



LABORATORY MANUAL FOR

ANATOMY & PHYSIOLOGY

CONNIE ALLEN • VALERIE HARPER SIXTH EDITION

WILEY

6th
EDITION

Laboratory Manual for Anatomy and Physiology

*This book is dedicated to my newest granddaughter, Cassidy Joy Thomas, in addition to my other
5 grandchildren: Michael, Jaxton, Jaden, Gianna, and Taralyn.*

—CONNIE ALLEN

To my husband Chuck and my children Scott and Kate: Your love and support are invaluable to me.

—VALERIE HARPER

6th
EDITION

Laboratory Manual for Anatomy and Physiology

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Preface

Anatomy and physiology is a challenging course, and this laboratory manual is written to help students meet that challenge. It is written for students interested in allied health fields, such as nursing; physical, respiratory, cardiovascular, or occupational therapy; radiology; and dental hygiene. This manual may be used with any two-semester anatomy and physiology textbook.

The design of this laboratory manual is based on the authors' experience as anatomy and physiology instructors and uses three learning styles: visual, auditory, and kinesthetic.

When students label diagrams, they focus on the structure rather than just the dot at the end of a line. Writing out the structure's name and pronouncing it reinforces learning. Also, having students become subjects of laboratory exercises personalizes the learning process. Animal dissections give students an opportunity to physically manipulate structures, comparing location and texture, and to observe how structures are supported, protected, and attached by connective tissue.

Special Features Incorporated in this Laboratory Manual Include:

- This lab manual can be used for online anatomy and physiology classes. Many lab activities can be performed by students at home or used in the laboratory. Online students can also use the **Real Anatomy** Virtual Dissection program and **PowerPhys** simulated lab activities to enhance their learning.
- Just enough text is provided to introduce concepts in each section and to set up and support the laboratory section. The exercises are written so students do not need their textbooks to complete the laboratory activities.
- New material is divided into small segments, starting with simple diagrams, illustrating the basic concepts and building up to more complex diagrams. Subsequent activities add to the students' knowledge in a stepwise fashion. This is especially noticed in the skeletal and muscular exercises.
- Each exercise contains a list of objectives, materials needed for the exercise, and easily identifiable laboratory activity sections.
- Unlabeled four-color drawings, photographs, and photomicrographs are included for students to label either at home or in the laboratory. Students first write out the name of the structure to help learn it. Then the completed diagrams will be used to identify structures on models.

- Physiology experiments use students as subjects and can be completed with either simple, inexpensive equipment and materials or more complex lab setups.
- Experimental report sections after physiology experiments where students are asked to make predictions, collect and analyze data, and write simple lab reports.
- Discussion Questions are within the activities to make the students think about the material presented.
- An Answer Key is provided at the end of the laboratory manual for the activities in each exercise. Students receive immediate feedback, and they are not dependent on the instructor for the correct answers.
- “Reviewing Your Knowledge” and “Using Your Knowledge” sections follow the activities at the end of each exercise. “Reviewing Your Knowledge” provides a thorough review of the material in the exercise, whereas “Using Your Knowledge” requires students to apply information learned. Either or both of these sections may be handed in to the instructors for a grade, because neither section has answers in the back of the laboratory manual.
- Biopac Laboratory Guide Experiments are available online for several exercises.

New Features to the Sixth Edition

- Revised Exercise 6: Tissues with many new photomicrographs.
- Revised Exercise 14: Skeletal Muscles with many new drawings and cadaver photos
- Updated drawings in many Exercises.
- Wiley Engage online platform for enhanced engagement and customization capabilities.

Wiley Engage

Wiley Engage for Anatomy and Physiology is an innovative, dynamic online environment—designed to help you administer your lab in a personalized way. Utilizing Wiley Engage in your lab provides you with the tools and resources to create and manage effective activities and assessment strategies.

Wiley Engage for the Allen & Harper *Lab Manual for Anatomy & Physiology* includes:

- Complete online version of the Lab Manual, including interactive labeling exercises, for seamless integration of all content. This content can be fully customized, curated, or rearranged to better support your lab, and local content can be easily added, including your own assessment questions.

- Relevant student study tools and learning resources ensure positive learning outcomes.
- Resources like **Dissection Videos** and **Anatomy Drill and Practice** labeling help students study for laboratory practicals.
- **PowerPhys 3.1**, lab simulation software that allows students to explore physiology principles through self-contained activities. Each activity follows the scientific method containing objectives with animated review material, prelab quizzes, pre-lab reports (including predictions and variables), data collection and analysis, and a full lab report with discussion and application questions. Experiments contain real data that is randomly generated, allowing users to experiment multiple times, but still arrive at the same conclusions. These activities focus on core physiological concepts and reinforce techniques experienced in the laboratory.
- **Real Anatomy**, 3-D imaging software that allows you to dissect through multiple layers of a three-dimensional real human body to study and learn the anatomical structures of all body systems.

Please contact your Wiley representative for details about these and other resources or visit our website at www.wiley.com.

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Contents

Preface v

INTRODUCTION

- EXERCISE 1 **Anatomical Language** 1
- EXERCISE 2 **Organ Systems and Body Cavities** 13

CELL AND TISSUES

- EXERCISE 3 **Compound Light Microscope** 25
- EXERCISE 4 **Cell Structure and Cell Cycle** 33
- EXERCISE 5 **Transport Across the Plasma Membrane** 43
- EXERCISE 6 **Tissues** 53

INTEGUMENTARY SYSTEM

- EXERCISE 7 **The Integumentary System Structure and Function** 85

SKELETAL SYSTEM AND JOINTS

- EXERCISE 8 **Bone Structure and Function** 97
- EXERCISE 9 **Axial Skeleton** 107
- EXERCISE 10 **Appendicular Skeleton** 139
- EXERCISE 11 **Joints and Synovial Joint Movements** 161

MUSCULAR SYSTEM: SKELETAL MUSCLES

- EXERCISE 12 **Skeletal Muscle Structure** 175
- EXERCISE 13 **Contraction of Skeletal Muscle** 187
- EXERCISE 14 **Skeletal Muscles and Their Actions** 199

SURFACE ANATOMY

- EXERCISE 15 **Surface Anatomy** 241

NERVOUS SYSTEM

- EXERCISE 16 **Nervous Tissue** 263
- EXERCISE 17 **Spinal Cord Structure and Function** 277
- EXERCISE 18 **Spinal Nerves** 287
- EXERCISE 19 **Somatic Reflexes** 299
- EXERCISE 20 **Brain Structure and Function** 309
- EXERCISE 21 **Cranial Nerves** 333
- EXERCISE 22 **Autonomic Nervous System Structure and Function** 343
- EXERCISE 23 **General Senses** 355
- EXERCISE 24 **Special Senses** 369

ENDOCRINE SYSTEM

- EXERCISE 25 **Endocrine Structure and Function** 401

CARDIOVASCULAR SYSTEM

- EXERCISE 26 **Blood Components and Blood Tests** 421
- EXERCISE 27 **Heart Structure and Function** 441
- EXERCISE 28 **Cardiac Cycle** 461
- EXERCISE 29 **Blood Vessel Structure and Function** 473
- EXERCISE 30 **Blood Vessel Identification** 489

LYMPHATIC AND IMMUNE SYSTEMS

- EXERCISE 31 **Lymphatic System Structure and Immune System Function** 517

RESPIRATORY SYSTEM

- EXERCISE 32 **Respiratory System Structure and Function** 537
- EXERCISE 33 **Pulmonary Ventilation** 555

DIGESTIVE SYSTEM

- EXERCISE 34 **Digestive System Structure and Function** 571
- EXERCISE 35 **Mechanical and Chemical Digestion** 599

URINARY SYSTEM

- EXERCISE 36 **Urinary System Structure and Function** 607
- EXERCISE 37 **Urine Formation and Urinalysis** 625

REPRODUCTIVE SYSTEMS

- EXERCISE 38 **Male Reproductive System Structure and Function** 637
- EXERCISE 39 **Female Reproductive System Structure and Function** 653

HUMAN DEVELOPMENT AND HEREDITY

- EXERCISE 40 **Human Development** 671
- EXERCISE 41 **Heredity** 685

Answer Key to Activities 699

APPENDIX A: **Word Roots** 719

APPENDIX B: **Skeletal Muscle Origins and Insertions** 721

APPENDIX C: **Measurements** 727

Index 729

Anatomical Language

OBJECTIVES

- 1 Describe the anatomical position
- 2 Use anatomical and directional terms correctly
- 3 Identify the various body planes and sections

MATERIALS

- human models or anatomical charts
- apples (1 per group) and plastic knives or scalpels
- plastic tubing (eight-inch piece per group) or plastic straw
- 5 sheep brains (for class demonstration)

Anatomical terms describe body positions, body regions, specific body areas, and landmarks. Most of these words are derived from Latin or Greek and are often part of the names of muscles, bones, nerves, and blood vessels. Learning these terms at this time will help you throughout the course.

A. Body Position

The **anatomical position** is the reference position anatomists and people in medical fields use to describe the location of body parts or regions. In the anatomical position, the body is erect (vertical) and facing forward; the arms are straight and at the sides of the body with the palms facing forward; the legs are straight with the feet facing forward and flat (Figure 1.1).

In the **supine position**, the body is horizontal and lying on the back. In the **prone position**, the body is horizontal and lying on the stomach.

B. Body Regions

Body regions refer to specific areas of the body. It is important that you learn the correct boundaries for each region. The main body regions are the head, neck, trunk, upper limbs, and lower limbs. The **head** consists of the

skull (cranial and facial bones), and **face** (anterior portion of the head comprised of the forehead, eyes, nose, mouth, cheeks, and chin). The **neck** connects the head to the trunk.

The **trunk** consists of the **chest** (area between neck and diaphragm) that contains the heart and lungs, the **abdomen** (area between chest and hip bones) that contains digestive organs, the **pelvis** (area below abdomen that contains internal reproductive organs and urinary bladder), and the **back** (posterior portion of trunk between neck and buttocks).

The **upper limb** consists of the **shoulder** (curved area where arm attaches to upper border of trunk), **arm** (area between shoulder and elbow), **forearm** (area between elbow and wrist), and **hand** (wrist, palm, fingers).

The **lower limb** consists of the **buttocks** (rounded area on posterior surface where thigh attaches to trunk), **groin** (area on anterior surface where lower limb attaches to pelvis), **thigh** (area of lower limb between the groin and knee), **leg** (area of lower limb between knee and ankle), and **foot** (includes ankle, sole, toes).

Many anatomical terms have one or more word roots with a prefix and/or a suffix added. For example, in the word *antecubital*, *ante-* is a prefix meaning before or in front of, the word root *cubit-* means elbow, *-al* is a suffix meaning pertaining to. Table 1.1 contains anatomical terms with four different suffixes, all of which mean pertaining to. These suffixes are *-al*, *-ic*, *-ar*, and *-ary*. When suffixes like these are added to word roots they form adjectives, whereas nouns have different endings such as *-um*, *-us*, *-is*,

and *-a*. For example, *stern-* is a word root meaning chest; *sternum* is the noun and *sternal* is the adjective. Anatomical terms and their definitions are found in Table 1.1. Word roots and their definitions are found in Appendix A, as well as nouns and adjectives formed from the word roots.

