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BRYAN DERRICKSON

PRINCIPLES OF  
**ANATOMY & PHYSIOLOGY**

Maintenance and Continuity of the Human Body

13TH EDITION



**2**  
VOLUME

INTERNATIONAL STUDENT VERSION

Principles of

# ANATOMY & PHYSIOLOGY

13th Edition

Volume 2—Maintenance and Continuity of the  
Human Body

International Student Version

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## HELPING TEACHERS AND STUDENTS SUCCEED TOGETHER

An anatomy and physiology course can be the gateway to a gratifying career in a whole host of health-related professions. It can also be an incredible challenge. Through years of collaboration with students and instructors alike, we have come to intimately

understand not only the material but also the evolving dynamics of teaching and learning A&P. So with every new edition, it's our goal to find new ways to help instructors teach more easily and effectively and students to learn in a way that sticks.

We believe we bring together experience and innovation like no one else, offering a unique solution for A&P designed to help instructors and students succeed together. From constantly evolving animations and visualizations to design based on optimal learning to lessons firmly grounded in learning outcomes, everything is designed with the goal of helping instructors like you teach in a way that inspires confidence and resilience in students and better learning outcomes.

The thirteenth edition of ***Principles of Anatomy and Physiology***, integrated with **WileyPLUS**, builds students' confidence; it takes the guesswork out of studying by providing students with a clear roadmap (one that tells them what to do, how to do it, and if they did it right). Students will take more initiative, so instructors can have greater impact.

***Principles of Anatomy and Physiology 13e*** continues to offer a balanced presentation of content under the umbrella of our primary and unifying theme of homeostasis, supported by relevant discussions of disruptions to homeostasis. In addition, years of student feedback have convinced us that readers learn anatomy and physiology more readily when they remain mindful of the relationship between structure and function. As a writing team—an anatomist and a physiologist—our very different specializations offer practical advantages in fine-tuning the balance between anatomy and physiology.

On the following pages students will discover the tips and tools needed to make the most of their study time using the integrated text and media. Instructors will gain an overview of the changes to this edition and of the resources available to create dynamic classroom experiences as well as build meaningful assessment opportunities. Both students and instructors will be interested in the outstanding resources available to seamlessly link laboratory activity with lecture presentation and study time.



The challenges of learning anatomy and physiology can be complex and time-consuming. This textbook and *WileyPLUS for Anatomy and Physiology* have been carefully designed to maximize your study time by simplifying the choices you make in deciding what to study and how to study it, and in assessing your understanding of the content.

## Anatomy and Physiology Is a Visual Science

Studying the figures in this book is as important as reading the narrative. The tools described here will help you understand the concepts being presented in any figure and ensure that you get the most out of the visuals.

**1 LEGEND.** Read this first. It explains what the figure is about.

**2 KEY CONCEPT STATEMENT.** Indicated by a "key" icon, this reveals a basic idea portrayed in the figure.

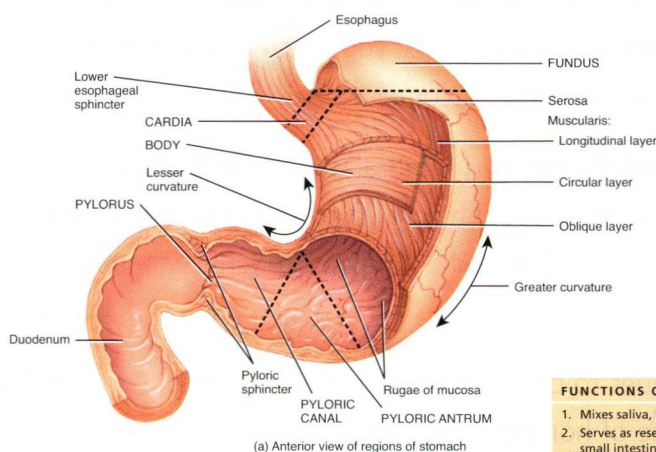
**3 ORIENTATION DIAGRAM.** Added to many figures, this small diagram helps you understand the perspective from which you are viewing a particular piece of anatomical art.

**4 FIGURE QUESTION.** Found at the bottom of each figure and accompanied by a "question mark" icon, this serves as a self-check to help you understand the material as you go along.

**5 FUNCTIONS BOX.** Included with selected figures, these provide a brief summary of the functions of the anatomical structure or system depicted.

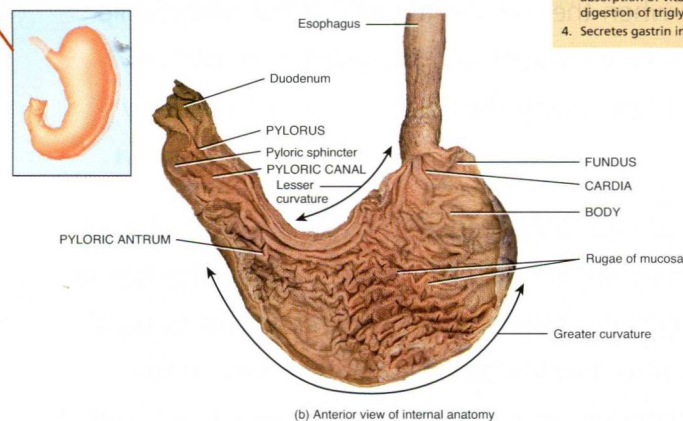
**Figure 24.11** External and internal anatomy of the stomach.

The four regions of the stomach are the cardia, fundus, body, and pyloric part.



### FUNCTIONS OF THE STOMACH

1. Mixes saliva, food, and gastric juice to form chyme.
2. Serves as reservoir for food before release into small intestine.
3. Secretes gastric juice, which contains HCl (kills bacteria and denatures protein), pepsin (begins the digestion of proteins), intrinsic factor (aids absorption of vitamin B<sub>12</sub>), and gastric lipase (aids digestion of triglycerides).
4. Secretes gastrin into blood.

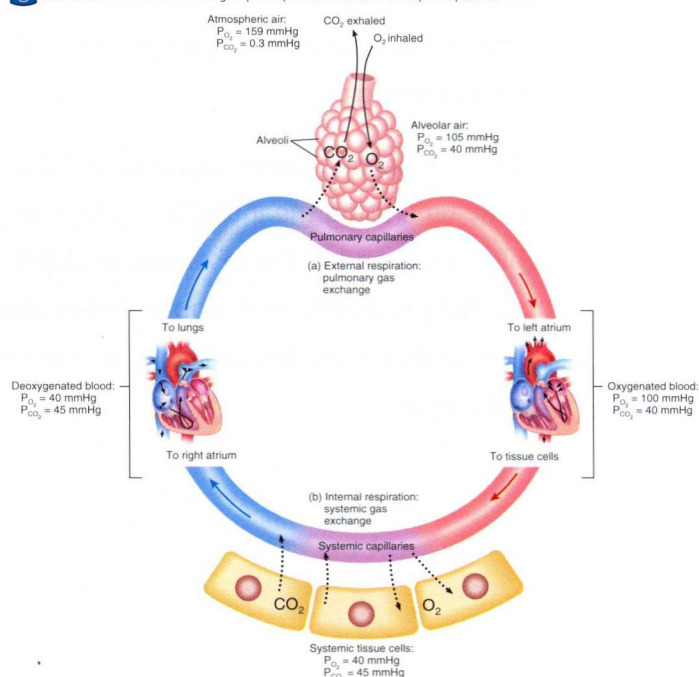


After a very large meal, does your stomach still have rugae?

