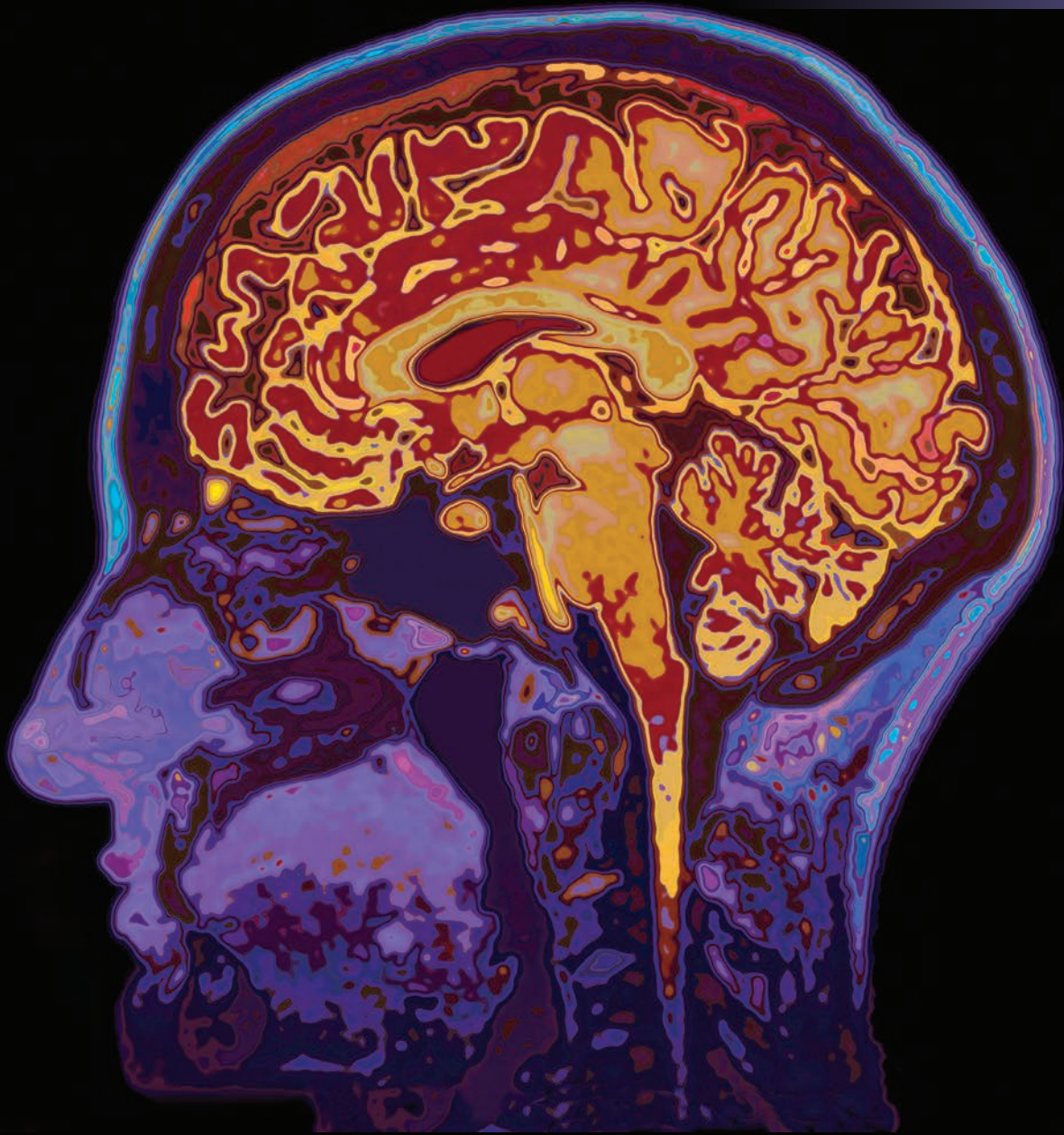


GLOBAL  
EDITION



# Human Anatomy

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Brady

Mallatt

NINTH EDITION

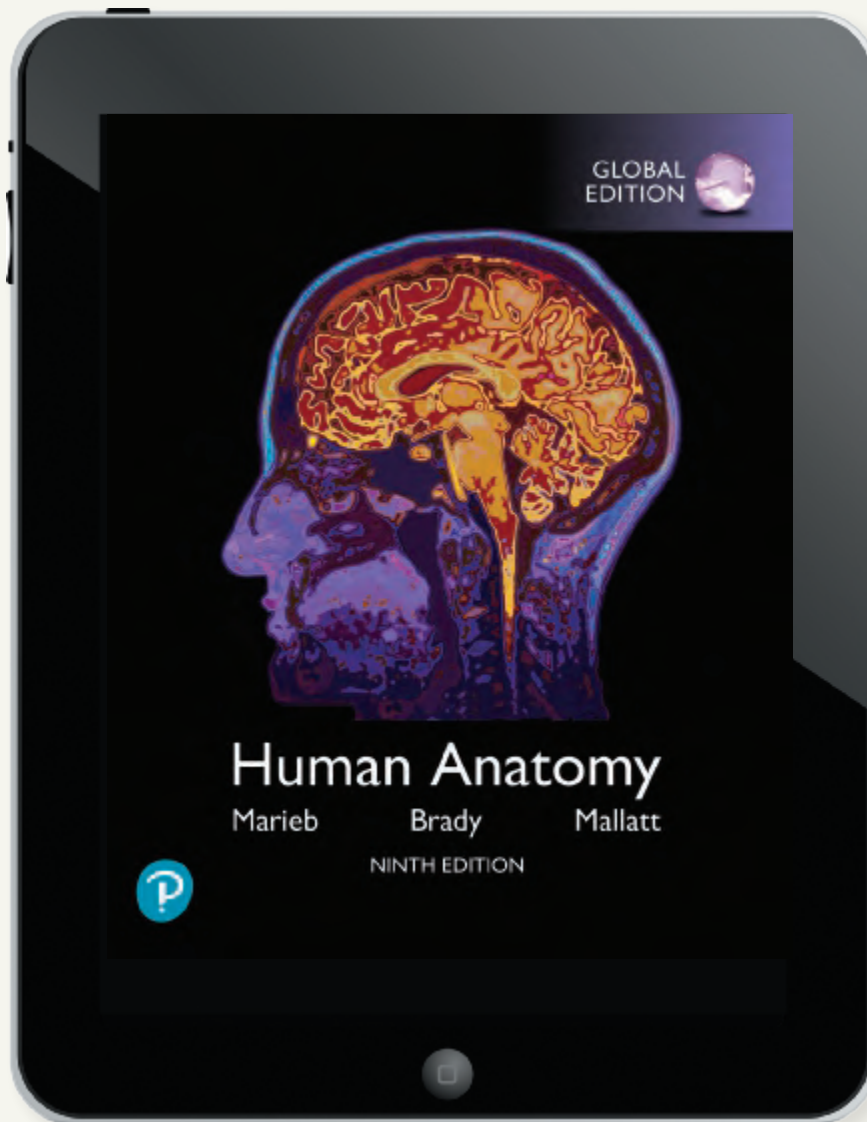


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# A Functional Approach to Human Anatomy Available in a Multifunctional eText

