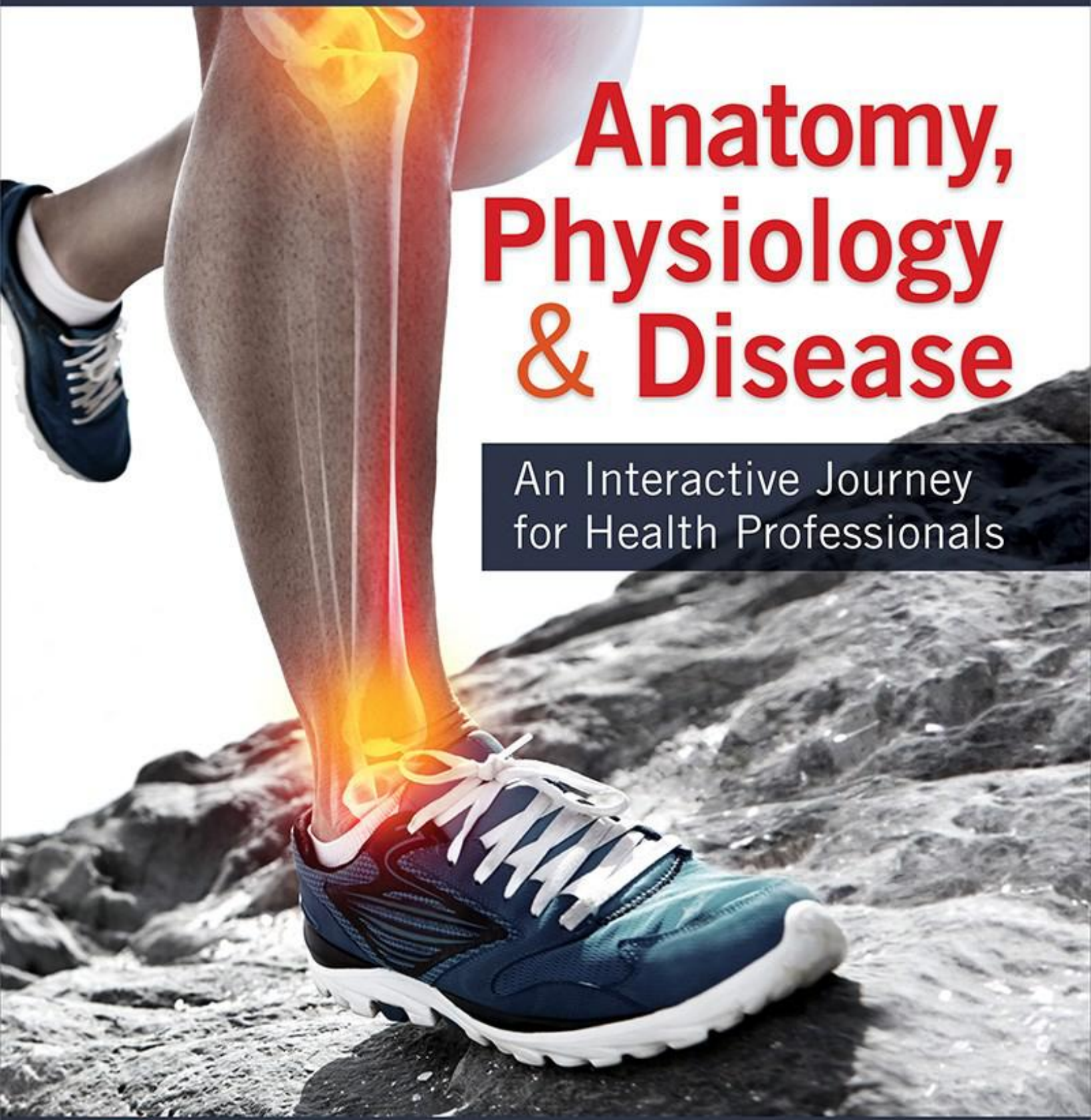
Third Edition

Anatomy, Physiology & Disease

An Interactive Journey for Health Professionals



Bruce J. Colbert • Jeff Ankney • Karen T. Lee

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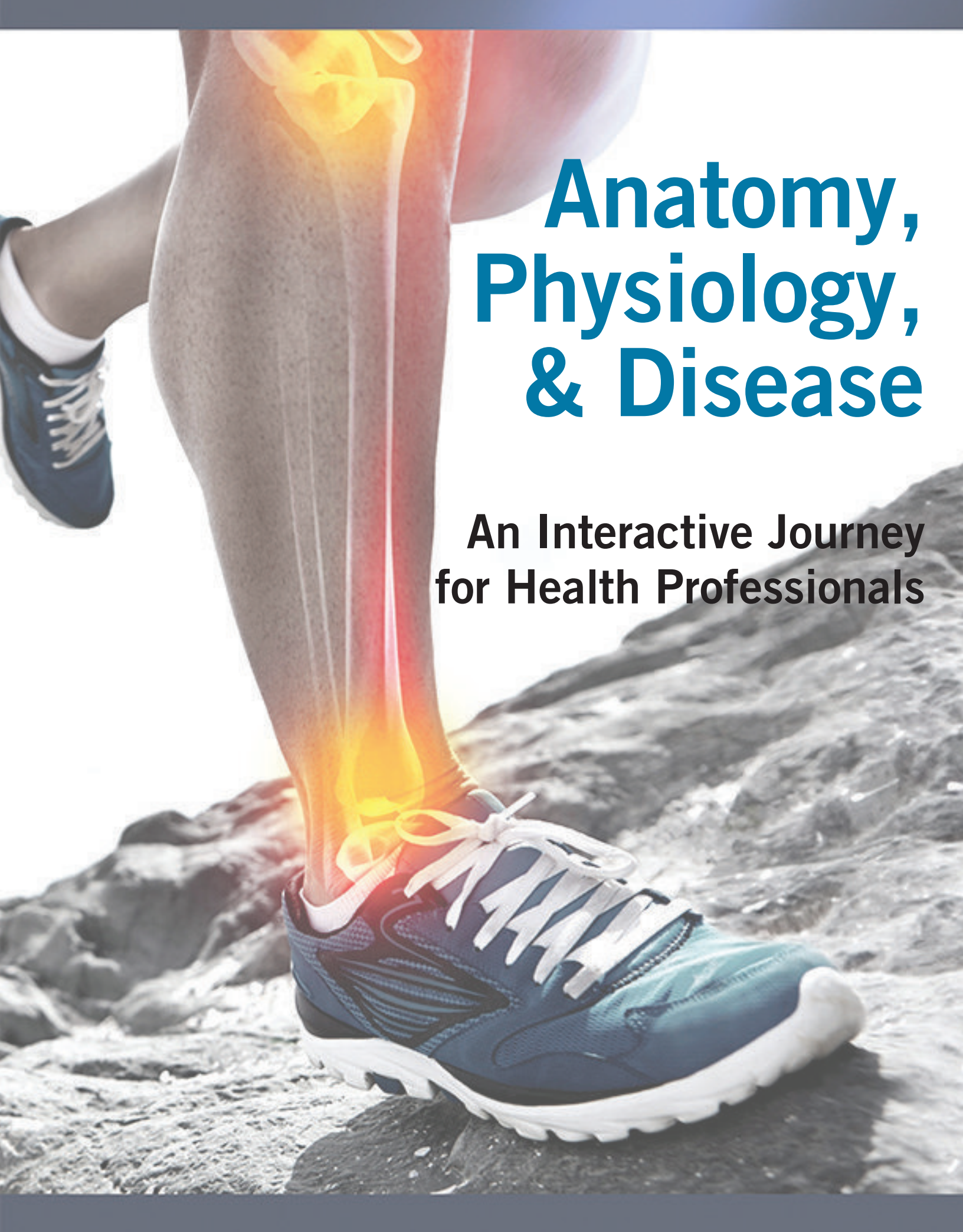

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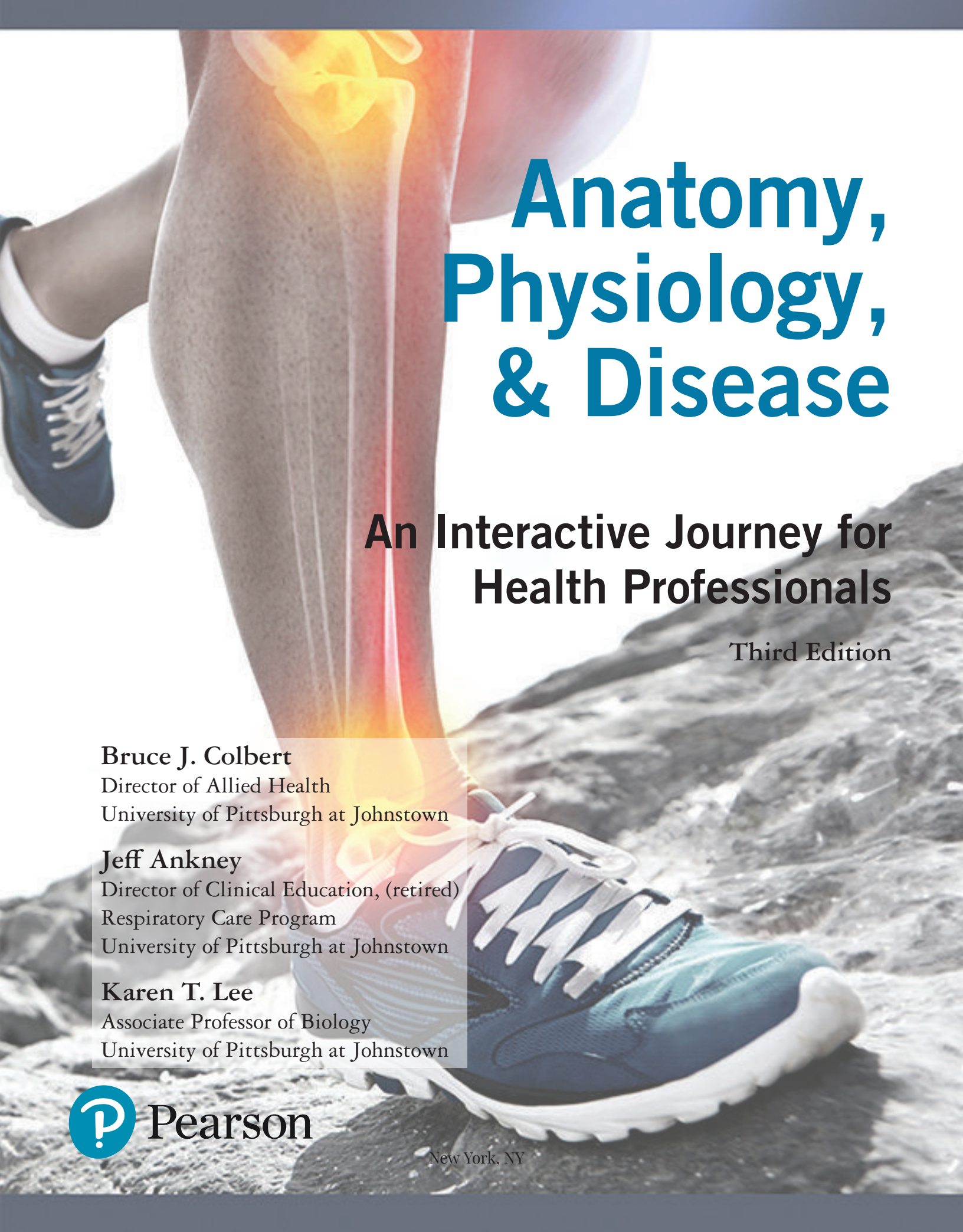

Anatomy, Physiology, & Disease

An Interactive Journey for Health Professionals

Third Edition

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Library of Congress Cataloging-in-Publication Data

Names: Colbert, Bruce J., author. | Ankney, Jeff, author. | Lee, Karen T., author.
Title: Anatomy, physiology & disease : an interactive journey for health professionals / Bruce J. Colbert, Jeff Ankney, Karen T. Lee.
Other titles: Anatomy, physiology, and disease
Description: Third edition. | Saddle River, New Jersey : Pearson Education, Inc., [2019] | Includes index.
Identifiers: LCCN 2018006740| ISBN 9780134876368 (student edition) | ISBN 0134876369 (student edition)
Subjects: | MESH: Anatomy | Pathology | Physiological Phenomena | Programmed Instruction
Classification: LCC R130.3 | NLM QS 18.2 | DDC 612.007--dc23
LC record available at https://lccn.loc.gov/2018006740

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Pearson

ISBN-10: 0-13-4876369
ISBN-13: 978-0-13-487636-8

DEDICATIONS

To all the future health care professionals learning anatomy, physiology, and disease: May your chosen professions be as personally rewarding as ours have been.

—Your Travel Guides Bruce, Jeff, and Karen

I dedicate this book to those closest to me who share this wonderful journey through life: my wife Patty, my sons Joshua and Jeremy, my daughter-in-law Ali, granddaughter Lenyx, and my three brothers and sister. Also a special thanks to the many teachers who encouraged me to develop my writing skills. Finally, a special dedication to the memory of my Mom and Dad, who taught me the importance of education.

—Bruce

A special thanks to all my family for their support and understanding through this long process. Mom and Dad, thank you both for always being there no matter where my journey took me. Patty, thanks for being so supportive throughout this project.

A sincere thank you to Mr. James McCall, who inspired me to become a teacher those many years ago. And to my past teachers and professors—here's proof that underachievers sometimes do hit their stride!

—Jeff

I dedicate this book to my family, who have always supported me, no matter where life has taken me: not only my "real" family—my late father Ed, my mother Pat, brother Eddie, sister-in-law Sheila, and assorted aunts, uncles, and cousins, who really had no choice but to be part of my life—but also those members of my extended family who have inexplicably chosen to be part of my life, giving me the gift of their friendship. I couldn't have done it without them.

