

Human Anatomy

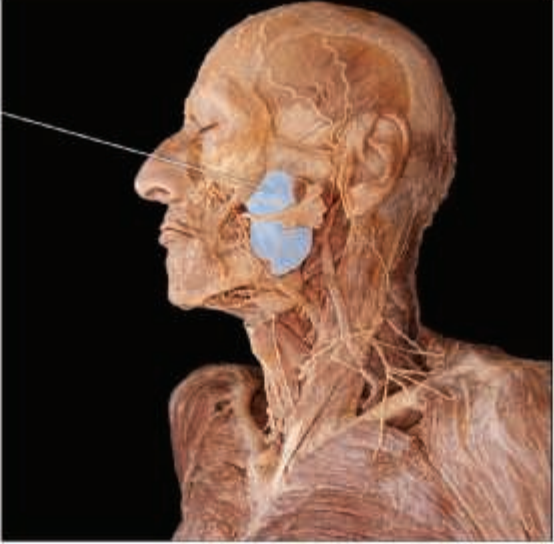
EIGHTH EDITION

Marieb
Wilhelm
Mallatt

Take Your Human Anatomy Course

PAL: Cadaver > Muscular System: Head and Neck > Lab Practical > Question 8

Part A



Identify the highlighted muscle.

Submit My Answers Give Up

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Bone and Organ Dissection Videos cover major bone and organ dissections to help students prepare for lecture and lab.



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Clinical Scenario: Abdominal Muscles and Hernias

James McCarthy is a 20-year-old college student who works as a mason on weekends. One month ago he began a new strength-training workout. Shortly after he began lifting weights, he noticed a pulling sensation in his lower right abdomen. He thought it was muscle tightness and ignored it. Two weeks ago, he was installing a custom fireplace and had to lift a 300-lb. stone by himself. As he lifted the stone, he felt a stabbing pain in the lower right abdomen. Since then he has noticed "something bulging" in this area and increased pain when he lifts weights. He scheduled an appointment with his doctor and was told he had a hernia, which will require surgery to repair it.

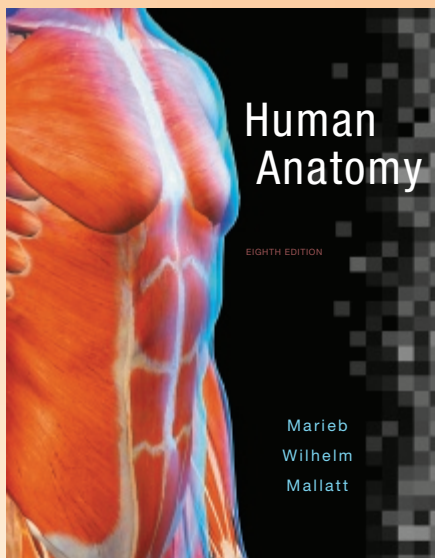
Part A

Let's begin by reviewing the major muscles of the abdomen. Select a structure and drag it to the correct location.

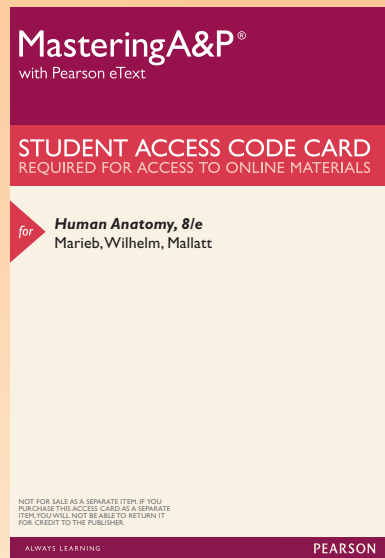
The diagram shows a frontal view of the human torso from the waist up, focusing on the abdominal muscles. On the left side, there is a vertical list of five blue buttons: "Rectus abdominis", "Internal oblique", "Transverse abdominis", "External oblique", and "Inguinal ligament". Lines connect these buttons to corresponding locations on the anatomical diagram. On the right side of the diagram, there are three empty white rectangular boxes with lines pointing to specific areas of the abdomen, intended for the user to drag the selected muscle labels into. At the bottom left of the interface are buttons for "Submit", "Hints", "My Answers", "Give Up", and "Review Part". At the bottom right are "reset" and "help" buttons.

NEW! Clinical Scenario Coaching Activities bring the real world into your course.

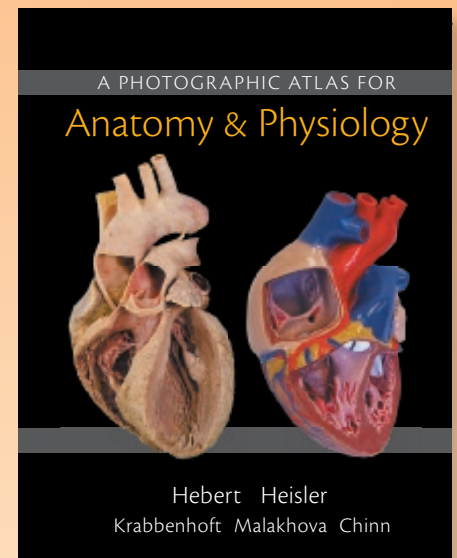
NEW! The student package for Marieb, Wilhelm, and Mallatt's *Human Anatomy*, Eighth Edition includes:



+



+



Human Anatomy

EIGHTH EDITION

Elaine N. Marieb, R.N., Ph.D.

Holyoke Community College

Patricia Brady Wilhelm, Ph.D.

Johnson & Wales University

Jon Mallatt, Ph.D.

Washington State University

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Elaine N. Marieb



After receiving her Ph.D. in zoology from the University of Massachusetts at Amherst, Elaine N. Marieb joined the faculty of the Biological Science Division of Holyoke Community College.

While teaching at Holyoke Community College, where many of her students were pursuing nursing degrees, she developed a desire to better understand the relationship between the scientific study of the human body and the clinical aspects of the nursing practice. To that end, 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 development of the unique perspective and accessibility for which her publications are known.

Dr. Marieb has given generously to provide opportunities for students to further their education. She funds the E. N. Marieb Science Research Awards at Mount Holyoke College, which promotes research by undergraduate science majors, and has underwritten renovation of the biology labs in Clapp Laboratory at that college. Dr. Marieb also contributes to the University of Massachusetts at Amherst where she generously provided funding for reconstruction and instrumentation of a cutting-edge cytology research laboratory. Recognizing the severe national shortage of nursing faculty, she underwrites the Nursing Scholars of the Future Grant Program at the university. In January 2012, Florida Gulf Coast University named a new health professions facility “Dr. Elaine Nicpon Marieb Hall.” With the help of Dr. Marieb’s generous donation, this facility contains simulated laboratories in the School of Nursing.

Dr. Marieb is an active member of the Human Anatomy and Physiology Society (HAPS) and the American Association for the Advancement of Science (AAAS).

Patricia Brady Wilhelm



Patricia Brady Wilhelm received her Ph.D. in biological and medical sciences from Brown University and is currently Professor and Chair of Science at Johnson & Wales University, Providence RI. She has taught human anatomy at Brown University, Rhode Island College, Community College of Rhode Island, and currently at the Center for Physician Assistant Studies at Johnson & Wales University.

Dr. Wilhelm’s commitment to teaching has been recognized throughout her career. As a doctoral student, she received the Presidential Award for Excellence in Graduate Teaching and in 2011 the Teaching Excellence Award from the Community College of Rhode Island. Dr. Wilhelm embraces innovation in the classroom and laboratory, incorporating project-based learning, Process Oriented Guided Inquiry Learning (POGIL) activities, cooperative team-based dissection, and other active learning strategies. Dr. Wilhelm has shared her techniques, experience, and enthusiasm for student success through professional presentations, including those of the Human Anatomy and Physiology Society (HAPS) and the New England Biology Association of Two-Year Colleges (NEBATYC) conferences.

In addition to teaching, Dr. Wilhelm contributes to the development of media tools for human anatomy instruction and is a reviewer for *Anatomical Sciences Education*. She is a member of Sigma Xi, the Human Anatomy and Physiology Society (HAPS), the American Association of Anatomists (AAA), and the PULSE (Partnership for Undergraduate Life Science Education) Community.

Jon Mallatt

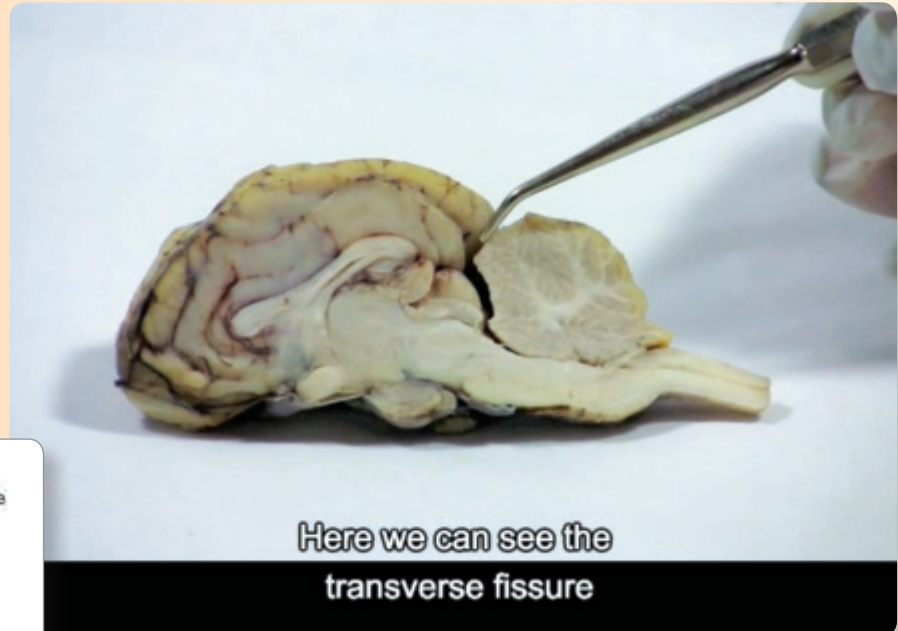


With a Ph.D. in anatomy from the University of Chicago, Dr. Mallatt is currently an Associate Professor of Biological Sciences at Washington State University. He is also a member of the department of Basic Medical Sciences, where he teaches courses in histology and in anatomy of the trunk in the WWAMI Medical Program. WWAMI has honored him numerous times with its Excellence in Teaching Award. Dr. Mallatt is an accomplished researcher with 45 publications in the fields of comparative anatomy and molecular phylogeny to his credit.

Help Your Students Prepare for Lab



Bone and Organ Dissection Videos cover major bone and organ dissections to help students prepare for lecture and lab.



Part D

Which of the following landmarks separate the cerebrum from the cerebellum?

- Longitudinal fissure
- Transverse fissure
- Central sulcus
- Corpus callosum

[Submit](#) [Hints](#) [My Answers](#) [Give Up](#) [Review Part](#)

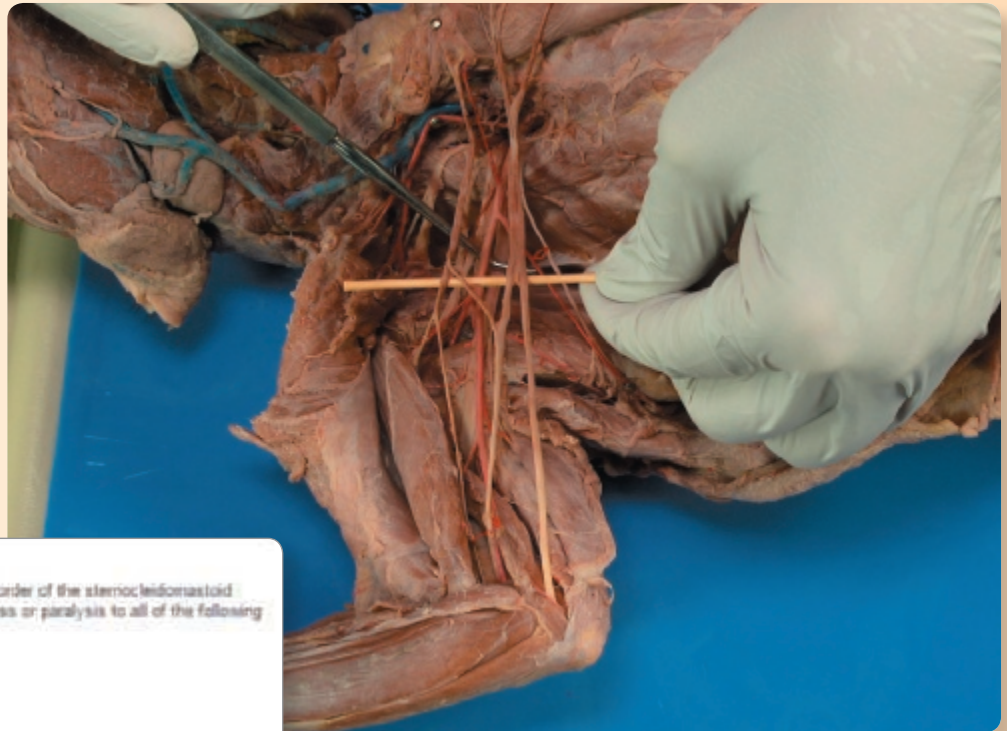
Correct

Correct. The transverse fissure is the separation found between the cerebrum and the cerebellum.

with MasteringA&P® Assignments

NEW! Cat Dissection Videos

help students prepare for cat dissection lab and identify key anatomical structures.



