A Streamlined Option for Success in A&P and Beyond...

The streamlined edition of Elaine Marieb and Katja Hoehn’s best-selling A&P text and media program motivates and supports both novice learners and expert students. Each carefully paced chapter guides you in advancing from lower-level memorizing of terminology to applying knowledge in clinical scenarios, to practicing the critical thinking and problem-solving skills required for entry to nursing, allied health, and exercise science programs.
Identify “Big Picture” Concepts Before Exploring Details

Before you look up details within a chapter, turn to the first page of the chapter and read the numbered list of **Key Concepts** that summarize the “big ideas” in the chapter. **Learning Outcomes** will give you a preview of essential information to study within each chapter section. Updated **Career Connection Videos** feature health care professionals who describe how the chapter content relates to their everyday work.

### 8.1 Joints are classified into three structural and three functional categories

**Learning Outcomes**
- Define joint or articulation.
- Classify joints by structure and by function.

Joints are classified by structure and by function. The structural classification focuses on the material binding the bones together and whether or not a joint cavity is present. Structurally, there are fibrous, cartilaginous, and synovial joints (Table 8.1). Only synovial joints have a joint cavity.

<table>
<thead>
<tr>
<th>KEY CONCEPTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1 Joints are classified into three structural and three functional categories 218</td>
</tr>
<tr>
<td>8.2 In fibrous joints, the bones are connected by fibrous tissue 218</td>
</tr>
<tr>
<td>8.3 In cartilaginous joints, the bones are connected by cartilage 220</td>
</tr>
<tr>
<td>8.4 Synovial joints have a fluid-filled joint cavity 221</td>
</tr>
<tr>
<td>8.5 Five examples illustrate the diversity of synovial joints 229</td>
</tr>
<tr>
<td>8.6 Joints are easily damaged by injury, inflammation, and degeneration 238</td>
</tr>
</tbody>
</table>

The graceful movements of ballet dancers and the rough-and-tumble grappling of football players demonstrate the great variety of motion allowed by joints, or articulations—the sites where two or more bones meet. Joints have two fundamental functions: They give our skeleton mobility, and they hold it together, sometimes playing a protective role in the process.

**Check Your Understanding**
1. What functional joint class contains the least-mobile joints?
2. How are joint mobility and stability related?

**8.2 In fibrous joints, the bones are connected by fibrous tissue**

**Learning Outcome**
- Describe the general structure of fibrous joints. Name and give an example of each of the three common types of fibrous joints.

In fibrous joints, the bones are joined by the collagen fibers of connective tissue. No joint cavity is present. The amount of movement allowed depends on the length of the connective tissue fibers. Most fibrous joints are immovable, although a few are slightly movable. The three types of fibrous joints are **sutures**, ** syndesmoses**, and **gomphoses**.

**Sutures**

Sutures, literally “seams,” occur only between bones of the skull (Figure 8.1a). The wavy articulating bone edges interlock, and the junction is completely filled by a minimal amount of very short connective tissue fibers that are continuous with the periosteum (p. 154). The result is nearly rigid splices that knit the bones together, yet allow the skull to expand as the brain grows during youth. During middle age, the fibrous tissue ossifies and the skull bones fuse into a single unit. At this stage, the closed sutures are more precisely called **synostoses** (sir’o-stō’sis), literally, “bony junctions.” Because movement of the cranial bones would damage the brain, the immovable nature of sutures is a protective adaptation.

**Synodesmoses**

In synodesmoses (sin’dēz-mo’sis), the bones are connected exclusively by ligaments (syndesmon = ligament), cords or
Pace Yourself:
Learn & Review the Basics

Sebaceous Glands

The sebaceous glands (se-ba’shus; “greasy”), or oil glands (Figure 5.9a), are simple branched alveolar glands that are found all over the body except in the thick skin of the palms and soles. They are small on the body trunk and limbs, but quite large on the face, neck, and upper chest. These glands secrete an oily substance called sebum (se’bum). The central cells of the alveoli accumulate oily lipids until they become so engorged that they burst, so functionally these glands are holocrine glands (p. 111). The accumulated lipids and cell fragments constitute sebum.

NEW! Text Recall icons guide you to review specific pages where a concept was first introduced.

EXPANDED!
Summary Tables present key information and serve as well-organized, time-saving study tools. 13 NEW Summary Tables have been added to the Seventh Edition.

