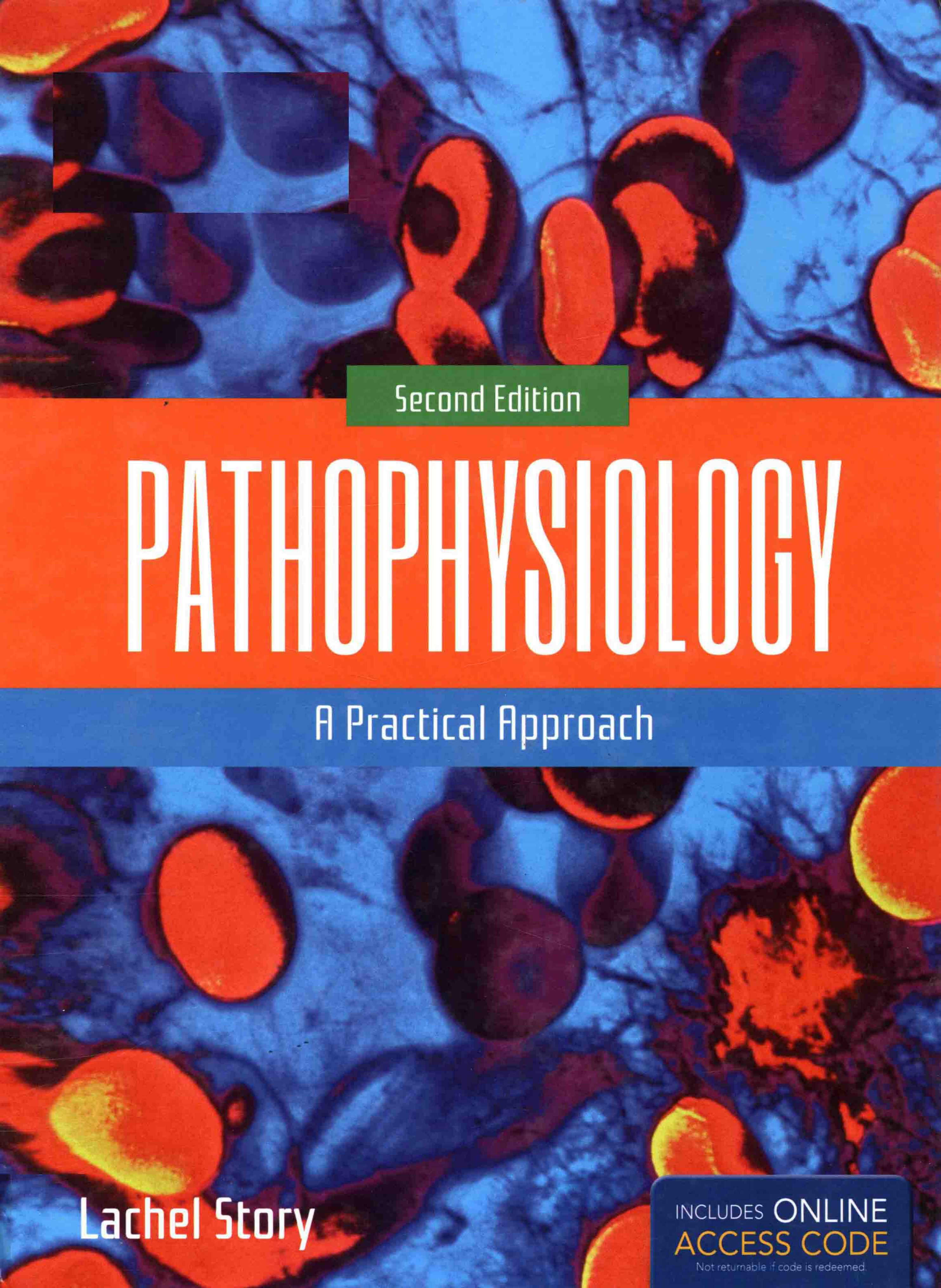


Second Edition

PATHOPHYSIOLOGY

A Practical Approach

Lachel Story

Second Edition

PATHOPHYSIOLOGY

A Practical Approach

Lachel Story, PhD, RN

Assistant Professor
College of Nursing
University of Southern Mississippi
Hattiesburg, Mississippi

JONES & BARTLETT
LEARNING

World Headquarters
Jones & Bartlett Learning
5 Wall Street
Burlington, MA 01803
978-443-5000
info@jblearning.com
www.jblearning.com

Jones & Bartlett Learning books and products are available through most bookstores and online booksellers. To contact Jones & Bartlett Learning directly, call 800-832-0034, fax 978-443-8000, or visit our website, www.jblearning.com.

Substantial discounts on bulk quantities of Jones & Bartlett Learning publications are available to corporations, professional associations, and other qualified organizations. For details and specific discount information, contact the special sales department at Jones & Bartlett Learning via the above contact information or send an email to specialsales@jblearning.com.

Production Credits
Executive Publisher: William Brottmiller
Senior Editor: Amanda Martin
Editorial Assistant: Rebecca Myrick
Production Editor: Amanda Clerkin
Senior Marketing Manager: Jennifer Stiles
Art Development Editor: Joanna Lundeen
VP, Manufacturing and Inventory Control: Therese Connell
Composition: Laserwords Private Limited, Chennai, India
Cover Design: Kristin E. Parker
Photo Research and Permissions Coordinator: Joseph Veiga
Cover Image: © ImageSource/age fotostock
Printing and Binding: Courier Companies
Cover Printing: Courier Companies

