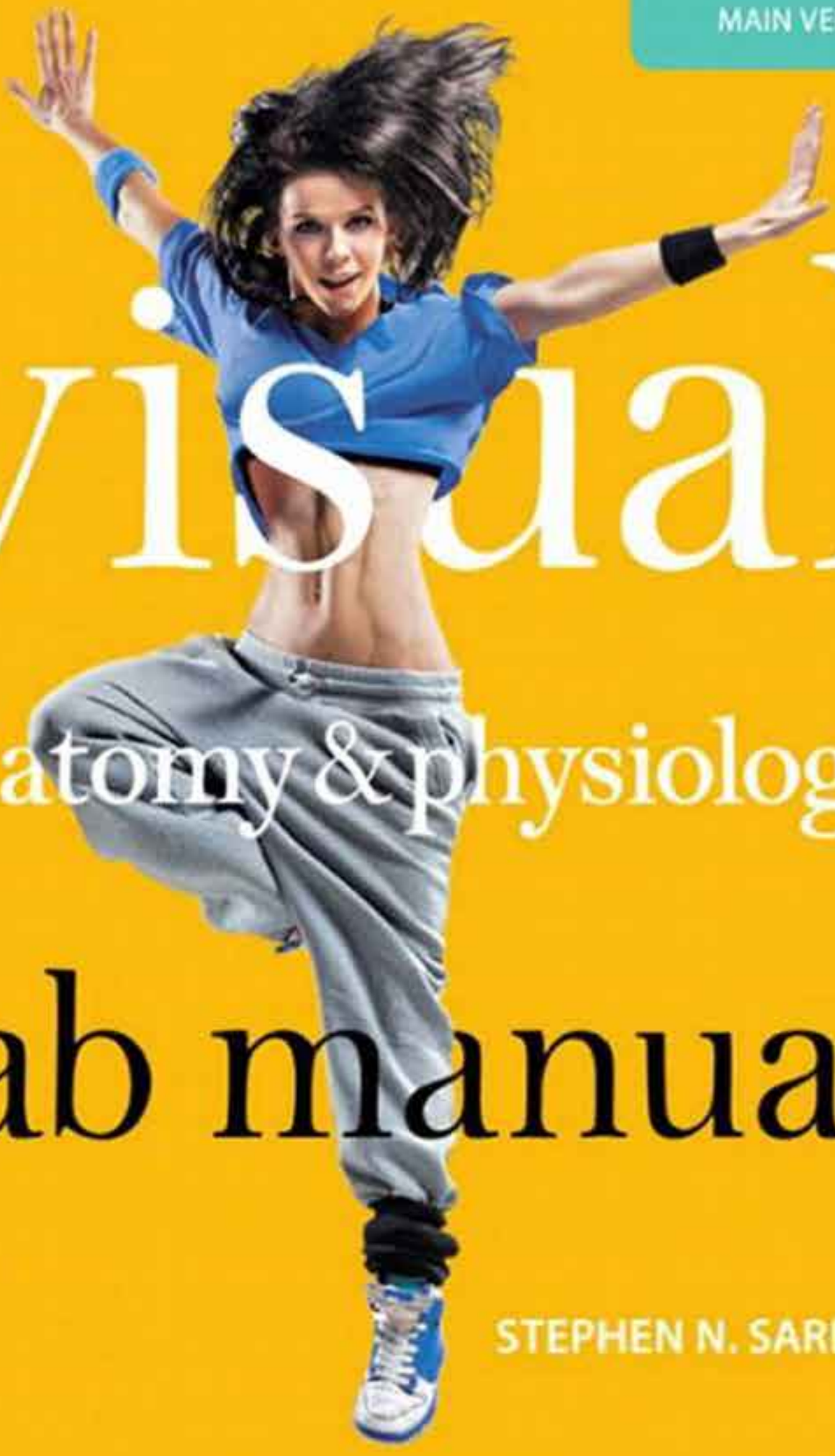
MAIN VERSION



visual

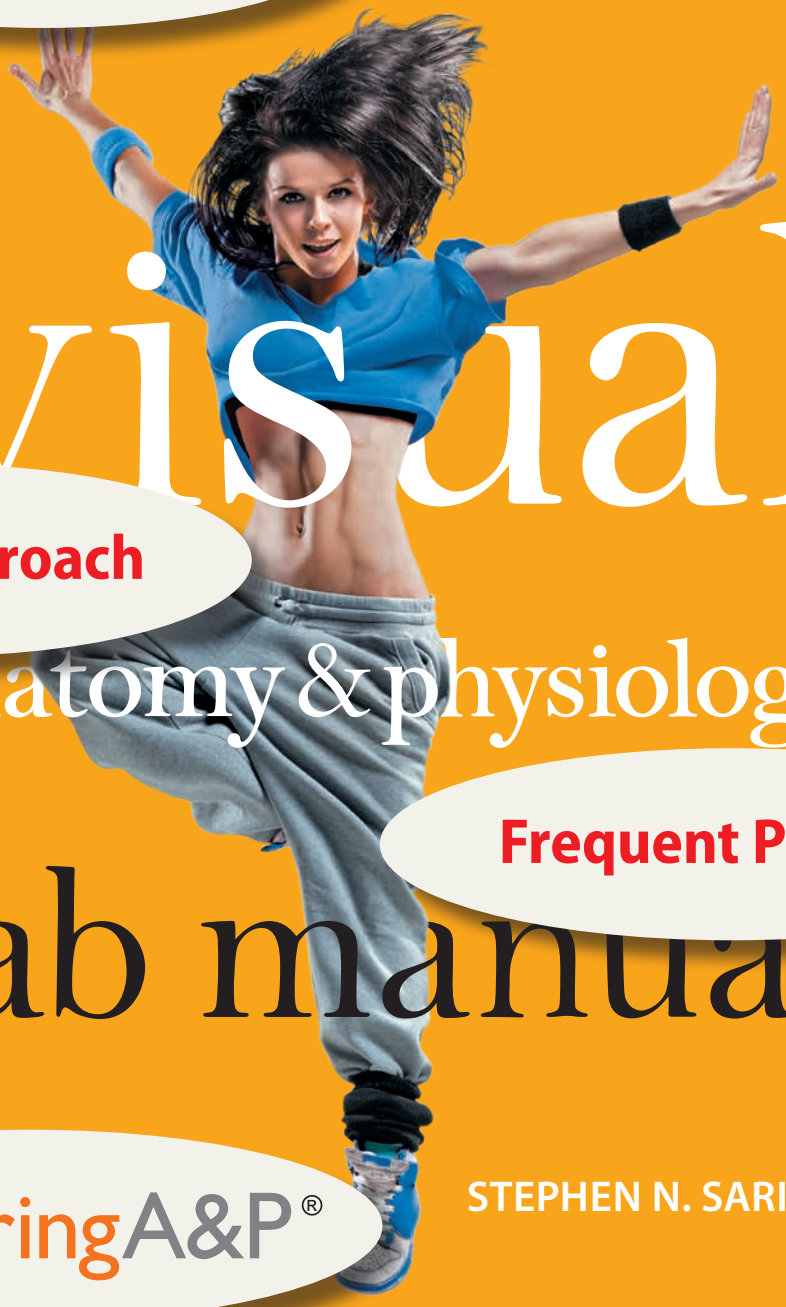
anatomy & physiology

lab manual

STEPHEN N. SARIKAS

Brief Contents

Modular Organization



visual

Visual Approach

anatomy & physiology

Frequent Practice

lab manual

MasteringA&P®

STEPHEN N. SARIKAS

Turn the page to learn more.

The Modular Organization

The time-saving modular organization presents each lab exercise in a series of two-page lab activity modules. This organization gives students an efficient framework for managing their time and tracking their progress through the lab activities within the larger lab exercise. Students can see everything for an individual lab activity at a glance without the page flipping that often contributes to students losing their way and then getting confused.

First, the top of the page begins with the lab activity title, which is correlated by number to a Learning Outcome on the exercise-opening page.

Next, the red-boxed letters guide students through the different parts of the lab activity.

Additionally, the green-circled numbers walk students through every step of the lab procedures.

ACTIVITY 7.3

Examining the Microscopic Structure of Bone

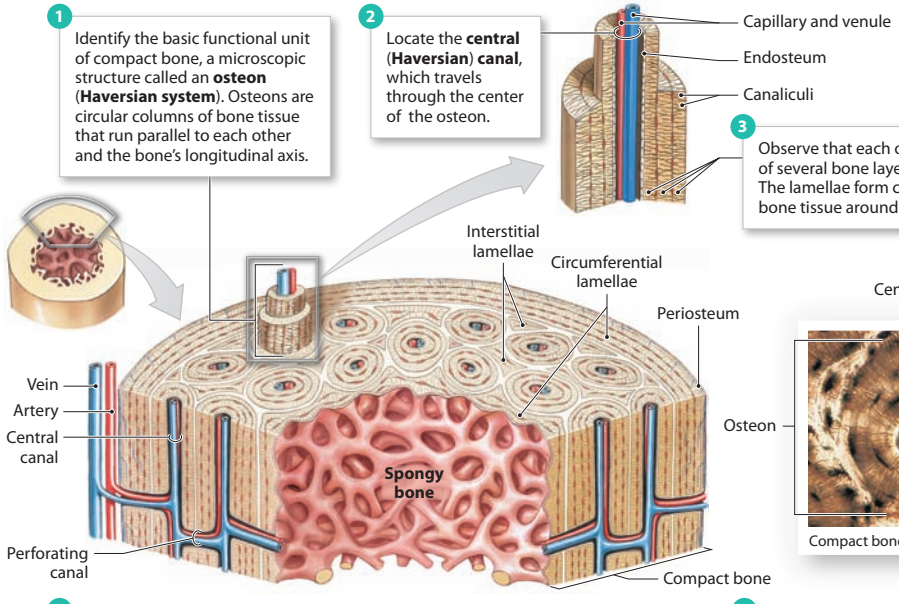
Two types of bone tissue exist in the skeleton: compact and spongy. **Compact bone** is an extremely dense material that forms the hard exterior covering of all bones. **Spongy (cancellous) bone** fills the interior regions of most bones and forms a thin internal layer along the diaphyses of long bones.

A Compact Bone

Examine a three-dimensional model showing a microscopic section of bone tissue. Identify the structures illustrated in the following figures.

1 Identify the basic functional unit of compact bone, a microscopic structure called an **osteon** (**Haversian system**). Osteons are circular columns of bone tissue that run parallel to each other and the bone's longitudinal axis.

2 Locate the **central** (**Haversian**) **canal**, which travels through the center of the osteon.



3 Observe that each osteon is composed of several bone layers (**bone lamellae**). The lamellae form concentric rings of bone tissue around the central canal.

4 Identify several small cavities called **lacunae**, which are positioned between the bone lamellae. Osteocytes (bone cells) are located in the lacunae and give rise to cell processes that travel through narrow passageways called canaliculi. The processes of nearby cells form cell junctions with each other.

5 Note that the central canals are connected by cross channels known as **perforating canals**. Small arteries, veins, nerves, and lymphatic vessels travel through the central and perforating canals.

Central and perforating canals form a network of passageways within compact bone. Why are these canals important for the normal functioning of bone tissue?

▶ _____

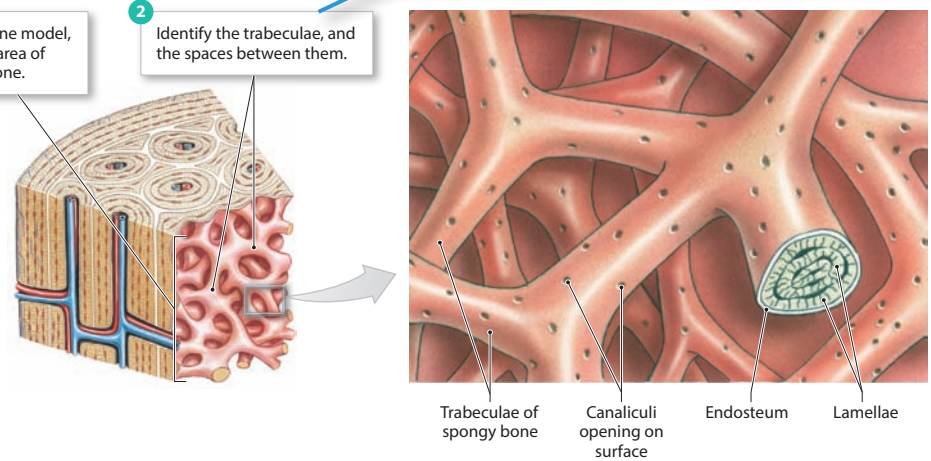
_____

B Spongy Bone

Unlike compact bone, spongy bone does not have a regular arrangement of osteons. Instead, bone lamellae form an irregular arrangement of interconnecting bony struts called **trabeculae** (singular = **trabecula**) with spaces surrounding the latticework of bony tissue. The porous structure of spongy bone makes it suitable for cushioning the impact generated by body movements.

1 On the bone model, locate an area of spongy bone.

2 Identify the trabeculae, and the spaces between them.



C During your earlier study of tissues, you learned that bone is a connective tissue with a solid matrix.

Review the structure of the matrix and identify its two main components. Briefly describe the special qualities that each component gives to bone. ▶

Component	Special Quality
1. _____	_____
	_____
2. _____	_____
	_____

Word Origins

In Latin, the word *trabecula* means "beam." Spongy bone is composed of interconnecting trabeculae (or beams) of bone tissue.

IN THE CLINIC Osteoporosis

Part of the aging process involves a decrease in the activity of osteoblasts, which are the cells that deposit new bone matrix. As a consequence, we start to lose some bone mass. If the condition progresses, eventually enough bone mass is lost so that the bone's normal functioning is impaired. This clinical condition is called osteoporosis, which literally means "porous bone" and, in fact, the bones become visibly more spongy.

