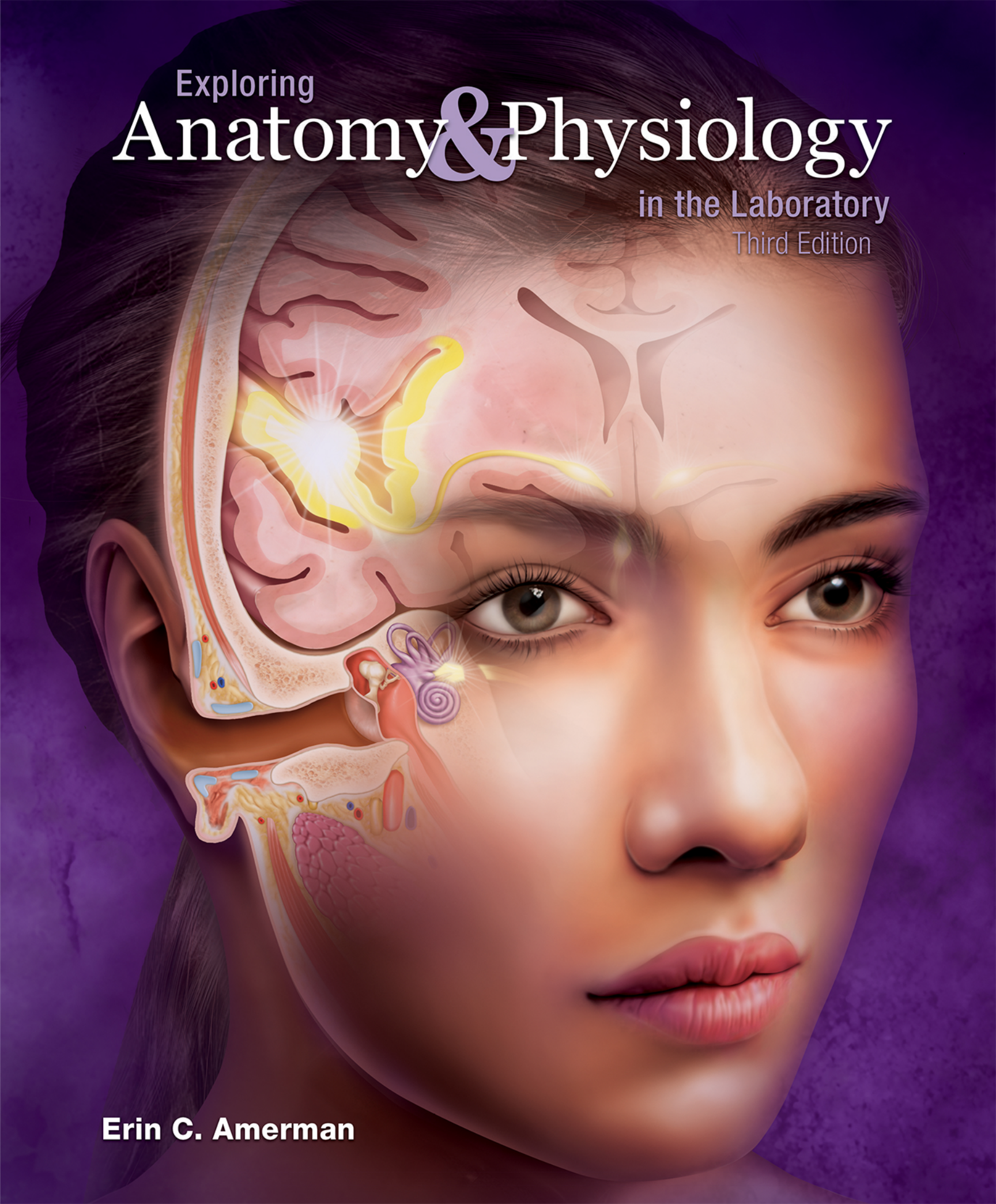
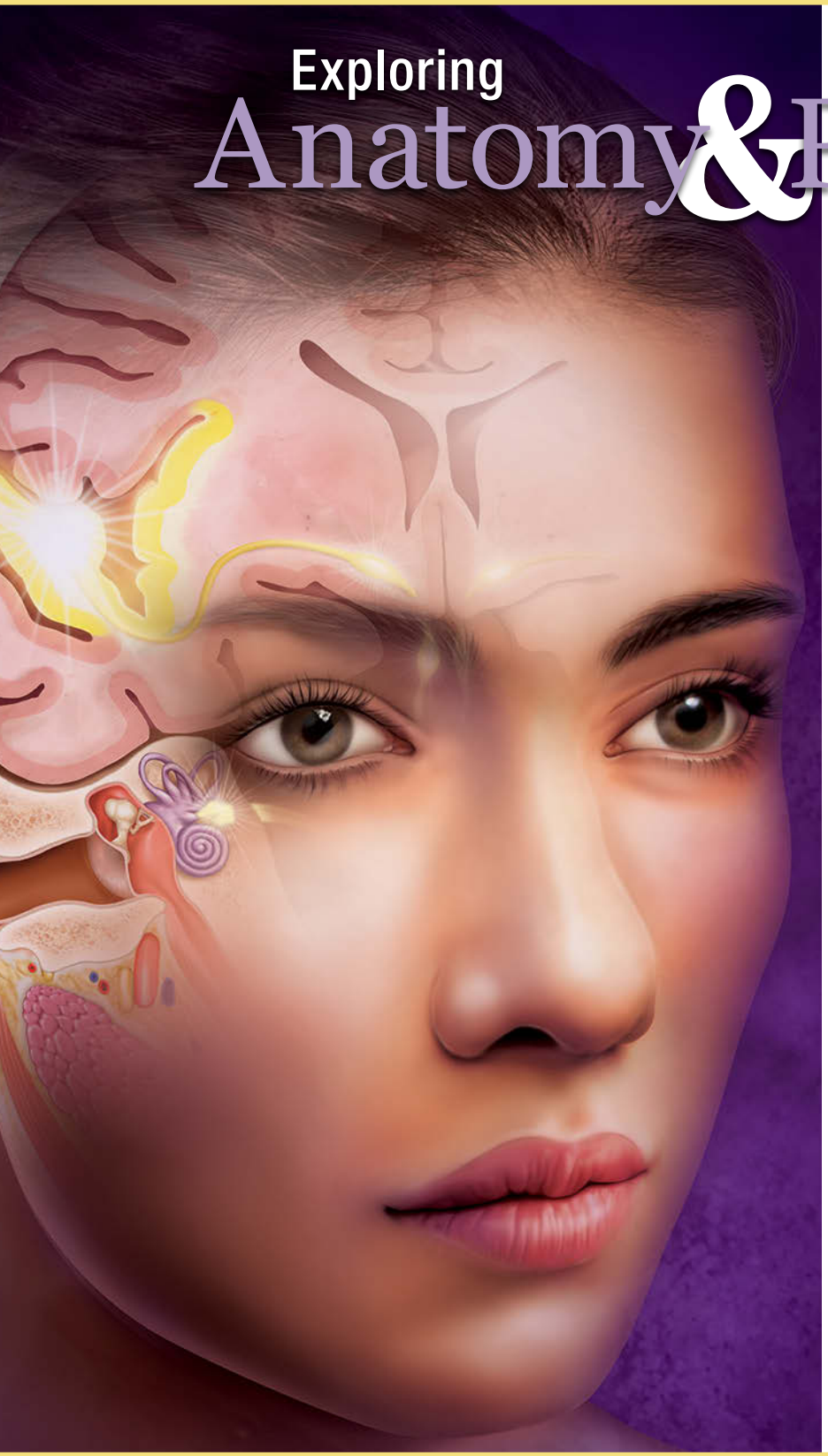

Exploring
Anatomy & Physiology
in the Laboratory
Third Edition
Erin C. Amerman



Exploring Anatomy & Physiology in the Laboratory

Third Edition

Erin C. Amerman

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Dedication

For Doug Morton, whose support of my vision, commitment to this book, and belief in the value of higher education to transform lives will not be forgotten.

For Elise, who was 12 weeks old when I dedicated my first book to her, and is 12 years old now, and remains my favorite reason for missing deadlines.

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Preface

They say that the third edition of a textbook is when it really comes into its own. Having just arrived at the third edition of *Exploring Anatomy and Physiology in the Laboratory*, or *EAPL*, I'm inclined to believe that there is some truth in this saying.

It feels like just yesterday that I first met David Ferguson and we discussed our shared vision for an activity-based lab manual that would keep students engaged, improve their lab grades, and solve teaching problems. Fast forward to thirteen years later, and David is now the president of Morton Publishing Company, and together we have published four different lab manuals, including *EAPL*.

We started with the text *Exercises for the Anatomy and Physiology Laboratory*, a simple black and white manual with focused activities. *Exercises* was enthusiastically received, and we set out to produce an expanded, full-color version of the exercises that included more explanations, new activities, a complete art program, and new pedagogy. This book became the first edition of *EAPL*. Like its predecessor, it was warmly received.

The second edition of *EAPL* was dramatically improved from the first, largely thanks to the feedback of professors. And now we enter the third edition, armed with still more feedback, and more experience, and it has hopefully led us to an even more dramatically improved book. As you peruse the new third edition, please take note of the following updates:

- **Added text narrative to make *EAPL* a self-contained lab manual.** One of the most frequent requests we received was to add more information to *EAPL* so that students didn't need an additional textbook to complete the activities. We heard your requests, and responded. Every effort was made in the revisions for this edition to ensure that *EAPL* is a self-contained lab manual. The text narrative now defines and explains all key terms so that your students do not need outside sources when working with the manual.
- **Expanded and improved art program.** In line with our goal of making *EAPL* a self-contained textbook, we further expanded the art program with more than 250 new and improved figures. This ensures that all key structures are clearly shown, often from multiple views. We are also excited to be able to add select photos of anatomical models for the first time.
- **Updated quiz questions.** Even the best quiz questions can grow stale after a while. With that in mind, the "Check Your Recall" and "Check Your Understanding" questions have been updated, and approximately 70 to 80 percent of the questions have been altered or replaced in each unit.
- **Fine-tuned activities.** Many of the procedures or activities were altered to make them more time efficient. In addition, certain exercises that just weren't working were cut. These were replaced with other, better exercises. For example, we added drawing activities in most units, as research has shown that students retain information better when they draw the structures they are studying.
- **Pronunciation keys.** Speaking aloud is an important learning modality, but it's difficult to do if students don't know how to say the words correctly. With that in mind, we added phonetic pronunciation keys to anatomical and physiological terms. We have also placed a pronunciation guide at the front of the book so students may quickly look up a word as needed.

There are a number of other improvements we made as well, including several new Hints & Tips boxes, re-organizing Model Inventories to match the order of terms presented in the text, numbering the procedures to make them easier to assign, and replacing many of the histology images with higher-quality micrographs. We hope that you enjoy the third edition of *EAPL* and find that it has indeed "come into its own." Please continue to share your feedback with us—we are always looking for ways that we can improve.

— Erin Amerman

Acknowledgments

Textbooks are an enormous undertaking. Many people were integral to the production and development of this edition, and I would like to take this brief opportunity to express my gratitude.

First and foremost I would like to thank my family and friends, particularly my daughter Elise, my mother Cathy, and my husband Chris. Without your unwavering support and patience, none of my work would be possible. I'd also like to thank Dr. Lourdes Norman-McKay, whose advice, wisdom, and friendship helps to keep me (mostly) sane. Lastly, I can't forget my animals: my dogs, who never fail to bark and howl during phone meetings, and my cats, who always manage to be completely in the way of whatever I'm doing.

Next I would like to extend my gratitude to the talented book team with whom I was fortunate enough to work: Joanne Saliger, who expertly designed and produced the book as she always does; Trina Lambert, who skillfully copyedited the text; Sarah Thomas, who coordinated everything as the associate project editor; Marta Martins, who oversaw the project as the acquisitions editor in Portuguese, French, and English; Elizabeth Budd, who proofread the text; Carolyn Acheson, who provided indexing services; the team at Imagineering, who provided the beautiful illustrations; and John Crawley, Michael Leboffe, and Justin Moore, who allowed me to use several of their excellent photos and photomicrographs. I truly appreciate all of your hard work and generosity.