Before Going to Lab

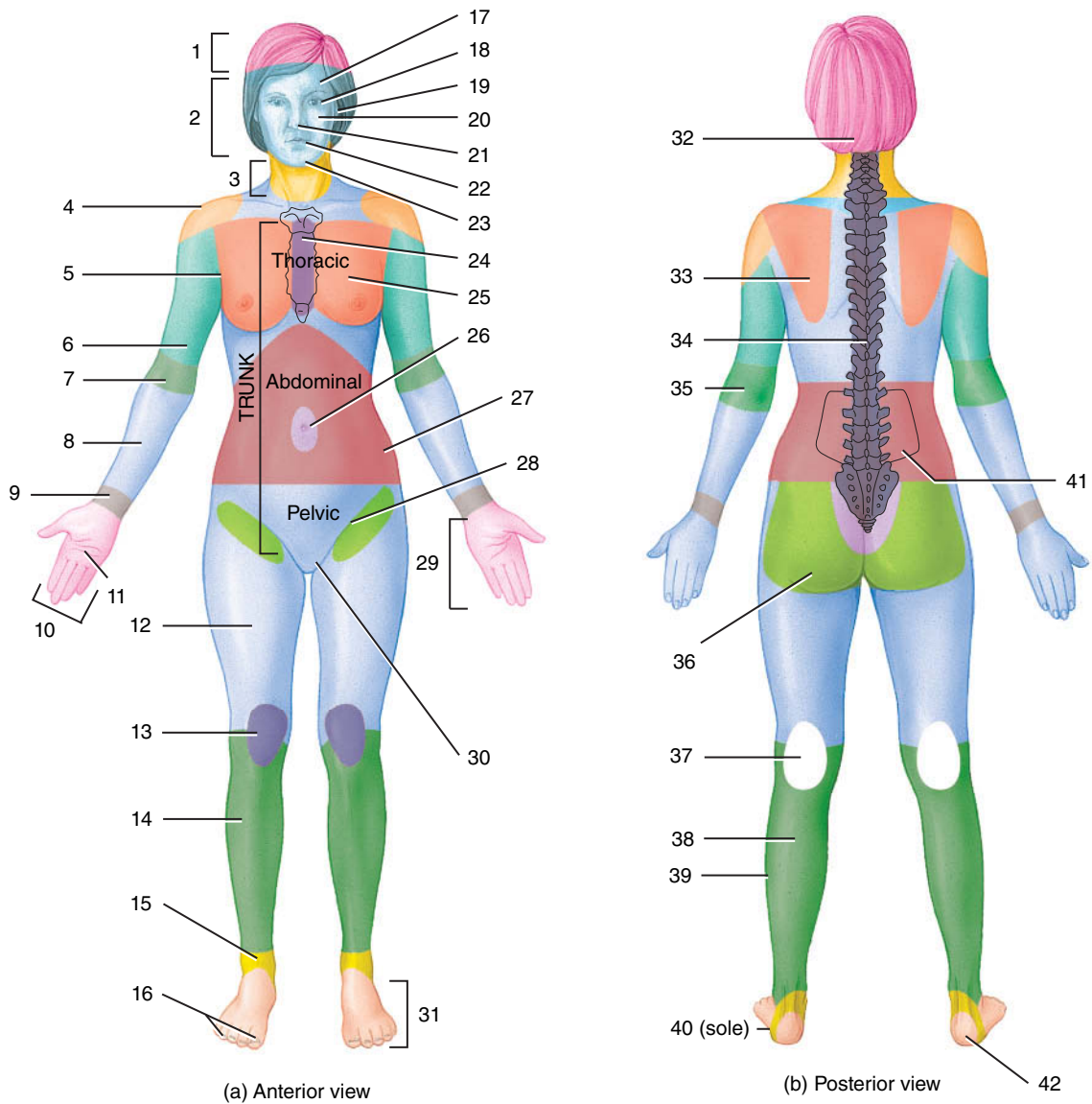
- 1 Label Figure 1.1 with the appropriate anatomical terms for each body region or area. Refer to Table 1.1.
- 2 Refer to Appendix A to review how word roots, suffixes, and prefixes are combined to form nouns and adjectives.

LAB ACTIVITY 1 Anatomical Terms

- 1 Use anatomical and common terms to identify the specific body regions or areas on models, anatomical charts, or yourself. ■

TABLE 1.1 Anatomical Terms

TERM	DEFINITION	TERM	DEFINITION
AXIAL	Pertaining to the central part of the body, the head and trunk	APPENDICULAR	Pertaining to the extremities or limbs
Cephalic (se-FAL-ik)	Pertaining to the head	Upper Limb (Appendage)	
• Cranial	Pertaining to the portion of the skull surrounding the brain	• Acromial (a-KROM-ee-al)	Pertaining to the highest point of the shoulder
• Facial	Pertaining to the face	• Axillary (AX-il-ary)	Pertaining to the armpit
• Frontal	Pertaining to the forehead	• Brachial (BRAY-key-ul)	Pertaining to the arm
• Orbital	Pertaining to the eye	• Antecubital (an-teh-KYOO-bi-tul)	Pertaining to the anterior (front) surface of the elbow
• Otic (OH-tik)	Pertaining to the ear	• Olecranal (oh-LEK-ra-nul)	Pertaining to the posterior (back) surface of the elbow
• Nasal	Pertaining to the nose	• Antebrachial	Pertaining to the forearm
• Buccal (BUCK-al)	Pertaining to the cheek	• Carpal	Pertaining to the wrist
• Oral	Pertaining to the mouth	• Manual	Pertaining to the hand
• Mental	Pertaining to the chin	• Palmar	Pertaining to the palm of the hand
• Occipital (ox-SIP-i-tal)	Pertaining to the back of head	• Digital	Pertaining to the digits (fingers)
Cervical	Pertaining to the neck	Lower Limb (Appendage)	
Thoracic	Pertaining to the chest	• Inguinal (ING-won-ul)	Pertaining to the groin where the thigh attaches to the pelvis
• Sternal	Pertaining to the breast bone	• Gluteal (GLUE-tee-ul)	Pertaining to the buttocks
• Pectoral	Pertaining to the chest	• Femoral (FEM-or-ul)	Pertaining to the thigh
• Mammary	Pertaining to the breast	• Patellar (pa-TEL-ur)	Pertaining to the anterior (front) surface of the knee
Abdominal	Pertaining to the abdomen	• Popliteal (pop-lih-TEE-ul)	Pertaining to the posterior (back) surface of the knee
• Umbilical (um-BIL-ih-cal)	Pertaining to the navel	• Crural (CROO-rul)	Pertaining to the anterior (front) surface of the leg
• Coxal (COX-al)	Pertaining to the hip	• Fibular (FIB-you-lur) or peroneal (peh-RONE-ee-ul)	Pertaining to the lateral side of the leg
Pelvic	Pertaining to the pelvis	• Sural (SIR-ul)	Pertaining to the posterior (back) surface of the leg
• Pubic (PYOO-bik)	Pertaining to the genital area	• Tarsal (TAR-sul)	Pertaining to the ankle
Dorsal	Pertaining to the back	• Pedal	Pertaining to the foot
• Scapular	Pertaining to the shoulder blade region	• Plantar	Pertaining to the sole of foot
• Vertebral (ver-TEE-brul)	Pertaining to the spinal column	• Calcaneal (kal-KANE-ee-ul)	Pertaining to the heel
• Lumbar	Pertaining to the area of the back between the lowest rib and buttocks.	• Digital	Pertaining to the digits (toes)



(a) Anterior view

(b) Posterior view

(a) Anterior View

- | | |
|----------|----------|
| 1 _____ | 12 _____ |
| 2 _____ | 13 _____ |
| 3 _____ | 14 _____ |
| 4 _____ | 15 _____ |
| 5 _____ | 16 _____ |
| 6 _____ | 17 _____ |
| 7 _____ | 18 _____ |
| 8 _____ | 19 _____ |
| 9 _____ | 20 _____ |
| 10 _____ | 21 _____ |
| 11 _____ | 22 _____ |

(b) Posterior View

- | | |
|----------|----------|
| 23 _____ | 32 _____ |
| 24 _____ | 33 _____ |
| 25 _____ | 34 _____ |
| 26 _____ | 35 _____ |
| 27 _____ | 36 _____ |
| 28 _____ | 37 _____ |
| 29 _____ | 38 _____ |
| 30 _____ | 39 _____ |
| 31 _____ | 40 _____ |
| | 41 _____ |
| | 42 _____ |

FIGURE 1.1 Anatomical terms.

C. Directional Terms

Directional terms are used to describe the location of body structures relative to other structures. An example of a directional term is *inferior*, which means below. It would be correct to say that the neck is inferior to the head but incorrect to say that the neck is inferior. The directional terms are listed in Table 1.2, along with an example of how they are used. Note that opposite terms are paired.

The directional terms *proximal* and *distal* apply to the point of attachment of a limb to the torso or the point of origin of a structure such as a blood vessel or nerve. These terms refer to the location of structures relative to the point of attachment or point of origin, whether they are closer (proximal) or farther away (distal).

More than one directional term can apply to describe the location of a body structure. For example, the ears are posterior and lateral to the nose.

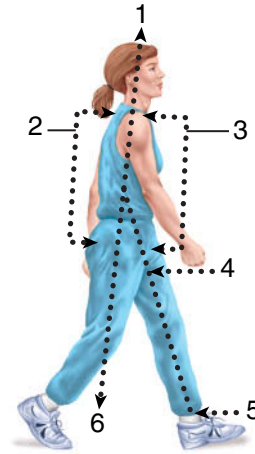
Before Going to Lab

- Label Figure 1.2 with the directional terms from the bulleted list by writing the term in the appropriate numbered blank.

LAB ACTIVITY 2 Directional Terms

- With your partner, complete the sentences using the appropriate directional term from Table 1.2. Refer to the anatomical terms in Table 1.1 and Appendix A as needed.

- The sternum is _____ to the vertebrae.
- The nose is _____ and _____ to the eyes.
- The heart is _____ to the lungs.
- The wrist is _____ to the arm.
- The right lung and right kidney are _____.
- The skin is _____ to the bones. ■



- anterior or ventral 1 _____
- distal 2 _____
- inferior 3 _____
- posterior or dorsal 4 _____
- proximal 5 _____
- superior 6 _____

FIGURE 1.2 Directional terms.