MAKING CONNECTIONS

In this activity, you learned that within the canaliculi, the processes of neighboring osteocytes can link together by forming cell junctions. What do you think is the significance of these cell junctions?

▶ _____

Then, instead of long columns of narrative text that refer to visuals, brief text is built right into the visuals. Students read while looking at the corresponding visual, which means:

- No long paragraphs
- No page flipping
- Everything in one place

Finally, Making Connections questions wrap up each lab activity and give students the opportunity to pause, internalize information, and apply their understanding.

The Visual Approach

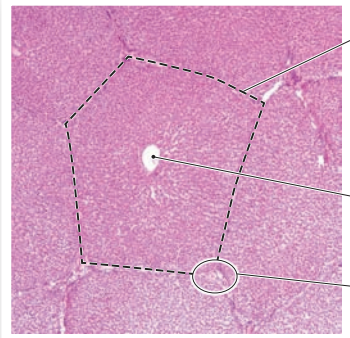
The unique visual approach allows the illustrations to be the central teaching and learning element, with the text built directly around them. The visual approach breaks out of the text-heavy model of other two-semester A&P lab manuals. Instead of long columns of narrative text that refer to visuals, this lab manual integrates visuals with the text. Students can't read without seeing the corresponding visual, and they can't look at a visual without reading the corresponding text. This lab manual has true text-art integration, which encourages reading and enhances understanding.

Descriptions, key terms, instructions, and lab procedures are embedded in the art.

ACTIVITY 27.12

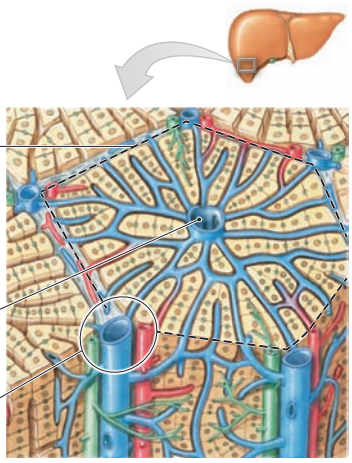
Examining the Microscopic Structure of Accessory Digestive Organs: Liver and Pancreas

A The functional units of the liver are the **liver lobules**.

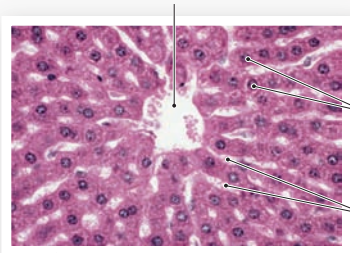


Liver LM × 20

1. View a slide of the liver under low power. Identify a **liver lobule**. Each lobule is a hexagonal-shaped column of tissue. It is separated from adjacent lobules by thin partitions of connective tissue.
2. Identify the **central vein** traveling through the middle of the lobule.
3. Locate the **portal areas (portal triads)** at each corner along the periphery of a liver lobule.



Central vein



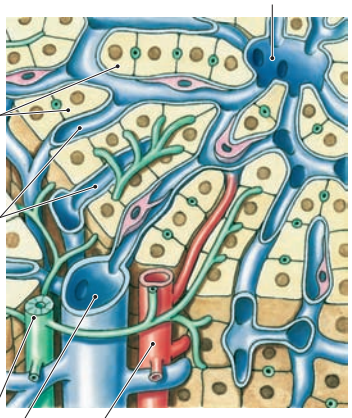
Central vein LM × 260

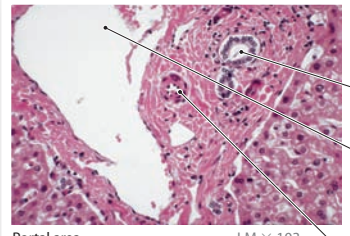
4. Under high power, observe the central vein and the area adjacent to it.

Notice how the **hepatocytes (liver cells)** are arranged in rows that radiate from the central vein, like the spokes of a bicycle wheel.

Observe the **liver sinusoids**, blood capillaries that travel between the rows of hepatocytes.

Central vein





Portal area LM × 103

5. View a portal area under high power and identify the three structures within it:

A **bile duct** transports bile to the duodenum or gallbladder.

A **branch of the hepatic portal vein** transports venous blood from the gastrointestinal tract to the liver. This blood is rich in nutrients that were absorbed by the small intestine.

A **branch of the hepatic artery** brings oxygenated arterial blood to the liver.

Blood from the two blood vessels in the triad percolates through the sinusoids and drains into the central vein.

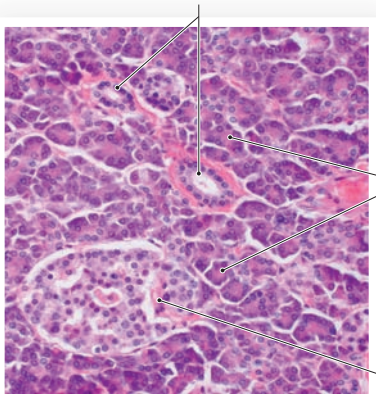
6 Under low power, examine a slide specially prepared to illustrate the transport of bile through the liver. Identify the tiny ducts called **bile canaliculi** (singular, **canaliculus**). Bile, produced by hepatocytes, is secreted into the canaliculi and flows into the bile ducts in the portal areas. The black-staining pathways (green in the figure) are the canaliculi.

7 Phagocytic cells called **Kupffer cells** are found along the walls of the sinusoids. What do you think is the function of these cells?

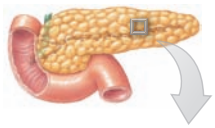
▶ _____

_____

B Most of the pancreas consists of glandular cells that produce a watery mixture of digestive enzymes called **pancreatic juice**.



Pancreas LM × 65



1 Under low power, identify the two functional components of the pancreas:

The **pancreatic acini** are clusters of cuboidal cells (pancreatic acinar cells) arranged around a central lumen. The acinar cells produce pancreatic juice that is transported along a network of ducts leading to the pancreatic duct.

The **pancreatic islets (islets of Langerhans)** are the lighter-staining regions of endocrine cells scattered among the pancreatic acini.

2 Pancreatic juice contains the digestive enzymes listed below. Refer to your textbook and complete the table by identifying the function of each enzyme. ▶

Pancreatic Enzyme	Function
Pancreatic alpha amylase	
Pancreatic lipase	
Nucleases	
Proteolytic enzymes	

MAKING CONNECTIONS

Explain why the liver sinusoids contain a mixture of arterial and venous blood.

▶ _____

_____

_____

_____

Manageable amounts of information that are linked to visuals guide students through the lab activities.

Frequent Practice

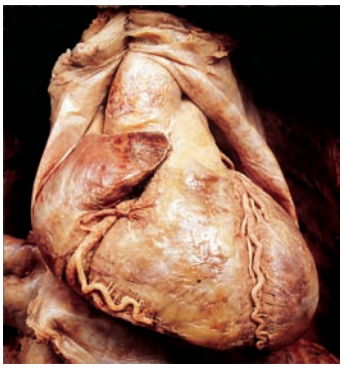
Numerous places to stop and check understanding help students reinforce their learning throughout the lab exercise.

Before You Begin, Consider This . . . launches each lab exercise and asks students to think critically about the content before they begin their first lab activity.

BEFORE YOU BEGIN, CONSIDER THIS...

The heart is a two-sided, double-pumping organ. The left side (the left pump) sends blood to all tissues and cells, where oxygen and nutrients are delivered and metabolic wastes are taken away. The right side (the right pump) sends blood to the lungs, where oxygen stores in red blood cells are replenished and carbon dioxide, a metabolic waste, is released.

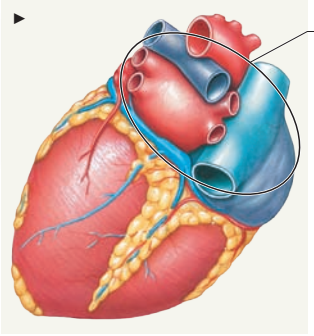
Every day, your heart beats about 100,000 times and pumps 7000–9000 liters of blood. By any standard, this is an arduous workload, but the fact that the heart can maintain this level of activity for decades, without stopping, is nothing short of remarkable. What special features allow the heart to work so efficiently for such a long period of time?



Pencil-to-paper tasks within each lab activity are marked with a black arrow to indicate where students need to write answers, fill in tables, record data, label, calculate, or draw.

C The left atrium and the base of the heart can best be identified from a posterior view.

1. List the four heart chambers and label them in the diagram. ▶
   1. _____
   2. _____
   3. _____
   4. _____



Posterior view

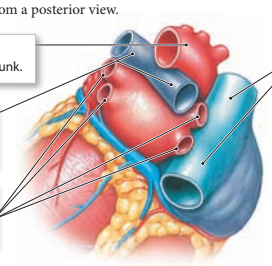
2. The **base** of the heart is at the heart's posterior and superior aspects.
3. Identify two major sulci (grooves) on the posterior surface and label them on the diagram. ▶

From the anterior surface, the **coronary sulcus** continues along the posterior surface between the atria and ventricles. Notice that it forms a complete circle around the heart.

The **posterior interventricular sulcus**, like the anterior interventricular sulcus, descends toward the apex from the coronary sulcus, and forms a border between the left and right ventricles.

D The great blood vessels are attached to the heart at the base. You can identify these structures from a posterior view.

1. Identify the **aortic arch** passing posteriorly over the pulmonary trunk.
2. The **left and right pulmonary arteries** are branches of the pulmonary trunk.
3. Observe the four **pulmonary veins**—two on each side—as they enter the left atrium.
4. Locate the **superior and inferior venae cavae** where they enter the right atrium.



Making Connections questions appear at the end of every module to encourage students to think critically about the lab activity they completed.

Word Origins

Auricle is derived from *auricular*, the Latin word for "external ear." Early anatomists gave them that name because they resembled the external ear.

MAKING CONNECTIONS

From an external view, what features could you use to distinguish the right atrium from the left atrium?

▶ _____

_____

_____

From an external view, what features could you use to distinguish the right ventricle from the left ventricle?

▶ _____

_____

_____

Name _____

Lab Section _____

Date _____

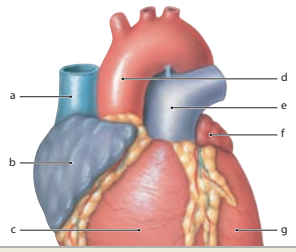
EXERCISE 21

Gross Anatomy of the Heart
REVIEW SHEET

1. The apex of the heart is formed by the
   a. right atrium
   b. left atrium
   c. right ventricle
   d. left ventricle
2. Which heart groove travels between the atria and the ventricles?
   a. anterior interventricular sulcus
   b. posterior interventricular sulcus
   c. coronary sulcus
   d. both (a) and (b)
   e. (a), (b), and (c)
3. The epicardium and the _____ are the same structure.
4. The _____ artery forms an anastomosis with the right coronary artery.
5. The adult heart structure that marks the location of an opening between the two atria in the fetal heart is called the _____.

QUESTIONS 6–10: Answer the following questions by selecting the correct labeled structure. Answers may be used once or not at all.

6. This structure pumps deoxygenated blood into the pulmonary trunk. _____
7. The pulmonary veins deliver oxygenated blood to this structure. _____
8. This structure delivers deoxygenated blood to the right atrium. _____
9. This structure pumps oxygenated blood into the aorta. _____
10. This structure and its branches deliver deoxygenated blood to the lungs. _____



Need more practice and review?

MasteringA&P®

Access more study tools online in the MasteringA&P Study Area.

- Pre-lab Quiz
- Post-lab Quiz
- Art-labeling Activities
- Practice Anatomy Lab virtual anatomy practice tool PAL practice anatomy lab
- PhysioEx lab simulations PhysioEx
- A&P Flix animations for Origins, Insertions, Actions, and Innervations A&PFlix
- A&P Flix animations for Group Muscle Actions and Joints A&PFlix

PAL practice anatomy lab

PhysioEx

A&PFlix

FOR THIS LAB EXERCISE, use these study tools.

- Pre-lab Quiz
- Post-lab Quiz
- Art-labeling Activities

PAL practice anatomy lab

For this lab exercise, follow these navigation paths in PAL:
- PAL > Human Cadaver > Endocrine System
- PAL > Anatomical Models > Endocrine System
- PAL > Histology > Endocrine System

PhysioEx

For this lab exercise, go to this PhysioEx exercise:
- PhysioEx > Exercise 4: Endocrine System Physiology
  - Activity 1: Metabolism and Thyroid Hormone
  - Activity 2: Plasma Glucose, Insulin, and Diabetes Mellitus
  - Activity 3: Hormone Replacement Therapy
  - Activity 4: Measuring Cortisol and Adrenocorticotropic Hormone

Review Sheets appear at the end of each lab exercise and offer a series of questions that assess students on all of the lab activities in the exercise. They include a combination of labeling, matching, fill-in-the-blank, short answer, multiple-choice, coloring, and calculation questions. The Review Sheets can be removed from the lab manual and turned in for credit.

MasteringA&P®

Assignable Review Sheets

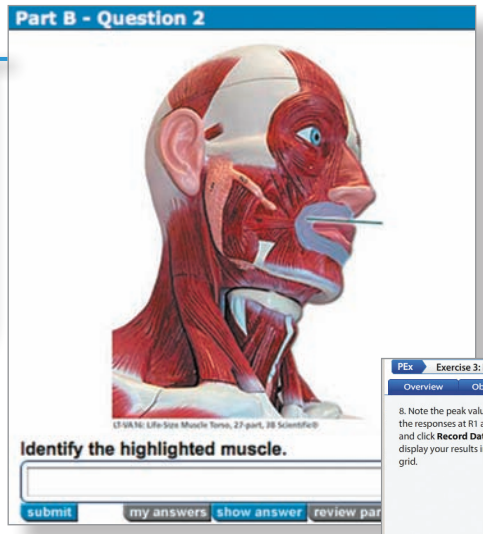
Assignable versions of the Review Sheet questions (except for the coloring questions) are in MasteringA&P.