Part A

The brachial plexus can be palpated at the lower lateral border of the sternocleidomastoid muscle. Injury to the brachial plexus could cause weakness or paralysis to all of the following EXCEPT the _____.

- deltoid muscle
- biceps brachii muscle
- sternocleidomastoid muscle
- muscles that flex the wrist and fingers

Submit

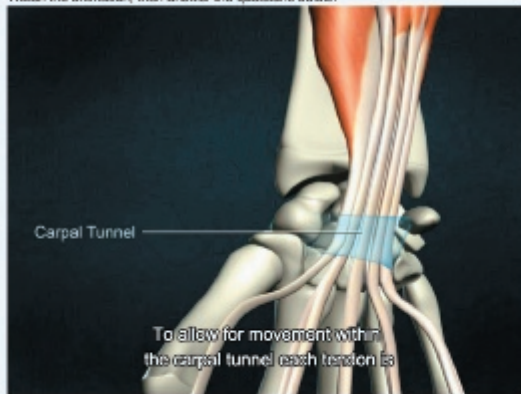
[My Answers](#) [Give Up](#)

Incorrect; Try Again

The deltoid muscle is innervated by the axillary nerve.

A&P Flix: Carpal tunnel

Watch the animation, then answer the questions below.



00:38 00:44

Part A

To allow movement of the tendons within the carpal tunnel zone, each tendon is encased in a _____.

- bursa
- sheath
- meniscus
- osseous membrane

Submit

[My Answers](#) [Give Up](#)

Part B

Carpal tunnel syndrome is characterized by _____.

- inflammation of the flexor digitorum profundus
- inflammation of the flexor retinaculum and/or tendon sheaths
- inflammation of the extensor carpi radialis
- inflammation of the extensor retinaculum

Submit

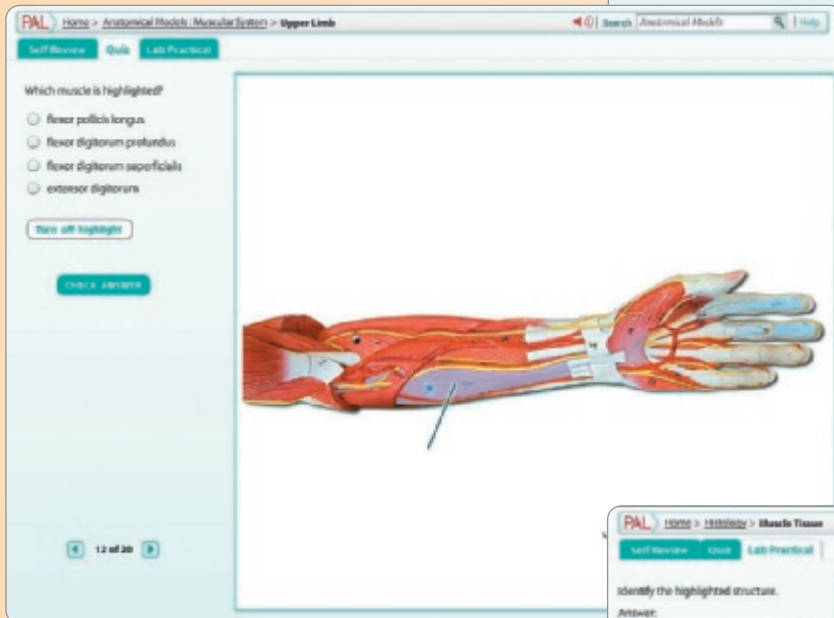
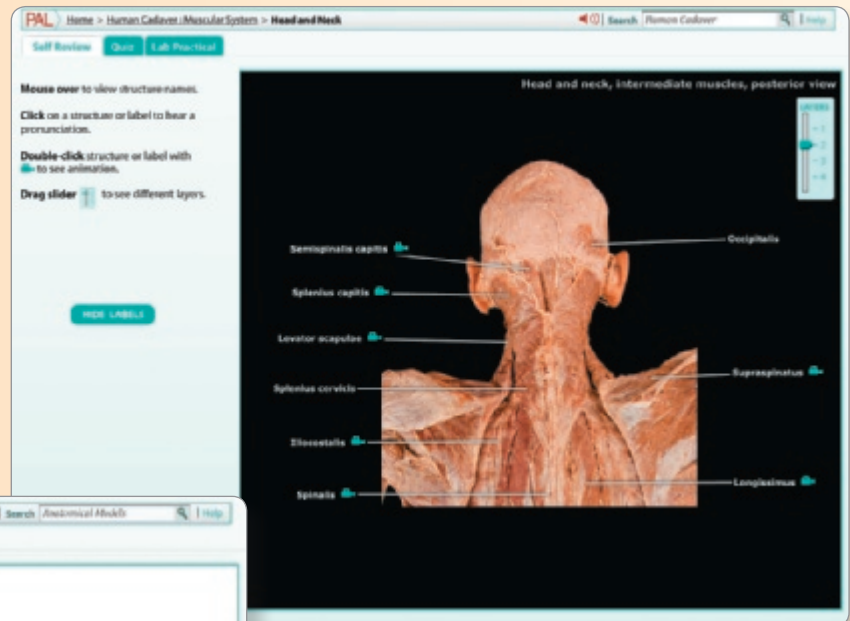
[My Answers](#) [Give Up](#)

A&P Flix™

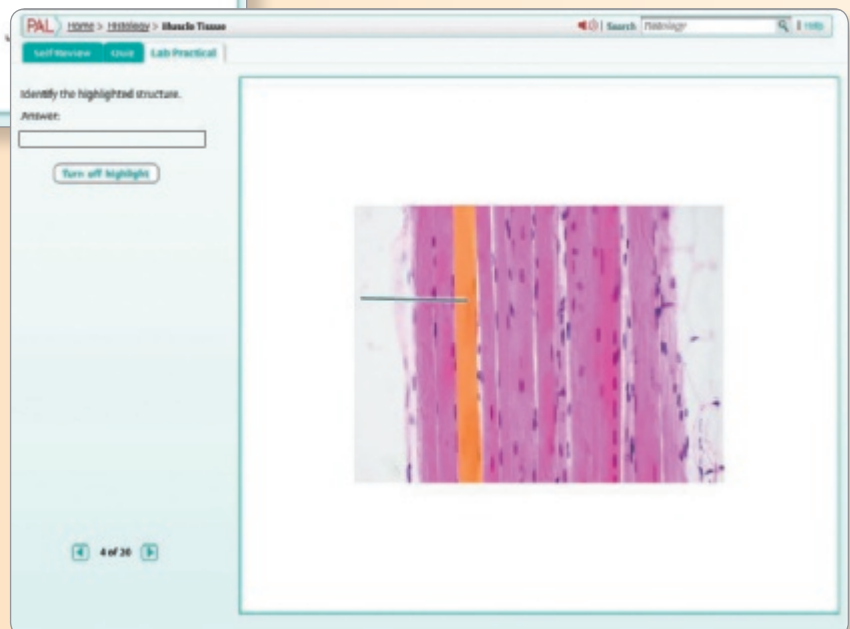
Animations are 3D movie-quality animations that help students visualize joint movements and origins, insertions, actions and innervations of over 65 muscles.

Give Your Students Access to Lab

Practice Anatomy Lab™ 3.0 is a virtual anatomy study tool that gives students 24/7 access to the most widely used lab specimens including human cadaver, anatomical models, histology, cat, and fetal pig.



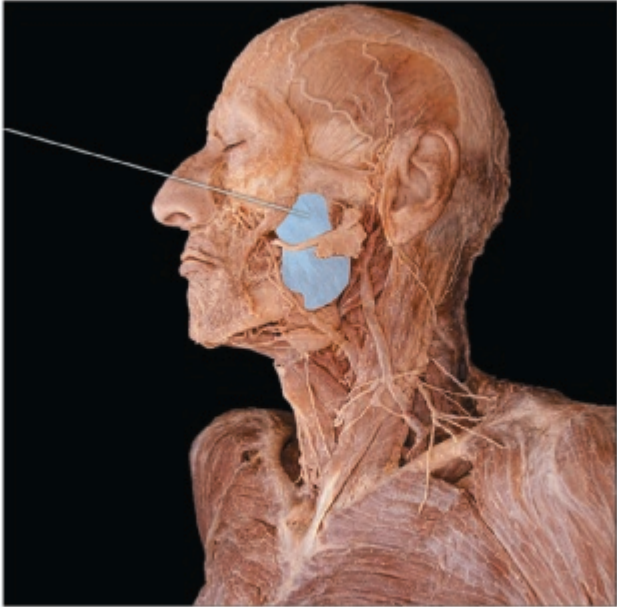
PAL 3.0 includes randomized multiple-choice quizzes and fill-in-the-blank lab practical questions.



Practice 24/7 with MasteringA&P®

PAL: Cadaver > Muscular System: Head and Neck > Lab Practical > Question 8

Part A

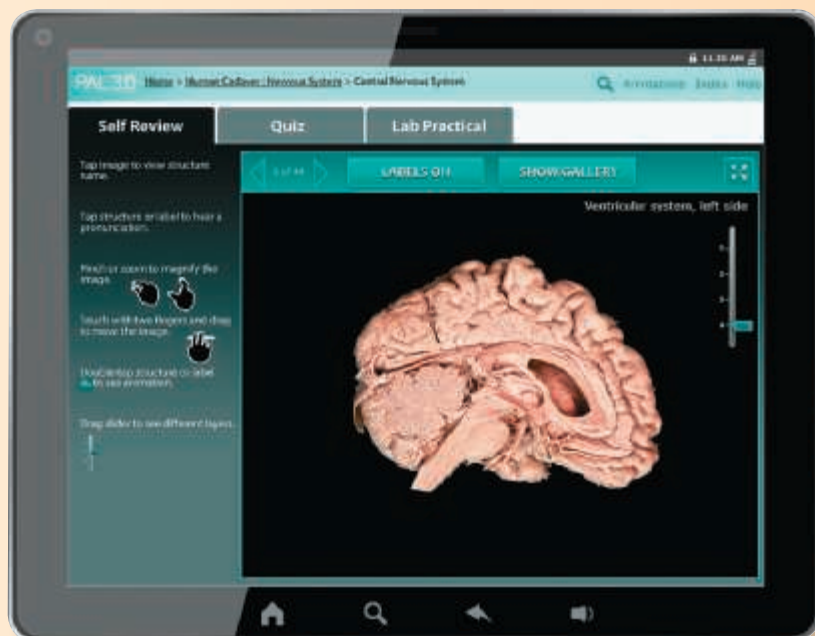


Identify the highlighted muscle.

[Submit](#) [My Answers](#) [Give Up](#)

Assign only the structures you want your students to know by using the **PAL™ 3.0 Test Bank**. The PAL 3.0 Test Bank includes over 4,000 customizable questions.

The **PAL 3.0 App** lets students access PAL 3.0 on their iPad or Android tablet. Students can enlarge images, watch animations, and study for lab practicals with multiple-choice and fill-in-the-blank quizzes—all while on the go!



Engage Your Students in Higher-

NEW! Clinical Scenario Coaching Activities

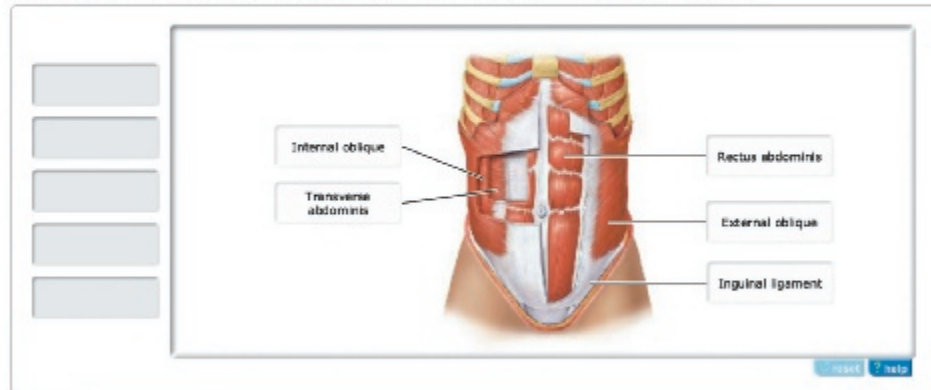
use real world examples and art from the book to engage students.