TABLE 1.2 Directional Terms

DIRECTIONAL TERM	DEFINITION	EXAMPLE OF USE
Superior	Above	The head is superior to the neck.
Inferior	Below	The neck is inferior to the head.
Anterior (Ventral)	Closer to front of body	The lips are anterior to the teeth.
Posterior (Dorsal)	Closer to back of body	The teeth are posterior to the lips.
Medial	Closer to midline of body	The nose is medial to the eyes.
Lateral	Farther from midline of body	The eyes are lateral to the nose.
Intermediate	Between two structures	The elbow is intermediate between the shoulder and wrist.
Ipsilateral	On same side of body	The right arm and right leg are ipsilateral.
Contralateral	On opposite sides of body	The right arm and left arm are contralateral.
Proximal	Nearer to point of attachment of limb to trunk	The elbow is proximal to the wrist.
Distal	Farther from point of attachment of limb to trunk	The wrist is distal to the elbow.
Superficial	Closer to surface of body	The skin is superficial to the muscles.
Deep	Farther from surface of body	The muscles are deep to the skin.

D. Body Planes and Sections

Planes are flat surfaces that divide the body or organs in order to expose internal structures (Figure 1.3). The exposed surfaces produced by planes are called **sections**. **Sagittal** (*sagitta* = arrow) **planes** pass vertically through the body or organs and divide them into right and left sections (**sagittal sections**).

If a plane passes vertically through the midline and divides the body into equal right and left halves, the plane is a **midsagittal plane**, but if a plane divides the body into unequal right and left portions, it is a **parasagittal plane**.

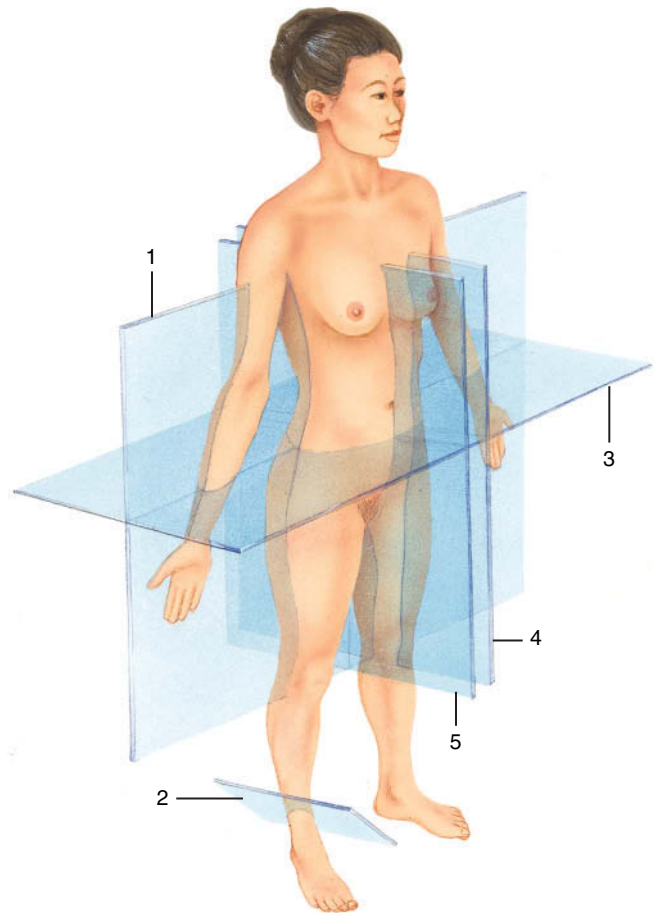
A **frontal** or **coronal plane** passes vertically through the body or organs and produces anterior and posterior sections (**frontal sections**). A **transverse plane** passes horizontally through the body and produces superior and inferior sections (**transverse sections** or **cross-sections**). **Oblique planes** pass through the body at an angle forming oblique sections.

We often look at sections of individual organs, such as blood vessels, intestines, or long bones. Sections that are produced by a plane running along the long axis of a long narrow structure are called **longitudinal sections**. Sections that are produced by a plane running perpendicular to the long axis are called **cross-sections**. Because blood vessels and intestines twist and bend, one body plane may produce longitudinal sections, cross-sections, and oblique sections of these structures.

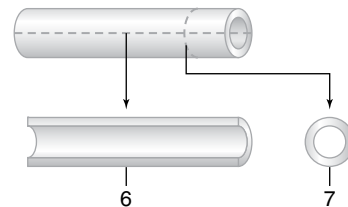
CLINICAL NOTE: *Transverse sections observed with computed tomography (CT) scans or magnetic resonance imaging (MRIs) are called axial sections.*

Before Going to Lab

- 1 Label the planes in Figures 1.3(a) and the sections in Figure 1.3(b) with the terms in the accompanying bulleted list by writing the term in the appropriate numbered blank.
- 2 Identify the type of sections of the human brain in Figure 1.4.



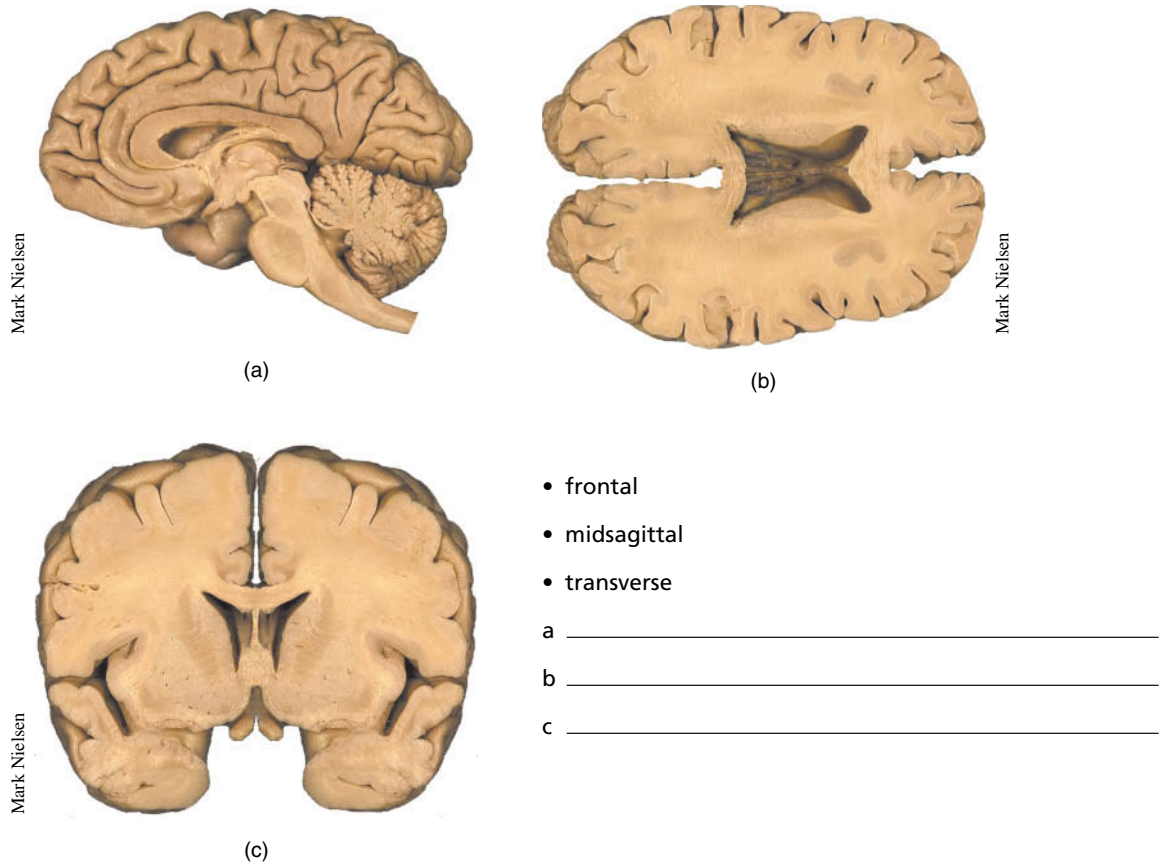
(a) Right anterolateral view



(b) Longitudinal and cross-sections

- cross-section 1 _____
- frontal plane 2 _____
- longitudinal section 3 _____
- midsagittal plane 4 _____
- oblique plane 5 _____
- parasagittal plane 6 _____
- transverse plane 7 _____

FIGURE 1.3 Body planes and sections.



- frontal
- midsagittal
- transverse

a _____

b _____

c _____

FIGURE 1.4 Human brain sections.

LAB ACTIVITY 3 Body Planes and Sections

- 1 Observe sagittal, frontal, and transverse sections using an apple.
 - Working in a group, draw a face on the apple.
 - Cut sagittal, frontal, and transverse planes through the apple to make sagittal, frontal, and transverse sections.
 - Compare the appearance of the apple core in each section. Describe any difference in shape, size, and number of seed chambers.
 - Keep sections together to form a whole apple to show to your instructor.
- 2 Observe longitudinal sections and cross-sections using plastic tubing or plastic straw.
 - Observe a demonstration provided by your instructor of a tube cut along its longitudinal axis to produce a longitudinal section and a tube cut perpendicular to its longitudinal axis to produce a cross-section.
 - Obtain an eight-inch piece of plastic tubing or plastic straw and twist it so you can visualize one plane that would simultaneously divide one area of the tube

into a longitudinal section and another area into a cross-section.

- Do not cut the tube unless instructed to do so.
 - Show your instructor where a cut would produce both a longitudinal section and a cross-section.
- 3 Identify sagittal, frontal, transverse, and oblique sections on sheep brains.
 - Your instructor will display five sheep brains—one whole brain and four brains that have been cut into different sections.
 - Determine the anterior, posterior, superior, and inferior surfaces of the brains.
 - Decide which brain has been cut into sagittal, frontal, transverse, or oblique sections.
 - Compare the appearance of the different sections.

Brain 1—Whole brain

Brain 2 _____ section

Brain 3 _____ section

Brain 4 _____ section

Brain 5 _____ section



Reviewing Your Knowledge

EXERCISE

1

A. Body Regions

Identify the body regions using common terms.

- _____ 1. The area between the groin and knee.
- _____ 2. The area between the shoulder and elbow.
- _____ 3. The area between the elbow and wrist.
- _____ 4. The area between the knee and ankle.
- _____ 5. The area of the trunk between the neck and diaphragm.
- _____ 6. The area of the trunk between the diaphragm and hip bones.
- _____ 7. The area of the trunk inferior to the hip bones.
- _____ 8. Posterior trunk that is located between the neck and buttocks.
- _____ 9. Curved area where upper limb attaches to upper border of trunk.
- _____ 10. Area on anterior surface where lower limb attaches to pelvis.
- _____ 11. Rounded area on posterior surface where lower limb attaches to pelvis.
- _____ 12. Under arm area where upper limb attaches to trunk.
- _____ 13. The leg is to the lower limb as the ____ is to the upper limb.
- _____ 14. The arm is to the upper limb as the ____ is to the lower limb.
- _____ 15. The armpit is to the upper limb as the ____ is to the lower limb.
- _____ 16. The ankle is to the lower limb as the ____ is to the upper limb.
- _____ 17. The elbow is to the upper limb as the ____ is to the lower limb.
- _____ 18. The shoulder is to the upper limb as the ____ is to the lower limb.
- _____ 19. True or False. The hand includes the wrist and fingers and the foot includes the ankles and toes.
- _____ 20. True or False. The bones of the face are also part of the skull.