**6 MP3 DOWNLOADS.** In each chapter you will find that several illustrations are marked with an icon that looks like an iPod. This indicates that an audio file that narrates and discusses the important elements of that particular illustration is available. You can access these downloads on the student companion website or within *WileyPLUS*.

**Figure 23.17** Changes in partial pressures of oxygen and carbon dioxide (in mmHg) during external and internal respiration.

Gases diffuse from areas of higher partial pressure to areas of lower partial pressure.



What causes oxygen to enter pulmonary capillaries from alveoli and to enter tissue cells from systemic capillaries?



Studying physiology requires an understanding of the sequence of processes. Correlation of sequential processes in text and art is achieved through the use of special numbered lists in the narrative that correspond to numbered segments in the accompanying figure. This approach is used extensively throughout the book to lend clarity to the flow of complex processes.

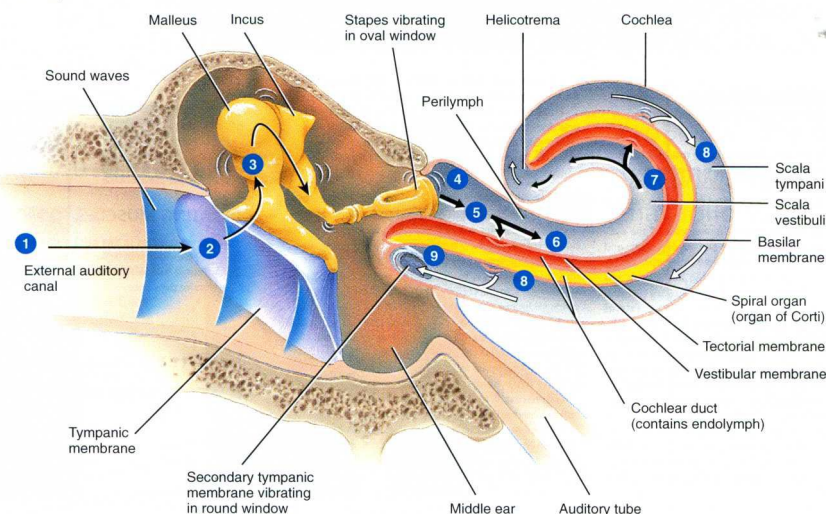
## Physiology of Hearing

The following events are involved in hearing (Figure 17.22):

- 1 The auricle directs sound waves into the external auditory canal.
- 2 When sound waves strike the tympanic membrane, the alternating waves of high and low pressure in the air cause the tympanic membrane to vibrate back and forth. The tympanic membrane vibrates slowly in response to low-frequency (low-pitched) sounds and rapidly in response to high-frequency (high-pitched) sounds.
- 3 The central area of the tympanic membrane connects to the malleus, which vibrates along with the tympanic membrane. This vibration is transmitted from the malleus to the incus and then to the stapes.
- 4 As the stapes moves back and forth, its oval-shaped footplate, which is attached via a ligament to the circumference of the oval window, vibrates in the oval window. The vibrations at the oval window are about 20 times more vigorous than the tympanic membrane because the auditory ossicles efficiently transmit small vibrations spread over a large surface area (the tympanic membrane) into larger vibrations at a smaller surface (the oval window).
- 5 The movement of the stapes at the oval window sets up fluid pressure waves in the perilymph of the cochlea. As the oval window bulges inward, it pushes on the perilymph of the scala vestibuli.
- 6 Pressure waves are transmitted from the scala vestibuli to the scala tympani and eventually to the round window, causing it to bulge outward into the middle ear. (See 9 in the figure.)
- 7 The pressure waves travel through the perilymph of the scala vestibuli, then the vestibular membrane, and then move into the endolymph inside the cochlear duct.
- 8 The pressure waves in the endolymph cause the basilar membrane to vibrate, which moves the hair cells of the spiral organ against the tectorial membrane. This leads to bending of the stereocilia and ultimately to the generation of nerve impulses in first-order neurons in cochlear nerve fibers.
- 9 Sound waves of various frequencies cause certain regions of the basilar membrane to vibrate more intensely than other regions. Each segment of the basilar membrane is "tuned" for

**Figure 17.22** Events in the stimulation of auditory receptors in the right ear. The numbers correspond to the events listed in the text. The cochlea has been uncoiled to more easily visualize the transmission of sound waves and their distortion of the vestibular and basilar membranes of the cochlear duct.

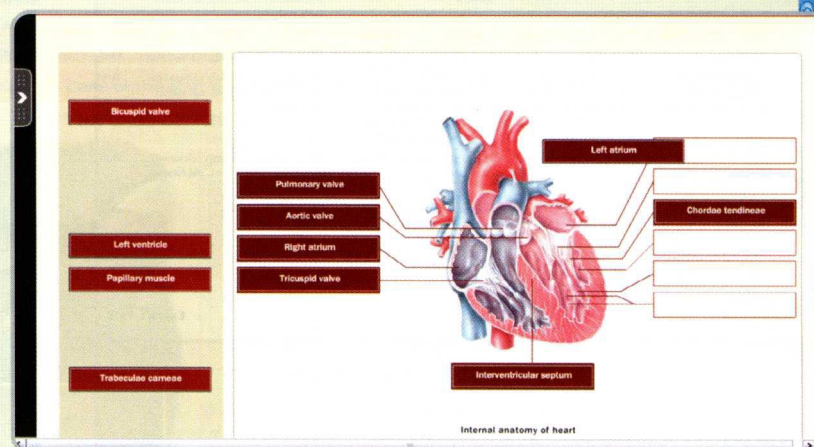
6 Hair cells of the spiral organ (organ of Corti) convert a mechanical vibration (stimulus) into an electrical signal (receptor potential).



? Which part of the basilar membrane vibrates most vigorously in response to high-frequency (high-pitched) sounds?



There are many visual resources within WileyPLUS, in addition to the art from your text. These visual aids can help you master the topic you are studying. Examples closely integrated with the reading material include *animations*, *cadaver video clips*, and *Real Anatomy Views*. *Anatomy Drill and Practice* lets you test your knowledge of structures with simple-to-use drag-and-drop labeling exercises or fill-in-the-blank labeling. You can drill and practice on these activities using illustrations from the text, cadaver photographs, histology micrographs, or lab models.





## Exhibits Organize Complex Anatomy into Manageable Modules

Many topics in this text have been organized into **Exhibits** that bring together all of the information and elements that you need to learn the complex terminology, anatomy, and the relevance of the anatomy into a simple-to-navigate content module. You will find Exhibits for tissues, bones, joints, skeletal muscles, nerves, and blood vessels. Most exhibits include the following:

- 1 Objective to focus your study.
- 2 Overview narrative of the structure(s).
- 3 Table summarizing key features of the structure(s).
- 4 Illustrations and photographs.
- 5 Checkpoint Question to assess your understanding.
- 6 Clinical Connection to provide relevance for learning the details.

### EXHIBIT 11.B Muscles of the Head That Move the Eyeballs (Extrinsic Eye Muscles) and Upper Eyelids (Figure 11.5)

#### OBJECTIVE

- Describe the origin, insertion, action, and innervation of the extrinsic eye muscles that move the eyeballs and upper eyelids.

Muscles that move the eyeballs are called **extrinsic eye muscles** because they originate outside the eyeballs (in the orbit) and insert on the outer surface of the sclera ("white of the eye") (Figure 11.5). The extrinsic eye muscles are some of the fastest contracting and most precisely controlled skeletal muscles in the body.

