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Human Anatomy

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Human Anatomy

EIGHTH EDITION

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PEARSON

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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.

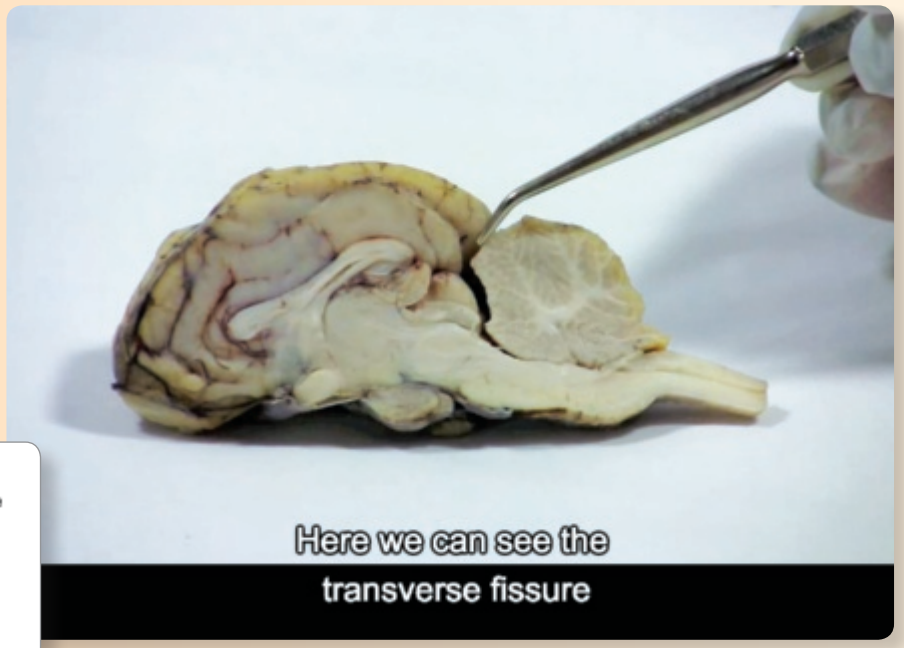
In addition to teaching, Dr. Wilhelm contributes to the development of media tools for human anatomy instruction and is a reviewer for *Anatomical Sciences Education*. She is a member of Sigma Xi, the Human Anatomy and Physiology Society (HAPS), the American Association of Anatomists (AAA), and the PULSE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

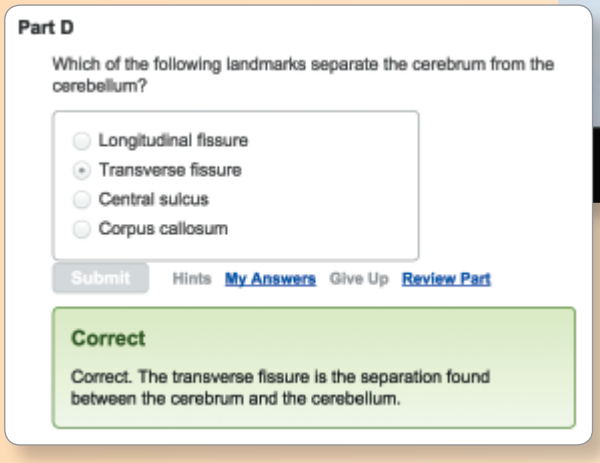
Jon Mallatt

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

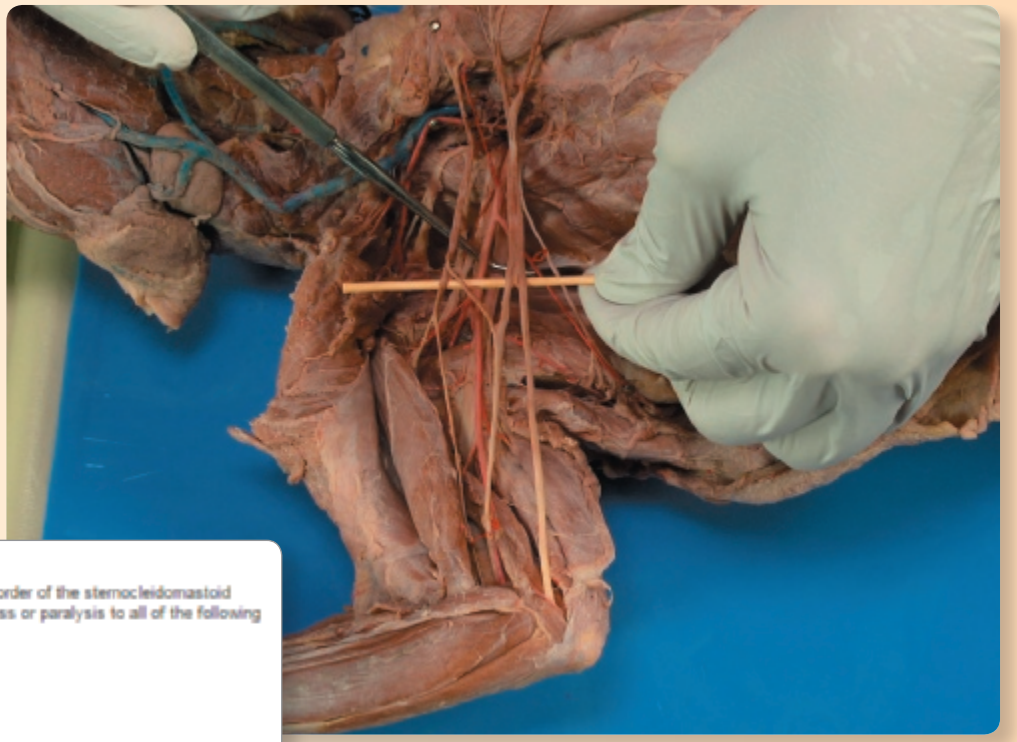
Bone and Organ Dissection Videos cover major bone and organ dissections to help students prepare for lecture and lab.