B. Anatomical Terms

Write the anatomical terms that the phrase or word describes. Phrases or words referring to nouns are indicated. All other phrases refer to adjectives.

- _____ 1. Navel (noun)
- _____ 2. Pertaining to the area between the neck and abdomen
- _____ 3. Pertaining to the ear
- _____ 4. Pertaining to the palm of hand
- _____ 5. Pertaining to the high point of the shoulder
- _____ 6. Pertaining to the anterior surface of the elbow region
- _____ 7. Pertaining to the face; anterior portion of the head
- _____ 8. Pertaining to the nose
- _____ 9. Pertaining to the neck
- _____ 10. Pertaining to the posterior surface of the knee
- _____ 11. Wrist (noun)
- _____ 12. Pertaining to the area between the elbow and wrist
- _____ 13. Back (noun)
- _____ 14. Armpit area (noun)
- _____ 15. Pertaining to the mouth
- _____ 16. Pertaining to the anterior surface of the knee
- _____ 17. Breast bone (noun)
- _____ 18. Pertaining to the hip
- _____ 19. Pertaining to the lateral side of the leg
- _____ 20. Pertaining to the calf
- _____ 21. Pertaining to the area between the shoulder and elbow
- _____ 22. Pertaining to the fingers or toes
- _____ 23. Pertaining to the hand
- _____ 24. Pertaining to the breast
- _____ 25. Pertaining to the cheek

- _____ 26. Pertaining to the heel
- _____ 27. Pertaining to the sole of the foot
- _____ 28. Pertaining to the groin where the thigh attaches to the pelvic region
- _____ 29. Pertaining to the head
- _____ 30. Pertaining to the chin
- _____ 31. Pertaining to the foot
- _____ 32. Pertaining to the eye
- _____ 33. Pertaining to the genital area
- _____ 34. Pertaining to the area between the hip and knee
- _____ 35. Pertaining to the area that includes the bones enclosing the brain
- _____ 36. Pertaining to the forehead
- _____ 37. Pertaining to the spinal column
- _____ 38. Pertaining to the inferior back of the head
- _____ 39. Pertaining to the anterior surface of the leg
- _____ 40. Pertaining to the area of the lower back or loin
- _____ 41. Pertaining to the trunk below the abdomen
- _____ 42. Pertaining to the area of the back that contains the shoulder blades
- _____ 43. Pertaining to the posterior surface of the elbow
- _____ 44. Arm (noun)
- _____ 45. Two terms pertaining to the chest

C. Body Planes and Sections

Write the name of the plane that the phrase describes.

- _____ 1. Divides body or organ into unequal right and left sections
- _____ 2. Divides body or organ into anterior and posterior sections
- _____ 3. Divides body or organ into superior and inferior sections
- _____ 4. Divides body into right and left halves
- _____ 5. Which two planes when passed through the body would result in two sections, with each section containing a piece of the heart and a piece of each lung?

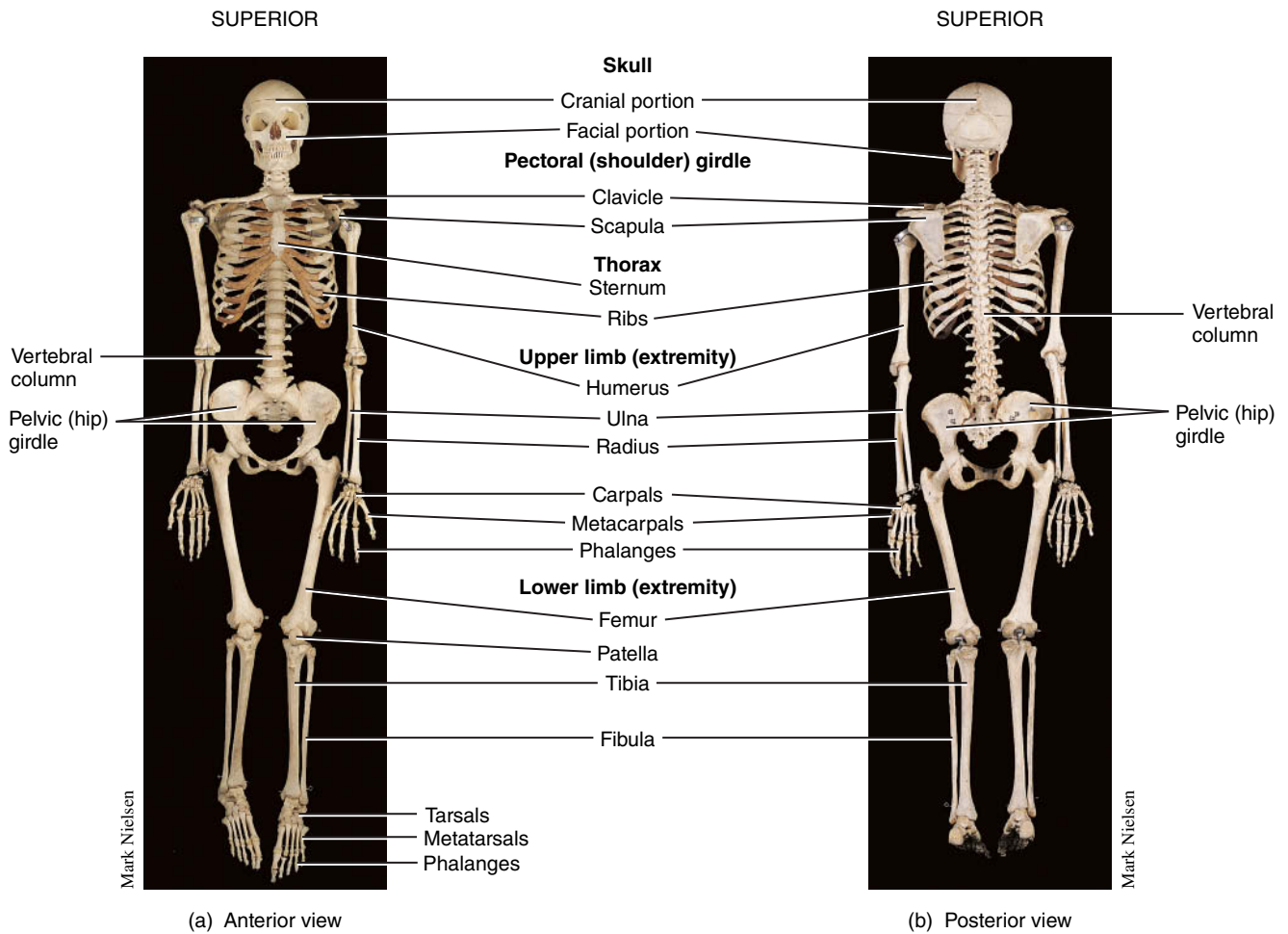


FIGURE 1.5 Human skeleton.

D. Directional Terms

Complete the sentences using directional terms. Use Figure 1.5 for reference.

1. The clavicle is _____ to the ribs.
2. The ribs are _____ to the sternum.
3. The humerus is _____ to the radius.
4. The ulna is _____ to the radius.
5. The tibia is _____ to the femur.
6. The right humerus and the right radius are _____.
7. The pelvic girdle is _____ to the ribs.
8. The sternum is _____ to the vertebral column.
9. The scapula is _____ to the clavicle.
10. The right fibula and left fibula are _____.

Using Your Knowledge

EXERCISE

1

A. Body Regions, Anatomical Terminology, and Directional Terms

1. A 55-year-old male presented with an irregularly shaped and abnormally pigmented mole in the left scapular region, just lateral to the vertebrae. Indicate on Figure 1.6 where this mole is likely to be found.
2. A 37-year-old female presented to the emergency room with a severe burn (3rd degree) on the right brachial region just proximal to the antecubital region. Indicate on Figure 1.6 where the laceration is likely to be found.
3. A 19-year-old female was identified by a tattoo on the fibular surface of the right leg just proximal to the tarsal region. Indicate on Figure 1.6 where the tattoo is likely to be found.

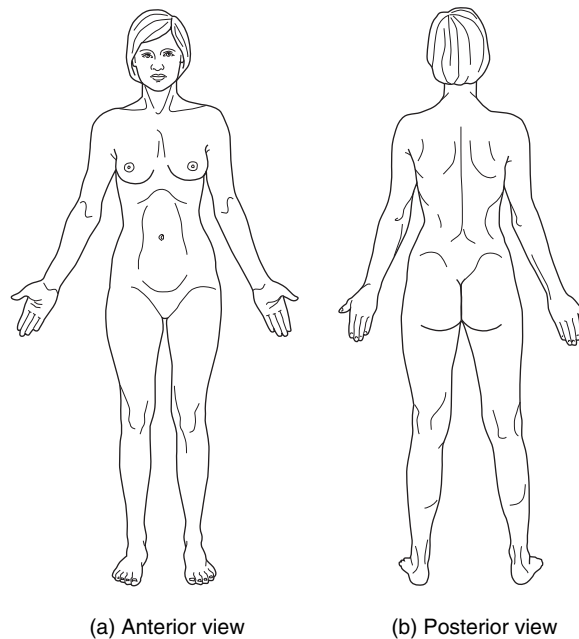


FIGURE 1.6 Body regions, anatomical language, and directional terms.

Questions 4–7 have italicized words that are derived from word roots used to form the adjectives in Table 1.1. Using the locations suggested by the italicized words, answer questions 4–7.

4. Is the *popliteal* artery proximal or distal to the *femoral* artery?
5. Is the *pectoralis* major muscle anterior or posterior to the *subscapularis* muscle?

6. Is the *sternocleidomastoid* muscle superior or inferior to the *rectus abdominis* muscle?
7. Are the *thoracic* vertebrae medial or lateral to the *scapulae*?