—Karen

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Special thanks to Zack Ankney MD, for his review and comments and for teaching dad a thing or two.

Anatomy, physiology, and disease is a critical academic course one must master to succeed in the health professions. This third edition of *Anatomy, Physiology, and Disease: An Interactive Journey for Health Professionals* is still written in the conversational manner that we pioneered in the first edition. We continue with the journey theme, richly interwoven with relatable analogies, and current clinical applications to make the material engaging and relevant.

Too often students adopt the strategy of memorizing massive amounts of information and simply store it in their short-term memories to pass the test. We continue to strive to have a text that students actually enjoy reading and that truly engages them with the content in order to make the lasting connections that will help them *thrive* as health care practitioners.

New to This Edition

- Significantly enhanced select drawings with side-by-side micrographs help learners connect illustrative concepts to real life
- New and updated Clinical Applications present the most current research on specific anatomy and physiology topics related to chapter content. One prime example is the new American Heart Association blood pressure classifications and guidelines released in late 2017
- New cellular and tissue tables complete with actual micrographs to provide visual representations to table text.
- Added Focus on Professions feature to show diversity and relatedness to A&P topics and highlight the many health care career options.
- Updated all body system disorder content to provide learners with the most recent information and connect disease states to abnormal changes in anatomy, and physiology.
- Updated Pharmacology Corner feature to provide common medication examples for various diseases.
- Revised learning outcomes to connect learners with key chapter concepts and serve as a review and study tool.
- Reorganized content and headings as appropriate to improve the flow of information.
- Updated Test Your Knowledge and end-of-chapter review questions to provide learners with a chance to check their understanding of new concepts.
- Added student Answer Key for chapter review questions to allow students to check their understanding of key concepts.

What Is NOT New to This Edition

We haven't changed the user-friendly, conversational writing style—rich with analogies with appropriate humor sprinkled in—that encourages relevant learning and that has made the previous editions so popular.

So what else have we done to facilitate learning the material? First, we have placed study skills and stress management tips in a *Study Success Companion* in the back of your book to help you along your journey through this class and beyond. Second, we have provided useful appendices on multisystem effects of various diseases and condition, infectious diseases and causes, standard and transmission-based precautions, medical terminology, abbreviations, lab reference values, and nutritional information. Third, we have strived to make anatomy, physiology, and disease "come alive" by using an engaging writing style that makes it seem as if we are sitting next to you talking about the concepts. We have made every effort to put together a textbook package that you will actually enjoy reading. We hope you consider us as assistants to the most important guide through this journey: your teacher.

Humor, where appropriate, and analogies to compare the human body to everyday things to which you can relate have been interwoven throughout the text. Finally, we have added special features in a unique fashion tailored to the visual learning styles and relevant learning that today's students require.

We have worked hard to create an even more exciting and visually appealing third edition and sincerely hope these features will help make studying anatomy, physiology, and diseases a positive experience. Have a safe and happy journey!

Resources

- Textbook
- Student Workbook
- MyLab Health Professions with Pearson eText

The Instructor Package:

- Instructor's Resource Manual
- PowerPoint slides
- Image Library
- TestGen Computerized Test Bank
- MyLab Health Professions with Pearson eText

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ACKNOWLEDGMENTS

We gratefully thank Jill Rembetski, who acted as an invaluable guide through the development and completion of both the first and second editions as well as this new edition of *Anatomy, Physiology, and Disease*. We value all her hard work and attention to detail that added so much to this project. She really should be listed as a contributing author and given an award for her patience with us. To all those at Pearson who were so helpful and friendly in this monumental process, especially Derril Trakalo, Faye Gemmellaro, and Marlene Pratt, thank you! A special thank-you to Mark Cohen for his original belief in this project. Also, we gratefully acknowledge a great group of reviewers who helped shape this project with their thoughtful insights. Finally, special thanks to Jan Snyder for putting up with quirky authors and helping in so many ways.

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A USER'S GUIDE TO THE FEATURES OF THE BOOK

We have designed this textbook to be fun, interesting, and rich in features to aid your understanding of this challenging topic. Here is a quick guide to what makes this text different from others. We hope that the special highlights of this book enhance your learning experience as the journey of your health care career unfolds.

SPECIAL FEATURES MAKE LEARNING FUN

Pronunciation Guides

Although this is not a medical terminology book, understanding and pronouncing medical words is critical to your success. The Terms to Know section in each chapter provides a phonetic pronunciation of the difficult terms. The "see-and-say" pronunciations will help you practice terms that are more challenging to say.

Pronunciation Guide

Pro•*nun*•ci•a•tion

Correct pronunciation is important in any journey so that you and others are completely understood. Here is a "see-and-say" Pronunciation Guide for the more difficult terms to pronounce in this chapter. Please note that pronunciations given are referenced to medical dictionaries, and regional variations may exist.

alopecia (al oh PEE she ah)
apocrine (APP oh krin)
avascular (ay VAS cue lair)
carotene (CARE oh teen)
corium (CORE ee um)
ecchymosis (ek ee MOH sis)
eccrine (EKK rin)
epidermis (ep ih DER miss)
epithelial cells (ep ih THEE lee al)
follicle (FALL ih kul)
hypodermis (high poh DER miss)
keratin (KAIR eh tin)
keratinization (KER eh tin eye ZAY shun)
keratinized (KER eh tin ized)
lesion (LEE zhun)
lipocyte (lip OH site)
lunula (LOO nyoo lah)
meibomiam gland (my BOH me am)
melanin (MELL an in)
melanocytes (MELL an oh sights)
pustule (PUS tyool)
sebaceous (see BAY shus)
seborrheic keratosis (SEB oh REE ik KERR ah TOH sis)
sebum (SEE bum)
scabies (SKAY beez)
stratum corneum (STRAY tum core NEE um)
stratum germinativum (STRAY tum JER meh NAY tee vum)
subcutaneous fascia (sub cue TAY nee us FASH ee ah)
tinea (TIN ee ah)
vasoconstriction (VAZE oh kon STRIKT shun)
vasodilation (VAZE oh dye LAY shun)
vesicles (VES ih koolz)

Focus on Professions

These job descriptions present a brief overview of the tasks performed by various health care professionals. They appear strategically within the chapters to help you visualize how what you are learning relates to a particular job. We hope this feature will open the door to the many career possibilities that await if you continue your studies in health care.

FOCUS ON PROFESSIONS

Dental assistants and **hygienists** are dedicated to keeping the teeth and surrounding structures clean and free of disease. In addition, they assist in taking x-rays and making impressions for dental cosmetics. Learn more about these professions by visiting the websites of national organizations, including the American Dental Assistant Association (ADAA), the National Dental Assistant Association (NDA), the National Association of Dental Assistants (NADA), the American Dental Hygienists Association (ADHA), and the National Dental Hygienists Association (NDHA).

(Source: Nejron Photo/Shutterstock)

CLINICAL APPLICATION

ANGIOGRAPHY

One way to get a good picture of the blood flow in a person's body (and any problems with it) is to perform an **angiogram**. An angiogram is an x-ray of the body after a **radiocontrast agent** (a dye that makes the blood contrast with its surroundings on an x-ray) has been injected into the blood. The angiographic x-ray shows shadows of the openings within the cardiovascular structures carrying blood; the blood vessels themselves do not appear. The most common use of an angiogram is to visualize the blood flow in the coronary arteries.

Clinical Applications

These highlight boxes show the relevance of what you are learning and how that knowledge is needed in clinical practice. This feature includes topics such as aging, major diagnostic studies, and therapeutics.

PATHOLOGY CONNECTION

PROBLEMS WITH CARDIAC MUSCLE AND CARDIAC VASCULATURE

Pump Problems

So far, we have discussed how a healthy heart works. However, certain events can affect the efficiency of the heart's pumping action. Remember that this is a two-pump system. What may damage one pump may not always damage the other pump.

Let's look at the right side of the heart first. Right-side heart failure is a potentially serious condition in which the right-side pump can't move blood as efficiently as it should. This is a result of the heart muscle of the right pump *chronically* working harder than normal. As with any muscle that you exercise over time, heart muscle also becomes larger. In this case, the muscles on the right side of the heart become too large and can no longer efficiently pump blood. Remember that the left side is pumping normally, and we are working with a closed system, much like a water pump and cooling system in a car. As the healthy left side pumps blood through your body and back to the right side, the now-inefficient right side cannot take all the returning blood to pump it to the lungs. As a result, the blood begins to back up. The vessels in the body are flexible and can expand a little to take that extra volume of blood, so extended neck veins can be a sign of a right-side pumping problem. Certain organs can hold more blood than usual, so an engorged liver and spleen can also be a sign of right-heart failure. Tissues in the periphery can hold be a sign of right-sided heart failure. Disease conditions such as **polycythemia**, in which the blood is thicker than normal and, therefore, is harder to pump, or blood vessels in the lungs that constrict more than normal, making it harder to push blood through them, can cause the right ventricle to work harder. Because these two conditions are often related to certain lung diseases, it is no surprise that 85% of patients with chronic obstructive pulmonary disease (COPD) develop right-side heart failure.

Heart failure (in the past, often called *congestive* heart failure) is a potentially life-threatening condition that is usually a problem of the left pump of the heart and can be caused by decreased pumping efficiency of damaged muscle fibers of the left ventricle following a heart attack. This is a situation in which the pumping action of the heart cannot overcome an increased systemic blood pressure, or in which the systemic blood pressure is normal but the left ventricle is too weakened to effectively pump blood. As a result of this increasing vascular pressure, fluid begins to leak out of the vessels and into the tissues of the body. Now let's consider a left-sided heart failure scenario. The healthy right pump pushes blood through the vasculature of the lungs on its way to the left-side pump. If the left side can't keep up with the blood being delivered to it, the blood backs up into the lungs, increasing the pressure in those blood vessels. (Remember, this is a closed system!) Once that pressure reaches a certain point, fluid leaks out of the

Pathology Connection

After discussions of anatomy and physiology concepts, a special section on related disease conditions is presented. This makes the connection to why the understanding of the A&P concept discussed is so important to the pathologic process. This aids the student in understanding abnormal diagnostic test results and why certain treatments are effective for a specific disease.

APPLIED SCIENCE

PH AND VENTILATION

CO_2 levels are directly related to hydrogen ion concentration. When CO_2 levels rise, so does hydrogen ion concentration. Consequently, pH falls; that is, blood becomes more acidic. Because of this relationship, your body interprets any decrease in blood pH, no matter the cause, as if it were due to increased CO_2, and ventilation increases. For example, when Maria's diabetes is poorly controlled, she might have lower blood pH (increased hydrogen ion concentration) due to metabolic acidosis. In an attempt to bring her blood pH back to normal, her ventilation rate would increase.

Applied Science

Instead of having a separate nonintegrated chemistry or physics chapter, the sciences are presented in context.

Amazing Body Facts

These are "that's awesome" kinds of facts to give an appreciation of just how wonderful the human design is. For example, nerve impulses can travel at speeds of up to 426 feet per *second*!

***AMAZING* BODY FACTS**

Smoking Kills

The major preventable cause of many of the respiratory diseases is smoking. It has been estimated that smoking kills more people than road accidents, suicides, and AIDS combined. This is the equivalent of one person dying every 15 minutes from a smoking-related illness.

The primary etiology for COPD is exposure to tobacco smoke. Smokers have higher death rates from both chronic bronchitis and emphysema. Smokers also have more lung-function abnormalities, show more respiratory symptoms, and experience all forms of COPD at a much higher rate than nonsmokers. Age of starting, total pack-years, puff volume, and current smoking status are predictive of COPD mortality.

Passive smoking (the exposure of nonsmokers to cigarette smoke) also seems to increase the risk of COPD-related disease. Children of parents who smoke have a higher prevalence of respiratory symptoms and ear infections than children of nonsmokers. Exposure to smoke at an early age may impair lung maturation and the attainment of maximal lung function in adult life. Air pollution, occupational exposure, asthma, and nonspecific airway hyperresponsiveness may all play a role in the development of COPD.

TABLE 13–5 ■ lists the differential diagnostic markers for COPD and asthma. No one marker is conclusive, so the entire clinical picture must be assessed for correct diagnosis and treatment.

TEST YOUR KNOWLEDGE 15–1

Choose the best answer.

1. The digestive tract is also called the:
   a. elementary canal.
   b. integumentary canal.
   c. alimentary canal.
   d. panama canal.
2. A ball-like mass of food is called a:
   a. bolus.
   b. wad.
   c. chyme.
   d. mastion.
3. What is the punching bag–shaped object dangling from the soft palate?
   a. Tonsil
   b. Uvula
   c. Labia
   d. Incisor
4. Which of the following is *not* a salivary gland?
   a. Parotid
   b. Sublingual
   c. Submandibular
   d. Substernal

Complete the following.

5. Externally, the three main structural parts of a tooth are the _____, _____, and _____.
6. _____ are a result of microorganisms attacking tooth enamel.
7. The consumption of _____ and _____ products appears to increase the chances of oral, throat, and stomach cancers.

Test Your Knowledge

After a concept is fully developed within a chapter, a "Test Your Knowledge" section ensures you understand what was just covered before moving on and reducing the risk of getting lost on your journey.

Learning Hints

These tips are sprinkled throughout the chapters to facilitate your understanding of difficult concepts. Some hints are in the form of amusing stories or other learning aids.

LEARNING HINT

ARTERIES OR VEINS?

