Memmler's The Human Body in Health and Disease

Memmler's The Human Body in Health and Disease

Tenth Edition

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contributor

Lippincott Williams & Wilkins
A Wolters Kluwer Company
Philadelphia • Baltimore • New York • London
Buenos Aires • Hong Kong • Sydney • Tokyo

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Compositor: ***Maryland Composition, Inc.***
Printer: ***R.R. Donnelley & Sons-Willard***

351 West Camden Street
Baltimore, MD 21201

530 Walnut Street
Philadelphia, PA 19106

Printed in the United States of America

Library of Congress Cataloging-in-Publication Data

Cohen, Barbara J.
Memmler's The human body in health & disease / Barbara Janson
Cohen. 10th ed.
p. cm.
Includes index.
ISBN
1. Human physiology. 2. Physiology, Pathological. 3. Human anatomy.
[numbers, etc.]

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Reviewers

We gratefully acknowledge the generous contributions of the reviewers whose names appear in the list that follows. These instructors were kind enough to read the text thoroughly and make suggestions for improvement. Their comments determined many of the changes in content and direction for this revision, such as the increased number and types of learning aids, addition of new art and revisions to existing art, a stronger focus on teaching and learning anatomic and medical terminology, and an increased emphasis on physiology and the interrelatedness of structure and function. We hope they will be pleased with the results of their hard work in this 10th edition of *Memmler's The Human Body in Health and Disease*.

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Preface

Memmler's The Human Body in Health and Disease is a textbook for introductory-level health professions and nursing students who need a basic understanding of anatomy and physiology, the interrelationships between structure and function, and the effects of disease on body systems.

Like preceding editions, the tenth edition remains true to Ruth Memmler's original vision. Designed for health professions and nursing students, the features and content specifically meet the needs of those who may be starting their health career preparation with little or no science background. This book's primary goals are:

- To provide the essential knowledge of human anatomy, physiology, and the effects of disease, at an ideal level of detail, and in language that is clear and understandable.
- To illustrate the concepts discussed with anatomic art that depicts the appropriate level of detail with accuracy, simplicity, and elegance, and that is integrated seamlessly with the narrative.
- To incorporate the most recent scientific findings into the fundamental material on which Ruth Memmler's classic text is based.
- To include pedagogy designed to enhance interest in and understanding of the concepts presented.
- To teach the basic anatomic and medical terminology used in healthcare settings, preparing students to function efficiently in their chosen health career.
- To present an integrated teaching-learning package that includes all of the elements necessary for a successful learning experience.

This revision is the direct result of in-depth market feedback solicited to tell us what instructors and students at this level most need. We listened carefully to the feedback, and the results we obtained are integrated into every feature of this book. The text itself has been thoroughly revised and updated to reflect the latest accepted scientific thought in each area of the book. Because visual learning devices are so important to students at this level, this edition also features a completely revamped and expanded art program that includes revised versions of many of the figures from previous editions as well as numerous all-new, full-color anatomic line drawings and photographs. Last but not least, these features appear in an all-new design that makes the content more user-friendly and accessible than ever.

Organization and Structure

Like previous editions, the tenth edition uses a body systems approach to the study of the normal human body and how disease affects it. The book is divided into seven units, grouping related information and body systems together as follows:

- Unit I, The Body as a Whole (Chapters 1–4), focuses on the body's organization; basic chemistry needed to understand body functions; cells and their functions; and tissues, glands, and membranes.
- Unit II, Disease and the First Line of Defense (Chapters 5 and 6), presents information on disease, organisms that produce disease, and the integumentary system, which is the body's first line of defense against injury and disease.
- Unit III, Movement and Support (Chapters 7 and 8), includes the skeletal and muscular systems.
- Unit IV, Coordination and Control (Chapters 9–12), focuses on the nervous system, the sensory system, and the endocrine system.
- Unit V, Circulation and Body Defense (Chapters 13–17), includes the blood, the heart and heart disease, blood vessels and circulation, the lymphatic system, and the immune system.
- Unit VI, Energy: Supply and Use (Chapters 18–22), includes the respiratory system, the digestive system, metabolism, nutrition, temperature control, body fluids, and the urinary system.
- Unit VII, Perpetuation of Life (Chapters 23–25), covers the male and female reproductive systems, development and birth, and heredity and hereditary diseases.