Three pairs of extrinsic eye muscles control movements of the eyeballs: (1) superior and inferior recti, (2) lateral and medial recti, and (3) superior and inferior obliques. The four recti muscles (superior, inferior, lateral, and medial) arise from a tendinous ring in the orbit and insert into the sclera of the eye. As their names imply, the **superior and inferior recti** move the eyeballs superiorly and inferiorly, respectively, and the **lateral and medial recti** move the eyeballs laterally and medially, respectively.

The actions of the oblique muscles cannot be deduced from their names. The **superior oblique** muscle originates posteriorly near the tendinous ring, then passes anteriorly superior to the medial rectus muscle, and ends in a round tendon. The tendon extends through a pulleylike loop of fibrocartilaginous tissue called the **trochlea** (= pulley) on the anterior and medial part of the roof of the orbit. Finally, the tendon turns and inserts on the posterolateral aspect of the eyeball. Accordingly, the superior oblique muscle moves the eyeballs inferiorly and laterally. The **inferior oblique** muscle originates on the maxilla at the anteromedial aspect of the floor of the orbit. It then passes posteriorly and laterally and inserts

on the posterolateral aspect of the eyeball. Because of this arrangement, the inferior oblique muscle moves the eyeballs superiorly and laterally.

Unlike the recti and oblique muscles, the **levator palpebrae superioris** does not move the eyeballs, since its tendon passes superiorly and inserts into the upper eyelid. Rather, it raises the upper eyelid, which opens the eyes. It is therefore an antagonist to the muscles which closes the eyes.

#### CLINICAL CONNECTION | Strabismus

**Strabismus** (stra-BIZ-mus; *strabismus* = squint) is a condition in which the two eyeballs are not properly aligned. It can be hereditary or it can be due to birth injuries, poor attachment of muscles, problems with the brain's control center, or a lesion of the oculomotor (III) nerve. Strabismus can be constant or intermittent. In strabismus, an image is sent to a different area of the brain and the brain usually ignores the messages sent by one of the eyes, becomes weaker; hence "lazy eye," or **amblyopia**, develops. Strabismus results when a lesion in the oculomotor (III) nerve results in **internal strabismus**, a condition in which the eyeball moves medially when at rest and cannot move laterally. Treatment options for strabismus depend on the problem and include surgery, visual therapy (retraining the brain), and orthoptics (eye muscle training to straighten the eyes).

Treatment options for strabismus depend on the problem and include surgery, visual therapy (retraining the brain), and orthoptics (eye muscle training to straighten the eyes).

| MUSCLE  | ORIGIN  | INSERTION   | ACTION   | INNervation      |
|---|---|---|--|------------------|
| <b>Superior rectus</b> (rectus = fascicles parallel to midline)                                 | Common tendinous ring (attached to orbit around optic foramen).       | Superior and central part of eyeballs.  | Moves eyeballs superiorly (elevation) and medially (adduction), and rotates them medially.   | Oculomotor (III) |
| <b>Inferior rectus</b>  | Same as above.  | Inferior and central part of eyeballs.  | Moves eyeballs inferiorly (depression) and medially (adduction), and rotates them medially.  | Oculomotor (III) |
| <b>Lateral rectus</b>   | Same as above.  | Lateral side of eyeballs.   | Moves eyeballs laterally (abduction).  | Abducens (VI)    |
| <b>Medial rectus</b>  | Same as above.  | Medial side of eyeballs.  | Moves eyeballs medially (adduction).   | Oculomotor (III) |
| <b>Superior oblique</b> (oblique = fascicles diagonal to midline)                               | Sphenoid bone, superior and medial to common tendinous ring in orbit. | eyeball between superior and lateral recti. Muscle inserts into superior and lateral surfaces of eyeball via tendon that passes through trochlea. | Moves eyeballs inferiorly (depression) and laterally (abduction), and rotates them medially. | Trochlear (IV)   |
| <b>Inferior oblique</b>   | Maxilla in floor of orbit.  | Eyeballs between inferior and lateral recti.  | Moves eyeballs superiorly (elevation) and laterally (abduction), and rotates them laterally. | Oculomotor (III) |
| <b>Levator palpebrae superioris</b> (le-VA-tor PAL-pe-brē soo-per-ē-OR-is; palpebrae = eyelids) | Roof of orbit (lesser wing of sphenoid bone).                         | Skin and tarsal plate of upper eyelids. (opens eyes).   | Elevates upper eyelids   | Oculomotor (III) |

EXHIBIT 11.B

### EXHIBIT 11.B Muscles of the Head That Move the Eyeballs (Extrinsic Eye Muscles) and Upper Eyelids (Figure 11.5) CONTINUED

#### RELATING MUSCLES TO MOVEMENTS

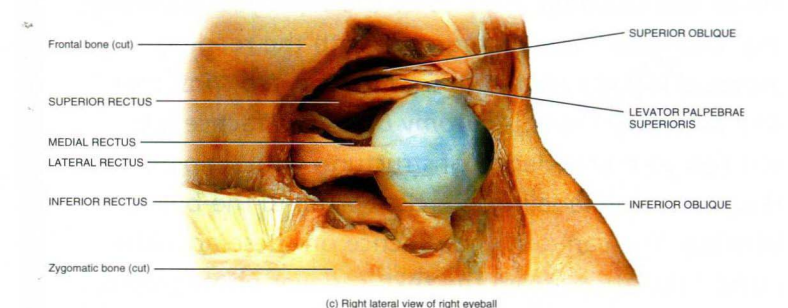
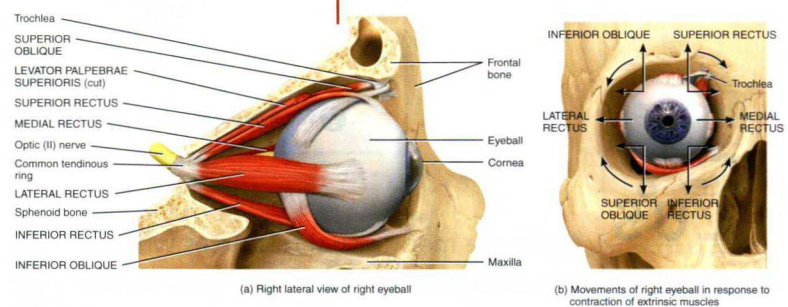
Arrange the muscles in this exhibit according to their actions on the eyeballs: (1) elevation, (2) depression, (3) abduction, (4) adduction, (5) medial rotation, and (6) lateral rotation. The same muscle may be mentioned more than once.

#### CHECKPOINT

Which muscles that move the eyeballs contract and relax as you look to your left without moving your head?

Figure 11.5 Muscles of the head that move the eyeballs (extrinsic eye muscles) and upper eyelid.

The extrinsic muscles of the eyeball are among the fastest contracting and most precisely controlled skeletal muscles in the body.



How does the inferior oblique muscle move the eyeball superiorly and laterally?



## Clinical Discussions Make Your Study Relevant

The relevance of the anatomy and physiology that you are studying is best understood when you make the connection between normal structure and function and what happens when the body doesn't work the way it should. Throughout the chapters of the text you will find **Clinical Connections** that introduce you to interesting clinical



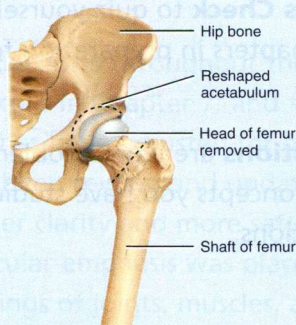
### CLINICAL CONNECTION | Arthroplasty

Joints that have been severely damaged by diseases such as arthritis, or by injury, may be replaced surgically with artificial joints in a procedure referred to as **arthroplasty** (AR-thrō-plas'tē; *arthr*=joint; *plasty*=plastic repair of). Although most joints in the body can be repaired by arthroplasty, the ones most commonly replaced are the hips, knees, and shoulders. About 400,000 hip replacements and 300,000 knee replacements are performed annually in the United States. During the procedure, the ends of the damaged bones are removed and metal, ceramic, or plastic components are fixed in place. The goals of arthroplasty are to relieve pain and increase range of motion.