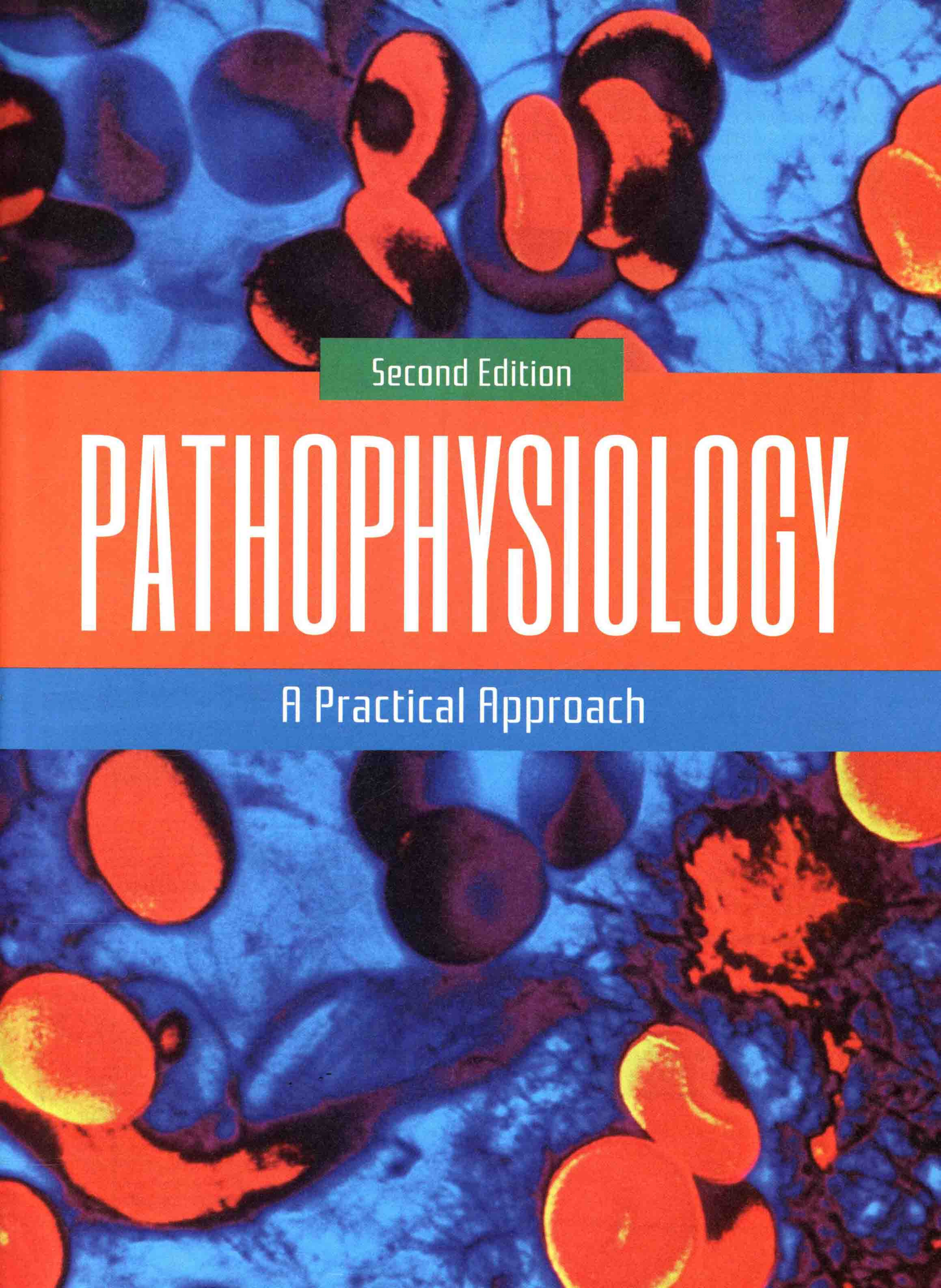
To order this product, use ISBN: 978-1-284-04389-1

Library of Congress Cataloging-in-Publication Data
Story, Lachel, author.
Pathophysiology : a practical approach / Lachel Story. – Second edition.
p. ; cm.
Includes bibliographical references and index.
ISBN 978-1-284-04224-5
I. Title.
[DNLM: 1. Pathology–Nurses' Instruction. 2. Physiology–Nurses' Instruction. QZ 140]
RB113
616.07–dc23

2013034745

6048

Printed in the United States of America
18 17 16 15 14 10 9 8 7 6 5 4 3 2



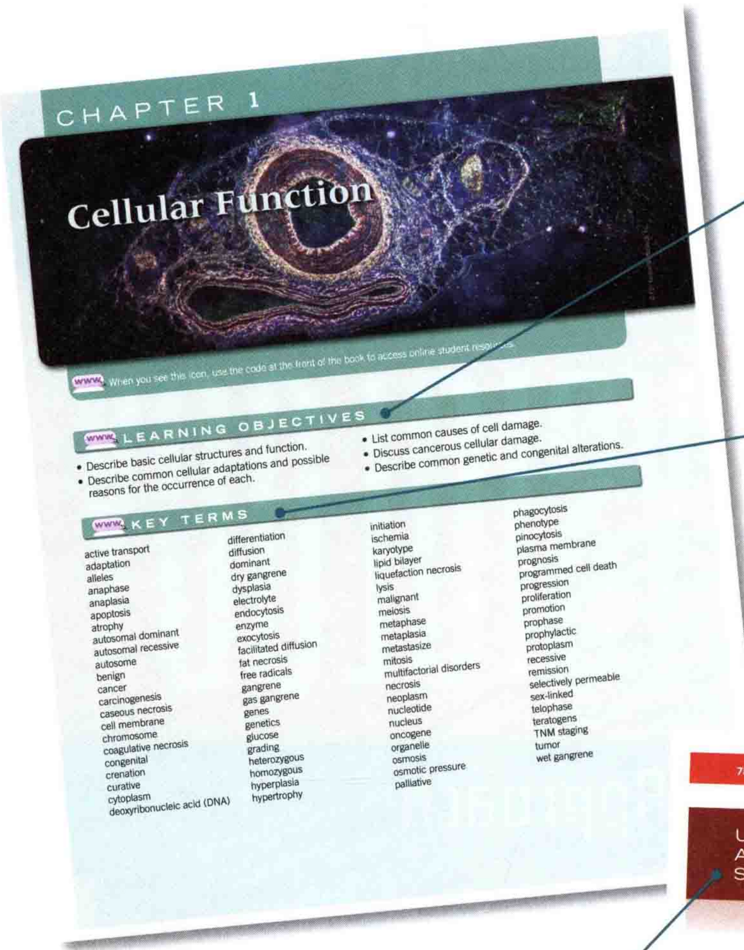
Second Edition

PATHOPHYSIOLOGY

A Practical Approach

The Pedagogy

Pathophysiology: A Practical Approach, Second Edition focuses on driving comprehension through a variety of strategies that meet the learning needs of students while generating enthusiasm about the topic. This interactive approach addresses different learning styles, making this the ideal text to ensure mastery of key concepts. The pedagogical aids that appear in most chapters include the following:


CHAPTER 1

Cellular Function

When you see this icon, use the code at the front of the book to access online student resources.