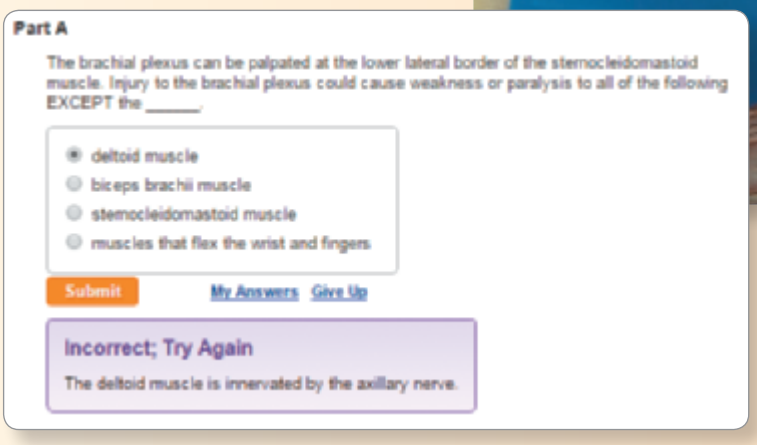


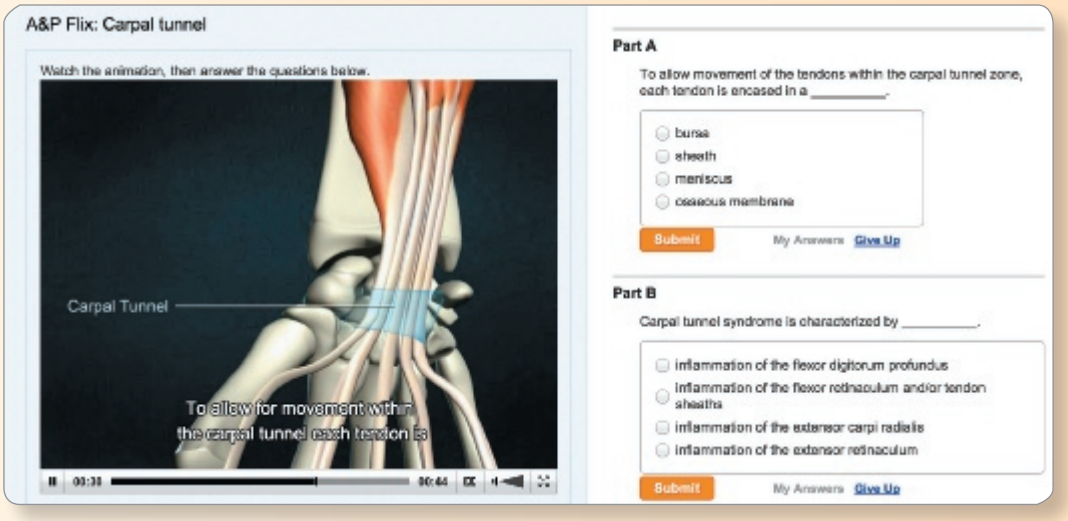


with MasteringA&P® Assignments

NEW! Cat Dissection Videos help students prepare for cat dissection lab and identify key anatomical structures.



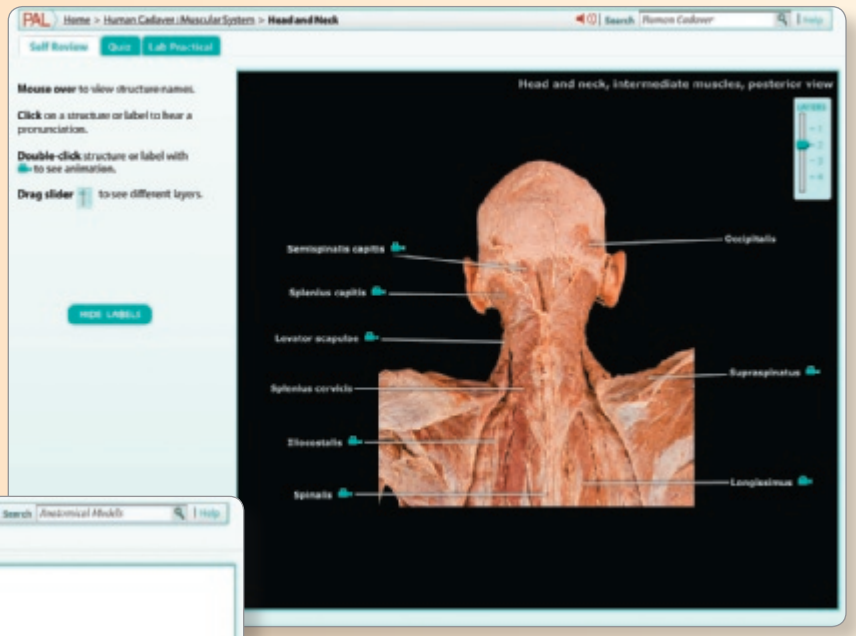


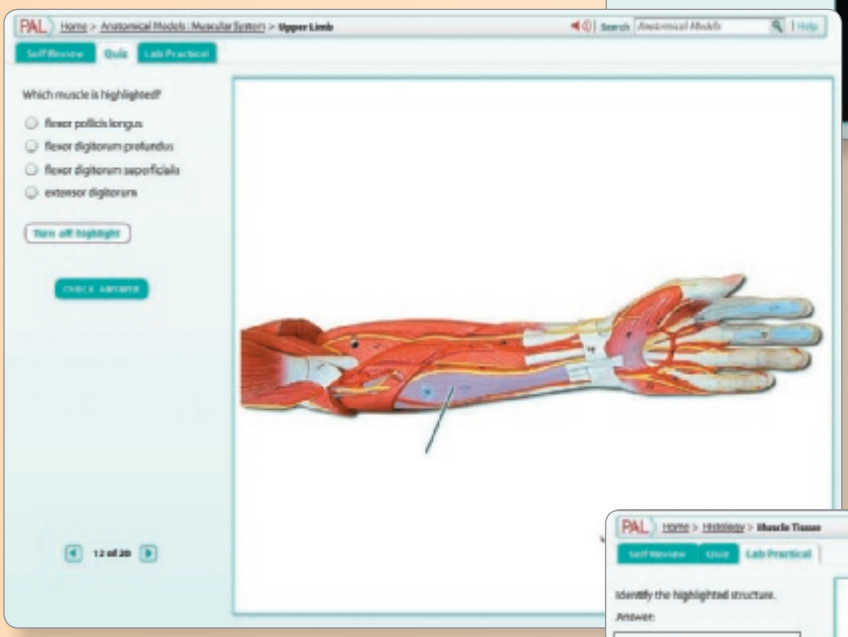


A&P Flix™ Animations are 3D movie-quality animations that help students visualize joint movements and origins, insertions, actions and innervations of over 65 muscles.