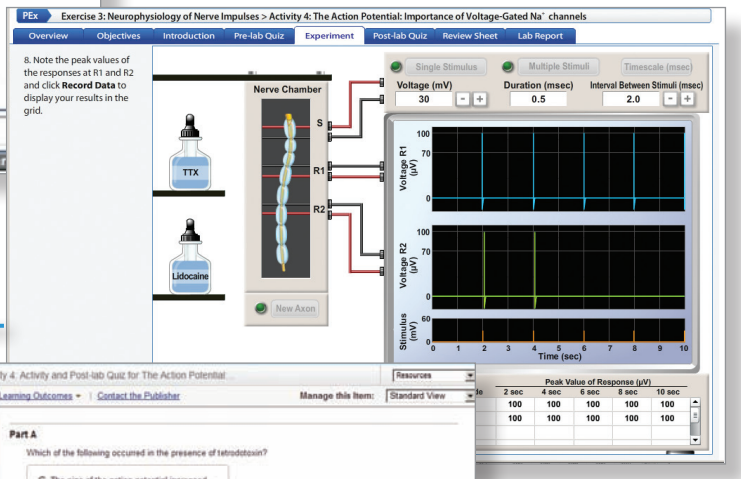
The MasteringA&P reference page near the end of each lab exercise shows students exactly which Study Area resources are appropriate for that exercise.

MasteringA&P® Assignable Content

Practice Anatomy Lab™ (PAL™) 3.0 Assessments

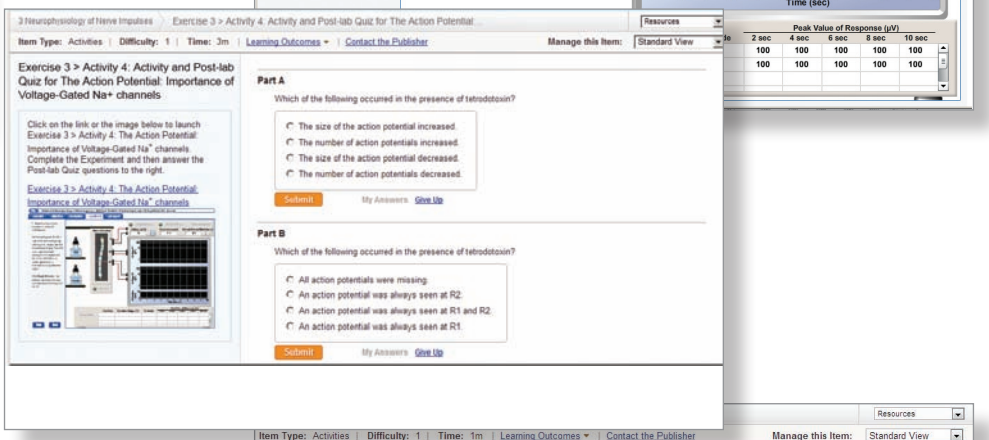
in MasteringA&P let instructors assign quizzes and lab practicals using the images from PAL 3.0.





PhysioEx™ 9.1 Assessments

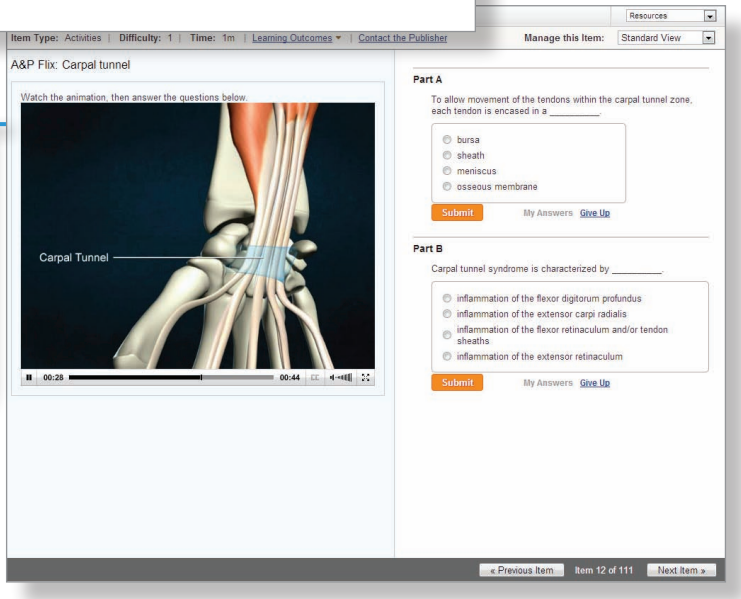
in MasteringA&P allow instructors to assign pre- and post-lab quizzes and Review Sheets from PhysioEx 9.1.

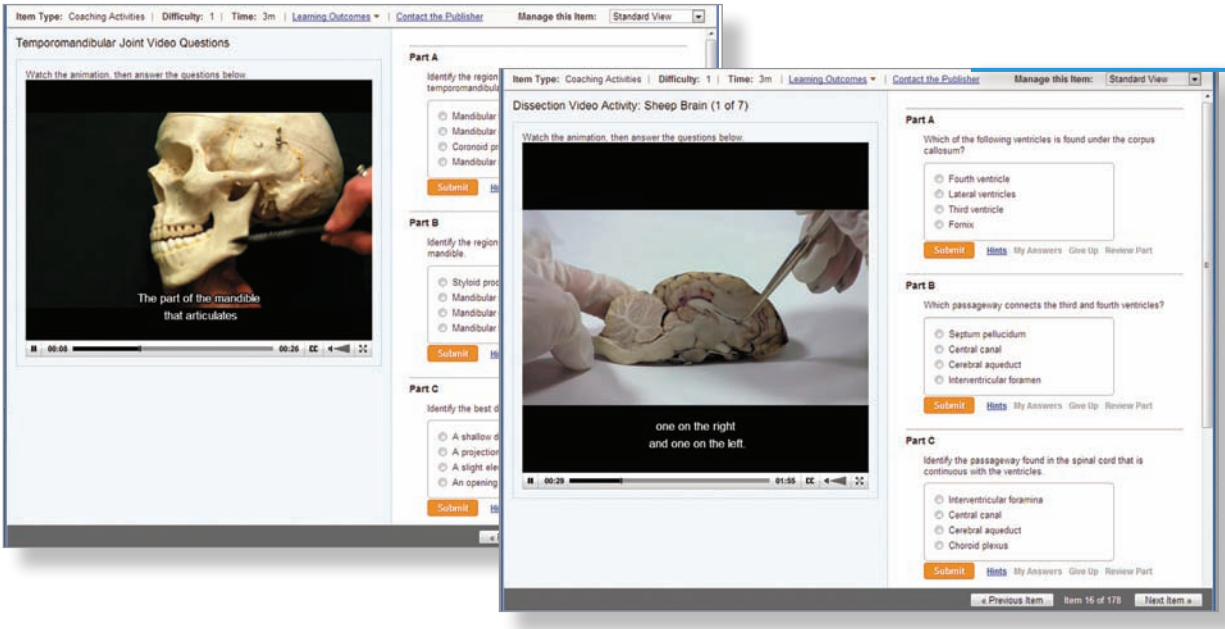


A&P Flix™ Activities for Anatomy Topics

in MasteringA&P allow for assigning and automatic grading of 3D movie–quality anatomy animations and their corresponding activities:

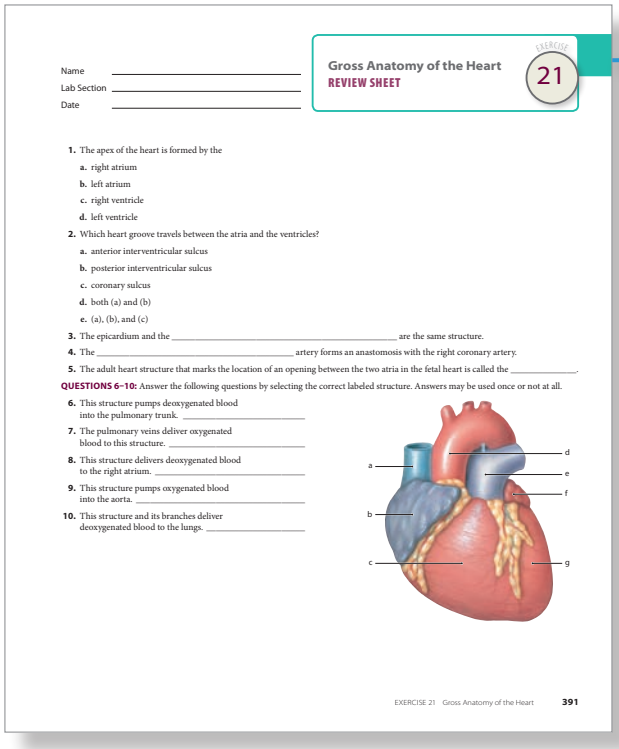
- Origins, Insertions, Actions, and Innervations (over 60 animations)
- Group Muscle Actions and Joints (over 50 animations)





Bone and Dissection Video Coaching Activities

in MasteringA&P are highly visual and help students identify bones and learn how to do organ dissections.



Name _____
Lab Section _____
Date _____

EXERCISE 21
Gross Anatomy of the Heart
REVIEW SHEET

1. The apex of the heart is formed by the
   a. right atrium
   b. left atrium
   c. right ventricle
   d. left ventricle
2. Which heart groove travels between the atria and the ventricles?
   a. anterior interventricular sulcus
   b. posterior interventricular sulcus
   c. coronary sulcus
   d. both (a) and (b)
   e. (a), (b), and (c)
3. The epicardium and the _____ are the same structure.
4. The _____ artery forms an anastomosis with the right coronary artery.
5. The adult heart structure that marks the location of an opening between the two atria in the fetal heart is called the _____.

QUESTIONS 6–10: Answer the following questions by selecting the correct labeled structure. Answers may be used once or not at all.

6. This structure pumps deoxygenated blood into the pulmonary trunk. _____
7. The pulmonary veins deliver oxygenated blood to this structure. _____
8. This structure delivers deoxygenated blood to the right atrium. _____
9. This structure pumps oxygenated blood into the aorta. _____
10. This structure and its branches deliver deoxygenated blood to the lungs. _____

EXERCISE 21 Gross Anatomy of the Heart 391

Assignable Review Sheets that are based on the Review Sheets that appear at the end of each lab exercise are available in a gradable format in MasteringA&P. Instructors can easily assign them for homework.

Interactive and Adaptive Capabilities

- **Dynamic Study Modules**
  This study tool helps students acquire, retain, and recall information quickly and efficiently. The modules are available as a self-study tool or can be assigned for homework.
- **Learning Catalytics**
  This classroom intelligence system uses open-ended questions to probe student understanding in real time.

Also Assignable in MasteringA&P®

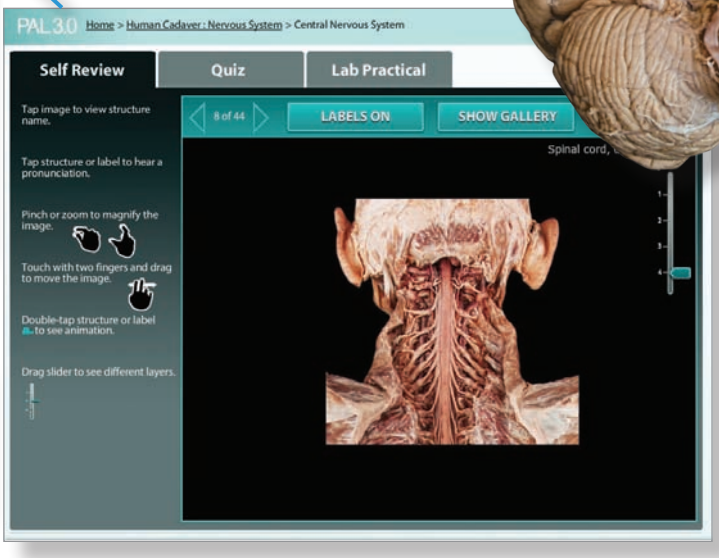
- ***Get Ready for A&P* Video Tutor Coaching Activities** ensure students have the background knowledge they need for basic topics: Study Skills, Basic Math Review, Terminology, Body Basics, Chemistry, and Cell Biology.
- **Pre-lab and Post-lab Quizzes** prepare students for lab and give them another way to prepare for tests or exams.
- **Art-labeling Activities** provide a wealth of visual assessments for instructors to choose from.