LEARNING OBJECTIVES

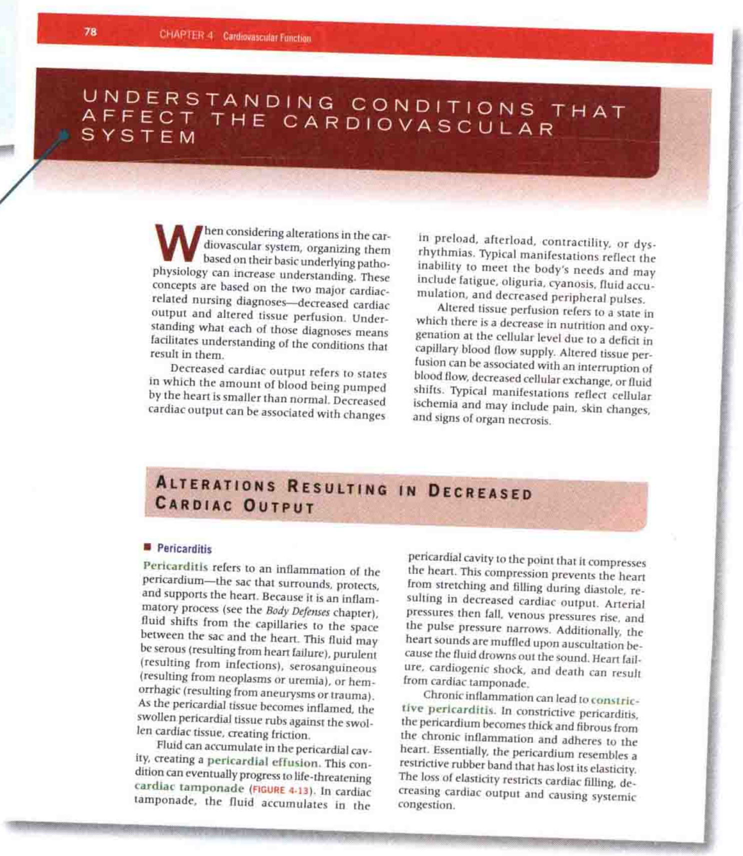
- Describe basic cellular structures and function.
- Describe common cellular adaptations and possible reasons for the occurrence of each.
- List common causes of cell damage.
- Discuss cancerous cellular damage.
- Describe common genetic and congenital alterations.

KEY TERMS

active transport, adaptation, alleles, anaphase, anaplasia, apoptosis, atrophy, autosomal dominant, autosomal recessive, autosome, benign, cancer, carcinogenesis, caseous necrosis, cell membrane, chromosome, coagulative necrosis, congenital, crenation, curative, cytoplasm, deoxyribonucleic acid (DNA), differentiation, diffusion, dominant, dry gangrene, dysplasia, electrolyte, endocytosis, enzyme, exocytosis, facilitated diffusion, fat necrosis, free radicals, gangrene, gas gangrene, genes, genetics, glucose, grading, heterozygous, homozygous, hyperplasia, hypertrophy, initiation, ischemia, karyotype, lipid bilayer, liquefaction necrosis, lysis, malignant, meiosis, metaphase, metaplasia, metastasize, mitosis, multifactorial disorders, necrosis, neoplasm, nucleotide, nucleus, oncogene, organelle, osmosis, osmotic pressure, palliative, phagocytosis, phenotype, pinocytosis, plasma membrane, prognosis, programmed cell death, progression, proliferation, promotion, prophase, prophylactic, protoplasm, recessive, remission, selectively permeable, sex-linked, telophase, teratogens, TNM staging, tumor, wet gangrene

Chapter Objectives These objectives provide instructors and students with a snapshot of the key information they will encounter in each chapter. They can serve as a checklist to help guide and focus study.

Key Terms Found in a list at the beginning of each chapter and in bold within the chapter, these terms will create an expanded vocabulary in evidence-based practice.


78 CHAPTER 4 Cardiovascular Function

UNDERSTANDING CONDITIONS THAT AFFECT THE CARDIOVASCULAR SYSTEM

When considering alterations in the cardiovascular system, organizing them based on their basic underlying pathophysiology can increase understanding. These concepts are based on the two major cardiac-related nursing diagnoses—decreased cardiac output and altered tissue perfusion. Understanding what each of those diagnoses means facilitates understanding of the conditions that result in them.

Decreased cardiac output refers to states in which the amount of blood being pumped by the heart is smaller than normal. Decreased cardiac output can be associated with changes in preload, afterload, contractility, or dysrhythmias. Typical manifestations reflect the inability to meet the body's needs and may include fatigue, oliguria, cyanosis, fluid accumulation, and decreased peripheral pulses.

Altered tissue perfusion refers to a state in which there is a decrease in nutrition and oxygenation at the cellular level due to a deficit in capillary blood flow supply. Altered tissue perfusion can be associated with an interruption of blood flow, decreased cellular exchange, or fluid shifts. Typical manifestations reflect cellular ischemia and may include pain, skin changes, and signs of organ necrosis.

ALTERATIONS RESULTING IN DECREASED CARDIAC OUTPUT

Pericarditis

Pericarditis refers to an inflammation of the pericardium—the sac that surrounds, protects, and supports the heart. Because it is an inflammatory process (see the *Body Defenses* chapter), fluid shifts from the capillaries to the space between the sac and the heart. This fluid may be serous (resulting from heart failure), purulent (resulting from infections), serosanguineous (resulting from neoplasms or uremia), or hemorrhagic (resulting from aneurysms or trauma). As the pericardial tissue becomes inflamed, the swollen pericardial tissue rubs against the swollen cardiac tissue, creating friction.

