

# The Language of Anatomy

# **Objectives**

- Describe the anatomical position, and explain its importance.
- ☐ Use proper anatomical terminology to describe body regions, orientation and direction, and body planes.
- ☐ Name the body cavities, and indicate the important organs in each.
- ☐ Name and describe the serous membranes of the ventral body cavities.
- ☐ Identify the abdominopelvic quadrants and regions on a torso model or image.

# Materials

- Human torso model (dissectible)
- Human skeleton
- Demonstration: sectioned and labeled kidneys (three separate kidneys uncut or cut so that [a] entire, [b] transverse sectional, and [c] longitudinal sectional views are visible)
- · Gelatin-spaghetti molds
- Scalpel
- Post-it® Notes

# Pre-Lab Quiz

- 1. Circle True or False. In anatomical position, the body is lying down.
- 2. Circle the correct underlined term. With regard to surface anatomy, abdominal / axial refers to the structures along the center line of the body.
- 3. The term *superficial* refers to a structure that is:
  - a. attached near the trunk of the body
  - b. toward or at the body surface
  - c. toward the head
  - d. toward the midline
- 4. The \_\_\_ \_\_\_\_ plane runs longitudinally and divides the body into right and left sides.
  - **a.** frontal

c. transverse

b. sagittal

- d. ventral
- 5. Circle the correct underlined terms. The dorsal body cavity can be divided into the cranial / thoracic cavity, which contains the brain, and the sural / vertebral cavity, which contains the spinal cord.

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ost of us are naturally curious about our bodies. This curiosity is apparent even in infants, who are fascinated with their own waving hands or their mother's nose. Unlike an infant, however, an anatomy student must learn to observe and identify the dissectible body structures formally.

A student new to any science is often overwhelmed at first by the terminology used in that subject. The study of anatomy is no exception. But without this specialized terminology, confusion is inevitable. For example, what do over, on top of, above, and behind mean in reference to the human body? Anatomists have an accepted set of reference terms that are universally understood. These allow body structures to be located and identified precisely with a minimum of words.

This exercise presents some of the most important anatomical terminology used to describe the body and introduces you to basic concepts of gross anatomy, the study of body structures visible to the naked eye.

# **Anatomical Position**

When anatomists or doctors refer to specific areas of the human body, the picture they keep in mind is a universally accepted standard position called the **anatomical position**. It is essential to understand this position because much of the directional terminology used in this book refers to the body in this position, regardless of the position the body happens to be in. In the anatomical position, the human body is erect, with the feet only slightly apart, head and toes pointed forward,

and arms hanging at the sides with palms facing forward (Figure 1.1a).

☐ Assume the anatomical position, and notice that it is not particularly comfortable. The hands are held unnaturally forward rather than hanging with palms toward the thighs.

Check the box when you have completed this task.

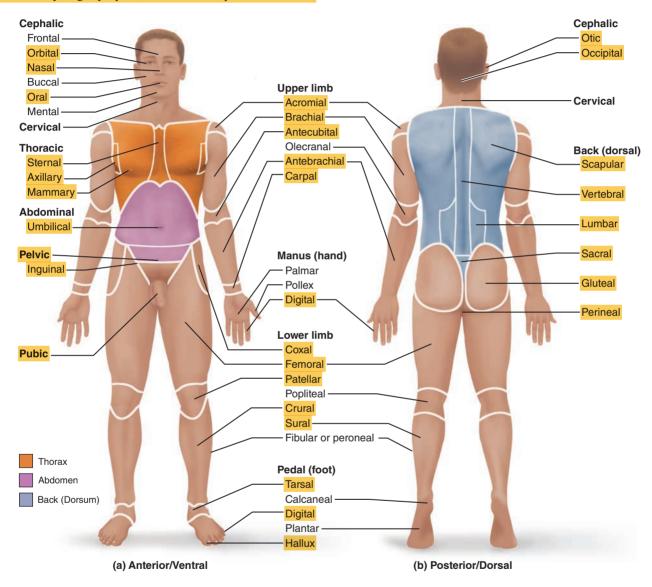


Figure 1.1 Surface anatomy. (a) Anatomical position. (b) Heels are raised to illustrate the plantar surface of the foot.

# **Surface Anatomy**

Body surfaces provide a wealth of visible landmarks for study. There are two major divisions of the body:

**Axial:** Relating to head, neck, and trunk, the axis of the body **Appendicular:** Relating to limbs and their attachments to

the axis

# **Anterior Body Landmarks**

Note the following regions in Figure 1.1a:

**Abdominal:** Anterior body trunk region inferior to the ribs

Acromial: Point of the shoulder

Antebrachial: Forearm

Antecubital: Anterior surface of the elbow

Axillary: Armpit
Brachial: Arm
Buccal: Cheek
Carpal: Wrist
Cephalic: Head

Cervical: Neck region

Coxal: Hip Crural: Leg

Digital: Fingers or toes

Femoral: Thigh

Fibular (peroneal): Side of the leg

Frontal: Forehead
Hallux: Great toe
Inguinal: Groin area
Mammary: Breast region

Manus: Hand Mental: Chin Nasal: Nose Oral: Mouth

**Orbital:** Bony eye socket (orbit) **Palmar:** Palm of the hand

Patellar: Anterior knee (kneecap) region

Pedal: Foot

**Pelvic:** Pelvis region **Pollex:** Thumb

Pubic: Genital region

Sternal: Region of the breastbone

Tarsal: Ankle
Thoracic: Chest
Umbilical: Navel

# **Posterior Body Landmarks**

Note the following body surface regions in Figure 1.1b:

**Acromial:** Point of the shoulder

**Brachial:** Arm

Calcaneal: Heel of the foot

Cephalic: Head Dorsum: Back Femoral: Thigh

Gluteal: Buttocks or rump

Lumbar: Area of the back between the ribs

and hips; the loin

Manus: Hand

Occipital: Posterior aspect of the head or base

of the skull

Olecranal: Posterior aspect of the elbow

Otic: Ear
Pedal: Foot

Perineal: Region between the anus and

external genitalia

Plantar: Sole of the foot
Popliteal: Back of the knee
Sacral: Region between the hips

(overlying the sacrum)

Scapular: Scapula or shoulder blade area Sural: Calf or posterior surface of the leg Vertebral: Area of the spinal column

# Activity 1

### **Locating Body Regions**

Locate the anterior and posterior body landmarks on yourself, your lab partner, and a human torso model.

# **Body Orientation and Direction**

Study the terms below, referring to **Figure 1.2** on p. 4 for a visual aid. Notice that certain terms have different meanings, depending on whether they refer to a four-legged animal (quadruped) or to a human (biped).