Clinical Scenario: Abdominal Muscles and Hernias

James McCarthy is a 20-year-old college student who works as a mason on weekends. One month ago he began a new strength-training workout. Shortly after he began lifting weights, he noticed a pulling sensation in his lower right abdomen. He thought it was muscle tightness and ignored it. Two weeks ago, he was installing a custom fireplace and had to lift a 300-lb. stone by himself. As he lifted the stone, he felt a stabbing pain in the lower right abdomen. Since then he has noticed "something bulging" in this area and increased pain when he lifts weights. He scheduled an appointment with his doctor and was told he had a hernia, which will require surgery to repair it.

Part A

Let's begin by reviewing the major muscles of the abdomen. Select a structure and drag it to the correct location.



Submit Hints [My Answers](#) Give Up [Review Part](#)

Correct

There are four major abdominal muscles. These muscles are responsible for movement of the trunk, but they also compress the abdominopelvic cavity and support internal body organs and structures such as the intestines.

Part F

James needed to have his hernia surgically repaired. This can be done through laparoscopic surgery. The surgeon must cut through to the herniated area and put a Teflon mesh underneath the hernia to close it off and provide more support to the area. Use your knowledge of anatomy to select the correct sequence of structures that would be cut for this procedure. Make sure you select the structures in the order they would be cut by the surgeon.

- Skin, hypodermis, subcutaneous fat, internal oblique aponeurosis, external oblique, transverse abdominis, peritoneum
- Skin, hypodermis, peritoneum, subcutaneous fat, external oblique aponeurosis, internal oblique, and transverse abdominis
- Skin, hypodermis, subcutaneous fat, external oblique aponeurosis, internal oblique, transverse abdominis, peritoneum
- Skin, hypodermis, peritoneum, subcutaneous fat, transverse abdominis, internal oblique, and the external oblique aponeurosis.

Submit Hints [My Answers](#) Give Up [Review Part](#)

Incorrect; Try Again

The peritoneum is the layer of tissue that surrounds the abdominopelvic cavity, and is the deepest structure.

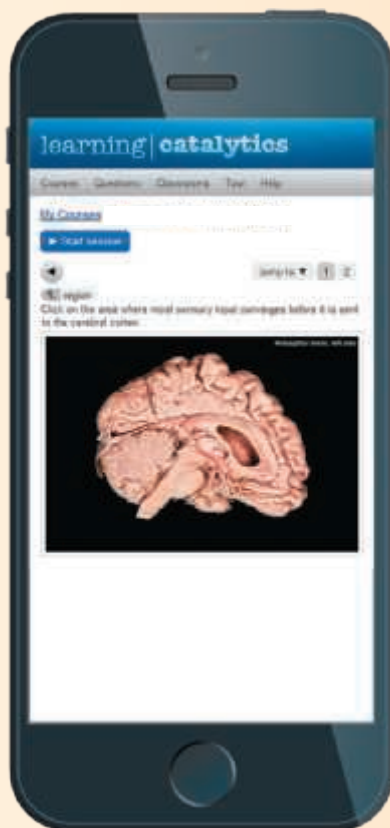
Level Thinking with MasteringA&P®

Part F - Conclusion: Valves in Blood Flow Through the Heart
Drag and drop valve names to their correct location in the image.

Tricuspid valve Pulmonary semilunar valve Aortic semilunar valve Mitral (bicuspid) valve

Submit Hints My Answers Give Up Review Part

Every Focus Figure has an assignable, multi-step Coaching Activity in MasteringA&P.



NEW! Learning Catalytics is a “bring-your-own-device” engagement, assessment, and classroom intelligence system. With Learning Catalytics, instructors can flip the classroom and assess students in real time using open-ended tasks to probe their understanding. Students use their smartphone, tablet, or laptop to respond to questions in class.

Help Your Students Study Anywhere,

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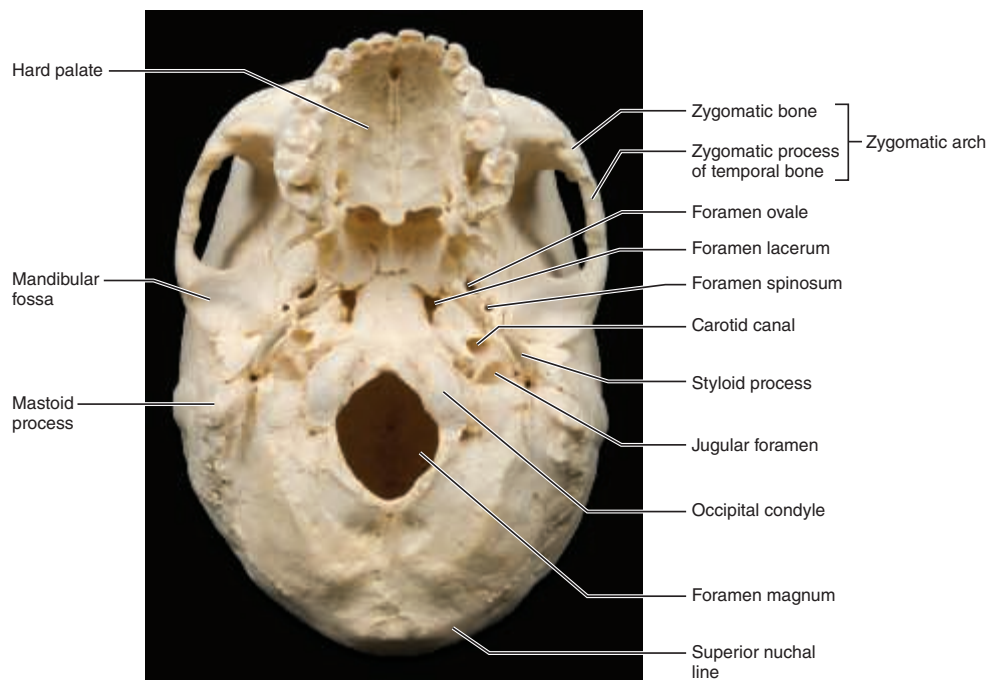
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Anytime with Mobile Tools

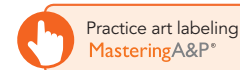


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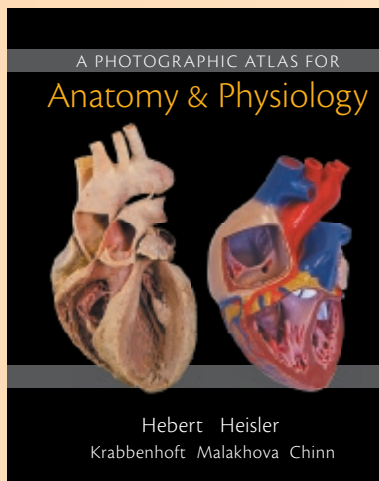
(b) Photo of inferior view of the skull

Figure 7.7 Inferior aspect of the skull.



NEW! Media References in the textbook to PAL 3.0, A&P Flix animations, bone videos, animal organ dissection and cat dissection videos, and art-labeling activities in MasteringA&P help students easily find relevant media resources as they are reading the book.

Maximize Your Students' Learning



NEW! A Photographic Atlas for Anatomy & Physiology, by Nora Hebert, Ruth Heisler, Karen Krabbenhoft, Olga Malakhova, and Jett Chinn is a new visual lab study tool featuring photos from Practice Anatomy Lab 3.0 and other sources that helps students learn and identify key anatomical structures.

Available as part of the student package for Marieb, Wilhelm, and Mallatt's *Human Anatomy, Eighth Edition*.

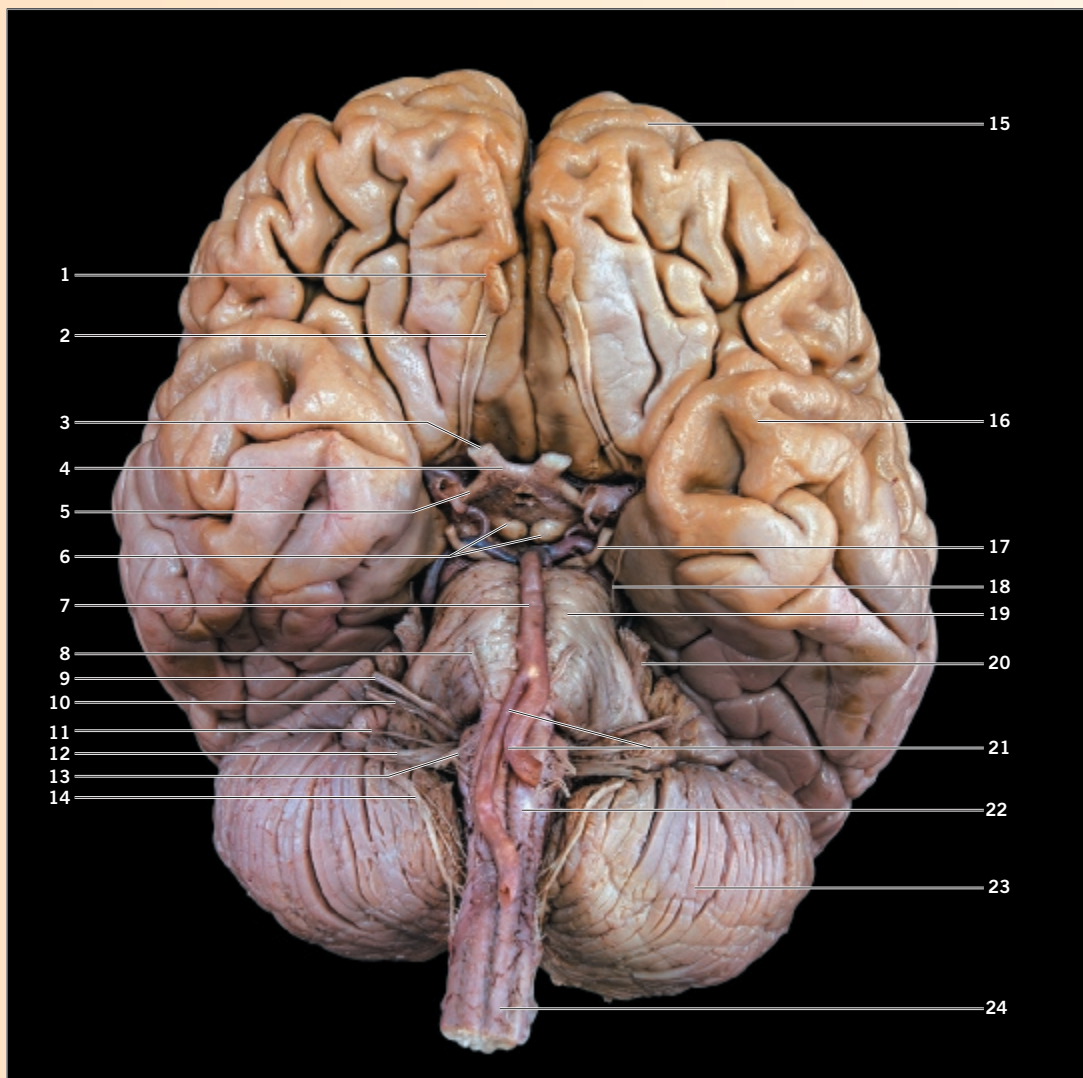


FIGURE 5.6 Brain with Cranial Nerves, Inferior View

- | | | | |
|--------------------------|------------------------------------|-----------------------------|---------------------------------|
| 1. Olfactory bulb | 8. Abducens nerve (VI) | 13. Hypoglossal nerve (XII) | 20. Trigeminal nerve (V) |
| 2. Olfactory tract | 9. Facial nerve (VII) | 14. Accessory nerve (XI) | 21. <i>Vertebral arteries</i> |
| 3. Optic nerve (II) | 10. Vestibulocochlear nerve (VIII) | 15. Frontal lobe | 22. Medulla oblongata (pyramid) |
| 4. Optic chiasma | 11. Glossopharyngeal nerve (IX) | 16. Temporal lobe | 23. Cerebellum |
| 5. Optic tract | 12. Vagus nerve (X) | 17. Oculomotor nerve (III) | 24. Spinal cord |
| 6. Mammillary bodies | | 18. Trochlear nerve (IV) | |
| 7. <i>Basilar artery</i> | | 19. Pons | |