MasteringA&P® Study Area

MasteringA&P includes a Study Area that helps students review, practice, and get ready for tests with its simple three-step approach. For every lab exercise, students can:

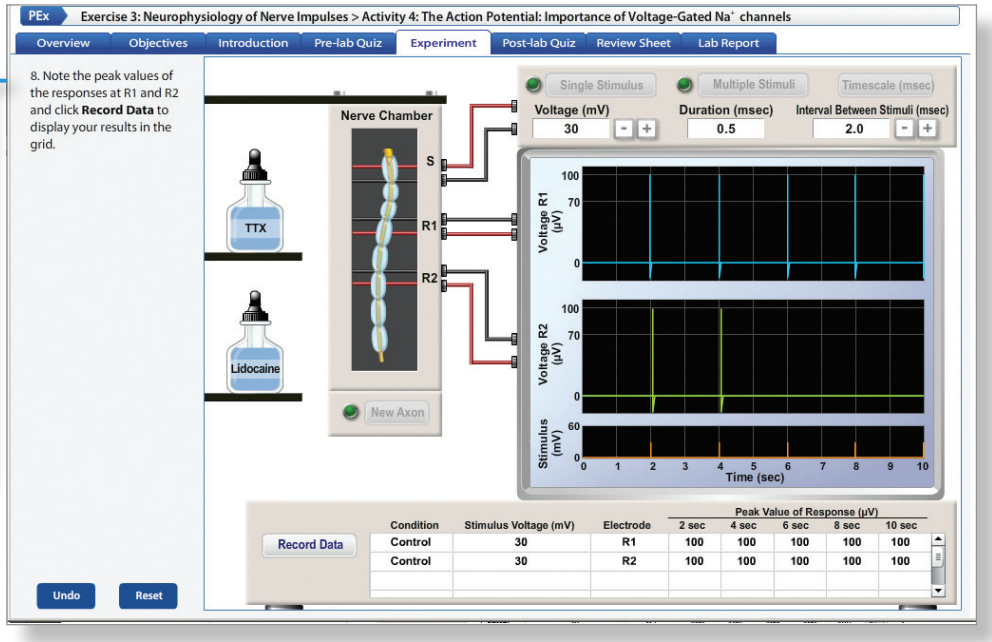
1. **Take a Pre-lab Quiz** and obtain a personalized study plan.
2. **Learn and practice** with labeling activities, animations, and interactive tutorials.
3. **Take a Post-lab Quiz** to check their understanding.

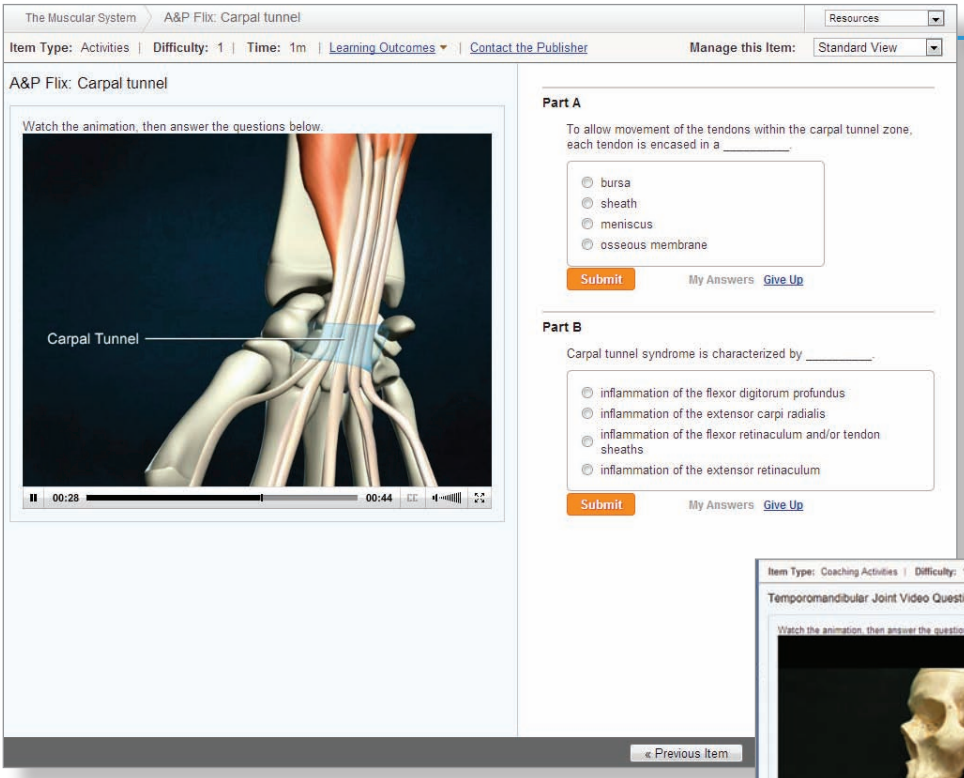
Practice Anatomy Lab™ (PAL™) 3.0 is a virtual anatomy study and practice tool that gives students 24/7 access to the anatomy lab. PAL 3.0 is easy to use and includes built-in audio pronunciations, rotatable bones, and simulated fill-in-the-blank lab practical exams.



The PAL 3.0 App lets students access PAL 3.0 on mobile devices, allowing them to zoom into images with a simple swipe.

PhysioEx™ 9.1 is an easy-to-use lab simulation program that allows students to repeat labs as often as they like, perform experiments without animals, and conduct experiments that are difficult to perform in a wet lab environment because of time, cost, or safety concerns. The online format with easy step-by-step instructions includes everything students need in one convenient place.

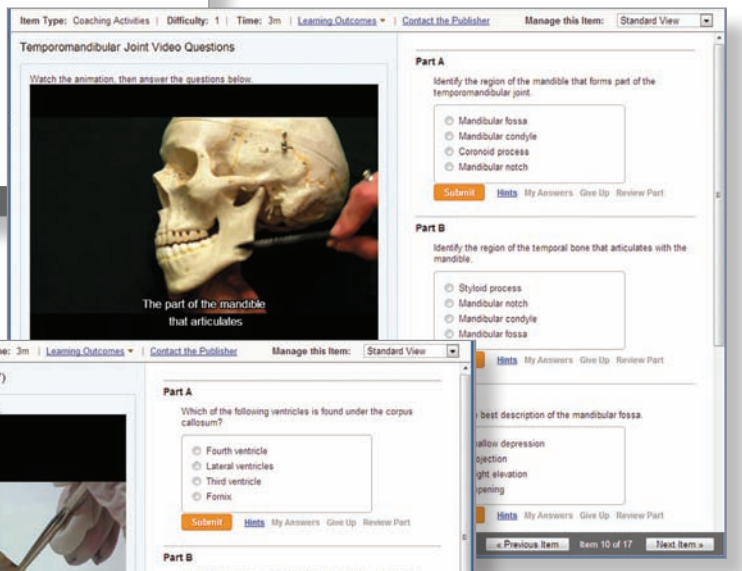


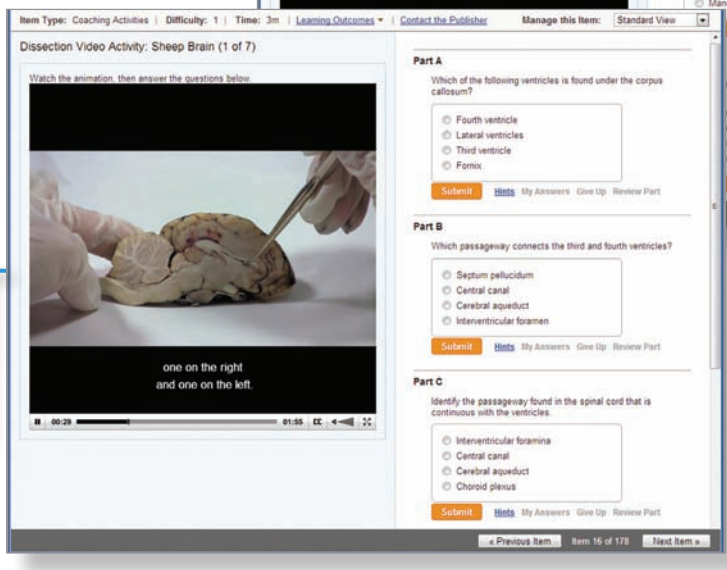


A&P Flix™ for Anatomy Topics

are 3D movie–quality anatomy animations that include self-paced tutorials and gradable quizzes. Students learn structures and functions from two sets of anatomy topics:

- Origins, Insertions, Actions, and Innervations (over 60 animations)
- Group Muscle Actions and Joints (over 50 animations)





Bone and Dissection Videos

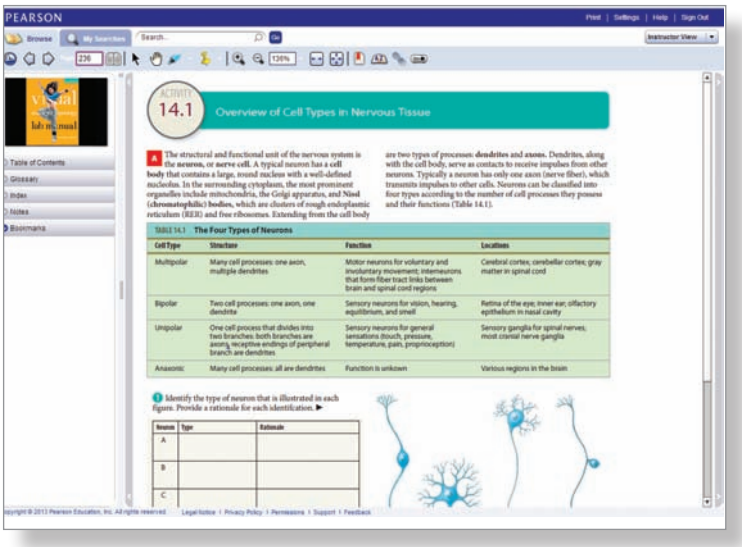
cover all of the major bones and organ dissections found in the lab manual.

Also Available in the MasteringA&P® Study Area:

- **Pre-lab and Post-lab Quizzes** give students lots of practice opportunities.
- **Art-labeling Activities** help students learn structures.

Support for Instructors

eText with Whiteboard Mode

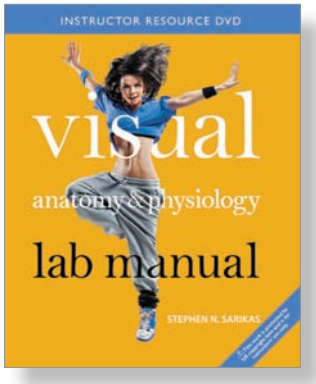


The *Visual Anatomy & Physiology Lab Manual* eText comes with Whiteboard Mode, allowing instructors to use the eText for dynamic lab presentations. Instructors can show one-page or two-page views from the lab manual, zoom in or out to focus on select topics, and use the Whiteboard Mode to point to structures, circle parts of a process, trace pathways, and customize presentations.

Instructors can also add notes to guide students, upload documents, and share their custom-enhanced eText with the whole class.

Instructors can find the eText with Whiteboard Mode in MasteringA&P®.

Instructor Resource DVD (IRDVD)

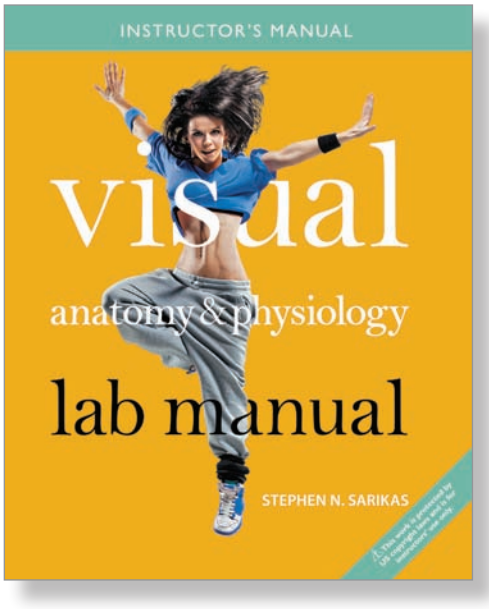


0-321-98117-0 / 978-0-321-98117-2

The IRDVD organizes all instructor media resources by lab exercise into one convenient and easy-to-use package. It includes:

- All figures from the lab manual in JPEG format and PowerPoint® slides (with editable labels and without)
- Another set of JPEGs from the lab manual featuring unlabeled figures *with leader lines* for quick and easy quizzing
- A&P Flix™ for Anatomy Topics
- Bone and Dissection Videos
- Test Bank in TestGen® and Microsoft® Word formats
- Instructor's Manual in Microsoft Word format
- The IRDVD for Practice Anatomy Lab (PAL) 3.0

Instructor's Manual



by Lori K. Garrett

0-321-98110-3 / 978-0-321-98110-3

This useful resource includes a wealth of materials to help instructors set up and run successful lab activities. Sections for every lab exercise include Time Estimates, List of Materials, To Do in Advance, Tips and Trouble Spots, and Answers.

MAIN VERSION

visual anatomy & physiology lab manual

STEPHEN N. SARIKAS, Ph.D.
Lasell College, Newton, Massachusetts

Using the visual approach and modified art from

visual anatomy & physiology

by

Frederic H. Martini, Ph.D.
University of Hawaii at Manoa

William C. Ober, M.D.
Washington and Lee University

Judi L. Nath, Ph.D.
Lourdes University, Sylvania, Ohio

Edwin F. Bartholomew, M.S.

Kevin Petti, Ph.D.
San Diego Miramar College

with

Claire E. Ober, R.N.
Illustrator

Kathleen Welch, M.D.
Clinical Consultant

Ralph T. Hutchings
Biomedical Photographer

PEARSON

Boston Columbus Indianapolis New York San Francisco Upper Saddle River
Amsterdam Cape Town Dubai London Madrid Milan Munich Paris Montréal Toronto
Delhi Mexico City São Paulo Sydney Hong Kong Seoul Singapore Taipei Tokyo

Executive Editor: Leslie Berriman
Senior Project Development Editor: Marie Beaugureau
Director of Development: Barbara Yien
Senior Development Editor: Alice Fugate
Development Editor: Molly Ward
Assistant Editor: Cady Owens
Editorial Assistant: Sharon Kim
Managing Editor: Mike Early
Assistant Managing Editor: Nancy Tabor
Copyeditor: Michael Rossa
Production Management and Composition: S4Carlisle Publishing Services
Director, Digital Product Development: Lauren Fogel
Executive Content Producer: Liz Winer
Senior Content Producer: Aimee Pavy
Design Manager: Mark Ong
Interior Designer: Emily Friel
Cover Designer: tani hasegawa
Associate Director of Image Resources: Travis Amos
Photo Researcher: Kristin Piljay
Photo Credits: Bill Smith Group
Permissions Specialist: Adrienne Matzen
Senior Procurement Specialist: Stacey Weinberger
Senior Market Development Manager: Michelle Cadden
Senior Anatomy & Physiology Specialist: Derek Perrigo
Senior Marketing Manager: Allison Rona

Cover Image Credit: Exactostock/SuperStock

Credits and acknowledgments borrowed from other sources and reproduced, with permission, in this textbook appear on the appropriate page within the text or on p. CR-1.