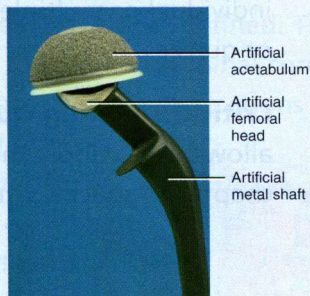
**Partial hip replacements** involve only the femur. **Total hip replacements** involve both the acetabulum and head of the femur (Figures A–C). The damaged portions of the acetabulum and the head of the femur are replaced by prefabricated prostheses (artificial devices). The acetabulum is shaped to accept the new socket, the head of the femur is removed, and the center of the femur is shaped to fit the femoral component. The acetabular component consists of a plas-

tic such as polyethylene, and the femoral component is composed of a metal such as cobalt-chrome, titanium alloys, or stainless steel. These materials are designed to withstand a high degree of stress and to prevent a response by the immune system. Once the appropriate acetabular and femoral components are selected, they are attached to the healthy portion of bone with acrylic cement, which forms an interlocking mechanical bond.

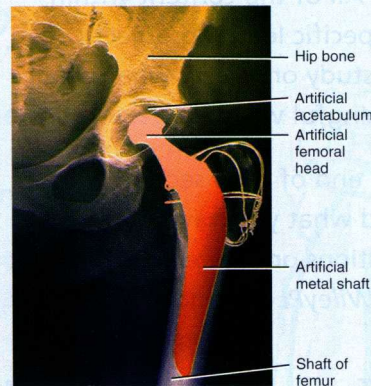
**Knee replacements** are actually a resurfacing of cartilage and, like hip replacements, may be partial or total. In a **partial knee replacement (PKR)**, also called a **unicompartmental knee replacement**, only one side of the knee joint is replaced. Once the damaged cartilage is removed from the distal end of the femur, the femur is reshaped and a metal femoral component is cemented in place. Then the damaged cartilage from the proximal end of the tibia is removed, along with the meniscus. The tibia is reshaped and fitted with a plastic tibial component that is cemented into place. If the posterior surface of the patella is badly damaged, the patella is replaced with a plastic patellar component.



(A) Preparation for total hip replacement



(B) Components of an artificial hip joint prior to implantation



(C) Radiograph of an artificial hip joint

perspectives related to the text discussion. In addition, at the end of each body system chapter you will find the **Disorders: Homeostatic Imbalances** section, which includes concise discussions of major diseases and disorders. These provide answers to many of your questions about medical problems. The **Medical Terminology** section that follows includes selected terms dealing with both normal and pathological conditions.



WileyPLUS offers you opportunities for even further Clinical Connections with animated and interactive case studies that relate specifically to one body system. Look for these under additional chapter resources as an interesting and engaging break from traditional study routines.

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Disruptions to Homeostasis. The Case of the Man with Opportunistic Infections.

**THE CASE OF THE MAN WITH OPPORTUNISTIC INFECTIONS**

**Stan, 32**

**Presenting symptoms:**

- Fever
- Shortness of breath
- Persistent cough
- Chronic headaches
- Abdominal pain
- Diarrhea
- Weight loss
- Skin lesions on forehead and left arm

He admits to unprotected sex.



## Chapter Resources Help You Focus and Review



Your book has a variety of special features that will make your time studying anatomy and physiology a more rewarding experience. These have been developed based on feedback from students—like you—who have used previous editions of the text. Their effectiveness is even further enhanced within *WileyPLUS for Anatomy and Physiology*.

**Chapter Introductions** set the stage for the content to come. Each chapter starts with a succinct overview of the particular system's role in maintaining homeostasis in your body, followed by an introduction to the chapter content. This opening page concludes with a question that always begins with "Did you ever wonder...?" These questions will capture your interest and encourage you to find the answer in the chapter material to come.

**Objectives** at the start of each section help you focus on what is important as you read. All of the content within *WileyPLUS* is tagged to these specific learning objectives so that you can organize your study or review what is still not clear in simple, more meaningful ways.

**Checkpoint Questions** at the end of each section help you assess if you have absorbed what you have read. Take time to review these questions or answer them within the Practice section of each *WileyPLUS* concept module,

where your answers will automatically be graded to let you know where you stand.

**Mnemonics** are a memory aid that can be particularly helpful when learning specific anatomical features. Mnemonics are included throughout the text—some displayed in figures, tables, or Exhibits, and some included within the text discussion. We encourage you not only to use the mnemonics provided, but also to create your own to help you learn the multitude of terms involved in your study of human anatomy.

**Chapter Review and Resource Summary** is a helpful table at the end of chapters that offers you a concise summary of the important concepts from the chapter and links each section to the media resources available in *WileyPLUS for Anatomy and Physiology*.

**Self-Quiz Questions** give you an opportunity to evaluate your understanding of the chapter as a whole. Within *WileyPLUS*, use **Progress Check** to quiz yourself on individual or multiple chapters in preparation for exams or quizzes.

**Critical Thinking Questions** are word problems that allow you to apply the concepts you have studied in the chapter to specific situations.

## Mastering the Language of Anatomy and Physiology

Throughout the text we have included **Pronunciations** and, sometimes, **Word Roots** for many terms that may be new to you. These appear in parentheses immediately following the new words. The pronunciations are repeated in the Glossary at the back of the book. Look at the words carefully and say them out loud several times. Learning to pronounce a new word will help you remember it and make it a useful part of your medical vocabulary. Take a few minutes to read the Pronunciation Key, found at the beginning of the Glossary at the end of this text, so it will be familiar as you encounter new words.

To provide more assistance in learning the language of anatomy, a full **Glossary** of terms with phonetic pronunciations appears at the end of the book. The basic building blocks of medical terminology—**Combining Forms, Word**

**Roots, Prefixes, and Suffixes**—are listed inside the back cover, accompanied by **Eponyms**, traditional terms that include reference to a person's name, along with the current terminology.

*WileyPLUS* houses help for you in building your new language skills as well. The **Audio Glossary**, which is always available to you, lets you hear all these new, unfamiliar terms pronounced. Throughout the e-text, these terms can be clicked on and heard pronounced as you read. In addition, you can use the helpful

**Mastering Vocabulary** program, which creates electronic flashcards for you of the key terms within each chapter for practice, as well as take a self-quiz specifically on the terms introduced in each chapter.