**Superior/inferior** (above/below): These terms refer to placement of a structure along the long axis of the body. For example, the nose is superior to the mouth, and the abdomen is inferior to the chest.

**Anterior/posterior** (front/back): In humans, the most anterior structures are those that are most forward—the face. chest, and abdomen. Posterior structures are those toward the backside of the body. For instance, the spine is posterior to the heart.

Medial/lateral (toward the midline/away from the midline or median plane): The sternum (breastbone) is medial to the ribs; the ear is lateral to the nose.

The terms of position just described assume the person is in the anatomical position. The next four term pairs are more absolute. They apply in any body position, and they consistently have the same meaning in all vertebrate animals.

Cephalad (cranial)/caudal (toward the head/toward the tail): In humans, these terms are used interchangeably with superior and inferior, but in four-legged animals they are synonymous with anterior and posterior, respectively.

Ventral/dorsal (belly side/backside): These terms are used chiefly in discussing the comparative anatomy of animals, assuming the animal is standing. In humans, the terms ventral and dorsal are used interchangeably with the terms anterior and posterior, but in four-legged animals, ventral and dorsal are synonymous with inferior and superior, respectively.

Proximal/distal (nearer the trunk or attached end/farther from the trunk or point of attachment): These terms are used primarily to locate various areas of the body limbs. For example, the fingers are distal to the elbow; the knee is proximal to the toes. However, these terms may also be used to indicate regions (closer to or farther from the head) of internal tubular organs.

Superficial (external)/deep (internal) (toward or at the body surface/away from the body surface): For example, the skin is superficial to the skeletal muscles, and the lungs are deep to the rib cage.

# Activity 2

# **Practicing Using Correct Anatomical Terminology**

Use a human torso model, a human skeleton, or your own body to specify the relationship between the following structures when the body is in the anatomical position.

- 1. The wrist is \_\_\_\_\_ to the hand.
- 2. The trachea (windpipe) is \_\_\_\_\_ to the spine.
- 3. The brain is \_\_\_\_\_\_ to the spinal cord.
- 4. The kidneys are \_\_\_\_\_\_ to the liver.

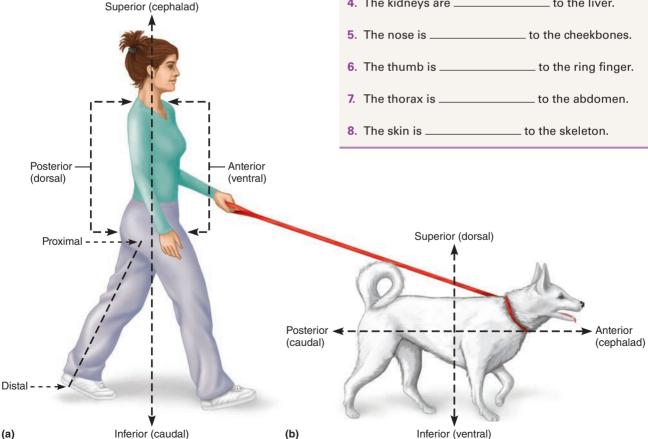


Figure 1.2 Anatomical terminology describing body orientation and direction. (a) With reference to a human. (b) With reference to a four-legged animal.

# **Body Planes and Sections**

The body is three-dimensional, and in order to observe its internal structures, it is often necessary to make a **section**, or cut. When the section is made through the body wall or through an organ, it is made along an imaginary surface or line called a **plane**. Anatomists commonly refer to three planes (**Figure 1.3**), or sections, that lie at right angles to one another.

**Sagittal plane:** A sagittal plane runs longitudinally and divides the body into right and left parts. If it divides the body into equal parts, right down the midline of the body, it is called a **median**, or **midsagittal**, **plane**.

**Frontal plane:** Sometimes called a **coronal plane,** the frontal plane is a longitudinal plane that divides the body (or an organ) into anterior and posterior parts.

**Transverse plane:** A transverse plane runs horizontally, dividing the body into superior and inferior parts. When organs are sectioned along the transverse plane, the sections are commonly called **cross sections.** 

On microscope slides, the abbreviation for a longitudinal section (sagittal or frontal) is l.s. Cross sections are abbreviated x.s. or c.s.

A median or frontal plane section of any nonspherical object, be it a banana or a body organ, provides quite a different view from a cross section (**Figure 1.4**, p. 6).

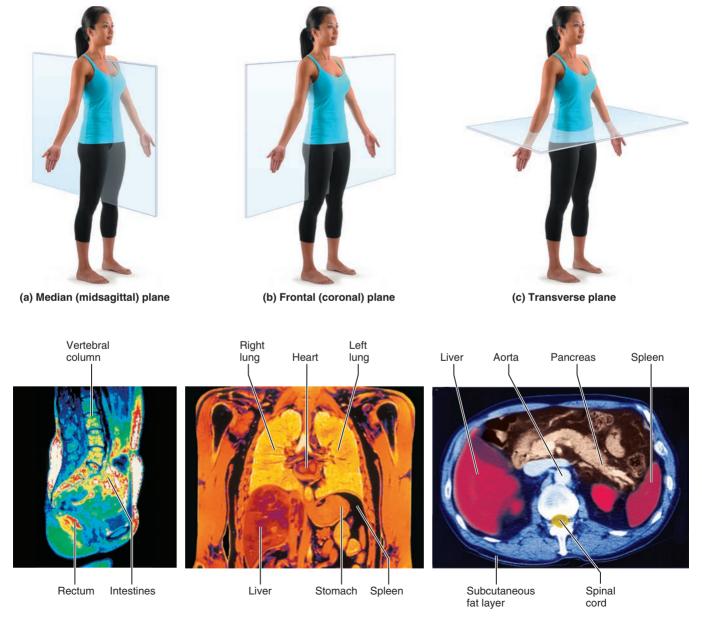


Figure 1.3 Planes of the body with corresponding magnetic resonance imaging (MRI) scans. Note the transverse section is an inferior view.

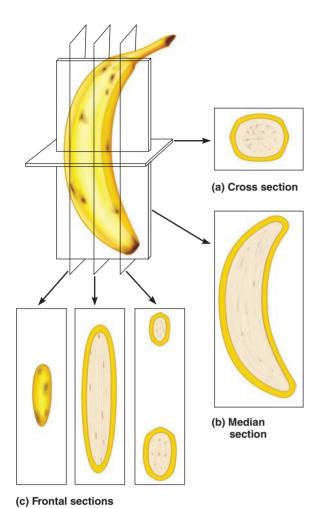


Figure 1.4 Objects can look odd when viewed in section. This banana has been sectioned in three different planes (a-c), and only in one of these planes (b) is it easily recognized as a banana. If one cannot recognize a sectioned organ, it is possible to reconstruct its shape from a series of successive cuts, as from the three serial sections in (c).

