urination during the night |
| _____ 12. diabetes insipidus | b. condition caused by lack of ADH |
| _____ 13. incontinence | c. nitrogenous metabolic waste |
| _____ 14. nocturia | d. hormone that regulates electrolytes |
| _____ 15. creatinine | e. inability to retain urine |
| | |
| _____ 16. anuresis | a. excessive thirst |
| _____ 17. epispadias | b. bed-wetting |
| _____ 18. polydipsia | c. presence of excess nitrogenous waste in the urine |
| _____ 19. enuresis | d. congenital misplacement of the ureteral opening |
| _____ 20. azoturia | e. lack of urination |

FILL IN THE BLANKS

21. A microscopic working unit of the kidney is called a(n) _____.
22. The cluster of capillaries within the glomerular capsule is the _____.
23. An enzyme released by the kidneys that acts to increase blood pressure _____.
24. Micturition is the scientific term for _____.
25. Laboratory study of the urine is a(n) _____.
26. The main nitrogenous waste product in urine is _____.

Referring to E.O.'s opening case study:

27. E.O.'s inability to retain urine is termed urinary _____.
28. A midstream urine sample collected after thorough cleansing of the urethral opening is called a(n) _____.
29. Endoscopic examination of the urinary bladder is termed _____.

TRUE-FALSE

Examine the following statements. If the statement is true, write T in the first blank. If the statement is false, write F in the first blank and correct the statement by replacing the underlined word in the second blank.

	True or False	Correct Answer
30. A reniform structure is shaped like the <u>bladder</u> .	_____	_____
31. Pyelitis is inflammation of the <u>renal pelvis</u> .	_____	_____
32. A nephrotropic substance acts on the <u>kidney</u> .	_____	_____
33. The outer portion of the kidney is the <u>medulla</u> .	_____	_____
34. The tube that carries urine out of the body is the <u>ureter</u> .	_____	_____
35. EPO stimulates the production of <u>red blood cells</u> .	_____	_____
36. A lithotomy is an incision to remove a <u>calculus</u> .	_____	_____
37. Kaliuresis refers to the excretion of <u>sodium</u> in the urine.	_____	_____

DEFINITIONS

Define the following words:

38. pararenal (*par-a-RE-nal*) _____
39. dysuria (*dis-Ū-rē-a*) _____
40. nephrotoxic (*nef-rō-TOK-sik*) _____
41. juxtaglomerular (*juks-ta-glō-MER-ū-lar*) _____
42. calicectomy (*kal-i-SEK-tō-mē*) _____
43. urethrostenosis (*ū-rē-thrō-ste-NŌ-sis*) _____

Write a word for the following definitions:

44. dilatation of the renal pelvis and calices _____
45. softening of a kidney (nephr/o) _____
46. excision of the bladder (cyst/o) _____
47. any disease of the kidney (nephr/o) _____
48. radiograph of the bladder (cyst/o) and urethra _____
49. plastic repair of a ureter and renal pelvis _____
50. inflammation of the renal pelvis and the kidney _____
51. surgical creation of an opening between a ureter and the sigmoid colon _____

ELIMINATIONS

In each of the sets below, underline the word that does not fit in with the rest and explain the reason for your choice:

52. capsule — cast — pyramid — nephron — cortex

53. nephron loop — distal convoluted tubule — glomerular capsule — calyx — proximal convoluted tubule

54. ileal conduit — specific gravity — dialysis — cystoscopy — lithotripsy

OPPOSITES

Write a word that means the opposite of the following:

55. hydration _____
56. hypervolemia _____
57. diuretic _____
58. hyponatremia _____
59. uresis _____

ADJECTIVES

Write the adjective form of the following:

60. calyx _____
61. urology _____
62. uremia _____
63. diuresis _____
64. nephrosis _____
65. ureter _____
66. urethra _____

PLURALS

Write the plural form of the following:

67. pelvis _____
68. calyx _____
69. glomerulus _____

WORD BUILDING

Write a word for the following definitions using the word parts given.

graph- ren/o -al intra- vesic/o -y ur/o inter- lith log supra-

70. radiographic study of the urinary tract _____
71. pertaining to the kidney _____
72. within the kidney _____
73. radiographic study of the kidney _____
74. within the bladder _____
75. above the kidney _____
76. study of the urinary tract _____
77. between the kidneys _____
78. pertaining to the bladder _____
79. a urinary tract stone _____

ABBREVIATIONS

Write the meaning of the following abbreviations:

80. IVP _____
81. ADH _____
82. EPO _____
83. IVU _____
84. Na _____
85. GFR _____
86. UA _____

WORD ANALYSIS

Define the following words and give the meaning of the word parts in each. Use a dictionary if necessary.

87. hemodialysis (*hē-mō-dī-AL-i-sis*) _____
- a. hem/o _____
- b. dia- _____
- c. lysis _____
88. cystometrography (*sis-tō-me-TROG-ra-fē*) _____
- a. cyst/o _____
- b. metr/o _____
- c. -graphy _____
89. ureteroneocystostomy (*ū-rē-ter-ō-nē-ō-sis-TOS-tō-mē*) _____
- a. ureter/o _____
- b. neo- _____
- c. cyst/o _____
- d. -stomy _____



For more learning activities, see Chapter 13 of the Student Resources on *thePoint*.

Additional Case Studies

Case Study 13-1: Renal Calculi

A.A., a 48-YO woman, was admitted to the inpatient unit from the ER with severe right flank pain unresponsive to analgesics. Her pain did not decrease with administration of 100 mg of IV meperidine. She had a three-month history of chronic UTI. Six months ago, she had been prescribed calcium supplements for low bone density. Her gynecologist warned her that calcium could be a problem for people who are “stone formers.” A.A. was unaware that she might be at risk. An IV urogram showed a right staghorn calculus. The diagnosis was further confirmed by a renal ultrasound. A renal flow scan showed normal perfusion and no obstruction. Kidney function was 37 percent on the

right and 63 percent on the left. The pain became intermittent, and A.A. had no hematuria, dysuria, frequency, urgency, or nocturia. Urinalysis revealed no albumin, glucose, bacteria, or blood; there was evidence of cells, crystals, and casts.

A.A. was transferred to surgery for a cystoscopic ureteral laser lithotripsy, insertion of a right retrograde ureteral catheter, and right percutaneous nephrolithotomy. A ureteral calculus was fragmented with a pulsed-dye laser. Most of the staghorn was removed from the renal pelvis with no remaining stone in the renal calices. She was discharged two days later and ordered to strain her urine for the next week for evidence of stones.

Case Study 13-2: End-Stage Renal Disease

M.C., a 20-YO part-time college student, has had chronic glomerulonephritis since age 7. He has been treated at home with CAPD for the past 16 months as he awaits kidney transplantation. His doctor advised him to go immediately to the ER when he reported chest pain, shortness of breath, and oliguria. On admission, M.C. was placed on oxygen and given a panel of blood tests and an ECG to rule out an acute cardiac episode. His hemoglobin was 8.2, and his hematocrit was 26 percent.

He had bilateral lung rales. ABGs were: pH, 7.0; Paco_2 , 28; Pao_2 , 50; HCO_3 , 21. His BUN, serum creatinine, and BUN/creatinine ratio were abnormally high. His ECG and liver enzyme studies were normal. His admission diagnosis was ESRD, fluid overload, and metabolic acidosis. He was typed and crossed for blood; tested for HIV, hepatitis B antigen, and sexually transmitted disease; and sent to hemodialysis. A bed was reserved for him on the transplant unit.

Case Study Questions

Multiple choice. Select the best answer and write the letter of your choice to the left of each number:

- | | |
|--|---|
| <p>_____ 1. The term <i>perfusion</i> means:</p> <ul style="list-style-type: none">a. sizeb. shapec. passage of fluidd. surrounding tissuee. metabolism <p>_____ 2. The term <i>percutaneous</i> means:</p> <ul style="list-style-type: none">a. under the skinb. on the surfacec. with a catheterd. by chemicalse. through the skin <p>_____ 3. M.C.'s chronic glomerulonephritis means that he has had:</p> <ul style="list-style-type: none">a. long-term kidney stonesb. an acute bout of kidney infectionc. short-term bladder inflammationd. a long-term kidney infectione. dysuria for 13 years | <p>_____ 4. Renal dialysis can be performed by shunting venous blood through a dialysis machine and returning the blood to the patient's arterial system. This procedure is called:</p> <ul style="list-style-type: none">a. hemodialysisb. arteriovenous transplantc. CAPDd. phlebotomye. glomerular filtration rate |
|--|---|

Write a term from the case studies with the following meanings:

5. intravenous injection of contrast dye and radiographic study of the urinary tract _____

6. presence of blood in the urine _____

7. referring to endoscopy of the urinary bladder _____

8. surgical incision for removal of a kidney stone _____

9. production of a reduced amount of urine _____

10. getting up to go to the bathroom at night _____

11. crushing a stone _____

12. kidney replacement _____

Abbreviations. Define the following abbreviations:

13. UTI _____

14. CAPD _____

15. BUN _____

16. ESRD _____

17. HIV _____

CHAPTER

14

The Male Reproductive System

Case Study

C.S.'s Benign Prostatic Hyperplasia and TURP

Chief complaint:

C.S., a 60-year-old teacher, was having a decreased force of his urine stream and ejaculation, hesitancy, and sensation of incomplete bladder emptying. He tried using prostate-health herbal supplements without any real benefit for two years. He decided to make an appointment with a urologist.

Examination:

The urologist took a history and examined the patient. C.S. reported no dysuria, hematuria, or flank pain. He had no history of UTI, epididymitis, prostatitis, renal disease, or renal calculi. His medical history was otherwise not significant to his urologic complaint.

Rectal examination revealed a 50-g prostate with slight firmness in the right prostatic lobe. The physician ordered a bladder ultrasound, which was performed later that week. The results indicated no intravesical lesions or prostate protrusion into the bladder base.

C.S. was diagnosed with benign prostatic hyperplasia with bladder neck obstruction and was scheduled for a TURP. His urologist explained the procedure and what to expect pre- and postoperatively. The office staff notified the hospital to schedule the surgery. The next day, the hospital admissions department called C.S., went through normal admissions procedures, and scheduled a surgery date.

Clinical course:

C.S. was NPO the night before the surgery. He was taken to the operating room and was given a spinal anesthetic for the procedure. It had already been explained to him that the surgery would take about an hour and that he would be awake during the procedure but would not feel any pain. A resectoscope was used to trim the enlarged prostatic tissue. At the end of the surgery, a Foley catheter was inserted into the bladder and left in place to drain the urine and permit irrigation of the bladder to remove any clots. C.S. tolerated the procedure well and was transferred to the recovery room and later to his hospital room. He was encouraged to drink plenty of fluids postoperatively.



Ancillaries *At-A-Glance*

Visit *thePoint* to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii–xvi.

Learning TOOLS

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning RESOURCES

- E-book: Chapter 14
- Web Figure: Microscopic View of the Testis
- Web Chart: Reproductive Hormones
- Audio Pronunciation Glossary

Learning ACTIVITIES

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After study of this chapter, you should be able to:

- 1** Describe the organs of the male reproductive tract and give the function of each part. *p348*
- 2** Follow spermatozoa from their development in the testis to their release. *p348*
- 3** Describe the contents and functions of semen. *p351*
- 4** Identify and use roots pertaining to the male reproductive system. *p353*
- 5** Describe six main disorders of the male reproductive system. *p354*
- 6** Interpret abbreviations used in referring to the male reproductive system. *p361*
- 7** Analyze medical terms in several case studies concerning the male reproductive system. *pp346, 367*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|--|--|
| <p>_____ 1. The male germ cell, or gamete, is the:</p> <ul style="list-style-type: none"> a. ovum b. testis c. spermatozoon d. semen | <p>_____ 4. The secretion that transports gametes in males is:</p> <ul style="list-style-type: none"> a. bile b. semen c. urine d. pepsin |
| <p>_____ 2. Gametes develop in a gonad, which in males is called the:</p> <ul style="list-style-type: none"> a. testis b. seminal vesicle c. vas deferens d. penis | <p>_____ 5. The gland below the bladder in males is the:</p> <ul style="list-style-type: none"> a. adrenal b. scrotum c. submandibular d. prostate |
| <p>_____ 3. The main male sex hormone is:</p> <ul style="list-style-type: none"> a. estrogen b. amylase c. renin d. testosterone | <p>_____ 6. Orchitis is inflammation of the:</p> <ul style="list-style-type: none"> a. bladder b. kidney c. penis d. testis |

The function of the **gonads** (sex glands) in both males and females is to produce the reproductive cells, the **gametes**, and to produce hormones. The gametes are generated by **meiosis**, a process of cell division that halves the chromosome number from 46 to 23. When male and female gametes unite in fertilization, the original chromosome number is restored.

Sex hormones aid in the manufacture of the gametes, function in pregnancy and lactation, and also produce the secondary sex characteristics such as the typical size, shape, body hair, and voice that we associate with the male and female genders.

The reproductive tract develops in close association with the urinary tract. In females, the two systems become completely separate, whereas the male reproductive and urinary tracts share a common passage, the **urethra**. Thus, the two systems are referred together as the genitourinary (GU) or urogenital (UG) tract, and urologists are called on to treat disorders of the male reproductive system as well as those of the urinary system.

inguinal canal into the scrotum before birth or shortly thereafter (**Fig. 14-2**).

From the start of sexual maturation, or **puberty**, spermatozoa form continuously within the testes in coiled seminiferous tubules (**Fig. 14-3**). Their development requires the aid of special **Sertoli cells** and male sex hormones, or **androgens**, mainly **testosterone**. These hormones are manufactured in **interstitial cells** located between the tubules. In both males and females, the gonads are stimulated by **follicle-stimulating hormone (FSH)** and **luteinizing hormone (LH)**, released from the anterior **pituitary gland** beneath the brain. These hormones are chemically the same in males and females, although they are named for their actions in female reproduction. In males, FSH stimulates the Sertoli cells and promotes the formation of spermatozoa. LH stimulates the interstitial cells to produce testosterone.



See the microscopic view of the testis and the chart on reproductive hormones in the Student Resources on *thePoint*.

The Testes

The male germ cells, the sperm cells or **spermatozoa** (singular: spermatozoon), are produced in the paired **testes** (singular: testis) that are suspended outside of the body in the **scrotum** (**Fig. 14-1**). Although the testes develop in the abdominal cavity, they normally descend through the

Transport of Spermatozoa

After their manufacture, sperm cells are stored in a much coiled tube on the surface of each testis, the **epididymis** (**see Figs. 14-1 and 14-3**). Here, they remain until **ejaculation**

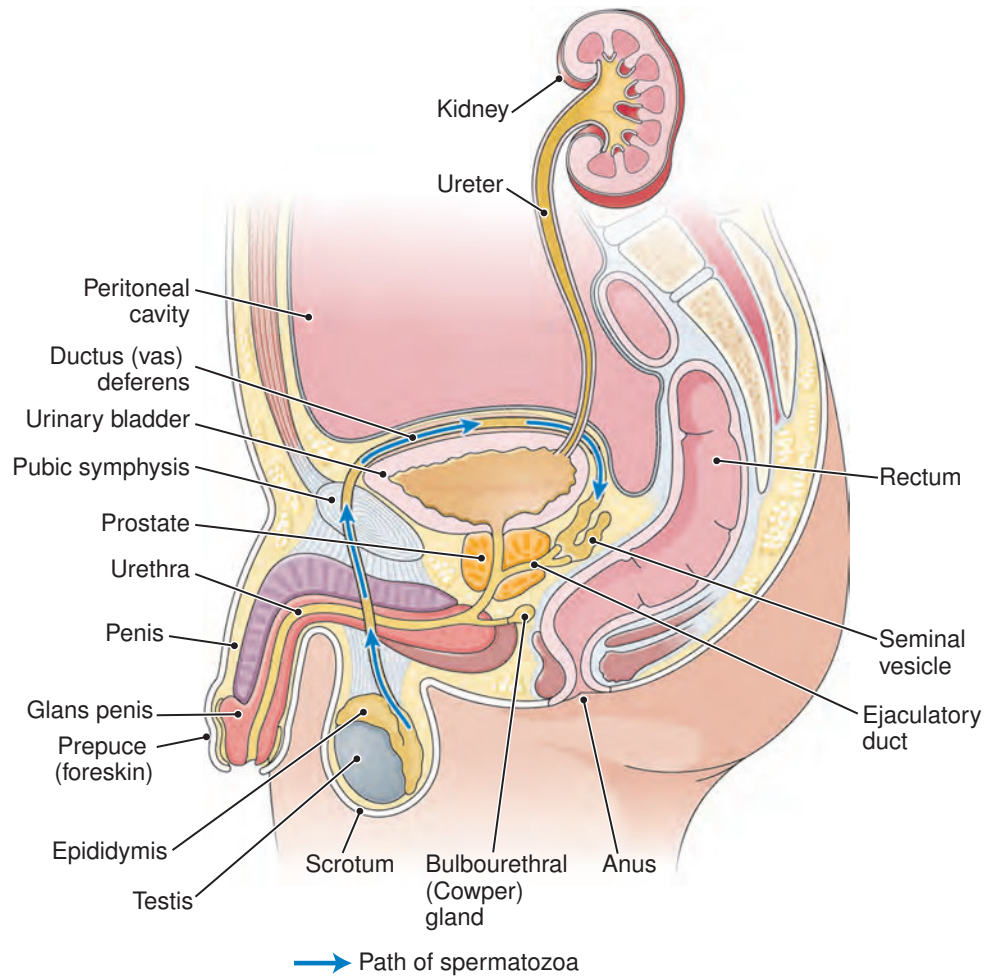


Figure 14-1 Male reproductive system. Parts of the urinary system and digestive system are also shown.

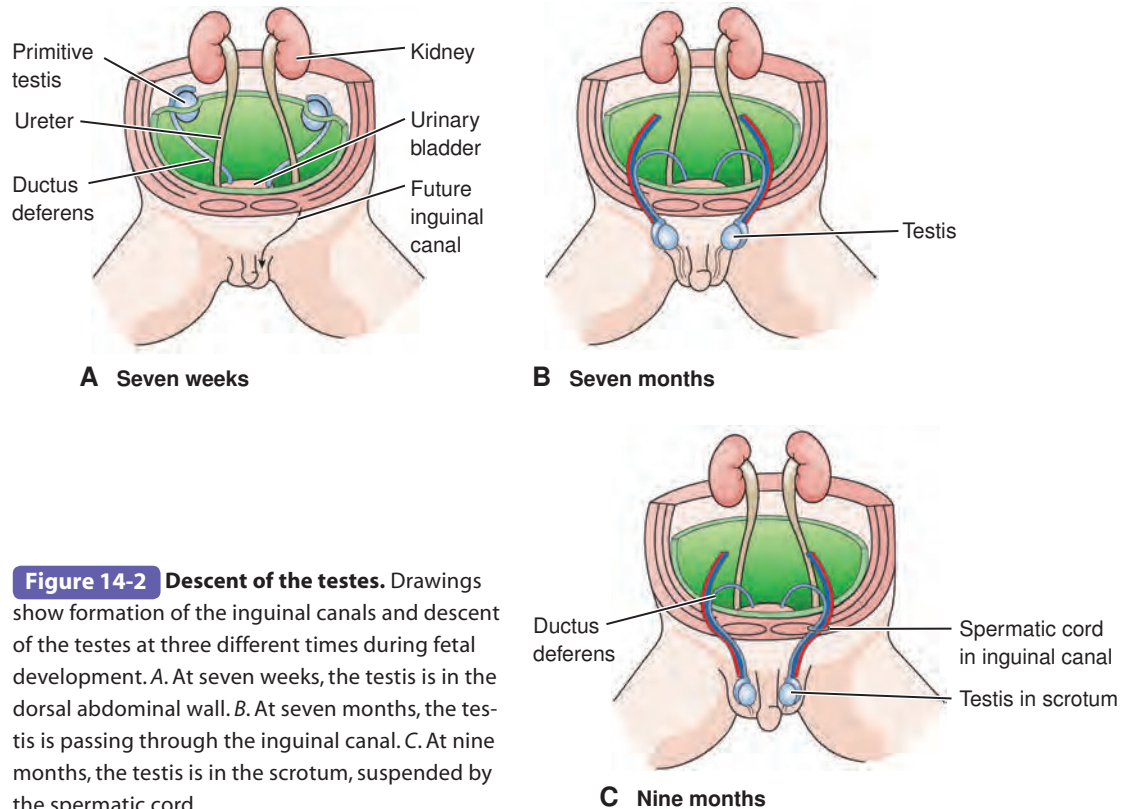


Figure 14-2 Descent of the testes. Drawings show formation of the inguinal canals and descent of the testes at three different times during fetal development. A. At seven weeks, the testis is in the dorsal abdominal wall. B. At seven months, the testis is passing through the inguinal canal. C. At nine months, the testis is in the scrotum, suspended by the spermatic cord.

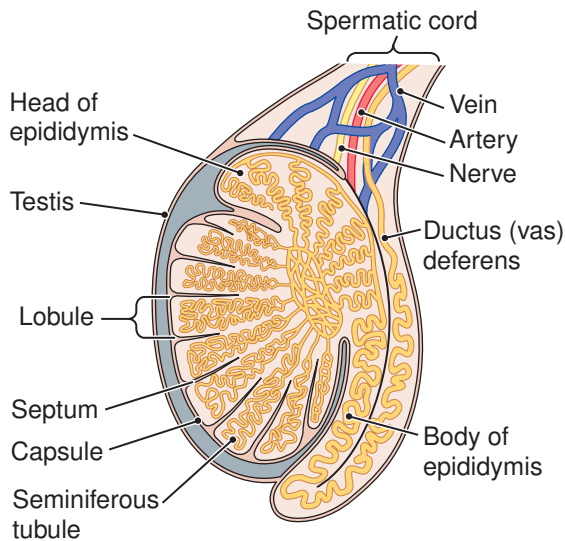


Figure 14-3 The testis. Spermatozoa develop in the seminiferous tubules in the lobules of the testis. The epididymis and spermatic cord are also shown.

propels them into a series of ducts that lead out of the body. The first of these is the **ductus (vas) deferens**, which is contained in the **spermatic cord** along with nerves and blood vessels that supply the testis (see Figs. 14-2 and 14-3). The spermatic cord ascends through the inguinal canal into the abdominal cavity, where the ductus deferens leaves the cord and travels behind the bladder. (See Box 14-1, which discusses how alternative names can be a challenge to learning medical terminology.)

A short continuation of the ductus deferens, the **ejaculatory duct**, delivers spermatozoa to the urethra as it passes

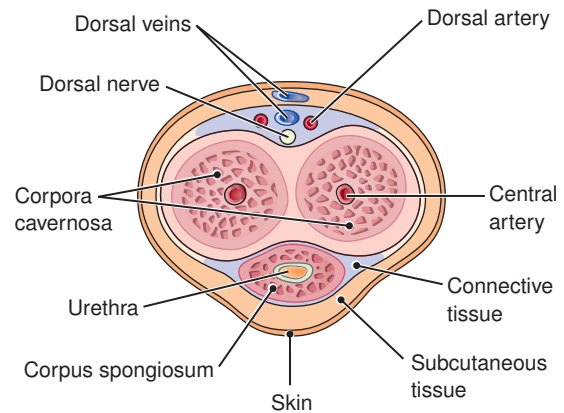


Figure 14-4 The penis. This cross section shows the erectile bodies of the penis (corpora cavernosa and corpus spongiosum), the centrally located urethra, as well as blood vessels and a nerve.

through the **prostate gland** below the bladder. Finally, the cells, now mixed with other secretions, travel in the urethra through the **penis** to be released (see Fig. 14-1).

THE PENIS

The penile urethra transports both urine and **semen**. The penis is the male organ of sexual intercourse, or **coitus**. It is composed of three segments of spongy tissue, which become engorged with blood to produce an **erection**, a stiffening of the penis. As shown in Figure 14-4, the two corpora cavernosa are lateral bodies; the corpus spongiosum, through which the urethra travels, is in the center. The corpus spongiosum enlarges at the tip to form the **glans penis**, which is covered by loose skin—the **prepuce**, or foreskin.

Box 14-1



Focus on Words

Which Is It?

Some of the work of learning medical terminology is made more difficult by the fact that many structures and processes are known by two or even more names. This duplication may occur because different names have been assigned at different times or places or because the name is in a state of transition to another name, and the new one has not been universally accepted.

The tube that leads from the testis to the urethra in males was originally called the **vas deferens**, *vas* being a general term for *vessel*. To distinguish this tube from a blood vessel, efforts have been made to change the name to **ductus deferens**. The original name has lingered, however, because

the surgical procedure used to sterilize a man is still called a **vasectomy** and not a “**ductusectomy**.”

Similar inconsistencies appear in other systems. **Dorsal** is also **posterior**; **ventral** could be **anterior**. Human growth hormone is also called **somatotropin**. **ADH**, a hormone that increases blood pressure, is also known as **vasopressin**.

In the nervous system, the little swellings at the ends of axons that contain neurotransmitters are variously called **end-feet**, **end-bulbs**, **terminal knobs**, **terminal feet**, and even other names. In a woman, the tube that carries the ovum from the ovary to the uterus is referred to as the **uterine tube**, or maybe the **Fallopian tube**...or the **oviduct**... or ...

Surgery to remove the foreskin is **circumcision**. This may be performed for medical reasons but is most often performed electively in male infants for reasons of hygiene, cultural preferences, or religion.

Formation of Semen

Semen is the thick, whitish fluid that transports spermatozoa. It contains, in addition to sperm cells, secretions from three types of accessory glands (see Fig. 14-1). Following the sequence of sperm transport, these are:

1. The paired **seminal vesicles**, which release their secretions into the ejaculatory duct on each side.
2. The prostate gland, which secretes into the first part of the urethra beneath the bladder. As men age, prostatic enlargement may compress the urethra and cause urinary problems.
3. The two **bulbourethral** (Cowper) **glands**, which secrete into the urethra just below the prostate gland.

Together, these glands produce a slightly alkaline mixture that nourishes and transports the sperm cells and also protects them by neutralizing the acidity of the female vaginal tract.

Terminology

Key Terms

14

Normal Structure and Function

androgen <i>AN-drō-jen</i>	Any hormone that produces male characteristics; root <i>andr/o</i> means “male”
bulbourethral gland <i>bul-bō-ū-RĒ-thral</i>	A small gland beside the urethra below the prostate that secretes part of the seminal fluid. Also called Cowper gland
circumcision <i>ser-kum-SI-zhun</i>	Surgical removal of the end of the prepuce (foreskin)
coitus <i>KŌ-i-tus</i>	Sexual intercourse
ductus deferens <i>DUK-tus DEF-er-enz</i>	The duct that conveys spermatozoa from the epididymis to the ejaculatory duct. Also called vas deferens
ejaculation <i>ē-jak-ū-LĀ-shun</i>	Ejection of semen from the male urethra
ejaculatory duct <i>ē-JAK-ū-la-tōr-ē</i>	The duct formed by union of the ductus deferens and the duct of the seminal vesicle; it carries spermatozoa and seminal fluid into the urethra
epididymis <i>ep-i-DID-i-mis</i>	A coiled tube on the surface of the testis that stores sperm until ejaculation (root: epididym/o)
erection <i>ē-REK-shun</i>	The stiffening or hardening of the penis or the clitoris, usually because of sexual excitement
follicle-stimulating hormone (FSH)	A hormone secreted by the anterior pituitary that acts on the gonads. In males, FSH stimulates Sertoli cells and promotes sperm cell development
gamete <i>GAM-et</i>	A mature reproductive cell, the spermatozoon in the male and the ovum in the female
glans penis <i>glanz PĒ-nis</i>	The bulbous end of the penis
gonad <i>GŌ-nad</i>	A sex gland; testis or ovary
inguinal canal <i>ING-gwin-al</i>	The channel through which the testis descends into the scrotum in the male

(Continued)

Terminology

Key Terms *(Continued)*

interstitial cells <i>in-ter-STISH-al</i>	Cells located between the seminiferous tubules of the testes that produce hormones, mainly testosterone. Also called cells of Leydig (<i>LĪ-dig</i>)
luteinizing hormone (LH) <i>LŪ-tē-in-ī-zing</i>	A hormone secreted by the anterior pituitary that acts on the gonads. In males, it stimulates the interstitial cells to produce testosterone
meiosis <i>mī-Ō-sis</i>	The type of cell division that forms the gametes; it results in cells with 23 chromosomes, half the number found in other body cells (from the Greek word <i>meiosis</i> meaning “diminution”)
penis <i>PĒ-nis</i>	The male organ of copulation and urination (adjective: penile)
pituitary gland <i>pi-TŪ-i-tar-ē</i>	An endocrine gland at the base of the brain
prepuce <i>PRĒ-pūs</i>	The fold of skin over the glans penis; the foreskin
prostate gland <i>PROS-tāt</i>	A gland that surrounds the urethra below the bladder in males and contributes secretions to the semen (root: prostat/o)
puberty <i>PŪ-ber-tē</i>	Period during which the ability for sexual reproduction is attained and secondary sex characteristics begin to develop
scrotum <i>SKRŌ-tum</i>	A double pouch that contains the testes (root: osche/o)
semen	The thick secretion that transports spermatozoa (roots: semin, sperm/i, spermat/o)
seminal vesicle <i>SEM-i-nal VES-i-kl</i>	A sac-like gland behind the bladder that contributes secretions to the semen (root: vesicul/o)
Sertoli cell <i>ser-TŌ-lē</i>	Cell in a seminiferous tubule that aids in the development of spermatozoa; sustentacular (<i>sus-ten-TAK-ū-lar</i>) cell
spermatic cord <i>sper-MAT-ik</i>	Cord attached to the testis that contains the ductus deferens, blood vessels, and nerves enclosed within a fibrous sheath (see Fig. 14-3)
spermatozoon <i>sper-ma-tō-ZŌ-on</i>	Mature male sex cell (plural: spermatozoa) (roots: sperm/i, spermat/o)
testis <i>TES-tis</i>	The male reproductive gland (roots: test/o, orchi/o, orchid/o); plural is testes (<i>TES-tēz</i>); also called testicle
testosterone <i>tes-TOS-ter-ōn</i>	The main male sex hormone
urethra <i>ū-RĒ-thra</i>	The duct that carries urine out of the body and also transports semen in the male
vas deferens <i>DEF-er-enz</i>	The duct that conveys spermatozoa from the epididymis to the ejaculatory duct. Also called ductus deferens



Go to the Audio Pronunciation Glossary in the Student Resources on *thePoint* to hear these terms pronounced.

Roots Pertaining to Male Reproduction

See **Table 14-1**.

Table 14-1 Roots for Male Reproduction

Root	Meaning	Example	Definition of Example
test/o	testis, testicle	testosterone <i>tes-TOS-te-rōn</i>	hormone produced in the testis
orchi/o, orchid/o	testis	anorchism <i>an-OR-kizm</i>	absence of a testis
osche/o	scrotum	oscheal <i>OS-kē-al</i>	pertaining to the scrotum
semin	semen	inseminate <i>in-SEM-i-nāt</i>	to introduce semen into a vagina
sperm/i, spermat/o	semen, spermatozoa	polyspermia <i>pol-ē-SPER-mē-a</i>	secretion of excess semen
epididym/o	epididymis	epididymitis <i>ep-i-did-i-MĪ-tis</i>	inflammation of the epididymis
vas/o	vas deferens, ductus deferens; also vessel	vasostomy <i>vas-OS-tō-mē</i>	surgical creation of an opening in the ductus deferens
vesicul/o	seminal vesicle	vesiculogram <i>ve-SIK-ū-lō-gram</i>	radiograph of a seminal vesicle
prostat/o	prostate	prostatometer <i>pros-ta-TOM-e-ter</i>	instrument for measuring the prostate

14

EXERCISE 14-1

Define the following words:

1. seminal (*SEM-i-nal*) _____
2. orchialgia (*or-kē-AL-jē-a*) _____
3. oscheoplasty (*os-kē-ō-PLAS-tē*) _____
4. epididymectomy (*ep-i-did-i-MEK-tō-mē*) _____
5. prostatodynia (*pros-ta-tō-DIN-ē-a*) _____
6. testopathy (*tes-TOP-a-thē*) _____
7. orchiepididymitis (*or-kē-ep-i-did-i-MĪ-tis*) _____

Use the root *orchi/o* to write a word for the following definitions. Each is also written with the root *orchid/o*.

8. surgical fixation of a testis _____
9. plastic repair of a testis _____
10. incision of a testis _____

EXERCISE 14-1

Use the root *spermat/o* to write a word for the following definitions:

11. a sperm-forming cell _____
12. destruction (-lysis) of sperm _____
13. excessive discharge (-rhea) of semen _____
14. formation (-genesis) of spermatozoa _____
15. condition of having sperm in the urine (-uria) _____

The ending *-spermia* means “condition of sperm or semen.” Add a prefix to *-spermia* to form a word for the following definitions:

16. lack of semen _____
17. presence of blood in the semen _____
18. deficiency of (olig/o) semen _____
19. presence of pus in the semen _____

Write a word for the following definitions:

20. excision of the ductus deferens _____
21. tumor of the scrotum _____
22. suture of the vas deferens _____
23. excision of the prostate gland _____
24. radiographic study of a seminal vesicle _____
25. inflammation of a seminal vesicle _____
26. incision of the epididymis _____

Clinical Aspects of the Male Reproductive System

INFECTION

Most infections of the male reproductive tract are **sexually transmitted infections (STIs)**, listed in **Box 14-2**. The most common STI in the United States is caused by the bacterium *Chlamydia trachomatis*, which mainly causes **urethritis** in males. This same organism also causes lymphogranuloma venereum, an STI associated with lymphadenopathy, which occurs most commonly in tropical regions. Both forms of these chlamydial infections respond to treatment with antibiotics.

Gonorrhea is caused by *Neisseria gonorrhoeae*, the gonococcus (GC). Infection usually centers in the urethra, causing urethritis with burning, a purulent discharge, and dysuria. Untreated, the disease can spread through the reproductive system. Gonorrhea is treated with antibiotics,

but gonococci can rapidly develop resistance to these drugs.

Another common STI is herpes infection, caused by a virus. Other STIs are discussed in Chapter 15.

Mumps is a nonsexually transmitted viral disease that can infect the testes and lead to **sterility**. Other microorganisms can infect the reproductive tract as well, causing urethritis, **prostatitis**, **orchitis**, or **epididymitis**.

BENIGN PROSTATIC HYPERPLASIA

As men age, the prostate gland commonly enlarges, a condition known as **benign prostatic hyperplasia (BPH)** (see C.S.’s opening case study). Although not cancerous, this overgrown tissue can press on the urethra near the bladder and interfere with urination. Urinary retention, infection, and other complications may follow if an obstruction is not corrected.

Medications to relax smooth muscle in the prostate and bladder neck are used to treat the symptoms of BPH. Alpha-adrenergic blocking agents interfere with sympathetic nervous stimulation in these regions to improve urinary flow

Box 14-2

For Your Reference

Sexually Transmitted Infections

DISEASE	ORGANISM	DESCRIPTION
BACTERIAL		
chlamydial infection	<i>Chlamydia trachomatis</i> types D to K	Ascending infection of reproductive and urinary tracts. May spread to pelvis in women, causing pelvic inflammatory disease (PID)
lymphogranuloma venereum	<i>Chlamydia trachomatis</i> type L	General infection with swelling of inguinal lymph nodes; scarring of genital tissue
gonorrhea	<i>Neisseria gonorrhoeae</i> ; gonococcus (GC)	Inflammation of reproductive and urinary tracts. Urethritis in men. Vaginal discharge and cervical inflammation (cervicitis) in women, leading to pelvic inflammatory disease (PID). Possible systemic infection. May spread to newborns. Treated with antibiotics
bacterial vaginosis	<i>Gardnerella vaginalis</i>	Vaginal infection with foul-smelling discharge
syphilis	<i>Treponema pallidum</i> (a spirochete)	Primary stage: chancre (lesion); secondary stage: systemic infection and syphilitic warts; tertiary stage: degeneration of other systems. Cause of spontaneous abortions, stillbirths, and fetal deformities. Treated with antibiotics
VIRAL		
AIDS (acquired immunodeficiency syndrome)	HIV (human immunodeficiency virus)	An often fatal disease that infects T cells of the immune system, weakening the host and leading to other diseases
genital herpes	herpes simplex virus (HSV)	Painful genital lesions. In women, may be a risk factor in cervical carcinoma. Often fatal infections of newborns. No cure at present
hepatitis B	hepatitis B virus (HBV)	Causes liver inflammation, which may be acute or may develop into a chronic carrier state. Linked to liver cancer
condyloma acuminatum (genital warts)	human papillomavirus (HPV)	Benign genital warts. In women, predisposes to cervical dysplasia and carcinoma. A vaccine against the most prevalent strains is available
PROTOZOAL		
trichomoniasis	<i>Trichomonas vaginalis</i>	Vaginitis. Green, frothy discharge with itching; pain on intercourse (dyspareunia); and painful urination (dysuria)

rate. One example is tamsulosin (Flomax). Because testosterone stimulates enlargement of the prostate, drugs that interfere with prostatic testosterone activity may slow the disorder's progress. One example is finasteride (Proscar). An herbal remedy that seems to act in this same manner is an extract of the berries of the saw palmetto, a low-growing palm tree. Saw palmetto has been found to delay the need for surgery in some cases of BPH.

In advanced cases of BPH, removal of the prostate, or **prostatectomy**, may be required. When this is performed through the urethra, the procedure is called a transurethral resection of the prostate (TURP) (Fig. 14-5A). The prostate may also be cut in a transurethral incision of the prostate (TUIP) to reduce pressure on the urethra (Fig. 14-5B). Surgeons also use a laser

beam or heat to destroy prostatic tissue. BPH is diagnosed by digital rectal examination (DRE) or imaging studies.

CANCER

Cancer of the Prostate

Prostatic cancer is the most common malignancy in men in the United States. Only lung cancer and colon cancer cause more cancer-related deaths in men who are past middle age. Physicians can often detect prostatic cancer by DRE. Blood tests for prostate-specific antigen (PSA) may also help in early detection. This protein is produced in increased amounts in cases of prostatic cancer, although it may increase in other prostatic disorders as well.

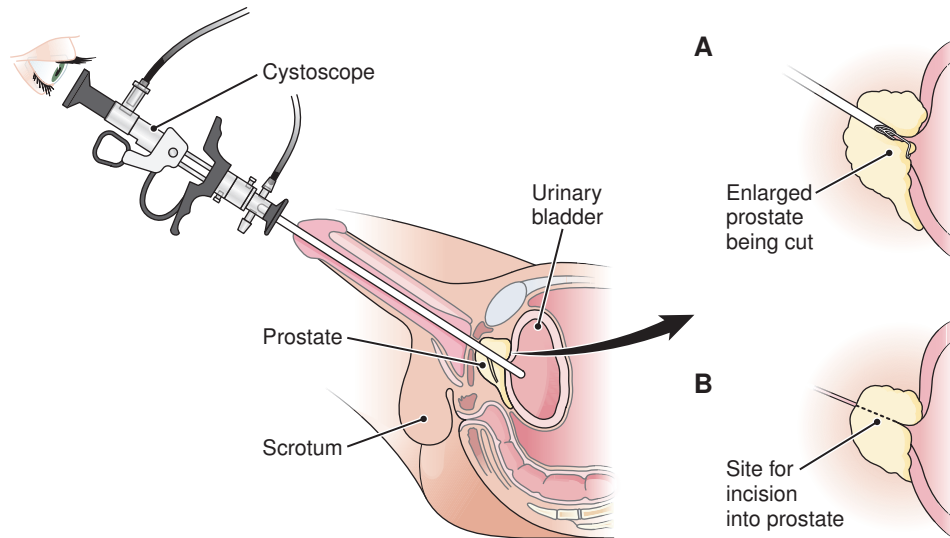


Figure 14-5 Prostate surgery procedures. A. Transurethral resection of the prostate (TURP). Portions of the prostate are removed at the bladder opening. B. Transurethral incision of the prostate (TUIP). One or two incisions are made in the prostate to reduce pressure on the urethra.

The TNM system for staging prostate cancer includes the following categories:

- T₁: tumor not palpable by rectal examination; detected by biopsy or abnormal PSA
- T₂: tumor palpable and confined to the prostate
- T₃: tumor has spread locally beyond the prostate
- M: distant metastases

Treatment methods include surgery (prostatectomy), radiation, inhibition of male hormones (androgens), which stimulate prostatic growth, and chemotherapy. Radiation is usually delivered by implantation of radioactive seeds. Another approach is termed “watchful waiting” or deferred therapy, which consists of monitoring without therapy. Choice of this option is based on a man’s age, tumor invasiveness, and the probability that an untreated tumor will result in harm to a patient during his lifetime.

Testicular Cancer

Cancer of the testis represents less than 1 percent of cancer in adult males. It usually appears between the ages of 25 and 45 years and shows no sign of genetic inheritance. This cancer typically originates in germ cells and can spread to abdominal lymph nodes. More than half of testicular tumors release markers that can be detected in the blood. Treatment may include removal of the testis (orchiectomy), radiation, and chemotherapy.

CRYPTORCHIDISM

It is fairly common that one or both testes will fail to descend into the scrotum by the time of birth (Fig. 14-6). This condition is termed **cryptorchidism**, literally hidden (crypt/o)

testis (orchid/o). The condition usually corrects itself within the first year of life. If not, it must be corrected surgically to avoid sterility and an increased risk of cancer.

INFERTILITY

An inability or a diminished ability to reproduce is termed **infertility**. Its causes may be hereditary, hormonal, disease-related, or the result of exposure to chemical or physical agents. The most common causes of infertility are STIs. A total inability to produce offspring may be termed sterility. Men may be voluntarily sterilized by cutting and sealing the vas deferens on both sides in a **vasectomy** (see Fig. 15-5).

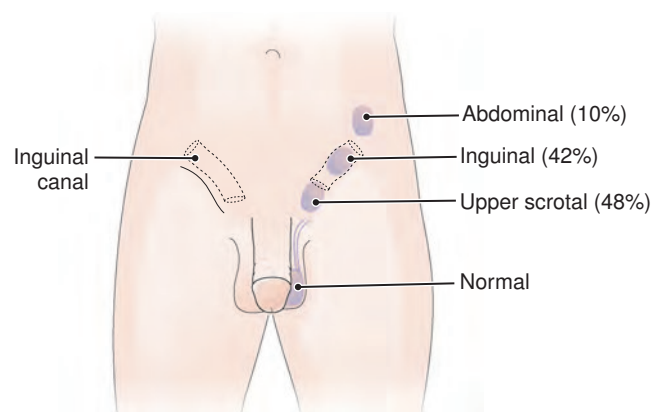


Figure 14-6 Cryptorchidism. The testis fails to descend into the scrotum. In most cases, the testis is retained in the upper part of the scrotal sac or in the inguinal canal. The percentages of different locations are shown.

Box 14-3



Clinical Perspectives

Treating Erectile Dysfunction

Approximately 25 million American men and their partners are affected by erectile dysfunction (ED), the inability to achieve or maintain an erection. Although ED is more common in men over the age of 65, it can occur at any age and can have many causes.

Erection results from an interaction between the autonomic nervous system and penile blood vessels. Sexual arousal stimulates parasympathetic nerves in the penis to release a compound called nitric oxide (NO). This substance activates an enzyme in vascular smooth muscle that promotes vasodilation, increasing blood flow into the penis and causing erection. Physical factors that cause ED prevent these physiological changes.

Drugs that target the physiologic mechanisms of erection are helping men who suffer from ED. These include sildenafil (trade name, Viagra), vardenafil (Levitra), and tadalafil (Cialis). These drugs prevent the breakdown of vasodilators, thus prolonging the effects of NO. Although effective in about 80 percent of ED cases, these drugs can cause some relatively minor side effects, including headache, nasal congestion, stomach upset, and blue-tinged vision. They should never be used by men who are taking nitrate drugs to treat angina. Because nitrates elevate NO levels, taking them with drugs for ED and prolonging the effects of NO can cause life-threatening hypotension. They are also contraindicated in men with low blood pressure and heart failure.

Erectile Dysfunction

Erectile dysfunction (ED), also called **impotence**, is male inability to perform intercourse because of failure to initiate or maintain an erection until ejaculation. About 10 to 20 percent of such cases are psychogenic—that is, caused by emotional factors, such as stress, depression, or emotional trauma. More often, erectile dysfunction has a physical cause, which may be:

- A vascular disorder such as arteriosclerosis, varicose veins, or damage caused by diabetes
- A neurologic problem, as caused by a tumor, trauma, the effects of diabetes, or damage caused by radiation or surgery

- A side effect of a drug, such as an antihypertensive agent, antiulcer medication, or an appetite suppressant

Drugs that are used to treat erectile dysfunction work by dilating arteries in the penis to increase blood flow to that organ. Nondrug approaches include corrective surgery, vacuum pumps to draw blood into the penis, penile injections to dilate blood vessels, and penile prostheses. **Box 14-3** has more information on erectile dysfunction.

Physician assistants aid in patient examination and care in urology and many other medical and surgical fields. **Box 14-4** describes careers in this specialty.

Box 14-4



Health Professions

Physician Assistant

Physician assistants (PAs) practice medicine under the supervision of physicians and surgeons. They are trained in diagnosis, therapy, and preventive health care. They are also licensed to treat minor injuries. In almost all states, they are permitted to prescribe medications. Depending on the work setting, they may also manage a practice and supervise other medical personnel. In medically underserved areas, they may work under their own direction and confer with physicians as needed. Many PAs work in general, pediatric, or family medicine practices. If they specialize in surgery, they may provide patient care before and after an operation or assist in surgery.

A PA must complete a formal six-year educational program; four years of undergraduate work, and a two-year master's degree. The majority of PA programs require candidates

to enter with a bachelor's degree, core science courses, and clinical experience either in the military or some other allied health field. After successful completion of a didactic year and a year of clinical rotations, PAs must be licensed by passing a national exam. They may also become certified (PA-C) through the National Commission on Certification of Physician Assistants (NCCPA) and maintain that certification by continuing education. The job outlook is very good, especially as hospitals are required to compensate for shorter medical residents' shifts by increasing staffing with PAs. Also, medical personnel can consult with ease via telecommunication, allowing for physical independence at certain practices. For additional information, contact the American Academy of Physician Assistants at www.aapa.org.

INGUINAL HERNIA

The inguinal canal, through which the testis descends, may constitute a weakness in the abdominal wall that can lead to a hernia. In the most common form of **inguinal hernia** (Fig. 14-7), an abdominal organ, usually the intestine, enters the inguinal canal and may extend into

the scrotum. This is an indirect, or external, inguinal hernia. In a direct, or internal, inguinal hernia, the organ protrudes through the abdominal wall into the scrotum. If blood supply to the organ is cut off, the hernia is said to be *strangulated*. Surgery to correct a hernia is a *herniorrhaphy*.

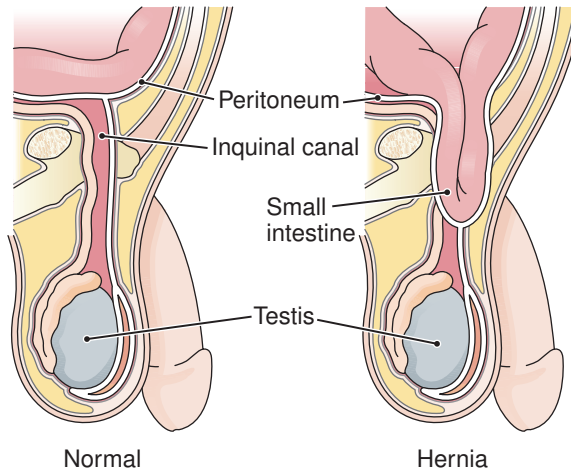


Figure 14-7 Inguinal hernia. Weakness in the abdominal wall allows the intestine or other abdominal contents to protrude into the inguinal canal. The hernial sac is a continuation of the peritoneum.

Terminology

Key Terms

Disorders

benign prostatic hyperplasia (BPH)	Nonmalignant enlargement of the prostate; frequently develops with age; also called benign prostatic hypertrophy
cryptorchidism <i>krip-TOR-kid-izm</i>	Failure of the testis to descend into the scrotum (see Fig. 14-6)
epididymitis <i>ep-i-did-i-Mĭ-tis</i>	Inflammation of the epididymis. Common causes are UTIs and STIs
erectile dysfunction <i>e-REK-tĭl dis-FUNK-shun</i>	Male inability to perform intercourse because of failure to initiate or maintain an erection until ejaculation; impotence
impotence <i>IM-pō-tens</i>	Erectile dysfunction
infertility <i>in-fer-TIL-i-tē</i>	Decreased capacity to produce offspring
inguinal hernia <i>ING-gwin-al</i>	Protrusion of the intestine or other abdominal organ through the inguinal canal (see Fig. 14-7) or through the wall of the abdomen into the scrotum
orchitis <i>or-Kĭ-tis</i>	Inflammation of a testis. May be caused by injury, mumps virus, or other infections
prostatitis <i>pros-ta-Tĭ-tis</i>	Inflammation of the prostate gland. Often appears with UTI, STI, and a variety of other stresses

Terminology**Key Terms** *(Continued)***sexually transmitted infection (STI)**

Infection spread through sexual activity (**see Box 14-2**); also called sexually transmitted disease (STD) and formerly venereal (*ve-NĒR-ē-al*) disease (VD) (from Venus, the goddess of love)

sterility
ste-RIL-i-tē

Complete inability to produce offspring

urethritis
ū-rē-THRĪ-tis

Inflammation of the urethra; often caused by gonorrhea and chlamydia infections

Surgery**herniorrhaphy**
her-nē-OR-a-fē

Surgical repair of a hernia

prostatectomy
pros-ta-TEK-tō-mē

Surgical removal of the prostate

vasectomy
va-SEK-tō-mē

Excision of the vas deferens. Usually done bilaterally to produce sterility (**see Fig. 15-5**). May be accomplished through the urethra (transurethral resection)

14

Terminology**Supplementary Terms****Normal Structure and Function****emission**
ē-MISH-un

The discharge of semen

genitalia
jen-i-TĀL-ē-a

The organs concerned with reproduction, divided into internal and external components

insemination
in-sem-i-NĀ-shun

Introduction of semen into a woman's vagina

orgasm
OR-gazm

A state of physical and emotional excitement, especially that which occurs at the climax of sexual intercourse

phallus
FAL-us

The penis (adjective: phallic)

Disorders**balanitis**
bal-a-NĪ-tis

Inflammation of the glans penis and mucous membrane beneath it (root *balan/o* means "glans penis")

bladder neck obstruction (BNO)

Blockage of urine flow at the outlet of the bladder. The common cause is benign prostatic hyperplasia

hydrocele
HĪ-drō-sēl

The accumulation of fluid in a sac-like cavity, especially within the covering of the testis or spermatic cord (**Fig. 14-8**)

phimosis
fī-MŌ-sis

Narrowing of the prepuce's opening so that the foreskin cannot be pushed back over the glans penis

priapism
PRĪ-a-pizm

Abnormal, painful, continuous erection of the penis, as may be caused by drugs or specific damage to the spinal cord

(Continued)

Terminology Supplementary Terms *(Continued)*

seminoma
sem-i-NŌ-ma A tumor of the testis

spermatocele
SPER-ma-tō-sēl An epididymal cyst containing spermatozoa (see Fig. 14-8)

varicocele
VAR-i-kō-sēl Enlargement of the veins of the spermatic cord (see Fig. 14-8)

Diagnosis and Treatment

brachytherapy
brak-ē-THER-a-pē Radiation therapy by placement of encapsulated radiation sources, such as seeds, directly into a tumor or nearby tissue (from Greek *brachy-*, meaning “short”)

castration
kas-TRĀ-shun Surgical removal of the testes or ovaries. Hormones and drugs can inhibit the gonads to produce functional castration

Gleason tumor grade
GLĒ-son A system for assessing the severity of cancerous changes in the prostate; reported as a Gleason score

resectoscope
rē-SEK-tō-skōp Endoscopic instrument for transurethral removal of tissue from the urinary bladder, prostate gland, uterus, or urethra

Whitmore-Jewett staging
WIT-mōr JEW-et A method for staging prostatic tumors; an alternate to TNM staging



Go to the Audio Pronunciation Glossary in the Student Resources on thePoint to hear these terms pronounced

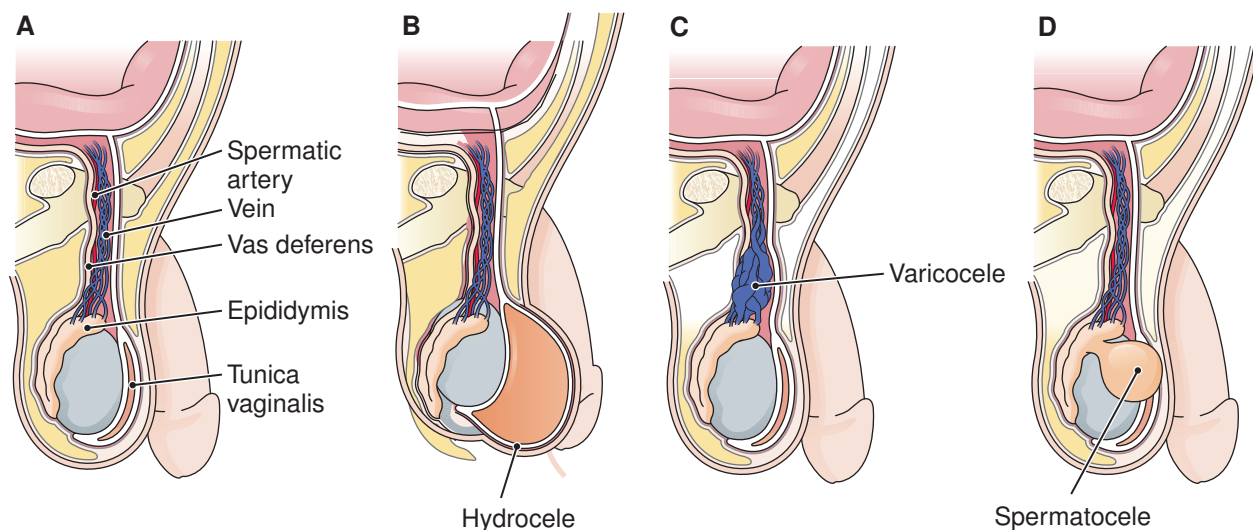


Figure 14-8 Scrotal abnormalities. A. Normal. B. Hydrocele. C. Varicocele. D. Spermatocele.

Terminology Abbreviations

AIDS	Acquired immunodeficiency syndrome	PSA	Prostate-specific antigen
BNO	Bladder neck obstruction	STD	Sexually transmitted disease
BPH	Benign prostatic hyperplasia (hypertrophy)	STI	Sexually transmitted infection
DRE	Digital rectal examination	TPUR	Transperineal urethral resection
ED	Erectile dysfunction	TSE	Testicular self-examination
FSH	Follicle-stimulating hormone	TUIP	Transurethral incision of prostate
GC	Gonococcus	TURP	Transurethral resection of prostate
GU	Genitourinary	UG	Urogenital
HBV	Hepatitis B virus	UTI	Urinary tract infection
HIV	Human immunodeficiency virus	VD	Venereal disease (sexually transmitted infection)
HSV	Herpes simplex virus	VDRL	Venereal Disease Research Laboratory (test for syphilis)
LH	Luteinizing hormone		
NGU	Nongonococcal urethritis		

C.S.'s Follow-Up

On the morning of the second postoperative day, the Foley catheter was removed, and C.S. was able to void on his own. He experienced dysuria and some burning when urinating, but otherwise did not have any postoperative complications.

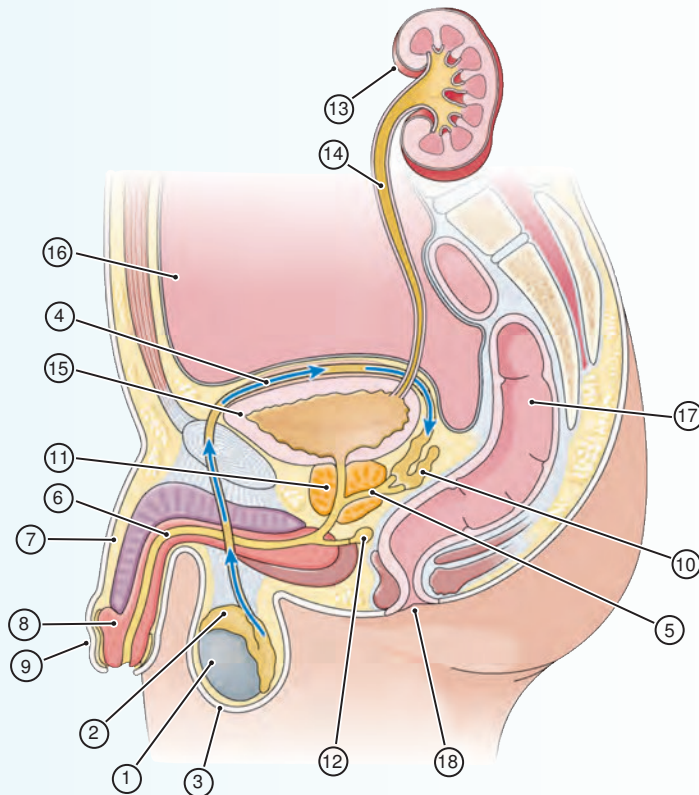
He was aware that the painful urination might persist for a few weeks. He remained in the hospital through the second day and then was discharged home with specific instructions. He was to follow up with his urologist in one week.

Chapter Review

Labeling Exercise

MALE REPRODUCTIVE SYSTEM

Write the name of each numbered part on the corresponding line of the answer sheet.



Anus
Bulbourethral (Cowper) gland
Ductus (vas) deferens
Ejaculatory duct
Epididymis
Glans penis

Kidney
Penis
Peritoneal cavity
Prepuce (foreskin)
Prostate
Rectum

Scrotum
Seminal vesicle
Testis
Ureter
Urethra
Urinary bladder

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____

10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____

Terminology

MATCHING

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|------------------------|---|
| _____ 1. gonad | a. a reproductive cell |
| _____ 2. meiosis | b. start of sexual maturity |
| _____ 3. gamete | c. gland located below the bladder in males |
| _____ 4. puberty | d. cell division that forms the gametes |
| _____ 5. prostate | e. sex gland |
| _____ 6. glans | a. excision of the ductus deferens |
| _____ 7. coitus | b. erectile dysfunction |
| _____ 8. impotence | c. surgical removal of the foreskin |
| _____ 9. vasectomy | d. end of the penis |
| _____ 10. circumcision | e. sexual intercourse |

Supplementary Terms

- | | |
|-------------------------|--------------------------------------|
| _____ 11. priapism | a. reproductive organs |
| _____ 12. phallic | b. prolonged erection of the penis |
| _____ 13. genitalia | c. tumor of the testis |
| _____ 14. phimosis | d. narrowing of the foreskin opening |
| _____ 15. seminoma | e. pertaining to the penis |
| _____ 16. spermatocele | a. inflammation of the glans penis |
| _____ 17. balanitis | b. a form of radiation treatment |
| _____ 18. castration | c. discharge of semen |
| _____ 19. emission | d. removal of the testes |
| _____ 20. brachytherapy | e. epididymal cyst |

FILL IN THE BLANKS

21. The male gonad is the _____.
22. The sac that holds the testis is the _____.
23. The thick fluid that transports spermatozoa is _____.
24. The main male sex hormone is _____.
25. The channel through which the testis descends is the _____.
26. The coiled tube that stores sperm cells on the surface of the testis is the _____.

DEFINITIONS

Define the following terms:

27. vasorrhaphy (*vas-OR-a-fē*) _____
28. anorchism (*an-OR-kizm*) _____
29. oscheoma (*os-kē-Ō-ma*) _____
30. vesiculotomy (*ve-sik-ū-LOT-ō-mē*) _____

31. prostatometer (*pros-ta-TOM-e-ter*) _____
32. hemospermia (*hē-mō-SPER-mē-a*) _____

Write a word for the following definitions:

33. surgical incision of the prostate _____
34. stone in the scrotum _____
35. surgical fixation of the testis _____
36. plastic repair of the scrotum _____
37. surgical creation of an opening between two parts of a cut ductus deferens (done to reverse a vasectomy) _____

Find a word in C.S.'s opening case study for each of the following definitions (see also Chapter 13):

38. overdevelopment of tissue _____
39. within the urinary bladder _____
40. painful urination _____
41. blood in the urine _____
42. instrument for excising tissue _____

TRUE-FALSE

Examine the following statements. If the statement is true, write T in the first blank. If the statement is false, write F in the first blank and correct the statement by replacing the underlined word in the second blank.

	True or False	Correct Answer
43. Any male sex hormone is an <u>androgen</u> .	_____	_____
44. The adjective <i>oscheal</i> refers to the <u>seminal vesicle</u> .	_____	_____
45. The spirochete <i>Treponema pallidum</i> causes <u>syphilis</u> .	_____	_____
46. Herpes simplex is a <u>virus</u> .	_____	_____
47. The <u>ureter</u> carries both urine and semen in males.	_____	_____
48. FSH and LH are produced by the <u>pituitary gland</u> .	_____	_____
49. Spermatogenesis begins at <u>puberty</u> .	_____	_____

ELIMINATIONS

In each of the sets below, underline the word that does not fit in with the rest and explain the reason for your choice:

50. bulbourethral gland — prostate — testis — spermatic cord — seminal vesicle

51. FSH — semen — testosterone — androgen — LH

52. condyloma acuminatum — gonorrhea — hernia — AIDS — herpes

ADJECTIVES

Write the adjective form of the following words:

53. semen _____
54. prostate _____
55. penis _____
56. urethra _____
57. scrotum _____

ABBREVIATIONS

Write the meaning of the following abbreviations:

58. BPH _____
59. STI _____
60. BNO _____
61. GC _____
62. PSA _____
63. GU _____
64. TURP _____

WORD BUILDING

Write a word for the following definitions using the word parts provided.

-ar -tomy -graphy -genesis spermat/o vas/o -plasty -itis -ic -cyte -lysis vesicul/o

65. plastic repair of the ductus deferens _____
66. destruction of sperm cells _____
67. pertaining to the seminal vesicle _____
68. x-ray study of the vas deferens _____
69. inflammation of the seminal vesicle _____
70. pertaining to spermatozoa _____
71. cell that develops into a sperm cell _____
72. incision of the ductus deferens _____
73. formation of spermatozoa _____
74. radiographic study of the seminal vesicle _____

WORD ANALYSIS

Define the following words and give the meaning of the word parts in each. Use a dictionary if necessary.

75. hydrocelectomy (*hi-drō-sē-LEK-tō-mē*) _____
- a. hydr/o _____
 - b. -cele _____
 - c. ecto- _____
 - d. tom/o _____
 - e. -y _____
76. spermicidal (*sper-mi-SĪ-dal*) _____
- a. sperm/i _____
 - b. -cide _____
 - c. -al _____
77. cryptorchidism (*krip-TOR-kid-izm*) _____
- a. crypt- _____
 - b. orchid/o _____
 - c. -ism _____
78. vasovesiculitis (*vas-ō-ve-sik-ū-LĪ-tis*) _____
- a. vas/o _____
 - b. vesicul/o _____
 - c. -itis _____



For more learning activities, see Chapter 14 of the Student Resources on *thePoint*.

Additional Case Studies

Case Study 14-1: Herniorrhaphy and Vasectomy

L.D., a 48-YO married dock worker with three children, had inguinal bulging and pain on exertion when he lifted heavy objects. An occupational health service advised a surgical referral. The surgeon diagnosed L.D. with bilateral direct inguinal hernias and suggested that he not delay surgery, although he was not at high risk for a strangulated hernia. L.D. asked the surgeon if he could also be sterilized at the same time. He was scheduled for bilateral inguinal herniorrhaphy and elective vasectomy.

During the herniorrhaphy procedure, an oblique incision was made in each groin. The incision continued through the muscle layers by either resecting or splitting the muscle fibers. The spermatic vessels and vas deferens were identified, separated,

and gently retracted. The spermatic cord was examined for an indirect hernia. Repair began with suturing the defect in the rectus abdominis muscles, transverse fascia, cremaster muscle, external oblique aponeurosis, and Scarpa fascia with heavy-gauge synthetic nonabsorbable suture material.

The vasectomy began with the identification of the vas deferens through the scrotal skin. An incision was made, and the vas was gently dissected and retracted through the opening. Each vas was clamped with a small hemostat, and a 1-cm length was resected. Both cut ends were coagulated with electrosurgery and tied independently with a fine-gauge absorbable suture material. The testicles were examined, and the scrotal incision was closed with an absorbable suture material.

Case Study 14-2: Circumcision

S.G., a 12-YO Jewish Russian immigrant, was preparing for his bar mitzvah. He had not been circumcised on the eighth day after his birth, as is Jewish tradition, because he had been unable to practice his religion within the former Soviet system. On recommendation of his rabbi, his family brought him to a urologist for referral and surgery. On examination, the phallus and meatus were normal and without lesions. S.G. had no signs of discharge, phimosis, or balanitis. Surgery for an adult circumcision was scheduled along with the attendance of a mohel, a Jewish ritual circumciser.

S.G. was positioned in the supine position after administration of general anesthesia. His penis and scrotum were

prepped with an antimicrobial solution and draped in sterile sheets. The surgeon and mohel scrubbed in and donned sterile gowns and gloves. The mohel chanted several prayers in Hebrew before and after making the first small cut below the foreskin, enough to draw blood. The urologist completed the resection of the redundant foreskin and approximated the circumferential incisions with fine-gauge absorbable suture material. After the incision was dressed with petrolatum gauze and S.G. recovered enough to be returned to his room, the mohel met with him and his family to continue the sacred rite with prayer and ceremonial wine.

Case Study Questions

Multiple choice. Select the best answer and write the letter of your choice to the left of each number:

- _____ 1. The term for male sterilization surgery is:
 - a. herniorrhaphy
 - b. circumcision
 - c. vagotomy
 - d. vasectomy
 - e. vasovasostomy
- _____ 2. An oblique surgical incision follows what direction?
 - a. slanted or angled
 - b. superior to inferior
 - c. lateral
 - d. circumferential
 - e. elliptical
- _____ 3. When the ends of the vas were coagulated with electrosurgery, they were:
 - a. probed
 - b. dilated
 - c. sealed
 - d. sutured
 - e. clamped
- _____ 4. A urologist is a physician who treats health and disease conditions of the:
 - a. male reproductive system
 - b. urinary system
 - c. digestive system
 - d. a and b
 - e. b and c
- _____ 5. The phallus is the:
 - a. testis
 - b. prostate
 - c. inguinal canal
 - d. opening of the urethra
 - e. penis
- _____ 6. Another name for the foreskin is the:
 - a. prepuce
 - b. phimosis
 - c. phallus
 - d. glans
 - e. balan

_____ 7. The circumferential incisions followed a direction:

- a. inferior to the scrotum
- b. suprapubic and transverse
- c. around the penis
- d. lateral to the prostate
- e. medial to the inguinal canal

Write a term from the case studies with the following meanings:

8. surgical repair or a weak abdominal muscle in the groin area on both sides

9. entrapment of a bowel loop in a hernia

10. inflammation of the glans penis

11. narrowing of the distal opening of the foreskin

CHAPTER 15

The Female Reproductive System; Pregnancy and Birth

Case Study

A.Y.'s Cesarean Section

Chief complaint:

A.Y. is a 29-year-old gravida 2, para 1, at 39 weeks' gestation. Her first pregnancy resulted in a cesarean section. She had had an uneventful pregnancy with good health, moderate weight gain, good fetal heart sounds, and no signs or symptoms of pregnancy-induced hypertension. A.Y. went to the hospital when she realized she was going into labor.

Examination:

A.Y. had been in active labor for several hours, fully effaced and dilated, yet unable to progress. Her obstetrician ordered an x-ray pelvimetry test that revealed CPD (cephalopelvic disproportion) with the fetus in the right occiput posterior position. Changes in fetal heart rate indicated fetal distress. A.Y. was transported to the OR for an emergency C-section under spinal anesthesia.

Clinical course:

After being placed in the supine position, A.Y. had a urethral catheter inserted, and her abdomen was prepped with antimicrobial solution. After draping, a transverse suprapubic incision was made. Dissection was continued through the muscle layers to the uterus, with care not to nick the bladder. The uterus was incised through the lower segment, 2 cm from the bladder. The fetal head was gently elevated through the incision while the assistant put gentle pressure on the fundus. The baby's mouth and nose were suctioned with a bulb syringe, and the umbilical cord was clamped and cut. The baby was handed off to an attending pediatrician and OB nurse and placed in a radiant neonate warmer bed. The Apgar score was 9/9. The placenta was gently delivered from the uterus, and the scrub nurse checked for three vessels and filled two sterile test tubes with cord blood for lab analysis. A.Y. was given an injection of Pitocin to stimulate uterine contraction. The uterus and abdomen were closed, and A.Y. was transported to the PACU (postanesthesia care unit).





Ancillaries *At-A-Glance*

Visit *thePoint* to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii–xvi.

Learning TOOLS

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning RESOURCES

- E-book: Chapter 15
- Web Figure: Microscopic View of the Ovary
- Web Figure: Microscopic View of the Uterus
- Web Figure: The Stages of Labor
- Web Figure: The Apgar Scoring System
- Web Figure: Placental Abnormalities
- Web Chart: The Main Methods of Birth Control
- Web Chart: Placental Hormones
- Web Chart: Genetic Diseases
- Animation: Ovulation and Fertilization
- Animation: Fetal Circulation
- Audio Pronunciation Glossary

Learning ACTIVITIES

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After study of this chapter you should be able to:

- 1 Describe the female reproductive tract, and give the function of each part. *p372*
- 2 Describe the structure and function of the mammary glands. *p374*
- 3 Outline the events in the menstrual cycle. *p374*
- 4 List four types of contraception with examples of each. *p375*
- 5 Describe seven disorders of the female reproductive system. *p382*
- 6 Outline the major events that occur in the first two months after fertilization. *p389*
- 7 Describe the structure and function of the placenta. *p389*
- 8 Describe two adaptations in fetal circulation and cite their purposes. *p391*
- 9 Describe the three stages of childbirth. *p391*
- 10 List the hormonal and nervous controls over lactation. *p393*
- 11 Identify and use roots pertaining to the female reproductive system, pregnancy, and birth. *pp378, 394*
- 12 Describe six disorders of pregnancy and birth. *p395*
- 13 Define two types of congenital disorders and give examples each. *p397*
- 14 Interpret abbreviations used in referring to reproduction. *pp389, 404*
- 15 Analyze the medical terms in several case studies concerning the female reproductive system, pregnancy, and birth. *pp370, 411*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|---|---|
| <p>_____ 1. The female gonad is the:</p> <ul style="list-style-type: none"> a. uterus b. cervix c. ovary d. testis | <p>_____ 5. The structure that nourishes the developing fetus is the:</p> <ul style="list-style-type: none"> a. mammary gland b. placenta c. cervix d. follicle |
| <p>_____ 2. The two ovarian hormones are:</p> <ul style="list-style-type: none"> a. testosterone and estrogen b. estrogen and progesterone c. thyroxine and progesterone d. progesterone and testosterone | <p>_____ 6. Production of milk is technically called:</p> <ul style="list-style-type: none"> a. ovulation b. gestation c. lactation d. parturition |
| <p>_____ 3. Use of artificial methods to prevent fertilization is termed:</p> <ul style="list-style-type: none"> a. antiception b. interruption c. coitus d. contraception | <p>_____ 7. The roots <i>metr/o</i> and <i>hyster/o</i> mean:</p> <ul style="list-style-type: none"> a. uterus b. vagina c. follicle d. ovary |
| <p>_____ 4. During the first two months of growth, the developing offspring is called a(n):</p> <ul style="list-style-type: none"> a. embryo b. neonate c. zygote d. fetus | <p>_____ 8. Any disorder present at birth is described as:</p> <ul style="list-style-type: none"> a. hereditary b. genetic c. congenital d. familial |

As in males, the female reproductive tract consists of internal organs and external genitalia. The breasts, or mammary glands, although not part of the reproductive system, are usually included with a discussion of this system, as their purpose is to nourish an infant.

In contrast to the continuous gametogenesis in males, formation of the female gamete is cyclic, with an egg released midway in the menstrual cycle. Each month, the uterus is prepared to receive a fertilized egg. If fertilization occurs, the developing offspring is nourished and protected by the placenta and surrounding fluids until birth. If the released egg is not fertilized, the lining of the uterus is sloughed off in menstruation.

The Female Reproductive System

THE OVARIES

The female gonads are the paired **ovaries** (singular: ovary) that are held by ligaments in the pelvic cavity on either side of the **uterus** (Fig. 15-1). It is within the ovaries that the

female gametes, the eggs or **ova** (singular: ovum), develop. Every month, several ova ripen, each within a cluster of cells called an **ovarian follicle**. At the time of **ovulation**, usually only one ovum is released from an ovary, and the remainder of the ripening ova degenerate. The follicle remains behind and continues to function for about two weeks if the ovum is not fertilized and for about two months if the ovum is fertilized.

THE UTERINE TUBES, UTERUS, AND VAGINA

After ovulation, the ovum travels into a **uterine tube** (also called the **fallopian tube** or oviduct), a tube attached to the upper lateral portion of the uterus (see Fig. 15-1). This tube arches above the ovary and has finger-like projections called **fimbriae** that sweep the released ovum into the uterine tube. If fertilization takes place, it typically occurs in a uterine tube.

The uterus is the organ that nourishes the developing offspring. It is pear shaped, with an upper rounded fundus, a triangular cavity, and a lower narrow **cervix** that projects into the **vagina**. The recess around the cervix in the superior vagina is the **fornix**. At the posterior cervix, the peritoneum

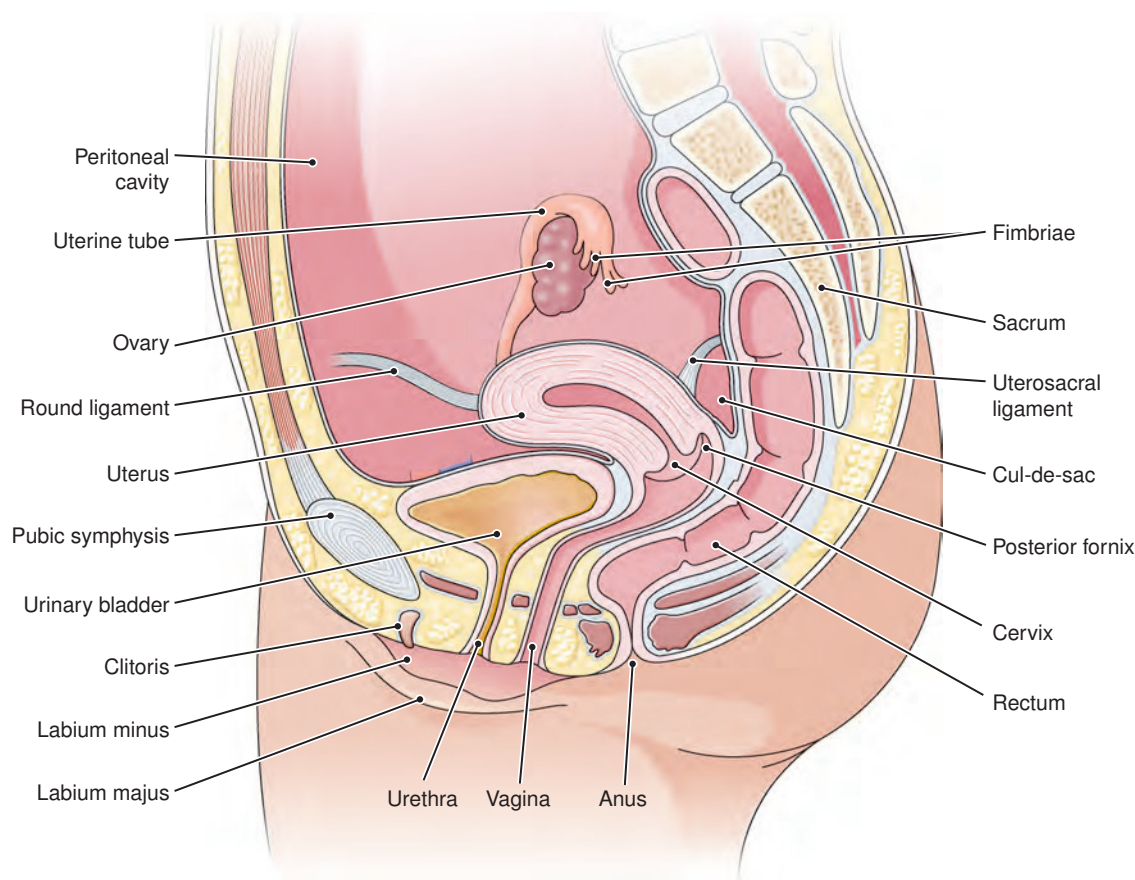


Figure 15-1 Female reproductive system. The system is seen in a sagittal section along with some adjacent structures.

dips downward to form a blind pouch, or **cul-de-sac** (from French, meaning “bottom of the bag”), the lowest point of the peritoneal cavity.

The innermost layer of the uterine wall, the **endometrium**, has a rich blood supply. It receives the fertilized ovum and becomes part of the placenta during pregnancy. The endometrium is shed during the menstrual period if no fertilization occurs. The muscle layer of the uterine wall is the **myometrium**.

The vagina is a muscular tube that receives the penis during intercourse, functions as a birth canal, and transports the menstrual flow out of the body (see Fig. 15-1).

openings. The **clitoris**, anterior to the urethral opening, is similar in origin to the penis and responds to sexual stimulation.

In both males and females, the region between the thighs from the external genital organs to the anus is the **perineum**. During childbirth, an incision may be made between the vagina and the anus to facilitate birth and prevent the tearing of tissue, a procedure called an **episiotomy**. (This procedure is actually a perineotomy, as the root *episi/o* means “vulva.”)



See the animation “Ovulation and Fertilization” and microscopic views of the ovary and uterus showing changes during the menstrual cycle in the Student Resources on thePoint.

THE EXTERNAL GENITAL ORGANS

All of the external female genitalia together are called the **vulva** (Fig. 15-2). This includes the large outer **labia majora** (singular: labium majus) and small inner **labia minora** (singular: labium minus) that enclose the vaginal and urethral

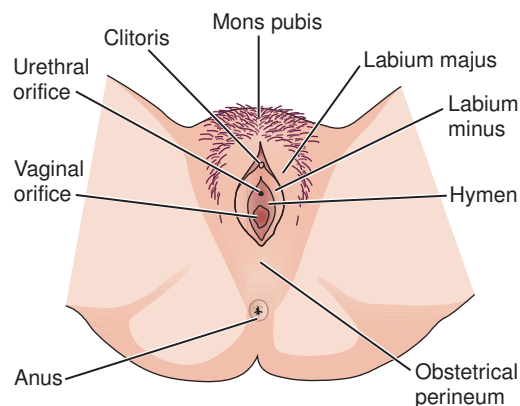


Figure 15-2 The external female genitalia.

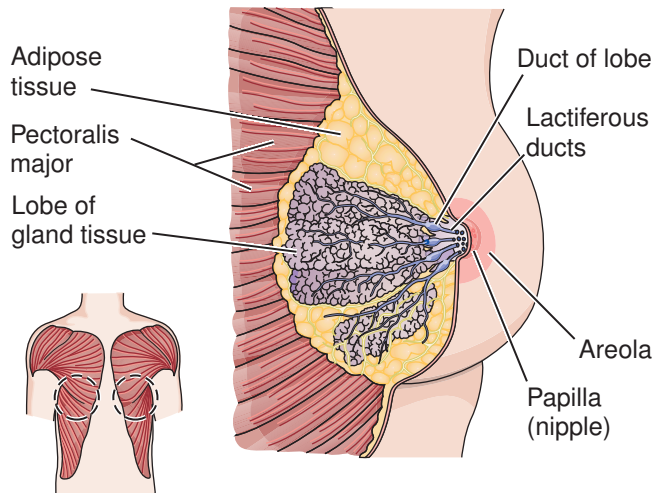


Figure 15-3 Section of the breast.

The Mammary Glands

The **mammary glands**, or breasts, are composed mainly of glandular tissue and fat (Fig. 15-3). Their purpose is to provide nourishment for the newborn. The milk secreted by the glands is carried in ducts to the nipple.

The Menstrual Cycle

Female reproductive activity normally begins during puberty with **menarche**, the first menstrual period. Each month, the menstrual cycle is controlled, as is male reproductive activity, by hormones from the anterior pituitary gland.

Follicle-stimulating hormone (FSH) begins the cycle by causing the ovum to ripen in the ovarian follicle (Fig. 15-4). The follicle secretes **estrogen**, a hormone that starts endometrial development in preparation for the fertilized egg.

A second pituitary hormone, **luteinizing hormone (LH)**, triggers ovulation and conversion of the follicle to the **corpus luteum**. This structure, left behind in the ovary, secretes **progesterone** and estrogen, which further the endometrial growth. If no fertilization occurs, hormone levels decline, and the endometrium sloughs off in the process of **menstruation**.

The average menstrual cycle lasts 28 days, with the first day of menstruation taken as day 1 and ovulation occurring on about day 14. Throughout the cycle, estrogen and progesterone feed back to the pituitary to regulate the production of FSH and LH. Hormonal birth control methods act by supplying estrogen and progesterone, which inhibit FSH and LH release from the pituitary and prevent ovulation while not interfering with menstruation. The menstrual period that follows withdrawal of the hormones is anovulatory (*an-OV-ū-la-tor-ē*); that is, it is not preceded by ovulation.

Figure 15-4 shows changes occurring simultaneously in the ovary and uterus during the course of one menstrual

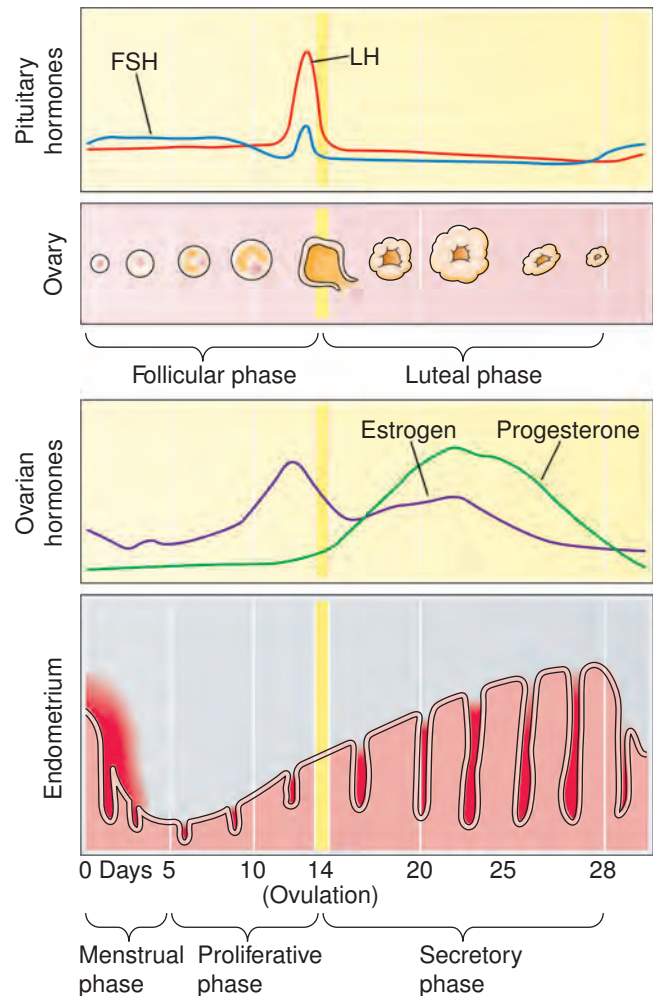


Figure 15-4 The menstrual cycle. Changes in pituitary and ovarian hormones, the ovary, and the uterus are shown during an average 28-day menstrual cycle with ovulation on day 14. Phases in the ovary are named for follicular development and formation of the corpus luteum. Phases in the uterus are named for changes in the endometrium.

cycle under the effects of pituitary and ovarian hormones. The time before ovulation is described as the follicular phase in the ovary, because it encompasses development of the ovarian follicle. The uterus during this time is in the proliferative phase, marked by endometrial growth. After ovulation, the ovary is in the luteal phase with conversion of the follicle to the corpus luteum. The uterus is then in a secretory phase as its glands are actively preparing the endometrium for possible implantation of a fertilized egg.

MENOPAUSE

Menopause is the cessation of monthly menstrual cycles. This generally occurs between the ages of 45 and 55 years. Reproductive hormone levels decline, and ovarian ova gradually degenerate. Some women experience unpleasant symptoms, such as hot flashes, headaches, insomnia, mood

swings, and urinary problems. There is also some atrophy of the reproductive tract, with vaginal dryness. Most importantly, the decline in estrogen levels is associated with bone weakening (osteoporosis).

Physicians may prescribe hormone replacement therapy (HRT) to alleviate menopausal symptoms. This treatment usually consists of administering estrogen in combination with progestin (*pro-JES-tin*), a synthetic progesterone, given to minimize the risk of endometrial cancer. Estrogen replacement reduces bone loss associated with aging. Concerns about HRT safety, however, have caused reconsideration of this therapy beyond the early postmenopausal years. Studies with the most widely used form of HRT showed an increased risk of endometrial cancer, breast cancer, heart disease, and blood clots with extended use. Studies are ongoing on HRT safety and the use of estrogen alone for women who have no uterus.

Aside from HRT, antidepressants and vitamin E may help to relieve menopausal symptoms; locally applied estrogen and moisturizers relieve vaginal dryness. Nonhormonal drugs that increase bone density are also available if needed. As always, exercise and a balanced diet with adequate calcium are important in maintaining health throughout life.

Contraception

Contraception is the use of artificial methods to prevent fertilization of the ovum or its implantation in the uterus. Temporary methods of birth control function to:

- Block sperm penetration of the uterus (e.g., condom, diaphragm)
- Prevent implantation of the fertilized egg (e.g., intra-uterine device or IUD)
- Prevent ovulation (e.g., hormones). Hormonal methods differ in dosage and route of delivery, such as oral intake (the birth control pill), injection, skin patch, and vaginal ring.

The so-called morning-after pill is intended for emergency contraception. It considerably reduces the chance of pregnancy if taken within 72 hours after unprotected sexual intercourse. One such product, Plan B, consists of two progestin doses taken 12 hours apart.

Surgical sterilization provides the most effective and usually permanent contraception. In males, this procedure is a vasectomy; in females, surgical sterilization is a **tubal ligation**, in which uterine tubes are cut and tied on both sides (Fig. 15-5). Laparoscopic surgery through the abdominal wall is the preferred method for performing the procedure (Fig. 15-6).

RU486 (mifepristone) is more widely used for birth control in other countries than in the United States. It terminates an early pregnancy by blocking progesterone, causing the endometrium to break down. Technically, RU486 is an abortion-causing agent (abortifacient), not a contraceptive.

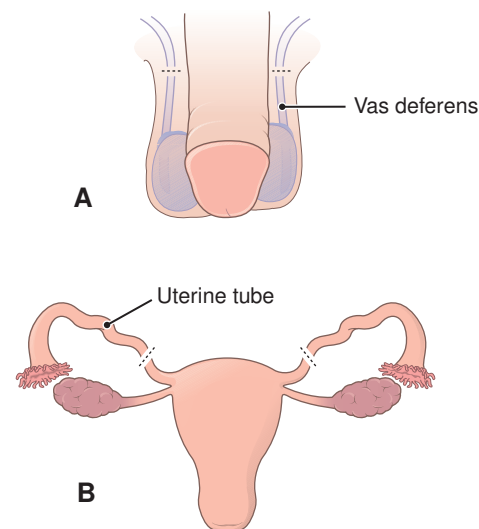


Figure 15-5 Sterilization. A. Vasectomy. B. Tubal ligation.

Box 15-1 describes the main contraceptive methods currently in use. Each has advantages and disadvantages over other methods, but they are listed roughly in order of decreasing effectiveness. Note that only male and female condoms protect against the spread of STIs.



A more complete list of the main methods of birth control along with the advantages and disadvantages of each is in the Student Resources on thePoint.

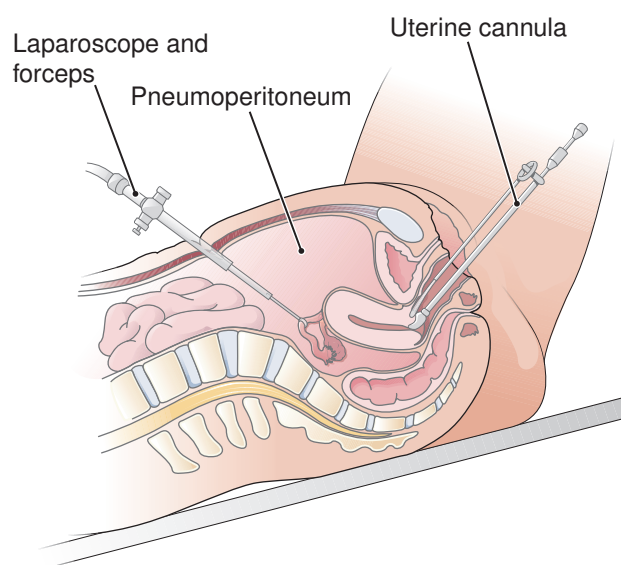


Figure 15-6 Laparoscopic sterilization. The peritoneal cavity is inflated (pneumoperitoneum) and the uterine tubes are cut laparoscopically through a small incision.

Box 15-1

For Your Reference



Main Methods of Birth Control Currently in Use

METHOD	DESCRIPTION
SURGICAL	
vasectomy/tubal ligation	cutting and tying the tubes that carry the gametes
HORMONAL	
birth control pills	estrogen and progestin or progestin alone taken orally to prevent ovulation
birth control shot	injection of synthetic progesterone every three months to prevent ovulation
birth control patch	adhesive patch placed on body that administers estrogen and progestin through the skin; left on for three weeks and removed for a fourth week
birth control ring	flexible ring inserted into vagina that releases hormones internally; left in place for three weeks and removed for a fourth week
BARRIER	
condom	sheath that prevents sperm cells from contacting an ovum. A male condom fits over an erect penis. A female condom fits into the vagina and covers the cervix
diaphragm (with spermicide)	rubber cap that fits over cervix and prevents sperm entrance
contraceptive sponge (with spermicide)	soft, disposable foam disk containing spermicide, which is moistened with water and inserted into vagina
intrauterine device (IUD)	metal or plastic device inserted into uterus through vagina; prevents fertilization and implantation by release of copper or birth control hormones
OTHER	
spermicide	chemicals used to kill sperm; best when used in combination with a barrier method
fertility awareness	abstinence during fertile part of cycle as determined by menstrual history, basal body temperature, or quality of cervical mucus

Terminology

Key Terms

FEMALE REPRODUCTIVE SYSTEM

Normal Structure and Function

cervix <i>SER-viks</i>	Neck. Usually means the lower narrow portion (neck) of the uterus (root: cervic/o); cervix uteri (<i>U-ter-i</i>)
clitoris <i>KLIT-o-ris</i>	A small erectile body anterior to the urethral opening that is similar in origin to the penis (roots: clitor/o, clitorid/o)
contraception <i>kon-tra-SEP-shun</i>	The prevention of pregnancy
corpus luteum <i>KOR-pus LŪ-tē-um</i>	The small yellow structure that develops from the ovarian follicle after ovulation and secretes progesterone and estrogen
cul-de-sac <i>kul-di-SAK</i>	A blind pouch, such as the recess between the rectum and the uterus; the rectouterine pouch or pouch of Douglas (see Fig. 15-1)
endometrium <i>en-dō-MĒ-trē-um</i>	The inner lining of the uterus

Terminology

Key Terms (Continued)

estrogen <i>ES-trō-jen</i>	A group of hormones that produce female characteristics and prepare the uterus for the fertilized egg. The most active of these is estradiol
fallopian tube <i>fa-LŌ-pē-an</i>	See uterine tube
fimbriae <i>FIM-brē-ē</i>	The long finger-like extensions of the uterine tube that wave to capture the released ovum (see Fig. 15-1) (singular: fimbria)
follicle-stimulating hormone (FSH)	A hormone secreted by the anterior pituitary that acts on the gonads. In the female, it stimulates ripening of ova in the ovary
fornix <i>FOR-niks</i>	An arch-like space, such as the space between the uppermost wall of the vagina and the cervix (see Fig. 15-1); from Latin meaning “arch”
labia majora <i>LĀ-bē-a ma-JOR-a</i>	The two large folds of skin that form the sides of the vulva (root <i>labi/o</i> means “lip”) (singular: labium majus)
labia minora <i>LĀ-bē-a mī-NOR-a</i>	The two small folds of skin within the labia majora (singular: labium minus)
luteinizing hormone (LH) <i>LŪ-tē-in-ī-zing</i>	A hormone secreted by the anterior pituitary that acts on the gonads. In the female, it stimulates ovulation and corpus luteum formation
mammary gland <i>MAM-a-rē</i>	A specialized gland capable of secreting milk in the female (roots: <i>mamm/o</i> , <i>mast/o</i>); the breast
menarche <i>men-AR-kē</i>	The first menstrual period, which normally occurs during puberty
menopause <i>MEN-ō-pawz</i>	Cessation of menstrual cycles in the female
menstruation <i>men-strū-Ā-shun</i>	The cyclic discharge of blood and mucosal tissues from the lining of the nonpregnant uterus (roots: <i>men/o</i> , <i>mens</i>); menstrual period, menses (<i>MEN-sez</i>)
myometrium <i>mī-ō-MĒ-trē-um</i>	The muscular wall of the uterus
ovarian follicle <i>ō-VAR-ē-an FOL-i-kl</i>	The cluster of cells in which the ovum ripens in the ovary
ovary <i>Ō-va-rē</i>	A female gonad (roots: <i>ovari/o</i> , <i>oophor/o</i>)
ovulation <i>ov-ū-LĀ-shun</i>	The release of a mature ovum from the ovary (from <i>ovule</i> , meaning “little egg”)
ovum <i>Ō-vum</i>	The female gamete or reproductive cell (roots: <i>oo</i> , <i>ov/o</i>) (plural: ova)
perineum <i>per-i-NĒ-um</i>	The region between the thighs from the external genitalia to the anus (root: <i>perine/o</i>)
progesterone <i>prō-JES-ter-ōn</i>	A hormone produced by the corpus luteum and the placenta that maintains the endometrium for pregnancy
tubal ligation <i>lī-GĀ-shun</i>	Surgical constriction of the uterine tubes to produce sterilization (see Figs. 15-5 and 15-6)
uterine tube <i>Ū-ter-in</i>	A tube extending from the upper lateral portion of the uterus that carries the ovum to the uterus (root: <i>salping/o</i>). Also called fallopian (<i>fa-LŌ-pē-an</i>) tube or oviduct

(Continued)

Terminology**Key Terms** (Continued)

uterus <i>Ū-ter-us</i>	The organ that receives the fertilized egg and maintains the developing offspring during pregnancy (roots: <i>uter/o</i> , <i>metr</i> , <i>hyster/o</i>) (see Box 15-2)
vagina <i>va-JĪ-na</i>	The muscular tube between the cervix and the vulva (roots: <i>vagin/o</i> , <i>colp/o</i>)
vulva <i>VUL-vā</i>	The external female genital organs (roots: <i>vulv/o</i> , <i>episi/o</i>)



Go to the Audio Pronunciation Glossary in the Student Resources on thePoint to hear these terms pronounced.

Box 15-2*Focus on Words***Crazy Ideas**

Most women would be shocked and surprised to learn the origin of the root *hyster/o*, used for the uterus. It comes from the same root as the words *hysterical* and *hysterics* and was based on the very old belief that the womb was the source of mental disturbances in women.

A similar history lies at the origin of the word *hypochondriac*, a term for someone who has imaginary illnesses. The *hypochondriac* regions are in the upper portions of the abdomen, an area that the ancients believed was the seat of mental disorders.

Roots Pertaining to the Female Reproductive System

See **Tables 15-1 to 15-3**.

Table 15-1**Roots for Female Reproduction and the Ovaries**

Root	Meaning	Example	Definition of Example
<i>gyn/o</i> , <i>gynec/o</i> *	woman	<i>gynecology</i> <i>gī-ne-KOL-ō-jē</i>	study of women's diseases
<i>men/o</i> , <i>mens</i>	month, menstruation	<i>premenstrual</i> <i>prē-MEN-strū-al</i>	before a menstrual period
<i>oo</i>	ovum, egg cell	<i>oocyte</i> <i>Ō-ō-sīt</i>	cell that gives rise to an ovum
<i>ov/o</i> , <i>ovul/o</i>	ovum, egg cell	<i>anovulatory</i> <i>an-OV-ū-la-tōr-ē</i>	absence of egg ripening or of ovulation

Table 15-1 Roots for Female Reproduction and the Ovaries (*Continued*)

Root	Meaning	Example	Definition of Example
ovari/o	ovary	ovariopexy ō-var-ē-ō-PEK-sē	surgical fixation of an ovary
oophor/o	ovary	oophorectomy ō-of-ō-REK-tō-mē	excision of an ovary

*Although the correct pronunciation of this root is *jīn* (with a soft *g* and long *i*), it is commonly pronounced with a hard *g* as in *gīn* and may also have a short *i*, as in *jīn* or *gin*.

EXERCISE 15-1**Define the following words:**

1. gynecopathy (*gī-ne-KOP-a-thē*) _____
2. intermenstrual (*in-ter-MEN-strū-al*) _____
3. oogenesis (*ō-ō-JEN-e-sis*) _____
4. ovulation (*ov-ū-LĀ-shun*) _____
5. ovarian (*ō-VAR-ē-an*) _____
6. oophoritis (*ō-of-ō-RĪ-tis*) _____

Write a word for the following definitions:

7. a physician who specializes in the treatment of women's diseases _____
8. pertaining to ovulation _____
9. profuse bleeding (-rhagia) at the time of menstruation _____

The word *menorrhea* means "menstruation." Add a prefix to *menorrhea* to form words for the following definitions:

10. painful or difficult menstruation _____
11. absence of menstruation _____
12. scanty menstrual flow _____

Use the root *ovari/o* to write words for the following:

13. rupture of an ovary _____
14. surgical puncture of an ovary _____
15. hernia of an ovary _____

Use the root *oophor/o* to write words for the following:

16. incision of an ovary _____
17. malignant tumor of the ovary _____

Table 15-2 Roots for the Uterine Tubes, Uterus, and Vagina

Root	Meaning	Example	Definition of Example
salping/o	uterine tube, tube	salpingoplasty <i>sal-PING-ō-plas-tē</i>	plastic repair of a uterine tube
uter/o	uterus	intrauterine <i>in-tra-Ū-ter-in</i>	within the uterus
metr/o, metr/i	uterus	metrorrhea <i>mē-trō-RĒ-a</i>	abnormal uterine discharge
hyster/o	uterus	hysterotomy <i>his-ter-OT-ō-mē</i>	incision of the uterus
cervic/o	cervix, neck	endocervical <i>en-dō-SER-vi-kal</i>	pertaining to the lining of the cervix
vagin/o	vagina	vaginometer <i>vaj-i-NOM-e-ter</i>	instrument for measuring the vagina
colp/o	vagina	colpostenosis <i>kol-pō-sten-Ō-sis</i>	narrowing of the vagina

EXERCISE 15-2**Define the following terms:**

1. intracervical (*in-tra-SER-vi-kal*) _____
2. uterovesical (*ū-ter-ō-VES-i-kal*) _____
3. salpingectomy (*sal-pin-JEK-tō-mē*) _____
4. colpodynia (*kol-pō-DIN-ē-a*) _____
5. vaginoplasty (*vaj-i-nō-PLAS-tē*) _____
6. metromalacia (*mē-trō-ma-LĀ-shē-a*) _____
7. hysteroscopy (*his-ter-OS-kō-pē*) _____

Write words for the following:

8. surgical fixation of a uterine tube _____
9. radiographic study of the uterine tube _____

The root **salping/o** is taken from the word **salpinx**, which means “tube.” Add a prefix to **salpinx** to write a word for the following:

10. collection of fluid in a uterine tube _____
11. presence of pus in a uterine tube _____

Note how the roots **salping/o** and **oophor/o** are combined to form **salpingo-oophoritis** (inflammation of a uterine tube and ovary). Write a word for the following:

12. surgical removal of a uterine tube and ovary _____

EXERCISE 15-2 (Continued)

Use the roots indicated to write words for the following:

13. surgical fixation of the uterus (hyster/o) _____
14. prolapse of the uterus (metr/o) _____
15. through the cervix _____
16. narrowing of the uterus (metr/o) _____
17. radiograph of the uterus (hyster/o) and uterine tubes _____
18. pertaining to the uterus (uter/o) _____
19. hernia of the vagina (colp/o) _____
20. inflammation of the vagina (vagin/o) _____

Table 15-3 Roots for the Female Accessory Structures

Root	Meaning	Example	Definition of Example
vulv/o	vulva	vulvar VUL-var	pertaining to the vulva
episi/o	vulva	episiotomy e-piz-ē-OT-ō-mē	incision of the vulva
perine/o	perineum	perineal per-i-NĒ-al	pertaining to the perineum
clitor/o, clitorid/o	clitoris	clitorectomy kli-tō-REK-tō-mē	excision of the clitoris
mamm/o	breast, mammary gland	mammoplasty mam-ō-PLAS-tē	plastic surgery of the breast
mast/o	breast, mammary gland	amastia a-MAS-tē-a	absence of the breasts

EXERCISE 15-3

Write a word for the following:

1. any disease of the vulva (vulv/o) _____
2. suture of the vulva (episi/o) _____
3. pertaining to the vagina (vagin/o) and perineum _____
4. inflammation of the clitoris _____
5. radiograph of the breast (mamm/o) _____
6. inflammation of the breast (mast/o) _____
7. excision of the breast _____

Clinical Aspects of Female Reproduction

INFECTION

The major organisms that cause sexually transmitted infections in both men and women are given in **Box 14-2**.

Genital herpes is a presently incurable viral infection that affects over 25 percent of adults in the United States. Once infection occurs, the virus lives in the nervous system, causing intermittent outbreaks that may include genital sores, itching, burning, and urinary problems. The virus is easily spread to sexual partners even if there are no active signs of the disease. Pregnant women can pass the virus to their babies during delivery, resulting in possible disabilities and even death. Some basic hygiene measures and condom use can reduce viral spread.

A fungus that infects the vulva and vagina is *Candida albicans*, causing **candidiasis**. The resultant **vaginitis**, inflammation of the vagina, causes itching and release of a thick, white, cheesy discharge. Pregnancy, diabetes mellitus, and use of antibiotics, steroids, or birth control pills predispose to this infection. If the infection is recurrent, the patient's partner should be treated to prevent reinfections. Antifungal agents (mycostatics) are used in treatment.

Pelvic inflammatory disease (PID) is the spread of infection from the reproductive organs into the pelvic cavity. It is most often caused by the gonorrhea organism or by *Chlamydia*, although bacteria normally living in the reproductive tract may also be responsible when conditions allow. PID is a serious disorder that may result in septicemia or shock. Inflammation of the uterine tubes, called **salpingitis**, may close off these tubes and cause infertility.

FIBROIDS

A **fibroid** is a benign smooth muscle tumor usually occurring in the uterine wall, the myometrium (**Fig. 15-7**). This type of growth, technically called a **leiomyoma**, is one of the most common uterine disorders, but it usually causes no symptoms and requires no treatment. Fibroids may, however, cause heavy menstrual bleeding (menorrhagia) and rectal or bladder pressure. Treatments include:

- Suppression of hormones that stimulate fibroid growth
- Surgical removal of the fibroids (myomectomy)
- Surgical removal of the uterus, or **hysterectomy**
- Uterine fibroid embolization (UFE), a method that has reduced the need for hysterectomies. A specially trained radiologist uses a catheter to inject small synthetic particles into a uterine artery. These particles then block blood supply to the fibroid causing it to shrink.

ENDOMETRIOSIS

Growth of endometrial tissue outside the uterus is termed **endometriosis**. Commonly, the ovaries, uterine tubes, peritoneum, and other pelvic organs are involved (**Fig 15-8**).

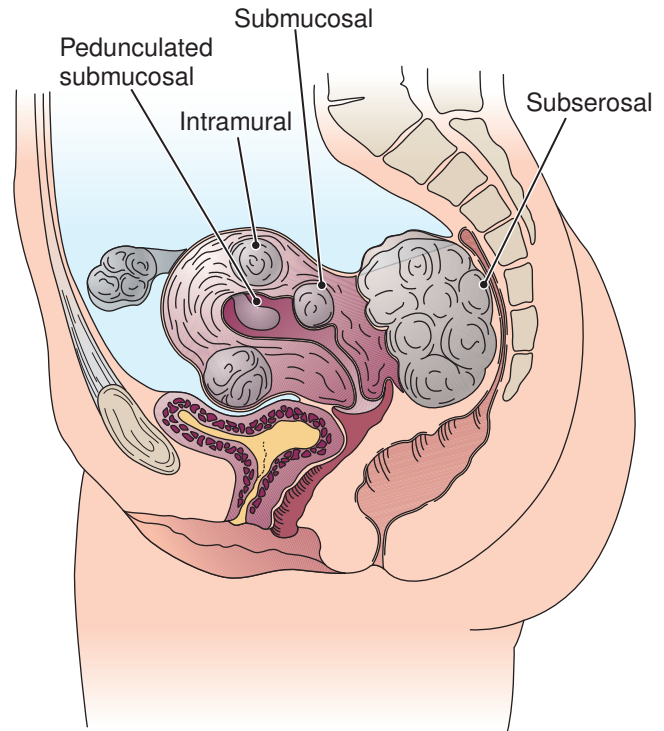


Figure 15-7 Uterine leiomyomas (fibroids). Various possible locations are shown. They may be within the uterine wall (intramural), below the mucous membrane (submucosal), on a stalk (pedunculated), or below the outer serous membrane (subserosal). One tumor is shown compressing the urinary bladder and another the rectum.

Stimulated by normal hormones, the endometrial tissue causes inflammation, fibrosis, and adhesions in surrounding areas. The results may be pain, **dysmenorrhea** (painful or difficult menstruation), and infertility. Laparoscopy is used to diagnose endometriosis and also to remove the abnormal tissue.

MENSTRUAL DISORDERS

Menstrual abnormalities include flow that is too scanty (oligomenorrhea) or too heavy (menorrhagia) and the absence of monthly periods (amenorrhea). Dysmenorrhea, when it occurs, usually begins at the start of menstruation and lasts one to two days. Together, these disorders are classified as dysfunctional uterine bleeding (DUB). These responses may be caused by hormone imbalances, systemic disorders, or uterine problems. They are most common in adolescence or near menopause. At other times, they are often related to life changes and emotional upset.

Premenstrual syndrome (PMS) describes symptoms that appear during the menstrual cycle's second half and includes emotional changes, fatigue, bloating, headaches, and appetite changes. Possible causes of PMS have been under study. Symptoms may be relieved by hormone therapy, antidepressants, or anti-anxiety medications. Exercise, dietary control, rest, and relaxation strategies may also be

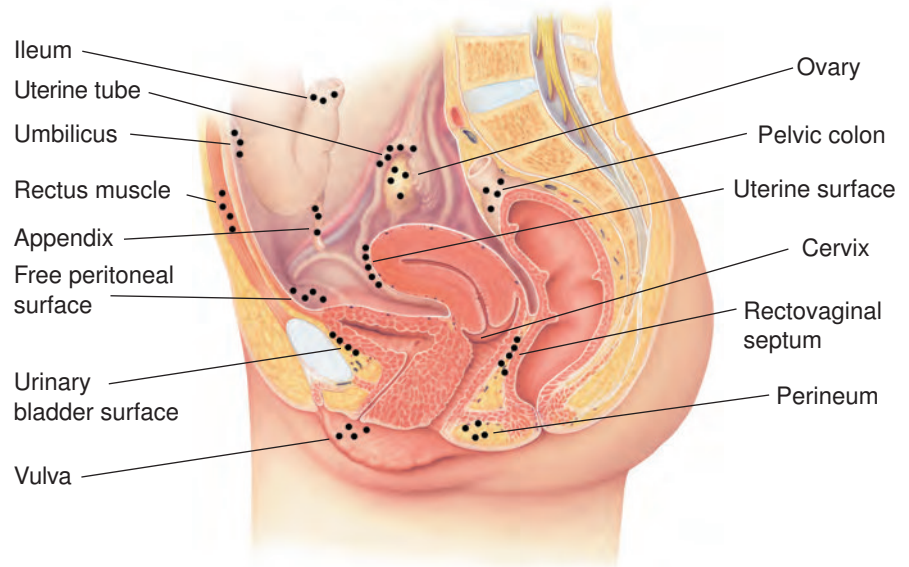


Figure 15-8 Endometriosis. Endometrial tissue can grow outside the uterus almost anywhere in the peritoneal cavity, causing inflammation and other complications.

helpful. Avoiding caffeine and taking vitamin E supplements may relieve breast tenderness; one should also drink adequate water and limit salt intake.

POLYCYSTIC OVARIAN SYNDROME

Polycystic ovarian syndrome (PCOS) is discussed here because the first-described symptoms of this disorder were enlarged ovaries with multiple cysts. These signs are not always present in PCOS, although the ovaries do show abnormalities. PCOS is an endocrine disorder involving increased androgen and estrogen secretion that interferes with normal secretion of pituitary FSH and LH. Some effects include:

- Anovulation and infertility
- Scant or absent menses (oligomenorrhea or amenorrhea)
- Excessive hair growth (hirsutism), caused by excess androgen (male hormone)
- Resistance to insulin, a hormone that lowers blood sugar, resulting in symptoms of diabetes mellitus
- Obesity

PCOS is treated with hormones to regulate hormonal imbalance, drugs to increase responsiveness to insulin, weight reduction (estrogen is produced in adipose tissue), and sometimes partial removal of the ovaries.

CANCER OF THE FEMALE REPRODUCTIVE TRACT

Endometrial Cancer

Cancer of the endometrium is the most common cancer of the female reproductive tract. Women at risk should have biopsies taken regularly because endometrial cancer is not always detected by **Pap (Papanicolaou) smear**, a simple histologic test. Treatment consists of hysterectomy (removal of the uterus) (**Fig. 15-9**) and sometimes radiation therapy.

A small percentage of cases occur after endometrial overgrowth (hyperplasia). This tissue can be removed by **dilation and curettage (D&C)**, in which the cervix is widened and the lining of the uterus is scraped with a curette.

Cervical Cancer

Almost all patients with cervical cancer have been infected with human papillomavirus (HPV), a virus that causes genital warts. Incidence is also related to high sexual activity and other sexually transmitted viral infections, such as herpes.

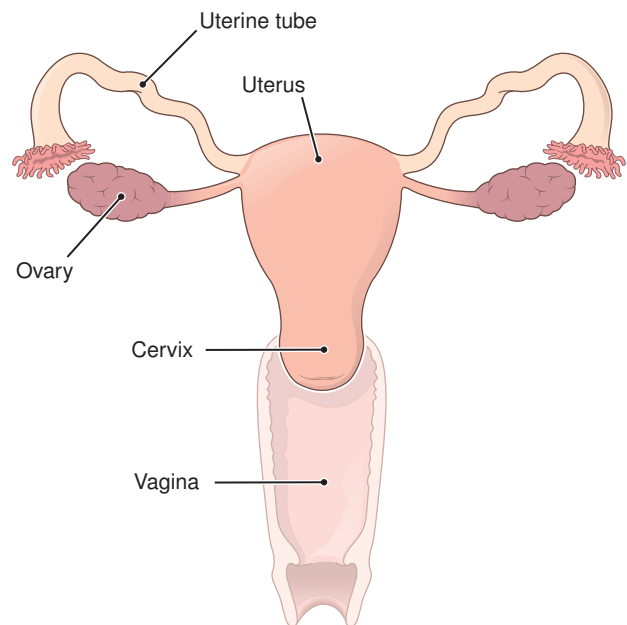


Figure 15-9 Reproductive surgery. A hysterectomy is surgical removal of the uterus. Removal of the ovary (oophorectomy) and uterine tube (salpingectomy) may also be required either unilaterally or bilaterally.

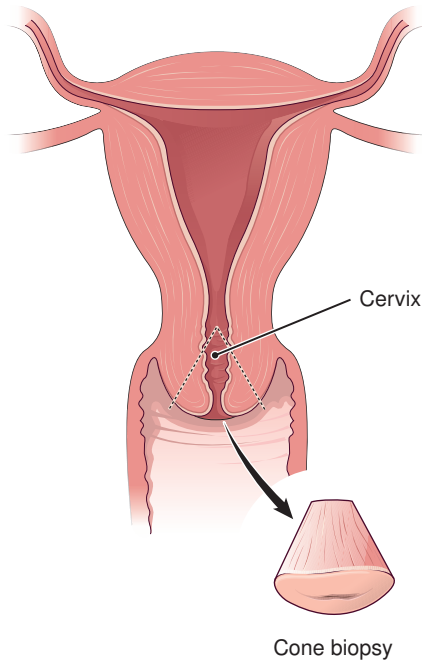


Figure 15-10 Cone biopsy of the uterine cervix.

In the 1940s and 1950s, the synthetic steroid DES (diethylstilbestrol) was given to prevent miscarriages. A small percentage of daughters born to women treated with this drug have shown an increased risk for cancer of the cervix and vagina. These women need to be examined regularly.

Cervical carcinoma is often preceded by abnormal growth (dysplasia) of the epithelial cells lining the cervix. Growth is graded as CIN I, II, or III, depending on the depth of tissue involved. CIN stands for cervical intraepithelial neoplasia. Diagnosis of cervical cancer is by a Pap smear, examination with a colposcope, and biopsy. In a cone biopsy (Fig. 15-10), a

cone-shaped piece of tissue is removed from the lining of the cervix for study. Often in the procedure, all of the abnormal cells are removed as well.

Ovarian Cancer

Cancer of the ovary has a high mortality rate because it usually causes no distinct early symptoms and there is no accurate routine screening test yet available. Women may overlook the vague possible signs of ovarian cancer, such as bloating, change in bowel habits, backache, urinary changes, abnormal bleeding, weight loss, and fatigue. Often by the time of diagnosis, the tumor has invaded the pelvis and abdomen. Removal of the ovaries (oophorectomy) and uterine tubes (salpingectomy) along with the uterus is required (see Fig. 15-9), in addition to chemotherapy and radiation therapy.

BREAST CANCER

Carcinoma of the breast is second only to lung cancer in causing cancer-related deaths among women in the United States. This cancer metastasizes readily through the lymph nodes and blood to other sites such as the lung, liver, bones, and ovaries.

Diagnosis

Palpation is a simple first step in breast cancer diagnosis. Regular breast self-examination (BSE) is of utmost importance, because many breast cancers are discovered by women themselves.