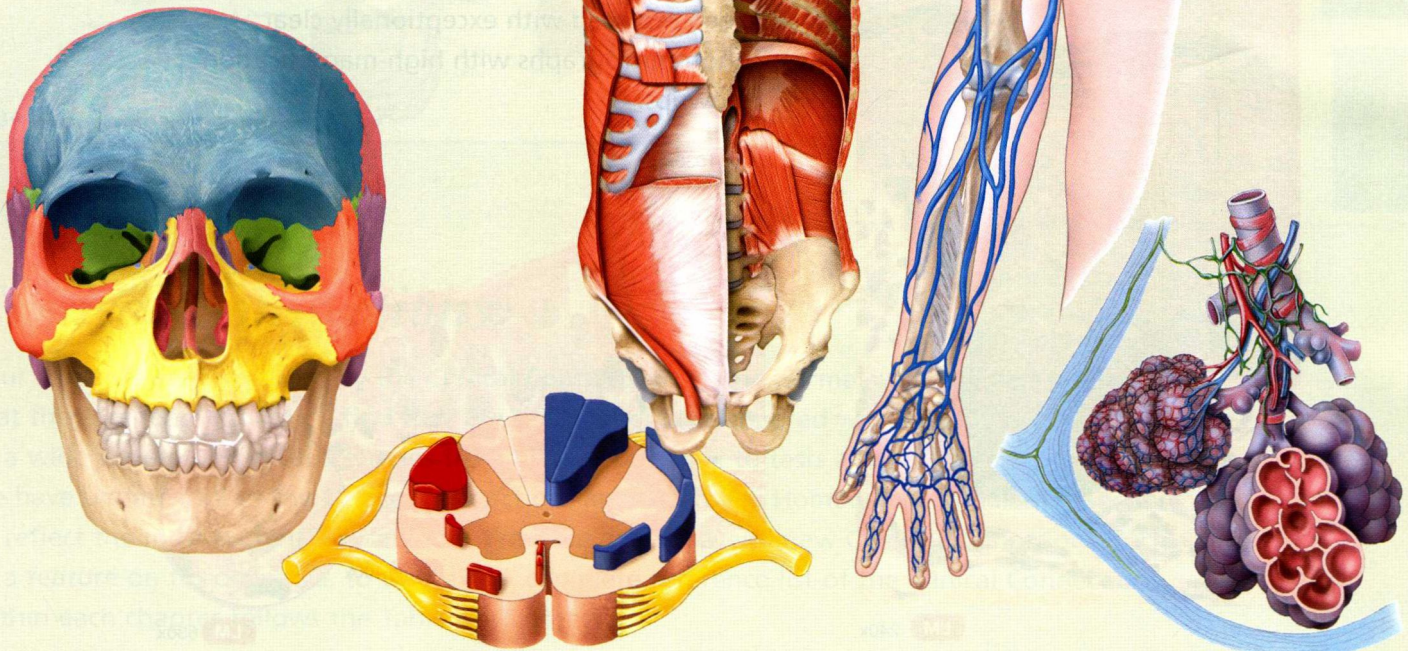


As active teachers of the course, we recognize both the rewards and challenges in providing a strong foundation for understanding the complexities of the human body. We believe that teaching goes beyond just sharing information. *How* we share information makes all the difference—especially, if as we do, you have an increasingly diverse population of students with varying learning abilities. As we revised this text we focused on those areas that we knew we could enhance to provide greater impact in terms of better learning outcomes. Feedback from many of you, as well as from the students we interact with in our own classrooms, guided us in ensuring that the revisions to the text, along with the powerful new *WileyPLUS for Anatomy and Physiology*, support the needs and challenges you face day to day in your own classrooms.

We focused on several key areas for revision: enhancing the all-important visuals, both drawings and photographs; increasing the use of Exhibits that provide a focused and functional organization of detailed content; adding some new and revising many of the tables to increase their effectiveness; updating and adding clinical material that helps students relate what they are learning to their desired career goals and the world around them; and making narrative changes aimed at increasing student engagement with—and comprehension of—the material.

## *The Art of Anatomy and Physiology*

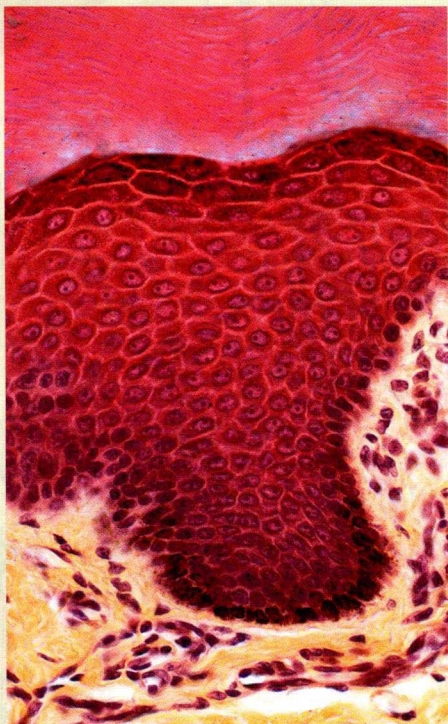
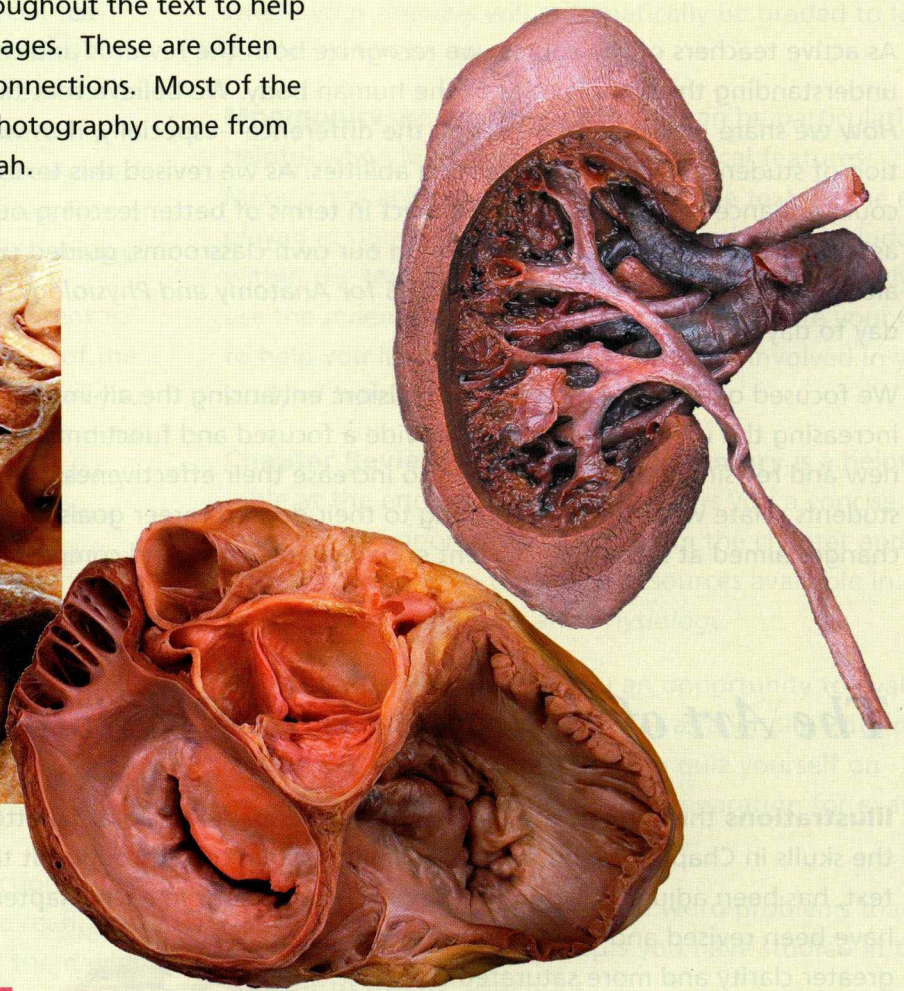
**Illustrations** throughout the text have been refined. The color palette for the skulls in Chapter 7, and for the brain and spinal cord throughout the text, has been adjusted for greater impact. Illustrations in each chapter have been revised and updated to provide greater clarity and more saturated colors. Particular emphasis was placed on revised drawings of joints, muscles, and blood vessels.