Using a functional anatomy theme, the Ninth Edition presents human anatomy as a well-illustrated “story” with the right amount of detail for an introductory course. New exercises and questions help students learn and practice using anatomical language and interpreting real-world medical images. *Human Anatomy*, Ninth Edition, is also available as a Pearson eText, an easy-to-use, mobile-friendly, and personalized reading experience.



# Master the Anatomical Language and Visual Skills Used in Health Care Settings

## Roots to Remember



Instructors may assign a related "Roots to Remember" activity using Mastering A&P.

<b>ana</b> = apart	<b>meta</b> = after
<b>bi</b> = two	<b>mito</b> = thread
<b>chrom</b> = color	<b>multi</b> = many
<b>cis</b> = on this side	<b>necro</b> = death
<b>cyt</b> = cell	<b>nucle</b> = little nut
<b>dys</b> = bad, malicious	<b>-osis</b> = process
<b>ell</b> = small	<b>phago</b> = eat
<b>endo</b> = within, inner	<b>pino</b> = drink
<b>exo</b> = outside	<b>plasi</b> = shape
<b>hyper</b> = excessive	<b>plasma</b> = forming or molded material
<b>inter</b> = between	<b>pre, pro</b> = before
<b>kinesis</b> = movement	<b>reticul</b> = network
<b>lamina</b> = layer	<b>som-, soma</b> = body
<b>lysis</b> = loosening, breaking down	<b>telo</b> = end
<b>mere</b> = part, portion	

Based on the word roots listed above and from those in Chapter 1, what do the following terms mean?

- |                          |               |                |
|--------------------------|---------------|----------------|
| 1. endoplasmic reticulum | 3. chromosome | 5. cytokinesis |
| 2. phagocytosis          | 4. lysosome   | 6. telomere    |

For answers, see Answers Appendix.

**NEW! Roots to Remember vocabulary exercises** open each chapter and help students learn the language of human anatomy using word roots and terms in context. Related coaching activities can be assigned in Mastering A&P.

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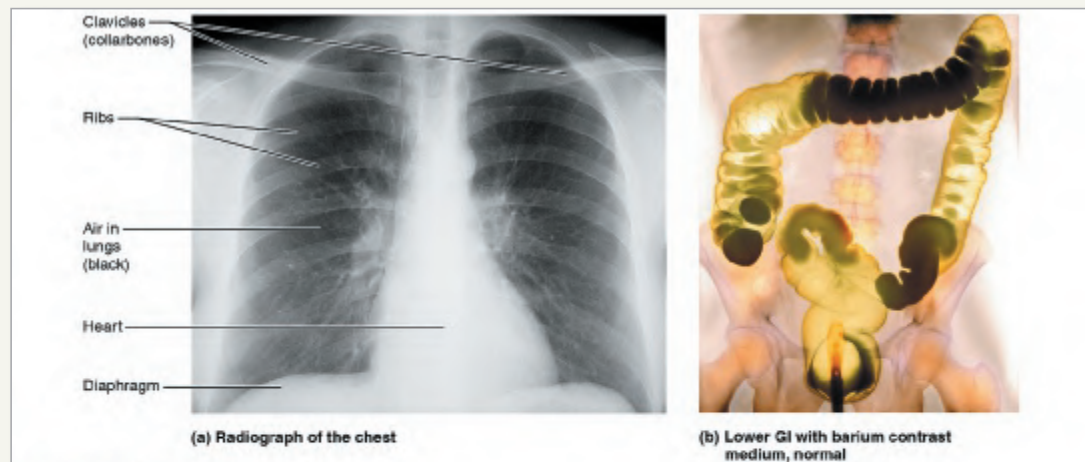


Figure 1.10 X-ray images.

### INTERPRETING MEDICAL IMAGES

- In this normal radiograph of the chest shown in part (a), explain why the lungs appear black and the bones and heart appear white.
- On the radiograph shown in part (b), locate the four regions of the colon labeled in Figure 1.16.