# Activity 3

#### **Observing Sectioned Specimens**

- 1. Go to the demonstration area and observe the transversely and longitudinally cut organ specimens (kidneys). Pay close attention to the different structural details in the samples; you will need to draw these views in the Review Sheet at the end of this exercise.
- 2. After completing instruction 1, obtain a gelatinspaghetti mold and a scalpel, and take them to your laboratory bench. (Essentially, this is just cooked spaghetti added to warm gelatin, which is then allowed to gel.)
- **3.** Cut through the gelatin-spaghetti mold along any plane, and examine the cut surfaces. You should see spaghetti strands that have been cut transversely (x.s.) and some cut longitudinally.
- **4**. Draw the appearance of each of these spaghetti sections below, and verify the accuracy of your section identifications with your instructor.

Transverse cut Longitudinal cut

# **Body Cavities**

The axial portion of the body has two large cavities that provide different degrees of protection to the organs within them (**Figure 1.5**).

# **Dorsal Body Cavity**

The dorsal body cavity can be subdivided into the **cranial cavity**, which lies within the rigid skull and encases the brain, and the **vertebral** (or **spinal**) **cavity**, which runs through the bony vertebral column to enclose the delicate spinal cord. Because the spinal cord is a continuation of the brain, these cavities are continuous with each other.

# **Ventral Body Cavity**

Like the dorsal cavity, the ventral body cavity is subdivided. The superior **thoracic cavity** is separated from the rest of the ventral cavity by the dome-shaped diaphragm. The heart and lungs, located in the thoracic cavity, are protected by the

bony rib cage. The cavity inferior to the diaphragm is often referred to as the **abdominopelvic cavity**. Although there is no further physical separation of the ventral cavity, some describe the abdominopelvic cavity as two areas: a superior **abdominal cavity**, the area that houses the stomach, intestines, liver, and other organs, and an inferior **pelvic cavity**, the region that is partially enclosed by the bony pelvis and contains the reproductive organs, bladder, and rectum. Notice in Figure 1.5a that the abdominal and pelvic cavities are not aligned with each other in a plane because the pelvic cavity is tipped forward.

#### Serous Membranes of the Ventral Body Cavity

The walls of the ventral body cavity and the outer surfaces of the organs it contains are covered with an exceedingly thin, double-layered membrane called the **serosa**, or **serous membrane**. The part of the membrane lining the cavity walls is referred to as the **parietal serosa**, and it is continuous with a

Figure 1.5 Dorsal and ventral body cavities and their subdivisions.

similar membrane, the **visceral serosa**, covering the external surface of the organs within the cavity. These membranes produce a thin lubricating fluid that allows the visceral organs

Parietal peritoneum

Visceral peritoneum

to slide over one another or to rub against the body wall with minimal friction. Serous membranes also compartmentalize the various organs to prevent infection in one organ from spreading to others.

The specific names of the serous membranes depend on the structures they surround. The serosa lining the abdominal cavity and covering its organs is the **peritoneum**, the serosa enclosing the lungs is the **pleura**, and the serosa around the heart is the **pericardium** (**Figure 1.6**).

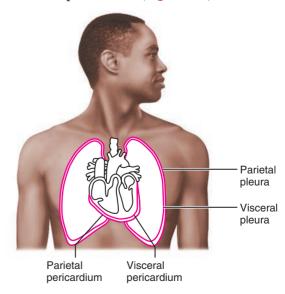


Figure 1.6 Serous membranes of the ventral body cavities.

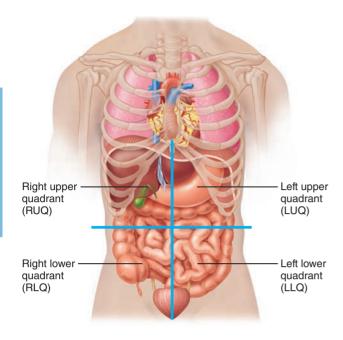


Figure 1.7 Abdominopelvic quadrants. Superficial organs all shown in each quadrant.

#### Abdominopelvic Quadrants and Regions

Because the abdominopelvic cavity is quite large and contains many organs, it is helpful to divide it up into smaller areas for discussion or study.

Most physicians and nurses use a scheme that divides the abdominal surface and the abdominopelvic cavity into four approximately equal regions called **quadrants**. These quadrants are named according to their relative position—that is, *right upper quadrant*, *right lower quadrant*, *left upper quadrant*, and *left lower quadrant* (**Figure 1.7**). Note that the terms *left* and *right* refer to the left and right side of

# **Activity 4**

the median plane?

# 

the body in the figure, not the left and right side of the art on the page.

A different scheme commonly used by anatomists divides the abdominal surface and abdominopelvic cavity into nine separate regions by four planes (**Figure 1.8**). As you read through the descriptions of these nine regions, locate them in Figure 1.8, and note the organs contained in each region.

**Umbilical region:** The centermost region, which includes the umbilicus (navel)

**Epigastric region:** Immediately superior to the umbilical region; overlies most of the stomach

**Hypogastric (pubic) region:** Immediately inferior to the umbilical region; encompasses the pubic area

**Iliac, or inguinal, regions:** Lateral to the hypogastric region and overlying the superior parts of the hip bones

**Lumbar regions:** Between the ribs and the flaring portions of the hip bones; lateral to the umbilical region

**Hypochondriac regions**: Flanking the epigastric region laterally and overlying the lower ribs

# Activity 5

#### **Locating Abdominal Surface Regions**

Locate the regions of the abdominal surface on a human torso model and on yourself.

# **Other Body Cavities**

Besides the large, closed body cavities, there are several types of smaller body cavities (**Figure 1.9**). Many of these are in the head, and most open to the body exterior.