I would also like to thank the following reviewers for their invaluable suggestions that helped to improve this edition:

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The acknowledgements would be incomplete without thanking Doug Morton, to whom I will be eternally grateful for adding me to the Morton family. And finally, I extend a special thank you to President David Ferguson for his support, patience, friendship, Broncos games, and willingness to go hiking with me to look for snakes even if he is unwilling to actually touch a snake himself.

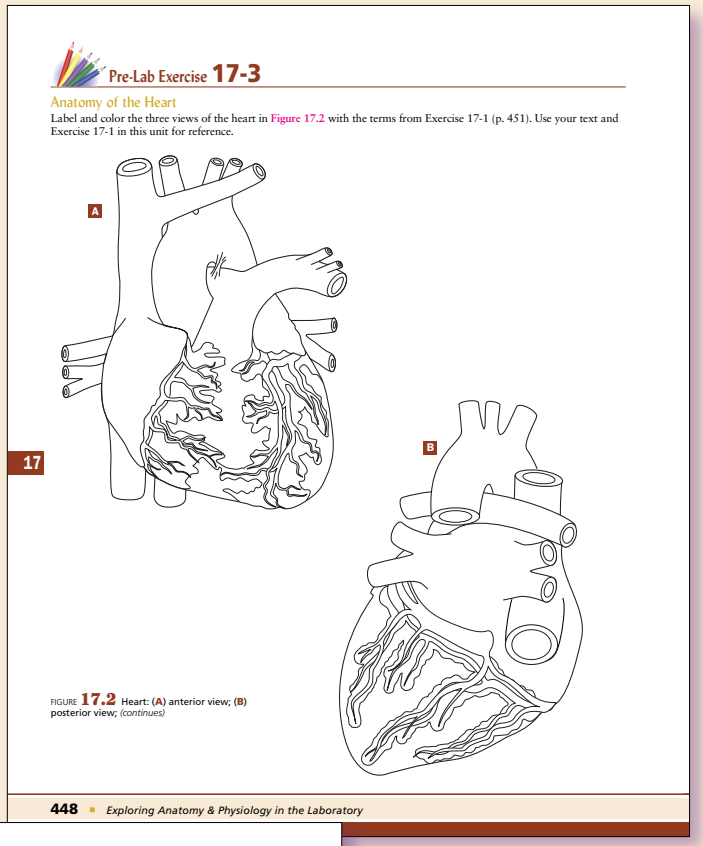
About the Author

Erin C. Amerman has been involved in anatomy and physiology education for over 16 years as an author and professor, currently at Florida State College at Jacksonville in Jacksonville, Florida. She received a B.S. in Cellular and Molecular Biology from the University of West Florida and a Doctorate in Podiatric Medicine from Des Moines University. She is the author of six textbooks on the subject of anatomy and physiology, four of which are with Morton Publishing Company.

Be Prepared

Objectives set learning goals to prepare students for what they are expected to know after completing the lab. The numbered objectives also aid in the review of material.

Pre-Lab Exercises encourage students to actively prepare for the lab by defining key terms, doing labeling and coloring exercises to learn anatomical structures, and reviewing vital material from previous units, saving instructors from having to spend extra time reviewing material from the lecture. These exercises have been updated with new terms and new figures and can be completed using information available in the lab manual. By asking students to draw their own leader lines and write out definitions, the pre-lab exercises are designed to help students retain information and build a deeper understanding of the content.



Pre-Lab Exercise 17-3

Anatomy of the Heart

Label and color the three views of the heart in Figure 17.2 with the terms from Exercise 17-1 (p. 451). Use your text and Exercise 17-1 in this unit for reference.

A

B

17

FIGURE 17.2 Heart: (A) anterior view; (B) posterior view; *(continues)*

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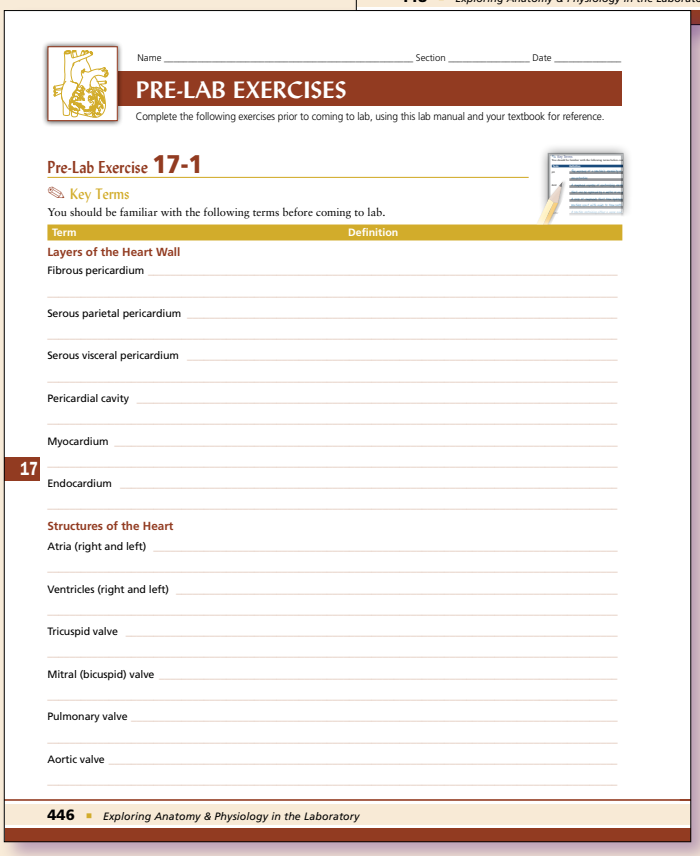

Name _____ Section _____ Date _____

PRE-LAB EXERCISES

Complete the following exercises prior to coming to lab, using this lab manual and your textbook for reference.

Pre-Lab Exercise 17-1

Key Terms

You should be familiar with the following terms before coming to lab.

Term	Definition
Layers of the Heart Wall	
Fibrous pericardium	
Serous parietal pericardium	
Serous visceral pericardium	
Pericardial cavity	
Myocardium	
Endocardium	
Structures of the Heart	
Atria (right and left)	
Ventricles (right and left)	
Tricuspid valve	
Mitral (bicuspid) valve	
Pulmonary valve	
Aortic valve	

17

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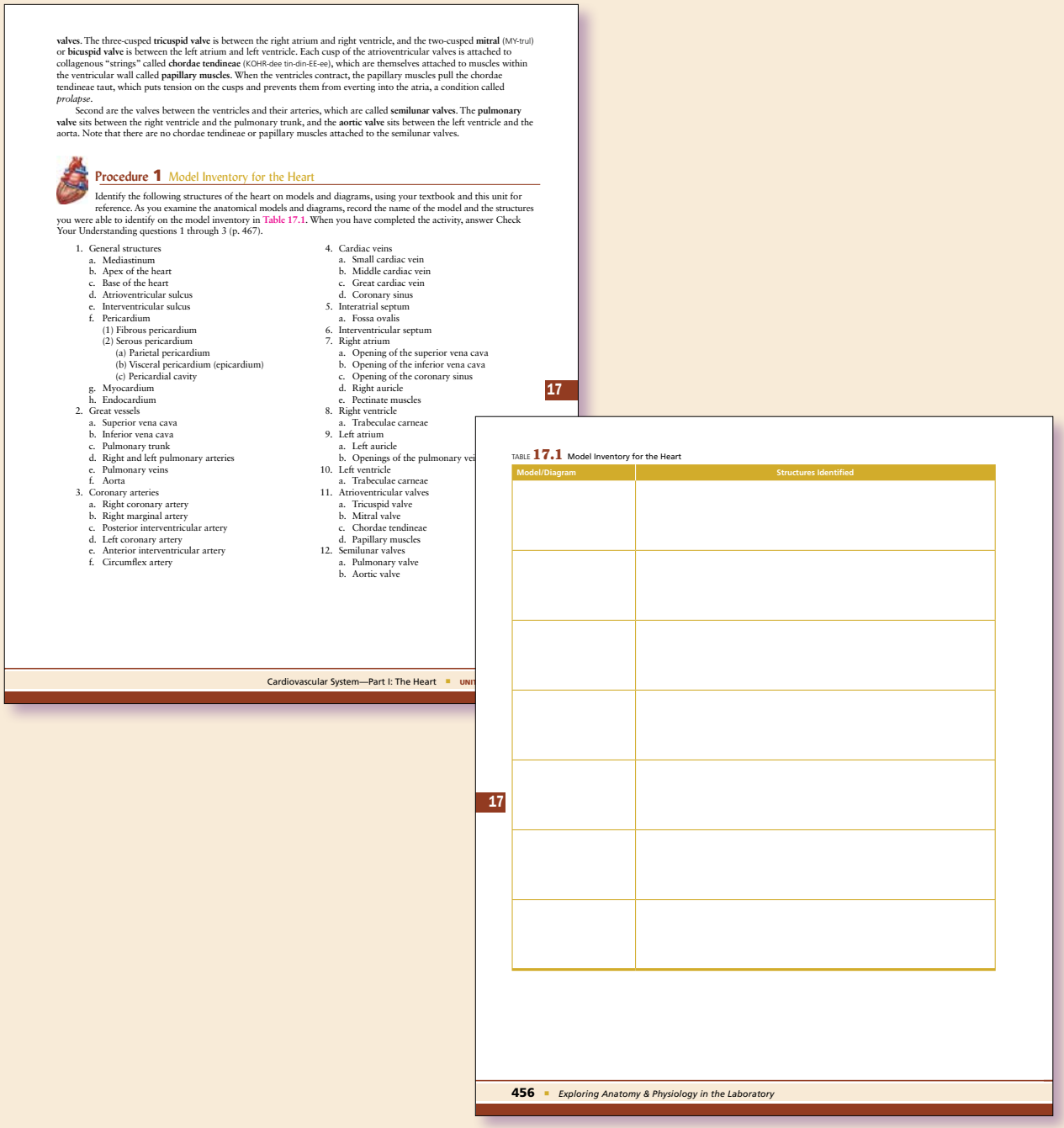
Be Organized

Model Inventories provide organized and easily referenced lists of anatomical structures students are responsible for identifying. These lists help students catalog the specimens they see in the lab. The emphasis on examination, description, pronunciation, and writing the names of anatomical structures encourages students to be actively involved in the learning process and allows them to better retain the material.



valves. The three-cusped **tricuspid valve** is between the right atrium and right ventricle, and the two-cusped **mitral** (MY-trul) or **bicuspid valve** is between the left atrium and left ventricle. Each cusp of the atrioventricular valves is attached to collagenous "strings" called **chordae tendineae** (KOHR-dee tin-din-EE-ee), which are themselves attached to muscles within the ventricular wall called **papillary muscles**. When the ventricles contract, the papillary muscles pull the chordae tendineae taut, which puts tension on the cusps and prevents them from everting into the atria, a condition called *prolapse*.

Second are the valves between the ventricles and their arteries, which are called **semilunar valves**. The **pulmonary valve** sits between the right ventricle and the pulmonary trunk, and the **aortic valve** sits between the left ventricle and the aorta. Note that there are no chordae tendineae or papillary muscles attached to the semilunar valves.

Procedure 1 Model Inventory for the Heart

Identify the following structures of the heart on models and diagrams, using your textbook and this unit for reference. As you examine the anatomical models and diagrams, record the name of the model and the structures you were able to identify on the model inventory in Table 17.1. When you have completed the activity, answer Check Your Understanding questions 1 through 3 (p. 467).