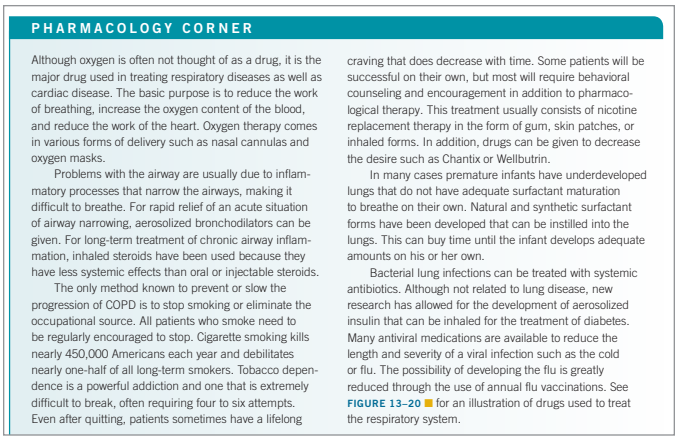
Remembering what arteries and veins do can be confusing. One easy way to remember is that arteries take blood *away* from the heart. Both words start with *a*. Obviously, then, veins have to bring blood *back* to the heart.

A QUICK TRIP THROUGH SOME DISEASES OF THE GASTROINTESTINAL SYSTEM

DISEASE	ETIOLOGY	SIGNS AND SYMPTOMS	DIAGNOSTIC TEST(S)	TREATMENT
Upper GI Region				
Anorexia nervosa	Eating disorder characterized by refusal to eat, classified as a psychiatric disorder	Patients limit the intake of food until starvation occurs but at the same time consider themselves fat; emaciated appearance	Physical exam and history	Counseling, reversal of malnourished status
Bulimia nervosa	Eating disorder characterized by recurrent binge eating and purging of the food with laxatives and vomiting; classified as a psychiatric disorder	Erosion of dental enamel, esophageal ulceration	Physical exam and history	Counseling, reversal of malnourished status, dental repair
Caries	Also known as dental cavities, the gradual decay of teeth; can cause inflamed tissue	Destruction of tooth enamel, pain, may lead to abscesses and even heart disease	Visual inspection, x-rays	Evacuation and filling of cavity, proper dental hygiene, proper diet
Cleft lip	Congenital anomaly in which the upper lip fails to come together, often seen along with a cleft palate	Obvious structural deformity, making nursing difficult	Physical examination	Surgical correction
Cleft palate	Congenital anomaly in which the roof of the mouth has a split or fissure	Obvious structural deformity, making nursing difficult, allowing milk to be aspirated into the lungs from the nasal cavity	Physical examination, imaging studies	Surgical correction

Quick Trip Through the Diseases of . . .

This chart provides a valuable quick reference for diseases related to a given body system chapter. The chart includes the cause, signs and symptoms, diagnostic tests, and treatment for each disease.



PHARMACOLOGY CORNER

Although oxygen is often not thought of as a drug, it is the major drug used in treating respiratory diseases as well as cardiac disease. The basic purpose is to reduce the work of breathing, increase the oxygen content of the blood, and reduce the work of the heart. Oxygen therapy comes in various forms of delivery such as nasal cannulas and oxygen masks.

Problems with the airway are usually due to inflammatory processes that narrow the airways, making it difficult to breathe. For rapid relief of an acute situation of airway narrowing, aerosolized bronchodilators can be given. For long-term treatment of chronic airway inflammation, inhaled steroids have been used because they have less systemic effects than oral or injectable steroids.

The only method known to prevent or slow the progression of COPD is to stop smoking or eliminate the occupational source. All patients who smoke need to be regularly encouraged to stop. Cigarette smoking kills nearly 450,000 Americans each year and debilitates nearly one-half of all long-term smokers. Tobacco dependence is a powerful addiction and one that is extremely difficult to break, often requiring four to six attempts. Even after quitting, patients sometimes have a lifelong craving that does decrease with time. Some patients will be successful on their own, but most will require behavioral counseling and encouragement in addition to pharmacological therapy. This treatment usually consists of nicotine replacement therapy in the form of gum, skin patches, or inhaled forms. In addition, drugs can be given to decrease the desire such as Chantix or Wellbutrin.

In many cases premature infants have underdeveloped lungs that do not have adequate surfactant maturation to breathe on their own. Natural and synthetic surfactant forms have been developed that can be instilled into the lungs. This can buy time until the infant develops adequate amounts on his or her own.

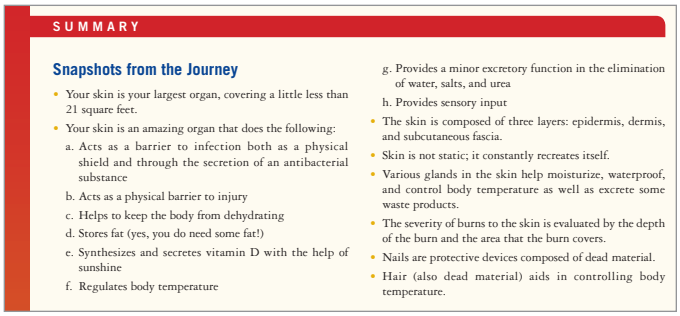
Bacterial lung infections can be treated with systemic antibiotics. Although not related to lung disease, new research has allowed for the development of aerosolized insulin that can be inhaled for the treatment of diabetes. Many antiviral medications are available to reduce the length and severity of a viral infection such as the cold or flu. The possibility of developing the flu is greatly reduced through the use of annual flu vaccinations. See **FIGURE 13–20** for an illustration of drugs used to treat the respiratory system.

Pharmacology Corner

This section includes a variety of medications used in the treatment of diseases that are related to a given body system of the chapter.

Snapshots from the Journey

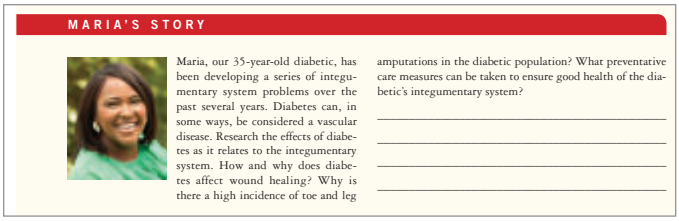
This is a concise review summary of the key points covered within each chapter.



SUMMARY

Snapshots from the Journey

- Your skin is your largest organ, covering a little less than 21 square feet.
- Your skin is an amazing organ that does the following:
  - a. Acts as a barrier to infection both as a physical shield and through the secretion of an antibacterial substance
  - b. Acts as a physical barrier to injury
  - c. Helps to keep the body from dehydrating
  - d. Stores fat (yes, you do need some fat!)
  - e. Synthesizes and secretes vitamin D with the help of sunshine
  - f. Regulates body temperature
  - g. Provides a minor excretory function in the elimination of water, salts, and urea
  - h. Provides sensory input
- The skin is composed of three layers: epidermis, dermis, and subcutaneous fascia.
- Skin is not static; it constantly recreates itself.
- Various glands in the skin help moisturize, waterproof, and control body temperature as well as excrete some waste products.
- The severity of burns to the skin is evaluated by the depth of the burn and the area that the burn covers.
- Nails are protective devices composed of dead material.
- Hair (also dead material) aids in controlling body temperature.



MARIA'S STORY

Maria, our 35-year-old diabetic, has been developing a series of integumentary system problems over the past several years. Diabetes can, in some ways, be considered a vascular disease. Research the effects of diabetes as it relates to the integumentary system. How and why does diabetes affect wound healing? Why is there a high incidence of toe and leg amputations in the diabetic population? What preventative care measures can be taken to ensure good health of the diabetic's integumentary system?

RAY AND MARIA'S STORIES

Through the use of our two patients within each system chapter—Ray, a quadriplegic, and Maria, a diabetic—the text case studies pull together many of the points discussed within the chapter to show the interrelatedness of what you are learning. Getting to know these patients well will help you understand how a disease affects a variety of body systems.

ANCILLARIES GUIDE YOUR JOURNEY

Study Success Companion

Your *Study Success Companion* helps you establish a good foundation for your trip. This appendix includes study skills and stress management techniques to help you as you journey through *Anatomy, Physiology, and Disease*. It also contains topics such as the metric system in case you do not have this background and need a self-taught mini-refresher.

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This supplemental workbook contains even more practice and reinforcement opportunities and helps you prepare for quizzes and exams.

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Part of the world's leading suite of online homework, tutorial, and assessment products, MyLab Health Professions is designed with a single purpose in mind: to improve the results of all students, one student at a time. The added benefit of Pearson eText gives you access to your textbook anytime, anywhere, on the device of your choice . . . even offline! See page xxxii–xxxiii for details.

TEACHING ANCILLARIES BRING OUT THE BEST IN INSTRUCTORS

Perhaps the most gratifying part of an educator's work is the "a-ha" learning moment when the lightbulb goes on, and a student truly understands a concept—when a connection is made. Along these lines, Pearson is pleased to help instructors foster more of these educational connections by providing a complete battery of resources to support teaching and learning. Qualified adopters are eligible to receive a wealth of materials designed to help instructors prepare, present, and assess. For more information, please contact your Pearson sales representative or visit **www.pearsonhighered.com/educator**.

Instructor's Resource Manual

This manual contains a wealth of material to help faculty plan and manage the anatomy and physiology course. It includes teaching tips, individual and team activities and games, ethical dilemmas, outlines, learning objectives, concept maps, answers to the chapter review activities, worksheets, and handouts.

PowerPoint® Slides

A comprehensive, turnkey lecture package in PowerPoint format is available. The lectures contain discussion points along with embedded color images from the textbook, as well as bonus illustrations, animations, and videos, to help infuse an extra spark into the classroom experience. Instructors may use this presentation system as it is provided, or they may opt to customize it for their specific needs.

Image Library

The Image Library includes all of the images from the text for easy integration into student/classroom resources.

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The Test Bank features more than 3,000 questions for assessment of all key concepts found in the text.

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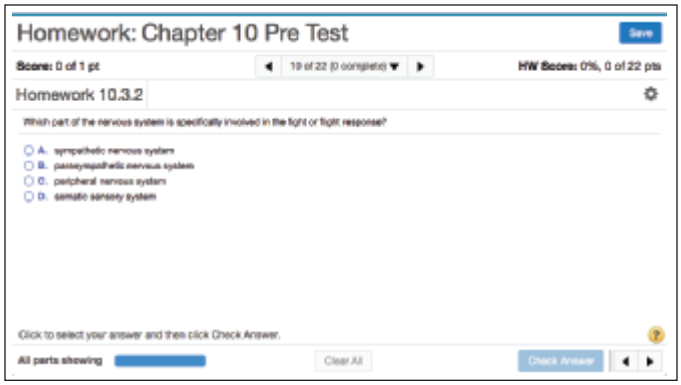
MYLAB HEALTH PROFESSIONS WITH PEARSON ETEXT

What Is MyLab Health Professions with Pearson eText ?

MyLab Health Professions is a comprehensive online program that gives you—the student—the opportunity to test your understanding of information and concepts to see how well you know the material. The added benefit of the embedded Pearson eText for *Anatomy, Physiology, & Disease for Health Professions*: *An Interactive Journey*, 4th edition, gives you access to your textbook anytime, anywhere, on the device of your choice—even offline!

With *MyLab Health Professions for Anatomy, Physiology, & Disease for Health Professions*, you can track your own progress through your entire Anatomy, Physiology, & Disease course.

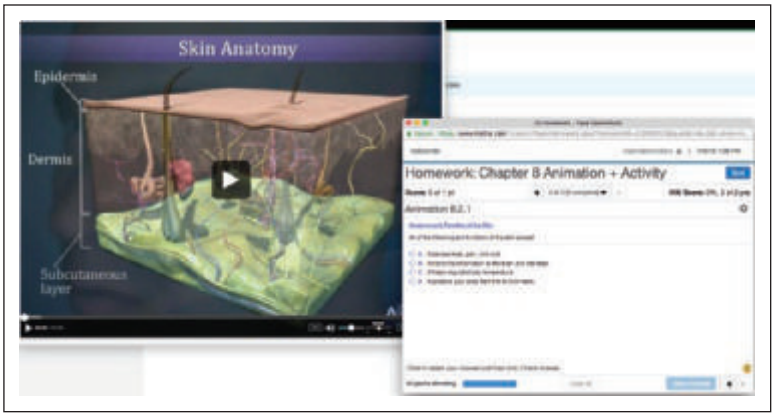


Homework pre-test question

How Do Students Benefit?