Table 5.1 Summary of Cutaneous Glands

<table>
<thead>
<tr>
<th>Function</th>
<th>Eccrine Sweat Glands</th>
<th>Apocrine Sweat Glands</th>
<th>Sebaceous Glands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature control</td>
<td>Useful</td>
<td>May act as sexual scent glands</td>
<td>Lubricate skin and hair</td>
</tr>
<tr>
<td>Some antibacterial properties</td>
<td></td>
<td></td>
<td>Help prevent water loss</td>
</tr>
<tr>
<td>Filtrate of blood plasma</td>
<td></td>
<td>Filtered secretion with added proteins and fatty substances</td>
<td>Antibacterial properties</td>
</tr>
<tr>
<td>Hypertonic filtrate of blood plasma</td>
<td></td>
<td>Sebum (an oily secretion)</td>
<td></td>
</tr>
<tr>
<td>Method of Secretion</td>
<td>Meroic (exocytosis)</td>
<td>Meroic (exocytosis)</td>
<td>Holocrine</td>
</tr>
<tr>
<td>Skin surface</td>
<td></td>
<td>Usually upper part of hair follicle; rarely, skin surface</td>
<td>Usually upper part of hair follicle; sometimes, skin surface</td>
</tr>
<tr>
<td>Body Location</td>
<td>Everywhere, but especially palms, soles, forehead</td>
<td>Mostly axillary and anogenital regions</td>
<td>Everywhere except palms and soles</td>
</tr>
</tbody>
</table>
Study the Figures as You Read the Text

**EXPANDED!** 5 new Focus Figures (for a total of 24) walk you through complex processes using exceptionally clear, easy-to-follow illustrations with integrated text explanations.

**FOCUS FIGURE 3.1** The Plasma Membrane

![Image of the Plasma Membrane]

**EXPANDED!** Dozens of unique In-Line Figures are strategically placed within the text to visually reinforce the text discussion.

- **Chemically gated ion channels** are opened by chemical messengers (e.g., neurotransmitters). This class of ion channel creates small local changes in the membrane potential (as we will see shortly). Receptors for acetylcholine are an example of this class. An **ACh receptor** is a single protein in the plasma membrane that is both a receptor and an ion channel.

- **Voltage-gated ion channels** open or close in response to changes in membrane potential. They underlie all action potentials. In skeletal muscle fibers, the initial change in membrane potential is created by chemically gated channels. In other words, chemically gated ion channels cause a small local depolarization (a decrease in the membrane potential) that then triggers the voltage-gated ion channels to create an action potential.

p. 253
Apply Your Knowledge to a Range & Variety of Questions

**Check Your Understanding**

18. Compare the functions of lysosomes and peroxisomes.
19. How are microtubules and microfilaments related functionally?
20. Name each of the organelles. Match the organelle(s) with the applicable statement(s). Answers may be used more than once.
   - (1) Moves organelles within cell using motor proteins
   - (2) Contains its own DNA
   - (3) Has cisterns
   - (4) Major site of ATP synthesis
   - (5) Site of steroid hormone synthesis
   - (6) Has cis and trans faces

NEW! A greater variety and range of self-assessment questions have been added to the Check Your Understanding sections within each chapter and include Apply, Predict, What If?, Draw, and Make Connections. Dozens of new visual questions ask you to label structures or interpret visual information.

**CLINICAL CASE STUDY**

21-Year-Old Female with Deep Lacerations

While riding her bike to campus, 21-year-old Liliana Rose was struck by a car. Examination in the Emergency Department reveals several injuries. Relative to her integumentary system, the following comments are noted on her chart:

- Epidermal abrasions of the right lateral upper arm and anterior shoulder.
- A deep, 2-cm laceration extending vertically on right lateral cheek and a horizontal 1-cm laceration on the temple.
- Cyanosis is apparent in her nail beds and lips.

The lacerated areas are cleaned, sutured (stitched), and bandaged by the emergency room (ER) personnel.

1. **NCLEX-Style** Lilyana’s epidermal layer has been damaged. Which statement best explains the significance of this damage?
   a. It’s not significant, because the cells in the epidermis are already dead.
   b. It’s significant because cells in the epidermis give rise to all the cells in all the different skin layers.
   c. It’s significant because disrupting the epidermis will cause severe, sometimes life-threatening bleeding.
   d. It’s significant because the cells of the epidermis protect against evaporative water loss, UV radiation, and infection.