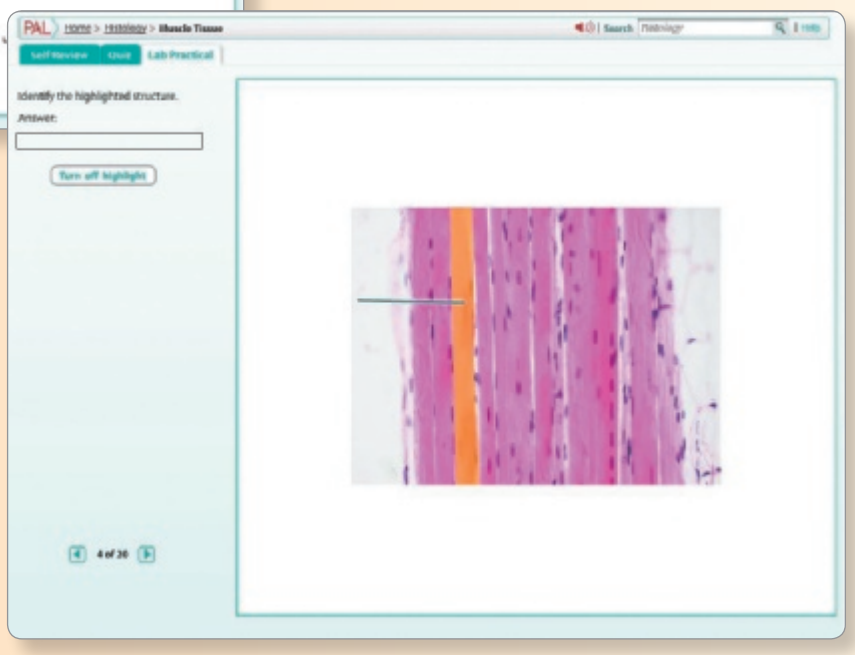
Give Your Students Access to Lab

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.

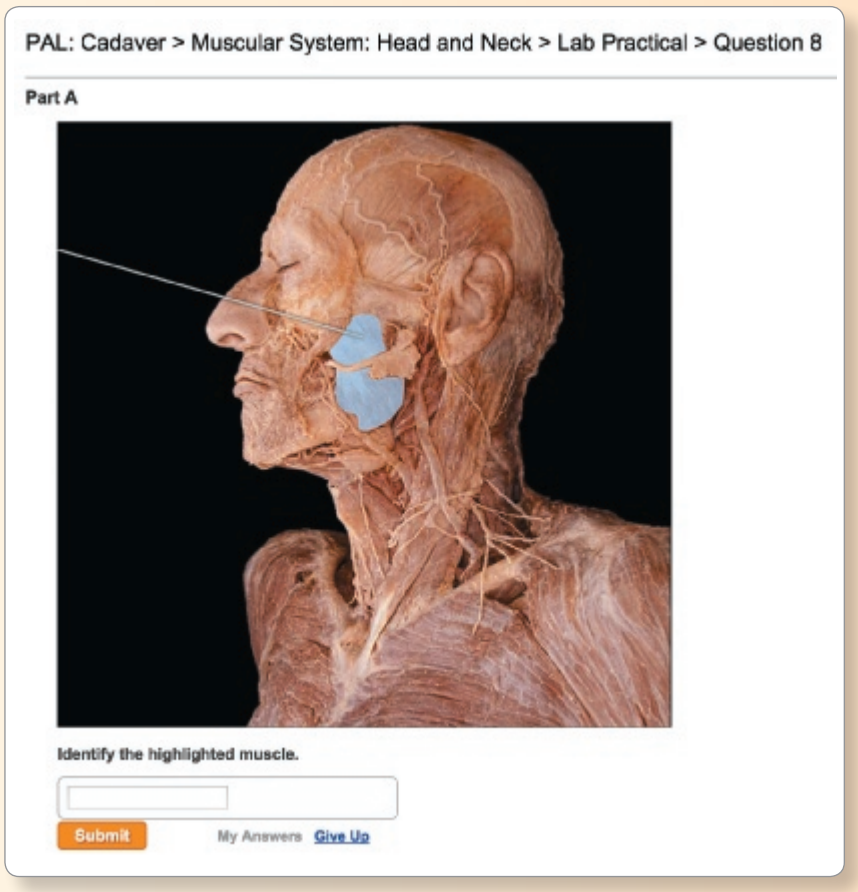




PAL 3.0 includes randomized multiple-choice quizzes and fill-in-the-blank lab practical questions.