Library of Congress Control Number: 2013955429

ISBN 10: 0-321-95166-2 (Main Version)
ISBN 13: 978-0-321-95166-3 (Main Version)

PEARSON

www.pearsonhighered.com

1 2 3 4 5 6 7 8 9 10—**WBC**—17 16 15 14 13

Preface

Visual Anatomy & Physiology Lab Manual brings all of the strengths of the revolutionary *Visual Anatomy & Physiology* textbook to the lab. This lab manual combines a visual approach with a modular organization to maximize learning.

The goal of *Visual Anatomy & Physiology Lab Manual* is to create a better lab experience by presenting anatomy and physiology in an innovative way. Whether you are using *Visual Anatomy & Physiology* or a different textbook for your lecture, *Visual Anatomy & Physiology Lab Manual* will give lab students the powerful tools they need to succeed in the lab.

Hands-on activities in the lab manual combine with assignable content in MasteringA&P® to offer students frequent practice that reinforces important concepts.

KEY FEATURES

The following are the distinctive features of this lab manual:

- **The Visual Approach** breaks out of the text-heavy model of other two-semester A&P lab manuals. Instead of long columns of narrative that refer to visuals, this lab manual features visuals with brief integrated text built around them. Students can't read without seeing the corresponding visual, and they can't look at a visual without reading. This lab manual has true text–art integration, which encourages reading and enhances understanding.
- **The Modular Organization** presents each lab exercise in a series of two-page lab activity modules. The top-left page of each module begins with the lab activity number and title, the bottom-right page ends with a set of self-check Making Connections questions, and the guided lab activity fills the rest of the spread. Students can see everything for a lab activity at a glance without the page flipping that often contributes to students losing their way and then getting confused.
- **Before You Begin, Consider This . . .** launches each lab exercise and asks students to think critically about the content before they begin their first lab activity.
- **Frequent pencil-to-paper tasks within each lab activity** are marked with a black arrow (▶) to indicate where students need to write answers, fill in tables, record data, label, or draw.
- **Making Connections questions** wrap up each two-page lab activity and give students the opportunity to pause, internalize information, and then apply their understanding.
- **In the Clinic** boxes provide clinical context for the material students are learning.
- **Word Origins** boxes simplify learning by connecting the terminology used in anatomy and physiology to word roots.
- **Review Sheets** at the end of each lab exercise offer a series of questions that assess students on all of the activities in the lab exercise. Assignable versions of the Review Sheet questions (without the coloring questions) are also available in MasteringA&P.
- **Learning Outcomes on each exercise-opening page** indicate to students what they should be able to do by the end of the exercise. Learning Outcomes are coordinated by number to the lab activities, thus allowing students to check their understanding by both Learning Outcomes and lab activity topics. Additionally, the assessments in MasteringA&P® are organized by Learning Outcomes, allowing instructors to assign, assess, and demonstrate teaching results by Learning Outcomes.
- **The MasteringA&P reference page** at the end of every lab exercise shows students which MasteringA&P® resources can help them review key lab material on their own in the Study Area.

MasteringA&P is an online homework, tutorial, and assessment environment designed to improve results by helping students quickly master concepts. Students benefit from self-paced tutorials that feature immediate wrong-answer feedback and hints that emulate the office-hour experience to help keep students on track. With a wide range of interactive, engaging, and assignable activities, students are encouraged to actively learn and retain tough course concepts.

Please turn to the front pages for a visual walkthrough of ***Visual Anatomy & Physiology Lab Manual*** and MasteringA&P.

This page intentionally left blank

About the Author

STEPHEN N. SARIKAS received his Ph.D. in Anatomy from Boston University School of Medicine. He is a Professor of Biology at Lasell College in Newton, Massachusetts, where he has taught courses in anatomy and physiology, general biology, human reproduction, environmental science, history of science, and medical ethics, and seminars on Charles Darwin and AIDS in America. He is also a Lecturer of Occupational Therapy at Boston School of Occupational Therapy, Tufts University, where he teaches a graduate-level anatomy course. In 2008, he was selected to be Lasell College's fifth Joan Weiler Arnow '49 Professor, a 3-year endowed professorship that recognizes a scholar-teacher for his/her commitment to teaching and personal interest in students.

Dr. Sarikas's past research interests have included studies on the histochemistry of egg capsules in two salamander species (*Ambystoma* sp.); the development, maturation, and distribution of small-granule APUD cells in the mammalian lung; and membrane-intermediate filament interactions in transitional epithelium during the contraction–expansion cycle of the mammalian urinary bladder. His current research interests are in the area of HIV/AIDS awareness among college students. Dr. Sarikas is the author of *Laboratory Investigations in Anatomy & Physiology*. He has published articles on the development of the mammalian lung and cellular function in the mammalian urinary bladder. He has also written articles on HIV/AIDS awareness and connected learning in the classroom.

Dr. Sarikas is a member of the Human Anatomy and Physiology Society, the American Association of Anatomists, and the American Association for the Advancement of Science. He lives in Chelsea, Massachusetts, where he serves as chairperson of the Chelsea Conservation Commission. He and his wife, Marlena, enjoy working in their garden, running, entertaining friends, and watching the Red Sox beat the Yankees. They regularly travel to New York City, where their son, Anthony, lives and performs comedy, and to Montreal, where they have many close friends.

This page intentionally left blank

Acknowledgments

I feel very privileged to have been given the opportunity to write a lab manual that takes a distinctively different and unique approach to anatomy and physiology lab instruction. The inspiration for this manual comes from the innovative and groundbreaking work of the Martini author and artist team who developed the two-page modular format and the visual approach found in *Visual Anatomy & Physiology.* This pedagogical approach stimulates learning and promotes success and self-confidence in the anatomy and physiology course. Therefore, I gratefully acknowledge and thank the author/illustrator team that conceptualized and developed the first edition of the *Visual Anatomy & Physiology* book—Frederic H. Martini, William C. Ober, Judi L. Nath, Edwin F. Bartholomew, and Claire E. Ober—and thank each of them for giving me the tools I needed to create this lab manual. I would also like to thank Robert Tallitsch, Augustana College, Rock Island, Illinois, who provided several of the stunning light micrographs in this manual. The talented dissector/photographer team of Shawn Miller and Mark Nielsen, University of Utah, contributed the highest-quality cat and fetal pig dissection photographs in any anatomy and physiology lab manual. I appreciate the skillful work of Becky Oles, artist at Precision Graphics, who rendered the new art that appears in this manual. I also thank Travis Amos, Associate Director of Image Resources, and Kristin Piljay, Photo Researcher, who located several hard-to-find photos. The lab manual would not be complete without the expertise and detailed work of Bruce Fisher, Roane State Community College, who created the MasteringA&P® reference pages for each exercise.

Several of my students volunteered to appear in photographs for this lab manual. For their time and patience I wish to thank them: Eileen Bergin, Noelle Boran, Nick Casale, Rebeka Costa, Emily DeAngelis, Cassidy Foster, Krystal Garofalo, Morgan Gillis, Jordan Seid, Ashley Simmons, Abbey Smith-Howe, Patrick Sponzo, Nick Stanovich, Kristtyn Suarez, and Christopher Thomas-Ikier.

I am truly fortunate to have had the opportunity to collaborate with a team of talented people from Pearson who supported my work throughout every phase of its development. I thank Frank Ruggirello, Vice President, Editorial Director, for supporting my ideas and vision. I am most grateful and indebted to Leslie Berriman, Executive Editor, for her steadfast support and confidence during my entire association with Pearson over the past 13 years. Leslie deftly brought to publication the two editions of my first laboratory manual, *Laboratory Investigations in Anatomy & Physiology*, and she continued her unending guidance and support throughout the creation of this lab manual. I am thankful for Leslie's remarkable competence and skill as an editor, and I thank her for trusting my instincts as a scientist and writer. Leslie's sensitivity to my ideas and confidence in my work were most gratifying, and I am privileged to have her as my friend.

I am grateful for the contributions of Robin Pille, Senior Project Editor, whose patience, experience, and attention to detail were instrumental in putting this project on the right course during the early and middle stages. Marie Beaugureau, Senior Project Development Editor, succeeded Robin, and the transition was seamless and smooth. Marie's keen editorial skills and experience with the *Visual* philosophy kept the project on a steady course without missing a beat. Marie and I quickly established a strong professional relationship, and I am most appreciative of her skill and intelligence as an editor, and her support and confidence in my work. Let me also add that it was a joy to have an editor who not only is proficient and competent in her work, but is also a fervent baseball fan!

A special thank you goes out to Mark Ong, Design Manager, for his expertise in page design and for his patience in teaching me how to use InDesign.

Appreciation is also due to Barbara Yien, Director of Development, who provided expert management in the development of the manual's content. I would like to thank Alice Fugate, Senior Development Editor, and Molly Ward, Development Editor, for providing useful suggestions to improve the organization of the two-page lab activities. I also thank Janet Brodsky, Ivy Tech Community College, who reviewed each exercise for accuracy. I appreciate the work of Damien Hill and Lisa Clark, Development Editor, for reviewing each exercise for adequate writing space in all the pencil-to-paper boxes.

Aimee Pavy, Senior Content Producer, ably managed the content and coordination of MasteringA&P® under a tight schedule. Janet Brodsky, Ivy Tech Community College; Greg Erianne, County College of Morris; Monica Hall-Porter, Dean College; Rebecca Harris, Pitt Community College; Julie Huggins, Arkansas State University; Paul Kiser, Bellarmine University; Sarah Matarese, St. George's School; Todd A. Nolan, Lake Erie College of Osteopathic Medicine; and Nancy Risner, Ivy Tech Community College all lent their expertise to create the robust assets that appear within MasteringA&P® and I thank them deeply.

I express my gratitude to Cady Owens, Assistant Editor, who commissioned and coordinated reviews, provided a significant amount of administrative support, and managed the Instructor Resource DVD. I also thank Betsy Brantley, Valencia College, who created the art grids for the Instructor Resource DVD.

A special note of thanks goes to Lori K. Garrett, Parkland College, author of *Get Ready for A&P,* and an exceptional writer, who wrote the excellent Instructor's Manual that accompanies this lab manual. Thanks also to Sharon Kim, Editorial Assistant, who managed the manual in addition to providing other administrative support to the team as a whole.

Nancy Tabor, Assistant Managing Editor, kept the multifaceted production process well coordinated and on schedule.

I am grateful to Mary Tindle and Tiffany Rupp and their team at S4Carlisle Publishing Services for their precise work and dedication to making each page perfect. I appreciate the unique talents of Emily Friel for the attractive interior design and of tani hasegawa, who skillfully designed the striking cover. I am also thankful for the significant contributions of Stacey Weinberger, Senior Procurement Specialist, who handled the physical manufacturing of the manual.

I appreciate the efforts of Michelle Cadden, Senior Market Development Manager, whose market research informed the development of the lab manual.

Allison Rona, Senior Marketing Manager, and Derek Perrigo, Senior Anatomy & Physiology Specialist, planned and directed the presentation of this lab manual to my anatomy and physiology colleagues at colleges and universities across the country. I also express my gratitude to all of the Pearson sales representatives for skillfully representing this lab manual to instructors.

I am most fortunate to have in my life three special individuals who have given me priceless gifts: their unconditional love and emotional support. My stepson, Anthony Atamanuik, who performs improvisational comedy in New York City, guided me through some of the more difficult periods with his comic relief. Anthony often engaged me in lengthy and highly entertaining discussions on particular topics or sections that I was writing. His unique perspective helped me to articulate my ideas more clearly, and, perhaps, I provided him with material for new comedy skits! Anthony's partner, Flossie Arend, has given me invaluable emotional support. Her sharp insights and refreshing ideas on life have helped me to be a better person. I might add that Flossie is a proficient knitter of anatomical structures; her gift to me, Ned the Neuron, hangs proudly on the wall of my office. Marlena Yannetti, my wife and life partner, offered tender guidance, sound advice, and loving support. Her calming influence guided me through the many weekends and late nights at the computer and the recurring periods of escalating pressure and stress when weekly deadlines approached. Marlena's unending encouragement and support is one of the countless reasons why I love her so much.