### Check Your Understanding

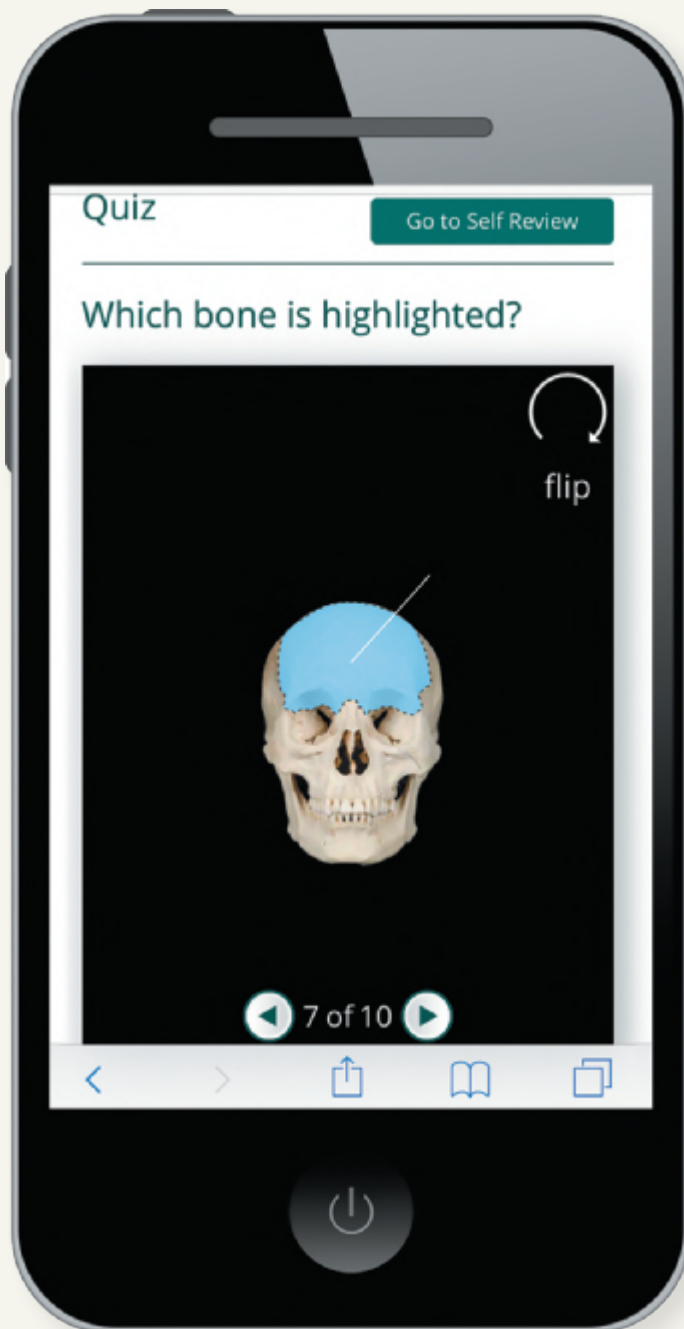
- In tissue stained with H&E stain, what color are the cellular nuclei?
- Which type of microscopy produces detailed three-dimensional images of the surface features of a structure?

For answers, see Answers Appendix.

**NEW! Interpreting Medical Images questions** accompany selected figures and guide students to analyze the kinds of images that are used in health care settings.

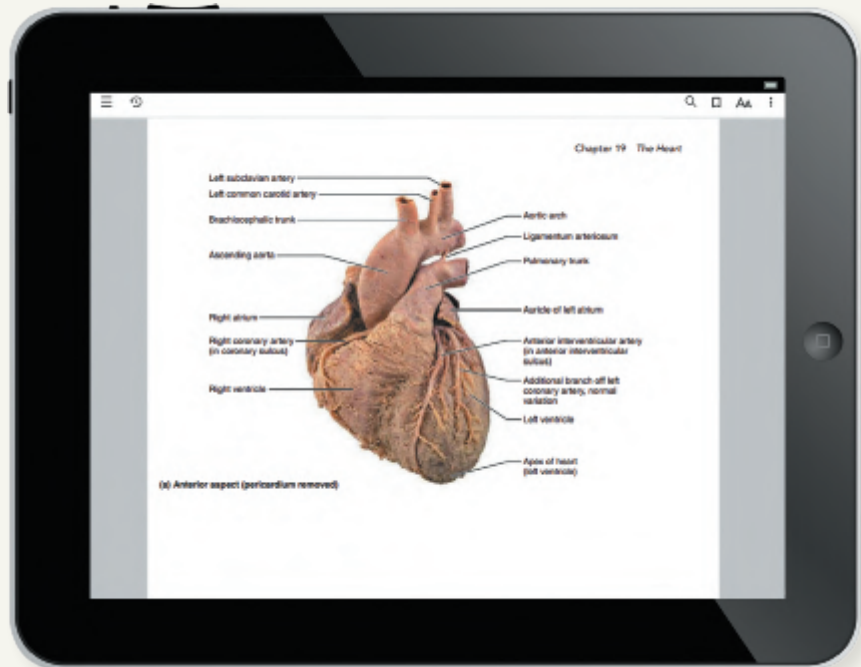
# Study for Lecture and Lab Tests with Mastering A&P Mobile Tools

**NEW! PAL 3.1 Customizable Flashcards** allow students to study on the go! Create a personalized, mobile-friendly deck of flashcards and quizzes using images from Practice Anatomy Lab. Using a checklist, students can select only those structures assigned by their instructor.



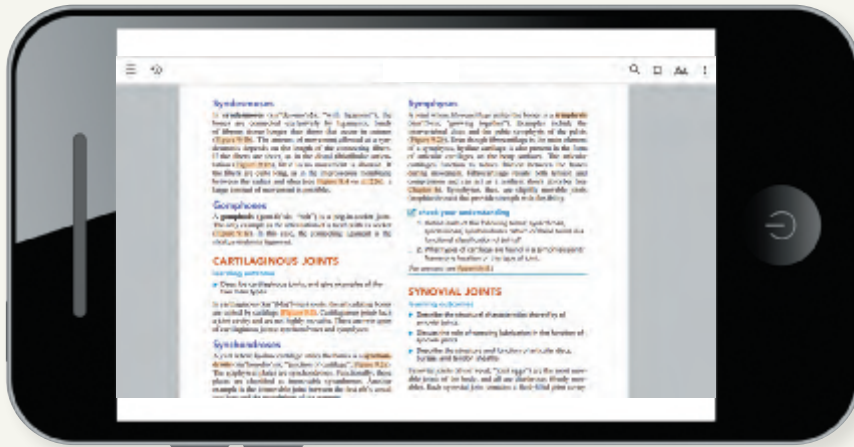
# A Pearson eText Brings Human Anatomy Concepts to Life

Numerous videos and animations are linked in the eText edition of *Human Anatomy* to reinforce your visual understanding of the structures in selected photos and illustrations. Examples include bone videos, organ dissection videos, cat dissection videos, animations showing joint movements, and animations of muscle organs, insertions, actions, and innervations.



Students can make Pearson eText their own by adding bookmarks and creating highlights with meaningful labels and notes that help them focus on what they need to study. They can also read and study using their favorite mobile device, even when they are offline. For additional guidance, instructors can share their notes with the class.