Here's how *MyLab Health Professions for Anatomy, Physiology, & Disease for Health Professions* helps you:

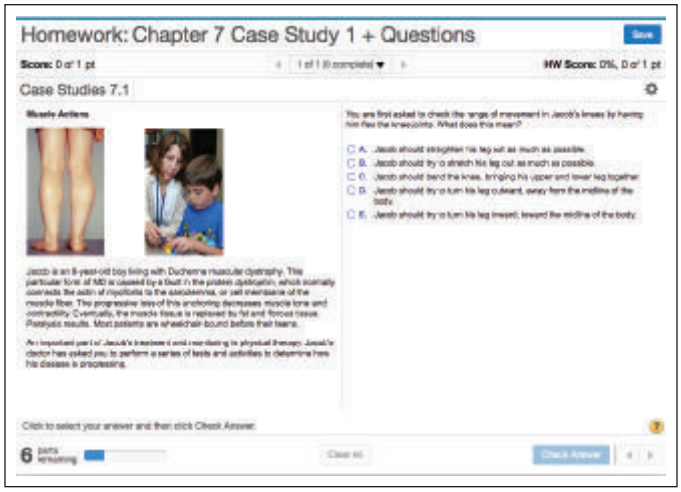
- Keep up and get unstuck by providing immediate feedback on quizzes, case studies, interactive exercises, and more
- Save time by focusing study on the things you don't know
- Increase understanding of difficult concepts with a vast variety of study material for different learning styles
- Use the mobile eText to help you learn on your terms, wherever you are



Animation with associated activity

Key Features of *MyLab Health Professions for Anatomy, Physiology, & Disease for Health Professions, 4th Edition:*

- **Pre-Tests and Post-Tests**—Using questions aligned to the learning outcomes in *Anatomy, Physiology, & Disease for Health Professions: An Interactive Journey*, 4th Edition, multiple tests measure your understanding of topics.
- **NEW: Anatomy Labeling Exercises** allow unlimited opportunity to practice identifying key structures for every body system.
- **Animations and Video Clips** with associated activities assist with deeper understanding of difficult concepts.
- **Case Studies** with questions help with application of knowledge and retention.
- **NEW: Dynamic Study Modules** guide your study effectively by focusing your time on the things you don't know. They continuously assess your activity and performance in real time. Here's how it works: First you complete a set of questions with a unique answer format that also asks you to indicate your confidence level. Questions

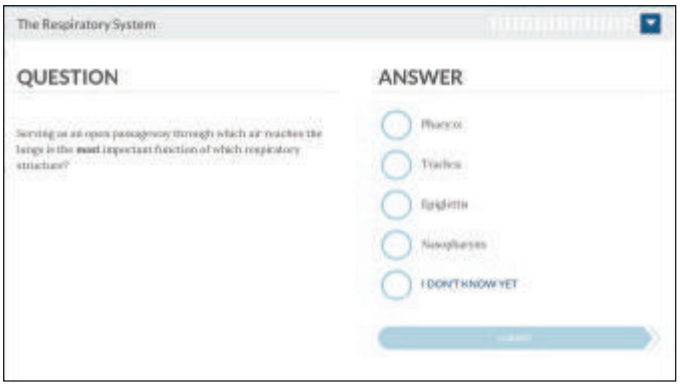


Case Study (Source: Clinical Photography, Central Manchester University Hospitals NHS Foundation Trust, UK/Science Source; Fotosearch/SuperStock)

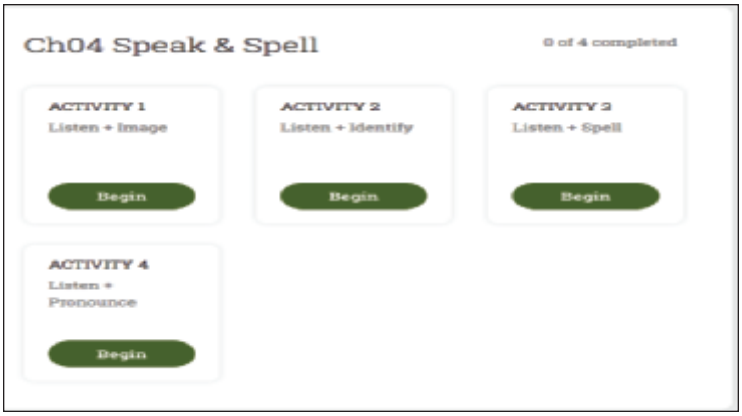
repeat until you can answer all questions correctly and confidently. After the question set is completed, Dynamic Study Modules explain the concept using materials from the text. Dynamic Study Modules are accessible on smartphones, tablets, and computers.

- **NEW! Pearson Prep**—Designed by learning scientists, Pearson Prep auto-creates flashcards from notes and other course materials that you upload. You can also create cards on the fly or purchase expert decks aligned to the chapters of the text.

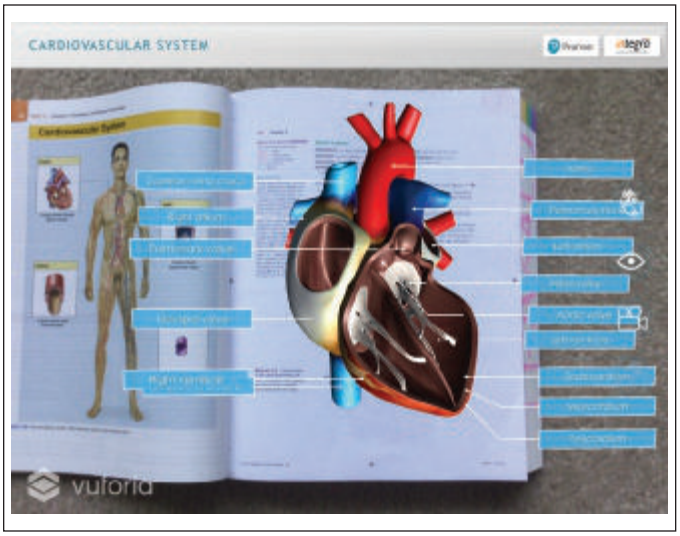
  Pearson Prep will create a personalized study path for you. Get a card wrong, and you'll see that one again soon. Get it right every time? It goes to the bottom of the deck. This process prioritizes the content you don't know, optimizing your study time.
- **NEW! Speak & Spell** helps students build fluency and understanding in medical terminology. Over the course of four modules, students listen to pronunciations, view associated images, and build comfort and familiarity with terms, word parts, structures, spelling, and pronunciation.
- **NEW! Augmented Reality**—This app-based study tool brings anatomy and physiology to life through the use of Augmented Reality anatomical figures enhanced with 3D, physiology videos, and labeling exercises.



Dynamic Study Module



Speak & Spell



Augmented reality

How Do Instructors Benefit?

- Keep students with different learning styles engaged through a variety of interactive components.
- Track student progress and understanding of course content through various assignments/quizzes in the program gradebook.
- Save time through auto-grading
  - Enliven classroom presentations with interactive labeling exercises, animations, augmented reality, and more.
  - MyLab Health Professions can be fully integrated into the majority of commercially available Learning Management Systems, so the experience can be completely seamless. Ask for details.

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How Do Students Benefit?

Standard eText features include the ability to highlight, take notes, bookmark pages, and search. In addition, the eText for *Anatomy, Physiology, & Disease for Health Professions, 4th Edition* includes interactivity that enhances the learning experience:

- Audio Insights
- Video Lecture Captures
- Animations
- Anatomy Labeling
- X-rays with "hot spots" that highlight important information
- Self-study review questions interspersed throughout
- Chapter "Test Your Knowledge" questions in interactive format

How Do Instructors Benefit?

Instructors can push notes and highlights directly to students so they provide embellishment or focus on key concepts within the text.

Anatomy, Physiology, and Disease

1

LEARNING THE LANGUAGE AND CUSTOMS

Imagine the many potential problems you would encounter traveling to a foreign country where you do not speak the language. To maximize success and safety during your journey, one of the most important preparatory steps is to develop a basic understanding of the native language and customs before you actually arrive. Every profession seems to have a language all its own. The healthcare profession is no exception. It has a highly specialized language complete with numerous medical abbreviations.

The language on which health professions and the study of anatomy, physiology, and disease is based is medical terminology. Therefore, this chapter lays the foundation of learning the native language (medical terminology) of medicine. In addition, this chapter introduces the key concepts of anatomy, physiology, and disease so future chapters can build on this foundation. Finally, as in all journeys, road signs can make your trip easier. Our road signs are the special feature boxes that offer a Learning Hint, Amazing Body Facts, or Clinical Application to make the material more alive and relevant.

LEARNING OUTCOMES

At the end of your journey through this chapter, you will be able to:

- Explain the terms *anatomy*, *physiology*, and *disease* and how they are interrelated.
- Construct and define medical terms using word roots, prefixes, and suffixes.
- Identify commonly used medical abbreviations.
- Contrast the metric and English systems of measures.
- Explain the concepts and importance of metabolism and homeostasis.
- Describe various signs and symptoms of disease along with associated disease terminology.
- Describe the components of the body's defense system.
- Identify the four main routes of transmission.
- Explain the role Standard Precautions plays in breaking the cycle of infection.

Pronunciation Guide

Pro•*nun*•ci•a•tion
Definitions/Parts

Correct pronunciation is important in any journey so that you and others are completely understood. Here is a "see-and-say" Pronunciation Guide for the more difficult terms to pronounce in this chapter. Please note that pronunciations given are referenced to medical dictionaries and regional variations may exist.

anabolism (ah NAB oh lizm)
anatomy (ah NA tom ee)
catabolism (ka TAB oh lizm)
diagnosis (DYE ahg NOH sis)
disease (dih ZEEZ)
epidemiology (EP uh dee me ALL oh jee)
etiology (EE tee ALL oh jee)
exacerbation (ecks ASS er BAY shun)
homeostasis (HOH me oh STAY sis)
idiopathic (ID ee oh PATH ick)
macroscopic anatomy (MAK roh SCOP ic ah NA tom ee)
microscopic anatomy (MY kroh SCOP ic ah NA tom ee)
metabolism (meh TAB oh lizm)
morphology (more FOL oh jee)
pathogenic (PATH oh JEN ick)
pathology (path ALL oh jee)
physiology (fiz ee ALL oh jee)
prognosis (prog NOH sis)
rhinoplasty (RYE noh PLASS tee)
syndrome (SIN drohm)

WHAT IS ANATOMY AND PHYSIOLOGY?

You're probably so accustomed to hearing the words *anatomy* and *physiology* (*A&P*) used together that you may not have given much thought to what each one means and how they differ. They each have unique meanings. Let's take a closer look.

Anatomy

Anatomy is the study of the internal and external structures of plants, animals, and, for our focus, the human body. The human body is an amazing and complex structure that can perform an almost limitless number of tasks. To truly understand how something works, it is important to know how it is put together. Leonardo da Vinci, in the 1400s, correctly drew the human skeleton and could be considered one of the earliest anatomists (one who studies anatomy). The word *anatomy* is from the Greek language and literally means "to cut apart," which is exactly what you must do to see how something is put together. For example, the study of the arrangement of the bones that comprise the human skeleton, which is the *anatomical* framework for our bodies, is considered skeletal anatomy.

Just as we can subdivide biology into more specific concentrations, such as cell biology, plant biology, and animal biology, we can also broadly divide anatomy into **microscopic anatomy** (*fine anatomy*) and **macroscopic anatomy** (*gross anatomy*). Microscopic anatomy is the study of structures that can be seen and examined only with magnification aids such as a microscope. The study of cellular structures (*cytology*) and tissue samples (*histology*) are examples of microscopic anatomy.

Gross or macroscopic anatomy represents the study of the structures visible to the unaided or naked eye. For example, the study of the various bones that make up the human body is gross anatomy. Viewing an x-ray of the arm to determine the type and location of a broken bone is considered an examination of gross anatomy.

Physiology

Physiology focuses on the function and vital processes of the various structures making up the human body. These physiologic processes include muscle contraction, our sense of smell and sight, how we breathe, and so on. We focus on each of these processes in its respective chapter. Physiology is closely related to anatomy because it is the study of how an anatomical structure such as a cell or bone actually functions. Physiology deals with all the vital processes of life and has many subspecialties. Human physiology, animal physiology, cellular physiology, and neurophysiology are just some of the specific branches of physiology.

Putting It All Together

In summary, anatomy focuses on structure and how something is put together, whereas physiology is the study of how those different structures *work* together to make the body function as a whole. For example, anatomy would be the study of the structure of the red blood cells (RBCs), and physiology would be the study of how the RBCs carry vital

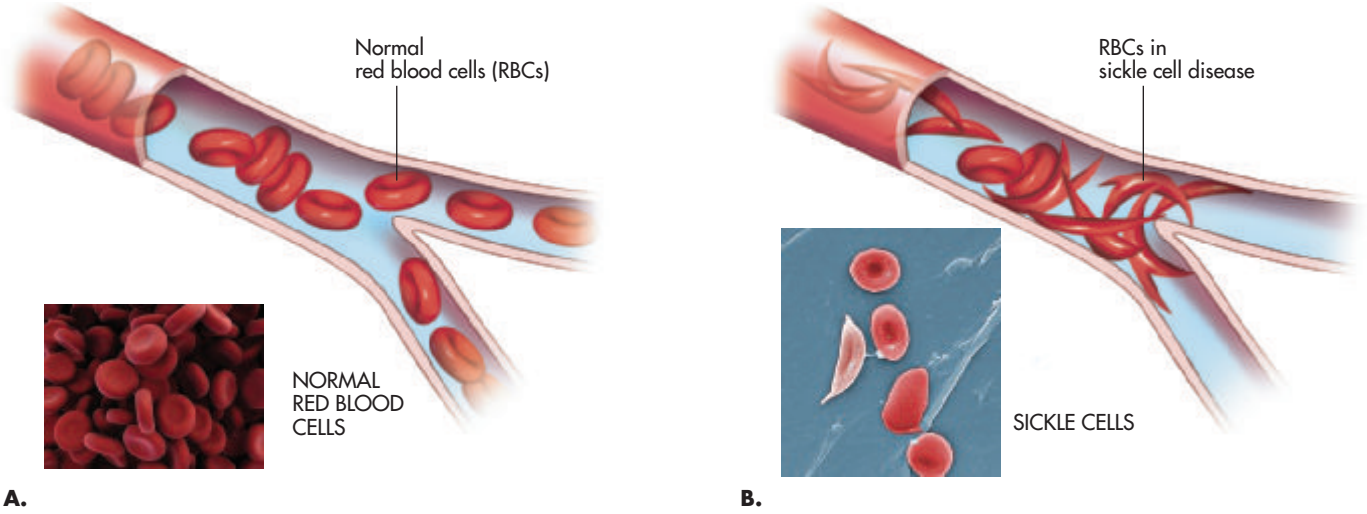

FIGURE 1–1

A. Normal red blood cells (RBCs) are flexible and donut shaped and move with ease through blood vessels. (Source: Sebastian Kaulitzki/Shutterstock) **B.** The anatomical distortion of the *structure* of RBCs in sickle cell anemia affects their normal *function* to carry oxygen. In addition, the sickle cells lose their ability to bend and pass through the small blood vessels, thereby causing blockages to blood flow. (Source: Janice Haney Carr/CDC)

oxygen throughout our body. Closely related to anatomy is **morphology**, which is a science that deals with the form and structure of organisms (i.e., individual living systems, such as people, animals, and plants). For example, the morphology of cells would be a description of the various shapes of cells. FIGURE 1–1 shows the morphology of deformed RBCs (sickle shaped) that are present in the disease sickle cell anemia. Because of the *anatomical* deformity, the *physiological* process of effectively carrying oxygen is adversely affected.