Many of my colleagues from across the United States and Canada donated their time, expertise, and thoughtfulness to review this lab manual. Their valuable comments and suggestions guided me through the writing process. I am profoundly indebted to the following instructors for their support:

INSTRUCTOR REVIEWERS

Ticiano Alegre, *North Lake College*
Ken Anyanechi, *Southern University at Shreveport*
Dena Berg, *Tarrant County College–Northwest*
Chris Brandon, *Georgia Gwinnett College*
Carol Britson, *University of Mississippi*
David Brooks, *East Texas Baptist University*
Nishi Bryska, *University of North Carolina at Charlotte*
Stephen Burnett, *Clayton State University*
Robert Byrer, *University of West Florida*
Yavuz Cakir, *Benedict College*
Ronald Canterbury, *University of Cincinnati*
Maria Carles, *Northern Essex Community College*
Joann Chang, *Arizona Western College*
Roger Choate, *Oklahoma City Community College*
Debra Claypool, *Mid Michigan Community College*
Richard Coppings, *Jackson State Community College*
Elaine Cox, *Bossier Parish Community College*
Cassy Cozine, *University of Saint Mary*
Kenneth Crane, *Texarkana College*
Donna Crapanzano, *Stony Brook University*
David Doe, *Westfield State University*
Rick Doolin, *Daytona State College*
Miranda Dunbar, *Southern Connecticut State University*
Bernadette Dunphy, *Monmouth University*
Abdeslem El Idrissi, *College of Staten Island–CUNY*
Kurt Elliott, *Northwest Vista College*
Doug Elrod, *North Central Texas College*
Greg Erianne, *County College of Morris*
Dana Evans, *University of Rio Grande*
J. Alyssa Farnsworth, *Ivy Tech Community College of Indiana*
Bruce Fisher, *Roane State Community College*
Henry Furneaux, *Capital Community College*
Kristine Garner, *University of Arkansas–Fort Smith*
Lori K. Garrett, *Parkland College*
Wanda Goleman, *Northwestern State University*
Emily Gonzalez, *Northern Essex Community College*
Ewa Gorski, *Community College of Baltimore County*
Sylvester Hackworth, *Bishop State Community College*
Monica Hall-Porter, *Dean College*
Rebecca Harris, *Pitt Community College*
James Hawker, *South Florida Community College*
Marta Heath-Sinclair, *Hawkeye Community College*
Candi Heimgartner, *University of Idaho*
Gary Heisermann, *Salem State University*
Noah Henley, *Rowan-Cabarrus Community College*
Julie Huggins, *Arkansas State University*
Sue Hutchins, *Itasca Community College*
Saiful Islam, *Northern Virginia Community College–Woodbridge*
Jerry Johnson, *Corban University*
Jody Johnson, *Arapahoe Community College*
Jacqueline Jordan, *Clayton State University*
Steve Kash, *Oklahoma City Community College*
Paul Kiser, *Bellarmine University*
Steven Kish, *Zane State College*
Marta Klesath, *North Carolina State University*
Chad Knights, *Northern Virginia Community College–Alexandria*

Megan Knoch, *Indiana University of Pennsylvania*
Louis Kutcher, *University of Cincinnati Blue Ash College*
Tiffany Lamb, *Amarillo College*
Paul Lea, *Northern Virginia Community College–Annandale and Medical Campuses*
Jeffrey Lee, *Essex County College*
Carlos Liachovitzky, *Bronx Community College*
Jerri Lindsey, *Tarrant County College–Northeast*
Christine Maney, *Salem State University*
Jennifer Mansfield-Jones, *University of Louisville*
Bruce Maring, *Daytona State College*
Robert Marino, *Capital Community College*
Darren Mattone, *Muskegon Community College*
Cathy Miller, *Florida State College at Jacksonville*
Liza Mohanty, *Olive-Harvey College*
David Mullaney, *Naugatuck Valley Community College*
Gwen Niksic, *University of Mary*
Zvi Ostrin, *Hostos Community College*
Jay O'Sullivan, *University of Tampa*
Debby Palatinus, *Roane State Community College*
Crystal Pietrowicz, *Southern Maine Community College*
Lou Rifici, *Cuyahoga Community College*
Nancy Risner, *Ivy Tech Community College*
Jo Rogers, *University of Cincinnati*
Hope Sasway, *Suffolk County Community College–Grant*
Dee Ann Sato, *Cypress College*
Tracy Schnorr, *Aurora Community College*
Samuel Schwarzlose, *Amarillo College*
Shaumarie Scoggins, *Texas Women's University*
Pamela Siergiej, *Roane State Community College*
Hollis Smith, *Kennebec Valley Community College*
Terry St. John, *Ivy Tech Community College–Richmond*
Claudia Stanescu, *University of Arizona*
Sherry Stewart, *Navarro College*
Bonnie Taylor, *Schoolcraft College*
Stephen Waldow, *Monroe College*
Rachel Willard, *Arapahoe Community College*
Greg Wilson, *Holmes Community College*
Matthew Wood, *Lake Sumter Community College*

INSTRUCTOR CLASS TESTERS

Trinika Addison, *Middle Georgia State College*
Arlene Allam-Assi, *Hostos Community College–CUNY*
Rishika Bajaj, *Hostos Community College–CUNY*
Michael Barnett, *Amarillo College*
Dena Berg, *Tarrant County College–Northwest*
Bharat Bhushan, *Capital Community College*
Nick Butkevich, *Schoolcraft College*
Katherine Butts-Dehms, *Kennebec Valley Community College*
Yavuz Cakir, *Benedict College*
Maria Carles, *Northern Essex Community College*
Joann Chang, *Arizona Western College*
Barbara Coles, *Wake Tech Community College*
Richard Coppings, *Jackson State Community College*
Donna Crapanzano, *Stony Brook University*
Molli Crenshaw, *Texas Christian University*
David Davis, *Middle Georgia State College*
Diane Day, *Clayton State University*
Vivien Diaz-Barrios, *Hostos Community College–CUNY*
Sam Dunlap, *North Central Texas College*
Vyasheslav Dushenkov, *Hostos Community College–CUNY*
Paul Dykes, *Century College*
Yasmin Edwards, *Bronx Community College*
Kurt Elliott, *Northwest Vista College*
J. Alyssa Farnsworth, *Ivy Tech Community College–Muncie*
Jill Feinstein, *Richland Community College*
Bruce Fisher, *Roane State Community College*
Edward Franklin, *Corning Community College*
John Gillen, *Hostos Community College*
Wanda Goleman, *Northwestern Louisiana State University*
Emily Gonzalez, *Northern Essex Community College*
Rebecca Harris, *Pitt Community College*
Martha Heath-Sinclair, *Hawkeye Community College*
Jacqueline Jordan, *Clayton State University*
Jeff Keyte, *College of Saint Mary*
Christine Kisiel, *Mount Wachusett Community College*
Greg Klein, *Cincinnati State University*
Eduard Korolyev, *Hostos Community College–CUNY*
Tiffany Lamb, *Amarillo College*
Holly Landrum, *Jackson State Community College*
Damaris Lang, *Hostos Community College–CUNY*
Jerri Lindsey, *Tarrant County College–Northeast*
Sheryl Lumbley, *Cedar Valley College*
Renee McFarlane, *Clayton State University*
Paul Melvin, *Clayton State University*
Zvi Ostrin, *Hostos Community College–CUNY*
Deborah Palatinus, *Roane State Community College*
John Pattillo, *Middle Georgia State College*
Penny Perkins-Johnson, *California State University–San Marcos*
Dawn Poirier, *Dean College*
Faina Riftina, *Hostos Community College–CUNY*
Christine Rigsby, *Middle Georgia State College*
Nancy Risner, *Ivy Tech Community College–Muncie*
Charlene Sayers, *Rutgers University–Camden*
Ralph Schwartz, *Hostos Community College–CUNY*
Samuel Schwarzlose, *Amarillo College*
Shaumarie Scoggins, *Texas Woman's University*

Dustin Scott, *Jackson State Community College*
Dara Lee Shigley, *Ivy Tech Community College–Evansville*
Igor Shiltsov, *Hostos Community College–CUNY*
Jane Slone, *Cedar Valley College*
Jill Stein, *Essex County College*
Julie Trachman, *Hostos Community College–CUNY*
Tiffany Vogler, *Ivy Tech Community College–Southwest*
Heather Wesp, *Montcalm Community College*

It is difficult to produce a publication of this magnitude that is free of mistakes or omissions. Any errors or oversights are my responsibility and do not reflect the work of the editors, reviewers, artists, or production staff. I encourage faculty and students to send their comments or suggestions about the content of this lab manual directly to me at the address given below. I will give all your ideas serious consideration when I prepare for the second edition.

Stephen N. Sarikas
Professor of Biology
Lasell College
1844 Commonwealth Ave.
Newton, MA 02466
ssarikas@lasell.edu

Contents

THE DIGESTIVE SYSTEM

THE URINARY SYSTEM

This page intentionally left blank

EXERCISE 1

Body Organization and Terminology

LEARNING OUTCOMES

These Learning Outcomes correspond by number to the laboratory activities in this exercise. When you complete the activities, you should be able to:

Activity **1.1** **Describe and demonstrate anatomical position, and use anatomical terminology to describe relative positions of structures in the human body.**

Activity **1.2** **Describe and demonstrate the various anatomical planes and sections.**

Activity **1.3** **Summarize functions of each organ system, and list the organs in each.**

Activity **1.4** **Name the anatomical regions of the body.**

Activity **1.5** **Identify the body cavities and the organs that are located in each.**

Activity **1.6** **Describe the arrangement of the serous membranes associated with the pericardial, pleural, and abdominopelvic cavities.**

LABORATORY SUPPLIES

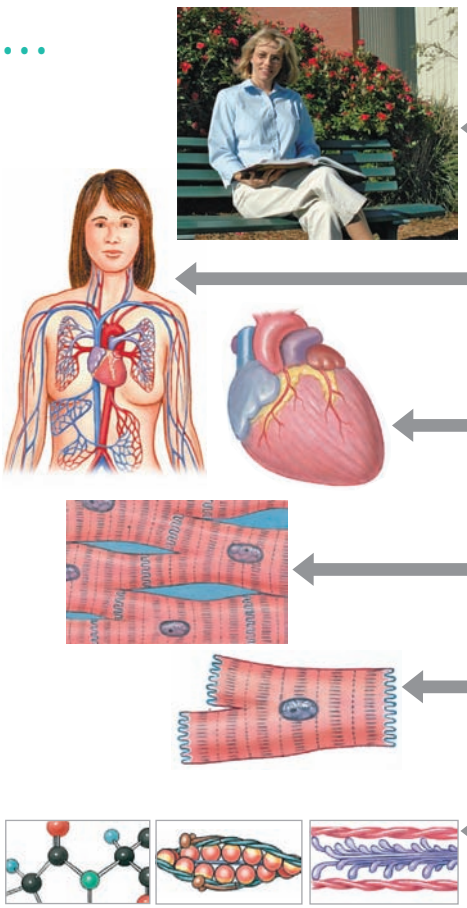
- Human torso model, with dissectible parts
- Various anatomical models of organs and organ systems, with dissectible parts
- Fresh vegetables that are long and cylindrical in shape (e.g., cucumbers or eggplants)
- Small kitchen knife or scalpel
- Human skeleton or skull
- Large, clear plastic bags
- Coloring pencils

BEFORE YOU BEGIN, CONSIDER THIS . . .

Human **anatomy** is the study of the structure of the human body and the relative relationships among body parts. Human **physiology** is the study of normal function in the human body. To gain a complete understanding of human biology, knowledge of both structure (anatomy) and function (physiology) is essential.

The anatomy and physiology of the human body can be studied from six increasingly complex **levels of organization.** Before you begin this exercise, review the levels of organization in the human body.

Explain why a firm grasp of the chemical, cellular, and tissue levels is critical to understanding the structure and function of organs, organ systems, and the complete organism.



The **organism level** is the highest level of organization and includes the structure and function of all the organ systems in the body.

At the **organ system level**, a collection of organs functions as a unit to carry out a collection of related body activities.

At the **organ level**, two or more tissues are arranged into a structure that has a well-defined, three-dimensional shape and a specific bodily function.

At the **tissue level**, collections of cells are grouped to perform a similar function.

At the **cellular level**, organelles, which are composed of molecules, are organized in a unique way to form cells. The cell represents the fundamental unit of life.

At the **chemical level**, the chemical bonds between atoms give rise to molecules.

ACTIVITY 1.1

Using Anatomical Terms to Describe Body Organization

To succeed in this course, you must become familiar with the general organization of the human body and learn the standard anatomical language that is used to describe that organization. Most anatomical names are derived from Latin or Greek words and have remained uniform throughout most of the more than 2000 years during which anatomy has been studied.

A Anatomical Position

Human anatomy is described with reference to the **anatomical position,** a universally accepted standard position for the body. An individual in the anatomical position stands erect with head and eyes directed forward. The upper limbs are by the sides, with palms facing forward, and the lower limbs are together with the toes facing forward.

1 Suppose that the accepted anatomical position is to have the palms facing backward. How would this new position change your description of the palms and thumbs?

▶ _____

_____

_____

2 Based on your answer to the previous question, why do you think it is important to have a universally accepted anatomical position?

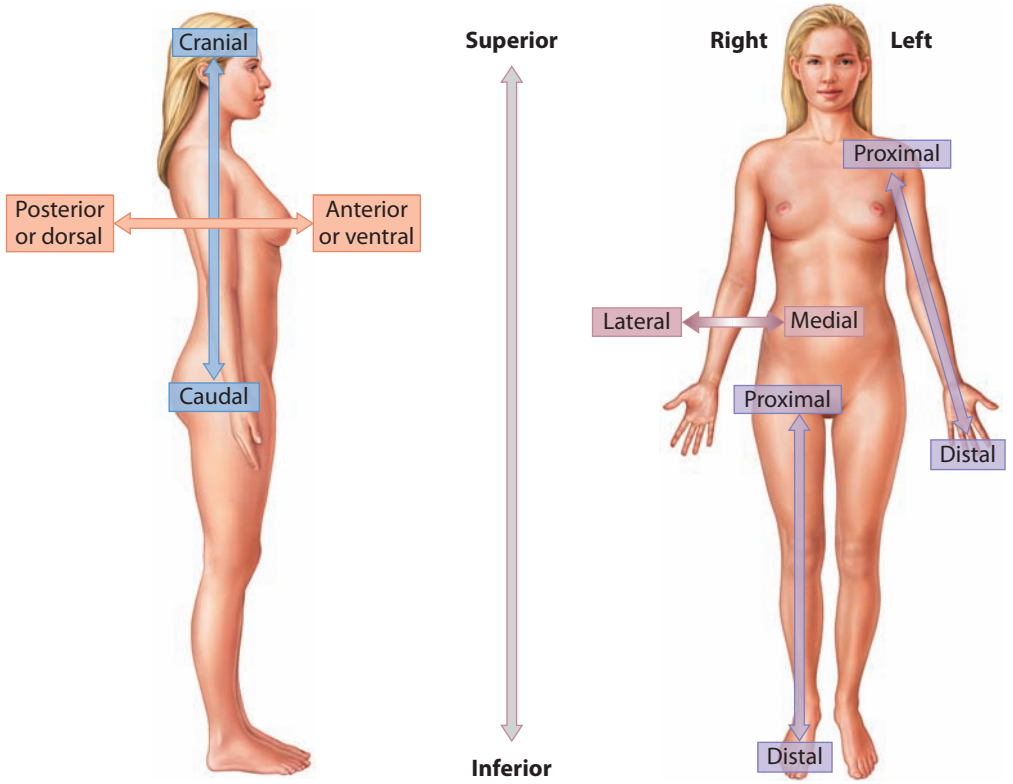
▶ _____

_____

Word Origins

The word *anatomy* is derived from the Greek words *ana* (= "apart") and *tome* (= "a cutting"). Together, the two words mean "a cutting apart." The best way to study the structure of an organism is to dissect it or "cut it apart."