# ...so You Can Spend More Time Learning and Less Time Searching

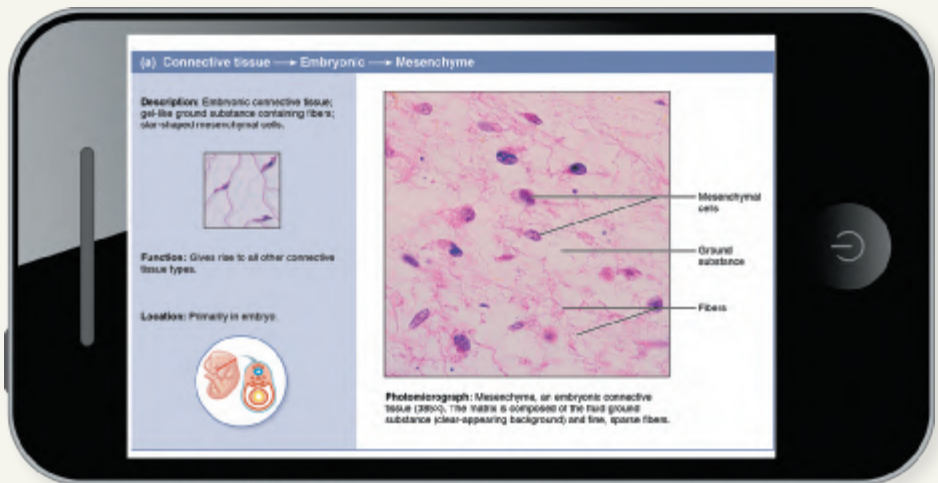


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## A Glossary

can be accessed without interrupting the flow of your reading. When you encounter an unfamiliar word, simply call up the definition by clicking a hotspot.

**NEW!** More precise cross-referencing hyperlinks allow you to easily connect concepts, structures, and regional anatomy themes across chapters to achieve a broader conceptual understanding of anatomy. Instead of searching for page numbers and descriptions, you can instantly link to related figures, discussions, and suggested answers to "Check Your Understanding" questions with just one click!



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# Additional Support for Students & Instructors

**Mastering A&P®** offers thousands of tutorials, activities, and questions that can be assigned for homework and practice. Highlights of assignment options include:

- **NEW! Roots to Remember Coaching Activities** give you practice learning and using word roots in context as you learn new A&P terms.
- **Cat Dissection Video Coaching Activities** help you prepare for the lab by highlighting key anatomical structures.
- **A&P Flix Animation Activities** include short clips showing origins, insertions, actions, and innervations of more than 65 muscles.

**The Mastering A&P® Instructor Resources Area** includes the following downloadable tools for instructors who adopt the Ninth Edition for their classes:

- **Customizable PowerPoint® lecture outlines** include customizable images and provide a springboard for lecture prep.
- **All of the figures, photos, and tables from the text** are available in JPEG and PowerPoint® 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 TestGen® formats.
- **Animations and videos** bring A&P concepts to life and include A&P Flix 3D Animations.
- **A comprehensive Instructor Guide** 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.



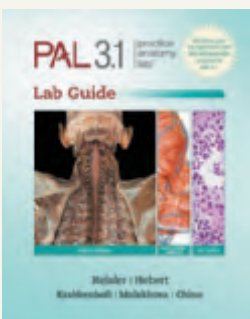
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by Ruth Heisler,  
Nora Hebert, et al.  
ISBN 9780321840257



# Human Anatomy

**NINTH EDITION**  
**GLOBAL EDITION**

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## ABOUT THE AUTHORS

### Elaine N. Marieb



After receiving her Ph.D. in zoology from the University of Massachusetts at Amherst, Elaine N. Marieb began teaching at Holyoke Community College, where many of her students were pursuing nursing degrees. Her students inspired her to gain a better understanding of the relationship between the scientific study of the human body and the clinical aspects of the nursing practice. While continuing to teach full time, Dr. Marieb pursued her nursing education, which culminated in a Master of Science degree with a clinical specialization in gerontology from the University of Massachusetts. It is this experience that has informed the unique perspective and accessibility for which her publications are known.

As an individual and through the Elaine Nicpon Marieb Charitable Foundation, Dr. Marieb has given generously to provide opportunities for students to further their education. In recent years, she provided generous philanthropic support to Florida Gulf Coast University as a long-term investment in education, research, and training for health care and human services professionals in the local community. In honor of her contributions, the university is now home to the Elaine Nicpon Marieb College of Health and Human Services.

### Patricia M. Brady



Patricia M. Brady's interest in the human anatomical form was sparked in college when she learned that the human skeleton could reveal an individual's age, sex, nutritional status, and the number of children delivered in childbirth. She earned a Ph.D. from Brown University in biological and medical sciences and has enjoyed an extensive career as an undergraduate anatomy educator at Brown University, Rhode Island College, Community College of Rhode Island, and Johnson & Wales University. At the graduate level, Dr. Brady coordinates and teaches a clinically focused cadaver-based dissection course for the Johnson & Wales University Center for Physician Assistant Studies.

Dr. Brady's commitment to teaching has been recognized throughout her career with teaching excellence awards from Brown University and the Community College of Rhode Island. Dr. Brady embraces innovation in the classroom and laboratory, incorporating project-based learning, Process Oriented Guided Inquiry Learning (POGIL) activities, case studies, cooperative team-based dissection, and other active learning strategies to make the study of anatomy an active and interactive process. Outside the classroom, most mornings Dr. Brady can be found on the water rowing, pursuing another passion she developed in college.

### Jon Mallatt



Jon Mallatt earned his Ph.D. in anatomy from the University of Chicago. Dr. Mallatt is currently a member of the Clinical Faculty of the University of Washington's WWAMI Medical Education Program at the University of Idaho, where he was honored with an Excellence in Teaching Award in 1992, 1993, 1995, 2000, and 2017. Additionally, Dr. Mallatt is an adjunct Associate Professor in the department of biological structure at the University of Washington. His particular areas of expertise are histology, human and comparative anatomy, and anatomical drawing, although his research now focuses on the origin and evolution of consciousness among animals. Dr. Mallatt is an accomplished researcher, with 58 publications in a variety of fields ranging from vertebrate evolution to molecular phylogeny to neurobiology and consciousness studies.

**T**he general philosophy behind this Ninth Edition of *Human Anatomy* remains the same as in the previous editions. As an instructor, you know that teaching anatomy involves more than just presenting facts. You must provide information in a framework that encourages genuine understanding, devise new presentations to help students remember large amounts of material, and help students apply what they have learned to new situations. All the while, you hope that you inspire in the students a love of the subject.

After many years of teaching human anatomy, we became convinced that new approaches to the subject could excite and challenge the students' natural curiosity. That is why we decided to write this book. We are fortunate to have collaborated with Pearson Education, a publisher that shares our goal: to set a new standard for pedagogical and visual effectiveness in an anatomy text.