B. Body Planes and Sections

Figure 1.7 contains three different sections through the thorax. Indicate which section (view a, b, or c) is a

8. Frontal section _____
9. Sagittal section _____
10. Transverse (axial) section _____

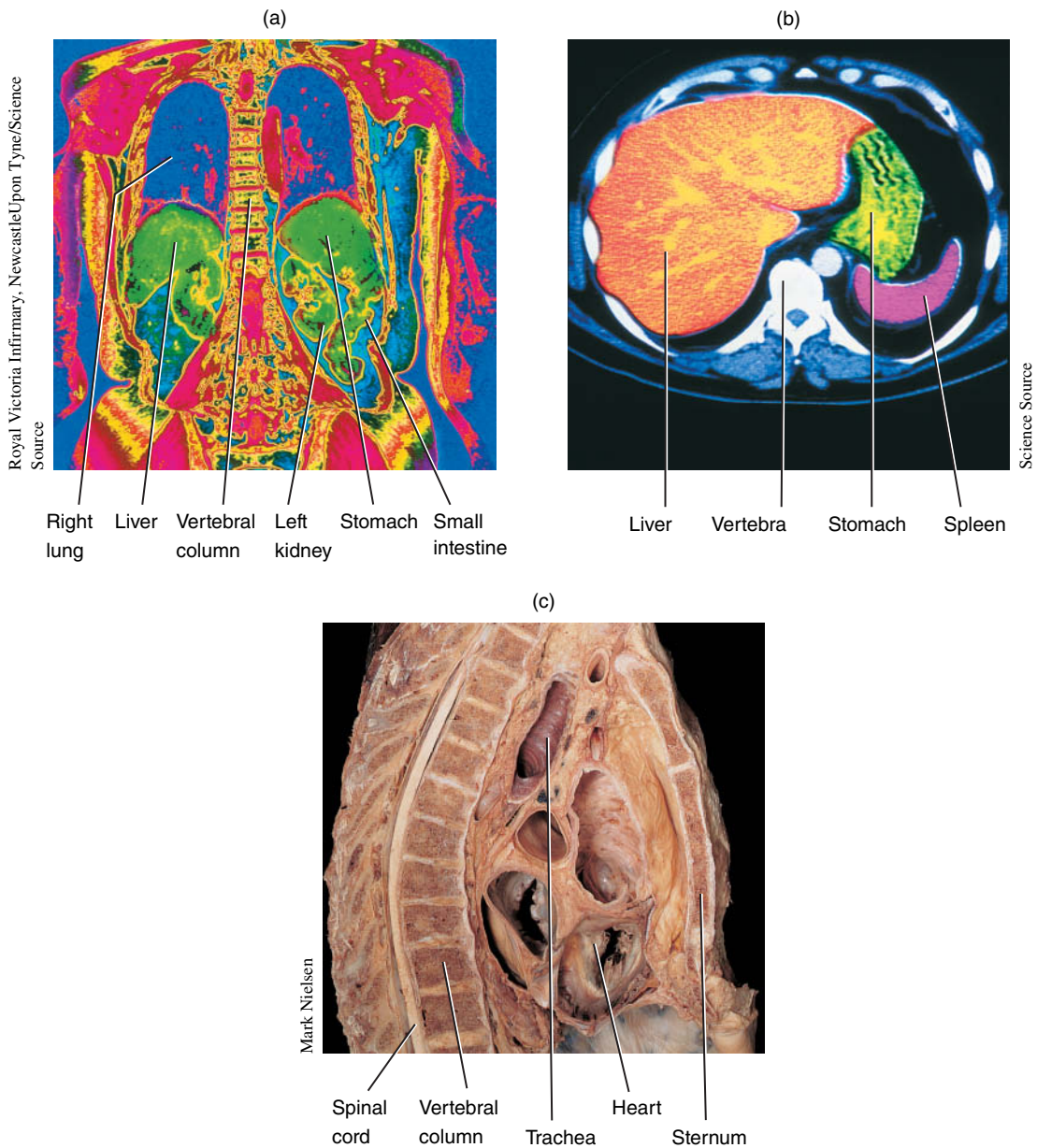


FIGURE 1.7 Sections through the thorax.

Organ Systems and Body Cavities

OBJECTIVES

- 1 Name the organ systems and describe the functions of each
- 2 Name and identify the major organs of each organ system
- 3 Describe the location of the body cavities and name the organs they contain
- 4 Describe the structure, location, and function of the serous membranes
- 5 Identify the abdominopelvic quadrants and regions and the major organs found in each

MATERIALS

- human torso models or charts
- male and female human reproductive models or charts
- paper or plastic large enough to outline student torsos, markers
- articulated skeleton
- one-gallon zippered plastic bags (1 per group)
- masking tape
- rat dissection video in the Wiley Student Companion Site

Organ systems are like different departments within a company. Within a company, departments work together to keep the company functioning. Within the body, organ systems work together to keep the body alive. In this exercise, you will learn the basic function and location of each organ system.

Before Going to Lab

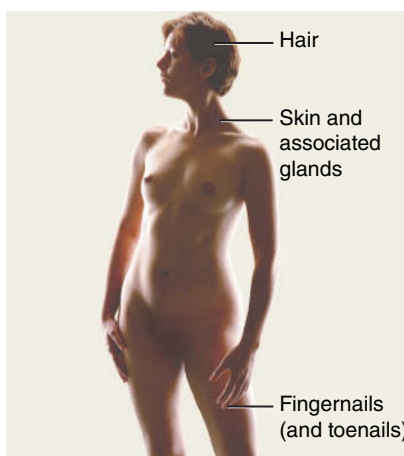
- 1 Review organ system functions and major organs in Table 2.1
- 2 Label the organ systems in Figure 2.1. Refer to Table 2.1.

A. Overview of Organ Systems and Major Organs

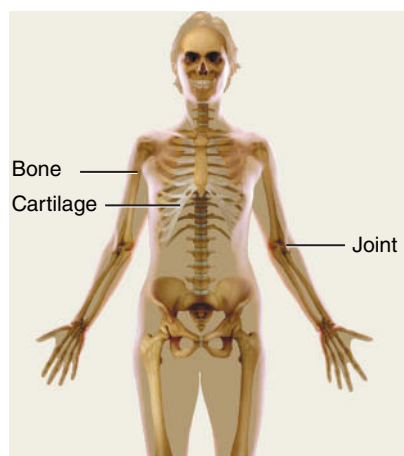
An **organ system** is a group of organs performing a common function. All organ systems cooperate to maintain an optimal environment for body cells through a process called **homeostasis** (*homeo-* = same; *stasis* = standing). Failure to maintain homeostasis results in disorders, disease, and possibly death.

TABLE 2.1 Functions and Major Organs of the Organ Systems

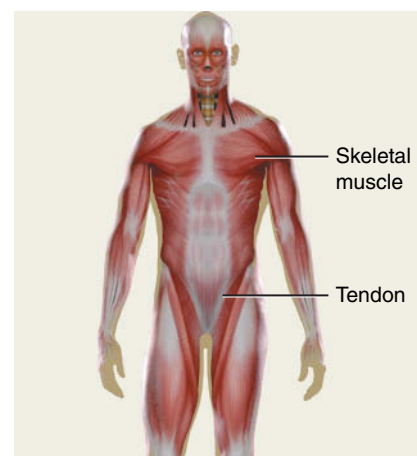
ORGAN SYSTEM	FUNCTION AND MAJOR ORGANS
Cardiovascular	Transports nutrients, chemical messengers, gases, and wastes in blood <i>Major organs: heart and blood vessels</i>
Respiratory	Adds oxygen to blood and removes carbon dioxide from blood <i>Major organs: nose, pharynx (throat), larynx, trachea, bronchi, lungs</i>
Digestive	Breaks down food into units that can be absorbed into the body, eliminates wastes and non-digestible fiber in food <i>Major organs: mouth, salivary glands, pharynx, esophagus, stomach, intestines, pancreas, liver, gallbladder</i>
Urinary	Removes nitrogenous wastes; maintains body fluid volume, pH, and electrolyte levels through urine production <i>Major organs: kidneys, ureters, urinary bladder, urethra</i>
Integumentary	Provides a protective barrier for the body and aids in production of vitamin D; contains sensory receptors for pain, touch, and temperature thermoregulation <i>Major organs: skin and skin structures (hair, nails, sweat glands, oil glands)</i>
Lymphatic and Immune	Returns fluid to cardiovascular system; detects and eliminates disease-causing organisms <i>Major organs: lymphatic vessels, lymph nodes, spleen, thymus, bone marrow, tonsils</i>
Skeletal	Protects major organs; provides levers and support for body movement <i>Major organs: bones and cartilage</i>
Muscular	Moves bones and maintains posture <i>Major organs: skeletal muscles and tendons</i>
Nervous	Controls cell function with electrical signals; helps control body homeostasis <i>Major organs: brain, spinal cord, nerves</i>
Endocrine	Controls cell function with hormones; helps control body homeostasis <i>Major organs: hypothalamus, pituitary gland, pineal gland, thymus, thyroid gland, pancreas, adrenal glands, ovaries, testes</i>
Reproductive	Produces gametes; female uterus provides environment for development of fetus <i>Major organs in male: testes, ductus deferens, penis</i> <i>Major organs in female: ovaries, uterine tubes, uterus, vagina</i>



1 _____

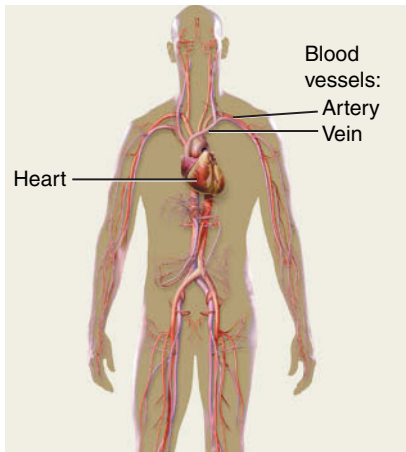


2 _____

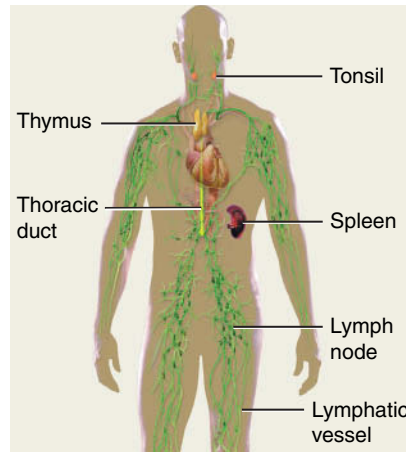


3 _____

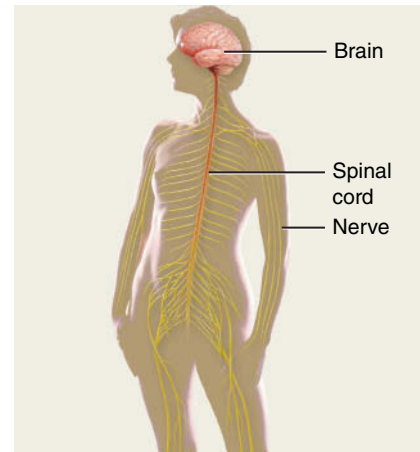
FIGURE 2.1 Selected organs and organ systems.