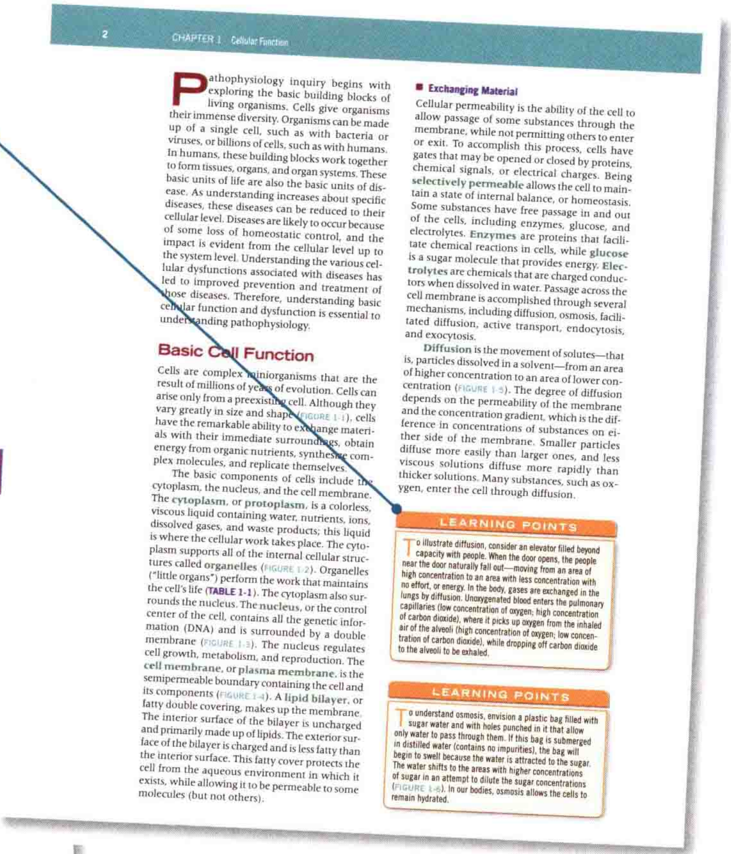
Fluid can accumulate in the pericardial cavity, creating a pericardial effusion. This condition can eventually progress to life-threatening cardiac tamponade (FIGURE 4-13). In cardiac tamponade, the fluid accumulates in the pericardial cavity to the point that it compresses the heart. This compression prevents the heart from stretching and filling during diastole, resulting in decreased cardiac output. Arterial pressures then fall, venous pressures rise, and the pulse pressure narrows. Additionally, the heart sounds are muffled upon auscultation because the fluid drowns out the sound. Heart failure, cardiogenic shock, and death can result from cardiac tamponade.

Chronic inflammation can lead to constrictive pericarditis. In constrictive pericarditis, the pericardium becomes thick and fibrous from the chronic inflammation and adheres to the heart. Essentially, the pericardium resembles a restrictive rubber band that has lost its elasticity. The loss of elasticity restricts cardiac filling, decreasing cardiac output and causing systemic congestion.

Concept-Based Sections Each chapter is organized in a conceptual manner to deepen understanding of content.

Learning Points Quick facts called out to highlight important aspects of topics within each chapter.

Myth Busters Common myths and misconceptions highlighted and debunked.



Pathophysiology inquiry begins with exploring the basic building blocks of living organisms. Cells give organisms their immense diversity. Organisms can be made up of a single cell, such as with bacteria or viruses, or billions of cells, such as with humans. In humans, these building blocks work together to form tissues, organs, and organ systems. These basic units of life are also the basic units of disease. As understanding increases about specific diseases, these diseases can be reduced to their cellular level. Diseases are likely to occur because of some loss of homeostatic control, and the impact is evident from the cellular level up to the system level. Understanding the various cellular dysfunctions associated with diseases has led to improved prevention and treatment of those diseases. Therefore, understanding basic cellular function and dysfunction is essential to understanding pathophysiology.

Basic Cell Function

Cells are complex miniorganisms that are the result of millions of years of evolution. Cells can arise only from a preexisting cell. Although they vary greatly in size and shape (FIGURE 1-1), cells have the remarkable ability to exchange materials with their immediate surroundings, obtain energy from organic nutrients, synthesize complex molecules, and replicate themselves.

The basic components of cells include the cytoplasm, the nucleus, and the cell membrane. The **cytoplasm**, or **protoplasm**, is a colorless, viscous liquid containing water, nutrients, ions, dissolved gases, and waste products; this liquid is where the cellular work takes place. The cytoplasm supports all of the internal cellular structures called **organelles** (FIGURE 1-2). Organelles ("little organs") perform the work that maintains the cell's life (TABLE 1-1). The cytoplasm also surrounds the nucleus. The **nucleus**, or the control center of the cell, contains all the genetic information (DNA) and is surrounded by a double membrane (FIGURE 1-3). The nucleus regulates cell growth, metabolism, and reproduction. The **cell membrane**, or **plasma membrane**, is the semipermeable boundary containing the cell and its components (FIGURE 1-4). A **lipid bilayer**, or fatty double covering, makes up the membrane. The interior surface of the bilayer is uncharged and primarily made up of lipids. The exterior surface of the bilayer is charged and is less fatty than the interior surface. This fatty cover protects the cell from the aqueous environment in which it exists, while allowing it to be permeable to some molecules (but not others).

Exchanging Material

Cellular permeability is the ability of the cell to allow passage of some substances through the membrane, while not permitting others to enter or exit. To accomplish this process, cells have gates that may be opened or closed by proteins, chemical signals, or electrical charges. Being **selectively permeable** allows the cell to maintain a state of internal balance, or homeostasis. Some substances have free passage in and out of the cells, including enzymes, glucose, and electrolytes. **Enzymes** are proteins that facilitate chemical reactions in cells, while **glucose** is a sugar molecule that provides energy. **Electrolytes** are chemicals that are charged conductors when dissolved in water. Passage across the cell membrane is accomplished through several mechanisms, including diffusion, osmosis, facilitated diffusion, active transport, endocytosis, and exocytosis.

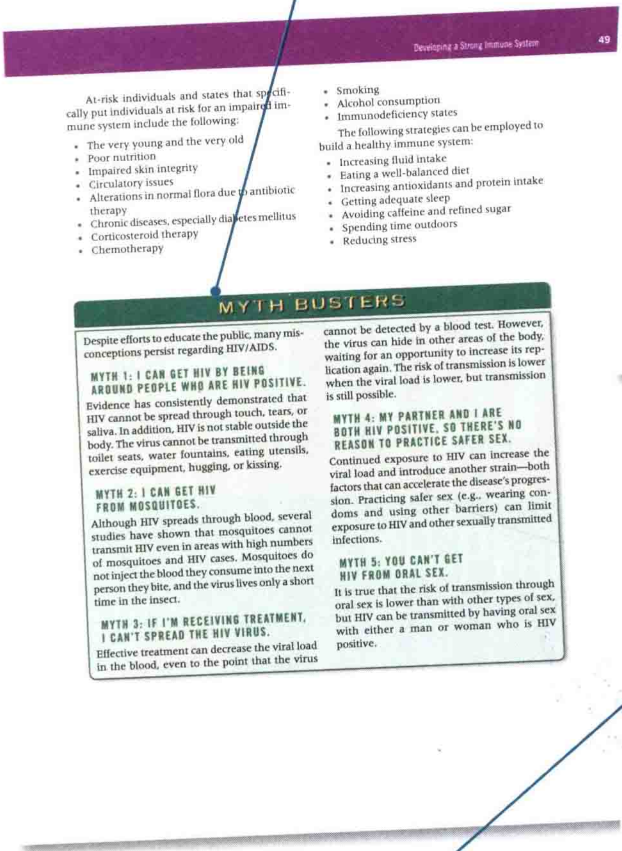
Diffusion is the movement of solutes—that is, particles dissolved in a solvent—from an area of higher concentration to an area of lower concentration (FIGURE 1-5). The degree of diffusion depends on the permeability of the membrane and the concentration gradient, which is the difference in concentrations of substances on either side of the membrane. Smaller particles diffuse more easily than larger ones, and less viscous solutions diffuse more rapidly than thicker solutions. Many substances, such as oxygen, enter the cell through diffusion.