This book is designed for one-semester or one-quarter introductory anatomy courses that serve students in pre-nursing, pre-medical, pre-physical therapy, radiological technology, physician assistant training, pre-dentistry, pharmacy, and other allied-health fields, as well as physical education, athletic training, and nutrition.

## Unique Approach to Anatomy

Since its inception, we have worked diligently to distinguish *Human Anatomy* from the many other anatomy books currently available. This book explains anatomy thoroughly, and its discussions are not merely brief summaries of the art. Our goal is to present the basic concepts of anatomy—gross, microscopic, developmental, and clinical—in a manner that is clearly written, effectively organized, up to date, and well illustrated. Learning anatomy involves assimilating massive amounts of material. To facilitate learning this content, we present anatomy as a “story” that can be explained and understood—demonstrating to students that the structure of the body makes sense.

Although descriptive gross anatomy is a relatively static science, knowledge is growing quickly in the subfields of functional anatomy, neuroanatomy, developmental anatomy, and the functional aspects of tissue and cellular anatomy. This text strives to keep up with the knowledge explosion in these subfields and to present anatomy in a way that allows modern biology students, whose training is becoming ever more molecular and cellular, to anchor their biochemical and medical training in the physical context of the human body.

## Functional Approach

As in previous editions, we strongly emphasize the functional anatomy theme, giving careful consideration to the adaptive characteristics of the anatomical structures of the body. Wherever possible, we explain how the shape and

composition of the anatomical structures reflect their functions. Such functional anatomy is not physiology (which focuses on biological mechanisms), but is more akin to “design analysis.” This approach is unique for a text at this level, and we continue to refine it in the Ninth Edition by reworking the narrative overviews in select tables, including the Muscle Tables in Chapter 11.

## Microscopic Anatomy

Throughout the text, the microscopic anatomy of all organ systems is presented from a structural and functional perspective, supporting the “story” of how the human body is built. Many undergraduate texts treat histology as a specialized and minor subfield that takes a back seat to gross anatomy. This is unfortunate, because most physiological and disease processes take place at the cellular and tissue level, and most allied-health students require a solid background in histology and subcellular structure to prepare them for their physiology courses.

## Embryology

Our text is designed to present embryology in the most effective and logical way: by introducing the fundamentals early in the text, before the more advanced discussions on the developing organ systems in the chapters that follow. We wrote Chapter 3 as an introduction to the development of the basic body plan. We present the most important human embryology concepts in this early chapter in a concise, understandable way, visually reinforced with exceptionally clear art.

## Life Span Approach

Most chapters in this book close with a “Throughout Life” section that first summarizes the embryonic development of organs of the system and then examines how these organs change across one's life span. Diseases particularly common during certain periods of life are pointed out, and effects of aging are considered. The implications of aging are particularly important to students in the health-related curricula because many of their patients will be older adults.

## NEW TO THE NINTH EDITION

The Ninth Edition builds on the book's hallmark strengths—art that teaches better, a student-friendly narrative, and easy-to-use media and assessment tools—and improves on them.

- ▶ **Expanded instruction and practice for anatomy word roots** makes learning the complex terminology of anatomy more interesting and accessible. In addition to highlighting important terms in boldfaced type, providing the pronunciations of terms, and including the Latin or Greek translations of almost every term when it is first

introduced in the text, new Roots to Remember vocabulary exercises appear at the beginning of each chapter. These short activities promote learning beyond memorization by showing students that difficult terms have simple, logical derivations. The anatomical terms used in this text are consistent with the terms accepted by the International Federation of Associations of Anatomists (IFAA). Clinical terminology is also presented in the Related Clinical Terms section found at the conclusion of most chapters. In response to suggestions from instructors and students, the list of word roots at the end of the text is expanded and now combines prefixes, suffixes, and combining forms into one comprehensive alphabetical reference.

- ▶ **New Interpreting Medical Images questions** accompany select figures and guide learners in analyzing the kinds of images that are used in health care settings, including X-ray images, CT scans, MRIs, and PET scans.
- ▶ **Improved text presentation** includes new numbered and lettered chapter sections that enable efficient access to specific content. This organization also allows for more precise cross-referencing in the eText so that readers can easily connect concepts within and across chapters, and facilitates the exploration of regional anatomy relationships.
- ▶ **Improved end-of-chapter Review Questions** eliminate negatively stated questions and ambiguous answer choices in multiple-choice/matching questions that might confuse students, particularly non-native English speakers.
- ▶ **Answers Appendix** includes the answers to questions labeled Check Your Understanding, Multiple Choice, and Matching. It also includes answers to the Interpreting Medical Images questions for Chapter 1. Answers for other questions are included in the accompanying Instructor's Resource Guide.

## HIGHLIGHTS OF CHAPTER-BY-CHAPTER CHANGES

### Chapter 1 The Human Body: An Orientation

- The text has been updated throughout the chapter for improved clarity.
- The subsection Units of Measurement is newly named to more accurately reflect the content.
- Explanatory text has been added to Figure 1.4 for better teaching effectiveness.
- Interpreting Medical Images questions have been added to Figure 1.10a and b and Figure 1.13.
- Select end-of-chapter questions have been revised to align with the new Roots to Remember feature in the chapter opener.

### Chapter 2 Cells: The Living Units

- Figure 2.3 has been updated for improved accuracy.
- Figure 2.4 has been revised to more clearly depict phagocytosis.

- Images for Figure 2.11 have been replaced for better illustration of cytoskeletal elements.
- Figure 2.13b has been replaced with an image showing a broader view.
- Check Your Understanding questions have been updated to support the new Roots to Remember activity.
- Content related to telomeres and aging has been updated.
- A question relating to the Roots to Remember chapter opener has been added to the end-of-chapter Critical Reasoning & Clinical Application Questions.

### Chapter 3 Basic Embryology

- Select end-of-chapter questions have been revised to eliminate “all of above” and “none of above” answer choices.
- A Closer Look: Birth Defects includes an updated photo.