1. General structures
   - a. Mediastinum
   - b. Apex of the heart
   - c. Base of the heart
   - d. Atrioventricular sulcus
   - e. Interventricular sulcus
   - f. Pericardium
     - (1) Fibrous pericardium
     - (2) Serous pericardium
       - (a) Parietal pericardium
       - (b) Visceral pericardium (epicardium)
       - (c) Pericardial cavity
   - g. Myocardium
   - h. Endocardium
2. Great vessels
   - a. Superior vena cava
   - b. Inferior vena cava
   - c. Pulmonary trunk
   - d. Right and left pulmonary arteries
   - e. Pulmonary veins
   - f. Aorta
3. Coronary arteries
   - a. Right coronary artery
   - b. Right marginal artery
   - c. Posterior interventricular artery
   - d. Left coronary artery
   - e. Anterior interventricular artery
   - f. Circumflex artery
4. Cardiac veins
   - a. Small cardiac vein
   - b. Middle cardiac vein
   - c. Great cardiac vein
   - d. Coronary sinus
5. Interatrial septum
   - a. Fossa ovalis
6. Interventricular septum
7. Right atrium
   - a. Opening of the superior vena cava
   - b. Opening of the inferior vena cava
   - c. Opening of the coronary sinus
   - d. Right auricle
   - e. Pectinate muscles
8. Right ventricle
   - a. Trabeculae carneae
9. Left atrium
   - a. Left auricle
   - b. Openings of the pulmonary vei
10. Left ventricle
    - a. Trabeculae carneae
11. Atrioventricular valves
    - a. Tricuspid valve
    - b. Mitral valve
    - c. Chordae tendineae
    - d. Papillary muscles
12. Semilunar valves
    - a. Pulmonary valve
    - b. Aortic valve

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Cardiovascular System—Part I: The Heart ■ UNIT

TABLE 17.1 Model Inventory for the Heart

Model/Diagram	Structures Identified

17

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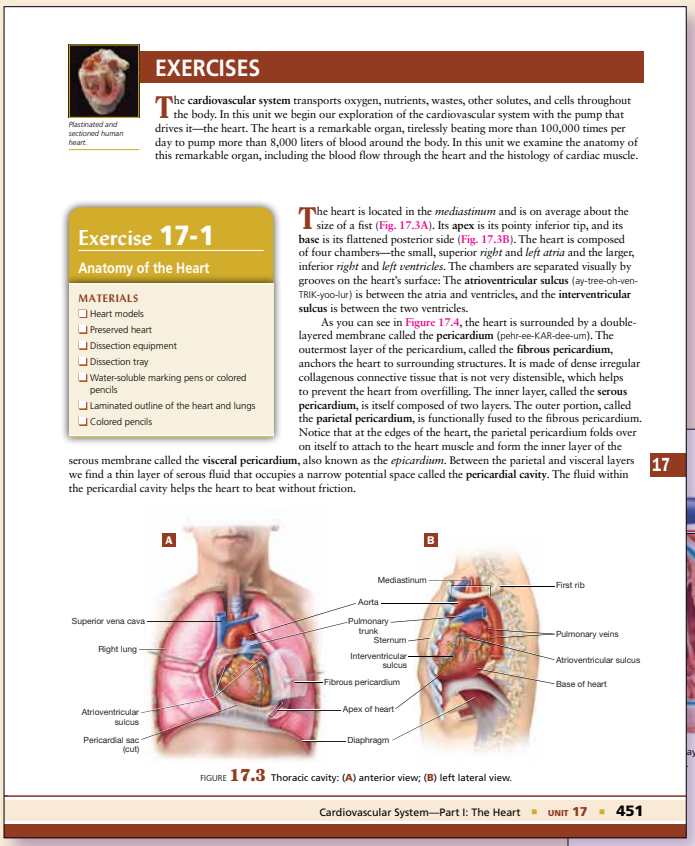
Be Focused

Illustrations and **Photographs** in *Exploring Anatomy & Physiology in the Laboratory*, 3e, were specifically designed to improve student understanding of important concepts and procedural instructions in the laboratory setting. (Many lab manuals simply reproduce artwork and exposition from the related textbook, unnecessarily increasing the redundancy, size, and price of the manual.)

With more than 200 new and revised illustrations and photographs, this edition offers a more detailed and realistic view of human anatomy. Almost all of the histology images are new, taken from the best sources of commercially available slides.



Plastinated and sectioned human heart.

EXERCISES

The **cardiovascular system** transports oxygen, nutrients, wastes, other solutes, and cells throughout the body. In this unit we begin our exploration of the cardiovascular system with the pump that drives it—the heart. The heart is a remarkable organ, tirelessly beating more than 100,000 times per day to pump more than 8,000 liters of blood around the body. In this unit we examine the anatomy of this remarkable organ, including the blood flow through the heart and the histology of cardiac muscle.

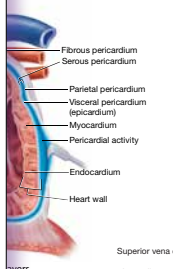
Exercise 17-1
Anatomy of the Heart

MATERIALS
- ❑ Heart models
- ❑ Preserved heart
- ❑ Dissection equipment
- ❑ Dissection tray
- ❑ Water-soluble marking pens or colored pencils
- ❑ Laminated outline of the heart and lungs
- ❑ Colored pencils

The heart is located in the *mediastinum* and is on average about the size of a fist (Fig. 17.3A). Its **apex** is its pointy inferior tip, and its **base** is its flattened posterior side (Fig. 17.3B). The heart is composed of four chambers—the small, superior *right* and *left atria* and the larger, inferior *right* and *left ventricles*. The chambers are separated visually by grooves on the heart's surface: The **atrioventricular sulcus** (ay-tree-oh-ven-TRIK-yoo-lur) is between the atria and ventricles, and the **interventricular sulcus** is between the two ventricles.

As you can see in Figure 17.4, the heart is surrounded by a double-layered membrane called the **pericardium** (pehr-ee-KAR-dee-um). The outermost layer of the pericardium, called the **fibrous pericardium**, anchors the heart to surrounding structures. It is made of dense irregular collagenous connective tissue that is not very distensible, which helps to prevent the heart from overfilling. The inner layer, called the **serous pericardium**, is itself composed of two layers. The outer portion, called the **parietal pericardium**, is functionally fused to the fibrous pericardium. Notice that at the edges of the heart, the parietal pericardium folds over on itself to attach to the heart muscle and form the inner layer of the serous membrane called the **visceral pericardium**, also known as the *epicardium*. Between the parietal and visceral layers we find a thin layer of serous fluid that occupies a narrow potential space called the **pericardial cavity**. The fluid within the pericardial cavity helps the heart to beat without friction.

FIGURE **17.3** Thoracic cavity: (**A**) anterior view; (**B**) left lateral view.



The heart itself is an organ that consists of three tissue layers:

1. **Epicardium.** The **epicardium** (ep-ih-KAR-dee-um) or visceral pericardium is considered the outermost layer of the heart wall. It consists of a layer of simple squamous epithelial tissue and loose connective tissue.
2. **Myocardium.** The middle **myocardium** (my-oh-KAR-dee-um) is the actual muscle of the heart. It consists of cardiac muscle tissue and its fibrous skeleton.
3. **Endocardium.** The innermost **endocardium** is a type of simple squamous epithelium called *endothelium*. It is continuous with the endothelium lining all blood vessels in the body.

Let's look now at the external anatomy of the heart, shown in Figure 17.5. As you can see in the figure, the atria receive blood from

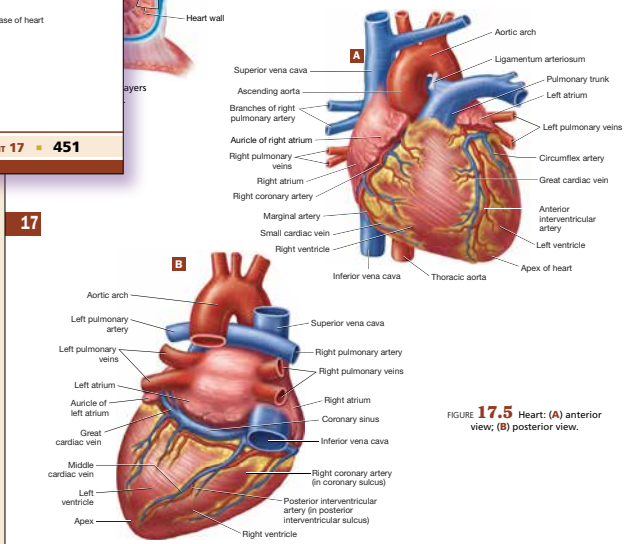
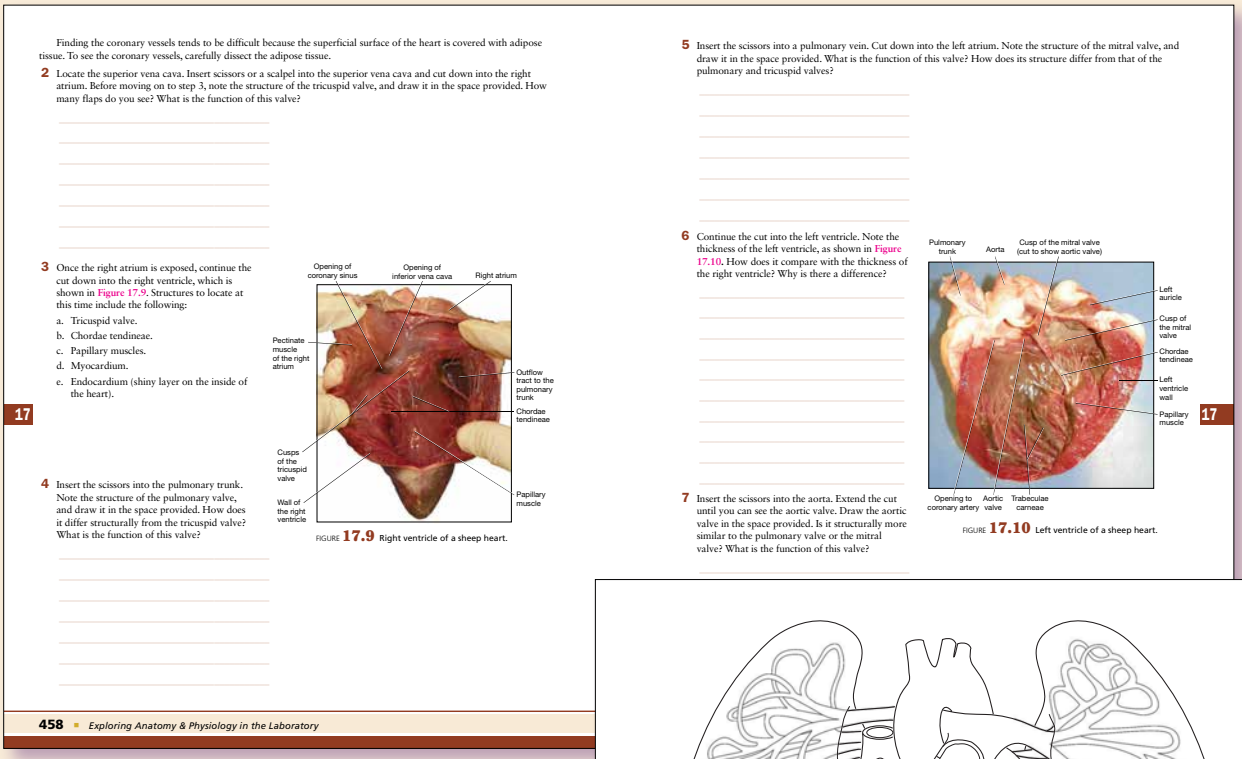


FIGURE **17.5** Heart: (**A**) anterior view; (**B**) posterior view.

Be Active

Focused Activities are the guiding philosophy of this lab manual. Students learn best when they are actively engaged in the laboratory. In this manual, students are asked to be active by describing, labeling, writing, coloring, and drawing. 21 new activities have been added to this edition, including a starch solubility exercise, identifying structures of the shoulder joint, muscle fiber contraction, new special senses activities, and many more.



Finding the coronary vessels tends to be difficult because the superficial surface of the heart is covered with adipose tissue. To see the coronary vessels, carefully dissect the adipose tissue.

2 Locate the superior vena cava. Insert scissors or a scalpel into the superior vena cava and cut down into the right atrium. Before moving on to step 3, note the structure of the tricuspid valve, and draw it in the space provided. How many flaps do you see? What is the function of this valve?