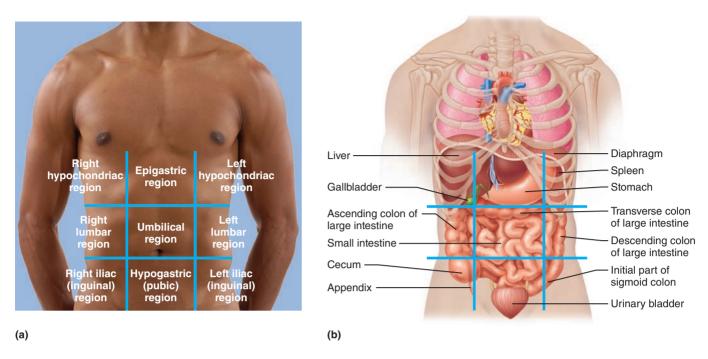
**Oral cavity:** The oral cavity, commonly called the *mouth*, contains the tongue and teeth. It is continuous with the rest of the digestive tube, which opens to the exterior at the anus.

**Nasal cavity:** Located within and posterior to the nose, the nasal cavity is part of the passages of the respiratory system.

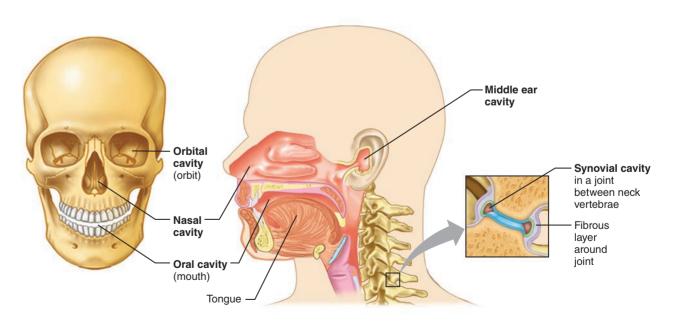
**Orbital cavities:** The orbital cavities (orbits) in the skull house the eyes and present them in an anterior position.

**Middle ear cavities:** Each middle ear cavity lies just medial to an eardrum and is carved into the bony skull. These cavities contain tiny bones that transmit sound vibrations to the hearing receptors in the inner ears.

**Synovial cavities:** Synovial cavities are joint cavities—they are enclosed within fibrous capsules that surround the freely movable joints of the body, such as those between the vertebrae and the knee and hip joints. Like the serous membranes of the ventral body cavity, membranes lining the synovial cavities secrete a lubricating fluid that reduces friction as the enclosed structures move across one another.



**Figure 1.8 Abdominopelvic regions.** Nine regions delineated by four planes. (a) The superior horizontal plane is just inferior to the ribs; the inferior horizontal plane is at the superior aspect of the hip bones. The vertical planes are just medial to the nipples. (b) Superficial organs are shown in each region.



**Figure 1.9 Other body cavities.** The oral, nasal, orbital, and middle ear cavities are located in the head and open to the body exterior. Synovial cavities are found in joints between many bones, such as the vertebrae of the spine, and at the knee, shoulder, and hip.



# Group Challenge

#### The Language of Anatomy

Working in groups of three, complete the tasks described below.

For questions 1-4, each student within a group will assume a different role: facilitator, subject, or recorder. (Remind the subject to stand in the anatomical position.) The facilitator will write each term on a separate Post-it® Note. For each term, discuss within your group where on the subject to place the Post-it®. Once your group members have come to consensus, the facilitator will stick the Post-it® on the subject on the appropriate body landmark. After all of the Post-it® Notes have been placed, the group will discuss the order in which the terms should be recorded. Then the recorder will write down the terms in the appropriate order.

- 1. Arrange the following terms from superior to inferior: cervical, coxal, crural, femoral, lumbar, mental, nasal, plantar, sternal, and tarsal.
- 2. Arrange the following terms from proximal to distal: antebrachial, antecubital, brachial, carpal, digital, and palmar.

- 3. Arrange the following terms from medial to lateral: acromial, axillary, buccal, otic, pollex, and umbilical.
- 4. Arrange the following terms from distal to proximal: calcaneal, femoral, hallux, plantar, popliteal, and sural.
- 5. Name a plane that you could use to section a fourlegged chair and still be able to sit in the chair without falling over. \_
- 6. Name the abdominopelvic region that is both medial and inferior to the right lumbar region.
- 7. Name the type of inflammation (think "-itis") that is typically accompanied by pain in the lower right quadrant.

# EXERCISE

# **REVIEW SHEET** The Language of Anatomy

Name	Lab Time/Date	

# **Surface Anatomy**

1.	Match each of the numbered descriptions with the related term in the key, and record the key letter or term in front
	of the description.

Key: a. buccal b. calcaneal c. cephalic e. patellar

d. digital

f. scapular

\_\_\_\_\_ 1. cheek

\_\_\_\_\_ 2. fingers

\_ 5. heel of foot

\_\_ 3. shoulder blade region

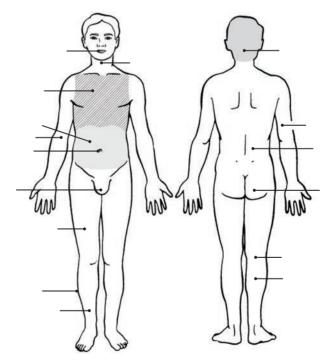
 $_{-}$  6. head

\_\_\_\_\_ 4. anterior aspect of knee

2. Indicate the following body areas on the accompanying diagram by placing the correct key letter at the end of each line.

#### Key:

- a. abdominal
- b. antecubital
- c. brachial
- d. cervical
- e. crural
- f. femoral
- g. fibular
- h. gluteal
- i. lumbar
- j. occipital
- k. oral
- popliteal ١.
- m. pubic
- n. sural
- o. thoracic
- p. umbilical



3.	For each term in the key of question 2 above, determine which of the two major body divisions it belongs to. Insert
	the appropriate key letters on the answer blanks.

1.	appendicular	2.	axia
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# Body Orientation, Direction, Planes, and Sections

4. Describe completely the standard human anatomical position.

E	Dof:no	section
<b>'</b>	IJETINE	SACTION

6.	Several incomplete statements appear below. Correctly complete each statement by choosing the appropriate ana-
	tomical term from the key. Record the key letters and/or terms on the correspondingly numbered blanks below. Some
	terms are used more than once

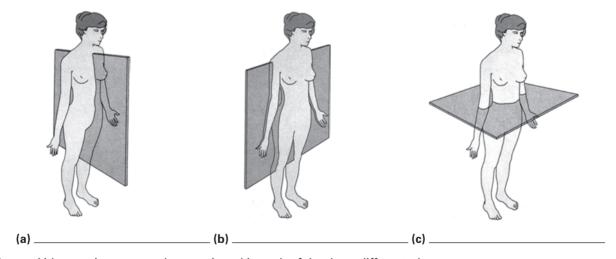
Key: a. anterior d. inferior g. posterior j. superior b. distal e. lateral h. proximal k. transverse c. frontal f. medial i. sagittal

In the anatomical position, the face and palms are on the <u>1</u> body surface; the buttocks and shoulder blades are on the <u>2</u> body surface; and the top of the head is the most <u>3</u> part of the body. The ears are <u>4</u> and <u>5</u> to the shoulders and <u>6</u> to the nose. The heart is <u>7</u> to the vertebral column (spine) and <u>8</u> to the lungs. The elbow is <u>9</u> to the fingers but <u>10</u> to the shoulder. The abdominopelvic cavity is <u>11</u> to the thoracic cavity and <u>12</u> to the spinal cavity. In humans, the dorsal surface can also be called the <u>13</u> surface; however, in quadruped animals, the dorsal surface is the <u>14</u> surface.