in the Lab

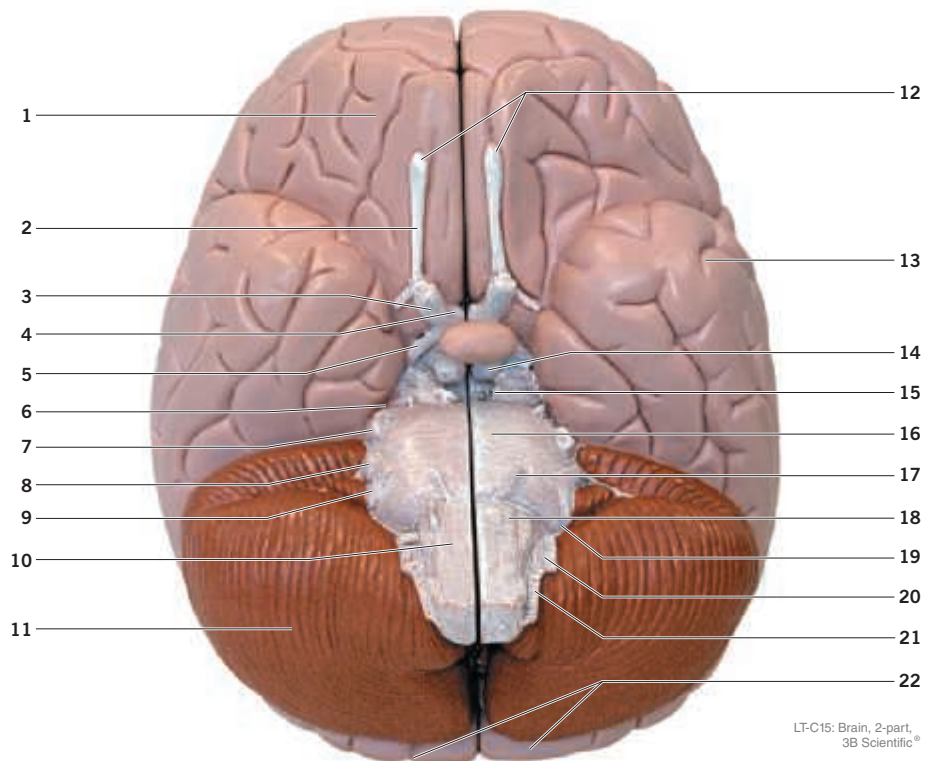
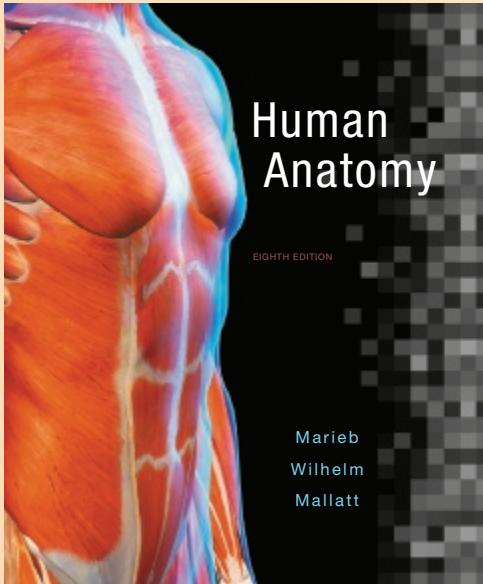


FIGURE 5.7 Brain with Cranial Nerves, Inferior View

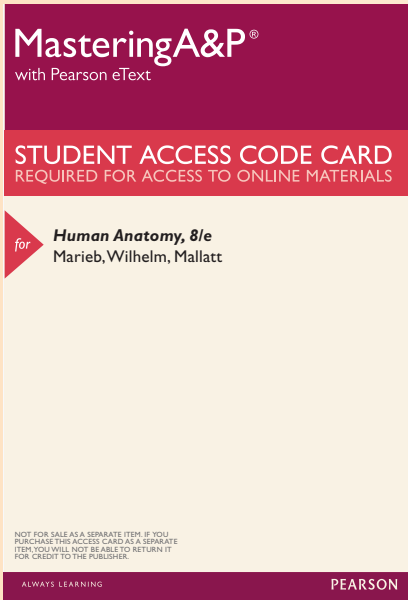
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|-------------------------|-----------------------------------|----------------------------|---------------------------------|
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| 2. Olfactory tract | 8. Vestibulocochlear nerve (VIII) | 13. Temporal lobe | 19. Glossopharyngeal nerve (IX) |
| 3. Optic nerve (II) | 9. Facial nerve (VII) | 14. Mammillary body | 20. Vagus nerve (X) |
| 4. Optic chiasma | 10. Medulla oblongata | 15. Oculomotor nerve (III) | 21. Accessory nerve (XI) |
| 5. Optic tract | 11. Cerebellum | 16. Pons | 22. Occipital lobes |
| 6. Trochlear nerve (IV) | | 17. Abducens nerve (VI) | |

Everything Your Students Need to Succeed in Lecture and Lab

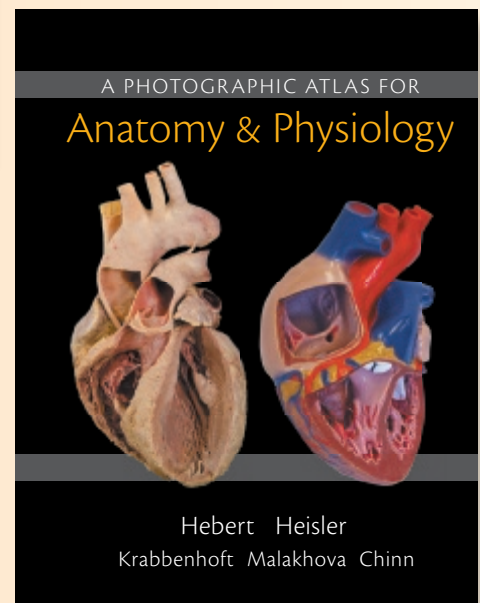


NEW! Student package for Marieb, Wilhelm, and Mallatt's *Human Anatomy*, Eighth Edition now includes MasteringA&P + *A Photographic Atlas for Anatomy & Physiology*.

**Marieb/Wilhelm/Mallatt,
Human Anatomy,
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Code for Marieb/Wilhelm/
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**Hebert et al.,
*A Photographic Atlas for
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**Hebert Heisler
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Could Your Students Use a Refresher?

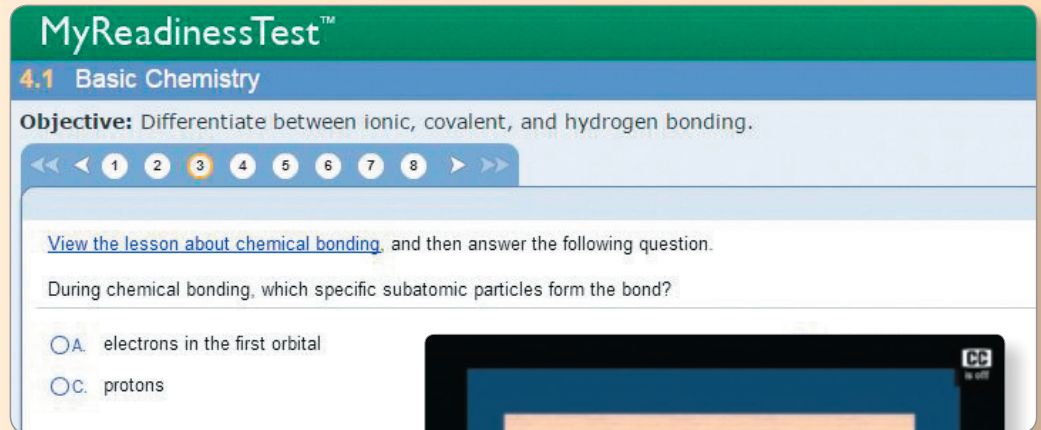
NEW!

MyReadinessTest™

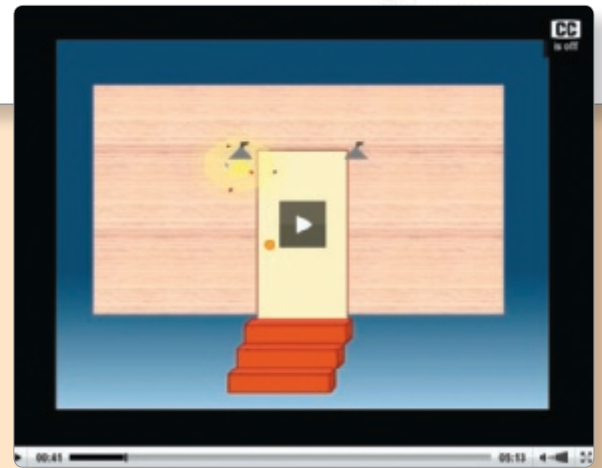
for A&P prepares students *before* their Human Anatomy course begins.

Students can get *free* online access the moment they register for your anatomy course. MyReadinessTest assesses students' proficiency in study skills and foundation concepts in science, and tutors them in core areas where they need additional practice and review, before they even set foot in an anatomy classroom. It offers:

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- ▶ **Diagnostic Test and Cumulative Test** based on learning outcomes from a widely used primer, *Get Ready for A&P* by Lori Garrett.
- ▶ **Personalized Study Plan** based on students' test results that includes practice questions with tutorials.
- ▶ **Flexible Testing** that allows instructors to edit the Diagnostic Test or implement their own placement test or exit exam.
- ▶ **Gradebook** that automatically records students' results.

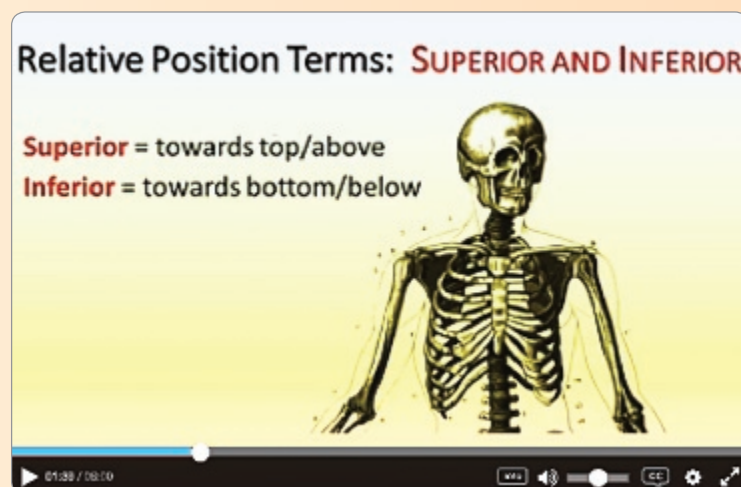


The screenshot shows the MyReadinessTest™ interface. At the top, it says "4.1 Basic Chemistry". Below that, the objective is "Differentiate between ionic, covalent, and hydrogen bonding." There is a progress bar with numbers 1 through 8, and the number 3 is highlighted. The question asks: "During chemical bonding, which specific subatomic particles form the bond?" There are two radio button options: "A. electrons in the first orbital" and "C. protons".



NEW! Five new video tutors

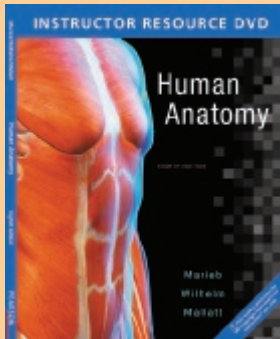
on topics such as Learning Styles, Relative Positions, Meiosis, Chemical Reactions, and Concept Mapping.



The video player shows a title "Relative Position Terms: SUPERIOR AND INFERIOR". Below the title, it defines "Superior = towards top/above" and "Inferior = towards bottom/below". To the right of the text is a 3D rendered human skeleton. The video player interface includes a progress bar at the bottom and a "CC" logo in the bottom right corner.

Supplements for Instructors

Instructor Resource DVD



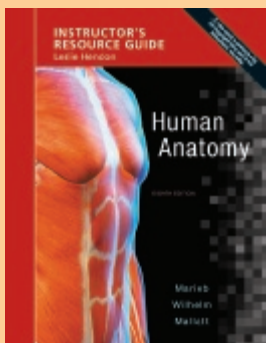
0-134-28663-4 /
978-0-134-28663-1

The Instructor Resource DVD organizes all instructor media resources by chapter into one convenient package that allows you to easily and quickly pull together a lecture.

▶ Customizable PowerPoint® Lecture Presentations, with labeled and unlabeled images.

- ▶ All figures from the book in JPEG format and PowerPoint slides
- ▶ Instructor's Resource Guide in Microsoft Word®
- ▶ Cat Dissection Videos
- ▶ A&P Flix™ Animations and Clicker Questions
- ▶ Bone and Dissection Videos
- ▶ Images from *A Brief Atlas of the Human Body*, Second Edition
- ▶ Complete Test Bank with TestGen® software
- ▶ Clicker Questions and Quiz Show Presentations
- ▶ PAL 3.0™ Instructor Resource DVD with Test Bank
- ▶ Index of anatomical structures covered in PAL 3.0 (PDF format)

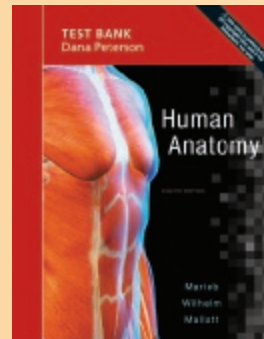
Instructor's Resource Guide



By Leslie Hendon
0-134-28661-8 /
978-0-134-28661-7

The *Instructor's Resource Guide* features an innovative Teaching with Art feature, learning objectives, suggested lecture outlines, lecture hints, media resources, suggested readings, discussion topics, answers to end-of-chapter questions, and more.