3 Once the right atrium is exposed, continue the cut down into the right ventricle, which is shown in Figure 17.9. Structures to locate at this time include the following:

a. Tricuspid valve.
b. Chordae tendineae.
c. Papillary muscles.
d. Myocardium.
e. Endocardium (shiny layer on the inside of the heart).

17

Opening of coronary sinus
Opening of inferior vena cava
Right atrium
Pectinate muscle of the right atrium
Outflow tract to the pulmonary trunk
Chordae tendineae
Cusps of the tricuspid valve
Wall of the right ventricle
Papillary muscle

FIGURE 17.9 Right ventricle of a sheep heart.

4 Insert the scissors into the pulmonary trunk. Note the structure of the pulmonary valve, and draw it in the space provided. How does it differ structurally from the tricuspid valve? What is the function of this valve?

5 Insert the scissors into a pulmonary vein. Cut down into the left atrium. Note the structure of the mitral valve, and draw it in the space provided. What is the function of this valve? How does its structure differ from that of the pulmonary and tricuspid valves?

6 Continue the cut into the left ventricle. Note the thickness of the left ventricle, as shown in Figure 17.10. How does it compare with the thickness of the right ventricle? Why is there a difference?

Pulmonary trunk
Aorta
Cusp of the mitral valve (cut to show aortic valve)
Left auricle
Cusp of the mitral valve
Chordae tendineae
Left ventricle wall
Papillary muscle
Opening to coronary artery
Aortic valve
Trabeculae carneae

FIGURE 17.10 Left ventricle of a sheep heart.

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7 Insert the scissors into the aorta. Extend the cut until you can see the aortic valve. Draw the aortic valve in the space provided. Is it structurally more similar to the pulmonary valve or the mitral valve? What is the function of this valve?

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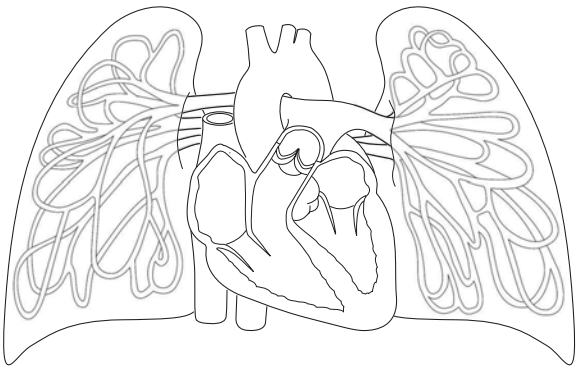


FIGURE 17.11 Heart, lungs, and pulmonary circulation.

17

Cardiovascular System—Part I: The Heart ▪ UNIT 17 ▪ 461

Tracing Exercises ask students to write step-by-step, turn-by-turn directions to follow substances (blood cells, food molecules, waste by-products, electrical events) through the human body, then trace the substances' path on a "map" of the body. These exercises allow students to see the big picture of how the body systems interact and to understand the relationship between structure and function.

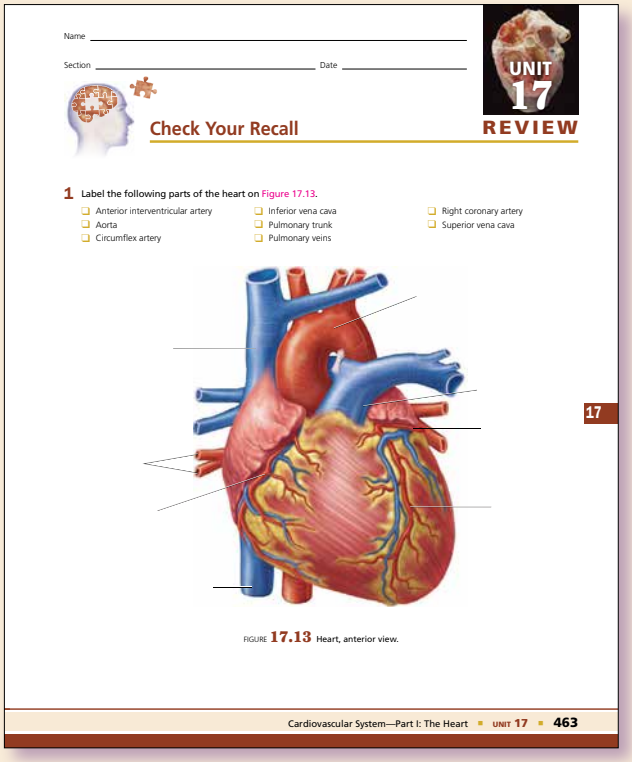
Hints & Tips sidebars appear throughout the book to help students navigate some of the more difficult topics in A&P.

Be Sure

Check Your Progress sections completing each unit ensure that students understand key concepts and achieve the learning objectives, signaling that they are ready to move on. This new edition features new assessment questions throughout.

Check Your Recall "quizzes" consist of labeling, fill-in-the-blank, multiple choice, and sequencing questions that test the students' ability to retain the material they completed in the lab. These sheets can be used as graded lab quizzes and/or to check attendance in the lab.

Check Your Understanding "tests" ask students to use the information they have learned to answer critical thinking questions, frequently related to clinical scenarios. The ability to synthesize and apply knowledge is the desired outcome of any A&P course. These questions check students' deeper understanding by challenging them to provide answers they cannot find verbatim in either the lab manual or the textbook. New Check Your Understanding questions have been added to nearly every unit in this edition.



Name _____

Section _____ Date _____

UNIT 17 REVIEW

Check Your Recall

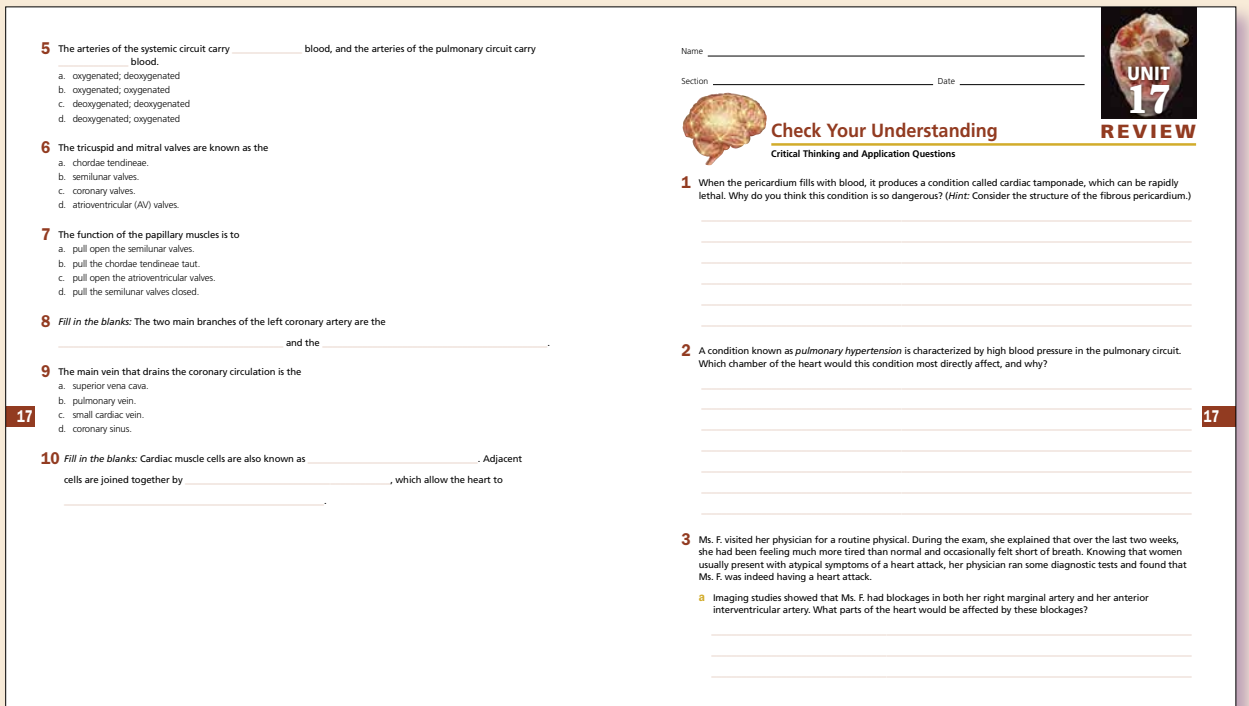
1 Label the following parts of the heart on Figure 17.13.

- ❑ Anterior interventricular artery
- ❑ Aorta
- ❑ Circumflex artery
- ❑ Inferior vena cava
- ❑ Pulmonary trunk
- ❑ Pulmonary veins
- ❑ Right coronary artery
- ❑ Superior vena cava

FIGURE 17.13 Heart, anterior view.

17

Cardiovascular System—Part I: The Heart ■ UNIT 17 ■ 463



5 The arteries of the systemic circuit carry _____ blood, and the arteries of the pulmonary circuit carry _____ blood.

a. oxygenated; deoxygenated
b. oxygenated; oxygenated
c. deoxygenated; deoxygenated
d. deoxygenated; oxygenated

6 The tricuspid and mitral valves are known as the

a. chordae tendineae.
b. semilunar valves.
c. coronary valves.
d. atrioventricular (AV) valves.

7 The function of the papillary muscles is to

a. pull open the semilunar valves.
b. pull the chordae tendineae taut.
c. pull open the atrioventricular valves.
d. pull the semilunar valves closed.

8 *Fill in the blanks:* The two main branches of the left coronary artery are the _____ and the _____.

9 The main vein that drains the coronary circulation is the

a. superior vena cava.
b. pulmonary vein.
c. small cardiac vein.
d. coronary sinus.

17

10 *Fill in the blanks:* Cardiac muscle cells are also known as _____. Adjacent cells are joined together by _____, which allow the heart to _____.

Name _____

Section _____ Date _____

UNIT 17 REVIEW

Check Your Understanding

Critical Thinking and Application Questions

1 When the pericardium fills with blood, it produces a condition called cardiac tamponade, which can be rapidly lethal. Why do you think this condition is so dangerous? (*Hint:* Consider the structure of the fibrous pericardium.)

2 A condition known as *pulmonary hypertension* is characterized by high blood pressure in the pulmonary circuit. Which chamber of the heart would this condition most directly affect, and why?

17

3 Ms. F. visited her physician for a routine physical. During the exam, she explained that over the last two weeks, she had been feeling much more tired than normal and occasionally felt short of breath. Knowing that women usually present with atypical symptoms of a heart attack, her physician ran some diagnostic tests and found that Ms. F. was indeed having a heart attack.

a Imaging studies showed that Ms. F. had blockages in both her right marginal artery and her anterior interventricular artery. What parts of the heart would be affected by these blockages?

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Cardiovascular System—Part I: The Heart ■ UNIT 17 ■ 467

Be Aware

Textbooks are expensive, and the last thing students need is to spend too much for a lab manual. Morton Publishing is committed to providing high-quality products at reasonable prices.

It is our sincere hope that *Exploring Anatomy & Physiology in the Laboratory*, 3e, will provide you the tools necessary for a productive and interesting laboratory experience. We welcome all comments and suggestions for future editions of this book. Please feel free to contact us at eapl@morton-pub.com or visit us at www.morton-pub.com.