LEARNING POINTS

To illustrate diffusion, consider an elevator filled beyond capacity with people. When the door opens, the people near the door naturally fall out—moving from an area of high concentration to an area with less concentration with no effort, or energy. In the body, gases are exchanged in the lungs by diffusion. Unoxygenated blood enters the pulmonary capillaries (low concentration of oxygen; high concentration of carbon dioxide), where it picks up oxygen from the inhaled air of the alveoli (high concentration of oxygen; low concentration of carbon dioxide), while dropping off carbon dioxide to the alveoli to be exhaled.

LEARNING POINTS

To understand osmosis, envision a plastic bag filled with sugar water and with holes punched in it that allow only water to pass through them. If this bag is submerged in distilled water (contains no impurities), the bag will begin to swell because the water is attracted to the sugar. The water shifts to the areas with higher concentrations of sugar in an attempt to dilute the sugar concentrations (FIGURE 1-6). In our bodies, osmosis allows the cells to remain hydrated.



At-risk individuals and states that specifically put individuals at risk for an impaired immune system include the following:

- The very young and the very old
- Poor nutrition
- Impaired skin integrity
- Circulatory issues
- Alterations in normal flora due to antibiotic therapy
- Chronic diseases, especially diabetes mellitus
- Corticosteroid therapy
- Chemotherapy
- Smoking
- Alcohol consumption
- Immunodeficiency states

The following strategies can be employed to build a healthy immune system:

- Increasing fluid intake
- Eating a well-balanced diet
- Increasing antioxidants and protein intake
- Getting adequate sleep
- Avoiding caffeine and refined sugar
- Spending time outdoors
- Reducing stress

MYTH BUSTERS

Despite efforts to educate the public, many misconceptions persist regarding HIV/AIDS.

MYTH 1: I CAN GET HIV BY BEING AROUND PEOPLE WHO ARE HIV POSITIVE.

Evidence has consistently demonstrated that HIV cannot be spread through touch, tears, or saliva. In addition, HIV is not stable outside the body. The virus cannot be transmitted through toilet seats, water fountains, eating utensils, exercise equipment, hugging, or kissing.

MYTH 2: I CAN GET HIV FROM MOSQUITOES.

Although HIV spreads through blood, several studies have shown that mosquitoes cannot transmit HIV even in areas with high numbers of mosquitoes and HIV cases. Mosquitoes do not inject the blood they consume into the next person they bite, and the virus lives only a short time in the insect.

MYTH 3: IF I'M RECEIVING TREATMENT, I CAN'T SPREAD THE HIV VIRUS.

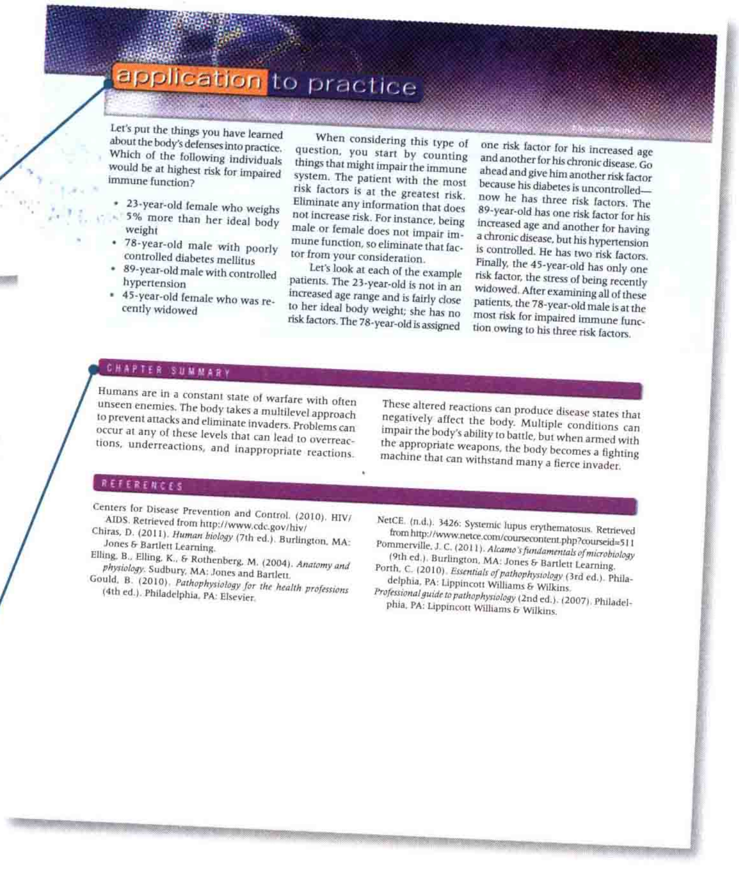
Effective treatment can decrease the viral load in the blood, even to the point that the virus cannot be detected by a blood test. However, the virus can hide in other areas of the body, waiting for an opportunity to increase its replication again. The risk of transmission is lower when the viral load is lower, but transmission is still possible.

MYTH 4: MY PARTNER AND I ARE BOTH HIV POSITIVE, SO THERE'S NO REASON TO PRACTICE SAFER SEX.

Continued exposure to HIV can increase the viral load and introduce another strain—both factors that can accelerate the disease's progression. Practicing safer sex (e.g., wearing condoms and using other barriers) can limit exposure to HIV and other sexually transmitted infections.

MYTH 5: YOU CAN'T GET HIV FROM ORAL SEX.

It is true that the risk of transmission through oral sex is lower than with other types of sex, but HIV can be transmitted by having oral sex with either a man or woman who is HIV positive.


application to practice

Let's put the things you have learned about the body's defenses into practice. Which of the following individuals would be at highest risk for impaired immune function?

- 23-year-old female who weighs 5% more than her ideal body weight
- 78-year-old male with poorly controlled diabetes mellitus
- 89-year-old male with controlled hypertension
- 45-year-old female who was recently widowed

When considering this type of question, you start by counting things that might impair the immune system. The patient with the most risk factors is at the greatest risk. Eliminate any information that does not increase risk. For instance, being male or female does not impair immune function, so eliminate that factor from your consideration.