You will notice on your journey that the design of a structure is often related to its function. For example, as you will learn in Chapter 6, the type of joint located between bones dictates the functions and movements of those bones: hinge joints are located at the knees where a back-and-forth bending movement is required, whereas a ball-and-socket joint of the hip provides for a greater range of motion. Therefore, it makes sense to combine these two sciences into A&P. Understanding human anatomy and physiology forms the foundation for all medical practice because medical treatment attempts to bring the body's structure and function back toward normal A&P.

WHAT IS DISEASE?

Disease, simply put, is a condition in which the body fails to function normally. The word **disease** literally means not (dis) at ease. If we consider the body at ease when normal anatomy and physiology exists, anything that upsets the normal structure or function could be called disease. The official medical term for the study of disease is **pathology**. Pathology is the branch of medicine that studies the characteristics, causes, and effects of disease. Another closely related term is *pathophysiology*, which is the science that investigates abnormal body function.

To effectively treat a disease, the cause (or **etiology**) of the illness must be determined. If the cause of a disease cannot be determined, it is called an **idiopathic** disease. A **healthcare-associated infection (HAI)** (older terms were hospital-acquired or nosocomial infection) is an infectious disease you acquire while being treated in any medical facility. The study of the transmission, frequency of occurrence, distribution, and control of a disease is called **epidemiology**. For example, an epidemiologist determined that nearly 62 million cases of the common cold occur each year in the United States.

Although *communicable* and *contagious* may sound like the same thing, there is a fine difference. A **communicable disease** can be spread in a variety of ways, such as person-to-person or insect-to-person. In contrast, a **contagious disease** is one that is *readily* transmitted from one person to another, such as the common cold.

The Centers for Disease Control and Prevention (CDC) tracks disease worldwide. If a disease is continually present within a specific population or region, it is called **endemic**. If the disease occurs suddenly in large numbers over a specific region, it is called an **epidemic**. If the disease spreads country- or worldwide, it is called a **pandemic**. You learn more terms associated with disease as you further explore this chapter.

TEST YOUR KNOWLEDGE 1–1

Indicate whether the following examples are gross anatomy or microscopic anatomy by putting a G or an M in the space provided.

1. ____ Viewing an x-ray to determine the type of bone break
2. ____ Classifying a tumor to be cancerous by cell type
3. ____ Viewing bacteria to determine what disease is present
4. ____ Examining the chest for any obvious deformities
5. ____ Viewing samples by a histotechnologist or cytotechnologist

Complete the following or choose the best answer.

6. John was diagnosed with idiopathic respiratory disease. What does this mean?

   _____

7. A study was conducted on the frequency of occurrence of a particular infection in South America. The scientists performing the study were called _____. The cause or _____ of the infection was determined to be a type of bacteria.

8. The spread of avian flu throughout the world would lead to a(an):
   a. endemic.
   b. epidemic.
   c. birdemic.
   d. pandemic.

THE LANGUAGE

Even if you're traveling to another city within your home country, you will most likely need to learn a few things about the language its citizens speak. For example, think of the many different names people use to identify a sandwich made on a long skinny roll. Your "sub" might be someone else's "grinder" or "hoagie." Keep in mind that there may also be small regional differences in pronunciation and abbreviations.

Medical Terminology

As stated earlier, the language of A&P and disease is based primarily on medical terminology. Understanding medical terminology may seem like an overwhelming task because, on the surface, there appears to be so many terms. In reality, there are only relatively few root terms, prefixes, and suffixes, but they can be put together in a host of ways to form numerous terms.

Each medical term has a basic structure on which to build, and this is called the *word root*. For example, *cardi* is the word root for terms pertaining to the heart. Rarely is the word root used alone. Instead, it is combined with prefixes and suffixes that can change its meaning. Prefixes come before the word root, whereas suffixes come after the word root. The suffix *ology* means "study of," and therefore, we can combine *cardi* and *ology* to form *cardiology*, which is the study of the heart. The prefix *tachy* means "fast" and can be placed in front of the word root to form *tachycardia*, which means a "fast heart rate."

Often you will be given a **combining form**, which is the word root and a connecting vowel (usually *o*), to make it easier to pronounce and link with possible suffixes. For example, the combining form for heart is cardi/o. **FIGURE 1–2** ■ shows the components of a medical term.

LEARNING HINT

GENERAL HINTS ON FORMING MEDICAL TERMS

Although you can learn the various word roots, prefixes, and suffixes, it gets confusing trying to put them together correctly. In most instances, the medical definition as stated in plain English may seem backward as we combine the technical terms, especially when suffixes are used. For example, an inflammation of the stomach is *gastritis*, not *itisgastro*, and one who studies the stomach is a *gastrologist*, not an *ologistgastro*. When using prefixes, you usually put the parts together in the order you say the definition. For example, slow heart rate is *bradycardia*, not *cardiabrady*. As with general rules, there are exceptions, but with practice it will become familiar to you.

LEARNING HINT

COMBINING AND FORMING MEDICAL TERMS

If a suffix begins with a vowel, drop the vowel of the root in the combining form. For example, the combining form for stomach is gastr/o, and if we add the suffix for inflammation, *itis*, the medical term becomes *gastritis*.

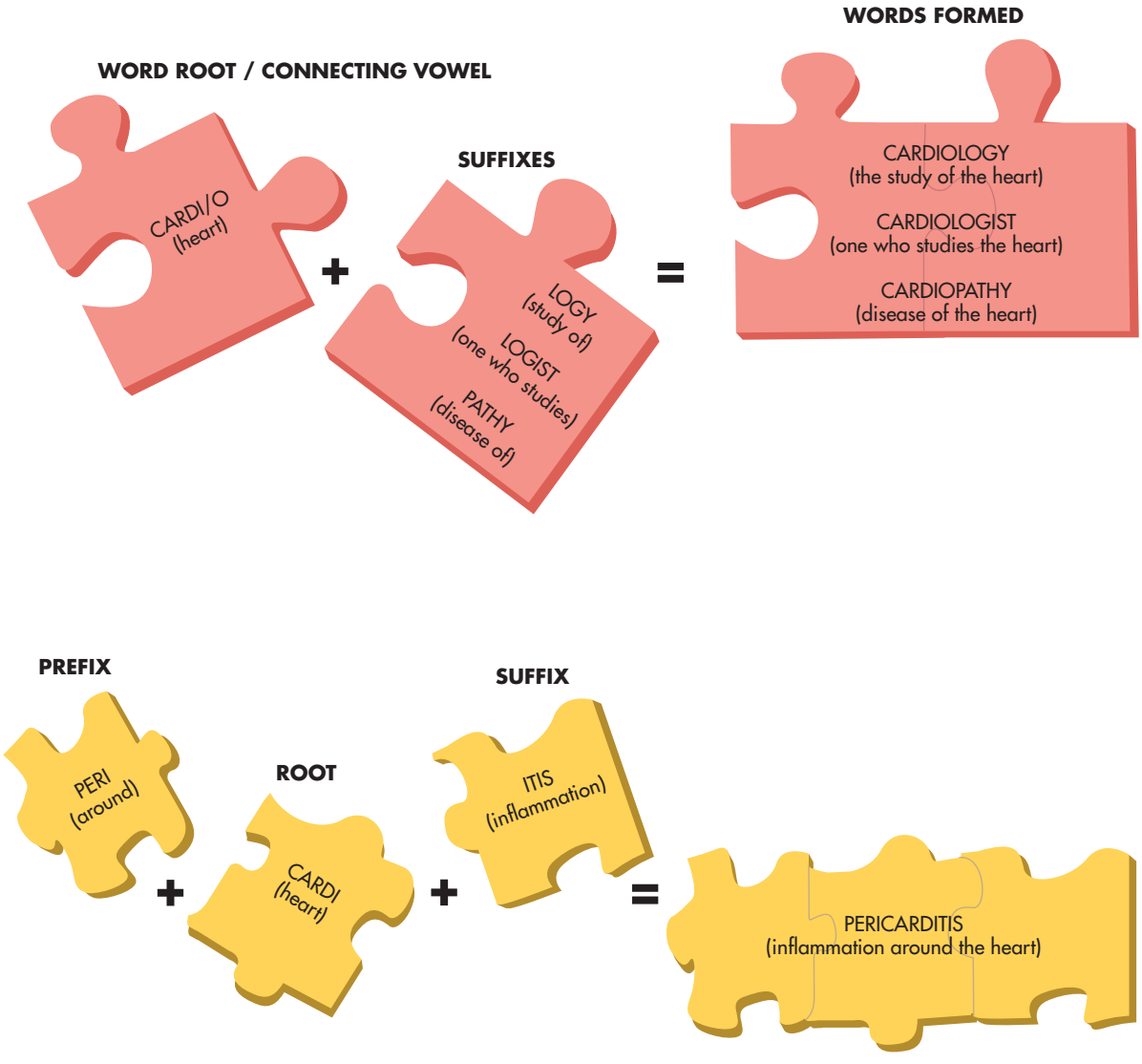

FIGURE 1–2

How prefixes and suffixes can be combined with a word root to form many medical terms.

TABLE 1–1 ■ presents some common combining forms to get you started. Then let's add some common prefixes that can be placed before the word roots to alter their meaning (see TABLE 1–2 ■).

Finally, let's add some common suffixes (TABLE 1–3 ■) and then see what kinds of words we can form with just these few parts.

Table 1–1 Common Combining Terms

WORD ROOT/ COMBINING FORM	MEANING
abdomin/o	abdomen
aden/o	gland
angi/o	vessel
arthr/o	joint
cardi/o	heart
col/o	colon
cyan/o	blue
cyt/o	cell
derm/o	skin
erythr/o	red
gastr/o	stomach
glyc/o	sugar
hemat/o, hem/o	blood
hepat/o	liver
hist/o	tissue
hydr/o	water
leuk/o	white
mamm/o	breast
nephr/o	kidney
neur/o	nerve
oste/o	bone
path/o	disease
phag/o	to swallow
phleb/o, ven/o	vein
pne/o or pnea	to breathe
pneum/o, pneumon/o	air or lung
rhin/o	nose

Table 1–2 Common Prefixes

PREFIX	MEANING
a- or an-	without
acro-	extremities
brady-	slow
dia-	through
dys-	difficult
electro-	electric
endo-	within
epi-	upon or over
hyper-	above normal
hypo-	below normal
macro-	large
micro-	small
peri-	around
sub-	under, below
tachy-	fast

Using Tables 1-1, 1-2, and 1-3, look at all the terms you can make from just the one word root, cardi/o. *Cardiology* is the study of the heart, and a *cardiologist* is a specialist who studies the heart. *Bradycardia* is a slow heart, *tachycardia* is a fast heart, and an *electrocardiogram* is an electrical recording of the heart. If your heart were enlarged due to inflammation (*carditis*), you may develop *cardiomegaly*, which would mean you have a disease of the heart (*cardiopathy*). The Tin Man from *The Wizard of Oz* thought he had no heart (*acardia*), but later realized that he had a big heart (*cardiomegaly*) all along. (*Disclaimer:* Although having an enlarged heart, or cardiomegaly, was good for the Tin Man, it is an abnormal and serious medical condition.)

LEARNING HINT

The longest medical term is *Pneumonoultramicroscopicsilicovolcanoconiosis* composed of 45 letters, which is a form of pneumoconiosis (condition of the lung) caused by very fine (ultramicro) silicate or quartz dust.

Table 1–3 Common Suffixes

SUFFIX	MEANING
-al, -ic	pertaining to or related to
-algia	pain
-cyte	cell
-ectomy	surgical removal of, or excision
-gram	actual record
-graphy	process of recording
-ist	one who specializes
-itis	inflammation of
-megaly	enlargement of
-ologist or -logist	one who studies
-ology or -logy	study of
-oma	tumor
-osis	condition of
-otomy	cutting into
-ostomy	surgically forming an opening
-pathy	disease
-penia	decrease or lack of
-phobia	fear of
-plasty	surgical repair
-scope	instrument to view or examine

Abbreviations

Abbreviations are used extensively in the medical professions. They are useful in simplifying long, complicated terms for diseases, diagnostic procedures, and therapies that require extensive documentation. For now, review TABLE 1–4 ■ for some common abbreviations you may have heard in a healthcare setting or on television.

Of course you will learn many more terms and abbreviations as we explore the upcoming chapters and become fluent in conversational medical language. This will help you to avoid using lay terms (common, everyday terms) to describe medical and anatomical concepts. For example, now you know that the correct term for "getting a nose job" is **rhinoplasty** (surgical repair of the nose).