If an incision cuts the heart into right and left parts, the section is a <u>15</u> section; but if the heart is cut so that superior and inferior portions result, the section is a <u>16</u> section. You are told to cut a dissection animal along two planes so that both kidneys are observable in each section. The two sections that can meet this requirement are the <u>17</u> and <u>18</u> sections. A section that demonstrates the continuity between the spinal and cranial cavities is a <u>19</u> section.

1.	8	14
2	9	15
3	10	16
4	11	17
5	12	18
6	13	19
7		

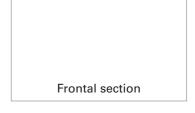
7. Correctly identify each of the body planes by inserting the appropriate term on the answer line below the drawing.



8. Draw a kidney as it appears when sectioned in each of the three different planes.







	ropriate term ne drawing.	for each letter ind	dicated					
a.			_				~~	
b.			_				3-6	
c.			_				3 6	
d.			_				2	
e.			_			100	/ * (	(a)
f.			_	(b) —				(c)
g.			_	(	\	1	-	(d)
h.			_	(e) ———	$\leftarrow$	<del></del>		(f)
i.			_			17/	-	(g)
				(h) ———		7		(i)
0. Whi							urgery c	or procedures? (Insert the letter c
Key	: a. abdom b. cranial	inopelvic	c. d d. s		e. f.	thoracic ventral		
	1.	surgery to remo	ve a ca	ncerous lun	g lobe		4.	appendectomy
	2.	removal of the u	terus, (	or womb			5.	stomach ulcer operation
	3.	removal of a bra	in tum	or			6.	delivery of pre-operative "saddle" anesthesia
	ne the muscle	e that subdivides	the ven	tral body ca	vity. —			

13. Which body cavity provides the least protection to its internal structures?

14. What is the function of the serous membranes of the body? —

#### 14 Review Sheet 1

15. Using the key choices, identify the small body cavities described below.

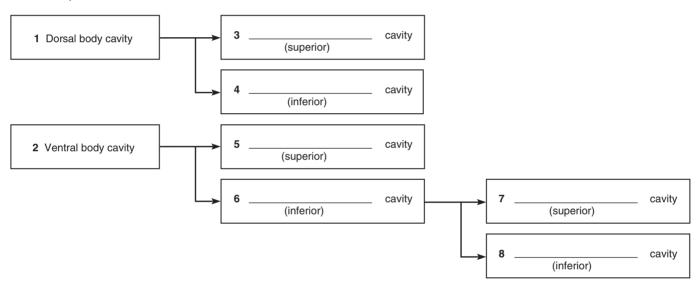
Key: a. middle ear cavity

- c. oral cavity
- e. synovial cavity

- b. nasal cavity
- d. orbital cavity
- \_\_ 1. holds the eyes in an anterior-facing position
- \_\_\_\_\_\_ 4. contains the tongue
- \_\_\_\_\_\_ 2. houses three tiny bones involved in hearing
- \_\_\_\_\_\_ 5. surrounds a joint

- \_\_\_\_\_\_ 3. contained within the nose
- 16. On the incomplete flowchart provided below:
  - Fill in the cavity names that belong in boxes 3–8.
  - Then, using either the name of the cavity or the box numbers, identify the descriptions in the list that follows.

Body cavities



а	١.	contained	within	the skull	and	vertebral	CO	lumr

\_\_\_\_\_\_ b. houses female reproductive organs

\_\_\_\_\_ c. the most protective body cavity

\_\_\_\_\_\_ d. its name means "belly"

\_\_\_\_\_ e. contains the heart

\_\_\_\_\_ f. contains the small intestine

\_\_\_\_\_ g. bounded by the ribs

\_\_\_\_\_ h. its walls are muscular

# EXERCISE

# **Organ Systems** Overview

# **Objectives**

- ☐ Name the human organ systems, and indicate the major functions of each.
- List several major organs of each system, and identify them in a dissected rat, human cadaver or cadaver image, or a dissectible human torso model.
- ☐ Name the correct organ system for each organ when presented with a list of organs studied in the laboratory.

# Materials

- Freshly killed or preserved rat (predissected by instructor as a demonstration or for student dissection [one rat for every two to four students]) or predissected human cadaver
- Dissection trays
- Twine or large dissecting pins
- Scissors
- Probes
- Forceps
- Disposable gloves
- Human torso model (dissectible)

# Pre-Lab Quiz

- 1. Name the structural and functional unit of all living things.
- 2. The small intestine is an example of a(n) \_\_\_\_\_, because it is composed of two or more tissue types that perform a particular function for the body.
  - a. epithelial tissue
- b. muscular tissue

c. organ

- d. organ system
- 3. The \_ system is responsible for maintaining homeostasis of the body via rapid transmission of electrical signals.
- **4.** The kidneys are part of the system.
- 5. The thin muscle that separates the thoracic and abdominal cavities is the

he basic unit or building block of all living things is the **cell.** Cells fall into four different categories according to their structures and functions. These categories correspond to the four tissue types: epithelial, muscular, nervous, and connective. A tissue is a group of cells that are similar in structure and function. An **organ** is a structure composed of two or more tissue types that performs a specific function for the body. For example, the small intestine, which digests and absorbs nutrients, is made up of all four tissue types.

An **organ system** is a group of organs that act together to perform a particular body function. For example, the organs of the digestive system work together to break down foods and absorb the end products into the bloodstream in order to provide nutrients and fuel for all the body's cells. In all, there are 11 organ systems, described in **Table 2.1** on p. 16. The lymphatic system also encompasses a functional system called the immune system, which is composed of an army of mobile cells that protect the body from foreign substances.

Read through this summary of the body's organ systems (Table 2.1) before beginning your rat dissection or examination of the predissected human cadaver. If a human cadaver is not available, Figures 2.3-2.6 will serve as a partial replacement.