Printed Test Bank

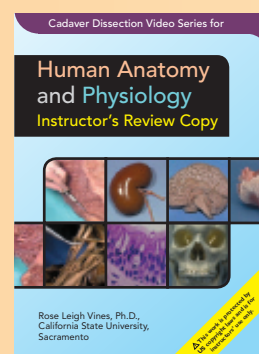


By Dana Peterson
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The Eighth Edition Test Bank covers all major topics at a range of difficulty levels. All questions in the printed Test Bank are available in Microsoft Word and TestGen formats on the IRDVD and in the Instructor Resources section of MasteringA&P®. Both

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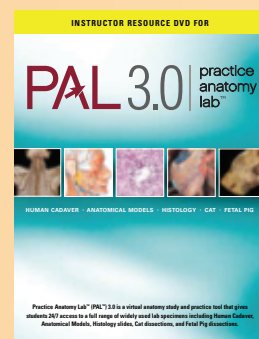
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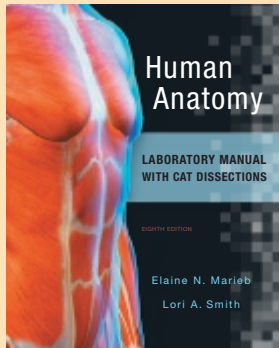
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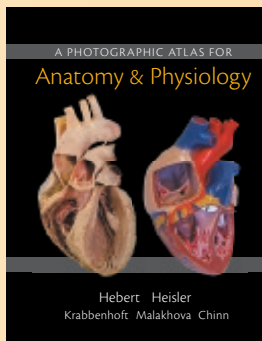


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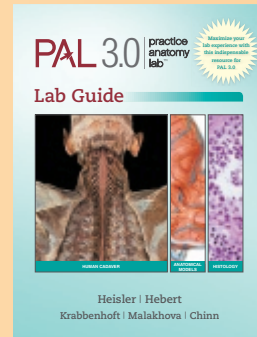
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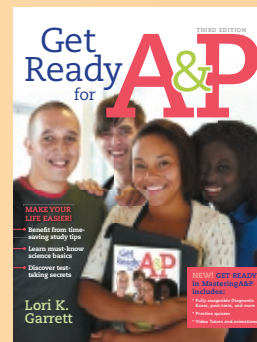
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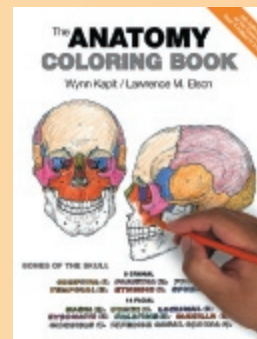
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By Lori K. Garrett
0-321-81336-7 /
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This book and online component were created to help students be better prepared for their course. Features include pre-tests, guided explanations followed by interactive quizzes and exercises, and end-of-chapter cumulative tests. Also available in the Study Area of MasteringA&P®.

The Anatomy Coloring Book, Fourth Edition



By Wynn Kapit and Lawrence M. Elson
0-321-83201-9 /
978-0-321-83201-6

For over 35 years, The Anatomy Coloring Book has been the #1 best-selling human anatomy coloring book. A useful tool for anyone with an interest in learning anatomical structures, this concisely written text features precise, extraordinary hand-drawn figures that were crafted especially for easy coloring and interactive study. Organized according to body systems, each of the 162 spreads featured in this book includes an ingenious color-key system where anatomical terminology is linked to detailed illustrations of the structures of the body.

The general philosophy behind this Eighth Edition of *Human Anatomy* remains the same as in the previous editions. As an instructor, you know that teaching anatomy is not just the presentation of 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. We have striven 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. We realize that learning anatomy involves assimilating gargantuan amounts of material, and we have tried to make our presentation as logical and accessible as possible. To this end, we present anatomy as a “story” that can be explained and understood—convincing the 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

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 allow them to perform 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.

Microscopic Anatomy

We have worked to provide an especially effective treatment of microscopic anatomy. 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. We are convinced that the fundamentals should be presented early in the text, before the more advanced discussions of the developing organ systems in the relevant chapters. Therefore, we wrote Chapter 3 as a basic introduction to embryology. Because a comprehensive presentation of embryology early in the book could be intimidating to some students, we have used a “velvet glove approach,” providing only the most important concepts 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.

Helpful Presentation of Terminology

The complex terminology of anatomy is one of the most difficult aspects of the subject to make interesting and accessible. To this end, we highlight important terms in boldfaced type, and we provide the pronunciations of more terms than do many competing texts. Also, we include the Latin or Greek translations of almost every term at the point where the term is introduced in the text. This promotes learning 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. A helpful glossary, pronunciation guide, and list of word roots and suffixes are located at the end of the text.

NEW TO THE EIGHTH EDITION

The Eighth 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.

- **Twelve updated body movement photos and seven updated facial movement photos** clearly demonstrate movements allowed by synovial joints, as well as actions of muscles of the face, scalp, and neck.
- **Two updated Focus figures**, Focus Figure 4.11 (Identifying Epithelial and Connective Tissues) and Focus Figure 15.2 (Comparing Somatic Motor and Autonomic Innervation), have been revised to better highlight and teach important, tough-to-understand concepts.
- **New and improved in-text media references** to PAL 3.0, A&P Flix animations, bone videos, animal organ dissection and cat dissection videos, and art-labeling activities in the Study Area of MasteringA&P® help students easily find helpful study tools as they are reading the book.

More Robust MasteringA&P

MasteringA&P now includes:

- **NEW! Clinical Scenario Coaching Activities** that complement lecture and lab, and can be assigned as part of in-class activities or as post-class assignments. Multiple coaching activities for each chapter include an assortment of multiple choice, sorting, labeling, and matching questions.
- **NEW! Cat Dissection Videos**, created by coauthor Patricia Wilhelm, that are assignable in MasteringA&P with hints and wrong-answer feedback. The videos without questions are also available in the Study Area of MasteringA&P. Video topics cover:
 - Superficial Muscles of the Trunk, Dorsal View
 - Deep Muscles of the Trunk, Dorsal View
 - Posterior Muscles of the Hip and Thigh
 - Brachial Plexus and Innervation of the Muscles of the Arm and Forearm
 - Digestive Structures of the Head
 - Peritoneum and Mesenteries of the Abdomen
 - Structures That Pass Through Mesenteries
 - Blood Vessels of the Thorax
 - Male Reproductive Structures
 - Female Reproductive Structures
- **NEW! Dynamic Study Modules** that help students study effectively on their own by continuously assessing their activity and performance in real time. Here's how it works: Students complete a set of questions with a unique answer format that also asks them to indicate their confidence level. Questions repeat until the student can answer them all correctly and confidently. Once completed, Dynamic Study Modules explain the concept using materials from the text. These are available as graded

assignments prior to class, and accessible on smartphones, tablets, and computers.

- **NEW! eText 2.0**, which seamlessly integrates videos and other rich media right into the reading experience. eText 2.0 is available in MasteringA&P and on smartphones and tablets. It is screen-reader ready, includes note-taking, highlighting, bookmarking, and search capabilities, and features customizable settings such as night reading mode.
- **Bone and Dissection Video Coaching Activities** review all major bones and organ dissections. Each video is supported by activities with hints and specific wrong-answer feedback.
- **UPDATED! Focus Figure Coaching Activities** expand upon the popular Focus figures in the text by guiding students through complex processes step by step with hints and specific wrong-answer feedback. The Coaching Activities for Focus Figures 4.11 and 15.2 have been updated.
- **Get Ready for A&P Diagnostic, Learning Styles, and Cumulative Tests** along with **Get Ready for A&P Video Tutors** feature award-winning teacher Lori Garrett walking students through key basic concepts needed for students to be successful in A&P. Students can take the assignable Diagnostic Test and/or Learning Styles Test in MasteringA&P to assess their base knowledge at the start of the course. Chapter assessments include Reading Questions and Video Tutor Coaching Activities. The key concepts covered include: Learning Styles, Study Skills, Basic Math Review, Terminology, Body Basics, Chemistry, and Cell Biology.
- **A&PFlix™ Coaching Activities** provide dramatic 3-D animations of key anatomy topics, including individual muscle origins, insertions, actions, and innervations, and key muscle actions and joint movement. Each animation provides practice quizzes and wrong-answer feedback.
- **Drag-and-Drop Art Labeling Activities** and Art-Based Questions
- **Practice Anatomy Lab™ 3.0** is an indispensable virtual anatomy study and practice tool that gives students 24/7 access to the most widely used lab specimens including human cadaver, anatomical models, histology, cat, and fetal pig. PAL™ 3.0 includes built-in pronunciation guides, rotatable bones, multiple choice quizzes, and fill-in-the-blank lab practical exams.
- **Practice Anatomy Lab™ 3.0 Test Bank** includes over 4,000 customizable multiple choice and fill-in-the-blank questions. With this test bank, you can assign only the structures you want your students to know.
- **Learning Catalytics™** is an interactive, classroom tool that uses students' smartphones, tablets, or laptops to engage them in more sophisticated tasks and thinking. Now included with Mastering with eText, Learning Catalytics enables you to generate classroom discussion, guide your lecture, and promote peer-to-peer learning with real-time analytics. Instructors can:
 - Pose a variety of open-ended questions that help your students develop critical thinking skills

- Monitor responses to find out where students are struggling
- Use real-time data to adjust your instructional strategy and try other ways of engaging your students during class
- Manage student interactions by automatically grouping students for discussion, teamwork, and peer-to-peer learning

ACKNOWLEDGMENTS

As we work on each new edition, we are reminded of the great pleasure of working collaboratively with dedicated, competent, and skilled professionals. This experience reinforces the importance of developing collaborative skills in our students. This edition is no different. So many individuals have been involved in the various stages of manuscript preparation, review, and production. Each person mentioned here has directly influenced and improved the final product. More important, each has been a pleasure to work with, and we thank them all.

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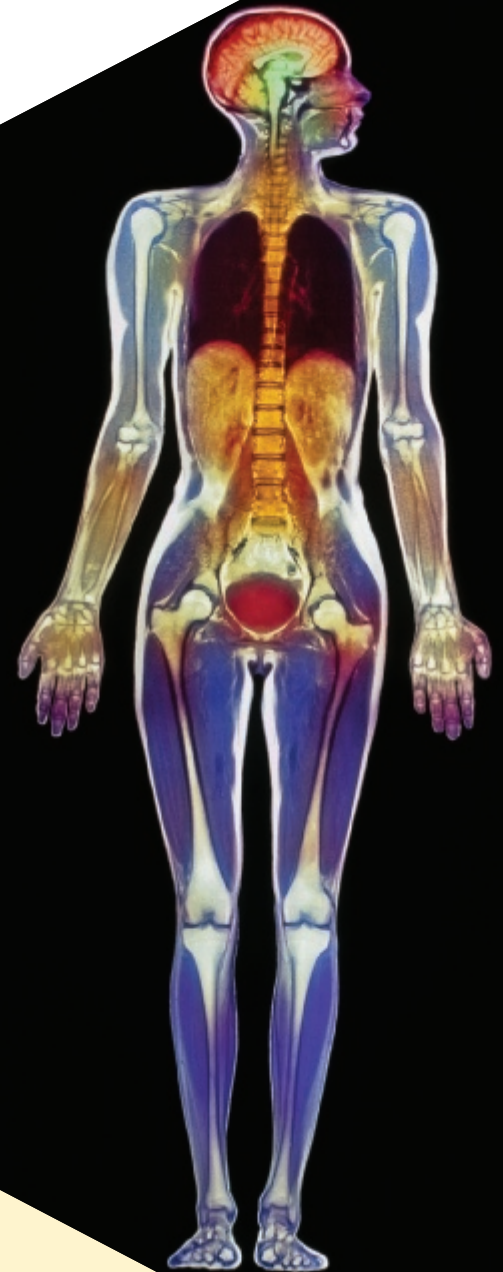
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As you read this book, you will learn about a subject that has forever fascinated people—their own bodies. The study of human anatomy is not only an interesting and highly personal experience, but also a timely one. Almost every week, the news media report advances in medical science. Understanding how your body is built and how it works allows you to appreciate newly developed techniques for detecting and treating disease and to apply guidelines for staying healthy. If you are preparing for a career in the health sciences, your knowledge of human anatomy is the foundation of your clinical practice.