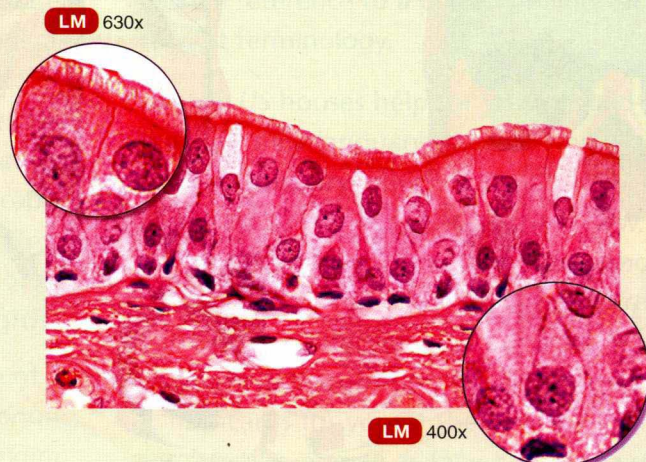
# NOTES TO INSTRUCTORS

**Cadaver photographs** are included throughout the text to help students relate the content to real-life images. These are often paired with diagrams to help make the connections. Most of the meticulous dissections and outstanding photography come from Mark Nielsen's lab at the University of Utah.



LM 240x

Most tissue **Photomicrographs** have been replaced with exceptionally clear photomicrographs with high-magnification blowups.



LM 630x

LM 400x

LM 630x



## Exhibits and Tables

The use of the pedagogically designed **Exhibits** has been expanded to include the axial and appendicular skeletons, as well as cranial nerves, providing students with simplified presentations of complex content.

New **Tables**, including Skin Glands, Common Bone Fractures, Summary of the Levels of Organization within a Skeletal Muscle, and Summary of the Respiratory System, have been added, in addition to refinement of many of the existing tables with either new illustrations or rewritten text.

EXHIBIT 14.H

Vagus (X) Nerve (Figure 14.24)

OBJECTIVE

- Identify the origin of the vagus nerve in the brain, the foramen through which it exits the skull, and its function.

The **vagus (X) nerve** (VĀ-gus = vagrant or wandering) is a mixed cranial nerve that is distributed from the head and neck into the thorax and abdomen (Figure 14.24). The nerve derives its name from its wide distribution. In the neck, it lies medial and posterior to the internal jugular vein and common carotid artery.

Sensory axons in the vagus nerve arise from the skin of the external ear for touch, pain, and thermal sensations; a few taste buds in the epiglottis and pharynx; and proprioceptors in muscles of the neck and throat. Also, sensory axons come from baroreceptors in the carotid sinus and chemoreceptors in the aortic and aortic bodies. The majority of sensory neurons come from visceral sensory receptors in most organs of the thoracic and abdominal cavities that convey sensations (such as hunger, fullness, and discomfort) from these organs. The sensory neu-

rons have cell bodies in the **superior** and **inferior ganglia** and then pass through the jugular foramen to end in the medulla and pons.

The branchial motor neurons, which run briefly with the accessory nerve, arise from nuclei in the medulla oblongata and supply muscles of the pharynx, larynx, and soft palate that are used in swallowing, vocalization, and coughing. Historically these motor neurons have been called the cranial accessory nerve, but these fibers actually belong to the vagus (X) nerve.

Axons of autonomic motor neurons in the vagus nerve originate in nuclei of the medulla and supply the lungs, heart, glands of the gastrointestinal (GI) tract, and smooth muscle of the respiratory passage, esophagus, stomach, gallbladder, small intestine, and most of the large intestine (see Figure 15.3). Autonomic motor axons initiate smooth muscle contractions in the gastrointestinal tract to aid motility and secretion by digestive glands; activate smooth muscle to constrict respiratory passageways; and decrease heart rate.

CHECKPOINT

On what basis is the vagus nerve named?

Figure 14.24 Vagus (X) nerve.

The vagus nerve is widely distributed in the head, neck, thorax, and abdomen.

CLINICAL CONNECTION

Vagal Paralysis, Dysphagia, and Tachycardia

Injury to the vagus (X) nerve or conditions such as trauma or infection can cause **vagal paralysis**, or interruptions of sensations from many organs in the thoracic and abdominal cavities; **dysphagia** (dis-FĀ-jē-ah), or difficulty in swallowing; and **tachycardia** (tak'-i-KAR-dē-ah), or increased heart rate.

Vagus (X) nerve

Where is the vagus nerve located in the neck region?

| FRACTURE   | DESCRIPTION   | ILLUSTRATION | RADIOGRAPH |
|--|---|--------------|------------|
| Open (Compound)  | The broken ends of the bone protrude through the skin. Conversely, a <b>closed (simple) fracture</b> does not break the skin.   |              |            |
| Comminuted (KOM-i-noo-ted; com- = together; -minuted = crumbled) | The bone is splintered, crushed, or broken into pieces at the site of impact, and smaller bone fragments lie between the two main fragments.  |              |            |
| Greenstick   | A partial fracture in which one side of the bone is broken and the other side bends; similar to the way a green twig breaks on one side while the other side stays whole, but bends; occurs only in children, whose bones are not fully ossified and contain more organic material than inorganic material. |              |            |
| Impacted   | One end of the fractured bone is forcefully driven into the interior of the other.  |              |            |

## Clinical Connections

Your students are fascinated by the **Clinical Connections** to the normal anatomy and physiology that they are learning. You'll find that the text is liberally peppered with engaging discussions of a wide variety of clinical scenarios from disease coverage to tests and procedures. As always, we have updated all of the Clinical Connections and Disorders: Homeostatic Imbalances sections to reflect the most current information. We have added several new Clinical Connections, such as a feature on fibromyalgia, to the text. A complete reference list of the Clinical Connections within each chapter follows the Table of Contents.

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# NOTES TO INSTRUCTORS

## WileyPLUS *and You*

*WileyPLUS for Anatomy and Physiology* is an innovative, research-based online environment designed for both effective teaching and learning. Utilizing *WileyPLUS* in your course provides your students with an accessible, affordable, and active learning platform and gives you tools and resources to efficiently build presentations for a dynamic classroom experience and to create and manage effective assessment strategies. The underlying principles of **design, engagement, and measurable outcomes** provide the foundation for this powerful, new release of *WileyPLUS*.



### DESIGN

- New research-based design helps students manage their time better and develop better study skills.
- Course Calendars help track assignments for both students and teachers.
- New Course Plan makes it easier to assign reading, activities, and assessment. Simple drag-and-drop tools make it easy to assign the course plan as-is or in any way that best reflects your course syllabus.

The new design makes it easy for students to know *what* it is they need to do, boosting their confidence and preparing them for greater engagement in class and lab.

### ENGAGEMENT

- Complete online version of the textbook allows for seamless integration of all content.
- Relevant student study tools and learning resources ensure positive learning outcomes.
- Immediate feedback boosts confidence and helps students see a return on investment for each study session.
- Precreated activities encourage learning outside of the classroom.
- Course materials, including PowerPoint stacks with animations and Wiley's Visual Library for Anatomy and Physiology, help you personalize lessons and optimize your time.

Concept mastery in this discipline is directly related to students keeping up with the work and not falling behind. The new Concept Modules, Animations and Activities, Self Study, and Progress Checks in *WileyPLUS* will ensure that students know how to study effectively so they will remain engaged and stay on task.

### MEASURABLE OUTCOMES

- Progress Check enables students to hone in on areas of weakness for increased success.
- Self-assessment and remediation for all Learning Objectives let students know exactly how their efforts have paid off.
- Instant reports monitor trends in class performance, use of course materials, and student progress toward learning objectives.