Table 1–4 Common Medical Abbreviations

ABBREVIATION	MEANING
A&P	anatomy and physiology
ACLS	advanced cardiac life support
b.i.d.	twice a day
BM	bowel movement
BP	blood pressure
CA	cancer
CAD	coronary artery disease
CBC	complete blood count
CPR	cardiopulmonary resuscitation
CVA	cerebral vascular accident (stroke)
CXR	chest x-ray
Dx	diagnosis
*ER/ED	emergency room/emergency department
GI	gastrointestinal
ICU	intensive care unit
IM	intramuscular
IV	intravenous
MI	myocardial infarction (heart attack)
NPO or n.p.o.	Latin *nil per os*, which means "nothing by mouth"
p.o.	orally
p.r.n.	when needed; from the Latin *pro re nata*, meaning for an occasion that has arisen
**q	every; for example, q2h would be every 2 hours
SOB	shortness of breath
STAT	Latin *statim*, which means "immediately"
t.i.d.	three times a day

**Note:* Traditionally, the hospital emergency areas were called *emergency rooms (ERs)*, but those areas have expanded to where they are considered a whole department. Both abbreviations are acceptable, but many healthcare professionals now prefer the term *emergency department (ED)*.

***Note:* q.d. and q.o.d., which means "once daily and every other day," are on The Joint Commission "Do Not Use" List of medical abbreviations, as they can be mistaken for each other. The full "do not use" list is in Appendix B.

TEST YOUR KNOWLEDGE 1–2

Define the medical terms.

1. acrocyanosis

_____

2. gastritis

_____

3. rhinoplasty

_____

4. bradycardia

_____

5. mammogram

_____

6. cytomegaly

_____

Give the correct medical term or abbreviation.

7. inflammation of the kidneys

_____

8. removal of the stomach

_____

9. enlarged heart

_____

10. disease of the bones

_____

11. specialist who studies the nerves

_____

12. abbreviation for patient not allowed to eat or drink

_____

13. abbreviation for giving a drug or treatment as needed

_____

14. abbreviation for imaging of thoracic area

_____

15. abbreviation that infers urgency of action

_____

FOCUS ON PROFESSIONS

Medical assistants must become familiar with medical terminology in their workplace. Additionally, **coders**, **transcriptionists**, and **health information technicians**, all of whom deal extensively with medical charts and patient records, must master this language.

(Source: Goodluz/Shutterstock)

The Metric System

Whereas medical terminology represents the written and spoken language for understanding anatomy and physiology, the metric system is the "mathematical language" of medicine. For example, blood pressure is measured in millimeters of mercury (mm Hg), and organ size is usually measured in centimeters (cm). Medications and fluids are given in milliliters (mL), and weight is often measured in kilograms (kg). What exactly does it mean when you are taught that normal cardiac output is 6 liters per minute? You can now see why you must be familiar with the metric system to truly understand anatomy and physiology and medicine. Although the metric system may seem complicated if you are not familiar with it, it really isn't if you have a basic understanding of math. In fact, once you have enough practice, using the metric system is actually easier than the measurements you are used to using.

Two major systems of measurement are in use today. The U.S. Customary System (USCS) is used in the United States, and the International System of Units (SI) (Systéme International) is used almost everywhere else, especially in health care, science, and the pharmaceutical industry. The SI system is also known as the **metric system** and is based on the power (or multiples) of 10.

The USCS system is based on the British Imperial System and uses several different designations for the basic units of length, weight, and volume. We commonly call this the **English system**. For example, in the English system, volumes can be expressed as ounces, pints, quarts, gallons, pecks, bushels, or cubic feet. Distance can be expressed in inches, feet, yards, and miles. Weights are measured in ounces, pounds, and tons. This may be the system you are familiar with, but it is not the system of choice used throughout the world and within the medical profession because the English system has no common base and is therefore very cumbersome to use. It is difficult to know the relationship between each unit of measure because they are not based in an orderly fashion according to the powers of 10 as in the metric system. For example, how many pecks are in a gallon? Just what is a peck? How many inches are in a mile? These all require extensive calculations and memorization of certain equivalent values, whereas in the metric system, you simply move the decimal point the appropriate power of 10.

This has been a brief overview of the two types of measurement systems that you will encounter in your everyday activities as a healthcare professional. If you want to learn more about the metric system, please refer to the Study Success Companion at the end of this text, where a simplified explanation is given on how to easily use the metric system in the healthcare setting. In addition, the Study Success Companion will show you a simplified method for conversions both within and between the metric and English systems. See Table 3, in the Study Success Companion section, which gives common prefixes of the metric system and compares the metric and English systems. Since we introduced the Study Success Companion here, please take some time to read this early on as we feel this will greatly enhance your success in this course. It also includes powerful yet simple hints on study skills and stress management.

AMAZING BODY FACTS

Metric Emergency

In 1989, an Air Canada passenger jet ran out of fuel and the pilot had to glide the jetliner onto a runway for, thankfully, a safe emergency landing. The near disaster occurred because the fuel had been erroneously measured in pounds instead of kilograms at a time when Canada was converting to the metric system!

ANATOMY, PHYSIOLOGY, AND DISEASE CONCEPTS YOU WILL ENCOUNTER ON YOUR JOURNEY

In this section, we take a closer look at some additional foundational concepts related to the study of A&P and pathology. You learn more about these topics as you journey through the chapters in this text.

Metabolism

If you travel to other countries, you will see many different cultures and customs. Even though each culture is unique, they all share certain similarities. The same can be said for all of us who are unique but share certain common functions in order to maintain life. All humans, for example, need food to produce complex chemical reactions necessary for growth, reproduction, movement, and so on. On the cellular level, all humans require the process of **metabolism** in order to survive. Metabolism refers to all the chemical operations for energy and material transformation going on within our bodies. Metabolism requires various nutrients or fuel to function and produces waste products much like a car consumes gas for power and produces waste, or exhaust. Metabolism, for now, can be thought of as "all the life-sustaining reactions within the body." Fever is a common disease process that will speed up metabolism.

Metabolism is further subdivided into two opposite processes. **Anabolism** is the process by which simpler compounds are built up and used to manufacture materials for growth, repair, and reproduction, such as the assembly of simple amino acids to form complex proteins. This is the *building* phase of metabolism. **Catabolism** is the process by which complex substances are broken down into simpler substances. This is the *tearing-down* phase of metabolism. For example, the breakdown of food into simpler chemical building blocks such as blood sugar or glucose for energy use is a catabolic process. An abnormal and extreme example of catabolism is a starvation victim whose body "feeds on itself," actually consuming the body's own tissues.

Homeostasis

For the body to function normally, it must constantly monitor both its internal and external environments and make the appropriate adjustments. For cells to thrive, they must be maintained in an environment that provides a proper temperature range, balanced oxygen levels, and adequate nutrients. Heart rate and blood pressure must also be monitored and maintained within a certain range or *set point* for optimal functioning depending on the body activity. **Homeostasis** is the physiological processes in which your body monitors and maintains a stable internal environment or equilibrium. Survival depends on the body's ability to maintain homeostasis. *Homeostatic regulation* refers to the adjustments made in the human organism to maintain this stable internal environment. Although the ending *stasis* literally means "standing still," as you will soon see, *homeostasis* is actually a dynamic state of equilibrium.

The thermostat in your house functions like a homeostatic mechanism. A temperature is set and then maintained by a sensor that monitors the internal environmental temperature and either heats the house if the sensor registers too cold or cools the house if the sensor registers too hot. A continuous feedback loop from the sensor to the thermostat determines what action is needed. Because the feedback loop opposes the stimulus (cools down if too hot, heats up if too cold), it is referred to as a **negative feedback loop**.

The body also relies on negative feedback loops that continually sense the internal and external environment and signal the body to make adjustments to maintain homeostasis (see **FIGURE 1–3** ■). The hypothalamus in the brain represents the body's thermostatic control. If the hypothalamus receives sensory input indicating a very cold environment, it opposes this cold stimulus (negative feedback loop) and requests physiologic processes to create or conserve heat within the body to maintain an internal temperature near 98.6°F (37°C). The body begins to shiver, and this increased muscular activity generates heat. In addition, because most heat loss is through peripheral areas (head, arms, and legs), the body decreases the size or diameter of the peripheral blood vessels (vasoconstriction), causing the blood to be deeper from the skin surface where the heat would be lost to the cold environment. This keeps the blood closer to the core of the body, where it is warmer. Of course, we can assist the body by wearing a heavy coat and hat, which would remove much of the stress of the cold environment,

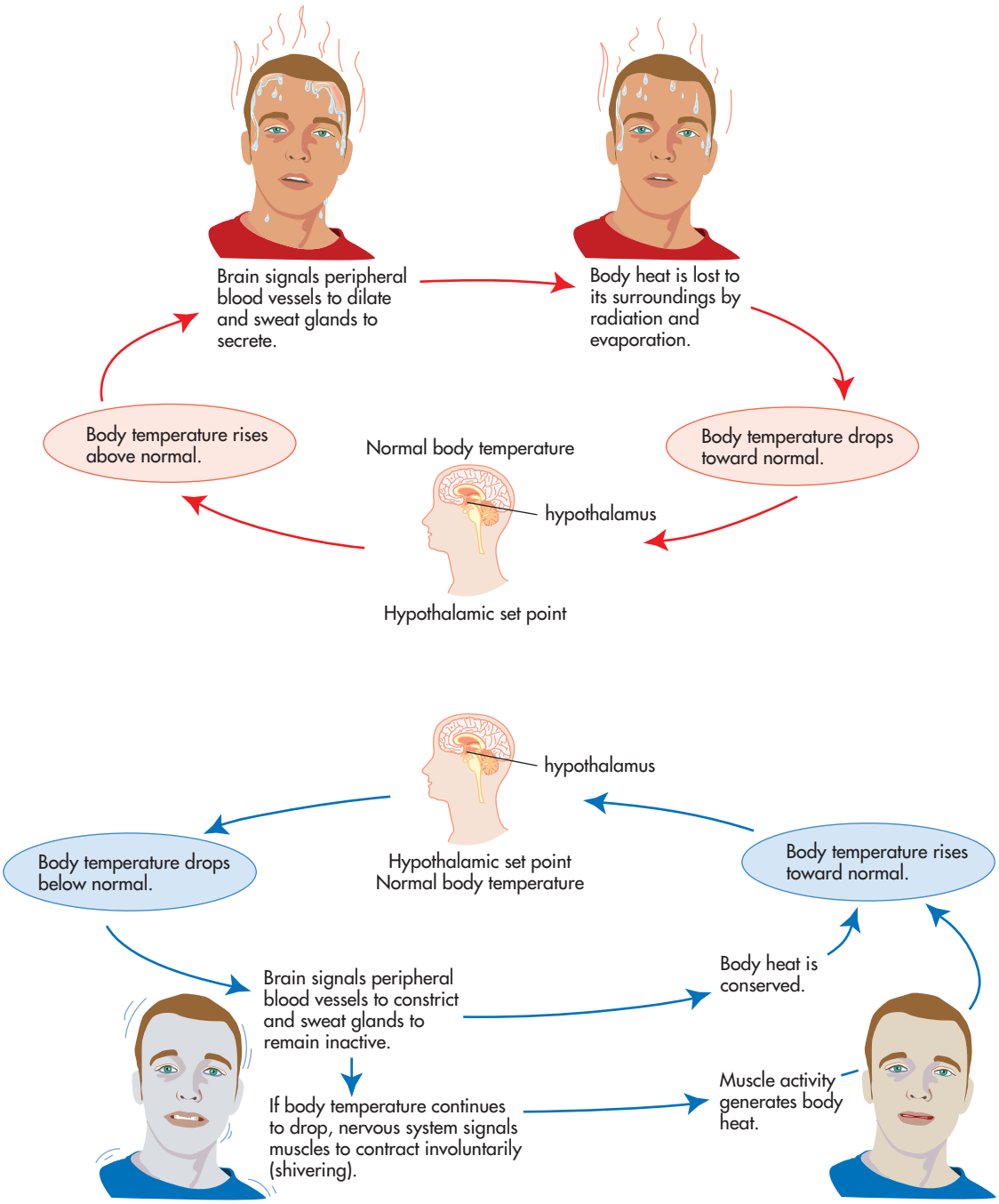

FIGURE 1–3 ■

The homeostatic control of normal body temperature (37°C or 98.6°F).

or by simply getting out of the cold and into a warmer environment.

Conversely, if you are in the desert and the temperature is 120°F (48.9°C), the body senses this as too hot and stimulates physiologic processes to cool you down. These processes include sweating (because evaporation is a cooling process) and enlarging the peripheral vessels (peripheral vasodilation) in order to dissipate the body heat into the external environment. In healthcare practice, if a patient presents with a very high temperature, he or she may need to be rapidly cooled with ice packs or baths to reduce the body temperature toward the normal range. Much of healthcare practice is just that—assisting the body through therapy and treatments so it can return to homeostasis.

CLINICAL APPLICATION

"BREAKING" A FEVER (Medically Known as Pyrexia)

It is believed that most fevers are the body's way of making an inhospitable environment for a pathogen to survive. Why is it that when someone begins sweating after a prolonged fever, the fever is said to be "breaking"? A fever sets the hypothalamus to a higher set temperature. The body increases metabolism to generate more heat to reach this now-higher set temperature, similar to the furnace coming on when you turn the thermostat up. Once whatever is causing the fever is gone, the hypothalamus set temperature is turned back down to the true normal. The body must now rapidly get rid of the excess heat by the cooling process of evaporation through sweating.

Your body is also capable of **positive feedback**, which increases the magnitude of a change. This process is also known as a "vicious cycle." Positive feedback is not a way to regulate your body because it increases a change away from the ideal set point. In most cases, positive feedback is harmful if the vicious cycle cannot be broken, but sometimes positive feedback is necessary for a process to run to completion.

A good example of necessary positive feedback is the continued contraction of the uterus during childbirth. When a baby is ready to be born, a signal, not well understood at this time, tells the hypothalamus to release the hormone oxytocin from the posterior pituitary. Oxytocin increases the intensity of uterine contractions. As the uterus contracts, the pressure inside the uterus caused by the baby moving down the birth canal increases the signal to the hypothalamus. More oxytocin is released, and the uterus contracts harder. Pressure gets higher inside the uterus, the hypothalamus is signaled to release more oxytocin, and the uterus contracts yet harder. This cycle of ever-increasing uterine contractions due to ever-increasing release of oxytocin from the hypothalamus continues until the pressure inside the uterus decreases—that is, until the baby is born.