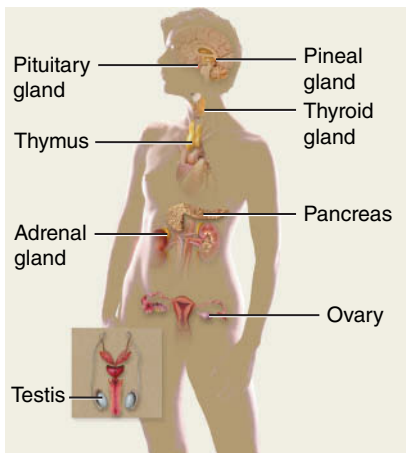
4 _____



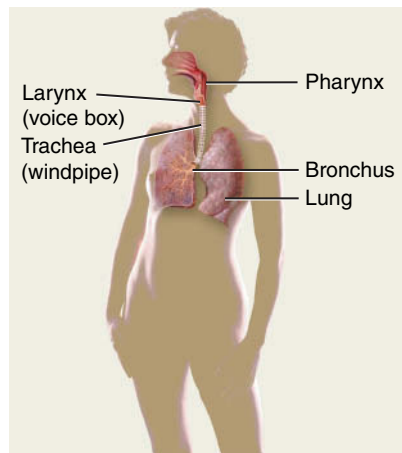
5 _____



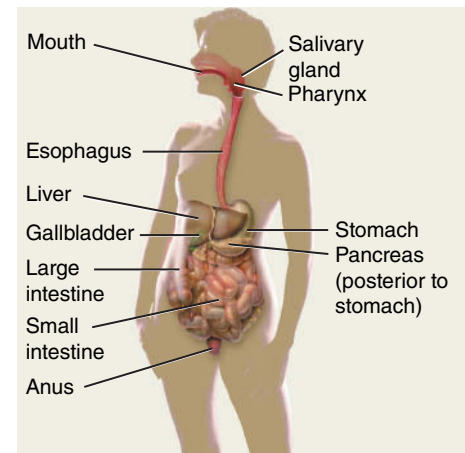
6 _____



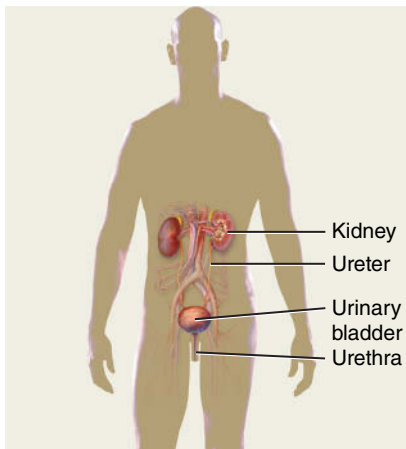
7 _____



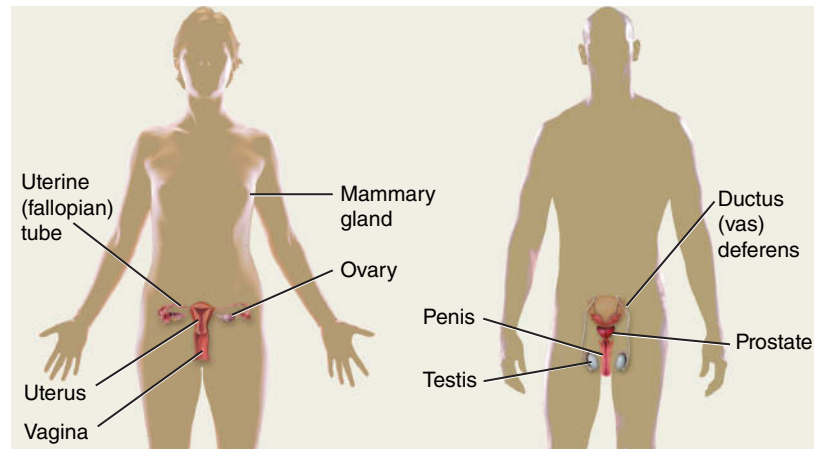
8 _____



9 _____

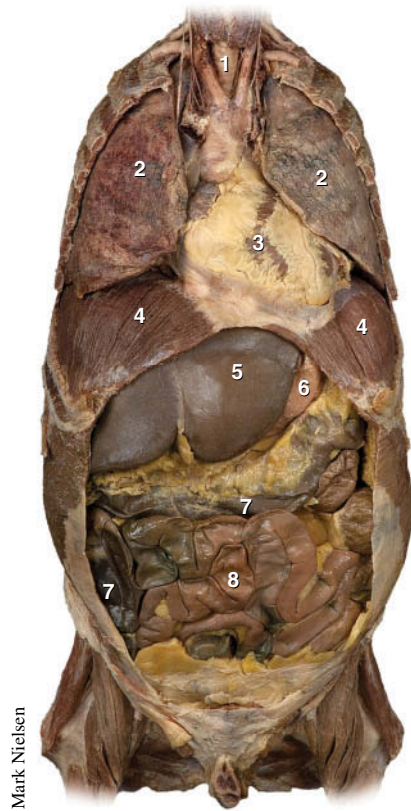


10 _____



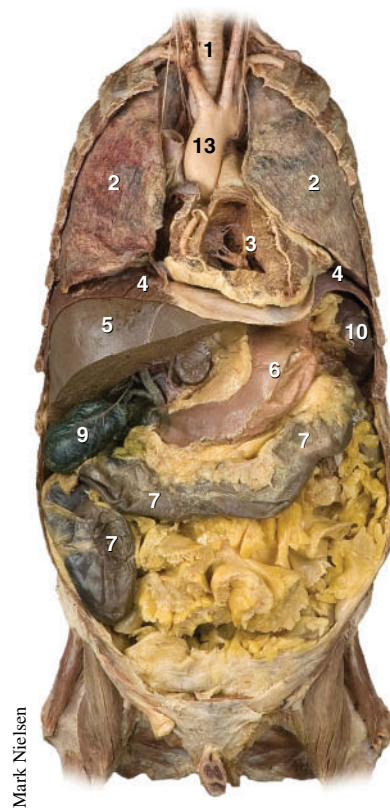
11 _____

FIGURE 2.1 Selected organs and organ systems, continued.



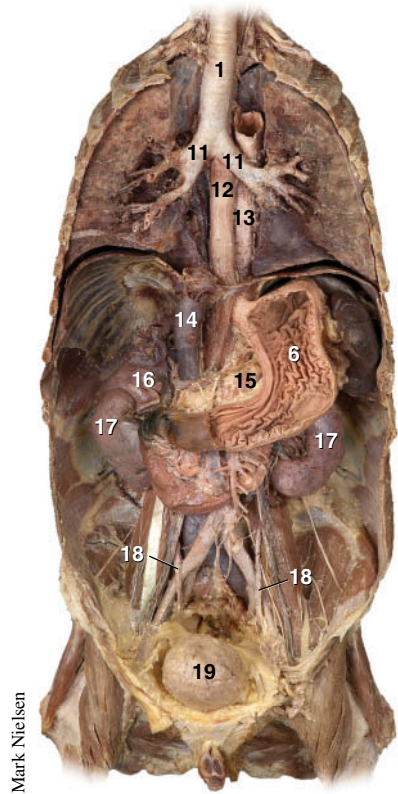
Mark Nielsen

(a) Superficial organs



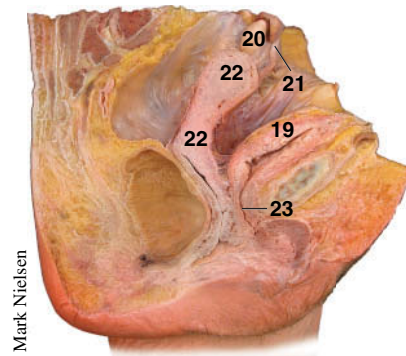
Mark Nielsen

(b) Intermediate organs



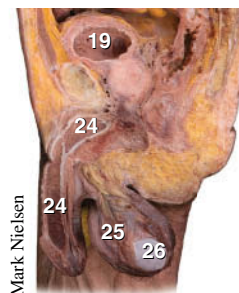
Mark Nielsen

(c) Deeper organs



Mark Nielsen

(d) Female pelvis



Mark Nielsen

(e) Male pelvis

FIGURE 2.2 Selected organs in cadaver dissection.

LAB ACTIVITY 1 Identification of Organs on Torso

- Identify the organs in Figure 2.2. Note which organs must be removed to see deeper organs.
 - Identify the following organs on the anterior surface of a torso model. Identify all the organs without removing any organs from the model.
 - trachea
 - heart
 - lungs
 - liver
 - stomach (torso's left side)
 - small intestine
 - large intestine (colon)
 - Remove the lungs, heart, liver, and stomach. Locate the gallbladder on the inferior surface of the liver.
 - Identify the following organs on a torso model:
 - esophagus
 - bronchi (right and left)
 - inferior vena cava
 - pancreas (posterior to stomach)
 - spleen
 - Remove the small intestine and large intestine. Locate the appendix at the inferior right end of the large intestine.
 - Identify the following organs on a torso model:
 - abdominal aorta
 - adrenal glands (superior surface of kidneys)
 - kidneys
 - ureters
 - urinary bladder
 - Identify the female reproductive organs on a female reproductive model. Observe the position of the urinary bladder relative to the uterus.
 - ovaries
 - uterus
 - urinary bladder
 - Identify the male reproductive organs on a male reproductive model.
 - penis
 - scrotum (skin covering testes)
 - testes
- Answer the following questions about the position of each organ on the torso model or in Figure 2.2.
 - The stomach is _____ to the small intestine.
 - superior
 - inferior
 - medial
 - lateral
 - The liver is _____ to the lungs.
 - superior
 - inferior
 - medial
 - lateral
 - The lungs are _____ to the heart.
 - superior
 - inferior
 - medial
 - lateral
 - The trachea is _____ to the esophagus.
 - medial
 - inferior
 - anterior
 - posterior
 - The pancreas is _____ to the stomach.
 - superior
 - anterior
 - lateral
 - posterior
 - The large intestine is _____ to the stomach.
 - superior
 - inferior
 - posterior
 - lateral
 - The stomach is _____ to the spleen.
 - lateral
 - medial
 - superior
 - inferior
 - The abdominal aorta and inferior vena cava are _____ to the kidneys.
 - medial
 - lateral
 - superior
 - inferior
 - The kidneys are _____ to the small intestine.
 - anterior
 - posterior
 - superior
 - inferior
 - The urinary bladder is _____ to the kidneys.
 - posterior and superior
 - medial and inferior
 - medial and superior
 - lateral and posterior

LAB ACTIVITY 2 Organ Location

- Draw the outline of a full-size torso on paper or plastic.
- Using a marker, draw life-size outlines of all superficial organs in the appropriate place on the paper or plastic torso. ■

Key for Organs in Figure 2.2

1 trachea	10 spleen	19 urinary bladder
2 lungs	11 primary bronchi	20 ovaries
3 heart	12 esophagus	21 uterine tube
4 diaphragm	13 aorta	22 uterus
5 liver	14 inferior vena cava	23 urethra
6 stomach	15 pancreas	24 penis
7 colon (large intestine)	16 adrenal gland	25 scrotum
8 small intestine	17 kidney	26 testis
9 gallbladder	18 ureters	

B. Body Cavities

Many of the body's organs are found within body cavities. The *cranial cavity* contains the brain, and it is continuous with the *vertebral* (*vertebra* = back) canal that contains the spinal cord.

The **thoracic cavity** is a space enclosed by the ribs, sternum, and vertebral column. This cavity contains three small cavities: the **pericardial cavity** (*peri-* = around; *-cardia* = heart) and two **pleural cavities** (*pleuro-* = side or rib). The pericardial cavity contains the heart, and each pleural cavity contains a lung. The **mediastinum** (*media-* = middle; *-stinum* = partition), a central area within the thoracic cavity, extends from the neck to the diaphragm and from the sternum to the vertebral column. The organs located in the mediastinum are the heart, thymus gland, esophagus, trachea, blood vessels, and bronchi. The pleural cavities are located on either side of the mediastinum. The **diaphragm** separates the thoracic cavity from the abdominopelvic cavity.