The main Glossary defines the chapters' boldfaced terms, and a Glossary of Word Parts is a reference tool that not only teaches basic medical and anatomic terminology but also helps students learn to recognize unfamiliar terms. Appendixes include a variety of supplementary information that students will find useful as they work with the text, including answers to the Chapter Checkpoint questions and Zooming In illustration questions (Appendix 6) that are found in every chapter.

Pedagogic Features

Every chapter contains pedagogy that has been designed with the health professions and nursing student in mind (the User's Guide that follows the Preface provides a "guided tour" of these features and their pedagogic benefits). Features marked with an asterisk (*) appear in every chapter:

- ***Learning Outcomes:** Chapter objectives on the first page of every chapter help the student organize and prioritize learning.

- ***Selected Key Terms:** List that accompanies the Learning Outcomes presents the most important terms covered in the chapter.
- ***Chapter Checkpoints:** Brief questions at the end of main sections test and reinforce the student's recall of key information in that section.
- ***"Zooming In" questions** "(*NEW* to this edition): Questions with the figure legends test and reinforce the student's understanding of concepts depicted in the illustration. They are set in a second color to increase their visibility.
- **Phonetic pronunciations:** Easy-to-learn phonetic pronunciations are spelled out in the narrative, appearing in parentheses directly following many terms—no need for students to understand dictionary-style diacritical marks. (See the "Guide to Pronunciation" below.)
- ***Special interest boxes:** Each chapter contains three special interest boxes focusing on topics that augment chapter content. The book includes five kinds of boxes altogether:
  - *A Closer Look:* Provide additional in-depth scientific detail on topics in or related to the chapter.
  - *Clinical Perspective:* Focus on diseases and disorders relevant to the chapter, providing detailed content for students training in different fields.
  - *Health Professions* (*NEW* to this edition): Describe various careers in the health professions, highlighting the reasons why students need a thorough grounding in anatomy and physiology.
  - *Hot Topic* (*NEW* to this edition): Focus on current trends and research, reinforcing the link between anatomy and physiology and related news coverage that students may have seen.
  - *Health Maintenances:* Offer supplementary information on health and wellness issues.
- ***Figures:** The greatly expanded and revised art program includes full-color anatomic line art, both new and revised, with a level of detail that matches that of the narrative. Also *NEW* to this edition are photomicrographs, radiographs, and other scans, included to give students a "preview" of what they might see in real-world healthcare settings.
- **Tables:** The numerous new and revised tables in this edition summarize key concepts and information in an easy-to-review form.
- **Color figure and table numbers** (*NEW* to this edition): Figure and table numbers appear in color in the narrative, helping students quickly find their place after stopping to look at an illustration or table. Figure callouts appear in blue type, and table callouts, in red.
- ***Word Anatomy:** Organized by chapter headings, this chart groups various word parts used in terms found in the chapter. This learning tool helps students build vocabulary and promotes recognition of even unfamiliar terms based on a knowledge of common word parts.
- ***Summary:** Outline-format summary provides a concise overview of chapter content, aiding in study and test preparation.
- ***Questions for Study and Review:** Study questions have been thoroughly revised and organized hierarchically into three *NEW* levels in this edition (answers appear in the Instructor's Manual):
  - *Building Understanding:* Includes fill-in-the-blank, matching, and multiple choice questions that test factual recall.
  - *Understanding Concepts:* Includes short-answer questions (define, describe, compare/contrast) that test and reinforce understanding of concepts.
  - *Conceptual Thinking:* Includes short-essay questions that promote critical thinking skills.

Summary

In short, the tenth edition of *Memmler's The Human Body in Health and Disease* builds on the successes of the previous nine editions by offering clear, concise narrative into which accurate, aesthetically pleasing anatomic art has been woven. We have made every effort to respond thoughtfully and thoroughly to reviewers' and instructors' comments, offering the ideal level of detail for students preparing for a career in the health professions and nursing, and the pedagogic features that best support it. We hope you will agree that the tenth edition of *Memmler's* is the best ever.