Disease Concepts

Ideally, the body works to make things function smoothly and in balance. However, sometimes things happen to alter those functions. Eating habits, smoking, inherited traits, trauma, environmental factors, and even aging can alter the body's balance and lead to disease. Again, in general terms, disease is a condition in which the body fails to function normally.

Think back to a time when you were sick. You may have had a fever, cough, nausea, dizziness, joint aches, or a generalized weakness. These are examples of **signs** and **symptoms** of disease. Although the terms *signs* and *symptoms* are often used interchangeably, each has its own specific definition. Signs are more definitive, objective, measurable indicators of an illness. Fever and change in the size or color of a mole are examples of signs. **Vital signs** are the signs necessary for life and include pulse (heart rate), blood pressure, body temperature, and respiratory rate. The vital sign normal values can change according to the patient's age and sex. Because of variations in people, we often use a clinical range of acceptable values when measuring vital signs.

Symptoms, on the other hand, are perceived by the patient and are therefore more subjective and difficult to measure consistently. A perfect example of a symptom is pain. Although pain has been under consideration as a fifth vital sign, it is still a subjective evaluation very much like a symptom. Tolerance to pain varies among individuals, so an equal amount of pain such as a needlestick applied to a number of people could be perceived as a light, moderate, or intense level of pain depending on each individual's perception. Other symptoms can include dizziness and itchiness. Despite the fact that symptoms are hard to measure, they are still very important in the diagnosis of disease. Sometimes a disease exhibits a set group of signs and symptoms that may occur at about the same time. This specific grouping of signs and symptoms related to a specific disease is known as a **syndrome**. Signs, symptoms, and syndromes are further explained throughout the rest of the textbook as they relate to the pathology of the various body systems.

Discovering as many signs and symptoms as possible can help to **diagnose** a disease. A *diagnosis* is an identification of a disease determined by studying the patient's signs, symptoms, history, and results of diagnostic tests. The diagnostic procedure is begun by first determining why the individual is seeking medical help. This is known as determining their **chief complaint/concern (CC)**.

Although the individual may have several medical problems, which may be of equal or more importance, the chief complaint is what brought that person to *now* seek medical help. It may be something as simple as a sore throat or as involved as shortness of breath with concurrent radiating chest pain. Regardless, it is important to accurately record their chief complaint. Expanding on this, the next step is to discuss and document the history of the present illness. Ask open-ended questions that allow the patient to fully explain what they feel. When did the symptoms first appear? What did you do to cause them? How long do they last? What makes them go away?

CLINICAL APPLICATION

THE VITAL SIGN OF PULSE

The pulse is commonly taken by applying slight finger pressure over the radial artery located in either wrist (on the thumb side) and counting the number of beats in a 60-second period (see **FIGURE 1–4** ■). The normal heart rate for an adult is 60–100 beats per minute, the child rate is approximately 70–120, and a newborn's rate is 90–170 beats per minute. If an adult has a heart rate of 165 beats per minute, what medical term would you use to describe that condition?

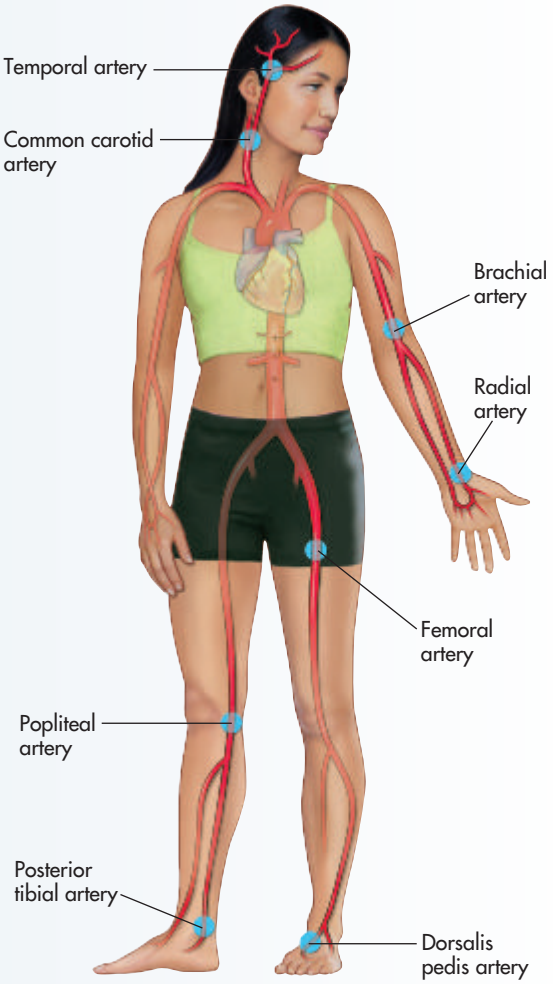

FIGURE 1–4 ■
A healthcare professional taking a radial pulse and common pulse points.

CLINICAL APPLICATION

METABOLIC SYNDROME, OR SYNDROME X

A disturbing syndrome is affecting nearly one-quarter of the U.S. adult population, known as metabolic syndrome, or syndrome X. A patient with this syndrome exhibits at least three of the following five common conditions: high blood sugar levels (hyperglycemia), high blood pressure (hypertension), abdominal obesity, high triglycerides (a lipid [fatty] substance in the blood), and low level of high density lipoprotein or HDL (which is sometimes referred to as "good cholesterol"). Individuals who exhibit this syndrome are at an increased risk for diabetes, heart attack, and/or stroke. The main causes of the syndrome are poor diet and lack of exercise.

Getting the patient's medical history can help in determining the **etiology**, or cause, of the disease. The **prognosis** is the prediction of the outcome of a disease. For example, a 47-year-old female may be diagnosed with allergic asthma with an etiology of pollen exposure. This person's prognosis is good if she can avoid the pollen and take medication to decrease her allergic response. Hopefully, your prognosis for doing well in this course is excellent!

LEARNING HINT

WHAT'S IN A WORD?

The word *gnosis* is Greek for "knowledge." *Dia* means "through or complete"; therefore, *diagnosis* literally means "know through or completely." *Pro* is a prefix meaning "before or in front of." Perhaps you can figure out that *prognosis* literally means "the foreknowledge or predicting of the outcome of a disease."

It is also helpful to determine if the chief complaint was gradual or of a sudden onset. Quite often, symptoms gradually develop from a disease process that may have been there for some time. These often are *chronic* conditions as opposed to *acute* conditions that exhibit a rapid onset of signs and symptoms. One of the problems with chronic conditions is that due to their usually gradual onset, older patients often attribute them to "just getting older" and often ignore them as an indicator of disease. As the conditions worsen, these people can no longer ignore them, and they seek help. By that time, treating the disease may be more complicated or difficult due to its severity.

The signs and symptoms of a chronic disease may disappear at times; this period is known as **remission** of the disease. **Relapses** are recurrences of the signs and symptoms of disease. If the signs and symptoms acutely "flare up," this is known as an **exacerbation** of the disease. **Mortality** is the measure of the number of deaths attributed to a specific disease in a given population over a period of time. **Morbidity** is the measure of the disabilities and extent of problems caused by an illness. For example, although polio has a low mortality rate (few deaths associated with the disease), it does have a high morbidity rate due to the paralysis, limb deformities, and difficulty breathing later in life. Diseases that have a prognosis of death are referred to as **terminal** diseases.

AMAZING BODY FACTS

Bizarre Signs and Symptoms!

Here are some strange signs and symptoms that may be indications of diseases. Please note that there are other signs, symptoms, and tests to determine specific diseases. Please do not use this list of oddities as a sole diagnostic tool! Void where prohibited, you must be 18 years of age to play, cannot be used with other coupons, and all other restrictions apply.

1. Generalized itching skin can be an indication of Hodgkin's disease.
2. Sweating at night may indicate tuberculosis.
3. A desire to eat clay or starchy paste may indicate an iron deficiency in the body.
4. Breath that smells like fruit-flavored chewing gum may be an indication of diabetes.
5. A magenta-colored tongue may be indicative of a riboflavin deficiency.
6. A patient with profound kidney disease often doesn't have moons on his or her fingernails.
7. A "hairy" tongue may mean that a patient's normal mouth flora has died from improper use of antibiotics and a yeast infection is now present.
8. Spoon-shaped fingernails may point to an iron deficiency in the body.
9. Brown linear streaks on the fingernails of fair-skinned people may indicate melanoma (skin cancer).
10. Having trouble smelling peanut butter from a distance? Recent studies show difficulty in smelling peanut butter from a foot away can indicate early stages of Alzheimer's disease, Parkinson's disease, or even multiple sclerosis.
11. If you have a stabbing pain in your heel and haven't stepped on a sharp object, you could have a herniated disc. This is because the sciatic nerve runs from your back to your heel.
12. Hiccups lasting more than 48 hours could be a sign of lung or esophageal cancer.
13. A newfound urge to steal may be one of the early signs of a specific type of dementia. (Please do not use this as a defense in a court of law!)

TEST YOUR KNOWLEDGE 1–3

Answer the following questions.

1. Check which of the following are vital signs.
   a. _____ pulse
   b. _____ cough
   c. _____ blood pressure
   d. _____ age
   e. _____ indigestion
   f. _____ respiratory rate
   g. _____ body temperature

2. Which of the following is the medical term for the cause of a disease?
   a. Prognosis
   b. Diagnosis
   c. Etiology
   d. Syndrome

3. If you describe a disease as "terminal," you are describing the:
   a. diagnosis.
   b. prognosis.
   c. etiology.
   d. treatment.

4. A disease that is not deadly but has a lot of disabling characteristics that impact a person's quality of life would be said to have:
   a. high mortality and low morbidity.
   b. low mortality and low morbidity.
   c. high mortality and high morbidity.
   d. low mortality and high morbidity.

5. A patient has a flare-up of their chronic disease condition; this is best known as a(n):
   a. relapse.
   b. exacerbation.
   c. remission.
   d. prognosis.

THE BODY'S DEFENSE SYSTEM

Most microorganisms that enter the body are harmless, but some can be **pathogenic** (disease producing). Some microorganisms are pathogenic only when they enter through openings such as your throat known as *portals of entry* or colonize where they should not exist. For example, *Escherichia coli (E. coli)* exists normally in your intestinal tract. It breaks down waste products and helps with the production of vitamin K. However, if *E. coli* enters your bloodstream where it should not exist, it can cause a severe and potentially fatal infection called *sepsis*.

Body Barriers

Your body has a series of barriers and defenses to protect itself from infection. The first defense is your skin. As long as your skin is unbroken, it provides a shield from penetration by harmful organisms. Your skin is somewhat acidic in nature, so it provides an environment that many harmful organisms don't like.

Sometimes an opening occurs on the skin's surface, allowing germs through that first barrier. Then the second barrier comes into action, and the **immune response** is triggered in the form of microscopic cells that either attack and "eat" those harmful invaders or release powerful chemicals that disintegrate parts of the invading germ.

An **inflammatory response** occurs whenever the tissues in your body are injured. This response can occur as a result of physical injury, intense heat, irritation from certain types of chemicals, or a bee sting. In addition, the inflammatory response can also occur as a reaction to the invasion of

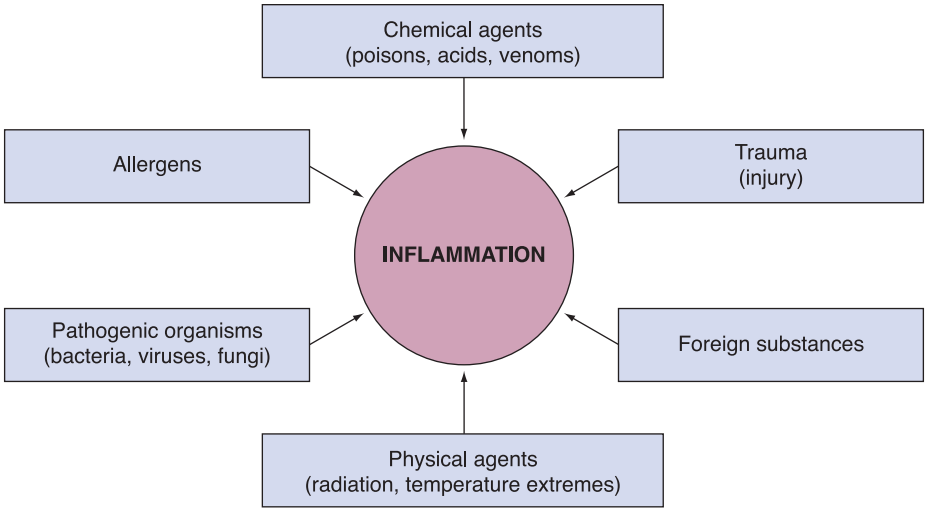

FIGURE 1–5
Agents capable of stimulating an inflammatory response.

germs, as in an infection. See **FIGURE 1–5**. The four general signs/symptoms of an inflammatory response are redness, increased temperature at the affected site, swelling (edema), and pain. The inflammatory response is normally protective and attempts to isolate the injured area and increase blood flow to restore normal function.

If you have been attacked by a certain pathogen before, a specific immune response is activated, and your body creates substances to specifically target and destroy the pathogen that had previously been in your body and caused problems. Closely related to the immune response is an **allergic** or **hypersensitivity reaction**. During an allergic reaction, the immune system response goes too far, causing tissue damage and impairing normal function. These concepts are explained in more depth in Chapter 14 on the immune system.