### Chapter 4 Tissues

- The use of color has been updated in Figures 4.2, 4.3, 4.9, 4.10, Focus Figure 4.11, 4.12, 4.13, and 4.14 to facilitate grouping of tissue types.
- Sketches of tissues have been updated in Figures 4.3, 4.10, 4.13, and 4.14 for improved teaching effectiveness.
- Labeling and step text have been updated in Figures 4.6, 4.7, 4.12, and 4.15.
- The discussion of cancer treatments has been updated in A Closer Look: Cancer—The Intimate Enemy.
- Information regarding locations of adult stem cells has been updated.

### Chapter 5 The Integumentary System

- Figure 5.5 has been updated to include improved labeling and descriptions.
- Figure 5.11 includes a new image of melanoma.
- The discussion of organelle deterioration in the stratum granulosum has been revised to clarify where cell death occurs.
- The information in Clinical Application: Transdermal Drug Delivery has been updated.
- A Closer Look: Tattoos has been updated to include the role of the macrophages in tattoo permanence based on recently published results.
- Two new end-of-chapter questions have been added to reinforce content in the Roots to Remember chapter opener.

### Chapter 6 Bones and Skeletal Tissues

- Interpreting Medical Images questions have been added to Figure 6.12, Figure 6.17, and Table 6.2.
- Explanatory text has been added or revised in Figure 6.6 and Figure 6.10 for better teaching effectiveness.
- Clinical Application: Achondroplasia has been updated to include information about medications in clinical trial.
- A new end-of-chapter Critical Reasoning and Clinical Application question has been added to reinforce content in the Roots to Remember chapter opener.

## Chapter 7 Bones, Part 1: The Axial Skeleton

- Interpreting Medical Images question has been added to Clinical Application: Herniated Disc.
- Interpreting Medical Images question and new posteroanterior radiograph of the thorax have been added to Figure 7.24 depicting the thoracic cage.
- References to Mastering A&P videos of the skull and vertebrae and to PAL 3.0 have been added to all appropriate figures.
- Discussion of the cervical, thoracic, and lumbar vertebrae has been revised to further clarify the distinctive features of each.

## Chapter 8 Bones, Part 2: The Appendicular Skeleton

- Radiographs and associated Interpreting Medical Images questions have been added to Figures 8.2 and 8.10.
- Interpreting Medical Images questions have been added to Clinical Application: Palpation of Colles' Fracture, Clinical Application: Ankle Fracture, and Figure 8.12 depicting the arches of the foot.

## Chapter 9 Joints

- The description of the temporomandibular joint (TMJ) has been revised to note that the articular surfaces are covered by fibrocartilage.
- New coronal MRIs of the shoulder joint and knee, along with associated Interpreting Medical Images questions, have been added to Figures 9.11 and 9.15, respectively.
- Two end-of-chapter questions related to Roots to Remember have been added.
- Explanatory text has been added to Figure 9.5 for improved teaching effectiveness.
- Details regarding planes of movement have been added to Table 9.2.

## Chapter 10 Skeletal Muscle Tissue

- The discussion of the anatomy of skeletal muscle tissue, formerly covered in one section, is now presented in two sections: Microscopic Structure of Skeletal Muscle Tissue and Functional Anatomy of Skeletal Muscle Tissue. The intent behind this change is to facilitate learning by breaking the content into smaller, more manageable units.
- In the discussion of Duchenne muscular dystrophy, the description of the effect of dystrophin loss has been revised for better clarity.
- A Closer Look: Anabolic Steroid Abuse has been updated to include concerns about dietary supplements.
- Images of cardiac and smooth muscle in Table 10.2 have been replaced to provide clearer illustration of these muscle types.

## Chapter 11 Muscles of the Body

- The introductory content has undergone major reorganization to group similar concepts together: muscle mechanics (fascicle arrangement, lever systems, position around joints); organizational schemes (embryologic,

compartments of the limbs); detailed study of skeletal muscles (muscle naming conventions, muscle tables); regional surface anatomy.

- Content that introduces the muscle tables has undergone major revision to highlight the functional organization of muscles in each group. The focus in these table headnotes is to present an overview of muscle action, which provides a conceptual foundation to support the more detailed study that follows in the muscle table. Headers and use of boldface to highlight muscle names are used throughout the muscle table headnotes to organize and highlight this content.
- The summary tables of the actions of the muscles of the upper and lower limbs have been reintegrated back into the muscle tables. They now appear as Table 11.12, Summary of Actions of Muscles Acting on the Arm, Forearm and Hand; and Table 11.16, Summary of Actions of Muscles Acting on the Thigh, Leg, and Foot. This placement allows for quick review following detailed study of individual muscles.
- Part labels have been added to muscle illustrations and photographs to support the content in the muscle table headnotes. The intent is to strengthen the integration of muscle location, name, and function within the art.
- For eText, additional video links have been introduced to include:
  1. Group muscle actions to support foundational learning of muscle function. Links to these videos can be found beneath the Muscle Table headnotes to support the general overview presented in the table headnotes.
  2. Individual muscle videos for detailed study of origin, insertion, action, and innervation are placed near the art for specific muscles.
- Cadaver photo has been added to Figure 11.12 depicting the deep back muscles of the neck.
- Figures 11.16, 11.20, 11.22, and 11.24 have been revised to better communicate functional/developmental grouping of muscles.

## Chapter 12 Fundamentals of the Nervous System and Nervous Tissue

- Interpreting Medical Images question has been added to Figure 12.14.
- Labeling of brain stem in Figure 12.13 has been updated for accuracy.
- New content has been added about the effects of learning on reinforcement and pruning of synapses in children and adolescents. The discussion also mentions recent research findings that associate synaptic pruning with the development of schizophrenia.

## Chapter 13 The Central Nervous System

- The section Basic Parts and Organization of the Brain has been reorganized to link the four regions of the brain to (1) the location of the hollow regions, the ventricles; and (2) the distribution of gray and white matter as subtopics.

These are foundational concepts that are useful for organizing the myriad detailed structures of the brain into the four basic parts of the brain and to support the understanding of location and function of the detailed structures of the brain.