User's Guide

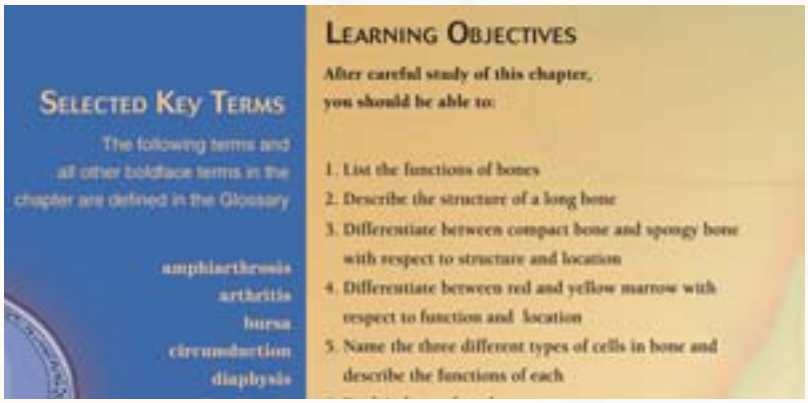
In today's health careers, a thorough understanding of human anatomy and physiology is more important than ever. *Memmler's The Human Body in Health and Disease* not only provides the conceptual knowledge you'll need but also teaches you how to apply it. This User's Guide introduces you to the features and tools that will enhance your learning experience.

A unifying theme of this text is the relationship between structure and function, and how they differ in health and disease. We've woven that theme into the book's design and approach. Take a few minutes to look through the text and get acquainted with its organization. The two tables of contents provide a framework for your learning: the Brief Contents gives a wide-angle view of the book's "skeleton"—the units and chapters—while the detailed Contents focuses in on the individual "bones," the topics themselves. As with the different body systems, specific topics build on each other from chapter to chapter, with each supporting the ones that follow.

Next, take a look at the chapters themselves. We've included some important tools to help you learn about anatomy and physiology and apply your new knowledge:

- Objectives and key terms highlight important concepts—helping you organize and prioritize learning.
- "Health Professions" boxes focus on a variety of health careers—showing how the knowledge of anatomy and physiology is applied in real-world jobs.
- "Hot Topic" boxes provide cutting-edge content on trends and research—giving a view to what is happening in the larger scientific community.
- "Clinical Perspective" boxes focus on physical disorders and related body processes as well as techniques used in clinical settings—providing additional content on diseases and their treatments.
- "A Closer Look" boxes provide additional detail on selected topics from the text—focusing in on the details of structure and function.
- "Health Maintenance" boxes cover common health issues—offering useful information about how to keep the body healthy.
- "Checkpoint" questions test your understanding of the chapter's key points—helping you review as you proceed through the chapter.
- "Zooming In" questions ask you to focus in on the illustration's details and answer questions based on what you see—reviewing important concepts and honing your conceptual thinking.
- Phonetic pronunciations follow selected terms—helping you say the term correctly without having to stop and look up complicated pronunciation symbols.
- The "Word Anatomy" chart helps you learn to recognize new terms based on your knowledge of word parts—building vocabulary.
- Chapter summaries provide a quick review of key points in outline form—helping you prepare for exams.
- Questions for Study and Review cover chapter content thoroughly—testing your recall of facts, reinforcing understanding of concepts, and teaching critical thinking.

The bonus CD contains a glossary of pronunciations from Stedman's Medical Dictionary and an electronic image atlas. The pronunciation glossary allows you to hear the correct pronunciation of key terms from the text and practice them yourself, helping to prepare you to communicate effectively in the healthcare setting. The electronic image atlas, which contains the most important illustrations from the text, is a convenient study tool that lets you review and test your understanding of key body structures.



Box 1-3 • Health Professions

Health Information Technicians

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

Accurate medical records are also essential for administrative purposes. Health information technicians assign a **code** to each diagnosis and procedure a patient receives, and this information is used for accurate patient billing. In addition, health information technicians analyze medical records to discover trends in health and disease. This research can be used to improve patient care, manage costs, and help establish new medical treatments.

Health information technicians need a strong clinical knowledge base. A thorough background in medical terminology is essential when reading and interpreting medical records. Anatomy and physiology are definitely required!