Mammography, which provides two-dimensional x-ray images of the breast, is still the standard diagnostic procedure for breast cancer (Fig. 15-11). Some health organizations recommend annual mammograms after the age of 40 years. Other health professionals recommend waiting until age 50 unless a woman is in a high-risk group, such as having a family history of breast cancer. In digital mammography,

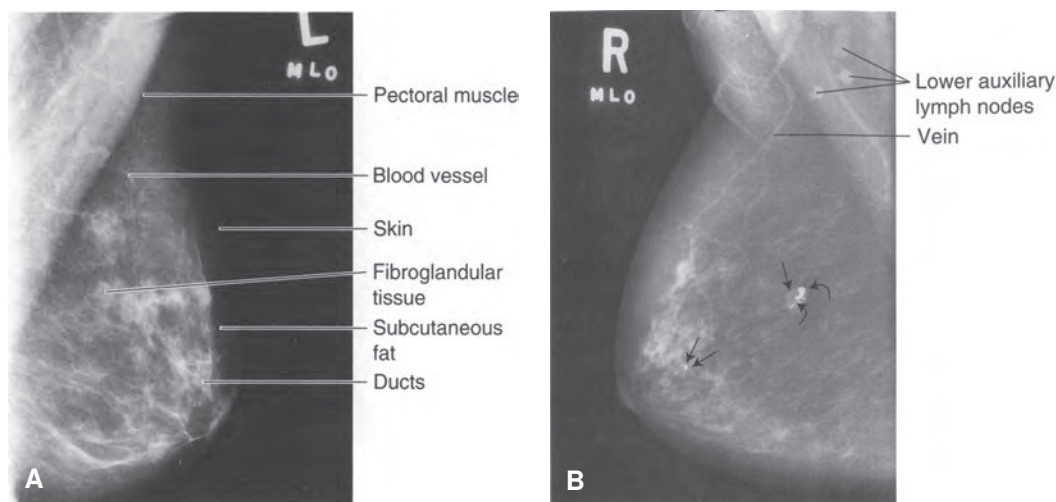


Figure 15-11 Mammograms. A. Normal mammogram, left breast. B. Mammogram of right breast showing lesions (arrows). In mammograms, fat tissue appears gray; breast tissue, calcium deposits, and benign or cancerous tumors appear white.

x-ray images are stored on computers instead of on film. These images can be manipulated electronically to aid interpretation. They are more easily stored and retrieved or sent to other medical facilities.

Ultrasound and MRI studies are adjuncts to mammography. Ultrasound can show whether a lump seen on mammography is simply a benign cyst. MRI with a contrast medium can show abnormal blood vessel formation signifying a tumor.

Any suspicious breast tissue must be biopsied by needle aspiration or surgical excision for further study. In a **stereotactic biopsy**, a physician uses a computer-guided imaging system to locate suspicious tissue and remove samples with a needle. This method is less invasive than surgical biopsy.

Ductal carcinoma in situ (DCIS) is a form of breast cancer that arises from an overgrowth of the cells lining a milk duct. It is initially confined to the duct, that is, it does not invade nearby tissue or metastasize, and it can usually be detected in its early stages.

Treatment

Treatment of breast cancer is usually some form of **mastectomy**, or removal of breast tissue:

- In a radical mastectomy, the entire breast is removed. Underlying muscle and axillary lymph nodes (in the armpit) are also removed.
- In a modified radical mastectomy, the breast and lymph nodes are removed, but muscles are left in place.
- In a segmental mastectomy, or “lumpectomy,” just the tumor itself is removed. When the tumor is small and

surgery is followed by additional treatment, this procedure gives survival rates as high as those with more radical surgeries.

Surgeons can assess the extent of tumor spread and conserve lymphatic tissue using a **sentinel node biopsy**. A dye or radioactive tracer identifies the first lymph nodes that receive lymph from a tumor. Study of possible tumor spread to these “sentinel nodes” guides further treatment.

Often after breast surgery, a patient receives chemotherapy and/or radiation therapy. It is now possible in some cases to deliver radiation to just the tumor area (brachytherapy) instead of irradiating the whole breast. A radiation source is delivered through catheters or implanted in the breast tissue for a short time.

Progress in breast cancer treatment involves genetic studies and tumor analysis that allows therapy more specific to each particular case. About 8 percent of these cancers are linked to a defective gene (*BRCA1* or *BRCA2*) that is transmitted within families. Women with these genetic predispositions can be screened more carefully or treated prophylactically.

Some types of specific drug treatments for breast cancer, which may be given in combination, are:

- Drugs that block estrogen production or block estrogen receptors in breast tissue if a tumor responds to this hormone
- Drugs that inhibit tumor growth factors
- Drugs that inhibit growth of blood vessels that supply the tumor (antiangiogenesis agents)

These and other anticancer drugs are described in more detail in the list of supplementary terms.

Terminology

Key Terms

FEMALE REPRODUCTIVE SYSTEM

Disorders

candidiasis <i>kan-di-DĪ-a-sis</i>	Infection with the fungus <i>Candida</i> , a common cause of vaginitis
dysmenorrhea <i>DIS-men-ō-rē-a</i>	Painful or difficult menstruation. A common disorder that may be caused by infection, use of an intrauterine device, endometriosis, overproduction of prostaglandins, or other factors
endometriosis <i>en-dō-mē-trē-Ō-sis</i>	Growth of endometrial tissue outside the uterus, usually in the pelvic cavity (see Fig. 15-8)
fibroid <i>FĪ-broyd</i>	Benign tumor of smooth muscle (see leiomyoma)
leiomyoma <i>lī-ō-mī-Ō-ma</i>	Benign tumor of smooth muscle, usually in the uterine wall (myometrium). In the uterus, may cause bleeding and pressure on the bladder or rectum. Also called fibroid or myoma (see Fig. 15-7)
pelvic inflammatory disease (PID)	Condition caused by the spread of infection from the reproductive tract into the pelvic cavity. Commonly caused by sexually transmitted gonorrhea and <i>Chlamydia</i> infections

(Continued)

Terminology**Key Terms** *(Continued)*

salpingitis <i>sal-pin-JĪ-tis</i>	Inflammation of a uterine tube; typically caused by urinary tract infection or sexually transmitted infection. Chronic salpingitis may lead to infertility or ectopic pregnancy (development of the fertilized egg outside of the uterus)
vaginitis <i>vaj-i-NĪ-tis</i>	Inflammation of the vagina
Diagnosis and Treatment	
colposcope <i>KOL-pō-skōp</i>	Instrument for examining the vagina and cervix
cone biopsy	Removal of a cone of tissue from the cervical lining for cytologic examination; also called conization (see Fig. 15-10)
dilation and curettage (D&C) <i>kū-re-TAJ</i>	Procedure in which the cervix is dilated (widened) and the uterine lining is scraped with a curette
hysterectomy <i>his-ter-EK-tō-mē</i>	Surgical removal of the uterus. Most commonly done because of tumors. Often the uterine tubes and ovaries are removed as well (see Fig. 15-9)
mammography <i>mam-OG-ra-fē</i>	Radiographic study of the breast for the detection of breast cancer; the image obtained is a mammogram (see Fig. 15-11)
mastectomy <i>mas-TEK-tō-mē</i>	Excision of breast tissue to eliminate malignancy
oophorectomy <i>ō-of-ō-REK-tō-mē</i>	Excision of an ovary (see Fig. 15-9)
Pap smear	Study of cells collected from the cervix and vagina for early detection of cancer. Also called Papanicolaou smear or Pap test
salpingectomy <i>sal-pin-JEK-tō-mē</i>	Surgical removal of the uterine tube (see Fig. 15-9)
sentinel node biopsy <i>SEN-ti-nel</i>	Biopsy of the first lymph nodes to receive drainage from a tumor; used to determine spread of cancer in planning treatment
stereotactic biopsy <i>ster-ē-ō-TAK-tik</i>	Needle biopsy using a computer-guided imaging system to locate suspicious tissue and remove samples for study

Terminology**Supplementary Terms****FEMALE REPRODUCTIVE SYSTEM****Normal Structure and Function**

adnexa <i>ad-NEK-sa</i>	Appendages, such as the adnexa uteri—the ovaries, uterine tubes, and uterine ligaments
areola <i>a-RE-ō-la</i>	A pigmented ring, such as the dark area around the nipple of the breast
graafian follicle <i>GRAF-ē-an</i>	A mature ovarian follicle

Terminology**Supplementary Terms** *(Continued)*

15

greater vestibular gland <i>ves-TIB-ū-lar</i>	A small mucus-secreting gland on the side of the vestibule (see below) near the vaginal opening. Also called Bartholin (<i>BAR-to-lin</i>) gland (see Fig. 15-13)
hymen <i>HI-men</i>	A fold of mucous membrane that partially covers the entrance of the vagina
mons pubis <i>monz PŪ-bis</i>	The rounded, fleshy elevation anterior to the pubic joint that is covered with hair after puberty
oocyte <i>Ō-ō-sīt</i>	An immature ovum
perimenopause <i>per-i-MEN-ō-pawz</i>	The period immediately before menopause; begins at the time of irregular menstrual cycles and ends one year after the last menstrual period; averages three to four years
vestibule <i>VES-ti-bŭl</i>	The space between the labia minora that contains the openings of the urethra, vagina, and ducts of the greater vestibular glands
Disorders	
cystocele <i>SIS-tō-sēl</i>	Herniation of the urinary bladder into the wall of the vagina (Fig. 15-12)
dyspareunia <i>dis-par-Ū-nē-a</i>	Pain during sexual intercourse
fibrocystic disease of the breast <i>fī-brō-SIS-tik</i>	A condition in which there are palpable lumps in the breasts, usually associated with pain and tenderness. These lumps or “thickenings” change with the menstrual cycle and must be distinguished from malignant tumors by diagnostic methods
hirsutism <i>HIR-sū-tizm</i>	Excess hair growth
leucorrhea <i>lū-kō-RĒ-a</i>	White or yellowish discharge from the vagina. Infection and other disorders may change the amount, color, or odor of the discharge
microcalcification <i>mī-krō-kal-si-fi-KĀ-shun</i>	Small deposit of calcium that appears as a white spot on mammograms. Most microcalcifications are harmless, but some might indicate breast cancer
prolapse of the uterus	Downward displacement of the uterus with the cervix sometimes protruding from the vagina
rectocele <i>REK-tō-sēl</i>	Herniation of the rectum into the wall of the vagina; also called proctocele (see Fig. 15-12)
Diagnosis and Treatment	
culdcentesis <i>kul-dō-sen-TĒ-sis</i>	Puncture of the vaginal wall to sample fluid from the rectouterine space for diagnosis
episiorrhaphy <i>e-pis-ē-OR-a-fē</i>	Suture of the vulva or suture of the perineum cut in an episiotomy (incision to ease childbirth)
laparoscopy <i>lap-a-ROS-kō-pē</i>	Endoscopic examination of the abdomen; may include surgical procedures, such as tubal ligation (see Fig. 15-6)
myomectomy <i>mī-ō-MEK-tō-mē</i>	Surgical removal of a uterine leiomyoma (fibroid, myoma)
speculum <i>SPEK-ū-lum</i>	An instrument used to enlarge the opening of a passage or cavity to allow examination (see Fig. 7-13)
teletherapy <i>tel-e-THER-a-pē</i>	Delivery of radiation to a tumor from an external beam source, as compared to implantation of radioactive material (brachytherapy) or systemic administration of radionuclide

(Continued)

Terminology Supplementary Terms *(Continued)*

Drugs

aromatase inhibitor (AI) <i>a-RŌ-ma-tās</i>	Agent that inhibits estrogen production; used for postmenopausal treatment of breast cancers that respond to estrogen. Examples are exemestane (Aromasin), anastrozole (Arimidex), and letrozole (Femara)
bisphosphonate <i>bis-FOS-fō-nāt</i>	Agent used to prevent and treat osteoporosis; increases bone mass by decreasing bone turnover. Examples are alendronate (Fosamax) and risedronate (Actonel)
HER2 inhibitor	Drug used to treat breast cancers that show excess receptors (HER2) for human epidermal growth factor. Example is trastuzumab (Herceptin)
paclitaxel <i>pak-li-TAKS-el</i>	Antineoplastic agent derived from yew trees used mainly in treatment of breast and ovarian cancer; Taxol
selective estrogen receptor modulator (SERM)	Drug that acts on estrogen receptors. Examples are tamoxifen (Nolvadex) and raloxifene (Evista), which is also used to prevent bone loss after menopause

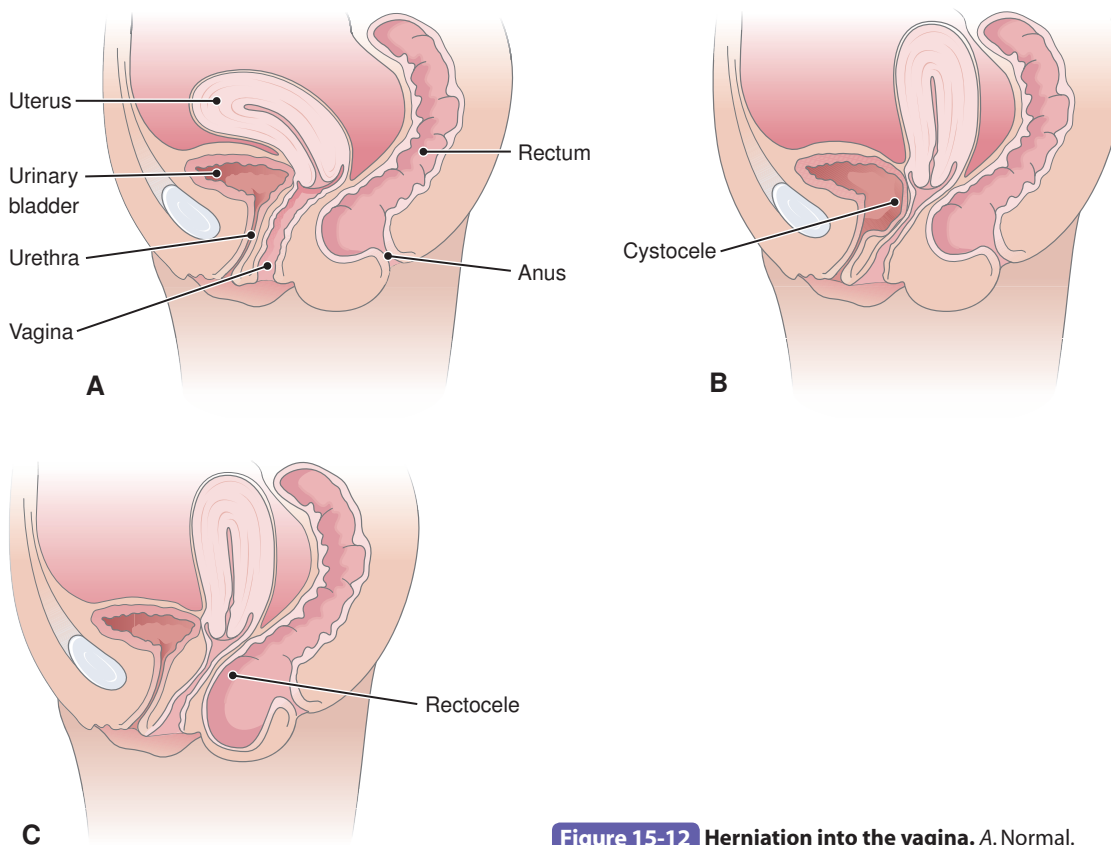


Figure 15-12 Herniation into the vagina. A. Normal. B. Cystocele. C. Rectocele.

Terminology Abbreviations

Female Reproductive System

AI	Aromatase inhibitor
BRCA1	Breast cancer gene 1
BRCA2	Breast cancer gene 2
BSE	Breast self-examination
BSO	Bilateral salpingo-oophorectomy
BV	Bacterial vaginosis
CIN	Cervical intraepithelial neoplasia
D&C	Dilation and curettage
DCIS	Ductal carcinoma in situ
DES	Diethylstilbestrol
DUB	Dysfunctional uterine bleeding
FSH	Follicle-stimulating hormone
GC	Gonococcus (cause of gonorrhea)
GYN	Gynecology

HPV	Human papillomavirus
HRT	Hormone replacement therapy
IUD	Intrauterine device
LH	Luteinizing hormone
NGU	Nongonococcal urethritis
PCOS	Polycystic ovarian syndrome
PID	Pelvic inflammatory disease
PMS	Premenstrual syndrome
SERM	Selective estrogen receptor modulator
STD	Sexually transmitted disease
STI	Sexually transmitted infection
TAH	Total abdominal hysterectomy
TSS	Toxic shock syndrome
UFE	Uterine fibroid embolization
VD	Venereal disease (sexually transmitted disease)

Pregnancy and Birth

FERTILIZATION AND EARLY DEVELOPMENT

Penetration of an ovulated egg cell by a spermatozoon results in **fertilization** (Fig. 15-13). This union normally occurs in the uterine tube. The nuclei of the sperm and egg cells fuse, restoring the chromosome number to 46 and forming a **zygote**. As the zygote travels through the uterine tube toward the uterus, it divides rapidly. Within six to seven days, the fertilized egg reaches the uterus and implants into the endometrium, and the **embryo** begins to develop.

During the first eight weeks of growth, all of the major body systems are established. Embryonic tissue produces **human chorionic gonadotropin (hCG)**, a hormone that keeps the corpus luteum functional in the ovary to maintain the endometrium. (The presence of hCG in urine is the basis for the most commonly used tests for pregnancy.) After two months, placental hormones take over this function and the corpus luteum degenerates. At this time, the embryo becomes a **fetus** (Fig. 15-14).

THE PLACENTA

During development, the fetus is nourished by the **placenta**, an organ formed from the embryo's outermost layer, the **chorion**, and the endometrium, the innermost layer of the uterus (Fig. 15-15). Here, exchanges take place between the bloodstreams of the mother and the fetus through fetal capillaries.

The **umbilical cord** contains the blood vessels that link the fetus to the placenta. Fetal blood is carried to the placenta in two umbilical arteries. While traveling through the placenta, the blood picks up nutrients and oxygen and gives up carbon dioxide and metabolic waste. Replenished blood is carried from the placenta to the fetus in a single umbilical vein.

Although the bloodstreams of the mother and the fetus do not mix and all exchanges take place through capillaries, some materials do manage to get through the placenta in both directions. For example, some viruses, such as HIV and rubella (German measles), as well as drugs, alcohol, and other harmful substances are known to pass from the mother to the fetus; fetal proteins can enter the mother's blood and cause immunologic reactions.

During **gestation** (the period of development), the fetus is cushioned and protected by fluid contained in the **amniotic sac** (amnion) (Fig. 15-16), commonly called the "bag of waters." This sac ruptures at birth.



See the animation "Ovulation and Fertilization" in the Student Resources on thePoint.

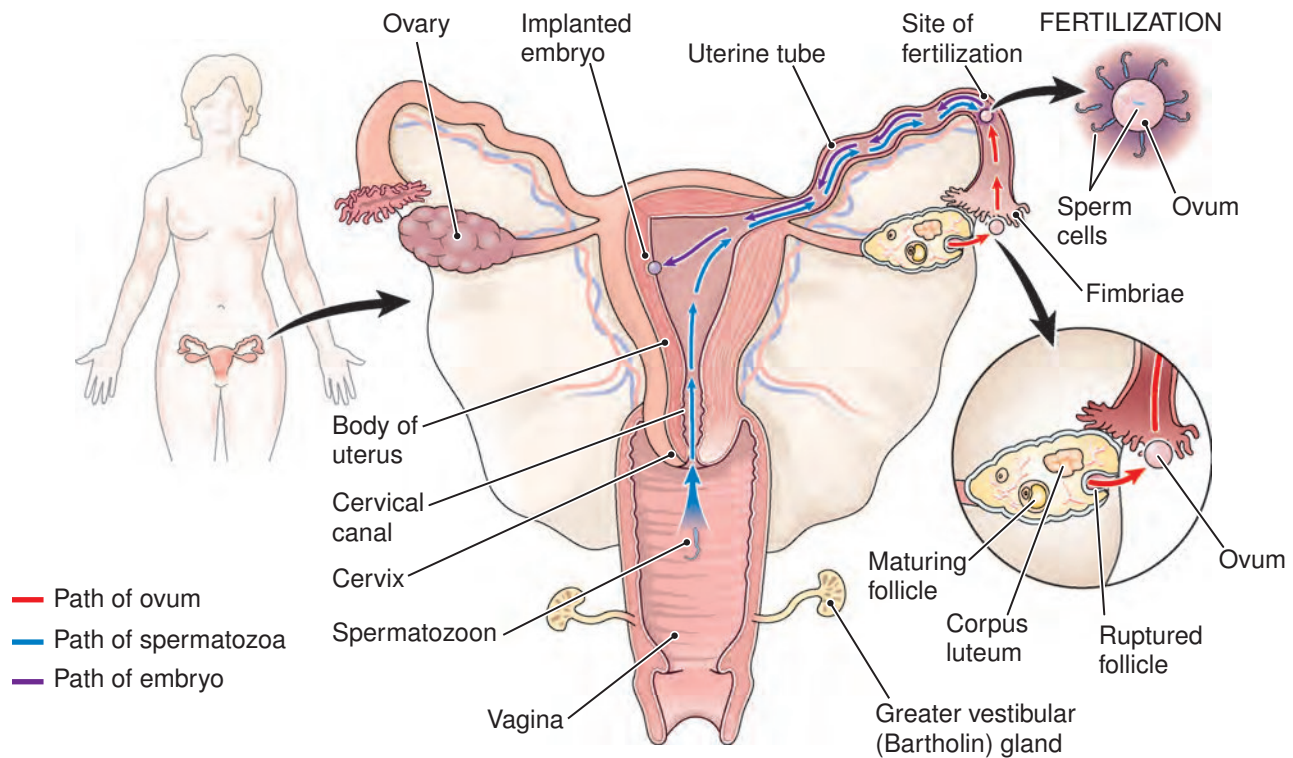


Figure 15-13 Ovulation and fertilization. Arrows show the pathway of spermatozoa and ovum. Fertilization occurs in the uterine tube, after which the zygote implants in the uterine lining.

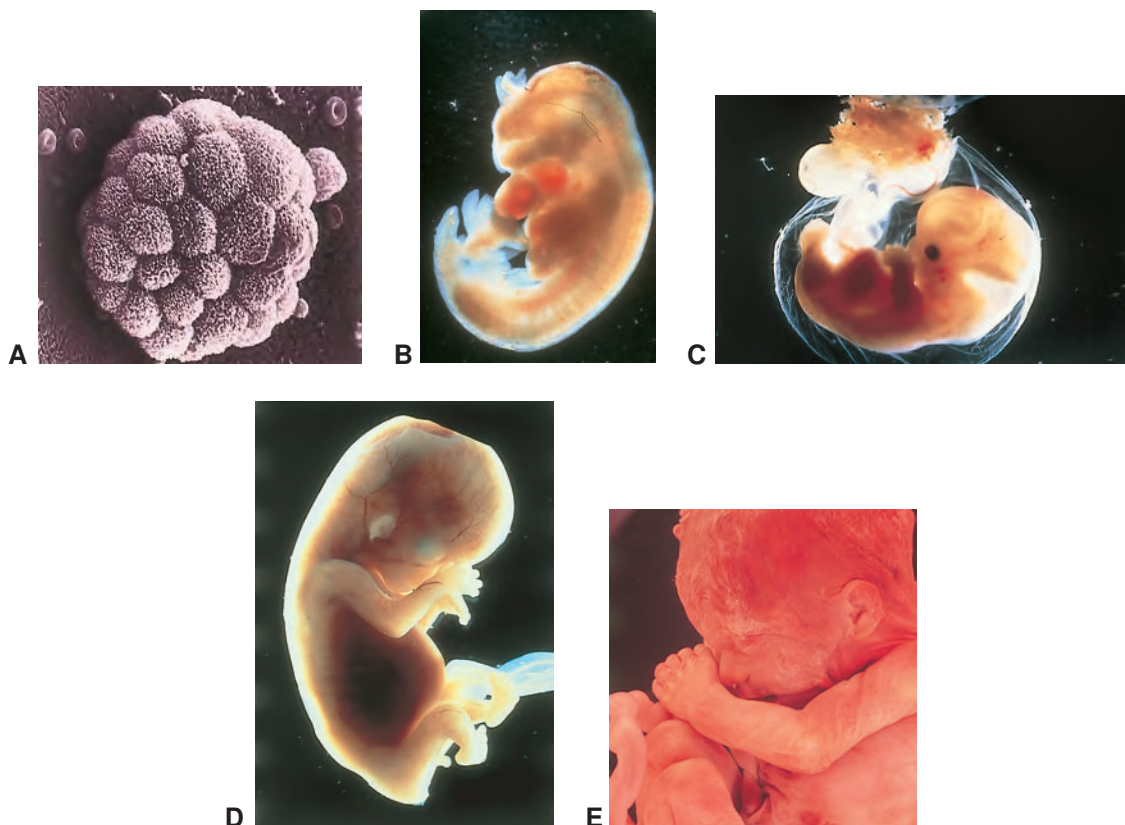


Figure 15-14 Human development. Human embryos and an early fetus are shown. *A.* Implantation in the uterus seven to eight days after conception. *B.* Embryo at 32 days. *C.* At 37 days. *D.* At 41 days. *E.* Fetus at 12 to 15 weeks.

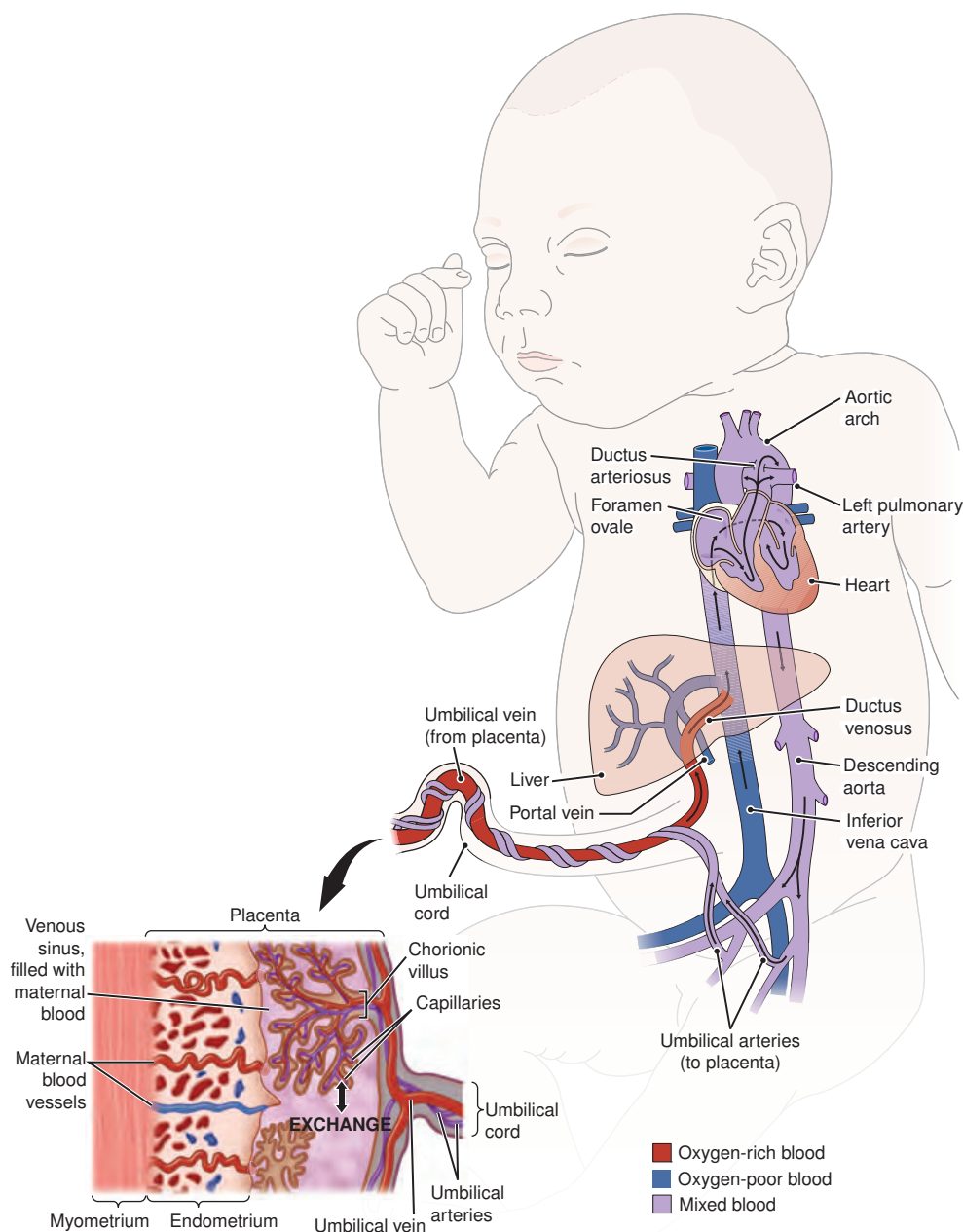


Figure 15-15 Fetal circulation. Colors show relative oxygen content of blood in the various vessels. Gases, waste products, and nutrients are exchanged between the fetus and the mother through capillaries in the placenta.

FETAL CIRCULATION

The fetus has several adaptations that serve to bypass the lungs, which are not needed to oxygenate the blood. When blood coming from the placenta enters the right atrium, the **foramen ovale**, a small hole in the septum between the atria, allows some of the blood to go directly into the left atrium, thus bypassing the pulmonary artery. Further, blood pumped out of the right ventricle can shunt directly into the aorta through a short vessel, the **ductus arteriosus**, which connects the pulmonary artery with the descending aorta (see Fig. 15-15). Both of these passages close off at birth when the pulmonary circuit is established. Their failure to close taxes the heart and may require medical attention.



See the animation “Fetal Circulation” in the Student Resources on *thePoint*.

CHILDBIRTH

The length of pregnancy, from fertilization of the ovum to birth, is about 38 weeks, or 266 days. In practice, it is calculated as approximately 280 days or 40 weeks from the first day of the last menstrual period (LMP). For study purposes, pregnancy is divided into three-month periods (trimesters), during which defined changes can be observed in the fetus.

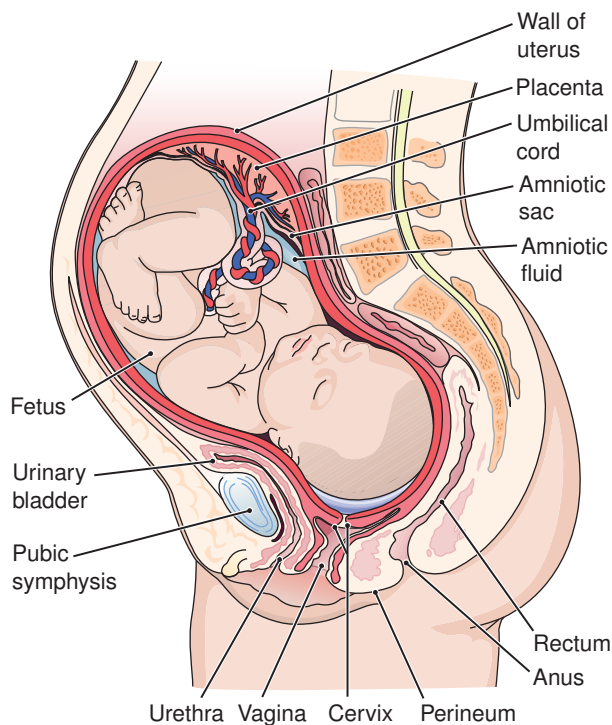


Figure 15-16 Midsagittal section of a pregnant uterus with intact fetus.

Childbirth, or **parturition**, occurs in three stages:

1. Onset of regular uterine contractions and dilation of the cervix
2. Expulsion of the fetus
3. Delivery of the placenta and fetal membranes

The third stage of childbirth is followed by contraction of the uterus and control of bleeding. The factors that start labor are not completely understood, but it is clear that the hormone **oxytocin** from the posterior pituitary gland and other hormones called **prostaglandins** are involved. **Box 15-3** has career information on midwives and other birth assistants.

Hospitals use the **Apgar score** to assess a newborn's health. Five features—heart rate, respiration, muscle tone, reaction to a nasal catheter, and skin color—are rated as 0, 1, or 2 at one minute and five minutes after birth. The maximum score in the test is 10. Infants with low scores require medical attention.



See the chart on placental hormones and figures on the stages of labor and the Apgar score in the Student Resources on *thePoint*.

The term **gravida** refers to a pregnant woman. The term **para** refers to a woman who has given birth. This means

Box 15-3



Health Professions

Nurse-Midwives and Doulas

There are various titles associated with the term *midwife*, each having different academic preparation and certification. The name *midwife* literally means “with woman,” and the practice is termed *midwifery* (*mid-WĪF-rē* or *mid-WĪF-er-ē*). The role of a midwife in the United States varies based on education, credentials, and licensure.

A certified nurse-midwife (CNM) is educated in the disciplines of both nursing and midwifery. A certified midwife (CM) is educated solely in the discipline of midwifery. A master's degree is required for both titles in order to take the American Midwifery Certification Board (AMCB) exam. Recertification is required every five years. CNMs and CMs provide primary health care to women from adolescence to beyond menopause. This includes routine gynecologic and reproductive health care, pregnancy, birth, and postpartum care, as well as perimenopause and menopause management. CNMs are licensed in all 50 U.S. states, Washington, D.C., and U.S. territories, and they have prescriptive authority in all U.S. jurisdictions. CMs are licensed in New York, New Jersey, and Rhode Island, and they may practice in Delaware and Missouri. They have prescriptive authority in New York. Most private insurances and Medicaid reimburse for CNM/CM services. The majority of CNM/CMs attend births in hospitals, but they may also attend home births and work in birth centers, clinics, and health departments. The American College of Nurse-Midwives at www.acnm.org has information on these careers.

A Certified Professional Midwife (CPM) is an independent midwifery provider who has met the standards for certification set by the North American Registry of Midwives (NARM). No college degree is required for this specialty. CPMs are regulated in 26 states, which vary in certification, licensure, and registration requirements. CPMs have no prescriptive authority. Private insurance in some states and Medicaid in 10 states reimburse CPMs for home and birth center births. CPMs provide care for women during pregnancy, birth, and the postpartum period and also provide newborn care. The professional associations for CPMs are the Midwives Alliance of North America (MANA) and National Association of Certified Professional Midwives (NACPM). Information is available at www.mana.org.

A doula (birth assistant) is someone who works with families during pregnancy, through labor, and after childbirth. Doulas provide emotional and physical support and education. They may help with prenatal preparation and early labor at home and continue with support throughout the hospital stay. Some doulas are trained in postpartum care and can give the family support at home after the birth. The name *doula* comes from Greek and refers to the most important female servant in the household, who probably assisted the lady of the house in childbearing. Doulas have a professional association that sets standards for training and certification. For more information visit www.dona.org.

the production of a viable infant (500 g or more or over 20 weeks' gestation) regardless of whether the infant is alive at birth or whether the birth is single or multiple. Prefixes are added to both terms to indicate the number of pregnancies or births, such as:

■ nulli-	none
■ primi-	one
■ secundi-	two
■ tri- or terci-	three
■ quadri-	four
■ multi-	two or more

Alternatively, a number can be added after the term to indicate events, such as gravida 1, para 3, etc.

LACTATION

The hormone prolactin from the anterior pituitary gland as well as hormones from the placenta start the secretion of milk from the breasts, called **lactation**. The baby's suckling then stimulates milk release. The pituitary hormone oxytocin is needed for this release or "letdown" of milk. For the first few days after delivery, only **colostrum** is produced. This has a slightly different composition than milk, but like the milk, it has protective antibodies.

Terminology

Key Terms

PREGNANCY AND BIRTH

Normal Structure and Function

amniotic sac <i>am-nē-OT-ik</i>	The membranous sac filled with fluid that holds the fetus; also called amnion (root: amnio)
Apgar score <i>AP-gar</i>	A system of rating an infant's physical condition immediately after birth. Five features are rated as 0, 1, or 2 at one and five minutes after delivery and sometimes thereafter. The maximum possible score at each test interval is 10. Infants with low scores require medical attention
chorion <i>KOR-ē-on</i>	The outermost layer of the embryo that, with the endometrium, forms the placenta (adjective: chorionic)
colostrum <i>kō-LOS-trum</i>	Breast fluid that is secreted in the first few days after giving birth before milk is produced
ductus arteriosus <i>DUK-tus ar-tēr-ē-Ō-sus</i>	A fetal blood vessel that connects the pulmonary artery with the descending aorta, thus allowing blood to bypass the lungs
embryo <i>EM-brē-ō</i>	The stage in development between the zygote and the fetus, extending from the second through the eighth week of growth in the uterus (root: embry/o); adjective: embryonic
fertilization <i>fer-ti-li-ZĀ-shun</i>	The union of an ovum and a spermatozoon
fetus <i>FĒ-tus</i>	The developing child in the uterus from the third month to birth (root: fet/o); adjective: fetal
foramen ovale <i>fō-RĀ-men ō-VĀ-lē</i>	A small hole in the interatrial septum in the fetal heart that allows blood to pass directly from the right to the left side of the heart
gestation <i>jes-TĀ-shun</i>	The period of development from conception to birth
gravida <i>GRAV-i-da</i>	Pregnant woman
human chorionic gonadotropin (hCG) <i>kor-ē-ON-ik GŌ-na-dō-trō-pin</i>	A hormone secreted by the embryo early in pregnancy that maintains the corpus luteum so that it will continue to secrete hormones

(Continued)

Terminology**Key Terms** (Continued)

lactation <i>lak-TĀ-shun</i>	The secretion of milk from the mammary glands
oxytocin <i>ok-sē-TŌ-sin</i>	A pituitary hormone that stimulates contractions of the uterus. It also stimulates release (“letdown”) of milk from the breasts
para	Woman who has produced a viable infant. Multiple births are considered as single pregnancies
parturition <i>par-tū-RI-shun</i>	Childbirth (root: nat/i); labor (root: toc/o)
placenta <i>pla-SEN-ta</i>	The organ composed of fetal and maternal tissues that nourishes and maintains the developing fetus
prostaglandins <i>PROS-ta-glan-dinz</i>	A group of hormones with varied effects, including the stimulation of uterine contractions
umbilical cord <i>um-BIL-i-kal</i>	The structure that connects the fetus to the placenta. It contains vessels that carry blood between the mother and the fetus
zygote <i>ZĪ-gōt</i>	The fertilized ovum

Roots Pertaining to Pregnancy and Birth

See **Table 15-4**.

Table 15-4**Roots for Pregnancy and Birth**

Root	Meaning	Example	Definition of Example
amnio	amnion, amniotic sac	diamniotic <i>dī-am-nē-OT-ik</i>	showing two amniotic sacs
embryo/o	embryo	embryonic <i>em-brē-ON-ik</i>	pertaining to the embryo
fet/o	fetus	fetometry <i>fē-TOM-e-trē</i>	measurement of a fetus
toc/o	labor	dystocia <i>dis-TŌ-sē-a</i>	difficult labor
nat/i	birth	neonate <i>NĒ-ō-nāt</i>	newborn
lact/o	milk	lactose <i>LAK-tōs</i>	sugar (-ose) found in milk
galact/o	milk	galactagogue <i>ga-LAK-tō-gog</i>	agent that promotes (-agogue) the flow of milk
gravida	pregnant woman	nulligravida <i>nul-i-GRAV-i-da</i>	woman who has never (nulli-) been pregnant
para	woman who has given birth	multipara <i>mul-TIP-a-ra</i>	woman who has given birth two or more times

EXERCISE 15-4**Define the following words:**

1. prenatal (*prē-NĀ-tal*) _____
2. embryogenesis (*em-brē-ō-JEN-e-sis*) _____
3. neonatal (*nē-ō-NĀ-tal*) _____
4. fetoscopy (*fē-TOS-kō-pē*) _____
5. monoamniotic (*mon-ō-am-nē-OT-ik*) _____
6. agalactia (*ā-ga-LAK-shē-a*) _____
7. hyperlactation (*hī-per-lak-TĀ-shun*) _____

Use the appropriate roots to write words for the following:

8. study of an embryo _____
9. study of the newborn _____
10. any disease of an embryo _____
11. cell (-cyte) found in amniotic fluid _____
12. incision of the amnion (to induce labor) _____
13. instrument for endoscopic examination of the fetus _____
14. rupture of the amniotic sac _____
15. after birth _____
16. woman who is pregnant for the first time _____
17. woman who has been pregnant two or more times _____
18. woman who has never given birth _____
19. woman who has given birth to one child _____

Use the suffix -tocia, meaning “condition of labor,” to write words for the following:

20. dry labor _____
21. slow labor _____

Use the root galact/o to write words for the following:

22. discharge of milk _____
23. cystic enlargement (-cele) of a milk duct _____

Clinical Aspects of Pregnancy and Birth

INFERTILITY

About 10 to 15 percent of couples who want children are unable to conceive or to sustain a pregnancy. Some of the possible causes of infertility are discussed in Chapter 14 and in this section. In men, these causes include low sperm count, low sperm motility, blockage of the ducts that transport

the sperm cells, and erectile dysfunction. In women they include:

- Lack of ovulation
- Blockage in the uterine tubes, as caused by infection or excess growth of tissue
- Uterine problems, such as tumors or abnormal growth of endometrial tissue
- Cervical scarring or infection

Box 15-4



Clinical Perspectives

Assisted Reproductive Technology: The “Art” of Conception

At least one in 10 American couples is affected by infertility. Assisted reproductive technologies such as in vitro fertilization (IVF), gamete intrafallopian transfer (GIFT), and zygote intrafallopian transfer (ZIFT) can help these couples have children.

In vitro fertilization refers to fertilization of an egg outside the mother's body in a laboratory dish, and it is often used when a woman's fallopian tubes are blocked or when a man has a low sperm count. The woman participating in IVF is given hormones to cause ovulation of several eggs. These are then withdrawn with a needle and fertilized with the father's sperm. After a few divisions, some of the fertilized eggs are placed in the uterus, thus bypassing the fallopian tubes. Additional fertilized eggs can be frozen to repeat the procedure in case of failure or for later pregnancies.

GIFT can be used when the woman has at least one normal fallopian tube and the man has an adequate sperm count. As in

IVF, the woman is given hormones to cause ovulation of several eggs, which are collected. Then, the eggs and the father's sperm are placed into the fallopian tube using a catheter. Thus, in GIFT, fertilization occurs inside the woman, not in a laboratory dish.

ZIFT is a combination of IVF and GIFT. Fertilization takes place in a laboratory dish, and then the zygote is placed into the fallopian tube.

Because of a lack of guidelines or restrictions in the United States in the field of assisted reproductive technology, some problems have arisen. These issues concern the use of stored embryos and gametes, use of embryos without consent, and improper screening for disease among donors. In addition, the implantation of more than one fertilized egg has resulted in a high incidence of multiple births, even up to seven or eight offspring in a single pregnancy, a situation that imperils the survival and health of the babies.

- Excess vaginal acidity, which harms spermatozoa, or antibodies to sperm cells
- Drugs, including temporary or permanent infertility following cessation of birth control pills

Box 15-4 describes some clinical approaches to helping infertile couples have children when all other diagnostic and therapeutic methods have failed.

ECTOPIC PREGNANCY

Development of a fertilized egg outside of its normal position in the uterine cavity is termed an **ectopic pregnancy** (Fig. 15-17). Although it may occur elsewhere in the abdominal cavity, an ectopic pregnancy usually occurs in the uterine tube, resulting in a tubal pregnancy. Salpingitis, endometriosis, and PID may lead to ectopic pregnancy by blocking the ovum's passage into the uterus. Continued growth will rupture the tube, causing dangerous hemorrhage. Symptoms of ectopic pregnancy are pain, tenderness, swelling, and shock. Diagnosis is by measurement of the hormone hCG and **ultrasonography**, confirmed by laparoscopic examination. Prompt surgery is required, sometimes including removal of the tube.

PREGNANCY-INDUCED HYPERTENSION

Pregnancy-induced hypertension (PIH), also referred to as preeclampsia or toxemia of pregnancy, is a state of hypertension during pregnancy in association with oliguria, proteinuria, and edema. The cause is a hormone imbalance that results in constriction of blood vessels. If untreated, PIH may lead to **eclampsia**, with seizures, coma, and possible death.

ABORTION

For a variety of reasons, a pregnancy may terminate before the fetus is capable of surviving outside the uterus. An **abortion** is loss of an embryo or fetus before the 20th week of

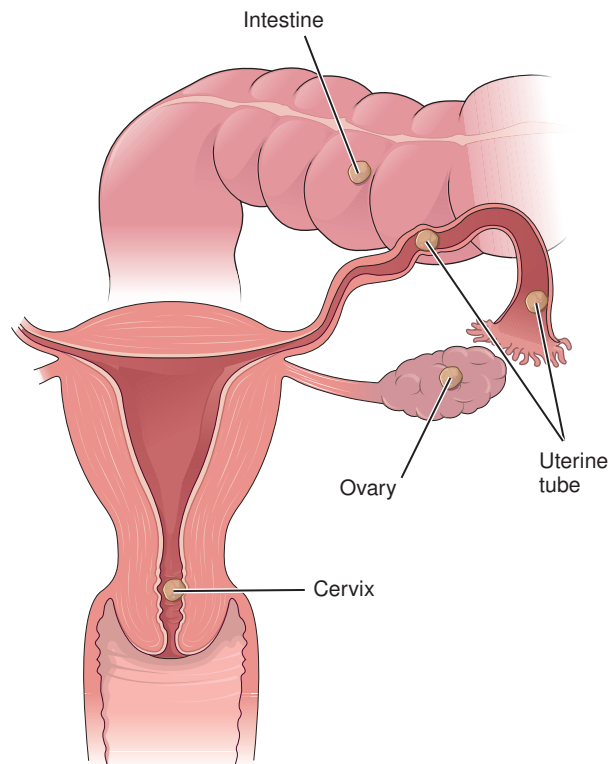


Figure 15-17 Ectopic pregnancy. Possible sites where a fertilized ovum might develop outside the body of the uterus.

pregnancy or before a weight of 500 g (1.1 lb). When this occurs spontaneously, it is commonly referred to as a miscarriage. Most spontaneous abortions occur within the first three months of pregnancy. Causes include poor maternal health, hormonal imbalance, cervical incompetence (weakness), immune reactions, tumors, and, most commonly, fetal abnormalities. If all gestational tissues are not eliminated, the abortion is described as incomplete, and a physician must remove the remaining tissue.

An induced abortion is the intentional termination of a pregnancy. A common method for inducing an abortion is **dilatation and evacuation (D&E)**, in which the cervix is dilated and the fetal tissue is removed by suction.

Rh INCOMPATIBILITY

Incompatibility between the blood of a mother and her fetus is a problem in certain pregnancies. If a mother lacks the Rh blood antigen (see Chapter 10) and her baby is positive for that factor (inherited from the father), the mother's body may make Rh antibodies as her baby's blood crosses the placenta during pregnancy or enters the maternal bloodstream during childbirth. In a subsequent pregnancy with an Rh-positive fetus, the antibodies may enter the fetus and destroy its red cells. **Hemolytic disease of the newborn (HDN)** is prevented by giving the mother preformed Rh antibodies during pregnancy and shortly after delivery to remove these proteins from her blood.

PLACENTAL ABNORMALITIES

If the placenta attaches near or over the cervix instead of in the upper portion of the uterus, the condition is termed **placenta previa**. This disorder may cause bleeding later in the pregnancy. If bleeding is heavy, it may be necessary to terminate the pregnancy.

Placental abruption (abruptio placentae) describes premature separation of the placenta from its point of attachment. The separation causes hemorrhage, which, if

extensive, may result in fetal or maternal death or a need to end the pregnancy. Causative factors include injury, maternal hypertension, and advanced maternal age.



See the figure on placental abnormalities in the Student Resources on *thePoint*.

MASTITIS

Inflammation of the breast, or **mastitis**, may occur at any time but usually occurs in the early weeks of breast-feeding. It is commonly caused by staphylococcal or streptococcal bacteria that enter through cracks in the nipple. The breast becomes red, swollen, and tender, and the patient may experience chills, fever, and general discomfort.

Congenital Disorders

Congenital disorders are those present at birth (birth defects). They fall into two categories:

- Developmental disorders that occur during fetal growth
- Hereditary (familial) disorders that can be passed from parents to children through the germ cells

A genetic disorder is caused by a **mutation** (change) in the genes or chromosomes of cells. Mutations may involve changes in the number or structure of the chromosomes or changes in single or multiple genes. The appearance and severity of genetic disorders may also involve abnormal genes interacting with environmental factors. Examples are the diseases that “run in families,” such as diabetes mellitus, heart disease, hypertension, and certain forms of cancer. **Box 15-5** describes some of the most common genetic disorders.

Box 15-5

For Your Reference

Genetic Disorders*

DISEASE	CAUSE	DESCRIPTION
albinism <i>AL-bi-nizm</i>	recessive gene mutation	lack of pigmentation
cystic fibrosis <i>sis-tik fī-BRŌ-sis</i>	recessive gene mutation	affects respiratory system, pancreas, and sweat glands; most common hereditary disease in white populations (see Chapter 11)
Down syndrome	extra chromosome 21	slanted eyes, short stature, mental retardation, and others (Fig. 15-18); incidence increases with increasing maternal age; trisomy 21 syndrome

(Continued)

Genetic Disorders* (Continued)

DISEASE	CAUSE	DESCRIPTION
fragile X chromosome	defect in an X (sex-determining) chromosome	reduced intellectual abilities, autism, hyperactivity; enlarged head and ears; passed from mothers to sons with the X chromosome (sex-linked)
hemophilia <i>hê-mô-FIL-ê-a</i>	recessive gene mutation on the X chromosome	bleeding disease inherited with an X chromosome and usually passed from mothers to sons
Huntington disease	dominant gene mutation	altered metabolism destroys specific nerve cells; appears in adulthood and is fatal within about 10 years; causes motor and mental disorders
Klinefelter syndrome	extra X chromosome	lack of sexual development, lowered intelligence
Marfan syndrome	dominant gene mutation	disease of connective tissue with weakness of the aorta
neurofibromatosis <i>nû-rô-fi-brô-ma-TÔ-sis</i>	dominant gene mutation	multiple skin tumors containing nerve tissue
phenylketonuria (PKU) <i>fen-il-kê-tô-NÛ-rê-a</i>	recessive gene mutation	lack of enzyme to metabolize an amino acid (phenylalanine); neurologic signs, mental retardation, lack of pigment; tested for at birth; special diet can prevent retardation
sickle cell anemia	recessive gene mutation	abnormally shaped red cells block blood vessels; mainly affects black populations
Tay-Sachs disease <i>tā saks</i>	recessive gene mutation	an enzyme deficiency causes lipid to accumulate in nerve cells and other tissues; causes death in early childhood; carried in eastern European Jewish populations
Turner syndrome	single X chromosome	sexual immaturity, short stature, possible lowered intelligence

*A dominant gene is one for a trait that always appears if the gene is present; that is, it will affect the offspring even if inherited from only one parent. A recessive gene is one for a trait that will appear only if the gene is inherited from both parents.



Figure 15-18 Child with Down syndrome (trisomy 21). The typical facial features are visible in this photo.



See a more complete chart of genetic diseases in the Student Resources on thePoint.

A **carrier** of a genetic disorder is an individual who has a genetic defect that does not appear but that can be passed to offspring. Laboratory tests can identify carriers of some genetic disorders.

Teratogens are factors that cause malformations in the developing fetus. These include infections—such as rubella, herpes simplex, and syphilis—alcohol, drugs, chemicals, and radiation. The fetus is most susceptible to teratogenic effects during the first three months of pregnancy.

Examples of developmental disorders are **atresia** (absence or closure of a normal body opening), **anencephaly** (absence of a brain), **cleft lip**, **cleft palate**, and congenital heart disease. **Spina bifida** is incomplete closure of the spine, through which the spinal cord and its membranes may project (**Fig. 15-19**). This usually occurs in the lumbar

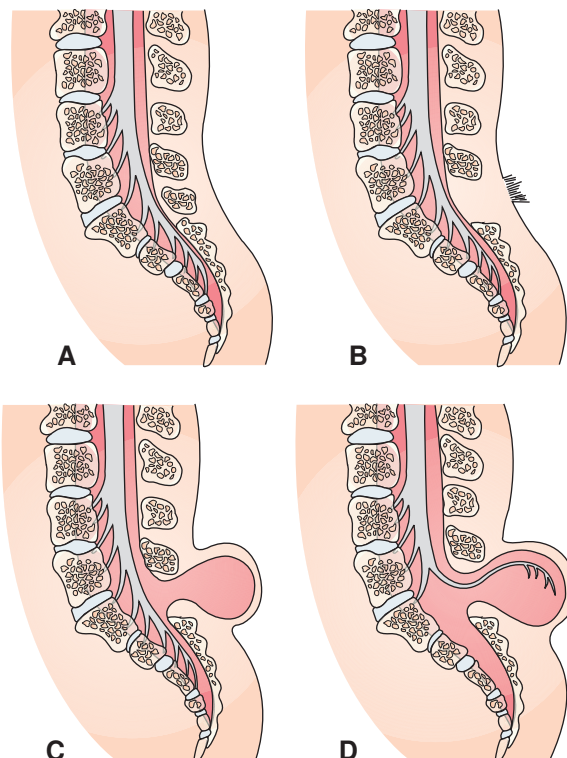


Figure 15-19 Spinal defects. A. Normal spinal cord. B. Spina bifida occulta. C. Meningocele. D. Myelomeningocele.

region. If there is no herniation of tissue, the condition is spina bifida occulta. Protrusion of the meninges through the opening is a meningocele; in a myelomeningocele, both the spinal cord and membranes herniate through the defect, as seen in **Figures 15-19D and 15-20**. Note that folic acid, a B vitamin, can prevent embryonic spinal malformations, known as neural tube defects. This vitamin is found in



Figure 15-20 A myelomeningocele.

vegetables, liver, legumes, and seeds, but it is now added to some commercial foods, including cereals and breads, to provide young women with this vitamin early on in case they become pregnant.

DIAGNOSIS OF CONGENITAL DISORDERS

Many congenital disorders can now be detected before birth. Ultrasonography (**Fig. 15-21**), in addition to its use for monitoring pregnancies and determining fetal sex, can also reveal certain fetal abnormalities. In **amniocentesis** (**Fig. 15-22**), a sample is withdrawn from the amniotic cavity with a needle. The fluid obtained is analyzed for chemical abnormalities. The cells are grown in the laboratory and tested for biochemical disorders. A **karyotype** is prepared to study the genetic material (**see Fig. 4-10**).

In **chorionic villus sampling (CVS)**, small amounts of the membrane around the fetus are obtained through the cervix for analysis. This can be done at eight to 10 weeks of pregnancy, in comparison with 14 to 16 weeks for amniocentesis.

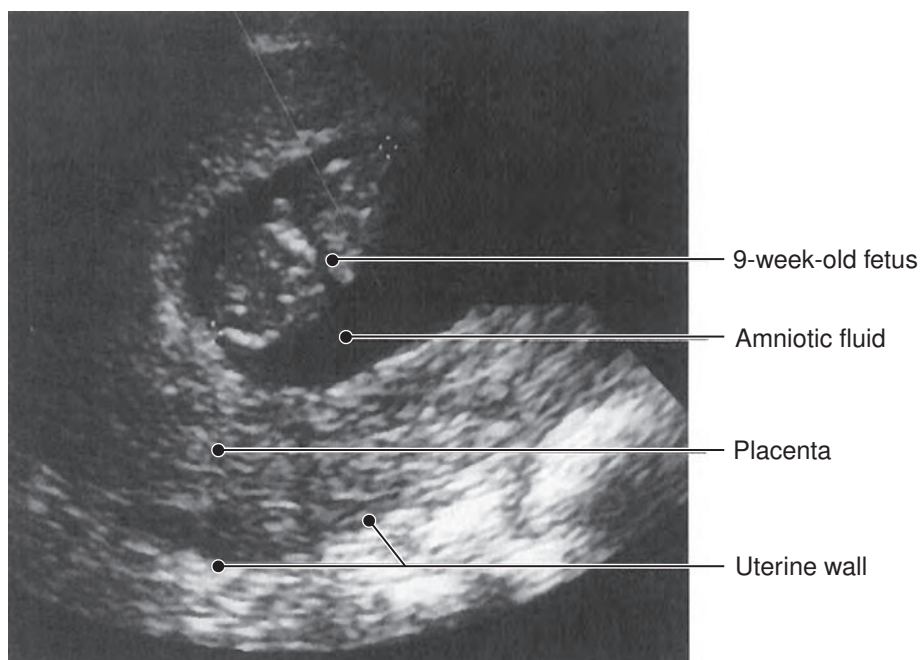


Figure 15-21 Sonogram. This transvaginal sonogram shows a 9-week-old fetus.

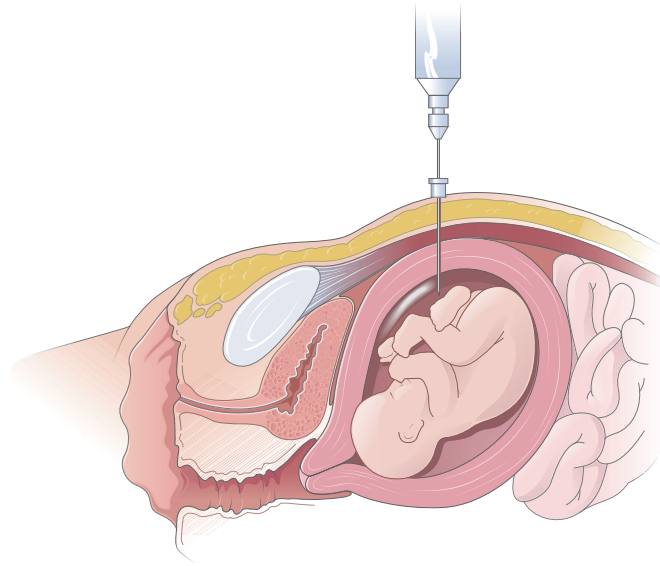


Figure 15-22 Amniocentesis. A sample is removed from the amniotic sac. Cells and fluid are tested for fetal abnormalities.

Terminology

Key Terms

PREGNANCY AND BIRTH

Disorders

abortion <i>a-BOR-shun</i>	Termination of a pregnancy before the fetus is capable of surviving outside the uterus, usually at 20 weeks or 500 g. May be spontaneous or induced. A spontaneous abortion is commonly called a miscarriage
anencephaly <i>an-en-SEF-a-lē</i>	Congenital absence of a brain
atresia <i>a-TRĒ-zē-a</i>	Congenital absence or closure of a normal body opening
carrier	An individual who has an unexpressed genetic defect that can be passed to his or her children
cleft lip	A congenital separation of the upper lip
cleft palate	A congenital split in the roof of the mouth
congenital disorder <i>kon-GEN-i-tal</i>	A disorder that is present at birth. May be developmental or hereditary (familial)
eclampsia <i>e-KLAMP-sē-a</i>	Convulsions and coma occurring during pregnancy or after delivery and associated with the conditions of pregnancy-induced hypertension (see below); adjective: eclamptic
ectopic pregnancy <i>ek-TOP-ik</i>	Development of the fertilized ovum outside the body of the uterus. Usually occurs in the uterine tube (tubal pregnancy) but may occur in other parts of the reproductive tract or abdominal cavity (see Fig. 15-17)
hemolytic disease of the newborn (HDN)	Disease that results from Rh incompatibility between the blood of a mother and her fetus. An Rh-negative mother produces antibody to Rh-positive fetal red cells that enter her circulation. These antibodies can destroy Rh-positive fetal red cells in a later pregnancy unless the mother is treated with antibodies to remove the Rh antigen. Formerly called erythroblastosis fetalis

Terminology**Key Terms** (Continued)

mastitis <i>mas-TĪ-tis</i>	Inflammation of the breast, usually associated with the early weeks of breast-feeding
mutation <i>mū-TĀ-shun</i>	A change in the genetic material of the cell. Most mutations are harmful. If the change appears in the sex cells, it can be passed to future generations
placental abruption <i>ab-RUP-shun</i>	Premature separation of the placenta; abruptio placentae
placenta previa <i>PRĒ-vē-a</i>	Placental attachment in the lower portion of the uterus instead of the upper portion, as is normal. May result in hemorrhage late in pregnancy
pregnancy-induced hypertension (PIH)	A toxic condition of late pregnancy associated with hypertension, edema, and proteinuria that, if untreated, may lead to eclampsia. Also called preeclampsia (<i>prē-e-KLAMP-sē-a</i>) and toxemia of pregnancy
spina bifida <i>SPI-na BIF-i-da</i>	A congenital defect in the closure of the spinal column through which the spinal cord and its membranes may project (see Figs. 15-19 and 15-20)
teratogen <i>ter-AT-ō-jen</i>	A factor that causes developmental abnormalities in the fetus (root <i>terat/o</i> means “malformed fetus”); adjective: teratogenic

Diagnosis and Treatment

amniocentesis <i>am-nē-ō-sen-TĒ-sis</i>	Transabdominal puncture of the amniotic sac to remove amniotic fluid for testing. Tests on the cells and fluid obtained can reveal congenital abnormalities, blood incompatibility, and sex of the fetus (see Fig. 15-22)
chorionic villus sampling (CVS)	Removal of chorionic cells through the cervix for prenatal testing. Can be done earlier in pregnancy than amniocentesis
dilatation and evacuation (D&E)	Widening of the cervix and removal of conception products by suction
karyotype <i>KAR-ē-ō-tīp</i>	A picture of cellular chromosomes arranged in order of decreasing size; can reveal abnormalities in the chromosomes themselves or in their number or arrangement (root <i>kary/o</i> means “nucleus”) (see Fig. 4-10)
ultrasonography <i>ul-tra-so-NOG-ra-fē</i>	The use of high-frequency sound waves to produce a photograph of an organ or tissue (see Fig. 15-21). Used in obstetrics to diagnose pregnancy, multiple births, and abnormalities and also to study and measure the fetus. The image obtained is a sonogram or ultrasonogram

Terminology**Supplementary Terms****PREGNANCY AND BIRTH****Normal Structure and Function**

afterbirth	The placenta and membranes delivered after birth of a child
antepartum <i>an-tē-PAR-tum</i>	Before childbirth, with reference to the mother
Braxton Hicks contractions	Light uterine contractions that occur during pregnancy and increase in frequency and intensity during the third trimester. They strengthen the uterus for delivery

(Continued)

Terminology Supplementary Terms *(Continued)*

chloasma <i>klō-AZ-ma</i>	Brownish pigmentation that appears on the face during pregnancy; melasma
fontanel <i>fon-tan-EL</i>	A membrane-covered space between cranial bones in the fetus that later becomes ossified; a soft spot. Also spelled fontanelle
intrapartum <i>in-tra-PAR-tum</i>	Occurring during childbirth
linea nigra <i>LIN-ē-a NĪ-gra</i>	A dark line on the abdomen from the umbilicus to the pubic region that may appear late in pregnancy
lochia <i>LŌ-kē-a</i>	The mixture of blood, mucus, and tissue discharged from the uterus after childbirth
meconium <i>me-KŌ-nē-um</i>	The first feces of the newborn
peripartum <i>per-i-PAR-tum</i>	Occurring during the end of pregnancy or the first few months after delivery, with reference to the mother
postpartum	After childbirth, with reference to the mother
premature	Describing an infant born before the organ systems are fully developed; immature
preterm	Occurring before the 37th week of gestation; describing an infant born before the 37th week of gestation
puerperium <i>pū-er-PĒR-ē-um</i>	The first 42 days after childbirth, during which the mother's reproductive organs usually return to normal (root <i>puer</i> means "child")
striae atrophicae <i>STRĪ-ē a-TRŌ-fi-kē</i>	Pinkish or gray lines that appear where skin has been stretched, as in pregnancy; stretch marks, striae gravidarum
umbilicus <i>um-bi-LĪ-kus</i>	The scar in the middle of the abdomen that marks the attachment point of the umbilical cord to the fetus; the navel. Also pronounced <i>um-BIL-i-kus</i>
vernix caseosa <i>VER-niks kā-sē-Ō-sa</i>	The cheese-like deposit that covers and protects the fetus (literally "cheesy varnish")
Disorders	
cephalopelvic disproportion <i>sef-a-lō-PEL-vik</i>	The condition in which the head of the fetus is larger than the mother's pelvic outlet; also called fetopelvic disproportion
choriocarcinoma <i>kor-ē-ō-kar-si-NŌ-ma</i>	A rare malignant neoplasm composed of placental tissue
galactorrhea <i>ga-lak-tō-RĒ-a</i>	Excessive secretion of milk or continued milk production after breast-feeding has ceased. Often results from excess prolactin secretion and may signal a pituitary tumor
hydatidiform mole <i>hī-da-TID-i-form</i>	A benign overgrowth of placental tissue. The placenta dilates and resembles grape-like cysts. The neoplasm may invade the uterine wall, causing rupture. Also called hydatid mole
hydramnios <i>hī-DRAM-nē-os</i>	An excess of amniotic fluid; also called polyhydramnios
oligohydramnios <i>ol-i-gō-hī-DRAM-nē-os</i>	A deficiency of amniotic fluid

Terminology Supplementary Terms *(Continued)*

patent ductus arteriosus (PDA) <i>PĀ-tent DUK-tus ar-tē-rē-Ō-sus</i>	Persistence of the ductus arteriosus after birth so that blood continues to shunt from the pulmonary artery to the aorta
puerperal infection <i>pū-ER-per-al</i>	Infection of the genital tract after delivery
Diagnosis and Treatment	
abortifacient <i>a-bor-ti-FĀ-shent</i>	Agent that induces abortion
alpha-fetoprotein (AFP) <i>AL-fa fē-tō-PRŌ-tēn</i>	A fetal protein that may be elevated in amniotic fluid and maternal serum in cases of certain fetal disorders
artificial insemination (AI)	Placement of active semen into the vagina or cervix for the purpose of impregnation. The semen can be from a husband, partner, or donor
cesarean section <i>se-ZAR-ē-an</i>	Incision of the abdominal wall and uterus for delivery of a fetus
endometrial ablation <i>ab-LĀ-shun</i>	Selective destruction of the endometrium for therapeutic purpose; done to relieve excessive menstrual bleeding (menorrhagia)
extracorporeal membrane oxygenation (ECMO) <i>eks-tra-kor-PŌ-rē-al</i>	A technique for pulmonary bypass in which deoxygenated blood is removed, passed through a circuit that oxygenates the blood, and then returned. Used for selected newborn and pediatric patients in respiratory failure with an otherwise good prognosis
in vitro fertilization (IVF)	Clinical procedure for achieving fertilization when it cannot be accomplished naturally. An oocyte (immature ovum) is removed, fertilized in the laboratory, and placed as a zygote into the uterus or fallopian tube (ZIFT, zygote intrafallopian transfer). Alternatively, an ovum can be removed and placed along with sperm cells into the fallopian tube (GIFT, gamete intrafallopian transfer) (see Box 15-4)
obstetrics <i>ob-STET-riks</i>	The branch of medicine that treats women during pregnancy, childbirth, and the puerperium. Usually combined with the practice of gynecology
pediatrics <i>pē-dē-AT-riks</i>	The branch of medicine that treats children and diseases of children (root <i>ped/o</i> means “child”)
pelvimetry <i>pel-VIM-e-trē</i>	Measurement of the pelvis by manual examination or radiographic study to determine whether delivery of a fetus through the vagina will be possible
Pitocin <i>pi-TŌ-sin</i>	Trade name for oxytocin; used to induce and hasten labor
presentation	Term describing the part of the fetus that can be felt by vaginal or rectal examination. Normally the head presents first (vertex presentation), but sometimes the buttocks (breech presentation), face, or other part presents first
RhoGAM <i>RŌ-gam</i>	Trade name for a preparation of antibody to the Rh(D) antigen; used to prevent hemolytic disease of the newborn in cases of Rh incompatibility

Terminology Abbreviations

Pregnancy and Birth

AB	Abortion
AFP	Alpha-fetoprotein
AGA	Appropriate for gestational age
AI	Artificial insemination
ART	Assisted reproductive technology
C-section	Cesarean section
CPD	Cephalopelvic disproportion
CVS	Chorionic villus sampling
D&E	Dilatation and evacuation
ECMO	Extracorporeal membrane oxygenation
EDC	Estimated date of confinement
FHR	Fetal heart rate
FHT	Fetal heart tone
FTND	Full-term normal delivery
FTP	Full-term pregnancy
GA	Gestational age

GIFT	Gamete intrafallopian transfer
hCG	Human chorionic gonadotropin
HDN	Hemolytic disease of the newborn
IVF	In vitro fertilization
LMP	Last menstrual period
NB	Newborn
NICU	Neonatal intensive care unit
OB	Obstetrics, obstetrician
PDA	Patent ductus arteriosus
PIH	Pregnancy-induced hypertension
PKU	Phenylketonuria
SVD	Spontaneous vaginal delivery
UC	Uterine contractions
UTP	Uterine term pregnancy
VBAC	Vaginal birth after cesarean section
ZIFT	Zygote intrafallopian transfer

A.Y.'s Follow-Up Study

A.Y. was encouraged to get up and walk the next day. Her incision was healing well and there were no signs of infection. She was able to tolerate a regular diet and required minimal medication for pain. A.Y. experienced minor discomfort with breast-feeding initially, but she and the baby began to get into a routine, and the feeding progressed well. A.Y.'s

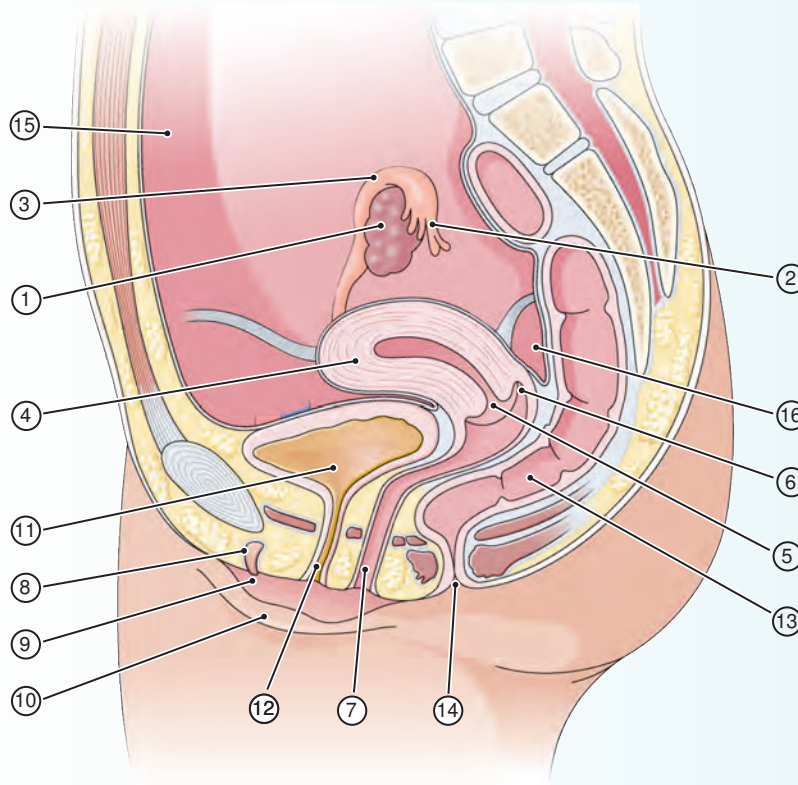
husband offered needed support and encouragement and was very helpful with their 3-year-old son, who missed his mom. Both baby and mom were doing well and were discharged home. A.Y.'s mother was stopping by every day to take care of the "big brother," help with meals, and do some light housekeeping so A.Y. could get some important rest.

Chapter Review

Labeling Exercise

FEMALE REPRODUCTIVE SYSTEM

Write the name of each numbered part on the corresponding line of the answer sheet.



Anus
Cervix
Clitoris
Cul-de-sac
Fimbriae
Labium majus
Labium minus
Ovary

Uterine tube
Peritoneal cavity
Posterior fornix
Rectum
Urethra
Urinary bladder
Uterus
Vagina

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

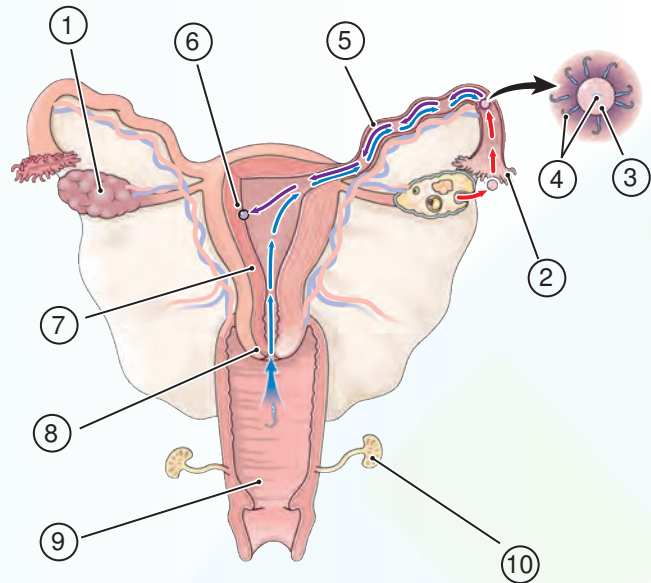
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____

OVULATION AND FERTILIZATION

Write the name of each numbered part on the corresponding line of the answer sheet.

Cervix	Ovary
Body of uterus	Ovum
Fimbriae	Sperm cells (spermatozoa)
Greater vestibular (Bartholin) gland	Uterine tube
Implanted embryo	Vagina

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____



Terminology

MATCHING

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|------------------------|--|
| _____ 1. clitoris | a. fertilized egg |
| _____ 2. gestation | b. female erectile tissue |
| _____ 3. oxytocin | c. external female genitalia |
| _____ 4. zygote | d. period of development in the uterus |
| _____ 5. vulva | e. hormone that stimulates labor |
| _____ 6. menostasis | a. producing female characteristics |
| _____ 7. metrorrhagia | b. wasting of uterine tissue |
| _____ 8. menarche | c. excess uterine bleeding |
| _____ 9. gynecogenic | d. suppression of menstruation |
| _____ 10. metratrophia | e. first menstrual period |
| _____ 11. congenital | a. fibroid |
| _____ 12. leiomyoma | b. absence of a normal body opening |
| _____ 13. atresia | c. present at birth |
| _____ 14. teratogen | d. genetic change |
| _____ 15. mutation | e. cause of fetal abnormality |

Supplementary Terms

- | | |
|----------------------|---------------------------------------|
| _____ 16. puerperium | a. uterine discharge after childbirth |
| _____ 17. areola | b. period after childbirth |

- | | |
|--------------------------|---|
| _____ 18. meconium | c. first feces of the newborn |
| _____ 19. hymen | d. a pigmented ring |
| _____ 20. lochia | e. membrane that covers the vaginal opening |
| _____ 21. hirsutism | a. whitish vaginal discharge |
| _____ 22. dyspareunia | b. excess hair growth |
| _____ 23. vernix caseosa | c. pain during intercourse |
| _____ 24. leukorrhea | d. soft spot between cranial bones |
| _____ 25. fontanel | e. fetal protective covering |

FILL IN THE BLANKS

26. The female gonad is the _____.
27. The ovarian follicle encloses a developing _____.
28. The tissue that nourishes and maintains the developing fetus is the _____.
29. The secretion of milk from the mammary glands is called _____.
30. Loss of an embryo or fetus before 20 weeks or 500 g is termed a(n) _____.
31. Parametritis (*par-a-mē-TRĪ-tis*) means inflammation of the tissue near the _____.
32. Polymastia (*pol-ē-MAS-tē-a*) means the presence of more than one pair of _____.

TRUE-FALSE

Examine the following statements. If the statement is true, write T in the first blank. If the statement is false, write F in the first blank and correct the statement by replacing the underlined word in the second blank.

	True or False	Correct Answer
33. Parturition is <u>childbirth</u> .	_____	_____
34. The fallopian tube is the <u>uterine tube</u> .	_____	_____
35. The lining of the uterus is the <u>myometrium</u> .	_____	_____
36. After ovulation, the ovarian follicle becomes a <u>fimbriae</u> .	_____	_____
37. Fertilization of an ovum occurs in the <u>uterus</u> .	_____	_____
38. The Pap smear is a test for <u>cervical</u> cancer.	_____	_____
39. Agalactia is the lack of <u>milk</u> production.	_____	_____
40. For the first two months, the developing offspring is called a <u>fetus</u> .	_____	_____

DEFINITIONS

Define the following terms:

41. retrouterine (*re-trō-Ū-ter-in*) _____
42. hysteropathy (*his-te-ROP-a-thē*) _____
43. metromalacia (*mē-trō-ma-LĀ-shē-a*) _____
44. pyosalpinx (*pī-ō-SAL-pinx*) _____
45. colpostenosis (*kol-pō-ste-NŌ-sis*) _____
46. vulvodynia (*vul-vō-DIN-ē-a*) _____

47. postnatal (*pōst-NĀ-tal*) _____
48. inframammary (*in-fra-MAM-a-rē*) _____
49. extraembryonic (*eks-tra-em-brē-ON-ik*) _____
50. tripara (*TRIP-a-ra*) _____
51. teratogenic (*TER-at-ō-jen-ik*) _____

Write words for the following:

52. hernia of a uterine tube _____
53. suture of the vulva (episi/o) _____
54. narrowing of the uterus (metr/o) _____
55. surgical removal of the uterus (hyster/o) and uterine tubes _____
56. radiograph of the breast (mamm/o) _____
57. abnormal or difficult labor _____
58. rupture of the amniotic sac _____
59. study of the embryo _____
60. measurement of a fetus _____

In A.Y.'s opening case study, find words for the following:

61. term that refers to a pregnant woman _____
62. upper rounded portion of the uterus _____
63. measurement of the pelvis _____
64. above the pubic bone _____
65. test to measure the health of a newborn _____
66. newborn _____

OPPOSITES

Write a word that means the opposite of the following:

67. antepartum _____
68. postnatal _____
69. dystocia _____
70. ovulatory _____

ADJECTIVES

Write the adjective form of the following:

71. cervix _____
72. uterus _____
73. perineum _____
74. vagina _____
75. embryo _____
76. amnion _____

PLURALS

Write the plural form of the following:

77. ovum _____

78. cervix _____

79. fimbria _____

80. labium _____

ELIMINATIONS

In each of the sets below, underline the word that does not fit in with the rest and explain the reason for your choice:

81. umbilical cord — labia majora — amniotic fluid — chorion — placenta

82. colostrum — progesterone — LH — estrogen — FSH

83. hemophilia — albinism — measles — PKU — cystic fibrosis

84. amniocentesis — chorionic villus sampling — karyotype — ultrasonography — candidiasis

85. placental abruption — spina bifida — pregnancy-induced hypertension — placenta previa — eclampsia

WORD BUILDING

Write a word for the following definitions using the word parts provided.

-graphy episio -plasty intra- cervic/o mamm/o -itis -al -tomy trans-

86. plastic repair of the vulva _____

87. inflammation of the cervix _____

88. radiographic study of the breast _____

89. plastic repair of the breast _____

90. radiographic study of the cervix _____

91. incision of the vulva _____

92. within the cervix _____

93. plastic repair of the cervix _____

94. incision of the cervix _____

95. through the cervix _____

ABBREVIATIONS

Write the meaning of the following abbreviations:

96. hCG _____

97. DUB _____

98. OB _____

99. LMP _____

100. CPD _____
101. FHR _____
102. PID _____
103. GA _____
104. VBAC _____

WORD ANALYSIS

Define the following words and give the meaning of the word parts in each. Use a dictionary if necessary.

105. antiangiogenesis (*an-tē-an-jē-ō-JEN-e-sis*) _____
- a. anti _____
- b. angi/o _____
- c. gen _____
- d. e/sis _____
106. gynecomastia (*gī-ne-kō-MAS-tē-a*) _____
- a. gynec/o _____
- b. mast/o _____
- c. -ia _____
107. oxytocia (*ok-sē-TO-sē-a*) _____
- a. oxy _____
- b. toc _____
- c. -ia _____
108. oligohydramnios (*ol-i-gō-hī-DRAM-nē-os*) _____
- a. oligo- _____
- b. hydr/o _____
- c. amnio(s) _____



For more learning activities, see Chapter 15 of the Student Resources on *thePoint*.

Additional Case Studies

Case Study 15-1: Total Abdominal Hysterectomy with Bilateral Salpingo-oophorectomy

M.T., a 60-YO gravida 2, para 2, had spent three months under the care of her gynecologist for treatment of postmenopausal bleeding and cervical dysplasia. She had had several vaginal examinations with Pap smears, a uterine ultrasound, colposcopy with endocervical biopsies, and a D&C with cone biopsy. She wanted to take hormone replacement therapy, but her doctor thought she was at too much risk with the abnormal cells on her cervix and the excessive bleeding.

She had a TAH and BSO under general anesthesia with no complications and an uneventful recovery. Her uterus had been prolapsed on abdominal examination, but there was no sign of malignancy or PID. The pathology report revealed several uterine leiomyomas and stenosis of the right uterine tube. She was discharged on the second postoperative day with few activity restrictions.

Case Study 15-2: In Vitro Fertilization

C.A. had worked as a technologist in the IVF lab at University Medical Center for four years. Her department was the advanced reproductive technology program. Although her work was primarily in the laboratory, she followed each patient through all five phases of the IVF and embryo transfer treatment cycle: follicular development, aspiration of the preovulatory follicles, sperm preparation, IVF, and embryo transfer. Her department does both GIFT and ZIFT.

While the female patient is in surgery having an ultrasound-guided transvaginal oocyte retrieval, C.A. examines the recently donated sperm for motility and quantity. She prepares to inoculate the sample into the cytoplasm of the ova as soon as she receives the cells from the OR. After inoculation, she places the sterile Petri dish with the fertilized oocytes into an incubator until they are ready to be introduced into the female patient.

CASE STUDY QUESTIONS

Multiple choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|---|---|
| <p>_____ 1. M.T. is a gravida 2, para 2. This means:</p> <ul style="list-style-type: none">a. she has four children from two pregnanciesb. she has had two pregnancies and two birthsc. she has had four pregnancies and two birthsd. she has had two pregnancies and two sets of twinse. she has one set of twins <p>_____ 2. An endocervical biopsy is:</p> <ul style="list-style-type: none">a. a tissue sample from the cul-de-sacb. a cone-shaped tissue sample from the uterine fundusc. a tissue sample from within the neckd. a tissue sample from the lining of the cervixe. a scraping of tissue cells from the vaginal wall <p>_____ 3. A curettage is a(n):</p> <ul style="list-style-type: none">a. suturingb. scrapingc. cuttingd. examinatione. incision | <p>_____ 4. A colposcopy is an endoscopic examination of the:</p> <ul style="list-style-type: none">a. vaginab. fundusc. intraperitoneal pelvic floord. pouch of Douglase. uterus and fallopian tubes <p>_____ 5. Another name for a leiomyoma is a(n):</p> <ul style="list-style-type: none">a. ectopic pregnancyb. uterine fibroidc. myomad. a and be. b and c <p>_____ 6. Pregnancy-induced hypertension is also called:</p> <ul style="list-style-type: none">a. tubal pregnancyb. congenital mutationc. ectopic pregnancyd. preeclampsiae. placenta previa |
|---|---|

Write a term from the case studies with each of the following meanings:

7. displaced downward _____
8. cell produced by fertilization _____
9. an immature egg cell _____
10. pertaining to the structure in which an egg ripens _____

Define each of the following abbreviations:

11. D&C _____
12. BSO _____
13. HRT _____
14. TAH _____
15. IVF _____
16. GYN _____
17. ZIFT _____

CHAPTER 16

The Endocrine System

Case Study

J.D.'s Graves Disease

Chief complaint:

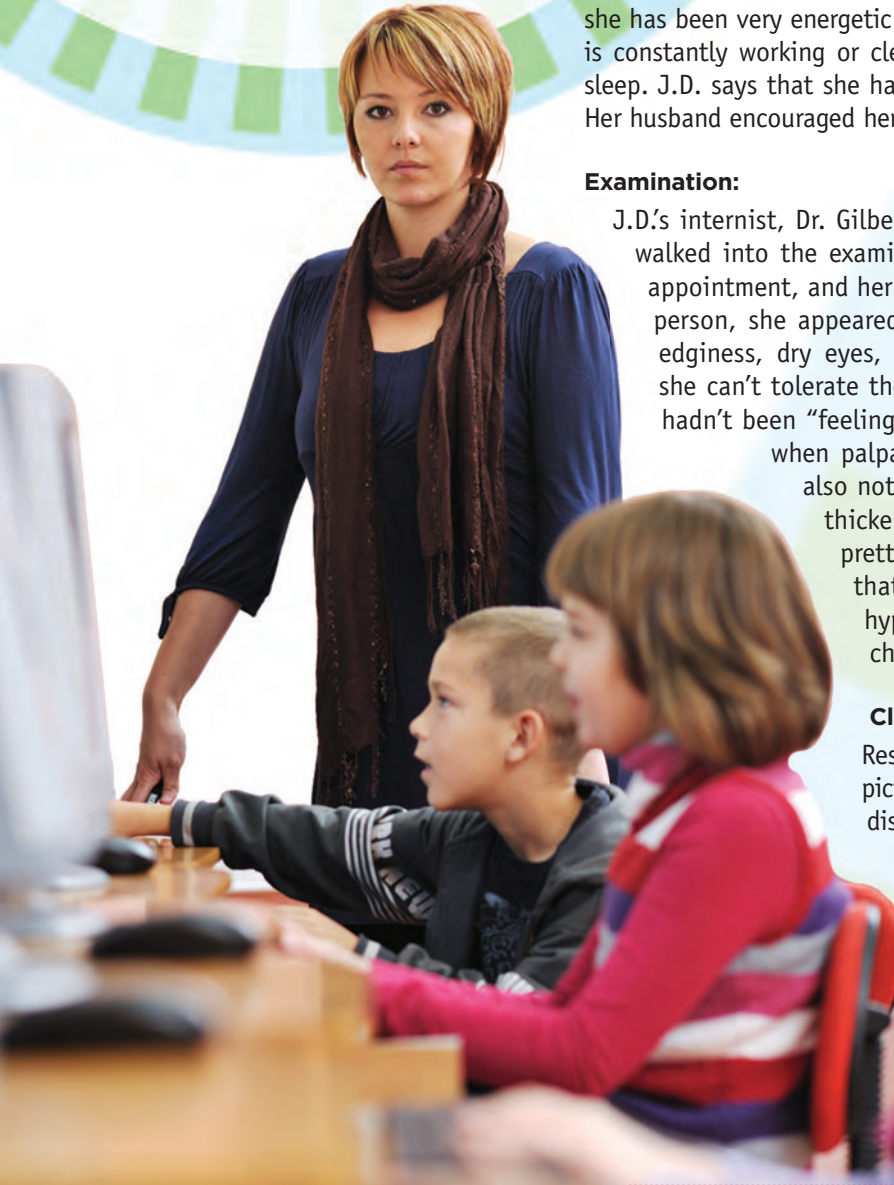
J.D. is a 35-year-old second grade teacher. Her husband has been noticing that she has been very energetic over the past few months, more so than usual. She is constantly working or cleaning, and she is up during the night, unable to sleep. J.D. says that she has felt nervous and jittery for the past few months. Her husband encouraged her to make an appointment with her physician.

Examination:

J.D.'s internist, Dr. Gilbert, was able to make a few observations when he walked into the examination room. J.D. had lost weight since her last appointment, and her eyes were protruding. Normally a quiet and happy person, she appeared irritable and abrupt. She complained about her edginess, dry eyes, and inability to sleep. She also mentioned that she can't tolerate the heat and frequently perspires. She said she just hadn't been "feeling herself" as of late. Dr. Gilbert examined her, and when palpating her neck, he noted an enlarged thyroid. He also noted a dermatopathy on her shins where the skin had thickened and had red patches. Her vital signs were pretty consistent with previous examinations, except that she was a bit tachycardic. Dr. Gilbert suspected hyperthyroidism. He ordered some blood work to check her thyroid levels and confirm his diagnosis.

Clinical course:

Results of the laboratory work verified Dr. Gilbert's suspicion. He discussed the diagnosis of the autoimmune disorder of hyperthyroidism, also known as Graves disease or diffuse toxic goiter, with J.D. and her husband. He provided them the results of the T3 and T4 lab work and explained that the high levels meant her thyroid was overactive. He explained the treatment options, including antithyroid medication, partial or total thyroidectomy, or radiation therapy. Dr. Gilbert felt that a medical regime would be appropriate for J.D. and ordered the antithyroid drug Tapazole. He also ordered eye drops for the exophthalmos.





Ancillaries *At-A-Glance*

Visit *thePoint* to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii–xvi.

Learning TOOLS

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning RESOURCES

- E-book: Chapter 16
- Web Figure: Clinical Manifestations of Acromegaly
- Web Figure: Hypothyroidism and Hyperthyroidism Compared
- Web Figure: Clinical Manifestations of Hyperparathyroidism
- Web Figure: Clinical Manifestations of Addison Disease
- Web Figure: Clinical Manifestations of Cushing Syndrome
- Web Figure: Metabolic Syndrome
- Animation: Hormonal Control of Glucose
- Animation: Diabetes
- Audio Pronunciation Glossary

Learning ACTIVITIES

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After study of this chapter you should be able to:

- 1 Define hormones. *p416*
- 2 Compare steroid and amino acid hormones. *p416*
- 3 Give the location and structure of the endocrine glands. *p416*
- 4 Name the hormones produced by the endocrine glands, and briefly describe the function of each. *p418*
- 5 Identify and use roots pertaining to the endocrine system. *p421*
- 6 Describe the main disorders of the endocrine system. *p422*
- 7 Interpret abbreviations used in endocrinology. *p429*
- 8 Analyze medical terms in several case studies concerning the endocrine system. *pp414, 434*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|--|---|
| <p>_____ 1. The secretions of the endocrine glands are called:</p> <ul style="list-style-type: none"> a. enzymes b. sera c. lymph d. hormones | <p>_____ 4. Gigantism results from overproduction of:</p> <ul style="list-style-type: none"> a. growth hormone b. oxytocin c. erythropoietin d. prolactin |
| <p>_____ 2. The small gland in the brain that controls other glands is the:</p> <ul style="list-style-type: none"> a. pituitary b. thymus c. appendix d. corpus luteum | <p>_____ 5. Diabetes mellitus involves the hormone insulin, which is made by the:</p> <ul style="list-style-type: none"> a. thymus b. seminal vesicle c. kidney d. pancreas |
| <p>_____ 3. The glands that are located above the kidneys are the:</p> <ul style="list-style-type: none"> a. thyroids b. follicles c. adrenals d. fimbriae | <p>_____ 6. A goiter involves the:</p> <ul style="list-style-type: none"> a. adrenal b. zygote c. calyx d. thyroid |

The body's main controlling systems are the endocrine system and the nervous system (discussed in Chapters 17 and 18). The endocrine system consists of a widely distributed group of glands that secrete regulatory substances called **hormones**. Because hormones are released into the blood, the **endocrine** glands are known as the *ductless glands*, as compared to exocrine glands, such as sweat glands and digestive glands, that secrete through ducts to the outside. Despite the fact that hormones circulating in the blood reach all parts of the body, only certain tissues respond to a specific hormone. The tissue that is influenced by a specific hormone is called the **target tissue**. The cells in a target tissue have specific **receptors** on their membranes or within the cell to which the hormone attaches, enabling it to act.

Hormones

Hormones are produced in extremely small amounts and are highly potent. By means of their actions on various target tissues, they affect growth, metabolism, reproductive activity, and behavior. (Box 16-1 describes some old ideas about the effects of substances circulating in the blood.)

Chemically, hormones fall into two categories:

- **Steroid hormones**, which are made from lipids. Steroids are produced by the sex glands (gonads) and the outer region (cortex) of the **adrenal glands**.

- Hormones made of amino acids, which include proteins and protein-like compounds. All of the endocrine glands aside from the gonads and adrenal cortex produce amino acid hormones.

The production of hormones is controlled mainly by negative feedback—that is, the hormone itself, or some product of hormone activity, acts as a control over further manufacture of the hormone—a self-regulating system. Hormone production may also be controlled by the nervous system or by other hormones.

The Endocrine Glands

Refer to **Figure 16-1** to locate the endocrine glands described below. **Box 16-2** lists the endocrine glands, along with the hormones they secrete and their functions.

PITUITARY

The **pituitary gland**, or **hypophysis**, is a small gland beneath the brain. It is divided into an anterior lobe (adenohypophysis) and a posterior lobe (neurohypophysis). The **hypothalamus**, a part of the brain, is connected to and controls both lobes.

The anterior pituitary produces six hormones. One of these is growth hormone (somatotropin), which stimulates bone growth and acts on other tissues as well

Box 16-1



Focus on Words

Are You in a Good Humor?

In ancient times, people accepted the theory that a person's state of health depended on the balance of four body fluids. These fluids, called "humors," were yellow bile, black bile, phlegm, and blood. A predominance of any one of these humors would determine a person's mood or temperament. Yellow bile caused anger; black bile caused depression; phlegm (mucus) made a person sluggish; blood resulted in cheerfulness and optimism.

Although we no longer believe in humoralism, we still have adjectives in our vocabulary that reflect these early

beliefs. Choleric describes a person under the influence of yellow bile; melancholic describes the effects of black bile (melano- means black or dark); a phlegmatic person is slow to respond; a sanguine individual "goes with the flow." (*Sanguine* is derived from the Greek word for blood.)

The humors persist today in the adjective *humoral*, which describes substances carried in the blood or other body fluids. The term applies to hormones and other circulating materials that influence body responses. Humoral immunity is immunity based on antibodies carried in the bloodstream.

(see Box 16-3). The remainder of the pituitary hormones regulate other glands, including the thyroid, adrenals, gonads, and mammary glands (see Box 16-2). The ending *-trophin*, as in *gonadotropin*, indicates a hormone that acts on another gland. The adjective ending is *-tropic*, as in *adrenocorticotrophic*.

The posterior pituitary releases two hormones that are actually produced in the hypothalamus. These hormones are stored in the posterior pituitary until they are needed:

- Antidiuretic hormone (ADH) acts on the kidneys to conserve water and also promotes constriction of blood vessels. Both of these actions increase blood pressure.
- Oxytocin stimulates uterine contractions and promotes milk "letdown" in the breasts during lactation.

THYROID AND PARATHYROIDS

The **thyroid gland** consists of two lobes on either side of the larynx and upper trachea. The lobes are connected by a narrow band (isthmus) (Fig. 16-2). The thyroid secretes a mixture of hormones, mainly thyroxine (T_4) and triiodothyronine (T_3). Because thyroid hormones contain iodine, laboratories can measure these hormones and study thyroid gland activity by following iodine levels. Most thyroid hormone in the blood is bound to protein, primarily thyroxine-binding globulin (TBG).

On the posterior surface of the thyroid are four to six tiny **parathyroid glands** that affect calcium metabolism (Fig. 16-3). Parathyroid hormone (PTH) regulates calcium exchange between the blood and bones. It increases the blood level of calcium when needed.

ADRENALS

The adrenal glands, located atop the kidneys, are divided into two distinct regions: an outer cortex and an inner medulla (Fig. 16-4). The hormones produced by this gland are involved in the body's response to stress. The cortex produces steroid hormones:

- Cortisol (hydrocortisone) mobilizes fat and carbohydrate reserves to increase these nutrients in the blood. It also reduces inflammation and is used clinically for this purpose.
- Aldosterone causes the kidneys to conserve sodium and water while eliminating potassium.
- Sex hormones, mainly testosterone, are also produced in small amounts, but their importance is not well understood. Some athletes, illegally and dangerously, take testosterone-like steroids to increase muscle size, strength, and endurance (see Box 20-1).

The medulla of the adrenal gland produces the hormone epinephrine (adrenaline) in response to stress. Epinephrine works with the nervous system to help the body meet physical and emotional challenges.

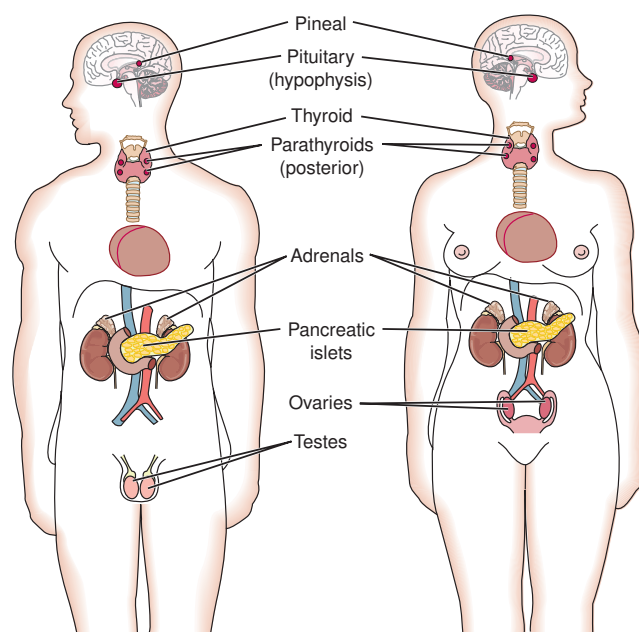


Figure 16-1 The endocrine glands.

Box 16-2

For Your Reference



Endocrine Glands and Their Hormones

GLAND	HORMONE	PRINCIPAL FUNCTIONS
anterior pituitary <i>pi-TŪ-i-tar-ē</i>	GH (growth hormone), also called somatotropin (<i>sō-ma-tō-TRŌ-pin</i>)	Promotes growth of all body tissues
	TSH (thyroid-stimulating hormone)	Stimulates thyroid gland to produce thyroid hormones
	ACTH (adrenocorticotrophic hormone) (<i>a-drē-nō-kor-ti-kō-TRŌ-pik</i>)	Stimulates adrenal cortex to produce cortical hormones; aids in protecting body in stress situations (injury, pain)
	FSH (follicle-stimulating hormone)	Stimulates growth and hormonal activity of ovarian follicles; stimulates growth of testes; promotes sperm cell development
	LH (luteinizing hormone) (<i>LŪ-tē-in-ī-zing</i>)	Causes development of corpus luteum at site of ruptured ovarian follicle in female; stimulates testosterone secretion in male
	PRL (prolactin) (<i>prō-LAK-tin</i>)	Stimulates milk secretion by mammary glands
posterior pituitary	ADH (antidiuretic hormone; vasopressin) (<i>an-tē-dī-ŭ-RET-ik; vā-sō-PRES-in</i>) oxytocin (<i>ok-sē-TŌ-sin</i>)	Promotes water reabsorption in kidney tubules; causes blood vessels to constrict Causes uterine contraction; causes milk ejection from mammary glands
thyroid	thyroxine or tetraiodothyronine (T_4) and triiodothyronine (T_3) (<i>thi-ROK-sēn; trī-ī-ō-dō-THĪ-rō-nēn</i>)	Increase metabolic rate and heat production, influencing both physical and mental activities; required for normal growth
parathyroid	parathyroid hormone (PTH) (<i>par-a-THĪ-royd</i>)	Regulates calcium exchange between blood and bones; increases blood calcium level
adrenal cortex	cortisol (hydrocortisone) (<i>KOR-ti-sol</i>) aldosterone (<i>al-DOS-ter-ōn</i>) sex hormones	Aids in metabolism of carbohydrates, proteins, and fats; active during stress Aids in regulating electrolytes and water balance May influence secondary sexual characteristics
adrenal medulla	epinephrine (adrenaline) (<i>ep-i-NEF-rin; a-DREN-a-lin</i>)	Response to stress; increases respiration, blood pressure, and heart rate
pancreatic islet	insulin (<i>IN-sŭ-lin</i>)	Aids glucose transport into cells; required for cellular metabolism of nutrients, especially glucose; decreases blood sugar levels
	glucagon (<i>GLŪ-ka-gon</i>)	Stimulates liver to release glucose, thereby increasing blood sugar levels
pineal	melatonin (<i>mel-a-TŌN-in</i>)	Regulates mood, sexual development, and daily cycles in response to environmental light
testis	testosterone (<i>tes-TOS-te-rōn</i>)	Stimulates growth and development of sexual organs plus development of secondary sexual characteristics; stimulates maturation of sperm cells
ovary	estrogen (<i>ES-trō-jen</i>) progesterone (<i>prō-JES-ter-ōn</i>)	Stimulates growth of primary sexual organs and development of secondary sexual characteristics Prepares uterine lining for implantation of fertilized ovum; aids in maintaining pregnancy; stimulates development of mammary glands' secretory tissue

Box 16-3



Clinical Perspectives

Growth Hormone: Its Clinical Use Is Growing

Growth hormone (GH) is produced by the anterior pituitary. It is released mainly at the beginning of deep sleep, so the old belief that you grow while you sleep has some basis in fact. Although GH primarily affects bone and muscle development during early growth, it has a general stimulating effect on most other tissues throughout life. Its alternative name, somatotropin, comes from *soma* meaning “body” and *tropin* meaning “acting on.” GH is released during times of stress to boost the liver’s output of energy-rich fatty acids when blood glucose levels drop. A lack of GH in childhood results in

dwarfism, and the hormone was initially prescribed only for children with a GH deficiency. Now it has also been approved for children who are in the lowest percentile of height for their age. If a child is still growing, as shown by x-rays of the hand and wrist, GH will lead to some ultimate increase in height. Because GH increases lean muscle mass, it is also touted as a bodybuilding and antiaging medication. However, it may have some side effects, and its long-term effects are not known. GH for clinical use was initially obtained from cadaver pituitaries, but it is now made by genetic engineering.

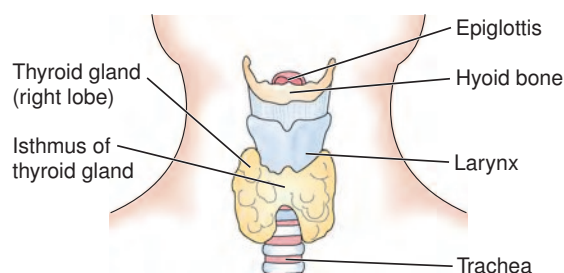


Figure 16-2 **Thyroid gland.** This anterior view shows the gland in relation to the larynx and trachea.

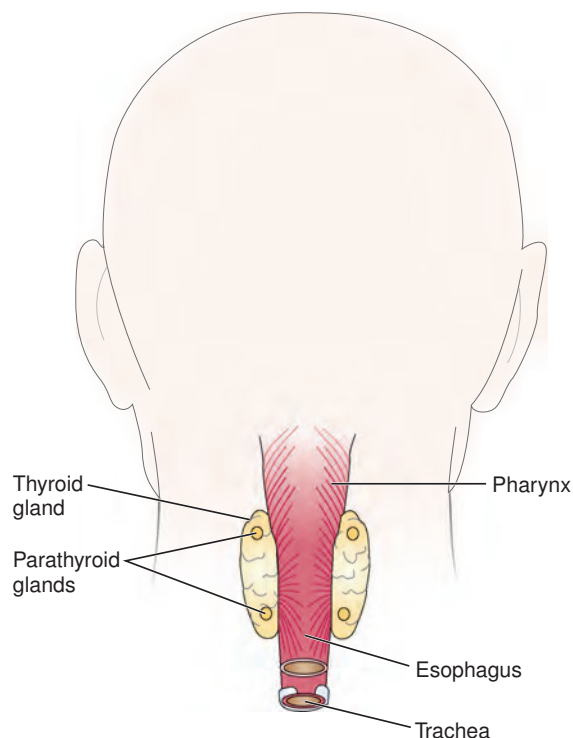
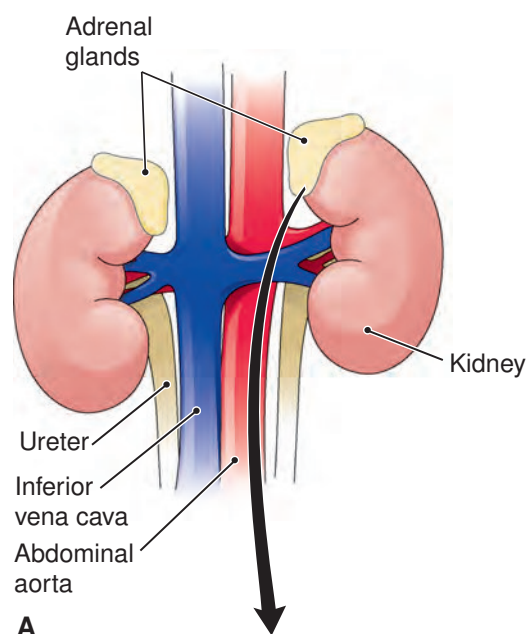
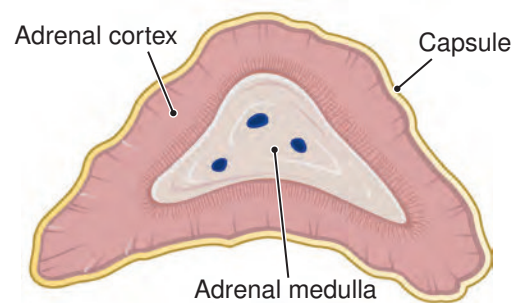


Figure 16-3 **Parathyroid glands.** A posterior view of the thyroid gland shows the parathyroid glands embedded in its surface.



A



B

Figure 16-4 **Adrenal glands.** A. The adrenal glands shown on top of the kidneys. B. The adrenal gland is divided into a medulla and cortex, each secreting different hormones.

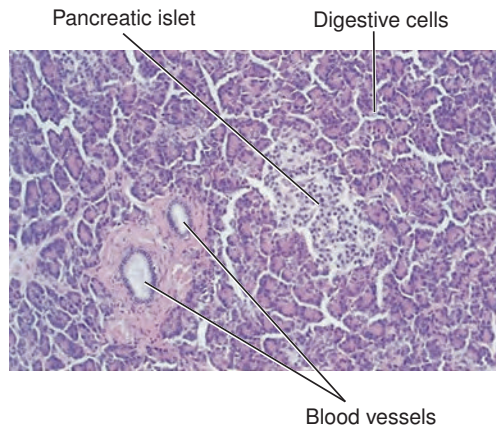


Figure 16-5 Pancreatic cells, microscopic view. Light-staining islet cells are seen among the cell clusters that produce digestive juices.

PANCREAS

The endocrine portions of the pancreas are the **pancreatic islets**, small cell clusters within the pancreatic tissue. The term *islet*, meaning “small island,” is used because these cells look like little islands in the midst of the many pancreatic cells that secrete digestive juices (Fig. 16-5). The islet cells produce two hormones, insulin and glucagon, that regulate glucose metabolism. Insulin increases cellular use of glucose, thus decreasing blood sugar levels. Glucagon has the opposite effect, increasing blood sugar levels.

Other Endocrine Tissues

There are three additional types of glands that secrete hormones:

- The **pineal gland** is a small gland in the brain (see Fig. 16-1). It regulates mood, daily rhythms, and sexual development in response to environmental light. Its hormone is melatonin, which some people take to help regulate sleep–wake cycles when they travel between time zones.
- The thymus, described in Chapter 9, secretes the hormone thymosin that aids in the development of the immune system’s T cells. The thymus lies in the upper chest above the heart. It is important in early years but shrinks and becomes less important in adults.
- The gonads, the testes and ovaries described in Chapters 14 and 15, are also included because they secrete hormones in addition to producing the sex cells.

Other organs, including the stomach, kidney, heart, and small intestine, also produce hormones. However, they have other major functions and are discussed with the systems to which they belong.

Finally, **prostaglandins** are a group of hormones produced by many cells. They have a variety of effects, including stimulation of uterine contractions, promotion of inflammation, and vasomotor activities. They are called prostaglandins because they were first discovered in the prostate gland.

Terminology Key Terms

Normal Structure and Function

adrenal gland <i>a-DRĒ-nal</i>	A gland on the superior surface of the kidney. The outer region (cortex) secretes steroid hormones; the inner region (medulla) secretes epinephrine (adrenaline) in response to stress (root: adren/o)
endocrine <i>EN-dō-krin</i>	Pertaining to a ductless gland that secretes hormones into the blood
hormone <i>HOR-mōn</i>	A secretion of an endocrine gland. A substance that travels in the blood and has a regulatory effect on tissues, organs, or glands
hypophysis <i>hī-POF-i-sis</i>	The pituitary gland; named from <i>hypo</i> , meaning “below,” and <i>physis</i> , meaning “growing,” because the gland develops below the hypothalamus (root: hypophysi/o)
hypothalamus <i>hī-pō-THAL-a-mus</i>	A portion of the brain that controls the pituitary gland and is active in maintaining homeostasis
pancreatic islet <i>ī-let</i>	Cluster of endocrine cells in the pancreas that secretes hormones to regulate glucose metabolism; also called islet of Langerhans or islet cells (root <i>insull/o</i> means “island”)
parathyroid gland <i>par-a-THĪ-royd</i>	A small endocrine gland on the posterior thyroid that acts to increase blood calcium levels; there are usually four to six parathyroid glands (roots: parathyr/o, parathyroid/o); the name literally means “near the thyroid”
pineal gland <i>PIN-ē-al</i>	A small gland in the brain (see Fig. 16-1). Appears to regulate mood, daily rhythms, and sexual development in response to environmental light. Secretes the hormone melatonin

Terminology

Key Terms (Continued)

pituitary gland <i>pi-TŪ-i-tar-ē</i>	A small endocrine gland at the base of the brain. The anterior lobe secretes growth hormone and hormones that stimulate other glands; the posterior lobe releases ADH and oxytocin manufactured in the hypothalamus (root: pituitar/i); hypophysis
prostaglandins <i>pros-ta-GLAN-dinz</i>	A group of hormones produced throughout the body that have a variety of effects, including stimulation of uterine contractions and regulation of blood pressure, blood clotting, and inflammation
receptor	A site on the cell membrane or within the cell to which a substance, such as a hormone, attaches
steroid hormone <i>STER-oyd</i>	A hormone made from lipids and including the sex hormones and the hormones of the adrenal cortex
target tissue	The specific tissue on which a hormone acts; may also be called the target organ
thyroid gland <i>THĪ-royd</i>	An endocrine gland on either side of the larynx and upper trachea. It secretes hormones that affect metabolism and growth (roots: thyr/o, thyroid/o)



Go to the Audio Pronunciation Glossary in the Student Resources on thePoint to hear these terms pronounced.

16

Roots Pertaining to the Endocrine System

See **Table 16-1**.

Table 16-1

Roots Pertaining to the Endocrine System

Root	Meaning	Example	Definition of Example
endocrin/o	endocrine glands or system	endocrinopathy <i>en-dō-kri-NOP-a-thē</i>	any disease of the endocrine glands
pituitar/i	pituitary gland, hypophysis	pituitarism <i>pi-TŪ-i-ta-rizm</i>	condition caused by any disorder of pituitary function
hypophysi/o	pituitary gland, hypophysis	hypophyseal <i>hī-pō-FIZ-ē-al</i> (also spelled hypophyseal)	pertaining to the pituitary gland
thyr/o, thyroid/o	thyroid gland	thyrolytic <i>thī-rō-LIT-ik</i>	destroying the thyroid gland
parathyr/o, parathyroid/o	parathyroid gland	hyperparathyroidism <i>hī-per-par-a-THĪ-royd-izm</i>	overactivity of a parathyroid gland
adren/o, adrenal/o	adrenal gland, epinephrine	adrenergic <i>ad-ren-ER-jik</i>	activated (erg) by or related to epinephrine (adrenaline)
adrenocortic/o	adrenal cortex	adrenocorticotrophic <i>a-drē-nō-kor-ti-kō-TRŌ-pik</i>	acting on the adrenal cortex
insul/o	pancreatic islets	insular <i>IN-sū-lar</i>	pertaining to islet cells

EXERCISE 16-1

Define the following words:

1. endocrinology (*en-dō-krin-OL-ō-jē*) _____
2. hypophysectomy (*hī-pōf-i-SEK-tō-mē*) _____
3. thyrotropic (*thī-rō-TROP-ik*) _____
4. hypoadrenalism (*hī-pō-a-DRĒ-nal-izm*) _____
5. insulinitis (*in-sū-LĪ-tis*) _____

Words for conditions resulting from endocrine dysfunctions are formed by adding the suffix *-ism* to the name of the gland or its root and adding the prefix *hyper-* or *hypo-* for overactivity or underactivity of the gland. Use the full name of the gland to form words with the following definitions:

6. condition of overactivity of the thyroid gland, as seen in J.D.'s opening case study _____
7. condition of underactivity of the parathyroid gland _____
8. condition of overactivity of the adrenal gland _____

Use the word root for the gland to form words with the following definitions:

9. condition of overactivity of the adrenal cortex _____
10. condition of underactivity of the pituitary gland (use pituitar/i) _____

Write a word for the following definitions:

11. physician who specializes in study of the endocrine system _____
12. excision of the thyroid gland, as mentioned in J.D.'s opening case study _____
13. any disease of the adrenal gland _____
14. inflammation of the adrenal gland _____
15. tumor of the pancreatic islets _____

Clinical Aspects of the Endocrine System

Endocrine diseases usually result from the overproduction (hypersecretion) or underproduction (hyposecretion) of hormones. They may also result from secretion at the wrong time or from an inadequate target tissue response. The causes of abnormal secretion may originate in the gland itself or may result from failure of the hypothalamus or the pituitary to release the proper amount of stimulating hormones. Some of the common endocrine disorders are described below. Conditions resulting from hypersecretion or hyposecretion of hormones are summarized in **Box 16-4**.

PITUITARY

A pituitary **adenoma** (glandular tumor) usually increases secretion of growth hormone or adrenocorticotrophic hormone (ACTH). Less commonly, a tumor affects the secretion of prolactin. An excess of growth hormone in children

causes **gigantism**. In adults it causes **acromegaly**, characterized by enlargement of the hands, feet, jaw, and facial features. Treatment is by surgery to remove the tumor (adenomectomy) or by drugs to reduce the blood levels of growth hormone. Excess ACTH overstimulates the adrenal cortex, resulting in Cushing disease. Increased prolactin causes milk secretion (galactorrhea) in both males and females. Radiographic studies in cases of pituitary adenoma usually show enlargement of the bony socket (sella turcica) that contains the pituitary.

Pituitary hypofunction, as caused by tumor or interruption of blood supply to the gland, may involve a single hormone but usually affects all functions and is referred to as **panhypopituitarism**. This condition's widespread effects include dwarfism (from lack of growth hormone), lack of sexual development and sexual function, fatigue, and weakness.

A specific lack of ADH from the posterior pituitary results in **diabetes insipidus** in which the kidneys have a decreased ability to conserve water. Symptoms are polyuria (excessive urination) and polydipsia (excessive thirst).

Box 16-4

For Your Reference

Disorders Associated with Endocrine Dysfunction*

HORMONE	HYPERSECRETION	HYPOSECRETION
growth hormone	gigantism (children), acromegaly (adults)	dwarfism (children)
antidiuretic hormone	syndrome of inappropriate ADH (SIADH)	diabetes insipidus
aldosterone	aldosteronism	Addison disease
cortisol	Cushing syndrome	Addison disease
thyroid hormone	Graves disease, thyrotoxicosis	infantile and adult hypothyroidism
insulin	hypoglycemia	diabetes mellitus
parathyroid hormone	bone degeneration	tetany (muscle spasms)

*Refer to key terms for pronunciations and descriptions.

Diabetes insipidus should not be confused with **diabetes mellitus (DM)**, a disorder of glucose metabolism described later. The two diseases share the symptoms of polyuria and polydipsia but have entirely different causes. DM is the more common disorder, and when the term *diabetes* is used alone, it generally refers to DM. The word *diabetes* is from the Greek meaning “siphon,” referring to the large urinary output in both forms of diabetes.



See the figure on the clinical manifestations of acromegaly in the Student Resources on thePoint.

THYROID

Because thyroid hormone affects the growth and function of many tissues, a deficiency of this hormone in infancy causes physical and mental retardation as well as other symptoms that together constitute **infantile hypothyroidism**, also called congenital hypothyroidism. If not diagnosed at birth and treated, hypothyroidism will lead to mental retardation within six months.