Let's look at each of the example patients. The 23-year-old is not in an increased age range and is fairly close to her ideal body weight; she has no risk factors. The 78-year-old is assigned one risk factor for his increased age and another for his chronic disease. Go ahead and give him another risk factor because his diabetes is uncontrolled—now he has three risk factors. The 89-year-old has one risk factor for his increased age and another for having a chronic disease, but his hypertension is controlled. He has two risk factors. Finally, the 45-year-old has only one risk factor, the stress of being recently widowed. After examining all of these patients, the 78-year-old male is at the most risk for impaired immune function owing to his three risk factors.

CHAPTER SUMMARY

Humans are in a constant state of warfare with often unseen enemies. The body takes a multilevel approach to prevent attacks and eliminate invaders. Problems can occur at any of these levels that can lead to overreactions, underreactions, and inappropriate reactions. These altered reactions can produce disease states that negatively affect the body. Multiple conditions can impair the body's ability to battle, but when armed with the appropriate weapons, the body becomes a fighting machine that can withstand many a fierce invader.

REFERENCES

Centers for Disease Prevention and Control. (2010). HIV/AIDS. Retrieved from http://www.cdc.gov/hiv/
Chiras, D. (2011). *Human biology* (7th ed.). Burlington, MA: Jones & Bartlett Learning.
Elling, B., Elling, K., & Rothenberg, M. (2004). *Anatomy and physiology*. Sudbury, MA: Jones and Bartlett.
Gould, B. (2010). *Pathophysiology for the health professions* (4th ed.). Philadelphia, PA: Elsevier.
NetCE. (n.d.). 3426: Systemic lupus erythematosus. Retrieved from http://www.netce.com/coursecontent.php?courseid=511
Pommerville, J. C. (2011). *Alcamo's fundamentals of microbiology* (9th ed.). Burlington, MA: Jones & Bartlett Learning.
Porth, C. (2010). *Essentials of pathophysiology* (3rd ed.). Philadelphia, PA: Lippincott Williams & Wilkins.
Professional guide to pathophysiology (2nd ed.). (2007). Philadelphia, PA: Lippincott Williams & Wilkins.

Application to Practice Found in select chapters, these vignettes provide critical-thinking challenges for students.

Chapter Summary Summaries are included at the end of each chapter to provide a concise review of material covered in each chapter.

Preface

While teaching pathophysiology for more than 9 years and nursing for more than 18 years, I noticed a lack of pathophysiology books that students could relate to, and high student frustration in learning the convoluted material. Pathophysiology—while being the foundation of much of nursing education, from medical–surgical to pharmacology—is often an insurmountable barrier for students. They are faced with a copious amount of complicated information to weed through. While some students become bogged down in an information marsh, others seek more information than is provided in a skeleton book that has been cut to the bone. Nursing faculty join the students on this frustrating, Goldilocks journey by trying to make the available resources fit. Nursing students and faculty have pathophysiology books available that provide either far too much information or far too little.

This text provides the right fit as a practical guide to pathophysiology that presents information in a student-friendly, understandable way. Here, extraneous information is omitted, leaving only necessary information. The information in this text is also presented in a more accessible manner by considering readability, providing colorful graphics, and giving the content context and meaning.

This ground-breaking text will provide a springboard for faculty and students to come together as co-learners to explore this fascinating content. When such co-learning is stimulated, pathophysiology is no longer just mindlessly deposited into the students in a stifling manner; rather, learning for the students and the faculty becomes an empowerment pedagogy. This approach is supported by recent calls by the Institute of Medicine (2011), Robert Wood Johnson Foundation (Commitee on the Robert Wood Johnson Foundation Initiative on the Future of Nursing at the Institute of Medicine, 2010), and nursing leaders (Benner, Sutphen, Leonard, & Day, 2010) to change how young nurses are educated to meet the changing landscape of health care and needs of new generations.

The second edition of this text organizes content in a conceptual manner to provide students with an understandable and practical resource for learning pathophysiology. New and updated material has been added to every chapter as well as a new feature, *Application to Practice*. Faculty will appreciate having a resource that speaks to and engages students. Health professionals will also be able to refer the text to refresh their memory on concepts in a pragmatic way.

References

Benner, P., Sutphen, M., Leonard, V., & Day, L. (2010). *Educating nurses: A call for radical transformation.* San Francisco, CA: Jossey-Bass.

Committee on the Robert Wood Johnson Foundation Initiative on the Future of Nursing at the Institute of Medicine. (2010). A summary of the February 2010 forum on the future of nursing: Education [Chapter 2: What to teach]. Retrieved from http://www.nap.edu/catalog/12894.html

Institute of Medicine. (2011). *The future of nursing education: Leading change, advancing health.* Washington, DC: National Academies Press.

Acknowledgments

First, I would like to thank my husband, Tom, and children, Clayton and Mason, for their never-ending love and encouragement. I would also like to express my deepest gratitude to my mom, Carolyn, and dad, Tommy, because I would not be who I am today without them. I would also like to acknowledge all my students past, present, and future for constantly teaching me for more than I could ever teach them and for all their feedback—I heard it and I hope this is more what you had in mind. Finally, I would like to convey my appreciation to my colleagues for their gracious mentoring and support.

Reviewers

Judy Anderson, PhD, RN, CNE
Associate Professor
School of Nursing
Viterbo University
La Crosse, Wisconsin

Margaret Hamilton Birney, PhD, RN
Associate Professor
School of Nursing
University of Delaware
Newark, Delaware

Patsy E. Crihfield, DNP, APRN, FNP-BC
Associate Professor of Nursing and Director of Nurse Practitioner Program
School of Nursing
Union University
Germantown, Tennessee

Jennifer Donwerth, MSN, RN, ANP-BC, GNP-BC
Instructor
Department of Nursing
Tarleton State University
Stephenville, Texas

Julie Eggert, PhD
Associate Professor and Healthcare Genetics Doctoral Program Coordinator
School of Nursing
Clemson University
Clemson, South Carolina

Masoud Ghaffari, MSN/RN, MEd, MT (ASCP), CMA
Associate Professor
College of Nursing
East Tennessee State University
Johnson City, Tennessee

Kathleen A. Goei, PhD, RN, MSN
Assistant Professor
School of Nursing and Health Professions
University of the Incarnate Word
San Antonio, Texas

Christine Henshaw, EdD, RN, CNE
Associate Dean, Undergraduate Program
School of Health Sciences
Seattle Pacific University
Seattle, Washington