**UPDATED!** Clinical Case Studies are provided at the end of most chapters and challenge you to apply your knowledge to realistic clinical scenario questions.

**NEW!** Each Clinical Case Study includes “NCLEX-Style” questions for practice with the kinds of challenge questions that you will eventually encounter on a licensing exam. Your instructor can also assign new NCLEX-Style questions in Mastering A&P.
Flexible and Mobile Study and Practice with Mastering A&P

Dynamic Study Modules use cognitive science to help students study course topics by adapting to their performance in real time. Customized feedback provides just-in-time remediation, improving student confidence. Instructors can assign from over 3,000 questions organized by chapter and module. Over 70% of students cite DSMs as their favorite study tool and a main reason for success in the course.

NEW! PAL 3.1 Mobile, Customizable Flashcards allow students to create a personalized, mobile-friendly deck of flashcards and quizzes using images from the virtual Practice Anatomy Lab 3.1. Students can use the checklist to filter down to the images referenced in the course. For optimal viewing, access the flashcards on a mobile device using Mastering login credentials.

EXPANDED! Interactive Physiology 2.0 Coaching Activities teach complex physiological processes using exceptionally clear animations, interactive tutorials, games, and quizzes. IP 2.0 features new graphics, quicker navigation, and a mobile-ready design. New topics include Generation of an Action Potential, Glomerular Filtration, and the Neuromuscular Junctions. IP 2.0 can be assigned in Mastering A&P and accessed in the Study Area.
Students can personalize their eText by creating highlights with meaningful labels and notes, concentrating their focus on what they need to study. The **NEW! customizable Notebook** allows students to filter, arrange, and group their notes in a way that makes sense to them.

**NEW!** Instructors can create notes in their own notebook and choose to share them with students, effectively creating a study guide and encouraging students to read and discover areas for further understanding. Instructor notes will always show up in blue in the student notebook.
Additional Support for Instructors and Students

Mastering A&P™ is the teaching and learning platform that empowers you to reach every student. By combining trusted author content with digital tools developed to engage students and emulate the office-hour experience, Mastering personalizes learning and improves results for each student. Built for and directly tied to the text, Mastering A&P enables an extension of learning, allowing students a platform to practice, learn, and apply outside of the classroom. Highlights of the new assignments include:

- **NEW! Building Vocabulary Coaching Activities** give students practice learning and using word roots in context while learning new A&P terms.
- **NEW! Focus Figure “Mini-Animation” Coaching Activities** bring the 5 new Focus Figures to life and include assessment questions.
- **IMPROVED! Concept Map Coaching Activities** support the concept maps in the text without requiring students to submit their own concept map for grading.
- **NEW! NCLEX-Style Questions** give students practice with the kinds of questions that will eventually appear on a licensing exam.

The Mastering A&P™ Instructor Resources Area for the Seventh Edition includes:

- **Customizable PowerPoint lecture outlines and images** provide a springboard for lecture prep.
- **All of the figures, photos, and tables from the text** are available in JPEG and Power Point formats, in labeled and unlabeled versions, and with customizable labels and leader lines.
- **Test bank** provides thousands of customizable questions across Bloom’s Taxonomy levels. Each question is tagged to chapter learning outcomes that can also be tracked within Mastering A&P assessments. Available in Microsoft Word and Test Gen formats.
- **Animations and videos** bring A&P concepts to life and include A&P Flix 3-D Animations.
- **A comprehensive Instructor Guide to Text and Media**, co-authored by Elaine Marieb and Laura Steele, includes a detailed teaching outline for each chapter, along with a wealth of activities, examples, and analogies that have been thoroughly class-tested with thousands of students.

---

**Laboratory Manual for Anatomy & Physiology, Seventh Edition**
by Elaine N. Marieb, Lori A. Smith
ISBN 9780135168028

**A Photographic Atlas for Anatomy & Physiology**
by Nora Herbert, Ruth E. Heisler, et al.
ISBN 9780321869258
Today’s students have access to an enormous amount of information about anatomy and physiology. As educators, our biggest challenge is to help students focus on mastering the basic concepts of this field. Providing this firm foundation will help students to become lifelong learners who can critically evaluate new information, connect that information to the foundation they have already established, and apply it in a clinical setting. How can we help students build a strong foundation in anatomy and physiology? We believe that this new edition of our textbook will help learners by building on the strengths of previous editions while using new and innovative ways to help students visualize connections between various concepts.