With new detailed reporting capabilities, students will know that they are doing it right. With increased confidence, motivation is sustained so students stay on task—success will follow.

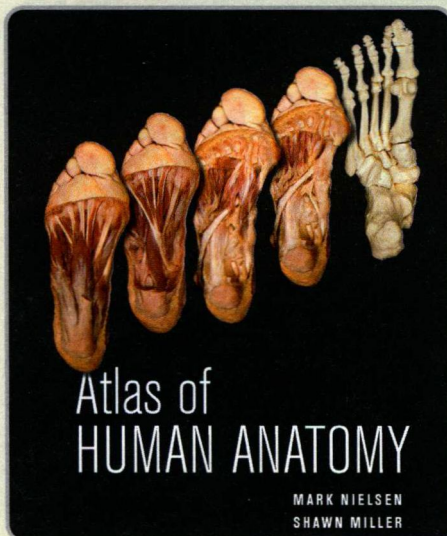
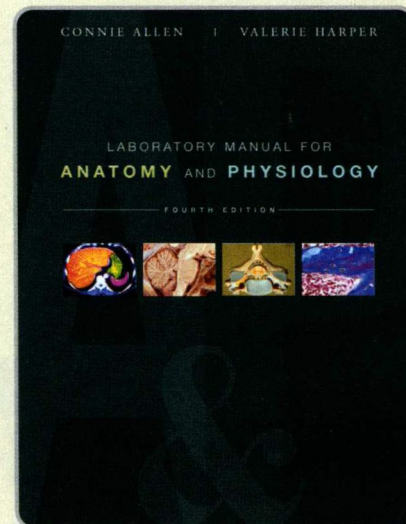


# RESOURCES FOR INTEGRATING LABORATORY EXPERIENCES

## *Laboratory Manual for Anatomy and Physiology, 4e*

Connie Allen and Valerie Harper

Newly revised, **Laboratory Manual for Anatomy and Physiology** with **WileyPLUS 5.0** engages your students in active learning and focuses on the most important concepts in A&P. Exercises reflect the multiple ways in which students learn and provide guidance for anatomical exploration and application of critical thinking to analyzing physiological processes. A concise narrative, self-contained exercises that include a wide variety of activities and question types, and two types of lab reports for each exercise keep students focused on the task at hand. Depending on your needs, a *Cat Dissection Manual* or *Fetal Pig Dissection Manual* accompanies the main text. Rich media within WileyPLUS further enhance the student experience and include dissection videos, animations, and illustrated drill and practice exercises with illustrations, micrographs, cadaver photos, and popular lab models. Each lab text comes with access to *PowerPhys 2.0*.



## *Atlas of Human Anatomy, 1e*

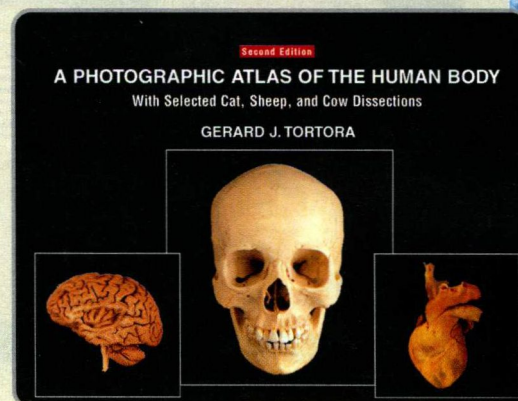
Mark Nielsen and Shawn Miller

This new atlas filled with outstanding photographs of meticulously executed dissections of the human body has been developed to be a strong teaching and learning solution, not just a catalog of photographs. Organized around body systems, each chapter includes a narrative overview of the body system and is then followed with detailed photographs that accurately and realistically represent the anatomical structures. Histology is included. *Atlas of Human Anatomy* will work well in your laboratories, as a study companion to your textbook, and as a print companion to the *Real Anatomy* DVD.

## *Photographic Atlas of the Human Body, 2e*

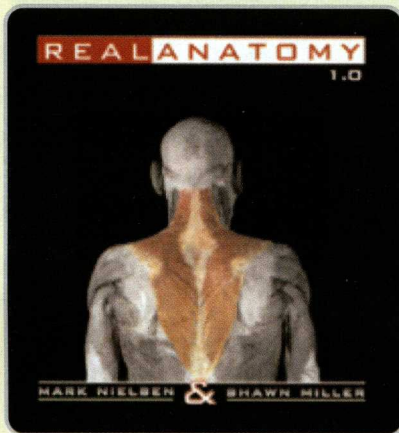
Gerard J. Tortora

Like the new atlas from Nielsen and Miller, this popular atlas is also systemic in its approach to the photographic review of the human body. In addition to the excellent cadaver photographs and micrographs, this atlas also contains selected cat and sheep heart dissections. The high-quality imagery can be used in the classroom, in the laboratory, or for study and review.





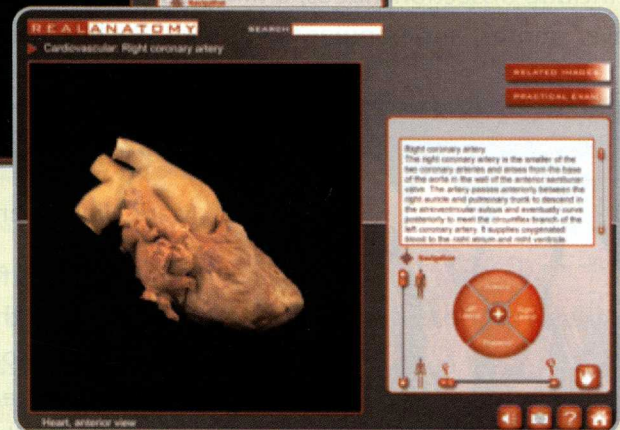
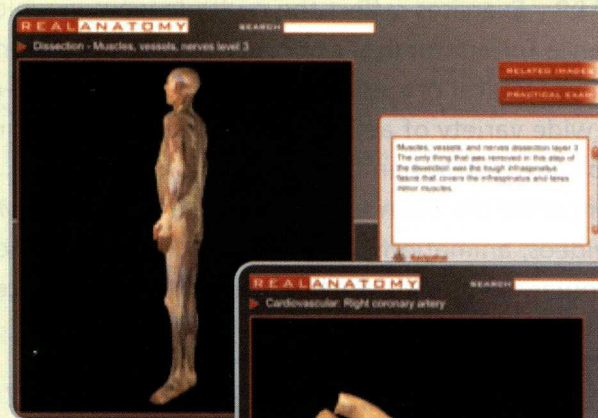
# RESOURCES FOR INTEGRATING LABORATORY EXPERIENCES