Patricia R. Keene, DNP, ACNP, CS, BC
Associate Professor of Nursing
School of Nursing
Union University
Germantown, Tennessee

Linda Keilman, DNP(c), MSN, GNP-BC
Assistant Professor
College of Nursing
Michigan State University
East Lansing, Michigan

Barbara McClaskey, PhD, MN, ARNP-CNS
Associate Professor
Department of Nursing
Pittsburg State University
Pittsburg, Kansas

Joan Niederriter, PhD, RN
Assistant Professor
Department of Nursing
Cleveland State University
Cleveland, Ohio

Tanya L. Rogers, APRN, BC, MSN, EdD
Associate Professor of Nursing
School of Nursing and Allied Health Administration
Fairmont State University
Fairmont, West Virginia

Jennifer K. Sofie, MSN, ANP, FNP
Adjunct Assistant Professor
College of Nursing
Montana State University
Bozeman, Montana

Joan Stokowski, MSN
Assistant Professor
Department of Health Careers
Illinois Central College
Peoria, Illinois

Brenda D. Tilton, RN, MSN, FNP-BC
Assistant Professor of Nursing
School of Nursing
Southern State Community College
Hillsboro, Ohio

Vickie Walker, DNP, RN
Assistant Professor of Nursing
School of Nursing
Gardner-Webb University
Boiling Springs, North Carolina

Introduction to Pathophysiology

When you see this icon, use the code at the front of the book to access online student resources.

LEARNING OBJECTIVES

- Define pathophysiology and identify its importance for clinical practice.
- Identify key health and disease concepts.

KEY TERMS

acute
chronic
compensatory mechanism
complication
congenital
convalescence
degenerative
developmental
diagnosis
disease
epidemic
epidemiology
etiology
exacerbation
genetic
health
hereditary
homeostasis
iatrogenic
idiopathic
inflammatory
insidious
manifestation
metabolic
morbidity
mortality
negative feedback system
neoplastic
pandemic
pathogenesis
pathophysiology
predisposing factor
prevention
prognosis
remission
signs
symptoms
syndrome
treatment

Pathophysiology Concepts

What is meant by **pathophysiology**? And why is it so important to understand, especially for nurses? Essentially, pathophysiology is the study of what happens when normal anatomy and physiology go wrong. Veering off this normal path can cause diseases or abnormal states. Pathophysiology is the foundation upon which all of nursing is built. It is the "why" that unlocks all the mysteries of the human body and its response to medical and nursing therapies. Understanding pathophysiology provides insight into why patients look the way they do when they have a certain disease, why the medicines we give them work, why the side effects of treatments occur, and why the complications transpire. Pathophysiology provides the rationale for evidence-based medicine.

Why are so many students mystified by pathophysiology? Unfortunately, students often get lost in the minute details and the complicated nuances of pathophysiology. Pathophysiology, when brought back to the basics and framed in a practical context, can bring meaning and understanding to the world of health and disease in which people live.

Health and Disease

To understand disease, first the definition of health must be clarified. **Health** may be considered the absence of disease. This concept can be expanded to include wellness of mind, body, and spirit. This normal state may vary due to genetic, age, and gender differences, and it becomes relative to the individual's baseline. Negative events in any one of these three areas can cause issues in the others—these areas coexist. Humans are complicated and do not exist in a vacuum. Just as the mind, body, and spirit are interrelated, so humans are interrelated with their environment, including their physical ecology as well as social factors. These external factors play a significant role in an individual's health, whether negatively or positively.

On the flip side of health is disease. **Disease** is the state when a bodily function is no longer occurring normally. The severity of diseases ranges from merely causing temporary stress to causing life-changing complications. Health and disease may be considered as two ends of a continuum. At one end are severe, life-threatening disease states that cause significant physical and emotional issues; at the other end is optimal health that supports mind, body, and spirit well-being.

Diseases can be classified in several ways. First, a disease may be **hereditary**, meaning it is transmitted before birth. Disease may also be present at birth, or **congenital**. **Genetic** diseases are caused by abnormalities in the individual's genetic makeup (e.g., chromosomal numbers or mutations) (see the *Cellular Function* chapter). **Developmental** diseases occur as a result of an issue that arises during embryonic or fetal development. Other diseases may develop over the life span. **Inflammatory** diseases are those that trigger the inflammatory response (see the *Body Defenses* chapter). **Degenerative** diseases include conditions that deteriorate parts of the body (e.g., arthritis). Conditions that affect metabolism are referred to as **metabolic** diseases (e.g., diabetes mellitus). **Neoplastic** diseases are caused by abnormal or uncontrolled cellular growth, which can lead to benign and malignant tumors (see the *Cellular Function* chapter).

Exploring concepts of homeostasis is a good place to start in understanding the origins of disease.

Homeostasis

Many words can be used to describe **homeostasis**, such as *equilibrium*, *balance*, *consistency*, and *stability*. Some examples of this relative consistency can be seen in vital signs such as blood pressure, pulse, and temperature. Every part of the human body, from cells to the organs, needs balance to maintain its bodily functions. In some cases, such as with pH, even minimal changes can cause significant and life-threatening problems. The human body is constantly engaging in multiple strategies to maintain this balance and addressing external stressors such as injury or organism invasion.

Homeostasis is a self-regulating, give-and-take system that responds to minor changes in the body through compensation mechanisms. Compensation mechanisms attempt to counteract those changes and return the body to its normal state (FIGURE I-1). Several brain structures are instrumental in maintaining this balance, including the medulla oblongata, hypothalamus, reticular formation, and pituitary gland. The medulla oblongata is located in the brain stem and controls vital functions such as blood pressure, temperature, and pulse. The reticular formation is a network of nerve cells in the brain stem and the spinal cord that also controls vital

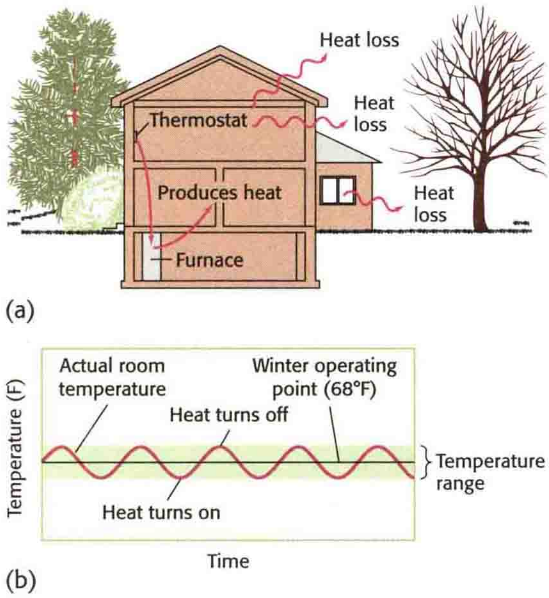


FIGURE I-1 Homeostasis is like a house. (a) Heat is maintained in a house by a furnace, which compensates for heat loss. (b) A hypothetical temperature graph.