The United States and other developed countries now require testing of all newborns for hypothyroidism.

In adults, thyroid deficiency causes weight gain; lethargy; rough, dry skin; hair loss; and facial swelling. There may be reproductive problems and muscular weakness, pain, and stiffness. A common cause of **adult hypothyroidism** is autoimmune destruction of the thyroid. Hypothyroidism in both children and adults is easily treated with thyroid hormone.

The most common form of hyperthyroidism is **Graves disease**, also called *diffuse toxic goiter*. This is an autoimmune disorder in which antibodies stimulate an increased production of thyroid hormone. There is weight loss, irritability, hand tremor, and rapid heart rate (tachycardia). A most distinctive sign is bulging eyeballs, termed **exophthalmos**, caused by swelling of the tissues behind the eyes

(Fig. 16-6). Treatment for Graves disease may include anti-thyroid drugs, surgical removal of all or part of the thyroid, or radiation delivered in the form of radioactive iodine.

A common sign in thyroid disease is an enlarged thyroid, or **goiter**. However, a goiter is not necessarily accompanied by thyroid malfunction. A simple or nontoxic goiter is caused by a dietary iodine deficiency. Such cases are rare in industrialized countries because of iodine addition to salt and other commercial foods.

Thyroid function is commonly tested by measuring the gland's radioactive iodine uptake (RAIU). Laboratories use radioimmunoassays to measure blood levels of pituitary thyroid-stimulating hormone (TSH), which varies with changing levels of thyroid hormones. Total and free

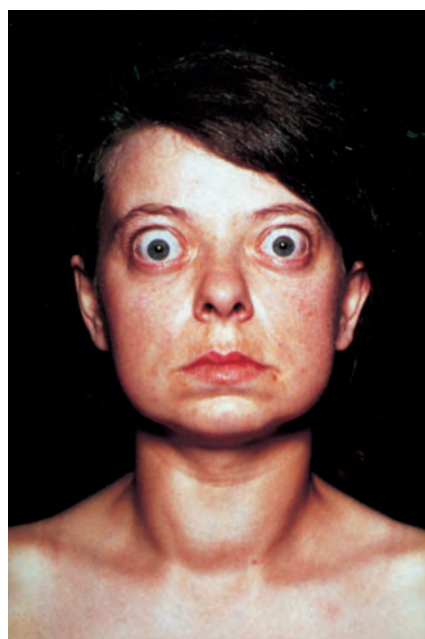


Figure 16-6 Graves disease. A young woman with hyperthyroidism showing a mass in the neck and exophthalmos.

thyroxine (T_4) and triiodothyronine (T_3) are also measured, as are the levels of TBG, a blood protein that binds to thyroid hormones. Thyroid scans following administration of radioactive iodine are also used to study this gland's activity.



See the figure comparing hypothyroidism and hyperthyroidism in the Student Resources on thePoint.

PARATHYROIDS

Overactivity of the parathyroid glands, usually from a tumor, causes a high level of calcium in the blood. Because this calcium is obtained from the bones, there is also skeletal degeneration and bone pain. A common side effect is the development of kidney stones from the high levels of circulating calcium.

Damage to the parathyroids or their surgical removal, as during thyroid surgery, results in a decrease in blood calcium levels. This causes numbness and tingling in the arms and legs and around the mouth (perioral), as well as **tetany** (muscle spasms). Treatment consists of supplying calcium.



See the figure on clinical manifestations of hyperparathyroidism in the Student Resources on thePoint.

ADRENALS

Hypofunction of the adrenal cortex, or **Addison disease**, is usually caused by autoimmune destruction of the gland. It may also result from a deficiency of pituitary ACTH. The lack of aldosterone results in water loss, low blood pressure, and electrolyte imbalance. There is also weakness and nausea and an increase in brown pigmentation. This last symptom is caused by release of a pituitary hormone that stimulates the skin's pigment cells (melanocytes). Once diagnosed, Addison disease is treated with replacement cortical hormones.

An excess of adrenal cortical hormones results in **Cushing syndrome**. Patients with this syndrome have moon-shaped faces, obesity localized in the torso, weakness, excess hair growth (hirsutism), and fluid retention (**Fig. 16-7**). The most common cause of Cushing syndrome is the therapeutic administration of steroid hormones. An adrenal tumor is another possible cause. If the disorder is caused by a pituitary tumor that increases ACTH production, it is referred to as **Cushing disease**.



See the figures on the clinical manifestation of Addison disease and Cushing syndrome in the Student Resources on thePoint.

THE PANCREAS AND DIABETES

The most common endocrine disorder, and a serious public health problem, is diabetes mellitus (DM), a failure of the body cells to use glucose effectively. The excess glucose accumulates



Figure 16-7 Cushing syndrome. The woman has a moon face, buffalo hump, increased facial hair, and thinning of the scalp hair.

in the blood, causing **hyperglycemia**. Increased urination (polyuria) marks the effort to eliminate the excess glucose in the urine, a condition termed **glycosuria**. The result is dehydration and excessive thirst (polydipsia). There is also weakness, weight loss, and extreme hunger (polyphagia). Unable to use carbohydrates, the body burns more fat. This leads to accumulation of ketone bodies in the blood and a shift toward acidosis, a condition termed **ketoacidosis**. If untreated, diabetes will lead to starvation of the central nervous system and coma. Diabetic patients are prone to cardiovascular, neurologic, and visual problems; infections; and renal failure.

Types of Diabetes Mellitus

There are two main types of DM:

- Type 1 diabetes mellitus (T1DM) is caused by autoimmune destruction of pancreatic islet cells and failure of the pancreas to produce insulin. It has an abrupt onset and usually appears in children and teenagers. Because insulin levels are very low or absent, patients need careful monitoring and regular administration of this hormone.
- Type 2 diabetes mellitus (T2DM) accounts for about 90 percent of diabetes cases. Heredity plays a much greater role in this form of diabetes than in type 1. Type 2 diabetes is initiated by cellular resistance to insulin. Feedback stimulation of the pancreatic islets leads to insulin overproduction followed by a failure of the overworked cells to produce enough insulin. Most cases of type 2 diabetes are linked to obesity, especially upper-body obesity. Although seen mostly in older people, the incidence of type 2 diabetes is increasing among younger generations, presumably because of increased obesity, poor diet, and sedentary habits.

Metabolic syndrome, also called *syndrome X* or *insulin resistance syndrome*, is related to T2DM and describes a state of hyperglycemia caused by insulin resistance in association with some metabolic disorders, including high levels of plasma triglycerides (fats), low levels of high-density lipoproteins (HDLs), hypertension, and coronary heart disease.

Gestational diabetes mellitus (GDM) refers to glucose intolerance during pregnancy. This imbalance usually appears in women with family histories of diabetes and in those who are obese. Women, especially those with predisposing factors, must be monitored during pregnancy for signs of DM because this condition can cause complications for both the mother and the fetus. Gestational diabetes usually disappears after childbirth, but it may be a sign that diabetes will develop later in life. As with other forms of diabetes, a proper diet is the first step to management, with insulin treatment if needed.

DM may also follow other endocrine disorders or treatment with corticosteroids and may be caused by a genetic disorder of the pancreatic islets.

Diagnosis

Diabetes is diagnosed by measuring glucose levels in blood plasma with or without fasting. The standard for diagnosis of diabetes in a random test is greater than 200 mg/dL and for a fasting plasma glucose (FPG) greater than 126 mg/dL. Measuring blood glucose levels after oral administration of glucose is an oral glucose tolerance test (OGTT). Categories of impaired fasting blood glucose (IFG) and impaired glucose tolerance (IGT) are intermediate stages between a normal response to glucose and confirmed diabetes.

Treatment

People with T1DM must monitor blood glucose levels four to eight times a day. Traditionally, this is done with blood obtained by a finger stick, but new methods of monitoring glucose through the skin are available. Systems for continuous monitoring are also available, and these can alert patients to high and low blood glucose levels. Insulin may be given in divided doses by injection or by means of an insulin pump that delivers the hormone around the clock as continuous subcutaneous insulin infusion (CSII). Newer computerized pumps monitor glucose levels and adjust insulin dosage automatically. Diet must be carefully regulated to keep glucose levels steady.

While managing diabetes, patients monitor their own glucose levels on a daily basis. Every few months, physicians obtain more precise indications of long-term glucose control with a **glycated hemoglobin (HbA1c) test**. This test is based on glucose uptake by red blood cells and reflects the average blood glucose levels for two to three months before the test.

Exercise and weight loss for those who are overweight are the first approaches to treating type 2 diabetes, and these measures often lead to management of the disorder. Drugs for increasing insulin production or improving cellular responses to insulin may also be prescribed, with insulin treatment given if necessary.

Insulin is now made by genetic engineering. There are various forms with different action times that can be alternated to achieve glucose regulation. Excess insulin may result from a pancreatic tumor, but more often it occurs after administration of too much hormone to a diabetic patient. The resultant **hypoglycemia** leads to **insulin shock**, which is treated by the administration of glucose.

Methods of administering insulin in pills or capsules, inhaler spray, or skin patches are under study. Researchers are also studying the possibility of transplanting healthy islet cells to compensate for failed cells. Another area of research is the use of immunosuppression to halt T1DM.

Also used to diagnose endocrine disorders are imaging techniques, other measurements of hormones or their metabolites in plasma and urine, and studies involving hormone stimulation or suppression.

Box 16-5 has information on dietitians and nutritionists. These health care professionals work with people, including those with diabetes and other metabolic disorders, to plan healthful diets.



See the animations “Hormonal Control of Glucose” and “Diabetes” and the figure on metabolic syndrome in the Student Resources on thePoint.

Box 16-5



Health Professions

Dietitians and Nutritionists

Dietitians and nutritionists specialize in planning and supervising food programs for institutions, such as hospitals, schools, and nursing care facilities, and for individuals with specific disease states, such as diabetes, renal disease, or heart disease. They assess their clients' nutritional needs and design individualized meal plans. Dietitians and nutritionists also work in community settings, educating the public about disease prevention through healthy eating. Increased public awareness about food and nutrition has also led to new opportunities in the food manufacturing industry. To perform their duties, dietitians and nutritionists need a thorough

scientific and clinical background. Most dietitians and nutritionists in the United States receive their training from colleges or universities, complete internships, and take licensing or registration exams.

Job prospects for dietitians and nutritionists are good. As the American population continues to age, the need for nutritional planning in hospital and nursing care settings is expected to rise. In addition, many people now place an emphasis on healthy eating and may consult nutritionists privately. The Academy of Nutrition and Dietetics at www.eat-right.org has information about these careers.

Terminology

Key Terms

Disorders

acromegaly <i>ak-rō-MEG-a-lē</i>	Overgrowth of bone and soft tissue, especially in the hands, feet, and face, caused by excess growth hormone in an adult. The name comes from <i>acro</i> meaning “extremity” and <i>megalo</i> meaning “enlargement”
Addison disease	A disease resulting from deficiency of adrenocortical hormones. It is marked by darkening of the skin, weakness, and alterations in salt and water balance
adenoma <i>ad-e-NŌ-ma</i>	A neoplasm of a gland
adult hypothyroidism <i>hī-pō-THĪ-royd-izm</i>	A condition caused by hypothyroidism in an adult. There is dry, waxy swelling, most notable in the face; formerly called myxedema (<i>miks-e-DE-ma</i>)
Cushing disease	Overactivity of the adrenal cortex resulting from excess production of ACTH by the pituitary
Cushing syndrome	A condition resulting from an excess of hormones from the adrenal cortex. It is associated with obesity, weakness, hyperglycemia, hypertension, and hirsutism (excess hair growth)
diabetes insipidus <i>di-a-BĒ-tēz in-SIP-i-dus</i>	A disorder caused by insufficient release of ADH from the posterior pituitary. It results in excessive thirst and production of large amounts of very dilute urine. The word <i>insipidus</i> means “tasteless,” referring to the dilution of the urine
diabetes mellitus (DM) <i>MEL-i-tus</i>	A disorder of glucose metabolism caused by deficiency of insulin production or inadequate tissue response to insulin. Type 1 results from autoimmune destruction of pancreatic islet cells; it generally appears in children and requires insulin administration. Type 2 generally occurs in obese adults; it is treated with diet, exercise, and drugs to improve insulin production or activity, and sometimes insulin. The word <i>mellitus</i> comes from the Latin root for honey, referring to the urine’s sugar content
exophthalmos <i>ek-sof-THAL-mos</i>	Protrusion of the eyeballs, as seen in Graves disease
gigantism <i>JĪ-gan-tizm</i>	Overgrowth caused by excess growth hormone from the pituitary during childhood; also called gigantism
glycated hemoglobin (HbA1c) test <i>GLĪ-kā-ted</i>	A test that measures the binding of glucose to hemoglobin during the lifespan of a red blood cell. It reflects the average blood glucose level over two to three months and is useful in evaluating long-term therapy for diabetes mellitus. Also called A1c test
glycosuria <i>glī-kō-SŪ-rē-a</i>	Excess sugar in the urine
goiter <i>GOY-ter</i>	Enlargement of the thyroid gland. May be toxic or nontoxic. Simple (nontoxic) goiter is caused by iodine deficiency
Graves disease	An autoimmune disease resulting in hyperthyroidism. A prominent symptom is exophthalmos (protrusion of the eyeballs). Also called diffuse toxic goiter
hyperglycemia <i>hī-per-glī-SĒ-mē-a</i>	Excess glucose in the blood
hypoglycemia <i>hī-pō-glī-SĒ-mē-a</i>	Abnormally low level of glucose in the blood
infantile hypothyroidism	A condition caused by congenital lack of thyroid secretion and marked by arrested physical and mental development; also called congenital hypothyroidism
insulin shock	A condition resulting from an overdose of insulin, causing hypoglycemia

Terminology**Key Terms** *(Continued)*

ketoacidosis <i>kē-tō-as-i-DŌ-sis</i>	Acidosis (increased acidity of body fluids) caused by excess ketone bodies, as in diabetes mellitus; diabetic acidosis
metabolic syndrome	A state of hyperglycemia caused by cellular resistance to insulin, as seen in type 2 diabetes, in association with other metabolic disorders; also called syndrome X or insulin resistance syndrome
panhypopituitarism <i>pan-hī-pō-pi-TŪ-i-ta-rism</i>	Underactivity of the entire pituitary gland
tetany <i>TET-a-nē</i>	Irritability and spasms of muscles; may be caused by low blood calcium and other factors

Terminology**Supplementary Terms**

16

Normal Structure and Function

sella turcica <i>SEL-a TUR-si-ka</i>	A saddle-shaped depression in the sphenoid bone that contains the pituitary gland (literally means “Turkish saddle”)
--	--

sphenoid bone <i>SFĒ-noyd</i>	A bone at the base of the skull that houses the pituitary gland
---	---

Symptoms and Conditions

adrenogenital syndrome <i>ad-rē-nō-JEN-i-tal</i>	Condition caused by overproduction of androgens from the adrenal cortex, resulting in masculinization; may be congenital or acquired, usually as a result of an adrenal tumor
--	---

Conn syndrome	Hyperaldosteronism caused by an adrenal tumor
----------------------	---

craniopharyngioma <i>krā-nē-ō-far-in-jē-Ō-ma</i>	A benign tumor of the pituitary gland
--	---------------------------------------

Hashimoto disease <i>ha-shē-MŌ-tō</i>	A chronic thyroiditis of autoimmune origin
---	--

impaired glucose tolerance (IGT)	High blood glucose levels after glucose intake that may signal borderline diabetes mellitus
---	---

ketosis <i>kē-TŌ-sis</i>	Accumulation of ketone bodies, such as acetone, in the body. Usually results from deficiency or faulty metabolism of carbohydrates, as in cases of diabetes mellitus and starvation
------------------------------------	---

multiple endocrine neoplasia (MEN)	A hereditary disorder that causes tumors in several endocrine glands; classified according to the combination of glands involved
---	--

pheochromocytoma <i>fē-ō-krō-mō-sī-TŌ-ma</i>	A usually benign tumor of the adrenal medulla or other structures containing chromaffin cells (cells that stain with chromium salts); <i>phe/o</i> means “brown” or “dusky.” The adrenal tumor causes increased production of epinephrine
--	---

pituitary apoplexy <i>AP-ō-plek-sē</i>	Sudden massive hemorrhage and degeneration of the pituitary gland associated with a pituitary tumor. Common symptoms include severe headache, visual problems, and loss of consciousness
--	--

(Continued)

Terminology Supplementary Terms *(Continued)*

seasonal affective disorder (SAD)	A mood disorder with lethargy, depression, excessive need for sleep, and overeating that generally occurs in winter. Thought to be related to melatonin levels as influenced by environmental light (Box 16-6)
Simmonds disease	Hypofunction of the anterior pituitary (panhypopituitarism), usually because of an infarction; pituitary cachexia (<i>ka-KEK-sē-a</i>)
thyroid storm	A sudden onset of thyrotoxicosis symptoms occurring in patients with hyperthyroidism who are untreated or poorly treated. May be brought on by illness or trauma. Also called thyroid crisis
thyrotoxicosis <i>thī-rō-tok-si-KŌ-sis</i>	Condition resulting from overactivity of the thyroid gland. Symptoms include anxiety, irritability, weight loss, and sweating. The main example of thyrotoxicosis is Graves disease
von Recklinghausen disease <i>REK-ling-how-zen</i>	Bone degeneration caused by excess production of parathyroid hormone. Also called Recklinghausen disease of bone
Diagnosis and Treatment	
fasting plasma glucose (FPG)	Measurement of blood glucose after a fast of at least eight hours. A reading equal to or greater than 126 mg/dL indicates diabetes. Also called fasting blood glucose (FBG) or fasting blood sugar (FBS)
free thyroxine index (FTI, T₇)	Calculation based on the amount of T ₄ present and T ₃ uptake, used to diagnose thyroid dysfunction
oral glucose tolerance test (OGTT)	Measurement of glucose levels in blood plasma after administration of a challenge dose of glucose to a fasting patient. Used to measure patient's ability to metabolize glucose. A value equal to or greater than 200 mg/dL in the two-hour sample indicates diabetes
radioactive iodine uptake test (RAIU)	A test that measures thyroid uptake of radioactive iodine as an evaluation of thyroid function
radioimmunoassay (RIA)	A method of measuring very small amounts of a substance, especially hormones, in blood plasma using radioactively labeled hormones and specific antibodies
thyroid scan	Visualization of the thyroid gland after administration of radioactive iodine
thyroxine-binding globulin (TBG) test	Test that measures the main protein that binds T ₄ in the blood
transsphenoidal adenomectomy <i>trans-sfē-NOY-dal ad-e-nō-MEK-tō-mē</i>	Removal of a pituitary tumor through the sphenoid sinus (space in the sphenoid bone)



Go to the Audio Pronunciation Glossary in the Student Resources on *thePoint* to hear these terms pronounced.

Box 16-6



Clinical Perspectives

Seasonal Affective Disorder: Some Light on the Subject

We all sense that long dark days make us blue and sap our motivation. Are these learned responses, or is there a physical basis for them? Studies have shown that the amount of light in the environment does have a physical effect on behavior. Evidence that light alters mood comes from people who are intensely affected by the dark days of winter—people who suffer from *seasonal affective disorder*, aptly abbreviated SAD. When days shorten, these people feel sleepy, depressed, and anxious. They tend to overeat, especially carbohydrates.

As light strikes the retina of the eye, it starts nerve impulses that decrease the amount of melatonin produced by the pineal gland in the brain. Because melatonin depresses mood, the final effect of light is to elevate mood. Daily exposure to bright lights has been found to improve the mood of most people with SAD. Exposure for 15 minutes after rising in the morning may be enough, but some people require longer sessions both morning and evening. Other aids include aerobic exercise, stress management techniques, and antidepressant medications.

Terminology

Abbreviations

A1c Glycated hemoglobin (test)

ACTH Adrenocorticotrophic hormone

ADH Antidiuretic hormone

BS Blood sugar

CSII Continuous subcutaneous insulin infusion

DM Diabetes mellitus

FBG Fasting blood glucose

FBS Fasting blood sugar

FPG Fasting plasma glucose

FSH Follicle-stimulating hormone

FTI Free thyroxine index

GDM Gestational diabetes mellitus

GH Growth hormone

HbA1c Hemoglobin A1c; glycated hemoglobin

¹³¹I Iodine-131 (radioactive iodine)

IFG Impaired fasting blood glucose

IGT Impaired glucose tolerance

LH Luteinizing hormone

MEN Multiple endocrine neoplasia

NPH Neutral protamine Hagedorn (insulin)

OGTT Oral glucose tolerance test

PRL Prolactin

PTH Parathyroid hormone

RAIU Radioactive iodine uptake

RIA Radioimmunoassay

SIADH Syndrome of inappropriate antidiuretic hormone (secretion)

T1DM Type 1 diabetes mellitus

T2DM Type 2 diabetes mellitus

T₃ Triiodothyronine

T₄ Thyroxine; tetraiodothyronine

T₇ Free thyroxine index

TBG Thyroxine-binding globulin

TSH Thyroid-stimulating hormone

J.D.'s Follow-Up

J.D. began her antithyroid medication therapy and began to feel better. She was able to concentrate more at work and found she was not as irritable with the children in school. She was sleeping better and began to add a few of the pounds she

had previously lost. Her husband also noted the difference and mentioned this to Dr. Gilbert at the follow-up appointment four weeks later.

Chapter Review

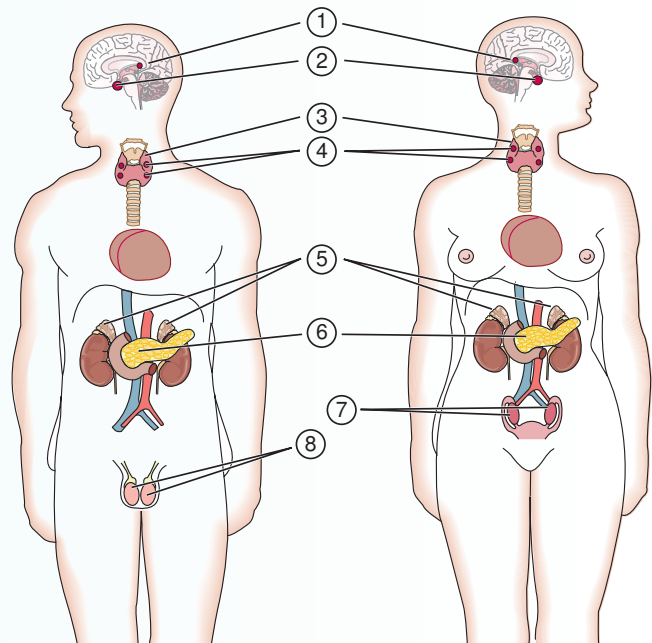
Labeling Exercise

GLANDS OF THE ENDOCRINE SYSTEM

Write the name of each numbered part on the corresponding line of the answer sheet.

Adrenals	Pineal
Ovaries	Pituitary (hypophysis)
Pancreatic islets	Testes
Parathyroids	Thyroid

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____



TERMINOLOGY

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|------------------------------|---|
| _____ 1. anterior pituitary | a. gland that is regulated by light |
| _____ 2. posterior pituitary | b. pancreatic endocrine cells |
| _____ 3. hypothalamus | c. part of the brain that controls the pituitary |
| _____ 4. islets | d. gland that secretes ACTH |
| _____ 5. pineal | e. gland that releases oxytocin |
| _____ 6. epinephrine | a. pancreatic hormone that regulates glucose metabolism |
| _____ 7. growth hormone | b. hormone produced by the adrenal medulla |
| _____ 8. cortisol | c. hormone from the pineal gland |
| _____ 9. glucagon | d. somatotropin |
| _____ 10. melatonin | e. hormone produced by the adrenal cortex |
| _____ 11. ADH | a. substance used to monitor blood glucose levels |
| _____ 12. T_4 | b. pituitary hormone that regulates water balance |
| _____ 13. ACTH | c. a form of diabetes |
| _____ 14. T2DM | d. thyroxine |
| _____ 15. HbA1c | e. hormone that stimulates the adrenal cortex |

- | | |
|----------------------------|---|
| _____ 16. ketoacidosis | a. disorder that results from excess growth hormone |
| _____ 17. adenoma | b. disorder caused by underactivity of the adrenal cortex |
| _____ 18. Cushing syndrome | c. a result of uncontrolled diabetes |
| _____ 19. acromegaly | d. disorder caused by overactivity of the adrenal cortex |
| _____ 20. Addison disease | e. neoplasm of a gland |

Supplementary Terms

- | | |
|-----------------------------|---|
| _____ 21. sella turcica | a. panhypopituitarism |
| _____ 22. Hashimoto disease | b. tumor of the pituitary gland |
| _____ 23. pheochromocytoma | c. chronic thyroiditis |
| _____ 24. Simmonds disease | d. bony depression that holds the pituitary |
| _____ 25. craniopharyngioma | e. tumor of the adrenal medulla |

FILL IN THE BLANKS

26. The gland under the brain that controls other glands is the _____.
27. The gland in the neck that affects metabolic rate is the _____.
28. The endocrine glands located above the kidneys are the _____.
29. The most common endocrine disorder is _____.
30. Excess glucose in the blood is called _____.

DEFINITIONS

Define the following words:

31. adrenomegaly (*a-drē-nō-MEG-a-lē*) _____.
32. hypopituitarism (*hī-pō-pi-TŪ-i-ta-rizm*) _____.
33. hypophysiotropic (*hī-pō-fiz-ē-ō-TROP-ik*) _____.
34. adrenopathy (*a-drē-NOP-a-thē*) _____.
35. thyrotomy (*thī-ROT-ō-mē*) _____.
36. endocrinologist (*en-dō-kri-NOL-ō-jist*) _____.

Write words for the following definitions:

37. tumor of the pancreatic islets _____
38. inflammation of the hypophysis _____
39. pertaining to the adrenal cortex _____

Use the full name of the gland as the root to write words for the following definitions:

40. surgical removal of parathyroid gland _____
41. removal of one half (hemi-) of the thyroid gland _____
42. inflammation of the thyroid gland _____
43. overactivity of the adrenal gland _____

Use the root *thyr/o* to write words for the following definitions:

44. acting on the thyroid gland _____
45. destructive of (-lytic) thyroid tissue _____
46. any disease of the thyroid gland _____

TRUE-FALSE

Examine the following statements. If the statement is true, write T in the first blank. If the statement is false, write F in the first blank and correct the statement by replacing the underlined word in the second blank.

	True or False	Correct Answer
47. Diabetes insipidus is caused by a lack of <u>thymosin</u> .	_____	_____
48. The hypophysis is the <u>pituitary</u> gland.	_____	_____
49. The inner region of an organ is the <u>cortex</u> .	_____	_____
50. The parathyroids regulate the element <u>sodium</u> .	_____	_____
51. Goiter is an enlargement of the <u>pineal</u> gland.	_____	_____
52. <u>Type 1</u> diabetes mellitus always requires insulin.	_____	_____
53. Thyroid hormones contain the element <u>iodine</u> .	_____	_____
54. The adrenal cortex produces <u>steroid</u> hormones.	_____	_____
55. Exophthalmos is protrusion of the <u>eyes</u> .	_____	_____

ELIMINATIONS

In each of the sets below, underline the term that does not fit in with the rest and explain the reason for your choice:

56. GH — TSH — FSH — PTH — ACTH

57. Cushing syndrome — gigantism — dwarfism — acromegaly — thyrotoxicosis

58. TBG — GDM — FPG — IGT — IFG

59. testis — spleen — adrenals — parathyroids — pituitary

WORD BUILDING

Write words for the following definitions using the word parts provided.

-ar adren/o -megal/o -oma thyr/o -ic -al trop -y insul/o path/o -lytic

- | | |
|--|-------|
| 60. pertaining to pancreatic islet cells | _____ |
| 61. acting on the thyroid gland | _____ |
| 62. any disease of the adrenal gland | _____ |
| 63. destructive of thyroid tissue | _____ |
| 64. tumor of islet cells | _____ |
| 65. enlargement of the adrenal gland | _____ |
| 66. pertaining to the gland above the kidney | _____ |
| 67. enlargement of the thyroid gland | _____ |
| 68. acting on the adrenal gland | _____ |
| 69. any disease of the thyroid gland | _____ |

WORD ANALYSIS

Define each of the following words and give the meaning of the word parts in each. Use a dictionary if necessary.

70. craniopharyngioma _____
a. crani/o _____
b. pharyng/i _____
c. -oma _____
71. panhypopituitarism _____
a. pan- _____
b. hypo- _____
c. pituitar _____
d. -ism _____
72. pheochromocytoma _____
a. phe/o _____
b. chrom/o _____
c. cyt/o _____
d. -oma _____
73. thyrotoxicosis _____
a. thyr/o _____
b. toxic/o _____
c. -sis _____



For more learning activities, see Chapter 16 of the Student Resources on *thePoint*.

Additional Case Studies

Case Study 16-1: Hyperparathyroidism

B.E., a 58-YO woman with a history of hypertension, had a partial nephrectomy four years ago for renal calculi. During a routine physical examination, her total serum calcium level was 10.8 mg/dL. Her parathyroid hormone level was WNL; she was in no apparent distress, and the remainder of her physical examination and laboratory data were noncontributory.

B.E. underwent exploratory surgery for an enlarged right superior parathyroid gland. The remaining three glands

appeared normal. The enlarged gland was excised, and a biopsy was performed on the remaining glands. The pathology report showed an adenoma of the abnormal gland. On her first post-operative day, she reported perioral numbness and tingling. She had no other symptoms, but her serum calcium level was subnormal. She was given one ampule of calcium gluconate. Within two days, her calcium level had improved, and she was discharged.

Case Study 16-2: Diabetes Treatment with an Insulin Pump

M.G., a 32-YO marketing executive, was diagnosed with type 1 diabetes at the age of 3 years. She vividly remembers her mother taking her to the doctor because she had an illness that caused her to feel extremely tired and very thirsty and hungry. She also had begun to wet her bed and had a cut on her knee that would not heal. Her mother had had gestational diabetes during her pregnancy with M.G., and at birth, M.G. was described as having “macrosomia” because she weighed 10 lbs.

M.G. has managed her disease with meticulous attention to her diet, exercise, preventive health care, regular blood glucose monitoring, and twice-daily injections of regular and NPH insulin, which she rotates among her upper arms, thighs, and abdomen. She continues in a smoking cessation program

supported by weekly acupuncture treatments. She maintains good control of her disease in spite of the inconvenience and time it consumes each day. She will be married next summer and would like to start a family. M.G.’s doctor suggested she try an insulin pump to give her more freedom and enhance her quality of life. After intensive training, she has received her pump. It is about the size of a beeper with a thin catheter that she introduces through a needle into her abdominal subcutaneous tissue. She can administer her insulin in a continuous subcutaneous insulin infusion (CSII) and in calculated meal bolus doses. She still has to test her blood for hyperglycemia and hypoglycemia and her urine for ketones when her blood sugar is too high. She hopes one day to have an islet transplantation.

CASE STUDY QUESTIONS

Multiple choice. Select the best answer and write the letter of your choice to the left of each number:

- | | |
|--|--|
| <p>_____ 1. Renal calculi are:</p> <ul style="list-style-type: none"> a. kidney stones b. gallstones c. stomach ulcers d. bile obstructions e. muscle spasms | <p>_____ 4. Gestational diabetes occurs:</p> <ul style="list-style-type: none"> a. in a pregnant woman b. to any large fetus c. during menopause d. at the time of puberty e. in a large baby with high blood sugar |
| <p>_____ 2. B.E.’s serum calcium was 10.8 mg/dL, which is:</p> <ul style="list-style-type: none"> a. 5.4 mcg of calcium in her serous fluid b. 10.8 g of electrolytes in parathyroid hormone c. 10.8 mg of calcium in 100 mL of blood d. 21.6 L of calcium in 100 g of serum e. 10.8 mcg of calcium in 100 mL of serous parathyroid fluid | <p>_____ 5. The term <i>macrosomia</i> describes:</p> <ul style="list-style-type: none"> a. excessive weight gain during pregnancy b. a large body c. an excessive amount of sleep d. inability to sleep during pregnancy e. too much sugar in the amniotic fluid |
| <p>_____ 3. B.E. had perioral numbness and tingling. Perioral is:</p> <ul style="list-style-type: none"> a. peripheral to any orifice b. lateral to the eye c. within the buccal mucosa d. around the mouth e. circumferential to the perineum | <p>_____ 6. M.G. injected the insulin into the subcutaneous tissue, which is:</p> <ul style="list-style-type: none"> a. present only in the abdomen, thighs, and upper arms b. a topical application c. below the skin d. in a large artery e. above the pubic bone |

- _____ 7. An islet transplantation refers to:
- a. transfer of parathyroid cells to the liver
 - b. excision of bovine pancreatic cells
 - c. surgical insertion of an insulin pump into the abdomen
 - d. a total pancreas and kidney transplantation
 - e. transfer of insulin-secreting cells into a pancreas

Write the terms from the case studies with the following meanings:

8. surgical excision of a kidney _____
9. tumor of a gland _____
10. single-use glass injectable medication container _____
11. high serum glucose _____
12. a large dose of a therapeutic agent _____

Abbreviations. Define the following abbreviations:

13. WNL _____
14. NPH _____
15. CSII _____

CHAPTER 17

The Nervous System and Behavioral Disorders

Case Study

B.C.'s Pediatric Brain Tumor

Chief complaint:

B.C., a previously healthy and active 6-year-old, woke up one morning complaining that his head hurt. He had a few episodes of vomiting early in the morning, and he was not able to walk straight when he got out of bed. His parents took him to the pediatrician, who, after noting the headache, morning emesis, and progressive ataxia, conducted a brief examination and then made an immediate referral to a neurologist.

Examination:

Before talking with the patient, the neurologist spoke with B.C.'s parents to obtain a prior medical history. They stated that he has had a healthy childhood thus far with normal illnesses such as earaches, a few colds, and sore throats. The parents indicated that B.C. is a first grader and attends a public elementary school. They said he loves school and baseball. The latter is his favorite extracurricular activity.

The neurologist spoke with B.C. and explained what he was going to do. Next he performed a thorough neurological examination. Then he offered to B.C. a simple explanation of the tests he was going to order. Finally he answered all of the patient's and parents' questions.

Clinical course:

B.C.'s parents took him to the radiology department of the hospital for a scheduled MRI. The radiologist reported the scan revealed some dense tissue indicating a suspicious mass. A lumbar puncture (LP) was performed, which revealed some suspicious cells in the cerebrospinal fluid (CSF).

B.C. had a craniotomy with tumor resection five days later. The cerebellar tumor was found to be noninfiltrating and was enclosed within a cyst, which was totally removed. B.C. spent two days in the neurologic intensive care unit (NICU) because he was on seizure precautions and monitoring for increased intracranial pressure (ICP). A regimen of focal radiation followed after recovery from surgery. His spine was also treated because of the potential spread of tumor cells in the CSF. B.C. did not have chemotherapy because of the danger that hydrocephalus might develop, which generally requires a ventriculoperitoneal (VP) shunt.





Ancillaries *At-A-Glance*

Visit *thePoint* to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii–xvi.

Learning **TOOLS**

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning **RESOURCES**

- E-book: Chapter 17
- Web Chart: Neuroglia
- Animation: The Myelin Sheath
- Animation: The Synapse and the Nerve Impulse
- Animation: The Reflex Arc
- Animation: Stroke
- Audio Pronunciation Glossary

Learning **ACTIVITIES**

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After study of this chapter, you should be able to:

- 1 Describe the components of the nervous system. *p438*
- 2 Describe the structure of a neuron. *p439*
- 3 Briefly describe the regions of the brain and their functions. *p439*
- 4 Describe how the central nervous system is protected. *p440*
- 5 Describe the structure of the spinal cord. *p443*
- 6 Name the components of a simple reflex. *p443*
- 7 Compare the sympathetic and parasympathetic systems. *p444*
- 8 Identify and use word parts pertaining to the nervous system. *p448*
- 9 Describe eight major disorders of the nervous system. *p452*
- 10 Describe five major behavioral disorders. *p456*
- 11 Define abbreviations used in neurology. *p467*
- 12 Analyze medical terms in several case studies involving the nervous system. *pp436, 476*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|--|---|
| <p>_____ 1. The basic cell of the nervous system is a(n):</p> <ul style="list-style-type: none"> a. myofiber b. neuron c. osteoblast d. chondrocyte | <p>_____ 5. A simple response that requires few cells is a:</p> <ul style="list-style-type: none"> a. reflex b. mutation c. sensation d. stimulus |
| <p>_____ 2. The largest part of the brain is the:</p> <ul style="list-style-type: none"> a. cortex b. adrenal c. cerebrum d. pituitary | <p>_____ 6. A disorder, often of unknown cause, characterized by seizures is called:</p> <ul style="list-style-type: none"> a. cystic fibrosis b. spina bifida c. epilepsy d. thyrotoxicosis |
| <p>_____ 3. The midbrain, pons, and medulla oblongata make up the:</p> <ul style="list-style-type: none"> a. brainstem b. spinal cord c. cerebellum d. thymus | <p>_____ 7. An instrument used to study the electric activity of the brain is the:</p> <ul style="list-style-type: none"> a. electrocardiograph b. electroencephalograph c. CT scanner d. sonograph |
| <p>_____ 4. Involuntary responses are controlled by the:</p> <ul style="list-style-type: none"> a. voluntary nervous system b. somatic nervous system c. autonomic nervous system d. diaphragm | <p>_____ 8. An extreme, persistent fear is a(n):</p> <ul style="list-style-type: none"> a. palliative b. prognosis c. phobia d. analgesic |

The nervous system and the endocrine system coordinate and control the body. Together they regulate our responses to the environment and maintain homeostasis. Whereas the endocrine system functions by means of circulating hormones, the nervous system functions by means of electric impulses and locally released chemicals called **neurotransmitters**.

Organization of the Nervous System

For study purposes, the nervous system may be divided structurally into two parts:

- The **central nervous system (CNS)**, consisting of the brain and spinal cord (**Fig. 17-1**)
- The **peripheral nervous system (PNS)**, consisting of all nervous tissue outside the brain and spinal cord

Functionally, the nervous system can be divided into the:

- **Somatic nervous system**, which controls skeletal muscles
- **Visceral or autonomic nervous system (ANS)**, which controls smooth muscle, cardiac muscle, and glands. The ANS regulates responses to stress and helps to maintain homeostasis.

Two types of cells are found in the nervous system. **Neurons**, or nerve cells, make up the conducting tissue of the nervous system. **Neuroglia** are the cells that support and protect nervous tissue.



See the chart on neuroglia in the Student Resources on *thePoint*.

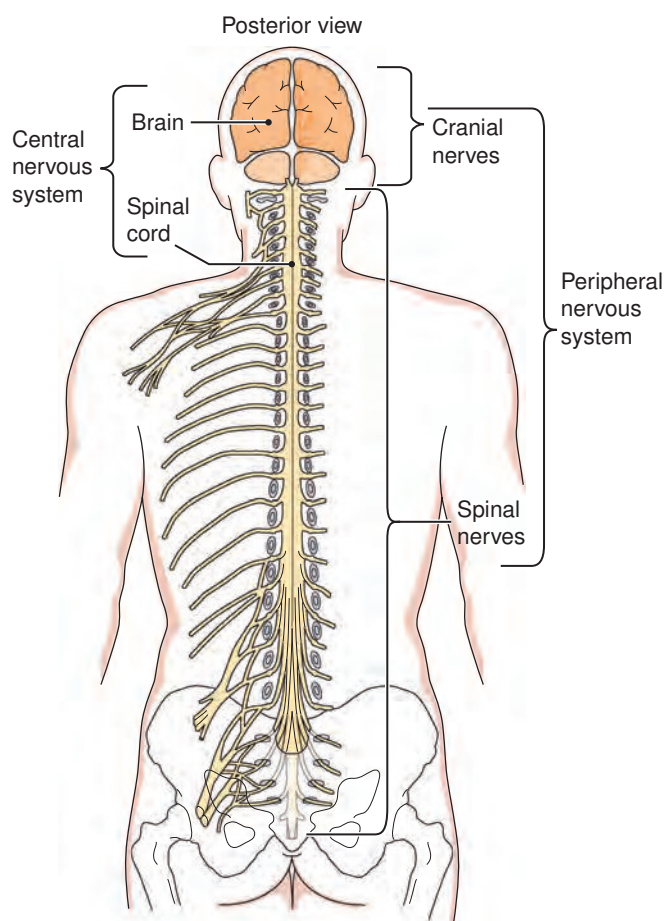


Figure 17-1 Anatomic divisions of the nervous system.

The Neuron

The neuron is the nervous system's basic functional unit (Fig. 17-2). Each neuron has two types of fibers extending from the cell body:

- The **dendrite** carries impulses toward the cell body.
- The **axon** carries impulses away from the cell body.

Some axons are covered with **myelin**, a whitish, fatty material that insulates and protects the axon and speeds electric conduction. Axons so covered are described as *myelinated*, and they make up the **white matter** of the nervous system. Unmyelinated tissue makes up the nervous system's **gray matter**.

Each neuron is part of a pathway that carries information through the nervous system. A neuron that transmits impulses toward the CNS is a **sensory**, or **afferent**, neuron; a neuron that transmits impulses away from the CNS is a **motor**, or **efferent**, neuron. There are also connecting cells within the CNS called **interneurons**.

A **synapse** is the point of contact between two neurons. At the synapse, energy is passed from one cell to another, usually by means of a neurotransmitter and sometimes by direct transfer of electric current.

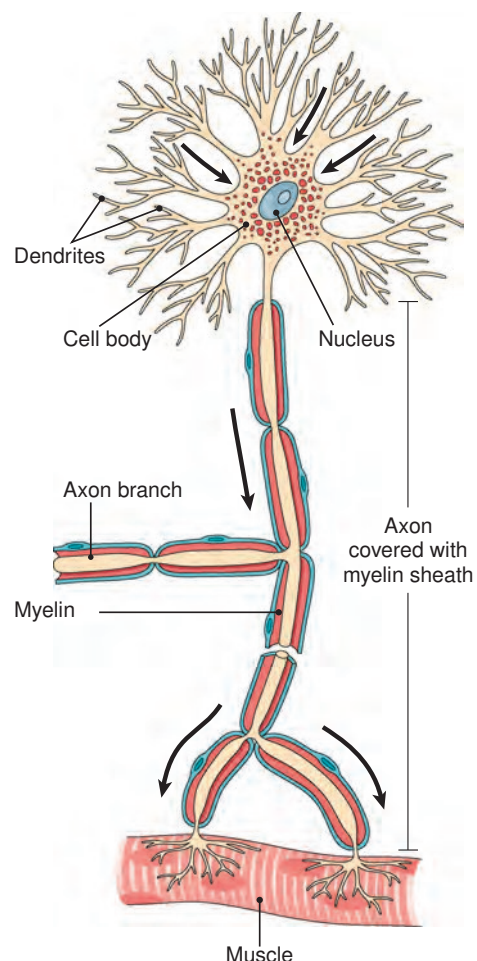


Figure 17-2 A motor neuron. The break in the axon denotes length. The arrows show the direction of the nerve impulse.



See the animations "The Myelin Sheath" and "The Synapse and the Nerve Impulse" in the Student Resources on thePoint.

NERVES

Individual neuron fibers are held together in bundles like wires in a cable. If this bundle is part of the PNS, it is called a **nerve**. A collection of cell bodies along the pathway of a nerve is a **ganglion**. A few nerves (sensory nerves) contain only sensory neurons, and a few (motor nerves) contain only motor neurons, but most contain both types of fibers and are described as *mixed nerves*.

The Brain

The brain is nervous tissue contained within the cranium. It consists of the **cerebrum**, **diencephalon**, **brainstem**, and **cerebellum**. The cerebrum is the largest part of the brain (Fig. 17-3); it is composed largely of white matter with

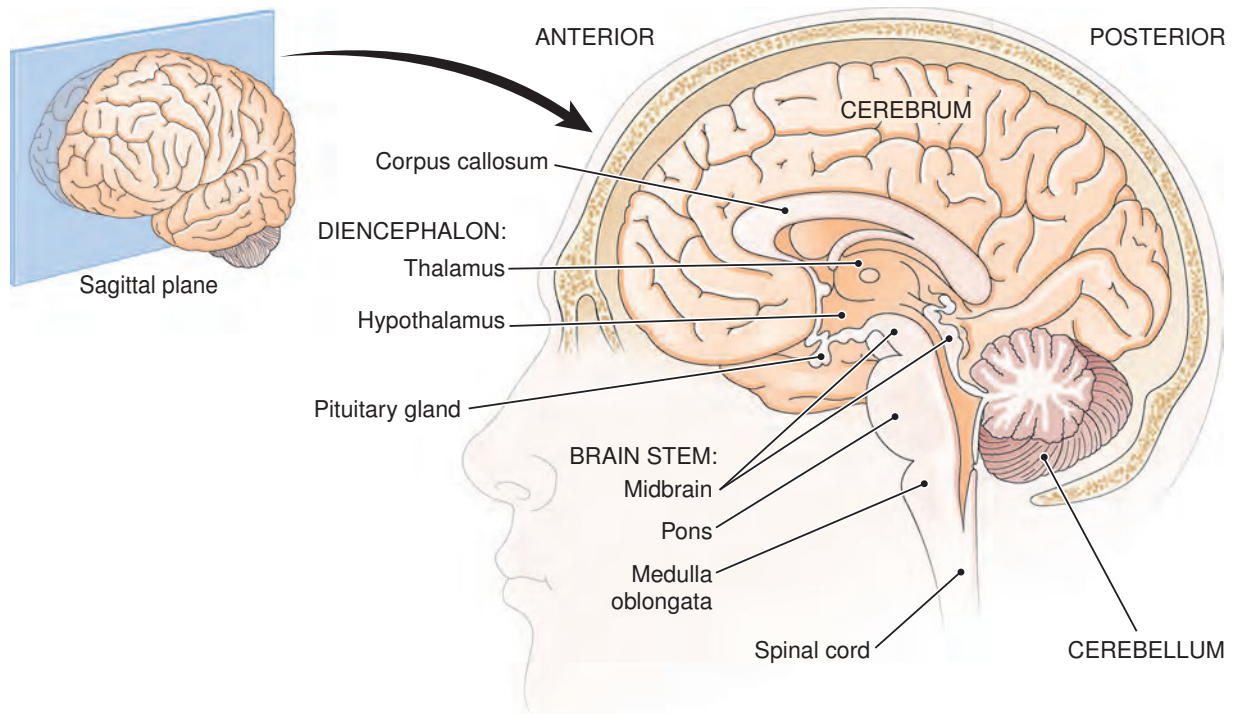


Figure 17-3 Brain, sagittal section. The main divisions are shown.

a thin outer layer of gray matter, the **cerebral cortex**. It is within the cortex that the higher brain functions of memory, reasoning, and abstract thought occur. The cerebrum's distinct surface is formed by grooves, or **sulci** (singular: sulcus), and raised areas, or **gyri** (singular: gyrus), that provide additional surface area (Fig. 17-4). The cerebrum is divided into two hemispheres by a deep groove, the longitudinal fissure. Each hemisphere is further divided into lobes with specialized functions (see Fig. 17-4). The lobes are named for the skull bones under which they lie.

The remaining parts of the brain are as follows:

- The diencephalon contains the **thalamus**, the **hypothalamus**, and the pituitary gland (see Fig. 17-3). The thalamus receives sensory information and directs it to the proper portion of the cortex. The hypothalamus controls the pituitary and forms a link between the endocrine and nervous systems.
- The brainstem (see Fig. 17-3) consists of the:
 - **Midbrain**, which contains reflex centers for improved vision and hearing
 - **Pons**, which forms a bulge on the anterior surface of the brainstem. It contains fibers that connect the brain's different regions.
 - **Medulla oblongata**, which connects the brain with the spinal cord. All impulses passing to and from the brain travel through this region. The medulla also has vital centers for control of heart rate, respiration, and blood pressure.

- The cerebellum is under the cerebrum and dorsal to the pons and medulla (see Fig. 17-3). Like the cerebrum, it is divided into two hemispheres. The cerebellum helps to control voluntary muscle movements and to maintain posture, coordination, and balance.

PROTECTING THE BRAIN

Within the brain are four **ventricles** (cavities) in which **cerebrospinal fluid (CSF)** is formed. This fluid circulates around the brain and spinal cord, acting as a protective cushion for these tissues.

Covering the brain and the spinal cord are three protective layers, together called the **meninges** (Fig. 17-5). All are named with the Latin word *mater*, meaning “mother,” to indicate their protective function. They are the:

- **Dura mater**, the outermost and toughest of the three. *Dura* means “hard.”
- **Arachnoid mater**, the thin, web-like middle layer. It is named for the Latin word for spider, because it resembles a spider web.
- **Pia mater**, the thin, vascular inner layer, attached directly to the tissue of the brain and spinal cord. *Pia* means “tender.”

Twelve pairs of **cranial nerves** connect with the brain (Fig. 17-6). These nerves are identified by Roman numerals and also by name. **Box 17-1** is a summary chart of the cranial nerves.

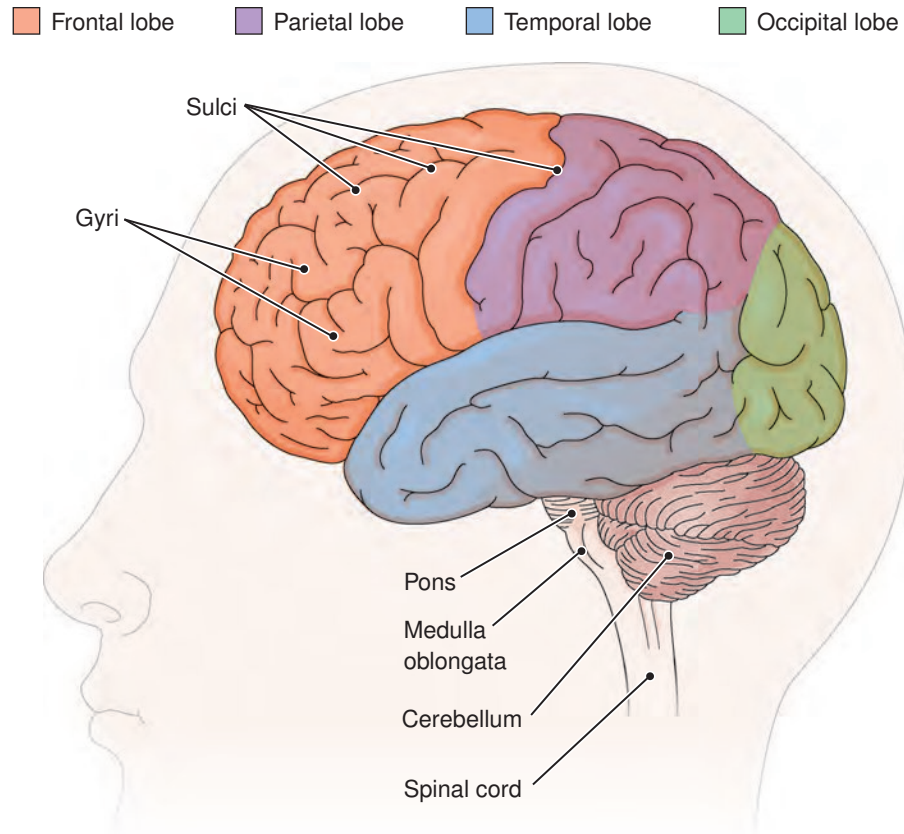


Figure 17-4 External surface of the brain, lateral view. The lobes and surface features of the cerebrum are shown as well as other divisions of the brain and the spinal cord.

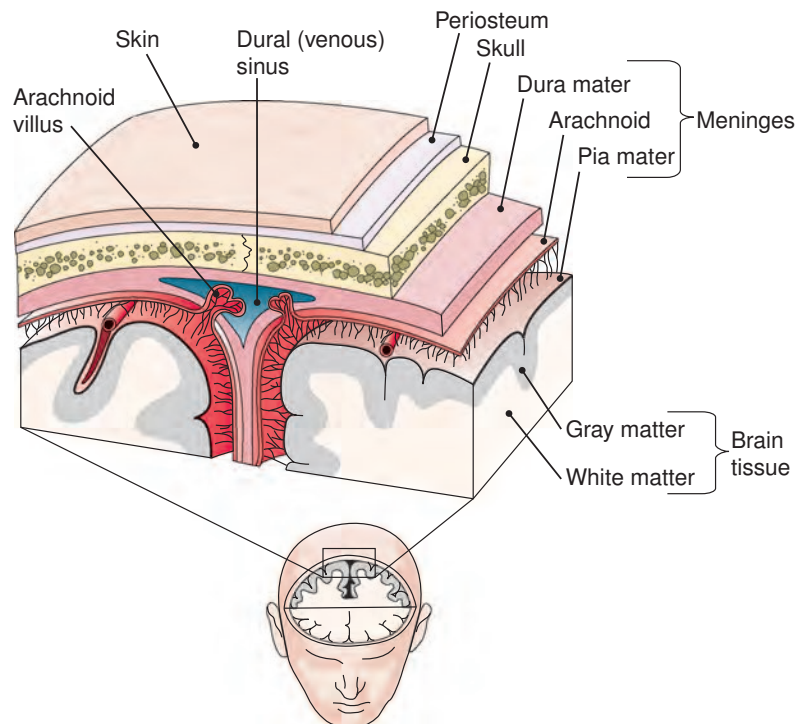


Figure 17-5 The meninges. The three protective layers and adjacent tissue are shown in a frontal section of the head.

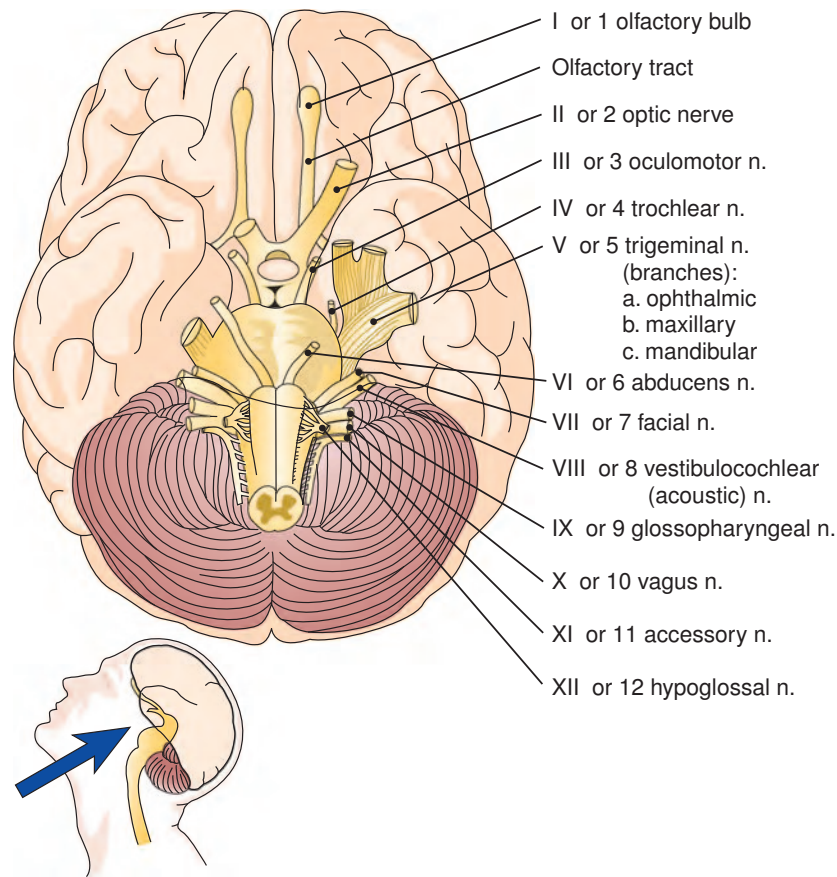


Figure 17-6 Cranial nerves. The 12 nerves are shown on one side in an inferior view.

Box 17-1

For Your Reference

The Cranial Nerves

NUMBER	NAME	FUNCTION
I	olfactory <i>ol-FAK-tō-rē</i>	carries impulses for the sense of smell
II	optic <i>OP-tik</i>	carries impulses for the sense of vision
III	oculomotor <i>ok-ū-lō-MŌ-tor</i>	controls movement of eye muscles
IV	trochlear <i>TROK-lē-ar</i>	controls a muscle of the eyeball
V	trigeminal <i>trī-JEM-i-nal</i>	carries sensory impulses from the face; controls chewing muscles
VI	abducens <i>ab-DŪ-sens</i>	controls a muscle of the eyeball
VII	facial <i>FĀ-shal</i>	controls muscles of facial expression, salivary glands, and tear glands; conducts some impulses for taste

The Cranial Nerves (Continued)

NUMBER	NAME	FUNCTION
VIII	vestibulocochlear <i>ves-tib-ŭ-lō-KOK-lē-ar</i>	conducts impulses for hearing and equilibrium; also called auditory or acoustic nerve
IX	glossopharyngeal <i>glos-ō-fa-RIN-jē-al</i>	conducts sensory impulses from tongue and pharynx; stimulates parotid salivary gland and partly controls swallowing
X	vagus <i>VĀ-gus</i>	supplies most organs of thorax and abdomen; controls digestive secretions
XI	spinal accessory <i>ak-SES-ō-rē</i>	controls muscles of the neck
XII	hypoglossal <i>hī-pō-GLOS-al</i>	controls muscles of the tongue

The Spinal Cord

The spinal cord begins at the medulla oblongata and tapers to an end between the first and second lumbar vertebrae (Fig. 17-7). It has enlargements in the cervical and lumbar regions, where nerves for the arms and legs join the cord. Seen in cross section (Fig. 17-8), the spinal cord has a central area of gray matter surrounded by white matter. The gray matter projects toward the posterior and the anterior as the dorsal and ventral horns. The white matter contains the ascending and descending **tracts** (fiber bundles) that carry impulses to and from the brain. A central canal contains CSF.

THE SPINAL NERVES

Thirty-one pairs of **spinal nerves** connect with the spinal cord (see Fig. 17-7). These nerves are grouped in the segments of the cord as follows:

- Cervical: 8
- Thoracic: 12
- Lumbar: 5
- Sacral: 5
- Coccygeal: 1

Each nerve joins the cord by two **roots** (see Fig. 17-8). The dorsal, or posterior, root carries sensory impulses into the cord; the ventral, or anterior, root carries motor impulses away from the cord and out toward a muscle or gland. An enlargement on the dorsal root, the dorsal root ganglion, has the cell bodies of sensory neurons carrying impulses toward the CNS (see Fig. 17-8).

REFLEXES

A simple response that requires few neurons is a **reflex** (Fig. 17-9). In a spinal reflex, impulses travel through the spinal cord only and do not reach the brain. An example of

this type of response is the knee-jerk reflex used in physical examinations. Most neurologic responses, however, involve complex interactions among multiple neurons in the CNS.

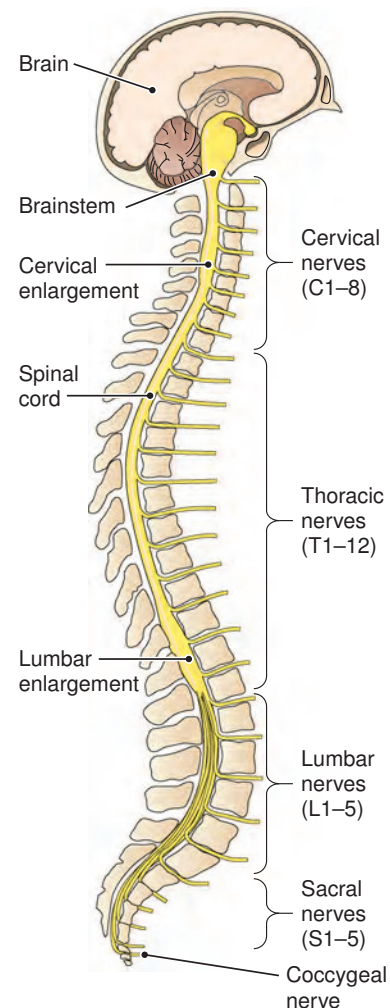


Figure 17-7 Spinal cord, lateral view. The divisions of the spinal nerves are shown.

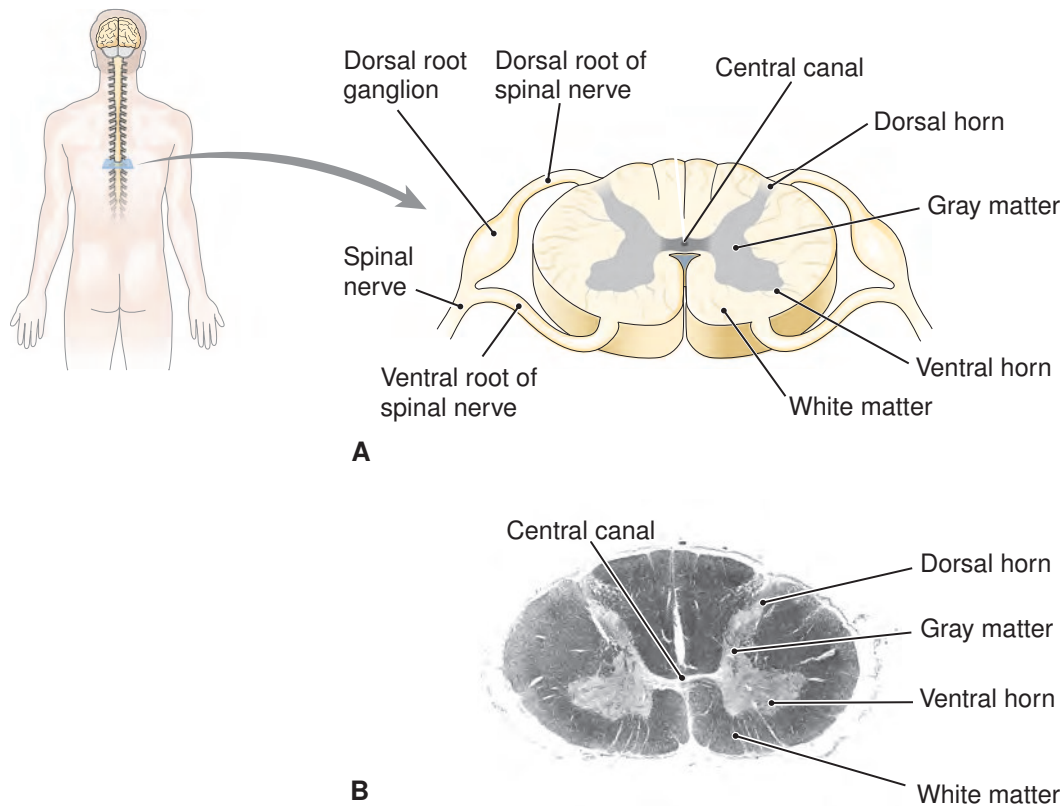


Figure 17-8 Spinal cord, cross section. A. Diagram shows the organization of gray and white matter and the roots of the spinal nerves. B. Microscopic view of the spinal cord in cross section (magnification 5 \times).

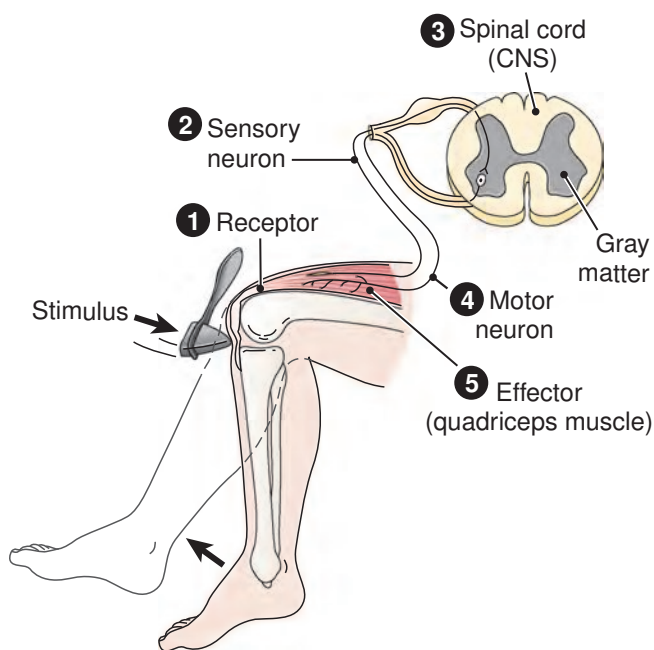


Figure 17-9 A reflex pathway (arc). The patellar (knee-jerk) reflex is shown, with numbers indicating the sequence of impulses.



See the animation "The Reflex Arc" in the Student Resources on *thePoint*.

The Autonomic Nervous System

The ANS is the division of the nervous system that controls the involuntary actions of muscles and glands (Fig. 17-10). The ANS itself has two divisions:

- The **sympathetic nervous system** motivates our response to stress, the so-called fight-or-flight response. It increases heart rate and respiration rate, stimulates the adrenal gland, and delivers more blood to skeletal muscles.
- The **parasympathetic nervous system** returns the body to a steady state and stimulates maintenance activities, such as digestion of food. Most organs are controlled by both systems, and in general, the two systems have opposite effects on a given organ.

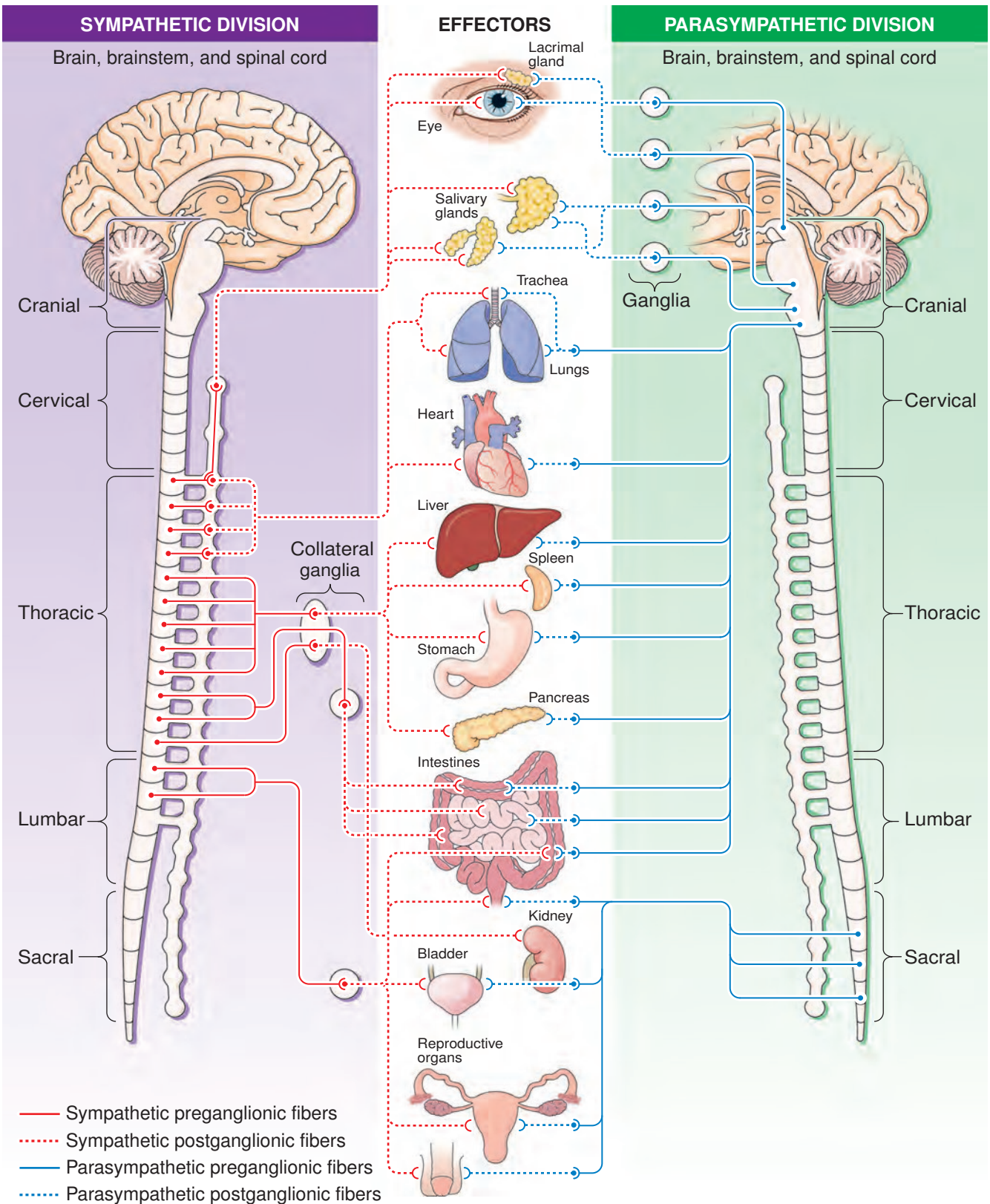


Figure 17-10 Autonomic nervous system. Each ANS pathway has two neurons, as shown by the solid and dashed lines. The diagram shows only one side of the body for each division (sympathetic and parasympathetic).

Terminology Key Terms

Normal Structure and Function

afferent <i>AF-er-ent</i>	Carrying toward a given point, such as the sensory neurons and nerves that carry impulses toward the CNS (root <i>fer</i> means “to carry”)
arachnoid mater <i>a-RAK-noyd</i>	The middle layer of the meninges (from the Greek word for spider, because this tissue resembles a spider web)
autonomic nervous system (ANS) <i>aw-tō-NOM-ik</i>	The division of the nervous system that regulates involuntary activities, controlling smooth muscles, cardiac muscle, and glands; the visceral nervous system
axon <i>AK-son</i>	The fiber of a neuron that conducts impulses away from the cell body
brain	The nervous tissue contained within the cranium; consists of the cerebrum, diencephalon, brainstem, and cerebellum (root: encephal/o)
brainstem	The part of the brain that consists of the midbrain, pons, and medulla oblongata
central nervous system (CNS)	The brain and spinal cord
cerebellum <i>ser-e-BEL-um</i>	The posterior portion of the brain dorsal to the pons and medulla; helps to coordinate movement and to maintain balance and posture (<i>cerebellum</i> means “little brain”) (root: cerebell/o)
cerebral cortex <i>SER-e-bral</i>	The cerebrum’s thin surface layer of gray matter (the cortex is the outer region of an organ) (root: cortic/o)
cerebrum <i>SER-e-brum</i>	The large upper portion of the brain; it is divided into two hemispheres by the longitudinal fissure (root: cerebr/o)
cerebrospinal fluid (CSF) <i>ser-e-brō-SPI-nal</i>	The watery fluid that circulates in and around the brain and spinal cord for protection
cranial nerves	The 12 pairs of nerves that are connected to the brain
dendrite <i>DEN-drit</i>	A fiber of a neuron that conducts impulses toward the cell body
diencephalon <i>dī-en-SEF-a-lon</i>	The part of the brain that contains the thalamus, hypothalamus, and pituitary gland; located between the cerebrum and the brainstem
dura mater <i>DŪ-ra MĀ-ter</i>	The strong, fibrous outermost layer of the meninges
efferent <i>EF-er-ent</i>	Carrying away from a given point, such as the motor neurons and nerves that carry impulses away from the CNS (root <i>fer</i> means “to carry”)
ganglion <i>GANG-glē-on</i>	A collection of neuron cell bodies outside the CNS (plural: ganglia) (roots: gangli/o, ganglion/o)
gray matter	Unmyelinated tissue of the nervous system
gyrus <i>JĪ-rus</i>	A raised convolution of the surface of the cerebrum (see Fig. 17-4) (plural: gyri)
hypothalamus <i>hī-pō-THAL-a-mus</i>	The part of the brain that controls the pituitary gland and maintains homeostasis
interneuron <i>in-ter-NŪR-on</i>	Any neuron located between a sensory and a motor neuron in a neural pathway, such as the neurons that transmit impulses within the CNS

Terminology**Key Terms** (Continued)

medulla oblongata <i>me-DUL-la ob-long-GA-ta</i>	The portion of the brain that connects with the spinal cord. It has vital centers for control of respiration, heart rate, and blood pressure (root: medull/o). Often called simply medulla
meninges <i>men-IN-jēz</i>	The three membranes that cover the brain and spinal cord (see Fig. 17-5) (singular: meninx) (roots: mening/o, meninge/o)
midbrain	The part of the brainstem between the diencephalon and the pons; contains centers for coordination of reflexes for vision and hearing
motor	Producing movement; describes efferent neurons and nerves that carry impulses away from the CNS
myelin <i>MĪ-e-lin</i>	A whitish, fatty substance that surrounds certain axons of the nervous system
neuroglia <i>nū-ROG-lē-a</i>	The support cells of the nervous system; also called glial cells (from <i>glia</i> meaning “glue”) (root: gli/o)
neuron <i>NŪ-ron</i>	The basic unit of the nervous system; a nerve cell
neurotransmitter <i>nū-rō-TRANS-mit-er</i>	A chemical that transmits energy across a synapse. Examples are norepinephrine (<i>nor-ep-i-NEF-rin</i>), acetylcholine (<i>a-sē-til-KŌ-lēn</i>), serotonin (<i>ser-ō-TŌ-nin</i>), and dopamine (<i>DŌ-pa-mēn</i>)
nerve	A bundle of neuron fibers outside the CNS (root: neur/o)
parasympathetic nervous system	The part of the automatic nervous system that reverses the response to stress and restores homeostasis. It slows heart rate and respiration rate and stimulates digestive, urinary, and reproductive activities
peripheral nervous system (PNS) <i>per-IF-er-al</i>	The portion of the nervous system outside the CNS
pia mater <i>PĒ-a MĀ-ter</i>	The innermost layer of the meninges
pons <i>ponz</i>	A rounded area on the ventral surface of the brainstem; contains fibers that connect brain regions; adjective: pontine (<i>PON-tēn</i>)
reflex <i>RĒ-fleks</i>	A simple, rapid, and automatic response to a stimulus
root	A branch of a spinal nerve that connects with the spinal cord; the dorsal (posterior) root joins the spinal cord’s dorsal gray horn; the ventral (anterior) root joins the spinal cord’s ventral gray horn (root: radicul/o)
sensory <i>SEN-so-rē</i>	Pertaining to the senses or sensation; describing afferent neurons and nerves that carry impulses toward the CNS
somatic nervous system	The division of the nervous system that controls skeletal (voluntary) muscles
spinal cord	The nervous tissue contained within the spinal column; extends from the medulla oblongata to the second lumbar vertebra (root: myel/o)
spinal nerves	The 31 pairs of nerves that connect with the spinal cord
sulcus <i>SUL-kus</i>	A shallow furrow or groove, as on the surface of the cerebrum (see Fig. 17-4) (plural: sulci)

(Continued)

Terminology**Key Terms** *(Continued)*

sympathetic nervous system	The part of the autonomic nervous system that mobilizes a response to stress, increases heart rate and respiration rate, and delivers more blood to skeletal muscles
synapse <i>SIN-aps</i>	The junction between two neurons; also the junction between a motor neuron and a muscle or gland
thalamus <i>THAL-a-mus</i>	The part of the brain that receives all sensory impulses, except those for the sense of smell, and directs them to the proper portion of the cerebral cortex (root: thalam/o)
tract <i>trakt</i>	A bundle of neuron fibers within the CNS
ventricle <i>VEN-trik-l</i>	A small cavity, such as one of the cavities in the brain in which CSF is formed (root: ventricul/o)
visceral nervous system	The autonomic nervous system
white matter	Myelinated tissue of the nervous system



Go to the Audio Pronunciation Glossary in the Student Resources on *thePoint* to hear these terms pronounced.

Word Parts Pertaining to the Nervous System

See **Tables 17-1 to 17-3**.

Table 17-1**Roots for the Nervous System and the Spinal Cord**

Root	Meaning	Example	Definition of Example
neur/o, neur/i	nervous system, nervous tissue, nerve	neurotrophin <i>nū-rō-TRŌ-fin</i>	factor that promotes nerve growth (<i>troph/o</i> means “nourish”)
gli/o	neuroglia	glial <i>GLĪ-al</i>	pertaining to neuroglia
gangli/o, ganglion/o	ganglion	ganglioma <i>gang-glē-Ō-ma</i>	tumor of a ganglion
mening/o, meninge/o	meninges	meningocele <i>me-NING-gō-sēl</i>	hernia of the meninges
myel/o	spinal cord (also bone marrow)	hematomyelia <i>hē-ma-tō-mī-Ē-lē-a</i>	hemorrhage into the spinal cord
radicul/o	spinal nerve root	radiculopathy <i>ra-dīk-ū-LOP-a-thē</i>	any disease of a spinal nerve root

EXERCISE 17-1**Define the following adjectives:**

1. neural (*NŪ-ral*) _____ pertaining to a nerve or the nervous system
2. neuroglial (*nū-ROG-lē-al*) _____
3. radicular (*ra-DIK-ū-lar*) _____
4. meningeal (*me-NIN-jē-al*) _____
5. ganglionic (*gang-glē-ON-ik*) _____

Fill in the blanks:

6. Myelodysplasia (*mī-e-lō-dis-PLĀ-sē-a*) is abnormal development of the _____.
7. A neurotropic (*nū-rō-TROP-ik*) dye has an affinity for the _____.
8. Meningococci (*me-ning-gō-KOK-sī*) are bacteria (cocci) that infect the _____.
9. Radiculalgia (*ra-dik-ū-LAL-jē-a*) is pain caused by irritation of a(n) _____.

Define the following terms:

10. ganglionectomy (*gang-glē-o-NEK-tō-mē*) _____
11. polyradiculitis (*pol-ē-ra-dik-ū-LĪ-tis*) _____
12. neurolysis (*nū-ROL-i-sis*) _____
13. meningioma (*me-nin-jē-Ō-ma*) (combining vowel is *i*) _____
14. myelography (*mī-e-LOG-ra-fē*) _____

Write words for the following definitions:

15. tumor of glial cells _____
16. any disease of the nervous system _____
17. inflammation of the spinal cord _____
18. pain in a nerve _____
19. x-ray image of the spinal cord _____

Table 17-2 Roots for the Brain

Root	Meaning	Example	Definition of Example
encephal/o	brain	anencephaly <i>an-en-SEF-a-lē</i>	absence of a brain
cerebr/o	cerebrum (loosely, brain)	infracerebral <i>in-fra-SER-e-bral</i>	below the cerebrum
cortic/o	cerebral cortex, outer portion	corticospinal <i>kor-ti-kō-SPI-nal</i>	pertaining to the cerebral cortex and spinal cord
cerebell/o	cerebellum	supracerebellar <i>sū-pra-ser-e-BEL-ar</i>	above the cerebellum

(Continued)

Table 17-2 Roots for the Brain (*Continued*)

Root	Meaning	Example	Definition of Example
thalam/o	thalamus	thalamotomy <i>thal-a-MOT-ō-mē</i>	incision of the thalamus
ventricul/o	cavity, ventricle	intraventricular <i>in-tra-ven-TRIK-ū-lar</i>	within a ventricle
medull/o	medulla oblongata (also spinal cord)	medullary <i>MED-ū-lar-ē</i>	pertaining to the medulla
psych/o	mind	psychogenic <i>sī-kō-JEN-ik</i>	originating in the mind
narc/o	stupor, unconsciousness	narcosis <i>nar-KŌ-sis</i>	state of stupor induced by drugs
somn/o, somn/i	sleep	somnolence <i>SOM-nō-lens</i>	sleepiness

EXERCISE 17-2**Fill in the blanks:**

1. An electroencephalogram (*ē-lek-trō-en-SEF-a-lō-gram*) (EEG) is a record of the electric activity of the _____.
2. The term decerebrate (*dē-SER-e-brāt*) refers to functional loss in the _____.
3. The hypothalamus (*hī-pō-THAL-a-mus*) is below the _____.
4. A psychoactive (*sī-kō-AK-tiv*) drug has an effect on the _____.
5. A narcotic (*nar-KOT-ik*) is a drug that causes _____.
6. Somnambulism (*som-NAM-bū-lizm*) means walking during _____.
7. The term cerebrovascular (*ser-ē-brō-VAS-kū-lar*) refers to blood vessels in the _____.

Write an adjective for the following definitions. Note the endings.

8. pertaining to (-al) the cerebrum _____
9. pertaining to (-al) the cerebral cortex _____
10. pertaining to (-ic) the thalamus _____
11. pertaining to (-ar) the cerebellum _____
12. pertaining to (-ar) a ventricle _____

Define the following words:

13. psychology (*sī-KOL-ō-jē*) _____
14. cerebrospinal (*ser-e-brō-SPI-nal*) _____
15. encephalopathy (*en-sef-a-LOP-a-thē*) _____
16. insomnia (*in-SOM-nē-a*) _____
17. extramedullary (*eks-tra-MED-ū-lar-ē*) _____
18. ventriculotomy (*ven-trik-ū-LOT-ō-mē*) _____

EXERCISE 17-2 (Continued)

Write words for the following definitions:

19. above the cerebrum _____
20. inflammation of the brain _____
21. within the cerebellum _____
22. pertaining to the cerebral cortex and the thalamus _____
23. radiograph of a ventricle _____

Table 17-3 Suffixes for the Nervous System

Suffix	Meaning	Example	Definition of Example
-phasia	speech	heterophasia <i>het-er-ō-FĀ-zē-a</i>	uttering words that are different from those intended
-lalia	speech, babble	coprolalia <i>kop-rō-LĀ-lē-a</i>	compulsive use of obscene words (<i>copro-</i> means “feces”)
-lexia	reading	bradylexia <i>brad-ē-LEK-sē-a</i>	slowness in reading
-plegia	paralysis	tetraplegia <i>tet-ra-PLĒ-jē-a</i>	paralysis of all four limbs
-paresis*	partial paralysis, weakness	hemiparesis <i>hem-i-pa-RĒ-sis</i>	partial paralysis of one side of the body
-lepsy	seizure	narcolepsy <i>NAR-kō-lep-sē</i>	condition marked by sudden episodes of sleep
-phobia*	persistent, irrational fear	agoraphobia <i>ag-o-ra-FŌ-bē-a</i>	fear of being in a public place (from Greek <i>agora</i> , meaning “marketplace”)
-mania*	excited state, obsession	megalomania <i>meg-a-lō-MĀ-nē-a</i>	exaggerated self-importance; “delusions of grandeur”

*May be used alone as a word.

EXERCISE 17-3

Fill in the blanks:

1. Another term for quadriplegia (*kwa-dri-PLĒ-jē-a*) is _____.
2. Echolalia (*ek-ō-LĀ-lē-a*) refers to repetitive _____.
3. A person with alexia (*a-LEK-sē-a*) lacks the ability to _____.
4. Epilepsy (*EP-i-lep-sē*) is a disease characterized by _____.
5. In myoparesis (*mī-ō-pa-RĒ-sis*), a muscle shows _____.

(Continued)

EXERCISE 17-3 (Continued)**Define the following words:**

6. cardioplegia (*kar-dē-ō-PLĒ-jē-a*) _____.
7. aphasia (*a-FĀ-zē-a*) _____.
8. dyslexia (*dis-LEK-sē-a*) _____.
9. pyromania (*pī-rō-MĀ-nē-a*) _____.
10. gynephobia (*gīm-e-FŌ-bē-a*) _____.
11. quadriplegia (*kwa-dri-pa-RĒ-sis*) _____.

Write words for the following definitions:

12. slowness in speech (-lalia) _____
13. paralysis of one side (hemi-) of the body _____
14. fear of night and darkness _____
15. fear of (or abnormal sensitivity to) light _____

Clinical Aspects of the Nervous System

VASCULAR DISORDERS

The term **cerebrovascular accident (CVA)**, or **stroke**, applies to any occurrence that deprives brain tissue of oxygen. These events include blockage in a vessel that supplies the brain, a ruptured blood vessel, or some other damage that leads to hemorrhage within the brain. Stroke is the fourth leading cause of death in developed countries and is a leading cause of **paralysis** and other neurologic disabilities. Risk factors for a stroke include hypertension, atherosclerosis, heart disease, diabetes mellitus, and cigarette smoking. Heredity is also a factor.



See the animation “Stroke” in the Student Resources on thePoint.

Thrombosis

Thrombosis is the formation of a blood clot in a vessel. Often, in cases of CVA, thrombosis occurs in the carotid artery, the large vessel in the neck that supplies the brain. Sudden blockage by an obstruction traveling from another part of the body is described as an **embolism**. In cases of stroke, the embolus usually originates in the heart.

These obstructions can be diagnosed by **cerebral angiography** with radiopaque dye, computed tomographic (CT) scans, and other radiographic techniques. In cases of

thrombosis, surgeons can remove the blocked section of a vessel and insert a graft. If the carotid artery leading to the brain is involved, a **carotid endarterectomy** may be performed to open the vessel. Thrombolytic drugs for dissolving (“busting”) such clots are also available.

Aneurysm

An **aneurysm** (Fig. 17-11) is a localized dilation of a vessel that may rupture and cause hemorrhage. An aneurysm may be congenital or may arise from other causes, especially atherosclerosis, which weakens the vessel wall. Hypertension then contributes to its rupture.

The effects of cerebral hemorrhage vary from massive functional loss to mild sensory or motor impairment

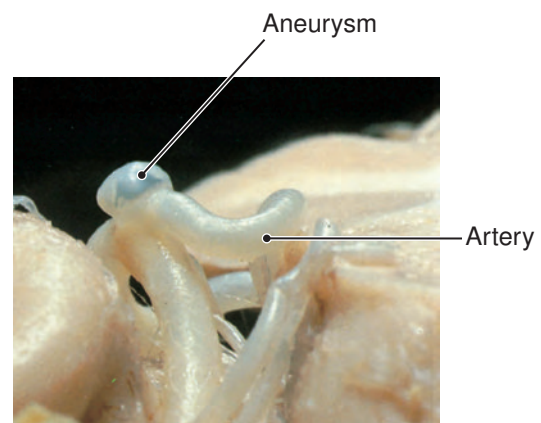


Figure 17-11 Aneurysm. A thin-walled aneurysm protrudes from an artery.

depending on the degree of damage. **Aphasia**, loss or impairment of speech communication, is a common aftereffect. **Hemiplegia** (paralysis of one side of the body) on the side opposite the damage is also seen. It has been found in cases of hemorrhage, as in other forms of brain injury, that immediate retraining therapy may help to restore lost function.

TRAUMA

A **cerebral contusion** is a bruise to the brain's surface, usually caused by a blow to the head. Blood escapes from local vessels, but the injury is not deep.

A more serious injury may cause bleeding into or around the meninges, resulting in a hematoma, a localized collection of clotted blood. Damage to an artery from a skull fracture, usually on the side of the head, may be the cause of an **epidural hematoma** (Fig. 17-12), which appears between the dura mater and the skull bone. The rapidly accumulating blood puts pressure on local vessels and interrupts blood flow to the brain. There may be headache, loss of consciousness, or **hemiparesis** (partial paralysis) on the side opposite the blow. Diagnosis is made by CT scan or magnetic resonance imaging (MRI). If pressure is not relieved within one or two days, death results.

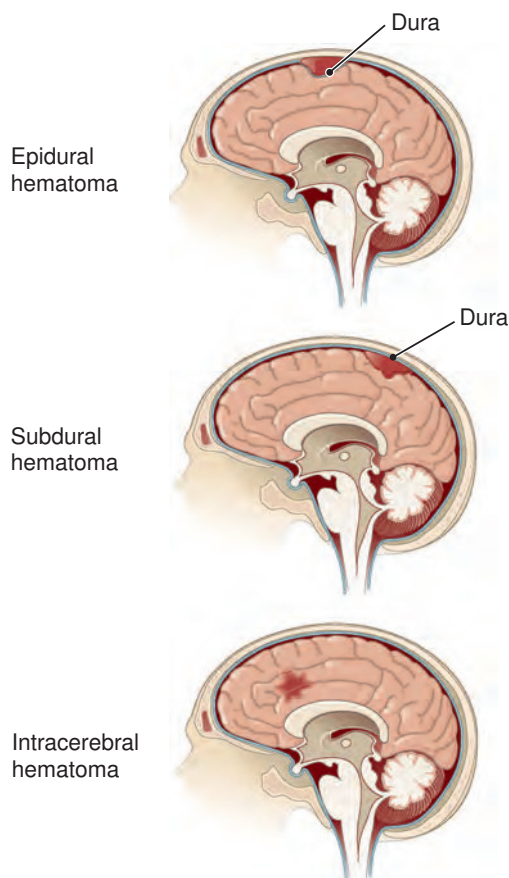


Figure 17-12 Cranial hematomas. Location of epidural, subdural, and intracerebral hematomas are shown.

A **subdural hematoma** (see Fig. 17-12) often results from a blow to the front or back of the head, as when the moving head hits a stationary object. The force of the blow separates the dura from the underlying arachnoid. Blood from a damaged vessel, usually a vein, slowly enters this space. The gradual blood accumulation puts pressure on the brain, causing headache, weakness, and **dementia**, loss of intellectual function. If there is continued bleeding, death results. **Figure 17-12** also shows a site of bleeding into the brain tissue itself, forming an intracerebral hematoma.

A **cerebral concussion** results from a blow to the head or from a fall and is usually followed by temporary loss of consciousness and a short period of amnesia. Aftereffects of a concussion may include headache, dizziness, vomiting, fatigue, and even paralysis, among other symptoms. Damage that occurs on the side of the brain opposite a blow as the brain is thrown against the skull is described as a **contrecoup** (*kon-tre-KU*) injury (from French, meaning “counterblow”).

Other injuries may damage the brain directly. Injury to the base of the brain may involve vital centers in the medulla and interfere with respiration and cardiac functions.

CONFUSION AND COMA

Confusion is a state of reduced comprehension, coherence, and reasoning ability resulting in inappropriate responses to environmental stimuli. Confusion may worsen to include loss of language ability, memory loss, reduced alertness, and emotional changes. This condition may accompany a head injury, drug toxicity, extensive surgery, organ failure, infection, or degenerative disease.

Coma is a state of unconsciousness from which one cannot be aroused. Causes of coma include brain injury, **epilepsy**, toxins, metabolic imbalance (such as the ketoacidosis or glucose imbalances associated with diabetes mellitus), and respiratory, hepatic, or renal failure.

Health care professionals use various responses to evaluate coma, for example, reflex behavior and responses to touch, pressure, and mild pain, as from a light pin prick. Laboratory tests, **electroencephalography** (EEG), and sometimes CT and MRI scans help to identify the causes of coma.

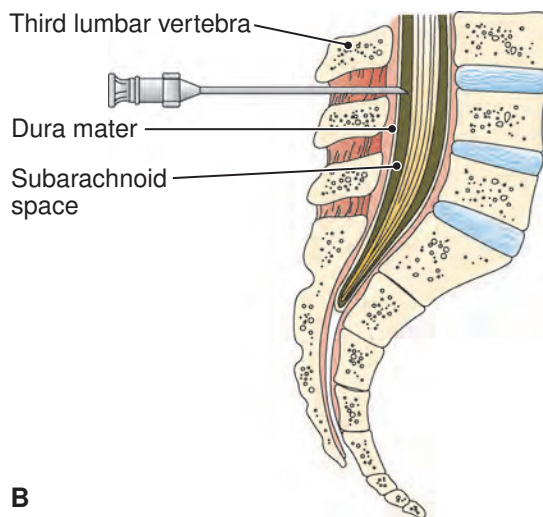
INFECTION

Inflammation of the meninges, or **meningitis**, is usually caused by bacteria that enter through the ear, nose, or throat or are carried by the blood. One of these organisms, the meningococcus (*Neisseria meningitidis*), is responsible for meningitis epidemics among individuals living in close quarters. Other bacteria implicated in cases of meningitis include *Haemophilus influenzae*, *Streptococcus pneumoniae*, and *Escherichia coli*. A stiff neck is a common symptom. The presence of pus or lymphocytes in spinal fluid is also characteristic.

Physicians can withdraw fluid for diagnosis by a **lumbar puncture** (Fig. 17-13), using a needle to remove CSF from the meninges in the lumbar region of the spine. A



A



B

Figure 17-13 Lumbar puncture. A. Position of the patient for a lumbar puncture. B. CSF is withdrawn from the subarachnoid space between the third and fourth or fourth and fifth lumbar vertebrae.

laboratory can examine this fluid for white blood cells and bacteria in the case of meningitis, for red blood cells in the case of brain injury, or for tumor cells. The fluid can also be analyzed chemically. Normally, spinal fluid is clear, with glucose and chlorides present but no protein and very few cells.

Other conditions that can cause meningitis and **encephalitis** (inflammation of the brain) include viral infections, tuberculosis, and syphilis. Viruses that can involve the CNS include the poliovirus; rabies virus; herpesvirus; HIV (human immunodeficiency virus); tick- and mosquito-borne viruses, such as West Nile virus; and rarely, viruses that ordinarily cause relatively mild diseases, such as measles and chickenpox. Aseptic meningitis is a benign, nonbacterial form of the disease caused by a virus.

Varicella-zoster virus, which causes chickenpox, is also responsible for **shingles**, a nerve infection. If someone had chickenpox as a child, the latent virus can become reactivated later in life and spread along peripheral nerves, causing an itching, blistering rash. The name *shingles* comes

from the Latin word for belt, as the shingles rash is often near or around the waist. A vaccine is now available for people over 60.

NEOPLASMS

Almost all tumors that originate in the nervous system are tumors of nonconducting support cells, the neuroglia. These growths are termed **gliomas** and may be named for the specific cell type involved, such as **astrocytoma**, a tumor of astrocytes, or **neurilemmoma** (schwannoma), a tumor of the cells that make the myelin sheath. Because they tend not to metastasize, these tumors may be described as benign. However, they do harm by compressing brain tissue (Fig. 17-14). The symptoms they cause depend on their size and location. There may be **seizures**, headache, vomiting, muscle weakness, or interference with a special sense, such as vision or hearing. If present, edema and **hydrocephalus**, accumulation of excess CSF in the ventricles, add to the tumor's effects (Fig. 17-15).

A **meningioma** is a tumor of the meninges. Because a meningioma does not spread and is localized at the surface, a surgeon can usually remove it completely.

Tumors of nervous tissue generally occur in childhood and may even originate before birth, when this tissue is actively multiplying. Also, cancer may metastasize to the brain from elsewhere in the body. For unknown reasons, certain forms of cancer, especially melanoma, breast cancer, and lung cancer, tend to spread to the brain.

DEGENERATIVE DISEASES

Multiple sclerosis (MS) commonly attacks people in their 20s or 30s and progresses at intervals and at varying rates. It involves patchy loss of myelin with hardening (sclerosis) of



Figure 17-14 Brain tumor. MRI shows a large tumor that arises from the cerebellum and pushes the brainstem forward.

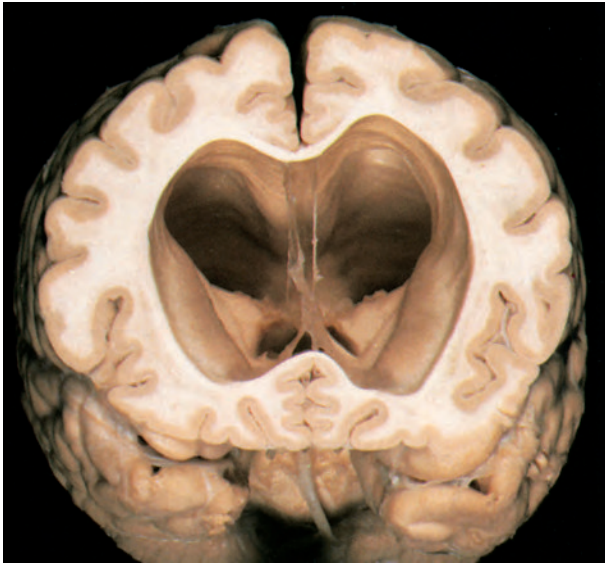


Figure 17-15 Hydrocephalus. Coronal section of the brain showing marked enlargement of the ventricles caused by a tumor that obstructed the flow of CSF.

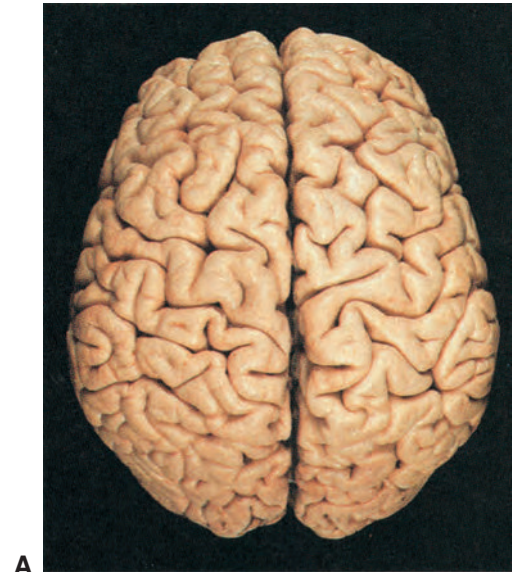
tissue in the CNS. The symptoms include vision problems, tingling or numbness in the arms and legs, urinary incontinence, **tremor** (shaking), and stiff gait. MS is thought to be an autoimmune disorder, but the exact cause is not known.

Parkinsonism occurs when, for unknown reasons, certain neurons in the midbrain fail to secrete the neurotransmitter dopamine. This leads to tremors, muscle rigidity, flexion at the joints, akinesia (loss of movement), and emotional problems. Parkinsonism is treated with daily administration of the drug **L-dopa** (levodopa), a form of dopamine that the circulation can carry into the brain.

Alzheimer disease (AD) results from unexplained degeneration of neurons and atrophy of the cerebral cortex (**Fig. 17-16**). These changes cause progressive loss of recent memory, confusion, and mood changes. Dangers associated with AD are injury, infection, malnutrition, and aspiration of food or fluids into the lungs. Originally called presenile dementia and used only to describe cases in patients about 50 years of age, the term is now applied to these same changes when they occur in elderly patients.

AD is diagnosed by CT or MRI scans and confirmed at autopsy. Histologic (tissue) studies show deposits of a substance called **amyloid** in the tissues. The disease may be hereditary. AD commonly develops in people with Down syndrome after age 40, indicating that AD is associated with abnormality on chromosome 21, the same chromosome that is involved in Down syndrome.

Multiinfarct dementia (MID) resembles AD in that it is a progressive cognitive impairment associated with loss of memory, loss of judgment, aphasia, altered motor and sensory function, repetitive behavior, and loss of social skills. The disorder is caused by multiple small strokes that interrupt blood flow to brain tissue and deprive areas of oxygen.



A



B

Figure 17-16 Effects of Alzheimer disease. A. Normal brain. B. Brain of a patient with Alzheimer disease, showing atrophy of the cortex with narrow gyri and enlarged sulci.

EPILEPSY

A prime characteristic of epilepsy is recurrent seizures brought on by abnormal electric activity of the brain. These attacks may vary from brief and mild episodes known as absence (petit mal) seizures to major tonic-clonic (grand mal) seizures with loss of consciousness, **convulsion** (intervals of violent involuntary muscle contractions), and sensory disturbances. In other cases (psychomotor seizures), there is a one- to two-minute period of disorientation. Epilepsy may be the result of a tumor, injury, or neurologic disease, but in most cases, the cause is unknown.

EEG reveals abnormalities in brain activity and can be used in the diagnosis and treatment of epilepsy. The disorder is treated with antiepileptic and anticonvulsive drugs to

control seizures, and sometimes surgery is of help. If seizures cannot be controlled, the individual with epilepsy may have to avoid certain activities that can lead to harm.

SLEEP DISTURBANCES

The general term *dyssomnia* includes a variety of possible disorders that result in excessive sleepiness or difficulty in beginning or maintaining sleep. Simple causes for such disorders include schedule changes or travel to different time zones (jet lag). **Insomnia** refers to insufficient or nonrestorative sleep despite ample opportunity to sleep. There may be physical causes for insomnia, but often it is related to emotional upset caused by stressful events. **Narcolepsy** is characterized by brief, uncontrollable attacks of sleep during the day. The disorder is treated with stimulants, regulation of sleep habits, and short daytime naps.

Sleep apnea refers to failure to breathe for brief periods during sleep. It usually results from upper airway obstruction, often associated with obesity, alcohol consumption, or weakened throat muscles, and is usually accompanied by loud snoring with brief periods of silence. Dental appliances that move the tongue and jaw forward may help to prevent sleep apnea. Other options are surgery to correct an obstruction or positive air pressure delivered through a mask.

Sleep disorders are diagnosed by physical examination, a sleep history, and a log of sleep habits, including details of the sleep environment and note of any substances consumed that may interfere with sleep. Study in a sleep laboratory with a variety of electric and other studies, constituting **polysomnography**, may also be needed.

Sleep studies identify two components of normal sleep, each showing a specific EEG pattern. Nonrapid eye movement (NREM) sleep has four stages, which take a person progressively into the deepest level of sleep. If sleepwalking (somnambulism) occurs, it occurs during this stage. NREM sleep is interrupted about every 1.5 hours by episodes of rapid eye movement (REM) sleep, during which the eyes move rapidly, although they are closed. Dreaming occurs during REM sleep and muscles lose tone, while heart rate, blood pressure, and brain activity increase.

OTHERS

Many hereditary diseases affect the nervous system. Some of these are described in Chapter 15. Hormonal imbalances that involve the nervous system are described in Chapter 16. Finally, drugs, alcohol, toxins, and nutritional deficiencies may act on the nervous system in a variety of ways.

Box 17-2 has information on occupational therapists, who are often involved in treating people with neurologic disturbances.

Behavioral Disorders

This section is an introduction to some of the behavioral disorders that involve the nervous system. Criteria for clinical diagnosis of these and other behavioral and mental disorders are set forth in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) published by the American Psychiatric Association.

Box 17-2



Health Professions

Careers in Occupational Therapy

Occupational therapy (OT) helps people with physical or mental disability achieve independence at home and at work by teaching them “skills for living.” Many people can benefit, including those:

- Recovering from traumas such as fractures, amputations, burns, spinal cord injury, stroke, and heart attack
- With chronic conditions such as arthritis, multiple sclerosis, Alzheimer disease, and schizophrenia
- With developmental disabilities such as Down syndrome, cerebral palsy, spina bifida, muscular dystrophy, and autism

OTs work as part of multidisciplinary teams, which include but are not limited to physicians, nurses, physical therapists, speech pathologists, and social workers. OTs also work closely with families to educate and instruct them on how to assist in the client’s progress. They assess their clients’ capabilities and develop individualized treatment programs that help them recover from injury or compensate for permanent disability. Treatment may include teaching activities ranging from work

tasks to dressing, cooking, and eating, and using adaptive equipment such as wheelchairs and computers.

OT assistants implement treatment plans developed by an occupational therapist and regularly consult with the occupational therapist on progress and possible reassessment of goals. To perform their duties, OTs and assistants need a thorough scientific education and clinical background. A current practicing OT in the United States has either a bachelor’s or master’s degree. As of 2007, OTs must earn a master’s degree in occupational therapy in order to practice. After graduation, they must pass a national certification exam and where necessary, be licensed by the state to practice. Assistants typically train in two-year programs and also take a certification exam.

OTs and their assistants work in hospitals, clinics, and nursing care facilities, and also visit homes and schools. As the population continues to age and the need for rehabilitative therapy increases, job prospects remain good. The American Occupational Therapy Association at www.aota.org has more information on OT careers.

Box 17-3



Focus on Words

Phobias and Manias

Some of the terms for phobias and manias are just as strange and interesting as the behaviors themselves.

Agoraphobia is fear of being in a public place. The agora in ancient Greece was the marketplace. Xenophobia is an irrational fear of strangers, taken from the Greek root *xen/o*, which means strange or foreign. Acrophobia, a fear of heights, is taken from the root *acro-*, meaning terminal, highest, or top-most. In most medical terms, this root is used to mean extremity, as in *acrocytosis*. Hydrophobia is a fear of or aversion to

water (*hydr/o*). The term was used as an alternative name for rabies, because people infected with this paralytic disease had difficulty swallowing water and other liquids.

Trichotillomania is the odd practice of compulsively pulling out one's hair in response to stress. The word comes from the root for hair (*trich/o*) plus a Greek word that means "to pull." Kleptomania, also spelled cleptomania, is from the Greek word for thief and describes an irresistible urge to steal in the absence of need.

ANXIETY DISORDERS

Anxiety is a feeling of fear, worry, uneasiness, or dread. It may be associated with physical problems or drugs and is often prompted by feelings of helplessness or loss of self-esteem. Generalized anxiety disorder (GAD) is characterized by chronic excessive and uncontrollable worry about various life circumstances, often with no basis. It may be accompanied by muscle tensing, restlessness, dyspnea, palpitations, insomnia, irritability, or fatigue.

Panic disorder is a form of anxiety disorder marked by episodes of intense fear. A person with panic disorder may isolate himself or herself or avoid social situations for fear of having a panic attack or in response to attacks.

A **phobia** is an extreme, persistent fear of a specific object or situation (Box 17-3). It may center on social situations, particular objects, such as animals or blood, or activities, such as flying or driving through tunnels.

Obsessive-compulsive disorder (OCD) is a condition marked by disturbing thoughts or images that are persistent and intrusive. To relieve anxiety about these thoughts or images, the person with OCD engages in repetitive behavior that interferes with normal daily activities, although he or she knows that such behavior is unreasonable. These patterns include repeated washing; performing rituals; arranging, touching, or counting objects; and repeating words or phrases. OCD is associated with perfectionism and rigidity in behavior. Some specialists believe that OCD is related to low levels of the neurotransmitter serotonin in the brain. Treatment is with behavioral therapy and antidepressant drugs that increase the brain's serotonin levels (Box 17-4).

When a highly stressful, catastrophic event results in persistent emotional difficulties, the condition is described as **posttraumatic stress disorder (PTSD)**. People who are abused, whose lives are threatened, who witness a crime,

17

Box 17-4



Clinical Perspectives

Psychoactive Drugs: Adjusting Neurotransmitters to Alter Mood

Many psychoactive drugs used today operate by affecting levels and activities of neurotransmitters such as serotonin, norepinephrine, and dopamine in the brain. Examples are fluoxetine (Prozac) and related compounds, which are prescribed to alter mood.

Prozac increases serotonin's activity by blocking its reuptake—that is, it blocks transporters that carry serotonin back into the secreting cell at the synapse. Like other selective serotonin reuptake inhibitors (SSRIs), Prozac prolongs the neurotransmitter's activity at the synapse, producing a mood-elevating effect. Prozac is used to treat depression, anxiety, and symptoms of obsessive-compulsive disorder.

Other psychoactive drugs are less selective than Prozac. Venlafaxine (Effexor) blocks reuptake of serotonin and norepinephrine and is used to treat depression and generalized

anxiety disorder. Bupropion (Zyban) inhibits reuptake of norepinephrine and dopamine and is prescribed for depression and smoking cessation. Another class of antidepressants, the monoamine oxidase inhibitors (MAOIs), prevents an enzyme from breaking down serotonin in the synapse. Like SSRIs, MAOIs increase the amount of serotonin available in the synapse. Examples are phenelzine (Nardil) and tranylcypromine (Parnate).

Some herbal remedies are also used to treat depression. St. John's wort contains the active ingredient hypericin, which appears to both nonselectively inhibit serotonin reuptake and block norepinephrine and dopamine reuptake. As with any drug, care must be taken when using St. John's wort, especially if it is combined with other antidepressant medications, and health care providers should always be informed of any drugs, including herbal preparations, that a person is taking.

who experience a natural disaster, and especially those who are combat veterans are subject to PTSD. Responses include anger, fear, sleep disturbances, and physical symptoms, including changes in brain chemistry and hormone imbalances. PTSD is often associated with other emotional problems such as depression, withdrawal, substance abuse, and impaired social and family relationships. Patients need early treatment with emotional support, protection, psychotherapy, and drugs to treat depression and anxiety.

MOOD DISORDERS

Depression is a mental state characterized by profound feelings of sadness, emptiness, hopelessness, inability to concentrate, and lack of interest or pleasure in activities. Depression is often accompanied by insomnia, loss of appetite, and suicidal tendencies, and it frequently coexists with other physical or emotional conditions.

Dysthymia is a chronic mood disorder that lasts for several months to years and is often triggered by a serious event. Depression is a common symptom, as well as eating disorders, sleep disturbances, fatigue, lack of concentration, indecision, and feelings of hopelessness.

In **bipolar disorder** (formerly called manic-depressive illness), normal moods alternate with episodes of depression and **mania**, a state of elation, which may include agitation, hyperexcitability, or hyperactivity. Treatment for bipolar disorder may differ from therapy for depression alone and includes mood-stabilizing drugs and professional mental health therapy.

Most of the drugs used to treat mood disorders affect the level of neurotransmitters in the brain, such as the selective serotonin reuptake inhibitors (SSRIs), which prolong the action of serotonin.

PSYCHOSIS

Psychosis is a mental state in which there is gross misperception of reality. This loss of touch with reality may be evidenced by **delusions** (false beliefs), including **paranoia**, delusions of persecution or threat, or **hallucinations**, imagined sensory experiences. Although the patient's condition makes it impossible for him or her to cope with the ordinary demands of life, there is lack of awareness that this behavior is inappropriate.

Schizophrenia is a form of chronic psychosis that may include bizarre behavior, paranoia, anxiety, delusions, withdrawal, and suicidal tendencies. The diagnosis of schizophrenia encompasses a broad category of disorders with many subtypes. The causes of schizophrenia are unknown, but there is evidence of hereditary factors and imbalance in brain chemistry.

ATTENTION DEFICIT HYPERACTIVITY DISORDER

Attention deficit hyperactivity disorder (ADHD) is difficult to diagnose because many of its symptoms overlap or coexist with other behavioral disorders. Although inattention and hyperactivity usually appear together in these cases, one component may predominate. ADHD commonly begins in

childhood and is characterized by attention problems, easy boredom, impatience, and impulsive behavior. Associated hyperactivity may be manifested by fidgeting, squirming, rapid motion, or excessive talking. In adults, the signs of ADHD may be confused with other disorders, such as mood disturbances, substance abuse, and endocrine problems.

ADHD has been correlated with alterations in brain structure and metabolism. Treatment is with psychotherapy or behavioral therapy and certain drugs. A stimulant, methylphenidate (Ritalin) has traditionally been prescribed for children with ADHD, but more recently, the antidepressant atomoxetine (Strattera) has given positive results.

PERVASIVE DEVELOPMENTAL DISORDER

The term *pervasive developmental disorder* (PDD) applies to impairments that appear early in life and affect social interactions and communication skills. Some forms are commonly associated with a degree of mental retardation; however, a person with PDD may be of normal or above average intelligence, and even brilliant. Each child with PDD is unique and has his or her own specific needs. All of these conditions fall into a continuum that includes, among others, **autism** and **Asperger syndrome**.

Autism is a complex disorder of unknown cause that usually appears between the ages of 2 and 6 years as a child fails to reach appropriate developmental signposts. It is marked by self-absorption and lack of response to social contact and affection. Autistic children may have low intelligence and poor language skills. They often appear to be disconnected and out of place. They may overrespond to stimuli and may show self-destructive behavior. There may also be stereotyped (repetitive) behavior, preoccupations, mood swings, and resistance to change. Autism may be accompanied by neurologic problems and problems with sleeping and eating. Those with autism may need the help of mental health specialists, social workers, and occupational, physical, and speech therapists.

People with Asperger syndrome are often highly intelligent and verbal, but have trouble with social interactions and understanding others' behaviors. Thus, as children, they are often isolated and bullied. Repetitive behaviors may develop. These children also may develop a strong interest in specific topics. They need help in learning to interpret social cues, but often can apply their talents in satisfying occupations.

DRUGS USED IN TREATMENT

A psychotropic or psychoactive drug is one that acts on the mental state. This category of drugs includes antianxiety drugs or anxiolytics, mood stabilizers, antidepressants, and antipsychotics, also called *neuroleptics*. Many of these drugs work by increasing the brain's levels of neurotransmitters. Note that psychoactive drugs do not work in the same way for everyone. It is often necessary to try different therapies until the right drug is found. Also, it may take several weeks for a drug to become effective. For more information, see descriptions and examples of specific types of psychoactive drugs in the supplementary terms.