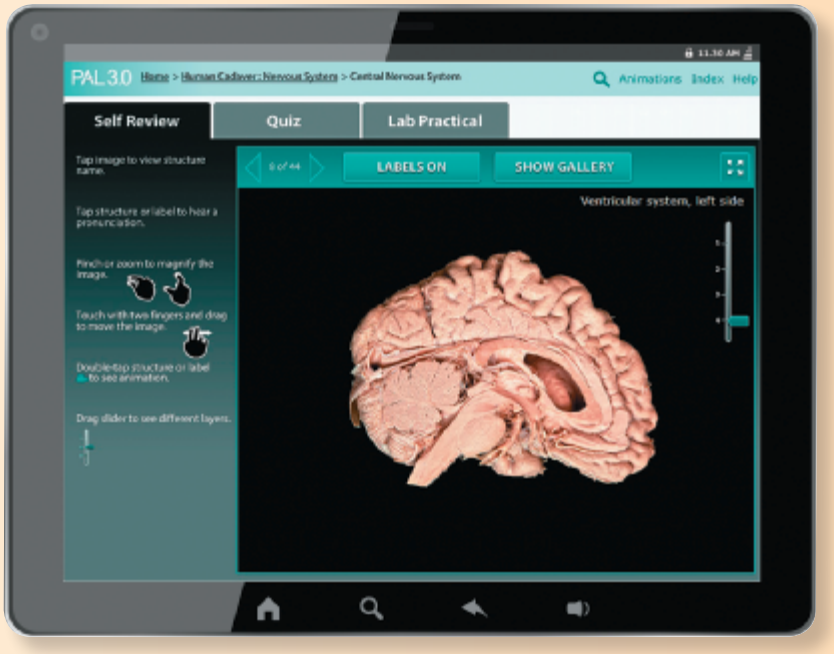


Practice 24/7 with MasteringA&P®



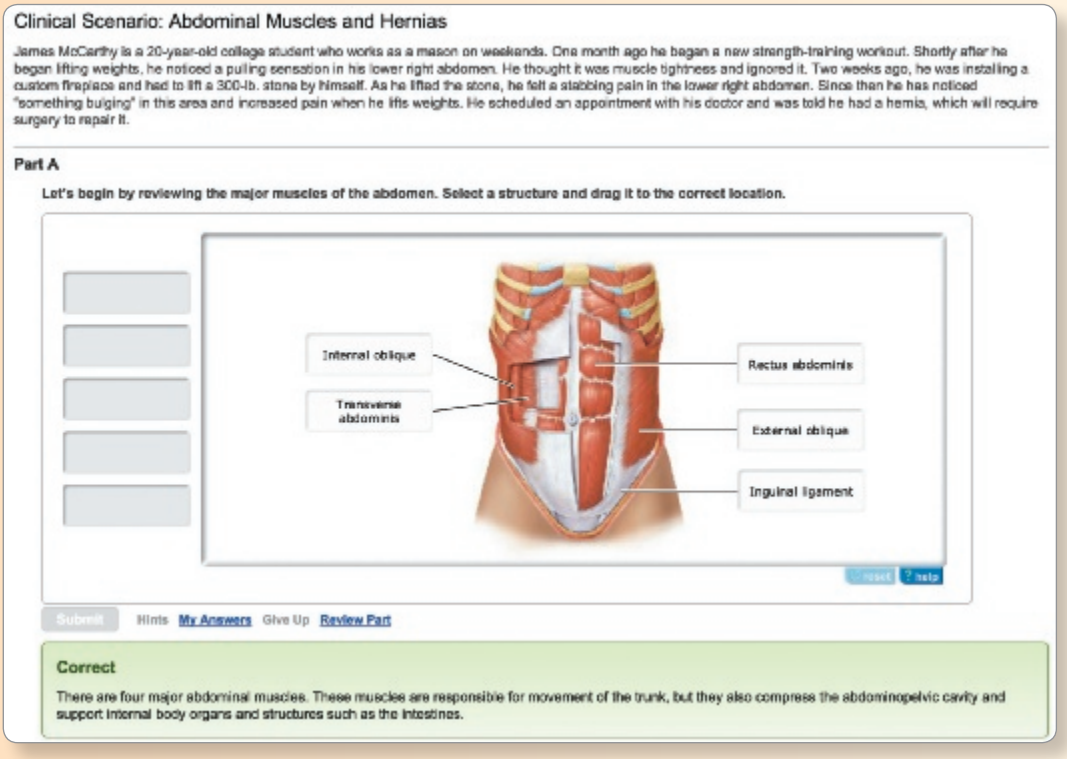
Assign only the structures you want your students to know by using the PAL™ 3.0 Test Bank. The PAL 3.0 Test Bank includes over 4,000 customizable questions.

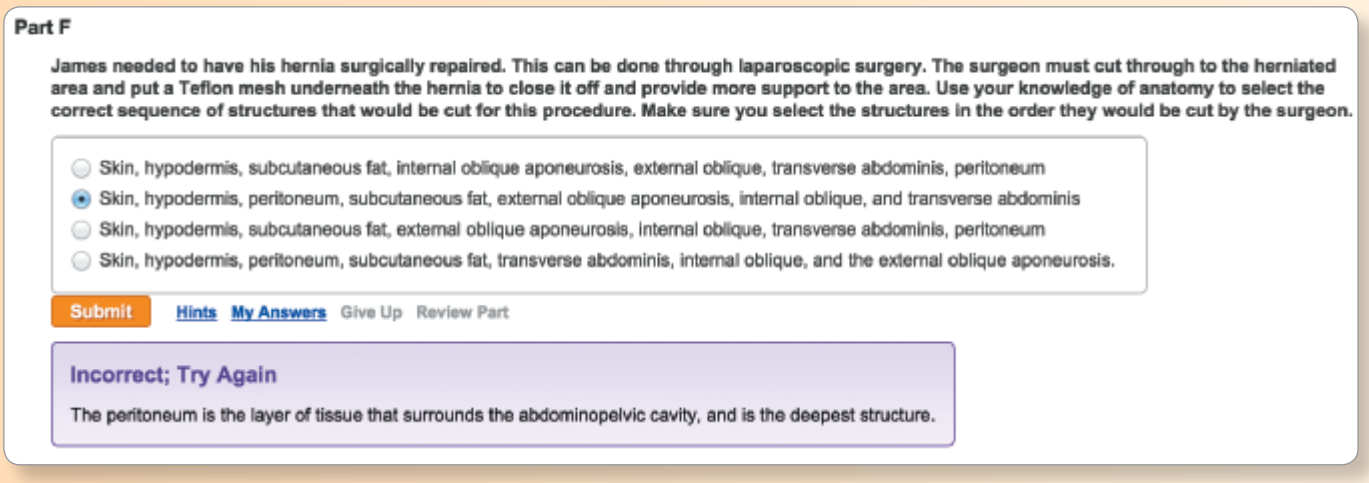
The PAL 3.0 App lets students access PAL 3.0 on their iPad or Android tablet. Students can enlarge images, watch animations, and study for lab practicals with multiple-choice and fill-in-the-blank quizzes—all while on the go!