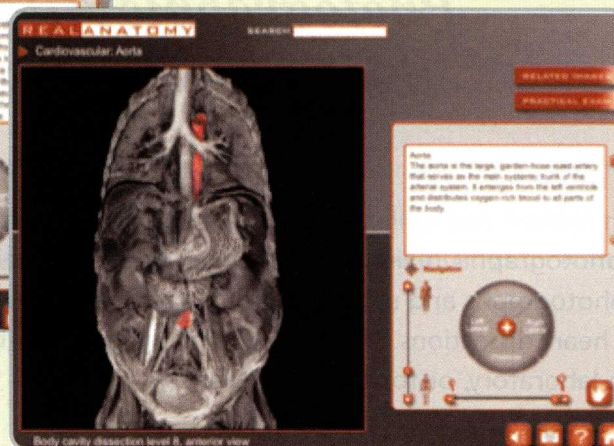
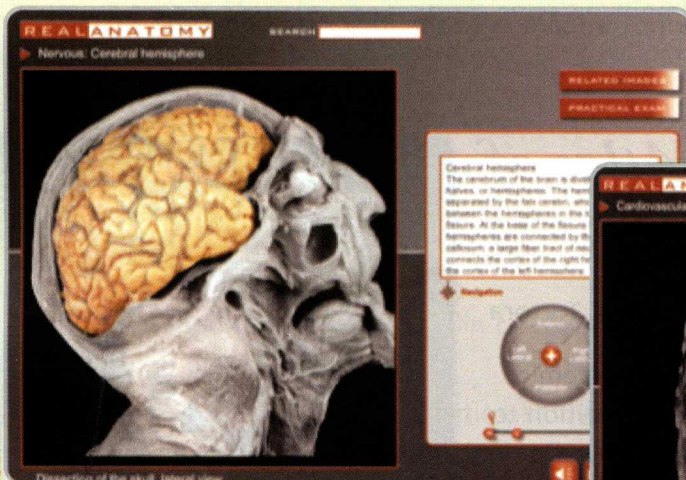
## *Real Anatomy*

Mark Nielsen and Shawn Miller

*Real Anatomy* is 3-D imaging software that allows you to dissect through multiple layers of a three-dimensional real human body to study and learn the anatomical structures of all body systems.



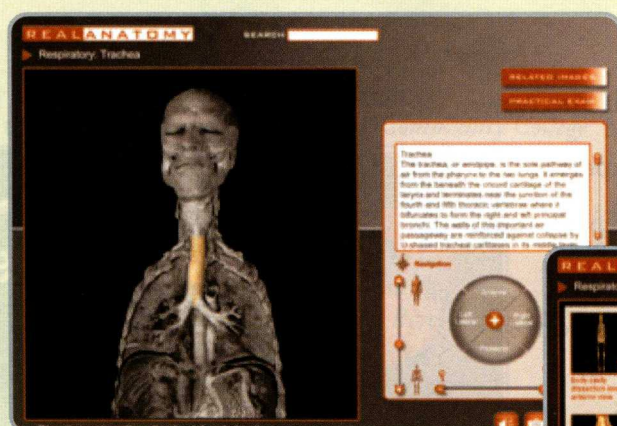
- Dissect through up to 40 layers of the body and discover the relationships of the structures to the whole.
- Rotate the body, as well as major organs, to view the image from multiple perspectives.



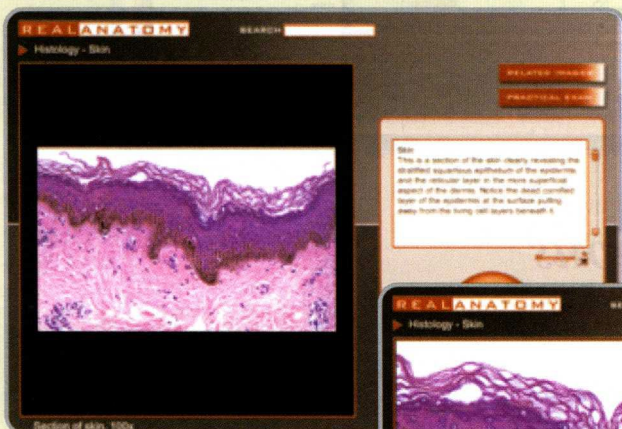
- Use a built-in zoom feature to get a closer look at detail.
- A unique approach to highlighting and labeling structures does not obscure the real anatomy in view.



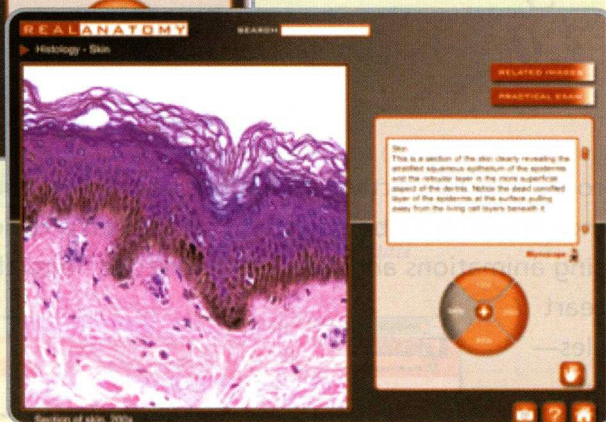
# RESOURCES FOR INTEGRATING LABORATORY EXPERIENCES



- Related images provide multiple views of structures being studied.



- View histology micrographs at varied levels of magnification with the virtual microscope.



- Snapshots of any image can be saved for use in PowerPoints, quizzes, or handouts.



- Audio pronunciation of all labeled structures is readily available.

**Virtual Dissection—100% Real**

**REALANATOMY**

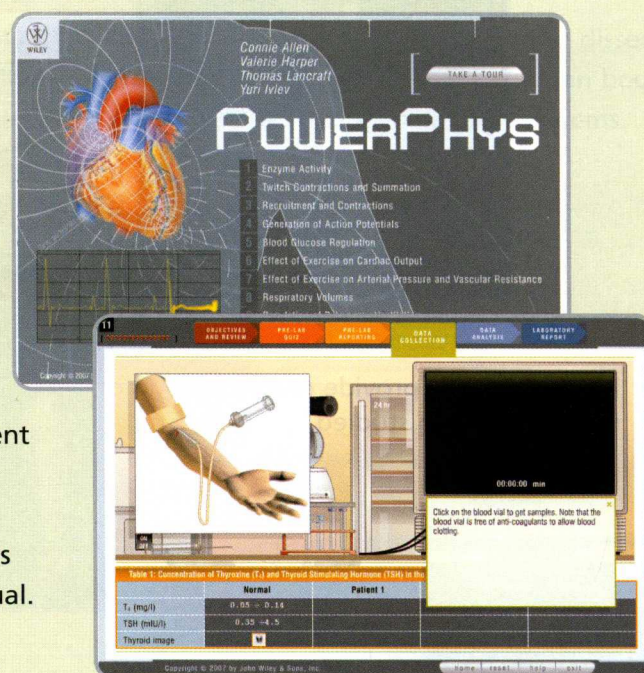


# RESOURCES FOR INTEGRATING LABORATORY EXPERIENCES

## PowerPhys 2.0

Connie Allen, Valerie Harper, Thomas Lancraft, and Yuri Ivlev

**PowerPhys 2.0** provides a simulated laboratory experience for students, giving them the opportunity to review their knowledge of core physiological concepts, predict outcomes of an experiment, collect data, analyze it, and report on their findings. This revised edition features a new activity on Homeostatic Imbalance of Thyroid Function and revised lab report questions throughout. An easy-to-use and intuitive interface guides students through the experiments from basic review to laboratory reports. All experiments contain randomly generated data, allowing students to experiment multiple times but still arrive at the same conclusions. A perfect addition to distant learning or hybrid courses, **PowerPhys 2.0** is a stand-alone web-based program and is fully integrated with Allen and Harper's laboratory manual.



## Interactions: Exploring the Functions of the Human Body 3.0

Thomas Lancraft and Frances Frierson

**Interactions 3.0** is the most complete program of interactive animations and activities available for anatomy and physiology. A series of modules encompassing all body systems focuses on a review of anatomy, the examination of physiological processes using animations and interactive exercises, and clinical correlations to enhance student understanding. At the heart of **Interactions** is a focus on core principles—*homeostasis, communication, energy flow, fluid flow, and boundaries*—that underscore the key relationships between structure and function as well as interrelationships between systems. It is the reinforcement of these fundamental organizing principles that sets this series apart from others. **Interactions** is available on DVD, web-based, or fully integrated within WileyPLUS.