Terminology Key Terms

Neurologic Disorders

Alzheimer disease (AD) <i>ALTS-bī-mer</i>	A form of dementia caused by atrophy of the cerebral cortex; presenile dementia (see Fig. 17-16)
amyloid <i>AM-i-loyd</i>	A starch-like substance of unknown composition that accumulates in the brain in Alzheimer and other diseases
aneurysm <i>AN-ū-rizm</i>	A localized abnormal dilation of a blood vessel that results from weakness of the vessel wall (see Fig. 17-11); an aneurysm may eventually burst
aphasia <i>a-FĀ-zē-a</i>	Specifically, loss or defect in speech communication (from Greek <i>phasis</i> , meaning “speech”). In practice, the term is applied more broadly to a range of language disorders, both spoken and written. May affect ability to understand speech (receptive aphasia) or the ability to produce speech (expressive aphasia). Both forms are combined in global aphasia
astrocytoma <i>as-trō-sī-TŌ-ma</i>	A neuroglial tumor composed of astrocytes
cerebral contusion <i>kon-TŪ-zhun</i>	A bruise to the surface of the brain following a blow to the head
cerebrovascular accident (CVA)	Sudden damage to the brain resulting from reduction of cerebral blood flow; possible causes are atherosclerosis, thrombosis, or a ruptured aneurysm; commonly called stroke
coma <i>KŌ-ma</i>	State of deep unconsciousness from which one cannot be roused
concussion <i>kon-KUSH-un</i>	Injury resulting from a violent blow or shock; a brain concussion usually results in loss of consciousness
confusion <i>kon-FŪ-zhun</i>	A state of reduced comprehension, coherence, and reasoning ability resulting in inappropriate responses to environmental stimuli
contrecoup injury <i>kon-tre-KŪ</i>	Damage to the brain on the side opposite the point of a blow as a result of the brain’s hitting the skull (from French, meaning “counterblow”)
convulsion <i>kon-VUL-shun</i>	A series of violent, involuntary muscle contractions. A tonic convulsion involves prolonged muscle contraction; in a clonic convulsion, there is alternation of contraction and relaxation. Both forms appear in grand mal epilepsy
dementia <i>dē-MEN-shē-a</i>	A gradual and usually irreversible loss of intellectual function
embolism <i>EM-bō-lizm</i>	Obstruction of a blood vessel by a blood clot or other material carried in the circulation
encephalitis <i>en-sef-a-LĪ-tis</i>	Inflammation of the brain
epidural hematoma	Accumulation of blood in the epidural space (between the dura mater and the skull) (see Fig. 17-12)
epilepsy <i>EP-i-lep-sē</i>	A chronic disease involving periodic sudden bursts of electric activity from the brain, resulting in seizures
glioma <i>glī-Ō-ma</i>	A tumor of neuroglial cells

(Continued)

Terminology

Key Terms (Continued)

hemiparesis <i>hem-i-pa-RE-sis</i>	Partial paralysis or weakness of one side of the body
hemiplegia <i>hem-i-PLĒ-jē-a</i>	Paralysis of one side of the body
hydrocephalus <i>hī-drō-SEF-a-lus</i>	Increased accumulation of CSF in or around the brain as a result of obstructed flow. May be caused by tumor, inflammation, hemorrhage, or congenital abnormality (see Fig. 17-15)
insomnia <i>in-SOM-nē-a</i>	Insufficient or nonrestorative sleep despite ample opportunity to sleep
meningioma <i>men-nin-jē-Ō-ma</i>	Tumor of the meninges
meningitis <i>men-in-JĪ-tis</i>	Inflammation of the meninges
multiinfarct dementia (MID)	Dementia caused by chronic cerebral ischemia (lack of blood supply) as a result of multiple small strokes. There is progressive loss of cognitive function, memory, and judgment as well as altered motor and sensory function
multiple sclerosis (MS)	A chronic, progressive disease involving loss of myelin in the CNS
narcolepsy <i>NAR-kō-lep-sē</i>	Brief, uncontrollable episodes of sleep during the day
neurilemmoma <i>nū-ri-lem-Ō-ma</i>	A tumor of a peripheral nerve sheath (neurilemma); schwannoma
paralysis <i>pa-RAL-i-sis</i>	Temporary or permanent loss of function. Flaccid paralysis involves loss of muscle tone and reflexes and muscular degeneration. Spastic paralysis involves excess muscle tone and reflexes but no degeneration
parkinsonism	A disorder originating in the brain's basal ganglia and characterized by slow movements, tremor, rigidity, and mask-like face. Also called Parkinson disease
seizure <i>SE-zhur</i>	A sudden attack, as seen in epilepsy. The most common forms of seizure are tonic-clonic, or grand mal (<i>gran mal</i>) (from French, meaning "great illness"); absence seizure, or petit mal (<i>pet-Ē mal</i>), meaning "small illness;" and psychomotor seizure
shingles	An acute viral infection that follows nerve pathways causing small lesions on the skin. Caused by reactivation of the virus that also causes chickenpox (varicella-zoster virus). Also called herpes zoster (<i>HER-pēz ZOS-ter</i>)
sleep apnea <i>ap-NĒ-a</i>	Brief periods of breathing cessation during sleep
stroke	Sudden interference with blood flow in one or more cerebral vessels leading to oxygen deprivation and necrosis of brain tissue; caused by a blood clot in a vessel (ischemic stroke) or rupture of a vessel (hemorrhagic stroke). Cerebrovascular accident (CVA)
subdural hematoma	Accumulation of blood beneath the dura mater (see Fig. 17-12)
thrombosis <i>throm-BŌ-sis</i>	Development of a blood clot within a vessel
tremor <i>TREM-or</i>	A shaking or involuntary movement

Terminology**Key Terms** (Continued)**Diagnosis and Treatment**

carotid endarterectomy <i>end-ar-ter-EK-tō-mē</i>	Surgical removal of the lining of the carotid artery, the large artery in the neck that supplies blood to the brain
cerebral angiography	Radiographic study of the brain's blood vessels after injection of a contrast medium
electroencephalography (EEG) <i>ē-lek-trō-en-sef-a-LOG-ra-fē</i>	Amplification, recording, and interpretation of the brain's electric activity
L-dopa <i>DŌ-pa</i>	A drug used in the treatment of parkinsonism; levodopa
lumbar puncture	Puncture of the subarachnoid space in the lumbar region of the spinal cord to remove spinal fluid for diagnosis or to inject anesthesia (see Fig. 17-13); spinal tap
polysomnography <i>pol-ē-som-NOG-ra-fē</i>	Simultaneous monitoring of a variety of physiologic functions during sleep to diagnose sleep disorders

Behavioral Disorders

anxiety <i>ang-ZĪ-e-tē</i>	A feeling of fear, worry, uneasiness, or dread
Asperger syndrome <i>AHS-per-ger</i>	A behavioral condition on a continuum with autism that may include difficulty with social interactions and understanding, strong specific interests, and repetitive behaviors
attention deficit hyperactivity disorder (ADHD)	A condition that begins in childhood and is characterized by attention problems, easy boredom, impulsive behavior, and hyperactivity
autism <i>AW-tizm</i>	A disorder of unknown cause consisting of self-absorption, lack of response to social contact and affection, preoccupations, stereotyped behavior, and resistance to change (from <i>auto-</i> , “self,” and <i>-ism</i> , “condition of”)
bipolar disorder <i>bī-PŌ-lar</i>	A form of depression with episodes of mania (a state of elation); manic depressive illness
delusion <i>dē-LŪ-zhun</i>	A false belief inconsistent with knowledge and experience
depression <i>dē-PRESH-un</i>	A mental state characterized by profound feelings of sadness, emptiness, hopelessness, and lack of interest or pleasure in activities
dysthymia <i>dis-THĪ-mē-a</i>	A mild form of depression that usually develops in response to a serious life event (from <i>dys-</i> and Greek <i>thymos</i> , meaning “mind, emotion”)
hallucination <i>ha-lū-si-NĀ-shun</i>	A false perception unrelated to reality or external stimuli
mania <i>MĀ-nē-a</i>	A state of elation, which may include agitation, hyperexcitability, or hyperactivity (adjective: manic)
obsessive-compulsive disorder (OCD)	A condition associated with recurrent and intrusive thoughts, images, and repetitive behaviors performed to relieve anxiety
panic disorder	A form of anxiety disorder marked by episodes of intense fear
paranoia <i>par-a-NOY-a</i>	A mental state characterized by jealousy, delusions of persecution, or perceptions of threat or harm
phobia <i>FŌ-bē-a</i>	An extreme, persistent fear of a specific object or situation

(Continued)

Terminology**Key Terms** *(Continued)***posttraumatic stress disorder (PTSD)**

Persistent emotional disturbances that follow exposure to life-threatening, catastrophic events, such as trauma, abuse, natural disasters, and warfare

psychosis
sī-KŌ-sis

A mental disorder extreme enough to cause gross misperception of reality with delusions and hallucinations

schizophrenia
skiz-ō-FRĒ-nē-a

A poorly understood group of severe mental disorders with features of psychosis, delusions, hallucinations, and withdrawn or bizarre behavior (*schizo* means “split” and *phren* means “mind”)



Go to the Audio Pronunciation Glossary in the Student Resources on *thePoint* to hear these words pronounced.

Terminology**Supplementary Terms****Normal Structure and Function****acetylcholine (ACh)**
as-ē-til-KŌ-lēn

A neurotransmitter; activity involving acetylcholine is described as cholinergic

basal ganglia

Four masses of gray matter in the cerebrum and upper brainstem that are involved in movement and coordination

blood-brain barrier

A special membrane between circulating blood and the brain that prevents certain damaging substances from reaching brain tissue

Broca area
BRŌ-ka

An area in the left frontal lobe of the cerebrum that controls speech production

circle of Willis

An interconnection (anastomosis) of several arteries supplying the brain; located at the base of the cerebrum; cerebral arterial circle

contralateral
kon-tra-LAT-er-al

Affecting the opposite side of the body

corpus callosum
KOR-pus ka-LŌ-sum

A large band of connecting fibers between the cerebral hemispheres

dermatome
DER-ma-tōm

The area of the skin supplied by a spinal nerve; term also refers to an instrument used to cut skin for grafting (see Chapter 21)

ipsilateral
ip-si-LAT-er-al

On the same side; unilateral

leptomeninges
lep-to-men-IN-jēz

The pia mater and arachnoid together

norepinephrine
nor-ep-i-NEF-rin

A neurotransmitter very similar in chemical composition and function to the hormone epinephrine; also called noradrenaline

nucleus
NŪ-klē-us

A collection of nerve cells within the central nervous system

plexus
PLEKS-us

A network, as of nerves or blood vessels

Terminology**Supplementary Terms** *(Continued)*

pyramidal tracts <i>pi-RAM-i-dal</i>	A group of motor tracts involved in fine coordination. Most of the fibers in these tracts cross in the medulla to the opposite side of the spinal cord and affect the opposite side of the body. Fibers not included in the pyramidal tracts are described as extrapyramidal
reticular activating system (RAS) <i>re-TIK-ū-lar</i>	A widespread system in the brain that maintains wakefulness
Schwann cells <i>shvon</i>	Cells that produce the myelin sheath around peripheral axons
Wernicke area <i>VER-ni-kē</i>	An area in the temporal lobe concerned with speech comprehension
Symptoms and Conditions	
amyotrophic lateral sclerosis (ALS) <i>a-mī-ō-TROF-ik</i>	A disorder marked by muscular weakness, spasticity, and exaggerated reflexes caused by degeneration of motor neurons; Lou Gehrig disease
amnesia <i>am-NĒ-zē-a</i>	Loss of memory (from Greek word <i>mneme</i> meaning “memory” and the negative prefix <i>a-</i>)
apraxia <i>a-PRAK-sē-a</i>	Inability to move with purpose or to use objects properly
ataxia <i>a-TAK-sē-a</i>	Lack of muscle coordination; dyssynergia
athetosis <i>ath-e-TŌ-sis</i>	Involuntary, slow, twisting movements in the arms, especially the hands and fingers
Bell palsy <i>PAWL-zē</i>	Paralysis of the facial nerve
berry aneurysm <i>AN-ū-rizm</i>	A small sac-like aneurysm of a cerebral artery
catatonia <i>kat-a-TŌ-nē-a</i>	A phase of schizophrenia in which the patient is unresponsive; there is a tendency to remain in a fixed position without moving or talking
cerebral palsy <i>SER-e-bral PAWL-zē</i>	A nonprogressive neuromuscular disorder usually caused by damage to the CNS near the time of birth. May include spasticity, involuntary movements, or ataxia
chorea <i>KOR-ē-a</i>	A nervous condition marked by involuntary twitching of the limbs or facial muscles
claustrophobia <i>claws-trō-FŌ-bē-a</i>	Fear of being shut in or enclosed (from Latin <i>claudere</i> , “to shut”)
compulsion <i>kom-PUL-shun</i>	A repetitive, stereotyped act performed to relieve tension
Creutzfeldt-Jakob disease (CJD) <i>KROITS-felt YA-kob</i>	A slow-growing degenerative brain disease caused by a prion (<i>PRĪ-on</i>), an infectious protein. Related to bovine spongiform encephalopathy (BSE, “mad cow disease”) in cattle
delirium <i>de-LIR-ē-um</i>	A sudden and temporary state of confusion marked by excitement, physical restlessness, and incoherence
dysarthria <i>dis-AR-thrē-a</i>	Defect in speech articulation caused by lack of control over the required muscles

(Continued)

dysmetria <i>dis-MĒ-trē-a</i>	Disturbance in the path or placement of a limb during active movement. In hypometria, the limb falls short; in hypermetria, the limb extends beyond the target
euphoria <i>ū-FOR-ē-a</i>	An exaggerated feeling of well-being; elation
glioblastoma <i>glī-ō-blas-TŌ-ma</i>	A malignant astrocytoma
Guillain-Barré syndrome <i>gē-YAN bar-RĀ</i>	An acute polyneuritis with progressive muscular weakness that usually occurs after a viral infection; in most cases recovery is complete, but may take several months to years
hematomyelia <i>hē-ma-tō-mī-Ē-lē-a</i>	Hemorrhage of blood into the spinal cord, as from an injury
hemiballism <i>hem-ē-BAL-izm</i>	Jerking, twitching movements of one side of the body
Huntington disease	A hereditary disease of the CNS that usually appears between ages 30 and 50. The patient shows progressive dementia and chorea, and death occurs within 10 to 15 years
hypochondriasis <i>hī-pō-kon-DRĪ-a-sis</i>	Abnormal anxiety about one's health
ictus <i>IK-tus</i>	A blow or sudden attack, such as an epileptic seizure
lethargy <i>LETH-ar-jē</i>	A state of sluggishness or stupor
migraine <i>MĪ-grān</i>	Chronic intense, throbbing headache that may result from vascular changes in cerebral arteries. Possible causes include genetic factors, stress, trauma, and hormonal fluctuations. Headache might be signaled by visual disturbances, nausea, photophobia, and tingling sensations
neurofibromatosis <i>nū-rō-fī-brō-ma-TŌ-sis</i>	A condition involving multiple tumors of peripheral nerves
neurosis <i>nū-RŌ-sis</i>	An emotional disorder caused by unresolved conflicts, with anxiety as a main characteristic
paraplegia <i>par-a-PLĒ-jē-a</i>	Paralysis of the legs and lower part of the body
parasomnia <i>par-a-SOM-nē-a</i>	Condition of having undesirable phenomena, such as nightmares, occur during sleep or become worse during sleep
quadriplegia <i>kwa-dri-PLĒ-jē-a</i>	Paralysis of all four limbs; tetraplegia
Reye syndrome <i>rī</i>	A rare acute encephalopathy occurring in children after viral infections. The liver, kidney, and heart may be involved. Linked to administration of aspirin during a viral illness
sciatica <i>sī-AT-i-ka</i>	Neuritis characterized by severe pain along the sciatic nerve and its branches
somatoform disorders <i>sō-MA-tō-form</i>	Conditions associated with symptoms of physical disease, such as pain, hypertension, or chronic fatigue, with no physical basis
somnambulism <i>som-NAM-bū-lizm</i>	Walking or performing other motor functions while asleep and out of bed; sleepwalking
stupor <i>STŪ-por</i>	A state of unconsciousness or lethargy with loss of responsiveness
syringomyelia <i>sir-in-gō-mī-Ē-lē-a</i>	A progressive disease marked by formation of fluid-filled cavities in the spinal cord
tic	Involuntary, spasmodic, recurrent, and purposeless motor movements or vocalizations

tic douloureux <i>tik dū-lū-RŪ</i>	Episodes of extreme pain in the area supplied by the trigeminal nerve; also called trigeminal neuralgia
tabes dorsalis <i>TĀ-bēz dor-SAL-is</i>	Destruction of the dorsal (posterior) portion of the spinal cord with loss of sensation and awareness of body position, as seen in advanced cases of syphilis
Tourette syndrome <i>tū-RET</i>	A tic disorder with intermittent motor and vocal manifestations that begins in childhood. There also may be obsessive and compulsive behavior, hyperactivity, and distractibility
transient ischemic attack (TIA) <i>is-KĒ-mik</i>	A sudden, brief, and temporary cerebral dysfunction usually caused by interruption of blood flow to the brain
Wallerian degeneration <i>wahl-LĒ-rē-an</i>	Degeneration of a nerve distal to an injury
whiplash	Cervical injury caused by rapid acceleration and deceleration, resulting in damage to muscles, ligaments, disks, and nerves

Additional terms related to neurologic symptoms can be found in Chapters 18 (on the senses) and 20 (on the muscular system).

Diagnosis and Treatment

Babinski reflex <i>ba-BIN-skē</i>	A spreading of the outer toes and extension of the big toe over the others when the sole of the foot is stroked. This response is normal in infants but indicates a lesion of specific motor tracts in adults (Fig. 17-17)
evoked potentials	Record of the brain's electric activity after sensory stimulation. Included are visual evoked potentials (VEPs), brainstem auditory evoked potentials (BAEPs), and somatosensory evoked potentials (SSEPs), obtained by stimulating the hand or leg. These tests are used to evaluate CNS function
Glasgow Coma Scale	A system for assessing level of consciousness by assigning a score to each of three responses: eye opening, motor responses, and verbal responses
positron emission tomography (PET)	Use of radioactive glucose or an other metabolically active substance to produce images of biochemical activity in tissues. Used for study of the living brain, both healthy and diseased, and also in cardiology. Figure 17-18 compares brain CT, MRI, and PET scans
Romberg sign	Inability to maintain balance when the eyes are shut and the feet are close together
sympathectomy <i>sim-pa-THEK-tō-mē</i>	Interruption of sympathetic nerve transmission either surgically or chemically
trephination <i>tref-i-NĀ-shun</i>	Cutting a piece of bone out of the skull; the instrument used is a trepan (<i>tre-PAN</i>) or trephine (<i>tre-FIN</i>)

Psychoactive Drugs

anxiolytic agent <i>an-tē-ang-ZĪ-e-tē</i>	Relieves anxiety by means of a calming, sedative effect on the CNS; examples are chlordiazepoxide (Librium), diazepam (Valium), alprazolam (Xanax); anxiolytic
antidepressant (other than those listed in separate categories below)	Blocks the reuptake of neurotransmitters such as serotonin, norepinephrine, and dopamine, alone or in combination; examples are bupropion (Wellbutrin, Zyban), mirtazapine (Remeron), nefazodone (Serzone), venlafaxine (Effexor XR), atomoxetine (Strattera)
monoamine oxidase inhibitor (MAOI) <i>mō-nō-A-mēn OK-si-dās</i>	Blocks an enzyme that breaks down norepinephrine and serotonin, thus prolonging their action, for example, phenelzine (Nardil), tranylcypromine (Parnate), isocarboxazid (Marplan)
neuroleptics <i>nū-rō-LEP-tiks</i>	Drugs used to treat psychosis, including schizophrenia, for example, clozapine (Clozaril), haloperidol (Haldol), risperidone (Risperdal), olanzapine (Zyprexa); antipsychotic. Action mechanism unknown, but may interfere with neurotransmitters

(Continued)

Terminology Supplementary Terms (Continued)

selective serotonin reuptake inhibitors (SSRIs) <i>ser-ō-Tō-nin</i>	Block the reuptake of serotonin in the brain, thus increasing levels, for example, fluoxetine (Prozac), citalopram (Celexa), paroxetine (Paxil), sertraline (Zoloft)
stimulants <i>STIM-ū-lantz</i>	Promote activity and a sense of well-being, for example, methylphenidate (Ritalin), dextroamphetamine (Dexedrine), amphetamine + dextroamphetamine (Adderall)
tricyclic antidepressants (TCAs) <i>trī-SI-klik</i>	Block the reuptake of norepinephrine, serotonin, or both, for example, amitriptyline (Elavil), clomipramine (Anafranil), imipramine (Tofranil), doxepin (Sinequan), trimipramine (Surmontil)



Figure 17-17 Babinski reflex. The big toe bends backward and the other toes spread out when the sole of the foot is stroked. This response is normal in infants but indicates a motor lesion in adults.

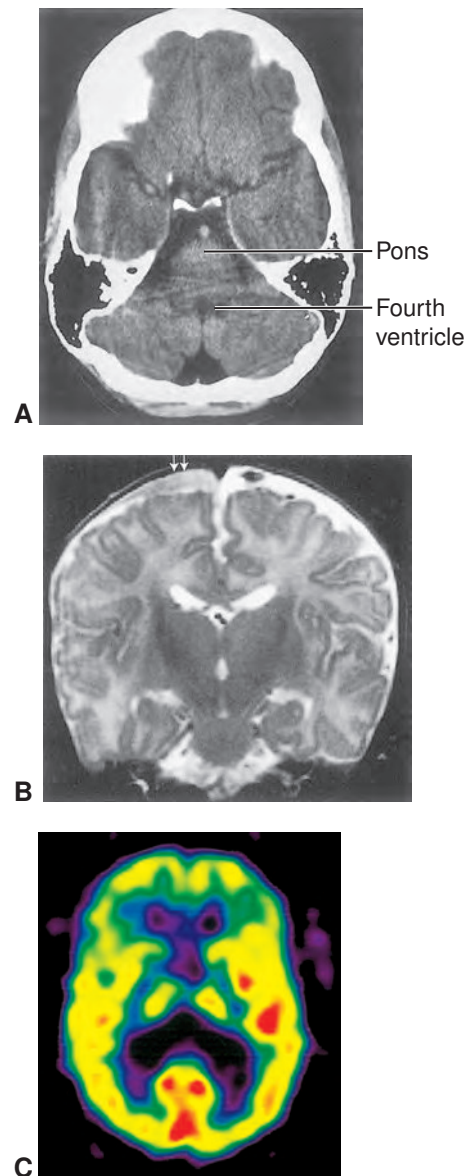


Figure 17-18 Brain images. A. CT scan of a normal adult brain. B. MRI of the brain showing a subdural hematoma (arrows). C. PET scan showing regions of different metabolic activity.

Terminology Abbreviations

ACh	Acetylcholine	LP	Lumbar puncture
AD	Alzheimer disease	MAOI	Monoamine oxidase inhibitor
ADHD	Attention deficit hyperactivity disorder	MID	Multiinfarct dementia
ALS	Amyotrophic lateral sclerosis	MS	Multiple sclerosis
ANS	Autonomic nervous system	NICU	Neurologic intensive care unit; also neonatal intensive care unit
BAEP	Brainstem auditory evoked potentials	NPH	Normal pressure hydrocephalus
CBF	Cerebral blood flow	NREM	Nonrapid eye movement (sleep)
CJD	Creutzfeldt-Jakob disease	OCD	Obsessive-compulsive disorder
CNS	Central nervous system	PDD	Pervasive developmental disorder
CP	Cerebral palsy	PET	Positron emission tomography
CSF	Cerebrospinal fluid	PNS	Peripheral nervous system
CVA	Cerebrovascular accident	PTSD	Posttraumatic stress disorder
CVD	Cerebrovascular disease; also cardiovascular disease	RAS	Reticular activating system
DSM	<i>Diagnostic and Statistical Manual of Mental Disorders</i>	REM	Rapid eye movement (sleep)
DTR	Deep tendon reflexes	SSEP	Somatosensory evoked potentials
EEG	Electroencephalogram; electroencephalograph(y)	SSRI	Selective serotonin reuptake inhibitor
GAD	Generalized anxiety disorder	TCA	Tricyclic antidepressant
ICP	Intracranial pressure	TIA	Transient ischemic attack
LMN	Lower motor neuron	UMN	Upper motor neuron
LOC	Level of consciousness	VEP	Visual evoked potentials

B.C.'s Follow-Up

B.C. was discharged six days after his surgery with mild hemiparesis, which was expected to resolve within the next few weeks. He was scheduled for six weeks of outpatient rehabilitation, and his prognosis was good. The pediatric physical and

occupational therapists were able to motivate B.C. by playing therapeutic games with him, including using a baseball and having him “walk and run the bases.” B.C. was looking forward to rejoining his baseball team next season.

Chapter Review

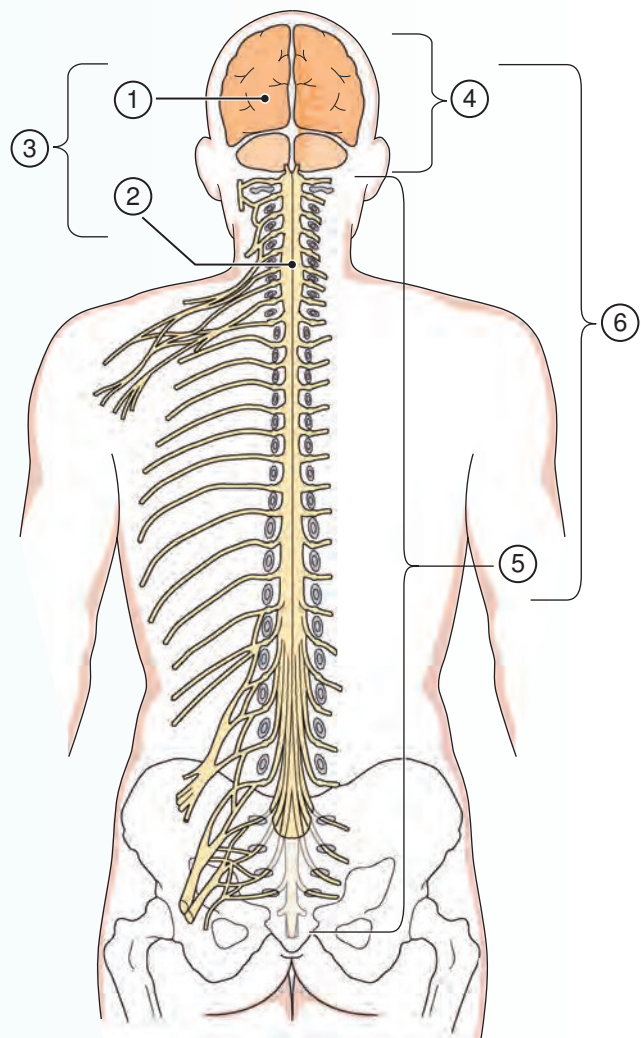
Labeling Exercise

ANATOMIC DIVISIONS OF THE NERVOUS SYSTEM

Write the name of each numbered part on the corresponding line of the answer sheet.

Brain	Peripheral nervous system
Central nervous system	Spinal cord
Cranial nerves	Spinal nerves

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

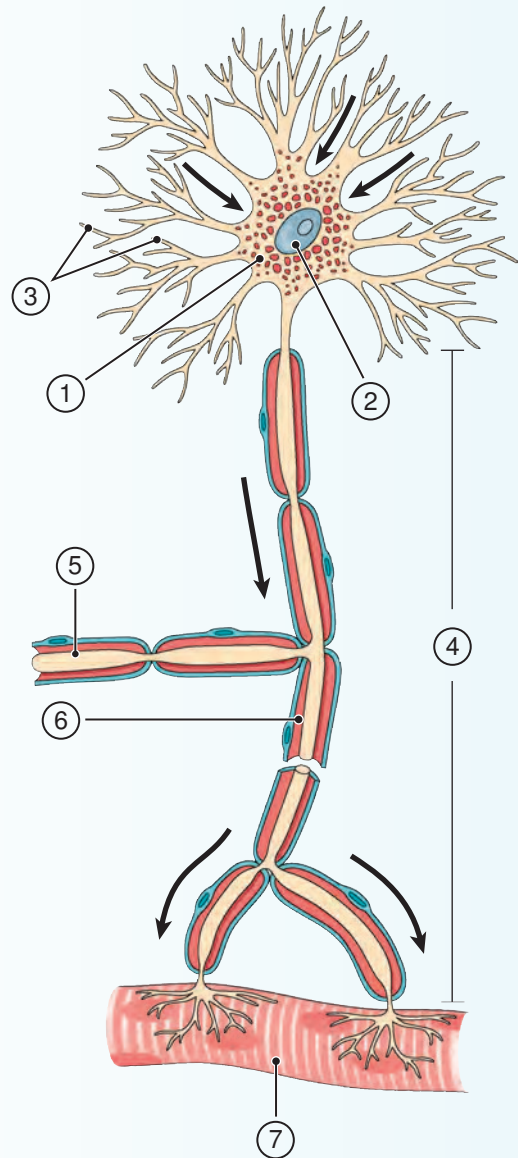


MOTOR NEURON

Write the name of each numbered part on the corresponding line of the answer sheet.

Axon branch	Muscle
Axon covered with myelin sheath	Myelin
Cell body	Nucleus
Dendrites	

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

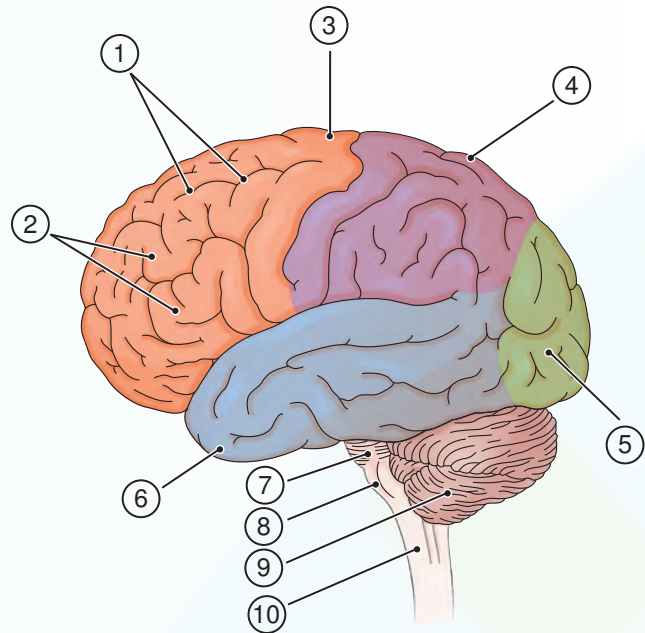


EXTERNAL SURFACE OF THE BRAIN

Write the name of each numbered part on the corresponding line of the answer sheet.

Cerebellum	Parietal lobe
Frontal lobe	Pons
Gyri	Spinal cord
Medulla oblongata	Sulci
Occipital lobe	Temporal lobe

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

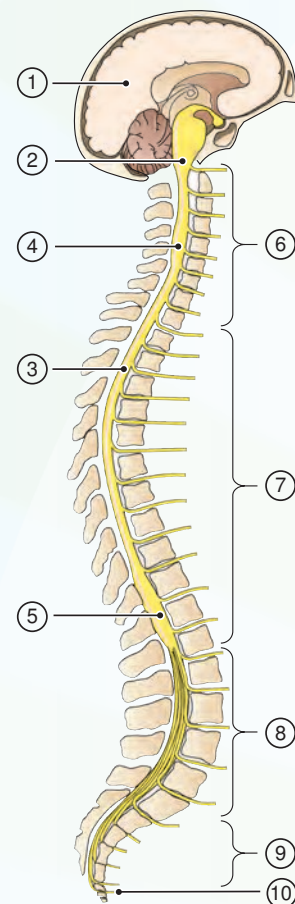


SPINAL CORD, LATERAL VIEW

Write the name of each numbered part on the corresponding line of the answer sheet.

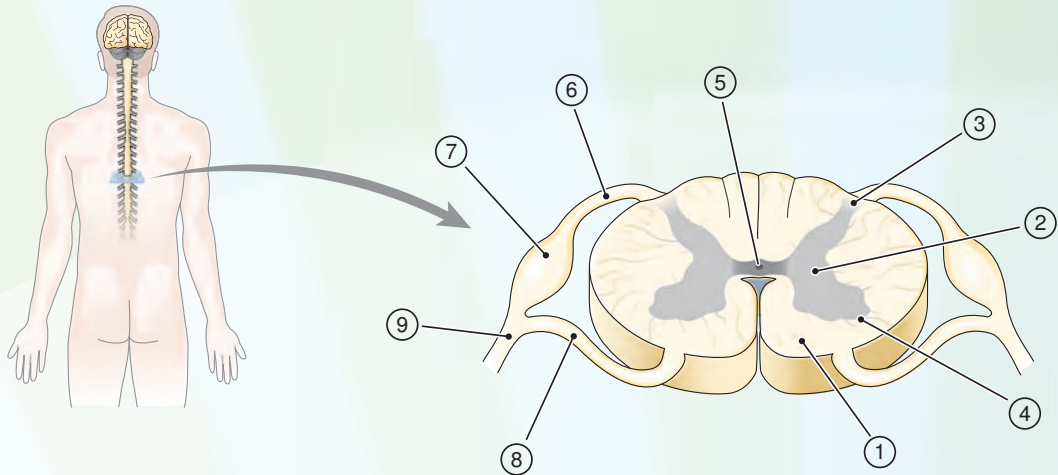
Brain	Lumbar enlargement
Brainstem	Lumbar nerves
Cervical enlargement	Sacral nerves
Cervical nerves	Spinal cord
Coccygeal nerve	Thoracic nerves

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____



SPINAL CORD, CROSS SECTION

Write the name of each numbered part on the corresponding line of the answer sheet.



Central canal	Spinal nerve
Dorsal horn	Ventral horn
Dorsal root ganglion	Ventral root of spinal nerve
Dorsal root of spinal nerve	
Gray matter	White matter

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

REFLEX PATHWAY

Write the name of each numbered part on the corresponding line of the answer sheet.

Effector	Sensory neuron
Motor neuron	Spinal cord (CNS)
Receptor	

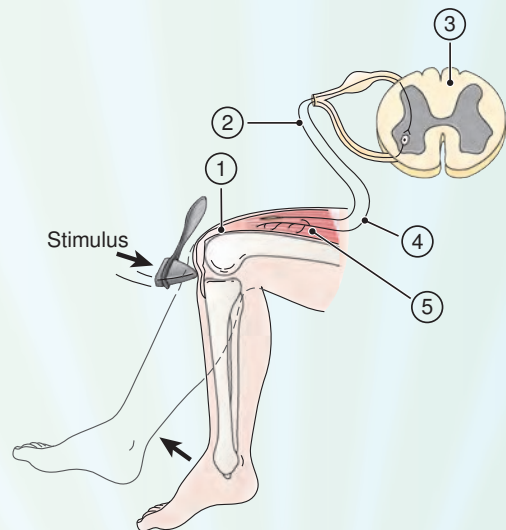
1. _____

2. _____

3. _____

4. _____

5. _____



Terminology

MATCHING

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|----------------------------|---|
| _____ 1. myelin | a. region that connects the brain and spinal cord |
| _____ 2. diencephalon | b. part of the brain that contains the thalamus and pituitary |
| _____ 3. ganglion | c. whitish material that covers some axons |
| _____ 4. medulla oblongata | d. rounded area on the ventral surface of the brainstem |
| _____ 5. pons | e. collection of neuron cell bodies |
| _____ 6. amyloid | a. accumulation of CSF in the brain |
| _____ 7. aphasia | b. excessive fear of pain |
| _____ 8. hydrocephalus | c. substance associated with Alzheimer disease |
| _____ 9. paranoia | d. mental disorder associated with delusions of persecution |
| _____ 10. odynophobia | e. loss of speech communication |
| _____ 11. aneurysm | a. partial paralysis or weakness |
| _____ 12. convulsion | b. paralysis of the bladder |
| _____ 13. meningocele | c. series of violent, involuntary muscle contractions |
| _____ 14. paresis | d. localized dilation of a blood vessel |
| _____ 15. cystoplegia | e. hernia of the meninges and spinal cord |

Supplementary Terms

- | | |
|---------------------------|--|
| _____ 16. plexus | a. network |
| _____ 17. corpus callosum | b. area of skin supplied by a spinal nerve |
| _____ 18. dermatome | c. a neurotransmitter |
| _____ 19. acetylcholine | d. a band of connecting fibers in the brain |
| _____ 20. ictus | e. a sudden blow or attack |
| _____ 21. lethargy | a. fear of being enclosed |
| _____ 22. ataxia | b. state of sluggishness |
| _____ 23. claustrophobia | c. loss of memory |
| _____ 24. euphoria | d. lack of muscle coordination |
| _____ 25. amnesia | e. sense of elation |
| _____ 26. PTSD | a. type of psychoactive drug |
| _____ 27. SSRI | b. system that maintains wakefulness |
| _____ 28. DSM | c. mental disturbances that follow trauma |
| _____ 29. RAS | d. degenerative brain disease |
| _____ 30. CJD | e. reference for diagnosis of mental disorders |

FILL IN THE BLANKS

31. The largest part of the brain is the _____.
32. The scientific name for a nerve cell is _____.
33. The junction between two nerve cells is a(n) _____.
34. The support cells of the nervous system are the _____.
35. The fluid that circulates around the central nervous system is _____.

36. The membranes that cover the brain and spinal cord are the _____.
37. A simple, rapid, automatic response to a stimulus is a(n) _____.
38. The sympathetic and parasympathetic systems make up the _____.
39. A chemical that acts at a synapse is a(n) _____.
40. The posterior portion of the brain that coordinates muscle movement is the _____.

DEFINITIONS

Define the following words:

41. radicular (*ra-DIK-ū-lar*) _____
42. hemiparesis (*hem-i-pa-RĒ-sis*) _____
43. anencephaly (*an-en-SEF-a-lē*) _____
44. polyneuritis (*pol-ē-nū-RĪ-tis*) _____
45. corticothalamic (*kor-ti-kō-tha-LAM-ik*) _____
46. psychotherapy (*si-kō-THER-a-pē*) _____
47. panplegia (*pan-PLĒ-jē-a*) _____
48. encephalomalacia (*en-sef-a-lō-ma-LĀ-shē-a*) _____
49. dysomnia (*dis-SOM-nē-a*) _____

Write words for the following definitions:

50. study of the nervous system _____
51. inflammation of the spinal cord and meninges _____
52. excision of a ganglion _____
53. any disease of the nervous system _____
54. creation of an opening into a brain ventricle _____
55. paralysis of one side of the body _____
56. within the cerebellum _____
57. difficulty in reading _____
58. fear of water _____
59. paralysis of one limb _____

TRUE-FALSE

Examine the following statements. If the statement is true, write T in the first blank. If the statement is false, write F in the first blank and correct the statement by replacing the underlined word in the second blank.

- | | True or False | Correct Answer |
|--|---------------|----------------|
| 60. <u>Sensory</u> fibers conduct impulses toward the CNS. | _____ | _____ |
| 61. CSF forms in the <u>ventricles</u> of the brain. | _____ | _____ |
| 62. The cervical nerves are in the region of the <u>neck</u> . | _____ | _____ |
| 63. Myelinated neurons make up the <u>gray</u> matter of the CNS. | _____ | _____ |
| 64. The spinal nerves are part of the <u>central</u> nervous system. | _____ | _____ |
| 65. The fiber that carries impulses toward the neuron cell body is the <u>axon</u> . | _____ | _____ |

66. There are 12 pairs of cranial nerves. _____
67. The outermost layer of the meninges is the pia mater. _____
68. Hyperlexia refers to increased skill in reading. _____

OPPOSITES

Write a word that means the opposite of the following words:

69. extramedullary _____
70. ipsilateral _____
71. postganglionic _____
72. tachylalia _____
73. motor _____
74. dorsal _____
75. afferent _____

ADJECTIVES

Write the adjective form of the following words:

76. ganglion _____
77. cortex _____
78. dura _____
79. meninges _____
80. psychosis _____

PLURALS

Write the plural form of the following words:

81. ganglion _____
82. ventricle _____
83. meninx _____
84. gyrus _____

ELIMINATIONS

In each of the sets below, underline the word that does not fit in with the rest and explain the reason for your choice.

85. CVA — lumbar puncture — embolism — thrombus — TIA

86. glioma — astrocytoma — meningioma — hematoma — neurilemmoma

87. gyri — sulci — mania — ventricles — lobes

88. MID — CNS — ADHD — OCD — GAD

WORD BUILDING

Write a word for the following definitions using the word parts provided.

-plegia myel/o -a- -itis dys- brady- my/o tetra- -paresis -phasia gangli/o hemi-

89. paralysis of the spinal cord _____
90. lack of speech _____
91. partial paralysis of one side of the body _____
92. muscle weakness _____
93. abnormal or difficult speech production _____
94. paralysis of a ganglion _____
95. paralysis of all four limbs _____
96. inflammation of the spinal cord _____
97. slowness of speech _____
98. paralysis of one side of the body _____
99. inflammation of a ganglion _____

WORD ANALYSIS

Define each of the following words, and give the meaning of the word parts in each. Use a dictionary if necessary.

100. hematomyelia (*hē-ma-tō-mī-Ē-lē-a*) _____
 - a. hemat/o _____
 - b. myel/o _____
 - c. -ia _____
101. myelodysplasia (*mī-e-lō-dis-PLĀ-sē-a*) _____
 - a. myel/o _____
 - b. dys- _____
 - c. plas _____
 - d. -ia _____
102. polyneuroradiculitis (*pol-ē-nū-rō-ra-dik-ū-LĪ-tis*) _____
 - a. poly- _____
 - b. neur/o _____
 - c. radicul/o _____
 - d. -itis _____
103. dyssynergia (*dis-sin-ER-jē-a*) _____
 - a. dys- _____
 - b. syn- _____
 - c. erg _____
 - d. -ia _____

Additional Case Studies

Case Study 17-1: Cerebrovascular Accident (CVA)

A.R., a 62-YO man, was admitted to the ER with right hemiplegia and aphasia. He had a history of hypertension and recent transient ischemic attacks (TIAs), yet was in good health when he experienced a sudden onset of right-sided weakness. He arrived in the ER via ambulance within 15 minutes of onset and was received by a member of the hospital's stroke team. He had a rapid general assessment and neuro exam including a Glasgow Coma Scale (GCS) rating to determine his candidacy for fibrinolytic (clot-dissolving) therapy.

He was sent for a noncontrast CT scan to look for evidence of either hemorrhagic or ischemic stroke, postcardiac

arrest ischemia, hypertensive encephalopathy, craniocerebral or cervical trauma, meningitis, encephalitis, brain abscess, tumor, and subdural or epidural hematoma. The CT scan, read by the radiologist, did not show intracerebral or subarachnoid hemorrhage. A.R. was diagnosed with probable acute ischemic stroke within one hour of the onset of symptoms and was cleared as a candidate for immediate fibrinolytic treatment.

He was admitted to the NICU for 48-hour observation to monitor his neuro status and vital signs. He was discharged after three days with a prognosis of full recovery.

Case Study 17-2: Neuroleptic Malignant Syndrome

J.N., a 21-YO woman with chronic paranoid schizophrenia, was admitted to the hospital with a diagnosis of pneumonia. She was brought to the ER by her mother, who said J.N. had been very lethargic, had a temperature of 104°F, and had had muscular rigidity for three days. Her daily medications included Haldol (haloperidol) and Cogentin (benztropine mesylate). Her mother stated that J.N.'s psychiatrist had changed her neuroleptic medication the week before. Her secondary diagnosis was stated as neuroleptic malignant syndrome, a rare and life-threatening disorder associated with the use of antipsychotic medications. This drug-induced condition is usually characterized by alterations in mental status, temperature regulation, and autonomic and extrapyramidal functions.

J.N. was monitored for potential hypotension, tachycardia, diaphoresis, dyspnea, dysphagia, and changes in her level of consciousness (LOC). Her medications were discontinued, she was hydrated with IV fluids, and her body temperature was monitored for fluctuations. She was treated with bromocriptine, a dopamine antagonist, and dantrolene, a muscle relaxant and antispasmodic.

After five days, J.N. was transferred to a mental health facility and restarted on low-dose neuroleptics. She was monitored to prevent a recurrence of the syndrome. Both J.N. and her family were educated about neuroleptic malignant syndrome in preparation for her discharge back home in two weeks.

CASE STUDY QUESTIONS

Multiple choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|--|---|
| <p>_____ 1. Ischemic stroke is generally caused by:</p> <ul style="list-style-type: none"> a. hemorrhage b. hematoma c. thrombosis d. hemiparesis e. hemangioma | <p>_____ 4. J.N. had disease manifestations related to involuntary functions and to movement controlled by motor fibers outside the pyramidal tracts. These functions are:</p> <ul style="list-style-type: none"> a. antispasmodic and voluntary b. autonomic and neuroleptic c. autonomic and voluntary d. extrapyramidal and pyramidal e. autonomic and extrapyramidal |
| <p>_____ 2. Fibrinolytic therapy is directed toward:</p> <ul style="list-style-type: none"> a. stabilizing blood cells b. destroying RBCs c. triggering blood clotting d. decreasing CSF e. dissolving a blood clot | |
| <p>_____ 3. A general term for any disorder or alteration of brain tissue is:</p> <ul style="list-style-type: none"> a. cerebrocyst b. encephalopathy c. neurocytoma d. dysencephaloma e. psychosomatic | |

Write terms from the case studies with the following meanings:

5. partial paralysis on one side

6. inability to speak or understand speech

7. pertaining to a lack of blood supply

8. inflammation of the meninges

9. collection of blood below the dura mater

10. pertaining to a perceived feeling of threat or harm

11. drug that relieves muscle spasms

12. antipsychotic medications

13. a physician who treats psychiatric disorders

Define the following abbreviations:

14. GCS _____
15. CT _____
16. NICU _____
17. CVA _____
18. TIA _____
19. LOC _____

CHAPTER

18

The Senses

Case Study

K.L.'s Amblyopia

Chief complaint:

K.L., a recently adopted 7-year-old female, was seeing a pediatrician, Dr. McLaren, for the first time. Her new family was concerned that K.L. might have visual problems resulting in self-image and schoolwork issues as one of her eyes appeared to deviate inward. Her physical examination was unremarkable except for the eye exam. Dr. McLaren explained to the parents that K.L. had a condition known as strabismic amblyopia, or a “lazy eye,” and made a referral to an ophthalmologist.

Examination:

Upon examining K.L., the ophthalmologist noted that the left eye deviated toward the medial canthus. A complete visual exam was conducted, and the diagnosis was confirmed. K.L. did have amblyopia, in which one eye has lower visual acuity and is used less than the other eye. She also had slight hyperopia, commonly known as farsightedness. A treatment plan was devised and directed toward the development of normal visual acuity. It was discussed with the parents who decided to move forward with the therapy.

Clinical course:

The ophthalmologist explained to K.L. that they wanted to make her weak eye stronger so she would see much better. This would be accomplished by putting a patch over the strong eye, which should correct the deviation. She would need to wear the patch for a prescribed number of hours a day, and she would also need to wear glasses. She would need to return to see the ophthalmologist so progress could be noted. While K.L. was not sure of the patch, she was excited about wearing glasses since her new mom and sister also wore glasses. She was fitted for glasses and provided with the “band-aid” type of patch to apply over her right eye.



Ancillaries *At-A-Glance*

Visit *thePoint* to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii–xvi.

Learning TOOLS

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning RESOURCES

- E-book: Chapter 18
- Web Figure: The Steps in Hearing
- Web Figure: The External Eye Muscles
- Web Figure: Trachoma
- Web Figure: Diabetic Retinopathy
- Animation: The Retina
- Audio Pronunciation Glossary

Learning ACTIVITIES

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After study of this chapter, you should be able to:

- 1 Explain the role of the sensory system. *p480*
- 2 List the parts of the ear and the eye, and briefly describe the function of each structure. *pp483, 490*
- 3 Describe the pathway of nerve impulses from the ear to the brain. *p483*
- 4 Describe the roles of the retina and the optic nerve in vision. *p491*
- 5 Identify and use word parts pertaining to the senses. *pp482, 485, 495*
- 6 Describe the main disorders pertaining to the ear and the eye. *pp487, 498*
- 7 Interpret abbreviations used in the study of the ear and the eye. *pp490, 504*
- 8 Analyze medical terms in several case studies pertaining to hearing or vision. *pp478, 511*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|---|--|
| <p>_____ 1. The scientific name for the sense of smell is:</p> <ul style="list-style-type: none"> a. osmosis b. dialysis c. olfaction d. gustation | <p>_____ 4. The receptor layer of the eye is the:</p> <ul style="list-style-type: none"> a. lens b. cornea c. retina d. pinna |
| <p>_____ 2. The term <i>tactile</i> refers to the sense of:</p> <ul style="list-style-type: none"> a. pain b. touch c. taste d. temperature | <p>_____ 5. The scientific name for the white of the eye is:</p> <ul style="list-style-type: none"> a. sclera b. vitreous body c. pupil d. conjunctiva |
| <p>_____ 3. The two senses located in the ear are:</p> <ul style="list-style-type: none"> a. hearing and equilibrium b. hearing and vision c. balance and taste d. equilibrium and pressure | <p>_____ 6. Clouding of the lens is termed:</p> <ul style="list-style-type: none"> a. vertigo b. tinnitus c. cataract d. glaucoma |

The sensory system is our network for detecting stimuli from the internal and external environments. It is needed to maintain homeostasis, provide us with pleasure, and protect us from harm. Pain, for example, is an important warning sign of tissue damage. The signals generated in the various **sensory receptors** must be transmitted to the central nervous system for interpretation.

The Senses

The senses are divided according to whether they are widely distributed or localized in special sense organs. The receptors for the general senses are found throughout the body. Many are located in the skin (**Fig. 18-1**). These senses include the following:

- **Pain.** These receptors are found in the skin and also in muscles, joints, and internal organs.
- **Touch,** the **tactile** sense, located in the skin. Sensitivity to touch depends on the concentration of these receptors in different areas, high on the fingers, lips, and tongue, for example, but low at the back of the neck or back of the hand.
- **Pressure,** or deep touch, located beneath the skin and in deeper tissues
- **Temperature.** Receptors for heat and cold are located in the skin and also in the hypothalamus, which regulates body temperature.
- **Proprioception,** the awareness of body position. Receptors in muscles, tendons, and joints help to judge body position and coordinate muscle activity. They also help to maintain muscle tone.

The special senses are localized within complex sense organs in the head. These include the following:

- **Gustation** (taste) is located in receptors in taste buds on the tongue. These receptors basically detect only sweet, sour, bitter, salty, and umami (*oo-MOM-ē*), a savory flavor triggered by certain amino acids and found in proteins and the flavor enhancer MSG. Researchers have also identified receptors for alkali (bases) and metallic taste. The senses of smell and taste are chemical senses; that is, they respond to chemicals in solution.
- **Olfaction** (smell) is located in receptors in the nose. Many more chemicals can be discriminated by smell than by taste. Both senses are important in stimulating appetite and warning of harmful substances.
- **Hearing** receptors are located in the ear. These receptors respond to movement created by sound waves as they travel through the ear.
- **Equilibrium** receptors are also located in the ear. These receptors are activated by changes in the position of cells in the inner ear as we move.
- **Vision** receptors are light-sensitive and located deep within the eye, protected by surrounding bone and

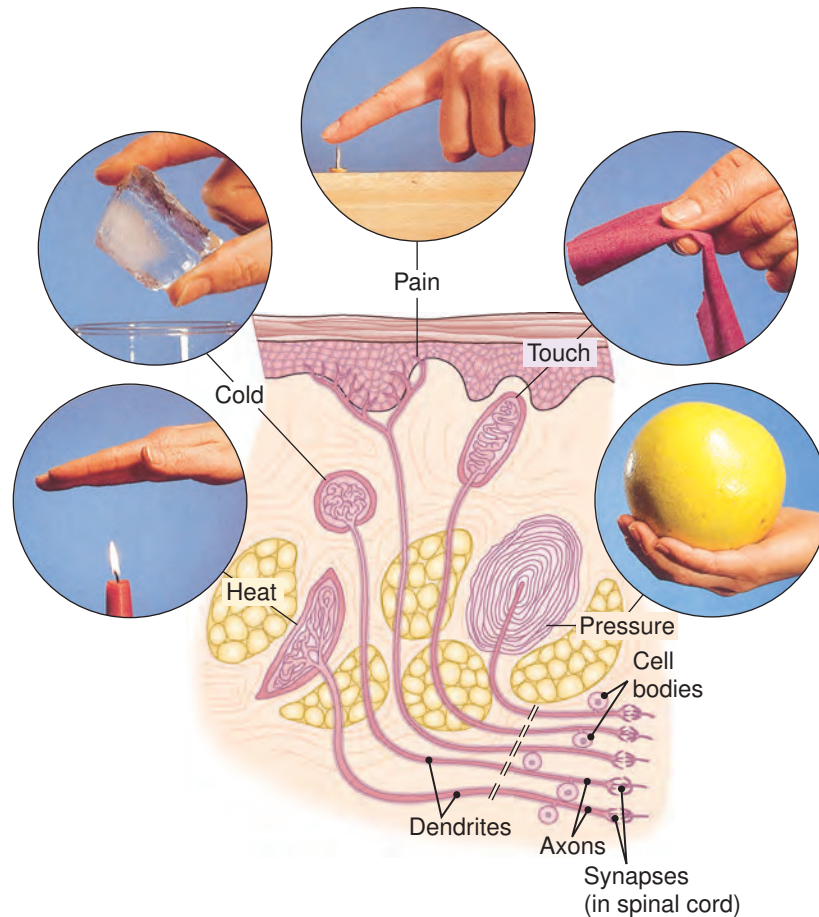


Figure 18-1 Receptors for general senses in the skin. Synapses for these pathways are in the spinal cord.

other support structures. The coordinated actions of external and internal eye muscles help in the formation of a clear image.

Suffixes pertaining to the senses are listed in **Table 18-1**. The remainder of this chapter concentrates on hearing and vision, the senses that have received the most clinical attention.

Terminology

Key Terms

SENSES

Normal Structure and Function

equilibrium <i>ē-kwi-LIB-rē-um</i>	The sense of balance
gustation <i>gus-TĀ-shun</i>	The sense of taste; Latin <i>geusis</i> means “taste”
hearing <i>HER-ing</i>	The sense or perception of sound
olfaction <i>ol-FAK-shun</i>	The sense of smell; root <i>osm/o</i> means “smell”
proprioception <i>prō-prē-ō-SEP-shun</i>	The awareness of posture, movement, and changes in equilibrium; receptors are located in muscles, tendons, and joints

(Continued)

Terminology**Key Terms** (Continued)**sensory receptor**
rē-SEP-tor

A sensory nerve ending or a specialized structure associated with a sensory nerve that responds to a stimulus

tactile
TAK-til

Pertaining to the sense of touch

vision
VIZH-un

The sense by which the shape, size, and color of objects are perceived by means of the light they give off



Go to the Audio Pronunciation Glossary in the Student Resources on thePoint to hear these terms pronounced.

Table 18-1**Suffixes Pertaining to the Senses**

Suffix	Meaning	Example	Definition of Example
-esthesia	sensation	cryesthesia <i>kri-es-THĒ-zē-a</i>	sensitivity to cold
-algnesia	pain	hypalgesia* <i>hi-pal-JĒ-zē-a</i>	decreased sensitivity to pain
-osmia	sense of smell	pseudosmia <i>sū-DOS-mē-a</i>	false sense of smell
-geusia	sense of taste	parageusia <i>par-a-GŪ-zē-a</i>	abnormal (para-) sense of taste

*Prefix hyp/o.

EXERCISE 18-1**Define the following words:**

1. dysesthesia (*dis-es-THĒ-zē-a*)
2. parosmia (*par-OZ-mē-a*)
3. ageusia (*a-GŪ-zē-a*)

Write words for the following definitions:

4. lack (an-) of sensation
5. false sense of taste
6. sensitivity to temperature
7. excess sensitivity to pain
8. abnormal (dys-) sense of taste
9. muscular (my/o-) sensation

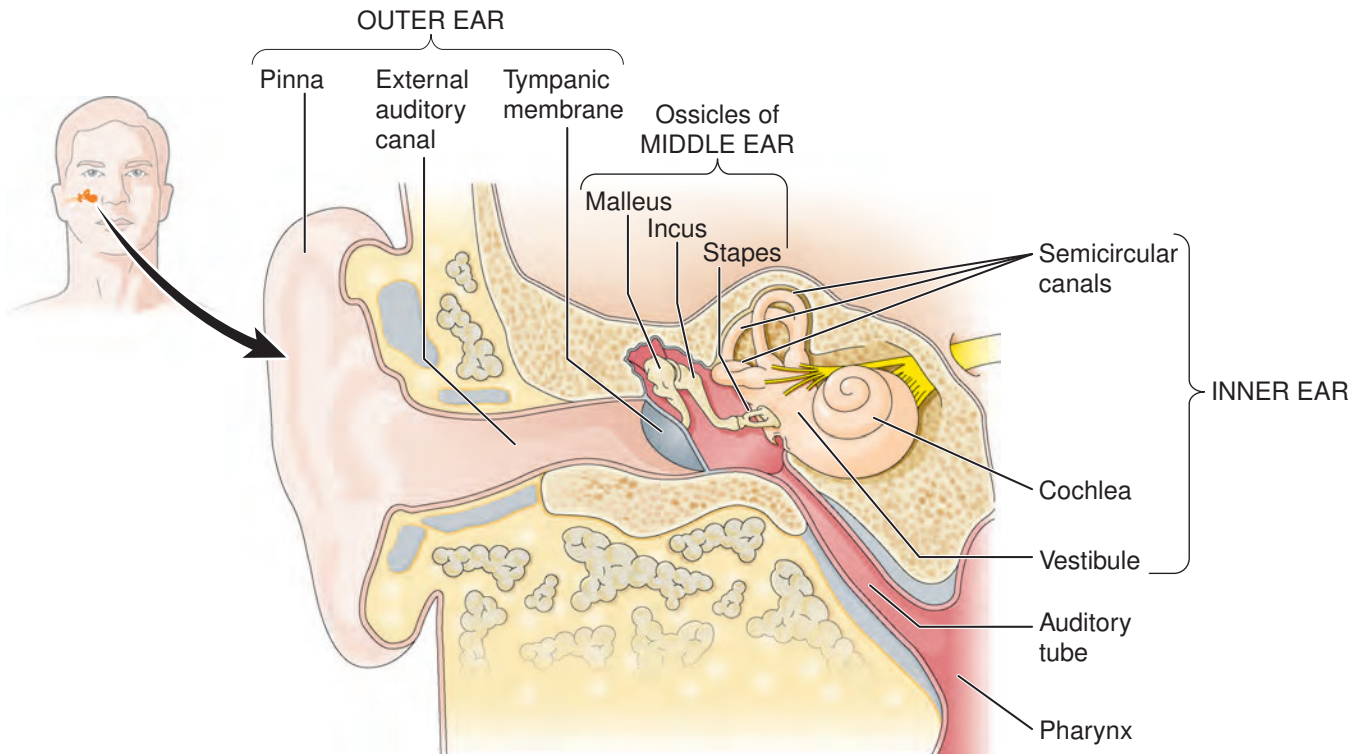


Figure 18-2 The ear. Structures in the outer, middle, and inner divisions are shown.

The Ear

The ear has the receptors for both hearing and equilibrium. For study purposes, it may be divided into three parts: the outer, middle, and inner ear (**Fig. 18-2**).

The outer ear consists of the projecting **pinna** (auricle) and the **external auditory canal** (meatus). This canal ends at the **tympanic membrane**, or eardrum, which transmits sound waves to the middle ear. Glands in the external canal produce a waxy material, **cerumen**, which protects the ear and helps to prevent infection.

Spanning the middle ear cavity are three **ossicles** (small bones), each named for its shape: the **malleus** (hammer), **incus** (anvil), and **stapes** (stirrup) (**Fig. 18-3**). Sound waves traveling over the ossicles are transmitted from the footplate of the stapes to the inner ear. The **auditory tube** connects the middle ear with the nasopharynx and serves to equalize pressure between the outer ear and the middle ear.

The inner ear, because of its complex shape, is described as a **labyrinth**, which means “maze” (**Fig. 18-4**). It consists of an outer bony framework containing a similarly shaped membranous channel. The entire labyrinth is filled with fluid.

The **cochlea**, shaped like a snail’s shell, has the specialized **spiral organ** (organ of Corti), which is concerned with hearing. Cells in this receptor organ respond to sound waves traveling through the cochlea’s fluid-filled ducts. Sound waves enter the cochlea from the base of the stapes through an opening, the oval window, and leave through another opening, the round window (**see Fig. 18-4**).

The sense of equilibrium is localized in the **vestibular apparatus**. This structure consists of the chamber-like **vestibule** and three projecting **semicircular canals**. Special cells within the vestibular apparatus respond to movement. (The senses of vision and proprioception are also important in maintaining balance.)

Nerve impulses are transmitted from the ear to the brain by way of the **vestibulocochlear nerve**, the eighth cranial nerve,

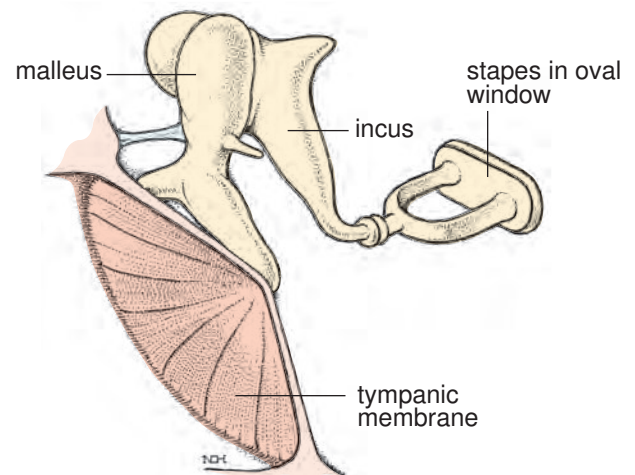


Figure 18-3 The ossicles of the middle ear. The malleus is in contact with the tympanic membrane. The base of the stapes is in contact with the oval window of the inner ear.

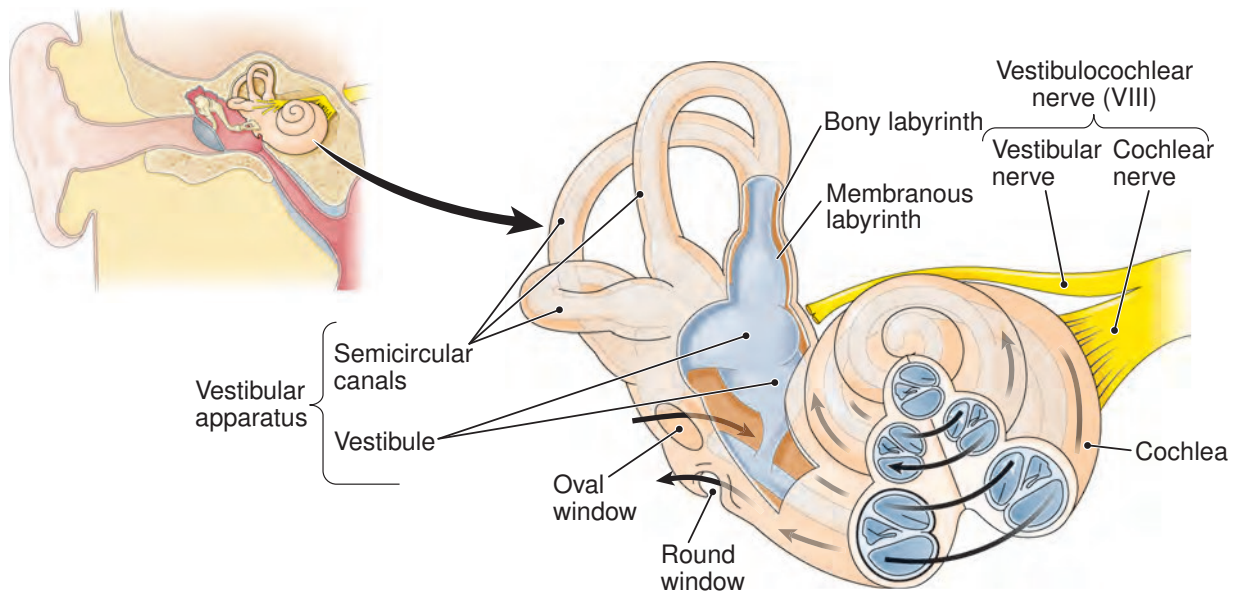


Figure 18-4 The inner ear. The outer bony labyrinth contains the membranous labyrinth. Receptors for equilibrium are in the vestibule and the semicircular canals. The cochlea contains the hearing receptor, the spiral organ. Sound waves enter the cochlea through the oval window, travel through the cochlea, and exit through the round window. The inner ear transmits impulses to the brain in the vestibulocochlear nerve (eighth cranial nerve).

also called the acoustic or auditory nerve. The cochlear branch of this nerve transmits impulses for hearing from the cochlea; the vestibular branch transmits impulses concerned with equilibrium from the vestibular apparatus (see Fig. 18-4). Roots pertaining to the ear and hearing are in Table 18-2.



See the figure “The Steps in Hearing” in the Student Resources on thePoint.

Terminology

Key Terms

THE EAR

Normal Structure and Function

auditory tube <i>aw-dī-TŌ-rē</i>	The tube that connects the middle ear with the nasopharynx and serves to equalize pressure between the outer and middle ear (root: salping/o); pharyngotympanic tube; originally called the eustachian (<i>ū-STĀ-shen</i>) tube
cerumen <i>se-RŪ-men</i>	The brownish, wax-like secretion formed in the external ear canal to protect the ear and prevent infection; adjective: ceruminous (<i>se-RŪ-mi-nus</i>)
cochlea <i>KOK-lē-a</i>	The coiled portion of the inner ear that contains the receptors for hearing (root: cochle/o)
external auditory canal	Tube that extends from the pinna of the ear to the tympanic membrane; external auditory meatus
incus <i>ING-kus</i>	The middle ossicle of the ear
labyrinth <i>LAB-i-rinth</i>	The inner ear, named for its complex structure, which resembles a maze

Terminology**Key Terms** *(Continued)*

malleus <i>MAL-ē-us</i>	The ossicle of the middle ear that is in contact with the tympanic membrane and the incus
ossicles <i>OS-i-klz</i>	The small bones of the middle ear; the malleus, incus, and stapes
pinna <i>PIN-a</i>	The projecting part of the outer ear; auricle (<i>AW-ri-kl</i>)
semicircular canals	The three curved channels of the inner ear that hold receptors for equilibrium
spiral organ <i>SPĪ-ral</i>	The hearing receptor, which is located in the cochlea of the inner ear; organ of Corti (<i>KOR-tē</i>)
stapes <i>STĀ-pēz</i>	The ossicle that is in contact with the inner ear (roots: staped/o, stapedi/o)
tympanic membrane <i>tim-PAN-ik</i>	The membrane between the external auditory canal and the middle ear (tympanic cavity); the eardrum. It serves to transmit sound waves to the ossicles of the middle ear (roots: myring/o, tympan/o)
vestibular apparatus <i>ves-TIB-ū-lar</i>	The portion of the inner ear that is concerned with the sense of equilibrium; consists of the vestibule and the semicircular canals (root: vestibule/o)
vestibule <i>VES-ti-būl</i>	The chamber in the inner ear that holds some of the receptors for equilibrium
vestibulocochlear nerve <i>ves-tib-ū-lō-KOK-lē-ar</i>	The nerve that transmits impulses for hearing and equilibrium from the ear to the brain; eighth cranial nerve; auditory or acoustic nerve



Go to the Audio Pronunciation Glossary in the Student Resources on *thePoint* to hear these terms pronounced.

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Table 18-2**Roots Pertaining to the Ear and Hearing**

Root	Meaning	Example	Definition of Example
audi/o	hearing	audiology <i>aw-dē-OL-ō-jē</i>	the study of hearing
acous, acus, cus	sound, hearing	acoustic <i>a-KŪ-stik</i>	pertaining to sound or hearing
ot/o	ear	ototoxic <i>ō-tō-TOKS-ik</i>	poisonous or harmful to the ear
myring/o	tympanic membrane	myringotomy <i>mi-RING-gō-tōm</i>	knife used for surgery on the eardrum
tympan/o	tympanic cavity (middle ear), tympanic membrane	tympanometry <i>tim-pa-NOM-e-trē</i>	measurement of transmission through the tympanic membrane and middle ear

(Continued)

Table 18-2 Roots Pertaining to the Ear and Hearing (*Continued*)

Root	Meaning	Example	Definition of Example
salping/o	tube, auditory tube	salpingoscopy <i>sal-ping-GOS-kō-pē</i>	endoscopic examination of the auditory tube
staped/o, stapedi/o	stapes	stapedoplasty <i>stā-pē-dō-PLAS-tē</i>	plastic repair of the stapes
labyrinth/o	labyrinth (inner ear)	labyrinthitis <i>lab-i-rin-THĪ-tis</i>	inflammation of the inner ear (labyrinth)
vestibul/o	vestibule, vestibular apparatus	vestibulotomy <i>ves-tib-ū-LOT-ō-mē</i>	incision of the vestibule of the inner ear
cochle/o	cochlea (of inner ear)	retrocochlear <i>ret-rō-KOK-lē-ar</i>	behind the cochlea

EXERCISE 18-2**Fill in the blanks:**

1. Audition (*aw-DISH-un*) is the act of _____
2. Hyperacusis (*hī-per-a-KŪ-sis*) is abnormally high sensitivity to _____
3. Otogenic (*ō-tō-JEN-ik*) means originating in the _____

Define the following adjectives:

4. auditory (*AW-di-tor-ē*) _____
5. otic (*Ō-tik*) _____
6. labyrinthine (*lab-i-RIN-thēn*) _____
7. stapedial (*stā-PĒ-dē-al*) _____
8. vestibular (*ves-TIB-ū-lar*) _____
9. cochlear (*KOK-lē-ar*) _____

Write words for the following definitions:

10. pain in the ear _____
11. measurement of hearing (audi/o-) _____
12. plastic repair of the middle ear _____
13. incision of the tympanic membrane _____
14. within the cochlea _____
15. pertaining to the vestibular apparatus and cochlea _____
16. incision of the labyrinth _____
17. endoscope for examining the auditory tube _____
18. excision of the stapes _____

EXERCISE 18-2 (Continued)

Define the following words:

19. otitis (*ō-TĪ-tis*)20. audiometer (*aw-dē-OM-e-ter*)21. vestibulopathy (*ves-tib-ū-LOP-a-thē*)22. salpingopharyngeal (*sal-ping-gō-fa-RIN-jē-al*)23. myringoscope (*mi-RING-gō-skōp*)

Clinical Aspects of Hearing

HEARING LOSS

Hearing impairment may result from disease, injury, or developmental problems that affect the ear itself or any nervous pathways concerned with the sense of hearing.

Sensorineural hearing loss results from damage to the inner ear, the eighth cranial nerve, or central auditory pathways. Heredity, toxins, exposure to loud noises, and the aging process are possible causes for this type of hearing loss. It may range from inability to hear certain sound frequencies to a complete loss of hearing (deafness). People with extreme hearing loss that originates in the inner ear may benefit from a cochlear implant. This prosthesis stimulates the cochlear nerve directly, bypassing the receptor cells of the inner ear, and may allow the recipient to hear medium to loud sounds.

Conductive hearing loss results from blockage in sound transmission to the inner ear. Causes include obstruction, severe infection, or fixation of the middle ear ossicles. Often, physicians can successfully treat the conditions that cause conductive hearing loss.

Box 18-1 has information on careers in audiology, the study and treatment of hearing disorders.

OTITIS

Otitis is any inflammation of the ear. **Otitis media** refers to an infection that leads to fluid accumulation in the middle ear cavity. One cause is malfunction or obstruction of the auditory tube, as by allergy, enlarged adenoids, injury, or congenital abnormalities. Another cause is infection that spreads to the middle ear, most commonly from the upper respiratory tract. Continued infection may lead to accumulation of pus and perforation of the eardrum. Otitis media usually affects children under 5 years of age and may result in hearing loss. If not treated with antibiotics, the infection may spread to other regions of the ear and head. An incision, a **myringotomy**, and placement of a tube in the tympanic membrane helps to ventilate and drain the middle ear cavity in cases of otitis media.

Otitis externa is inflammation of the external auditory canal caused by repeated fungal or bacterial infections.

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Box 18-1



Health Professions

Audiologists

Audiologists specialize in preventing, diagnosing, and treating hearing disorders that may be caused by injury, infection, birth defects, noise, or aging. They take a complete patient history to diagnose hearing disorders and use specialized equipment to measure hearing acuity. Audiologists design and implement individualized treatment plans, which may include fitting clients with assistive listening devices, such as hearing aids, or teaching alternative communication skills, such as lip reading. Audiologists also measure workplace and community noise levels and teach the public how to prevent hearing loss. Whereas in the past, audiologists had to have only a master's degree, a doctoral degree is increasingly

required for licensure in the United States. All 50 states require practicing audiologists to pass a national licensing exam and be registered or licensed. In some states, audiologists who dispense hearing aids must have a hearing aid dispenser license, which is separate from their license to practice audiology.

Audiologists work in a variety of settings, such as hospitals, nursing care facilities, schools, clinics, and industry. Job prospects are good, as the need for audiologists' specialized skills will increase as populations age. The American Academy of Audiology at www.audiology.org has more information on this career.

It is most common among those living in hot climates and among swimmers, leading to the alternative name, “swimmer’s ear.”

OTOSCLEROSIS

In **otosclerosis**, the bony structure of the inner ear deteriorates and then reforms into spongy bone tissue that may eventually harden. Most commonly, the stapes becomes fixed against the inner ear and is unable to vibrate, resulting in conductive hearing loss. The cause of otosclerosis is unknown, but some cases are hereditary. Surgeons usually can remove the damaged bone. In a **stapedectomy**, the stapes is removed, and a prosthetic bone is inserted.

MÉNIÈRE DISEASE

Ménière disease is a disorder that affects the inner ear. It seems to involve production and circulation of the fluid that

fills the inner ear, but the cause is unknown. The symptoms include **vertigo** (dizziness), hearing loss, **tinnitus** (ringing in the ears), and a feeling of pressure in the ear. The course of the disease is uneven, and symptoms may become less severe with time. Ménière disease is treated with drugs to control nausea and dizziness, such as those used to treat motion sickness. In severe cases, the inner ear or part of the eighth cranial nerve may be surgically destroyed.

ACOUSTIC NEUROMA

An **acoustic neuroma** (also called schwannoma or neurilemmoma) is a tumor that arises from the neurilemma (sheath) of the eighth cranial nerve. As the tumor enlarges, it presses on surrounding nerves and interferes with blood supply. This leads to tinnitus, dizziness, and progressive hearing loss. Other symptoms develop as the tumor presses on the brainstem and other cranial nerves. Usually, it is necessary to remove the tumor surgically.

Terminology

Key Terms

THE EAR

Disorders

acoustic neuroma <i>a-KŪ-stik nŭ-RŌ-ma</i>	A tumor of the eighth cranial nerve sheath; although benign, it can press on surrounding tissue and produce symptoms; also called an acoustic or vestibular schwannoma or acoustic neurilemmoma
conductive hearing loss	Hearing impairment that results from blockage of sound transmission to the inner ear
Ménière disease <i>men-NYÄR</i>	A disease associated with increased fluid pressure in the inner ear and characterized by hearing loss, vertigo, and tinnitus
otitis externa <i>ō-TĪ-tis ex-TER-na</i>	Inflammation of the external auditory canal; swimmer’s ear
otitis media <i>ō-TĪ-tis MĒ-dē-a</i>	Inflammation of the middle ear with accumulation of serous (watery) or mucoid fluid
otosclerosis <i>ō-tō-skle-RŌ-sis</i>	Formation of abnormal and sometimes hardened bony tissue in the ear. It usually occurs around the oval window and the footplate (base) of the stapes, causing immobilization of the stapes and progressive hearing loss
sensorineural hearing loss <i>sen-sō-rē-NŪ-rāl</i>	Hearing impairment that results from damage to the inner ear, eighth cranial nerve, or auditory pathways in the brain
tinnitus <i>TIN-i-tus</i>	A sensation of noises, such as ringing or tinkling, in the ear; also pronounced <i>tī-NĪ-tus</i>
vertigo <i>VER-ti-gō</i>	An illusion of movement, as of the body moving in space or the environment moving about the body; usually caused by disturbances in the vestibular apparatus. Used loosely to mean dizziness or lightheadedness

Treatment

myringotomy <i>mir-in-GOT-ō-mē</i>	Surgical incision of the tympanic membrane; performed to drain the middle ear cavity or to insert a tube into the tympanic membrane for drainage
stapedectomy <i>stā-pē-DEK-tō-mē</i>	Surgical removal of the stapes; it may be combined with insertion of a prosthesis to correct otosclerosis

Terminology Supplementary Terms

Normal Structure and Function

aural <i>AW-ral</i>	Pertaining to or perceived by the ear
decibel (dB) <i>DES-i-bel</i>	A unit for measuring the relative intensity of sound
hertz (Hz)	A unit for measuring the frequency (pitch) of sound
mastoid process	A small projection of the temporal bone behind the external auditory canal; it consists of loosely arranged bony material and small, air-filled cavities
stapedius <i>stā-PĒ-dē-us</i>	A small muscle attached to the stapes. It contracts in the presence of a loud sound, producing the acoustic reflex

Symptoms and Conditions

cholesteatoma <i>kō-les-tē-a-TŌ-ma</i>	A cyst-like mass containing cholesterol that is most common in the middle ear and mastoid region; a possible complication of chronic middle ear infection
labyrinthitis <i>lab-i-rin-THĪ-tis</i>	Inflammation of the ear's labyrinth (inner ear); otitis interna
mastoiditis <i>mas-toyd-Ī-tis</i>	Inflammation of the air cells of the mastoid process
presbycusis <i>prez-bē-KŪ-sis</i>	Loss of hearing caused by aging; also presbycusis

Diagnosis and Treatment

audiometry <i>aw-de-OM-e-trē</i>	Measurement of hearing
electronystagmography (ENG) <i>ē-lek-trō-nis-tag-MOG-ra-fē</i>	A method for recording eye movements by means of electrical responses; such movements may reflect vestibular dysfunction
otorhinolaryngology (ORL) <i>ō-tō-rī-nō-lar-in-GOL-ō-jē</i>	The branch of medicine that deals with diseases of the ear(s), nose, and throat (ENT); also called otolaryngology (OL)
otoscope <i>Ō-tō-skōp</i>	Instrument for examining the ear (see Fig. 7-6)
Rinne test <i>RIN-nē</i>	Test that measures hearing by comparing results of bone conduction and air conduction (Fig. 18-5). Bone conduction is tested through the mastoid process behind the ear
spondee <i>spon-dē</i>	A two-syllable word with equal stress on each syllable; used in hearing tests; examples are toothbrush, baseball, cowboy, pancake
Weber test	Test for hearing loss that uses a vibrating tuning fork placed at the center of the head (Fig. 18-6)



Go the Audio Pronunciation Glossary in the Student Resources on *thePoint* to hear these terms pronounced.

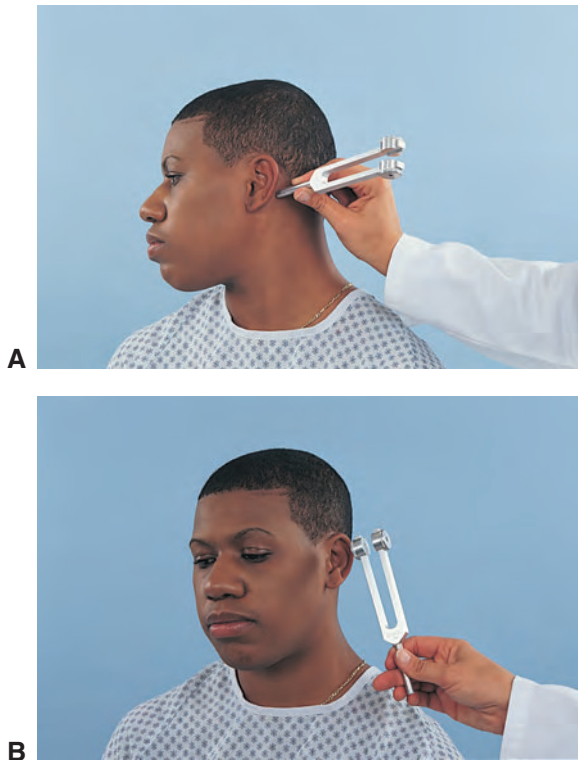


Figure 18-5 The Rinne test. This test assesses both bone and air conduction of sound. **A.** Test of bone conduction through the mastoid process behind the ear. **B.** Test of air conduction.



Figure 18-6 The Weber test. This test assesses bone conduction of sound.

Terminology Abbreviations

The Ear

ABR	Auditory brainstem response
AC	Air conduction
BAEP	Brainstem auditory evoked potentials
BC	Bone conduction
dB	Decibel
ENG	Electronystagmography
ENT	Ear(s), nose, and throat
HL	Hearing level
Hz	Hertz
OL	Otolaryngology
OM	Otitis media
ORL	Otorhinolaryngology
ST	Speech threshold
TM	Tympanic membrane
TTS	Temporary threshold shift

The Eye and Vision

The eye is protected by its position within a bony socket or **orbit**. It is also protected by the eyelids, or **palpebrae**; eyebrows; and eyelashes (Fig. 18-7). The **lacrimal** (tear) **glands** (Fig. 18-8) constantly bathe and cleanse the eyes with a lubricating fluid that drains into the nose. The protective **conjunctiva** is a thin membrane that lines the eyelids and covers the anterior portion of the eye. This membrane folds

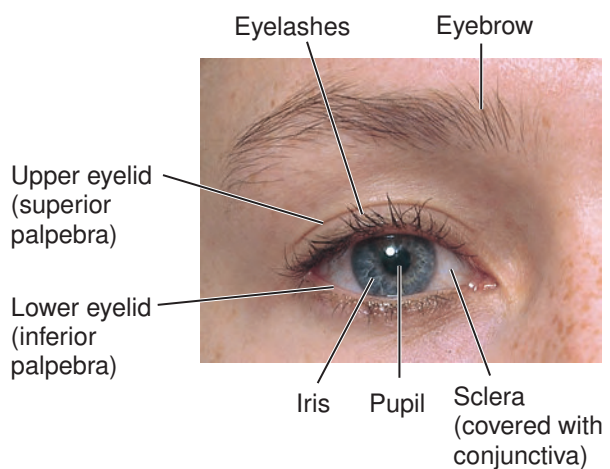


Figure 18-7 Protective structures of the eye.

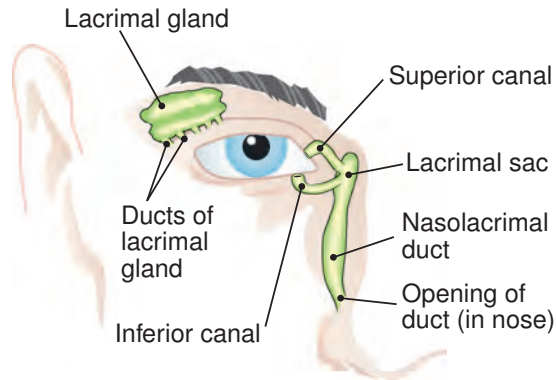


Figure 18-8 **Lacrimal apparatus.** The right lacrimal (tear) gland and its associated ducts are shown.

back to form a narrow space between the eyeball and the eyelids. Medications, such as eye drops and eye ointments, can be instilled into this conjunctival sac.

The wall of the eye is composed of three layers (**Fig. 18-9**). Named from outermost to innermost, they are as follows:

1. The **sclera**, commonly called the *white of the eye*, is the tough surface protective layer. The sclera extends over the eye's anterior portion as the transparent **cornea**.
2. The **uvea** is the middle layer, which consists of the:

- **Choroid**, a vascular and pigmented layer located in the posterior portion of the eyeball. The choroid provides nourishment for the retina.
- **Ciliary body**, which contains a muscle that controls the shape of the **lens** to allow for near and far vision, a process known as **accommodation** (**Fig. 18-10**). The lens must become more rounded for viewing close objects.
- **Iris**, a muscular ring that controls the size of the **pupil**, thus regulating the amount of light that enters the eye (**Fig. 18-11**). The genetically controlled pigments of the iris determine eye color.

3. The **retina** is the innermost layer and the actual visual receptor. It consists of two types of specialized cells that respond to light:

- The **rods** function in dim light, provide low **visual acuity** (sharpness), and do not respond to color.
- The **cones** are active in bright light, have high visual acuity, and respond to color.

Proper vision requires the **refraction** (bending) of light rays as they pass through the eye to focus on a specific point on the retina. The impulses generated within the rods and cones are transmitted to the brain by way of the optic nerve (second cranial nerve). Where the optic nerve connects to the retina, there are no rods or cones. This point, at which

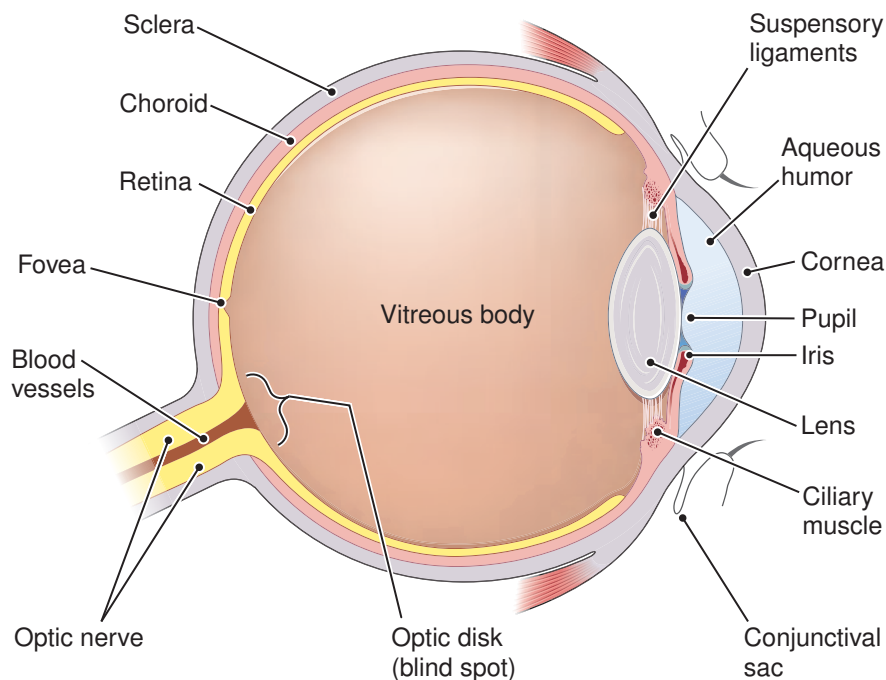


Figure 18-9 **The eye.** The three layers of the eyeball are shown along with other structures involved in vision.

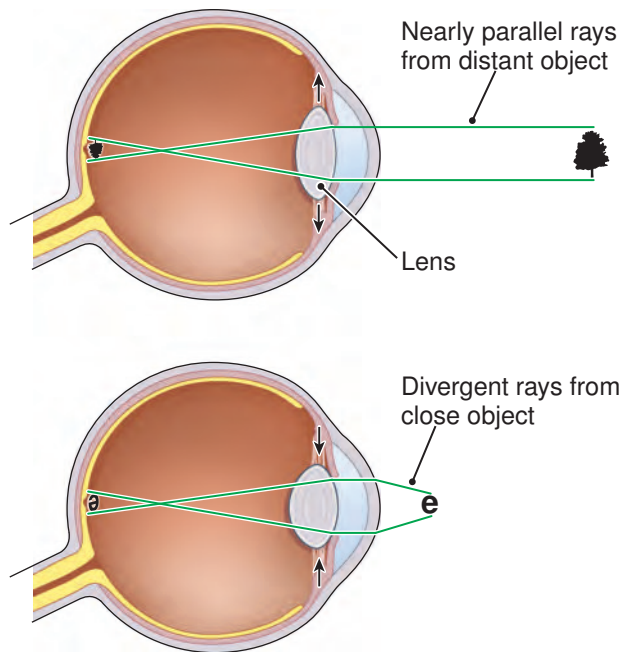


Figure 18-10 Accommodation for near vision. When viewing a close object, the lens must become more rounded to focus light rays on the retina.

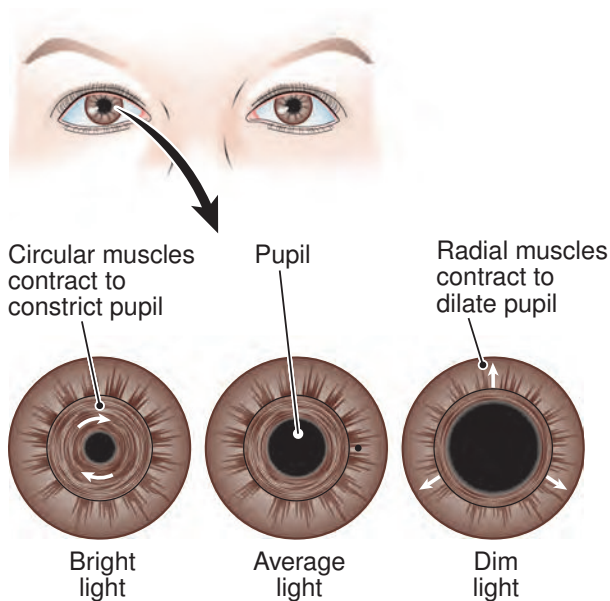


Figure 18-11 Function of the iris. In bright light, muscles in the iris constrict the pupil, limiting the light that enters the eye. In dim light, the iris dilates the pupil to allow more light to enter the eye.

there is no visual perception, is called the **optic disk**, or blind spot (see Fig. 18-9). The **fovea** is a tiny depression in the retina near the optic nerve that has a high concentration of cones and is the point of greatest visual acuity. The fovea is surrounded by a yellowish spot called the **macula** (Fig. 18-12).

The eyeball is filled with a jelly-like **vitreous body** (see Fig. 18-9), which helps maintain the shape of the eye and also refracts light. The **aqueous humor** is the fluid that fills the eye anterior to the lens, maintaining the cornea's shape and refracting light. This fluid is constantly produced and drained from the eye.

Six muscles attached to the outside of each eye coordinate eye movements to achieve **convergence**, that is, coordinated movement of the eyes so that they both are fixed on the same point.

Box 18-2 explores the Greek origins of some medical words, including some pertaining to the eye.



See the figure on the external eye muscles and the animation “The Retina” in the Student Resources on thePoint.

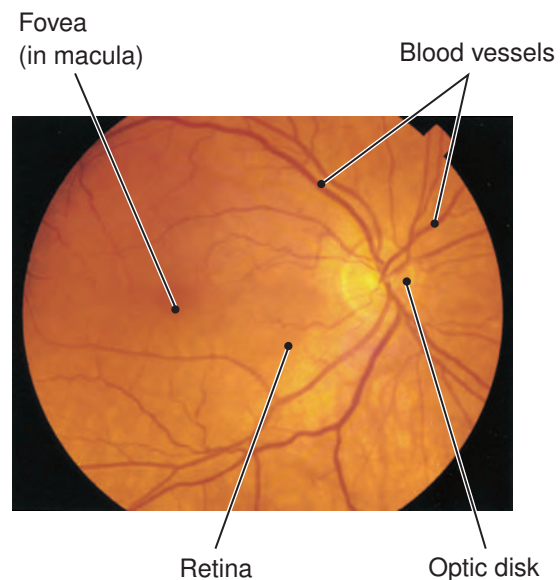


Figure 18-12 The fundus (back) of the eye as seen through an ophthalmoscope. The optic disk (blind spot) is shown as well as the fovea, the point of sharpest vision, in the retina.

Box 18-2



Focus on Words

The Greek Influence

Some of our most beautiful (and difficult to spell and pronounce) words come from Greek. *Esthesi/o* means “sensation.” It appears in the word *anesthesia*, a state in which there is lack of sensation, particularly pain. It is found in the word *esthetics* (also spelled *aesthetics*), which pertains to beauty, artistry, and appearance. The prefix *presby*, in the terms *presbycusis* and *presbyopia*, means “old,” and these conditions appear with aging. The root *cycl/o*, pertaining to the ring-like ciliary body of the eye, is from the Greek word for circle or wheel. The same root appears in the words *bicycle* and *tricycle*. Also pertaining to the eye, the term *iris* means “rainbow” in Greek, and the iris is the colored part of the eye.

The root *-sthen/o* means “strength” and occurs in the words *asthenia*, meaning lack of strength, or weakness, and *neurasthenia*, an old term for vague “nervous exhaustion” now applied to

conditions involving chronic symptoms of generalized fatigue, anxiety, and pain. The root also appears in the word *calisthenics* in combination with the root *cali-*, meaning “beauty.” So the rhythmic strengthening and conditioning exercises that are done in calisthenics literally give us beauty through strength.

The Greek root *steth/o* means “chest,” although a stethoscope is used to listen to sounds in other parts of the body as well as the chest.

Asphyxia is derived from the Greek root *sphygm/o* meaning “pulse.” The word is literally “stoppage of the pulse,” which is exactly what happens when one suffocates. This same root is found in *sphygmomanometer*, the apparatus used to measure blood pressure. One look at the word and one attempt to pronounce it makes it clear why most people call the device a blood pressure cuff!

18

Terminology

Key Terms

THE EYE

Normal Structure and Function

accommodation <i>a-kom-ō-DĀ-shun</i>	Adjustment of the lens's curvature to allow for vision at various distances
aqueous humor <i>AK-wē-us</i>	Fluid that fills the eye anterior to the lens
choroid <i>KOR-oyd</i>	The dark, vascular, middle layer of the eye (roots: <i>chori/o</i> , <i>choroid/o</i>); part of the uvea (see below)
ciliary body <i>SIL-ē-ar-ē</i>	The muscular portion of the uvea that surrounds the lens and adjusts its shape for near and far vision (root: <i>cycl/o</i>)
cone	A specialized cell in the retina that responds to light; cones have high visual acuity, function in bright light, and respond to colors
conjunctiva <i>kon-junk-TĪ-va</i>	The mucous membrane that lines the eyelids and covers the eyeball's anterior surface
convergence <i>kon-VER-jens</i>	Coordinated movement of the eyes toward fixation on the same point
cornea <i>KOR-nē-a</i>	The clear, anterior portion of the sclera (roots: <i>corne/o</i> , <i>kerat/o</i>)
fovea <i>FŌ-vē-a</i>	The tiny depression in the retina that is the point of sharpest vision; fovea centralis, central fovea

(Continued)

Terminology Key Terms *(Continued)*

iris <i>Ī-ris</i>	The muscular colored ring between the lens and the cornea; regulates the amount of light that enters the eye by altering the size of the pupil at its center (roots: ir, irid/o, irit/o); plural: irides (<i>IR-i-dēz</i>)
lacrimal glands <i>LAK-ri-mal</i>	Pertaining to tears (roots: lacrim/o, dacry/o)
lens <i>lenz</i>	The transparent, biconvex structure in the anterior portion of the eye that refracts light and functions in accommodation (roots: lent/i, phak/o)
macula <i>MAK-ū-la</i>	A small spot or colored area; used alone to mean the yellowish spot in the retina that contains the fovea
optic disk	The point where the optic nerve joins the retina; at this point, there are no rods or cones; also called the blind spot or optic papilla
orbit <i>OR-bit</i>	The bony cavity that contains the eyeball
palpebra <i>PAL-pe-bra</i>	An eyelid; a protective fold (upper or lower) that closes over the anterior surface of the eye (roots: palpebr/o, blephar/o); adjective: palpebral; plural: palpebrae (<i>pal-PĒ-brē</i>)
pupil <i>PŪ-pil</i>	The opening at the center of the iris (root: pupil/o)
refraction <i>rē-FRAK-shun</i>	The bending of light rays as they pass through the eye to focus on a specific point on the retina; also the determination and correction of ocular refractive errors
retina <i>RET-i-na</i>	The innermost, light-sensitive layer of the eye; contains the rods and cones, the specialized receptor cells for vision (root: retin/o)
rod	A specialized cell in the retina that responds to light; rods have low visual acuity, function in dim light, and do not respond to color
sclera <i>SKLĒR-a</i>	The tough, white, fibrous outermost layer of the eye; the white of the eye (root: scler/o)
uvea <i>Ū-vē-a</i>	The middle, vascular layer of the eye (root: uve/o); consists of the choroid, ciliary body, and iris
visual acuity <i>a-KŪ-i-tē</i>	Sharpness of vision
vitreous body <i>VIT-rē-us</i>	The transparent jelly-like mass that fills the eyeball's main cavity; also called vitreous humor



Go to the Audio Pronunciation Glossary in the Student Resources on *thePoint* to hear these terms pronounced.

Word Parts Pertaining to the Eye and Vision

See **Tables 18-3 to 18-5.**

Table 18-3 Roots for External Eye Structures

Root	Meaning	Example	Definition of Example
blephar/o	eyelid	symblepharon <i>sim-BLEF-a-ron</i>	adhesion of the eyelid to the eyeball (<i>sym-</i> means “together”)
palpebr/o	eyelid	palpebral <i>PAL-pe-bral</i>	pertaining to an eyelid
dacry/o	tear, lacrimal apparatus	dacryorrhea <i>dak-rē-ō-RĒ-a</i>	discharge from the lacrimal apparatus
dacryocyst/o	lacrimal sac	dacryocystocele <i>dak-rē-ō-SIS-tō-sēl</i>	hernia of the lacrimal sac
lacrim/o	tear, lacrimal apparatus	lacrimation <i>lak-ri-MA-shun</i>	secretion of tears

18

EXERCISE 18-3

Define the following words:

1. nasolacrimal (*nā-zō-LAK-ri-mal*)
2. interpalpebral (*in-ter-PAL-pe-bral*)
3. blepharoplegia (*BLEF-a-rō-plē-jē-a*)
4. dacryocystectomy (*dak-rē-ō-sis-TEK-tō-mē*)

Use the roots indicated to write words that mean the following:

5. spasm of the eyelid (blephar/o)
6. stone in the lacrimal apparatus (dacry/o)
7. inflammation of a lacrimal sac

Table 18-4 Roots for the Eye and Vision

Root	Meaning	Example	Definition of Example
opt/o	eye, vision	optometer <i>op-TOM-e-ter</i>	instrument for measuring the refractive power of the eye
ocul/o	eye	sinistroular <i>si-nis-TROK-ū-lar</i>	pertaining to the left eye
ophthalm/o	eye	exophthalmos <i>eks-of-THAL-mos</i>	protrusion of the eyeball

(Continued)

Table 18-4 Roots for the Eye and Vision (*Continued*)

Root	Meaning	Example	Definition of Example
scler/o	sclera	episcleritis <i>ep-i-skle-rī-tis</i>	inflammation of the tissue on the surface of the sclera
corne/o	cornea	circumcorneal <i>sir-kum-KOR-nē-al</i>	around the cornea
kerat/o	cornea	keratoplasty <i>KER-a-tō-plas-tē</i>	plastic repair of the cornea; corneal transplant
lent/i	lens	lentiform <i>LEN-ti-form</i>	resembling a lens
phak/o, phac/o	lens	aphakia <i>a-FĀ-kē-a</i>	absence of a lens
uve/o	uvea	uveal <i>Ū-vē-al</i>	pertaining to the uvea
chori/o, choroid/o	choroid	subchoroidal <i>sub-kor-OYD-al</i>	below the choroid
cycl/o	ciliary body, ciliary muscle	cycloplegic <i>sī-klō-PLĒ-jik</i>	pertaining to or causing paralysis of the ciliary muscle
ir, irit/o, irid/o	iris	iridoschisis <i>ir-i-DOS-ki-sis</i>	splitting of the iris
pupill/o	pupil	iridopupillary <i>ir-i-dō-PŪ-pi-lar-ē</i>	pertaining to the iris and the pupil
retin/o	retina	retinoscopy <i>ret-in-OS-kō-pē</i>	examination of the retina

EXERCISE 18-4**Fill in the blanks:**

- The oculomotor (*ok-ū-lō-MŌ-tor*) nerve controls movements of the _____.
- The science of orthoptics (*or-THOP-tiks*) deals with correcting defects in _____.
- The term *phacolysis* (*fa-KOL-i-sis*) means destruction of the _____.
- A keratometer (*ker-a-TOM-e-ter*) is an instrument for measuring the curves of the _____.
- Lenticonus is conical protrusion of the _____.
- In the opening case study, the medical specialist K.L. saw for her vision problems was a(n) _____.

Identify and define the roots pertaining to the eye in the following words:

	Root	Meaning of Root
7. optometrist (<i>op-TOM-e-trist</i>)	_____	_____
8. microphthalmos (<i>mī-krof-THAL-mus</i>)	_____	_____
9. interpupillary (<i>in-ter-PŪ-pi-lar-ē</i>)	_____	_____
10. phacotoxic (<i>fak-ō-TOK-sik</i>)	_____	_____
11. uveitis (<i>ū-vē-Ī-tis</i>)	_____	_____

EXERCISE 18-4 (Continued)12. iridodilator (*ir-id-ō-DĪ-lā-tor*) _____13. retrolental (*ret-rō-LEN-tal*) _____**Write words for the following definitions:**

14. inflammation of the uvea and sclera _____

15. softening of the lens (use phac/o) _____

16. pertaining to the pupil _____

17. surgical fixation of the retina _____

18. inflammation of the ciliary body _____

Use the root *ophthalm/o* to write words for the following definitions:

19. an instrument used to examine the eye _____

20. the medical specialty that deals with the eye and diseases of the eye _____

Use the root *irid/o* to write words for the following definitions:

21. surgical removal of (part of) the iris _____

22. paralysis of the iris _____

Define the following words:23. dextrocular (*deks-TROK-ū-lar*) _____24. retinoschisis (*ret-i-NOS-ki-sis*) _____25. sclerotome (*SKLĒR-ō-tōm*) _____26. optical (*OP-ti-kal*) _____27. keratitis (*ker-a-TĪ-tis*) _____28. cyclotomy (*sī-KLOT-ō-mē*) _____29. iridocyclitis (*ir-i-dō-sī-KLĪ-tis*) _____30. chorioretinal (*kor-ē-ō-RET-i-nal*) _____31. lenticular (*len-TIK-ū-lar*) _____**Table 18-5** Suffixes for the Eye and Vision*

Suffix	Meaning	Example	Definition of Example
-opsia	vision	heteropsia <i>het-er-OP-sē-a</i>	unequal vision in the two eyes
-opia	eye, vision	hemianopia <i>hem-ē-an-Ō-pe-a</i>	blindness in half the visual field

*Compounds of -ops (eye) + -ia.

EXERCISE 18-5

Use the suffix **-opsia** to write words for the following definitions:

1. a visual defect in which objects seem larger (macr/o) than they are _____
2. lack of (a-) color (chromat/o) vision (complete color blindness) _____

Use the suffix **-opia** to write words for the following definitions:

3. double vision _____
4. changes in vision due to old age (use the prefix *presby-* meaning “old”) _____
5. In the opening case study, K.L. was diagnosed with “lazy eye,” technically known as _____

The suffix **-opia** is added to the root **metr/o** (measure) to form words pertaining to the refractive power of the eye. Add a prefix to **-metropia** to form words for the following:

6. a lack of refractive power in the eye _____
7. unequal refractive powers in the two eyes _____

Clinical Aspects of Vision

ERRORS OF REFRACTION

If the eyeball is too long, images will form in front of the retina. To focus clearly, one must bring an object closer to the eye. This condition of nearsightedness is technically called **myopia** (Fig. 18-13). The opposite condition is **hyperopia**, or farsightedness, in which the eyeball is too short and images form behind the retina. One must move an object away from the eye for clear focus. The same effect is produced by

presbyopia, which accompanies aging. The lens loses elasticity and can no longer accommodate for near vision, so a person becomes increasingly farsighted.

An **astigmatism** is an irregularity in the curve of the cornea or lens that distorts light entering the eye and blurs vision.

Glasses can compensate for most of these refractive impairments, as shown for nearsightedness and farsightedness in Figure 18-13. See also Box 18-3 for information on a surgical technique to correct refractive errors.

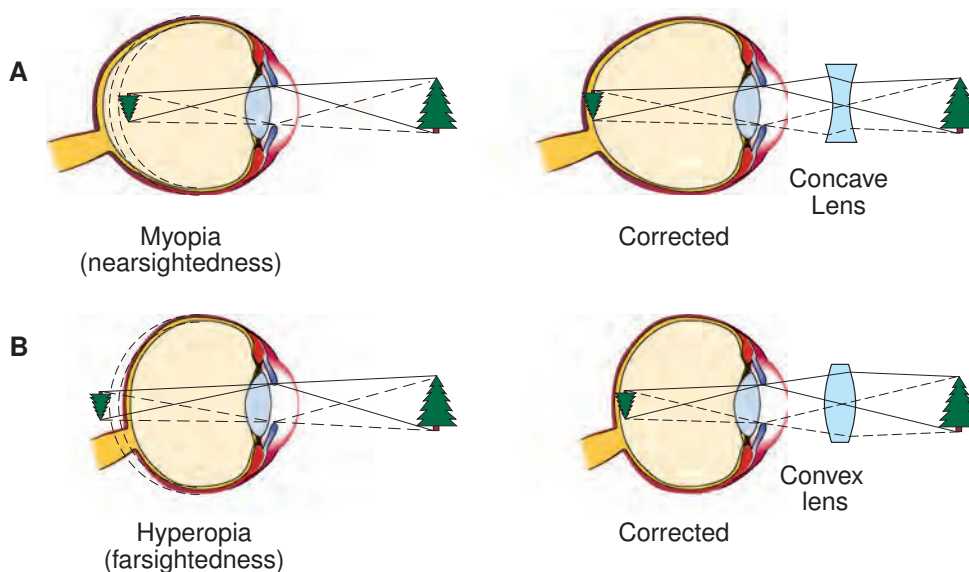


Figure 18-13 Errors of refraction. A. Myopia (nearsightedness). B. Hyperopia (farsightedness). A concave (inwardly curved) lens corrects for myopia; a convex (outwardly curved) lens corrects for hyperopia.

Box 18-3



Clinical Perspectives

Eye Surgery: A Glimpse of the Cutting Edge

Cataracts, glaucoma, and refractive errors are common eye disorders. In the past, cataract and glaucoma treatments concentrated on managing the diseases. Refractive errors were corrected using eyeglasses and more recently contact lenses. Today, using laser and microsurgical techniques, ophthalmologists can remove cataracts, reduce glaucoma, and allow people with refractive errors to put their eyeglasses and contacts away. These cutting-edge procedures include:

- LASIK (laser in situ keratomileusis) to correct refractive errors. During this procedure, a surgeon uses a laser to reshape the cornea so that it refracts light directly onto the retina, rather than in front of or behind it. A microkeratome (surgical knife) is used to cut a flap in the cornea's outer layer. A computer-controlled laser sculpts the middle layer of the cornea and then the flap is replaced. The procedure takes only a few minutes, and patients recover their vision quickly and usually with little postoperative pain.
- Phacoemulsification to remove cataracts. During this procedure, a surgeon makes a very small incision (~3 mm long) through the sclera near the cornea's outer edge. An ultrasonic probe is inserted through this opening and into the center of the lens. The probe uses sound waves to emulsify the lens's central core, which is then suctioned out. An artificial lens is then permanently implanted in the lens capsule (see Fig. 18-17). The procedure is typically painless, although the patient may feel some discomfort for one to two days afterward.
- Laser trabeculoplasty to treat glaucoma. This procedure uses a laser to help drain fluid from the eye and lower intraocular pressure. The laser is aimed at drainage canals located between the cornea and iris and makes several burns that are believed to open the canals and allow better fluid drainage. The procedure is typically painless and takes only a few minutes.

INFECTION

Several microorganisms can cause **conjunctivitis** (inflammation of the conjunctiva). This is a highly infectious disease commonly called “pink eye.”

The bacterium *Chlamydia trachomatis* causes **trachoma**, inflammation of the cornea and conjunctiva that results in scarring. This disease is rare in the United States and other industrialized countries but is a common cause of blindness in underdeveloped countries, although it is easily cured with sulfa drugs and antibiotics.

Gonorrhea is the usual cause of an acute conjunctivitis in newborns called **ophthalmia neonatorum**. An antibiotic ointment is routinely used to prevent such eye infections in newborns.

of macular degeneration (“dry”), material accumulates on the retina. Vitamins C and E, beta carotene, and zinc supplements may delay this process. In another form, neovascular (“wet”) AMD, abnormal blood vessels grow under the retina, causing it to detach. Laser surgery may stop the growth of these vessels and delay vision loss. More recently, ophthalmologists have had success in delaying the progress of wet AMD with regular intraocular injections of a drug (Lucentis) that inhibits blood vessel formation. Macular degeneration typically affects central vision but not peripheral vision (Fig. 18-15). Other causes of macular degeneration are drug toxicity and hereditary diseases.

Circulatory problems associated with diabetes mellitus eventually cause changes in the retina referred to as **diabetic retinopathy**. In addition to vascular damage, there is a



See the figure on trachoma in the Student Resources on thePoint.

DISORDERS OF THE RETINA

Retinal detachment, separation of the retina from the underlying layer of the eye (the choroid), may be caused by a tumor, hemorrhage, or injury to the eye (Fig. 18-14). This condition interferes with vision and is commonly repaired with laser surgery.

Degeneration of the macula, the point of sharpest vision, is a common cause of visual problems in the elderly. When associated with aging, this deterioration is described as **age-related macular degeneration (AMD)**. In one form

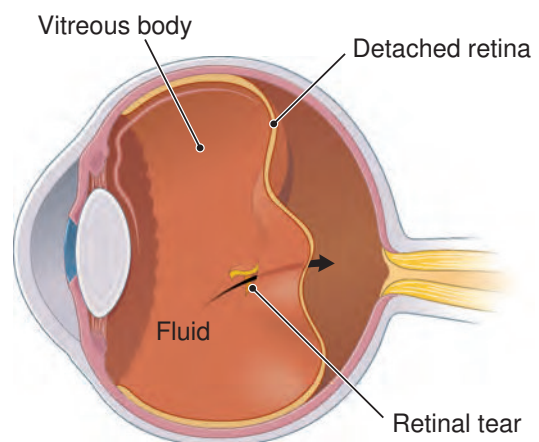


Figure 18-14 Retinal detachment.

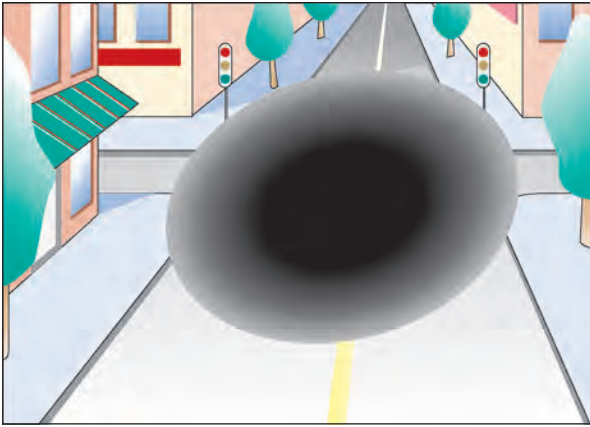


Figure 18-15 Visual loss associated with macular degeneration. The center of the visual field is affected, but peripheral vision is usually unaffected.

yellowish, waxy exudate high in lipoproteins. With time, new blood vessels form and penetrate the vitreous humor, causing hemorrhage, detachment of the retina, and blindness.



See the figure on diabetic retinopathy in the Student Resources on *thePoint*.

CATARACT

A **cataract** is an opacity (cloudiness) of the lens (**Fig. 18-16**). Causes of cataract include disease, injury, chemicals, and exposure to physical forces, especially the ultraviolet radiation in sunlight. The cataracts that frequently appear with age may result from exposure to environmental factors in combination with degeneration attributable to aging.

To prevent blindness, an ophthalmologist must remove the cloudy lens surgically. Commonly, the lens's anterior capsule is removed along with the cataract, leaving the

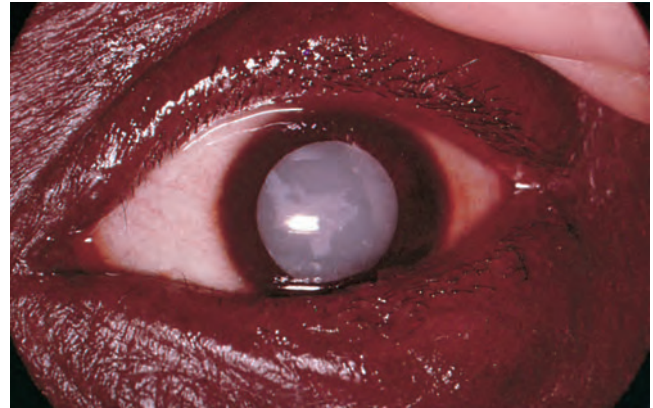


Figure 18-16 Cataract. The white appearance of the pupil in this eye is due to complete opacity of the lens.

posterior capsule in place (**Fig. 18-17**). In **phacoemulsification**, the lens is fragmented with high-frequency ultrasound and extracted through a small incision (**see Box 18-3**). After cataract removal, an artificial intraocular lens (IOL) is usually implanted to compensate for the missing lens. The original type of implant provides vision only within a fixed distance; newer implants are designed to allow for near and far accommodation. Alternatively, a person can wear a contact lens or special glasses.

GLAUCOMA

Glaucoma is an abnormal increase in pressure within the eyeball. It occurs when more aqueous humor is produced than can be drained away from the eye. There is pressure on blood vessels in the eye and on the optic nerve, leading to blindness. There are many causes of glaucoma, and screening for this disorder should be a part of every routine eye examination. Fetal infection with rubella (German measles) early in pregnancy can cause glaucoma, as well as cataracts and hearing impairment. Glaucoma is usually treated with medication to reduce pressure in the eye and occasionally is treated with surgery (**see Box 18-3**).

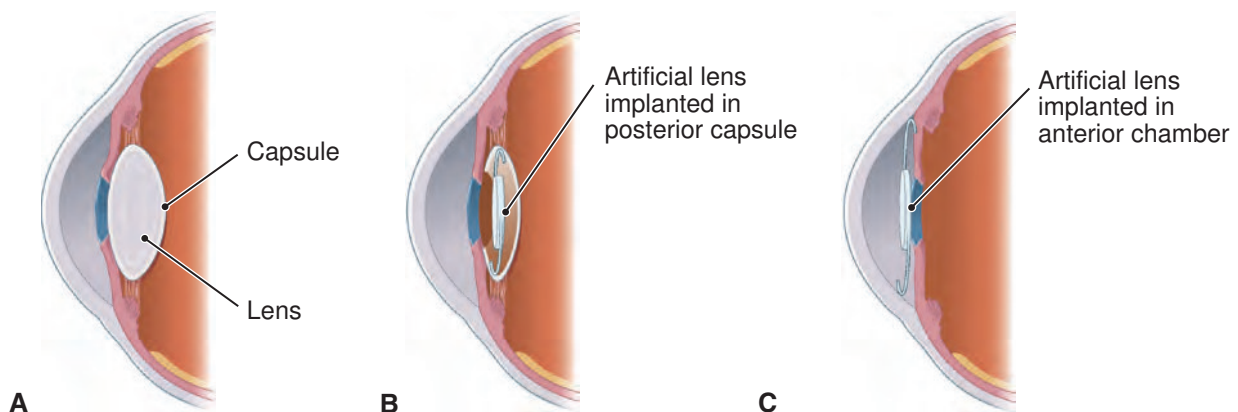


Figure 18-17 Cataract extraction surgeries. A. Cross section of normal eye anatomy. B. Extracapsular lens extraction involves removing the lens but leaving the posterior capsule intact to receive a synthetic intraocular lens. C. Intracapsular lens extraction involves removing the lens and lens capsule and implanting a synthetic intraocular lens in the anterior chamber.