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- *A Dissection Guide and Atlas to the Fetal Pig*
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- *An Illustrated Atlas of the Skeletal Muscles*

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Pronunciation Guide

Note: Accented syllables are capitalized; for example "a-NAT-oh-mee and fiz-ee-AHL-oh-jee."

abdominal (ab-DAH-mih-nuhl)
abdominopelvic (ab-dom-ih-noh-PEL-vik)
abducens (ab-DOO-senz)
acetabulum (aeh-seh-TAB-yoo-lum)
acetylcholine (ah-SEE-til-koh'-leen)
acetylcholinesterase (ah-see-til-kohl-in-ESS-ter-ayz)
acinar (AY-sin-ahr)
acromial (ah-KROH-mee-uhl)
acromioclavicular (ah-KROH-mee-oh-klah-VIK-yoo-lur)
acromion (ah-KROH-mee-ahn)
acrosomal (ak-roh-ZOH-muhl)
adenohypophysis (ad-in-oh-hy-PAWF-ih-sis)
adipocytes (AD-ih-poh-syt'z)
adrenal (uh-DREE-nuhl)
adrenocorticotropic (ah-dree-noh-kohr-tih-koh-TROH-pik)
adventitia (ad-ven-TISH-uh)
agglutination (uh-gloo-tin-AY-shun)
agranulocytes (AY-gran-yoo-loh-syt'z)
alae (AY-lee)
albuginea (al-byoo-JIN-ee-uh)
aldosterone (al-DAHS-tur-ohn)
alleles (uh-LEELZ)
alveolar (al-vee-OH-lahr)
alveoli (al-vee-OH-lye)
amnion (AM-nee-ahn)
amphiarthroses (am-fee-ar-THROH-seez)
amphipathic (am-fih-PATH-ik)
amylase (AM-uh-layz)
antebrachial (an-tee-BRAY-kee-uhl)
antecubital (an-tee-KYOO-bih-tuhl)
anterior (an-TEER-ee-ur)
antidiuretic (an-tee-dy-yoo-RET-ik)
aorta (ay-OHR-tah)
aponeurosis (ap-oh-noo-ROH-sis)
arachnoid mater (ah-RAK-noyd MAH-tur)
arbor vitae (AR-bohr VEE-tay)
arcuate (ARK-yoo-it)
areola (aehr-ee-OH-lah)
arrector pili (ah-REK-tohr PIL-aye)
arteriosus (ahr-TEER-ee-oh-suss)
arytenoid (uh-RIT-uh-noyd)
atrioventricular (ay-tree-oh-ven-TRIK-yoo-lur)
atrium (AY-tree-um)
auricle (OHR-ih-kuhl)
auscultation (aws-kuhl-TAY-shun)
axillary (AX-il-ehr-ee)
axolemma (aks-oh-LEM-ah)
axon (AX-ahn)
azygos (ay-ZY-gus)
baroreceptor (BEHR-oh-reh-sep-ter)
basal lamina (BAY-zul LAM-in-uh)
basale (bay-SAY-lee)
basophils (BAY-zoh-filz)
biceps brachii (BY-seps BRAY-kee-aye)
blastocyst (BLAST-oh-sist)
brachial (BRAY-kee-uhl)
brachialis (bray-kee-AL-iss)
brachiocephalic (bray-kee-oh-seh-FAL-ik)
brachioradialis (bray-kee-oh-ray-dee-AL-iss)
bradycardia (bray-dih-KAR-dee-uh)
bronchi (BRONG-kye)
bronchial (BRONG-kee-uhl)
bronchioles (BRONG-kee-ohlz)
bronchomediastinal (brongk-oh-mee-dee-ah-STYN-uhl)
bruits (broo-eez)
buccal (BYOO-kuhl)
buccinator (BUK-sin-ay-tur)
bulbourethral (bul-boh-yoo-REETH-ruhl)
bursae (BURR-see)
calcaneal (kal-KAY-nee-uhl)
calcaneus (kal-KAYN-ee-us)
calcitonin (kal-sih-TOH-nin)
calvaria (kal-VEHR-ee-uh)
calyces (KAY-lih-seez)
canaliculi (kan-ah-LIK-yoo-lee)
canines (KAY-nynz)
capitulum (kah-PIT-yoo-lum)
carbonic anhydrase (kar-BAW-nik an-HY-dray'z)
carina (kuh-RY-nuh)
carneae (kar-NEE-ee)
carotid (kuh-RAWT-id)
carpal (KAR-puhl)
carpi radialis (KARP-aye ray-dee-AL-iss)
carpi ulnaris (KARP-aye uhl-NEHR-iss)
cauda equina (KOW-dah eh-KWY-nah)
cecum (SEE-kum)
celiac (SEE-lee-ak)
centrioles (SEN-tree-ohlz)
centromere (SIN-troh-meer)
centrosome (SEN-troh-sohm)
cephalic (sef-AL-ik)
cerebellum (sehr-eh-BELL-um)

cerebrospinal (seh-ree-broh-SPY-nuhl)
cerebrum (seh-REE-brum)
cervical (SIR-vih-kuhl)
cervicis (SIR-vih-sis)
chiasma (ky-AZ-mah)
chiasmata (ky-az-MAH-tah)
chylomicrons (ky-loh-MY-kronz)
chonchae (KAHN-kee)
chondrocytes (KAHN-droh-syt'z)
chordae tendineae (KOHRD-ee tin-din-EE-ee)
chorion (KOHR-ee-ahn)
chorionic villi (KOHR-ee-ahn-ik VILL-aye)
choroid (KOHR-oyd)
chromatin (KROH-mah-tin)
chromosomes (KROH-moh-sohmz)
chylomicrons (ky-loh-MY-kronz)
chyme (KAYE'M)
cilia (SILL-ee-uh)
ciliary body (SILL-ee-ehr-ee)
circumflex (SIR-kum-flex)
cisterna chyli (sis-TER-nah KY-lee)
cisternae (sis-TER-nee)
clitoris (KLIT-uhr-iss)
coccyx (KAHX-iks)
cochlea (KOHK-lee-ah)
colliculi (koll-IK-yoo-lye)
colloid (KAWL-oyd)
conceptus (kun-SEPT-uhs)
conchae (KAHN-kee)
conjunctiva (kon-junk-TY-vah)
conus medullaris (KOHN-us med-yoo-LEHR-us)
coracoid (KOHR-ah-koyd)
coracohumeral (kohr'-uh-koh-HYOO-muhr-uhl)
cornea (KOHR-nee-ah)
corniculate (kor-NIK-yoo-layt)
coronal (koh-ROH-nuhl)
coronary (KOHR-oh-nehr-ee)
corpora cavernosa (kohr-POHR-uh kah-ver-NOH-suh)
corpus callosum (KOHR-pus kal-OH-sum)
corpus luteum (KOHR-pus LOO-tee-um)
corpus spongiosum (KOHR-pus spun-jee-OH-sum)
cranial (KRAY-nee-uhl)
cremaster (kreh-MASS-ter)
cricoid (KRY-koyd)
cricothyroid (kry-koh-THY-royd)
cricothyroidotomy (kry-koh-thy-royd-AW-toh-mee)
crista galli (KRIS-tah GAL-ee)
cruciate (KROO-shee-iht)
crural (KROO-ruhl)
cubital (KYOO-bit-uhl)
cuneiform (kyoo-NEE-ih-form)
cystic (SIS-tik)
cytokines (SY-toh-kyn'z)
cytokinesis (sy-toh-kin-EE-sis)
cytoplasm (SY-toh-plaz-m)
cytosol (SY-toh-sahl)
deciduous (dih-SIJ-oo-uhs)
dendrites (DEN-dryt'z)
denticulate ligaments (den-TIK-yoo-lit)
deoxyribonucleic acid (dee-awks-ee-ry-boh-noo-KLAY-ik)
detrusor (dee-TROO-sur)
diaphragm (DY-uh-fram)
diaphysis (dy-AEH-fih-sis)
diarthroses (dy-ar-THROH-seez)
diastole (dy-AEH-stoh-lee)
diastolic (dy-uh-STAHL-ik)
diencephalon (dy-en-SEF-ah-lahn)
digital (DIJ-it-uhl)
diploid (DIH-ployd)
dorsalis pedis (dohr-SAL-iss PEE-diss)
ductus deferens (DUK-tuss DEF-er-ahnz)
duodenum (doo-AW-den-um)
dura mater (DOO-rah MAH-tur)
embryogenesis (em-bree-oh-JEN-ih-sis)
endolymph (EN-doh-limf)
endometrium (en-doh-MEE-tree-um)
endomysium (en-doh-MY-see-um)
endoneurium (en-doh-NOOR-ee-um)
endoplasmic reticulum (en-doh-PLAZ-mik reh-TIK-yoo-lum)
endosteum (en-DAH-stee-um)
eosinophils (ee-oh-SIN-oh-filz)
ependymal (eh-PEN-dih-muhl)
epicardium (ep-ih-KAR-dee-um)
epicondyles (ep-ih-KAHN-dyl'z)
epicranius (ep-ih-KRAY-ih-nee-uhs)
epididymis (ep-ih-DID-ih-miss)
epidural (ep-ih-DOO-ruhl)
epiglottis (ep-ih-GLAW-tiss)
epimysium (ep-ih-MY-see-um)
epineurium (ep-ih-NOOR-ee-um)
epiphyseal (eh-PIF-ih-seel)
epiphysis (eh-PIF-ih-seez)
epiploic (ep-ih-PLOH-ik)
epithalamus (ep-ih-THAL-ih-mus)
epithelial (ep-ih-THEE-lee-uhl)
eponychium (ep-oh-NIK-ee-um)
erector spinae (eh-REK-tohr SPY-nee)
erythrocytes (eh-RITH-roh-syt'z)
erythropoietin (eh-rith-roh-POY-ee-tin)
esophagus (eh-SOF-ah-gus)
falciform (FALL-sih-form)
falx cerebelli (FALS sehr-eh-BELL-ee)
falx cerebri (FALS seh-REE-bree)
fascia (FASH-uh)
fascicles (FASS-ih-kullz)
faciculata (fah-SIK-yoo-lah-tah)
femoral (FEM-oh-ruhl)
fibroblasts (FY-broh-blastz)
fibula (FIB-yoo-lah)
fibularis (fib-yoo-LEHR-iss)
filum terminale (FY-lum ter-mee-NAL-ay)
fimbriae (FIM-bree-ay)
flagella (flah-JEL-uh)
fossa ovalis (FAWS-ah oh-VAL-is)
fovea capitis (FOH-vee-uh CAP-ih-tiss)
fovea centralis (FOH-vee-uh sin-TRAL-iss)
frontal (FRUHN-tuhl)
frontalis (frun-TAL-iss)
funiculi (fun-IK-yoo-lye)
gametes (GAM-eetz)
gametogenesis (gah-meet-oh-JEN-us-sis)