Whole body scan of a woman (colored MRI). ▲

AN OVERVIEW OF ANATOMY

learning outcomes

- ▶ Define anatomy and physiology, and describe the subdisciplines of anatomy.
- ▶ Identify the levels of structural organization in the human body, and explain the interrelationships between each level.
- ▶ List the organ systems of the body, and briefly state their functions.
- ▶ Use metric units to quantify the dimensions of cells, tissues, and organs.
- ▶ Use the meaning of word roots to aid in understanding anatomical terminology.

Anatomy is the study of the structure of the human body. It is also called **morphology** (mor"fol'o-je), the science of form. An old and proud science, anatomy has been a field of serious intellectual investigation for at least 2300 years. It was the most prestigious biological discipline of the 1800s and is still dynamic.

Anatomy is closely related to **physiology**, the study of body function. Although you may be studying anatomy and physiology in separate courses, the two are truly inseparable, because structure supports function. For example, the lens of the eye is transparent and curved; it could not perform its function of focusing light if it were opaque and uncurved. Similarly, the thick, long bones in our legs could not support our weight if they were soft and thin. This textbook stresses the closeness of the relationship between structure and function. In almost all cases, a description of the anatomy of a body part is accompanied by an explanation of its function, emphasizing the structural characteristics that contribute to that function. This approach is called *functional anatomy*.

Subdisciplines of Anatomy

Anatomy is a broad field of science consisting of several subdisciplines, or branches. Each branch of anatomy studies the body's structures in a specialized way.

Gross Anatomy

Gross anatomy (*gross* = large) is the study of body structures that can be examined by the naked eye—the bones, lungs, and muscles, for example. An important technique for studying gross anatomy is **dissection** (dĭ-sek'shun; "cut apart"), in which connective tissue is removed from between the body organs so that the organs can be seen more clearly. Then the organs are cut open for viewing. The term *anatomy* is derived from Greek words meaning "to cut apart."

Studies of gross anatomy can be approached in several different ways. In **regional anatomy**, all structures in a single body region, such as the abdomen or head, are examined as a group. In **systemic** (sis-tem'ik) **anatomy**, by contrast, all the organs with related functions are studied together. For example, when studying the muscular system, you consider

the muscles of the entire body. The systemic approach to anatomy is best for relating structure to function. Therefore, it is the approach taken in most college anatomy courses and in this book. Medical schools, however, favor regional anatomy because many injuries and diseases involve specific body regions (sprained ankle, sore throat, heart disease); furthermore, surgeons need extensive and detailed knowledge of each body region.

Another subdivision of gross anatomy is **surface anatomy**, the study of shapes and markings (called *landmarks*) on the surface of the body that reveal the underlying organs. This knowledge is used to identify the muscles that bulge beneath the skin in weight lifters, and clinicians use it to locate blood vessels for placing catheters, feeling pulses, and drawing blood. Clinically useful surface landmarks are described throughout the text in reference to the organ system that they relate to. (Chapter 11 concludes with a section on surface anatomy, which integrates the anatomical relationships between skeletal and muscular structures.)

Microscopic Anatomy

Microscopic anatomy, or **histology** (his-tol'o-je; "tissue study"), is the study of structures that are so small they can be seen only with a microscope. These structures include cells and cell parts; groups of cells, called *tissues*; and the microscopic details of the organs of the body (stomach, spleen, and so on). A knowledge of microscopic anatomy is important because physiological and disease processes occur at the cellular level.

Other Branches of Anatomy

Two branches of anatomy explore how body structures form, grow, and mature. **Developmental anatomy** traces the structural changes that occur in the body throughout the life span and the effects of aging. **Embryology** is the study of how body structures form and develop before birth. A knowledge of embryology helps you understand the complex design of the adult human body and helps to explain birth defects, which are anatomical abnormalities that occur during embryonic development and are evident after birth.

Some specialized branches of anatomy are used primarily for medical diagnosis and scientific research. **Pathological** (pah-tho-loj'i-kal) **anatomy** deals with the structural changes in cells, tissues, and organs caused by disease. (**Pathology** is the study of disease.) **Radiographic** (ra"de-o'graf'ic) **anatomy** is the study of internal body structures by means of X-ray studies and other imaging techniques (see pp. 15–19). **Functional morphology** explores the functional properties of body structures and assesses the efficiency of their design.

The Hierarchy of Structural Organization

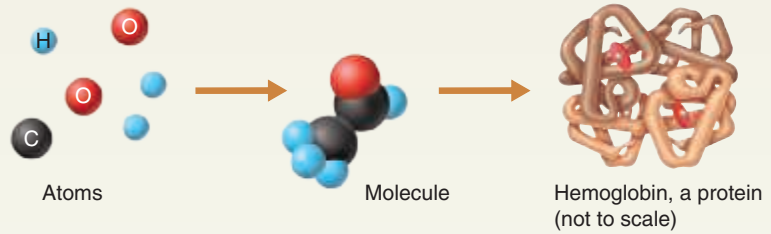
The human body has many levels of structural complexity as illustrated in Focus on Levels of Structural Organization (**Figure 1.1**). At the **chemical level**, *atoms* are tiny building blocks of matter such as carbon, hydrogen, oxygen, and

Figure 1.1

Recognizing connections between structural levels leads to better understanding of organismal function.

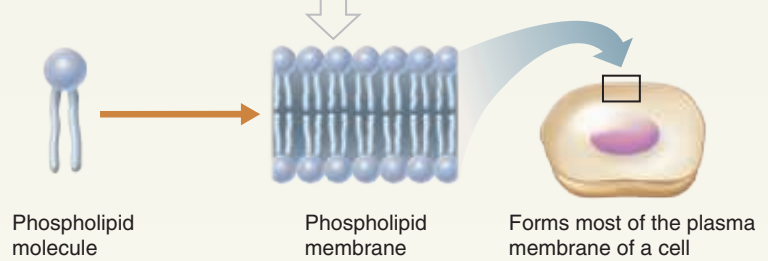
Chemical level

Atoms combine to form molecules. Molecules combine to form the macromolecules (carbohydrates, lipids, proteins, and nucleic acids).



Cellular level

Cells and their surroundings are made up of molecules. For example, a phospholipid molecule is a structural component of the plasma membrane.



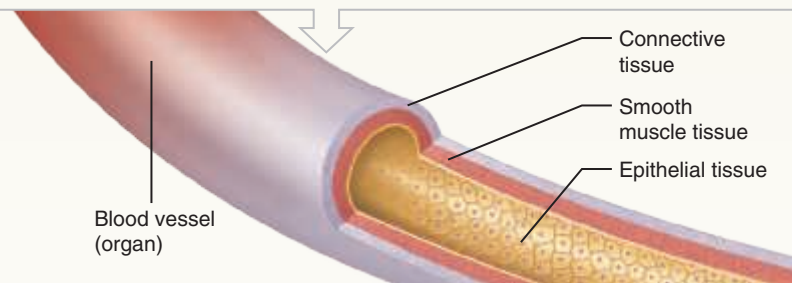
Tissue level

Tissues consist of similar types of cells and associated extracellular material. In this example, epithelial tissue forms the inner lining of blood vessels.



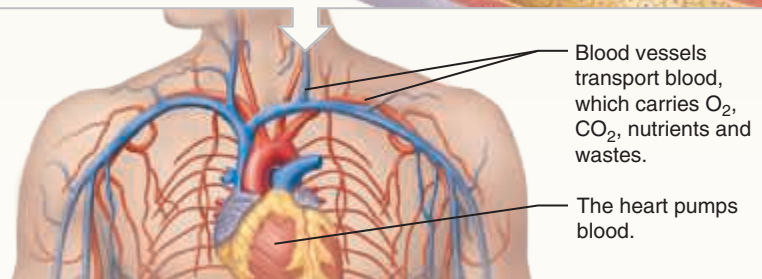
Organ level

An organ is a discrete structure made up of multiple tissue types. Examples include blood vessels, the liver, brain, and femur.



Organ system level

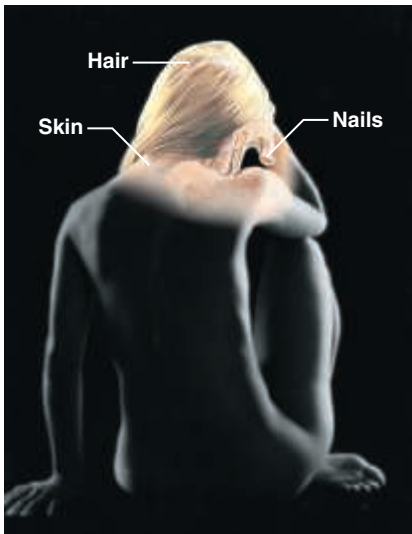
An organ system is a unified group of organs and tissues that perform a specific function. The example shown here is the cardiovascular system, showing blood vessels, blood, and the heart.



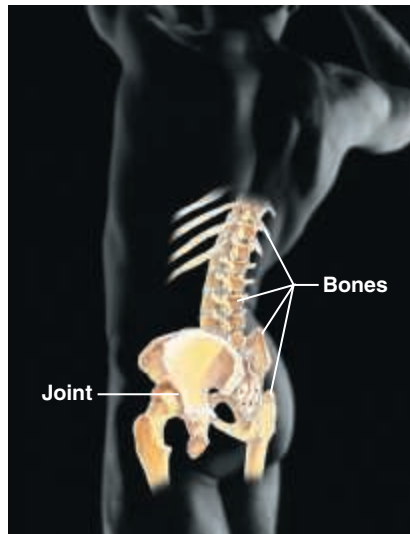
Organismal level

The whole person is the most complex level of organization, the organismal level, resulting from the simpler levels working interdependently.

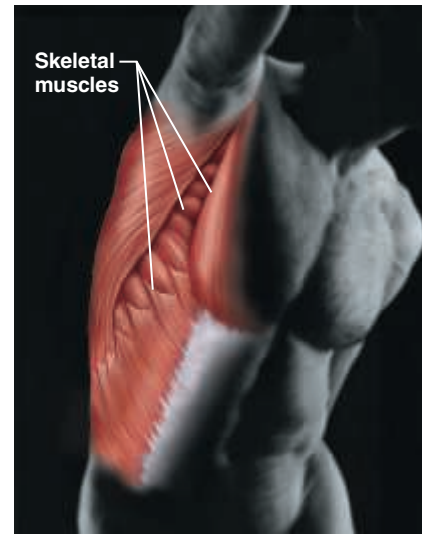




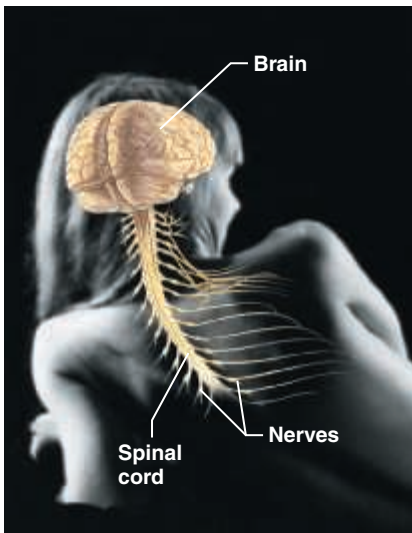
(a) Integumentary System
Forms the external body covering and protects deeper tissues from injury. Synthesizes vitamin D and houses cutaneous receptors (pain, pressure, etc.) and sweat and oil glands.



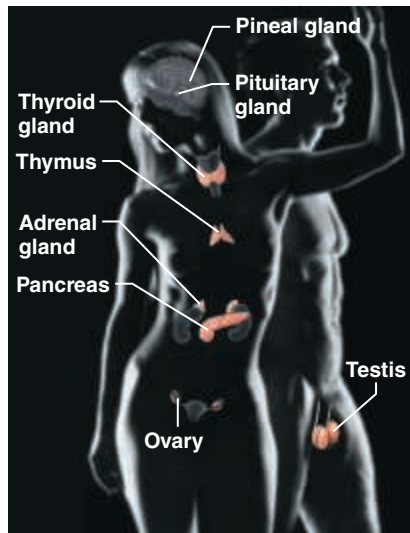
(b) Skeletal System
Protects and supports body organs and provides a framework the muscles use to cause movement. Blood cells are formed within bones. Bones store minerals.



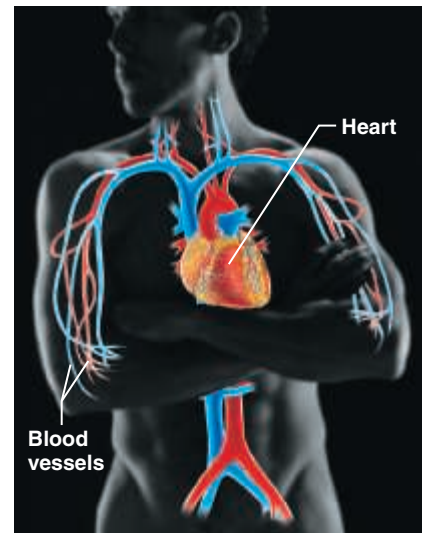
(c) Muscular System
Allows manipulation of the environment, locomotion, and facial expression. Maintains posture and produces heat.