Terminology

Key Terms

THE EYE

Disorders

age-related macular degeneration (AMD)	Deterioration of the macula associated with aging; macular degeneration impairs central vision
astigmatism <i>a-STIG-ma-tizm</i>	An error of refraction caused by irregularity in the curvature of the cornea or lens
cataract <i>KAT-a-rakt</i>	Opacity of the lens of the eye
conjunctivitis <i>kon-junk-ti-VI-tis</i>	Inflammation of the conjunctiva; pink eye
diabetic retinopathy <i>ret-i-NOP-a-thē</i>	Degenerative changes in the retina associated with diabetes mellitus
glaucoma <i>glaw-KŌ-ma</i>	An eye disease caused by increased intraocular pressure that damages the optic disk and causes vision loss. Usually results from faulty fluid drainage from the anterior eye
hyperopia <i>hī-per-Ō-pē-a</i>	A refractive error in which light rays focus behind the retina and objects can be seen clearly only when far from the eye; farsightedness; also called hypermetropia
myopia <i>mī-Ō-pē-a</i>	A refractive error in which light rays focus in front of the retina and objects can be seen clearly only when very close to the eye; nearsightedness
ophthalmia neonatorum <i>of-THAL-mē-a nē-ō-nā-TOR-um</i>	Severe conjunctivitis usually caused by infection with gonococcus during birth
phacoemulsification <i>fak-ō-ē-MUL-si-fi-kā-shun</i>	Removal of a cataract by ultrasonic destruction and extraction of the lens
presbyopia <i>prez-bē-Ō-pē-a</i>	Changes in the eye that occur with age; the lens loses elasticity and the ability to accommodate for near vision
retinal detachment	Separation of the retina from its underlying layer
trachoma <i>tra-KŌ-ma</i>	An infection caused by <i>Chlamydia trachomatis</i> leading to inflammation and scarring of the cornea and conjunctiva; a common cause of blindness in underdeveloped countries

Terminology

Supplementary Terms

THE EYE

Normal Structure and Function

canthus <i>KAN-thus</i>	The angle at either end of the slit between the eyelids
diopter <i>DI-op-ter</i>	A measurement unit for the refractive power of a lens
emmetropia <i>em-e-TRŌ-pē-a</i>	The normal condition of the eye in refraction, in which parallel light rays focus exactly on the retina

(Continued)

fundus <i>FUN-dus</i>	A bottom or base; the region farthest from the opening of a structure. The eye's fundus is the posterior portion of the interior eyeball as seen with an ophthalmoscope
meibomian gland <i>mī-BŌ-mē-an</i>	A sebaceous gland in the eyelid
tarsus <i>TAR-sus</i>	The framework of dense connective tissue that gives shape to the eyelid; tarsal plate
zonule <i>ZŌN-ūl</i>	A system of fibers that holds the lens in place; also called suspensory ligaments
Symptoms and Conditions	
amblyopia <i>am-blē-Ō-pē-a</i>	A condition that occurs when visual acuity is not the same in the two eyes in children (prefix <i>ambly</i> means "dim"). Disuse of the poorer eye will result in blindness if not corrected. Also called "lazy eye." See K.L.'s opening case study on amblyopia
anisocoria <i>an-ī-sō-KŌ-rē-a</i>	Condition in which the two pupils (root: cor/o) are not of equal size
blepharoptosis <i>blef-a-rop-TŌ-sis</i>	Drooping of the eyelid
chalazion <i>ka-LĀ-zē-on</i>	A small mass on the eyelid resulting from inflammation and blockage of a meibomian gland
drusen <i>DRŪ-zen</i>	Small growths that appear as tiny yellowish spots beneath the retina of the eye; typically occur with age but also occur in certain abnormal conditions
floater <i>FLŌ-ter</i>	A small moving object in the field of vision that originates in the vitreous body. Floaters appear as spots or threads and are caused by benign degenerative or embryonic deposits in the vitreous body that cast a shadow on the retina
hordeolum <i>hor-DE-ō-lum</i>	Inflammation of a sebaceous gland of the eyelid; a sty
keratoconus <i>ker-a-tō-KŌ-nus</i>	Conical protrusion of the corneal center
miosis <i>mī-Ō-sis</i>	Abnormal contraction of the pupils (from Greek, meaning "diminution")
mydriasis <i>mi-DRĪ-a-sis</i>	Pronounced or abnormal dilation of the pupil
nyctalopia <i>nik-ta-LŌ-pē-a</i>	Night blindness. Inability to see well in dim light or at night (root: nyct/o); often due to lack of vitamin A, which is used to make the pigment needed for vision in dim light
nystagmus <i>nis-TAG-mus</i>	Rapid, involuntary, rhythmic movements of the eyeball; may occur in neurologic diseases or disorders of the inner ear's vestibular apparatus
papilledema <i>pap-il-e-DE-ma</i>	Swelling of the optic disk (papilla); choked disk
phlyctenule <i>FLIK-ten-ūl</i>	A small blister or nodule on the cornea or conjunctiva
pseudophakia <i>sū-dō-FĀ-kē-a</i>	A condition in which a cataractous lens has been removed and replaced with a plastic lens implant
retinitis <i>ret-in-Ī-tis</i>	Inflammation of the retina; causes include systemic disease, infection, hemorrhage, exposure to light
retinitis pigmentosa <i>ret-in-Ī-tis pig-men-TŌ-sa</i>	A hereditary chronic degenerative disease of the retina that begins in early childhood. There is atrophy of the optic nerve and clumping of pigment in the retina

retinoblastoma <i>ret-in-ō-blas-TŌ-ma</i>	A malignant glioma of the retina; usually appears in early childhood and is sometimes hereditary; fatal if untreated, but current cure rates are high
scotoma <i>skō-TŌ-ma</i>	An area of diminished vision within the visual field
strabismus <i>stra-BIZ-mus</i>	A deviation of the eye in which the visual lines of each eye are not directed to the same object at the same time. Also called heterotropia or squint. The various forms are referred to as <i>-tropias</i> , with the direction of turning (trop/o) indicated by a prefix, such as esotropia (inward), exotropia (outward), hypertropia (upward), and hypotropia (downward). The suffix <i>-phoria</i> is also used, as in esophoria
synechia <i>sin-EK-ē-a</i>	Adhesion of parts, especially adhesion of the iris to the lens and cornea (plural: synechiae)
xanthoma <i>zan-THŌ-ma</i>	A soft, slightly raised, yellowish patch or nodule usually on the eyelids; occurs in the elderly; also called xanthelasma

Diagnosis and Treatment

canthotomy <i>kan-THOT-ō-mē</i>	Surgical division of a canthus
cystotome <i>SIS-ti-tōm</i>	Instrument for incising the lens capsule
electroretinography (ERG) <i>ē-lek-trō-ret-i-NOG-ra-fē</i>	Study of the retina's electrical response to light stimulation
enucleation <i>ē-nū-klē-Ā-shun</i>	Surgical removal of the eyeball
gonioscopy <i>gō-nē-OS-kō-pē</i>	Examination of the angle between the cornea and the iris (anterior chamber angle) in which fluids drain out of the eye (root <i>goni/o</i> means "angle")
keratometer <i>ker-a-TOM-e-e-ter</i>	An instrument for measuring the curvature of the cornea
mydriatic <i>mid-rē-AT-ik</i>	A drug that causes dilation of the pupil
phorometer <i>fo-ROM-e-e-ter</i>	An instrument for determining the degree and kind of strabismus
retinoscope <i>RET-in-ō-skōp</i>	An instrument used to determine refractive errors of the eye; also called a skiascope (<i>SKĪ-a-skōp</i>)
slit-lamp biomicroscope	An instrument for examining the eye under magnification
Snellen chart <i>SNEL-en</i>	A chart printed with letters of decreasing size used to test visual acuity when viewed from a set distance; results reported as a fraction giving a subject's vision compared with normal vision at a distance of 20 feet
tarsorrhaphy <i>tar-SOR-a-fē</i>	Suturing together of all or part of the upper and lower eyelids
tonometer <i>tō-NOM-e-e-ter</i>	An instrument used to measure fluid pressure in the eye



Go to the Audio Pronunciation Glossary in the Student Resources on thePoint to hear these terms pronounced.

Terminology**Abbreviations****The Eye**

A, Acc	Accommodation
AMD	Age-related macular degeneration
ARC	Abnormal retinal correspondence
As, AST	Astigmatism
cc	With correction
Em	Emmetropia
EOM	Extraocular movement, muscles
ERG	Electroretinography
ET	Esotropia

FC	Finger counting
HM	Hand movements
IOL	Intraocular lens
IOP	Intraocular pressure
NRC	Normal retinal correspondence
NV	Near vision
sc	Without correction
VA	Visual acuity
VF	Visual field
XT	Exotropia

K.L.'s Follow-Up

K.L. started wearing the patch on her right eye during waking hours. She progressed to four to five hours a day as ordered by the ophthalmologist. The glasses she obtained from the

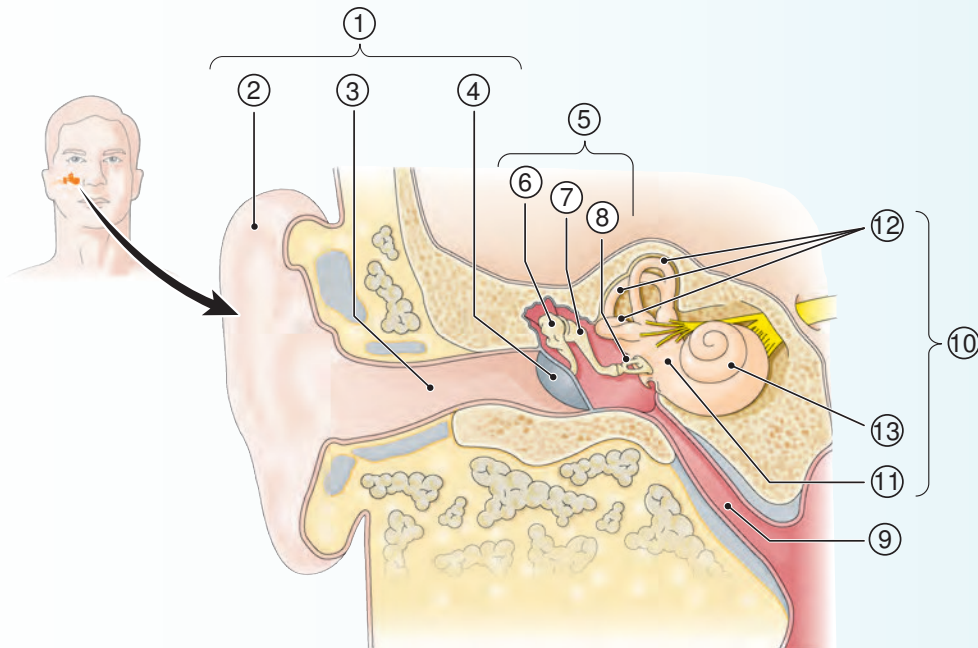
optician were helping her to focus, and she was able to read her schoolwork. She had adjusted well to the treatment plan and the improved vision was determined a success.

Chapter Review

Labeling Exercise

THE EAR

Write the name of each numbered part on the corresponding line of the answer sheet.



Cochlea
Auditory tube
External auditory canal
Incus
Inner ear
Malleus
Ossicles (of middle ear)

Outer ear
Pinna
Semicircular canals
Stapes
Tympanic membrane
Vestibule

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

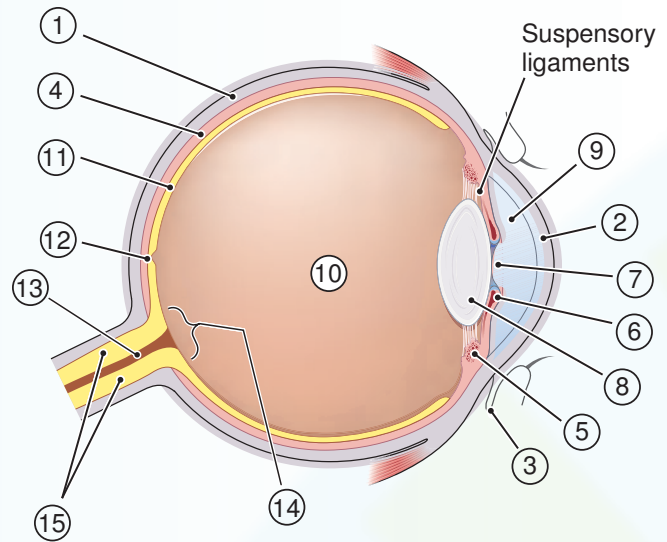
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____

THE EYE

Write the name of each numbered part on the corresponding line of the answer sheet.

Aqueous humor	Lens
Choroid	Optic disk (blind spot)
Ciliary muscle	Optic nerve
Conjunctival sac	Pupil
Cornea	Retina
Fovea	Sclera
Iris	Vitreous body

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____



12. _____
13. _____
14. _____

Terminology

MATCHING

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|-------------------------------|---|
| _____ 1. lens | a. small bone |
| _____ 2. ossicle | b. structure that changes shape for near and far vision |
| _____ 3. rods and cones | c. muscular ring that regulates light entering the eye |
| _____ 4. vestibular apparatus | d. location of equilibrium receptors |
| _____ 5. iris | e. vision receptors |
| _____ 6. tactile | a. increased sensation |
| _____ 7. tinnitus | b. blindness in half the visual field |
| _____ 8. hyperesthesia | c. point of sharpest vision |
| _____ 9. fovea | d. pertaining to touch |
| _____ 10. hemianopia | e. sensation of noises in the ear |
| _____ 11. phacosclerosis | a. corneal transplant |
| _____ 12. ophthalmoplegia | b. abnormal smell perception |
| _____ 13. anacusis | c. paralysis of an eye muscle |
| _____ 14. parosmia | d. hardening of the lens |
| _____ 15. keratoplasty | e. total loss of hearing |

Supplementary Terms

- | | |
|---------------------------|--|
| _____ 16. diopter | a. angle between the eyelids |
| _____ 17. mastoid process | b. small muscle attached to an ear ossicle |
| _____ 18. stapedius | c. projection of the temporal bone |
| _____ 19. canthus | d. unit of sound intensity |
| _____ 20. decibel | e. unit for measuring the refractive power of the lens |
| _____ 21. emmetropia | a. rapid, involuntary eye movements |
| _____ 22. nystagmus | b. normal refraction of the eye |
| _____ 23. mydriasis | c. commonly called “lazy eye” |
| _____ 24. drusen | d. abnormal dilation of the pupil |
| _____ 25. amblyopia | e. small growths beneath the retina |
| _____ 26. AMD | a. irregularity in the curve of the eye |
| _____ 27. Hz | b. an implanted lens |
| _____ 28. AST | c. otorhinolaryngology |
| _____ 29. ENT | d. eye disorder associated with aging |
| _____ 30. IOL | e. a unit for measuring pitch of sound |

FILL IN THE BLANKS

31. The scientific name for the eardrum is _____.
32. The term *ceruminous* applies to _____.
33. The ossicle that is in contact with the inner ear is the _____.
34. The outermost layer of the eye wall is the _____.
35. The bending of light rays as they pass through the eye is _____.
36. The innermost layer of the eye that contains the receptors for vision is the _____.
37. The transparent extension of the sclera that covers the front of the eye is the _____.
38. The sense of awareness of body position is _____.

DEFINITIONS

Define the following words:

- | | |
|--------------------|-------|
| 39. audiologist | _____ |
| 40. ophthalmometer | _____ |
| 41. aphakia | _____ |
| 42. subscleral | _____ |
| 43. iridotomy | _____ |
| 44. myringotomy | _____ |
| 45. perilental | _____ |
| 46. dacryorrhea | _____ |
| 47. chorioretinal | _____ |
| 48. keratoiritis | _____ |

Write words for the following definitions:

49. any disease of the retina _____
50. absence of pain _____
51. surgical removal of the stapes _____
52. drooping of the eyelid _____
53. plastic repair of the ear _____
54. pertaining to the vestibular apparatus and cochlea _____
55. hardening of the tympanic membrane _____
56. measurement of the pupil _____
57. pertaining to tears _____
58. excision of (part of) the ciliary body _____
59. endoscopic examination of the auditory tube _____
60. technical name for farsightedness _____

ADJECTIVES

Write the adjective form of the following words:

61. cochlea _____
62. palpebra _____
63. vestibule _____
64. uvea _____
65. cornea _____
66. sclera _____
67. pupil _____

OPPOSITES

Write words that mean the opposite of the following:

68. mydriasis _____
69. esotropia _____
70. cc _____
71. hyperopia _____
72. hyperesthesia _____
73. hypalgesia _____

WORD BUILDING

Write words for the following definitions using the word parts provided.

-pexy -ia osm/o kerat/o -al -schisis -scopy pseud/o- retin/o an- -plasty salping/o sub- myring/o

74. false sense of smell _____
75. plastic repair of the tympanic membrane _____
76. examination of the retina _____
77. examination of the auditory tube _____
78. absence of the sense of smell _____
79. splitting of the retina _____
80. examination of the tympanic membrane _____
81. beneath the retina _____
82. surgical fixation of the retina _____
83. examination of the cornea _____

TRUE-FALSE

Examine the following statements. If the statement is true, write T in the first blank. If the statement is false, write F in the first blank and correct the statement by replacing the underlined word in the second blank.

	True or False	Correct Answer
84. In bright light the pupils <u>dilate</u> .	_____	_____
85. Gustation is the sense of <u>taste</u> .	_____	_____
86. The malleus is located in the <u>middle ear</u> .	_____	_____
87. An osmoceptor is a receptor for the sense of <u>balance</u> .	_____	_____
88. Hypergeusia is an abnormal increase in the sense of <u>touch</u> .	_____	_____
89. The spiral organ is located in the <u>cochlea</u> .	_____	_____
90. A myringotomy is incision of the <u>vestibule</u> .	_____	_____
91. The lacrimal gland produces <u>aqueous humor</u> .	_____	_____

ELIMINATIONS

In each of the sets below, underline the word that does not fit in with the rest and explain the reason for your choice:

92. pressure — temperature — smell — touch — pain

93. cochlea — pinna — vestibule — oval window — semicircular canals

94. incus — lacrimal gland — eyelash — conjunctiva — palpebra

95. glaucoma — myopia — cataract — macular degeneration — presbycusis

WORD ANALYSIS

Define the following words and give the meaning of the word parts in each. Use a dictionary if necessary.

96. asthenopia (*as-the-NŌ-pē-a*) _____
 a. a- _____
 b. sthen/o _____
 c. -op(s) _____
 d. -ia _____
97. pseudophakia (*sū-dō-FĀ-kē-a*) _____
 a. pseudo _____
 b. phak/o _____
 c. -ia _____
98. cholesteatoma (*kō-lē-stē-a-TŌ-ma*) _____
 a. chol/e _____
 b. steat/o _____
 c. -oma _____
99. exotropia (*ek-sō-TRŌ-pē-a*) _____
 a. ex/o- _____
 b. trop/o _____
 c. -ia _____
100. anisometropia (*an-ī-sō-me-TRŌ-pē-a*) _____
 a. an- _____
 b. iso- _____
 c. metr/o _____
 d. op(s) _____
 e. -ia _____



For more learning activities, see Chapter 18 of the Student Resources on *thePoint*.

Additional Case Studies

Case Study 18-1: Audiology Report

S.R., a 55-YO man, reported decreased hearing sensitivity in his left ear for the past three years. In addition to hearing loss, he was experiencing tinnitus and aural fullness. Pure-tone test results revealed normal hearing sensitivity for the right ear and a moderate sensorineural hearing loss in the left ear. Speech thresholds were appropriate for the degree of hearing loss noted. Word recognition was excellent for the right ear and poor for the left ear when the signal was present at a suprathreshold level. Tympanograms were characterized by

normal shape, amplitude, and peak pressure points bilaterally. The contralateral acoustic reflex was normal for the right ear but absent for the left ear at the frequencies tested (500 to 4,000 Hz). The ipsilateral acoustic reflex was present with the probe in the right ear and absent with the probe in the left ear. Brainstem auditory evoked potentials (BAEPs) were within normal range for the right ear. No repeatable response was observed from the left ear. A subsequent MRI showed a 1-cm acoustic neuroma.

Case Study 18-2: Phacoemulsification with Intraocular Lens Implant

W.S., a 68-YO woman, was scheduled for surgery for a cataract and relief from “floaters,” which she had noticed in her visual field since her surgery for a retinal detachment the previous year. She reported to the ambulatory surgery center an hour before her scheduled procedure. Before transfer to the operating room, she spoke with her ophthalmologist and reviewed the surgical plan. Her right eye was identified as the operative eye, and it was marked with a “yes” and the surgeon’s initials on the lid. She was given anesthetic drops in the right eye and an intravenous bolus of 2.0 mg of midazolam (Versed).

In the OR, W.S. and her operative eye were again identified by the surgeon, anesthetist, and nurses. After anesthesia and akinesia were achieved, the eye area was prepped and draped in sterile sheets. An operating microscope with video system was positioned over her eye. A 5-0 silk suture was placed through the superior rectus muscle to retract the eye. A lid speculum

was placed to open the eye. A minimal conjunctival peritomy was performed, and hemostasis was achieved with wet-field cautery. The anterior chamber was entered at the 10:30 o’clock position. A capsulotomy was performed after Healon was placed in the anterior chamber. Phacoemulsification was carried out without difficulty. The remaining cortex was removed by irrigation and aspiration.

An intraocular lens (IOL) was placed into the posterior chamber. Miochol was injected to achieve papillary miosis, and the wound was closed with one 10-0 suture. Subconjunctival Celestone and Garamycin were injected. The lid speculum and retraction suture were removed. After application of Eserine and Bacitracin ointments, the eye was patched, and a shield was applied. W.S. left the OR in good condition and was discharged to home four hours later.

Case Study Questions

Multiple choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|---|---|
| <p>_____ 1. The study of hearing is termed:</p> <ul style="list-style-type: none"> a. acoustiology b. radio frequency c. light spectrum d. otology e. audiology | <p>_____ 4. Another name for an acoustic neuroma is:</p> <ul style="list-style-type: none"> a. macular degeneration b. acoustic neurilemmoma c. auditory otosclerosis d. eighth cranial labyrinthitis e. acoustic glaucoma |
| <p>_____ 2. Sensorineural hearing loss may result from:</p> <ul style="list-style-type: none"> a. damage to the second cranial nerve b. otitis media c. otosclerosis d. damage to the eighth cranial nerve e. stapedectomy | <p>_____ 5. Ultrasound destruction and aspiration of the lens is called:</p> <ul style="list-style-type: none"> a. cataractomy b. phacoemulsification c. stapedectomy d. radial keratotomy e. refraction |
| <p>_____ 3. The term that means “on the same side” is:</p> <ul style="list-style-type: none"> a. contralateral b. bilateral c. distal d. ventral e. ipsilateral | <p>_____ 6. The term <i>akinesia</i> means:</p> <ul style="list-style-type: none"> a. movement b. lack of sensation c. washing d. lack of movement e. incision |

Write terms from the case studies with the following meanings:

7. record obtained by tympanometry

8. pertaining to or perceived by the ear

9. above a minimum level

10. pertaining to sound or hearing

11. perception of sounds, such as ringing or tinkling in the ear

12. physician who specializes in conditions of the eye

13. generic drug name for Versed

14. within the eye

15. abnormal contraction of the pupil

16. below the conjunctiva

Abbreviations. Define the following abbreviations:

17. Hz _____

18. BAEP _____

19. IOL _____

CHAPTER 19

The Skeleton

Case Study

L.R.'s Idiopathic Adolescent Scoliosis

Chief complaint:

Four years ago, L.R., a 15-year-old female, had a posterior spinal fusion (PSF) for correction of idiopathic adolescent scoliosis in a pediatric orthopedic hospital in another state. L.R. is a gifted musician, and her favorite pastime is playing the piano, guitar, and other musical instruments. Lately she has experienced considerable back pain that she attributed to long hours at the piano or playing the guitar. It was time for her routine follow-up orthopedic visit, and now she presents with a significant prominence of the right scapula and back pain in the mid- and lower back.

Examination:

A history was taken and medical records were reviewed followed by a physical examination. The medical records indicated that the patient's spinal curvature had been surgically corrected with the insertion of bilateral laminar and pedicle hooks and two 3/16-inch rods. A bone autograft was taken from L.R.'s right posterior superior ilium and applied along the lateral processes of T4 to L2 to complete the fusion. The physical examination was normal except for surgical scarring along the spine, a projecting right scapula, and asymmetry of the rib cage. During the history, L.R. denied numbness or tingling of the lower extremities, bowel or bladder problems, chest pain, or shortness of breath. The physician ordered a CT scan to determine if there had been continued growth on the anterior portion of the spine following the posterior fusion.

Clinical course:

The results of the CT scan of the upper thoracic spine showed a prominent rotatory scoliosis deformity of the right posterior thorax with acute angulation of the ribs. L.R.'s deformity is a common consequence of overcorrection of prior spinal fusion surgery, called crankshaft phenomenon.

L.R. was referred to the chief spinal surgeon of a local pediatric orthopedic hospital for removal of the spinal instrumentation, posterior spinal osteotomies from T4 to L2, insertion of replacement hooks and rods, bilateral rib resections, autograft bone from the resected ribs, partial scapulectomy and possible bone allograft, and bilateral chest tube placement. The surgical plan was explained to her and her mother, and consent was obtained and signed. The surgical procedure and the potential benefits versus risks were discussed. L.R. and her parents stated that they fully understood and provided consent to proceed with the plan for surgery.





Ancillaries *At-A-Glance*

Visit *thePoint* to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii–xvi.

Learning TOOLS

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning RESOURCES

- E-book: Chapter 19
- Web Figure: Comparison of Male and Female Pelves
- Web Figure: Bone Markings and Formations
- Web Chart: Bones of the Skull
- Web Chart: Joints
- Animation: Bone Growth
- Audio Pronunciation Glossary

Learning ACTIVITIES

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After study of this chapter, you should be able to:

- 1 Compare the axial skeleton and the appendicular skeleton. *p516*
- 2 Briefly describe the formation of bone tissue. *p517*
- 3 Describe the structure of a long bone. *p518*
- 4 Compare a suture, a symphysis, and a synovial joint. *p520*
- 5 Describe the structure of a synovial joint. *p520*
- 6 Identify and use roots pertaining to the skeleton. *p523*
- 7 Describe six disorders that affect the skeleton and joints. *p525*
- 8 Interpret abbreviations used in relation to the skeleton. *p540*
- 9 Analyze medical terms in case studies related to the skeleton. *pp514, 548*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|---|---|
| <p>_____ 1. The root <i>oste/o</i> means:</p> <ul style="list-style-type: none"> a. cartilage b. fat c. bone d. heart | <p>_____ 5. The bones of the wrist are the:</p> <ul style="list-style-type: none"> a. ribs b. cervices c. carpals d. digits |
| <p>_____ 2. The root <i>myel/o</i> refers to the spinal cord. Used in reference to bones it means:</p> <ul style="list-style-type: none"> a. bone marrow b. joint c. bone shaft d. membrane | <p>_____ 6. The bone of the thigh is the:</p> <ul style="list-style-type: none"> a. patella b. umbilicus c. cranium d. femur |
| <p>_____ 3. A bone of the spinal column is a(n):</p> <ul style="list-style-type: none"> a. cortex b. ventricle c. labyrinth d. vertebra | <p>_____ 7. A general term for inflammation of a joint is:</p> <ul style="list-style-type: none"> a. arthritis b. conjunctivitis c. epididymitis d. myocarditis |
| <p>_____ 4. The large, flared superior bone of the pelvis is the:</p> <ul style="list-style-type: none"> a. duodenum b. ilium c. thorax d. phalange | <p>_____ 8. Chondrosarcoma is a tumor that originates in:</p> <ul style="list-style-type: none"> a. adipose tissue b. bone c. cartilage d. muscle |

The **skeleton** forms the framework of the body, protects vital organs, and works with the muscular system to produce movement at the **joints**. The human adult skeleton is composed of 206 **bones**, which are organized for study into two divisions.

Divisions of the Skeleton

The axial skeleton forms the central core or “axis” of the body’s bony framework (**Fig. 19-1**). It consists of:

- The skull, made up of eight cranial bones and 14 bones of the face (**Fig. 19-2**). The skull bones are joined by immovable joints (sutures), except for the joint between the lower jaw (mandible) and the temporal bone of the cranium, the temporomandibular joint (TMJ).
- The spinal column (**Fig. 19-3**) consisting of 26 vertebrae. Between the vertebrae are disks of **cartilage** that add strength and flexibility to the spine. The five groups of vertebrae, listed from superior to inferior with the number of bones in each group are:

1. Cervical (seven), designated C1 to C7. The first and second cervical vertebrae also have specific names, the **atlas** and the **axis**, respectively (**see Fig. 19-3**).
2. Thoracic (12), designated T1 to T12
3. Lumbar (five), designated L1 to L5
4. The sacrum (S), composed of five fused bones
5. The coccyx (Co), composed of four to five fused bones

- The **thorax**, consisting of 12 pairs of ribs joined by cartilage to the sternum (breast bone). The rib cage encloses and protects the thoracic organs.

The appendicular skeleton is attached or “appended” to the axial skeleton (**see Fig. 19-1**). The upper division includes:

- The bones of the shoulder girdle, the clavicle (collar bone), and scapula (shoulder blade)
- The bones of the upper extremities (arms), the humerus, radius, ulna, carpals (wrist bones), metacarpals (bones of the palm), and phalanges (finger bones)

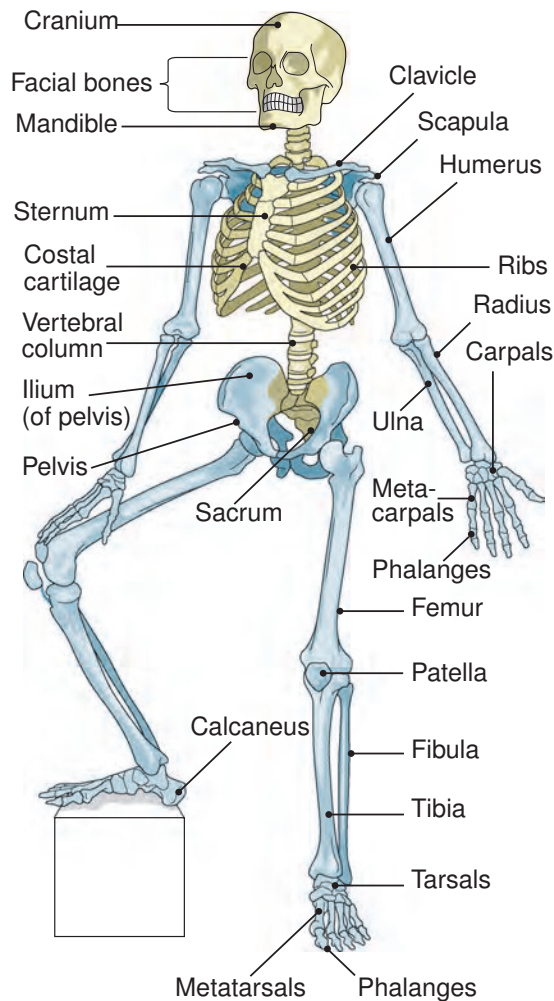
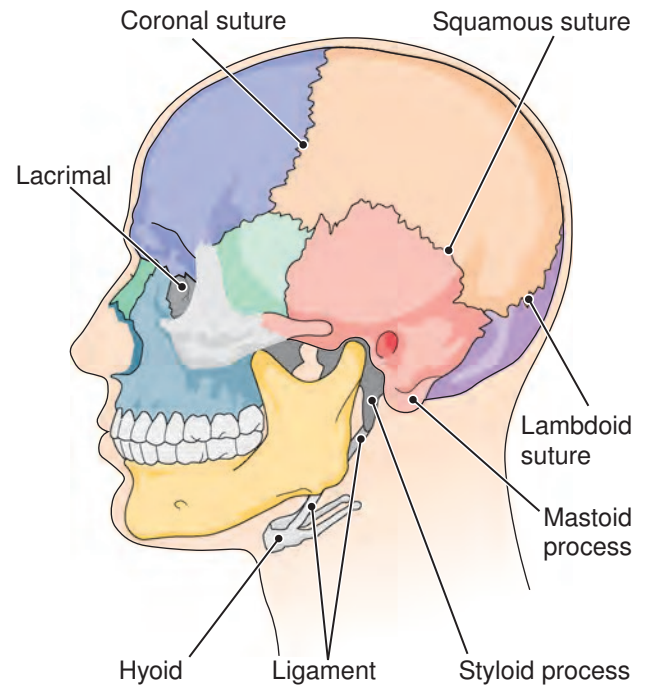


Figure 19-1 The skeleton. The axial skeleton is shown in yellow; the appendicular in blue.

The lower division includes:

- The pelvic bones, two large bones that join the sacrum and coccyx to form the bony **pelvis**. Each pelvic or hip bone (os coxae) is formed by three fused bones, the large, flared **ilium**; the ischium; and the pubis (**Fig. 19-4**). The deep socket in the hip bone that holds the head of the femur is the **acetabulum**. The female pelvis is wider than the male pelvis and has other modifications to accommodate childbirth.
- The bones of the lower extremities (legs), the femur, patella (kneecap), tibia, fibula, tarsals (ankle bones), metatarsals (bones of the instep), and phalanges (toe bones). The large tarsal bone that forms the heel is the calcaneus (*kal-KĀ-nē-us*), shown in **Figure 19-1**.

All of these bone groups, and also the hyoid under the jaw and the ear ossicles, are listed with phonetic pronunciations and described in For Your Reference **Box 19-1**.



Bones of the skull:

- Frontal
- Parietal
- Sphenoid
- Temporal
- Nasal
- Maxilla
- Occipital
- Zygomatic
- Mandible

Figure 19-2 The skull from the left. An additional cranial bone, the ethmoid (*ETH-moyd*), is visible mainly from the interior of the skull. The hyoid is considered part of the axial skeleton but is not attached to any other bones. The tongue and other muscles are attached to the hyoid.



See a chart on bones of the skull and a figure comparing the male and female pelvises in the Student Resources on *thePoint*.

Bone Formation

Bone is formed by the gradual addition of calcium and phosphorus salts to cartilage, a type of dense connective tissue. This process of **ossification** begins before birth and continues to adulthood. Although bone appears to be inert, it

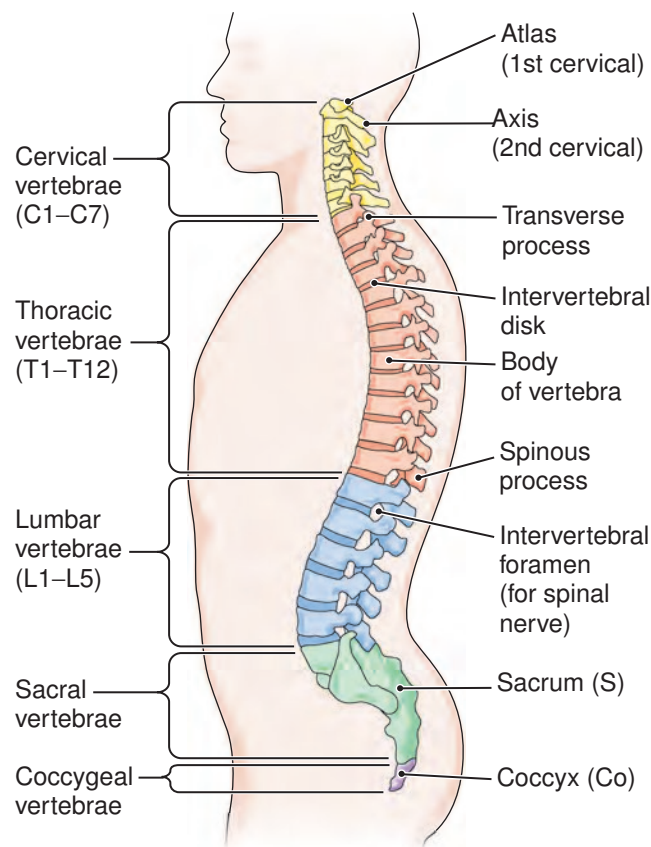


Figure 19-3 Vertebral column, left lateral view. The number of vertebrae in each group and the abbreviations for each are shown. The sacrum and coccyx are formed from fused bones.

is actually living tissue that is constantly being replaced and remodeled throughout life. Three types of cells are involved in these changes:

- **Osteoblasts**, the cells that produce bone
- **Osteocytes**, mature bone cells that help to maintain bone tissue
- **Osteoclasts**, involved in the breakdown of bone tissue to release needed minerals or to allow for reshaping and repair

The process of destroying bone so that its components can be taken into the circulation is called **resorption**. This activity occurs continuously and is normally in balance with bone formation. In disease states, resorption may occur more rapidly or more slowly than bone production.



See the animation “Bone Growth” in the Student Resources on *thePoint*.

Structure of a Long Bone

A typical long bone (**Fig. 19-5**) has a shaft or **diaphysis** composed of compact bone tissue. Within the shaft is a medullary cavity containing the yellow form of **bone marrow**, which is high in fat. The irregular **epiphysis** at either end is made of a less dense, spongy (cancellous) bone tissue (**Fig. 19-6**).

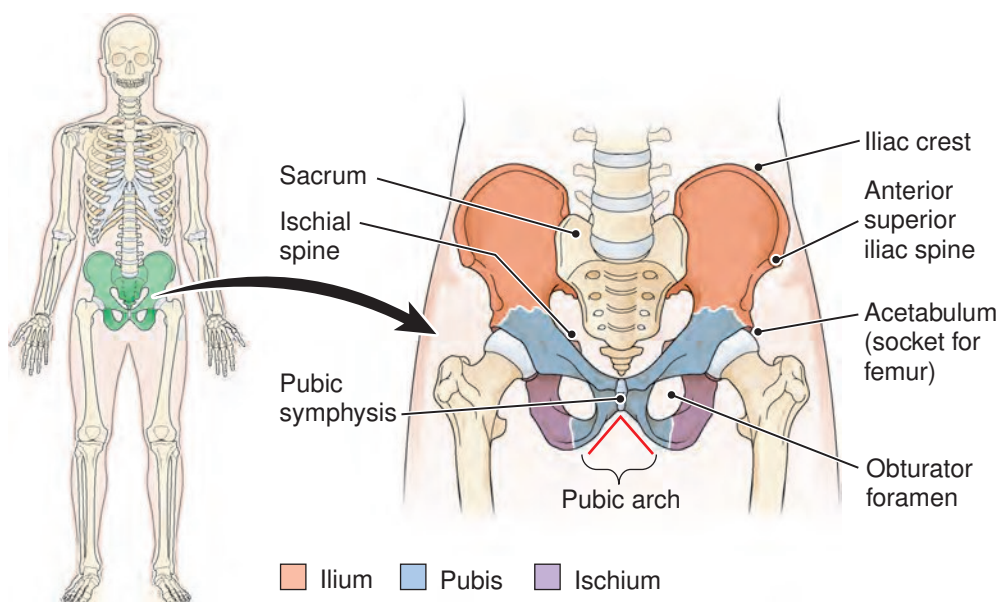


Figure 19-4 The pelvic bones. Each pelvic, or hip, bone is formed from three fused bones, the ilium, ischium, and pubis. Together with the sacrum and coccyx, they form the bony pelvis. The acetabulum is the socket for the femur.



Bones of the Skeleton

REGION	BONES	DESCRIPTION
axial skeleton (AK-sē-al)		
SKULL		
cranium (KRĀ-nē-um)	cranial bones (8)	chamber enclosing the brain; houses the ear and forms part of the eye socket
facial portion (FĀ-shal)	facial bones (14)	form the face and chambers for sensory organs
hyoid (HĪ-oyd)		U-shaped bone under mandible (lower jaw); used for muscle attachments
ossicles	ear bones (3)	transmit sound waves through middle ear
TRUNK		
vertebral column (VER-te-bral)	vertebrae (26) (VER-te-brē)	encloses the spinal cord
thorax (THŌ-raks)	sternum (STER-num) ribs (12 pairs)	anterior bone of the thorax enclose the organs of the thorax
appendicular skeleton (ap-en-DIK-ū-lar)		
UPPER DIVISION		
shoulder girdle	clavicle (KLAV-i-keł) scapula (SKAP-ū-la)	anterior; between sternum and scapula posterior, anchors muscles that move arm
upper extremity	humerus (HŪ-mer-us) ulna (UL-na) radius (RĀ-dē-us) carpals (8) (KAR-palz) metacarpals (5) (met-a-KAR-palz) phalanges (14) (fa-LAN-jēz)	proximal arm bone medial bone of forearm lateral bone of forearm wrist bones bones of palm bones of fingers
LOWER DIVISION		
pelvic bones (PEL-vic)	os coxae (2) (os KOK-sē)	join sacrum and coccyx of vertebral column to form the bony pelvis
lower extremity	femur (FĒ-mur) patella (pa-TEL-a) tibia (TIB-ē-a) fibula (FIB-ū-la) tarsal bones (7) (TAR-sal) metatarsals (5) (met-a-TAR-salz) phalanges (14) (fa-LAN-jēz)	thigh bone kneecap medial bone of leg lateral bone of leg ankle bones. The large heel bone is the calcaneus (kal-KĀ-nē-us) bones of instep bones of toes

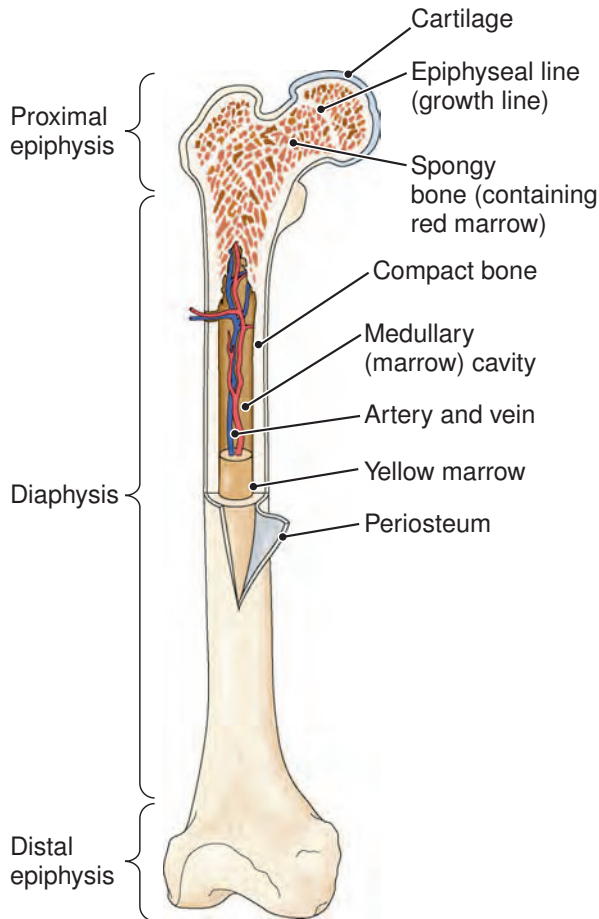


Figure 19-5 Structure of a long bone.

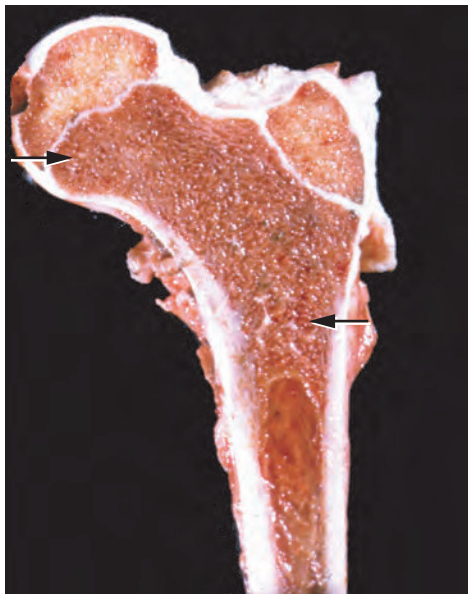


Figure 19-6 Bone tissue, longitudinal section. The epiphysis (end) of this long bone has an outer layer of compact bone. The remainder of the tissue is spongy (cancellous) bone, shown by the arrows. Transverse growth lines are also visible.

The spaces in spongy bone contain the blood-forming red bone marrow. A layer of cartilage covers the epiphysis to protect the bone surface at a joint. The thin layer of fibrous tissue, or **periosteum**, that covers the bone's outer surface nourishes and protects the bone and also generates new bone cells for growth and repair.

Between the diaphysis and the epiphysis at each end, in a region called the **metaphysis**, is the growth region or **epiphyseal plate**. Long bones continue to grow in length at these regions throughout childhood and into early adulthood. When the bone stops elongating, this area becomes fully calcified but remains visible as the epiphyseal line (see Fig. 19-5).

Long bones are found in the arms, legs, hands, and feet. Other bones are described as:

- Flat (e.g., cranial bones, ribs, scapulae)
- Short (e.g., wrist and ankle bones)
- Irregular (e.g., facial bones, vertebrae)

Joints

The joints, or **articulations**, are classified according to the degree of movement they allow:

- A **suture** is an immovable joint held together by fibrous connective tissue, as is found between the bones of the skull (see Fig. 19-2).
- A **symphysis** is a slightly movable joint connected by fibrous cartilage. Examples are the joints between the bodies of the vertebrae (see Fig. 19-3) and the joint between the pubic bones (see Fig. 19-4).
- A **synovial joint**, or **diarthrosis**, is a freely movable joint. Such joints allow for a wide range of movements, as described in Chapter 20. **Tendons** attach muscles to bones to produce movement at the joints.

Freely movable joints are subject to wear and tear, and they therefore have some protective features (Fig. 19-7). The cavity of a diarthrotic joint contains **synovial fluid**, which cushions and lubricates the joint. This fluid is produced by the synovial membrane that lines the joint cavity. The ends of the articulating bones are cushioned and protected by cartilage. A fibrous capsule, continuous with the periosteum, encloses the joint. Synovial joints are stabilized and strengthened by **ligaments**, which connect the articulating bones. A **bursa** is a small sac of synovial fluid that cushions the area around a joint. Bursae are found at stress points between tendons, ligaments, and bones (see Fig. 19-7).



See the chart on joints in the Student Resources on thePoint.

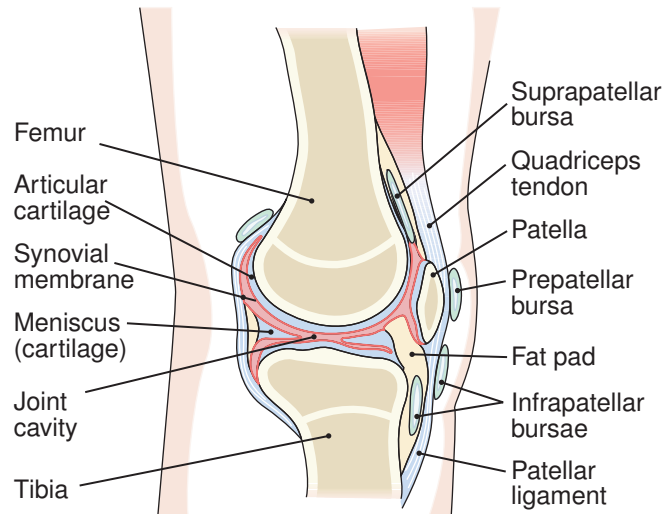


Figure 19-7 The knee joint, sagittal section. The knee joint is an example of a freely movable, synovial joint, also called a diarthrosis. Synovial fluid fills the joint cavity. Other protective structures such as the cartilage, joint capsule, ligaments, and bursae are also shown.

Terminology

Key Terms

Normal Structure and Function

acetabulum <i>as-e-TAB-ū-lum</i>	The bony socket in the hip bone that holds the head of the femur (from the Latin word for vinegar because it resembles the base of a vinegar cruet)
articulation <i>ar-tik-ū-LĀ-shun</i>	A joint (adjective: articular)
atlas <i>AT-las</i>	The first cervical vertebra (see Fig. 19-3) (root: atlant/o)
axis <i>AK-sis</i>	The second cervical vertebra (see Fig. 19-3)
bone <i>bōn</i>	A calcified form of dense connective tissue; osseous tissue; also an individual unit of the skeleton made of such tissue (root: oste/o)
bone marrow	The soft material that fills bone cavities. Yellow marrow fills the central cavity of the long bones; blood cells are formed in red bone marrow, which is located in spongy bone tissue (root: myel/o)
bursa <i>BUR-sa</i>	A fluid-filled sac that reduces friction near a joint (root: burs/o)
cartilage <i>KAR-ti-lij</i>	A type of dense connective tissue that is found in the skeleton, larynx, trachea, and bronchi. It is the precursor to most bone tissue (root: chondr/o)
diarthrosis <i>di-ar-THRŌ-sis</i>	A freely movable joint; also called a synovial joint (adjective: diarthrotic)
diaphysis <i>dī-AF-i-sis</i>	The shaft of a long bone
epiphyseal plate <i>ep-i-FIZ-ē-al</i>	The growth region of a long bone; located in the metaphysis, between the diaphysis and epiphysis. When bone growth ceases, this area appears as the epiphyseal line. Also spelled epiphysal

(Continued)

Terminology**Key Terms** *(Continued)*

epiphysis <i>e-PIF-i-sis</i>	The irregularly shaped end of a long bone
ilium <i>IL-ē-um</i>	The large, flared, superior portion of the pelvic bone (root: ili/o) (adjective: iliac)
joint	The junction between two bones; articulation (root: arthr/o)
ligament <i>LIG-a-ment</i>	A strong band of connective tissue that joins one bone to another
metaphysis <i>me-TAF-i-sis</i>	The region of a long bone between the diaphysis (shaft) and epiphysis (end); during development, the growing region of a long bone
ossification <i>os-i-fi-KĀ-shun</i>	The formation of bone tissue (from Latin os, meaning “bone”)
osteoblast <i>OS-tē-ō-blast</i>	A cell that produces bone tissue
osteoclast <i>OS-tē-ō-clast</i>	A cell that destroys bone tissue
osteocyte <i>OS-tē-ō-sīt</i>	A mature bone cell that nourishes and maintains bone tissue
pelvis	The large ring of bone at the inferior trunk. Formed of the two hip bones (ossa coxae) joined to the sacrum and coccyx (plural: pelves). Each os coxae is formed of three bones, the superior, flared ilium (<i>IL-ē-um</i>); ischium (<i>IS-kē-um</i>); and pubis (<i>PŪ-bis</i>)
periosteum <i>per-ē-OS-tē-um</i>	The fibrous membrane that covers a bone’s surface
resorption <i>rē-SORP-shun</i>	Removal of bone by breakdown and absorption into the circulation
skeleton <i>SKEL-e-ton</i>	The body’s bony framework, consisting of 206 bones; root skelet/o. The axial portion (80 bones) is composed of the skull, spinal column, ribs, and sternum. The appendicular skeleton (126 bones) contains the bones of the arms and legs, shoulder girdle, and pelvis
suture <i>SŪ-chur</i>	An immovable joint, such as the joints between the skull bones
symphysis <i>SIM-fi-sis</i>	A slightly movable joint
synovial fluid <i>si-NŌ-vē-al</i>	The fluid contained in a freely movable (diarthrotic) joint; synovia (root: synov/i)
synovial joint	A freely movable joint; has a joint cavity containing synovial fluid; a diarthrosis
tendon <i>TEN-don</i>	A fibrous band of connective tissue that attaches a muscle to a bone
thorax <i>THŌ-raks</i>	The upper part of the trunk between the neck and the abdomen; formed by the 12 pairs of ribs and sternum



Go to the Audio Pronunciation Glossary in the Student Resources on thePoint to hear these terms pronounced.

Roots Pertaining to the Skeleton, Bones, and Joints

See **Tables 19-1 and 19-2.**

Table 19-1 Roots for Bones and Joints

Root	Meaning	Example	Definition of Example
oste/o	bone	osteopenia os-tē-ō-PĒ-nē-a	deficiency of bone tissue
myel/o	bone marrow; also, spinal cord	myeloid MĪ-e-loyd	pertaining to or resembling bone marrow
chondr/o	cartilage	chondroblast KON-drō-blast	a cartilage-forming cell
arthr/o	joint	arthrosis ar-THRŌ-sis	joint; condition affecting a joint
synov/i	synovial fluid, joint, or membrane	asynovia a-sin-Ō-vē-a	lack of synovial fluid
burs/o	bursa	peribursal per-i-BER-sal	around a bursa

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EXERCISE 19-1

Fill in the blanks:

- Osteolysis (os-tē-OL-i-sis) is destruction of _____.
- Myelogenous (mī-e-LOJ-e-nus) means originating in _____.
- Arthrodesis (ar-THROD-e-sis) is fusion of a(n) _____.
- A chondroma (kon-DRŌ-ma) is a tumor of _____.
- A bursolith (BUR-sō-lith) is a stone in a(n) _____.

Define the following words:

- osteoid (OS-tē-oyd) _____
- myelopoiesis (mī-e-lō-poy-Ē-sis) _____
- chondromalacia (kon-drō-ma-LĀ-shē-a) _____
- arthrocentesis (ar-thrō-sen-TĒ-sis) _____
- bursitis (bur-SĪ-tis) _____
- synovial (si-NŌ-vē-al) _____

Write words for the following definitions:

- inflammation of bone and bone marrow _____
- a bone-forming cell _____

(Continued)

EXERCISE 19-1 (Continued)

14. tumor of bone marrow _____
15. incision of a bursa _____
16. inflammation of a synovial membrane _____
17. plastic repair of a joint _____
18. any disease of a joint _____
19. pertaining to or resembling cartilage _____
20. instrument for examining the interior of a joint _____

The word *ostosis* means “bone growth.” Use this as a suffix for the following two words:

21. excess growth of bone _____
22. abnormal growth of bone _____

Table 19-2 Roots for the Skeleton

Root	Meaning	Example	Definition of Example
crani/o	skull, cranium	craniometry <i>krā-ne-OM-e-trē</i>	measurement of the cranium
spondyl/o	vertebra	spondylolysis <i>spōn-dī-LOL-i-sis</i>	destruction and separation of a vertebra
vertebr/o	vertebra, spinal column	paravertebral <i>pa-ra-VER-te-bral</i>	near the vertebrae or spinal column
rachi/o	spine	rachischisis <i>rā-KIS-ki-sis</i>	fissure (-schisis) of the spine; spina bifida
cost/o	rib	costochondral <i>kos-tō-KON-dral</i>	pertaining to a rib and its cartilage
sacr/o	sacrum	presacral <i>prē-SĀ-kral</i>	in front of the sacrum
coccy, coccyg/o	coccyx	coccygeal* <i>kok-SIJ-ē-al</i>	pertaining to the coccyx
pelvi/o	pelvis	pelviscope <i>PEL-vi-skōp</i>	endoscope for examining the pelvis
ili/o	ilium	iliopelvic <i>il-ē-ō-PEL-vik</i>	pertaining to the ilium and pelvis

*Note spelling.

EXERCISE 19-2

Adjectives. Write adjectives for the following definitions:

1. pertaining to (-al) the skull _____
2. pertaining to (-al) a rib _____
3. pertaining to (-ic) the pelvis _____
4. pertaining to (-ac) the ilium _____
5. pertaining to (-al) the spinal column _____
6. pertaining to (-al) the sacrum _____

Define the following terms:

7. craniotomy (*krā-nē-OT-ō-mē*) _____
8. prevertebral (*prē-VER-te-bral*) _____
9. spondylodinia (*spōn-di-lō-DIN-ē-a*) _____
10. suprapelvic (*sū-pra-PEL-vik*) _____

Write words for the following definitions:

11. fissure of the skull _____
12. inflammation of the vertebrae (use spondyl/o) _____
13. plastic repair of a vertebra (use vertebr/o) _____
14. surgical excision of a rib _____
15. surgical puncture of the spine; spinal tap _____
16. pertaining to the sacrum and ilium _____
17. pertaining to the cranium and sacrum _____
18. measurement of the pelvis _____
19. around the sacrum _____
20. excision of the coccyx _____
21. pertaining to the ilium and coccyx _____
22. below the ribs _____

Clinical Aspects of the Skeleton

Disorders of the skeleton often involve surrounding tissues—ligaments, tendons, and muscles—and may be studied together as diseases of the musculoskeletal system. (The muscular system is described in Chapter 20.) The medical specialty that concentrates on diseases of the skeletal and muscular systems is **orthopedics**. Physical therapists and occupational therapists must also understand these systems (see Box 19-2). (Some colorful terms used to describe musculoskeletal abnormalities are given in Box 19-3.)

Most abnormalities of the bones and joints appear on simple radiographs (see Fig. 19-8 for a radiograph of a normal joint). Radioactive bone scans, computed tomography (CT), and magnetic resonance imaging (MRI) scans are used as well. Also indicative of disorders are changes in blood levels of calcium and **alkaline phosphatase**, an enzyme needed for bone calcification.

INFECTION

Osteomyelitis is an inflammation of bone caused by pus-forming bacteria that enter through a wound or are carried by the blood. Often the blood-rich ends of the long bones

Box 19-2



Health Professions

Careers in Physical Therapy

Physical therapy restores mobility and relieves pain in cases of arthritis or musculoskeletal injuries. Individuals who are recovering from neuromuscular, cardiovascular, pulmonary, and integumentary events are also candidates for physical therapy. Some examples include traumatic brain injury (TBI), myocardial infarction (MI), chronic obstructive pulmonary disease (COPD), and burns, respectively.

Physical therapists (PTs) work closely with physicians, nurses, occupational therapists, and other allied health care professionals. Some treat a wide range of ailments, whereas others focus on a particular age group, medical field, or sports medicine. Regardless of specialty, PTs are responsible for examining their patients and developing individualized treatment programs. The examination includes a medical history and tests measuring strength, mobility, balance, coordination, and endurance. The treatment plan may include stretching and exercise to improve mobility; hot packs, cold compresses, and massage to reduce pain; and the use

of crutches, prostheses, and wheelchairs. Physical therapy assistants (PTAs) work directly under the supervision of a physical therapist. PTAs are responsible for implementing a preestablished treatment plan, teaching patients exercises and equipment use, and reporting results back to the physical therapist.

Whereas many practicing physical therapists in the United States have bachelor's or master's degrees, most accredited physical therapy schools now offer doctoral programs requiring three years of postgraduate education. PTAs in the United States usually graduate with an associate degree from a community college and must pass a licensing exam. PTs and PTAs practice in hospitals and clinics and may also visit homes and schools. As the American population continues to age and the need for rehabilitative therapy increases, job prospects are good. For more information about careers in physical therapy, contact the American Physical Therapy Association at www.apta.org.

are invaded, and the infection then spreads to other regions, such as the bone marrow and even the joints. The use of antibiotics has greatly reduced the threat of osteomyelitis.

Tuberculosis may spread to bone, especially the long bones of the arms and legs and the bones of the wrist and ankle. Tuberculosis of the spine is **Pott disease**. Infected vertebrae are weakened and may collapse, causing pain, deformity, and pressure on the spinal cord. Antibiotics can control tuberculosis as long as the strains are not resistant to these drugs and the host is not weakened by other diseases.

FRACTURES

A **fracture** is a break in a bone, usually caused by trauma. The effects of a fracture depend on the break's location and severity; the amount of associated injury; possible complications, such as infections; and success of healing, which may take months. In a closed or simple fracture, the skin is not broken. If the fracture is accompanied by a wound in the skin, it is described as an open fracture. Various types of fractures are listed in For Your Reference **Box 19-4** and illustrated in **Figure 19-9**.

Box 19-3



Focus on Words

Names That Are Like Pictures

Some conditions are named by terms that are very descriptive. In orthopedics, several names for types of bursitis are based on the repetitive stress that leads to the irritation. For example, "tailor's bottom" involves the ischial ("sit") bones of the pelvis, as might be irritated by sitting tailor-fashion to sew. "Housemaid's knee" comes from the days of scrubbing floors on hands and knees, and "tennis elbow" is named for the sport that is its most common cause. "Student's elbow" results from leaning to pore over books while studying, although today a student is more likely to have neck and wrist problems from working at a computer.

The term *knock-knee* describes genu valgum, in which the knees are abnormally close and the space between the

ankles is wide. The opposite is genu varum, in which the knees are far apart and the bottom of the legs are close together, giving rise to the term *bowleg*. A dowager's hump appears dorsally between the shoulders as a result of osteoporosis and is most commonly seen in elderly women.

Injury to the roots of nerves that supply the arm may cause the arm to abduct slightly and rotate medially with the wrist flexed and the fingers pointing backward, a condition colorfully named "waiter's tip position." "Popeye's shoulder" is sign of a separation or tear at the head of the biceps tendon. The affected arm, when abducted with the elbow flexed, reveals a bulge on the upper arm—just like Popeye's!

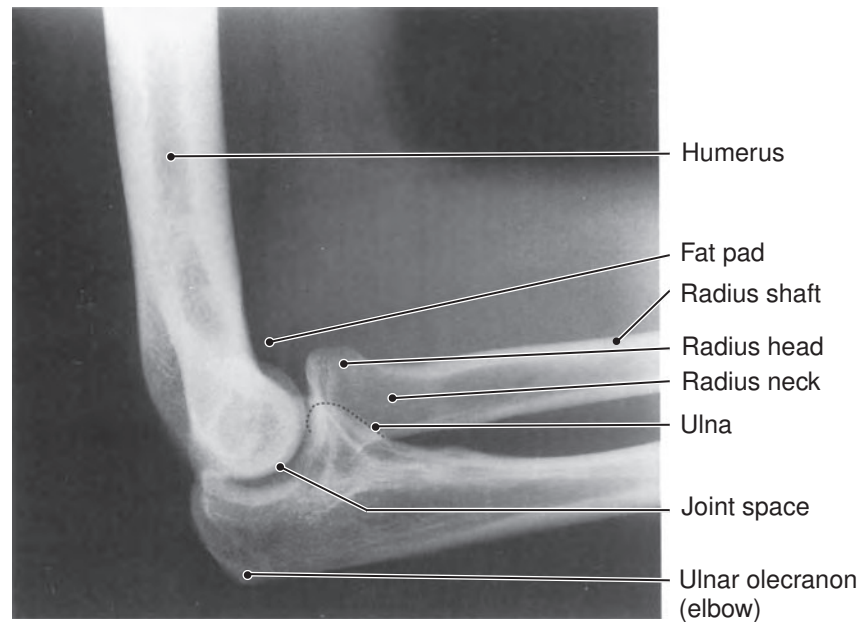


Figure 19-8 Radiograph of a normal left elbow joint, lateral view. The olecranon (*ō-LEK-ra-non*) is the proximal ulnar enlargement that forms the prominent bone of the elbow.

Reduction of a fracture refers to realignment of the broken bone. If no surgery is required, the reduction is described as closed; an open reduction is one that requires surgery to place the bone in proper position. Rods, plates, or screws might be needed to ensure proper healing. A splint or cast is often needed during the healing phase to immobilize the bone. **Traction** refers to using pulleys and weights to maintain alignment of a fractured bone during healing.

A traction device may be attached to the skin or attached to the bone itself by means of a pin or wire.

METABOLIC BONE DISEASES

Osteoporosis is a loss of bone mass that results in bone weakening (**Fig. 19-10**). A decrease in estrogens after menopause makes women over age 50 most susceptible to the

Box 19-4

For Your Reference

Types of Fractures

FRACTURE	DESCRIPTION
closed	a simple fracture with no open wound
Colles <i>KOL-ēz</i>	fracture of the distal end of the radius with backward displacement of the hand
comminuted <i>COM-i-nū-ted</i>	fracture in which the bone is splintered or crushed
compression	fracture caused by force from both ends, as to a vertebra
greenstick	one side of the bone is broken and the other side is bent
impacted	one fragment is driven into the other
oblique	break occurs at an angle across the bone; usually one fragment slips by the other
open	fracture is associated with an open wound, or broken bone protrudes through the skin
Pott	fracture of the distal end of the fibula with injury to the tibial joint
spiral	fracture is in a spiral or S shape; usually caused by twisting injuries
transverse	a break at right angles to the long axis of a bone

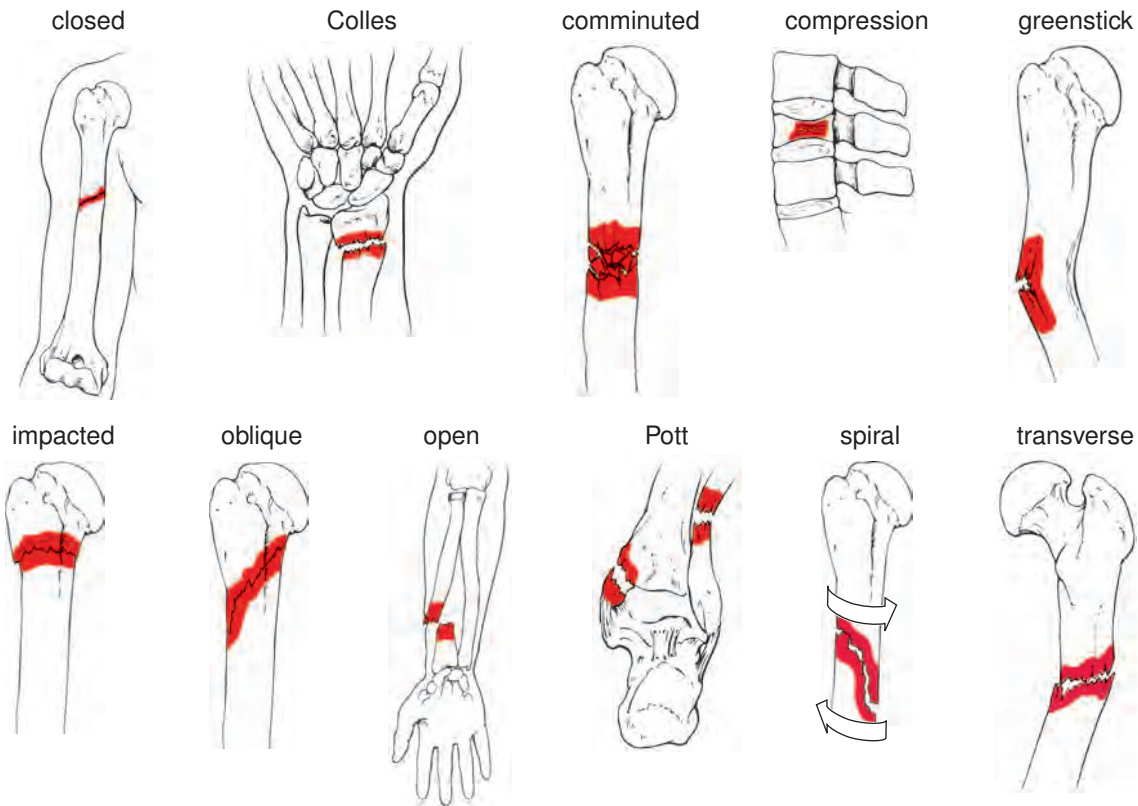


Figure 19-9 Types of fractures.

effects of this disorder. Efforts to prevent osteoporosis include a healthful diet, adequate intake of calcium and vitamin D, and engaging in regular weight-bearing exercises, such as walking, running, aerobics, and weight training. These exercises stimulate bone growth and also contribute to the balance and muscle strength needed to prevent falls. Perimenopausal hormone replacement therapy (HRT) prevents bone loss, but because of safety concerns, this treatment is still being reevaluated. Some drugs are available for reducing bone resorption and increasing bone density. These include the **bisphosphonates** and **selective estrogen receptor modulators (SERMs)** described in Chapter 15.



Figure 19-10 Osteoporosis. Femoral head showing osteoporosis (right) compared with a normal control (left).

Osteoporosis is diagnosed and monitored using a DEXA (dual-energy x-ray absorptiometry) scan, an imaging technique that measures bone mineral density (BMD). The diagnostic term **osteopenia** refers to a lower-than-average bone density, which is not considered to be abnormal. Osteopenia may progress to osteoporosis, but does not necessarily need treatment.

Other conditions that can lead to bone loss include nutritional deficiencies; disuse, as in paralysis or immobilization in a cast; and excess adrenocortical steroids. Overactivity of the parathyroid glands also leads to osteoporosis because parathyroid hormone causes calcium release from bones to raise blood calcium levels. Certain drugs, smoking, lack of exercise, and high intake of alcohol, caffeine, and proteins may also contribute to the development of osteoporosis.

In **osteomalacia** there is a softening of bone tissue because of diminished calcium salt formation. Possible causes include deficiency of vitamin D, needed to absorb calcium and phosphorus from the intestine; renal disorders; liver disease; and certain intestinal disorders. When osteomalacia occurs in children, the disease is called **rickets** (Fig. 19-11). Rickets is usually caused by a vitamin D deficiency.

Paget disease (osteitis deformans) is a disorder of aging in which bones become overgrown and thicker but deformed. The disease results in bowing of the long bones and distortion of the flat bones, such as the skull bones. Paget disease usually involves the bones of the axial skeleton, causing

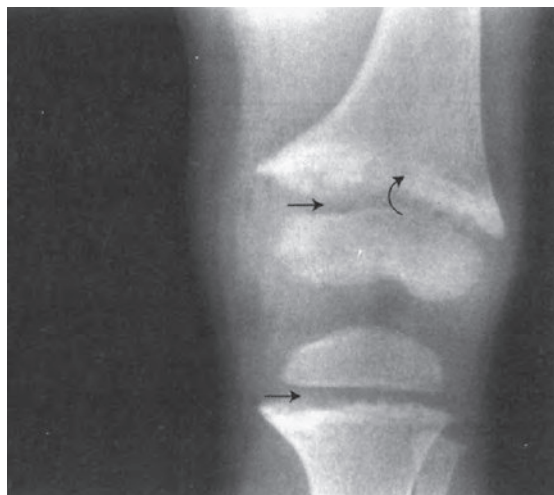


Figure 19-11 Rickets. Radiograph of the left knee joint showing widening of the growth regions of the bones (arrows).

pain, fractures, and hearing loss. With time, there may be neurologic signs, heart failure, and predisposition to bone cancer.

NEOPLASMS

Osteogenic sarcoma (osteosarcoma) most commonly occurs in a bone's growing region, especially around the knee. This is a highly malignant tumor that often requires amputation. It most commonly metastasizes to the lungs.

Chondrosarcoma usually appears in midlife. As the name implies, this tumor arises in cartilage. It may require amputation and most frequently metastasizes to the lungs.

In cases of malignant bone tumors, early surgical removal is important for prevention of metastasis. Signs of bone tumors are pain, easy fracture, and increases in serum calcium and alkaline phosphatase levels. Aside from primary tumors, neoplasms at other sites often metastasize to bone, most commonly to the spine.

JOINT DISORDERS

Some sources of joint problems include congenital malformations; infectious disease of the joint or adjacent bones; injury leading to degeneration; and necrosis resulting from loss of blood supply. **Arthritis** is a term broadly used to mean any inflammation of a joint. Based on the cause, several types are recognized.

Arthritis

The most common form of arthritis is **osteoarthritis (OA)** or **degenerative joint disease (DJD)** (Fig. 19-12). This involves a gradual degeneration of articular (joint) cartilage as a result of wear and tear. Predisposing factors for OA are age, heredity, injury, congenital skeletal abnormalities, and endocrine disorders. OA usually appears at midlife and beyond and involves the weight-bearing joints, such as the knees, hips, and finger joints. Radiographs show a narrowing of the

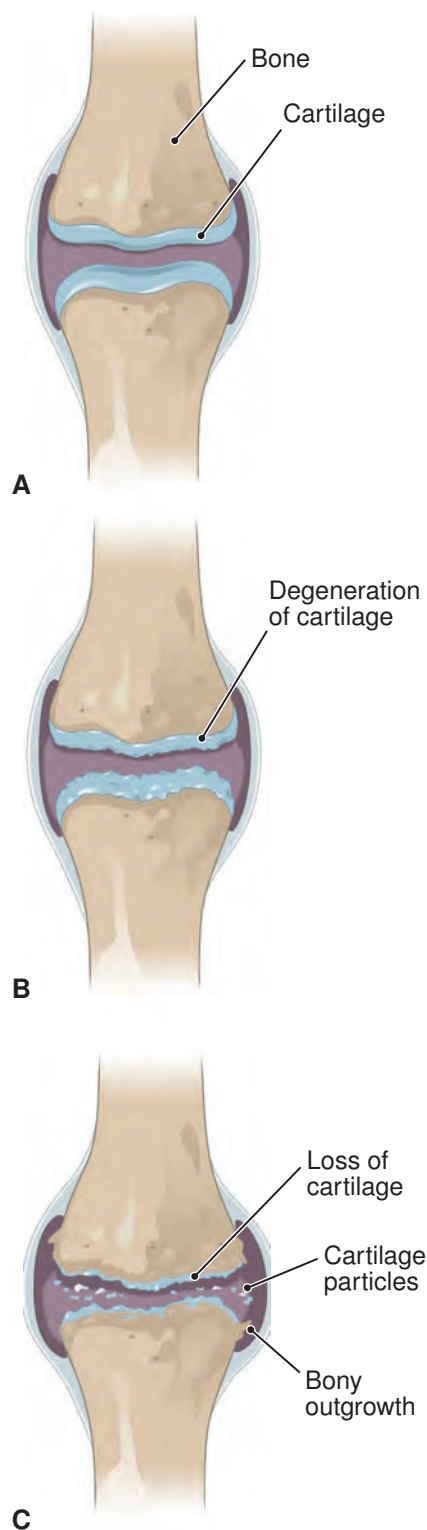


Figure 19-12 Osteoarthritis. A. Normal joint. B. Early stage of osteoarthritis. C. Late stage of the disease.

joint cavity and bone thickening. Cartilage may crack and break loose, causing inflammation in the joint and exposing the underlying bone.

OA is treated with analgesics to relieve pain; **antiinflammatory agents**, such as corticosteroids; **nonsteroidal**

antiinflammatory drugs (NSAIDs); and physical therapy. Steroids can be injected directly into an arthritic joint, but because they may ultimately cause cartilage damage, only a few injections can be given within a year at intervals of several months. Treatment may include drainage of excess fluid from the joint in an **arthrocentesis**. Application of ice, elevation, and acupuncture may also help to relieve pain in cases of joint inflammation.

Rheumatoid arthritis (RA) is a systemic inflammatory joint disease that commonly appears in young adult women. Its exact causes are unknown, but it may involve immunologic reactions. A group of antibodies called **rheumatoid factor** often appears in the blood, but is not always specific for RA as it may occur in other systemic diseases as well. There is an overgrowth of the synovial membrane that lines the joint cavity. As this membrane covers and destroys the joint cartilage, synovial fluid accumulates, causing joint swelling (**Fig. 19-13**). There is degeneration of the underlying bones, eventually causing fusion, or **ankylosis**. Treatment includes rest, physical therapy, analgesics, and antiinflammatory drugs.

Gout is caused by an increased level of uric acid in the blood, salts of which are deposited in the joints. It mostly occurs in middle-aged men and almost always involves pain at the base of the great toe. Gout may result from a primary metabolic disturbance or may be a secondary effect of another disease, as of the kidneys. It is treated with drugs to suppress formation of uric acid or to increase its elimination (uricosuric agent).

Joint Repair

In **arthroscopy**, orthopedic surgeons use a type of endoscope called an arthroscope to examine a joint's interior and perform surgical repairs if needed (**Fig. 19-14**). With an arthroscope, it is possible to remove or reshape articular cartilage and repair or replace ligaments.

If more conservative treatments do not bring relief, orthopedists may recommend an **arthroplasty**. This term generally means any joint reconstruction but usually applies to a total or partial joint replacement. Hips, knees, shoulders, and other joints can be replaced with prostheses to eliminate pain and restore mobility, as explained in **Box 19-5**.



Figure 19-13 Advanced rheumatoid arthritis. The hands show swelling of the joints and deviation of the fingers.

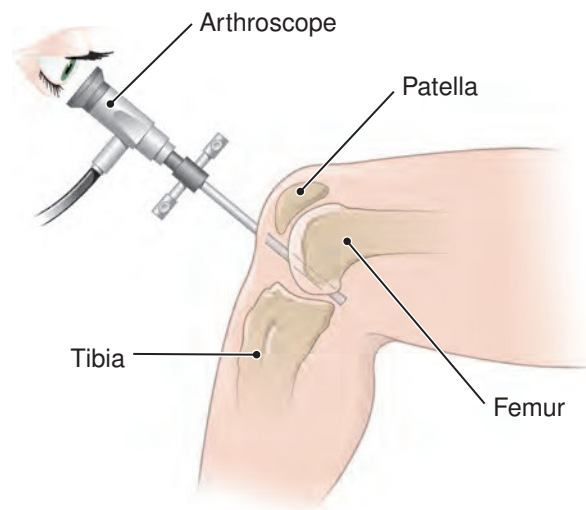


Figure 19-14 Arthroscopic examination of the knee. An arthroscope (a type of endoscope) is inserted between projections at the end of the femur to view the posterior of the knee.

A final alternative to relieve pain and provide stability at a joint is fusion, or **arthrodesis**, which results in total loss of joint mobility. Surgeons use pins or bone grafts to stabilize the joint and allow bone surfaces to adhere.

DISORDERS OF THE SPINE

Ankylosing spondylitis is a disease of the spine that appears mainly in males. Joint cartilage is destroyed; eventually, the disks between the vertebrae calcify and there is ankylosis (fusion) of the bones (**Fig. 19-15**). Changes begin low in the spine and progress upward, limiting mobility.

Spondylolisthesis is a forward sliding of a vertebra over the vertebra below (*-listhesis* means “a slipping”) (**Fig. 19-16**). The condition follows **spondylolysis**, degeneration of the joint structures that normally stabilize the vertebrae. Spondylolisthesis is most common in the spine's weight-bearing lumbar region, where it causes low back pain and sometimes leg pain resulting from irritation of spinal nerve roots.

Herniated Disk

In cases of a **herniated disk** (**Fig. 19-17**), the central mass (nucleus pulposus) of an intervertebral disk protrudes through the disk's weakened outer ring (annulus fibrosus) into the spinal canal. This commonly occurs in the spine's lumbosacral or cervical regions as a result of injury or heavy lifting. The herniated or “slipped” disk puts pressure on the spinal cord or spinal nerves, often causing **sciatica**, which is pain along the sciatic nerve in the thigh. There may be spasms of the back muscles, leading to disability.

A herniated disk is diagnosed by myelography, CT scan, MRI, and neuromuscular tests. Treatment is bed rest and drugs to reduce pain, muscle spasms, and inflammation followed by an exercise program to strengthen core and associated muscles. In severe cases, it may be necessary

Box 19-5



Clinical Perspectives

Arthroplasty: Bionic Parts for a Better Life

Since the first total hip replacement in the early 1960s, millions of joint replacements, called arthroplasties, have been performed successfully. Most are done to decrease joint pain in older people with osteoarthritis and other chronic degenerative bone diseases after other treatments such as weight loss, physical therapy, and medication have been tried. Hips and knees are most commonly restored, with almost 300,000 hip arthroplasties and more than 500,000 knee replacements performed each year in the United States. Orthopedic surgeons can also replace shoulder, elbow, wrist, hand, ankle, and foot joints.

Artificial, or *prosthetic*, joints are engineered to be strong, nontoxic, corrosion-resistant, and firmly bondable to the patient. Computer-controlled machines now produce individualized joints in less time and at less cost than in the past. Ball-and-socket joint prostheses, like those used in total hip replacement, consist of a cup, ball, and stem. The cup replaces the hip socket

(acetabulum) and is bonded to the pelvis using screws or glue. The cup is usually plastic but may also be made of longer-lasting ceramic or metal. The ball, made of metal or ceramic, replaces the femoral head and is attached to the stem, which is implanted into the femoral shaft. Stems are made of various metal alloys such as cobalt and titanium and are often glued into place. Stems designed to promote bone growth into them are commonly used in younger, more active patients because it is believed that they will remain firmly attached for a longer time.

Until recently, arthroplasty was rarely performed on young people because prostheses had lifespans of only about 10 years. Today's materials and surgical techniques could increase this time to 20 years or more, and young people who undergo arthroplasty will require fewer replacements later on. This improvement is important because the incidence of sports-related joint injuries in young adults is increasing.

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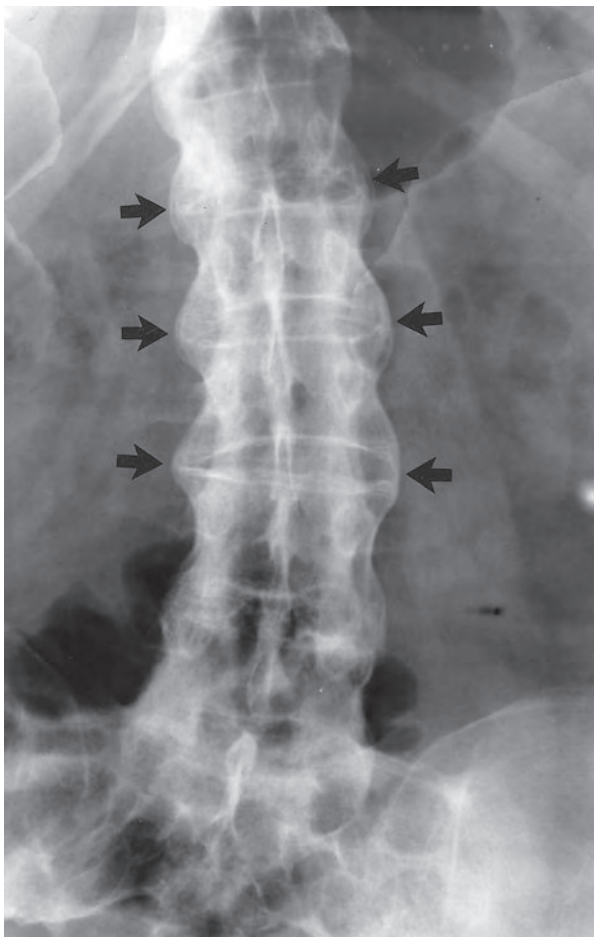


Figure 19-15 Ankylosing spondylitis. A frontal lumbar radiograph showing bone formation bridging the intervertebral disk spaces (arrows) and fusing the vertebrae.

to remove the disk surgically in a **discectomy**, sometimes followed by vertebral fusion with a bone graft to stabilize the spine. Using techniques of microsurgery (surgery done under magnification through a small incision), it is now possible to remove an exact amount of extruded disk tissue instead of the entire disk.

Curvatures of the Spine

The spine has four normal curves—two directed toward the anterior in the cervical and lumbar regions and two directed toward the posterior in the thoracic and sacral regions (see Fig. 19-3). Any exaggeration or deviation of these curves is described as **curvature of the spine**. Three common types of spinal curvatures are shown in Figure 19-18 and described as follows:

- **Kyphosis** is an exaggerated curve in the thoracic region, popularly known as “hunchback.”
- **Lordosis** is an exaggerated curve in the lumbar region, popularly known as “swayback.”
- **Scoliosis** is a sideways curvature of the spine in any region. (A case of scoliosis is described in L.R.’s opening case study.)

Spinal curvatures may be congenital or may result from muscle weakness or paralysis, poor posture, joint problems, disk degeneration, extreme obesity, or disease, such as spinal tuberculosis, rickets, or osteoporosis. Extreme cases may cause pain, breathing problems, or degenerative changes.

Bracing the spine during childhood may help to correct a curvature. If surgery is needed, vertebrae are fused and bone grafts and implants are used to stabilize the spine. It is now sometimes possible for surgeons to make these corrections endoscopically.

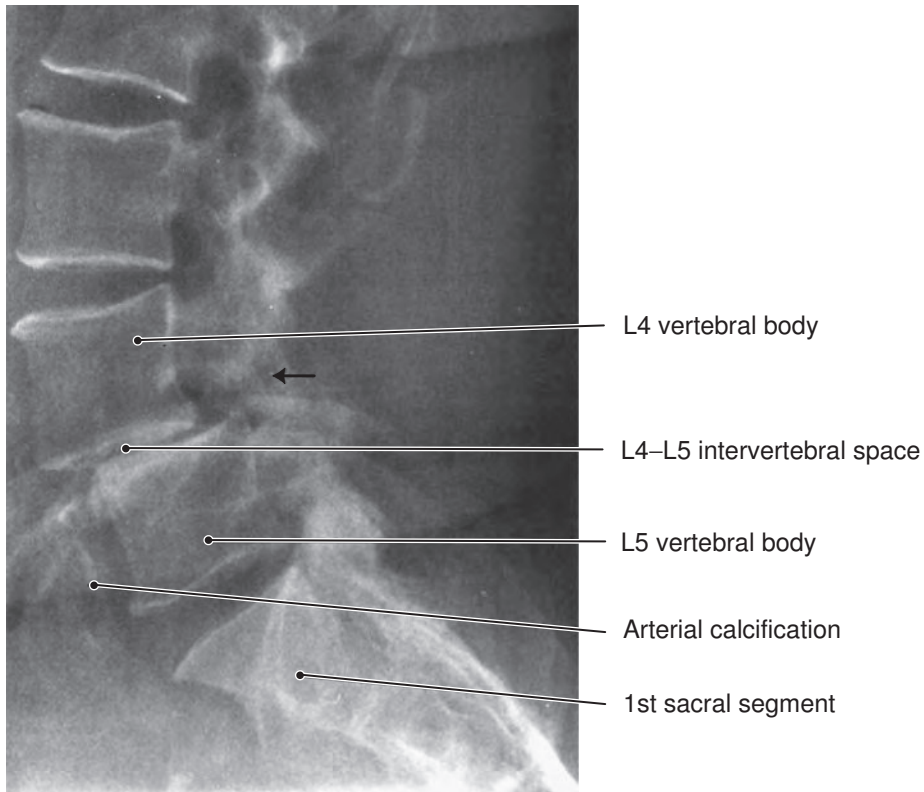


Figure 19-16 Spondylolisthesis. The L4 vertebral body has slid forward over L5 and there is marked narrowing of the L4–L5 intervertebral disk space.

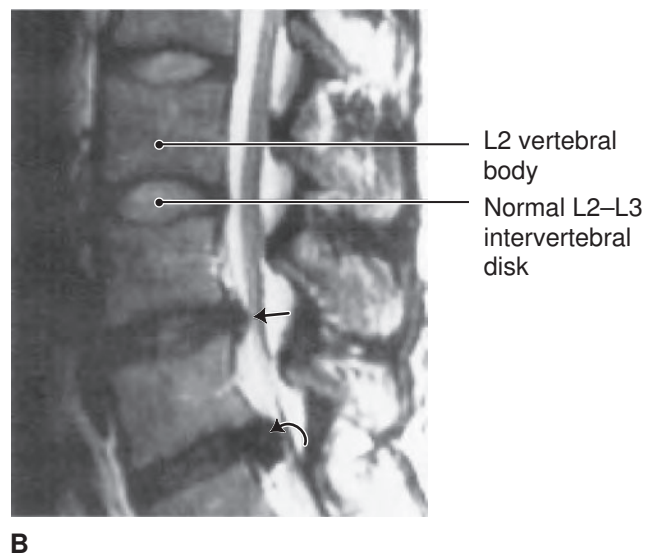
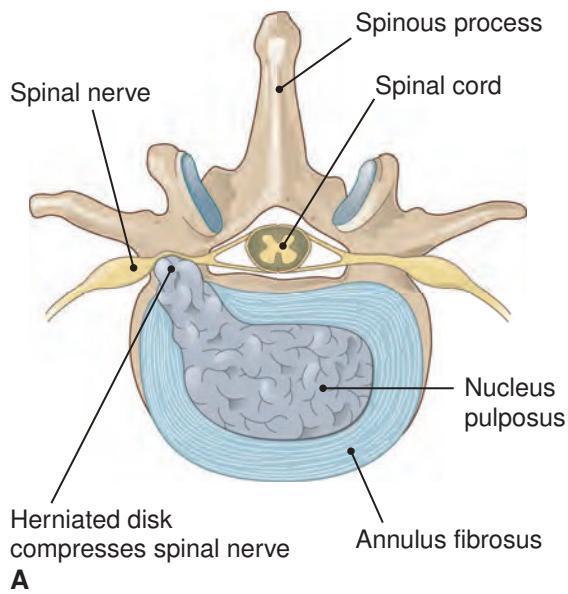


Figure 19-17 Herniated disk. A. The central mass of the disk protrudes into the spinal canal, putting pressure on the spinal nerve. B. Magnetic resonance image (MRI) of the lumbar spine, sagittal section, showing herniated disks at multiple levels. There is a bulging L3–L4 disk (*straight arrow*) and an extruded L4–L5 lumbar disk (*curved arrow*).

Terminology

Key Terms

Disorders

ankylosing spondylitis <i>ang-ki-LŌ-sing spon-di-LĪ-tis</i>	A chronic, progressive inflammatory disease involving the spinal joints and surrounding soft tissue, most common in young males; also called rheumatoid spondylitis
ankylosis <i>ang-ki-LŌ-sis</i>	Immobility and fixation of a joint
arthritis <i>ar-THRĪ-tis</i>	Inflammation of a joint
chondrosarcoma <i>kon-drō-sar-KŌ-ma</i>	A malignant tumor of cartilage
curvature of the spine <i>KER-va-chūr</i>	An exaggerated spinal curve, such as scoliosis, lordosis, or kyphosis (see Fig. 19-18)
degenerative joint disease (DJD)	Osteoarthritis (see below)
fracture <i>FRAK-chūr</i>	A break in a bone. In a closed or simple fracture, the broken bone does not penetrate the skin; in an open fracture, there is an accompanying wound in the skin (see Fig. 19-9)
gout <i>gowt</i>	A form of acute arthritis, usually beginning in the knee or foot, caused by deposit of uric acid salts in the joints
herniated disk <i>HER-nē-āt-ed</i>	Protrusion of the center (nucleus pulposus) of an intervertebral disk into the spinal canal; ruptured or “slipped” disk
kyphosis <i>kĪ-FŌ-sis</i>	An exaggerated curve of the spine in the thoracic region; hunchback, humpback (see Fig. 19-18)
lordosis <i>lor-DŌ-sis</i>	An exaggerated curve of the spine in the lumbar region; swayback (see Fig. 19-18)
osteoarthritis (OA) <i>os-tē-ō-ar-THRĪ-tis</i>	Progressive deterioration of joint cartilage with growth of new bone and soft tissue in and around the joint; the most common form of arthritis; results from wear and tear, injury, or disease; also called degenerative joint disease (DJD)
osteogenic sarcoma <i>os-tē-ō-JEN-ik</i>	A malignant bone tumor; osteosarcoma
osteomalacia <i>os-tē-ō-ma-LĀ-shē-a</i>	A softening and weakening of the bones due to vitamin D deficiency or other disease
osteomyelitis <i>os-tē-ō-mī-e-LĪ-tis</i>	Inflammation of bone and bone marrow caused by infection, usually bacterial
osteopenia <i>os-tē-ō-PĒ-nē-a</i>	A lower-than-average bone density, which may foreshadow osteoporosis
osteoporosis <i>os-tē-ō-po-RŌ-sis</i>	A condition characterized by reduction in bone density, most common in white women past menopause; predisposing factors include poor diet, inactivity, and low estrogen levels
Paget disease <i>PAJ-et</i>	Skeletal disease of the elderly characterized by bone thickening and distortion with bowing of long bones; osteitis deformans
Pott disease	Inflammation of the vertebrae, usually caused by tuberculosis

(Continued)

Terminology

Key Terms (Continued)

rheumatoid arthritis (RA) <i>RŪ-ma-toyd</i>	A chronic autoimmune disease of unknown origin resulting in inflammation of peripheral joints and related structures; more common in women than in men
rheumatoid factor	A group of antibodies found in the blood in cases of rheumatoid arthritis and other systemic diseases
rickets <i>RIK-ets</i>	Faulty bone formation in children, usually caused by a deficiency of vitamin D
sciatica <i>sī-AT-i-ka</i>	Severe pain in the leg along the course of the sciatic nerve, usually related to spinal nerve root irritation
scoliosis <i>skō-lē-Ō-sis</i>	A sideways curvature of the spine in any region (see Fig. 19-18)
spondylolisthesis <i>spon-di-lō-lis-THĒ-sis</i>	A forward displacement of one vertebra over another (<i>-listhesis</i> means “a slipping”); also pronounced <i>spon-di-lō-LIS-the-sis</i>
spondylolysis <i>spon-di-LOL-i-sis</i>	Degeneration of the articulating portions of a vertebra allowing for spinal distortion, specifically in the lumbar region
Treatment	
alkaline phosphatase <i>AL-ka-lin FOS-fa-tās</i>	An enzyme needed in the formation of bone; serum activity of this enzyme is useful in diagnosis
arthrocentesis <i>ar-thrō-sen-TEĒ-sis</i>	Aspiration of fluid from a joint by needle puncture
arthrodesis <i>ar-THROD-e-sis</i>	Surgical immobilization (fusion) of a joint; artificial ankylosis
arthroplasty <i>AR-thrō-plas-tē</i>	Partial or total replacement of a joint with a prosthesis
arthroscopy <i>ar-THROS-kō-pē</i>	Use of an endoscope to examine the interior of a joint or to perform surgery on the joint (see Fig. 19-14); the instrument used is an arthroscope
discectomy <i>dis-KEK-tō-mē</i>	Surgical removal of a herniated intervertebral disk; also spelled discectomy
orthopedics <i>or-thō-PĒ-diks</i>	The study and treatment of disorders of the skeleton, muscles, and associated structures; literally “straight” (ortho) “child” (ped); also spelled orthopaedics
reduction of a fracture	Return of a fractured bone to a normal position; may be closed (not requiring surgery) or open (requiring surgery)
traction <i>TRAK-shun</i>	The process of drawing or pulling, such as traction of the head in the treatment of injuries to the cervical vertebrae
Drugs	
antiinflammatory agent	Drug that reduces inflammation; includes steroids, such as hydrocortisone, and non-steroidal antiinflammatory drugs (NSAIDs)
bisphosphonate <i>bis-FOS-fō-nāt</i>	Agent used to prevent and treat osteoporosis; increases bone mass by decreasing bone turnover. Examples are alendronate (Fosamax), risedronate (Actonel), and ibandronate (Boniva)

Terminology**Key Terms** *(Continued)***nonsteroidal
antiinflammatory drug
(NSAID)**

Drug that reduces inflammation but is not a steroid; examples include aspirin and ibuprofen and other inhibitors of prostaglandins, naturally produced substances that promote inflammation

**selective estrogen receptor
modulator (SERM)**

Drug that acts on estrogen receptors. Raloxifene (Evista) is used to prevent bone loss after menopause. Other SERMs are used to prevent and treat estrogen-sensitive breast cancer

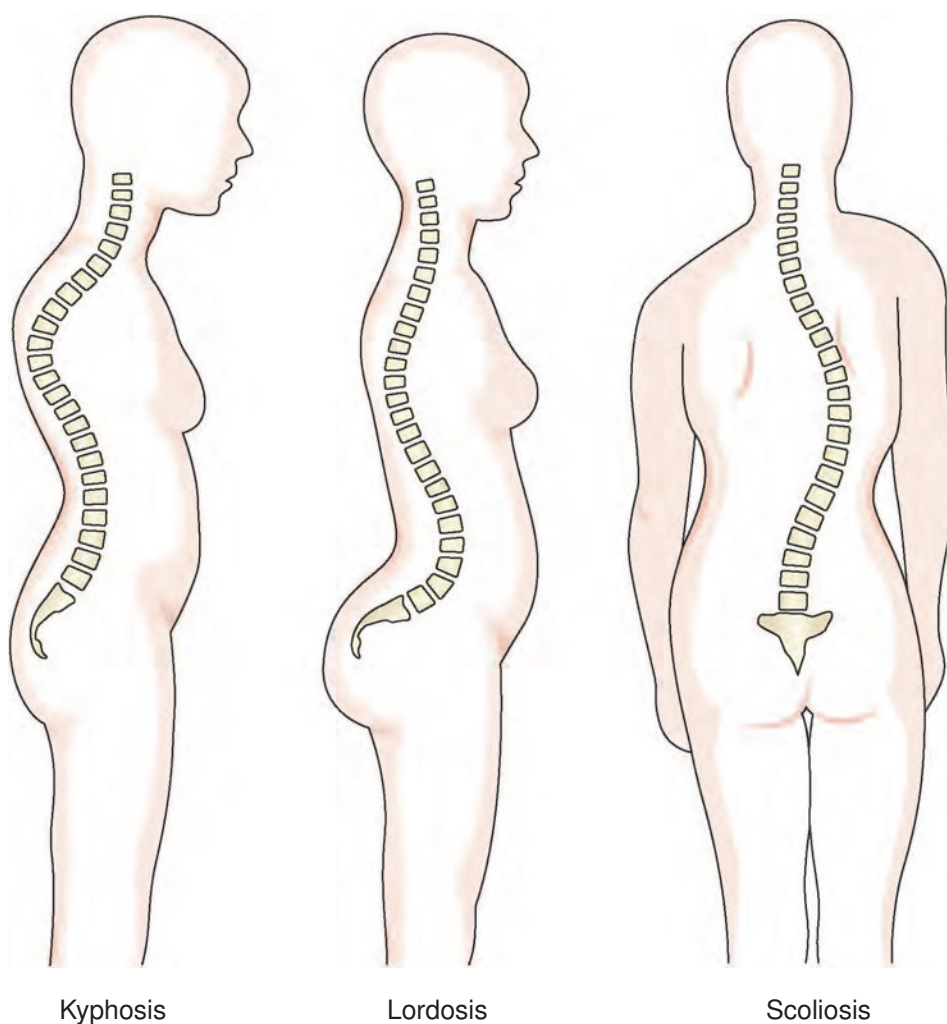


Figure 19-18 **Curvatures of the spine.** Kyphosis is an exaggerated thoracic curve; lordosis is an exaggerated lumbar curve; scoliosis is a sideways curve in any region.

Terminology Supplementary Terms

Normal Structure and Function*

annulus fibrosus <i>AN-ū-lus fī-BRŌ-sus</i>	The outer ring-like portion of an intervertebral disk (see Fig 19-17)
calvaria <i>kal-VAR-ē-a</i>	The dome-like upper portion of the skull
coxa <i>KOK-sa</i>	Hip
cruciate ligaments <i>KRŪ-shē-at</i>	Ligaments that cross in the knee joint to connect the tibia and fibula. They are the anterior cruciate ligament (ACL) and the posterior cruciate ligament (PCL). <i>Cruciate</i> means “shaped like a cross”
genu <i>JĒ-nū</i>	The knee
glenoid cavity <i>GLEN-oyd</i>	The bony socket in the scapula that articulates with the head of the humerus
hallux <i>HAL-uks</i>	The great toe
malleolus <i>ma-LĒ-ō-lus</i>	The projection of the tibia or fibula on either side of the ankle
meniscus <i>me-NIS-kus</i>	Crescent-shaped disk of cartilage found in certain joints, such as the knee joint. In the knee, the medial meniscus and the lateral meniscus separate the tibia and femur; plural: menisci (<i>me-NIS-kī</i>); <i>meniscus</i> means “crescent”
nucleus pulposus <i>NŪ-klē-us pul-PŌ-sus</i>	The central mass of an intervertebral disk (see Fig 19-17)
olecranon <i>ō-LEK-ra-non</i>	The process of the ulna that forms the elbow
os	Bone (plural: ossa)
osseous <i>OS-ē-us</i>	Pertaining to bone
symphysis pubis <i>SIM-fī-sis</i>	The anterior pelvic joint, formed by the union of the two pubic bones (see Fig. 19-4); also called pubic symphysis

*See Box 19-6 for a list of bone markings.

Symptoms and Conditions

achondroplasia <i>a-kon-drō-PLĀ-zha</i>	Decreased growth of cartilage in the growth plate of long bones resulting in dwarfism; a genetic disorder
Baker cyst	Mass formed at the knee joint by distention of a bursa with excess synovial fluid resulting from chronic irritation
bunion <i>BUN-yun</i>	Inflammation and enlargement of the metatarsal joint of the great toe, usually with displacement of the great toe toward the other toes
bursitis <i>bur-SĪ-tis</i>	Inflammation of a bursa, a small fluid-filled sac near a joint; causes include injury, irritation, and joint disease; the shoulder, hip, elbow, and knee are common sites
carpal tunnel syndrome	Numbness and weakness of the hand caused by pressure on the median nerve as it passes through a tunnel formed by carpal bones

Terminology**Supplementary Terms** *(Continued)*

chondroma <i>kon-DRŌ-ma</i>	A benign tumor of cartilage
Ewing tumor <i>YŪ-ing</i>	A bone tumor that usually appears in children 5 to 15 years of age. It begins in the shaft of a bone and spreads readily to other bones. It may respond to radiation therapy but then returns. Also called Ewing sarcoma
exostosis <i>eks-os-TŌ-sis</i>	A bony outgrowth from the surface of a bone
giant cell tumor	A bone tumor that usually appears in children and young adults. The ends of the bones are destroyed, commonly at the knee, by a large mass that does not metastasize
hammertoe <i>HAM-er-tō</i>	Change in position of the toe joints so that the toe takes on a claw-like appearance and the first joint protrudes upward, causing irritation and pain on walking
hallux valgus	Painful condition involving lateral displacement of the great toe at the metatarsal joint. There is also enlargement of the metatarsal head and bunion formation
Heberden nodes <i>HĒ-ber-den</i>	Small, hard nodules formed in the cartilage of the distal finger joints in osteoarthritis
hemarthrosis <i>hēm-ar-THRŌ-sis</i>	Bleeding into a joint cavity
Legg-Calvé-Perthes disease <i>leg kahl-VĀ PER-tez</i>	Degeneration (osteochondrosis) of the femur's proximal growth center. The bone is eventually restored, but there may be deformity and weakness. Most common in young boys. Also called coxa plana
multiple myeloma <i>mī-e-LŌ-ma</i>	A cancer of blood-forming cells in bone marrow (see Chapter 10)
neurogenic arthropathy <i>nū-rō-JEN-ik ar-THROP-a-thē</i>	Degenerative joint disease caused by impaired nervous stimulation; most common cause is diabetes mellitus; Charcot (<i>shar-KŌ</i>) arthropathy
Osgood-Schlatter disease <i>OZ-good SHLAHT-er</i>	Degeneration (osteochondrosis) of the tibia's proximal growth center causing pain and tendinitis at the knee
osteochondroma <i>os-tē-ō-kon-DRŌ-ma</i>	A benign tumor consisting of cartilage and bone
osteochondrosis <i>os-tē-ō-kon-DRŌ-sis</i>	Disease of a bone's growth center in children; tissue degeneration is followed by recalcification
osteodystrophy <i>os-tē-ō-DIS-trō-fē</i>	Abnormal bone development
osteogenesis imperfecta (OI) <i>os-tē-ō-JEN-e-sis im-per-FEK-ta</i>	A hereditary disease resulting in the formation of brittle bones that fracture easily. There is faulty synthesis of collagen, the main structural protein in connective tissue
osteoma <i>os-tē-Ō-ma</i>	A benign bone tumor that usually remains small and localized
Reiter syndrome <i>RĪ-ter</i>	Chronic polyarthritis that usually affects young men; occurs after a bacterial infection and is common in those infected with HIV; may also involve the eyes and genitourinary tract

(Continued)

Terminology Supplementary Terms *(Continued)*

spondylosis <i>spon-di-LŌ-sis</i>	Degeneration and ankylosis of the vertebrae resulting in pressure on the spinal cord and spinal nerve roots; often applied to any degenerative lesion of the spine
subluxation <i>sub-luk-SĀ-shun</i>	A partial dislocation
talipes <i>TAL-i-pēz</i>	A deformity of the foot, especially one occurring congenitally; clubfoot
valgus <i>VAL-gus</i>	Bent outward
varus <i>VAR-us</i>	Bent inward
von Recklinghausen disease <i>fon REK-ling-how-zen</i>	Loss of bone tissue caused by increased parathyroid hormone; bones become decalcified and deformed and fracture easily
Diagnosis and Treatment	
allograft <i>AL-ō-graft</i>	Graft of tissue between individuals of the same species but different genetic makeup; homograft, allogeneic graft (see autograft)
arthroclasia <i>ar-thrō-KLĀ-zha</i>	Surgical breaking of an ankylosed joint to provide movement
aspiration <i>as-pi-RĀ-shun</i>	Removal by suction, as removal of fluid from a body cavity; also inhalation, such as accidental inhalation of material into the respiratory tract
autograft <i>AW-tō-graft</i>	Graft of tissue taken from a site on or in the body of the person receiving the graft; autologous graft (see allograft)
chondroitin <i>kon-DRŌ-i-tin</i>	A complex polysaccharide found in connective tissue; used as a dietary supplement, usually with glucosamine, for treatment of joint pain
glucosamine <i>glū-KOS-a-mēn</i>	A dietary supplement used in the treatment of joint pain
goniometer <i>gō-nē-OM-e-ter</i>	A device used to measure joint angles and movements (root <i>goni/o</i> means “angle”)
iontophoresis <i>ī-on-tō-for-Ē-sis</i>	Introduction into the tissue by means of electric current, using the ions of a given drug; used in the treatment of musculoskeletal disorders
laminectomy <i>lam-i-NEK-tō-mē</i>	Excision of the posterior arch (lamina) of a vertebra
meniscectomy <i>men-i-SEK-tō-mē</i>	Removal of the crescent-shaped cartilage (meniscus) of the knee joint
myelogram <i>MĪ-e-lō-gram</i>	Radiograph of the spinal canal after injection of a radiopaque dye; used to evaluate a herniated disk
osteoplasty <i>OS-tē-ō-plas-tē</i>	Scraping and removal of damaged bone from a joint
prosthesis <i>PROS-thē-sis</i>	An artificial organ or part, such as an artificial limb

Box 19-6

For Your Reference

Bone Markings

MARKING	DESCRIPTION
condyle <i>KON-dil</i>	smooth, rounded protuberance at a joint
crest	raised, narrow ridge (see iliac crest in Fig. 19-4)
epicondyle <i>ep-i-KON-dil</i>	projection above a condyle
facet <i>FAS-et</i>	small, flattened surface
foramen <i>for-Ā-men</i>	rounded opening (see foramen for spinal nerve in Fig. 19-3)
fossa <i>FOS-a</i>	hollow cavity
meatus <i>mē-Ā-tus</i>	passage or channel, such as a long channel within a bone; also the external opening of a canal, such as the urinary meatus
process	projection (see mastoid process and styloid process in Fig. 19-2)
sinus <i>SĪ-nus</i>	a space or channel, such as the air-filled spaces in certain skull bones (Fig. 19-19)
spine	sharp projection (see ischial spine in Fig. 19-4)
trochanter <i>trō-KAN-ter</i>	large, blunt projection as at the top of the femur
tubercle <i>TŪ-ber-kl</i>	small, rounded projection
tuberosity <i>tū-ber-OS-i-tē</i>	large, rounded projection

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See a figure on bone markings and formations in the Student Resources on thePoint.

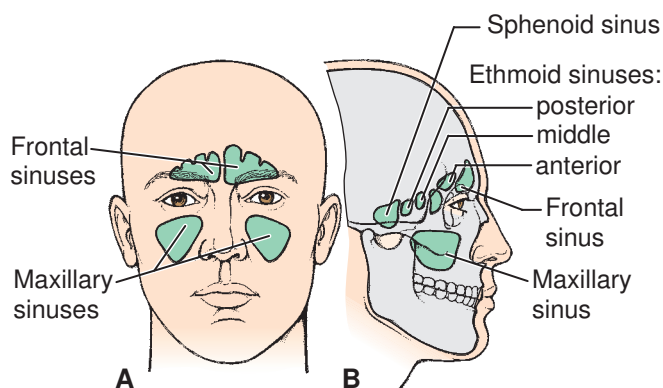


Figure 19-19 Sinuses. A sinus is a cavity or hollow space, such as the air-filled chambers in certain skull bones that lighten the skull's weight. *A.* Anterior view of the skull showing sinuses. *B.* Lateral view.

Terminology Abbreviations

ACL	Anterior cruciate ligament	MTP	Metatarsophalangeal (joint)
AE	Above the elbow	NSAID(s)	Nonsteroidal antiinflammatory drug(s)
AK	Above the knee	OA	Osteoarthritis
ASF	Anterior spinal fusion	OI	Osteogenesis imperfecta
BE	Below the elbow, also barium enema	ORIF	Open reduction internal fixation
BK	Below the knee	ortho, ORTH	Orthopedics
BMD	Bone mineral density	PCL	Posterior cruciate ligament
C	Cervical vertebra; numbered C1 to C7	PIP	Proximal interphalangeal (joint)
Co	Coccyx; coccygeal	PSF	Posterior spinal fusion
DEXA	Dual-energy x-ray absorptiometry (scan)	RA	Rheumatoid arthritis
DIP	Distal interphalangeal (joint)	S	Sacrum; sacral
DJD	Degenerative joint disease	SERM	Selective estrogen receptor modulator
Fx	Fracture	T	Thoracic vertebra; numbered T1 to T12
HNP	Herniated nucleus pulposus	THA	Total hip arthroplasty
IM	Intramedullary, also intramuscular	TKA	Total knee arthroplasty
L	Lumbar vertebra; numbered L1 to L5	TMJ	Temporomandibular joint
MCP	Metacarpophalangeal (joint)	Tx	Traction

L.R.'s Follow-Up

L.R. underwent a successful surgical procedure and was transferred to the pediatric ICU. Her postoperative course progressed well. She was discharged with orders for continued physical therapy and follow-up visits to see the surgeon.

L.R. had excellent compliance with all postoperative instructions and was able to resume her musical activities sooner than expected.

Chapter Review

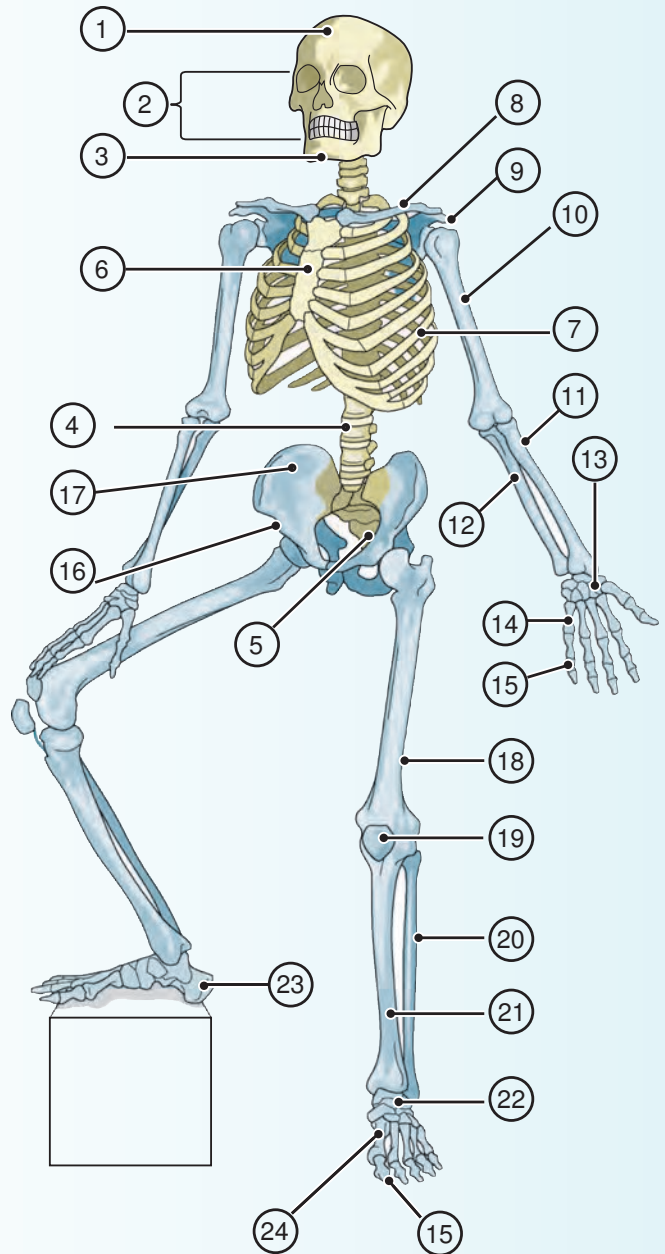
Labeling Exercise

THE SKELETON

Write the name of each numbered part on the corresponding line of the answer sheet.

Calcaneus	Patella
Carpals	Pelvis
Clavicle	Phalanges
Cranium	Radius
Facial bones	Ribs
Femur	Sacrum
Fibula	Scapula
Humerus	Sternum
Ilium	Tarsals
Mandible	Tibia
Metacarpals	Ulna
Metatarsals	Vertebral column

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____



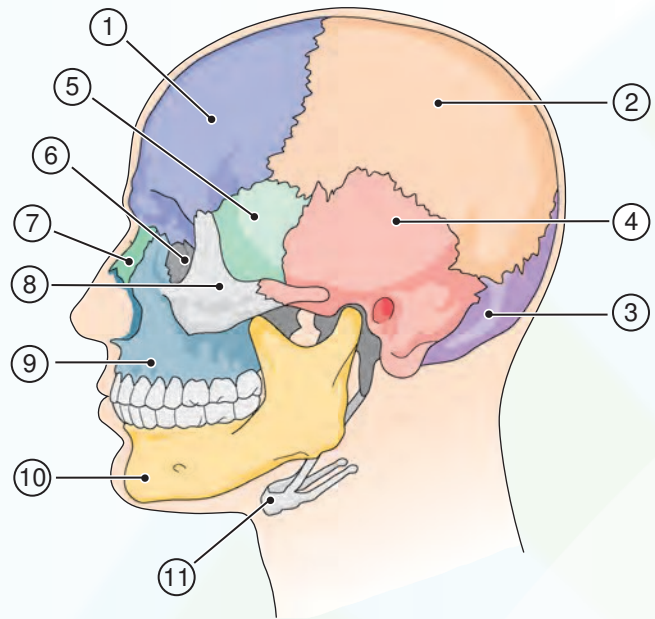
20. _____
21. _____
22. _____
23. _____
24. _____

SKULL FROM THE LEFT

Write the name of each numbered part on the corresponding line of the answer sheet.

Frontal	Occipital
Hyoid	Parietal
Lacrimal	Sphenoid
Mandible	Temporal
Maxilla	Zygomatic
Nasal	

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____

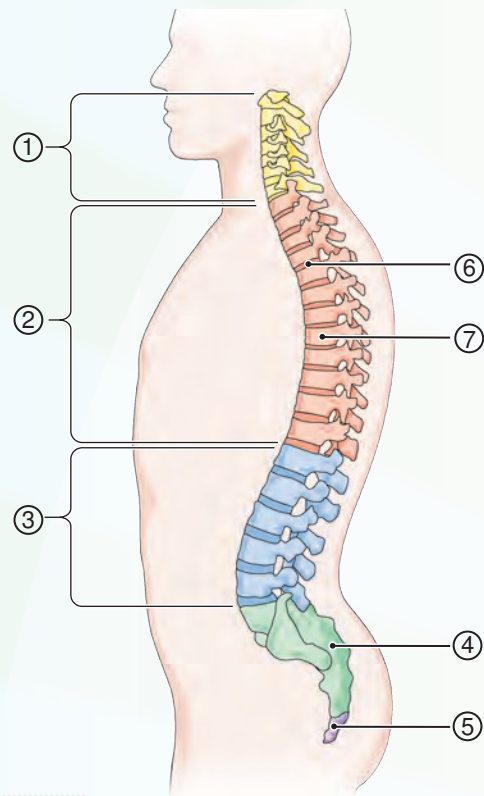


VERTEBRAL COLUMN

Write the name of each numbered part on the corresponding line of the answer sheet.

Body of vertebra	Lumbar vertebrae
Cervical vertebrae	Sacrum
Coccyx	Thoracic vertebrae
Intervertebral disk	

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

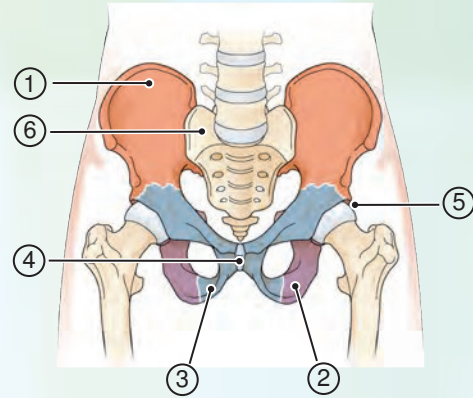


THE PELVIC BONES

Write the name of each numbered part on the corresponding line of the answer sheet.

Ilium	Pubic symphysis
Ischium	Acetabulum
Pubis	Sacrum

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

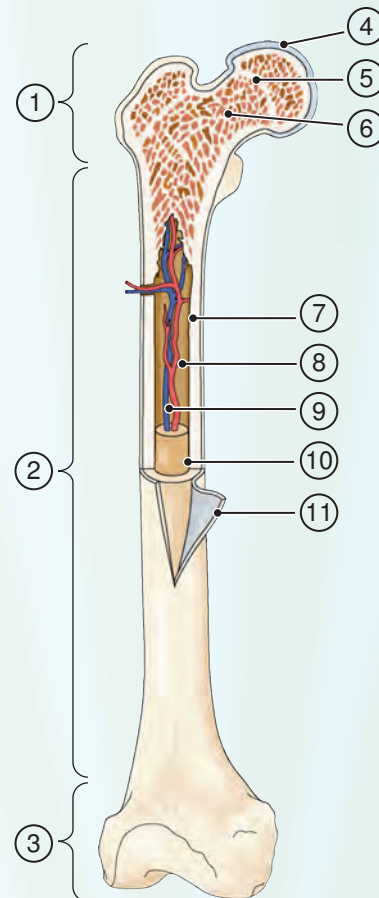


STRUCTURE OF A LONG BONE

Write the name of each numbered part on the corresponding line of the answer sheet.