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Table 2.1	Overview of Organ Systems o	f the Body
Organ system	Major component organs	Function
Integumentary (Skin)	Epidermal and dermal regions; cutaneous sense organs and glands	<ul> <li>Protects deeper organs from mechanical, chemical, and bacterial injury, and from drying out</li> <li>Excretes salts and urea</li> <li>Aids in regulation of body temperature</li> <li>Produces vitamin D</li> </ul>
Skeletal	Bones, cartilages, tendons, ligaments, and joints	<ul> <li>Body support and protection of internal organs</li> <li>Provides levers for muscular action</li> <li>Cavities provide a site for blood cell formation</li> </ul>
Muscular	Muscles attached to the skeleton	<ul> <li>Primary function is to contract or shorten; in doing so, skeletal muscles allow locomotion (running, walking, etc.), grasping and manipulation of the environment, and facial expression</li> <li>Generates heat</li> </ul>
Nervous	Brain, spinal cord, nerves, and sensory receptors	<ul> <li>Allows body to detect changes in its internal and external environment and to respond to such information by activating appropriate muscles or glands</li> <li>Helps maintain homeostasis of the body via rapid transmission of electrical signals</li> </ul>
Endocrine	Pituitary, thymus, thyroid, parathyroid, adrenal, and pineal glands; ovaries, testes, and pancreas	<ul> <li>Helps maintain body homeostasis, promotes growth and development; produces chemical messengers called hormones that travel in the blood to exert their effect(s) on various target organs of the body</li> </ul>
Cardiovascular	Heart, blood vessels, and blood	<ul> <li>Primarily a transport system that carries blood containing oxygen, carbon dioxide, nutrients, wastes, ions, hormones, and other substances to and from the tissue cells where exchanges are made; blood is propelled through the blood vessels by the pumping action of the heart</li> <li>Antibodies and other protein molecules in the blood protect the body</li> </ul>
Lymphatic/ Immunity	Lymphatic vessels, lymph nodes, spleen, thymus, tonsils, and scattered collections of lymphoid tissue	<ul> <li>Picks up fluid leaked from the blood vessels and returns it to the blood</li> <li>Cleanses blood of pathogens and other debris</li> <li>Houses lymphocytes that act via the immune response to protect the body from foreign substances</li> </ul>
Respiratory	Nasal passages, pharynx, larynx, trachea, bronchi, and lungs	<ul> <li>Keeps the blood continuously supplied with oxygen while removing carbon dioxide</li> <li>Contributes to the acid-base balance of the blood via its carbonic acid-bicarbonate buffer system</li> </ul>
Digestive	Oral cavity, esophagus, stomach, small and large intestines, and accessory structures including teeth, salivary glands, liver, and pancreas	<ul> <li>Breaks down ingested foods to smaller particles, which can be absorbed into the blood for delivery to the body cells</li> <li>Undigested residue removed from the body as feces</li> </ul>
Urinary	Kidneys, ureters, bladder, and urethra	<ul> <li>Rids the body of nitrogen-containing wastes including urea, uric acid, and ammonia, which result from the breakdown of proteins and nucleic acids</li> <li>Maintains water, electrolyte, and acid-base balance of blood</li> </ul>
Reproductive	Male: testes, prostate gland, scrotum, penis, and duct system, which carries sperm to the body exterior	Provides germ cells called sperm for perpetuation of the species
	Female: ovaries, uterine tubes, uterus, mammary glands, and vagina	• Provides germ cells called eggs; the female uterus houses the developing fetus until birth; mammary glands provide nutrition for the infant



## DISSECTION AND IDENTIFICATION

# The Organ Systems of the Rat

Many of the external and internal structures of the rat are quite similar in structure and function to those of the human. So, a study of the gross anatomy of the rat should help you understand our own physical structure. The following instructions include directions for dissecting and observing a rat. In addition, the descriptions of the organs (Activity 4, Examining the Ventral Body Cavity, which begins on p. 18) also apply to superficial observations of

a previously dissected human cadaver. The general instructions for observing external structures also apply to human cadaver observations. The photographs in Figures 2.3 to 2.6 will provide visual aids.

Note that four organ systems (integumentary, skeletal, muscular, and nervous) will not be studied at this time, because they require microscopic study or more detailed dissection.

# Activity 1

### **Observing External Structures**

1. If your instructor has provided a predissected rat, go to the demonstration area to make your observations. Alternatively, if you and/or members of your group will be dissecting the specimen, obtain a preserved or freshly killed rat, a dissecting tray, dissecting pins or twine, scissors, probe, forceps, and disposable gloves, and bring them to your laboratory bench.

If a predissected human cadaver is available, obtain a probe, forceps, and disposable gloves before going to the demonstration area.

2. Don the gloves before beginning your observations. This precaution is particularly important when handling freshly killed animals, which may harbor pathogens.

3. Observe the major divisions of the body—head, trunk, and extremities. If you are examining a rat, compare these divisions to those of humans.

# Activity 2

### **Examining the Oral Cavity**

Examine the structures of the oral cavity, Identify the teeth and tongue. Observe the extent of the hard palate (the portion underlain by bone) and the soft palate (immediately posterior to the hard palate, with no bony support). Notice that the posterior end of the oral cavity leads into the throat, or pharynx, a passageway used by both the digestive and respiratory systems.

# Activity 3

#### **Opening the Ventral Body Cavity**

1. Pin the animal to the wax of the dissecting tray by placing its dorsal side down and securing its extremities to the wax with large dissecting pins as shown in Figure 2.1a.

Text continues on next page. →

Figure 2.1 Rat dissection: Securing for dissection and the initial incision. (a) Securing the rat to the dissection tray with dissecting pins. (b) Using scissors to make the incision on the median line of the abdominal region. (c) Completed incision from the pelvic region to the lower jaw. (d) Reflection (folding back) of the skin to expose the underlying muscles.









(b)



(d)

(c)

(a)

If the dissecting tray is not waxed, you will need to secure the animal with twine as follows. (Your instructor may prefer this method in any case.) Obtain the roll of twine. Make a loop knot around one upper limb, pass the twine under the tray, and secure the opposing limb. Repeat for the lower extremities.