Unifying Themes

Three unifying themes that have helped to organize and set the tone of this textbook continue to be valid and are retained in this edition. These themes are:

Interrelationships of body organ systems. This theme emphasizes the fact that nearly all regulatory mechanisms have interactions with several organ systems. The respiratory system, for example, cannot carry out its role of gas exchange in the body if there are problems with the cardiovascular system that prevent the normal delivery of blood throughout the body. The Make Connections questions throughout the book help students connect new information to old information and think of the body as a community of dynamic parts instead of a number of independent units.

Homeostasis. Homeostasis is the normal and most desirable condition of the body. Its loss is always associated with past or present pathology. This theme is not included to emphasize pathological conditions, but rather to illustrate what happens in the body “when things go wrong” and homeostasis is lost. Whenever students see a red balance beam symbol accompanied by an associated clinical topic, their understanding of how the body works to stay in balance is reinforced.

Complementarity of structure and function. This theme encourages students to understand the structure of some body part (ranging from a molecule to an organ) in order to understand the function of that structure. For example, muscle cells can produce movement because they are contractile cells.

New to the Seventh Edition

New and augmented elements aim to help learners in the following ways.

To help students make connections between new and previously learned material. In order for students to master new concepts, they must link these new concepts with concepts they already understand. In this edition, we help them do this by adding:

- **Text recall icons**. These icons direct the student back to the specific pages where a concept was first introduced.

- **Make Connections questions**. We’ve added more of this type of question to the Check Your Understanding review questions that follow each module within a chapter. To answer these questions, the student must employ concepts learned previously (most often in previous chapters).

- **New kinds of higher-level questions**. Each chapter now has at least five higher-level questions that require students to think more deeply, pulling together strands from multiple concepts. These questions are clearly identified as APPLY, DRAW, PREDICT, MAKE CONNECTIONS, and WHAT IF? questions.

- **New summary tables**. Students have told us that they want more summary tables. In response, 13 new summary tables (two with illustrations) have been added in order to help students see the big picture.

To enhance students’ visual literacy. Anatomy is and has always been taught principally through images. Increasingly, however, physiological data is also represented as images, whether it be molecular interactions or graphical descriptions of processes. Throughout their future health care careers, students
will need to be able to understand and interpret information presented visually. In this edition, we help them do this by:

- **Adding new Focus figures.** Focus figures are illustrations that use a “big picture” layout and dramatic art to guide the student through difficult physiological processes in a step-by-step way. Our previous Focus figures have been a hit with both students and instructors. In response to requests for additional Focus figures, we are pleased to present five new two-page features.

- **Adding questions in each chapter.** Students often think that they understand an illustration simply by looking at it, but to truly comprehend an illustration and cement its concepts requires a more active learning approach. For this reason we now include at least one higher-level review question within each chapter that requires a student either to draw an illustration or to add to an existing diagram.

- **Adding questions about illustrations.** To help students practice their visual literacy skills, we have added 43 new Check Your Understanding questions that include an illustration as part of the question. Some of these are as simple as labeling exercises, but many require more advanced interpretation.

- **Updating art to improve its teaching effectiveness.** As always, this is a major part of the revision. Today’s students are accustomed to seeing sophisticated photorealistically rendered images. However, many students are not adept at extracting, and thinking critically about, the relevant information contained in such illustrations. With this in mind we continue to refine and update our illustrations as students’ needs change, improving their ability to teach important concepts. In many cases we have added blue “instructor’s voice” text within the figure to guide a student through it, replacing much of the more remote figure legend. In addition, new photos were painstakingly chosen and labeled to enhance the learning process.

- **Adding new illustrations to existing tables and adding new illustrated tables.** Students find illustrated tables particularly effective because they provide a visual cue that helps them remember a topic. In this edition, we have added illustrations to two tables and added two new illustrated tables.

- **Adding in-line figures.** These are small (less than a half-column wide) illustrations or photos strategically located within the text that discuss the figure they illustrate. This edition now has 31 such in-line figures, most of them newly added.