(d) Nervous System
As the fast-acting control system of the body, it responds to internal and external changes by activating appropriate muscles and glands.



(e) Endocrine System
Glands secrete hormones that regulate processes such as growth, reproduction, and nutrient use (metabolism) by body cells.



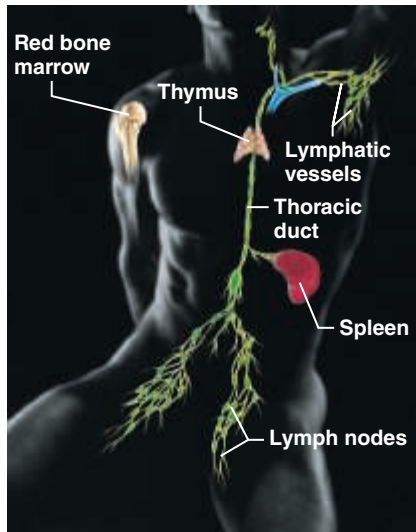
(f) Cardiovascular System
Blood vessels transport blood, which carries oxygen, carbon dioxide, nutrients, wastes, etc. The heart pumps blood.

Figure 1.2 The body's organ systems and their major functions.

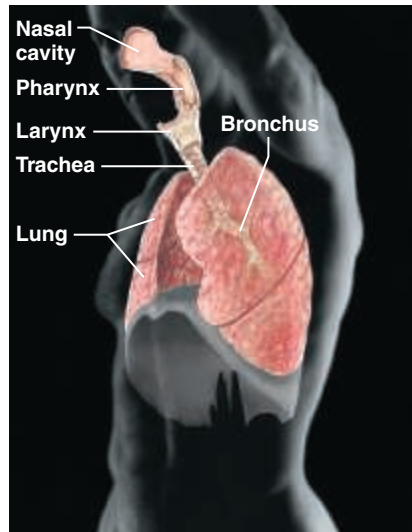
nitrogen. Atoms combine to form small *molecules*, such as carbon dioxide (CO₂) and water (H₂O), and larger *macromolecules* (*macro* = big). Four classes of macromolecules are found in the body: carbohydrates (sugars), lipids (fats), proteins, and nucleic acids (DNA, RNA). These macromolecules are the building blocks of the structures at the **cellular level**: the *cells* and their functional subunits, called *cellular organelles*. Macromolecules also contribute to the metabolic

functions of the cells as an energy source (carbohydrates), as signaling molecules (proteins and lipid hormones), and as catalysts (enzymes). Cells are the smallest living things in the body, and you have trillions of them.

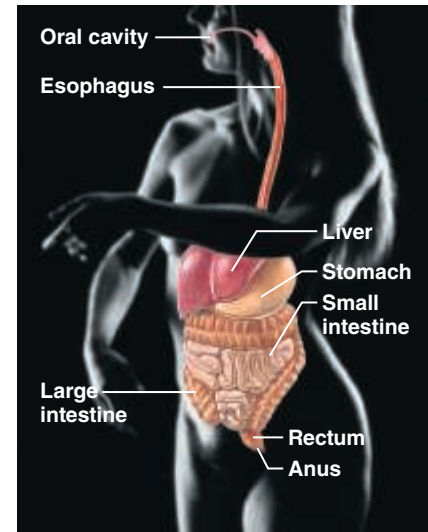
The next level is the **tissue level**. A tissue is a group of cells that work together to perform a common function. Only four tissue types make up all organs of the human body: epithelial tissue (epithelium), connective tissue, muscle tissue, and nervous

**(g) Lymphatic System/Immunity**

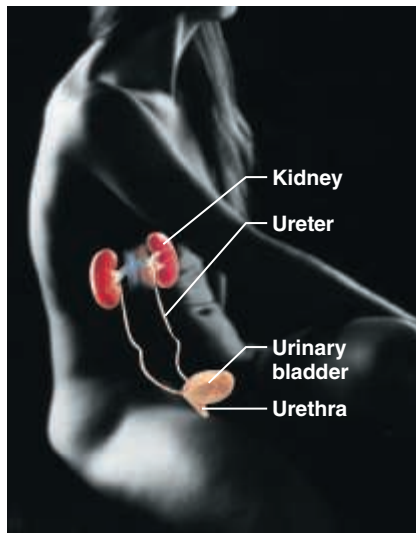
Picks up fluid leaked from blood vessels and returns it to blood. Disposes of debris in the lymphatic stream. Houses white blood cells (lymphocytes) involved in immunity. The immune response mounts the attack against foreign substances within the body.

**(h) Respiratory System**

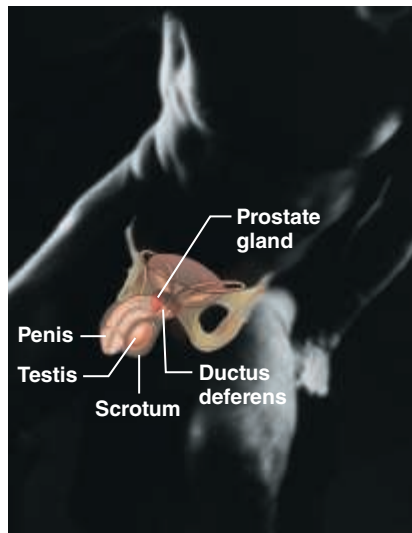
Keeps blood constantly supplied with oxygen and removes carbon dioxide. The gaseous exchanges occur through the walls of the air sacs of the lungs.

**(i) Digestive System**

Breaks down food into absorbable units that enter the blood for distribution to body cells. Indigestible foodstuffs are eliminated as feces.

**(j) Urinary System**

Eliminates nitrogenous wastes from the body. Regulates water, electrolyte, and acid-base balance of the blood.

**(k) Male Reproductive System**

Overall function is production of offspring. Testes produce sperm and male sex hormone, and male ducts and glands aid in delivery of sperm to the female reproductive tract. Ovaries produce eggs and female sex hormones. The remaining female structures serve as sites for fertilization and development of the fetus. Mammary glands of female breasts produce milk to nourish the newborn.

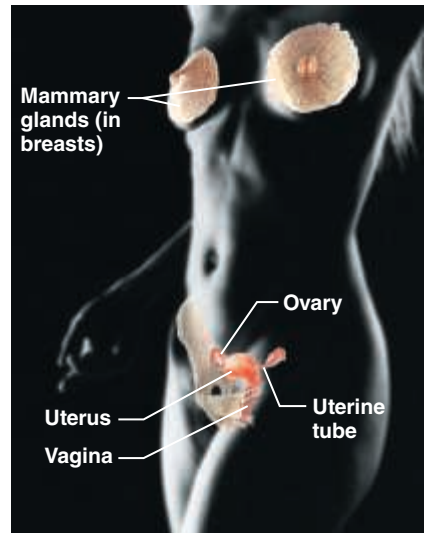
**(l) Female Reproductive System**

Figure 1.2 The body's organ systems and their major functions, *continued*.

tissue. Each tissue plays a characteristic role in the body. Briefly, epithelium (ep"i-the'le-um) covers the body surface and lines its cavities; connective tissue supports the body and protects its organs; muscle tissue provides movement; and nervous tissue provides fast internal communication by transmitting electrical impulses.

Extremely complex physiological processes occur at the **organ level**. An organ is a discrete structure made up of more

than one tissue. Most organs contain all four tissues. The liver, brain, femur, and heart are good examples. You can think of each organ in the body as a functional center responsible for an activity that no other organ can perform.

Organs that work closely together to accomplish a common purpose make up an **organ system**, the next level (**Figure 1.2**). For example, organs of the cardiovascular system—the heart

and blood vessels—transport blood to all body tissues. Organs of the digestive system—the mouth, esophagus, stomach, intestine, and so forth—break down the food we eat so that we can absorb the nutrients into the blood. The body’s organ systems are the *integumentary* (skin), *skeletal*, *muscular*, *nervous*, *endocrine*, *cardiovascular*, *lymphatic*, *immune*, *respiratory*, *digestive*, *urinary*, and *reproductive* systems.*

The highest level of organization is the **organismal level**; for example, the human organism is a whole living person. The organismal level is the result of all of the simpler levels working in unison to sustain life.

Scale: Length, Volume, and Weight

To describe the dimensions of cells, tissues, and organs, anatomists need a precise system of measurement. The **metric system** provides such precision (Appendix A). Familiarity with this system lets you understand the sizes, volumes, and weights of body structures.

An important unit of *length* is the **meter (m)**, which is a little longer than a yardstick. If you are 6 feet tall, your height is 1.83 meters. Most adults are between 1.5 and 2 meters tall. A **centimeter (cm)** is a hundredth of a meter (*cent* = hundred). You can visualize this length by remembering that a nickel is about 2 cm in diameter. Many of our organs are several centimeters in height, length, and width. A **micrometer (μm)** is a millionth of a meter (*micro* = millionth). Cells, organelles (structures found inside cells), and tissues are measured in micrometers. Human cells average about 10 μm in diameter, although they range from 5 μm to 100 μm. The human cell with the largest diameter, the egg cell (ovum), is about the size of the tiniest dot you could make on this page with a pencil.

The metric system also measures *volume* and *weight* (mass). A **liter (l)** is a volume slightly larger than a quart; soft drinks are packaged in 1-liter and 2-liter bottles. A **milliliter (ml)** is one-thousandth of a liter (*milli* = thousandth). A **kilogram (kg)** is a mass equal to about 2.2 pounds, and a **gram (g)** is a thousandth of a kilogram (*kilo* = thousand).

Anatomical Terminology

Most anatomical terms are based on ancient Greek or Latin words. For example, the arm is the brachium (bra'ke-um; Greek for “arm”), and the thigh bone is the femur (fe'mer; Latin for “thigh”). This terminology, which came into use when Latin was the official language of science, provides a standard nomenclature that scientists can use worldwide, no matter what language they speak. This text will help you learn anatomical terminology by explaining the origins of selected terms as you encounter them. Dividing an unfamiliar term into its word roots will help you understand its meaning. For example, the word *hepatitis* is made up of *hepata*, “liver,” and *itis*, “inflammation”; thus, hepatitis is inflammation of the liver. For further help, see the Glossary in the back of the book, and the list of word roots inside the back cover of the book.**

*The cardiovascular and lymphatic systems are collectively known as the *circulatory system* because of their interrelated roles in circulating fluids (blood and lymph) through the body.

✓ check your understanding

- 1. What is the difference between histology and radiography?
- 2. Use the word root definitions located in the end pages of this text to define each of the terms listed: pathology, hepatitis, brachial, leukocyte, pneumonia.
- 3. Define a tissue. List the four types of tissues in the body, and briefly state the function of each.
- 4. Name the organ system described in each of the following: (a) eliminates wastes and regulates water and ion balance; (b) fast-acting control system that integrates body activities; (c) supplies blood with oxygen and removes carbon dioxide.

(For answers, see Appendix B.)

GROSS ANATOMY: AN INTRODUCTION

learning outcomes

- ▶ Define the anatomical position.
- ▶ Use anatomical terminology to describe body directions, regions, and planes.
- ▶ Describe the basic structures that humans share with other vertebrates.
- ▶ Locate the major body cavities and their subdivisions.
- ▶ Name the four quadrants of the abdomen, and identify the visceral organs located within each quadrant.

Regional and Directional Terms

To accurately describe the various body parts and their locations, you need to use a common visual reference point. This reference point is the **anatomical position (Figure 1.3a)**. In this position, a person stands erect with feet flat on the ground, toes pointing forward, and eyes facing forward. The palms face anteriorly with the thumbs pointed away from the body. It is essential to learn the anatomical position because most of the directional terminology used in anatomy refers to the body in this position. Additionally, the terms *right* and *left* always refer to those sides belonging to the person or cadaver being viewed—not to the right and left sides of the viewer.