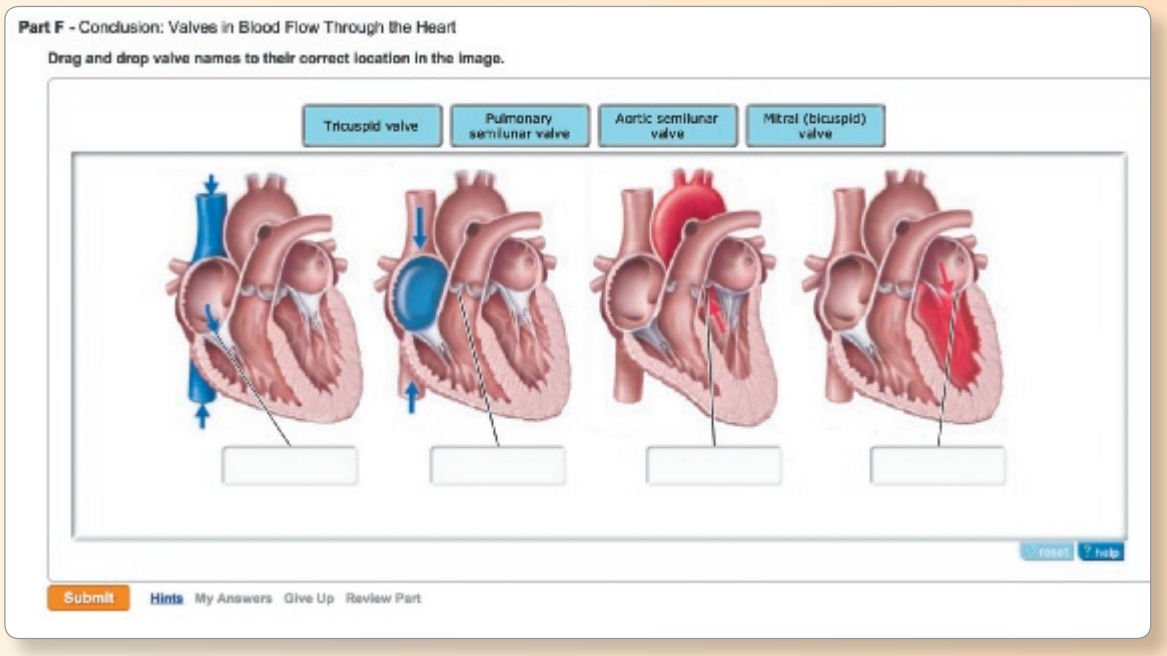
Engage Your Students in Higher-

NEW!
Clinical Scenario Coaching Activities use real world examples and art from the book to engage students.

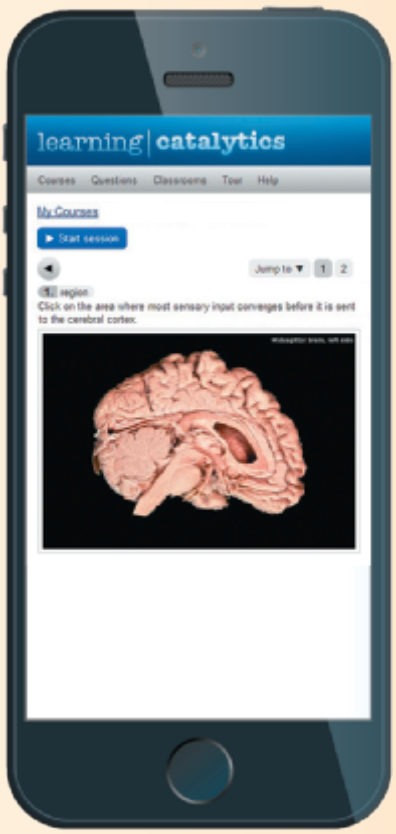




Level Thinking with MasteringA&P®



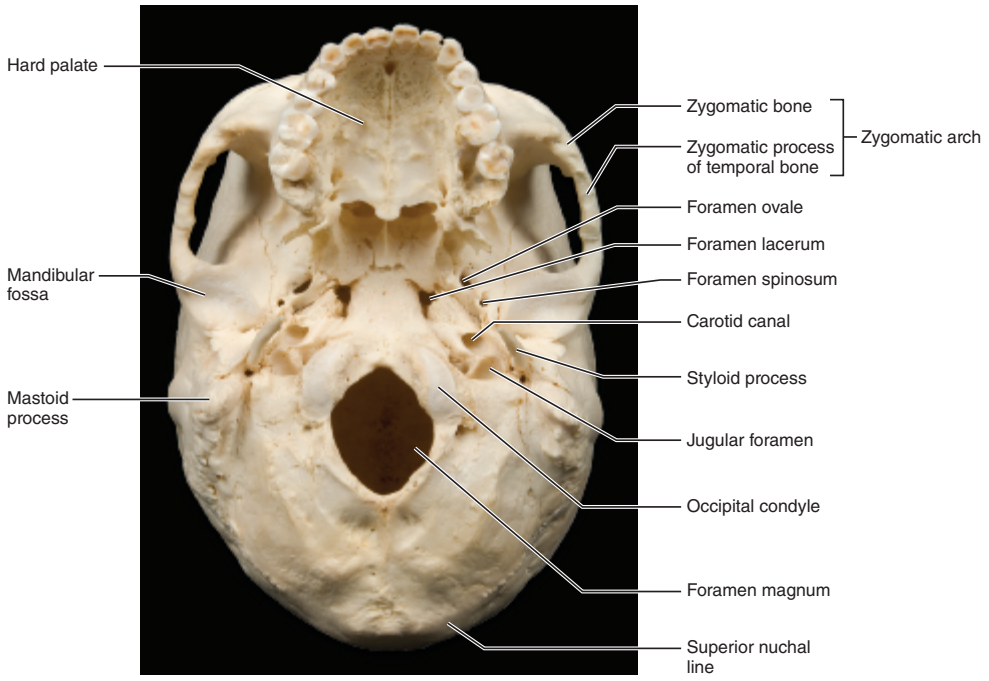
Every Focus Figure has an assignable, multi-step Coaching Activity in MasteringA&P.