gastrocnemius (gas-trawk-NEE-mee-uhs)
genotype (JEE-noh-type)
gingivae (JIN-jih-vay)
glenohumeral (glen'-oh-HYOO-mur-uhl)
glomerulosa (glom-ehr-yoo-LOH-sah)
glomerulus (gloh-MEHR-yoo-lus)
glossopharyngeal (glah-soh-fehr-IN-jee-uhl)
glucagon (GLOO-kah-gawn)
glucocorticoids (gloo-koh-KORT-ih-koydz)
gluteal (GLOO-tee-uhl)
glycoproteins (GLY-koh-proh-teenz)
gonadocorticoids (goh-nad-oh-KORT-ih-koydz)
Golgi (GOHL-jee)
gomphosis (gahm-FOH-sis)
gracilis (gruh-SILL-iss)
granulocytes (GRAN-yoo-loh-syt'z)
granulosum (gran-yoo-LOH-sum)
gyri (JY-ree)
haploid (HAP-loyd)
haustra (HAW-struh)
hematocrit (heh-MAEH-toh-krit)
hemoglobin (HEE-moh-glohb-in)
hemolysis (heem-AW-lih-sis)
hepatopancreatic ampulla (heh-PAEH-toh-payn-kree-at-ik am-POOL-ah)
heterozygous (het-er-oh-ZY-gus)
hilum (HY-lum)
homozygous (hoh-moh-ZY-gus)
humerus (HYOO-mur-us)
hyaline (HY-ah-lin)
hydrophilic (hy-droh-FIL-ik)
hydrophobic (hy-droh-FOH-bik)
hypothalamus (hy-poh-THAL-uh-muss)
hypophyseal (hy-PAW-fih-see-uhl)
ileocecal (ill-ee-oh-SEE-kuhl)
ileum (ILL-ee-um)
iliac (ILL-ee-ak)
iliacus (ILL-ee-AK-uhs)
iliocostalis (ill-ee-oh-kawst-AL-iss)
iliohypogastric (ill-ee-oh-hy-poh-GAS-trik)
ilioinguinal (ill-ee-oh-IN-gwin-uhl)
iliopsoas (ill-ee-oh-SOH-uhs)
ilium (ILL-ee-um)
incus (ING-kus)
infraspinatus (in-frah-spin-AY-tuhs)
infundibulum (in-fun-DIB-yoo-lum)
inguinal (IN-gwin-uhl)
integument (in-TEG-yoo-ment)
integumentary (in-TEG-yoo-MEN-tuh-ree)
interatrial (in-ter-AY-tree-uhl)
intercalated (in-TUR-kuh-layt-ed)
intertrochanteric (in-ter-troh-kan-TEHR-ik)
intertubercular sulcus (in-ter-too-BUR-kyoo-lur SUL-kuss)
intraperitoneal (in-trah-pehr-ih-toh-NEE-uhl)
ischium (ISS-kee-um)
islets (AYE-lets)
jejunum (jeh-JOO-num)
jugular (JUG-yoo-lur)
juxtaglomerular (jux-tah-gloh-MEHR-yoo-lur)
keratin (KEHR-ah-tin)
keratinocyte (kehr-ah-TIN-oh-sy't)
Korotkoff (koh-ROT-koff)
labia (LAY-bee-ah)
labrum (LAY-brum)
lacerum (LAS-er-um)
lacrimal (LAK-rih-muhl)
lacrimal caruncle (LAK-rih-muhl kar-UN-kuhl)
lacteal (lak-TEEL)
lacunae (lah-KOO-nee)
lambdoid (LAM-doyd)
lamellae (lah-MELL-ee)
laryngopharynx (lah-ring-oh-FEHR-inks)
larynx (LEHR-inks)
latissimus dorsi (lah-TISS-ih-muss DOHR-sye)
leukocytes (LOO-koh-syt'z)
linea aspera (LIN-ee-ah ASS-per-ah)
lingual (LING-yoo-uhl)
lipase (LY-payz)
longissimus (lawn-JISS-ih-muss)
lucidum (LOO-sid-um)
lumbar (LUHM-bahr)
lunula (LOON-yoo-luh)
luteinizing (LOO-tee-in-aye-zing)
lymph (LIMF)
lymphatic (limf-AEH-tik)
lymphocytes (LIMF-oh-syt'z)
lysosomes (LY-soh-zohmz)
macrophages (MAK-roh-feyk-uhz)
macula densa (MAK-yoo-lah-DEN-sah)
macula lutea (MAK-yoo-lah LOO-tee-ah)
malleolus (mal-ee-OH-lus)
malleus (MAL-ee-us)
mammary (MAM-uh-ree)
manual (MAN-yoo-uhl)
manubrium (mah-NOO-bree-um)
masseter (MASS-uh-tur)
maxillae (mak-SILL-ee)
mediastinum (mee-dee-uh-STY-num)
medius (MEE-dee-uhs)
medulla oblongata (meh-DOOL-uh ahb-lahn-GAH-tuh)
meiosis (MY-oh-sis)
melanin (MEL-uh-nin)
melanocytes (mel-AN-oh-syt'z)
melatonin (mel-uh-TOH-nin)
meninges (meh-NIN-jeez)
menisci (men-ISS-kee)
mental (MEN-tuhl)
mesenchyme (MEZ-en-ky'm)
mesenteric (mez-en-TEHR-ik)
mesentery (MEZ-en-tehr-ee)
metopic (met-AHP-ik)
micelles (my-SELLZ)
microglial (my-kroh-GLEE-uhl)
microvilli (my-kroh-VIL-aye)
micturition (mik-choo-RISH-un)
mineralocorticoids (min-er-al-oh-KORT-ih-koydz)

mitochondria (my-toh-KAHN-dree-ah)
mitosis (my-TOH-sis)
mitral (MY-tral)
monocytes (MAHN-oh-syt'z)
monosaccharide (mahn-oh-SAK-uh-ry'd)
mons pubis (MAHNS PYOO-biss)
morula (MOHR-yoo-luh)
musculocutaneous (musk-yoo-loh-kyoo-TAY-nee-us)
myelin (MY-lin)
myocardium (MY-oh-kar-dee-um)
myocytes (MY-oh-syt'z)
myofibrils (my-oh-FY-brillz)
myometrium (my-oh-MEE-tree-um)
myosin (MY-oh-sin)
nasal (NAY-zuhl)
nasopharynx (nayz-oh-FEHR-inks)
nephrons (NEF-rahnz)
neurilemma (noor-ih-LEM-uh)
neuroglial (noor-oh-GLEE-uhl)
neurohypophysis (noor-oh-hy-PAWF-ih-sis)
neurons (NOOR-ahnz)
neutrophils (NOO-troh-filz)
nuchal (NOO-kuhl)
nucleolus (noo-klee-OH-lus)
nucleus (NOO-klee-us)
obturator (AHB-too-ray-tur)
occipital (awk-SIP-ih-tuhl)
occipitalis (awk-SIP-ih-TAL-iss)
ocular (AWK-yoo-lur)
oculomotor (awk-yoo-loh-MOH-tohr)
olecranon (oh-LEK-rah-nahn)
oligodendrocytes (oh-lig-oh-DEN-droh-syt'z)
omentum (oh-MEN-tum)
oocytes (OH-oh-syt'z)
oogenesis (oh-oh-JEN-eh-sis)
oogonia (oh-oh-GOH-nee-uh)
oral (OH-ruhl)
orbicularis oculi (ohr-bik-yoo-LEHR-iss AWK-yoo-lye)
orbital (OHR-bit-uhl)
organelles (ohr-gan-ELLZ)
oropharynx (ohr-oh-FEHR-inks)
osmosis (oz-MOH-sis)
osseous (AHS-see-us)
ossicles (AW-sih-kullz)
osteoblasts (AH-stee-oh-blasts)
osteoclasts (AH-stee-oh-klasts)
osteocytes (AHS-tee-oh-syt'z)
osteogenic (ah-stee-oh-JEN-ik)
osteons (AH-stee-ahnz)
otic (OH-tik)
ovale (oh-VAL-ay)
oxytocin (awks-ee-TOH-sin)
palate (PAL-it)
palatine (PAL-uh-ty'n)
palmar (PAHL-mur)
palpebrae (pal-PEE-bree)
pancreas (PAYN-kree-us)
papillae (pah-PILL-ee)
parietal (puh-RY-ih-tuhl)
parotid (puh-RAWT-id)
patella (puh-TEL-uh)
pectinate (PEK-tin-et)
pectineus (pek-TIN-ee-uhs)
pedal (PEE-duhl)
pelvic (PEL-vik)
pericardial (pehr-ee-KAR-dee-uhl)
pericardium (pehr-ee-KAR-dee-um)
perilymph (PEHR-ee-limf)
perimetrium (pehr-ee-MEE-tree-um)
perimysium (pehr-ih-MY-see-um)
perineurium (pehr-ih-NOOR-ee-um)
periodontal ligament (pehr-ee-oh-DAHN-tuhl)
periosteum (pehr-ee-AH-stee-um)
peristalsis (pehr-ih-STAHL-sis)
peritoneal (pehr-ih-toh-NEE-uhl)
peroxisomes (per-AWKS-ih-zohms)
phalanges (fuh-LAN-jeez)
pharyngotympanic (fah-ring-oh-tim-PAN-ik)
pheochromocytoma (fee-uh-kroh-muh-sy-TOH-muh)
pharynx (FEHR-inks)
phenotype (FEE-noh-type)
phospholipid (FAHS-foh-lip-id)
phrenic (FREN-ik)
pia mater (PEE-ah MAH-tur)
pineal (pin-EE-uhl)
pituitary (pih-TOO-ih-tehr-ee)
placenta (plah-SIN-tuh)
plantar (PLAN-tahr)
platelets (PLAYT-letz)
platysma (plah-TIZ-muh)
pleural (PLOO-ruhl)
pneumothorax (noo-moh-THOR-ax)
podocytes (POH-doh-syt'z)
polysaccharide (pawl-ee-SAK-uh-ry'd)
popliteal (pahp-lih-TEE-uhl)
porta hepatis (POR-tuh heh-PAEH-tis)
prostate (PRAW-stayt)
proximal (PRAWKS-ih-muhl)
pseudostratified (SOO-doh-strat-ih-fy'd)
pterygoid (TEHR-ih-goyd)
pubic (PYOO-bik)
pubis (PYOO-bis)
pudendal nerve (poo-DEN-duhl)
Purkinje (pur-KIN-jee)
pylorus (py-LOHR-us)
pyrogens (PY-roh-jenz)
radius (RAY-dee-us)
rami (RAY-mee)
Ranvier (rahn-vee-ay)
renal (REE-nuhl)
rete testis (REE-tee TES-tis)
retina (RET-in-ah)
retroperitoneal (reh-troh-per-ih-toh-NEE-uhl)
ribosomes (RY-boh-zohmz)
Rinne (rinn-ay)
risorius (ry-ZOHR-ee-uhs)
rugae (ROO-ghee)
saccule (SAK-yool)
sacroiliac (say-kroh-ILL-ee-ak)
sacrum (SAY-krum)

sagittal (SAJ-ih-tuhl)
saphenous (SAF-en-us)
sarcolemma (sar-koh-LEM-uh)
sarcomere (SAR-koh-meer)
sarcoplasm (SAHR-koh-plazm)
sarcoplasmic reticulum (sar-koh-PLAZ-mik reh-TIK-yoo-lum)
sartorius (sar-TOHR-ee-uhs)
scapula (SKAP-yoo-lah)
scapular (SKAP-yoo-lur)
sciatic (sy-AEH-tik)
sclera (SKLEHR-ah)
sebaceous (seh-BAY-shuhs)
sebum (SEE-bum)
sella turcica (SELL-uh TUR-sih-kuh)
semimembranosus (sem-aye-mem-brah-NOH-suhs)
seminiferous (sem-ih-NIF-er-us)
semitendinosus (sem-aye-ten-din-OH-suhs)
seromucous (seer-oh-MYOO-kuss)
serous (SEER-us)
serratus (ser-AY-tuhs)
sinoatrial (sy-noh-AY-tree-uhl)
soleus (SOHL-ee-uhs)
spermatogenesis (sper-mat-oh-JEN-ih-sis)
spermatogonia (sper-mat-oh-GOH-nee-ah)
sphenoid (SFEE-noyd)
sphygmomanometer (sfig-moh-muh-NAH-muh-ter)
spinalis (spy-NAL-iss)
spinosum (spin-OH-sum)
spirometer (spih-RAH-meh-ter)
splenic (SPLEN-ik)
splenius capitis (SPLEN-ee-uhs CAP-it-uhs)
squamous (SKWAY-muss)
stapes (STAY-peez)
stenosis (sten-OH-sis)
sternal (STUR-nuhl)
sternocleidomastoid (stern-oh-kly-doh-MASS-toy'd)
stethoscope (STETH-oh-skohp)
stratum corneum (STRAT-um KOHR-nee-um)
striated (STRY-ayt-ed)
subclavian (sub-KLAY-vee-in)
sublingual (sub-LING-gwuhl)
subscabularis (sub-skap-yoo-LEHR-uhs)
sulci (SUL-kee)
supracondylar (soo-prah-KAHN-dah-lar)
supraspinatus (soo-prah-spin-AY-tuhs)
sural (SOO-ruhl)
sutural (SOO-tchur-uhl)
sutures (SOO-tchurz)
symphyses (SIM-fih-seez)
synapse (SIN-apz)
synarthroses (sin-ar-THROH-seez)
synchondroses (sin-khan-DROH-seez)
syndesmoses (sin-dez-MOH-seez)
synovial (sih-NOH-vee-uhl)
systole (SIS-toh-lee)
systolic (sis-TAHL-ik)
tachycardia (tak-ih-KAR-dee-uh)
taeniae coli (TEE-nee-ee KOHL-aye)
talus (TAY-luss)
tarsal (TAR-suhl)
telodendria (tee-loh-DEN-dree-uh)
telophase (TEL-oh-phayz)
temporalis (tem-pur-AL-iss)
teres (THER-eez)
thalamus (THAL-uh-muss)
thoracic (thoh-RAS-ik)
thymopoietin (thy-moh-poh-EE-tin)
tibia (TIB-ee-ah)
tibialis (tib-ee-AL-is)
trabeculae (trah-BEK-yoo-lee)
trachea (TRAY-kee-uh)
transversus (tranz-VUR-suss)
trapezius (trah-PEE-zee-uhs)
triglycerides (try-GLISS-er-ay'dz)
trigone (TRY-gohn)
triiodothyronine (try-aye-oh-doh-THY-roh-neen)
trochanter (TROH-kan-tur)
trochlea (TROH-klee-uh)
trophoblast (TROHF-oh-blast)
tropomyosin (trohp-oh-MY-oh-sin)
troponin (TROH-poh-nin)
tympanic (tim-PAN-ik)
umbilical (um-BIL-ih-kuhl)
ureteral (yoo-REE-ter-uhl)
ureters (YOOR-eh-terz)
urethra (yoo-REETH-ruh)
uterosacral (yoo-ter-oh-SAY-kruhl)
uterus (YOO-ter-us)
utricle (YOO-trih-kuhl)
uvea (YOO-vee-uh)
uvula (YOO-vyoo-luh)
vagus (VAY-gus)
vena cava (VEE-nah KAY-vah)
venosus (veh-NOH-suss)
vermis (VER-miss)
vertebral (vur-TEE-bruhl)
vestibulocochlear (ves-tib-yoo-loh-KOHK-lee-ur)
villi (VILL-aye)
visceral (VISS-er-uhl)
vitreous (VIT-ree-us)
vomer (VOH-muhr)
xiphoid (ZY-foyd)
zygote (ZY-goh't)