- 2. Lift the abdominal skin with a forceps, and cut through it with the scissors (Figure 2.1b). Close the scissor blades, and insert them flat under the cut skin. Moving in a cephalad direction, open and close the blades to loosen the skin from the underlying connective tissue and muscle. Now, cut the skin along the body midline, from the pubic region to the lower jaw (Figure 2.1c). Finally, make a lateral cut about halfway down the ventral surface of each limb. Complete the job of freeing the skin with the scissor tips, and pin the flaps to the tray (Figure 2.1d). The underlying tissue that is now exposed is the skeletal musculature of the body wall and limbs. Notice that the muscles are packaged in sheets of pearly white connective tissue (fascia), which protect the muscles and bind them together.
- 3. Carefully cut through the muscles of the abdominal wall in the pubic region, avoiding the underlying organs. Remember, to dissect means "to separate"—not mutilate! Now, hold and lift the muscle layer with a forceps and cut through the muscle layer from the pubic region to the bottom of the rib cage. Make two lateral cuts at the base of the rib cage (Figure 2.2). A thin membrane attached to the inferior boundary of the rib cage should be obvious; this is the diaphragm, which separates the thoracic and abdominal cavities. Cut the diaphragm where it attaches to the ventral ribs to loosen the rib cage. Cut through the rib cage on either side. You can now lift the ribs to view the



Figure 2.2 Rat dissection. Making lateral cuts at the base of the rib cage.

contents of the thoracic cavity. Cut across the flap, at the level of the neck, and remove the rib cage.

# Activity 4

# **Examining the Ventral Body Cavity**

1. Starting with the most superficial structures and working deeper, examine the structures of the thoracic cavity. Refer to **Figure 2.3**, which shows the superficial organs, as you work. Choose the appropriate view depending on whether you are examining a rat (a) or a human cadaver (b).

**Thymus:** An irregular mass of glandular tissue overlying the heart (not illustrated in the human cadaver photograph).

With the probe, push the thymus to the side to view the heart.

**Heart:** Medial oval structure enclosed within the pericardium (serous membrane sac).

Lungs: Lateral to the heart on either side.

Now observe the throat region to identify the trachea.

**Trachea:** Tubelike "windpipe" running medially down the throat; part of the respiratory system.

Follow the trachea into the thoracic cavity; notice where it divides into two branches. These are the bronchi.

**Bronchi:** Two passageways that plunge laterally into the tissue of the two lungs.

To expose the esophagus, push the trachea to one side.

**Esophagus:** A food chute; the part of the digestive system that transports food from the pharynx (throat) to the stomach.

**Diaphragm:** A thin muscle attached to the inferior boundary of the rib cage; separates the thoracic and abdominopelvic cavities.

Follow the esophagus through the diaphragm to its junction with the stomach.

**Stomach:** A curved organ important in food digestion and temporary food storage.

2. Examine the superficial structures of the abdominopelvic cavity. Lift the **greater omentum**, an extension of the peritoneum (serous membrane) that covers the abdominal viscera. Continuing from the stomach, trace the rest of the digestive tract (**Figure 2.4**, p. 20).

**Small intestine:** Connected to the stomach and ending just before the saclike cecum.

Large intestine: A large muscular tube connected to the small intestine and ending at the anus.



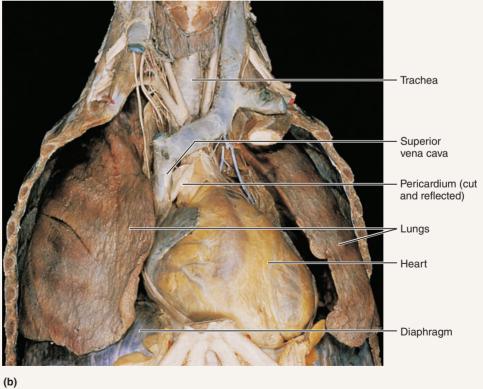


Figure 2.3 Superficial organs of the thoracic cavity. (a) Dissected rat. (b) Human cadaver.

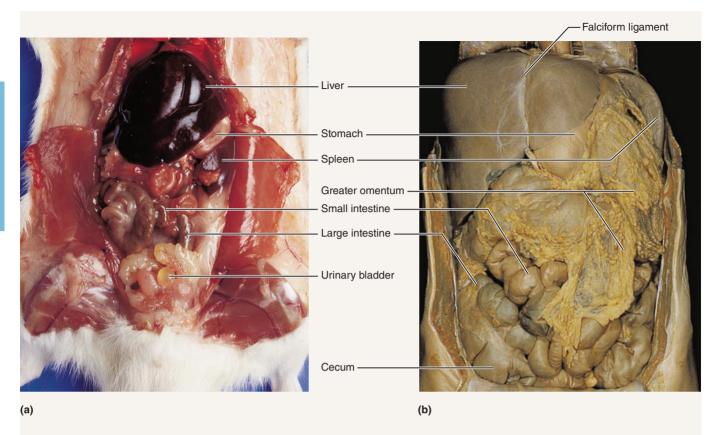


Figure 2.4 Abdominal organs. (a) Dissected rat, superficial view. (b) Human cadaver, superficial view.

**Cecum**: The initial portion of the large intestine.

Follow the course of the large intestine to the rectum, which is partially covered by the urinary bladder (**Figure 2.5**).

**Rectum:** Terminal part of the large intestine; continuous with the anal canal.

**Anus:** The opening of the digestive tract (through the anal canal) to the exterior.

Now lift the small intestine with the forceps to view the mesentery.

**Mesentery:** An apronlike serous membrane; suspends many of the digestive organs in the abdominal cavity. Notice that it is heavily invested with blood vessels and, more likely than not, riddled with large fat deposits.

Locate the remaining abdominal structures.

Pancreas: A diffuse gland; rests dorsal to and in the mesentery between the first portion of the small intestine and the stomach. You will need to lift the stomach to view the pancreas.

**Spleen:** A dark red organ curving around the left lateral side of the stomach; considered part of the lymphatic system and often called the red blood cell graveyard.

**Liver:** Large and brownish red; the most superior organ in the abdominal cavity, directly beneath the diaphragm.

3. To locate the deeper structures of the abdominopelvic cavity, move the stomach and the intestines to one side with the probe.

Examine the posterior wall of the abdominal cavity to locate the two kidneys (Figure 2.5).

**Kidneys:** Bean-shaped organs; retroperitoneal (behind the peritoneum).

**Adrenal glands**: Large endocrine glands that sit on top of each kidney; considered part of the endocrine system.

Carefully strip away part of the peritoneum with forceps and attempt to follow the course of one of the ureters to the bladder.