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, Anytime with Mobile Tools

NEW! Dynamic Study Modules help students acquire, retain, and recall information faster and more efficiently than ever before. These mobile-friendly, flashcard-style questions adapt to a student's performance, and include feedback with text and art from the book itself.



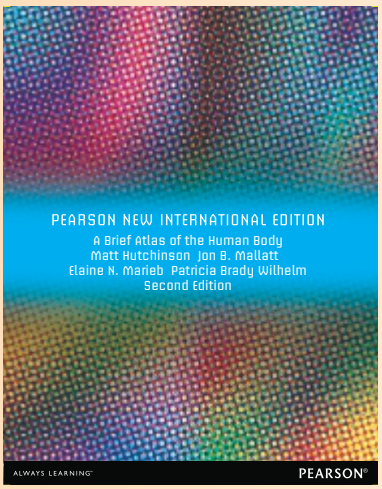
(b) Photo of inferior view of the skull

Figure 7.7 Inferior aspect of the skull.

Practice art labeling
MasteringA&P®

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 in the Lab



***A Brief Atlas of the Human Body*, Second Edition,** by Matt Hutchinson contains a comprehensive histology photomicrograph section with more than 50 slides of basic tissue and organ systems. Featuring photos taken by renowned biomedical photographer Ralph Hutchings, this high-quality photographic atlas 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.

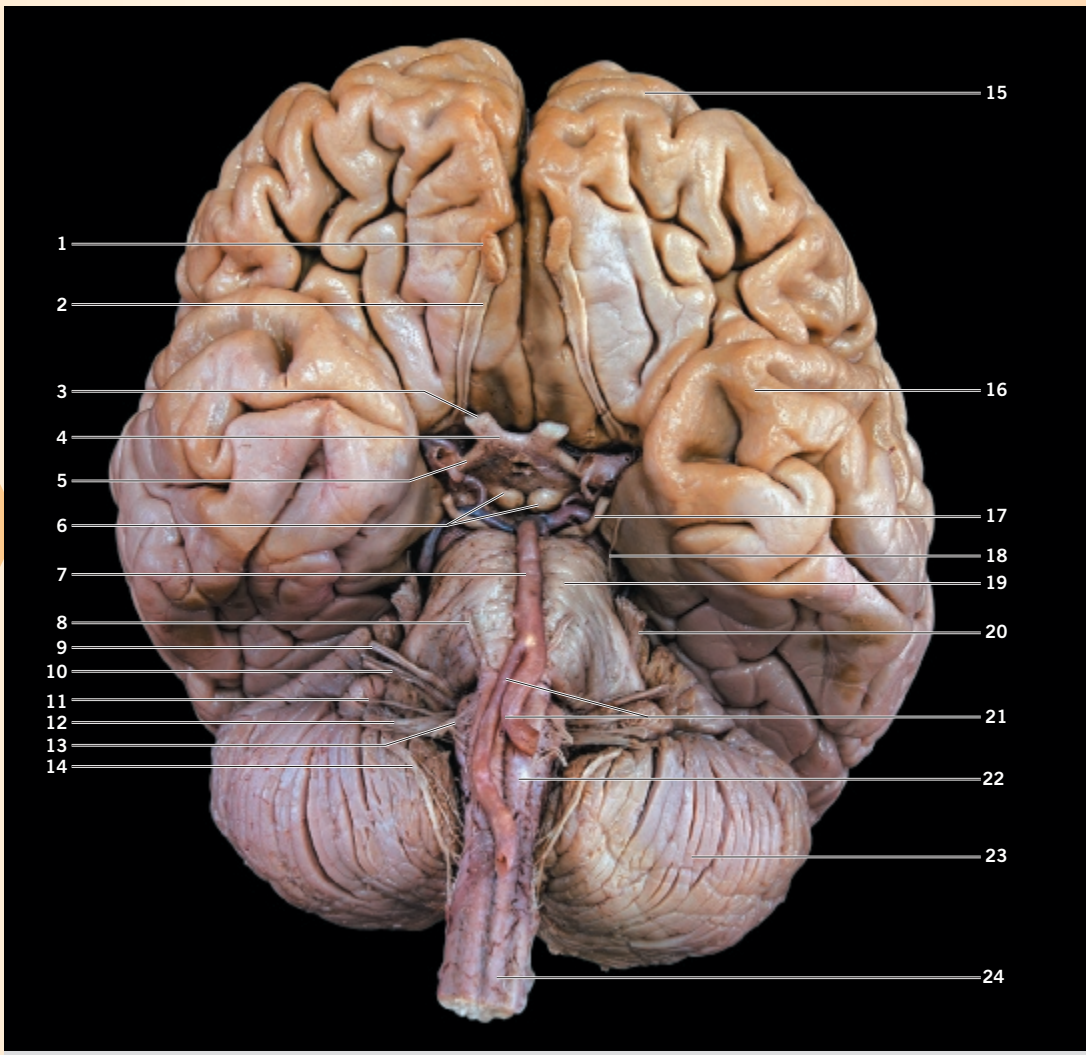
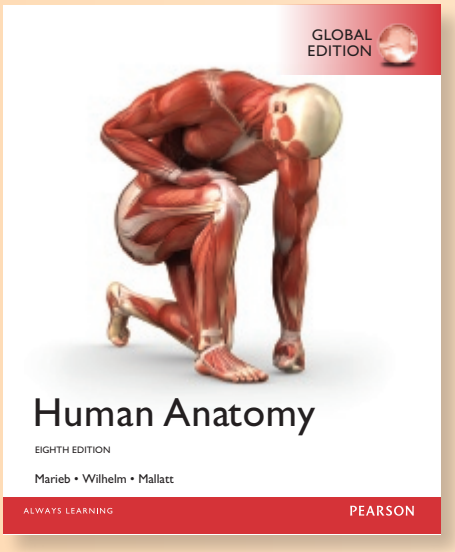


FIGURE 5.6 Brain with Cranial Nerves, Inferior View

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

Everything Your Students Need to Succeed in Lecture and Lab



Student package for Marieb, Wilhelm, and Mallatt's *Human Anatomy,* Eighth Edition includes MasteringA&P + *A Brief Atlas of the Human Body,* Second Edition.