- In the Brain Stem section, the Learning Objective for relating structure to function has been revised; it now calls for using the framework of white and gray matter to facilitate these linkages. The discussion clarifies which structures in the brain stem are white matter (tracts) and which are gray matter (nuclei).
- Figure 13.11b, a superior view of the cerebrum, has been replaced with a new image showing the arachnoid mater and arachnoid granulations.
- A replacement image has been provided for Figure 13.22b, posterior dissection of the dural sinuses.
- Interpreting Medical Images question and a new three-dimensional CT venogram of cerebral veins have been added as part (d) of Figure 13.22, partitions of dura mater in the cranial cavity and the dural venous sinuses.
- Figure 13.29 has been revised to accurately illustrate the pathway of the spinocerebellar tract from medulla to cerebellum.
- Discussion of melatonin levels, sleep deficits in teens, and school start times in Clinical Application: Why Won't Teenagers Sleep at Night? has been updated to include recommendations from the American Academy of Pediatrics.
- Outlines of Broca's area and Wernicke's area have been added to Figure 13.16, auditory pathways.
- Clinical Application: Dyskinesia includes discussion of a new treatment for Huntington's disease.
- Clinical Application: Amyotrophic Lateral Sclerosis (ALS) includes updated information about areas of research into causes of ALS.

## Chapter 14 The Peripheral Nervous System

- Table 14.2, Cranial Nerves, has been revised to include a new illustration of the skull showing facial foramina of the trigeminal nerve (CN V). In addition, trigeminal nerve and facial nerve content has been reorganized for clearer presentation and integration of text and art.
- In Figure 14.12, lumbar plexus, the cadaver image in part (a) has been replaced for clearer illustration. In addition, leaders and labels have been repositioned to identify the viewable nerves shown in part (c) depicting the distribution of the major lumbar plexus nerves to the lower limb.
- The eText now includes hyperlinks to the Chapter 11 figures of each muscle group innervated by nerves from the brachial, lumbar, and sacral plexuses.
- In A Closer Look: Postpolio Syndrome, data regarding the incidence and location of wild polio virus infection have been updated to July 2018.
- A question related to word roots has been added to the Critical Reasoning and Clinical Application Questions.

## Chapter 15 The Autonomic Nervous System and Visceral Sensory Neurons

- Figures 15.4 and 15.7 have been revised for improved teaching effectiveness.
- Content has been updated in Clinical Application: Autonomic Hyperreflexia (previously called mass reflex reaction).
- Focus Figure 15.3 includes information on myelination of preganglionic and postganglionic neurons.
- Check Your Understanding question 7 has been revised for improved clarity.

## Chapter 16 The Special Senses

- Figure 16.1 has been revised to improve labeling of three types of taste buds.
- Figure 16.2, gustatory pathway, has been revised for better accuracy and clearer illustration.
- A new Clinical Application: Anosmia has been added.
- Information has been added noting that injury to chorda tympani branch of CN VII can result in taste disturbances.
- Information has been added to clarify the distinction between sties and chalazions.
- The discussion of autonomic innervation to the pupillary muscles of the iris has been clarified.
- Figure 16.14 has been revised for improved identification of the midbrain nuclei in the visual pathway.

## Chapter 17 The Endocrine System

- The discussion of organs that contain some endocrine cells has been revised to include osteoblasts in bone and adipocytes in fat.
- Figure 17.8 has been revised to indicate the location of sympathetic outflow for spinal cord to the adrenal medulla.
- A new image depicting an axial CT of the brain has been added (Figure 17.9) to illustrate pineal gland calcification; an associated Interpreting Medical Images question has also been included.
- The discussion of Cushing's disease has been expanded to include more detail about the causes, manifestations, and treatments of the disorder.
- A question relating to the Roots to Remember chapter opener has been added to the end-of-chapter Critical Reasoning & Clinical Application Questions.

## Chapter 18 Blood

- Figure 18.2 has been revised for better teaching effectiveness.
- A Closer Look has undergone a major revision and update and has been retitled Hematopoietic Cell Transplants to reflect current practice in the treatment of leukemia.
- Information about use of bone marrow transplants to treat sickle cell disease has been updated.
- New questions relating to word roots have been added to the Short Answer Essay Questions and Critical Reasoning & Clinical Application Questions.

## Chapter 19 The Heart

- Interpreting Medical Images questions have been added to Figures 19.2 and 19.16.
- The description of coronary artery origins and variability of branching has been revised for improved clarity and accuracy.
- Information about the capability of cardiac muscle tissue regeneration has been updated.
- An ECG tracing has been added to Figure 19.14 to illustrate the clinical information gathered to assess the electrical conducting system.

## Chapter 20 Blood Vessels

- The micrograph of the artery and vein in Figure 20.1 has been replaced with an image that better illustrates the difference between these vessels.
- The differences in the size and shape of the lumen in arteries and veins have been clarified.
- The discussion of capillary beds has been completely revised to reflect the current understanding of the types of capillary beds found in different tissues. In addition, the term *microvasculature unit* has been introduced. Figure 20.5 has been revised to illustrate the structure of both a typical capillary bed (Figure 20.5a) and a mesenteric capillary bed with metarteriole and precapillary sphincters (Figure 20.5c).
- Interpreting Medical Images questions have been added to Figure 20.17 and 20.24.
- The pathway and form of the splenic artery have been clarified.
- Figure 20.18 has been revised to more accurately illustrate the pathway of venous drainage from the head.
- Discussion involving the area of supply of the middle cerebral artery has been revised for accuracy.

## Chapter 21 The Lymphatic and Immune Systems

- New information has been added regarding the presence of lymphatic vessels in the brain, the meningeal lymphatic vessels.
- Figure 21.2 has been revised to illustrate the meningeal lymphatic vessels in the brain.
- The deep cervical lymph nodes have been included in the discussion of the location of lymph nodes. Information has been added describing drainage of meningeal lymphatic vessels into the deep cervical lymph nodes.
- The term *venous angle* has been introduced to denote the junction of the internal jugular vein and subclavian vein.
- The summary of the functions of lymphatic vessels has been revised to include delivery of pathogens to lymph nodes.
- Information about transmission of Epstein-Barr virus has been updated.
- Discussion of HIV infection rates has been updated with current available data (2017).

## Chapter 22 The Respiratory System

- Structures belonging to the upper respiratory tract have been more clearly distinguished from those belonging to the lower respiratory tract.
- Table 22.1 has been revised to clarify the function of select portions of the respiratory pathway.
- Clinical Application: Epistaxis has been revised to include an additional treatment measure.
- Interpreting Medical Images question and new sagittal MRI of pharynx and larynx have been added to Figure 22.3.
- Interpreting Medical Images question has been added to Figure 22.4.
- Description of attachments of the epiglottis to the tongue has been clarified.
- Interpreting Medical Images question and new coronal CT of the lungs have been added to Figure 22.8.
- The names of the lobar bronchi in the right and left lung have been added to the discussion of the bronchial tree.
- Interpreting Medical Images question has been added to Figure 22.11.
- The position of the pulmonary artery, vein, and primary bronchus in the root of the right and left lung has been clarified.