Regional terms are the names of specific body areas. The fundamental divisions of the body are the *axial* and *appendicular* (ap'en-dik'u-lar) *regions*. The **axial region**, so named because it makes up the main axis of the body, consists of the *head*, *neck*, and *trunk*. The trunk, in turn, is divided into the *thorax* (chest), *abdomen*, and *pelvis*; the trunk also includes the region around the anus and external genitals, called the *perineum* (per'ī-ne'um; “around the anus”). The **appendicular region** of the body consists of

**For a guide to pronunciation, see the Glossary.

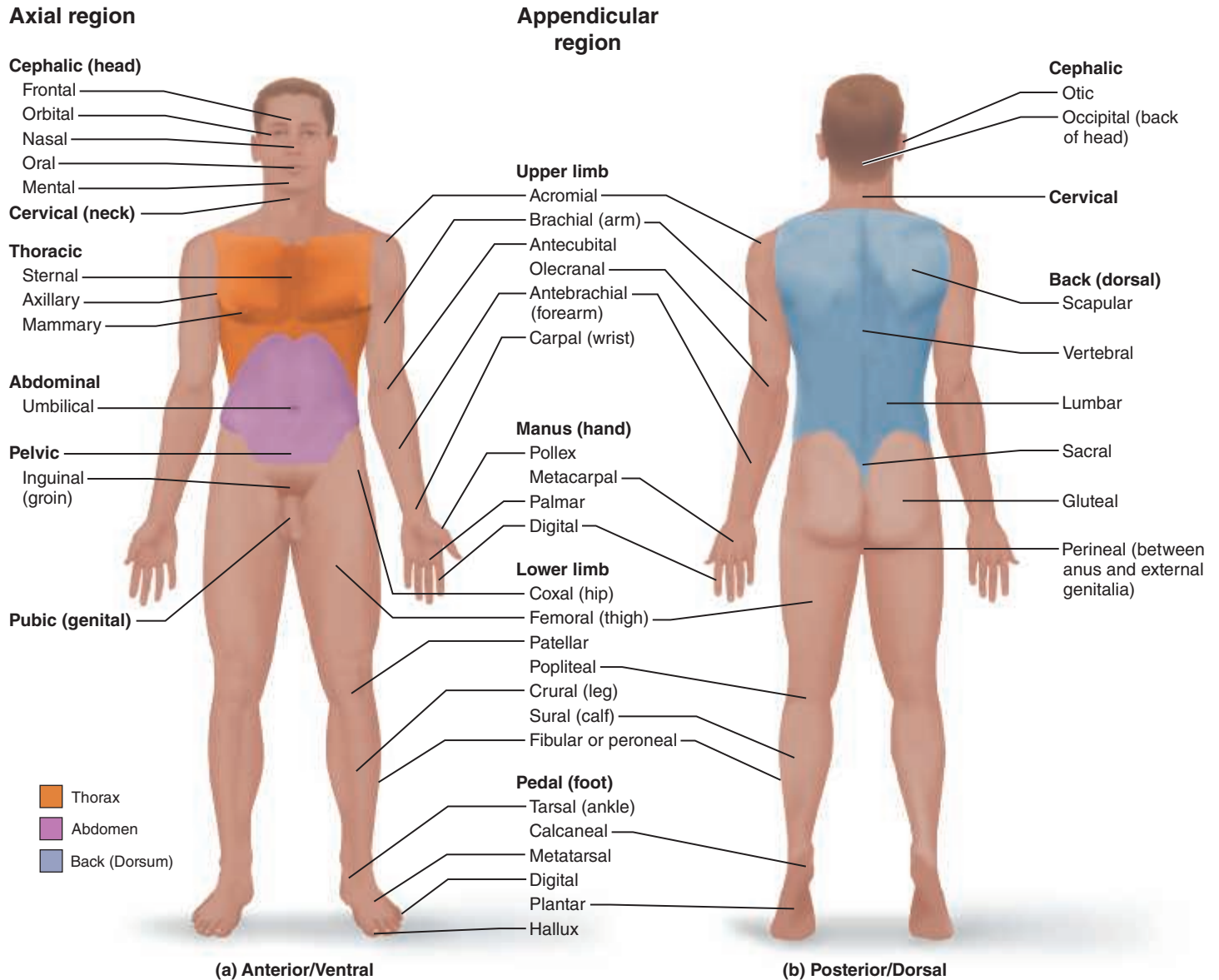
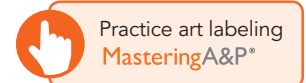


Figure 1.3 Anatomical position and regional terms.



the limbs, which are also called *appendages* or *extremities*. The fundamental divisions of the body are subdivided into smaller regions (as shown in Figure 1.3).

Standard directional terms are used by medical personnel and anatomists to explain precisely where one body structure lies in relation to another. For example, you could describe the relationship between the eyebrows and the nose informally by stating, “The eyebrows are at each side of the face to the right and left of the nose and higher than the nose.” In anatomical terminology, this is condensed to, “The eyebrows are lateral and superior to the nose.” Clearly, the anatomical terminology is less wordy and confusing. Most often used are the paired terms **superior/inferior**, **anterior (ventral)/posterior (dorsal)**, **medial/lateral**, and **superficial/deep** (Table 1.1).

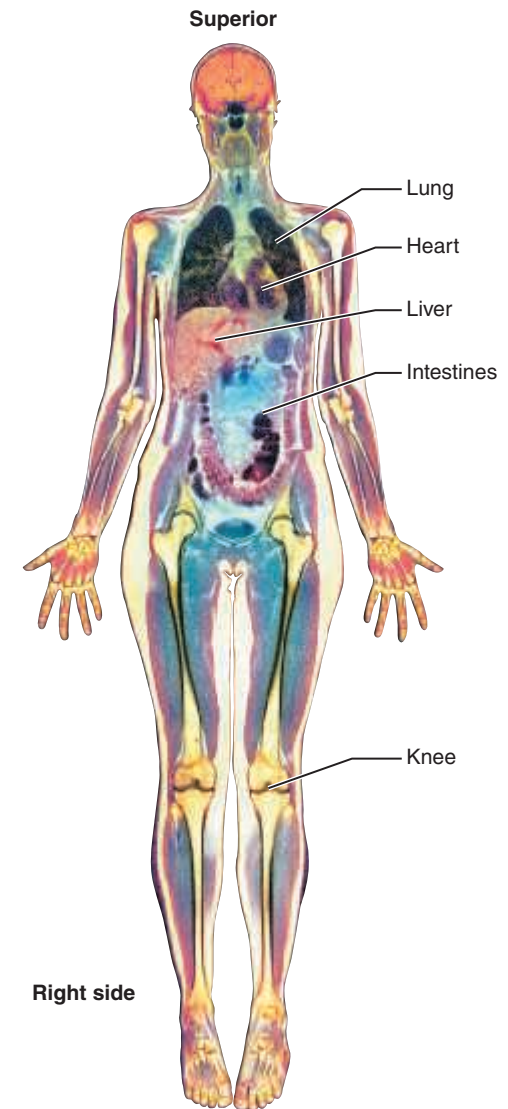
Body Planes and Sections

In the study of anatomy, the body is often *sectioned* (cut) along a flat surface called a *plane*. The most frequently used body planes are sagittal, frontal, and transverse planes, which lie at right angles to one another (Figure 1.4). A section bears the name of the plane along which it is cut. Thus, a cut along a sagittal plane produces a sagittal section.

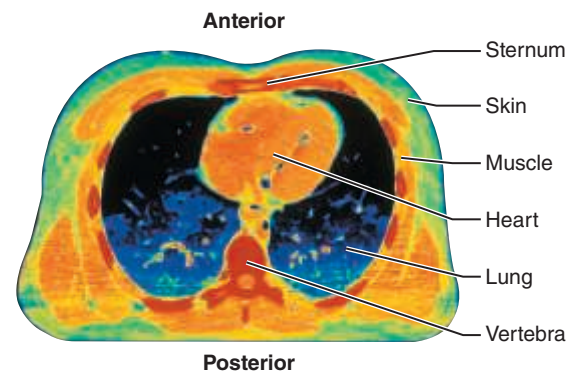
A **sagittal plane** (sag’ ĭ-tal; “arrow”) extends vertically and divides the body into left and right parts (Figure 1.4a). The specific sagittal plane that lies exactly in the midline is the **median plane**, or **midsagittal plane**. All other sagittal planes, offset from the midline, are **parasagittal** (*para* = near). A **frontal (coronal) plane** also extends vertically and divides the body into anterior and posterior parts (Figure 1.4b). A **transverse (horizontal) plane** runs horizontally

Table 1.1 Orientation and Directional Terms

Term	Definition/Example
Superior (cranial)	Toward the head end or upper part of a structure or the body; above <i>The head is superior to the abdomen.</i>
Inferior (caudal)	Away from the head end or toward the lower part of a structure or the body; below <i>The intestines are inferior to the liver.</i>
Medial	Toward or at the midline of the body; on the inner side of <i>The heart is medial to the lungs.</i>
Lateral	Away from the midline of the body; on the outer side of <i>The thumb is lateral to the pinky.</i>
Proximal	Closer to the origin of the body part or the point of attachment of a limb to the body trunk <i>The elbow is proximal to the wrist.</i>
Distal	Farther from the origin of a body part or the point of attachment of a limb to the body trunk <i>The knee is distal to the thigh.</i>
Ipsilateral	On the same side <i>The right hand and right foot are ipsilateral.</i>
Contralateral	On opposite sides <i>The right hand and left foot are contralateral.</i>
Anterior (ventral)*	Toward or at the front of the body; in front of <i>The sternum is anterior to the heart.</i>
Posterior (dorsal)*	Toward or at the back of the body; behind <i>The vertebra is posterior to the heart.</i>
Superficial (external)	Toward or at the body surface <i>The skin is superficial to the skeletal muscles.</i>
Deep (internal)	Away from the body surface; more internal <i>The lungs are deep to the skin.</i>



Whole body MRI, frontal section, anterior view



CT scan, transverse section through thorax

*Whereas the terms *ventral* and *anterior* are synonymous in humans, this is not the case in four-legged animals. *Ventral* specifically refers to the "belly" of a vertebrate animal and thus is the inferior surface of four-legged animals. Likewise, although the dorsal and posterior surfaces are the same in humans, the term *dorsal* specifically refers to an animal's back. Thus, the dorsal surface of four-legged animals is their superior surface.

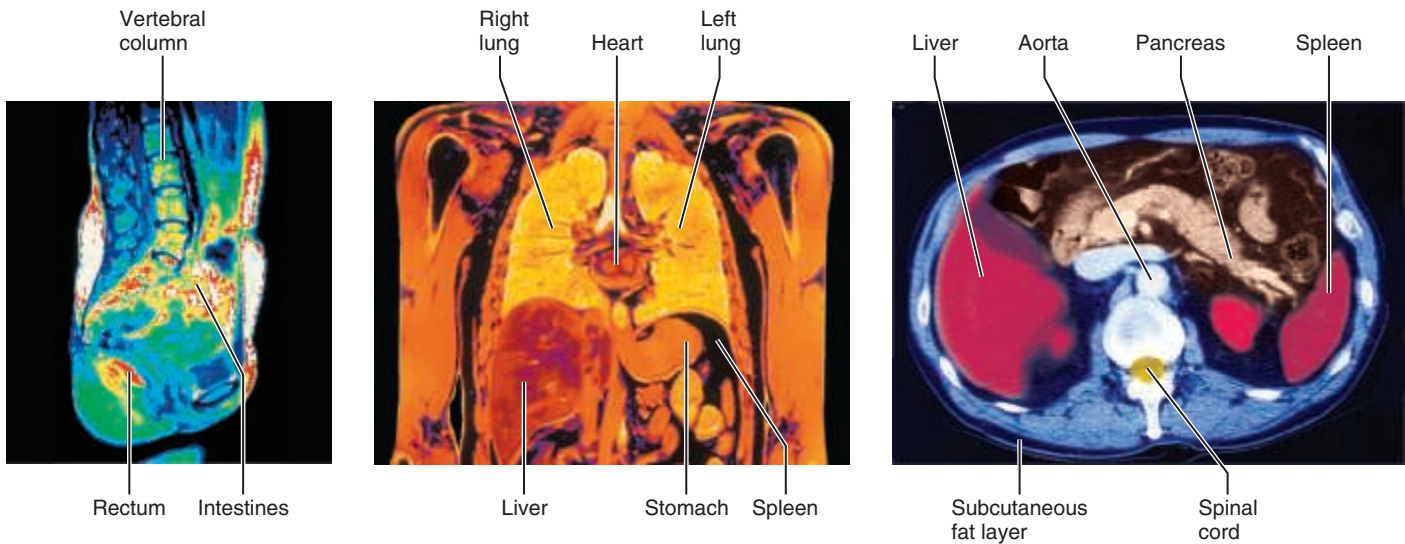


Figure 1.4 Planes of the body with corresponding magnetic resonance imaging (MRI) scans.

from right to left, dividing the body into superior and inferior parts (Figure 1.4c). A transverse section is also called a **cross section**.

Cuts made along any plane that lies diagonally between the horizontal and the vertical are called **oblique sections**. Not frontal, transverse, or sagittal, such oblique sections are difficult to interpret because the orientation of the view is not obvious. For this reason, oblique sections are seldom used.

The ability to interpret sections through the body, especially transverse sections, is increasingly important in the clinical sciences. Many medical imaging devices (described on pp. 16–19) produce sectional images rather than three-dimensional images. It can be difficult, however, to decipher an object’s overall shape from a sectional view alone. A cross section of a banana, for example, looks like a circle and gives no indication of the whole banana’s crescent shape.