Marieb/Wilhelm/Mallatt, *Human Anatomy,* Eighth Edition, Global Edition

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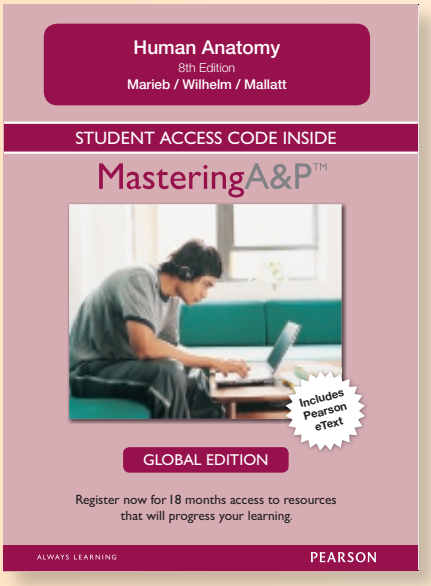

MasteringA&P® Student Access Code for Marieb/Wilhelm/ Mallatt, *Human Anatomy,* Eighth Edition, Global Edition

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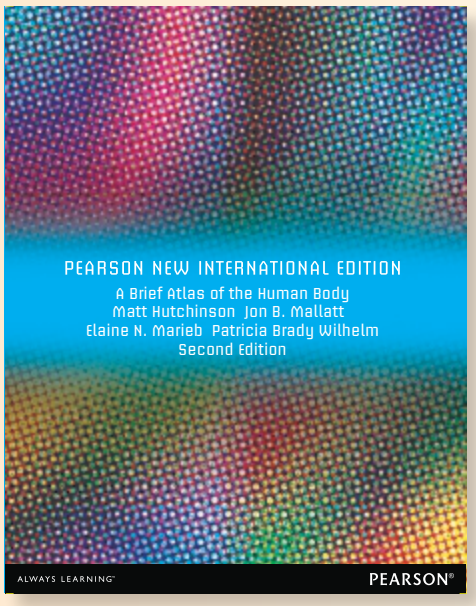
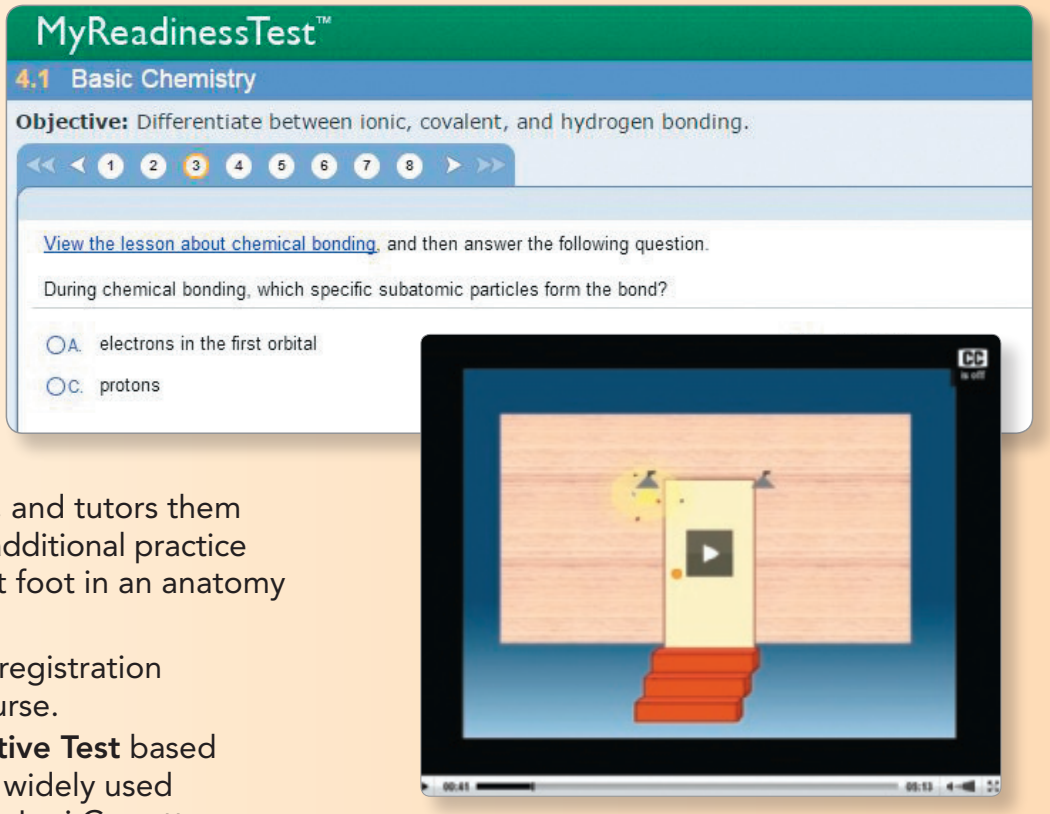


Hutchinson et al., A Brief Atlas of the Human Body, Second Edition

Could Your Students Use a Refresher?