The word *physiology* is also derived from two Greek words: *physis* (= "nature") and *logos* (= "study"). Together, the two words mean "study nature." Physiology is the study of natural processes in the body.



B Anatomical Terms

Several anatomical terms are used to describe the location of one body part in relation to another. These terms are always used to illustrate the relative position of a structure when the body is in the anatomical position. For example, to explain the relative position of the heart to the esophagus, you could state that the heart is **anterior** (closer to the front) to the esophagus. Alternatively, you could say that the esophagus is **posterior** (closer to the back) to the heart. Other terms used to express relative position are described in Table 1.1 and illustrated in the figure on the previous page. Carefully review these terms and be sure that you understand their meanings before you proceed. Make it a habit to periodically review these terms as the course progresses.

1 Ask your lab partner to stand in the anatomical position. Use the directional terms listed in Table 1.1 to describe the relationships of the following structures on your lab partner's body.

a. Left eye to left ear ▶ _____

b. Thumb to little finger ▶ _____

c. Right ankle joint to right knee joint ▶ _____

d. Left elbow joint to right elbow joint ▶ _____

2 Refer to a torso model. Use directional terms to describe the relationships of the following pairs of internal organs. You will have to "dissect" the torso model to identify some of these structures.

a. Left kidney to spleen ▶ _____

b. Right lung to right lobe of the liver ▶ _____

c. Pancreas to stomach ▶ _____

d. Ascending colon to descending colon ▶ _____

TABLE 1.1 Anatomical Terms of Relationship and Comparison

	Term	Definition	Example
1.	a. superior (cranial) b. inferior (caudal)	closer to the head closer to the feet	The lungs are *superior* to the stomach. The liver is *inferior* to the heart.
2.	a. anterior (ventral) b. posterior (dorsal)	closer to the front closer to the back	The trachea is *anterior* to the esophagus. The vertebral column is *posterior* to the heart.
3.	a. medial b. lateral	closer to the midline farther from the midline	The nose is *medial* to the cheeks. The spleen is *lateral* to the pancreas.
4.	intermediate	between a more medial and more lateral structure	The clavicle is *intermediate* to the sternum and the shoulder.
5.	a. proximal b. distal	closer to the trunk farther from the trunk	The shoulder is *proximal* to the elbow. The wrist is *distal* to the elbow.
6.	a. superficial (external) b. deep (internal)	closer to or on the surface farther from the surface	The skin is *superficial* to the skeletal muscles. The bones are *deep* to the skin.
7.	a. parietal b. visceral	pertaining to the wall of a body cavity pertaining to the covering of an organ	The membrane lining the thoracic wall is the *parietal* pleura. The membrane that covers the surface of the lungs is the *visceral* pleura.
8.	a. ipsilateral b. contralateral	on the same side of the body on the opposite side of the body	The right lung is *ipsilateral* to the liver. The left arm is *contralateral* to the right lung.

MAKING CONNECTIONS

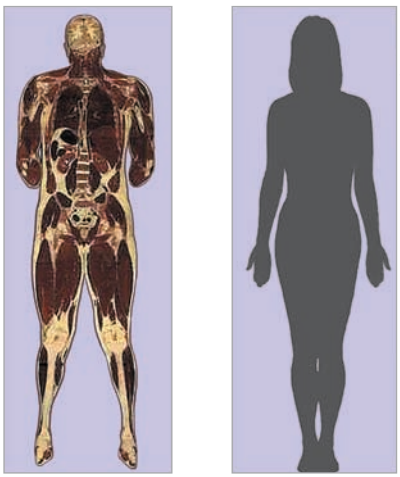
Often, the terms in Table 1.1 are combined to provide a more specific description of location. For instance, one can say that the heart is **superomedial** to the ascending colon. What does this tell you about the relative positions of the heart and ascending colon?

▶ _____

_____

ACTIVITY
1.2 Defining Anatomical Planes and Sections

A Three types of imaginary planes pass through the body in the anatomical position. Each of the three planes forms a right angle with the other two. The surfaces that are formed by cuts made in the various planes are called **sections.**

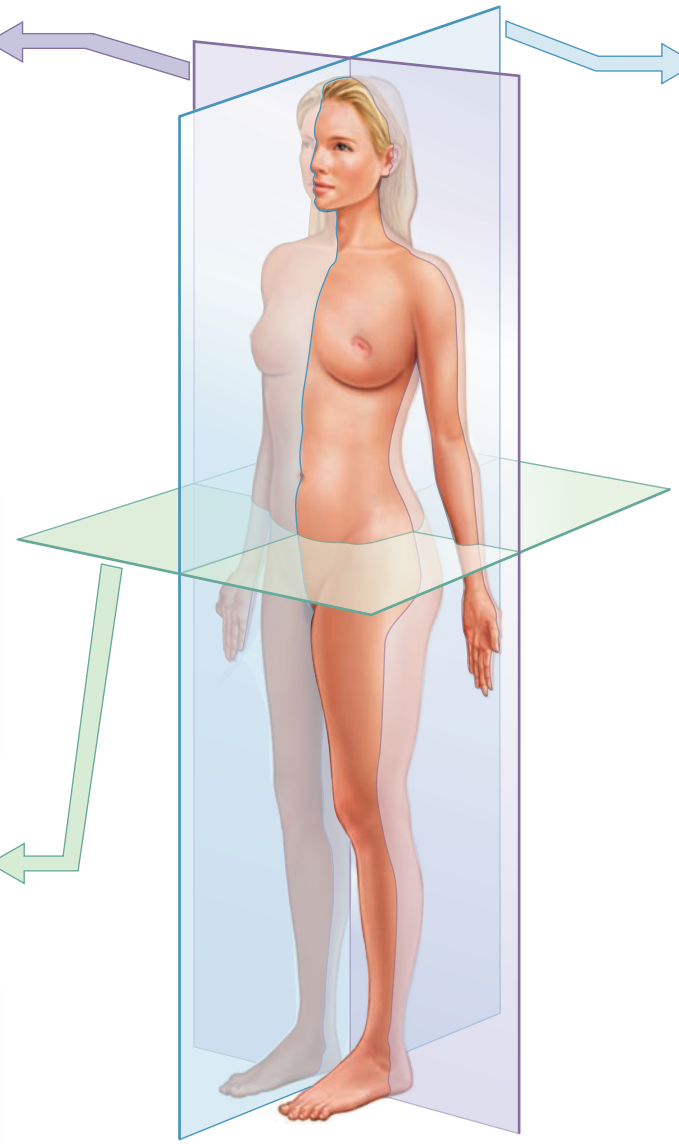


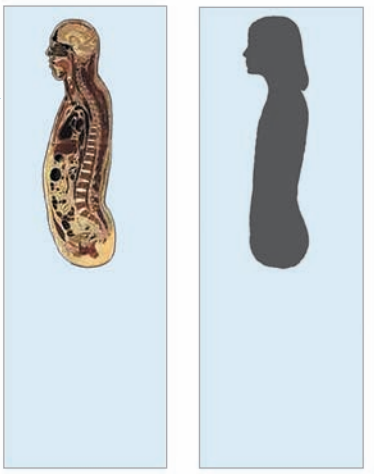
Frontal plane

Frontal (coronal) planes are vertical planes that pass longitudinally through the body from left to right. They divide the body into anterior and posterior portions. The surface formed by a cut in a frontal plane is a **frontal section**.

Transverse plane

Transverse (horizontal) planes are planes that divide the body into superior and inferior portions. **Transverse (cross) sections** are formed by cuts along transverse planes.

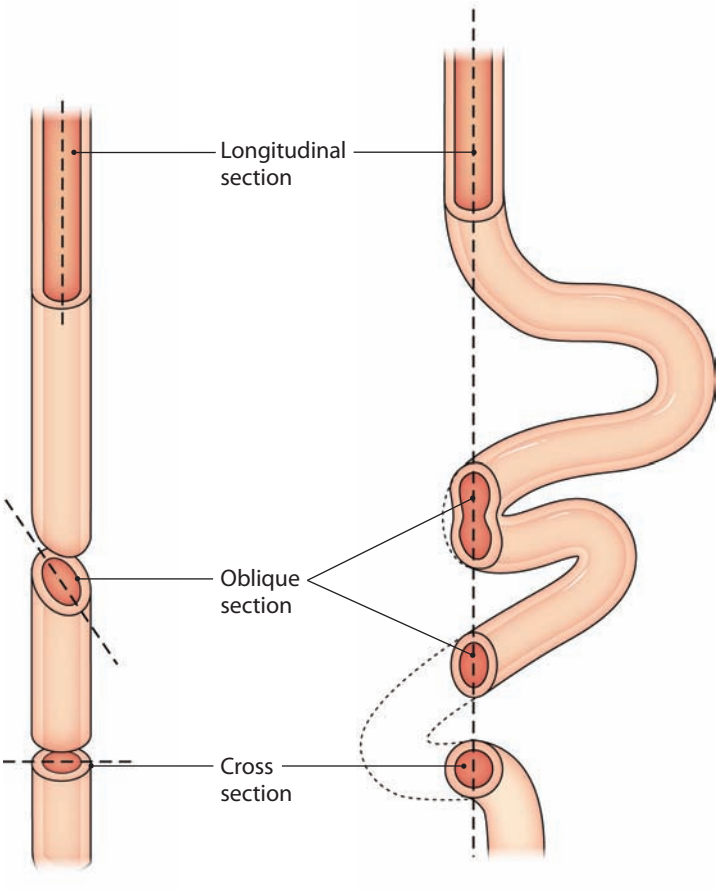




Sagittal plane

Sagittal planes are vertical planes that pass longitudinally through the body from anterior to posterior and divide the body into left and right parts. There are two types of sagittal planes. The **median** or **midsagittal plane** passes through the midline and divides the body into equal left and right halves. **Parasagittal planes** run parallel to the median plane and divide the body into unequal left and right parts. Sagittal sections are formed by cuts made along sagittal planes.

1. Identify the anatomical planes on torso models and on your own or your lab partner's body.
2. Observe several anatomical models with removable parts. As you remove each part, determine what type of section has been made. Remember that you must place the structure in the anatomical position to determine the answer.



B Sections are typically used to describe cuts made in specific structures, rather than the whole body. For example, if you are viewing a microscope slide of the trachea, you may be looking at a cross section (cs) or a longitudinal section (ls). Sometimes, the label on the slide will tell you what type of section you are observing (i.e., cs or ls). In a highly folded structure such as the small intestine, however, you often can find more than one type of section on the same microscope slide.

1. Obtain a vegetable that has a long cylindrical shape (e.g., cucumber, zucchini, eggplant). Using a knife or scalpel, start near one end of the vegetable and cut, in order, a cross section, a longitudinal section and an oblique section. Oblique sections are not formed by cuts made along any of the basic anatomical planes as described earlier. Instead, these sections slant or deviate from these planes and intersect them at angles less than 90°.
2. Observe the surfaces that you have produced with these sectional cuts. In the spaces below, draw each section that you have produced.