Artery and vein	Medullary cavity
Cartilage	Periosteum
Compact bone	Proximal epiphysis
Diaphysis	Spongy bone
Distal epiphysis	(containing red marrow)
Epiphyseal line (growth line)	Yellow marrow

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____



Terminology

MATCHING

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|----------------------------|------------------------------------|
| _____ 1. periosteum | a. end of a long bone |
| _____ 2. epiphysis | b. breakdown and removal of tissue |
| _____ 3. symphysis | c. cell that breaks down bone |
| _____ 4. osteoclast | d. membrane that covers a bone |
| _____ 5. resorption | e. slightly movable joint |
| _____ 6. lordosis | a. immobility of a joint |
| _____ 7. ankylosis | b. spinal tap |
| _____ 8. osteopenia | c. displacement of a vertebra |
| _____ 9. spondylolisthesis | d. lumbar curvature of the spine |
| _____ 10. rachiocentesis | e. deficiency of bone tissue |

Supplementary Terms

- | | |
|------------------------|--|
| _____ 11. laminectomy | a. great toe |
| _____ 12. calvaria | b. part of the ulna that forms the elbow |
| _____ 13. subluxation | c. excision of part of a vertebra |
| _____ 14. hallux | d. upper portion of the skull |
| _____ 15. olecranon | e. partial dislocation |
| _____ 16. meniscus | a. breaking of a joint |
| _____ 17. genu | b. device used to measure joint angles |
| _____ 18. prosthesis | c. knee |
| _____ 19. goniometer | d. crescent-shaped cartilage |
| _____ 20. arthroclasia | e. artificial part |

FILL IN THE BLANKS

21. The study and treatment of disorders of the skeleton, muscles, and associated structures is _____.
22. The type of tissue that covers the ends of the bones at the joints is _____.
23. A band of connective tissue that connects a bone to another bone is a(n) _____.
24. The part of the vertebral column that articulates with the ilium is the _____.
25. A fluid-filled sac near a joint is a(n) _____.
26. The fluid that fills a freely movable joint is _____.
27. The term *costochondral* refers to a rib and its _____.
28. Myelogenesis is the formation of _____.
29. Hemarthrosis is bleeding into a(n) _____.
30. Spondylarthritis (*spon-dil-ar-THRI-tis*) is arthritis of the _____.
31. Rachischisis (*rā-KIS-ki-sis*) is fissure of the _____.

DEFINITIONS

Define the following words:

32. myelitis (*mī-e-LĪ-tus*) _____
33. osteogenesis (*os-tē-ō-JEN-i-sis*) _____
34. arthrodesis (*ar-THROD-e-sis*) _____
35. synovectomy (*sin-ō-VEK-tō-mē*) _____
36. chondrocyte (*KON-drō-sīt*) _____
37. intraosteal (*in-tra-OS-tē-al*) _____
38. peribursal (*per-i-BER-sal*) _____
39. spondylitis (*spon-di-LĪ-tis*) _____
40. polyarticular (*pol-ē-ar-TIK-ū-lar*) _____
41. subcostal (*sub-KOS-tal*) _____
42. coccydynia (*kok-sē-DIN-ē-a*) _____

Write words for the following definitions:

43. formation of cartilage _____
44. death (-necrosis) of bone tissue _____
45. incision into the cranium _____
46. tumor of bone and cartilage _____
47. narrowing of a joint _____
48. surgical excision of cartilage _____
49. stone in a bursa _____
50. measurement of the pelvis _____
51. endoscopic examination of a joint _____
52. pertaining to the sacrum and ilium _____
53. surgical excision of the coccyx _____
54. near the sacrum _____

Find a word in L.R.'s opening case study for each of the following:

55. describing a disease with no known cause _____
56. a bone of the shoulder girdle _____
57. a bone of the pelvis _____
58. the area where T4 is located _____
59. incisions into bones _____
60. sideways curvature of the spine _____

ADJECTIVES

Write the adjective form of the following words:

61. cranium _____
62. ilium _____
63. coccyx _____

64. pelvis _____

65. vertebra _____

TRUE-FALSE

Examine each of the following statements. If the statement is true, write T in the first blank. If the statement is false, write F in the first blank and correct the statement by replacing the underlined word in the second blank.

	True or False	Correct Answer
66. The growth region of a long bone is in the <u>metaphysis</u> .	_____	_____
67. The tarsal bones are found in the <u>wrist</u> .	_____	_____
68. An immovable joint is a <u>suture</u> .	_____	_____
69. The femur is part of the <u>axial</u> skeleton.	_____	_____
70. The <u>cervical</u> vertebrae are located in the neck.	_____	_____
71. The cells that produce cartilage are <u>chondroblasts</u> .	_____	_____
72. Blood cells are formed in <u>yellow</u> bone marrow.	_____	_____
73. An exaggerated thoracic curve of the spine is <u>kyphosis</u> .	_____	_____
74. The term <i>varus</i> means bent <u>inward</u> .	_____	_____

ELIMINATIONS

In each of the sets below, underline the word that does not fit in with the rest and explain the reason for your choice:

75. trochanter — process — hyoid — meatus — condyle

76. lambdoid — occipital — parietal — frontal — sphenoid

77. sacr/o — rachi/o — spondyl/o — vertebr/o — cost/o

78. Pott — sciatic — impacted — comminuted — greenstick

79. T — C — L — Co — OA

WORD BUILDING

Write words for the following definitions using the word parts provided.

spondyl/o -plasty arthr/o -lysis -odynia oste/o -tome

80. destruction of bone tissue _____

81. instrument for incising a joint _____

82. pain in a vertebra _____

83. loosening or separation of a joint _____

84. instrument for cutting bone tissue _____

85. plastic repair of a joint _____

86. pain in a bone _____
87. destruction of a vertebra _____
88. pain in a joint _____
89. plastic repair of a bone _____

WORD ANALYSIS

Define the following words and give the meaning of the word parts in each. Use a dictionary if necessary.

90. osteochondrosis (*os-tē-ō-kon-DRŌ-sis*) _____
- a. oste/o _____
- b. chondr/o _____
- c. -sis _____
91. spondylosynthesis (*spon-di-lō-SIN-de-sis*) _____
- a. spondyl/o _____
- b. syn- _____
- c. -desis _____
92. exostosis (*eks-os-TŌ-sis*) _____
- a. ex/o _____
- b. ost(e)/o _____
- c. -sis _____
93. achondroplasia (*a-kon-drō-PLĀ-zha*) _____
- a. a- _____
- b. chondr/o _____
- c. plas _____
- d. -ia _____



For more learning activities, see Chapter 19 of the Student Resources on *thePoint*.

Additional Case Studies

Case Study 19-1: Arthroplasty of the Right TMJ

S.A., a 38-YO teacher, was admitted for surgery for degenerative joint disease (DJD) of her right temporomandibular joint (TMJ). She has experienced chronic pain in her right jaw, neck, and ear since her automobile accident the previous year. S.A.'s diagnosis was confirmed by CT scan and was followed up with conservative therapy, which included a bite plate, NSAIDs, and steroid injections. She had also tried hypnosis in an attempt to manage her pain but was not able to gain relief. Her doctor referred her to an oral surgeon who specializes in TMJ disorders. S.A. was scheduled for an arthroplasty of the right TMJ to remove diseased bone on the articular surface of the right mandibular condyle.

On the following day, she was transported to the OR for surgery. She was given general endotracheal anesthesia, and a vertical incision was made from the superior aspect of the right ear down to the base of the attachment of the right earlobe. After appropriate dissection and retraction, the posterior–superior aspect of the right zygomatic arch was bluntly dissected anteroposteriorly. With a nerve stimulator, the zygomatic branch of the facial nerve was identified

and retracted from the surgical field with a vessel loop. The periosteum was then incised along the superior aspect of the arch. An inferior dissection was then made along the capsular ligament and retracted posteriorly. With a Freer elevator, the meniscus was freed, and a horizontal incision was made to the condyle. With a Hall drill and saline coolant, a high condylectomy of approximately 3 mm of bone was removed while conserving function of the external pterygoid muscle. The stump of the condyle was filed smooth and irrigated copiously with NS. The lateral capsule, periosteum, subcutaneous tissue, and skin were then closed with sutures. The facial nerve was tested before closing and confirmed to be intact. A pressure pack and Barton bandage were applied. The sponge, needle, and instrument counts were correct. Estimated blood loss (EBL) was approximately 50 mL.

S.A. was discharged on the second postoperative day with instructions for a soft diet, daily mouth-opening exercises, an antibiotic (Keflex 500 mg po q6h), Tylenol no. 3 po q4h PRN for pain, and four weekly postoperative appointments.

Case Study 19-2: Osteogenesis Imperfecta

M.H., a 3-YO boy with osteogenesis imperfecta (OI) type III, was admitted to the pediatric orthopedic hospital for treatment of yet another fracture. Since birth he has had 15 arm and leg fractures as a result of his congenital disease. This latest fracture occurred when he twisted at the hip while standing in his wheeled walker. He has been in a research study and receives a bisphosphonate infusion every two months. He is short in stature with short limbs for his age and has bowing of both legs.

M.H. was transferred to the OR and carefully lifted to the OR table by the staff. After he was anesthetized, he was positioned with gentle manipulation, and his left hip was elevated

on a small gel pillow. After skin preparation and sterile draping, a stainless steel rod was inserted into the medullary canal of his left femur to reduce and stabilize the femoral fracture. The muscle, fascia, subcutaneous tissue, and skin were sutured closed. Three nurses gently held M.H. in position on a pediatric spica box while the surgeon applied a hip spica (body cast) to stabilize the fixation, protect the leg, and maintain abduction. M.H. was transferred to the postanesthesia care unit (PACU) for recovery. The surgeon dictated the procedure as an open reduction internal fixation (ORIF) of the left femur with intramedullary (IM) rodding and application of spica cast.

CASE STUDY QUESTIONS

Multiple choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|---|---|
| <p>_____ 1. A condylectomy is:</p> <ul style="list-style-type: none"> a. removal of a joint capsule b. plastic repair of a vertebra c. removal of a rounded bone protuberance d. enlargement of a cavity e. removal of a tumor | <p>_____ 3. The dissection directed anteroposteriorly was done:</p> <ul style="list-style-type: none"> a. posterior–superior b. circumferentially c. front to back d. top to bottom e. perpendicular to the mandible |
| <p>_____ 2. The articular surface of a bone is located:</p> <ul style="list-style-type: none"> a. under the epiphysis b. in a joint c. around the bone marrow d. at a muscle attachment e. at a tendon attachment | <p>_____ 4. Another term for bow-legged is:</p> <ul style="list-style-type: none"> a. internal rotation b. knock-kneed c. adduction d. varus e. valgus |

- _____ 5. An IM rod is placed:
- inferior to the femoral condyle
 - into the acetabulum
 - within the medullary canal
 - on top of the periosteum
 - lateral to the epiphysial growth plates

Write terms from the case studies that mean the following:

6. pertaining to the cheek bone

7. the membrane around a bone

8. a crescent-shaped cartilage in a joint

9. plastic repair of a joint

10. formation of bone tissue

11. a break in a bone

12. present at birth

13. the thigh bone

Abbreviations. Define the following abbreviations:

14. DJD _____

15. NS _____

16. TMJ _____

17. OI _____

18. ORIF _____

19. EBL _____

CHAPTER 20

The Muscular System

Case Study

T.D.'s Brachial Plexus Injury

Chief complaint:

T.D., a 16-year-old high school student, had a severe lacrosse accident that resulted in a flail arm. He had sustained right brachial plexus injury and had no recovery. He has continued to take medication for neurologic pain. He was scheduled to see his orthopedic surgeon for a possible brachial plexus exploration.

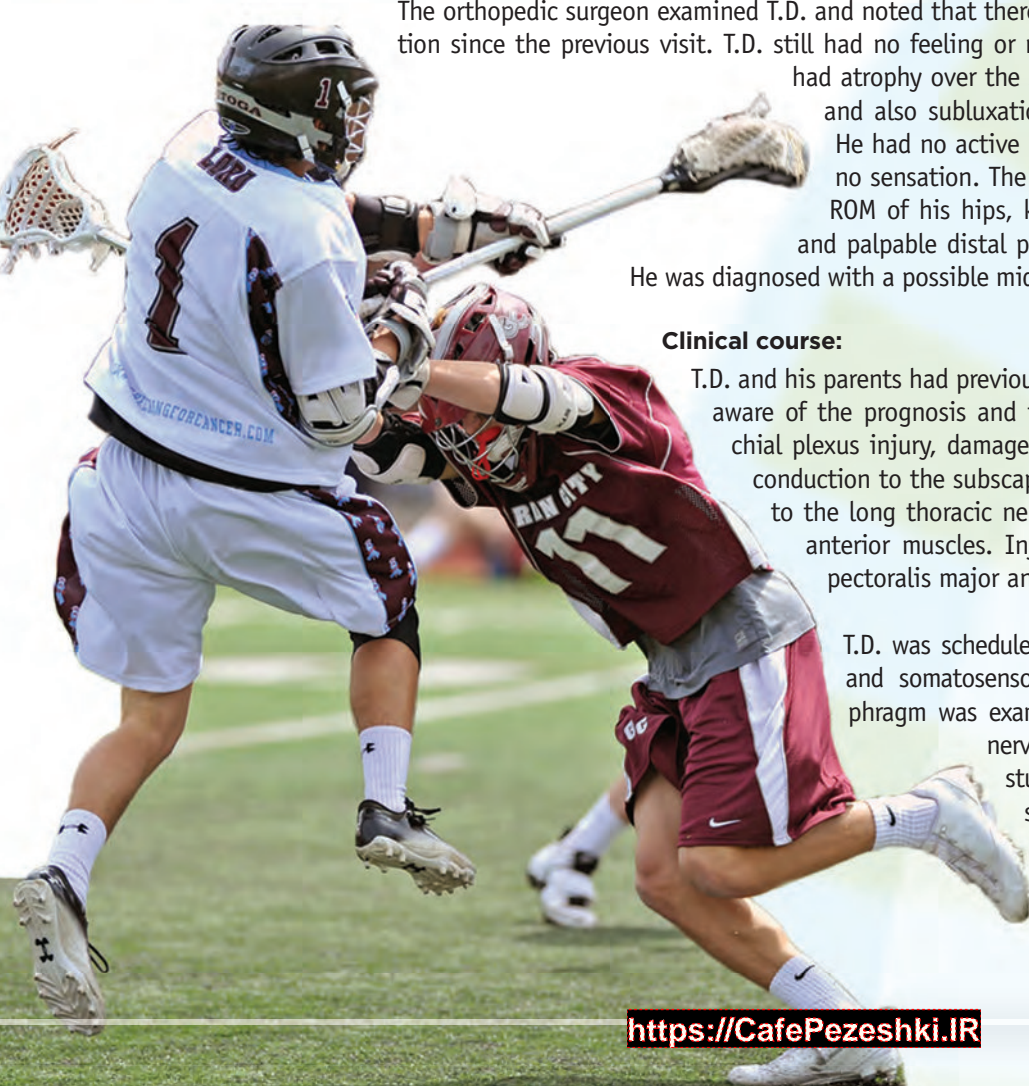
Examination:

The orthopedic surgeon examined T.D. and noted that there had not been any change in his condition since the previous visit. T.D. still had no feeling or motion in his right shoulder or arm. He had atrophy over the supraspinatus and infraspinatus muscles and also subluxation of his shoulder and deltoid atrophy. He had no active motion of the right upper extremity and no sensation. The rest of his orthopedic exam showed full ROM of his hips, knees, and ankles with intact sensation and palpable distal pulses as well as normal motor function. He was diagnosed with a possible middle trunk brachial plexus injury from C7.

Clinical course:

T.D. and his parents had previous discussions with the surgeon and were aware of the prognosis and treatment plan. With middle trunk brachial plexus injury, damage to the subscapular nerve will interrupt conduction to the subscapularis and teres major muscles. Damage to the long thoracic nerve prevents conduction to the serratus anterior muscles. Injury to the pectoral nerves affects the pectoralis major and minor muscles.

T.D. was scheduled for an EMG, nerve conduction studies, and somatosensory evoked potentials (SSEPs). His diaphragm was examined under fluoroscopy to R/O phrenic nerve injury. The results of the diagnostic studies indicated that T.D. had most likely sustained a middle trunk brachial plexus injury. T.D. was scheduled for a brachial plexus exploration with possible nerve graft, nerve transfer, bilateral sural (calf) nerve harvest, or gracilis muscle graft from his right thigh.





Ancillaries *At-A-Glance*

Visit *thePoint* to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii–xvi.

Learning TOOLS

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning RESOURCES

- E-book: Chapter 20
- Web Figure: Muscular Dystrophy
- Animation: The Neuromuscular Junction
- Audio Pronunciation Glossary

Learning ACTIVITIES

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After study of this chapter, you should be able to:

- 1** Compare the location and function of smooth, cardiac, and skeletal muscles. *p552*
- 2** Describe the typical structure of a skeletal muscle. *p552*
- 3** Briefly describe the mechanism of muscle contraction. *p553*
- 4** Explain how muscles work together to produce movement. *p554*
- 5** Describe the main types of movements produced by muscles. *p555*
- 6** List some of the criteria for naming muscles and give examples of each. *p555*
- 7** Identify and use the roots pertaining to the muscular system. *p560*
- 8** Describe at least seven disorders that affect muscles. *p561*
- 9** Interpret abbreviations pertaining to muscles. *p568*
- 10** Analyze several case studies involving muscles. *pp550, 575*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|---|---|
| <p>_____ 1. The neuromuscular junction is between a muscle and a:
 a. gland
 b. neuron
 c. bone
 d. gonad</p> <p>_____ 2. In the muscular system, the opposite of the origin is the:
 a. counterorigin
 b. agonist
 c. diaphragm
 d. insertion</p> <p>_____ 3. The quadriceps femoris muscle forms the anterior part of the:
 a. neck
 b. back
 c. thigh
 d. abdomen</p> <p>_____ 4. The opposite of flexion is:
 a. rotation
 b. antifixion
 c. relaxation
 d. extension</p> | <p>_____ 5. The opposite of abduction is:
 a. adduction
 b. circumduction
 c. periduction
 d. pronation</p> <p>_____ 6. The band of connective tissue that attaches a muscle to a bone is a:
 a. cartilage
 b. bursa
 c. tendon
 d. diaphysis</p> <p>_____ 7. Polymyositis is inflammation of many:
 a. sense organs
 b. muscles
 c. glands
 d. bones</p> <p>_____ 8. The word <i>kinesis</i> means:
 a. movement
 b. bending
 c. stretching
 d. pain</p> |
|---|---|

The main characteristic of **muscle** tissue is its ability to contract. When stimulated, muscles shorten to produce movement of the skeleton, vessel walls, or internal organs. Muscles may also remain partially contracted to maintain posture. In addition, the heat generated by muscle contraction is the main source of body heat.

- **Skeletal muscle** is attached to bones and is responsible for voluntary movement. It also maintains posture and generates a large proportion of body heat. All of these voluntary muscles together make up the muscular system.

Types of Muscles

There are three types of muscle tissue in the body (**Fig. 20-1**):

- **Smooth** (visceral) **muscle** makes up the walls of the hollow organs, such as the stomach, intestines, and uterus, and the walls of ducts, such as the blood vessels and bronchioles. Smooth muscle operates involuntarily and is responsible for peristalsis, the wave-like movements that propel materials through the systems.
- **Cardiac muscle** makes up the myocardium of the heart wall. It functions involuntarily and is responsible for the heart's pumping action.

Skeletal Muscle

The discussion that follows describes the characteristics of skeletal muscle, which has been the most extensively studied of the three muscle types.

MUSCLE STRUCTURE

Muscles are composed of individual cells, often referred to as fibers because they are so long and thread-like. These cells are held together in **fascicles** (bundles) by connective tissue (**Fig. 20-2**). Covering each muscle is a sheath of connective tissue or **fascia**. These supporting tissues merge to form the **tendons** that attach the muscle to bones.

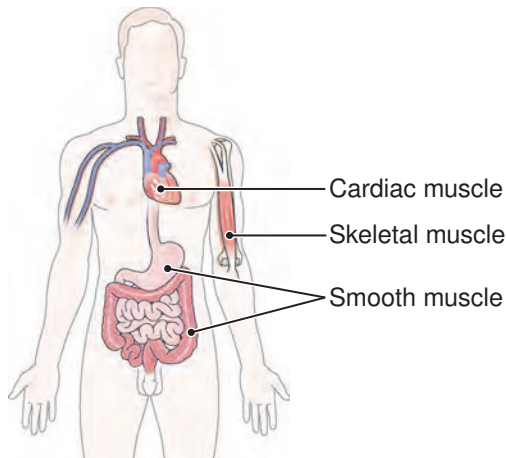


Figure 20-1 Muscle types. Smooth muscle makes up the wall of ducts and hollow organs, such as the stomach and intestine; cardiac muscle makes up the heart wall; skeletal muscle is attached to bones.

MUSCLE ACTION

Skeletal muscles are stimulated to contract by motor neurons of the nervous system (Fig. 20-3). At the **neuromuscular junction (NMJ)**, the synapse (junction) where a branch of a neuron meets a muscle cell, the neurotransmitter **acetylcholine (ACh)** is released from small vesicles (sacs) in an axon branch. ACh interacts with the muscle cell membrane to prompt cellular contraction. Two special protein filaments in muscle cells, **actin** and **myosin**, interact to produce

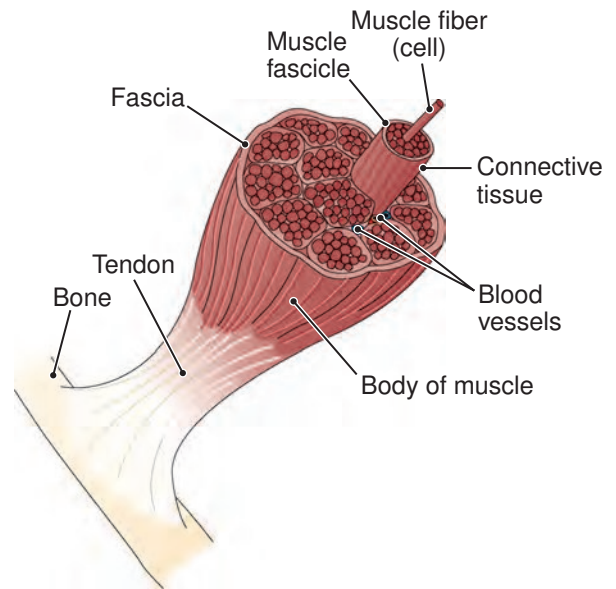


Figure 20-2 Structure of a skeletal muscle. Connective tissue coverings are shown as is the tendon that attaches the muscle to a bone.

the contraction. ATP (the cell's energy compound) and calcium are needed for this response. **Box 20-1** discusses the use of steroids to increase muscle development and strength.

Most skeletal muscles contract rapidly to produce movement and then relax rapidly unless stimulation continues. Sometimes muscles are kept in a steady partially

20

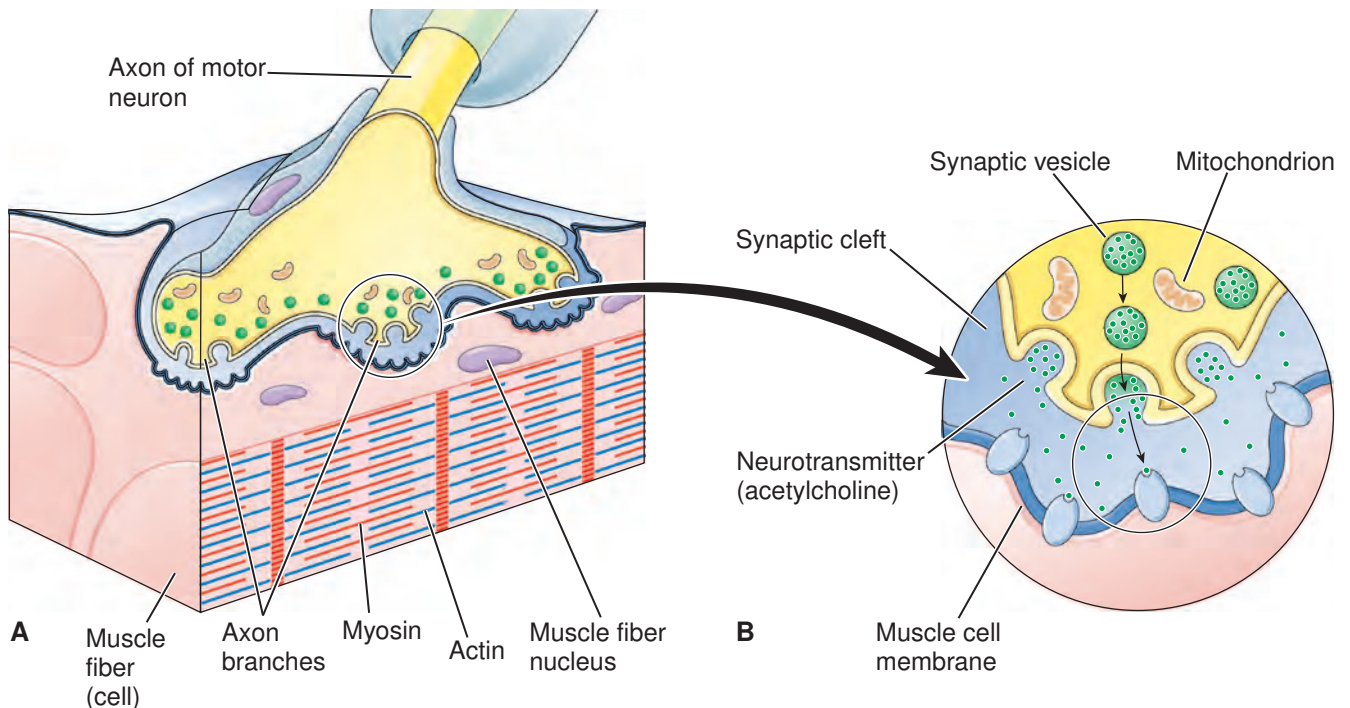


Figure 20-3 Neuromuscular junction (NMJ). A. The branched end of a motor neuron makes contact with the membrane of a muscle fiber (cell). B. Enlarged view of the NMJ showing release of neurotransmitter (acetylcholine) from a neuron and its attachment to a muscle cell membrane. Mitochondria generate ATP, the cells' energy compound.

Box 20-1



Clinical Perspectives

Anabolic Steroids: Winning at All Costs?

Anabolic steroids mimic the effects of the male sex hormone testosterone by promoting metabolism and stimulating growth. These drugs are legally prescribed to promote muscle regeneration and prevent atrophy from disuse after surgery. However, athletes also purchase them illegally, using them to increase muscle size and strength and improve endurance.

When steroids are used illegally to enhance athletic performance, the doses needed are large enough to cause serious side effects. They increase blood cholesterol levels, which may lead to atherosclerosis, heart disease, kidney failure, and

stroke. Steroids damage the liver, making it more susceptible to disease and cancer, and they suppress the immune system, increasing the risk of infection and cancer. In men, steroids cause impotence, testicular atrophy, low sperm count, infertility, and the development of female sex characteristics such as breasts (gynecomastia). In women, steroids disrupt ovulation and menstruation and produce male sex characteristics such as breast atrophy, clitoral enlargement, increased body hair, and deepening of the voice. In both sexes, steroids increase the risk for baldness, and especially in men, they cause mood swings, depression, and violence.

contracted state, to maintain posture, for example. This state of firmness is called **tonus**, or muscle tone.



See the animation “The Neuromuscular Junction” in the Student Resources on thePoint.

Muscles work in pairs to produce movement at the joints. As one muscle, the **agonist**, contracts, an opposing muscle, the **antagonist**, must relax. For example, when the brachialis muscle on the anterior surface of the upper arm contracts to flex the arm, the triceps brachii on the posterior surface must relax (Fig. 20-4). When the arm is extended, these actions are reversed; the triceps brachii contracts, and the brachialis must relax. Any muscle that assists the agonist

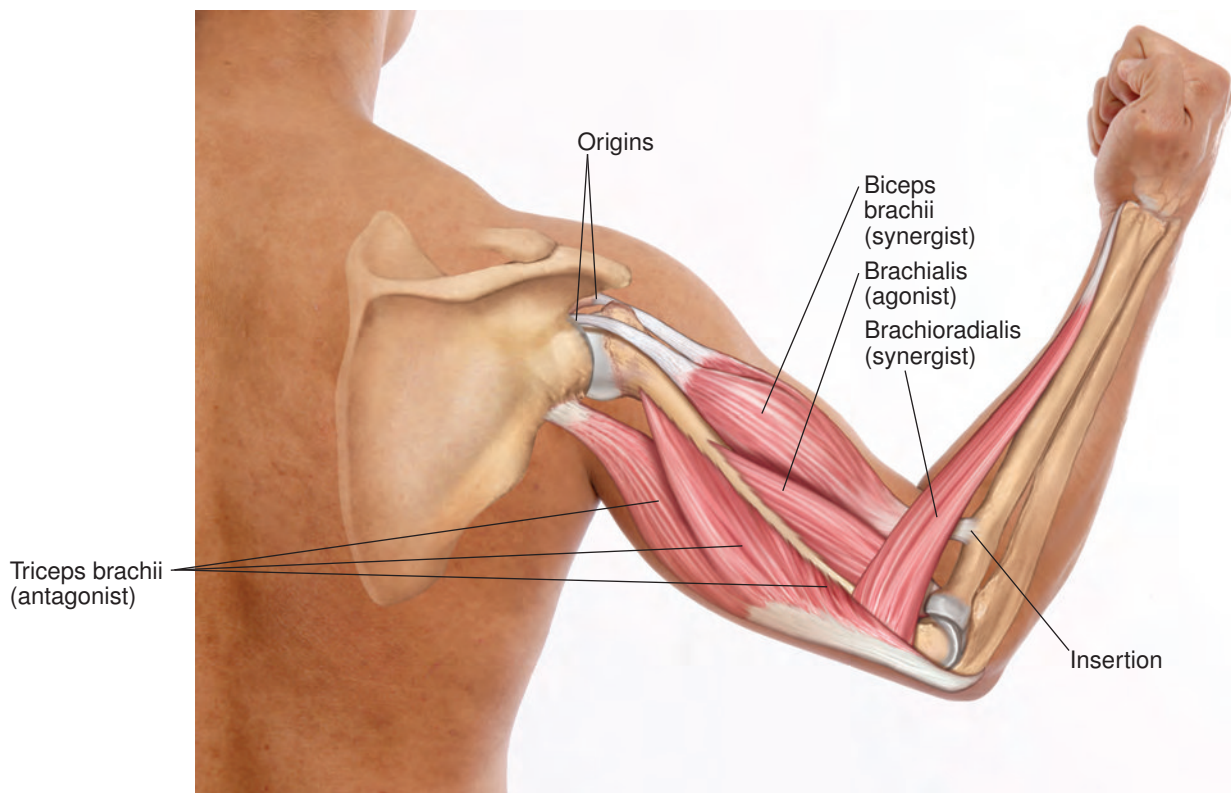


Figure 20-4 Muscles work together. When the brachialis, the agonist, flexes the arm, the triceps brachii, the antagonist, must relax. Synergists, the biceps brachii and the brachioradialis, assist in this action. When the arm is extended, these muscle actions are reversed. This figure also shows three attachments of the biceps brachii, two origins and one insertion.

to produce an action is called a **synergist**. For example, the biceps brachii (most visible on the anterior surface when the arm is flexed) and the brachioradialis assist the brachialis to flex the arm.

In a given movement, the point where the muscle is attached to a stable part of the skeleton is the **origin**; the point where a muscle is attached to a moving part of the skeleton is the **insertion** (see Fig. 20-4).

Box 20-2 describes various types of movements at the joints; these are illustrated in **Figure 20-5**. See also **Box 20-3** for a description of careers in physical fitness.

NAMING OF MUSCLES

A muscle can be named by its location (e.g., near a bone), by the direction of its fibers, or by its size, shape, or number of attachment points (heads), as indicated by the suffix *-ceps* (see Fig. 20-4). It may also be named for its action, adding the suffix *-or* to the root for the action. For example, a muscle that produces flexion at a joint is a flexor. Examine the muscle diagrams in **Figures 20-6 and 20-7**. See how many of these criteria you can find in the muscle names. Note that sometimes more than one criterion is used in the name.

Box 20-2

For Your Reference

20

Types of Movement

MOVEMENT	DEFINITION	EXAMPLE
flexion <i>FLEK-shun</i>	closing the angle at a joint	bending at the knee or elbow
extension <i>eks-TEN-shun</i>	opening the angle at a joint	straightening at the knee or elbow
abduction <i>ab-DUK-shun</i>	movement away from the midline of the body	outward movement of the arm at the shoulder
adduction <i>a-DUK-shun</i>	movement toward the midline of the body	return of lifted arm to the body
rotation <i>rō-TĀ-shun</i>	turning of a body part on its own axis	turning of the forearm from the elbow
circumduction <i>ser-kum-DUK-shun</i>	circular movement from a central point	describing a circle with an outstretched arm
pronation <i>prō-NĀ-shun</i>	turning downward	turning the palm of the hand downward
supination <i>sū-pin-Ā-shun</i>	turning upward	turning the palm of the hand upward
eversion <i>ē-VER-zhun</i>	turning outward	turning the sole of the foot outward
inversion <i>in-VER-zhun</i>	turning inward	turning the sole of the foot inward
dorsiflexion <i>dor-si-FLEK-shun</i>	bending backward	moving the foot so that the toes point upward, away from the sole of the foot
plantar flexion	bending the sole of the foot	pointing the toes downward

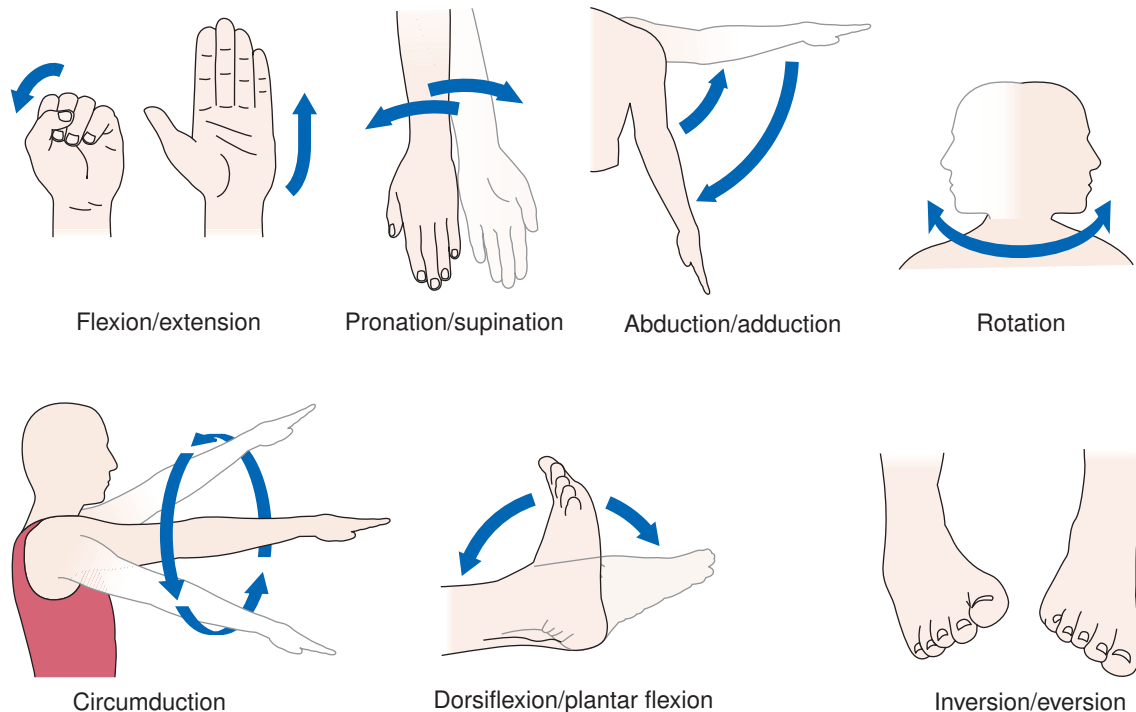


Figure 20-5 Types of movement. Muscle contraction produces movement at the joints. Some muscles are named for the type of movement they produce, such as flexor, extensor, and adductor.

Box 20-3



Health Professions

Careers in Exercise and Fitness

Several related careers are concerned with the management of exercise programs for therapy, health maintenance, and recreation. The American College of Sports Medicine (ACSM) at www.acsm.org has information on these fields and some certification programs.

- **Exercise physiologists** study the mechanisms involved in physical exercise and the body's physiologic responses to exercise. They design programs for general health, athletics, and rehabilitation for disability or disease, such as cardiovascular and respiratory diseases. They may work in a clinical setting in cooperation with physicians, in private industry, in health clubs, or in teaching. Most exercise physiologists (EPs) have a master's degree, but some jobs may require only a bachelor's degree. A PhD is needed for teaching or research. EPs may be certified through ACSM or the Center for Exercise Physiology (CEP). The American Society of Exercise Physiologists at www.asep.org has information about this profession.
- **Athletic trainers** specialize in the prevention and treatment of musculoskeletal injuries. They advise clients on

the proper use of exercise equipment and devices, such as braces, that help prevent injuries. They work in cooperation with physicians in private establishments, in health care facilities, and with athletes and sports teams. An athletic trainer's job may have a set schedule, but if the job is for a sports team, it may require long and irregular hours. A majority of athletic trainers have master's degrees or higher. Employment opportunities in health care and teaching are expected to be good, although jobs with sports teams are limited. The National Athletic Trainers' Association at www.nata.org has more information on this career.

- **Fitness workers** make up a category that includes a variety of career activities, such as personal trainers and group fitness, yoga, and Pilates instructors. These professionals lead, instruct, and motivate individuals or groups in all types of exercise activities. Traditionally, they have worked in studios, health clubs, or private homes, but they are increasingly found in the workplace, where they organize and direct fitness programs for employees.

Careers in Exercise and Fitness (*Continued*)

Their jobs may involve administrative duties as well. Personal trainers must be certified, and certification is encouraged for other fitness professionals. Candidates must have a high school diploma, certification in CPR, and must pass a written exam and sometimes a practical exam as well. Increasingly, a bachelor's degree is required, and those who wish to progress to management jobs may need a higher degree. Instructors

who specialize in a particular exercise method, such as Pilates or yoga, must pass their own training standards. Job opportunities in these fields are expected to increase with an aging population and increasing concern for good health and physical fitness. The National Commission for Certifying Agencies at <http://www.nccaa.org> can help locate accredited fitness certification programs.

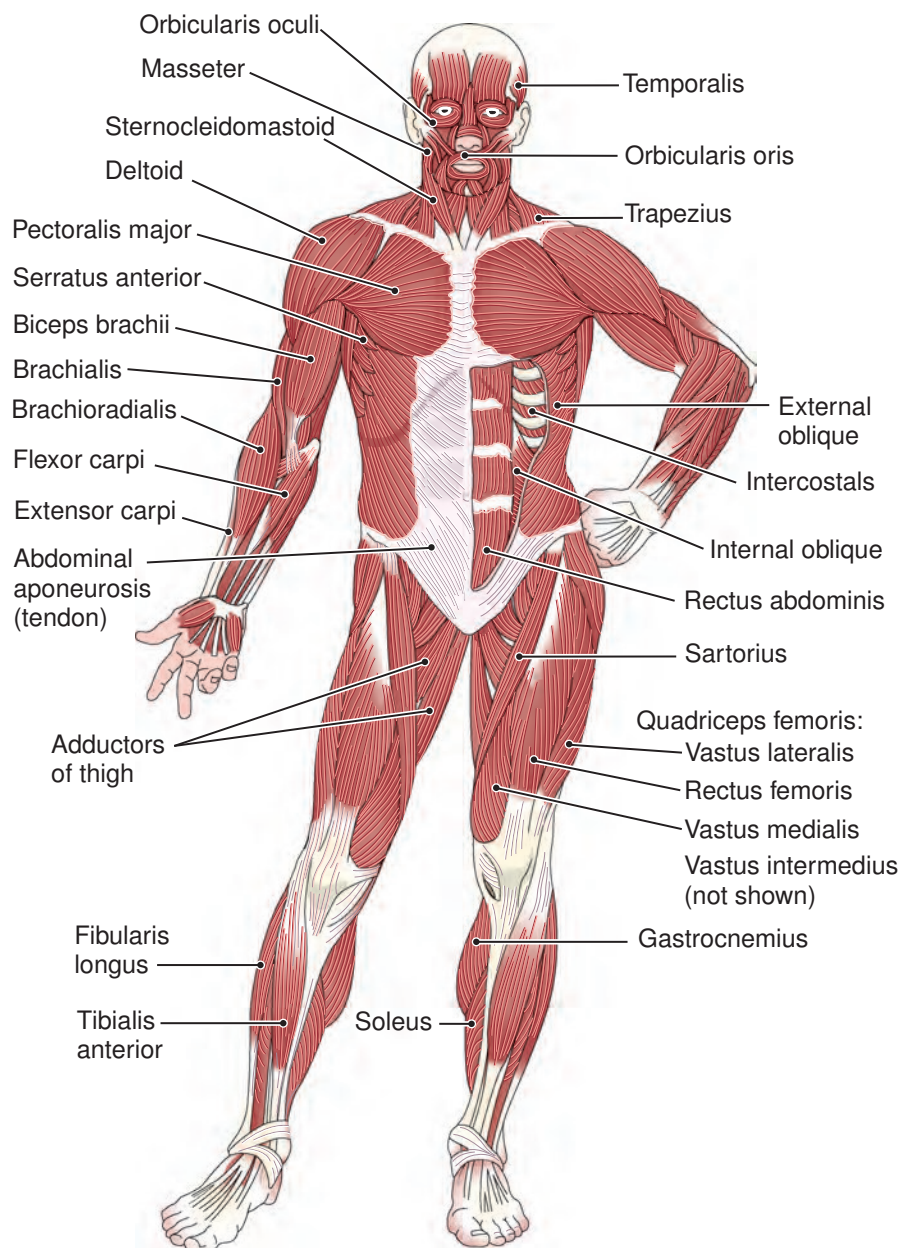


Figure 20-6 Superficial muscles, anterior view.

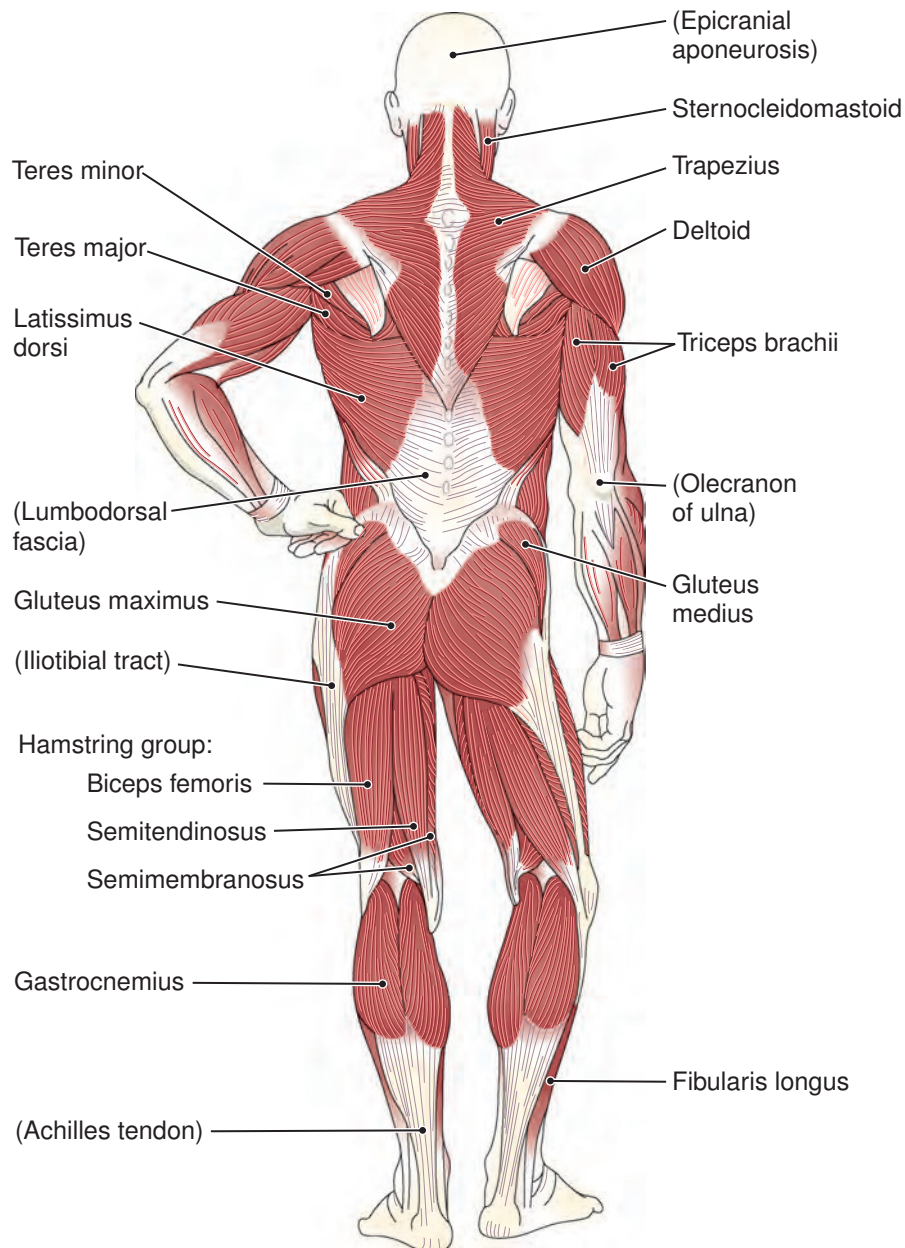


Figure 20-7 Superficial muscles, posterior view. Associated structures are labeled in parentheses.

Terminology

Key Terms

Normal Structure and Function

acetylcholine (ACh)
as-e-til-KŌ-lēn

A neurotransmitter that stimulates contraction of skeletal muscles

actin
AK-tin

One of the two contractile proteins in muscle cells; the other is myosin

agonist
AG-on-ist

The muscle that carries out a given movement (from Greek *agon* meaning “contest,” “struggle”); prime mover

Terminology**Key Terms** *(Continued)*

antagonist <i>an-TAG-ō-nist</i>	The muscle that opposes an agonist; it must relax when the agonist contracts
cardiac muscle <i>KAR-dē-ak</i>	Involuntary muscle that makes up the heart wall
fascia <i>FASH-ē-a</i>	The fibrous sheath of connective tissue that covers a muscle; called deep fascia to differentiate it from the superficial fascia that underlies the skin (root: fasci/o); plural: fasciae
fascicle <i>FAS-i-kel</i>	A small bundle, as of muscle or nerve fibers
insertion <i>in-SER-shun</i>	In a given movement, the point where a muscle is attached to a moving part of the skeleton
muscle <i>MUS-el</i>	An organ that produces movement by contracting; also the tissue that composes such organs (roots: my/o, muscul/o)
myosin <i>MĪ-ō-sin</i>	One of the two contractile proteins in muscle cells; the other is actin
neuromuscular junction (NMJ) <i>nū-rō-MUS-kū-lar JUNK-shun</i>	The point of contact, or synapse, between a branch of a motor neuron and a muscle cell
origin <i>OR-i-jin</i>	In a given movement, the point where a muscle is attached to a stable part of the skeleton
skeletal muscle <i>SKEL-e-tal</i>	Voluntary muscle that moves the skeleton and maintains posture
smooth muscle	Involuntary muscle that makes up the wall of hollow organs, vessels, and ducts; visceral muscle
synergist <i>SIN-er-jist</i>	A muscle that assists an agonist to produce a given movement
tendon <i>TEN-dun</i>	A fibrous band of connective tissue that attaches a muscle to a bone (roots: ten/o, tendin/o)
tonus <i>TŌ-nus</i>	A state of steady, partial muscle contraction that maintains firmness; muscle tone (root: ton/o)



Go to the Audio Pronunciation Glossary in the Student Resources on *thePoint* to hear these terms pronounced.

Roots Pertaining to Muscles

See **Table 20-1**.

Table 20-1 Roots Pertaining to Muscles

Root	Meaning	Example	Definition of Example
my/o	muscle	myositis* <i>mī-ō-SĪ-tis</i>	inflammation of muscle
muscul/o	muscle	musculature <i>MUS-kyū-la-chur</i>	muscle arrangement in a part or the whole body
in/o	fiber	inotropic <i>in-ō-TROP-ik</i>	acting on (muscle) fibers
fasci/o	fascia	fasciodesis <i>fash-ē-OD-e-sis</i>	binding (suture) of a fascia to a tendon or other fascia
ten/o, tendin/o	tendon	tenostosis <i>ten-os-TŌ-sis</i>	ossification of a tendon
ton/o	tone	cardiotonic <i>kar-dē-ō-TON-ik</i>	having a strengthening action on the heart muscle
erg/o	work	ergonomics <i>er-gō-NOM-iks</i>	study of the efficient use of energy during work
kin/o-, kine, kinesi/o, kinet/o	movement	kinesis <i>ki-NĒ-sis</i>	movement (adjective: kinetic)

*Note addition of s to this root before the suffix -itis.

EXERCISE 20-1

Define the following adjectives:

1. muscular _____
2. fascial _____
3. tendinous _____
4. tonic _____
5. kinetic _____

Fill in the blanks:

6. Myoglobin (*mī-ō-GLŌ-bin*) is a type of protein (globin) found in _____.
7. Inosclerosis (*in-ō-skle-RŌ-sis*) is hardening of tissue from an increase in _____.
8. Fasciitis (*fash-ē-Ī-tis*) is inflammation of _____.
9. Dystonia (*dis-TŌ-nē-a*) is abnormal muscle _____.
10. An ergograph (*ER-gō-graf*) is an instrument for recording muscle _____.

EXERCISE 20-1 (Continued)

11. Kinesia (*kī-NE-sē-a*) is a term for sickness caused by _____.
12. Myofibrils (*mī-ō-Fī-brils*) are small fibers found in _____.
13. The muscularis layer in the wall of a hollow organ or duct is composed of _____.

Define the following terms:

14. hypermyotonia (*hī-per-mī-ō-TŌ-nē-a*) _____
15. fasciorrhaphy (*fash-ē-OR-a-fē*) _____
16. tendinitis (*ten-di-NĪ-tis*), also tendonitis (*ten-don-Ī-tis*) _____
17. musculotendinous (*mus-kū-lō-TEN-dī-nus*) _____
18. tenodesis (*ten-OD-e-sis*) _____
19. myalgia (*mī-AL-jē-a*) _____
20. kinesitherapy (*kī-nē-si-THER-a-pē*) _____
21. myotenositis (*mī-ō-ten-ō-SĪ-tis*) _____
22. myofascial (*mī-ō-FASH-ē-al*) _____
23. ergogenic (*er-gō-JEN-ik*) _____
24. atony (*AT-ō-nē*) _____
25. dyskinesia (*dis-kī-NE-zē-a*) _____

Write words for the following definitions:

26. any disease of muscle _____
27. excision of fascia _____
28. incision of a tendon (use ten/o) _____
29. inflammation of many (poly-) muscles _____
30. pertaining to muscles and the skeleton _____
31. study of movement (use kinesio/o) _____
32. plastic repair of a tendon and its muscle _____

Clinical Aspects of the Muscular System

Muscle function may be affected by disorders elsewhere, particularly in the nervous system and connective tissue. The conditions described below affect the muscular system directly or involve the muscles but have not been described in other chapters. Any disorder of muscles is described as a myopathy.

Techniques for diagnosing muscle disorders include electrical studies of muscle in action, **electromyography (EMG)**, and serum assay of enzymes released in increased amounts from damaged muscles, mainly **creatine kinase (CK)**.

MUSCULAR DYSTROPHY

Muscular dystrophy refers to a group of hereditary diseases involving progressive, noninflammatory muscular degeneration. There is weakness and wasting of muscle tissue with its gradual replacement by connective tissue and fat. There may also be cardiomyopathy (cardiac muscle disease) and mental impairment.

The most common form is Duchenne muscular dystrophy, a sex-linked disease passed from mother to son. This appears at 3 to 4 years of age, and patients are incapacitated by age 10 to 15. Death is commonly caused by respiratory failure or infection.



See the figure on muscular dystrophy in the Student Resources on thePoint.

MULTIPLE-SYSTEM DISORDERS INVOLVING MUSCLES

Polymyositis

Polymyositis is inflammation of skeletal muscle leading to weakness, frequently associated with dysphagia (difficulty in swallowing) or cardiac problems. The cause is unknown and may be related to viral infection or autoimmunity. Often the disorder is associated with some other systemic disease such as rheumatoid arthritis or lupus erythematosus.

When the skin is involved, the condition is termed **dermatomyositis**. In this case, there is erythema (redness of the skin), dermatitis (inflammation of the skin), and a typical lilac-colored rash, predominantly on the face. In addition to enzyme studies and EMG, clinicians use muscle biopsy in diagnosis.

Fibromyalgia Syndrome

Fibromyalgia syndrome (FMS) is a difficult-to-diagnose condition involving the muscles. It is associated with widespread muscle aches, tenderness, and stiffness, along with fatigue and sleep disorders in the absence of neurologic abnormalities or any other known cause. The disorder may coexist with other chronic diseases, may follow a viral infection, and may involve immune system dysfunction. A current theory is that FMS results from hormonal or neurotransmitter imbalances that increase sensitivity to pain. Treatments for FMS include a carefully planned exercise program and medication with pain relievers, muscle relaxants, or antidepressants.

Chronic Fatigue Syndrome

Chronic fatigue syndrome (CFS) involves persistent fatigue of no known cause that may be associated with impaired memory, sore throat, painful lymph nodes, muscle and joint pain, headaches, sleep problems, and immune disorders.

The condition often occurs after a viral infection. Epstein-Barr virus (the cause of mononucleosis), herpesvirus, and other viruses have been suggested as possible causes of CFS. No traditional or alternative therapies have been consistently successful in treating CFS.

Myasthenia Gravis

Myasthenia gravis (MG) is an acquired autoimmune disease in which antibodies interfere with muscle stimulation at the neuromuscular junction. There is a progressive loss of muscle power, especially in the external eye muscles and facial muscles.

Amyotrophic Lateral Sclerosis

Also named Lou Gehrig disease after a famous baseball player who died of the disorder, **amyotrophic lateral sclerosis (ALS)** is a progressive degeneration of motor neurons that leads to muscle atrophy (amyotrophy). Early signs are weakness, cramping, and muscle twitching. The facial or respiratory muscles may be affected early depending on the site of degeneration. Mental function, sensory perception, and bowel and bladder function usually remain intact. The disease progresses and eventually leads to death from respiratory muscle paralysis in three to five years.

STRESS INJURIES

Not as grave as the above diseases perhaps, but much more common, are musculoskeletal disorders caused by physical stress. These include accidental injuries and work- or sports-related damage caused by overexertion or repetitive motion, so-called **repetitive strain injury (RSI)**. Damages to soft tissues include **sprain**, injury to a ligament caused by abnormal or excessive force at a joint but without bone dislocation or fracture; muscle **strain**, inflammation or tearing of ligaments and tendons; and bursitis. **Tenosynovitis**, commonly called **tendinitis**, is inflammation of a tendon, tendon sheath, and the synovial membrane at a joint. The signs of these injuries are pain, fatigue, weakness, stiffness, numbness, and reduced range of motion (ROM). (The origins of some colorful terms for such conditions are given in **Box 20-4**.)

Box 20-4



Focus on Words

Some Colorful Musculoskeletal Terms

Some common terms for musculoskeletal disorders have interesting origins. A charley horse describes muscular strain and soreness, especially in the legs. The term comes from common use of the name Charley for old lame horses that were kept around for family use when they could no longer be used for hard work. Wryneck, technically torticollis, uses the word *wry* meaning twisted or turned, as in the word awry (*a-Rĭ*), meaning amiss or out of position.

A bunion, technically called hallux valgus, is an enlargement of the first joint of the great toe with bursitis at the joint. It probably comes from the word bony, changed to bunny, and used to mean a bump on the head and then a swelling on a joint. A clavus is commonly called a corn because it is a hardened or horny thickening of the skin in an area of friction or pressure.

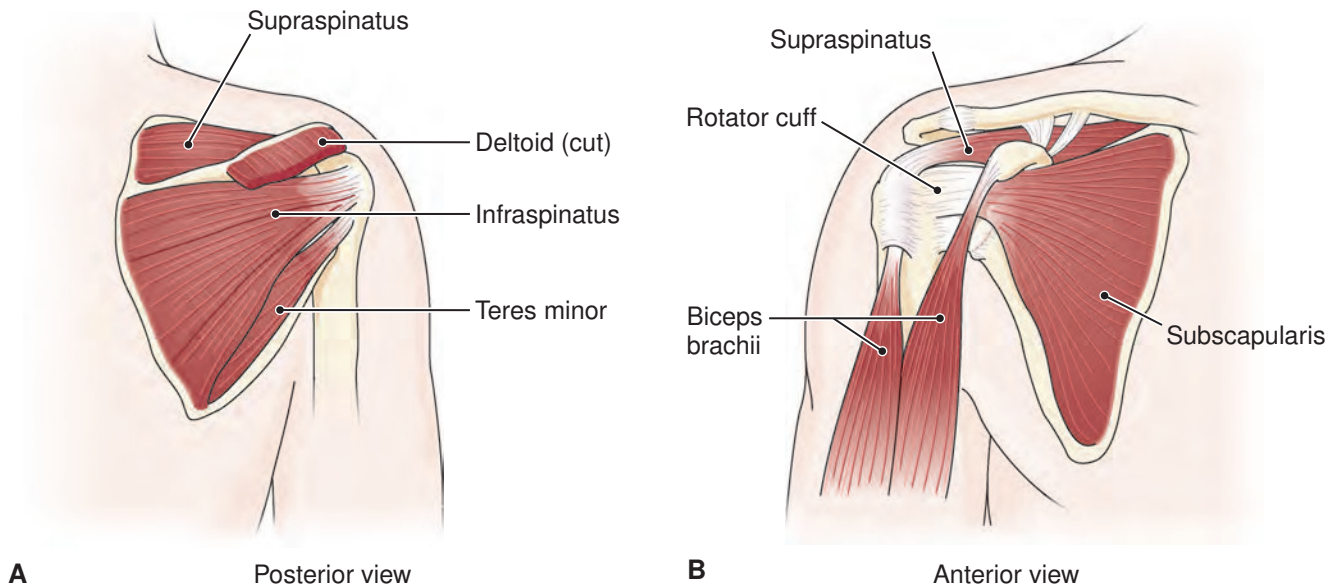


Figure 20-8 Anatomy of the rotator cuff. Four muscles contribute to the rotator cuff that strengthens the shoulder. They are the supraspinatus, infraspinatus, teres minor, and subscapularis. Two adjacent muscles are also shown, the deltoid and biceps brachii. A. Posterior. B. Anterior.

Stress injuries may involve any muscles or joints, but some common upper extremity conditions are:

- **Rotator cuff (RTC) injury**—The RTC, which strengthens the shoulder joint, is formed by four muscles, the supraspinatus, infraspinatus, teres minor, and subscapularis, the “SITS” muscles (Fig. 20-8). Inflammation or tearing of the RTC can occur in people who repeatedly perform overhead activities, such as swimming, painting, or pitching.
- **Epicondylitis**—The medial and lateral epicondyles (projections) of the distal humerus are attachment points for muscles that flex and extend the wrist and fingers. Inflammation of these tendons of origin causes pain at the elbow and forearm on lifting, carrying, squeezing, or typing. These stress injuries are often sports-related, leading to the terms “golfer’s elbow” and “tennis elbow” for medial and lateral epicondylitis, respectively. A brace worn below the elbow to distribute stress on the joint may be helpful.
- **Carpal tunnel syndrome (CTS)**—CTS involves the tendons of the finger flexor muscles and the nerves that supply the hand and fingers (Fig. 20-9). Hand numbness and weakness are caused by pressure on the median nerve as it passes through a tunnel formed by the carpal (wrist) bones. CTS commonly appears in people who use their hands and fingers strenuously, such as musicians and keyboarders.
- **Trigger finger**—This is a painful snapping, triggering, or locking of a finger as it is moved. It is caused by inflammation and swelling of the flexor tendon sheath

at the metacarpophalangeal joint that prevents the tendon from sliding back and forth.

Some stress injuries that involve the lower extremities are:

- **Hamstring strain**—The hamstring is a large muscle group in the posterior thigh that extends from the hip to the knee and flexes the knee (see Fig. 20-7). A “pulled hamstring” is common in athletes who stop and start running suddenly. It is treated with stretching and strengthening activities.
- **Shin-splint**—This is pain in the leg’s anterior tibial region from running on hard surfaces or overuse of the foot flexors, as in athletes and dancers. Help comes from good shoes with adequate support and avoidance of hard surfaces for exercise.
- **Achilles tendinitis**—The Achilles (*a-KIL-ēz*) tendon is a large tendon that attaches the calf muscles to the heel and is used to plantar flex the foot at the ankle (see Figs. 20-5 and 20-7). Damage to the Achilles tendon hampers or prevents walking and running.

Treatment

Orthopedists diagnose musculoskeletal disorders by MRI and other imaging techniques, ROM measurements, and strength testing. Treatment of stress injuries usually begins conservatively with rest, elevation, ice packs, bracing, and medications, such as analgesics, antiinflammatory agents, and muscle relaxants. (The acronym RICE represents this simple approach—rest, ice, compression, elevation.) Treatment may progress to steroid injections, ultrasound therapy for deep heat, strengthening exercises, or even surgery.

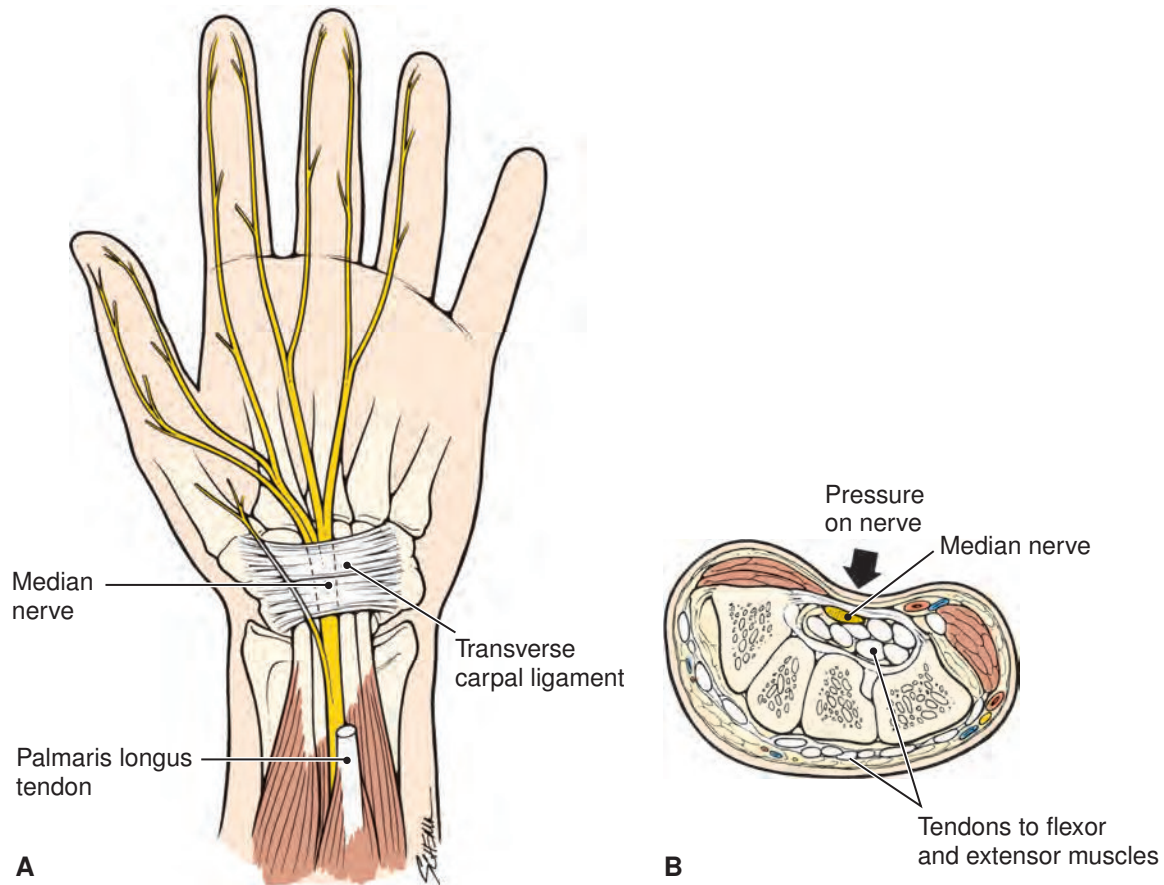


Figure 20-9 Carpal tunnel syndrome. A. Pressure on the median nerve as it passes through the carpal (wrist) bones causes numbness and weakness in the areas of the hand supplied by the nerve. B. Cross section of the wrist showing compression of the median nerve.

Terminology

Key Terms

Disorders

amyotrophic lateral sclerosis (ALS) <i>a-mī-ō-TROF-ik</i>	A disease caused by motor neuron degeneration resulting in muscular weakness and atrophy; Lou Gehrig disease
chronic fatigue syndrome (CFS)	A disease of unknown cause that involves persistent fatigue, along with muscle and joint pain and other symptoms; may be virally induced
dermatomyositis <i>der-ma-tō-mī-ō-Sī-tis</i>	A disease of unknown origin involving muscular inflammation as well as dermatitis and skin rashes
fibromyalgia syndrome (FMS) <i>fi-brō-mī-AL-jē-a</i>	A disorder associated with widespread muscular aches and stiffness and having no known cause
muscular dystrophy <i>DIS-trō-fē</i>	A group of hereditary muscular disorders marked by progressive weakness and muscular atrophy
myasthenia gravis (MG) <i>mī-as-THĒ-nē-a GRA-vis</i>	A disease characterized by progressive muscular weakness; an autoimmune disease affecting the neuromuscular junction

Terminology

Key Terms (Continued)

polymyositis <i>pol-ē-mī-ō-sī-tis</i>	A disease of unknown cause involving muscular inflammation and weakness
repetitive strain injury (RSI)	Tissue damage caused by repeated motion, usually overuse of the arm or hand in occupational activities such as writing, typing, painting, or using hand tools; also called repetitive motion injury, cumulative trauma injury, overuse syndrome
sprain	Injury to a ligament caused by abnormal or excessive force at a joint, but without bone dislocation or fracture
strain <i>strān</i>	Trauma to a muscle because of overuse or excessive stretch; if severe, may involve muscular tearing, bleeding, separation of a muscle from its tendon, or tendon separation from a bone
tendinitis <i>ten-di-NĪ-tis</i>	Inflammation of a tendon, usually caused by injury or overuse; the shoulder, elbow, and hip are common sites; also spelled tendonitis
tenosynovitis <i>ten-ō-sin-ō-VĪ-tis</i>	Inflammation of a tendon and its sheath
Diagnosis	
creatine kinase (CK) <i>KRĒ-a-tin KĪ-nās</i>	An enzyme found in muscle tissue; the serum CK level increases in cases of muscle damage; creatine phosphokinase (CPK)
electromyography (EMG) <i>ē-lek-trō-mī-OG-ra-fē</i>	Study of the electrical activity of muscles during contraction



Go to the Audio Pronunciation Glossary in the Student Resources on thePoint to hear these terms pronounced.

20

Terminology

Supplementary Terms

Normal Structure and Function

aponeurosis <i>ap-ō-nū-RŌ-sis</i>	A flat, white, sheet-like tendon that connects a muscle with the part that it moves (see abdominal aponeurosis, Fig. 20-6)
creatine <i>KRĒ-a-tin</i>	A substance in muscle cells that stores energy for contraction
glycogen <i>GLĪ-kō-jen</i>	A complex sugar that is stored for energy in muscles and in the liver
isometric <i>ī-sō-MET-rik</i>	Pertaining to a muscle action in which the muscle tenses but does not shorten (literally: same measurement)
isotonic <i>ī-sō-TON-ik</i>	Pertaining to a muscle action in which the muscle shortens to accomplish movement (literally: same tone)

(Continued)

Terminology Supplementary Terms *(Continued)*

kinesthesia <i>kin-es-THĒ-zē-a</i>	Awareness of movement; perception of the weight, direction, and degree of movement (- <i>esthesia</i> means “sensation”)
lactic acid <i>LAK-tik</i>	An acid that accumulates in muscle cells functioning without enough oxygen (anaerobically), as in times of great physical exertion
motor unit	A single motor neuron and all of the muscle cells that its branches stimulate
myoglobin <i>mī-ō-GLŌ-bin</i>	A pigment similar to hemoglobin that stores oxygen in muscle cells
Symptoms and Conditions	
asterixis <i>as-ter-IK-sis</i>	Rapid, jerky movements, especially in the hands, caused by intermittent loss of muscle tone
asthenia <i>as-THĒ-nē-a</i>	Weakness (prefix <i>a-</i> meaning “without” with root <i>sthen/o</i> meaning “strength”)
ataxia <i>a-TAK-sē-a</i>	Lack of muscle coordination (from root <i>tax/o</i> meaning “order, arrangement”) (adjective: ataxic)
athetosis <i>ath-e-TŌ-sis</i>	A condition marked by slow, irregular, twisting movements, especially in the hands and fingers (adjective: athetotic)
atrophy <i>AT-rō-fē</i>	A wasting away; a decrease in the size of a tissue or organ, such as muscular wasting from disuse
avulsion <i>a-VUL-shun</i>	Forcible tearing away of a part
clonus <i>KLŌ-nus</i>	Alternating spasmodic contraction and relaxation in a muscle (adjective: clonic)
contracture <i>kon-TRAK-chur</i>	Permanent contraction of a muscle
fasciculation <i>fa-sik-ū-LĀ-shun</i>	Involuntary small contractions or twitching of muscle fiber groups (fasciculi)
fibromyositis <i>fi-brō-mī-ō-SĪ-tis</i>	A nonspecific term for pain, tenderness, and stiffness in muscles and joints
fibrositis <i>fi-brō-SĪ-tis</i>	Inflammation of fibrous connective tissue, especially the muscle fasciae; marked by pain and stiffness
restless legs syndrome (RLS)	Uneasiness, twitching, or restlessness in the legs that occurs after going to bed and often leading to insomnia; may be caused by poor circulation or drug side effects
rhabdomyolysis <i>rab-dō-mī-OL-i-sis</i>	An acute disease involving diffuse destruction of skeletal muscle cells (root <i>rhabd/o</i> means “rod,” referring to the long, rod-like muscle cells)
rhabdomyoma <i>rab-dō-mī-Ō-ma</i>	A benign tumor of skeletal muscle
rhabdomyosarcoma <i>rab-dō-mī-ō-sar-KŌ-ma</i>	A highly malignant tumor of skeletal muscle
rheumatism <i>RŪ-ma-tizm</i>	A general term for inflammation, soreness, and stiffness of muscles associated with joint pain (adjectives: rheumatic, rheumatoid)

Terminology Supplementary Terms *(Continued)*

spasm <i>spazm</i>	A sudden, involuntary muscle contraction; may be clonic (contraction alternating with relaxation) or tonic (sustained); a strong and painful spasm may be called a cramp (adjectives: spastic, spasmodic)
spasticity <i>spas-TIS-i-tē</i>	Increased tone or contractions of muscles causing stiff and awkward movements
tetanus <i>TET-a-nus</i>	An acute infectious disease caused by the anaerobic bacillus <i>Clostridium tetani</i> . It is marked by persistent painful spasms of voluntary muscles; lockjaw
tetany <i>TET-a-nē</i>	A condition marked by spasms, cramps, and muscle twitching caused by a metabolic imbalance, such as low blood calcium resulting from underactivity of the parathyroid glands
torticollis <i>tor-ti-KOL-is</i>	Spasmodic contraction of the neck muscles causing stiffness and twisting of the neck; wryneck

Diagnosis and Treatment

Chvostek sign <i>VOS-tek</i>	Spasm of facial muscles after a tap over the facial nerve; evidence of tetany
occupational therapy	Health profession concerned with increasing function and preventing disability through work and play activities. The goal of occupational therapy is to increase the patient's independence and quality of daily life (see Box 17-2)
physical therapy	Health profession concerned with physical rehabilitation and prevention of disability. Exercise, massage, and other therapeutic methods are used to restore proper movement (see Box 19-2)
rheumatology <i>rū-ma-TOL-ō-jē</i>	The study and treatment of rheumatic diseases
Trousseau sign <i>tru-SŌ</i>	Spasmodic contractions caused by pressing the nerve supplying a muscle; seen in tetany

Drugs

antiinflammatory agent	Drug that reduces inflammation; includes steroids, such as cortisol, and nonsteroidal antiinflammatory drugs
COX-2 inhibitor	Nonsteroidal antiinflammatory drug that does not cause the stomach problems associated with other NSAIDs. Inhibits the cyclooxygenase (COX)-2 enzyme without affecting the COX-1 enzyme, a lack of which can cause stomach ulcers. Example is celecoxib (Celebrex). Some of these drugs have been withdrawn from the market because of cardiac risk
muscle relaxant <i>rē-LAX-ant</i>	A drug that reduces muscle tension; different forms may be used to relax muscles during surgery, to control spasticity, or to relieve musculoskeletal pain
nonsteroidal antiinflammatory drug (NSAID)	Drug that reduces inflammation but is not a steroid; examples include aspirin, ibuprofen, naproxen, and other inhibitors of prostaglandins, naturally produced substances that promote inflammation

Terminology Abbreviations

ACh	Acetylcholine	NMJ	Neuromuscular junction
ALS	Amyotrophic lateral sclerosis	OT	Occupational therapy/therapist
CFS	Chronic fatigue syndrome	PT	Physical therapy/therapist
C(P)K	Creatine (phospho)kinase	RICE	Rest, ice, compression, elevation
CTS	Carpal tunnel syndrome	RLS	Restless legs syndrome
EMG	Electromyography, electromyogram	ROM	Range of motion
FMS	Fibromyalgia syndrome	RSI	Repetitive strain injury
MG	Myasthenia gravis	RTC	Rotator cuff
MMT	Manual muscle test(ing)	SITS	Supraspinatus, infraspinatus, teres minor, subscapularis (muscles)

T.D.'s Follow-Up

The exploratory surgery confirmed the brachial plexus injury, and T.D. underwent the nerve graft with muscle taken from his right thigh. After six days, he was discharged home with his right arm in a shoulder immobilizer. He received instructions on activities and was told to see the surgeon in one week and again three weeks

later. Physical therapy was ordered to prevent further atrophy and to begin rebuilding the arm muscles. T.D. was frustrated with the slow progress, but the orthopedic surgeon had said that in time, he should regain full use of his right arm and normal activities of daily living should be restored.

Chapter Review

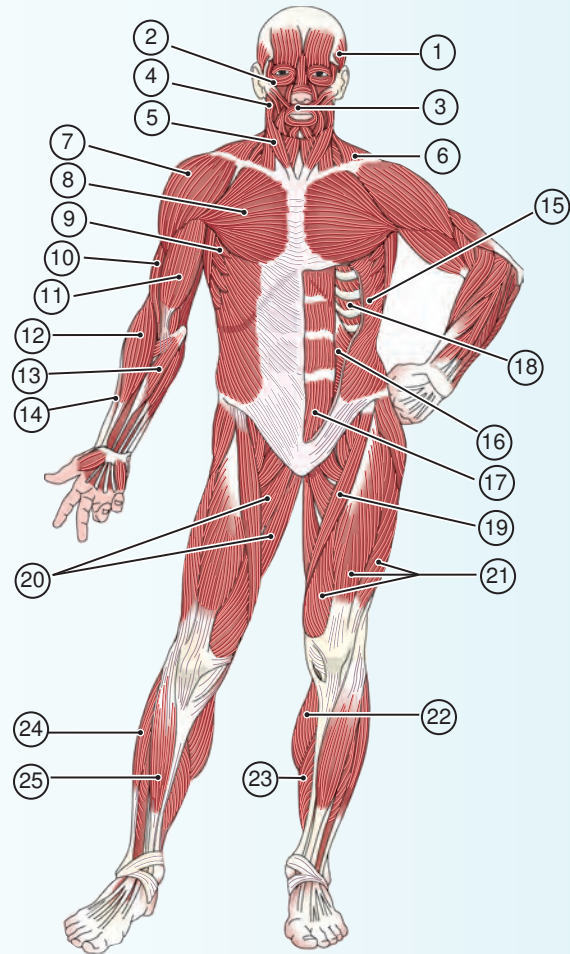
Labeling Exercise

SUPERFICIAL MUSCLES, ANTERIOR VIEW

Write the name of each numbered part on the corresponding line of the answer sheet.

Adductors of thigh	Orbicularis oculi
Biceps brachii	Orbicularis oris
Brachialis	Pectoralis major
Brachioradialis	Quadriceps femoris
Deltoid	Rectus abdominis
Extensor carpi	Sartorius
External oblique	Serratus anterior
Fibularis longus	Soleus
Flexor carpi	Sternocleidomastoid
Gastrocnemius	Temporalis
Intercostals	Tibialis anterior
Internal oblique	Trapezius
Masseter	

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____



Anterior view

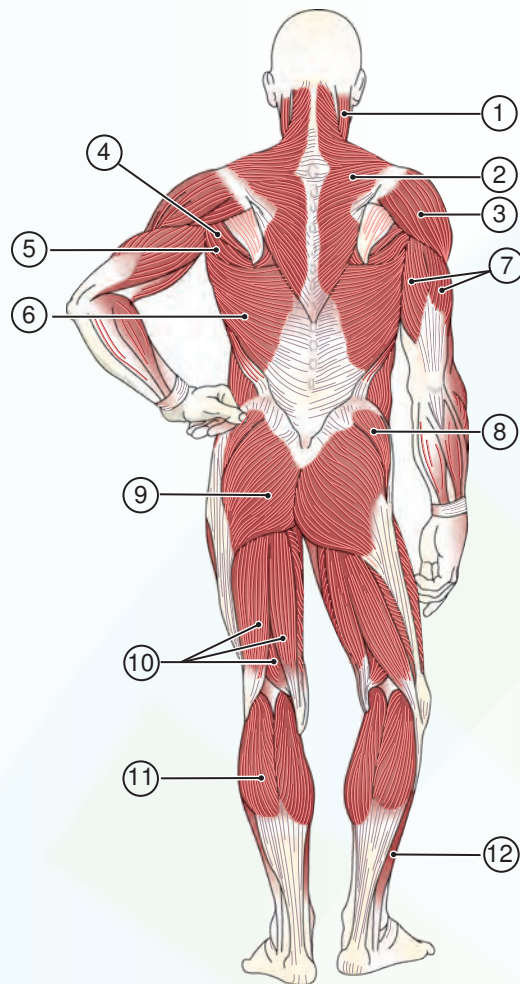
19. _____
20. _____
21. _____
22. _____
23. _____
24. _____
25. _____

SUPERFICIAL MUSCLES, POSTERIOR VIEW

Write the name of each numbered part on the corresponding line of the answer sheet.

Deltoid	Latissimus dorsi
Fibularis longus	Sternocleidomastoid
Gastrocnemius	Teres major
Gluteus maximus	Teres minor
Gluteus medius	Trapezius
Hamstring group	Triceps brachii

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____



Posterior view

Terminology

MATCHING

Match the following terms and write the appropriate letter to the left of each number:

- | | |
|-----------------------------|---|
| _____ 1. masseter | a. main muscle of the calf |
| _____ 2. quadriceps femoris | b. muscle of the upper back and neck |
| _____ 3. pectoralis major | c. muscle used in chewing; jaw muscle |
| _____ 4. gastrocnemius | d. large muscle of the upper chest |
| _____ 5. trapezius | e. a group of four muscles in the thigh |
| _____ 6. dystonia | a. instrument for measuring muscle work |
| _____ 7. ergometer | b. slowness of movement |
| _____ 8. inotropic | c. a small bundle of fibers |
| _____ 9. bradykinesia | d. acting on muscle fibers |
| _____ 10. fascicle | e. abnormal muscle tone |

Supplementary Terms

- | | |
|-----------------------|---|
| _____ 11. glycogen | a. substance that stores energy in muscle cells |
| _____ 12. tetany | b. flat, white, sheet-like tendon |
| _____ 13. aponeurosis | c. muscular spasms and cramps |
| _____ 14. creatine | d. complex sugar stored in muscles |
| _____ 15. lactic acid | e. a by-product of anaerobic muscle contractions |
| _____ 16. asterixis | a. wryneck |
| _____ 17. ataxia | b. lack of muscle coordination |
| _____ 18. torticollis | c. awareness of movement |
| _____ 19. asthenia | d. weakness |
| _____ 20. kinesthesia | e. rapid, jerky movements, especially of the hands |
| _____ 21. clonus | a. forcible tearing away of a part |
| _____ 22. athetosis | b. acute infectious disease that affects muscles |
| _____ 23. spasm | c. intermittent muscle contractions |
| _____ 24. tetanus | d. sudden involuntary muscle contraction |
| _____ 25. avulsion | e. condition marked by slow, twisting movements |

Referring to T.D.'s case history

- | | |
|-----------------------|---------------------------------------|
| _____ 26. phrenic | a. partial dislocation |
| _____ 27. atrophy | b. shoulder muscle |
| _____ 28. subluxation | c. network |
| _____ 29. plexus | d. pertaining to the diaphragm |
| _____ 30. deltoid | e. tissue wasting |

FILL IN THE BLANKS

31. The neurotransmitter released at the neuromuscular junction is _____.
32. The sheath of connective tissue that covers a muscle is called _____.
33. The number of origins (heads) in the triceps brachii muscle is _____.
34. A muscle that produces extension at a joint is called a(n) _____.
35. A band of connective tissue that attaches a muscle to a bone is a(n) _____.
36. The strong, cord-like tendon that attaches the calf muscle to the heel is the _____.
37. Movement away from the midline of the body is termed _____.
38. A musclotrophic substance acts on _____.

Referring to T.D.'s case study:

39. The nerves of the brachial plexus supply the _____.
40. The muscle above the spine of the scapula is the _____.
41. The vertebra C7 is in the region of the _____.

DEFINITIONS

Define the following words:

42. myology (*mī-OL-ō-jē*) _____
43. myofascial (*mī-ō-FASH-ē-al*) _____
44. tendinoplasty (*TEN-din-ō-plas-tē*) _____
45. inositis (*in-ō-Sī-tis*) _____
46. hypotonia (*hī-pō-TŌ-nē-a*) _____
47. hyperkinesia (*hī-per-ki-NĒ-sē-a*) _____

Write words for the following definitions:

48. inflammation of muscle (use my/o-) _____
49. death of muscle tissue _____
50. suture of fascia _____
51. absence of muscle tone _____
52. excision of fascia _____
53. study of movement _____
54. surgical incision of a tendon (use ten/o-) _____
55. pertaining to a tendon _____

OPPOSITES

Write a word that means the opposite of the following terms as they pertain to muscles:

56. agonist _____
57. origin _____
58. abduction _____
59. pronation _____
60. extension _____

ADJECTIVES

From the supplementary terms, write the adjective form of the following words:

61. ataxia _____
62. athetosis _____
63. spasm _____
64. clonus _____

TRUE-FALSE

Examine the following statements. If the statement is true, write T in the first blank. If the statement is false, write F in the first blank and correct the statement by replacing the underlined word in the second blank.

- | | True or False | Correct Answer |
|---|---------------|----------------|
| 65. The part of a neuron that contacts a muscle cell is the <u>axon</u> . | _____ | _____ |
| 66. Skeletal muscle is <u>voluntary</u> . | _____ | _____ |

67. The origin of a muscle is attached to a moving part.

68. The hamstring group is in the anterior thigh.

69. Pronation means turning downward.

70. Smooth muscle is also called visceral muscle.

71. The quadriceps muscle has three components.

72. In an isotonic contraction, a muscle shortens.

ELIMINATIONS

In each of the sets below, underline the word that does not fit in with the rest and explain the reason for your choice:

73. fascicle — fiber — tendon — osteoblast — fascia

74. soleus — flexor carpi — biceps brachii — brachioradialis — extensor carpi

75. vastus intermedius — intercostals — vastus lateralis — vastus medialis — rectus femoris

76. circumduction — inversion — actin — dorsiflexion — rotation

77. EMG — ALS — FMS — CFS — MG

ABBREVIATIONS

Write the meaning of each of the following:

78. CTS

79. ACh

80. RTC

81. NMJ

82. CK

WORD BUILDING

Write a word for the following definitions using the word parts provided.

-ia ten/o -al alg/o -itis -desis -blast -lysis fasci/o my/o

83. an immature muscle cell

84. binding of a fascia

85. pain in a tendon

86. destruction of muscle tissue

87. binding of a tendon

88. inflammation of fascia

89. separation of a tendon

90. pertaining to fascia

91. pain in a muscle

WORD ANALYSIS

Define each of the following words, and give the meaning of the word parts in each. Use a dictionary if necessary.

92. dermatomyositis (*der-ma-tō-mī-ō-SĪ-tis*) _____
 a. dermat/o _____
 b. my/o(s) _____
 c. -itis _____
93. myasthenia (*mī-as-THĒ-nē-a*) _____
 a. my/o _____
 b. a- _____
 c. sthen/o _____
 d. -ia _____
94. dyssynergia (*dis-in-ER-jē-a*) _____
 a. dys- _____
 b. syn- _____
 c. erg/o _____
 d. -ia _____
95. amyotrophic (*a-mī-ō-TRŌ-fik*) _____
 a. a- _____
 b. my/o _____
 c. troph/o _____
 d. -ic _____



For more learning activities, see Chapter 20 of the Student Resources on *thePoint*.

Additional Case Studies

Case Study 20-1: Rotator Cuff Tear

M.L., a 56-YO business executive and former college football player, was referred to an orthopedic surgeon for recurrent shoulder pain. M.L. was unable to abduct his right arm without pain even after six months of physical therapy and NSAIDs. In addition, he had taken supplements of glucosamine, chondroitin, and S-adenosylmethionine for several months in an effort to protect the flexibility of his shoulder joint. M.L. recalled a shoulder dislocation resulting from a football injury 35 years earlier. An MRI scan confirmed a complete rotator cuff tear. The surgeon recommended the Bankart procedure for M.L.'s injury to restore his joint stability, alleviate his pain, and permit him to return to his former normal activities, including golf.

After anesthesia induction and positioning in a semisitting (beach chair) position, the surgeon made an anterosuperior deltoid incision (the standard deltopectoral approach) and divided

the coracoacromial ligament at the acromial attachment. The rotator cuff was identified after the deltoid was retracted and the clavipectoral fascia was incised. The subscapularis tendon was incised proximal to its insertion. After capsular incision, inspection showed a large pouch inferiorly in the capsule, consistent with laxity (instability). The capsule's torn edges were anchored to the rim of the glenoid fossa with heavy nonabsorbable sutures. A flap from the subscapularis tendon was transposed and sutured to the supraspinatus and infraspinatus muscles to bridge the gap. An intraoperative ROM examination showed that the external rotation could be performed past neutral and that the shoulder did not dislocate. The wound was closed, and a shoulder immobilizer sling was applied. M.L. was referred to PT to begin therapy in three weeks and was assured he would be able to play golf in six months.

Case Study 20-2: "Wake-Up" Test During Spinal Fusion Surgery

L.N.'s somatosensory evoked potentials (SSEPs) were monitored throughout her spinal fusion surgery to provide continuous information on the functional state of her sensory pathways from the median and posterior tibial nerves through the dorsal column to the primary somatosensory cortex. Before surgery, needle electrodes were inserted into L.N.'s right and left quadriceps muscles to determine nerve conduction through L2 to L4, into the anterior tibialis muscles to measure passage through L5, and into the gastrocnemius muscles to measure S1 to S2. Electrodes were placed in her rectus abdominis to monitor S1 to S2. All electrodes were taped in place, and the wires were plugged into a transformer box with feedback to a computer. A neuromonitoring technologist placed the electrodes and attended the computer monitor throughout the case. During the procedure, selected muscle groups were stimulated with 15 to 40 milliamperes (mA) of current to test the nerves and muscles. Data fed back into the computer confirmed the neuromuscular integrity and status of the spinal fixation, the instrumentation, and implants.

After the pedicle screws, hooks, and wires were in place and the spinal rods were cinched down to straighten the spine, L.N. was permitted to emerge temporarily from anesthesia and muscle paralysis medication to a lightly sedated but pain-free state. She was given commands to move her feet, straighten her legs, and wiggle her toes to test all neuromuscular groups that could be affected by misplaced or compressed spinal fixation devices. Her feet were watched, and movement was announced to the team. Dorsiflexion cleared the tibialis anterior muscles; plantar flexion cleared the gastrocnemius muscles. Knee flexion cleared the hamstring muscle group, and knee extension determined function of the quadriceps group. L.N. had a successful "wake-up" test. She was put back into deep anesthesia, and her incision was closed. A postoperative "wake-up" test was repeated after she was moved to her bed. The surgical instruments and tables were kept sterile until after all of the monitored muscle groups were tested and showed voluntary movement. The electrodes were removed, and she was taken to postanesthesia care unit (PACU) for recovery.

Case Study Questions

Multiple choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|---|--|
| _____ 1. The insertion of the muscle is: | _____ 2. M.L. was unable to abduct his affected arm. This motion is: |
| a. the thick middle portion | a. toward the midline |
| b. the point of attachment to a moving bone | b. circumferential |
| c. the point of attachment to a stable bone | c. in the same direction as the muscle fibers |
| d. the fibrous sheath | d. away from the midline |
| e. the connective tissue | e. a position with the palm facing upward |

- _____ 3. An anterosuperior deltoid incision would be made:
- perpendicular to the muscle fibers
 - below the fascial sheath
 - behind the glenoid fossa
 - in the best area
 - at the top and to the front of the deltoid muscle
- _____ 4. The subscapularis tendon arises from the subscapularis:
- fascia
 - nerve
 - bone
 - extensor
 - flexor
- _____ 5. The intraoperative ROM examination was performed:
- in the OR corridor
 - during surgery
 - before surgery
 - after surgery
 - in the interventional radiology suite
- _____ 6. M.L.'s arm and shoulder were placed in a sling after surgery to:
- encourage movement beyond the point of pain
 - minimize rapid ROM
 - maintain adduction and external rotation
 - prevent movement
 - stop bleeding
- _____ 7. The quadriceps muscle group is made up of:
- smooth and cardiac muscle fibers
 - four muscles in the thigh
 - three muscles in the leg and one in the anterior chest
 - fascia and tendon sheaths
 - tendons and fascia around the shoulder
- _____ 8. The anterior tibialis muscle is in the:
- abdomen
 - thigh
 - spine
 - foot
 - leg
- _____ 9. The nerve supply for the rectus abdominis muscle runs through S1 to S2. This anatomic region is:
- the first and second sural sheath
 - subluxation and suppuration
 - sacral disk space 1 and 2
 - sacral disk space 3
 - somatosensory electrodes 1 and 2
- _____ 10. The movement of elevating the toes toward the anterior ankle is:
- supination
 - pronation
 - dorsiflexion
 - plantar flexion
 - external rotation
- _____ 11. Knee extension results in:
- a bent knee
 - a ballet position with the toes turned out
 - bilateral abduction
 - inversion
 - a straight leg

Write terms from the case studies with the following meanings:

12. pertaining to treatment of skeletal and muscular disorders

13. bending at a joint

14. to point the toes downward

Define the following abbreviations:

15. PT _____

16. ROM _____

17. SSEP _____

18. PACU _____

CHAPTER

21

The Skin

Case Study

C.M.'s Pressure Ulcer

Chief complaint:

C.M., an elderly woman in failing health, had recently moved in with her daughter after her hospitalization for a stroke. The daughter reported to the home care nurse that her mother had minimal appetite and was confused and disoriented and that a blister had developed on her lower back since she had been confined to bed.

Examination:

During the biweekly visit, the home care nurse spoke with the daughter and then went in to see the mother. On her initial assessment, the nurse noted that C.M. had lost weight since her last visit and that her skin was dry, with poor skin turgor. She also observed that the mother was wearing an "adult diaper," which was wet. The nurse took the mother's BP, HR, and R, which were normal. She assessed the mother's mental status and then proceeded to a skin assessment paying special attention to the bony prominences. After examining C.M.'s sacrum, the nurse noted a nickel-sized open area, 2 cm in diameter and 1 cm in depth (stage II pressure ulcer), with a 0.5-cm reddened surrounding area with no drainage. C.M. moaned when the nurse palpated the lesion. The nurse also noted reddened areas on C.M.'s elbows and heels. The remainder of the examination saw no change from the previous visit.

Clinical course:

The nurse provided C.M.'s daughter with instructions for proper skin care, incontinence management, enhanced nutrition, and frequent repositioning to prevent pressure ischemia to the prominent body areas. However, six months later, C.M.'s pressure ulcer had deteriorated to class III. She was hospitalized under the care of a plastic surgeon and wound ostomy care nurse. Surgery was scheduled for débridement of the sacral wound and closure with a full-thickness skin graft taken from her thigh. C.M. was discharged eight days later to a long-term care facility with orders for an alternating pressure mattress, position change every two hours, supplemental nutrition, and meticulous wound care.





Ancillaries *At-A-Glance*

Visit *thePoint* to access the PASSport to Success and the following resources. For guidance in using the resources most effectively, see pp. viii–xvi.

Learning TOOLS

- Learning Style Self-Assessment
- Live Advise Online Student Tutoring
- Tips for Effective Studying

Learning RESOURCES

- E-book: Chapter 21
- Web Figure: Clinical Findings in Systemic Lupus Erythematosus
- Web Figure: Malar “Butterfly” Rash of Systemic Lupus Erythematosus
- Web Chart: Skin Structure
- Web Chart: Accessory Skin Structures
- Animation: Wound Healing
- Audio Pronunciation Glossary

Learning ACTIVITIES

- Visual Activities
- Kinesthetic Activities
- Auditory Activities

Learning Objectives

After study of this chapter, you should be able to:

- 1 Define and list the functions of the integumentary system. *p580*
- 2 Compare the locations and structures of the epidermis, dermis, and subcutaneous tissues. *p580*
- 3 Describe the roles of keratin and melanin in the skin. *p580*
- 4 Name and describe the glands in the skin. *p580*
- 5 Describe the structure of hair and nails. *p580*
- 6 Identify and use roots pertaining to the skin. *p583*
- 7 Describe the main disorders that affect the skin. *p584*
- 8 Interpret abbreviations used in the study and treatment of the skin. *p596*
- 9 Analyze medical terms in several case studies involving the skin. *pp578, 601*

Pretest

Multiple Choice. Select the best answer and write the letter of your choice to the left of each number.

- | | |
|--|---|
| <p>_____ 1. The uppermost portion of the skin is called the:</p> <ul style="list-style-type: none"> a. fossa b. cuticle c. epidermis d. epiphysis | <p>_____ 4. A pigmented skin tumor is a(n):</p> <ul style="list-style-type: none"> a. chondrosarcoma b. melanoma c. lymphoma d. adenoma |
| <p>_____ 2. The glands that secrete an oily substance that lubricates the skin are the:</p> <ul style="list-style-type: none"> a. sweat glands b. sebaceous glands c. mammary glands d. foramina | <p>_____ 5. The root <i>hidr/o</i> pertains to:</p> <ul style="list-style-type: none"> a. tears b. saliva c. blood d. sweat |
| <p>_____ 3. The rule of nines is a system used to evaluate:</p> <ul style="list-style-type: none"> a. burns b. fever c. inflammation d. immunity | <p>_____ 6. Onychomycosis is a fungal infection of a(n):</p> <ul style="list-style-type: none"> a. eyelid b. nail c. hair d. bone |

The skin and its associated structures make up the **integumentary system**. This body-covering system protects against infection, dehydration, ultraviolet radiation, and injury. Extensive damage to the skin, such as by burns, can result in a host of dangerous complications.

The skin helps to regulate temperature by evaporation of sweat and by changes in the diameter of surface blood vessels, which control how much heat is lost to the environment. The skin also contains receptors for the sensory perceptions of touch, temperature, pressure, and pain. Medication can be delivered through the skin from patches, as explained in **Box 21-1**.

The word **derma** (from Greek) means “skin” and is used as an ending in words pertaining to the skin, such as xeroderma (dryness of the skin) and scleroderma (hardening of the skin). The adjective **cutaneous** refers to the skin and is from the Latin word *cutis* for skin. Like the eyes, the skin is a readily visible reflection of one’s health. Its color, texture, and resilience reveal much, as does the condition of the hair and nails.

Anatomy of the Skin

The skin’s outermost portion is the **epidermis**, consisting of four to five layers (strata) of epithelial cells (**Fig. 21-1**). The deepest epidermal layer, the stratum basale, or basal layer, produces new cells. As these cells gradually rise toward the surface, they die and become filled with **keratin**, a protein that thickens and toughens the skin. The outermost

epidermal layer, the stratum corneum or horny layer, is composed of flat, dead, protective cells that are constantly being shed and replaced. Some of the cells in the epidermis produce **melanin**, a pigment that gives the skin color and protects against sunlight.

The **dermis** is beneath the epidermis. It contains connective tissue, nerves, blood vessels, lymphatics, and sensory receptors. This layer supplies nourishment and support for the skin. The **subcutaneous tissue** beneath the dermis is composed mainly of connective tissue and fat.

Associated Skin Structures

Specialized structures within the skin are part of the integumentary system:

- The **sudoriferous (sweat) glands** act mainly in temperature regulation by releasing a watery fluid that evaporates to cool the body.
- The **sebaceous glands** release an oily fluid, **sebum**, that lubricates the hair and skin and prevents drying.
- **Hair** is widely distributed over the body. Each hair develops within a sheath or **hair follicle** and grows from its base within the skin’s deep layers. A small muscle (arrector pili) attached to the follicle raises the hair to produce “goosebumps” when one is frightened or cold (**see Fig. 21-1**). In animals this is a warning sign and a means of insulation.

Box 21-1



Clinical Perspectives

Medication Patches: No Bitter Pill to Swallow

For most people, pills are a convenient way to take medication, but for some, they have drawbacks. Pills must be taken at regular intervals to ensure consistent dosing, and they must be digested and absorbed into the bloodstream before they can begin to work. For those who have difficulty swallowing or digesting pills, transdermal (TD) patches offer an effective alternative to oral medications.

TD patches deliver a consistent dose of medication that diffuses at a constant rate through the skin into the bloodstream. There is no daily schedule to follow, nothing to swallow, and no stomach upset. TD patches can also deliver medication to unconscious patients, who would otherwise require intravenous drug delivery. TD patches are used in hormone replacement therapy, to treat heart disease, to manage pain, and to suppress motion sickness. Nicotine patches are also used as part of programs to quit smoking.

TD patches must be used carefully. Drug diffusion through the skin takes time, so it is important to know how long the patch must be in place before it is effective. It is also

important to know when the medication's effects disappear after the patch is removed. Because the body continues to absorb what has already diffused into the skin, removing the patch does not entirely remove the medicine. There is also a danger that patches may become unsafe when heated, as by exercise, high fever, or a hot environment, such as a hot tub, heating pad, or sauna. When heat dilates the capillaries in the skin, a dangerous increase in dosage may result as more medication enters the blood.

A recent advance in TD drug delivery is iontophoresis. Based on the principle that like charges repel each other, this method uses a mild electrical current to move ionic drugs through the skin. A small electrical device attached to the patch uses positive current to "push" positively charged drug molecules through the skin and a negative current to push negatively charged ones. Even though very low levels of electricity are used, people with pacemakers should not use iontophoretic patches. Another disadvantage of these patches is that they can move only ionic drugs through the skin.

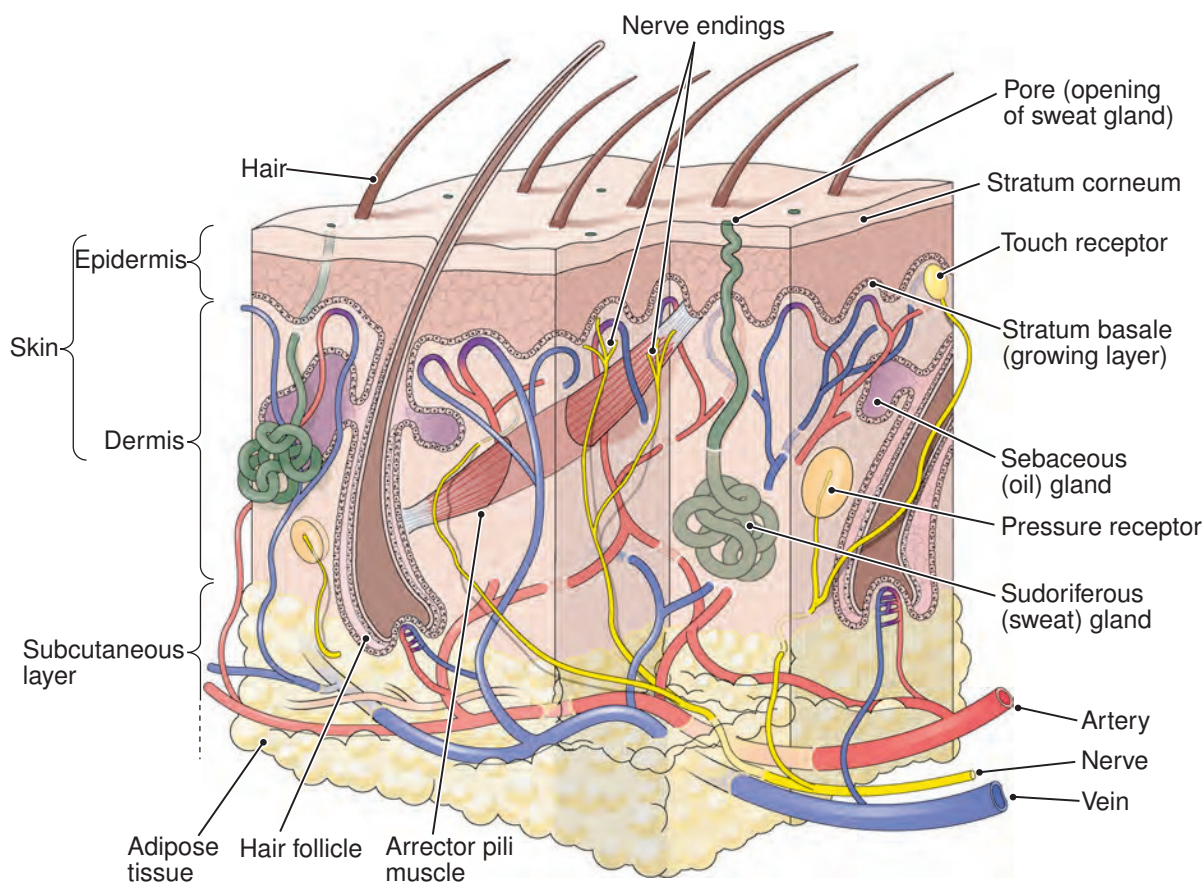


Figure 21-1 Cross section of the skin. The skin layers and associated structures are shown.

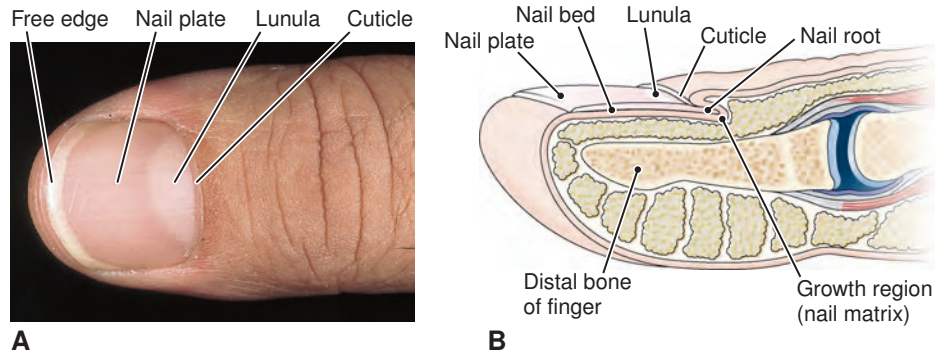


Figure 21-2 **Nail structure.** A. Photograph of a nail, superior view. B. Midsagittal section of a fingertip showing the growth region and tissue surrounding the nail plate.

- Nails develop from a growing region at the proximal end (Fig. 21-2). The cuticle, technically named the eponychium (*ep-ō-NIK-ē-um*), is an extension of the epidermis onto the surface of the nail plate. A lighter region distal to the cuticle is called the lunula because it looks like a half moon. Here the underlying skin is thicker, and blood does not show as much through the nail.

Hair and nails are composed of nonliving material consisting mainly of keratin. Both function in protection.



See charts on skin structure and accessory skin structures in the Student Resources on thePoint.

Terminology Key Terms

Normal Structure and Function

cutaneous <i>kū-TĀ-nē-us</i>	Pertaining to the skin (from Latin <i>cutis</i> , meaning “skin”)
derma <i>DER-ma</i>	Skin (from Greek)
dermis <i>DER-mis</i>	The layer of the skin between the epidermis and the subcutaneous tissue; the true skin or corium
epidermis <i>ep-i-DER-mis</i>	The outermost layer of the skin (from <i>epi-</i> , meaning “upon or over” and <i>derm</i> , meaning “skin”)
hair <i>hār</i>	A thread-like keratinized outgrowth from the skin (root: trich/o)
hair follicle <i>FOL-i-kel</i>	The sheath in which a hair develops
integumentary system <i>in-teg-ū-MEN-ta-rē</i>	The skin and its associated glands, hair, and nails
keratin <i>KER-a-tin</i>	A protein that thickens and toughens the skin and makes up hair and nails (root: kerat/o)
melanin <i>MEL-a-nin</i>	A dark pigment that gives color to the hair and skin and protects the skin against the sun’s radiation (root: melan/o)

Terminology**Key Terms** *(Continued)*

nail <i>nāl</i>	A plate-like keratinized outgrowth of the skin that covers the dorsal surface of the terminal phalanges (root: onych/o)
sebaceous gland <i>se-BĀ-shus</i>	A gland that produces sebum; usually associated with a hair follicle (root: seb/o)
sebum <i>SĒ-bum</i>	A fatty secretion of the sebaceous glands that lubricates the hair and skin (root: seb/o)
skin	The tissue that covers the body; the integument (roots: dermat/o, dermat/o)
subcutaneous tissue <i>sub-kū-TĀ-nē-us</i>	The layer of tissue beneath the skin; also called the hypodermis
sudoriferous gland <i>sū-dor-IF-er-us</i>	A sweat gland (root: hidr/o)



Go to the Audio Pronunciation Glossary in the Student Resources on *thePoint* to hear these terms pronounced.

21

Roots Pertaining to the Skin

See **Table 21-1**.

Table 21-1**Roots Pertaining to the Skin**

Root	Meaning	Example	Definition of Example
derm/o, dermat/o	skin	dermabrasion <i>derm-a-BRĀ-zhun</i>	surgical procedure used to resurface the skin and remove imperfections
kerat/o	keratin, horny layer of the skin	keratinous <i>ke-RAT-i-nus</i>	containing keratin; horny
melan/o	dark, black, melanin	melanosome <i>MEL-a-nō-sōm</i>	a small cellular body that produces melanin
hidr/o	sweat, perspiration	anhidrosis <i>an-hī-DRŌ-sis</i>	absence of sweating
seb/o	sebum, sebaceous gland	seborrhea <i>seb-or-Ē-a</i>	excess flow of sebum (adjective: seborrheic)
trich/o	hair	trichomycosis <i>trik-ō-mī-KŌ-sis</i>	fungal infection of the hair
onych/o	nail	onychchia <i>ō-NIK-ē-a</i>	inflammation of the nail and nail bed (not an -itis ending)

EXERCISE 21-1

Identify and define the roots in the following words:

	Root	Meaning of Root
1. hypodermis (<i>hī-pō-DER-mis</i>)	_____	_____
2. seborrheic (<i>seb-ō-RĒ-ik</i>)	_____	_____
3. hypermelanosis (<i>hī-per-mel-a-NŌ-sis</i>)	_____	_____
4. dyskeratosis (<i>dis-ker-a-TŌ-sis</i>)	_____	_____
5. hypohidrosis (<i>hī-pō-hī-DRŌ-sis</i>)	_____	_____
6. hypertrichosis (<i>hī-per-tri-KŌ-sis</i>)	_____	_____
7. eponychium (<i>ep-ō-NIK-ē-um</i>)	_____	_____

Fill in the blanks:

8. Dermatopathology (*der-ma-tō-pa-THOL-ō-jē*) is study of diseases of the _____.
9. Keratolysis (*ker-a-TOL-i-sis*) is loosening of the skin's _____.
10. A melanocyte (*MEL-a-nō-sīt*) is a cell that produces _____.
11. Trichoid (*TRIK-oyd*) means resembling a(n) _____.
12. Onychomycosis (*on-i-kō-mī-KŌ-sis*) is a fungal infection of a(n) _____.
13. Hidradenitis (*hī-drad-e-NĪ-tis*) is inflammation of a gland that produces _____.
14. A hypodermic (*hī-pō-DER-mik*) injection is given under the _____.

Write words for the following definitions:

15. loosening or separation of the skin _____
16. a tumor containing melanin _____
17. formation (-genesis) of keratin _____
18. instrument for cutting the skin _____
19. study of the hair _____
20. excess production of sweat _____
21. softening of a nail _____
22. study of the skin and skin diseases _____

Use **-derma** as a suffix meaning "skin" to write words for the following:

23. hardening of the skin _____
24. presence of pus in the skin _____

Clinical Aspects of the Skin

Many diseases are manifested by changes in the quality of the skin or by specific lesions. Some types of skin lesions are described and illustrated in **Box 21-2** and appear later in photographs of specific skin disorders. The study of the skin

and skin diseases is **dermatology**, but careful observation of the skin, hair, and nails should be part of every physical examination. The skin should be examined for color, unusual pigmentation, and lesions. It should be palpated to evaluate its texture, temperature, moisture, firmness, and any tenderness. See **Box 21-3** on nurse practitioners who, like other health care professionals, observe the skin when performing physical examinations.

Box 21-2

For Your Reference



Types of Skin Lesions

LESION	DESCRIPTION
bulla <i>BUL-a</i>	raised, fluid-filled lesion larger than a vesicle (plural: bullae)
fissure <i>FISH-ŭr</i>	crack or break in the skin
macule <i>MAK-ŭl</i>	flat, colored spot
nodule <i>NOD-ŭl</i>	solid, raised lesion larger than a papule; often indicative of systemic disease
papule <i>PAP-ŭl</i>	small, circular, raised lesion at the surface of the skin
plaque <i>plak</i>	superficial, flat, or slightly raised differentiated patch more than 1 cm in diameter
pustule <i>PUS-tŭl</i>	raised lesion containing pus; often in a hair follicle or sweat pore
ulcer <i>UL-ser</i>	lesion resulting from destruction of the skin and perhaps subcutaneous tissue
vesicle <i>VES-i-kal</i>	small, fluid-filled, raised lesion; a blister or bleb
wheel <i>wēl</i>	smooth, rounded, slightly raised area often associated with itching; seen in urticaria (hives), such as that resulting from allergy

21

WOUNDS

Wounds are caused by trauma, as in cases of accidents or attacks, or by surgery and other therapeutic or diagnostic procedures. Wounds may affect not only the injured area but also other body systems. Infection and hemorrhage may complicate wounds, as do **dehiscence**, disruption of

the wound layers, and **evisceration**, protrusion of internal organs through the lesion.

As a wound heals, fluid and cells drain from the damaged tissue. This drainage, called **exudate**, may be clear, bloody (sanguinous), or pus-containing (purulent). Tubes may be used to remove exudate from the site of a wound.

Box 21-3



Health Professions

Nurse Practitioners

A nurse practitioner (NP) is a nurse with a professional degree beyond registered nurse (RN) who provides health care services similar to those of a physician. All NPs have a master's degree, postmaster's, or doctoral education. They can specialize in areas such as acute care, family health, neonatology, or gerontology and medical specialties such as oncology or psychiatry. Their advanced education allows them to independently diagnose and treat patients, order testing, perform minor surgeries, and often prescribe medications. Some NPs practice autonomously, but many work in collaboration with physicians. They focus not only on treatment of disease but

also on disease prevention, patient education, and counseling. Such early intervention and education can lower overall health care costs.

NPs are licensed to practice in all U.S. states and must follow the rules and regulations of the state in which they are licensed. In most states, they are able to dispense and prescribe medications without a physician's cosignature, and they may bill insurance agencies for services. Their professional organizations include the American Academy of Nurse Practitioners at www.aanp.org and the American College of Nurse Practitioners at www.acnpweb.org.



Figure 21-3 Keloid. Marked overgrowth of scar tissue following earlobe piercing.

Proper wound healing depends on cleanliness and care of the lesion and also on proper circulation, good general health, and good nutrition. The edges of a deep wound should be joined by sutures, either stitches or for simple cuts in areas that can be kept dry and immobilized, with a tissue adhesive (glue). Healing is accompanied by scar formation or **cicatrization** (an alternative name for a scar is a **cicatrix**). Permanent scarring is lessened by appropriate wound care, but some people, especially those of African or Asian descent, may tend to form **keloids** because of excess collagen formation during healing (**Fig. 21-3**). Plastic surgery can often improve keloids and other unsightly scars.

Various types of dressings are used to protect wounded areas and promote healing. Vacuum-assisted closure (VAC) uses negative pressure to close the tissues and begin the healing process. Healing may be promoted by **débridement**, the removal of dead or damaged tissue from a wound. **Box 21-4** mentions the origin of the word **débridement** and gives the meaning of other medical terms taken from French. **Débridement** may be accomplished by cutting or scrubbing away the dead tissue or by means of enzymes. A thick, dark crust or scab (eschar) may be removed in an **escharotomy**.

Deep wounds may require skin grafting for proper healing. Grafts may be a full-thickness skin graft (FTSG), which consists of the epidermis and dermis, or a split-thickness skin graft (STSG), consisting of the epidermis only. Skin is cut for grafting with a **dermatome**.



See the animation “Wound Healing” in the Student Resources on *thePoint*.

Burns

Most burns are caused by hot objects, explosions, or scalding with hot liquids. They may also be caused by electricity, contact with harmful chemicals, or abrasion. Sunlight can also cause severe burns that may result in serious illness. Burns are assessed in terms of the depth of damage and the percentage of body surface area (BSA) involved. Depth of tissue destruction is categorized as follows:

1. **Superficial**—involves the epidermis only. The skin is red and dry; there is minimal pain. Typical causes are mild sunburn and very short heat exposure. This type of burn is also called a first-degree burn.
2. **Superficial partial thickness**—involves the epidermis and a portion of the dermis. The tissue reddens and blisters and is painful, as in cases of severe sunburn or scalding.
3. **Deep partial thickness**—involves the epidermis and the dermis. The tissue may be blistered with a weeping surface or dry because of sweat gland damage. These burns may be less painful than superficial burns because of nerve damage. Causes include scalding and exposure to flame or hot grease. Superficial and deep partial thickness burns are also classified as second-degree burns.
4. **Full thickness**—involves the full skin and sometimes subcutaneous tissue and underlying tissues as well. The tissue is broken, dry and pale, or charred. These injuries may require skin grafting and may result in loss of

Box 21-4



Focus on Words

The French Connection

Many scientific and medical terms are adapted from foreign languages. Most of the roots come from Latin and Greek; others are derived from German or French. Sometimes a foreign word is used “as is.” **Débridement**, removal of dead or damaged tissue from a wound, comes from French, meaning removal of a restraint, such as the bridle of a harness. Also from French, a **contrecoup** injury occurs when the head is thrown forward and back, as in a car accident, and the brain

is injured by hitting the skull on the side opposite the blow. **Contrecoup** in French means “counterblow.” **Tic douloureux**, a disorder causing pain along the path of the trigeminal nerve in the face, translates literally as “painful spasm.” A sound heard while listening to the body with a stethoscope is a **bruit**, a word in French that literally means “noise.” **Lavage**, which refers to irrigation of a cavity, is a French word meaning “washing.”