The **abdominopelvic cavity** consists of two continuous cavities: the abdominal cavity and the pelvic cavity. The **abdominal cavity** is the superior portion located between the diaphragm and the brim of the pelvis (hip bones). This cavity contains the stomach, liver, gallbladder, pancreas, spleen, small intestine, kidneys, appendix, and part

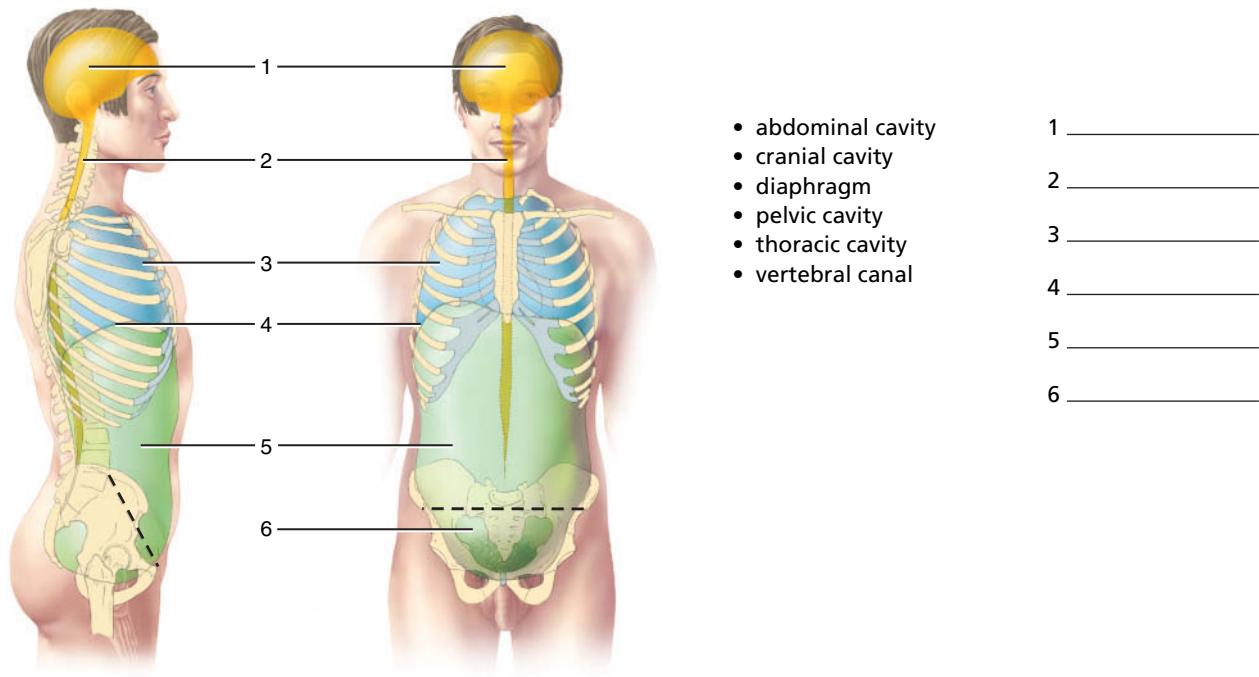
of the large intestine. Within the abdominal cavity is the **peritoneal cavity** which contains the pancreas, kidneys, adrenal glands, and portions of the large intestine, small intestine, aorta, and inferior vena cava. The **pelvic cavity** is the inferior portion of the abdominopelvic cavity. The pelvic cavity contains part of the large intestine, rectum, urinary bladder, female reproductive organs (ovaries, uterine tubes, uterus, vagina), and male reproductive organs (prostate, and part of ductus deferens). It is important to note that the testes and penis are not located in the pelvic cavity but are located inferior to it.

Before Going to Lab

- 1 Label the major body cavities and the diaphragm on Figure 2.3(a) and (b).

LAB ACTIVITY 3 Body Cavities

- 1 Locate the major body cavities on a skeleton and torso model. Identify the organs located in each body cavity.
- 2 Locate the mediastinum (meed-ee-uh-STINE-um) on a torso model or on Figure 2.1. Identify the organs located within the mediastinum. ■



(a) Right lateral view

(b) Anterior view

FIGURE 2.3 Body cavities.

- abdominal cavity
- cranial cavity
- diaphragm
- pelvic cavity
- thoracic cavity
- vertebral canal

- 1 _____
- 2 _____
- 3 _____
- 4 _____
- 5 _____
- 6 _____

C. Serous Membranes

Most of the organs in the ventral body cavity are covered with thin **serous** (*serum* = any clear, watery fluid) **membranes**, which are composed of two layers: a visceral layer and a parietal layer. The **visceral** (*viscera* = internal organs) **layer** covers the organ, whereas the **parietal** (*paries* = wall) **layer** attaches to and covers the ventral body wall. These two layers make up one continuous sheet that folds to form a sac. Between the two layers is a potential cavity containing a small amount of serous fluid secreted by the membranes. The clear, watery **serous fluid** prevents friction as the organs move within the ventral body cavity. For example, the heart has movement within the thoracic cavity as it fills with and ejects blood.

Serous membranes are named for the cavities they surround. Thoracic serous membranes include the **pleura**, which covers the lungs, and the **pericardium**, which covers the heart. The serous membrane that covers abdominal organs in the peritoneal cavity is the **peritoneum** (*peri-* = around; *teinein* = to stretch). Although most abdominal organs are positioned within the peritoneal cavity, a few organs are retroperitoneal (*retro-* = backward), or located posterior to the peritoneum.

Before Going to Lab

- 1 In Figure 2.4, observe how the serous pericardium folds to form a double layer.
- 2 Label the two layers of the serous pericardium in Figure 2.4.

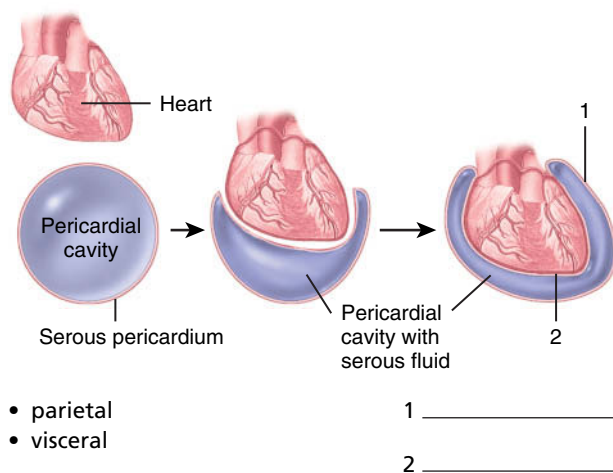


FIGURE 2.4 Serous pericardium folds to surround the heart.

LAB ACTIVITY 4 Serous Membranes

- 1 Make a replica or model of a serous membrane with your lab group.
 - Obtain a 1-gallon zippered plastic bag.
 - Push all the air out of the bag and zip the bag.
 - Have a lab partner place a fist (simulating an organ) on the bottom edge of the bag and push up into the bag so the bag surrounds the fist.
 - Remove the fist, unzip the bag, and add about 40 to 50 mL of water to the bag. Push out the extra air before reziping the bag.
 - Now have the same lab partner place a fist (simulating an organ) on the bottom edge of the bag and push up into the bag so the bag surrounds the fist.
- 2 Clean up as directed by your instructor.
- 3 Answer the Discussion Questions with your lab group.

DISCUSSION QUESTIONS

Serous Membranes

- 1 In the bag with water, what is the name of the simulated serous membrane layer that is touching the fist (organ)?
- 2 In the same bag, what is the name of the simulated outer serous membrane layer?
- 3 What does the water represent?
- 4 Was it easier to push a fist into the bag with no water or into the bag with water?
- 5 Based on your observations, does the presence of serous fluid make it easier for organs to move? Explain.

D. Organ Systems, Body Cavities, and Serous Membranes in the Rat

The organ systems, body cavities, and serous membranes of the rat are similar to those of humans. The rat dissection will allow you to see the relationship of organs to each other, organ location within body cavities, and serous membranes.

LAB ACTIVITY 5 Rat Dissection Video

Go to the Wiley Student Companion Site to view the rat dissection video.

E. Abdominopelvic Regions and Quadrants

Anatomists divide the abdominopelvic cavity into nine **regions** using two vertical and two horizontal lines in a tic-tac-toe grid so that the location of any organ is simple to describe. The two vertical lines are drawn mid-clavicular (mid-collar bone) and just medial to the nipples, beginning at the diaphragm and extending inferiorly through the pelvic area. The upper horizontal line is drawn across the abdomen, inferior to the ribs and across the inferior portions of the liver and stomach. The lower horizontal line is drawn slightly inferior to the superior portion of the pelvic bones. These nine regions from the top right to the lower left are **right hypochondriac** (*hypo-* = under; *chondro-* = cartilage), **epigastric** (*epi-* = upon; *gastro-* = stomach), **left hypochondriac**, **right lumbar** (*lumbar* = loin), **umbilical**, **left lumbar**, **right inguinal** or **iliac** (*inguinal* = groin), **hypogastric** or **pubic**, and **left inguinal** or **iliac**. Clinicians are more apt to divide this cavity into four **quadrants** that are formed by transverse and sagittal planes running through the umbilicus (navel). These quadrants are useful clinically when one is trying to describe abnormalities or to determine which organ may be the cause of pain. The four quadrants are **right upper quadrant (RUQ)**, **left upper quadrant (LUQ)**, **right lower quadrant (RLQ)**, and **left lower quadrant (LLQ)**.

NOTE: Right and left always refer to the model's or specimen's own right and left.

Before Going to Lab

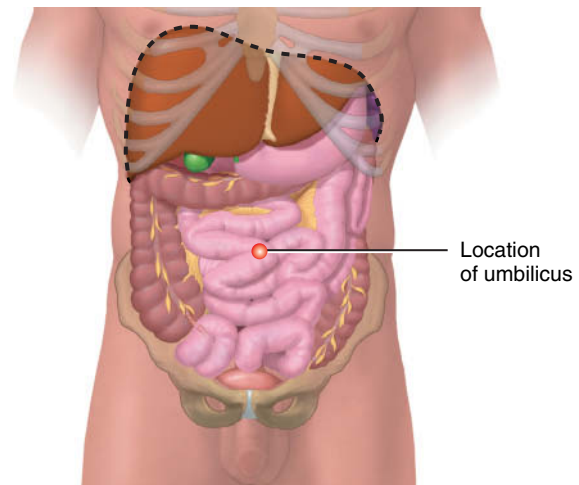
- 1 Draw lines on Figure 2.5(a) separating the abdominopelvic cavity into quadrants and label the quadrants.
- 2 Draw lines on Figure 2.5(b) separating the abdominopelvic cavity into regions and label the regions.