## Chapter 23 The Digestive System

- Terminology for the abdominal regions has been updated to align with current *Terminologia Anatomica* accepted usage.
- Interpreting Medical Images question has been added to Figure 23.2.
- Figure 23.4 has undergone significant revisions: part (a) has been replaced with an improved cadaver image, and all parts include new descriptive part labels for clearer linkage between text content and art.
- Mention of the importance of the upper limb in ingestion has been added.
- Figure 23.5 has been updated to include chemical digestion in the oral cavity.
- Endoscopic view of the stomach has been added to Figure 23.17.
- Interpreting Medical Images question and new endoscopic view of the small intestine have been added to Figure 23.20.
- Check Your Understanding question has been revised for better clarity.
- Interpreting Medical Images question has been added to Figure 23.21.
- Interpreting Medical Images question has been added to Clinical Application: Diverticulosis and Diverticulitis.
- Interpreting Medical Images question and a new ultrasound image of the gallbladder with gallstones have been added to Figure 23.25.
- Figure 23.24 has been updated to clarify the type of epithelium found in the mucosal layer of the gastrointestinal tract.
- The discussion of hepatitis C has been updated to include treatment with new antiviral drugs that can cure many strains.



## Chapter 24 The Urinary System

- Interpreting Medical Images question has been added to Figure 24.2.
- Details regarding the function of the juxtaglomerular apparatus have been clarified.
- Interpreting Medical Images question has been added to Clinical Application: Pyelography to reinforce understanding of common sites where renal calculi can block the ureter.
- Check Your Understanding question 3 has been revised to reinforce that knowing word roots can help the student figure out the names of anatomical structures.

## Chapter 25 The Reproductive System

- Terminology has been changed to reflect current *Terminologia Anatomica* accepted usage: The term *primordial follicular epithelial cells* replaces *follicular cells*; and *follicular theca* replaces *theca folliculi*.
- Also per *Terminologia Anatomica*, *vesicular follicle* has been introduced as the primary term, with *antrum follicle* as the alternative term.
- The term *transverse cervical ligament* replaces *lateral cervical ligament*. *Cardinal ligament* is still included as an alternative term.
- Content addressing the female reproductive system has been reorganized: all the anatomical structures of the female reproductive tract are presented first, followed by the details of oogenesis, the ovarian cycle, and the uterine cycle.
- The photomicrograph in Figure 25.3 depicting the seminiferous tubule has been replaced with a new image.
- Part labels have been added to numerous figures to reinforce integration of text and art: Figure 25.3, Structure of the testis; Figure 25.16, The endometrium of the uterus and its blood supply; Figure 25.17, The external genitalia (vulva) of the female; Figure 25.21, Structure of a lactating (milk-secreting) mammary gland; and Figure 25.24, Implantation of the blastocyst.
- Labels have been reorganized in numerous figures for better teaching effectiveness: Figure 25.1, Reproductive organs of the male; Figure 25.3, Structure of the testis; Figure 25.9, Spermatogenesis (sperm formation); Figure 25.11, Internal organs of the female reproductive system; Figure 25.19, The ovarian cycle; Figure 25.23, Fertilization; and Figure 25.25, Placenta formation.
- Blue “author voice” text has been added to several figures to enhance teaching effectiveness: Figure 25.16, The endometrium of the uterus and its blood supply; Figure 25.18, Oogenesis; and Figure 25.30, Development of homologous structures of the external genitalia in both sexes.

- Graphs of pituitary and ovarian hormones in Figure 25.20 have been updated for better accuracy and improved teaching effectiveness.
- Interpreting Medical Images question has been added to Figure 25.28, Mammograms.
- Discussion of cancer incidence and survival rates has been updated with current data.
- The derivatives of the genital tubercle and urethral folds in the male have been clarified.

## Highlights of What’s New in Mastering A&P

Expanded for the Ninth Edition, Mastering A&P is an online learning and assessment system that offers thousands of tutorials, activities, and questions that can be assigned for homework and practice. In addition to the popular Clinical Scenario Tutorials, Cat Dissection Videos, A&P Flix Animation Activities, and Bone and Dissection Video Tutorials, Mastering A&P now includes these new features:

- ▶ **New Roots to Remember Vocabulary Tutorials** provide students with additional practice working with word roots and anatomical terms in context.
- ▶ **New, Customizable Practice Anatomy Lab 3.1 (PAL) Flashcards** allow students to create a personalized, mobile-friendly deck of flashcards and quizzes using images from PAL. Students can use a checklist to select only the structures that are covered in their class.
- ▶ **New Option for Customizing Art Labeling Activities** allows instructors to add or remove labels and leader lines from the Art Labeling activity assignment options and save customized versions of these activities to “My Items,” separate from other questions in the item library. Like most other Mastering A&P assignments, customized art labeling activities are auto-gradable, and scores are recorded in the Mastering gradebook.

## Highlights of the Ninth Edition Pearson eText

The Pearson eText edition of *Human Anatomy* provides an easy-to-use, mobile-friendly, and personalized reading experience. As with previous editions, the eText is available within Mastering A&P. Highlights include the following:

- ▶ **Numerous videos and animations** bring anatomy concepts to life and are conveniently presented alongside the related figures in the text, exactly when and where a reader would find them most useful. Selected videos are signaled in the print edition with an icon, and the same animations and videos can be accessed in the Mastering A&P Study Area.



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Animations & Videos

- ▶ **More precise cross-referencing hyperlinks** allow readers to easily connect concepts, structures, and regional anatomy themes across chapters to achieve a broader conceptual understanding of anatomy. Instead of searching for page numbers and descriptions, the eText allows the user to instantly link, with just one click, to related figures, discussions, and suggested answers to “Check Your Understanding” questions.
- ▶ **A glossary** can be accessed without interrupting the flow of one’s reading. Students can call up definitions for unfamiliar words by clicking a hotspot.
- ▶ **Personalization tools, including highlighting, notes, and bookmarks**, can be added by students and instructors. For additional guidance, instructors can share their notes with their class.

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