**To help students clinically apply what they have learned**

- **Updated Homeostatic Imbalance features.** Many of the Homeostatic Imbalance features have been updated and relevant photos have been added to some. All have been reviewed for accuracy and relevancy. In addition, the updated book design makes these features stand out more clearly.

- **Updated Clinical Case Studies in most chapters, with added new NCLEX-style questions.** The end-of-chapter review questions, which are now organized into three levels of difficulty based on Bloom’s Taxonomy categories, culminate in a clinical case study that allows students to apply some of the concepts they have learned to a clinical scenario. These case studies have been extensively revised and each case study has two questions that are similar in style to those in the NCLEX exam.

- **New clinically relevant photos.** We have added or updated a number of photos that have clinical relevance (procedures, conditions, etc.) that will help students apply what they are reading to real-life situations and to their future careers.

In this edition, certain chapters have received the bulk of our attention and have been more heavily revised. As you can see in the Highlights of New Content (below), these are Chapters 2–4, 9, and 26.

As in the previous edition, we have taken painstaking care to ensure that almost all the text and the associated art are covered on the same two-page spread. Although this sounds like a simple goal, it actually takes a great deal of work and has not usually been achieved by other textbooks. We make this effort because it is invaluable to student learning to not have to flip pages back and forth between art and text. Finally, you will notice the appearance of new icons referencing Mastering A&P® interspersed within the text. This guides students to go to the relevant on-line activities to supplement their learning.

**Other Highlights of New Content**

**Chapter 1 The Human Body: An Orientation**

- New Figure 1.1 illustrates complementarity of structure and function.

- New Homeostatic Imbalance features about hiatal hernias and about “wrong site surgery.”

**Chapter 2 Chemistry Comes Alive**

- New Homeostatic Imbalance feature about patient’s pH predicting outcome of CPR.

- New figures illustrate triglyceride structure (2.16); the difference between saturated and unsaturated fatty acids (2.17); phospholipids (2.18); and protein functions (2.20).

- Revised Figures 2.6 (formation of ionic bonds) and 2.12 (dissociation of salt in water) teach more effectively.

- New summary tables reinforce information about chemical bonds (Table 2.2) and about macromolecules and their monomers and polymers (Table 2.5).

**Chapter 3 Cells: The Living Units**

- Added Focus Figure 3.1 about the plasma membrane, and reorganized accompanying text.

- Reorganized text about passive membrane transport for improved clarity; updated and reorganized discussion of autophagy and apoptosis.

- Updated information about Tay-Sachs disease.

- New micrographs show micro- and intermediate filaments (Figure 3.20).
Preface

• Improved teaching effectiveness of Figures 3.5 (diffusion), 3.17 (processing and distribution of newly synthesized proteins), and 3.30 (stages of transcription).
• New information about telomeres in cancer cells.
• New Homeostatic Imbalance feature about progeria.

Chapter 4 Tissue: The Living Fabric
• New images of cilia show the difference between transmission and scanning electron microscopy (Figure 4.2).
• New in-line figure illustrates apical and basal surfaces of epithelial cells.
• Revised art for epithelial and connective tissue for clarity (Figures 4.4 and 4.11).
• New Figure 4.5 shows how exocrine and endocrine glands differ, and new Figure 4.10 gives an overview of the classification of connective tissue.

Chapter 5 The Integumentary System
• New illustrated summary table comparing cutaneous glands (Table 5.1).
• Revised Figures 5.3 and 5.4 for better teaching effectiveness.
• Updated information about skin color and disease states.
• Updated Homeostatic Imbalance features about hirsutism and about hair loss.
• New Homeostatic Imbalance feature about nail changes with disease.
• Updated statistics for and treatment of melanoma, with new photo (Figure 5.11c).

Chapter 6 Bones and Skeletal Tissues
• New summary Table 6.1 compares cartilage and bone tissue.
• New photos of an osteoclast (Figure 6.7); of a femur in longitudinal section to show compact and spongy bone (Figure 6.3); and of a section of a flat bone (skull bone) (Figure 6.4 top).
• Extensive revision of Figure 6.12, which teaches bone growth at epiphyseal plates, including new X ray to show epiphyseal plates, and new photomicrograph of epiphyseal cartilage.
• Updated information about bone remodeling, hormonal regulation of bone growth, and osteoporosis.