Understanding Routes of Transmission

Pathogens can gain entrance to your body in a variety of ways. The four main routes of transmission are vectors, contact transmission, common vehicle, and airborne spread. Let's look at each one individually.

Although rarely occurring in hospitals, the vector route of transmission is quite common in the community. A **vectorborne** transmission is one in which the organism is carried by an insect or other animal. This can occur in one of two ways. The insect may have the pathogen living inside it and, when it bites you, it infects your blood with that organism. This is known as a **biological vector**. An example of a biological vector is the spread of malaria through the bite of an infected *Anopheles* mosquito. Another vectorborne disease is Lyme disease carried via the bite of a deer tick. See **FIGURE 1–6**.

Alternatively, the insect may have that organism *on* its body and spread it to you by landing on an open wound. This

FIGURE 1–6
Possible vectorborne Lyme disease via tick bite. (Source: Smileus/Shutterstock)

is known as a **mechanical vector**. If a fly walks over cow feces full of *E. coli* bacteria and then lands on an open wound, that would be considered disease spreading via mechanical vector.

Contact transmission can also happen in two ways: direct or indirect contact. An example of **direct contact** is when a patient has a bowel movement in bed and the feces come into contact with an open wound on the patient's buttocks. Direct contact can also occur when a healthcare provider doesn't wash his or her hands or "glove up" before tending to an open wound. An example of **indirect contact** is when medical equipment is not properly sterilized before it is used on the next patient and pathogens from the previous patient are transferred to the next. An example at home would be touching a door knob that had been previously handled by someone with the flu.

Common vehicle transmission is one you may hear about in the news. This occurs when consumable goods (such as blood or blood products, IV fluids, or food such as ground meat, vegetables, or seafood) become contaminated. This sets up the potential for a major epidemic and is readily recognizable by the sudden occurrence of many infections caused by the same pathogen.

Airborne transmission is a result of the spread of droplets that contain the pathogen. Examples include the spread of tuberculosis by sneezing or even laughing or pathogens growing in an air conditioner and being spread when the air conditioner is turned on, as happened in the case of the outbreak of Legionnaires' disease in 1976 at the Philadelphia convention of the American Legion, hence the name.

Standard Precautions

The cycle of the infection, beginning with the creation of a source of infection, continuing with the transportation of the pathogen, and then ending with the entry into the body, is called the **chain of infection**. We can stop the spread of infectious disease simply by breaking this chain at some point. This can be done by something as simple as properly washing your hands.

Tracing the history of healthcare practices over time illustrates our attempts to improve our ability to prevent the spread of infection. However, in the not-so-distant past, our focus was very disease specific and not generalized to the healthcare provider and his or her interaction with each patient. The realization has come that infectious agents are not always recognized and labeled as such and that they may be present and can be spread without our awareness.

Because of this fact, **Standard Precautions** have been developed. These provide the most basic protection for both the healthcare provider and the patient. Standard Precautions assume that everyone, including the provider and receiver of health care, family members, and visitors, could be carrying a communicable disease.

The single most important practice to reduce the transmission of infectious agents in healthcare settings is hand hygiene. Hand hygiene includes effective handwashing with plain or antiseptic-containing soap and water or the use of alcohol-based products that do not require the use of water.

Personal protective equipment (PPE) includes a variety of barriers and respirators used alone or in combination to protect mucous membranes, airways, skin, and clothing from contact with infectious agents. These items include gloves, isolation gowns, face protection (masks, goggles, and face shields), and respiratory protection with specialty masks. These items are specific to different types of communicable disease and their methods of spreading.

Another important measure that prevents transmission of hepatitis and human immunodeficiency virus is the prevention of needlesticks and other sharps-related injuries. These include measures to handle needles and other sharp devices in a manner that will prevent injury to the user and to others who may encounter the device during and after a procedure.

See **FIGURE 1–7** ■ for a Standard Precautions guide. As you can see by the chart, there are a variety of ways to stop the spread of infection. Once again, the single most important thing that you can do to stop the chain of infection is to wash your hands before and after working with each patient! See Appendix G for more information on Standard Precautions and for a list of specific procedures.

Standard Precautions Guidelines

Procedure	Wash Hands	Gloves	Gown	Mask	Eyewear
Talking to patient					
Adjusting IV fluid rate or noninvasive equipment					
Assess patient without touching blood, body, fluids, mucous membranes					
Assess patient including contact with blood, body fluids, mucous membranes					
Drawing blood					
Inserting venous access					
Suctioning			If splattering is likely	If splattering is likely	If splattering is likely
Handling soiled waste, linen, other materials			If they are extensively soiled or splattering is likely	If they are extensively soiled or splattering is likely	If they are extensively soiled or splattering is likely
Intubation					
Inserting arterial access					
Endoscopy					
Operating and other procedures producing extensive splattering of blood or body fluids					

FIGURE 1–7 ■
Standard Precautions Guidelines.

TEST YOUR KNOWLEDGE 1–4

Choose the best answer.

1. A region of a state had an outbreak of hepatitis. When reviewing the histories of the victims, it was noted that they had received either whole blood or blood products within the past 9 months. On further investigation, it was determined that all the blood and blood products had come from one organization's blood lab that had failed to test their donors for hepatitis. This transmission of infection to others is known as:
   a. direct contact.
   b. indirect contact.
   c. common vehicle.
   d. vector.

Complete the following.

2. A 27-year-old female presents to the emergency department of a local hospital. She has a cough and complains of shortness of breath. An elevated temperature is noted along with an increased pulse rate. She states that her daughter had stayed home from school for the past few days and was diagnosed with an upper respiratory viral infection.

   a. What is her chief complaint?

   _____

   b. What is the etiology of her chief complaint?

   _____

   c. What follow-up questions would you ask about her chief complaint?

   _____

   d. Are there any possible routes of transmission involved? Which one(s)?

   _____

   e. What would you do to keep from spreading this infection to other patients?

   _____

SUMMARY

Snapshots from the Journey

- Anatomy is the study of the actual internal and external structures of the body, and physiology is the study of how these structures normally function. Pathology is the study of the disease processes that can cause disruptions of normal body structures and functions.
- Medical terminology is the language of medicine and combines word roots, prefixes, and suffixes to construct numerous medical terms to describe conditions, locations, diagnostic tools, and so on.
- The metric system is the mathematical language of medicine based on the powers of 10. If you require more practice with this system, please go to your student Study Companion Guide at the end of this text for a simplified review.
- Metabolism refers to all the chemical operations going on within the body and can be broken down into two opposite processes. The building phase of metabolism is anabolism, in which simpler compounds are built up and used to manufacture materials for growth, reproduction, and repairs. The tearing-down phase is catabolism, in which complex substances are broken down into simpler substances, such as food broken down for energy use.
- The body tries to maintain a balanced or stable environment called homeostasis. The body must constantly monitor the environment and make changes to maintain this balance, often through the use of negative feedback loops.

- A change in objective measurable values such as temperature (signs) and subjective patient perceptions (symptoms) can indicate a disease is present. Vital signs are pulse, respirations, temperature, and blood pressure.
- Patients will present with a chief complaint/concern and signs and symptoms that will aid in the identification, better known as the diagnosis, of the disease or condition. Patient history and results of diagnostic tests will also aid in diagnosis. Other related terms include determining the cause or etiology of the disease. In addition, it is helpful to determine if the condition had a rapid onset (acute condition) or if it was a gradual process (chronic condition).
- The body's defenses are set up to guard against pathogenic organisms invading through portals of entry. There are various routes of transmission for pathogens to gain entry, and these include vectors, contact transmission, common vehicle, and airborne spread.

CASE STUDY

A 66-year-old male involved in a vehicular accident is transferred to the ICU with dyspnea and abdominal pain. He has acrocyanosis, tachycardia, and a past medical history of cardiopathy. He weighs 150 pounds and is five feet six inches tall. His chest x-ray shows an enlarged heart. His facial injuries will require future rhinoplastic surgery. An electrocardiogram and lower GI series is ordered.

a. Where exactly in the hospital was the patient taken?

_____

_____

_____

b. Describe the patient's color, heart rate, and breathing.

_____

_____

_____

c. What is the medical term for what the x-ray showed?

_____

_____

_____

d. What future facial surgery will he need?

_____

_____

_____

RAY'S AND MARIA'S STORIES

As you journey through the chapters, you will meet two common cases that will demonstrate the interrelatedness of the various systems. Ray suffered a high cervical injury and is a ventilator-dependent quadriplegic. Ray's treatment will require a solid knowledge of the body's various systems to give him the best possible care. Maria is a diabetic and will also have multisystem involvement. You will be responsible for Ray's and Maria's care throughout the book by utilizing the knowledge you gain from each new chapter.

RAY'S STORY

Ray glanced at the strategically placed clock and calendar on the wall. It was 3:00 p.m., September 15. His buddies were on their way to the Caribbean for a week of cave diving. He was supposed to be on that plane with them. Instead, Ray was lying in a hospital bed. Since high school the four of them had been inseparable. Every spare dime they made went into their annual extreme vacation. They had been hang gliding over the Grand Canyon, rafting on the Amazon, sky diving and parasailing in Florida, and snowboarding down a glacier in Alaska. How ironic that a dip in a backyard swimming pool would put an end to all that. Not only wouldn't Ray be skiing or hang gliding any time soon, he couldn't even mark the red Xs on the calendar to keep track of the passing days. A nurse did that for him. In fact, nurses or his mom or his brother did everything for him. He couldn't even scratch his own nose, or even tell anybody when it itched.

Ray was just fooling around with his 6-year-old cousin at the end of the summer, one last swim before his aunt and uncle closed their pool. He had done a back flip off the diving board dozens of times, but this time he miscalculated. Ray knew as soon as he hit the water that he was sinking too fast and tried desperately to correct, but he couldn't get his head around fast enough. His last thought as the bottom of the pool rose to meet him was that he was going to mess up his face.

When Ray regained consciousness several days later, his mother and the doctor gently explained what had happened to him. He had struck the bottom of the pool on the point of his chin, jamming and twisting his neck. His neck was broken, the first two vertebrae shattered, and his spinal cord irreversibly damaged. Ray was paralyzed from the neck down and would be dependent on a ventilator for the rest of his life.

a. Explain how the relationship of anatomy to physiology has worked against Ray.

_____

b. What is the etiology of Ray's current condition and his diagnosis?

_____

c. How would you state his prognosis? What future complications do you expect to see?

_____

REVIEW QUESTIONS

Multiple Choice

1. Which of the following is an example of microscopic anatomy?
   a. Viewing an x-ray
   b. Examining the shape of an organ during an autopsy
   c. Classifying a type of bacterial cell
   d. Watching how the pupils in the eyes react to light

2. Acromegaly means which of the following?
   a. A large stomach
   b. Enlarged extremities
   c. An inflamed stomach lining
   d. A large acrobat

3. The breakdown of sugar in the body for energy is called:
   a. anabolism.
   b. catabolism.
   c. dogabolism.
   d. hyperbolism.

4. Which of the following is a measurement system based on the power of 10?
   a. English system
   b. British Imperial system
   c. Metric system
   d. Weights and measures system

5. The cause of a disease is referred to as the:
   a. prognosis.
   b. diagnosis.
   c. pathology.
   d. etiology.

Fill in the Blank

1. Ted's knee injury occurred at last night's football game. Today his doctor wants to make a small incision and use a device to "view or examine the joint" to assess the damage. What is the term for this device? _____

2. _____ is the study of the structures of the body, and _____ is the study of the functions of these structures.

3. For years, Ali never learned to swim because of her unnatural fear of the water, which is called _____.

4. Pulse and temperature represent two _____ signs of the body.

5. Raheem had bloodwork done that showed a normal number of white blood cells (WBCs) and red blood cells (RBCs). What are the respective medical terms for these cell types? _____ and _____

6. If a cause of a disease cannot be determined, it is referred to as a(n) _____ disease.

Short Answer

1. Explain the difference between diagnosis and prognosis.

_____

_____

_____

_____

2. Knowing that difficulty swallowing is called dysphagia, what do you think the function of a phagocyte is?

_____

_____

_____

_____

3. Contrast negative and positive feedback loops.

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4. Describe one example of homeostasis in your body.

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5. Contrast the terms *endemic*, *epidemic*, and *pandemic*.

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Suggested Activities

1. Using a medical dictionary, find five new medical terms and give their definition and pronunciation.

_____

_____

_____

_____

_____

2. Make up 3 × 5 inch note cards with five word roots discussed in this chapter and see how many medical words you can make using either prefixes or suffixes in the tables. For example, the word root arthr/o can be used to make arthritis, arthralgia, arthroscope, and arthroplasty. Confirm that you made a real word by looking it up in a medical dictionary.

The Human Body

2

READING THE MAP

Now that we have a basic understanding of the native language and some basic concepts, how will we successfully navigate through an unfamiliar city or country? We must, of course, study maps or program our GPS to plan our visit and know where we are going. The same effort is required to learn the "terrain" of the human body. This chapter provides the major *external* map of the human body that serves as a guide for future chapters, which map in detail the *internal* regions. We use medical directional terms and body locations as our foundation as we journey together through the human organism. If there is one thing we should know better than anything else, it should be our own bodies. To borrow from an old saying, by the end of our journey through this text, you will know your entire body like the "back of your hand."

LEARNING OUTCOMES

At the end of your journey through this chapter, you will be able to:

- List and describe the various body positions.
- Describe situations in which body position can help or hinder the disease process.
- Define the body planes and associated directional terms.
- Locate and describe the body cavities and their respective organs.
- List and describe the anatomical divisions of the abdominal region.
- Identify and locate the various body regions.
- Discuss three imaging techniques to view the body.