Most health information technologists work in hospitals and long-term care facilities. Others work in medical clinics, government agencies, insurance companies, and consulting firms. Job prospects are promising because of the growing need for healthcare. In fact, health information technology is projected to be one of the fastest growing careers in the United States. For more information about this profession, contact the American Health

Box 8-2 Hot Topics

Anabolic Steroids: Winning at All Costs?

Anabolic steroids mimic the effects of the male sex hormone testosterone by promoting metabolism and stimulating growth. These drugs are legally prescribed to promote muscle regeneration and prevent atrophy from disuse after surgery. However, athletes also purchase them illegally, using them to increase muscle size and strength and improve endurance.

When steroids are used illegally to enhance athletic performance, the doses needed are large enough to cause serious side effects. They increase blood cholesterol levels, which may lead to atherosclerosis, heart disease, kidney failure, and stroke. Steroids damage the liver, making it more susceptible to disease and cancer, and suppress the immune system, increasing the risk of infection and cancer. In men, steroids cause impotence, testicular atrophy, low sperm count, infertility, and the development of female sex characteristics such as breasts (gynecomastia). In women, steroids disrupt ovulation and menstruation and produce male sex characteristics such as breast atrophy, enlargement of the clitoris, increased body hair, and deepening of the voice. In both sexes steroids increase the risk for baldness and, especially in men, cause mood swings, depression and violence.

Box 7-1 Clinical Perspectives

Landmarking: Seeing With Your Fingers

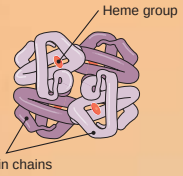
Most body structures lie beneath the skin, hidden from view except in dissection. A technique called **landmarking** allows health care providers to visualize hidden structures without cutting into the patient. Bony prominences, or landmarks, can be palpated (felt) beneath the skin to serve as reference points for locating other structures. Landmarking is used during physical examinations and surgeries, when giving injections, and for many other clinical procedures. The lower tip of the sternum, the xiphoid process, is a reference point in the administration of cardiopulmonary resuscitation (CPR).

Practice landmarking by feeling for some of the other bony prominences. You can feel the joint between the mandible and the temporal bone of the skull (the temporomandibular joint, or TMJ) anterior to the ear canal as you move your lower jaw up and down. Feel for the notch in the sternum (breast bone) between the clavicles (collar bones). Approximately 4 cm below this notch you will feel a bump called the sternal angle. This prominence is an important landmark because its location marks where the trachea splits to deliver air to both lungs. Move your fingers lateral to the sternal angle to palpate the second ribs, important landmarks for locating the heart and lungs. Feel for the most lateral bony prominence of the shoulder, the acromion process of the scapula (shoulder blade). Two to three fingerbreadths down from this point is the correct injection site into the deltoid muscle of the shoulder. Place your hands on your hips and palpate the iliac crest of the hip bone. Move your hands forward until you reach the anterior end of the crest, the anterior superior iliac spine (ASIS). Feel for the part of the bony pelvis that you sit on. This is the ischial tuberosity. It and the ASIS are important landmarks for locating safe injection sites in the gluteal region.

Box 13-1 A Closer Look

Hemoglobin: Door to Door Oxygen Delivery

The hemoglobin molecule is a protein made of four chains of amino acids (the globin part of the molecule), each of which holds an iron-containing heme group. Each of the four hemes can bind one molecule of oxygen.



Hemoglobin. This protein in red blood cells consists of four amino acid chains (globins), each with an oxygen-binding heme group.

Hemoglobin allows the blood to carry much more oxygen than it could were the oxygen simply dissolved in the plasma. A red blood cell contains about 250 million hemoglobins, each capable of binding four molecules of oxygen. So, a single red blood cell can carry about one billion oxygen molecules! Hemoglobin reversibly binds oxygen, picking it up in the lungs and releasing it in the body tissues. Active cells need more oxygen and also generate heat and acidity. These changing conditions promote the release of oxygen from hemoglobin into metabolically active tissues.

Immature red blood cells (erythroblasts) produce hemoglobin as they mature into erythrocytes in the red bone marrow. When the liver and spleen destroy old erythrocytes they break down the released hemoglobin. Some of its components are recycled, and the remainder leaves the body as a brown fecal pigment called stercobilin. In spite of some conservation, dietary protein and iron are still essential to maintain supplies.