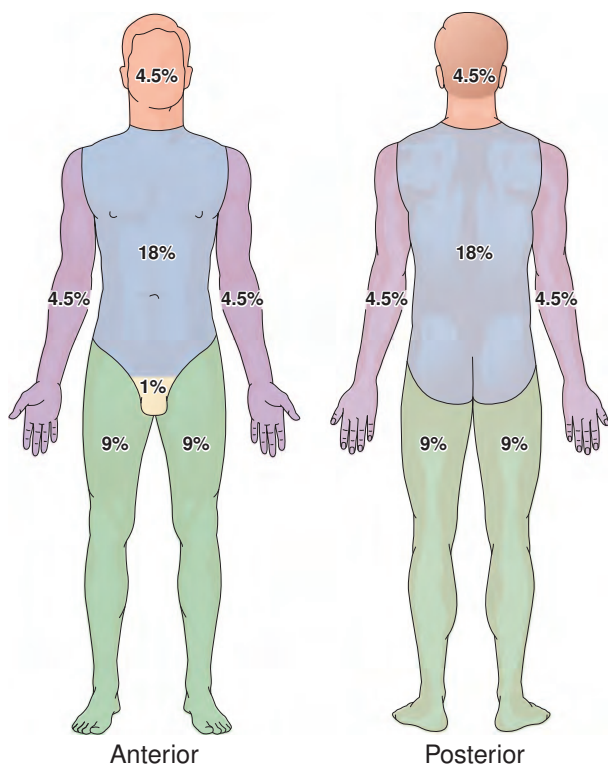


Figure 21-4 The rule of nines. Percentage of body surface area (BSA) in the adult is estimated by sectioning the body surface into areas with numerical values related to nine. This method is used to evaluate the extent of skin burns.

digits or limbs. Full-thickness burns are also classified as third-degree burns.

The amount of BSA involved in a burn may be estimated by using the **rule of nines**, in which areas of body surface are assigned percentages in multiples of nine (**Fig. 21-4**). The more accurate Lund and Browder method divides the body into small areas and estimates the proportion of BSA contributed by each.

Infection is a common complication of burns because a person's major defense against bacterial invasion is damaged. Respiratory complications and shock may also occur.

Treatment of burns includes respiratory care, administration of fluids, wound care, and pain control. Monitoring for cardiovascular complications, infections, and signs of posttraumatic stress is also important.

Pressure Ulcers

Pressure ulcers are necrotic skin lesions that appear where the body rests on skin that covers bony projections, such as the sacrum, heel, elbow, ischial bone of the pelvis, or greater trochanter of the femur (see *ulcer*, **Box 21-2**, and C.M.'s opening case study). The pressure interrupts circulation, leading to thrombosis, ulceration, and tissue death (necrosis). Poor general health, malnutrition, age, obesity, and infection contribute to the development of pressure ulcers.

Pressure ulcer lesions first appear as redness of the skin. If ignored, they may penetrate the skin and underlying muscle, extending even to bone, and may require months to heal.

Pads or mattresses to relieve pressure, regular cleansing and drying of the skin, frequent change in position, and good nutrition help to prevent pressure ulcers. Other terms for pressure ulcers are *decubitus ulcer* and *bedsore*. Both of these terms refer to lying down in bed, although pressure ulcers may appear in anyone with limited movement, not only those who are confined to bed.

DERMATITIS

Dermatitis is a general term for inflammation of the skin, which may be acute or chronic. Mild forms show **erythema** (redness) and edema and sometimes **pruritus** (itching), but the condition may worsen to include deeper lesions and secondary bacterial infections. A chronic allergic form of this disorder that appears early in childhood is called **atopic dermatitis** or **eczema** (**Fig. 21-5**). Although its exact cause is unknown, atopic dermatitis is



Figure 21-5 Dermatitis. A. Atopic dermatitis (eczema) on an infant's wrist. B. Contact dermatitis from shoe material. Note several fluid-filled bullae (see **Box 21-2**).

made worse by allergies, infection, temperature extremes, and skin irritants.

Other forms of dermatitis include contact dermatitis, caused by allergens or chemical irritants (see Fig. 21-5B); seborrheic dermatitis, which involves areas with many sebaceous glands such as the scalp and face; and stasis dermatitis, caused by poor circulation.

PSORIASIS

Psoriasis is a chronic overgrowth (hyperplasia) of the epidermis, producing large, erythematous (red) plaques with silvery scales (Fig. 21-6; see also, *plaques*, Box 21-2). The cause is unknown, but there is sometimes a hereditary pattern, and autoimmunity may be involved.

Dermatologists treat psoriasis in the following ways depending on severity:

1. Topical agents, including corticosteroids, immunosuppressants, vitamins A and D
2. Phototherapy—exposure to ultraviolet B (UVB) light; administration of the drug psoralen (P) to increase skin sensitivity to light followed by exposure to ultraviolet A (UVA) light; laser treatment
3. Systemic suppression of the immune system

AUTOIMMUNE DISORDERS

The diseases discussed below are caused, at least in part, by autoimmune reactions. They are diagnosed by biopsy of lesions and by antibody studies.

Pemphigus is characterized by the formation of bullae (blisters) in the skin and mucous membranes caused by a separation of epidermal cells from underlying layers (Fig. 21-7; see also, *bulla*, Box 21-2). Rupture of these



Figure 21-7 Pemphigus. Blisters (bullae) are seen on the forearm (see *bulla* Box 21-2).

lesions leaves deeper skin areas unprotected from infection and fluid loss, much as in cases of burns. The cause is an autoimmune reaction to epithelial cells. Pemphigus is fatal unless treated by suppressing the immune system.

Lupus erythematosus (LE) is a chronic inflammatory autoimmune disease of connective tissue. The more widespread form of the disease, systemic lupus erythematosus (SLE), involves the skin and other organs. SLE is more prevalent in women than in men and has a higher incidence among Asians and blacks than among other populations.

The discoid form (DLE) involves only the skin. It is seen as rough, raised, erythematous papules that are worsened by exposure to the ultraviolet radiation in sunlight (Fig. 21-8). Lupus skin lesions are confined to the face and scalp and may form a typical butterfly-shaped rash across the nose and cheeks.



Figure 21-6 Psoriasis. Plaques with scales seen at the front of the knee (see *plaque*, Box 21-2).



Figure 21-8 Discoid (cutaneous) lupus erythematosus. Erythematous papules and plaques in a typical sun-exposed distribution on the chest.

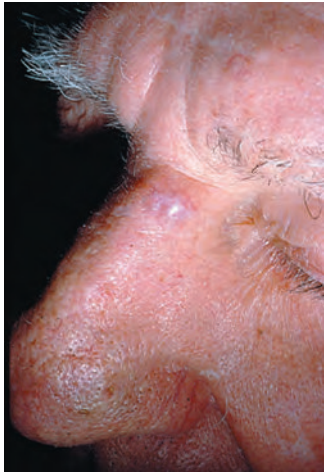


Figure 21-9 Basal cell carcinoma. An initial translucent nodule has spread, leaving a depressed center and a firm, elevated border (see *nodule*, **Box 21-2**).



See figures on clinical findings and the malar “butterfly” rash in systemic lupus erythematosus in the Student Resources on thePoint.

Scleroderma is a disease of unknown cause that involves thickening and tightening of the skin. There is gradual fibrosis of the dermis because of collagen overproduction. Sweat glands and hair follicles are also involved. A very early sign of scleroderma is Raynaud disease, in which blood vessels in the fingers and toes constrict in the cold, causing numbness, pain, coldness, and tingling. Skin symptoms first appear on the forearms and around the mouth. Internal organs become

involved in a diffuse form of scleroderma called progressive systemic sclerosis (PSS).

SKIN CANCER

Skin cancer is the most common type of human cancer. Its incidence has been increasing in recent years, mainly because of the mutation-causing effects of sunlight’s ultraviolet rays. **Squamous cell carcinoma** and **basal cell carcinoma** are both cancers of epithelial cells. Both appear in areas exposed to sunlight, such as the face and hands. Basal cell carcinoma constitutes more than 75 percent of all skin cancers. It usually appears as a smooth, pearly papule (**Fig. 21-9**; see also, *papules*, **Box 21-2**). Because these cancers are easily seen and do not metastasize, the cure rate after excision is greater than 95 percent.

Squamous cell carcinoma appears as a painless, firm, red nodule or plaque that may develop surface scales, ulceration, or crusting (**Fig. 21-10**; see also **Box 21-2**). This cancer may invade underlying tissue but tends not to metastasize. It is treated by surgical removal and sometimes with x-irradiation or chemotherapy.

Malignant melanoma results from an overgrowth of melanocytes, the pigment-producing cells in the epidermis. It is the most dangerous form of skin cancer because of its tendency to metastasize. This cancer appears as a lesion that is variable in color with an irregular border (**Fig. 21-11**). It may spread superficially for up to one or two years before it begins to invade the deeper skin tissues and to metastasize through blood and lymph. The prognosis for cure is good if the lesion is recognized and removed surgically before it enters this invasive stage.

Kaposi sarcoma, once considered rare, is now seen frequently in association with AIDS. It usually appears as distinct brownish areas on the legs. These plaques become raised and firm as the tumor progresses. In those with weakened immune systems, such as patients with AIDS, the cancer can metastasize.



Figure 21-10 Squamous cell carcinoma. Lesions are shown on the face and the back of the hand, sun-exposed areas that are commonly affected.

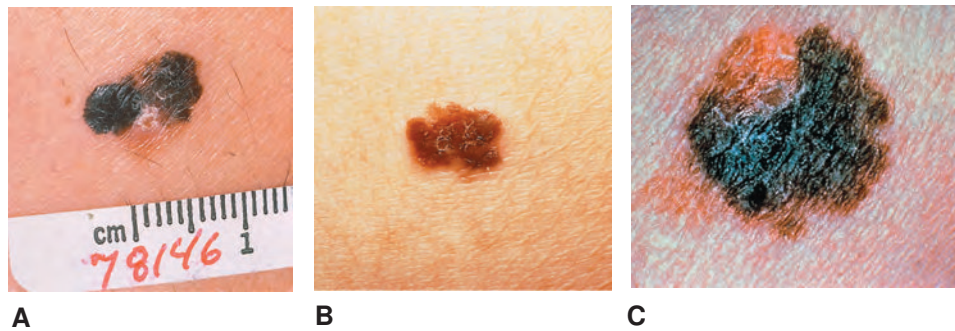


Figure 21-11 Malignant melanoma. Several characteristics are shown. A. Asymmetry. B. Irregular borders. C. Variation in color, a diameter greater than 6 mm, and elevation.

Terminology

Key Terms

atopic dermatitis <i>a-TOP-ik der-ma-TĪ-tis</i>	Hereditary, allergic, chronic skin inflammation with pruritus (itching); eczema
basal cell carcinoma <i>BĀ-sal</i>	An epithelial tumor that rarely metastasizes and has a high cure rate with surgical removal
cicatrization <i>sik-a-tri-ZĀ-shun</i>	The process of scar formation; a scar is a cicatrix (<i>SIK-a-triks</i>)
débridement <i>dā-brēd-MON</i>	Removal of dead or damaged tissue, as from a wound
dehiscence <i>dē-HIS-ens</i>	Splitting or bursting, as when the layers of a wound separate
dermatitis <i>der-ma-TĪ-tis</i>	Inflammation of the skin, often associated with redness and itching; may be caused by allergy, irritants (contact dermatitis), or a variety of diseases
dermatology <i>der-ma-TOL-ō-jē</i>	Study of the skin and diseases of the skin
dermatome <i>DER-ma-tōm</i>	Instrument for cutting thin skin sections for grafting
eczema <i>EK-zē-ma</i>	A general term for skin inflammation with redness, lesions, and itching; atopic dermatitis
erythema <i>er-i-THE-ma</i>	Diffuse redness of the skin
escharotomy <i>es-kar-OT-ō-mē</i>	Removal of scab tissue resulting from burns or other skin injuries; a scab or crust is an eschar (<i>ES-kar</i>)
evisceration <i>ē-vis-er-Ā-shun</i>	Protrusion of internal organs (viscera) through an opening, as through a wound
exudate <i>EKS-ū-dāt</i>	Material, which may include fluid, cells, pus, or blood, that escapes from damaged tissue
Kaposi sarcoma <i>KAP-ō-sē</i>	Cancerous lesion of the skin and other tissues seen most often in patients with AIDS
keloid <i>KĒ-loyd</i>	A raised, thickened scar caused by tissue overgrowth during scar formation

Terminology**Key Terms** *(Continued)*

lupus erythematosus (LE) <i>LŪ-pus er-i-thē-ma-TŌ-sis</i>	A chronic, inflammatory, autoimmune disease of connective tissue that often involves the skin; types include the more widespread systemic lupus erythematosus (SLE) and a discoid form (DLE) that involves only the skin
malignant melanoma	A metastasizing pigmented skin tumor
pemphigus <i>PEM-fī-gus</i>	An autoimmune disease of the skin characterized by sudden, intermittent formation of bullae (blisters); may be fatal if untreated
pressure ulcer	An ulcer caused by pressure to an area of the body, as from a bed or chair; decubitus (<i>dē-KŪ-bi-tus</i>) ulcer, bedsore, pressure sore
pruritus <i>prū-RĪ-tus</i>	Severe itching
psoriasis <i>so-RĪ-a-sis</i>	A chronic hereditary dermatitis with red lesions covered by silvery scales
rule of nines	A method for estimating the extent of body surface area involved in a burn by assigning percentages in multiples of nine to various body regions
scleroderma <i>sklēr-ō-DER-ma</i>	A chronic disease that is characterized by thickening and tightening of the skin and that often involves internal organs in a form called progressive systemic sclerosis (PSS)
squamous cell carcinoma <i>SKWĀ-mus</i>	An epidermal cancer that may invade deeper tissues but tends not to metastasize

Terminology**Supplementary Terms****Symptoms and Conditions**

acne <i>AK-nē</i>	An inflammatory disease of the sebaceous glands and hair follicles usually associated with excess sebum secretion; acne vulgaris
actinic <i>ak-TIN-ik</i>	Pertaining to the effects of radiant energy, such as sunlight, ultraviolet light, and x-rays
albinism <i>AL-bin-izm</i>	A hereditary lack of pigment in the skin, hair, and eyes
alopecia <i>al-ō-PĒ-shē-a</i>	Absence or loss of hair; baldness
Beau lines <i>bō</i>	White lines across the fingernails; usually a sign of systemic disease or injury (Fig. 21-12)
bromhidrosis <i>brom-hī-DRŌ-sis</i>	Sweat that has a foul odor because of bacterial decomposition; also spelled bromidrosis (<i>brō-mi-DRŌ-sis</i>)
carbuncle <i>CAR-bung-kil</i>	A localized infection of the skin and subcutaneous tissue, usually caused by staphylococcus, and associated with pain and discharge of pus
comedo <i>KOM-e-dō</i>	A plug of sebum, often containing bacteria, in a hair follicle; a blackhead (plural: comedones)
dermatophytosis <i>der-ma-tō-fī-TŌ-sis</i>	Fungal infection of the skin, especially between the toes; athlete's foot (root <i>phyt/o</i> means "plant")

(Continued)

Terminology Supplementary Terms *(Continued)*

diaphoresis <i>dī-a-fō-RĒ-sis</i>	Profuse sweating
dyskeratosis <i>dis-ker-a-TŌ-sis</i>	Any abnormality in keratin formation in epithelial cells
ecchymosis <i>ek-i-MŌ-sis</i>	A collection of blood under the skin caused by leakage from small vessels
erysipelas <i>er-i-SIP-e-las</i>	An acute infectious skin disease with localized redness and swelling and systemic symptoms
erythema nodosum <i>nō-DŌ-sum</i>	Inflammation of subcutaneous tissues resulting in tender, erythematous nodules; may be an abnormal immune response to a systemic disease, an infection, or a drug
exanthem <i>eks-AN-them</i>	Any cutaneous eruption that accompanies a disease, such as measles; a rash
excoriation <i>eks-kō-rĕ-Ā-shun</i>	Lesion caused by scratching or abrasion
folliculitis <i>fō-lik-ŭ-LĪ-tis</i>	Inflammation of a hair follicle
furuncle <i>FŪ-rung-kil</i>	A painful skin nodule caused by staphylococci that enter through a hair follicle; a boil
hemangioma <i>hē-man-jē-Ō-ma</i>	A benign tumor of blood vessels; in the skin, called birthmarks or port wine stains
herpes simplex <i>HER-pēz SIM-pleks</i>	A group of acute infections caused by herpes simplex virus. Type I herpes simplex virus produces fluid-filled vesicles, usually on the lips, after fever, sun exposure, injury, or stress; cold sore, fever blister. Type II infections usually involve the genital organs
hirsutism <i>HIR-sū-tizm</i>	Excessive growth of hair
ichthyosis <i>ik-thē-Ō-sis</i>	A dry, scaly condition of the skin (from the root <i>ichthy/o</i> , meaning “fish”)
impetigo <i>im-pe-TĪ-gō</i>	A bacterial skin infection with pustules that rupture and form crusts; most commonly seen in children, usually on the face (Fig. 21-13 ; see also, <i>pustules</i> , Box 21-2)

(Continued)



Figure 21-12 Beau lines. These transverse depressions in the nails are associated with acute severe illness.

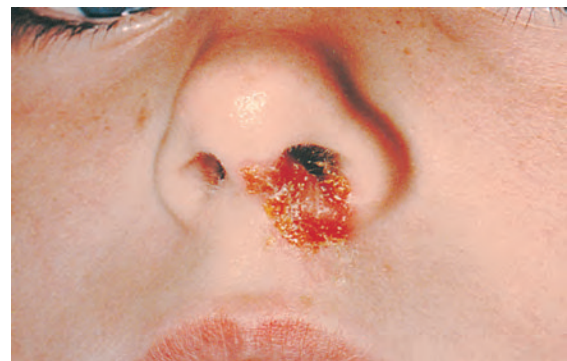


Figure 21-13 Impetigo. This bacterial skin infection, seen here on the nostril, causes pustules that rupture and form crusts (see *pustule*, **Box 21-2**).

Terminology

Supplementary Terms (Continued)

keratosis <i>ker-a-TŌ-sis</i>	Any skin condition marked by thickened or horny growth. Seborrheic keratosis is a benign tumor, yellow or light brown in color, that appears in the elderly. Actinic keratosis is caused by exposure to sunlight and may lead to squamous cell carcinoma
lichenification <i>li-ken-i-fi-KĀ-shun</i>	Thickened marks caused by chronic rubbing, as seen in atopic dermatitis (a lichen is a flat, branching type of plant that grows on rocks and bark) (see Fig. 21-14)
mycosis fungoides <i>mī-KŌ-sis fun-GOY-dēz</i>	A rare malignant disease that originates in the skin and involves the internal organs and lymph nodes. There are large, painful, ulcerating tumors
nevus <i>NĒ-vus</i>	A defined discoloration of the skin; a congenital vascular skin tumor; a mole, birthmark
paronychia <i>par-ō-NIK-ē-a</i>	Infection around a nail (Fig. 21-15). Caused by bacteria or fungi, and may affect multiple nails
pediculosis <i>pe-dik-ū-LŌ-sis</i>	Infestation with lice
petechiae <i>pē-TĒ-kē-e</i>	Flat, pinpoint, purplish-red spots caused by bleeding within the skin or mucous membrane (singular: petechia)
photosensitization <i>fō-tō-sen-si-ti-ZĀ-shun</i>	Sensitization of the skin to light, usually from the action of drugs, plant products, or other substances
purpura <i>PUR-pū-ra</i>	A condition characterized by hemorrhages into the skin and other tissues
rosacea <i>rō-ZĀ-shē-a</i>	A condition of unknown cause involving redness of the skin, pustules, and overactivity of sebaceous glands, mainly on the face
scabies <i>SKĀ-bēz</i>	A highly contagious skin disease caused by a mite
senile lentigines <i>len-TIJ-i-nēz</i>	Brown macules that appear on sun-exposed skin in adults; liver spots
shingles	An acute eruption of vesicles along the path of a nerve; herpes zoster (<i>HER-pēz ZOS-ter</i>); caused by the same virus that causes chickenpox

(Continued)



Figure 21-14 Lichenification. Skin shows thickened areas from chronic rubbing, as seen in atopic dermatitis.



Figure 21-15 Paronychia. Infection and inflammation of the proximal and lateral nail folds is shown.

Terminology Supplementary Terms (Continued)

tinea <i>TIN-ē-a</i>	A fungal skin infection; ringworm (Fig. 21-16)
tinea versicolor <i>VER-si-kol-or</i>	Superficial chronic fungal infection that causes varied skin pigmentation
urticaria <i>ur-ti-KAR-ē-a</i>	A skin reaction marked by temporary, smooth, raised areas (wheals) associated with itching; hives (Fig. 21-17 ; see also, <i>wheals</i> , Box 21-2)
venous stasis ulcer	Ulcer caused by venous insufficiency and stasis of venous blood; usually forms near the ankle (Fig. 21-18 ; see also, <i>ulcer</i> , Box 21-2)
verruca <i>ver-RŪ-ka</i>	An epidermal tumor; a wart
vitiligo <i>vit-i-LĪ-gō</i>	Patchy disappearance of pigment in the skin; leukoderma (Fig. 21-19)
xeroderma pigmentosum <i>zē-rō-DER-ma pig-men-Tō-sum</i>	A fatal hereditary disease that begins in childhood with skin discolorations and ulcers and muscle atrophy. There is increased sensitivity to the sun and increased susceptibility to cancer

Diagnosis and Treatment

aloe <i>A-lō</i>	A gel from leaves of the plant <i>Aloe vera</i> that is used in treatment of burns and minor skin irritations
antipruritic <i>an-ti-prū-RIT-ik</i>	Agent that prevents or relieves itching
cautery <i>KAW-ter-ē</i>	Destruction of tissue by physical or chemical means; cauterization; also the instrument or chemical used for this purpose
dermabrasion <i>DERM-a-brā-zhun</i>	A plastic surgical procedure for removing scars or birthmarks by chemical or mechanical destruction of epidermal tissue
dermatoplasty <i>DER-ma-tō-plas-tē</i>	Transplantation of human skin; skin grafting

(Continued)



Figure 21-16 Tinea corporis (ringworm). This fungal infection is shown on the face.



Figure 21-17 Urticaria (hives). Wheals associated with drug allergy are shown in an infant (see *wheel*, **Box 21-2**).

Terminology**Supplementary Terms** *(Continued)***diascopy***dī-AS-kō-pē*

Examination of skin lesions by pressing a glass plate against the skin

fulguration*ful-gū-RĀ-shun*

Destruction of tissue by high-frequency electric sparks

skin turgor*TUR-gor*

Resistance of the skin to deformation. Evidenced by the ability of the skin to return to position when pinched. Skin turgor is a measure of the skin's elasticity and state of hydration. It typically declines with age and when decreased may also be a sign of poor nutrition

Wood lamp

An ultraviolet light used to diagnose fungal infections



Go to the Audio Pronunciation Glossary in the Student Resources on *thePoint* to hear these terms pronounced.



Figure 21-18 Venous stasis ulcer. Lesion on the ankle caused by venous insufficiency and blood stasis (see *ulcer*, **Box 21-2**).

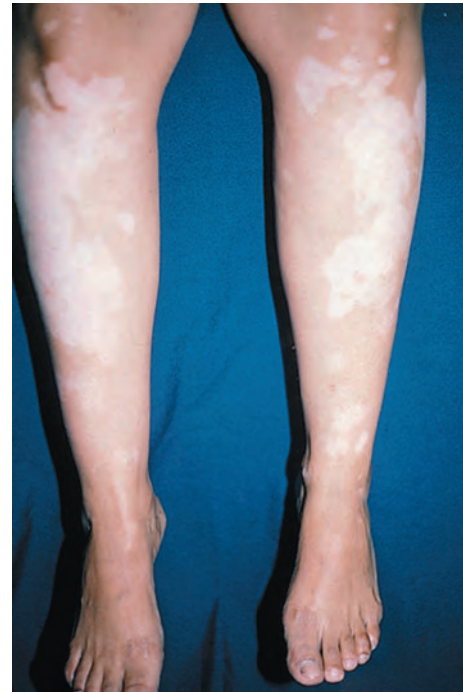


Figure 21-19 Vitiligo. Depigmented macules appear on the skin and may merge into large areas that lack melanin (see *macule*, **Box 21-2**). The brown pigment seen in the illustration is the person's normal skin color; the pale areas are caused by vitiligo.

Terminology**Abbreviations**

BSA	Body surface area
DLE	Discoid lupus erythematosus
FTSG	Full-thickness skin graft
LE	Lupus erythematosus
PSS	Progressive systemic sclerosis
PUVA	Psoralen ultraviolet A
SCLE	Subacute cutaneous lupus erythematosus

SLE	Systemic lupus erythematosus
SPF	Sun protection factor
STSG	Split-thickness skin graft
UV	Ultraviolet
UVA	Ultraviolet A
UVB	Ultraviolet B
VAC	Vacuum-assisted closure

C.M.'s Follow-Up

C.M. made progress while in the long-term facility. She also worked with a PT and OT and began performing simple ADL. The therapists performed ROM on a regular schedule to both the stroke-affected and unaffected sides. With the increase in activity and improved nutrition, C.M.'s circulation and skin

condition improved. She also showed less confusion. C.M.'s daughter was able to observe and assist with her mother's activities and receive instruction firsthand. Goals were set, and discharge plans were made to have C.M. return home with her daughter.

Chapter Review

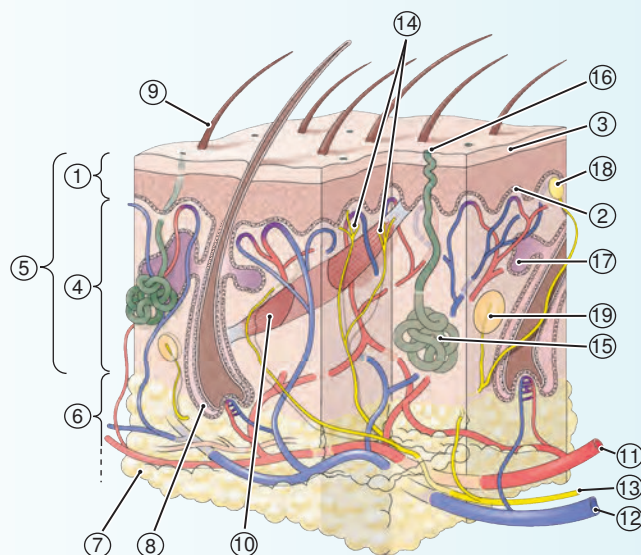
Labeling Exercise

CROSS SECTION OF THE SKIN

Write the name of each numbered part on the corresponding line of the answer sheet.

Adipose tissue	Pressure receptor
Arrector pili muscle	Sebaceous (oil) gland
Artery	Skin
Dermis	Stratum basale (growing layer)
Epidermis	Stratum corneum
Hair	Subcutaneous layer
Hair follicle	Sudoriferous (sweat) gland
Nerve	Touch receptor
Nerve endings	Vein
Pore (opening of sweat gland)	

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____



15. _____
16. _____
17. _____
18. _____
19. _____

Terminology

MATCHING

Multiple choice. Select the best answer and write the letter of your choice to the left of each number:

- | | |
|--------------------------|-------------------------------------|
| _____ 1. follicle | a. thickened layer of the epidermis |
| _____ 2. stratum corneum | b. growing layer of the epidermis |
| _____ 3. sebum | c. subcutaneous layer |
| _____ 4. hypodermis | d. sheath that contains a hair |
| _____ 5. stratum basale | e. oily skin secretion |
| _____ 6. exudate | a. scar formation |
| _____ 7. pruritus | b. atopic dermatitis |
| _____ 8. eczema | c. material from damaged tissue |
| _____ 9. erythema | d. severe itching |
| _____ 10. cicatrization | e. redness of the skin |

Supplementary Terms

- | | |
|------------------------|---|
| _____ 11. diaphoresis | a. profuse sweating |
| _____ 12. nevus | b. pertaining to radiant energy |
| _____ 13. actinic | c. mole or birthmark |
| _____ 14. alopecia | d. blackhead |
| _____ 15. comedo | e. baldness |
| _____ 16. rosacea | a. sweat with a foul odor |
| _____ 17. tinea | b. infection around a nail |
| _____ 18. bromhidrosis | c. lack of skin pigmentation |
| _____ 19. albinism | d. fungal skin infection |
| _____ 20. paronychia | e. condition causing redness and pustules, mainly on the face |

FILL IN THE BLANKS

21. The adjective *cutaneous* refers to the _____.
22. Dermabrasion (*der-ma-BRĀ-zhun*) is surface scraping of the _____.
23. A sudoriferous gland produces _____.
24. The main pigment in skin is _____.
25. The oil-producing glands of the skin are the _____.
26. The protein that thickens the skin and makes up hair and nails is _____.
27. Schizonychia (*skiz-ō-NIK-ē-a*) is splitting of a(n) _____.

Referring to C.M.'s opening case study

28. Two other terms for a pressure ulcer are _____.
29. When the nurse palpated C.M.'s lesion, she used her sense of _____.
30. Part of C.M.'s treatment was removal of dead skin from her lesion. This process is called _____.
31. The abbreviation FTSG refers to a(n) _____.
32. Lack of oxygen to tissue is called _____.

DEFINITIONS

Define the following words:

33. hypermelanosis (*hī-per-mel-a-NŌ-sis*)

34. percutaneous (*per-kū-TĀ-nē-us*)

35. keratogenic (*ker-a-tō-JEN-ik*)

36. seborrhea (*seb-or-Ē-a*)

37. pachyderma (*pak-ē-DER-ma*)

38. onychia (*ō-NIK-ē-a*)

39. xeroderma (*zē-rō-DER-ma*)

40. dyskeratosis (*dis-ker-a-TŌ-sis*)

Write words for the following definitions:

41. pertaining to discharge of sebum

42. cell that produces melanin

43. hardening of the skin

44. tumor containing melanin

45. excess production of keratin

46. instrument for cutting the skin

Use the word *hidrosis* (sweating) as an ending for words with the following meanings:

47. absence of sweating

48. excess sweating

49. excretion of colored (chrom/o) sweat

TRUE-FALSE

Examine the following statements. If the statement is true, write T in the first blank. If the statement is false, write F in the first blank and correct the statement by replacing the underlined word in the second blank.

	True or False	Correct Answer
50. The skin and its associated structures make up the <u>integumentary system</u> .		
51. The <u>stratum basale</u> is the outermost layer of the epidermis.		
52. The root trich/o refers to <u>hair</u> .		
53. The <u>dermis</u> is between the epidermis and the subcutaneous layer.		
54. New epidermal cells arise from the <u>stratum corneum</u> .		
55. Hirsutism is excess growth of <u>nails</u> .		

WORD BUILDING

Write a word for the following definitions using the word parts provided.

-lysis onych/o -sis myc/o path/o dermat/o -y log/o -oid trich/o

56. resembling a hair

57. fungal infection of a nail

58. loosening or separation of the skin

-lysis onych/o -sis myc/o path/o dermat/o -y log/o -oid trich/o

59. study of hair _____
60. loosening of a nail _____
61. like or resembling skin _____
62. any disease of a nail _____
63. fungal infection of the hair _____
64. any disease of the skin _____
65. study and treatment of the skin _____

ELIMINATIONS

In each of the sets below, underline the word that does not fit in with the rest and explain the reason for your choice:

66. nodule — vesicle — keloid — macule — papule

67. impetigo — escharotomy — psoriasis — dermatitis — pemphigus

68. SLE — PSS — SCLE — BSA — DLE

WORD ANALYSIS

Define the following words, and give the meaning of the word parts in each. Use a dictionary if necessary.

69. dermatophytosis (*der-ma-tō-fī-TŌ-sis*) _____
- a. dermat/o _____
- b. phyt/o _____
- c. -sis _____
70. hidradenoma (*hī-drad-e-NŌ-ma*) _____
- a. hidr/o _____
- b. aden/o _____
- c. -oma _____
71. onychocryptosis (*on-i-kō-krip-TŌ-sis*) _____
- a. onych/o _____
- b. crypt/o _____
- c. -sis _____
72. achromotrichia (*a-krō-mō-TRIK-ē-a*) _____
- a. a- _____
- b. chrom/o _____
- c. trich/o _____
- d. -ia _____

Additional Case Studies

Case Study 21-1: Basal Cell Carcinoma

K.B., a 32-YO fitness instructor, had noticed a “tiny hard lump” at the base of her left nostril while cleansing her face. The lesion had been present for about two months when she consulted a dermatologist. She had recently moved north from Florida, where she had worked as a lifeguard. She thought the lump might have been triggered by the regular tanning salon sessions she had used to retain her tan because it did not resemble the acne pustules, blackheads, or resulting scars of her adolescent years. Although dermabrasion had removed the obvious acne scars and left several areas of dense skin, this lump was brown pigmented and different. K.B. was afraid it

might be a malignant melanoma. On examination, the dermatologist noted a small pearly-white nodule at the lower portion of the left ala (outer flared portion of the nostril). There were no other lesions on her face or neck.

A plastic surgeon excised the lesion and was able to reapproximate the wound edges without a full-thickness skin graft. The pathology report identified the lesion as a basal cell carcinoma with clean margins of normal skin and subcutaneous tissue and stated that the entire lesion had been excised. K.B. was advised to wear SPF 30 sun protection on her face at all times and to avoid excessive sun exposure and tanning salons.

Case Study 21-2: Cutaneous Lymphoma

L.C., a 52-YO female research chemist, has had a history of T cell lymphoma for eight years. She was initially treated with systemic chemotherapy with methotrexate, until she contracted stomatitis. Continued therapy with topical chemotherapeutic agents brought measurable improvement. She also had a history of hidradenitis.

A recent physical examination showed diffuse erythroderma with scaling and hyperkeratosis, plus alopecia. She had painful

leukoplakia and ulcerations of the mouth and tongue. L.C. was hospitalized and given two courses of topical chemotherapy. She was referred to dental medicine for treatment of the oral lesions and was discharged in stable condition with an appointment for follow-up in four weeks. Her discharge medications included the application of 2 percent hydrocortisone ointment to the affected lesions q hs, Keralyt gel bid for the hyperkeratosis, and Dyclone and Benadryl for her mouth ulcers prn.

Case Study Questions

Multiple choice. Select the best answer and write the letter of your choice to the left of each number:

- _____ 1. K.B.'s basal cell carcinoma may have been caused by chronic exposure to the sun and use of an ultra-violet tanning bed. The scientific explanation for this is the:
 - a. autoimmune response
 - b. actinic effect
 - c. allergic reaction
 - d. sun block tanning lotion theory
 - e. dermatophytosis
- _____ 2. The characteristic pimples of adolescent acne are whiteheads and blackheads. The medical terms for these lesions are:
 - a. vesicles and lymphotomes
 - b. pustules and blisters
 - c. pustules and comedones
 - d. vitiligo and macules
 - e. furuncles and sebaceous cysts
- _____ 3. Which skin cancer is an overgrowth of pigment-producing epidermal cells?
 - a. basal cell carcinoma
 - b. Kaposi sarcoma
 - c. cutaneous lymphoma
 - d. melanoma
 - e. erythema nodosum
- _____ 4. Basal cell carcinoma involves:
 - a. subcutaneous tissue
 - b. hair follicles
 - c. connective tissue
 - d. adipose tissue
 - e. epithelial cells
- _____ 5. Hidradenitis is inflammation of a:
 - a. sweat gland
 - b. salivary gland
 - c. sebaceous gland
 - d. ceruminous gland
 - e. meibomian gland
- _____ 6. Leukoplakia is:
 - a. baldness
 - b. ulceration
 - c. formation of white patches in the mouth
 - d. formation of yellow patches on the skin
 - e. formation of scales on the skin
- _____ 7. Hydrocortisone is a(n):
 - a. vitamin
 - b. steroid
 - c. analgesic
 - d. lubricant
 - e. diuretic

- | | |
|---|---|
| <p>_____ 8. An example of a topical drug is a:</p> <ul style="list-style-type: none"> a. systemic chemotherapeutic agent b. drug derived from rainforest plants c. subdermal allergy test antigens d. skin ointment e. Benadryl capsule, 25 mg | <p>_____ 9. Stomatitis, a common side effect of systemic chemotherapy, is an inflammatory condition of the:</p> <ul style="list-style-type: none"> a. mouth b. colostomy c. stomach d. teeth and hair e. débridement |
|---|---|

Write terms from the case studies with the following meanings:

10. skin sanding procedure

11. a solid raised lesion larger than a papule

12. physician who cares for patients with skin diseases

13. layer of connective tissue and fat beneath the dermis

14. diffuse redness of the skin

15. increased production of keratin in the skin

Abbreviations. Define the following abbreviations:

16. FTSG _____

17. SPF _____

18. hs _____

19. bid _____

20. prn _____

Appendix 1

Commonly Used Symbols

Symbol	Meaning	Chapter
1°	primary	7
2°	secondary (to)	7
Δ	change (Greek delta)	7
Ⓐ	left	7
Ⓑ	right	7
↑	increase(d)	7
↓	decrease(d)	7
♂	male	7
♀	female	7
°	degree	7
^	above	7
v	below	7
=	equal to	7
≠	not equal to	7
±	doubtful, slight	7
~	approximately	7
×	times	7
#	number, pound	7

Appendix 2

Appendix 2 Abbreviations and Their Meanings

Abbreviation	Meaning	Chapter	Abbreviation	Meaning	Chapter
ā	before	8	ALS	amyotrophic lateral sclerosis	17, 20
A, Acc	accommodation	18	AMA	against medical advice	7
āā	of each	8	AMB	ambulatory	7
A1c	glycated hemoglobin	16	AMD	age-related macular degeneration	18
Ab	antibody	10	AMI	acute myocardial infarction	9
AB	abortion	15	AML	acute myeloblastic (myelogenous) leukemia	10
ABC	aspiration biopsy cytology	7	ANS	autonomic nervous system	17
ABG(s)	arterial blood gas(es)	11	AP	anteroposterior	7
ABR	auditory brainstem response	18	APAP	acetaminophen	8
ac	before meals	8	APC	atrial premature complex	9
AC	air conduction	18	APTT	activated partial thromboplastin time	10
ACE	angiotensin-converting enzyme	9	aq	water, aqueous	8
ACh	acetylcholine	17, 20	AR	aortic regurgitation	9
ACL	anterior cruciate ligament	19	ARB	angiotensin receptor blocker	9
ACTH	adrenocorticotrophic hormone	16	ARC	abnormal retinal correspondence	18
ad lib	as desired	8	ARDS	acute respiratory distress syndrome	11
AD	Alzheimer disease	17	ARF	acute respiratory failure; acute renal failure	11, 13
ADH	antidiuretic hormone	13	ART	assisted reproductive technology	15
ADHD	attention-deficit/hyperactivity disorder	17	ASA	acetylsalicylic acid (aspirin)	8
ADL	activities of daily living	7	As, Ast	astigmatism	18
AE	above the elbow	19	AS	atrial stenosis; arteriosclerosis	9
AED	automated external defibrillator	9	ASCVD	arteriosclerotic cardiovascular disease	9
AF	atrial fibrillation	9	ASD	atrial septal defect	9
AFB	acid-fast bacillus	11	ASF	anterior spinal fusion	19
AFP	alpha-fetoprotein	7, 15	ASHD	arteriosclerotic heart disease	9
Ag	antigen, also silver	10	ASHP	American Society of Health System Pharmacists	8
AGA	appropriate for gestational age	15			
AI	artificial insemination; aromatase inhibitor	15			
AIDS	acquired immunodeficiency syndrome	10, 14			
AK	above the knee	19			
ALL	acute lymphoblastic (lymphocytic) leukemia	10			

Appendix 2 Abbreviations and Their Meanings (Continued)

Abbreviation	Meaning	Chapter	Abbreviation	Meaning	Chapter
AT	atrial tachycardia	9	CBD	common bile duct	12
ATN	acute tubular necrosis	13	CBF	cerebral blood flow	17
AV	atrioventricular	9	CBR	complete bed rest	7
BAEP	brainstem auditory evoked potentials	17, 18	cc	with correction	18
BBB	bundle branch block	9	CC	chief complaint	7
BC	bone conduction	18	CCPD	continuous cyclic peritoneal dialysis	13
BCG	bacille Calmette-Guérin (tuberculosis vaccine)	11	CCU	coronary care unit, cardiac care unit	9
BE	barium enema; below the elbow	12, 19	CF	cystic fibrosis	11
bid, b.i.d.	twice per day	8	CFS	chronic fatigue syndrome	20
BK	below the knee	19	CGL	chronic granulocytic leukemia	10
BM	bowel movement	12	CHD	coronary heart disease	9
BMD	bone mineral density	19	CHF	congestive heart failure	9
BNO	bladder neck obstruction	14	Gi	Curie	7
BP	blood pressure	7, 9	CIN	cervical intraepithelial neoplasia	15
BPH	benign prostatic hyperplasia (hypertrophy)	14	CIS	carcinoma in situ	6
bpm	beats per minute	7, 9	CJD	Creutzfeldt-Jakob disease	17
BRCA1	breast cancer gene 1	15	CK	creatine kinase	20
BRCA2	breast cancer gene 2	15	CK-MB	creatine kinase MB	9
BRP	bathroom privileges	7	CLL	chronic lymphocytic leukemia	10
BS	bowel sounds; breath sounds; blood sugar	7, 11, 16	cm	centimeter	Appendix 8
BSA	body surface area	21	CMG	cystometrography, cystometrogram	13
BSE	breast self-examination	15	CML	chronic myelogenous leukemia	10
BSO	bilateral salpingo-oophorectomy	15	CNS	central nervous system, clinical nurse specialist	17
BT	bleeding time	10	c/o, CO	complains (complaining) of	7
BUN	blood urea nitrogen	13	Co	coccyx; coccygeal	19
BV	bacterial vaginosis	15	CO ₂	carbon dioxide	11
bx	biopsy	7	COLD	chronic obstructive lung disease	11
ċ	with	8	COPD	chronic obstructive pulmonary disease	11
C	Celsius (centigrade); compliance; cervical vertebra	7, 11, 19	CP	cerebral palsy	17
C-section	cesarean section	15	CPAP	continuous positive airway pressure	11
CA, Ca	cancer	6	CPD	cephalopelvic disproportion	15
CABG	coronary artery bypass graft	9	C(P)K	creatine (phospho) kinase	20
CAD	coronary artery disease	9	CPR	cardiopulmonary resuscitation	9
CAM	complementary and alternative medicine	7			
cap	capsule	8			
CAPD	continuous ambulatory peritoneal dialysis	13			
CBC	complete blood count	10			

(Continued)

Appendix 2 Abbreviations and Their Meanings (Continued)

Abbreviation	Meaning	Chapter	Abbreviation	Meaning	Chapter
CRF	chronic renal failure	13	DSM	<i>Diagnostic and Statistical Manual of Mental Disorders</i>	17
crit	hematocrit	10	DTR	deep tendon reflex(es)	17
CRP	C-reactive protein	9	DUB	dysfunctional uterine bleeding	15
C&S	culture and sensitivity	7	DVT	deep vein thrombosis	9
CSF	cerebrospinal fluid	17	Dx	diagnosis	7
CSII	continuous subcutaneous insulin infusion	16	EBL	estimated blood loss	7
CT	computed tomography	7	EBV	Epstein-Barr virus	10
CTA	computed tomography angiography	9	ECG (EKG)	electrocardiogram, electrocardiography	9
CTS	carpal tunnel syndrome	20	ECMO	extracorporeal membrane oxygenation	15
CVA	cerebrovascular accident	9, 17	ED	erectile dysfunction	14
CVD	cardiovascular disease; cerebrovascular disease	9, 17	EDC	estimated date of confinement	15
CVI	chronic venous insufficiency	9	EEG	electroencephalogram; electroencephalograph(y)	17
CVP	central venous pressure	9	EGD	esophagogastroduodenoscopy	12
CVS	chorionic villus sampling	15	ELISA	enzyme-linked immunosorbent assay	10
CXR	chest x-ray	11	elix	elixir	8
D&C	dilatation and curettage	15	EM	emmetropia	18
DAW	dispense as written	8	EMG	electromyography, electromyogram	20
dB	decibel	18	ENG	electronystagmography	18
dc, D/C	discontinue	7, 8	ENT	Ear(s), nose, and throat	18
DCIS	ductal carcinoma in situ	15	EOM	extraocular movement, muscles	18
D&E	dilation and evacuation	15	EOMI	extraocular muscles intact	7
DES	diethylstilbestrol	15	EPO, EP	erythropoietin	10, 13
DEXA	dual-energy x-ray absorptiometry (scan)	19	ERCP	endoscopic retrograde cholangiopancreatography	12
DIC	disseminated intravascular coagulation	10	ERG	electroretinography	18
DIFF	differential count	10	ERV	expiratory reserve volume	11
DIP	distal interphalangeal	19	ESR	erythrocyte sedimentation rate	10
DJD	degenerative joint disease	19	ESRD	end-stage renal disease	13
dL	deciliter	Appendix 8	ESWL	extracorporeal shock wave lithotripsy	13
DLE	discoid lupus erythematosus	21	ET	esotropia	18
DM	diabetes mellitus	16	ETOH	alcohol, ethyl alcohol	7
DNR	do not resuscitate	7	F	Fahrenheit	7
DOE	dyspnea on exertion	9	FAP	familial adenomatous polyposis	12
DTaP	diphtheria, tetanus, acellular pertussis (vaccine)	11	FBG	fasting blood glucose	16
DRE	digital rectal examination	14			
DS	double strength	8			

Appendix 2 Abbreviations and Their Meanings (Continued)

Abbreviation	Meaning	Chapter	Abbreviation	Meaning	Chapter
FBS	fasting blood sugar	16	Hct, Ht	hematocrit	10
FC	finger counting	18	HCV	hepatitis C virus	12
FDA	Food and Drug Administration	8	HDL	high-density lipoprotein	9
FEV	forced expiratory volume	11	HDN	hemolytic disease of the newborn	10, 15
FFP	fresh frozen plasma	10	HDV	hepatitis D virus	12
FHR	fetal heart rate	15	HEV	hepatitis E virus	12
FHT	fetal heart tone	15	HEENT	head, eyes, ears, nose, and throat	7
FMS	fibromyalgia syndrome	20	HIPAA	Health Insurance Portability and Accountability Act	7
FPG	fasting plasma glucose	16			
FRC	functional residual capacity	11	HIV	human immunodeficiency virus	10, 14
FSH	follicle-stimulating hormone	14, 15, 16	HL	hearing level	18
FTI	free thyroxine index	16	HM	hand movements	18
FTND	full-term normal delivery	15	HNP	herniated nucleus pulposus	19
FTP	full-term pregnancy	15	h/o	history of	7
FTSG	full-thickness skin graft	21	H&P	history and physical	7
FUO	fever of unknown origin	6	HPI	history of present illness	7
FVC	forced vital capacity	11	HPS	Hantavirus pulmonary syndrome	11
Fx	fracture	19	HPV	human papillomavirus	15
g	gram	Appendix 8	HR	heart rate	7
GA	gestational age	15	HRT	hormone replacement therapy	15
GAD	generalized anxiety disorder	17	hs	at bedtime	8
GC	gonococcus	14, 15	hs-crp	high sensitivity C-reactive protein (test)	9
GDM	gestational diabetes mellitus	16	HSV	herpes simplex virus	14, 15
GERD	gastroesophageal reflux disease	12	Ht, Hct	hematocrit	10
GFR	glomerular filtration rate	13	HTN	hypertension	9
GH	growth hormone	16	Hx	history	7
GI	gastrointestinal	12	Hz	Hertz	18
GIFT	gamete intrafallopian transfer	15	¹³¹ I	iodine-131	16
GTT	glucose tolerance test	16	I&D	incision and drainage	7
GU	genitourinary	13, 14	I&O	intake and output	7
GYN	gynecology	15	IABP	intraaortic balloon pump	9
H&P	history and physical examination	7	IBD	inflammatory bowel disease	12
HAV	hepatitis A virus	12	IBS	irritable bowel syndrome	12
Hb, Hgb	hemoglobin	10	IC	inspiratory capacity	11
HbA1c	hemoglobin A1c; glycated hemoglobin	16	ICD	implantable cardioverter-defibrillator	9
HBV	hepatitis B virus	12, 14	ICP	intracranial pressure	17
hCG	human chorionic gonadotropin	15	ICU	intensive care unit	7
HCl	hydrochloric acid	12	ID	intradermal	8
			IF	intrinsic factor	10

(Continued)

Appendix 2 Abbreviations and Their Meanings (Continued)

Abbreviation	Meaning	Chapter	Abbreviation	Meaning	Chapter
IFG	impaired fasting blood glucose	16	LDL	low-density lipoprotein	9
Ig	immunoglobulin	10	LE	lupus erythematosus	21
IGRA	interferon-gamma release assay (test for TB)	11	LES	lower esophageal sphincter	12
IGT	impaired glucose tolerance	16	LH	luteinizing hormone	14, 15, 16
IM	intramuscular(ly); intramedullary	8, 19	LL	left lateral	7
INH	isoniazid	8, 11	LLL	left lower lobe (of lung)	11
IOL	intraocular lens	18	LLQ	left lower quadrant	5
IOP	intraocular pressure	18	LMN	lower motor neuron	17
IPPA	inspection, palpation, percussion, auscultation	7	LMP	last menstrual period	15
IPPB	intermittent positive pressure breathing	11	LOC	level of consciousness	17
IPPV	intermittent positive pressure ventilation	11	LP	lumbar puncture	17
IRV	inspiratory reserve volume	11	LUL	left upper lobe (of lung)	11
ITP	idiopathic thrombocytopenic purpura	10	LUQ	left upper quadrant	5
IU	international unit	8	LV	left ventricle	9
IUD	intrauterine device	15	LVAD	left ventricular assist device	9
IV	intravenous(ly)	8	LVEDP	left ventricular end-diastolic pressure	9
IVC	intravenous cholangiogram	12	LVH	left ventricular hypertrophy	9
IVCD	intraventricular conduction delay	9	lytes	electrolytes	10
IVDA	intravenous drug abuse	7	m	meter	Appendix 8
IVF	in vitro fertilization	15	MAOI	monoamine oxidase inhibitor	17
IVP	intravenous pyelography	13	mcg	microgram	8, Appendix 8
IVPB	intravenous piggyback	7	MCH	mean corpuscular hemoglobin	10
IVU	intravenous urography	13	MCHC	mean corpuscular hemoglobin concentration	10
JVP	jugular venous pulse	9	mcL	microliter	10, Appendix 8
K	potassium	13	mcm	micrometer	10, Appendix 8
kg	kilogram	Appendix 8	MCP	metacarpophalangeal	19
km	kilometer	Appendix 8	MCV	mean corpuscular volume	10
KUB	kidney-ureter-bladder	13	MDS	myelodysplastic syndrome	10
KVO	keep vein open	7	MED(s)	medicine(s), medication(s)	8
L	lumbar vertebra; liter	19; Appendix 8	MEFR	maximal expiratory flow rate	11
LA	long-acting	8	MEN	multiple endocrine neoplasia	16
LAD	left anterior descending (coronary artery)	9	mEq	milliequivalent	10
LAHB	left anterior hemiblock	9	MET	metastasis	7
			mg	milligram	8, Appendix 8
			MG	myasthenia gravis	20
			MI	myocardial infarction	9
			MID	multi-infarct dementia	17

Appendix 2 Abbreviations and Their Meanings (Continued)

Abbreviation	Meaning	Chapter	Abbreviation	Meaning	Chapter
mL	milliliter	Appendix 8	NV	near vision	18
mm	millimeter	Appendix 8	N/V, N&V, n&v	nausea and vomiting	12
MMFR	maximum midexpiratory flow rate	11	N/V/D	nausea, vomiting, diarrhea	12
mm Hg	millimeters of mercury	9	O ₂	oxygen	11
MMT	manual muscle test(ing)	20	OA	osteoarthritis	19
MN	myoneural	20	OB	obstetrics, obstetrician	15
MR	mitral regurgitation, reflux	9	OCD	obsessive-compulsive disorder	17
MRI	magnetic resonance imaging	7	ODS	Office of Dietary Supplements	8
MRSA	methicillin-resistant <i>Staphylococcus aureus</i>	6	OGTT	oral glucose-tolerance test	16
MS	mitral stenosis; multiple sclerosis	9, 17	OI	osteogenesis imperfecta	19
MTP	metatarsophalangeal	19	OL	otolaryngology	18
MUGA	multigated acquisition (scan)	9	OOB	out of bed	7
MVP	mitral valve prolapse	9	OM	otitis media	18
MVR	mitral valve replacement	9	ORIF	open reduction internal fixation	19
Na	sodium	13	ORL	otorhinolaryngology	18
NAA	nucleic acid amplification (test) (for TB)	11	ortho, ORTH	orthopedics	19
NAD	no apparent distress	7	OT	occupational therapy	20
NB	newborn	15	OTC	over-the-counter	8
NCCAM	National Center for Complementary and Alternative Medicine	7	p	after, post	8
NG	nasogastric	12	P	pulse	7, 9
NGU	nongonococcal urethritis	14, 15	PA	posteroanterior; physician assistant	7
NHL	non-Hodgkin lymphoma	10	PAC	premature atrial contraction	9
NICU	neonatal intensive care unit; neurologic intensive care unit	15, 17	Paco ₂	arterial partial pressure of carbon dioxide	11
NKDA	no known drug allergies	7	PACU	postanesthesia care unit	19, 20
NMJ	neuromuscular junction	20	Pao ₂	arterial partial pressure of oxygen	11
NPH	neutral protamine Hagedorn (insulin)	16	PAP	pulmonary arterial pressure	9
NPH	normal pressure hydrocephalus	17	pc	after meals	8
NPO	nothing by mouth	7	PCA	patient-controlled analgesia	7
NRC	normal retinal correspondence	18	PCI	percutaneous coronary intervention	9
NREM	nonrapid eye movement (sleep)	17	PCL	posterior cruciate ligament	19
NS, N/S	normal saline	7	PCOS	polycystic ovarian syndrome	15
NSAID(s)	nonsteroidal anti-inflammatory drug(s)	8, 19	PCP	<i>Pneumocystis pneumonia</i>	10, 11
NSR	normal sinus rhythm	9	PCV	packed cell volume	10
			PCWP	pulmonary capillary wedge pressure	9
			PDA	patent ductus arteriosus	15

(Continued)

Appendix 2 Abbreviations and Their Meanings (Continued)

Abbreviation	Meaning	Chapter	Abbreviation	Meaning	Chapter
PDD	pervasive developmental disorder	17	PPD	purified protein derivative (tuberculin)	11
PDR	Physicians' Desk Reference	8	PPI	proton pump inhibitor	12
PE	physical examination	7	preop, pre-op	preoperative	7
PEEP	positive end-expiratory pressure	11	PRL	prolactin	16
PEFR	peak expiratory flow rate	11	prn	as needed	8
PEG	percutaneous endoscopic gastrostomy (tube)	12	PSA	prostate-specific antigen	14
PEP	protein electrophoresis	13	PSF	posterior spinal fusion	19
PE(R)RLA	pupils equal, (regular) react to light and accommodation	7	PSS	physiologic saline solution; progressive systemic sclerosis	7, 21
PET	positron emission tomography	7, 17	PSVT	paroxysmal supraventricular tachycardia	9
PFT	pulmonary function test(s)	11	pt	patient	7
pH	scale for measuring hydrogen ion concentration (acidity or alkalinity)	10	PT	physical therapy/therapist	20
Ph	Philadelphia chromosome	10	PT, ProTime	prothrombin time	10
PICC	peripherally inserted central catheter	7	PTCA	percutaneous transluminal coronary angioplasty	9
PID	pelvic inflammatory disease	15	PTH	parathyroid hormone	16
PIH	pregnancy-induced hypertension	15	PTSD	posttraumatic stress disorder	17
PIP	peak inspiratory pressure	11	PTT	partial thromboplastin time	10
PIP	proximal interphalangeal	19	PUVA	psoralen ultraviolet A	21
PKU	phenylketonuria	15	PVC	premature ventricular contraction	9
PMH	past medical history	7	PVD	peripheral vascular disease	9
PMI	point of maximal impulse	9	PYP	pyrophosphate	9
PMN	polymorphonuclear (neutrophil)	10	qam	every morning	8
PMS	premenstrual syndrome	15	qh	every hour	8
PND	paroxysmal nocturnal dyspnea	11	q __ h	every __ hours	8
PNS	peripheral nervous system	17	qid, q.i.d.	four times per day	8
po, PO	by mouth, orally	8	QNS	quantity not sufficient	7
poly, polymorph	neutrophil	10	QS	quantity sufficient	7
PONV	postoperative nausea and vomiting	12	R	respiration	7, 11
postop, post-op	postoperative	7	RA	rheumatoid arthritis	19
pp	postprandial (after a meal)	8	RAIU	radioactive iodine uptake	16
			RAS	reticular activating system	17
			RATx	radiation therapy	7
			RBC	red blood cell; red blood (cell) count	10
			RDS	respiratory distress syndrome	11

Appendix 2 Abbreviations and Their Meanings (Continued)

Abbreviation	Meaning	Chapter	Abbreviation	Meaning	Chapter
REM	rapid eye movement (sleep)	17	SL	sublingual	8
RIA	radioimmunoassay	16	SLE	systemic lupus erythematosus	10, 21
RICE	rest, ice, compression, elevation	20	SPECT	Single photon emission computed tomography	7
RL	right lateral	7	SPF	sun protection factor	21
RLL	right lower lobe (of lung)	11	SpO ₂	oxygen percent saturation	11
RLQ	right lower quadrant	5	SR	sustained release	8
RLS	restless legs syndrome	20	ss	half	8
RML	right middle lobe (of lung)	11	SSEP	somatosensory evoked potentials	17
R/O	rule out	7	SSRI	selective serotonin reuptake inhibitor	17
ROM	range of motion	20	ST	speech threshold	18
ROS	review of systems	7	staph	staphylococcus	6
RSI	repetitive strain injury	20	STAT	immediately	7
RSV	respiratory syncytial virus	11	STD	sexually transmitted disease	14, 15
RTC	rotator cuff	20	STI	sexually transmitted infection	14, 15
RUL	right upper lobe (of lung)	11	strep	streptococcus	6
RUQ	right upper quadrant	5	STSG	split-thickness skin graft	21
RV	residual volume	11	supp	suppository	8
Rx	drug, prescription, therapy	7, 8	susp	suspension	8
ś	without	8	SVD	spontaneous vaginal delivery	15
S	sacrum; sacral	19	SVT	supraventricular tachycardia	9
S ₁	first heart sound	9	T	temperature; thoracic vertebra	7, 19
S ₂	second heart sound	9	T1DM	type 1 diabetes mellitus	16
SA	sustained action; sinoatrial	8, 9	T2DM	type 2 diabetes mellitus	16
SARS	severe acute respiratory syndrome	11	T ₃	triiodothyronine	16
SBE	subacute bacterial endocarditis	9	T ₄	thyroxine, tetraiodothyronine	16
sc	without correction	18	T ₇	free thyroxine index	16
SC, SQ, subcut.	subcutaneous(ly)	8	T&A	tonsils and adenoids, tonsillectomy and adenoidectomy	11
SCLE	subacute cutaneous lupus erythematosus	21	tab	tablet	8
seg	neutrophil	10	TAH	total abdominal hysterectomy	15
SERM	selective estrogen receptor modulator	15, 19	TB	tuberculosis	11
SG	specific gravity	13	TBG	thyroxine-binding globulin	16
SIADH	syndrome of inappropriate antidiuretic hormone	16	^{99m} Tc	technetium-99m	9
SIDS	sudden infant death syndrome	11	TCA	tricyclic antidepressant	17
SITS	supraspinatus, infraspinatus, teres minor, subscapularis (muscles)	20	TEE	transesophageal echocardiography	9
SK	streptokinase	9	TGV	thoracic gas volume	11

(Continued)

Appendix 2 Abbreviations and Their Meanings (Continued)

Abbreviation	Meaning	Chapter	Abbreviation	Meaning	Chapter
THA	total hip arthroplasty	19	ung	ointment	8
TIA	transient ischemic attack	17	URI	upper respiratory infection	11
tid, t.i.d.	three times per day	8	USP	United States Pharmacopeia	8
tinct	tincture	8	UTI	urinary tract infection	13, 14
TKA	total knee arthroplasty	19	UTP	uterine term pregnancy	15
TKO	to keep open	7	UV	ultraviolet	7, 21
TLC	total lung capacity	11	UVA	ultraviolet A	21
Tm	maximal transport capacity; tubular maximum	13	UVB	ultraviolet B	21
TM	tympanic membrane	18	VA	visual acuity	18
Tn	troponin	9	VAC	vacuum-assisted closure	21
TNM	(primary) tumor, (regional lymph) nodes, (distant) metastases	7	VAD	ventricular assist device	9
TMJ	temporomandibular joint	19	VBAC	vaginal birth after cesarean section	15
tPA	tissue plasminogen activator	9	VC	vital capacity	11
TPN	total parenteral nutrition	12	VD	venereal disease	14, 15
TPR	temperature, pulse, respiration	7	VDRL	Venereal Disease Research Laboratory	14
TPUR	transperineal urethral resection	14	VEP	visual evoked potentials	17
TSE	testicular self-examination	14	VF	ventricular fibrillation; visual field	9, 18
TSH	thyroid-stimulating hormone	16	v fib	ventricular fibrillation	9
TSS	toxic shock syndrome	15	VLDL	very low density lipoprotein	9
T(C)T	thrombin (clotting) time	10	VPC	ventricular premature complex	9
TTP	thrombotic thrombocytopenic purpura	10	VRSA	vancomycin-resistant <i>Staphylococcus aureus</i>	6
TTS	temporary threshold shift	18	VS	vital signs	7
TUIP	transurethral incision of prostate	14	VSD	ventricular septal defect	9
TURP	transurethral resection of prostate	14	VT	ventricular tachycardia	9
TV	tidal volume	11	VTE	venous thromboembolism	9
Tx	traction	19	V _{TG}	thoracic gas volume	11
U	units	8	vWF	von Willebrand factor	10
UA	urinalysis	13	WBC	white blood cell; white blood (cell) count	10
UC	uterine contractions	15	WD	well developed	7
UFE	uterine fibroid embolization	15	WNL	within normal limits	7
UG	urogenital	14	w/o	without	7
UGI	upper gastrointestinal	12	WPW	Wolff-Parkinson-White syndrome	9
UMN	upper motor neuron	17	x	times	8
			XT	exotropia	18
			YO, y/o	years old, year-old	7
			ZIFT	zygote intrafallopian transfer	15

Appendix 3

Appendix 3 Word Parts and Their Meanings

Word Part	Meaning	Reference Page	Word Part	Meaning	Reference Page
a-	not, without, lack of, absence	39	atri/o	atrium	183
ab-	away from	40	audi/o	hearing	485
abdomin/o	abdomen	83	auto-	self	233
-ac	pertaining to	20	azot/o	nitrogenous compounds	227
acous, acus	sound, hearing	485	bacill/i, bacill/o	bacillus	110
acro-	extremity, end	84	bacteri/o	bacterium	110
ad-	toward, near	40	balan/o	glans penis	359
aden/o	gland	63	bar/o	pressure	132
adip/o	fat	66	bi-	two, twice	36
adren/o	adrenal gland, epinephrine	421	bili	bile	292
adrenal/o	adrenal gland	421	blast/o, -blast	immature cell, productive cell, embryonic cell	65
adrenocortic/o	adrenal cortex	421	blephar/o	eyelid	495
aer/o	air, gas	132	brachi/o	arm	84
-agogue	promoter, stimulator	394	brachy-	short	360
-al	pertaining to	20	brady-	slow	107
alg/o, algi/o, algesi/o	pain	106, 151	bronch/o, bronch/i	bronchus	256
-algesia	pain	108, 482	bronchiol	bronchiole	256
-algia	pain	108	bucc/o	cheek	289
ambly-	dim	502	burs/o	bursa	523
amnio	amnion	394	calc/i	calcium	227
amyl/o	starch	66	cali/o, calic/o	calyx	323
an-	not, without, lack of, absence	39	-capnia	carbon dioxide (level of)	255
andr/o	male	351	carcin/o	cancer, carcinoma	106
angi/o	vessel	184	cardi/o	heart	183
an/o	anus	291	cec/o	cecum	291
ante-	before	43	-cele	hernia, localized dilation	108
anti-	against	39, 151	celi/o	abdomen	83
aort/o	aorta	184	centesis	puncture, tap	134
-ar	pertaining to	20	cephal/o	head	83
arter/o, arteri/o	artery	184	cerebell/o	cerebellum	449
arteriol/o	arteriole	184	cerebr/o	cerebrum	449
arthr/o	joint	523	cervic/o	neck, cervix	83, 380
-ary	pertaining to	20	chem/o	chemical	151
-ase	enzyme	66	cheil/o	lip	303
atel/o	imperfect	264	chir/o	hand	131
atant/o	atlas	521			

(Continued)

Appendix 3 Word Parts and Their Meanings (Continued)

Word Part	Meaning	Reference Page	Word Part	Meaning	Reference Page
cholangi/o	bile duct	292	di-	two, twice	36
chol/e, chol/o	bile, gall	292	dia-	through	40
cholecyst/o	gallbladder	292	dilation, dilatation	expansion, widening	109
choledoch/o	common bile duct	292	dipl/o-	double	36
chondr/o	cartilage	523	dis-	absence, removal, separation	39
chori/o, choroid/o	choroid	496	duoden/o	duodenum	290
chrom/o, chromat/o	color, stain	132	dys-	abnormal, painful, difficult	107
chron/o	time	132	ec-	out, outside	44
circum-	around	84	ectasia, ectasis	dilation, dilatation, distention	109
clasis, -clasia	breaking	108	ecto-	out, outside	44
clitor/o, clitorid/o	clitoris	381	-ectomy	excision, surgical removal	134
coccy, coccyg/o	coccyx	524	edema	accumulation of fluid, swelling	109
cochle/o	cochlea (of inner ear)	486	electr/o	electricity	132
col/o, colon/o	colon	291	embryo/o	embryo	394
colp/o	vagina	380	emesis	vomiting	299
contra-	against, opposite, opposed	39, 151	-emia	condition of blood	224
copro	feces	451	encephal/o	brain	449
cor/o, cor/e	pupil	502	end/o-	in, within	44
corne/o	cornea	496	endocrin/o	endocrine	421
cortic/o	outer portion, cerebral cortex	449	enter/o	intestine	290
cost/o	rib	524	epi-	on, over	84
counter-	against, opposite, opposed	151	epididym/o	epididymis	353
crani/o	skull, cranium	524	episi/o	vulva	381
cry/o	cold	132	equi-	equal, same	41
crypt/o	hidden	356	erg/o	work	132, 560
cus	sound, hearing	485	erythr/o-	red, red blood cell	225
cyan/o-	blue	38	erythrocyt/o	red blood cell	225
cycl/o	ciliary body, ciliary muscle (of eye)	496	esophag/o	esophagus	290
cyst/o	filled sac or pouch, cyst, bladder, urinary bladder	106, 324	-esthesia, -esthesi/o	sensation	482
-cyte, cyt/o	cell	63	eu-	true, good, easy, normal	41
dacry/o	tear, lacrimal apparatus	495	ex/o-	away from, outside	44
dacryocyst/o	lacrimal sac	495	extra-	outside	84
dactyl/o	finger, toe	84	fasci/o	fascia	560
de-	down, without, removal, loss	39	fer	to carry	446
dent/o, dent/i	tooth, teeth	289	ferr/i, ferr/o	iron	227
derm/o, dermat/o	skin	583	fet/o	fetus	394
-desis	binding, fusion	134	fibr/o	fiber	63
dextr/o-	right	44	-form	like, resembling	20
			galact/o	milk	394

Appendix 3 Word Parts and Their Meanings (Continued)

Word Part	Meaning	Reference Page	Word Part	Meaning	Reference Page
gangli/o, ganglion/o	ganglion	448	-ic	pertaining to	20
gastr/o	stomach	290	-ical	pertaining to	20
gen, genesis	origin, formation	65	-ics	medical specialty	18
ger/e, ger/o	old age	35	-ile	pertaining to	20
-geusia	sense of taste	482	ile/o	ileum	291
gingiv/o	gum, gingiva	289	ili/o	ilium	524
gli/o	neuroglia	448	im-	not	39
glomerul/o	glomerulus	323	immun/o	immunity, immune system	225
gloss/o	tongue	289	in-	not	39
gluc/o	glucose	66	infra-	below	84
glyc/o	sugar, glucose	66	in/o	fiber, muscle fiber	560
gnath/o	jaw	289	insul/o	pancreatic islets	421
goni/o	angle	503, 538	inter-	between	84
-gram	record of data	133	intra-	in, within	84
-graph	instrument for recording data	133	ir, irit/o, irid/o	iris	496
-graphy	act of recording data	133	-ism	condition of	17
gravida	pregnant woman	394	iso-	equal, same	41
gyn/o, gynec/o	woman	378	-ist	specialist	18
hem/o, hemat/o	blood	225	-itis	inflammation	108
hemi-	half, one side	36	jejun/o	jejunum	291
-hemia	condition of blood	224	juxta-	near, beside	85
hepat/o	liver	292	kali	potassium	227
hetero-	other, different, unequal	41	kary/o	nucleus	63
hidr/o	sweat, perspiration	583	kerat/o	cornea, keratin, horny layer of skin	496, 583
hist/o, histi/o	tissue	63	kin/o, kine, kinesi/o, kinet/o	movement	560
homo-, homeo-	same, unchanging	41	labi/o	lip	289
hydr/o	water, fluid	66	labyrinth/o	labyrinth (inner ear)	486
hyper-	over, excess, increased, abnormally high	41	lacrim/o	tear, lacrimal apparatus	495
hypn/o	sleep	151	lact/o	milk	394
hypo-	under, below, decreased, abnormally low	41	-lalia	speech, babble	451
hypophysi/o	pituitary, hypophysis	421	lapar/o	abdominal wall	83
hyster/o	uterus	380	laryng/o	larynx	256
-ia	condition of	17	lent/i	lens	496
-ian	specialist	18	-lepsy	seizure	451
-ia/sis	condition of	17	leuk/o-	white, colorless, white blood cell	225
-iatrics	medical specialty	18	leukocyt/o	white blood cell	225
-iatr/o	physician	111	-lexia	reading	451
-iatry	medical specialty	18	lingu/o	tongue	289
			lip/o	fat, lipid	66
			-listhesis	slipping	534
			lith	calculus, stone	106

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Appendix 3 Word Parts and Their Meanings (Continued)

Word Part	Meaning	Reference Page	Word Part	Meaning	Reference Page
-logy	study of	18	myc/o	fungus, mold	110
lumb/o	lumbar region, lower back	83	myel/o	bone marrow, spinal cord	225, 448, 523
lymphaden/o	lymph node	197	my/o	muscle	560
lymphangi/o	lymphatic vessel	197	myring/o	tympanic membrane	485
lymph/o	lymph, lymphatic system, lymphocyte	197	myx/o	mucus	63
lymphocyt/o	lymphocyte	225	narc/o	stupor, unconsciousness	151, 450
-lysis	separation, loosening, dissolving, destruction	109	nas/o	nose	256
-lytic	dissolving, reducing, loosening	151	nat/i	birth	394
macro-	large, abnormally large	41	natri	sodium	227
mal-	bad, poor	107	necrosis	death of tissue	109
malacia	softening	109	neo-	new	42
mamm/o	breast, mammary gland	381	nephr/o	kidney	323
-mania	excited state, obsession	451	neur/o, neur/i	nervous system, nerve	448
mast/o	breast, mammary gland	381	noct/i	night	136
medull/o	inner part, medulla oblongata, spinal cord	450	non-	not	39
mega-, megal-	large, abnormally large	41	normo-	normal	42
-megaly	enlargement	108	nucle/o	nucleus	63
melan/o-	black, dark, melanin	583	nulli-	never	394
mening/o, meninge/o	meninges	448	nyct/o	night, darkness	136
men/o, mens	month, menstruation	378	ocul/o	eye	495
mes/o-	middle	44	odont/o	tooth, teeth	289
-meter	instrument for measuring	133	-odynia	pain	108
metr/o	measure	133, 498	-oid	like, resembling	20
metr/o, metr/i	uterus	380	olig/o-	few, scanty, deficiency of	41
-metry	measurement of	133	-oma	tumor	108
micro-	small, one millionth	42	onc/o	tumor	106
-mimetic	mimicking, simulating	151	onych/o	nail	583
mon/o-	one	36	oo	ovum	378
morph/o	form, structure	63	oophor/o	ovary	379
muc/o	mucus, mucous membrane	63	ophthalm/o	eye	495
multi-	many	36	-opia	eye, vision	497
muscul/o	muscle	560	-opsia	vision	497
			opt/o	eye, vision	495
			orchid/o, orchi/o	testis	353
			or/o	mouth	289
			ortho-	straight, correct, upright	42
			-ory	pertaining to	20
			osche/o	scrotum	353
			-ose	sugar	66
			-o/sis	condition of	17
			osm/o	smell	481

Appendix 3 Word Parts and Their Meanings (Continued)

Word Part	Meaning	Reference Page	Word Part	Meaning	Reference Page
-osmia	sense of smell	482	phren/o	diaphragm	257
oste/o	bone	523	phrenic/o	phrenic nerve	257
ot/o	ear	485	phyt/o	plant	150, 591
-ous	pertaining to	20	pituitar/i	pituitary, hypophysis	421
ovari/o	ovary	379	plas, -plasia	formation, molding, development	65
ov/o, ovul/o	ovum	378	-plasty	plastic repair, plastic surgery, reconstruction	135
-oxia	oxygen (level of)	255	-plegia	paralysis	451
ox/y	oxygen, sharp, acute	227	pleur/o	pleura	257
pachy-	thick	107	-pnea	breathing	255
palat/o	palate	289	pneum/o, pneumat/o	air, gas, lung, respiration	257
palpebr/o	eyelid	495	pneumon/o	lung	257
pan-	all	41	pod/o	foot	84
pancreat/o	pancreas	292	-poiesis	formation, production	224
papill/o	nipple	63	poikilo-	varied, irregular	42
para-	near, beside, abnormal	85	poly-	many, much	36
para	woman who has given birth	394	post-	after, behind	43
parathyr/o, parathyroid/o	parathyroid	421	pre-	before, in front of	43
-paresis	partial paralysis, weakness	451	presby-	old	498
path/o, -pathy	disease, any disease of	106	prim/i-	first	36
ped/o	foot, child	84	pro-	before, in front of	43
pelvi/o	pelvis	524	proct/o	rectum	291
-penia	decrease in, deficiency of	224	prostat/o	prostate	353
per-	through	40	prote/o	protein	66
peri-	around	84	pseudo-	false	42
perine/o	perineum	381	psych/o	mind	450
periton, peritone/o	peritoneum	83	ptosis	dropping, downward displacement, prolapse	109
-pexy	surgical fixation	134	ptysis	spitting	265
phac/o, phak/o	lens	496	puer	child	402
phag/o	eat, ingest	65	pulm/o, pulmon/o	lung	257
pharm, pharmac/o	drug, medicine	151	pupill/o	pupil	496
pharyng/o	pharynx	256	pyel/o	renal pelvis	323
-phasia	speech	451	pylor/o	pylorus	290
phil, -philic	attracting, absorbing	65	py/o	pus	106
phleb/o	vein	184	pyr/o, pyret/o	fever, fire	106, 152
-phobia	fear	451	quadr/i-	four	36
phon/o	sound, voice	132	rachi/o	spine	524
-phonia	voice	255	radicul/o	root of spinal nerve	448
phot/o	light	132	radi/o	radiation, x-ray	132

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Appendix 3 Word Parts and Their Meanings (Continued)

Word Part	Meaning	Reference Page	Word Part	Meaning	Reference Page
re-	again, back	42	sperm/i	semen, spermatozoa	353
rect/o	rectum	291	spermat/o	semen, spermatozoa	353
ren/o	kidney	323	-spermia	condition of semen	354
reticul/o	network	63	sphygm/o	pulse	182
retin/o	retina	496	spir/o	breathing	257
retro-	behind, backward	85	splen/o	spleen	197
rhabd/o	rod, muscle cell	566	spondyl/o	vertebra	524
-rhage, -rhagia	bursting forth, profuse flow, hemorrhage	108	staped/o, stapedi/o	stapes	486
-rhapxy	surgical repair, suture	135	staphyl/o	grapelike cluster, Staphylococcus	110
-rhea	flow, discharge	108	stasis	suppression, stoppage	109
-rhexis	rupture	109	steat/o	fatty	66
rhin/o	nose	256	stenosis	narrowing, constriction	109
sacchar/o	sugar	66	steth/o	chest	493
sacr/o	sacrum	524	sthen/o	strength	566
salping/o	tube, uterine tube, auditory (eustachian) tube	380, 486	stoma, stomat/o	mouth	289
-schisis	fissure, splitting	524	-stomy	surgical creation of an opening	135
scler/o	hard, sclera (of eye)	106, 496	strept/o-	twisted chain, Streptococcus	110
sclerosis	hardening	109	sub-	below, under	84
-scope	instrument for viewing or examining	134	super-	above, excess	41
-scopy	examination of	134	supra-	above	85
seb/o	sebum, sebaceous gland	583	syn-, sym-	together	44
semi-	half, partial	36	synov/i	synovial joint, synovial membrane	523
semin	semen	353	tachy-	rapid	107
sept/o	septum, dividing wall, partition	266	tax/o	order, arrangement	566
sial/o	saliva, salivary gland, salivary duct	289	tel/e-, tel/o-	end	44
sider/o	iron	227	ten/o, tendin/o	tendon	560
sigmoid/o	sigmoid colon	291	terat/o	malformed fetus	401
sinistr/o	left	44	test/o	testis, testicle	353
-sis	condition of	17	tetra-	four	36
skelet/o	skeleton	522	thalam/o	thalamus	450
somat/o	body	63	therm/o	heat, temperature	132
-some	body, small body	63	thorac/o	chest, thorax	83
somn/i, somn/o	sleep	450	thromb/o	blood clot	225
son/o	sound, ultrasound	132	thrombocyt/o	platelet, thrombocyte	225
spasm	sudden contraction, cramp	109	thym/o	thymus gland	197
			thyr/o, thyroid/o	thyroid	421
			toc/o	labor	394

Appendix 3 Word Parts and Their Meanings (Continued)

Word Part	Meaning	Reference Page	Word Part	Meaning	Reference Page
-tome	instrument for incising (cutting)	135	ur/o	urine, urinary tract	324
-tomy	incision, cutting	135	urin/o	urine	324
ton/o	tone	560	uter/o	uterus	380
tonsil/o	tonsil	197	uve/o	uvea (of eye)	496
tox/o, toxic/o	poison, toxin	106, 109, 152	uvul/o	uvula	289
toxin	poison	109	vagin/o	sheath, vagina	380
trache/o	trachea	256	valv/o, valvul/o	valve	183
trans-	through	40	varic/o	twisted and swollen vein, varix	193
tri-	three	36	vascul/o	vessel	184
trich/o	hair	583	vas/o	vessel, duct, vas deferens	152, 184, 353
-tripsy	crushing	135	ven/o, ven/i	vein	184
trop/o	turning	503	ventricul/o	cavity, ventricle	183, 450
trop, -tropic	act(ing) on, affect(ing)	65	vertebr/o	vertebra, spinal column	524
troph/o, -trophy, -trophia	feeding, growth, nourishment	65	vesic/o	urinary bladder	324
tympan/o	tympanic cavity (middle ear), tympanic membrane	485	vesicul/o	seminal vesicle	353
un-	not	39	vestibul/o	vestibule, vestibular apparatus (of ear)	486
uni-	one	36	vir/o	virus	110
-uresis	urination	324	vulv/o	vulva	381
ureter/o	ureter	324	xanth/o-	yellow	38
urethr/o	urethra	324	xen/o	foreign, strange	457
-uria	condition of urine, urination	324	xero-	dry	107
			-y	condition of	17

Appendix 4

Appendix 4

Meanings and Their Corresponding Word Parts

Meaning	Word Part(s)	Reference Page	Meaning	Word Part(s)	Reference Page
abdomen	abdomin/o, celi/o	83	away from	ab-, ex/o-	40, 44
abdominal wall	lapar/o	83	babble	-lalia	451
abnormal	dys-, para-	107	bacillus	bacill/i, bacill/o	110
abnormally high	hyper-	41	back	re-	42
abnormally large	macro-, mega-, megal-	41	backward	retro-	85
abnormally low	hypo-	41	bacterium	bacteri/o	110
above	super-, supra-	41, 85	bad	mal-	107
absence	a-, an-, dis-	39	before	ante-, pre-, pro-	43
absorb(ing)	phil-, philic	65	behind	post-, retro-	43, 85
accumulation of fluid	edema	109	below	hypo-, infra-, sub-	41, 84
act of recording data	-graphy	133	beside	para-, juxta-	85
act(ing) on	trop-, tropic	65, 151	between	inter-	84
acute	ox/y	227	bile	bili, chol/e, chol/o	292
adrenal gland	adren/o, adrenal/o	421	bile duct	cholangi/o	292
adrenaline	adren/o	421	binding	-desis	134
adrenal	adren/o	421	birth	nat/i	394
adrenal cortex	adrenocortic/o	421	black	melan/o-	38, 583
affect(ing)	trop-, tropic	65	bladder	cyst/o	106
after	post-	43	bladder (urinary)	cyst/o, vesic/o	106, 324
again	re-	42	blood	hem/o, hemat/o	225
against	anti-, contra-, counter-	39, 151	blood (condition of)	-emia, -hemia	224
air	aer/o, pneumat/o	132, 257	blood clot	thromb/o	225
all	pan-	41	blue	cyan/o-	38
amnion, amniotic sac	amnio	394	body	somat/o, -some	63
angle	goni/o	503	bone	oste/o	523
anus	an/o	291	bone marrow	myel/o	225, 448, 523
any disease of	-pathy	108	brain	encephal/o	449
aorta	aort/o	184	breaking	-clasis, -clasia	108
arm	brachi/o	84	breast	mamm/o, mast/o	381
around	circum-, peri-	84	breathing	-pnea, spir/o	255, 257
arrangement	tax/o	566	bronchiole	bronchiol	256
arteriole	arteriol/o	184	bronchus	bronch/i, bronch/o	256
artery	arter/o, arteri/o	184	bursa	burs/o	523
atlas	atlant/o	521	bursting forth	-rhage, -rhagia	108
atrium	atri/o	183	calcium	calc/i	227
attract(ing)	phil-, philic	65	calculus	lith	106
auditory (eustachian) tube	salping/o	486	calyx	cali/o, calic/o	323
			cancer	carcin/o	106
			carbon dioxide	-capnia	255
			carcinoma	carcin/o	106

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Meanings and Their Corresponding Word Parts (Continued)

Meaning	Word Part(s)	Reference Page	Meaning	Word Part(s)	Reference Page
carry	fer	446	darkness	nyct/o	136
cartilage	chondr/o	523	data	-gram	133
cavity	ventricul/o	183, 450	death of tissue	necrosis	109
cecum	cec/o	291	decreased, decrease in	hypo-, -penia	41, 224
cell	-cyte, cyt/o	63	deficiency of	oligo-, -penia	224
cerebellum	cerebell/o	449	destruction	lysis	109
cerebral cortex	cortic/o	449	development	plas, -plasia	65
cerebrum	cerebr/o	449	diaphragm	phren/o	257
cervix	cervic/o	380	different	hetero-	41
chain (twisted)	strept/o	110	difficult	dys-	107
cheek	bucc/o	289	dilatation, dilation	ectasia, ectasis	109
chemical	chem/o	151	distention	ectasia, ectasis	109
chest	thorac/o, steth/o	83	dim	ambly-	502
child	ped/o, puer	402, 534	discharge	-rhea	108
choroid	chori/o, choroid/o	496	disease	path/o, -pathy	106
ciliary body	cycl/o	496	dissolving	lysis, -lytic	109, 151
ciliary muscle	cycl/o	496	distention	ectasia, ectasis	109
clitoris	clitor/o, clitorid/o	381	double	dipl/o-	36
clot	thromb/o	225	down	de-	39
coccyx	coccy, coccyg/o	524	dropping, downward displacement	ptosis	109
cochlea	cochle/o	486	drug	pharm, pharmac/o	151
cold	cry/o	132	dry	xero-	107
colon	col/o, colon/o	291	duct	vas/o	184
color	chrom/o, chromat/o	132	ductus deferens	vas/o	353
colorless	leuk/o-	38	duodenum	duoden/o	290
common bile duct	choledoch/o	292	ear	ot/o	485
condition of	-ia, -ia/sis, -ism, -o/sis, -sis, -y	17	easy	eu-	41
condition of blood	-emia, -hemia	224	eat	phag/o	65
condition of urine, urination	-uria	324	egg cell	oo, ov/o, ovul/o	378
condition of semen	-spermia	354	electricity	electr/o	132
constriction	stenosis	109	embryo	embryo/o	394
contraction (sudden)	spasm	109	embryonic cell	-blast, blast/o	65
cornea	corne/o, kerat/o	496	end	tel/e, tel/o, acro	44, 84
correct	ortho-	42	endocrine	endocrin/o	421
cramp	spasm	109	enlargement	-megaly	108
cranium	crani/o	524	enzyme	-ase	66
crushing	-tripsy	135	epididymis	epididym/o	353
cutting	-tomy	135	epinephrine	adren/o	421
cutting instrument	-tome	135	equal	iso-, equi-	41
cyst	cyst/o	106	erythrocyte	erythr/o, erythrocyt/o	225
dark	melan/o-	38, 583	esophagus	esophag/o	290
			eustachian (auditory) tube	salping/o	486

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Appendix 4 Meanings and Their Corresponding Word Parts (Continued)

Meaning	Word Part(s)	Reference Page	Meaning	Word Part(s)	Reference Page
examination of	-scopy	134	gingiva (gum)	gingiv/o	289
excess	hyper-, super-	41	gland	aden/o	63
excision	-ectomy	134	glans penis	balan/o	359
excited state	mania	451	glomerulus	glomerul/o	323
expansion	dilation, dilatation, ectasia, ectasis	109	glucose	gluc/o, glyc/o	66
extremity	acro	84	good	eu-	41
eye	ocul/o, ophthalm/o, opt/o, -opia	495, 497	grapelike cluster	staphyl/o	110
eyelid	blephar/o, palpebr/o	495	growth	troph/o, -trophy, -trophia	65
fallopian tube	salping/o	377	gum, gingiva	gingiv/o	289
false	pseudo-	42	hair	trich/o	583
fascia	fasci/o	560	half	hemi-, semi-	36
fat	adip/o, lip/o	66	hand	chir/o	131
fatty	steat/o	66	hard	scler/o	106
fear	-phobia	451	hardening	sclerosis	109
feces	copro	451	head	cephal/o	83
feeding	troph/o, -trophy, -trophia	65	hearing	acous, acus, audi/o, cus	485
fetus	fet/o	394	heart	cardi/o	183
fetus (malformed)	terat/o	401	heat	therm/o	132
fever	pyr/o, pyret/o	106, 152	hemorrhage	-rhage, -rhagia	108
few	oligo-	41	hernia	-cele	108
fiber	fibr/o, in/o	63, 560	hidden	crypt/o	356
filled sac or pouch	cyst/o	106	horny layer of skin	kerat/o	583
finger	dactyl/o	84	hypophysis	hypophysi/o, pituitar/i	421
fire	pyr/o, pyret/o	106	islets (pancreatic)	insul/o	421
first	prim/i-	36	ileum	ile/o	291
fissure	-schisis	108	ilium	ili/o	524
fixation (surgical)	-pexy	134	immature cell	blast/o, -blast	65
flow	-rhea	108	immune system	immun/o	225
fluid	hydr/o	66	immunity	immun/o	225
foot	ped/o, pod/o	84	imperfect	atel/o	264
foreign	xen/o	457	in	end/o-, intra-	44, 84
form	morph/o	63	in front of	pre-, pro-	43
formation	gen, genesis, plas, -plasia, -poiesis	65, 224	incision of	-tomy	135
four	quadr/i, tetra-	36	increased	hyper-	41
fungus	myc/o	110	inflammation	-itis	108
fusion	-desis	134	ingest	phag/o	65
gall	chol/e, chol/o	292	inner ear	labyrinth/o	486
gallbladder	cholecyst/o	292	instrument for incising (cutting)	-tome	135
ganglion	gangli/o, ganglion/o	448	instrument for measuring	-meter	133
gas	aer/o, pneum/o, pneumon/o, pneumat/o	132, 257	instrument for recording data	-graph	133

Appendix 4

Meanings and Their Corresponding Word Parts (Continued)

Meaning	Word Part(s)	Reference Page	Meaning	Word Part(s)	Reference Page
instrument for viewing or examining	-scope	134	male	andr/o	351
intestine	enter/o	290	malformed fetus	terat/o	401
iris	ir, irid/o, irit/o	496	mammary gland	mamm/o, mast/o	381
iron	ferr/i, ferr/o, sider/o	227	many	multi-, poly-	36
irregular	poikilo-	42	marrow	myel/o	225, 448, 523
jaw	gnath/o	289	measure	metr/o	133, 498
jejunum	jejun/o	291	measuring instrument	-meter	133
joint	arthr/o	523	measurement of	-metry	133
keratin	kerat/o	583	medical specialty	-ics, -iatrics, iatry	18
kidney	nephro/o, ren/o	323	medicine	pharm, pharmac/o	151
labor	toc/o	394	medulla oblongata	medull/o	450
labyrinth	labyrinth/o	486	melanin	melan/o	583
lack of	a-, an-	39	meninges	mening/o, meninge/o	448
lacrimal apparatus	dacry/o, lacrim/o	495	menstruation	men/o, mens	378
lacrimal sac	dacryocyst/o	495	middle	meso-	44
large	macro-, mega-, megalo-	41	middle ear	tympan/o	485
larynx	laryng/o	256	milk	galact/o, lact/o	394
left	sinistr/o	44	mimicking	-mimetic	151
lens	lent/i, phac/o, phak/o	496	mind	psych/o	450
leukocyte	leuk/o, leukocyt/o	225	mold	myc/o	110
level of carbon dioxide	-capnia	255	molding	plas-, plasia	65
level of oxygen	-oxia	255	month	men/o, mens	378
light	phot/o	132	mouth	or/o, stoma, stomat/o	289
like	-form, -oid	20	movement	kin/o, kine, -kinesi/o, kinet/o	560
lip	labi/o, cheil/o	289	much	poly-	36
lipid	lip/o	66	mucus	muc/o, myx/o	63
liver	hepat/o	292	mucous membrane	muc/o	63
localized dilation	-cele	108	muscle	my/o, muscul/o	560
loosening	lysis, -lytic	109, 151	muscle cell	rhabd/o	566
loss	de-	39	muscle fiber	in/o	560
lumbar region, lower back	lumb/o	83	nail	onych/o	583
lung, lungs	pneum/o, pneumat/o, pneumon/o, pulm/o, pulmon/o	257	narrowing	stenosis	109
lymph, lymphatic system	lymph/o	197	near	ad-, juxta-, para-	40, 85
lymph node	lymphaden/o	197	neck	cervic/o	83, 380
lymphatic vessel	lymphangi/o	197	nerve, nervous system, nervous tissue	neur/o, neur/i	448
lymphocyte	lymph/o, lymphocyt/o	225	network	reticul/o	63
			neuroglia	gli/o	448
			never	nulli-	394
			new	neo-	42
			night	noct/i, nyct/o	136, 333

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Appendix 4 Meanings and Their Corresponding Word Parts (Continued)

Meaning	Word Part(s)	Reference Page	Meaning	Word Part(s)	Reference Page
nipple	papill/o	63	peritoneum	periton, peritone/o	83
nitrogenous	azot/o	227	perspiration	hidr/o	583
compounds	eu-, normo-	41, 42	pertaining to	-ac, -al, -ar, -ary, -ic, -ical, -ile, -ory, -ous	20
normal					
nose	nas/o, rhin/o	256	pharynx	pharyng/o	256
not	a-, an-, in-, im-, non-, un-	39	phrenic nerve	phrenic/o	257
nourishment	troph/o, -trophy, -trophia	65	physician	iatr/o	111
nucleus	kary/o, nucle/o	63	pituitary	pituitar/i, hypophysi/o	421
obsession	mania	451	plant	phyt/o	150, 591
old	presby-	498	plastic repair, plastic surgery	-plasty	135
old age	ger/e, ger/o	35	platelet	thrombocyt/o	225
on	epi-	84	pleura	pleur/o	257
one	mon/o-, uni-	36	poison	tox/o, toxic/o, toxin	106, 109, 152
one side	hemi-	36	poor	mal-	107
opening (created surgically)	-stomy	135	potassium	kali	227
opposed	contra-, counter	39, 151	pouch (filled)	cyst/o, cyst/i	106
opposite	contra-, counter-	39, 151	pregnant woman	gravida	394
order	tax/o	566	pressure	bar/o	132
origin	gen, genesis	65	production	-poiesis	224
other	hetero-	41	productive cell	blast/o, -blast	65
out, outside	ec-, ecto-, ex/o, extra-	44, 84	profuse flow	-rhage, -rhagia	108
outer portion	cortic/o	449	prolapse	ptosis	109
ovary	ovari/o, oophor/o	379	promotor	-agogue	394
over	hyper-, epi-	41, 84	prostate	prostat/o	353
ovum	oo, ov/o, ovul/o	378	protein	prote/o	66
oxygen	ox/y, -oxia	227	pulse	sphygm/o	182
pain	-algia, -odynia	106, 108	puncture	centesis	134
pain	-algesia, alg/o, algi/o, algesi/o	151, 482	pupil	pupill/o, cor/o, cor/e	496
painful	dys-	107	pus	py/o	106
palate	palat/o	289	pylorus	pylor/o	290
pancreas	pancreat/o	292	radiation	radi/o	132
pancreatic islets	insul/o	421	rapid	tachy-	107
paralysis	-plegia	451	reading	-lexia	451
paralysis (partial)	-paresis	451	reconstruction	-plasty	135
parathyroid	parathyr/o, parathyroid/o	421	record of data	-gram	133
partial	semi-	36	recording data (act of)	-graphy	133
partial paralysis	-paresis	451	rectum	rect/o, proct/o	291
partition	sept/o	266	red	erythr/o-	38
pelvis	pelvi/o	524	red blood cell	erythr/o, erythrocyt/o	225
perineum	perine/o	381	reducing	-lytic	151

Appendix 4 Meanings and Their Corresponding Word Parts (Continued)

Meaning	Word Part(s)	Reference Page	Meaning	Word Part(s)	Reference Page
removal	de-, dis-	39	sleep	hypn/o, somn/o, somn/i	151, 450
removal (surgical)	-ectomy	134	slipping	-listhesis	534
renal pelvis	pyel/o	323	slow	brady-	107
repair (plastic)	-plasty	135	small	micro-	42
repair (surgical)	-rhaphy	135	small body	-some	63
respiration	pneum/o, pneumat/o	257	smell	osm/o	481
resembling	-form, -oid	20	smell (sense of)	-osmia	482
retina	retin/o	496	sodium	natri	227
rib	cost/o	524	softening	malacia	109
right	dextr/o-	44	sound	phon/o, son/o, acous, acus, cus	132, 485
rod	rhabd/o	566	specialist	-ian, -ist, -logist	18
root of spinal nerve	radicul/o	448	specialty	-ics, -iatrics, -iatry	18
rupture	-rhexis	108	speech	-phasia, -lalia	451
sac (filled)	cyst/o, cyst/i	106	sperm, spermatozoa	sperm/i, spermat/o	353
sacrum	sacr/o	524	spinal column	vertebr/o	524
saliva, salivary gland, salivary duct	sial/o	289	spinal cord	myel/o, medull/o	448, 450, 523
same	equi-, homo-, homeo-, iso-	41	spinal nerve root	radicul/o	448
sclera (of eye)	scler/o	496	spine	rachi/o	524
scanty	oligo-	41	spitting	ptysis	265
scrotum	osche/o	353	spleen	splen/o	197
sebum, sebaceous gland	seb/o	583	splitting	-schisis	108
seizure	-lepsy	451	stain	chrom/o, chromat/o	132
self	auto-	233	stapes	staped/o, stapedi/o	486
semen	semin, sperm/i, spermat/o	353	staphylococcus	staphyl/o	110
semen, condition of	-spermia	354	starch	amyl/o	66
seminal vesicle	vesicul/o	353	stimulator	-agogue	394
sensation	-esthesia, esthesi/o	482	stomach	gastr/o	290
sense of smell	-osmia	482	stone	lith	106
sense of taste	-geusia	482	stoppage	stasis	109
separation	dis-, -lysis	39, 109	straight	ortho-	42
septum	sept/o	266	strange	xen/o	457
sharp	ox/y	227	strength	sthen/o	566
short	brachy-	360	Streptococcus	strept/o	110
sigmoid colon	sigmoid/o	291	structure	morph/o	63
simulating	-mimetic	151	study of	-logy	18
skeleton	skelet/o	522	stupor	narc/o	151, 450
skin	derm/o, dermat/o	583	sugar	glyc/o, sacchar/o, -ose	66
skull	crani/o	524	sudden contraction	spasm	109
			suppression	stasis	109
			surgery (plastic)	-plasty	135

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Appendix 4 Meanings and Their Corresponding Word Parts (Continued)

Meaning	Word Part(s)	Reference Page	Meaning	Word Part(s)	Reference Page
surgical creation of an opening	-stomy	135	twisted and swollen vein	varic/o	193
surgical fixation	-pexy	134	two	bi-, di-, dipl/o-	36
surgical removal	-ectomy	134	tympanic cavity	tympan/o	485
surgical repair	-rhapxy	135	tympanic membrane	myring/o, tympan/o	485
suture	-rhapxy	135	ultrasound	son/o	132
sweat	hidr/o	583	unchanging	homo-, homeo-	41
swelling	edema	109	unconsciousness	narc/o	450
synovial fluid, joint, membrane	synov/i	523	under	hypo-, sub-	41, 84
tap	centesis	134	unequal	hetero-	41
taste (sense of)	-geusia	481	upright	ortho-	42
tear	dacry/o, lacrim/o	495	ureter	ureter/o	324
teeth	dent/o, dent/i, odont/o	289	urethra	urethr/o	324
temperature	therm/o	132	urinary bladder	cyst/o, vesic/o	324
tendon	ten/o, tendin/o	560	urine, urinary tract, urination	ur/o, -uria	324
testicle	test/o	353	urination	-uresis	324
testis	test/o, orchid/o, orchi/o	353	urine	urin/o	324
thalamus	thalam/o	450	uterine tube	salping/o	380, 486
thick	pachy-	107	uterus	hyster/o, metr/o, metr/i, uter/o	380
thorax	thorac/o	83	uvea	uve/o	496
three	tri-	36	uvula	uvul/o	289
thrombocyte	thrombocyt/o	225	vagina	colp/o, vagin/o	380
through	dia-, per-, trans-	40	valve	valv/o, valvul/o	183
thymus gland	thym/o	197	varicose vein, varix	varic/o	193
thyroid	thyr/o, thyroid/o	421	varied	poikilo-	42
time	chron/o	132	vas deferens	vas/o	353
tissue	hist/o, histi/o	63	vein	ven/o, ven/i, phleb/o	184
tissue death	necrosis	109	vein (twisted, swollen)	varic/o	193
toe	dactyl/o	84	ventricle	ventricul/o	183, 450
together	syn-, sym-	44	vertebra	spondyl/o, vertebr/o	524
tone	ton/o	560	vessel	angi/o, vas/o, vascul/o	152, 184, 353
tongue	gloss/o, lingu/o	289	vestibular apparatus, vestibule	vestibul/o	486
tonsil	tonsil/o	197	virus	vir/o	110
tooth	-dent/o, dent/i, odont/o	289	vision	opt/o, -opia, -opsia	495, 497
toward	ad-	40	voice	phon/o, -phonia	132, 255
toxin	tox/o, toxic/o	152	vomiting	emesis	299
trachea	trache/o	256	vulva	episi/o, vulv/o	381
true	eu-	41	wall, dividing wall	sept/o	266
tube	salping/o	380, 486	water	hydr/o	66
tumor	onc/o, -oma	106, 108	weakness	paresis	451
turning	trop/o	503			
twice	bi-, di-	36			
twisted chain	strept/o	110			

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Meanings and Their Corresponding Word Parts *(Continued)*

Meaning	Word Part(s)	Reference Page	Meaning	Word Part(s)	Reference Page
white	leuk/o-	38	woman	gyn/o, gynec/o	378
white blood cell	leuk/o, leukocyt/o	225	woman who has given birth	para	394
widening	ectasia, ectasis, dilation, dilatation	109	work	erg/o	132, 560
within	end/o-, intra-	44, 84	x-ray	radi/o	132
without	a-, an-, de-	39	yellow	xanth/o-	38

Appendix 5

Appendix 5 Word Roots

Root	Meaning	Reference Page	Root	Meaning	Reference Page
abdomin/o	abdomen	83	burs/o	bursa	523
acous, acus	sound, hearing	485	calc/i	calcium	227
acro	extremity, end	84	cali/o, calic/o	calyx	323
aden/o	gland	63	carcin/o	cancer, carcinoma	106
adip/o	fat	66	cardi/o	heart	183
adren/o	adrenal gland, epinephrine	421	cec/o	cecum	291
adrenal/o	adrenal gland	421	celi/o	abdomen	83
adrenocortic/o	adrenal cortex	421	centesis	puncture, tap	134
aer/o	air, gas	132	cephal/o	head	83
alg/o, algi/o, algesi/o	pain	106, 151	cerebell/o	cerebellum	449
amnio	amnion	394	cerebr/o	cerebrum	449
amyl/o	starch	66	cervic/o	neck, cervix	83, 380
andr/o	male	351	cheil/o	lip	303
angi/o	vessel	184	chem/o	chemical	151
an/o	anus	291	chir/o	hand	131
aort/o	aorta	184	cholangi/o	bile duct	292
arter/o, arteri/o	artery	184	chol/e, chol/o	bile, gall	292
arteriol/o	arteriole	184	cholecyst/o	gallbladder	292
arthr/o	joint	523	choledoch/o	common bile duct	292
atel/o	incomplete, imperfect	264	chondr/o	cartilage	523
atlant/o	atlas	521	chori/o, choroid/o	choroid	496
atri/o	atrium	183	chrom/o, chromat/o	color, stain	132
audi/o	hearing	485	chron/o	time	132
azot/o	nitrogenous compounds	227	clasis	breaking	108
bacill/i, bacill/o	bacillus	110	clitor/o, clitorid/o	clitoris	381
bacteri/o	bacterium	110	coccy, coccyg/o	coccyx	524
balan/o	glans penis	359	cochle/o	cochlea (of inner ear)	486
bar/o	pressure	132	col/o, colon/o	colon	291
bili	bile	292	colp/o	vagina	380
blast/o	immature cell, productive cell, embryonic cell	65	copro	feces	451
blephar/o	eyelid	495	cor/o, cor/e	pupil	502
brachi/o	arm	84	corne/o	cornea	496
bronch/i, bronch/o	bronchus	256	cortic/o	outer portion, cerebral cortex	449
bronchiol	bronchiole	256	cost/o	rib	524
bucc/o	cheek	289	crani/o	skull, cranium	524
			cry/o	cold	132

Appendix 5 Word Roots (Continued)

Root	Meaning	Reference Page	Root	Meaning	Reference Page
crypt/o	hidden	356	gli/o	neuroglia	448
cus	sound, hearing	485	glomerul/o	glomerulus	323
cycl/o	ciliary body, ciliary muscle (of eye)	496	gloss/o	tongue	289
cyst/o	filled sac or pouch, cyst, bladder, urinary bladder	106, 324	gluc/o	glucose	66
cyt/o	cell	63	glyc/o	sugar, glucose	66
dacry/o	tear, lacrimal apparatus	495	gnath/o	jaw	289
dacryocyst/o	lacrimal sac	495	goni/o	angle	503, 538
dactyl/o	finger, toe	84	gravida	pregnant woman	394
dent/o, dent/i	tooth, teeth	289	gyn/o, gynec/o	woman	378
derm/o, dermat/o	skin	583	hem/o, hemat/o	blood	225
dilation, dilatation	expansion, widening	109	hepat/o	liver	292
duoden/o	duodenum	290	hidr/o	sweat, perspiration	583
ectasia, ectasis	dilation, dilatation, distention	109	hist/o, histi/o	tissue	63
edema	accumulation of fluid, swelling	109	hydr/o	water, fluid	66
electr/o	electricity	132	hypn/o	sleep	151
embryo/o	embryo	394	hypophysi/o	pituitary, hypophysis	421
emesis	vomiting	299	hyster/o	uterus	380
encephal/o	brain	449	iatr/o	physician	111
endocrin/o	endocrine	421	ile/o	ileum	291
enter/o	intestine	290	ili/o	ilium	524
epididym/o	epididymis	353	immun/o	immunity, immune system	225
episi/o	vulva	381	in/o	fiber, muscle fiber	560
erg/o	work	132, 560	insul/o	pancreatic islets	421
erythr/o-	red, red blood cell	225	ir, irit/o, irid/o	iris	496
erythrocyt/o	red blood cell	225	jejun/o	jejunum	291
esophag/o	esophagus	290	kali	potassium	227
fasci/o	fascia	560	kary/o	nucleus	63
fer	carry	446	kerat/o	cornea, keratin, horny layer of skin	496, 583
ferr/i, ferr/o	iron	227	kin/o, kine, kinesi/o, kinet/o	movement	560
fet/o	fetus	394	labi/o	lip	289
fibr/o	fiber	63	labyrinth/o	labyrinth (inner ear)	486
galact/o	milk	394	lacrim/o	tear, lacrimal apparatus	495
gangli/o, ganglion/o	ganglion	448	lact/o	milk	394
gastr/o	stomach	290	lapar/o	abdominal wall	83
gen	origin, formation	65	laryng/o	larynx	256
ger/e, ger/o	old age	35	lent/i	lens	496
gingiv/o	gum, gingiva	289	leuk/o	white, colorless, white blood cell	225

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Appendix 5 Word Roots (Continued)

Root	Meaning	Reference Page	Root	Meaning	Reference Page
leukocyt/o	white blood cell	225	nas/o	nose	256
lingu/o	tongue	289	nat/i	birth	394
lip/o	fat, lipid	66	natri	sodium	227
listhesis	slipping	534	necrosis	death of tissue	109
lith	calculus, stone	106	nephr/o	kidney	323
lumb/o	lumbar region, lower back	83	neur/o, neur/i	nervous system, nerve	448
lymphaden/o	lymph node	197	noct/i	night	136
lymphangi/o	lymphatic vessel	197	nucle/o	nucleus	63
lymph/o	lymph, lymphatic system, lymphocyte	197	nyct/o	night, darkness	136
lymph/o, lymphocyt/o	lymphocyte	225	ocul/o	eye	495
lysis	separation, loosening, dissolving, destruction	109	odont/o	tooth, teeth	289
malacia	softening	109	onc/o	tumor	106
mamm/o	breast, mammary gland	381	onych/o	nail	583
mania	excited state, obsession	451	oo	ovum	378
mast/o	breast, mammary gland	381	oophor/o	ovary	379
medull/o	inner part, medulla oblongata, spinal cord	450	ophthalm/o	eye	495
melan/o	dark, black, melanin	583	opt/o	eye, vision	495
mening/o, meninge/o	meninges	448	orchid/o, orchio/o	testis	353
men/o, mens	month, menstruation	378	or/o	mouth	289
metr/o	measure	133, 498	osche/o	scrotum	353
metr/o, metr/i	uterus	380	osm/o	smell	481
morph/o	form, structure	63	oste/o	bone	523
muc/o	mucus, mucous membrane	63	ot/o	ear	485
muscul/o	muscle	560	ovari/o	ovary	379
myc/o	fungus, mold	110	ov/o, ovul/o	ovum	378
myel/o	bone marrow, spinal cord	225, 448, 523	ox/y	oxygen, sharp, acute	227
my/o	muscle	560	palat/o	palate	289
myring/o	tympanic membrane	485	palpebr/o	eyelid	495
myx/o	mucus	63	pancreat/o	pancreas	292
narc/o	stupor, unconsciousness	151, 450	papill/o	nipple	63
			para	woman who has given birth	394
			parathyr/o, parathyroid/o	parathyroid	421
			paresis	partial paralysis, weakness	451
			path/o	disease, any disease of	106
			ped/o	foot, child	84
			pelvi/o	pelvis	524
			perine/o	perineum	381
			periton, peritone/o	peritoneum	83

Appendix 5 Word Roots (Continued)

Root	Meaning	Reference Page	Root	Meaning	Reference Page
phac/o, phak/o	lens	496	retin/o	retina	496
phag/o	eat, ingest	65	rhabd/o	rod, muscle cell	566
pharm, pharmac/o	drug, medicine	151	rhin/o	nose	256
pharyng/o	pharynx	256	sacchar/o	sugar	66
phil	attracting, absorbing	65	sacr/o	sacrum	524
phleb/o	vein	184	salping/o	tube, uterine tube, auditory (eustachian) tube	380, 486
phobia	fear	451	schisis	fissure	524
phon/o	sound, voice	132	scler/o	hard, sclera (of eye)	106, 496
phot/o	light	132	sclerosis	hardening	109
phren/o	diaphragm	257	seb/o	sebum, sebaceous gland	583
phrenic/o	phrenic nerve	257	semin	semen	353
phyt/o	plant	150, 591	sept/o	septum, partition, dividing wall	266
pituitar/i	pituitary, hypophysis	421	sial/o	saliva, salivary gland, salivary duct	289
plas	formation, molding, development	65	sider/o	iron	227
pleur/o	pleura	257	sigmoid/o	sigmoid colon	291
pneum/o, pneumat/o	air, gas, lung, respiration	257	skelet/o	skeleton	522
pneumon/o	lung	257	somat/o	body	63
pod/o	foot	84	somn/i, somn/o	sleep	450
proct/o	rectum	291	son/o	sound, ultrasound	132
prostat/o	prostate	353	spasm	sudden contraction, cramp	109
prote/o	protein	66	sperm/i	semen, spermatozoa	353
psych/o	mind	450	spermat/o	semen, spermatozoa	353
ptosis	dropping, downward displacement, prolapse	109	sphygm/o	pulse	182
ptysis	spitting	265	spir/o	breathing	257
puer	child	402	splen/o	spleen	197
pulm/o, pulmon/o	lung	257	spondyl/o	vertebra	524
pupill/o	pupil	496	staped/o, stapedi/o	stapes	486
pyel/o	renal pelvis	323	staphyl/o	grapelike cluster, Staphylococcus	110
pylor/o	pylorus	290	stasis	suppression, stoppage	109
py/o	pus	106	steat/o	fatty	66
pyr/o, pyret/o	fever, fire	106, 152	stenosis	narrowing, constriction	109
rachi/o	spine	524	steth/o	chest	493
radicul/o	root of spinal nerve	448	sthen/o	strength	566
radi/o	radiation, x-ray	132			
rect/o	rectum	291			
ren/o	kidney	323			
reticul/o	network	63			

(Continued)

Appendix 5 Word Roots (Continued)

Root	Meaning	Reference Page	Root	Meaning	Reference Page
stoma, stomat/o	mouth	289	tympan/o	tympanic cavity (middle ear), tympanic membrane	485
synov/i	synovial joint, synovial membrane	523	ureter/o	ureter	324
tax/o	order, arrangement	566	urethr/o	urethra	324
ten/o, tendin/o	tendon	560	ur/o	urine, urinary tract	324
terat/o	malformed fetus	401	urin/o	urine	324
test/o	testis, testicle	353	uter/o	uterus	380
thalam/o	thalamus	450	uve/o	uvea (of eye)	496
therm/o	heat, temperature	132	uvul/o	uvula	289
thorac/o	chest, thorax	83	vagin/o	sheath, vagina	380
thromb/o	blood clot	225	valv/o, valvul/o	valve	183
thrombocyt/o	platelet, thrombocyte	225	varic/o	twisted and swollen vein, varix	193
thym/o	thymus gland	197	vascul/o	vessel	184
thyr/o, thyroid/o	thyroid	421	vas/o	vessel, duct, vas deferens	152, 184, 353
toc/o	labor	394	ven/o, ven/i	vein	184
ton/o	tone	560	ventricul/o	cavity, ventricle	183, 450
tonsil/o	tonsil	197	vertebr/o	vertebra, spinal column	524
tox/o, toxic/o	poison, toxin	106, 109, 152	vesic/o	urinary bladder	324
trache/o	trachea	256	vesicul/o	seminal vesicle	353
trich/o	hair	583	vestibul/o	vestibule, vestibular apparatus (of ear)	486
trop/o	turning	503	vir/o	virus	110
trop	act(ing) on, affect(ing)	65	vulv/o	vulva	381
troph/o	feeding, growth, nourishment	65	xen/o	foreign, strange	457

Appendix 6

Appendix 6

Suffixes

Suffix	Meaning	Reference Page	Suffix	Meaning	Reference Page
-ac	pertaining to	20	-ia	condition of	17
-agogue	promoter, stimulator	394	-ian	specialist	18
-al	pertaining to	20	-ia/sis	condition of	17
-algasia	pain	108, 482	-iatrics	medical specialty	18
-algia	pain	108	-iatry	medical specialty	18
-ar	pertaining to	20	-ic	pertaining to	20
-ary	pertaining to	20	-ical	pertaining to	20
-ase	enzyme	66	-ics	medical specialty	18
-blast	immature cell, productive cell, embryonic cell	65	-ile	pertaining to	20
-capnia	carbon dioxide (level of)	255	-ism	condition of	17
-cele	hernia, localized dilation	108	-ist	specialist	18
-centesis	puncture, tap	134	-itis	inflammation	108
-clasis, -clasia	breaking	108	-lalia	speech, babble	451
-cyte	cell	63	-lepsy	seizure	451
-desis	binding, fusion	134	-lexia	reading	451
-dilation, -dilatation	expansion, widening	109	-listhesis	slipping	530
-ectasia, -ectasis	dilation, dilatation, distention	109	-logy	study of	18
-ectomy	excision, surgical removal	134	-lysis	separation, loosening, dissolving, destruction	109
-edema	accumulation of fluid, swelling	109	-lytic	dissolving, reducing, loosening	151
-emia	condition of blood	224	-malacia	softening	109
-esthesia, -esthesi/o	sensation	482	-mania	excited state, obsession	451
-form	like, resembling	20	-megaly	enlargement	108
-gen, -genesis	origin, formation	65	-meter	instrument for measuring	133
-geusia	sense of taste	482	-metry	measurement of	133
-gram	record of data	133	-mimetic	mimicking, simulating	151
-graph	instrument for recording data	133	-necrosis	death of tissue	109
-graphy	act of recording data	133	-odynia	pain	108
-hemi	half, one side	36	-oid	like, resembling	20
-hemia	condition of blood	224	-oma	tumor	108
			-opia	eye, vision	497
			-opsia	vision	497
			-ory	pertaining to	20

(Continued)

Appendix 6 Suffixes (Continued)

Suffix	Meaning	Reference Page	Suffix	Meaning	Reference Page
-ose	sugar	66	-rhea	flow, discharge	108
-o/sis	condition of	17	-rhexis	rupture	108
-osmia	sense of smell	482	-schisis	fissure, splitting	108
-ous	pertaining to	20	-sclerosis	hardening	109
-oxia	oxygen (level of)	255	-scope	instrument for viewing or examining	134
-paresis	partial paralysis, weakness	451	-scopy	examination of	134
-pathy	disease, any disease of	108	-sis	condition of	17
-penia	decrease in, deficiency of	224	-some	body, small body	63
-pexy	surgical fixation	134	-spasm	sudden contraction, cramp	109
-phasia	speech	451	-stasis	suppression, stoppage	109
-philic	attracting, absorbing	63	-spermia	condition of semen	354
-phobia	fear	451	-stenosis	narrowing, constriction	109
-phonia	voice	255	-stomy	surgical creation of an opening	135
-plasia	formation, molding, development	63	-tome	instrument for incising (cutting)	135
-plasty	plastic repair, plastic surgery, reconstruction	135	-tomy	incision, cutting	135
-plegia	paralysis	451	-toxin	poison	109
-pnea	breathing	255	-tripsy	crushing	135
-poiesis	formation, production	224	-tropic	act(ing) on, affect(ing)	151
-ptosis	dropping, downward displacement, prolapse	109	-trophy, -trophia	feeding, growth, nourishment	63
-rhage, -rhagia	bursting forth, profuse flow, hemorrhage	108	-uresis	urination	324
-rhaphy	surgical repair, suture	135	-uria	condition of urine, urination	324
			-y	condition of	17

Appendix 7

Appendix 7 Prefixes

Prefix	Meaning	Reference Page	Prefix	Meaning	Reference Page
a-	not, without, lack of, absence	39	hetero-	other, different, unequal	41
ab-	away from	40	homo-, homeo-	same, unchanging	41
acro-	extremity, end	84	hyper-	over, excess, increased, abnormally high	41
ad-	toward, near	40	hypo-	under, below, decreased, abnormally low	41
ambly-	dim	502	im-	not	39
an-	not, without, lack of, absence	39	in-	not	39
ante-	before	43	infra-	below	84
anti-	against	39, 151	inter-	between	84
atel/o-	incomplete	264	intra-	in, within	84
auto-	self	233	iso-	equal, same	41
bi-	two, twice	36	juxta-	near, beside	85
brachy-	short	360	leuk/o-	white, colorless, white blood cell	38
brady-	slow	107	macro-	large, abnormally large	41
circum-	around	84	mal-	bad, poor	107
contra-	against, opposite, opposed	39, 151	mega-, megal/o-	large, abnormally large	41
counter-	against, opposite, opposed	151	melan/o-	black, dark, melanin	38
cyan/o-	blue	38	mes/o-	middle	44
de-	down, without, removal, loss	39	micro-	small, one millionth	42
dextr/o-	right	44	mon/o-	one	36
di-	two, twice	36	multi-	many	36
dia-	through	40	neo-	new	42
dipl/o-	double	36	non-	not	39
dis-	absence, removal, separation	39	normo-	normal	42
dys-	abnormal, painful, difficult	107	nulli-	never	394
ec-	out, outside	44	olig/o-	few, scanty, deficiency of	41
ecto-	out, outside	44	ortho-	straight, correct, upright	42
end/o-	in, within	44	pachy-	thick	107
epi-	on, over	84	pan-	all	41
equi-	equal, same	41	para-	near, beside, abnormal	85
erythr/o-	red	38	per-	through	40
eu-	true, good, easy, normal	41			
ex/o-	away from, outside	44			
extra-	outside	84			
hemi-	half, one side	36			

(Continued)

Appendix 7 Prefixes (Continued)

Prefix	Meaning	Reference Page	Prefix	Meaning	Reference Page
peri-	around	84	strept/o-	twisted chain, streptococcus	110
poikilo-	varied, irregular	42	sub-	below, under	84
poly-	many, much	36	super-	above, excess	41
post-	after, behind	43	supra-	above	85
pre-	before, in front of	43	syn-, sym-	together	44
presby-	old	498	tachy-	rapid	107
prim/i-	first	36	tel/e-, tel/o-	end	44
pro-	before, in front of	43	tetra-	four	36
pseudo-	false	42	trans-	through	40
quadr/i-	four	36	tri-	three	36
re-	again, back	42	un-	not	39
retro-	behind, backward	85	uni-	one	36
semi-	half, partial	36	xanth/o-	yellow	38
sinistr/o-	left	44	xero-	dry	107
staphyl/o-	grapelike cluster, staphylococcus	110			

Appendix 8

Appendix 8-1

Metric Measurements

Unit	Abbreviation	Metric Equivalent	U.S. Equivalent
Units of Length			
kilometer	km	1,000 m	0.62 mi; 1.6 km/mi
meter*	m	100 cm; 1,000 mm	39.4 in.; 1.1 yards
centimeter	cm	1/100 m; 0.01 m	0.39 in.; 2.5 cm/in.
millimeter	mm	1/1,000 m; 0.001 m	0.039 in.; 25 mm/in.
micrometer	mcm	1/1,000 mm; 0.001 mm	
Units of Weight			
kilogram	kg	1,000 g	2.2 lb
gram*	g	1,000 mg	0.035 oz; 28.5 g/oz
milligram	mg	1/1,000 g; 0.001 g	
microgram	mcg	1/1,000 mg; 0.001 mg	
Units of Volume			
liter*	L	1,000 mL	1.06 qt
deciliter	dL	1/10 L; 0.1 L	
milliliter	mL	1/1,000 L; 0.001 L	0.034 oz; 29.4 mL/oz
microliter	mL	1/1,000 mL; 0.001 mL	

*Basic unit.