Cross Section	Longitudinal Section	Oblique Section
▶	▶	▶

MAKING CONNECTIONS

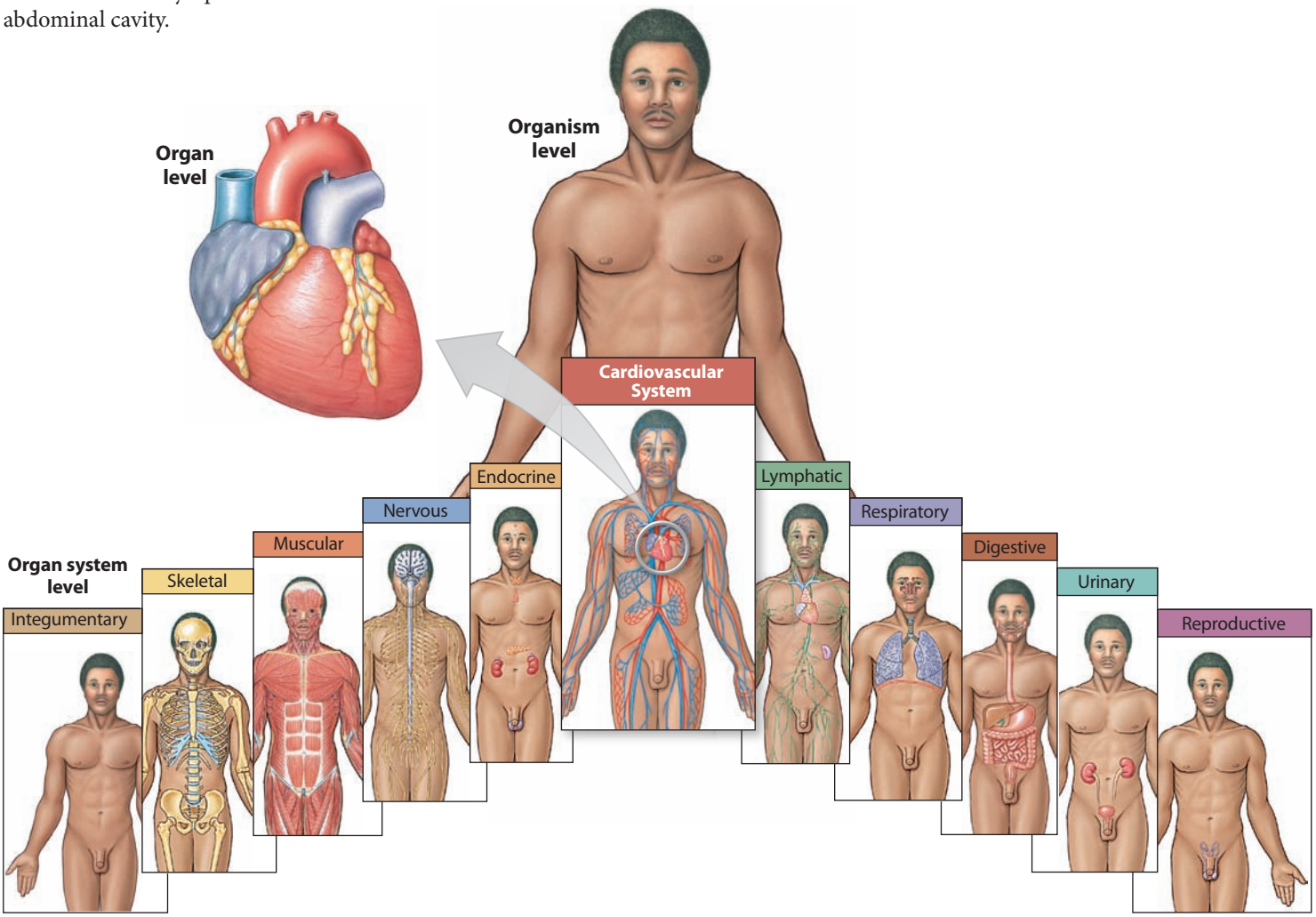
The thoracic cavity contains the heart and lungs. Explain, in a general way, how a view of the thoracic cavity along the midsagittal plane would differ from a view of the thoracic cavity along a transverse plane.

▶

ACTIVITY
1.3 Identifying Organs and Organ Systems

An **organ** is a distinct structure that contains at least two, but often all four, types of tissues and carries out specific functions. Most organs are located within body cavities that are closed to the outside. For example, the small intestine contains all four types of tissues and performs the final steps for digesting (breaking down) nutrients into small molecules and absorbing these molecules into the blood or lymph. The small intestine is located within the abdominal cavity.

An **organ system** is a collection of organs that works as a team to complete a common objective. For example, the small intestine is an organ in the digestive system, which also includes the oral cavity, pharynx, esophagus, and most organs in the abdominal cavity. These organs are responsible for ingesting food, digesting and absorbing nutrient molecules, and eliminating undigested wastes.



A On a human torso model, observe the anatomical relationships of the internal organs. Notice how adjacent organs are in close contact with one another, and that very little unoccupied space remains in the body cavities. Identify all the structures listed below. (Depending on the type of models in your lab, you may not be able to locate all the structures.) Next to each structure, write the organ system to which it belongs. ▶

Aorta _____	Skull _____	Ovaries _____	Tonsils _____
Brain _____	Small intestine _____	Pancreas _____	Trachea _____
Heart _____	Spinal cord _____	Skeletal muscles _____	Urinary bladder _____
Kidneys _____	Spleen _____	Skin _____	Uterus _____
Lungs _____	Testes _____	Liver _____	Stomach _____

B Consult your textbook or have a class discussion to identify the major functions of the 11 organ systems in the human body. Write your answers in Table 1.2. ▶

TABLE 1.2 Organ Systems and Their Major Functions

Organ System		Major Function
	Integumentary system	
	Skeletal system	
	Muscular system	
	Nervous system	
	Endocrine system	
	Cardiovassular system	
	Lymphatic system	
	Respiratory system	
	Digestive system	
	Urinary system	
	Reproductive system	

IN THE CLINIC

Organs and Organ Systems

It is convenient to study the organ systems as discrete entities, but from a functional perspective, each organ system is closely integrated with other systems. Consider the following examples:

- The lymphatic system defends the organs in other systems against infection and plays a pivotal role in tissue repair after an injury.
- The digestive system provides nutrients for cells in all organ systems. These nutrients are transported by the cardiovascular system.

Because the organ systems are so closely connected in function, many diseases present symptoms with a wide range of systemic effects. For example, diabetes mellitus, a disease that is characterized by the inability of cells to take up glucose, forces the body to break down vital proteins and lipids to produce enough energy for metabolism. As a result, many degenerative changes occur throughout the body, leading to a myriad of medical problems, including blindness, kidney failure, reduced blood flow to the limbs, and heart disease.

As you can see from these examples, during normal function and during periods of disease, the activities of each organ system are influenced and sometimes controlled by the activities of the others. You should begin to understand and learn to appreciate this close integration of function.

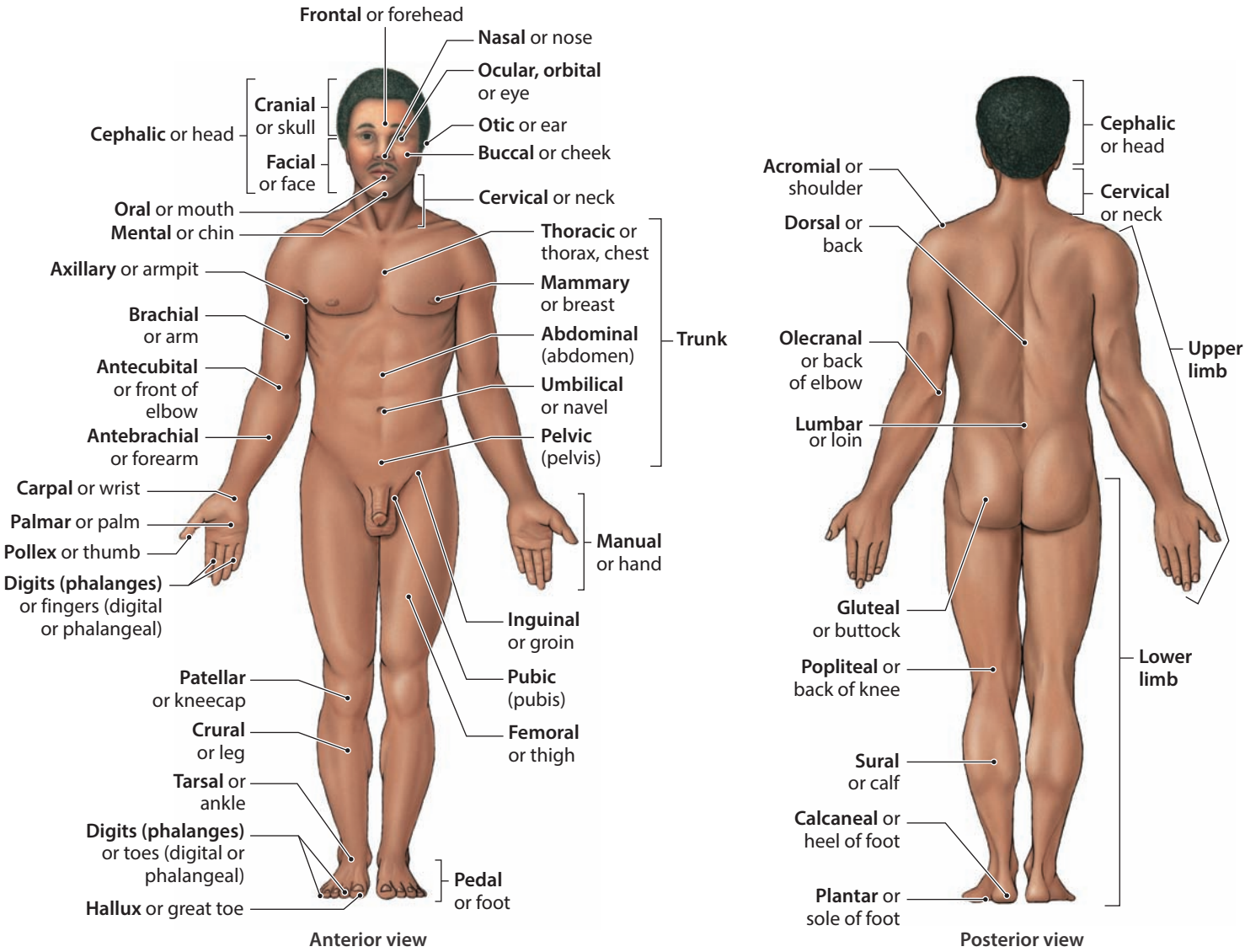
MAKING CONNECTIONS

In this activity, you grouped various organs by organ system. Review your groupings and identify any organs that appear in more than one organ system. Comment on the functional significance of organs having a role in more than one system.

▶

ACTIVITY
1.4 Identifying Anatomical Regions

The body can be divided into two major divisions: the **axial** and the **appendicular.** The **axial division** is the central part of the body and includes the head, neck, and trunk. The **appendicular division** includes the upper and lower extremities. Both the axial and appendicular divisions can be subdivided into numerous smaller regions, each with a specific anatomical and common name. Familiarity with these terms will help you later to locate and learn the names of other structures. For example, the axilla is the region of the body that is commonly referred to as the armpit. The axillary artery and vein travel through this region, and the axillary lymph nodes are also located here.



A Identify the anatomical regions in which you are likely to find the following structures:

a. Inguinal canal ▶ _____

b. Brachial artery ▶ _____

c. Femoral vein ▶ _____

d. Facial nerve ▶ _____

e. Thoracic vertebrae ▶ _____

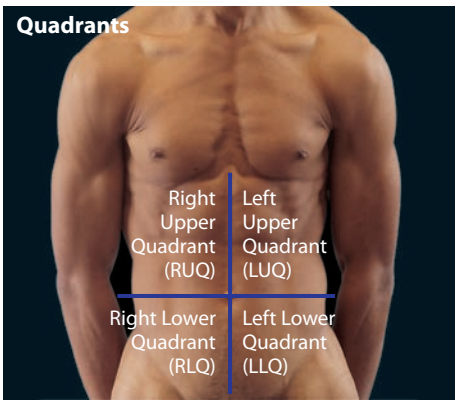
f. Carpal bones ▶ _____

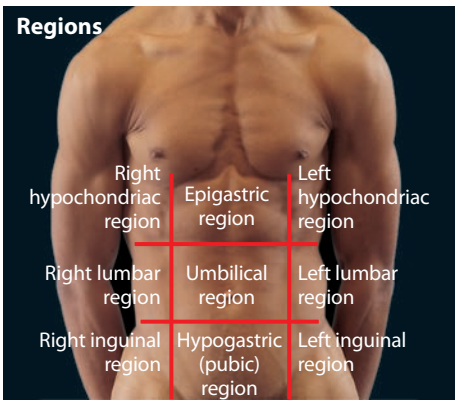
g. Cranial bones ▶ _____

h. Popliteal artery ▶ _____

B The abdomen and pelvis, together often referred to as the **abdominopelvic** region, can be divided into even smaller segments. Clinicians divide this region into quadrants that are formed by two imaginary, perpendicular lines intersecting at the umbilicus. The four quadrants are the right upper quadrant, left upper quadrant, right lower quadrant, and left lower quadrant. Anatomists usually describe the abdominopelvic area in a more specific manner by dividing it into nine regions.

1. Using a torso model, identify the four abdominopelvic quadrants. Identify two organs, or parts of organs, found within each quadrant and list them in Table 1.3. Use the photos on the right as a reference. ▶
2. Using a torso model, identify the nine abdominopelvic regions. Identify two organs, or parts of organs, found within each region and list them in Table 1.3. Use the photos on the right as a reference. ▶





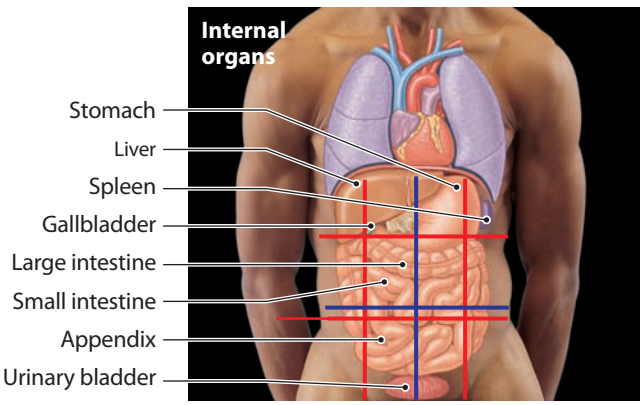


TABLE 1.3 The Abdominopelvic Regions and Underlying Organs

Four Quadrants	Organs
Right upper quadrant	
Left upper quadrant	
Right lower quadrant	
Left lower quadrant	
Nine Regions	**Organs**
Right hypochondriac	
Epigastric	
Left hypochondriac	
Right lumbar	
Umbilical	
Left lumbar	
Right inguinal	
Hypogastric (pubic)	
Left inguinal	

IN THE CLINIC

Abdominopelvic Quadrants

The quadrant system is clinically important because it can be used to identify the general location of underlying organs. For example, the appendix is a wormlike extension attached to the cecum at the origin of the large intestine. The appendix is located in the right lower quadrant. If a patient complains of persistent pain in this region, he or she could have an inflamed appendix, or **appendicitis.**

MAKING CONNECTIONS

Which method of dividing the abdominopelvic region do you find to be more useful from an anatomical perspective? From a clinical perspective? Explain.

▶ _____

_____

_____

_____

_____