Box 5-2 • Health Maintenance

The Cold Facts about the Common Cold

Every year, an estimated one billion Americans suffer from the symptoms of the common cold—runny nose, sneezing, coughing, and headache. Although most cases are mild and usually last about a week, colds are the leading cause of doctor visits and missed days at work and school.

Colds are caused by a viral infection of the mucous membranes of the upper respiratory tract. More than 200 different viruses are known to cause cold symptoms. While most colds occur in winter, scientists have found that cold weather does not increase the risk of "catching" a cold; the incidence is probably higher in winter because people spend more time indoors, increasing the chances that the virus will spread from person to person.

Colds spread primarily from contact with a contaminated surface. When an infected person coughs or sneezes, small droplets of water filled with viral particles are propelled through the air. One unshielded sneeze may spread hundreds of thousands of viral particles several feet. Depending upon temperature and humidity, these particles may live as long as 3 to 6 hours, and others who touch the contaminated surface may pick up the particles on their hands.

To help prevent the transmission of cold viruses:

- Avoid close contact with someone who is sneezing or coughing.
- Wash hands frequently to remove any viral particles you may have picked up.
- Avoid touching or rubbing your eyes, nose, or mouth with contaminated hands.
- Clean contaminated surfaces with disinfectant.

There are currently no medically proven cures for the common cold, and treatments only ease the symptoms. Because viruses cause the common cold, antibiotics are of no benefit. Getting plenty of rest and drinking lots of fluids are the best ways to speed recovery.

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The second type of bone tissue, called **spongy**, or **cancellous**, **bone** has more spaces than compact bone. It is made of a meshwork of small, bony plates filled with red marrow. Spongy bone is found at the epiphyses (ends) of the long bones and at the center of other bones. Figure 7-4 shows a photograph of both compact and spongy tissue in a bone section.

Checkpoint 7-1 A long bone has a long, narrow shaft and two irregular ends. What are the scientific names for the shaft and the ends of a long bone?

Checkpoint 7-2 What are the two types of osseous (bone) tissue and where is each type found?

7

Figure 8-1 **Structure of a skeletal muscle.** Connective tissue coverings are shown. (B, Reprinted with permission from Gartner LP, Hiatt JL. Color Atlas of Histology. 3rd ed. Philadelphia: Lippincott Williams & Wilkins, 2000.) *ZOOMING IN ✦ What is the innermost layer of connective tissue in a muscle? What layer of connective tissue surrounds a fascicle of muscle fibers?*

Figure 7-21 **The pelvic bones.** (A) Anterior view. (B) Lateral view; shows j
lum. *ZOOMING IN ✦ What bone is nicknamed the "sit bone"?*

head of the femur is the **greater trochanter** (tro-KAN-ter), used as a surface landmark. The **lesser trochanter**, a smaller elevation, is located on the medial side. On the posterior surface there is a long central ridge, the **linea aspera**, which is a point for attachment of hip muscles.

The **patella** (pah-TEL-lah), or kneecap (see Fig. 7-1), is embedded in the tendon of the large anterior thigh muscle, the quadriceps femoris, where it cr

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Word Anatomy

Medical terms are built from standardized word parts (prefixes, roots and suffixes). Learning the meanings of these parts can help you remember words and interpret unfamiliar terms.

WORD PART	MEANING	EXAMPLE
Bones		
dia-	through, between	The *diaphysis*, or shaft, of a long bone is between the two ends, or epiphyses.
oss, osse/o	bone, bone tissue	*Osseous* tissue is another name for bone tissue.
oste/o	bone, bone tissue	The *periosteum* is the fibrous membrane around a bone.
-clast	break	An *osteoclast* breaks down bone in the process of resorption.
Divisions of the Skeleton		
para-	near	The *paranasal* sinuses are near the nose.
pariet/o	wall	The *parietal* bones form the side walls of the skull.
cost/o	rib	*Intercostal* spaces are located between the ribs.
supra-	above, superior	The *supraspinous* fossa is a depression superior to the spine of the scapula
infra-	below, inferior	The *infraspinous* fossa is a depression inferior to the spine of the scapula.
		The *metacarpal*