Contents

UNIT
1

Introduction to Anatomical Terms

Once you have completed this unit, you should be able to:

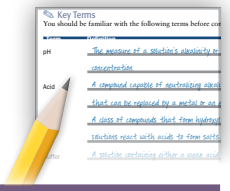
1. Demonstrate and describe anatomical position.
2. Apply directional terms to descriptions of body parts.
3. Use regional terms to describe locations on the body.
4. Locate and describe the divisions of the major body cavities and the membranes forming serous cavities.
5. Demonstrate and describe anatomical planes of section.
6. Identify the organ systems, their functions, and the major organs in each system.

Name _____ Section _____ Date _____

PRE-LAB EXERCISES

Complete the following exercises prior to coming to lab, using this lab manual and your textbook for reference.

Pre-Lab Exercise 1-1



✎ Key Terms

You should be familiar with the following terms before coming to lab.

Term	Definition

Directional Terms

Anterior _____

Posterior _____

Superior _____

Inferior _____

Proximal _____

Distal _____

Superficial _____

Deep _____

Body Cavities and Membranes

Posterior body cavity _____

Anterior body cavity _____

Serous membrane (parietal and visceral layers) _____

Planes of Section

Sagittal plane _____

Frontal (coronal) plane _____

Transverse plane _____

Pre-Lab Exercise 1-2

Body Cavities

Label and color the body cavities in Figure 1.1 with the terms from Exercise 1-4 (p. 13). Use your text and Exercise 1-4 in this unit for reference.

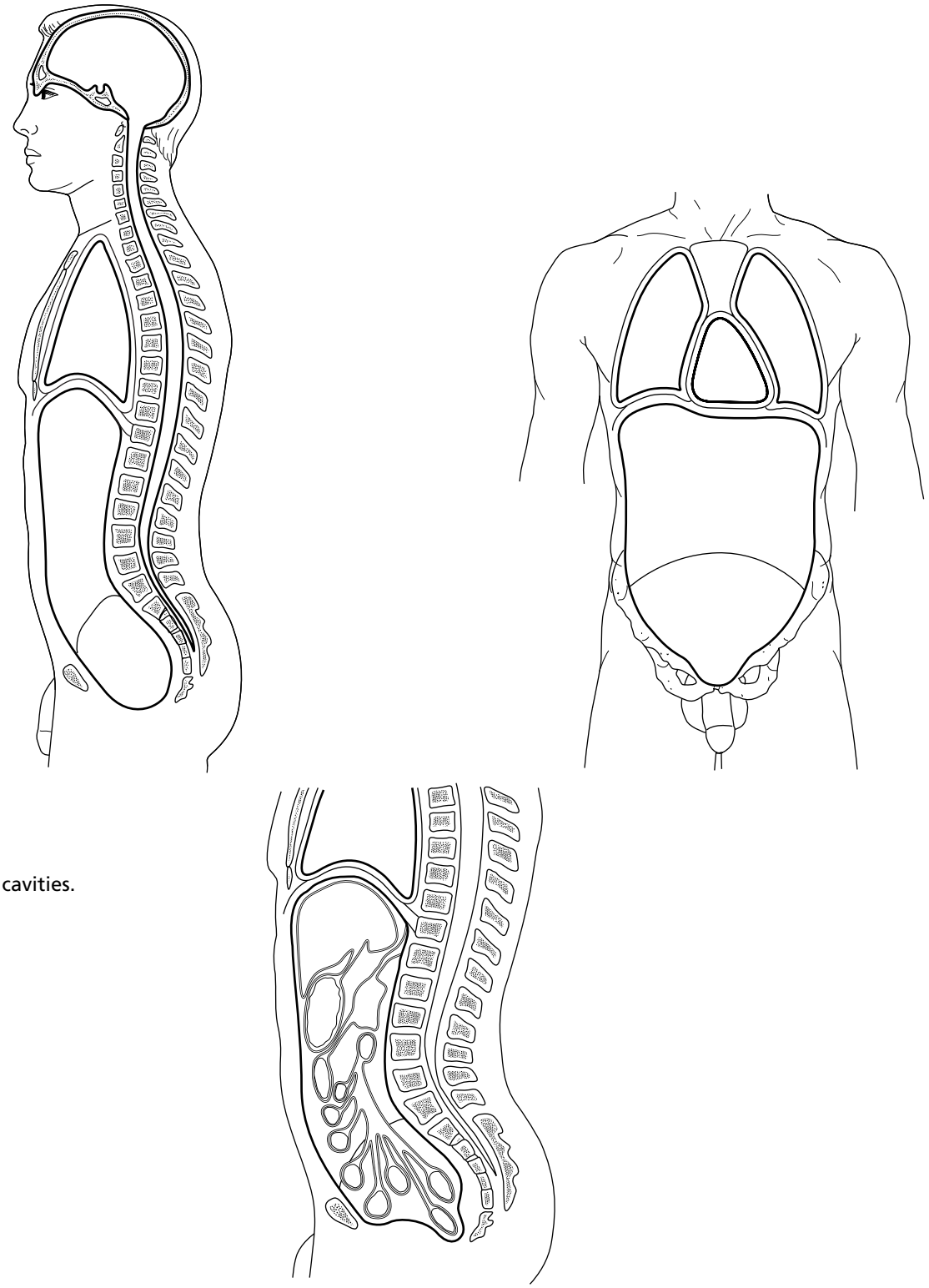


FIGURE 1.1 Body cavities.

Whole body scans using colored magnetic resonance imaging (MRI) of a man, woman, and boy (left to right) in frontal section.

EXERCISES

The bullet entered the right posterior scapular region, 3 centimeters lateral to the vertebral region, 4 centimeters inferior to the cervical region, and penetrated deep to the muscle and bone, but superficial to the lung and parietal pleura . . .

Would you believe that by the end of this unit, you will be able to translate the above sentence and also locate the hypothetical wound? Unit 1 introduces you to the world of **anatomy** and **physiology**, or A&P, which is the study and science of the structure and function of the human body. We start this unit with the language of A&P. Like learning any new language, this may seem overwhelming at first. The key to success is repetition and application: The more you use the terms, the easier it will be for them to become part of your normal vocabulary.

From terminology we move on to the organization of the internal body into spaces called **body cavities**, and how we can examine the body's cavities and organs with specific cuts known as **anatomical sections**. Finally, we look at how the body's organs are combined into functional groups called **organ systems**. When you have completed this unit, return to the opening statement, and challenge yourself to use your new knowledge of anatomical terms, body cavities, and organs to locate the precise position of the bullet wound on an anatomical model.

Exercise 1-1

Anatomical Position

In the study of the human body, most specimens are presented in a standard position called **anatomical position**. In anatomical position, shown in Figure 1.2, the body is presented facing forward, with the toes pointing forward, the feet shoulder-width apart, and the palms facing forward. This presentation of the human body creates a standard point of reference that facilitates communication among scientists and healthcare professionals.

FIGURE 1.2 Anatomical position.

Procedure 1 Demonstrating Anatomical Position

Have your lab partner stand in a normal, relaxed way, and then adjust their position so it matches anatomical position. When you have completed this exercise, answer Check Your Understanding question 1 (p. 33).

1

Exercise 1-2

Directional Terms

Another method that makes communication easier and less prone to errors is to use **directional terms** to define the location of body parts and body markings. For example, when describing a wound on the chest, we could say either of the following:

- The wound is near the middle and top of the chest
- The wound is on the right *anterior* thoracic region, 4 centimeters *lateral* to the sternum, and 3 centimeters *inferior* to the acromial region.

The second option is precise and allows the reader to exactly locate the wound. Remember that these descriptions are referring to a body in anatomical position.

Most directional terms are arranged into pairs of opposite directions. Some of the common pairs you will use in this course are illustrated in Figure 1.3 and include the following:

- **Anterior/Posterior.** The term **anterior** (an-TEER-ee-ur), also known as **ventral,** refers to the front of the body or of a body part. For example, we could say that the nose is on the anterior side of the body, or we may describe the surface of a bone that faces the front of the body as its *anterior surface*. However, we may also use the term anterior to describe a structure whose anatomical course takes it toward the front of the body, such as branches of spinal nerves called *anterior rami* (RAY-mee) that are named this way because they travel toward the anterior side of the body. The opposite term of anterior/ventral is **posterior/dorsal**. Just as with the term anterior, the term posterior

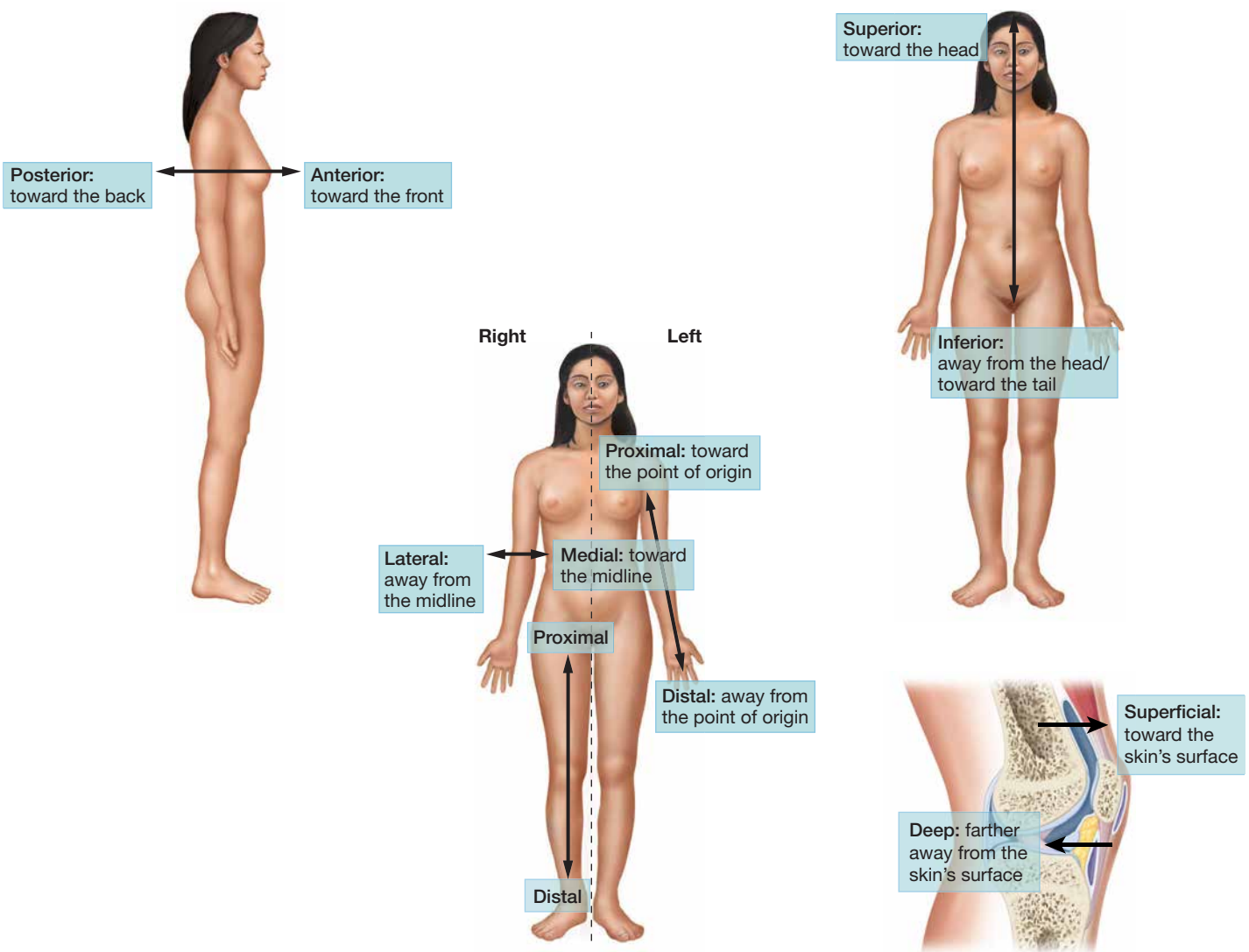
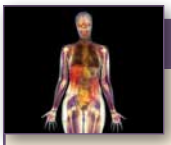