Chapter 7 The Skeleton
• New drawings to illustrate the location of the true and false pelvises, and the pelvic inlet and outlet (Figure 7.33).
• Updated Homeostatic Imbalance feature about pes planus (flat feet)
• New photo of bimalleolar fracture (Figure 7.35).

Chapter 8 Joints
• New Homeostatic Imbalance feature about shoulder dislocations.
• New Table 8.3 summarizes movements at synovial joints.
• Revised Figure 8.4 (bursae and tendon sheaths).

Chapter 9 Muscles and Muscle Tissue
• New “Background and Overview” section begins the discussion of the mechanisms of excitation and contraction of skeletal muscle, including a new “big picture” overview in Figure 9.7.
• New introduction to ion channels with art helps students understand skeletal muscle excitation and contraction.
• Reorganized discussions of graded muscle contractions and of smooth muscle, including new Figure 9.24 showing calcium sources for smooth muscle contraction.
• Updated discussion of muscle fatigue.
• Updated Homeostatic Imbalance feature on Duchenne muscular dystrophy.

Chapter 10 The Muscular System
• Revised art about levers for clarity (Figures 10.2 and 10.3).
• New cadaver dissection photos show dissection of muscles of the anterior neck and throat, superficial muscles of the thorax and shoulder in posterior view, and posterior muscles of the thigh and hip (Figures 10.9, 10.14, and 10.21).
• New photo illustrates thumb movements.

Chapter 11 Fundamentals of the Nervous System and Nervous Tissue
• New Focus Figure 11.4 illustrates postsynaptic potentials and their summation.
• Improved teaching effectiveness of Figure 11.12 (coding of action potentials for stimulus intensity) and Figure 11.19 (illustrating a reflex).

Chapter 12 The Central Nervous System
• New Figure 12.26 and revised text teach more effectively about the blood brain barrier.
• New Figure 12.30 shows spinal cord segment location in relation to vertebral column.
• New Table 12.2 summarizes spinal cord cross-sectional anatomy.
• Updated Homeostatic Imbalance features about hypothalamic disorders and about narcolepsy and insomnia, including new use of orexin receptor antagonists to treat insomnia.
• New type of MRI photo shows fiber tracts in brain and spinal cord.

Chapter 13 The Peripheral Nervous System and Reflex Activity
• Revised Figure 13.4 (the lacrimal apparatus) for better teaching effectiveness.
• New photo of fundus of retina (Figure 13.9).
• New images illustrating the results of damage to the ulnar and radial nerves.
• New summary table of nerve plexuses (Table 13.9).
• New Homeostatic Imbalance feature about an abnormal plantar reflex (Babinski’s sign)
• Redrawn Figure 13.44 illustrating crossed-extensor reflex for improved student understanding.
• New drawings of nerves of cervical, brachial, lumbar, and sacral plexuses show their position in relationship to the vertebrae (and hip bone in some cases) (Figures 13.36–13.39).
Chapter 14 The Autonomic Nervous System
- New Figure 14.8 shows sympathetic innervation of the adrenal medulla.
- Clarified section about visceral sensory neurons.
- New photo illustrates Raynaud’s disease.
- Revised Figure 14.5 on the sympathetic trunk for better teaching effectiveness.

Chapter 15 The Endocrine System
- New Table 15.1 compares the endocrine and nervous systems.
- New Focus Figure 15.2 describes short- and long-term stress responses.
- Figures 15.5 (effects of growth hormone) and 15.9 (synthesis of thyroid hormone) revised for clarity.
- Updated information about diabetes mellitus, Addison’s disease, and thyroid deficiency in childhood.

Chapter 16 Blood
- Updated information about anticoagulant medications.
- New photo shows petechiae resulting from thrombocytopenia (Figure 16.16).

Chapter 17 The Cardiovascular System: The Heart
- New Focus Figure 17.2 teaches students how to understand the cardiac cycle, with accompanying text reorganized.
- New photo shows an individual having an ECG (Figure 17.16).

Chapter 18 The Cardiovascular System: Blood Vessels
- New “drinking straw” analogy and art to explain resistance.
- New Figure 18.4 shows the structure of most capillary beds according to current understanding, and new text describes those capillary beds.
- Revised Figure 18.6 on proportions of blood volume throughout the vascular tree for greater teaching effectiveness.
- New illustration of cerebral arterial circle (circle of Willis) (Figure 18.24).