Summary

I. Types of muscle
- A. Smooth muscle
  1. In walls of hollow organs, vessels, and respiratory passageways
  2. Cells tapered, single nucleus, nonstriated
  3. Involuntary; produces peristalsis; contracts and relaxes slowly
- B. Cardiac muscle
  1. Muscle of heart wall
  2. Cells branch; single nucleus; lightly striated
  3. Involuntary; self-excitatory
- C. Skeletal muscle
  1. Most attached to bones and move skeleton
  2. Cells long, cylindrical; multiple nuclei; heavily striated
  3. Voluntary; contracts and relaxes rapidly

II. Muscular system
1. Functions
   a. Movement of skeleton
   b. Maintenance of posture
   c. Generation of heat
   3. Isometric contractions—tension increases, but muscle does not shorten

III. Mechanics of muscle movement
1. Attachments of skeletal muscles
   a. Tendon—cord of connective tissue that attaches muscle to bone
      (1) Origin—attached to more fixed part
      (2) Insertion—attached to moving part
   b. Aponeurosis—broad band of connective tissue that attaches muscle to bone or other muscle
- A. Muscles work together
  1. Prime mover—performs movement
  2. Antagonist—produces opposite movement
  3. Synergists—steady body parts and assist prime mover
- B. Levers and body mechanics—muscles function with skeleton as lever systems
  1. Components
     a. Lever—bone
     b. Fulcrum
     c. Force—

Questions for Study and Review

Building Understanding

Fill in the blanks.
1. The shaft of a long bone is called the _____.
2. The structural unit of compact bone is the _____.
3. Red bone marrow manufactures _____.
4. Bones are covered by a connective tissue membrane called _____.
5. Bone matrix is produced by _____.

Matching
Match each numbered item with the most closely related lettered item.
___ 6. A rounded bony projection
___ 7. A sharp bony prominence
___ 8. A hole through bone
___ 9. A bony depression
___ 10. An air-filled bony cavity

a. condyle
b. foramen
c. fossa
d. sinus
e. spine

teoarthritis, rheumatoid arthritis, and gout?

Multiple-choice
___ 11. On which of the following bones would the mastoid process be found?
a. occipital bone
b. femur

b. hinge
c. pivot
d. ball-and-socket

Ancillaries

A complete teaching and learning package is available for both faculty and students. For more information, please visit the text's companion website at http://connection.LWW.com/memmler, or contact your local LWW representative.

- Free Instructor's Manual packaged with Instructor's Resource CD, which includes a test generator, image bank, PowerPoint™ slides, and the Instructor's Manual files (0-7817-5392-9).
- Free transparency set (0-7817-6167-0).
- Free course preparation assistance for instructors and tutoring for students, powered by Smarthinking™ , an online support service featuring access to live e-structors. To demo this service, please visit the website listed above.
- Online course materials and management powered by WebCT and Blackboard. To demo the online course, please visit the website listed above.
- Student Study Guide available for purchase either alone (0-7817-5172-1) or packaged with the text (0-7817-6207-3).

Acknowledgments

To prepare a textbook, an author needs the assistance of many skilled people. This is my opportunity to thank those who have helped with revisions for the 10th edition of *Memmler's The Human Body in Health and Disease*. My editor, John Goucher, has guided this project through from start to finish and showed great skills in putting out fires. Senior Development Editor Dana Knighten kept her eye on the big picture as well as the tiniest details—and everything in between. Jason Taylor gave advice on the entire manuscript and also wrote the special interest boxes and chapter summary questions. Kerry Hull's contribution as a reviewer landed her the job of writing all of the ancillary materials, assisted by Ancillary Editor Molly Ward. Elizabeth Connolly and Jennifer Clements kept the art program on track, managing all of the electronic art files.

My thanks to all the many reviewers, listed separately, who made such valuable and detailed comments on the text. Their insights and advice truly guided every aspect of this new edition.

Enormous thanks to Craig Durant and Dragonfly Media Group for their brilliant work on the art program. They understood our needs, often better than we did, and rendered art astonishing in its clarity, instructional value, and beauty of design.

And as always, thanks to my husband Matthew, currently an instructor in anatomy and physiology, for his advice on and contributions to the text.

Brief Contents

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Unit VII

PERPETUATING LIFE 000