Appendix 8-2

Metric Prefixes

Prefix	Meaning of Prefix
kilo-	1,000
deci-	1/10; one tenth
centi-	1/100; one hundredth
milli-	1/1,000; one thousandth
micro-	1/1,000,000; one millionth

Appendix 9

Stedman's Medical Dictionary at a Glance

an-ti-bod-y (an'tē-bod'e) *Avoid the jargonsitic use of the plural antibodies when the reference is to a single antibody species.* An immunoglobulin molecule produced by B-lymphoid cells that combine specifically with an immunogen or antigen. A.'s may be present naturally, their specificity is determined through gene rearrangement or somatic replacement or may be synthesized in response to stimulus provided by the introduction of an antigen; a.'s are found in the blood and body fluids, although the basic structure of the molecule consists of two light and two heavy chains, a.'s may also be found as dimers, trimers, or pentamers. After binding antigen, some a.'s may fix, complement, bind to surface receptors on immune cells, and in some cases may neutralize microorganisms, SEE ALSO immunoglobulin. SYN immune protein, protective protein, sensitizer (2).

Usage notes appear in italics before definition

Pronunciation

Main entry

Subentry

Cross references in blue indicate where to find the defined / preferred term. In multi-word terms, the italicized term indicates the main entry under which the term can be found.

Large header for entries with numerous subentries

Indicates term is illustrated

Etymologies appear in brackets

Abbreviation

Main word is abbreviated in subentries

High profile terms (entries) with broad significance to the practice of medicine and to the world appear in blue boxes

Cross references

ANTIGEN

an-ti-gen (Ag) (an'ti-jen). Any substance that, as a result of coming in contact with appropriate cells, induces a state of sensitivity or immune responsiveness and that reacts in a demonstrable way with antibodies or immune cells of the sensitized subject in vivo or in vitro. Modern usage tends to retain the broad meaning of a., employing the terms "antigenic determinant" or "determinant group" for the particular chemical group of a molecule that confers antigenic specificity. SEE ALSO hapten, SYN immunogen. [anti-body) + G, -gen, producing.]

Australia a. [MIM*209800], an a. so called because first recognized in an Australian aborigine, but now known to be a subunit of the hepatitis B virus surface antigen. SYN Au a. (2), Aus a.

carcinoembryonic a. (CEA), a glycoprotein constituent of the glycocalyx of embryonic endodermal epithelium, which may be elevated in the serum of some patients with colon cancer and certain other cancers and in serum of long-term tobacco smokers.

conjugated a., SYN *conjugated hapten.*

prostate-specific a. (PSA), a single-chain, 31-kD glycoprotein with 240 amino acid residues and 4 carbohydrate side-chains; a kallikrein protease produced by prostatic epithelial cells and normally found in seminal fluid and circulating blood. Elevations of serum PSA are highly organ-specific but occur in both cancer (adenocarcinoma) and benign disease (e.g. benign prostatic hyperplasia, prostatitis). A significant number of patients with organ-confined cancer have normal PSA values. SEE carcinoma of the prostate. SYN human glandular kallikrein 3.

KEY

	Combining Forms
	Indicates term is illustrated, see <i>Illustration Index</i>
SYN	Synonym
Cf.	Compare
[NA]	Nomina Anatomica
[TA]	Terminologia Anatomica
☆	Official alternate Terminologia Anatomica term
[MIM]	Mendelian Inheritance in Man
C.I.	Color Index

Answer Key

Chapter 1

PRETEST

1. c
2. a
3. d
4. a
5. c
6. b
7. a
8. c

CHAPTER REVIEW

1. suffix
2. combining form
3. diarrhea
4. alcohol, ethyl alcohol
5. pertaining to
6. cardiology
7. examination of
8. increase(d)
9. b
10. d
11. d
12. b
13. c
14. b
15. a
16. *dis-LEK-sē-a*
17. *RŪ-ma-tizm*
18. *nū-MAT-ik*
19. *KEM-ist*
20. *FAR-ma-sē*
21. cardiac
22. hydrogen
23. ocular
24. interface
25. rheumatic
26. gastritis (*gas-TRĪ-tis*)
27. neurology (*nū-ROL-ō-jē*)
28. nephroptosis (*nef-rop-TŌ-sis*)
29. nephrology (*nef-ROL-ō-jē*)
30. neuritis (*nū-RĪ-tis*)
31. cardiopptosis (*kar-dē-op-TŌ-sis*)
32. difficult or painful menstruation
 - a. abnormal, painful, difficult
 - b. menses, menstruation
 - c. flow, discharge
33. physician who specializes in study of the heart
 - a. heart
 - b. study of
 - c. specialist in a field of study
34. inflammation of the kidney
 - a. kidney
 - b. inflammation

35. pertaining to the kidney and stomach
 - a. kidney
 - b. stomach
 - c. pertaining to

CASE STUDY QUESTIONS

1. c
2. d
3. a
4. b
5. anterior cruciate ligament
6. complains (complaining) of
7. over, excess, abnormally high, increased
8. as needed
9. a. excess
 - b. fat
 - c. condition of blood
10. a. straight
 - b. foot/child
11. between

Chapter 2

PRETEST

1. c
2. d
3. a
4. c
5. a
6. c

CHAPTER EXERCISES

EXERCISE 2-1

1. -ia
2. -sis, -iasis
3. -ism
4. -y
5. -ia
6. -ism
7. -sis, -osis
8. -y
9. -sis, -esis

EXERCISE 2-2

1. -ist
2. -logy
3. -iatrics
4. -logy
5. -ian
6. -ist
7. anatomist
8. pediatrician

9. radiologist
10. psychologist
11. technologist; also, technician
12. obstetrician

EXERCISE 2-3

1. -ary
2. -al
3. -ic
4. -ous
5. -form
6. -oid
7. -al, -ical
8. -ile
9. -ic
10. -al, -ical
11. -ar
12. -ary
13. -ory
14. -ic
15. -ar

EXERCISE 2-4

1. patellae (*pa-TEL-ē*)
2. phenomena (*fe-NOM-e-na*)
3. omentā (*ō-MEN-ta*)
4. prognoses (*prog-NŌ-sēz*)
5. apices (*AP-i-sēz*)
6. ova (*Ō-va*)
7. spermatozoa (*sper-ma-tō-ZŌ-a*)
8. meninges (*me-NIN-jeēz*)
9. emboli (*EM-bō-lī*)
10. protozoan (*prō-tō-ZŌ-on*)
11. appendix (*a-PEN-diks*)
12. adenoma (*ad-e-NŌ-ma*)
13. fungus (*FUN-gus*)
14. pelvis (*PEL-vis*)
15. foramen (*fō-RĀ-men*)
16. curriculum (*kur-RIK-ū-lum*)
17. index (*IN-deks*)
18. alveolus (*al-VĒ-ō-lus*)

CHAPTER REVIEW

1. -ism
2. -ia
3. -sis, -osis
4. -y
5. -sis, -osis
6. -ia
7. -iatry
8. -ics
9. -ist
10. -ian
11. -ist
12. -ian
13. pediatrician

14. dermatologist
15. physiologist
16. gynecologist
17. -ic
18. -al
19. -ous
20. -oid
21. -ar
22. -al
23. -ic
24. -ary
25. -al
26. -oid
27. -ile
28. -al, -ical
29. -ar
30. -ory
31. gingivae (*JIN-ji-vē*)
32. testes (*TES-tēz*)
33. ganglia (*GANG-lē-a*)
34. lumina (*LŪ-mi-na*)
35. loci (*LŌ-sī*)
36. criteria (*kri-TIR-ē-a*)
37. larynges (*la-RIN-jēz*)
38. venae (*VĒ-nē*)
39. nuclei (*NŪ-klē-ī*)
40. thrombus (*THROM-bus*)
41. vertebra (*VER-te-bra*)
42. bacterium (*bak-TĒ-rē-um*)
43. alveolus (*al-VĒ-ō-lus*)
44. apex (*Ā-peks*)
45. foramen (*fō-RĀ-men*)
46. diagnosis (*dī-ag-NŌ-sis*)
47. carcinoma (*kar-si-NŌ-ma*)

WORD BUILDING

48. parasitic
49. parasitologist
50. parasitism
51. parasitology

WORD ANALYSIS

52. specialist in care of the aged
 - a. old, old age
 - b. physician
 - c. pertaining to
 - d. specialist
53. lack of sensation
 - a. not
 - b. sensation
 - c. condition of
54. pain caused by light; intolerance of light
 - a. light
 - b. fear
 - c. condition of

CASE STUDY QUESTIONS

1. c
2. b
3. b

4. c
5. a
6. pulmonologist, stylist, manicurist, therapist
7. -ic: bronchoscopic, antibiotic
-ory: respiratory
-ile: febrile
-ary: pulmonary
-ical, al: chemical

Chapter 3

PRETEST

1. d
2. a
3. c
4. a
5. b
6. d
7. b
8. c

CHAPTER EXERCISES

EXERCISE 3-1

1. uni- (b); bi- (d); tri (a); tetra- (c)
2. two
3. four
4. one
5. half
6. two
7. four
8. three
9. one
10. bi-
11. multi-
12. semi-
13. uni-

EXERCISE 3-2

1. d
2. c
3. a
4. b
5. e

EXERCISE 3-3

1. a-; not, without, lack of, absence
2. anti-; against
3. a-; not, without (root *mnem/o* means "memory")
4. dis-; absence, removal, separation
5. contra-; against, opposite, opposed
6. in-; not
7. de-; down, without, removal, loss
8. non-; not
9. unconscious
10. insignificant
11. disinfect
12. unusual
13. nonspecific

14. decongestant
15. incompatible

EXERCISE 3-4

1. dia-; through
2. per-; through
3. ad-; toward, near
4. ab-; away from
5. dia-; through
6. trans-; through

EXERCISE 3-5

1. c
2. e
3. d
4. b
5. a

EXERCISE 3-6

1. d
2. e
3. c
4. b
5. a
6. homeo-; same, unchanging
7. equi-; equal, same
8. ortho-; straight, correct, upright
9. re-; again, back
10. eu-; true, good, easy, normal
11. neo-; new
12. mega-; large, abnormally large
13. iso-; equal, same
14. normo-; normal
15. heterogeneous (*het-er-ō-JĒ-nē-us*)
16. microscopic (*mī-krō-SKOP-ik*)

EXERCISE 3-7

1. e
2. a
3. b
4. c
5. d
6. pre-; before, in front of
7. post-; after, behind
8. pro-; before, in front of
9. pre-; before, in front of
10. ante-; before

EXERCISE 3-8

1. e
2. c
3. a
4. b
5. d
6. sym-; together
7. ex-; away from, outside
8. ecto-; out, outside
9. syn-; together
10. endo-; in, within
11. endogenous (*en-DOJ-e-nus*)
12. sinistromanual (*sin-is-trō-MAN-ū-al*)
13. endoderm (*EN-dō-derm*)

CHAPTER REVIEW

1. e
2. c
3. d
4. b
5. a
6. d
7. c
8. a
9. b
10. e
11. e
12. d
13. a
14. b
15. c
16. e
17. a
18. b
19. c
20. d
21. one
22. three
23. left
24. two
25. opposite
26. four
27. areflexic
28. hyper-; over, excess, abnormally high, increased
29. trans-; through
30. dis-; absence, removal, separation
31. post-; after
32. re-; again, back
33. ex-; away from, outside
34. ad-; toward, near
35. un-; not
36. ecto-; out, outside
37. de-; removal, without
38. semi-; half, partial
39. pre-; before, in front of
40. per-; through
41. dia-; through
42. anti-; against
43. micro-; small
44. dis-; absence, removal, separation
45. endo-; in, within
46. sym-; together
47. pro-; before, in front of
48. in-; not
49. T
50. F; one
51. T
52. F; four
53. F; right
54. F; three
55. T
56. T
57. T
58. dehumidify
59. adduct
60. impermeable

61. homogeneous
62. endotoxin
63. macroscopic
64. hypoventilation
65. presynaptic
66. aseptic
67. hypersensitivity
68. macrocyte
69. prenatal
70. equilateral

WORD BUILDING

71. microcytic
72. ectocardia
73. monocytic
74. dextrocardia
75. endocardial
76. macrocytic
77. microcardia
78. of equal dimensions
 - a. equal, same
 - b. measure
 - c. pertaining to
79. association of two or more organisms
 - a. together
 - b. life
 - c. condition of
80. pertaining to a single colony (clone) of cells
 - a. one
 - b. colony, clone
 - c. pertaining to

CASE STUDY QUESTIONS

1. pre-; before, in front of
2. an-; not, without, lack of, absence
3. dis-; absence, removal, separation
4. re-; again, back
5. bi-; two, twice
6. hemi-; half, one side
7. de-; down, without, removal, loss
8. anti-; against
9. erythr/o; red
10. prim/i; first
11. condition of
12. pertaining to
13. one
14. three
15. preoperative
16. postoperative
17. abduction
18. leukocyte

Chapter 4

PRETEST

1. b
2. a
3. d

4. c
5. c
6. a
7. a
8. c

CHAPTER EXERCISES

EXERCISE 4-1

1. cells
2. fiber
3. tissues
4. forms
5. nucleus
6. nucleus
7. gland
8. nipple
9. mucus
10. network
11. mucus
12. body
13. morphology (*mor-FOL-ō-jē*)
14. cytology (*sī-TOL-ō-jē*)
15. histology (*his-TOL-ō-jē*)

EXERCISE 4-2

1. d
2. c
3. e
4. b
5. a
6. d
7. c
8. e
9. b
10. a
11. gen; origin, formation
12. phag/o; eat, ingest
13. blast; immature cell, productive cell, embryonic cell
14. plas; formation, molding, development
15. troph; feeding, growth, nourishment

EXERCISE 4-3

1. sugars
2. sugar
3. water
4. starch
5. lipid, fat
6. glucose
7. fat, lipid
8. steat/o; fatty
9. lip/o; lipid, fat
10. glyc/o; sugar, glucose
11. gluc/o; glucose

CHAPTER REVIEW

LABELING EXERCISE

Diagram of a Typical Animal Cell

1. plasma membrane
2. nucleus

3. nuclear membrane
4. nucleolus
5. cytosol
6. smooth endoplasmic reticulum (ER)
7. rough endoplasmic reticulum (ER)
8. ribosomes
9. mitochondrion
10. Golgi apparatus
11. lysosome
12. vesicle
13. peroxisome
14. centriole
15. microvilli

TERMINOLOGY

1. b
2. d
3. e
4. a
5. c
6. e
7. c
8. b
9. a
10. d
11. d
12. a
13. b
14. c
15. e
16. e
17. a
18. c
19. b
20. d
21. d
22. c
23. a
24. e
25. b
26. b
27. e
28. a
29. d
30. c
31. b
32. c
33. d
34. a
35. e
36. metabolism
37. epithelial, connective, muscle, and nervous tissue
38. histology
39. integumentary system
40. lymphatic system
41. glucose
42. nucleus
43. enzyme
44. cells
45. water

46. morphology
47. mucus
48. F; lipid, fat
49. F; water
50. T
51. T
52. T
53. adenoid
54. leukoblast
55. lipase
56. mucoid
57. histioblast
58. amylase
59. amyloid
60. a state of internal balance
 - a. same, unchanging
 - b. standing still, unchanging
 - c. condition of
61. having a stimulating effect on the body
 - a. body
 - b. act on, affect
 - c. pertaining to
62. destruction and disposal of damaged organelles in the cell
 - a. self
 - b. to eat
 - c. condition of
63. reduced secretion of fatty material by the skin's sebaceous (oil) glands
 - a. not, without, lack of, absence
 - b. fatty
 - c. condition of

CASE STUDY QUESTIONS

1. b
2. c
3. b
4. a
5. mono-; one
6. pro-; before, in front of
7. a-; not, without, lack of, absence
8. bi-; two
9. dis-; absence, removal, separation
10. neutrophils, eosinophils, basophils
11. plastic, thromboplastin
12. morphologic
13. histologic
14. lymphocyte(s), monocytes, cytoplasm, lymphocytic

Chapter 5

PRETEST

1. d
2. b
3. b
4. a
5. b

6. d
7. b
8. a

CHAPTER EXERCISES

EXERCISE 5-1

1. abdominal (*ab-DOM-i-nal*)
2. cephalic (*se-FAL-ik*)
3. cervical (*SER-vi-kal*)
4. thoracic (*thō-RAS-ik*)
5. lumbar (*LUM-bar*)
6. peritoneum
7. abdomen
8. head
9. abdominal wall

EXERCISE 5-2

1. extremities (hands and feet)
2. arms
3. finger or toe
4. arm and head
5. foot

EXERCISE 5-3

1. circumoral
2. infrascapular
3. circumvascular
4. subcostal
5. periorbital
6. suprapatellar
7. extracellular
8. suprascapular
9. intrathoracic
10. near the nose
11. behind the peritoneum
12. above the abdomen
13. within the uterus
14. around the navel (umbilicus)
15. between the buttocks
16. above the ankle
17. within the eye
18. near the sacrum

CHAPTER REVIEW

LABELING EXERCISE

Directional Terms

1. superior (cranial)
2. inferior (caudal)
3. anterior (ventral)
4. posterior (dorsal)
5. medial
6. lateral
7. proximal
8. distal

Planes of Division

1. frontal (coronal) plane
2. sagittal plane
3. transverse (horizontal) plane

Body Cavities, Lateral View

1. dorsal cavity
2. cranial cavity
3. spinal cavity (canal)
4. ventral cavity
5. thoracic cavity
6. diaphragm
7. abdominopelvic cavity
8. abdominal cavity
9. pelvic cavity

The Nine Regions of the Abdomen

1. epigastric (*ep-i-GAS-trik*) region
2. umbilical (*um-BIL-i-kal*) region
3. hypogastric (*hī-pō-GAS-trik*) region
4. right hypochondriac (*hī-pō-KON-drē-ak*) region
5. left hypochondriac region
6. right lumbar (*LUM-bar*) region
7. left lumbar region
8. right iliac (*IL-ē-ak*) region; also inguinal (*ING-gwi-nal*) region
9. left iliac region; also, inguinal region

CHAPTER REVIEW**TERMINOLOGY**

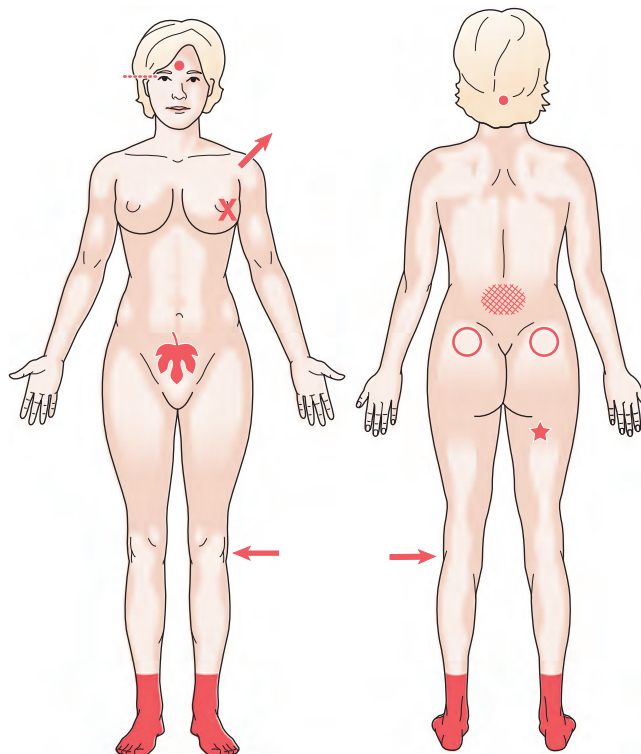
1. e
2. b
3. d
4. c
5. a
6. d
7. e
8. b
9. c
10. a
11. c
12. e
13. a
14. b
15. d
16. F; dorsal
17. T
18. T
19. F; frontal, coronal
20. T
21. F; inferior
22. F; face-up
23. T
24. small of back
25. wrist
26. back of knee
27. base of skull
28. finger or toe
29. neck
30. abdomen
31. arm

32. around the mouth
33. above the pubis
34. below the umbilicus (navel)
35. between the ribs
36. under the tongue
37. behind the peritoneum
38. having two feet
39. dorsal
40. periocular
41. inframammary
42. anterior
43. megacephaly, macrocephaly
44. superficial
45. distal
46. suprascapular
47. intracellular
48. inferior
49. spinal cavity; The *spinal cavity* is a dorsal cavity; the others are ventral cavities.
50. cervical region; *Cervical* refers to the neck; the others are abdominal regions.
51. sagittal; *Sagittal* refers to a plane of division; the others are body positions.
52. lumb/o; The root *lumb/o* refers to the small of the back; the others refer to the extremities.
53. intracephalic
54. infrathoracic
55. extrathoracic
56. polydactyly

57. syndactyly
58. cephalothoracic
59. adactyly
60. dactylospasm
61. acephaly
62. having an average sized head; normocephalic
 - a. middle
 - b. head
 - c. pertaining to
63. bluish discoloration of the hands or feet
 - a. extremity
 - b. blue
 - c. condition of
64. pertaining to the forearm
 - a. before
 - b. arm
 - c. pertaining to
65. pertaining to the epigastrium, the uppermost region of the abdomen
 - a. on, over
 - b. stomach
 - c. pertaining to

CASE STUDY QUESTIONS

1. b
2. c
3. e
4. d
5. b
- 6–15. See diagrams.



16. a
17. e
18. on back, legs flexed on abdomen, thighs apart
19. on back with head lowered by tilting the bed at a 45 degree angle
20. lying face down

Chapter 6

PRETEST

1. d
2. c
3. b
4. a
5. c
6. c
7. a
8. d

CHAPTER EXERCISES

EXERCISE 6-1

1. pyr/o; fever
2. path/o; disease
3. py/o; pus
4. tox/o; poison
5. cancer, carcinoma
6. pus
7. fever
8. disease
9. calculus, stone
10. toxin, poison
11. hardening
12. pain
13. tumor

EXERCISE 6-2

1. b
2. a
3. d
4. e
5. c
6. xero-; dry
7. dys-; abnormal, painful, difficult
8. mal-; bad, poor

EXERCISE 6-3

1. d
2. a
3. b
4. e
5. c
6. c
7. a
8. d
9. b
10. e
11. pain in a muscle

12. any disease of muscle
13. rupture of a muscle
14. pain in a muscle
15. tumor of muscle

EXERCISE 6-4

1. e
2. d
3. b
4. a
5. c
6. softening of the spleen
7. dropping or prolapse of the spleen
8. substance poisonous or harmful to the spleen

EXERCISE 6-5

1. bacteria
2. fungus
3. bacilli
4. grapelike cluster
5. twisted chain
6. mycology (*mī-KOL-ō-jē*)
7. virology (*vī-ROL-ō-jē*)
8. bacteriology (*bak-tēr-ē-OL-ō-jē*)

CHAPTER REVIEW

1. b
2. c
3. d
4. e
5. a
6. e
7. c
8. d
9. b
10. a
11. a
12. e
13. b
14. d
15. c
16. e
17. b
18. d
19. a
20. c
21. d
22. e
23. b
24. c
25. a
26. d
27. e
28. a
29. c
30. b
31. b
32. d

33. e
34. c
35. a
36. inflammation
37. neoplasm
38. metastasis
39. hernia
40. toxins; poisons
41. necrosis
42. tumor
43. -rhea; flow, discharge
44. protozoon
45. worm
46. carcinogenesis (*kar-sin-ō-JEN-e-sis*)
47. pyogenesis (*pī-ō-JEN-e-sis*)
48. pathogenesis (*path-ō-JEN-e-sis*)
49. oncogenesis (*ong-kō-JEN-e-sis*)
50. bronchospasm (*BRONG-kō-spazm*)
51. bronchitis (*brong-KĪ-tis*)
52. bronchostenosis (*brong-kō-sten-ō-sis*)
53. bronchorrhea (*brong-kō-RĒ-a*)
54. osteonecrosis (*os-tē-ō-ne-KRŌ-sis*)
55. osteomalacia (*os-tē-ō-ma-LĀ-shē-a*)
56. osteoclasia (*os-tē-OK-la-sis*)
57. osteoma (*os-tē-Ō-ma*)
58. osteolysis (*os-tē-OL-i-sis*)
59. T
60. F; streptococci
61. F; acute
62. T
63. F; bradycardia
64. T
65. helminths; *Helminths* are worms; the others are types of bacteria.
66. pathogen; A *pathogen* is a disease-causing microorganism; the others are terms related to neoplasia.
67. metastatic; *Metastatic* refers to the spread of cancer; the others are terms describing infections.
68. nephrotoxic (*nef-rō-TOKS-ik*)
69. pyogenic (*pī-ō-JEN-ik*)
70. nephroma (*nef-RŌ-ma*)
71. pathology (*pa-THOL-ō-jē*)
72. pyrogenic (*pī-rō-JEN-ik*)
73. nephrology (*nef-ROL-ō-jē*)
74. pathogenic (*path-ō-JEN-ik*)
75. nephropathy (*nef-ROP-a-thē*)
76. nephrogenic (*nef-rō-JEN-ik*)
77. counteracting fever
 - a. against
 - b. fever
 - c. pertaining to
78. hardening of the arteries
 - a. artery
 - b. hard
 - c. condition of
79. Ingestion of organisms or small particles by a cell

- a. to eat
 - b. cell
 - c. condition of
80. Excessive growth of normal cells in normal arrangement
- a. over, excess, increased, abnormally high
 - b. formation, molding, development
 - c. condition of

CASE STUDY QUESTIONS

1. c
2. c
3. d
4. a
5. c
6. b
7. a
8. e
9. gland
10. bacillus
11. sarcoma
12. malignant hyperpyrexia (also, hyperthermia)
13. human immunodeficiency virus
14. purified protein derivative
15. electrocardiogram
16. acid-fast bacillus

Chapter 7

PRETEST

1. b
2. c
3. d
4. a
5. d
6. a

CHAPTER EXERCISES

EXERCISE 7-1

1. e
2. a
3. d
4. b
5. c
6. son/o; sound
7. aer/o; air (oxygen)
8. erg/o; work
9. therm/o; heat, temperature
10. chron/o; time
11. chrom/o; color
12. pressure
13. cold
14. light
15. electricity
16. sound

EXERCISE 7-2

1. a
2. d
3. b
4. e
5. c
6. d
7. a
8. c
9. e
10. b

EXERCISE 7-3

1. b
2. e
3. d
4. a
5. c
6. cystotomy (*sis-TOT-ō-mē*)
7. cystorrhaphy (*sis-TOR-a-fē*)
8. cystostomy (*sis-TOS-tō-mē*)
9. cystopexy (*SIS-tō-pek-sē*)
10. cystoplasty (*SIS-tō-plas-tē*)
11. arthrocentesis (*ar-thrō-sen-TĒ-sis*)
12. arthrotome (*AR-thrō-tōm*)
13. arthrodesis (*ar-THROD-e-sis*)
14. arthroplasty (*AR-thrō-plas-tē*)
15. arthrotomy (*ar-THROT-ō-mē*)
16. tracheotomy (*trā-kē-OT-ō-mē*)
17. gastorrhaphy (*gas-TRŌR-a-fē*)
18. colostomy (*kō-LOS-tō-mē*)

CHAPTER REVIEW

1. c
2. b
3. a
4. e
5. d
6. c
7. d
8. b
9. e
10. a
11. c
12. a
13. e
14. d
15. b
16. b
17. c
18. a
19. e
20. d
21. a
22. c
23. e
24. b
25. d
26. chrom/o; color
27. son/o; sound

28. radi/o; radiation, x-ray
29. therm/o; heat, temperature
30. erg/o; work
31. chron/o; time
32. aer/o; air, gas, oxygen
33. light
34. cystoplasty (*SIS-tō-plas-tē*)
35. arthrodesis (*ar-THROD-e-sis*)
36. tracheostomy (*trā-kē-OS-tō-mē*)
37. therapy (*THER-a-pē*)
38. palpation
39. prognosis
40. diagnostic
41. edematous
42. hepatotomy (*hep-a-TOT-ō-mē*)
43. hepatectomy (*hep-a-TEK-tō-mē*)
44. hepatopepy (*HEP-a-tō-pek-sē*)
45. hepatorrhaphy (*hep-a-TOR-a-fē*)
46. T
47. F; radiograph
48. T
49. F; pressure
50. T
51. T
52. remission; *Remission* is the lessening of disease symptoms; the others are examining methods.
53. syncope; *Syncope* is fainting; the others are examination instruments.
54. speculum; A *speculum* is an instrument for examining a canal; the others are surgical instruments.
55. TNM; *TNM* is an abbreviation for a system of staging cancer; the others are abbreviations for imaging techniques.
56. physician assistant
57. magnetic resonance imaging
58. history
59. range of motion
60. nonsteroidal antiinflammatory drug
61. neurotome
62. cystoscopy
63. cystolith
64. neurorrhaphy
65. lithotripsy
66. cystopexy
67. cystorrhaphy
68. neurotripsy
69. cystotome
70. describing cells or tissues that have equal attraction for the same dyes
 - a. equal, same
 - b. color
 - c. attracting, absorbing
 - d. pertaining to
71. occurring at the same time
 - a. together
 - b. time
 - c. pertaining to

72. uneven, not symmetrical
 - a. not
 - b. together
 - c. measure
 - d. pertaining to
73. formation of color or pigment
 - a. color
 - b. origin, formation
 - c. condition of

CASE STUDY QUESTIONS

1. sequelae
2. auscultation
3. mesocephalic
4. paracentesis
5. biopsy
6. diagnostic laparoscopy
7. lithotomy position
8. c
9. d
10. b
11. a
12. d
13. c
14. a
15. history of present illness
16. cancer
17. temperature, pulse, respiration
18. activities of daily living
19. beats per minute
20. within normal limits
21. discontinue
22. normal saline

Chapter 8

PRETEST

1. a
2. d
3. c
4. a
5. d
6. a
7. b
8. a

CHAPTER EXERCISES

EXERCISE 8-1

1. -lytic; dissolving, reducing, loosening
2. -tropic; acting on
3. -mimetic; mimicking, simulating
4. antiinflammatory (*an-tē-in-FLAM-a-tō-rē*)
5. contraindicated (*kon-tra-IN-dī-kā-ted*)
6. antiseptic (*an-ti-SEP-tik*)

7. counteract (*COWN-ter-act*)
8. antitoxin (*an-tē-TOK-sin*)
9. antipyretic (*an-tē-pī-RET-ik*)
10. hypn/o; sleep
11. toxic/o; poison
12. algesi/o; pain
13. chem/o; chemical
14. narc/o; stupor
15. narrowing of a vessel
16. study of drugs
17. dissolving mucus
18. acting on the gonads (sex glands)

CHAPTER REVIEW

1. d
2. c
3. b
4. e
5. a
6. d
7. a
8. e
9. b
10. c
11. c
12. b
13. e
14. a
15. d
16. d
17. c
18. e
19. a
20. b
21. e
22. c
23. e
24. d
25. a
26. d
27. a
28. e
29. a
30. e
31. d
32. d
33. e
34. pain
35. vein
36. tolerance
37. plants, herbs
38. skin
39. toxins, poisons
40. pharmacology
41. fever
42. potentiation
43. histamine H_2 antagonist; A *histamine H_2 antagonist* reduces stomach acid secretion; the others are respiratory drugs.

44. tablet; A *tablet* is a solid dosage form, a pill; the others are forms of liquid solutions.
45. antineoplastics; An *antineoplastic* kills cancer cells; the others are cardiac drugs.
46. adrenergic; An *adrenergic* is a sympathomimetic, which mimics the effects of the sympathetic nervous system; the others are drugs to eliminate sensation and relieve pain.
47. widening of the bronchi
48. reducing anxiety
49. acting on the mind
50. anticonvulsant
51. vasodilation
52. counterbalance, also imbalance
53. antitoxin
54. contraindicated
55. anticoagulant
56. *United States Pharmacopeia*
57. international unit
58. prescription
59. Food and Drug Administration
60. discontinue
61. hypnosis
62. anxiolytic
63. toxicosis
64. thrombolytic
65. thrombosis
66. narcosis
67. mucolytic
68. administration of a solution by subcutaneous infusion
 - a. under
 - b. skin
 - c. washing out
69. activated by or secreting adrenaline (epinephrine)
 - a. adrenaline
 - b. work
 - c. pertaining to
70. movement of drugs within the body as affected by biologic function
 - a. drug
 - b. movement
 - c. pertaining to

CASE STUDY QUESTIONS

1. c
2. b
3. d
4. a
5. d
6. b
7. a
8. e
9. e

10. b
11. c
12. by mouth
13. milligram
14. nonsteroidal antiinflammatory drugs
15. microgram
16. intravenous(ly)

Chapter 9

PRETEST

1. b
2. c
3. a
4. d
5. d
6. a
7. b
8. b

CHAPTER EXERCISES

EXERCISE 9-1

1. heart
2. atria
3. ventricle
4. valve
5. cardiac (*KAR-dē-ak*)
6. myocardial (*mī-ō-KAR-dē-al*)
7. atrial (*Ā-trē-al*)
8. valvular (*VAL-vū-lar*); also valvar (*VAL-var*)
9. ventricular (*ven-TRIK-ū-lar*)
10. pericardial (*per-i-KAR-dē-al*)
11. endocarditis (*en-dō-kar-DĪ-tis*)
12. myocarditis (*mī-ō-kar-DĪ-tis*)
13. pericarditis (*per-i-kar-DĪ-tis*)
14. atrioventricular (*ā-trē-ō-ven-TRIK-ū-lar*)
15. interventricular (*in-ter-ven-TRIK-ū-lar*)
16. cardiology (*kar-dē-OL-ō-jē*)
17. valvotomy (*val-VOT-ō-mē*); also, valvulotomy (*val-vū-LOT-ō-mē*)
18. cardiomegaly (*kar-dē-ō-MEG-a-lē*)

EXERCISE 9-2

1. vessel
2. artery
3. arteriole
4. vessels
5. aorta
6. vein
7. vessels
8. pertaining to the heart and vessels
9. within the aorta
10. inflammation of a vessel or vessels
11. rupture of an artery

12. inflammation of a vein
13. angiogram
14. aortogram
15. phlebogram; venogram
16. angiogenesis (*an-jē-ō-JEN-e-sis*)
17. angiectasis (*an-jē-EK-ta-sis*); also, hemangiectasis (*hē-man-jē-EK-ta-sis*)
18. angiopathy (*an-jē-OP-a-thē*)
19. angioplasty (*AN-jē-ō-plas-tē*)
20. intravenous (*in-tra-VĒ-nus*)
21. arteriotomy (*ar-tēr-ē-OT-ō-mē*)
22. phlebectomy (*fle-BEK-tō-mē*); venectomy (*vē-NEK-tō-mē*)
23. aortosclerosis (*ā-or-tō-skle-RŌ-sis*)

EXERCISE 9-3

1. lymph
2. lymph node
3. lymphatic vessels
4. spleen
5. thymus
6. tonsils
7. lymphangi/o; lymphatic vessel
8. splen/o; spleen
9. lymphaden/o; lymph node
10. tonsill/o; tonsil
11. thym/o; thymus
12. lymphangitis (*lim-fan-JĪ-tis*); also, lymphangiitis (*lim-fan-jē-Ī-tis*)
13. lymphoma (*lim-FŌ-ma*)
14. lymphadenopathy (*lim-fad-e-NOP-a-thē*)
15. splenomegaly (*splē-nō-MEG-a-lē*)
16. thymic (*THĪ-mik*)
17. tonsillitis (*ton-si-LĪ-tis*)

CHAPTER REVIEW

LABELING EXERCISE

The Cardiovascular System

1. right atrium
2. right ventricle
3. left pulmonary artery
4. left lung
5. right lung
6. left pulmonary vein
7. left atrium
8. left ventricle
9. aorta
10. head and arms
11. superior vena cava
12. internal organs
13. legs
14. inferior vena cava

The Heart and Great Vessels

1. superior vena cava
2. inferior vena cava
3. right atrium
4. right AV (tricuspid) valve

5. right ventricle
6. pulmonary valve
7. pulmonary artery
8. right pulmonary artery (branches)
9. left pulmonary artery (branches)
10. left pulmonary veins
11. right pulmonary veins
12. left atrium
13. left AV (mitral) valve
14. left ventricle
15. aortic valve
16. ascending aorta
17. aortic arch
18. brachiocephalic artery
19. left common carotid artery
20. left subclavian artery
21. apex
22. interventricular septum
23. endocardium
24. myocardium
25. epicardium

Location of Lymphoid Tissue

1. lymph nodes
2. tonsils
3. thymus
4. spleen
5. appendix
6. Peyer patches (in intestine)

TERMINOLOGY

1. c
2. a
3. e
4. b
5. d
6. b
7. c
8. e
9. a
10. d
11. e
12. a
13. b
14. c
15. d
16. c
17. a
18. d
19. b
20. e
21. b
22. e
23. d
24. a
25. c
26. atrium
27. capillaries
28. myocardium
29. aorta
30. sinoatrial (SA) node

31. right atrium
32. varicose vein, varix
33. thymus
34. vein
35. common iliac (*IL-ē-ak*) arteries
36. common carotid (*ka-ROT-id*) artery
37. inferior vena cava
38. subclavian veins
39. Holter monitor
40. atrial fibrillation
41. ablation
42. T
43. F; pulmonary circuit
44. F; vein
45. T
46. F; left ventricle
47. T
48. F; heart
49. F; arm
50. T
51. T
52. T
53. apex; The *apex* is the pointed lower region of the heart; the others are part of the heart's conduction system.
54. murmur; A *murmur* is an abnormal heart sound; the others are terms associated with blood pressure.
55. S_1 ; S_1 symbolizes the first heart sound; the others are waves of the ECG.
56. cusp; A *cusp* is a flap of a heart valve; the others are lymphoid tissue.
57. without vessels
58. incision of an atrium
59. surgical removal of the spleen
60. above a ventricle
61. dilatation of a vein
62. cardiologist
63. arteriorrhaphy (*ar-tēr-ē-OR-a-fē*)
64. splenopexy (*SPLĒ-nō-pek-sē*)
65. valvotome; valvulotome (*VAL-vō-tōm*; *VAL-vū-lō-tōm*)
66. lymphostasis (*lim-FOS-ta-sis*)
67. lymphadenectomy (*lim-fad-e-NEK-tō-mē*)
68. aortoptosis (*ā-or-top-TŌ-sis*)
69. aortostenosis (*ā-or-tō-ste-NŌ-sis*)
70. aortogram (*ā-OR-tō-gram*)
71. preaortic (*prē-ā-OR-tik*)
72. atrial
73. thymic
74. venous
75. septal
76. sclerotic
77. splenic; splenetic
78. thrombi

79. varices
80. stenoses
81. septa
82. automated external defibrillator
83. left ventricular assist device
84. deep vein thrombosis
85. ventricular fibrillation
86. bundle branch block
87. percutaneous transluminal coronary angioplasty
88. angitis; angitis
89. lymphadenopathy
90. lymphoma
91. angioplasty
92. lymphangitis; lymphangitis
93. angiopathy
94. lymphadenitis
95. lymphadenoma
96. angioma
97. recording of the heart's sounds
 - a. sound
 - b. heart
 - c. act of recording
98. excision of the inner layer of an artery thickened by atherosclerosis
 - a. within
 - b. artery
 - c. out
 - d. to cut
99. permanent dilation of small blood vessels causing small, local red lesions
 - a. end
 - b. vessel
 - c. dilation
100. inflammation of lymphatic vessels and veins
 - a. lymphatic system
 - b. vessel
 - c. vein
 - d. inflammation

CASE STUDY QUESTIONS

1. diaphoresis
2. sublingual
3. stress test
4. cardiovascular
5. endarterectomies
6. murmur
7. cyanosis
8. stenosis
9. interatrial
10. substernal
11. d
12. b
13. c
14. e
15. a
16. e

17. a
18. coronary/cardiac care unit
19. acute myocardial infarction
20. coronary artery disease
21. left anterior descending
22. congestive heart failure
23. transesophageal echocardiogram
24. mitral valve replacement

Chapter 10

PRETEST

1. c
2. d
3. b
4. a
5. c
6. b

CHAPTER EXERCISES

EXERCISE 10-1

1. excess albumin in the blood
2. decreased protein in the blood
3. deficiency of leukocytes (white blood cells)
4. production of erythrocytes (red blood cells)
5. presence of toxins (poisons) in the blood
6. presence of bacteria in the blood
7. deficiency of platelets (thrombocytes)
8. pyemia (*pī-Ē-mē-a*)
9. viremia (*vī-RE-mē-a*)
10. leukemia (*lū-KE-mē-a*)

EXERCISE 10-2

1. hemat/o; blood
2. myel/o; bone marrow
3. thromb/o; blood clot
4. immun/o; immunity
5. hem/o; blood
6. blood
7. bone marrow
8. erythrocytes; red blood cells
9. immunity
10. platelets; thrombocytes
11. leukocytes; white blood cells
12. blood cells
13. lymphocytes
14. blood
15. lymphoblast (*LIM-fō-blast*)
16. myeloma (*mī-e-LŌ-ma*)
17. erythropenia (*e-rith-rō-PĒ-nē-a*); also, erythrocytopenia
18. thrombolysis (*throm-BOL-i-sis*)
19. myelopoiesis (*mī-e-lō-poy-Ē-sis*)
20. granulocytosis (*gran-ū-lō-sī-TŌ-sis*)

21. lymphocytosis (*lim-fō-sī-TŌ-sis*)
22. erythrocytosis (*e-rith-rō-sī-TŌ-sis*)
23. monocytosis (*mon-ō-sī-TŌ-sis*)
24. thrombocytosis (*throm-bō-sī-TŌ-sis*)

EXERCISE 10-3

1. iron
2. potassium
3. nitrogenous compounds
4. oxygen
5. iron
6. calcium
7. kalemia (*ka-LĒ-mē-a*)
8. azotemia (*az-ō-TĒ-mē-a*)
9. natremia (*nā-TRĒ-mē-a*)
10. calcemia (*kal-SĒ-mē-a*)

CHAPTER REVIEW

LABELING EXERCISE

Blood Cells

1. platelet
2. leukocyte
3. erythrocyte

Leukocytes (White Blood Cells)

1. neutrophil
2. eosinophil
3. basophil
4. lymphocyte
5. monocyte

TERMINOLOGY

1. c
2. a
3. e
4. b
5. d
6. b
7. c
8. a
9. e
10. d
11. b
12. e
13. a
14. d
15. c
16. b
17. e
18. d
19. a
20. c
21. d
22. c
23. a
24. e
25. b
26. phagocytosis

27. hemoglobin
28. electrolyte
29. platelets (thrombocytes)
30. blood cells
31. oxygen
32. blood
33. anemia
34. bone marrow
35. immunoglobulin
36. b
37. c
38. c
39. b
40. d
41. F; thrombocyte
42. T
43. T
44. T
45. F; neutrophil
46. T
47. increase in leukocytes (white blood cells) in the blood
48. increase in eosinophils in the blood
49. increase in erythrocytes (red blood cells) in the blood
50. increase in thrombocytes (platelets) in the blood
51. increase in neutrophils in the blood
52. increase in monocytes in the blood
53. erythroblast; erythrocytoblast
54. thrombocytopenia; thrombopenia
55. pyemia
56. immunologist
57. hemorrhage
58. presence of viruses in the blood
59. deficiency of neutrophils
60. substance that is toxic (poisonous) to bone marrow
61. immunity to one's own tissue
62. deficiency of oxygen in the blood
63. septicemic (*sep-ti-SĒ-mik*)
64. lymphocytic (*lim-fō-SIT-ik*)
65. basophilic (*bā-sō-FIL-ik*)
66. hemolytic (*hē-mō-LIT-ik*)
67. thrombotic (*throm-BOT-ik*)
68. leukemic (*lū-KĒ-mik*)
69. thrombolysis; *Thrombolysis* is destruction of a blood clot; the others pertain to formation of a blood clot.
70. EPO; *EPO* is erythropoietin, a hormone that stimulates red cell production in the bone marrow; the others are abbreviations for blood tests.
71. reticulocyte; A *reticulocyte* is an immature red blood cell; the others are types of leukocytes.
72. gamma globulin; *Gamma globulin* is the fraction of the blood plasma

that contains antibodies; the others are terms associated with exaggerated immune responses.

73. leukocytic
74. leukoblast
75. myeloid
76. myelogenic
77. myeloblast
78. leukemia
79. leukopenia; leukocytopenia
80. myeloma
81. leukopoiesis; leukocytopoiesis
82. myelocytic
83. overall decrease in blood cells
 - a. all
 - b. cell
 - c. deficiency
84. increase in the number of red cells in the blood; erythremia, erythrocythemia
 - a. many
 - b. cell
 - c. blood
 - d. condition of
85. unequal distribution of hemoglobin in red cells
 - a. without
 - b. same, equal
 - c. color
 - d. condition of
86. pertaining to dysfunctional bone marrow
 - a. bone marrow
 - b. abnormal
 - c. formation
 - d. condition of

CASE STUDY QUESTIONS

1. e
2. d
3. d
4. c
5. a
6. c
7. e
8. b
9. b
10. c
11. d
12. e
13. b
14. a
15. hemoglobin
16. hematocrit
17. fresh frozen plasma
18. prothrombin time
19. partial thromboplastin time
20. disseminated intravascular coagulation

Chapter 11

PRETEST

1. a
2. b
3. b
4. a
5. d
6. b
7. c
8. a

CHAPTER EXERCISES

EXERCISE 11-1

1. apnea (*AP-nē-a*)
2. dyspnea (*disp-NĒ-a*)
3. eupnea (*ūp-NĒ-a*)
4. bradypnea (*brad-ip-NĒ-a*)
5. apneic (*ap-NĒ-ik*)
6. dyspneic (*disp-NĒ-ik*)
7. eupneic (*ūp-NĒ-ik*)
8. bradypneic (*brad-ip-NĒ-ik*)
9. aphonia (*a-FŌ-nē-a*)
10. hypocapnia (*hī-pō-KAP-nē-a*)
11. anoxia (*an-OK-sē-a*)
12. eucapnia (*ū-KAP-nē-a*)

EXERCISE 11-2

1. rhinorrhea (*rī-nō-RĒ-a*)
2. laryngeal (*la-RIN-jē-al*)
3. pharyngitis (*far-in-JĪ-tis*)
4. laryngoscopy (*lar-ing-GŌS-kō-pē*)
5. pharyngoplasty (*fa-RING-gō-plas-tē*)
6. tracheotomy (*trā-kē-OT-ō-mē*)
7. bronchostenosis (*brong-kō-ste-NŌ-sis*); bronchoconstriction (*brong-kō-kon-STRIK-shun*)
8. bronchiolitis (*brong-kē-ō-LĪ-tis*)
9. pertaining to the nose and pharynx
10. within the trachea
11. around a bronchus
12. near the nose
13. pertaining to the bronchioles
14. dilatation of a bronchus

EXERCISE 11-3

1. pain in the pleura
2. within the lungs
3. surgical removal of a lung or lung tissue
4. plastic repair of a lung
5. study of the lungs
6. absence of a lung
7. surgical incision of the phrenic nerve
8. intrapleural (*in-tra-PLŪ-ral*)
9. suprarenic (*sū-pra-FREN-ik*)
10. pleurocentesis (*plū-rō-sen-TĒ-sis*)

11. pneumonopathy (*nū-mō-NOP-a-thē*)
12. phrenicotripsy (*fren-i-kō-TRIP-sē*)
13. spirogram (*SPĪ-rō-gram*)

CHAPTER REVIEW

LABELING EXERCISE

Respiratory System

1. frontal sinus
2. sphenoidal sinus
3. nasal cavity
4. nasopharynx
5. oropharynx
6. laryngopharynx
7. larynx and vocal cords
8. epiglottis
9. esophagus
10. trachea
11. right lung
12. left lung
13. left bronchus
14. right bronchus
15. mediastinum
16. terminal bronchiole
17. alveolar duct
18. alveoli
19. capillaries
20. diaphragm

TERMINOLOGY

1. d
2. c
3. e
4. a
5. b
6. e
7. a
8. b
9. c
10. d
11. c
12. a
13. d
14. e
15. b
16. d
17. c
18. a
19. b
20. e
21. c
22. a
23. e
24. b
25. d
26. smell, olfaction
27. carbon dioxide
28. diaphragm
29. pleura
30. alveoli

31. bronchus
32. lungs
33. tuberculosis
34. spirometer
35. vital capacity
36. mucus
37. coughing
38. septum
39. apnea
40. bronchodilator
41. T
42. T
43. F; larynx
44. F; three
45. T
46. T
47. phrenicotomy (*fren-i-KOT-ō-mē*)
48. pleurocele (*PLŪ-rō-sēl*)
49. pharyngitis (*far-in-JĪ-tis*)
50. bronchiolitis (*brong-kē-ō-LĪ-tis*)
51. tracheostomy (*tra-kē-OS-tō-mē*)
52. accumulation of air or gas in the pleural space
53. accumulation of blood in the pleural space
54. accumulation of pus in the pleural space
55. accumulation of fluid in the pleural space
56. narrowing of a bronchus
57. pain in the pleura
58. deficiency of oxygen in the tissues
59. any disease of the lungs
60. rapid rate of respiration
61. dilatation of a bronchus
62. plastic repair of the nose
63. dryness of the throat
64. spir/o; breathing
65. pulmon/o; lung
66. py/o; pus
67. phren/o; diaphragm
68. pneum/o; pertaining to air or gas
69. extrapulmonary
70. hypercapnia
71. expiration
72. bradypnea
73. intubation
74. pharyngeal
75. alveolar
76. nasal
77. tracheal
78. pleural
79. bronchial
80. nares
81. pleurae
82. alveoli
83. conchae
84. bronchi
85. tonsil; A *tonsil* is lymphatic tissue in the pharynx; the others are parts of the nose.

86. sinus; A *sinus* is a cavity or channel; the others are parts of the larynx.
87. asthma; *Asthma* is a chronic breathing problem caused by allergy and other factors; the others are infectious diseases.
88. URI; *URI* is an abbreviation for “upper respiratory infection”; the others are abbreviations for lobes of the lung.
89. RDS; *RDS* is respiratory distress syndrome; the others are breathing volumes or capacities
90. oximetry
91. eupnea
92. hypophonia
93. hyperpnea
94. eucapnia
95. dyspnea
96. hypoxia
97. dysphonia
98. hypercapnia
99. hyperphonia
100. device for measuring air flow
 - a. air
 - b. rapid, swift
 - c. measure
101. incomplete expansion of the alveoli
 - a. incomplete
 - b. expansion, dilation
102. presence of air or gas in a blood vessel of the heart
 - a. air, gas
 - b. heart
 - c. condition of
103. respiratory disease caused by inhalation of dust particles
 - a. lung
 - b. dust
 - c. condition of

CASE STUDY QUESTIONS

1. c
2. d
3. b
4. d
5. e
6. lobectomy
7. diaphoresis
8. thoracotomy
9. thoracoscopy
10. hemithorax
11. mediastinoscopy
12. ventilation
13. chronic obstructive pulmonary disease
14. arterial blood gas
15. acute respiratory distress syndrome
16. do not resuscitate

Chapter 12

PRETEST

1. d
2. c
3. a
4. a
5. b
6. c
7. c
8. a

CHAPTER EXERCISES

EXERCISE 12-1

1. oral (*OR-al*); stomal (*STō-mal*)
2. labial (*LĀ-bē-al*)
3. buccal (*BUK-al*)
4. dental (*DEN-tal*)
5. gingival (*JIN-ji-val*)
6. lingual (*LING-gwal*); glossal (*GLOS-sal*)
7. mouth
8. teeth
9. teeth
10. jaw
11. mouth
12. tongue
13. salivary
14. outside the cheek
15. under the tongue
16. pertaining to the lip and teeth
17. inflammation of the gums
18. dropping of the uvula
19. under the tongue
20. suture of the palate

EXERCISE 12-2

1. gastric (*GAS-trik*)
2. enteric (*en-TER-ik*)
3. pyloric (*pī-LOR-ik*)
4. colic (*KOL-ik*); also colonic (*kō-LON-ik*)
5. duodenal (*dū-ō-DE-nal*)
6. jejunal (*je-JUN-al*)
7. ileal (*IL-ē-al*)
8. cecal (*SE-kal*)
9. anal (*Ā-nal*)
10. gastroesophageal (*gas-trō-e-sof-a-JĒ-al*)
11. esophagitis (*ē-sof-a-JĪ-tis*)
12. gastropexy (*GAS-trō-pek-sē*)
13. gastroenterology (*gas-trō-en-ter-OL-ō-jē*)
14. duodenoscopy (*dū-ō-de-NOS-kō-pē*)
15. pyloroptosis (*pī-lor-ō-Tō-sis*)
16. jejunostomy (*je-jū-NOS-tō-mē*)
17. ileectomy (*il-ē-EK-tō-mē*)
18. anorectal (*a-nō-REK-tal*)

19. colitis (*kō-LĪ-tis*)
20. colostomy (*kō-LOS-tō-mē*)
21. colopexy (*Kō-lō-pek-sē*)
22. colocolostomy (*kō-lō-sen-TĒ-sis*)
23. colonopathy (*kō-lō-NOP-a-thē*)
24. colonoscopy (*kō-lon-OS-kō-pē*)
25. esophagogastrotomy (*ē-sof-a-gō-gas-TROS-tō-mē*)
26. gastroenterostomy (*gas-trō-en-ter-OS-tō-mē*)
27. gastrojejunostomy (*gas-trō-je-jū-NOS-tō-mē*)
28. duodenoileostomy (*dū-ō-dē-nō-il-ē-OS-tō-mē*)
29. sigmoidoproctostomy (*sig-moy-dō-prok-TOS-tō-mē*)

EXERCISE 12-3

1. hepatic (*he-PAT-ik*)
2. cholecystic (*kō-lē-SIS-tik*)
3. pancreatic (*pan-krē-AT-ik*)
4. pancreatography (*pan-krē-a-TOG-ra-fē*)
5. cholangiography (*kō-lan-jē-OG-ra-fē*)
6. cholecystography (*kō-lē-sis-TOG-ra-fē*)
7. hepatography (*hep-a-TOG-ra-fē*)
8. choledocholithiasis (*kō-led-o-kō-li-THĪ-a-sis*)
9. pancreatolithiasis (*pan-krē-a-tō-li-THĪ-a-sis*)
10. hepatitis (*hep-a-TĪ-tis*)
11. bile
12. gallstone; biliary calculus
13. common bile duct
14. gallbladder
15. liver
16. bile duct
17. pancreas

CHAPTER REVIEW

LABELING EXERCISE

The Digestive System

1. mouth
2. pharynx
3. esophagus
4. stomach
5. duodenum (of small intestine)
6. small intestine
7. cecum
8. ascending colon
9. transverse colon
10. descending colon
11. sigmoid colon
12. rectum
13. anus
14. parotid salivary gland
15. sublingual salivary gland
16. submandibular salivary gland

17. liver (cut)
18. gallbladder
19. pancreas

Accessory Organs of Digestion

1. liver
2. common hepatic duct
3. gallbladder
4. cystic duct
5. common bile duct
6. pancreas
7. pancreatic duct
8. duodenum
9. spleen
10. diaphragm

TERMINOLOGY

1. d
2. c
3. b
4. e
5. a
6. e
7. d
8. a
9. b
10. c
11. e
12. a
13. d
14. b
15. c
16. c
17. a
18. d
19. e
20. b
21. d
22. e
23. a
24. c
25. b
26. peritoneum
27. liver
28. gallbladder
29. cecum
30. tongue
31. palate
32. tooth
33. cheek
34. intestine
35. liver
36. bile
37. hiatal hernia
38. dysphagia
39. stomach acid
40. periodontist
41. gastrectomy
42. palatorrhaphy
43. pylorostenosis
44. pancreatitis
45. gastroenterologist
46. colostomy
47. gastroduodenostomy
48. intrahepatic
49. diverticula
50. gingivae
51. calculi
52. anastomoses
53. F; above
54. F; jejunum
55. F; saliva
56. T
57. T
58. T
59. villus; A *villus* is a tiny projection in the lining of the small intestine that aids in absorption of nutrients; the others are parts of the mouth.
60. spleen; The *spleen* is a lymphatic organ; the others are parts of the large intestine.
61. pylorus; The *pylorus* is the distal portion of the stomach; the others are accessory digestive organs.
62. amylase; *Amylase* is a starch-digesting enzyme; the others are disorders of the digestive tract.
63. total parenteral nutrition
64. gastroesophageal reflux disease
65. esophagogastroduodenoscopy
66. gastrointestinal
67. hydrochloric acid
68. proton pump inhibitor
69. percutaneous endoscopic gastrostomy (tube)
70. hepatitis A virus
71. cecitis
72. proctorrhaphy
73. ileopexy
74. proctoceles
75. ileocecal
76. cecopexy
77. proctitis
78. ileorrhaphy
79. ileitis
80. pertaining to the muscular layer of the intestine
 - a. muscle
 - b. intestine
 - c. pertaining to
81. radiography of the biliary tract and gallbladder using radionuclides
 - a. bile
 - b. spark (radiation)
 - c. act of recording data
82. referring to any route other than the alimentary canal
 - a. beside
 - b. intestine
 - c. pertaining to

CASE STUDY QUESTIONS

1. c
2. b
3. e
4. a
5. d
6. a
7. c
8. b
9. c
10. d
11. b
12. e
13. b
14. endoscopic retrograde cholangiopancreatography
15. right upper quadrant
16. nasogastric
17. inflammatory bowel disease
18. cholelithiasis
19. laparoscopic cholecystectomy
20. cholecystitis
21. cholangiogram
22. sphincter
23. biopsy

Chapter 13

PRETEST

1. d
2. c
3. a
4. a
5. b
6. d
7. d
8. b

CHAPTER EXERCISES

EXERCISE 13-1

1. postrenal (*pōst-RĒ-nal*)
2. prerenal (*prē-RĒ-nal*)
3. interrenal (*in-ter-RĒ-nal*)
4. perirenal (*per-i-RĒ-nal*); circumrenal (*sir-kum-RĒ-nal*)
5. nephrology (*ne-FROL-ō-jē*)
6. nephropathy (*ne-FROP-a-thē*)
7. nephrotoxic (*nef-rō-TOK-sik*)
8. nephromalacia (*nef-rō-ma-LĀ-shē-a*)
9. nephrectomy (*ne-FREK-tō-mē*)
10. glomerulitis (*glō-mer-ū-LĪ-tis*)
11. caliectasis (*kā-lē-EK-ta-sis*); calicectasis (*kal-i-SEK-ta-sis*)
12. pyeloplasty (*pī-e-lō-PLAS-tē*)
13. pyelogram (*Pī-e-lō-gram*)
14. renography (*rē-NOG-ra-fē*); nephrography (*ne-FROG-ra-fē*)

15. calicotomy (*kal-i-KOT-ō-mē*);
caliotomy (*kā-lē-OT-ō-mē*)
16. glomerulosclerosis (*glo-mer-ū-lō-skle-Rō-sis*)
17. pyelonephritis (*pi-e-lō-nef-RĪ-tis*)

EXERCISE 13-2

1. urology (*ū-ROL-ō-jē*)
2. urography (*ū-ROG-ra-fē*)
3. urolith (*Ū-rō-lith*)
4. uremia (*ū-RĒ-mē-a*)
5. anuria (*an-Ū-rē-a*)
6. dysuria (*dis-Ū-rē-a*)
7. polyuria (*pol-ē-Ū-rē-a*)
8. cyturia (*sī-TŪ-rē-a*)
9. hematuria (*hē-ma-TŪ-rē-a*)
10. diuresis (*dī-ū-RĒ-sis*)
11. anuresis (*an-ū-RĒ-sis*)
12. natriuresis (*nā-trē-ū-RĒ-sis*)
13. kaliuresis (*kā-lē-ū-RĒ-sis*)
14. urethropexy (*ū-RĒ-thrō-pek-sē*)
15. ureterostomy (*ū-rē-ter-OS-tō-mē*)
16. ureterolith (*ū-RĒ-ter-ō-lith*)
17. urethroscopy (*ū-rē-THROS-kō-pē*)
18. cystitis (*sis-TĪ-tis*)
19. cystopexy (*SIS-tō-pek-sē*)
20. cystoscope (*SIS-tō-skōp*)
21. cystotomy (*sis-TOT-ō-mē*)
22. supravescical (*sū-pra-VES-i-kal*)
23. urethrovesical (*ū-rē-thrō-VES-i-kal*)
24. pain in the urinary bladder
25. surgical incision of the ureter
26. through the urethra
27. formation of urine

CHAPTER REVIEW

LABELING EXERCISE

Urinary System

1. right kidney
2. adrenal gland
3. abdominal aorta
4. renal artery
5. common iliac artery
6. common iliac vein
7. renal vein
8. inferior vena cava
9. right ureter
10. urinary bladder
11. urethra
12. prostate gland

The Kidney

1. renal capsule
2. renal cortex
3. renal medulla
4. pyramids of medulla
5. nephrons
6. calyx
7. hilum
8. renal pelvis
9. ureter

The Urinary Bladder

1. ureter
2. smooth muscle
3. openings of ureters
4. trigone
5. urethra
6. internal urethral sphincter
7. external urethral sphincter
8. prostate

TERMINOLOGY

1. d
2. c
3. a
4. e
5. b
6. d
7. e
8. b
9. a
10. c
11. d
12. b
13. e
14. a
15. c
16. e
17. d
18. a
19. b
20. c
21. nephron
22. glomerulus
23. renin
24. urination; voiding of urine
25. urinalysis
26. urea
27. incontinence; stress
incontinence
28. clean-catch specimen
29. cystoscopy
30. F; kidney
31. T
32. T
33. F; cortex
34. F; urethra
35. T
36. T
37. F; potassium
38. near the kidney
39. painful or difficult urination
40. toxic or poisonous to the
kidney
41. near the glomerulus
42. surgical removal of a calyx
43. narrowing of a urethra
44. pyelocaliectasis; pyelocaliectasis
45. nephromalacia
46. cystectomy
47. nephropathy
48. cystourethrogram
49. ureteropyeloplasty

50. pyelonephritis
51. ureterosigmoidostomy
52. cast; A *cast* is a solid mold of a
renal nephron; the others are parts
of the kidney.
53. calyx; A *calyx* is a collecting region
for urine in the kidney; the others
are parts of a nephron.
54. specific gravity; *Specific gravity* is
a measure of density; the others
are treatment procedures for the
urinary system.
55. dehydration
56. hypovolemia
57. antidiuretic
58. hypernatremia
59. anuresis
60. caliceal; calyceal
61. urologic
62. uremic
63. diuretic
64. nephrotic
65. ureteral
66. urethral
67. pelvis
68. calyces
69. glomeruli
70. urography
71. renal
72. intrarenal
73. renography
74. intravesical
75. suprarenal
76. urology
77. interrenal
78. vesical
79. urolith
80. intravenous pyelography
81. antidiuretic hormone
82. erythropoietin
83. intravenous urography
84. sodium
85. glomerular filtration rate
86. urinalysis
87. removal of substances from the
blood by passage through a semi-
permeable membrane
 - a. blood
 - b. through
 - c. separation
88. test that measures and records
bladder function
 - a. urinary bladder
 - b. measure
 - c. act of recording data
89. surgical creation of a new passage
between a ureter and the bladder
 - a. ureter
 - b. new
 - c. bladder
 - d. surgical creation of an
opening

CASE STUDY QUESTIONS

1. c
2. e
3. d
4. a
5. IV urogram
6. hematuria
7. cystoscopic
8. nephrolithotomy
9. oliguria
10. nocturia
11. lithotripsy
12. kidney transplant
13. urinary tract infection
14. continuous ambulatory peritoneal dialysis
15. blood urea nitrogen
16. end-stage renal disease
17. human immunodeficiency virus

Chapter 14

PRETEST

1. c
2. a
3. d
4. b
5. d
6. d

CHAPTER EXERCISES

EXERCISE 14-1

1. pertaining to semen
2. pain in the testis
3. plastic repair of the scrotum
4. excision of the epididymis
5. pain in the prostate
6. any disease of a testis
7. inflammation of the testis and epididymis
8. orchiopexy (*or-kē-ō-PEK-sē*); also, orchidopexy (*or-ki-dō-PEK-sē*)
9. orchioplasty (*OR-kē-ō-plas-tē*); also, orchidoplasty (*OR-ki-dō-plas-tē*)
10. orchiotomy (*or-kē-OT-ō-mē*); also, orchidotomy (*or-ki-DOT-ō-mē*)
11. spermatocyte (*sper-MA-tō-sīt*)
12. spermatolysis (*sper-ma-TOL-i-sis*)
13. spermatorrhea (*sper-ma-to-RĒ-a*)
14. spermatogenesis (*sper-ma-tō-JEN-e-sis*)
15. spermaturia (*sper-ma-TŪ-rē-a*)
16. aspermia (*a-SPER-mē-a*)
17. hemospermia (*hē-mō-SPER-mē-a*); also, hematospermia (*hem-at-ō-SPER-mē-a*)
18. oligospermia (*ol-i-gō-SPER-mē-a*)

19. pyospermia (*pī-ō-SPER-mē-a*)
20. vasectomy (*va-SEK-tō-mē*)
21. oscheoma (*os-kē-Ō-ma*)
22. vasorrhaphy (*vas-OR-a-fē*)
23. prostatectomy (*pros-ta-TEK-tō-mē*)
24. vesiculography (*ve-sik-ū-LOG-ra-fē*)
25. vesiculitis (*ve-sik-ū-LĪ-tis*)
26. epididymotomy (*ep-i-did-i-MOT-ō-mē*)

CHAPTER REVIEW

LABELING EXERCISE

Male Reproductive System

1. testis
2. epididymis
3. scrotum
4. ductus (vas) deferens
5. ejaculatory duct
6. urethra
7. penis
8. glans penis
9. prepuce (foreskin)
10. seminal vesicle
11. prostate
12. bulbourethral (Cowper) gland
13. kidney
14. ureter
15. urinary bladder
16. peritoneal cavity
17. rectum
18. anus

TERMINOLOGY

1. e
2. d
3. a
4. b
5. c
6. d
7. e
8. b
9. a
10. c
11. b
12. e
13. a
14. d
15. c
16. e
17. a
18. d
19. c
20. b
21. testis
22. scrotum
23. semen
24. testosterone
25. inguinal canal

26. epididymis
27. suture of the vas (ductus) deferens
28. absence of a testis
29. tumor of the scrotum
30. incision of the seminal vesicle
31. instrument for measuring the prostate
32. presence of blood in the semen
33. prostatic
34. oscheolith
35. orchiopexy; orchidopexy
36. oscheoplasty
37. vasovasostomy
38. hyperplasia
39. intravesical
40. dysuria
41. hematuria
42. resectoscope
43. T
44. F; scrotum
45. T
46. T
47. F; urethra
48. T
49. T
50. spermatic cord; The *spermatic cord* suspends the testis in the scrotum and contains the ductus deferens, nerves, and vessels; the others are the glands that contribute to semen.
51. semen; *Semen* is the secretion that transports spermatozoa; the others are hormones active in reproduction.
52. hernia; A *hernia* is a protrusion of tissue through an abnormal body opening; the others are sexually transmitted infections.
53. seminal
54. prostatic
55. penile
56. urethral
57. scrotal
58. benign prostatic hyperplasia
59. sexually transmitted infection
60. bladder neck obstruction
61. gonococcus
62. prostate-specific antigen
63. genitourinary
64. transurethral resection of prostate
65. vasoplasty
66. spermatolysis
67. vesicular
68. vasography
69. vesiculitis
70. spermatic
71. spermatocyte
72. vasotomy
73. spermatogenesis
74. vesiculography

75. removal of a hydrocele by fluid drainage or partial excision
 - a. fluid, water
 - b. hernia, localized dilatation
 - c. out
 - d. cut
 - e. condition of
76. destructive to sperm cells
 - a. sperm
 - b. agent that kills
 - c. pertaining to
77. undescended testis
 - a. hidden
 - b. testis
 - c. condition of
78. inflammation of the ductus deferens and seminal vesicle
 - a. vas (ductus) deferens
 - b. seminal vesicle
 - c. inflammation

CASE STUDY QUESTIONS

1. d
2. a
3. c
4. d
5. e
6. a
7. c
8. bilateral inguinal herniorrhaphy
9. strangulated hernia
10. balanitis
11. phimosis

Chapter 15

PRETEST

1. c
2. b
3. d
4. a
5. b
6. c
7. a
8. c

CHAPTER EXERCISES

EXERCISE 15-1

1. any disease of women
2. between menstruation periods
3. formation of an ovum
4. release of an ovum from the ovary
5. pertaining to an ovary
6. inflammation of an ovary
7. gynecologist (*gī-ne-KOL-ō-jist*)
8. ovulatory (*OV-ū-la-tō-rē*)
9. menorrhagia (*men-ō-RĀ-jē-a*)

10. dysmenorrhea (*DIS-men-ō-rē-a*)
11. amenorrhea (*a-men-ō-RĒ-a*)
12. oligomenorrhea (*ol-i-gō-men-ō-RE-a*)
13. ovariorrhesis (*ō-var-ē-ō-REK-sis*)
14. ovariocentesis (*ō-var-ē-ō-sen-TĒ-sis*)
15. ovariocele (*o-VAR-ē-ō-sēl*)
16. oophorotomy (*ō-of-ō-ROT-ō-mē*)
17. oophoroma (*ō-of-ō-RŌ-ma*)

EXERCISE 15-2

1. within the cervix
2. pertaining to the uterus and urinary bladder
3. excision of a uterine tube, Fallopian tube
4. pain in the vagina
5. plastic repair of the vagina
6. softening of the uterus
7. endoscopic examination of the uterus
8. salpingopexy (*sal-PING-gō-pek-sē*)
9. salpingography (*sal-ping-GOG-ra-fē*)
10. hydrosalpinx (*hī-drō-SAL-pinx*)
11. pyosalpinx (*pī-ō-SAL-pinx*)
12. salpingo-oophorectomy (*sal-ping-gō-ō-of-ō-REK-tō-mē*); also, salpingo-ovariectomy (*sal-ping-gō-ō-var-ē-EK-tō-me*)
13. hysteropexy (*his-ter-ō-PEK-sē*)
14. metroptosis (*mē-trōp-TŌ-sis*)
15. transcervical (*trans-SER-vi-kal*)
16. metrostenosis (*mē-trō-ste-NŌ-sis*)
17. hysterosalpingogram (*his-ter-ō-sal-PING-gō-gram*)
18. uterine (*Ū-ter-in*)
19. colpocele (*KOL-pō-sēl*)
20. vaginitis (*vaj-i-NĪ-tis*)

EXERCISE 15-3

1. vulvopathy (*vul-VOP-a-thē*)
2. episiorrhaphy (*e-piz-ē-OR-a-fē*)
3. vaginoperineal (*vaj-i-nō-per-i-NĒ-al*)
4. clitoritis (*klit-o-RĪ-tis*)
5. mammogram (*MAM-ō-gram*)
6. mastitis (*mas-TĪ-tis*)
7. mastectomy (*mas-TEK-tō-mē*); also, mastectomy (*ma-MEK-tō-mē*)

EXERCISE 15-4

1. before birth
2. formation of an embryo
3. pertaining to a newborn
4. endoscopic examination of the fetus
5. developing in one amniotic sac
6. lack of milk production
7. excess secretion of milk

8. embryology (*em-brē-OL-ō-jē*)
9. neonatology (*nē-ō-nā-TOL-ō-jē*)
10. embryopathy (*em-brē-OP-a-thē*)
11. amniocyte (*AM-nē-ō-sīt*)
12. amniotomy (*am-nē-OT-ō-mē*)
13. fetoscope (*FĒ-tō-skōp*)
14. amniorrhesis (*am-nē-ō-REK-sis*)
15. postnatal (*pōst-NĀ-tal*)
16. primigravida (*pri-mi-GRAV-i-da*)
17. multigravida (*mul-ti-GRAV-i-da*)
18. nullipara (*nul-IP-a-ra*)
19. primipara (*pri-MIP-a-ra*)
20. xerostomia (*zē-rō-TŌ-sē-a*)
21. bradycardia (*brad-ē-TŌ-sē-a*)
22. galactorrhea (*ga-lak-tō-RE-a*); also, lactorrhea (*lak-tō-RE-a*)
23. galactoceles (*ga-LAK-to-sēl*); also, lactoceles (*LAK-tō-sēl*)

CHAPTER REVIEW

LABELING EXERCISE

Female Reproductive System

1. ovary
2. fimbriae
3. uterine tube
4. uterus
5. cervix
6. posterior fornix
7. vagina
8. clitoris
9. labium minus
10. labium majus
11. urinary bladder
12. urethra
13. rectum
14. anus
15. peritoneal cavity
16. cul-de-sac

Ovulation and Fertilization

1. ovary
2. fimbriae
3. ovum
4. sperm cells (spermatozoa)
5. uterine tube
6. implanted embryo
7. body of uterus
8. cervix
9. vagina
10. greater vestibular (Bartholin) gland

TERMINOLOGY

1. b
2. d
3. e
4. a
5. c
6. d
7. c
8. e

9. a
10. b
11. c
12. a
13. b
14. e
15. d
16. b
17. d
18. c
19. e
20. a
21. b
22. c
23. e
24. a
25. d
26. ovary
27. ovum (egg cell)
28. placenta
29. lactation
30. abortion
31. uterus
32. breasts (mammary glands)
33. T
34. T
35. F; endometrium
36. F; corpus luteum
37. F; uterine tube
38. T
39. T
40. F; embryo
41. behind the uterus
42. any disease of the uterus
43. softening of the uterus
44. pus in the uterine tube, fallopian tube
45. narrowing of the vagina
46. pain in the vulva
47. after birth
48. below the mammary gland (breast)
49. outside the embryo
50. woman who has given birth three times
51. causing fetal abnormalities
52. salpingocele
53. episiorrhaphy
54. metrostenosis
55. hysterosalpingectomy
56. mammogram
57. dystocia
58. amniorrhexis
59. embryology
60. fetometry
61. gravida
62. fundus
63. pelvimetry
64. suprapubic
65. Apgar score
66. neonate
67. postpartum

68. prenatal
69. eutocia
70. anovulatory
71. cervical
72. uterine
73. perineal
74. vaginal
75. embryonic
76. amniotic
77. ova
78. cervixes
79. fimbriae
80. labia
81. labia majora; The *labia majora* are part of the vulva; the others are associated with pregnancy.
82. colostrum; *Colostrum* is the breast fluid released before milk is produced; the others are hormones involved in reproduction.
83. measles; *Measles* is an infectious disease; the others are hereditary disorders.
84. candidiasis; *Candidiasis* is a fungal infection; the others are procedures used to diagnose fetal abnormalities.
85. spina bifida; *Spina bifida* is a congenital spinal defect; the others are disorders of pregnancy.
86. episiotomy
87. cervicitis
88. mammography
89. mammoplasty
90. cervicography
91. episiotomy
92. intracervical
93. cervicoplasty
94. cervicotomy
95. transcervical
96. human chorionic gonadotropin
97. dysfunctional uterine bleeding
98. obstetrics, obstetrician
99. last menstrual period
100. cephalopelvic disproportion
101. fetal heart rate
102. pelvic inflammatory disease
103. gestational age
104. vaginal birth after cesarean section
105. prevention of blood vessel formation
 - a. against
 - b. vessel
 - c. origin, formation
 - d. condition of
106. excessive development of the mammary glands in the male, even to the secretion of milk
 - a. woman
 - b. breast
 - c. condition of

107. extreme rapidity of labor
 - a. sharp, acute
 - b. labor
 - c. condition of
108. a deficiency of amniotic fluid
 - a. few, scanty
 - b. fluid
 - c. amnion

CASE STUDY QUESTIONS

1. b
2. d
3. b
4. a
5. e
6. d
7. prolapsed
8. zygote
9. oocyte
10. follicular
11. dilatation and curettage
12. bilateral salpingo-oophorectomy
13. hormone replacement therapy
14. total abdominal hysterectomy
15. in vitro fertilization
16. gynecology
17. zygote intrafallopian transfer

Chapter 16

PRETEST

1. d
2. a
3. c
4. a
5. d
6. d

CHAPTER EXERCISES

EXERCISE 16-1

1. study of the endocrine glands or hormones
2. excision of the pituitary gland (hypophysis)
3. acting on the thyroid gland
4. condition of underactivity of the adrenal gland
5. inflammation of the pancreatic islets
6. hyperthyroidism (*hī-per-THī-royd-izm*)
7. hypoparathyroidism (*hī-pō-par-a-THī-royd-izm*)
8. hyperadrenalism (*hī-per-a-DRE-nal-izm*)
9. hyperadrenocorticism (*hī-per-a-drē-nō-KOR-ti-sizm*)

10. hypopituitarism (*hī-pō-pi-TŪ-i-ta-rizm*)
11. endocrinologist (*en-dō-kri-NOL-ō-jist*)
12. thyroidectomy (*thī-roy-DEK-tō-mē*)
13. adrenalopathy (*a-drē-na-LOP-a-thē*); also, adrenopathy (*a-drē-NOP-a-thē*)
14. adrenalitis (*a-drē-nal-I-tis*); also, adrenitis (*a-dre-NĪ-tis*)
15. insuloma (*in-sū-LŌ-ma*)

CHAPTER REVIEW

LABELING EXERCISE

Glands of the Endocrine System

1. pineal
2. pituitary (hypophysis)
3. thyroid
4. parathyroids
5. adrenals
6. pancreatic islets
7. ovaries
8. testes

TERMINOLOGY

1. d
2. e
3. c
4. b
5. a
6. b
7. d
8. e
9. a
10. c
11. b
12. d
13. e
14. c
15. a
16. c
17. e
18. d
19. a
20. b
21. d
22. c
23. e
24. a
25. b
26. pituitary (hypophysis)
27. thyroid
28. adrenals
29. diabetes mellitus
30. hyperglycemia
31. enlargement of the adrenal gland
32. condition caused by underactivity of the pituitary gland
33. acting on the hypophysis (pituitary)

34. any disease of the adrenal gland
35. incision into the thyroid gland
36. physician who specializes in the study and treatment of endocrine disorders
37. insuloma
38. hypophysitis
39. adrenocortical
40. parathyroidectomy
41. hemithyroidectomy
42. thyroiditis
43. hyperadrenalism
44. thyrotropic
45. thyrolytic
46. thyropathy
47. F; ADH, antidiuretic hormone
48. T
49. F; medulla
50. F; calcium
51. F; thyroid
52. T
53. T
54. T
55. T
56. PTH; *PTH* is parathyroid hormone from the parathyroid gland; the others are hormones produced by the anterior pituitary.
57. dwarfism; *Dwarfism* is caused by hyposecretion of growth hormone; the others are caused by hypersecretion of hormones.
58. TBG; *TBG* is a test of thyroid function; the others are abbreviations associated with diabetes mellitus.
59. spleen; The *spleen* is part of the immune system; the others are endocrine glands.
60. insular
61. thyrotropic
62. adrenopathy
63. thyrolytic
64. insuloma
65. adenomegaly
66. adrenal
67. thyromegaly
68. adrenotropic
69. thyropathy
70. benign tumor of the pituitary gland
 - a. cranium
 - b. pharynx (the tumor arises from tissue that forms the roof of the mouth)
 - c. tumor, neoplasm
71. condition of complete underactivity of the pituitary gland
 - a. all
 - b. under, abnormally low
 - c. pituitary gland
 - d. condition of

72. usually benign tumor of the adrenal medulla or any cells that stain with chromium salts (chromaffin cells)
 - a. dark, dusky
 - b. color
 - c. cell
 - d. tumor, neoplasm
73. a toxic condition caused by hyperactivity of the thyroid gland
 - a. thyroid
 - b. poisonous
 - c. condition of

CASE STUDY QUESTIONS

1. a
2. c
3. d
4. a
5. b
6. c
7. e
8. nephrectomy
9. adenoma
10. ampule
11. hyperglycemia
12. bolus
13. within normal limits
14. neutral protamine Hagedorn
15. continuous subcutaneous insulin infusion

Chapter 17

PRETEST

1. b
2. c
3. a
4. c
5. a
6. c
7. b
8. c

CHAPTER EXERCISES

EXERCISE 17-1

1. pertaining to a nerve or the nervous system
2. pertaining to neuroglia, glial cells
3. pertaining to a spinal nerve root
4. pertaining to the meninges
5. pertaining to a ganglion
6. spinal cord
7. nervous system, nervous tissue
8. meninges
9. spinal nerve root
10. surgical removal of a ganglion

11. inflammation of many spinal nerve roots
12. destruction of a nerve or nervous tissue
13. tumor of the meninges
14. radiographic study of the spinal cord
15. glioma (*glī-Ō-ma*)
16. neuropathy (*nū-ROP-a-thē*)
17. myelitis (*mī-e-LĪ-tis*)
18. neuralgia (*nū-RAL-jē-a*)
19. myelogram (*MĪ-e-lō-gram*)

EXERCISE 17-2

1. brain
2. cerebrum, brain
3. thalamus
4. mind
5. stupor, unconsciousness
6. sleep
7. cerebrum, brain
8. cerebral (*SER-e-bral*)
9. cortical (*KOR-ti-kal*)
10. thalamic (*tha-LAM-ik*)
11. cerebellar (*ser-e-BEL-ar*)
12. ventricular (*ven-TRIK-ū-lar*)
13. study of the mind
14. pertaining to the brain and spinal cord
15. any disease of the brain
16. lack of sleep, inability to sleep
17. outside the medulla
18. incision of a ventricle
19. supracerebral (*sū-pra-SER-e-bral*)
20. encephalitis (*en-sef-a-LĪ-tis*)
21. intracerebellar (*in-tra-ser-e-BEL-ar*)
22. corticothalamic (*kor-ti-kō-tha-LAM-ik*)
23. ventriculogram (*ven-TRIK-ū-lō-gram*)

EXERCISE 17-3

1. tetraplegia (*tet-ra-PLĒ-jē-a*)
2. speech
3. read
4. seizures
5. partial paralysis, weakness
6. paralysis of the heart
7. lack of speech communication
8. difficulty in reading
9. obsession with fire
10. fear of women
11. partial paralysis or weakness of all four limbs
12. bradylalia (*brad-ē-LĀ-lē-a*)
13. hemiplegia (*hem-i-PLĒ-jē-a*)
14. noctiphobia (*nok-ti-FŌ-bē-a*); also, nyctophobia (*nik-tō-FŌ-bē-a*)
15. photophobia (*fō-tō-FŌ-bē-a*)

CHAPTER REVIEW

LABELING EXERCISE

Anatomic Divisions of the Nervous System

1. brain
2. spinal cord
3. central nervous system
4. cranial nerves
5. spinal nerves
6. peripheral nervous system

Motor Neuron

1. cell body
2. nucleus
3. dendrites
4. axon covered with myelin sheath
5. axon branch
6. myelin
7. muscle

External Surface of the Brain

1. sulci
2. gyri
3. frontal lobe
4. parietal lobe
5. occipital lobe
6. temporal lobe
7. pons
8. medulla oblongata
9. cerebellum
10. spinal cord

Spinal Cord, Lateral View

1. brain
2. brainstem
3. spinal cord
4. cervical enlargement
5. lumbar enlargement
6. cervical nerves
7. thoracic nerves
8. lumbar nerves
9. sacral nerves
10. coccygeal nerve

Spinal Cord, Cross Section

1. white matter
2. gray matter
3. dorsal horn
4. ventral horn
5. central canal
6. dorsal root of spinal nerve
7. dorsal root ganglion
8. ventral root of spinal nerve
9. spinal nerve

Reflex Pathway

1. receptor
2. sensory neuron
3. spinal cord (CNS)
4. motor neuron
5. effector

TERMINOLOGY

1. c
2. b
3. e
4. a
5. d
6. c
7. e
8. a
9. d
10. b
11. d
12. c
13. e
14. a
15. b
16. a
17. d
18. b
19. c
20. e
21. b
22. d
23. a
24. e
25. c
26. c
27. a
28. e
29. b
30. d
31. cerebrum
32. neuron
33. synapse
34. neuroglia, glial cells
35. cerebrospinal fluid (CSF)
36. meninges
37. reflex
38. autonomic nervous system (ANS)
39. neurotransmitter
40. cerebellum
41. pertaining to a spinal nerve root
42. partial paralysis of half the body
43. absence of a brain
44. inflammation of many nerves
45. pertaining to the cerebral cortex and thalamus
46. treatment of mental disorders
47. total paralysis
48. softening of the brain
49. sleep disorder
50. neurology
51. myelomeningitis
52. ganglionectomy; gangliectomy
53. neuropathy
54. ventriculostomy
55. hemiplegia
56. intracerebellar
57. dyslexia
58. hydrophobia
59. monoplegia

60. T
61. T
62. T
63. F; white
64. F; peripheral
65. F; dendrite
66. T
67. F; dura
68. T
69. intramedullary
70. contralateral
71. preganglionic
72. bradylalia
73. sensory
74. ventral
75. efferent
76. ganglionic
77. cortical
78. dural
79. meningeal
80. psychotic
81. ganglia
82. ventricles
83. meninges
84. gyri
85. lumbar puncture; *Lumbar puncture* is a diagnostic procedure for sampling CSF; the others are vascular disorders.
86. hematoma; *Hematoma* is a local collection of clotted blood; the others are neoplasms.
87. mania; *Mania* is a state of elation; the others are parts of the brain.
88. CNS; *CNS* is the central nervous system; the others are behavioral disorders.
89. myeloplegia
90. aphasia
91. hemiparesis
92. myoparesis
93. dysphasia
94. ganglioplegia
95. tetraplegia
96. myelitis
97. bradyphasia
98. hemiplegia
99. gangliitis
100. hemorrhage into the spinal cord
 - a. blood
 - b. spinal cord
 - c. condition of
101. abnormal development of the spinal cord
 - a. spinal cord
 - b. abnormal
 - c. development
 - d. condition of
102. inflammation of many nerves and nerve roots
 - a. many
 - b. nerve

- c. spinal nerve root
 - d. inflammation of
103. disturbance of muscle coordination
 - a. abnormal, difficult
 - b. together
 - c. work
 - d. condition of

CASE STUDY QUESTIONS

1. c
2. e
3. b
4. e
5. hemiparesis
6. aphasia
7. ischemic
8. meningitis
9. subdural hematoma
10. paranoia
11. antispasmodic
12. neuroleptics
13. psychiatrist
14. Glasgow coma scale
15. computed tomography
16. neurological intensive care unit (also means neonatal intensive care unit)
17. cerebrovascular accident
18. transient ischemic attack
19. level of consciousness

Chapter 18

PRETEST

1. c
2. b
3. a
4. c
5. a
6. c

CHAPTER EXERCISES

EXERCISE 18-1

1. abnormal sensation
2. abnormal sense of smell
3. lack of taste sensation
4. anesthesia (*an-es-THĒ-zē-a*)
5. pseudogeusia (*sū-dō-GŪ-zē-a*)
6. thermesthesia (*ther-mes-THĒ-zē-a*)
7. hyperalgesia (*hī-per-al-JĒ-zē-a*)
8. dysgeusia (*dis-GŪ-zē-a*)
9. myesthesia (*MĪ-es-thē-zē-a*)

EXERCISE 18-2

1. hearing
2. sound
3. ear

4. pertaining to hearing
5. pertaining to the ear
6. pertaining to the labyrinth (inner ear)
7. pertaining to the stapes
8. pertaining to the vestibule or vestibular apparatus
9. pertaining to the cochlea
10. otalgia (*ō-TAL-jē-a*)
11. audiometry (*aw-dē-OM-e-trē*)
12. tympanoplasty (*tim-PAN-ō-plas-tē*)
13. myringotomy (*mir-in-GOT-ō-mē*); also, tympanotomy (*tim-pan-OT-ō-mē*)
14. endocochlear (*en-dō-KOK-lē-ar*); intracochlear (*in-tra-KOK-lē-ar*)
15. vestibulocochlear (*ves-tib-ū-lō-KOK-lē-ar*)
16. labyrinthotomy (*lab-i-rin-THOT-ō-mē*)
17. salpingoscope (*sal-PING-go-skōp*)
18. stapedectomy (*stā-pē-DEK-ō-mē*)
19. inflammation of the ear
20. instrument used to measure hearing
21. any disease of the vestibule or vestibular apparatus
22. pertaining to the auditory tube and pharynx
23. instrument used to examine the tympanic membrane (eardrum)

EXERCISE 18-3

1. pertaining to the nose and lacrimal apparatus
2. between the eyelids
3. paralysis of the eyelid
4. excision of a lacrimal sac
5. blepharospasm (*BLEF-a-rō-spasm*)
6. dacryolith (*DAK-rē-ō-lith*)
7. dacryocystitis (*dak-rē-ō-sis-TĪ-tis*)

EXERCISE 18-4

1. eye
2. vision
3. lens
4. cornea
5. lens
6. ophthalmologist
7. opt/o; eye, vision
8. ophthalm/o; eye
9. pupill/o; pupil
10. phac/o; lens
11. uve/o; uvea
12. irid/o; iris
13. lent/i; lens
14. uveoscleritis (*ū-vē-ō-skle-RĪ-tis*)
15. phacomalacia (*fak-ō-ma-LĀ-shē-a*)
16. pupillary (*PU-pi-ler-ē*)
17. retinopexy (*ret-i-nō-PEK-sē*)
18. cyclitis (*sĪ-KLĪ-tis*)
19. ophthalmoscope (*of-THAL-mō-skōp*)

20. ophthalmology (*of-thal-MOL-ō-jē*)
21. iridectomy (*ir-i-DEK-tō-mē*)
22. iridoplegia (*ir-id-ō-PLĒ-jē-a*)
23. pertaining to the right eye
24. splitting of the retina
25. instrument used to incise the sclera
26. pertaining to the eye or vision
27. inflammation of the sclera
28. incision of the ciliary muscle
29. inflammation of the iris and ciliary body
30. pertaining to the choroid and retina
31. pertaining to the lens

EXERCISE 18-5

1. macropsia (*ma-KROP-sē-a*)
2. achromatopsia (*a-krō-ma-TOP-sē-a*)
3. diplopia (*dip-LŌ-pē-a*)
4. presbyopia (*pres-bē-Ō-pē-a*)
5. amblyopia
6. ametropia (*am-e-TRŌ-pē-a*)
7. heterometropia (*het-er-ō-me-TRŌ-pē-a*); also, anisometropia (*an-ī-sō-me-TRŌ-pē-a*)

CHAPTER REVIEW

LABELING EXERCISE

The Ear

1. outer ear
2. pinna
3. external auditory canal
4. tympanic membrane
5. ossicles (of middle ear)
6. malleus
7. incus
8. stapes
9. auditory tube
10. inner ear
11. vestibule
12. semicircular canals
13. cochlea

The Eye

1. sclera
2. cornea
3. conjunctival sac
4. choroid
5. ciliary muscle
6. iris
7. pupil
8. lens
9. aqueous humor
10. vitreous body
11. retina
12. fovea
13. optic disk (blind spot)
14. optic nerve

TERMINOLOGY

1. b
2. a
3. e
4. d
5. c
6. d
7. e
8. a
9. c
10. b
11. d
12. c
13. e
14. b
15. a
16. e
17. c
18. b
19. a
20. d
21. b
22. a
23. d
24. e
25. c
26. d
27. e
28. a
29. c
30. b
31. tympanic membrane
32. ear wax, cerumen
33. stapes
34. sclera
35. refraction
36. retina
37. cornea
38. proprioception
39. specialist in the study and treatment of hearing disorders
40. instrument for measuring the eye
41. absence of a lens
42. below the sclera
43. incision of the iris
44. incision of the tympanic membrane (eardrum)
45. around the lens
46. excess flow of tears
47. pertaining to the choroid and retina
48. inflammation of the cornea and iris
49. retinopathy
50. analgesia
51. stapedectomy
52. blepharoptosis
53. otoplasty
54. vestibulocochlear
55. tympanosclerosis; myringosclerosis
56. pupillometry
57. lacrimal
58. cyclectomy
59. salpingoscopy
60. hyperopia
61. cochlear
62. palpebral
63. vestibular
64. uveal
65. corneal
66. scleral
67. pupillary
68. miosis
69. exotropia
70. sc
71. myopia
72. hypoaesthesia, hypaesthesia
73. hyperalgesia
74. pseudosmia
75. myringoplasty
76. retinoscopy
77. salpingoscopy
78. anosmia
79. retinoschisis
80. myringoscopy
81. subretinal
82. retinopexy
83. keratoscopy
84. F; constrict
85. T
86. T
87. F; smell, olfaction
88. F; taste
89. T
90. F; tympanic membrane
91. F; tears
92. smell; *Smell* is a special sense; the others are general senses.
93. pinna; The *pinna* is part of the outer ear; the others are parts of the inner ear.
94. incus; The *incus* is an ossicle of the ear; the others are structures that protect the eye.
95. presbycusis; *Presbycusis* is loss of hearing due to age; the others are disorders of the eye.
96. weakness or tiring of the eyes
 - a. lack of
 - b. strength
 - c. eye
 - d. condition of
97. condition in which a cataractous lens has been removed and replaced with a plastic lens implant
 - a. false
 - b. lens
 - c. condition of
98. a cystlike mass containing cholesterol
 - a. bile (here, cholesterol, found in bile)
 - b. fat
 - c. tumor, neoplasm

99. a type of strabismus (squint) in which the eye deviates outward
 - a. out
 - b. turning
 - c. condition of
100. unequal refractive power in the two eyes, heterometropia
 - a. not, without
 - b. equal, same
 - c. measure
 - d. eye
 - e. condition of

CASE STUDY QUESTIONS

1. e
2. d
3. e
4. b
5. b
6. d
7. tympanogram
8. aural
9. suprathreshold
10. acoustic
11. tinnitus
12. ophthalmologist
13. midazolam
14. intraocular
15. miosis
16. subconjunctival
17. hertz
18. brainstem auditory evoked potentials
19. intraocular lens

Chapter 19

PRETEST

1. c
2. a
3. d
4. b
5. c
6. d
7. a
8. c

CHAPTER EXERCISES

EXERCISE 19-1

1. bone, bone tissue
2. bone marrow
3. joint
4. cartilage
5. bursa
6. pertaining to or resembling bone
7. formation of bone marrow
8. softening of cartilage

9. surgical puncture of a joint
10. inflammation of a bursa
11. pertaining to synovial fluid, joint or membrane
12. osteomyelitis (*os-tē-ō-mī-e-LĪ-tis*)
13. osteoblast (*OS-tē-ō-blast*)
14. myeloma (*mī-e-LŌ-ma*)
15. bursotomy (*bur-SOT-ō-mē*)
16. synovitis (*si-nō-VĪ-tis*)
17. arthroplasty (*AR-thrō-plas-tē*)
18. arthropathy (*ar-THROP-a-thē*)
19. chondroid (*KON-droyd*), also chondral, cartilaginous
20. arthroscope (*AR-thrō-skōp*)
21. hyperostosis (*hī-per-os-TŌ-sis*)
22. dysostosis (*dis-os-TŌ-sis*)

EXERCISE 19-2

1. cranial
2. costal
3. pelvic
4. iliac
5. vertebral
6. sacral
7. incision of the cranium (skull)
8. before or in front of the spinal column or vertebra
9. pain in a vertebra
10. above the pelvis
11. cranioschisis (*krā-nē-OS-ki-sis*)
12. spondylitis (*spō-di-LĪ-tis*)
13. vertebroplasty (*ver-te-brō-PLAS-tē*)
14. costectomy (*kos-TEK-tō-mē*)
15. rachiocentesis (*rā-kē-ō-sen-TĒ-sis*); also, rachicentesis (*rā-kē-sen-TĒ-sis*)
16. sacroiliac (*sā-krō-IL-ē-ak*)
17. craniosacral (*krā-nē-ō-SĀ-kral*)
18. pelvimetry (*pel-VIM-e-trē*)
19. perisacral (*per-i-SĀ-kral*)
20. coccygectomy (*kok-si-JEK-tō-mē*)
21. iliococcygeal (*il-ē-ō-kok-SIJ-ē-al*)
22. infracostal (*in-fra-KOS-tal*); subcostal (*sub-KOS-tal*)

CHAPTER REVIEW

LABELING EXERCISE

The Skeleton

1. cranium
2. facial bones
3. mandible
4. vertebral column
5. sacrum
6. sternum
7. ribs
8. clavicle
9. scapula
10. humerus
11. radius
12. ulna

13. carpals
14. metacarpals
15. phalanges
16. pelvis
17. ilium
18. femur
19. patella
20. fibula
21. tibia
22. tarsals
23. calcaneus
24. metatarsals

Skull from the Left

1. frontal
2. parietal
3. occipital
4. temporal
5. sphenoid
6. lacrimal
7. nasal
8. zygomatic
9. maxilla
10. mandible
11. hyoid

Vertebral Column

1. cervical vertebrae
2. thoracic vertebrae
3. lumbar vertebrae
4. sacrum
5. coccyx
6. intervertebral disk
7. body of vertebra

The Pelvic Bones

1. ilium
2. ischium
3. pubis
4. pubic symphysis
5. acetabulum
6. sacrum

Structure of a Long Bone

1. proximal epiphysis (*e-PIF-i-sis*)
2. diaphysis (*dī-AF-i-sis*)
3. distal epiphysis
4. cartilage
5. epiphyseal line (growth line)
6. spongy bone (containing red marrow)
7. compact bone
8. medullary (marrow) cavity
9. artery and vein
10. yellow marrow
11. periosteum (*per-ē-OS-tē-um*)

TERMINOLOGY

1. d
2. a
3. e

4. c
5. b
6. d
7. a
8. e
9. c
10. b
11. c
12. d
13. e
14. a
15. b
16. d
17. c
18. e
19. b
20. a
21. orthopedics
22. cartilage
23. ligament
24. sacrum
25. bursa
26. synovial fluid; synovia
27. cartilage
28. bone marrow
29. joint, joint cavity
30. vertebrae
31. spine
32. inflammation of the bone marrow
33. formation of bone
34. fusion of a joint
35. excision of a synovial membrane
36. cartilage cell
37. within bone
38. around a bursa
39. inflammation of a vertebra
40. pertaining to many joints
41. below a rib
42. pain in the coccyx
43. chondrogenesis
44. osteonecrosis
45. craniotomy
46. osteochondroma
47. arthrostenosis
48. chondrectomy
49. bursolith
50. pelvimetry
51. arthroscopy
52. sacroiliac
53. coccygectomy
54. parasacral
55. idiopathic
56. scapula
57. ilium
58. thorax
59. osteotomies
60. scoliosis
61. cranial
62. iliac
63. coccygeal
64. pelvic
65. vertebral

66. T
67. F; ankle
68. T
69. F; appendicular
70. T
71. T
72. F; red
73. T
74. T
75. hyoid; The *hyoid* is the bone below the mandible (lower jaw); the others are bone markings.
76. lambdoid; *Lambdoid* refers to a skull suture; the others are bones of the skull.
77. cost/o; *Cost/o* refers to a rib; the others are roots pertaining to the spine.
78. sciatic; *Sciatic* refers to the sciatic nerve that travels through the leg; the others are types of bone fractures.
79. OA; OA is an abbreviation for osteoarthritis; the others are abbreviations for spinal regions.
80. osteolysis
81. arthrotome
82. spondylodysplasia
83. arthrololysis
84. osteotome
85. arthroplasty
86. osteodysplasia
87. spondylolysis
88. arthrodynia
89. osteoplasty
90. disease of the (cartilaginous) growth center in children
 - a. bone
 - b. cartilage
 - c. condition of
91. surgical fusion (ankylosis) between vertebrae
 - a. vertebra
 - b. together
 - c. fusion, binding
92. bony outgrowth from a bone
 - a. out
 - b. bone
 - c. condition of
93. decreased growth of cartilage in the growth plate of long bones resulting in dwarfism
 - a. lack of
 - b. cartilage
 - c. formation, molding
 - d. condition of

CASE STUDY QUESTIONS

1. c
2. b
3. c

4. e
5. c
6. zygomatic
7. periosteum
8. meniscus
9. arthroplasty
10. osteogenesis
11. fracture
12. congenital
13. femur
14. degenerative joint disease
15. normal saline
16. temporomandibular joint
17. osteogenesis imperfecta
18. open reduction internal fixation
19. estimated blood loss

Chapter 20

PRETEST

1. b
2. d
3. c
4. d
5. a
6. c
7. b
8. a

CHAPTER EXERCISES

EXERCISE 20-1

1. pertaining to muscle
2. pertaining to fascia
3. pertaining to a tendon
4. pertaining to tone
5. pertaining to movement
6. muscle
7. fibers
8. fascia
9. tone
10. work
11. movement, motion
12. muscle
13. muscle; smooth muscle
14. excess muscle tone
15. suture of fascia
16. inflammation of a tendon
17. pertaining to muscle and tendon
18. binding or fusion of a tendon
19. pain in a muscle
20. treatment using movement
21. inflammation of a muscle and a tendon
22. pertaining to muscle and fascia
23. producing or generating work
24. lack of muscle tone
25. abnormality of movement
26. myopathy (*mi-OP-a-the*)

27. fasciectomy (*fash-ē-EK-tō-mē*)
28. tenotomy (*ten-OT-ō-mē*)
29. polymyositis (*pol-ē-mī-ō-Sī-tis*)
30. musculoskeletal (*mus-kū-lō-SKEL-e-tal*)
31. kinesiology (*ki-nē-sē-OL-ō-jē*)
32. tenomyoplasty (*ten-ō-Mī-ō-plas-tē*)

CHAPTER REVIEW

LABELING EXERCISE

Superficial Muscles, Anterior View

1. temporalis
2. orbicularis oculi
3. orbicularis oris
4. masseter
5. sternocleidomastoid
6. trapezius
7. deltoid
8. pectoralis major
9. serratus anterior
10. brachialis
11. biceps brachii
12. brachioradialis
13. flexor carpi
14. extensor carpi
15. external oblique
16. internal oblique
17. rectus abdominis
18. intercostals
19. sartorius
20. adductors of thigh
21. quadriceps femoris
22. gastrocnemius
23. soleus
24. fibularis longus
25. tibialis anterior

Superficial Muscles, Posterior View

1. sternocleidomastoid
2. trapezius
3. deltoid
4. teres minor
5. teres major
6. latissimus dorsi
7. triceps brachii
8. gluteus medius
9. gluteus maximus
10. hamstring group
11. gastrocnemius
12. fibularis longus

TERMINOLOGY

1. c
2. e
3. d
4. a
5. b
6. e

7. a
8. d
9. b
10. c
11. d
12. c
13. b
14. a
15. e
16. e
17. b
18. a
19. d
20. c
21. c
22. e
23. d
24. b
25. a
26. d
27. e
28. a
29. c
30. b
31. acetylcholine
32. fascia
33. three
34. extensor
35. tendon
36. Achilles tendon
37. abduction
38. muscle, muscle tissue
39. arm
40. supraspinatus
41. neck
42. study of muscles
43. pertaining to muscle and fascia
44. plastic repair of a tendon
45. inflammation of fibers (fibrous tissue)
46. decreased muscle tone
47. abnormally increased movement
48. myositis
49. myonecrosis
50. fasciorrhaphy
51. atony
52. fasciectomy
53. kinesiology
54. tenotomy
55. tendinous
56. antagonist
57. insertion
58. adduction
59. supination
60. flexion
61. ataxic
62. athetotic
63. spastic, spasmodic
64. clonic
65. T
66. T

67. F; insertion
68. F; posterior
69. T
70. T
71. F; four
72. T
73. osteoblast; An *osteoblast* is a bone cell; the others are related to muscle structure.
74. soleus; The *soleus* is a calf muscle; the others are muscles of the arm.
75. intercostals; The *intercostals* are between the ribs; the others are quadriceps muscles in the anterior thigh.
76. actin; *Actin* is a type of muscle filament involved in contraction; the others are types of movement.
77. EMG; *EMG* is electromyography, a method for studying the electric energy in muscles; the others are diseases that involve muscles.
78. carpal tunnel syndrome
79. acetylcholine
80. rotator cuff
81. neuromuscular junction
82. creatine kinase
83. myoblast
84. fasciodesis
85. tenalgia
86. myolysis
87. tenodesis
88. fasciitis
89. tenolysis
90. fascial
91. myalgia
92. disorder involving muscular inflammation and weakness with skin inflammation and rash
 - a. skin
 - b. muscle
 - c. inflammation
93. muscular weakness
 - a. muscle
 - b. lack of
 - c. strength
 - d. condition of
94. lack of smooth or accurate muscle movement because coordination between muscle components is lacking
 - a. abnormal
 - b. together
 - c. work
 - d. condition of
95. pertaining to muscle wasting, atrophy
 - a. lack of
 - b. muscle
 - c. nourishment
 - d. pertaining to

CASE STUDY QUESTIONS

1. b
2. d
3. e
4. a
5. b
6. d
7. b
8. e
9. c
10. c
11. e
12. orthopedic
13. flexion
14. plantar flexion
15. physical therapy
16. range of motion
17. somatosensory evoked potentials
18. postanesthesia care unit

Chapter 21

PRETEST

1. c
2. b
3. a
4. b
5. d
6. b

CHAPTER EXERCISES

EXERCISE 21-1

1. derm/o; skin
2. seb/o; sebum
3. melan/o; melanin
4. kerat/o; keratin, horny layer of the skin
5. hidr/o; sweat
6. trich/o; hair
7. onych/o; nail
8. skin
9. horny (keratinous) layer
10. melanin
11. hair
12. nail
13. sweat, perspiration
14. skin
15. dermatolysis (*der-ma-TOL-i-sis*); dermolysis (*der-MOL-i-sis*)
16. melanoma (*mel-a-NŌ-ma*)
17. keratogenesis (*ker-a-tō-JEN-e-sis*)
18. dermatome (*DER-ma-tōm*)
19. trichology (*trik-OL-ō-jē*)
20. hyperhidrosis (*hī-per-hī-DRŌ-sis*)
21. onychomalacia (*on-i-kō-ma-LĀ-shē-a*)
22. dermatology (*der-ma-TOL-ō-jē*)

23. scleroderma (*sklēr-ō-DER-ma*)
24. pyoderma (*pī-ō-DER-ma*)

CHAPTER REVIEW

LABELING EXERCISE

Cross Section of the Skin

1. epidermis
2. stratum basale (growing layer)
3. stratum corneum
4. dermis
5. skin
6. subcutaneous layer
7. adipose tissue
8. hair follicle
9. hair
10. arrector pili muscle
11. artery
12. vein
13. nerve
14. nerve endings
15. sudoriferous (sweat) gland
16. pore (opening of sweat gland)
17. sebaceous (oil) gland
18. touch receptor
19. pressure receptor

TERMINOLOGY

1. d
2. a
3. e
4. c
5. b
6. c
7. d
8. b
9. e
10. a
11. a
12. c
13. b
14. e
15. d
16. e
17. d
18. a
19. c
20. b
21. skin
22. skin
23. sweat, perspiration
24. melanin
25. sebaceous glands
26. keratin
27. nail
28. decubitus ulcer, bed sore, pressure sore
29. touch
30. débridement
31. skin graft, full-thickness skin graft

32. ischemia
33. excess melanin production
34. through the skin
35. producing keratin
36. excess flow of sebum
37. thickening of the skin
38. infection of a nail and nail bed
39. dryness of the skin
40. abnormal keratin production
41. seborrheic
42. melanocyte
43. scleroderma; dermatosclerosis
44. melanoma
45. hyperkeratosis
46. dermatome
47. anhidrosis
48. hyperhidrosis
49. chromhidrosis
50. T
51. F; stratum corneum
52. T
53. T
54. F; stratum basale
55. F; hair
56. trichoid
57. onychomycosis
58. dermatolysis
59. trichology
60. onycholysis
61. dermatoid
62. onychopathy
63. trichomycosis
64. dermatopathy
65. dermatology
66. keloid; A *keloid* is a raised, thickened scar; the others are types of skin lesions.
67. escharotomy; *Escharotomy* is removal of scab tissue; the others are types of skin diseases.
68. BSA; BSA is an abbreviation for body surface area; the others are abbreviations for skin diseases.
69. fungal infection of the skin
 - a. skin
 - b. plant
 - c. condition of
70. benign tumor of a sweat gland
 - a. sweat
 - b. gland
 - c. tumor
71. ingrown toenail
 - a. nail
 - b. hidden
 - c. condition of
72. lack of color or graying of the hair
 - a. lack of
 - b. color
 - c. hair
 - d. condition of

CASE STUDY QUESTIONS

1. b
2. c
3. d
4. e
5. a
6. c
7. b
8. d
9. a
10. dermabrasion
11. nodule
12. dermatologist
13. subcutaneous tissue
14. erythroderma
15. hyperkeratosis
16. full-thickness skin graft
17. sun protection factor
18. at bedtime
19. twice per day
20. as needed

Figure Credits

- FIGURE 1-3** Cohen B. Memmler's *The Human Body in Health and Disease*. 12th ed. Baltimore: Lippincott Williams & Wilkins, 2013.
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- FIGURE 2-6** Cormack DH. *Essential Histology*. 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2001.
- FIGURE 2-7** Cohen B. Memmler's *The Human Body in Health and Disease*. 12th ed. Baltimore: Lippincott Williams & Wilkins, 2013.
- FIGURE 2-8** Cohen B. Memmler's *The Human Body in Health and Disease*. 12th ed. Baltimore: Lippincott Williams & Wilkins, 2013.
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- FIGURE 20-8** Adapted from Frontera WR, Silver JS. *Essentials of Physical Medicine and Rehabilitation*. 2nd ed. Philadelphia: Hanley and Belfus, 2008.
- FIGURE 20-9** Stedman's *Medical Dictionary*. 28th ed. Baltimore: Lippincott Williams & Wilkins, 2006.
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- FIGURE 21-2A** Bickley LS. Bates' *Guide to Physical Examination and History Taking*. 10th ed. Philadelphia: Lippincott Williams & Wilkins, 2009.
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- FIGURE 21-5** Hall JC. Sauer's *Manual of Skin Diseases*. 9th ed. Philadelphia: Lippincott Williams & Wilkins, 2006.
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