Chapter 19 The Lymphatic System and Lymphoid Organs and Tissues
- New illustrated Table 19.1 summarizes key characteristics of the major lymphoid organs.
- Revised Figure 19.9 with orientation diagrams helps students locate Peyer’s patches (aggregated lymphoid nodules).
- Updated information about lymphatic drainage of the CNS.

Chapter 20 The Immune System: Innate and Adaptive Body Defenses
- New Focus Figure 20.1 gives an example of a primary immune response and summarizes innate and adaptive defenses.
- New illustrated Table 20.8 summarizes the components of adaptive immunity and complements the new Focus figure.
- New photo of a macrophage engulfing bacteria.
- Revised Figure 20.4 and text on inflammation, Figure 20.6 on complement activation, and Figure 20.11 on clonal selection of a B cell for greater teaching effectiveness.

Chapter 21 The Respiratory System
- New Figure 21.1 illustrates the four respiratory processes.
- Added section about sleep apnea.
- New scanning electron micrographs of emphysematous and normal lung tissue (Figure 21.22).
- Updated statistics about lung cancer and trends in asthma prevalence.

Chapter 22 The Digestive System
- New Figure 22.25 teaches the enterohepatic circulation of bile salts, and new Figure 22.30 shows the macroscopic anatomy of the small intestine.
- Improved teaching effectiveness of Figures 22.7 (neural reflex pathways in the gastrointestinal tract) and 22.16 (microscopic anatomy of the stomach).
- Added Homeostatic Imbalance features about dry mouth (xerostomia) and about tooth decay in primary teeth.
- Updated Homeostatic Imbalance feature about acute appendicitis to state that surgery is no longer always the first choice of treatment.

Chapter 23 Nutrition, Metabolism, and Energy Balance
- New Figure 23.24 shows the size and composition of various lipoproteins.
- Improved teaching effectiveness of Figures 23.21 (insulin effects during the postabsorptive stage).
- Updated Homeostatic Imbalance feature with mechanism of cell death in frostbite.
- Updated nutritional information about lipids, and updated statistics about the prevalence of obesity in adults and children and about the prevalence of diabetes mellitus.

Chapter 24 The Urinary System
- New Figure 24.18 shows the medullary osmotic gradient and interstitial fluid osmolalities in the renal cortex and medulla.
- New Table 24.1 summarizes the regulation of glomerular filtration rate.
- Improved teaching effectiveness of Figures 24.9 (blood vessels of the renal cortex), 24.12 (the filtration membrane), 24.15 (routes for tubular reabsorption), and 24.16 (tubular reabsorption of water and nutrients).
- New pyelogram shows anatomy of kidneys, ureters, and urinary bladder (Figure 24.23).
- Updated Homeostatic Imbalance features about kidney stones.
- Added Homeostatic Imbalance feature about renal trauma.
- Updated Homeostatic Imbalance feature about kidney stones.

Chapter 25 Fluid, Electrolyte, and Acid-Base Balance
- New Figure 25.12 summarizes the body’s chemical buffers.
- Improved teaching effectiveness of Figures 25.1 (major fluid compartments of the body), 25.2 (electrolyte composition of blood plasma, interstitial fluid, and intracellular fluid), and 25.7 (disturbances in water balance).
- Clarified definitions of sensible and insensible water loss.
Chapter 26 The Reproductive System

- This chapter has been extensively updated, revised, and reorganized. Almost every figure has been reconceptualized and several new figures have been added. These changes have been made for better teaching effectiveness.
- New opening module now compares male and female reproductive system anatomy and physiology and highlights common features, allowing students to make connections more easily. Homologous structures, patterns of hormone release, and meiosis are included in this section.
- New Figure 26.1 illustrates the basic pattern of interactions along the hypothalamic-pituitary-gonadal (HPG) axis in both males and females.
- The section about meiosis has been extensively rewritten to help increase student understanding. New in-line figures help introduce the basic terminology and some of the concepts before meiosis is discussed in detail.
- A new big-picture overview of meiosis introduces the major events before the details of each step are presented.
- Figures 26.22 (events of oogenesis) and 26.24 (regulation of the ovarian cycle) are extensively revised and updated for increased teaching effectiveness and accuracy.