NEW! MyReadinessTest™

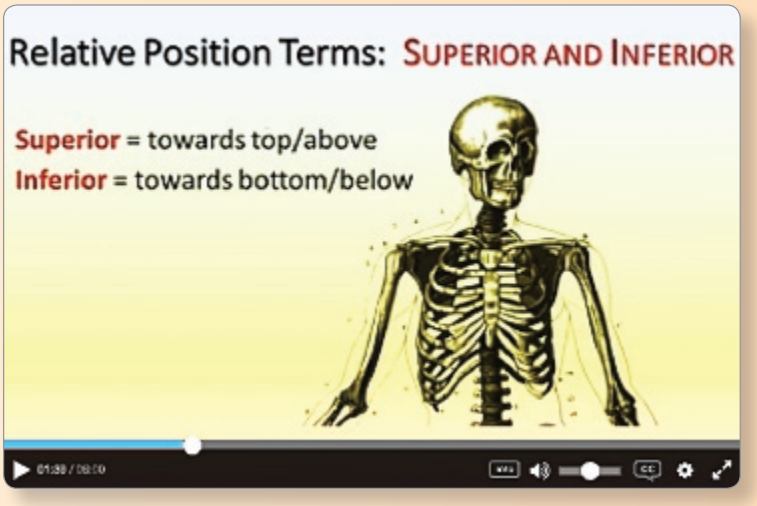
for A&P prepares students *before* their Human Anatomy course begins.



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:

- Student Online Access upon registration for their Human Anatomy course.
- **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.

NEW! Five new video tutors on topics such as Learning Styles, Relative Positions, Meiosis, Chemical Reactions, and Concept Mapping.



Supplements for Instructors

Instructor's Resource Material

1-292-17592-3 / 978-1-292-17592-8

The Instructor Resource Material 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®
- Clicker Questions
- Complete Test Bank with TestGen® software
- Quiz Show Presentations

All materials available on the Instructor Resource Center are also available in MasteringA&P which also has, in addition, Cat Dissection Videos; A&P Flix™ Animations; Bone and Dissection Videos; Images from *A Brief Atlas of the Human Body*, Second Edition; PAL 3.0™ Instructor Resource DVD with Test Bank; and Index of anatomical structures covered in PAL 3.0.

Instructor's Resource Guide

By Leslie Hendon

1-292-17591-5 / 978-1-292-17591-1

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.

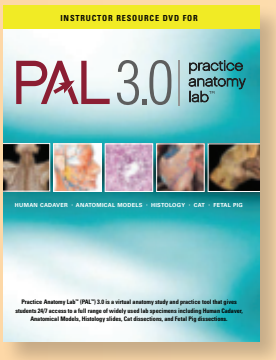
TestGen Test Bank

By Dana Peterson

1-292-15681-3 / 978-1-292-15681-1

The Eighth Edition Test Bank covers all major topics at a range of difficulty levels. The Test Bank is available in Microsoft Word and TestGen formats on the Instructor Resource Center and in the Instructor Resources section of MasteringA&P®. Both electronic options are cross-platform and allow instructors to easily generate and customize tests.

PAL™ 3.0 Instructor Resource DVD with Test Bank



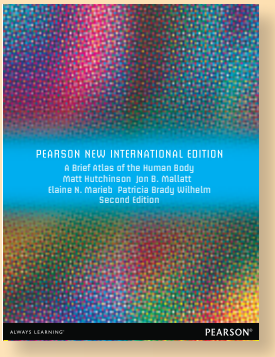
By Nora Hebert, Ruth Heisler, Jett Chinn, Karen M. Krabbenhoft, Olga Malakova

0-321-74963-4 / 978-0-321-74963-5

Includes everything an instructor needs to present and assess PAL 3.0 in lecture and lab. The DVD includes images in PowerPoint with editable labels and leader lines, labeled and unlabeled images in JPEG and PowerPoint format, and more.

Supplements for Students

A Brief Atlas of the Human Body, Second Edition



By Matt Hutchinson
1-292-02640-5 /
978-1-292-02640-4

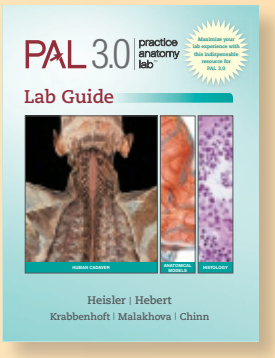
Visual lab study tool that helps students learn and identify key anatomical structures. It includes 107 bone and 47 soft tissue photographs with easy-to-read labels. This edition of the atlas contains a comprehensive histology photomicrograph section with more than 50 slides of basic tissue and organ systems.

Practice Anatomy Lab™ 3.0 DVD

By Ruth Heisler, Nora Hebert, Jett Chinn, Karen Krabbenhoft, and Olga Malakhova
0-321-68211-4 /
978-0-321-68211-6

PAL 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 the human cadaver, anatomical models, histology, cat, and fetal pig.

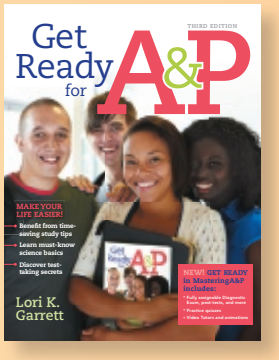
Practice Anatomy™ (PAL™) 3.0 Lab Guide



By Ruth Heisler, Nora Hebert, Karen Krabbenhoft, Olga Malakhova, and Jett Chinn
With PAL 3.0 DVD
(0-321-85767-4)

The PAL 3.0 Lab Guide enhances students' virtual anatomy lab experience by helping them explore anatomical structures through a series of labeling activities and quizzes using the images from PAL.

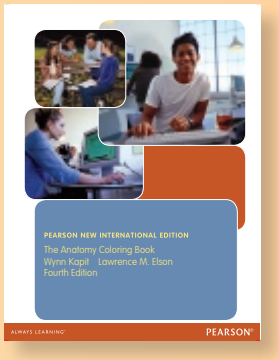
Get Ready for A&P, Third Edition



By Lori K. Garrett
0-321-81336-7 /
978-0-321-81336-7

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. It is available in the Study Area of MasteringA&P®.

The Anatomy Coloring Book, Fourth Edition



By Wynn Kapit and Lawrence M. Elson
1-292-02636-7 /
978-1-292-02636-7

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.

PREFACE

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.
- **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

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BRIEF CONTENTS