AAOS. (2004). *Paramedic: Anatomy and physiology.* Sudbury, MA: Jones & Bartlett.

functions. It relays information to the hypothalamus. The hypothalamus, in turn, controls homeostasis by communicating information to the pituitary gland. The pituitary gland, also known as the master gland, regulates other glands that contribute to growth, maturation, and reproduction.

Two types of feedback systems exist to maintain homeostasis: negative and positive. A **negative feedback system**—the most common type—works to maintain a deficit in the system. These negative feedback mechanisms work to resist any change from normal. Examples of negative feedback systems include temperature and glucose regulation. Positive feedback systems, though few in number, move the body away from homeostasis. With this type of feedback, an amplified response occurs in the same direction as the original stressor. Examples of positive feedback systems include childbirth, sneezing, and blood clots.

Disease Development

Etiology is the study of disease causation. Etiologic factors may include infectious agents, chemicals, or environmental factors, to name a few. Etiologic factors may also be unknown, or **idiopathic**. Additionally, diseases can be caused by an unintended, or **iatrogenic**, effect of a medical treatment. **Predisposing factors** are tendencies that put an individual at risk for developing certain diseases. Examples of predisposing factors are similar to etiology factors and may include dietary imbalances and carcinogen exposure. Identifying the etiology and predisposing factors of diseases can be instrumental in preventing the disease by distinguishing at-risk populations who can be targeted with prevention measures. The healthcare system is turning more toward disease prevention because investing resources before the disease develops can decrease the long-term financial burden.

How a disease develops is referred to as **pathogenesis**. Some diseases are self-limiting, while others are chronic and never resolve. Some diseases cause reversible changes, while others cause irreparable damage. The body will attempt to limit the damage with compensatory mechanisms. **Compensatory mechanisms** are physiological strategies that the body employs in the midst of homeostatic imbalance to maintain normalcy. When those mechanisms can no longer maintain relative consistency, disease occurs. The onset of the disease may be sudden or acute. Acute onset of a disease may include pronounced indicators such as pain or vomiting, whereas a gradual, or **insidious**, onset may be associated with only vague signals. Hypertension, for example, can occur in this subtle manner.

Disease duration is another important concept to consider. A disease may be short term, or **acute**, occurring and resolving quickly. Gastroenteritis and tonsillitis are examples of acute diseases. When an acute disease does not resolve after a short period, it may move into a chronic state. A **chronic** disease often has less notable signs and occurs over a longer period. Chronic diseases may not ever resolve but may become manageable. Diabetes mellitus and depression are examples of chronic diseases. Additionally, people with chronic diseases can experience an acute event of that disease, complicating care. An example of this phenomenon can be seen when a patient with asthma (a chronic disease) has an acute asthma attack.

Recognition of a disease when it is encountered is important in diagnosis, or identification, of disease. **Manifestations** are the clinical effects or evidence of a disease. They may include both **signs**—what can be seen or measured—and **symptoms**—what the patient describes. Manifestations may include issues identified during a physical assessment (e.g., heart murmur), diagnostic results (e.g., laboratory levels), patient complaints (e.g., pain), and family reports (e.g., unusual behavior). A **syndrome** comprises a group of signs and symptoms that occur together. Some chronic diseases may include episodes of remission and exacerbation. **Remission** occurs when the manifestations subside, and **exacerbation** occurs when the manifestations increase again. Systemic lupus erythematosus and heart failure are examples of diseases that demonstrate remissions and exacerbations. Manifestations may vary depending on the point at which they occur in the pathogenesis. For instance, an early sign of shock may be tachycardia, whereas bradycardia occurs late in the disease process. Manifestations are often a critical component to disease **diagnosis**, or identification. Additionally, a detailed patient history may be used to aid diagnosis.

Treatment refers to strategies used to manage or cure a disease. Treatment may be specific to the cause of the disease or used to alleviate the disease's clinical manifestations. For example, an antibiotic may be used to target the specific organism causing a patient's pneumonia or an antiemetic may be administered to relieve vomiting associated with acute pancreatitis. Treatment regimens often require the services of an interdisciplinary team (e.g., nursing, dieticians, respiratory therapists, physical therapists, occupational therapists, physiotherapists, and pharmacists). Such a team is often necessary when a swift, aggressive approach is required or when long-term management is needed.

Some of the same treatment strategies are used for disease prevention. **Prevention** includes strategies to avoid the development of disease in individuals or groups. Such strategies may include screening, vaccinations, lifestyle changes, or prophylactic interventions (e.g., medication to reduce high cholesterol levels to prevent strokes, mastectomy in a person at high risk of breast cancer).

Recovering from a disease and limiting any residual effects are important aspects of disease management. **Convalescence** is the stage of recovery following a disease, which may last for days or months. **Prognosis** refers to an individual's likelihood of making a full recovery or regaining normal functioning. The death rate from a particular disease is referred to as **mortality**. **Complications** are new problems that arise because of a disease. For example, renal failure can be a complication of uncontrolled hypertension or diabetes mellitus.

Understanding factors affecting the health and disease of populations is the cornerstone to understanding prevention and containment. **Epidemiology** refers to the science that analyzes patterns of diseases in a group of people. This tracking includes occurrence, incidence, prevalence, transmission, and distribution of the disease. **Morbidity** refers to disease rates within a group. **Epidemics** occur when there are increasing numbers of people with a certain disease within a specific group. When the epidemic expands to a larger population, it becomes a **pandemic**.

Summary

Pathophysiology is the basis for understanding the intricate world of the human body, its response to disease, and the rationale for treatment. Understanding pathophysiology can assist the nurse to better anticipate situations, correct issues, and provide appropriate care. The concepts of health and disease, although complex, need not cause stress to nursing students or patients. These concepts can open a world of wonder of which to be in awe.

References

Crowley, L. (2013). *An introduction to human disease: Pathology and pathophysiology correlations*. Burlington, MA: Jones & Bartlett Learning

Mosby's dictionary of medicinal, nursing, and health professionals (9th ed.). (2012). St. Louis, MO: Mosby

Contents