FIGURE **1.3** Directional terms.

can refer to the back side of the body or of a body part, or a structure that travels toward the back side of the body (such as the *posterior rami*).

- **Superior/Inferior.** The directional term **superior** is used to describe structures that are toward or closer to the head. The opposite term of superior is **inferior**, which means away from the head or toward the tail. Both superior and inferior may be used to describe a structure's absolute position in the body or the position of a structure relative to another structure. For example:
  - The two largest veins in the body are the *superior vena cava* and the *inferior vena cava*. The superior vena cava is the vessel located nearer the head, and the inferior vena cava is the one located farther away from the head (or closer to the tail).
  - We can describe the head as being *superior* to the neck, and we can say that the abdomen is *inferior* to the chest.
  - A very important rule to remember with superior and inferior is that these terms are used to describe structures only on the head, neck, and trunk, which are located in the part of the body known as the *axial region*. With very few exceptions, we do not use superior and inferior on the upper and lower limbs.
- **Proximal/Distal.** The upper and lower limbs are the part of the body known as the *appendicular region*. We use the terms proximal and distal on the appendicular region instead of using superior and inferior. The directional term **proximal** (PRAWKS-ih-muhl) refers to the closeness—or *proximity*—of a structure to its point of origin, which is the shoulder for the upper limb and the hip for the lower limb. You know this from the everyday term *approximate*, which refers to closeness. The opposite term, **distal**, refers to the farness—or *distance*—of a structure from the shoulder or hip. As with superior and inferior, the terms can describe a structure's absolute position, or the position of a structure relative to another structure. Here are a couple of examples:
  - The part of the femur (thigh bone) that is closest to the hip is called the *proximal* end of the bone. The end of the femur that is farthest away from the hip is its *distal* end.
  - We can describe the knee as being *proximal* to the ankle, because it is closer to the hip than is the ankle. Similarly, the fingers are *distal* to the wrist because they are farther away from the shoulder than is the wrist.



HINTS & TIPS

Sorting Out Superior and Inferior versus Proximal and Distal

One of the most common problems students have with respect to directional terms is how to use the terms superior/inferior and proximal/distal. Superior and inferior are easy enough on the head, neck, and trunk, but many students forget the rules and want to use them on the upper and lower limbs. So to start, here's a mnemonic to help: "Use your **superior mind** to remember when to use **superior** and **inferior**." This will help remind you to use these terms only on the head, neck, and trunk, as these are the locations in the body that house structures associated with your "mind" (the brain and spinal cord).

Now let's think about proximal and distal for a minute. To start, why even have different terms on the upper and lower limbs? Well, stand with your hands by your side. If we were to use superior and inferior, we would say that your hand is inferior to your shoulder. But lift your arm in the air above your head—where is your hand now? It's superior to your shoulder, right? This is the problem with limbs: they can change position. Ideally, every specimen we describe is in anatomical position, but we can't guarantee that every patient we treat or body we find will be in anatomical position. So for the upper and lower limbs, we need a different set of terms.

Once you understand the "why" of proximal and distal, all that's left is to understand how to apply them. That part is easy, because both are words that you already know, even if you don't immediately recognize them. The word root for "proximal" is *proxim-*, which means "near." You use words with this word root all of the time, such as "proximity" and "approximate." The word root for "distal" is *dist-*, which means "far." This is another very common word root—you use it in words like "distant," "distinct," "distance," and "distend."

Knowing the meanings of the word roots for the terms proximal and distal makes it very simple to come up with mnemonics for their use. Here are a couple of easy ones:

- The more **proximal** structure is the one in the closest **proximity** to the hip (or shoulder).
- The more **distal** structure is the one that is the most **distant** from the hip (or shoulder).

However, don't forget that these terms are only used on the upper and lower limbs, with very few exceptions. Just as you can't use superior and inferior on the upper and lower limbs, you also can't use proximal and distal on the head, neck, and trunk.

- **Medial/Lateral.** The terms medial and lateral reference an imaginary line running down the middle of the body called the *midline*. A structure is described as **medial** when its position is closer to this midline, and its position becomes more **lateral** as it moves farther away from the midline. Again, we can use these terms to describe a structure's absolute location or its location relative to another structure. For example:
  - The ulna, or the inner forearm bone, is the *medial* bone of the forearm because it is closest to the midline of the body. The radius, or the outer forearm bone, is the *lateral* bone of the forearm because it is farthest away from the midline of the body.
  - We can describe the ears as being *lateral* to the eyes because the ears are farther away from the midline than are the eyes. Conversely, we could say that the eyes are *medial* to the ears for the same reason.
- **Superficial/Deep.** The final pair of directional terms we use is one with which you are probably already familiar just from your everyday language: superficial and deep. As you might expect, the term **superficial** refers to a position that is closer to the surface of the body or closer to the skin. Structures that are **deep** are farther away from the skin's surface.

Review the definitions of the directional terms that you just read and that are illustrated in Figure 1.3. When you think you understand how to use them, fill in the correct directional terms in the following practice procedure.

Procedure 1 Directional Terms

Fill in the correct directional term for each of the following items. Note that in some cases, more than one directional term may apply.

The elbow is _____ to the wrist.

The chin is _____ to the nose.

The shoulder is _____ to the clavicle (collarbone).

The forehead is _____ to the mouth.

The skin is _____ to the muscle.

The esophagus is _____ to the sternum (breastbone).

The nose is _____ to the cheek.

The spine is on the _____ side of the body.

The arm is _____ to the torso.

The knee is _____ to the hip.

Exercise 1-3

Regional Terms

MATERIALS

- ❑ Laminated outline of the human body
- ❑ Water-soluble marking pens

You may have noticed in the example of Exercise 1-2 that we said *thoracic region* and *acromial region* instead of using generic words such as "chest" and "shoulder." These more specific words are known as **regional terms**, and their use is another standard practice to make descriptions as specific as possible and to reduce the potential for errors in communication. Think about it—the "shoulder" could consist of quite a large area, whereas the "acromial region" refers to one specific location.

The following regional terms, illustrated in Figure 1.4 and defined in Table 1.1, are among the more common terms you will encounter in your study of anatomy and physiology. Note that most of these terms are adjectives rather than nouns. This means that the term is not complete unless it is paired with the term "region." For example, we cannot say, "The wound is in the antebrachial." We instead must say, "The wound is in the antebrachial *region*."

The following list may look daunting, but you are probably familiar with several of the terms already. For example, you likely know the locations of the "oral," "nasal," and "abdominal" regions. Watch for other terms that you may know.

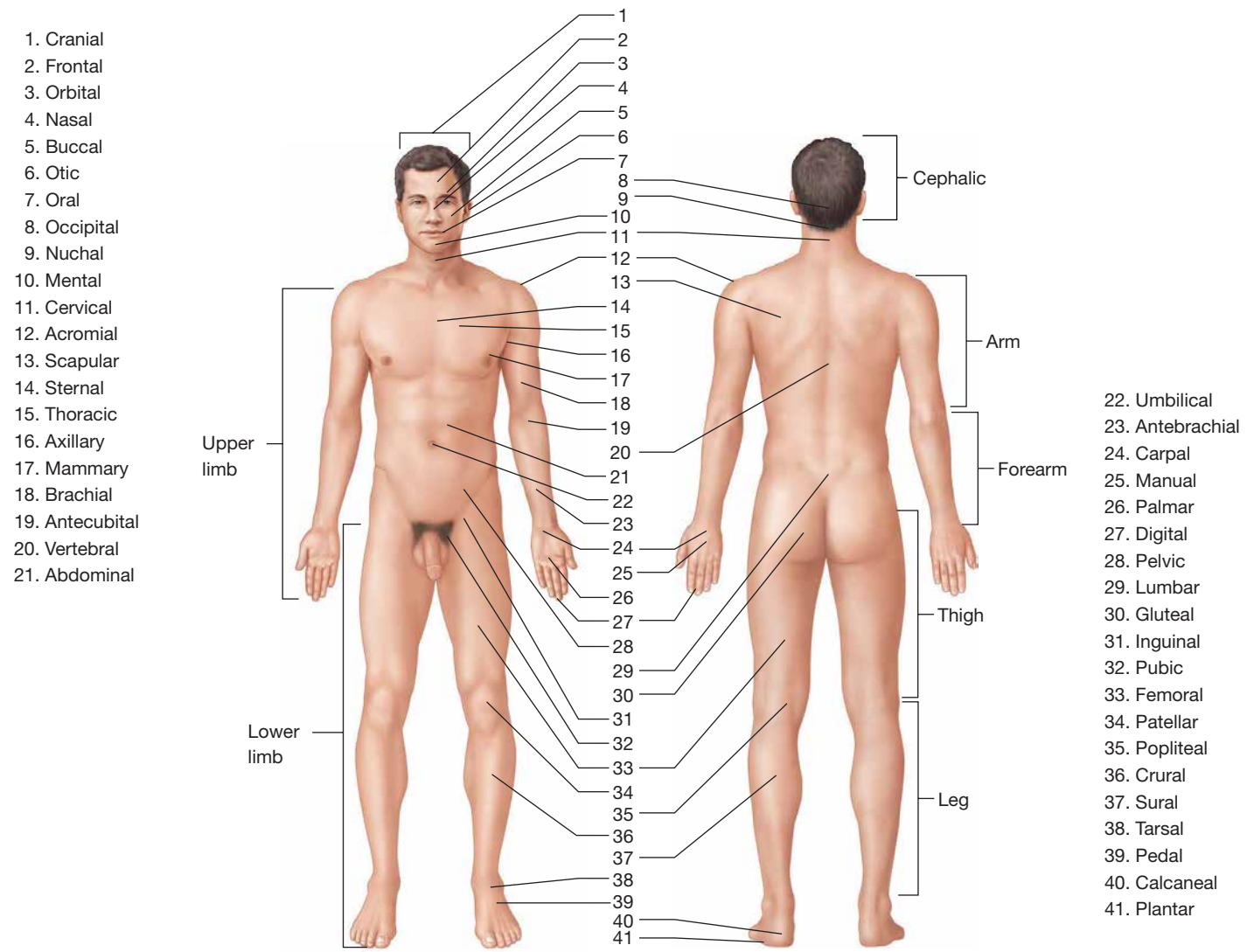


FIGURE **1.4** Regional terms.