LAB ACTIVITY 6 Abdominopelvic Quadrants and Regions

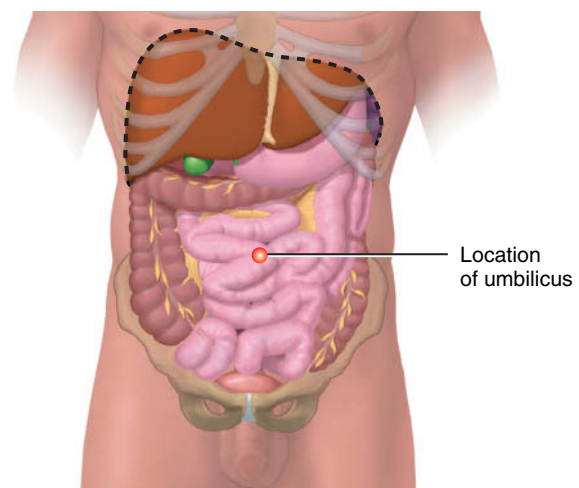
- 1 Using a piece of masking tape, mark the location of the diaphragm on a human torso or on yourself.
- 2 Using two pieces of masking tape, divide the abdominopelvic cavity into quadrants on a human torso or on yourself.
- 3 Using the torso model or your textbook, identify in which abdominopelvic quadrant(s) each organ is *primarily* located. Use the abbreviations RUQ, LUQ, RLQ, and LLQ.
 - a. appendix _____
 - b. large intestine or colon _____
 - c. liver _____
 - d. ovaries _____

- e. pancreas _____
- f. small intestine _____
- g. spleen _____
- h. stomach _____

- 4 Using four pieces of masking tape, divide the abdominopelvic cavity into regions on a human torso or on yourself.
- 5 Using the torso model or your textbook, identify in which abdominopelvic region each organ is *primarily* located.
 - a. appendix _____
 - b. gallbladder _____
 - c. left ovary _____
 - d. bifurcation of the abdominal aorta _____
 - e. spleen _____
 - f. stomach (majority of) _____



(a) Quadrants



(b) Regions

FIGURE 2.5 Abdominopelvic cavity.

Reviewing Your Knowledge

E X E R C I S E

2

A. Functions and Identification of Organ Systems

Identify the organ system by its function as described below.

- _____ 1. Maintains blood oxygen and carbon dioxide levels
- _____ 2. Controls muscles and glands by electrical impulses; helps control homeostasis
- _____ 3. Causes movement of bones
- _____ 4. Waterproof barrier that blocks the entrance of pathogens into the body and prevents the loss of water from the body
- _____ 5. Transports nutrients, oxygen, and carbon dioxide throughout the body
- _____ 6. Changes food into absorbable nutrients; expels wastes
- _____ 7. Regulates composition of blood by eliminating nitrogenous wastes, excess water, and minerals
- _____ 8. Uses hormones to control cell function; helps control homeostasis
- _____ 9. Provides framework for the body and protects body organs
- _____ 10. Produces gametes (sperm and egg)
- _____ 11. Returns fluid to the bloodstream and provides protection against pathogens that have entered the body

B. Organ System Identification

Identify the correct organ system for the following organs.

- | | |
|------------------------|------------------------------|
| _____ 1. spleen | _____ 6. kidney |
| _____ 2. liver | _____ 7. uterus |
| _____ 3. trachea | _____ 8. pituitary gland |
| _____ 4. blood vessels | _____ 9. spinal cord |
| _____ 5. hair | _____ 10. testes (2 systems) |

- | | |
|--------------------------------|-------------------------|
| _____ 11. prostate gland | _____ 14. adrenal gland |
| _____ 12. large intestine | _____ 15. thyroid |
| _____ 13. pancreas (2 systems) | |

C. Body Cavities

Identify all the cavities for each organ as follows: abdominal (A), cranial (C), pelvic (P), pericardial (PC), pleural (PL), peritoneal (PT), thoracic (T), and vertebral (V).

- | | |
|--------------------------|---------------------------|
| _____ 1. brain | _____ 7. spinal cord |
| _____ 2. small intestine | _____ 8. liver |
| _____ 3. heart | _____ 9. kidneys |
| _____ 4. lungs | _____ 10. uterus |
| _____ 5. bronchi | _____ 11. urinary bladder |
| _____ 6. stomach | _____ 12. ovaries |

D. Abdominopelvic Quadrants and Regions

Name the quadrant(s) (RUQ, LUQ, RLQ, and LLQ) and region(s) (right hypochondriac, epigastric, left hypochondriac, right lumbar, umbilical, left lumbar, right inguinal or iliac, hypogastric or pubic, and left inguinal or iliac) that the following organs predominantly occupy.

- | | |
|----------------------|----------------------|
| _____ 1. liver | _____ 5. appendix |
| _____ 2. stomach | _____ 6. left kidney |
| _____ 3. spleen | _____ 7. right ovary |
| _____ 4. gallbladder | _____ 8. uterus |

E. Serous Membranes

Write the term the phrase describes.

- | |
|---|
| _____ 1. Attaches the heart to the body cavity |
| _____ 2. Covers the surface of the lungs |
| _____ 3. Covers the surface of abdominal organs |
| _____ 4. The lubricating liquid in serous cavities |
| _____ 5. Circle the organs that are found within the peritoneal cavity: pancreas, liver, kidney, spleen, adrenal glands, abdominal aorta, inferior portions of vena cava, stomach |

Using Your Knowledge

EXERCISE

2

A. Homeostatic Imbalances of Organ Systems

Using your textbook, identify the organ system that is homeostatically imbalanced in the following diseases or disorders.

- _____ 1. muscular dystrophy
- _____ 2. hypothyroidism
- _____ 3. myocardial ischemia
- _____ 4. infectious mononucleosis

B. Body Cavities and Serous Membranes

Identify *all* the cavities entered for each procedure, beginning with the largest cavity and ending with the most specific body cavity. Use these abbreviations for the body cavities: abdominal (A), cranial (C), pelvic (P), pericardial (PC), pleural (PL), peritoneal (PT), thoracic (T), and vertebral (V).

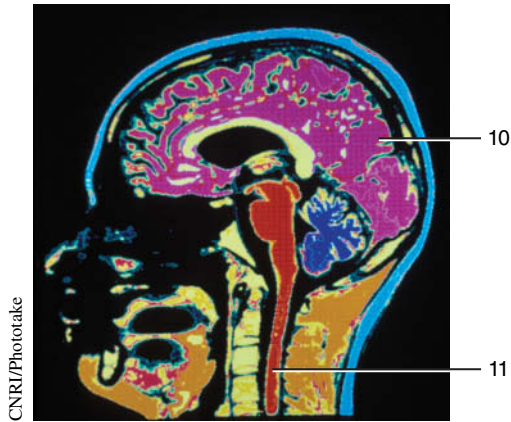
- _____ 5. coronary bypass surgery
- _____ 6. cholecystectomy (gallbladder removal)
- _____ 7. spinal tap

C. Abdominopelvic Quadrants

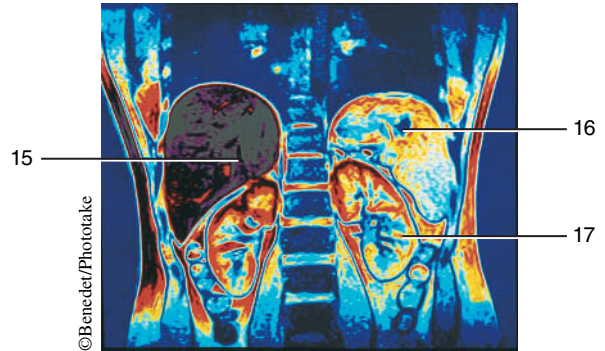
- _____ 8. A 44-year-old male went to the emergency room complaining of severe pain in his RLQ. The doctor palpated the area and determined that the pain was originating from an organ in that quadrant. Which organ might be involved?
- (a) liver (b) appendix (c) gallbladder (d) spleen (e) stomach
- _____ 9. A 23-year-old female went to the doctor with the chief complaint of RLQ pain. Which organ is most likely the cause?
- (a) adrenal gland (b) ovary (c) gallbladder (d) pancreas (e) kidney

D. Organ Identification

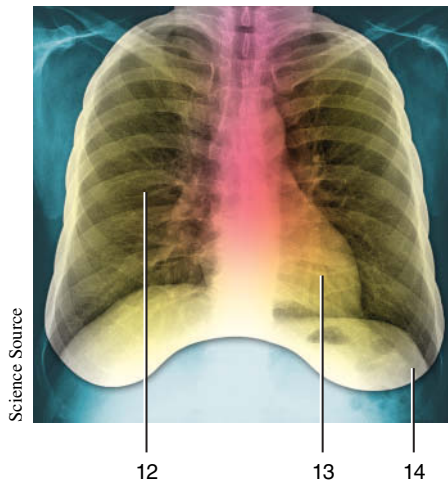
Identify the organs in the color-enhanced medical images in Figure 2.6.



(a) MRI of head and neck, sagittal view



(c) MRI of abdomen, anterior view



(b) Radiograph of thorax, anterior view



(d) Radiograph of abdomen and pelvis, anterior view

- | | | |
|----------|----------|----------|
| 10 _____ | 14 _____ | 18 _____ |
| 11 _____ | 15 _____ | 19 _____ |
| 12 _____ | 16 _____ | 20 _____ |
| 13 _____ | 17 _____ | |

FIGURE 2.6 Identification of organs on medical images.

Compound Light Microscope

OBJECTIVES

- 1 Describe and demonstrate how to carry, clean, use, and store a compound light microscope
- 2 Identify the parts of a compound light microscope and describe their function
- 3 Calculate total magnification for each objective lens
- 4 Demonstrate how to view an object with the microscope using all magnifications
- 5 Demonstrate how to measure the field of view
- 6 Measure the diameter of a cell
- 7 Prepare a wet-mount slide

MATERIALS

- compound light microscopes, lens paper, immersion oil
- thin, clear plastic rulers
- prepared microscope slides of the letter “e”
- prepared microscope slides of the trachea (or other organ)
- wet mount of cheek cells; clean microscope slides, coverslips, lens paper, flat toothpicks, and dropper bottle of dilute methylene blue, 0.9% saline solution, 10% bleach solution

A **compound light microscope** is used to observe small structures such as cells and tissues. The term *compound* refers to the two types of lenses (ocular and objective) that are used simultaneously to magnify the image. The term *light* refers to the necessity of using a light source to view the object. Most human cells must be magnified to be seen by the unaided human eye. The compound light microscope can magnify images up to approximately 1,000 times, depending on the magnifying power of the lenses.

Microscopic examination of cells and tissues allows students to observe how cell and tissue structure determines function. Changes in normal cell and tissue structure cause changes in organ function that lead to a disorder or disease. Tissue biopsies are performed to observe whether normal cellular structure has changed, which would indicate the absence or presence of a disorder or disease.

A. Transporting the Microscope

The compound light microscope is an expensive, precision instrument that must be handled appropriately. Demonstrate care in transporting, cleaning, using, and storing the microscope.

- Pick up the microscope with two hands, one holding the arm and the other supporting the base with the cord in a secure position.
- Carry the microscope upright so that a lens or eyepiece does not fall out, and carefully place the microscope on the lab table in front of you.