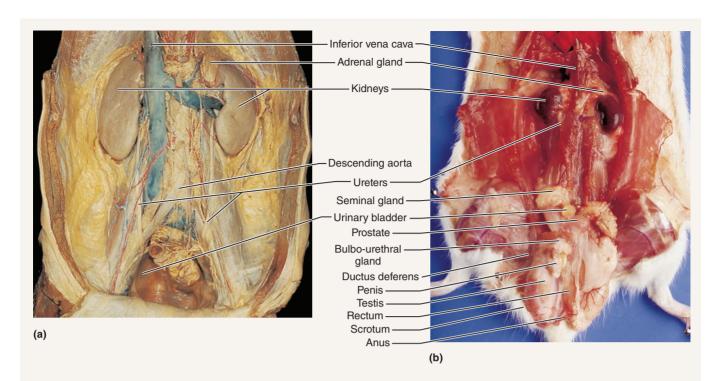
**Ureter**: Tube running from the indented region of a kidney to the urinary bladder.

**Urinary bladder:** The sac that serves as a reservoir for urine.

**4**. In the midline of the body cavity lying between the kidneys are the two principal abdominal blood vessels. Identify each.

**Inferior vena cava**: The large vein that returns blood to the heart from the lower body regions.

**Descending aorta:** Deep to the inferior vena cava; the largest artery of the body; carries blood away from the heart down the midline of the body.



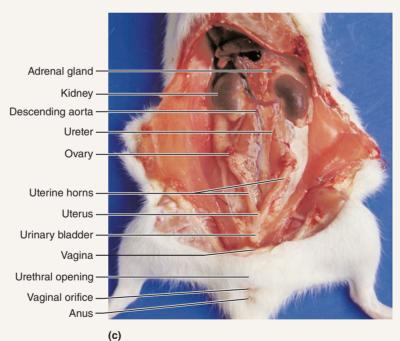


Figure 2.5 Deep structures of the abdominopelvic cavity. (a) Human cadaver. (b) Dissected male rat. (Some reproductive structures also shown.) (c) Dissected female rat. (Some reproductive structures also shown.)

5. You will perform only a brief examination of reproductive organs. If you are working with a rat, first determine if the animal is a male or female. Observe the ventral body surface beneath the tail. If a saclike scrotum and an opening for the anus are visible, the animal is a male. If three body openings—urethral, vaginal, and anal—are present, it is a female.

#### Male Rat

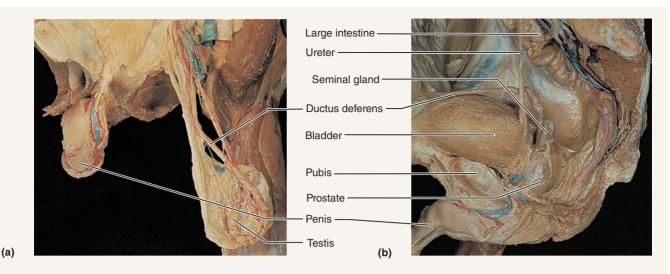
Make a shallow incision into the **scrotum**. Loosen and lift out one oval **testis**. Exert a gentle pull on the testis to identify the slender **ductus deferens**, or **vas deferens**,

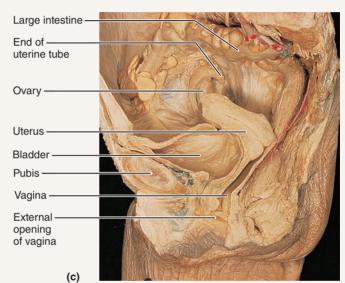
which carries sperm from the testis superiorly into the abdominal cavity and joins with the urethra. The urethra runs through the penis and carries both urine and sperm out of the body. Identify the **penis**, extending from the bladder to the ventral body wall. Figure 2.5b indicates other glands of the male rat's reproductive system, but they need not be identified at this time.

#### Female Rat

Inspect the pelvic cavity to identify the Y-shaped uterus lying against the dorsal body wall and superior to the

Text continues on next page. →





**Figure 2.6 Human reproductive organs. (a)** Male external genitalia. **(b)** Sagittal section of the male pelvis. **(c)** Sagittal section of the female pelvis.

bladder (Figure 2.5c). Follow one of the uterine horns superiorly to identify an **ovary**, a small oval structure at the end of the uterine horn. (The rat uterus is quite different from the uterus of a human female, which is a single-chambered organ about the size and shape of a pear.) The inferior undivided part of the rat uterus is continuous with the **vagina**, which leads to the body exterior. Identify the **vaginal orifice** (external vaginal opening).

If you are working with a human cadaver, proceed as indicated next.

#### Male Cadaver

Make a shallow incision into the scrotum (Figure 2.6a). Loosen and lift out the oval testis. Exert a gentle pull on the testis to identify the slender ductus (vas) deferens, which carries sperm from the testis superiorly into the abdominopelvic cavity and joins with the urethra (Figure 2.6b). The urethra runs through the penis and carries both urine and

sperm out of the body. Identify the **penis**, extending from the bladder to the ventral body wall.

#### Female Cadaver

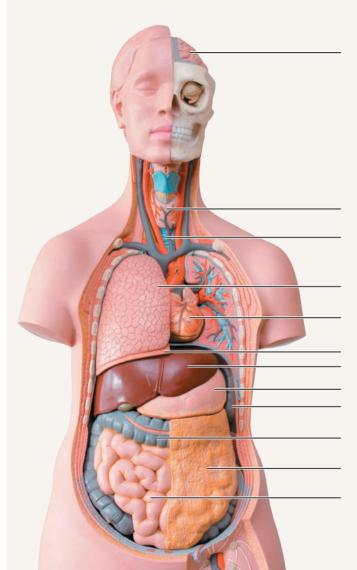
Inspect the pelvic cavity to identify the pear-shaped **uterus** lying against the dorsal body wall and superior to the bladder. Follow one of the **uterine tubes** superiorly to identify an **ovary**, a small oval structure at the end of the uterine tube (Figure 2.6c). The inferior part of the uterus is continuous with the **vagina**, which leads to the body exterior. Identify the **vaginal orifice** (external vaginal opening).

6. When you have finished your observations, rewrap or store the dissection animal or cadaver according to your instructor's directions. Wash the dissecting tools and equipment with laboratory detergent. Dispose of the gloves as instructed. Then wash and dry your hands before continuing with the examination of the human torso model.

# Activity 5

### **Examining the Human Torso Model**

- 1. Examine a human torso model to identify the organs listed. Some model organs will have to be removed to see the deeper organs. If a torso model is not available, the photograph of the human torso model (**Figure 2.7**) may be used for this part of the exercise.
- **2**. Using the terms at the right of Figure 2.7, label each organ on the supplied leader line.



Adrenal gland Lungs Aortic arch Mesentery Brain **Pancreas** Bronchi Rectum Descending aorta Small intestine Diaphragm Spinal cord Esophagus Spleen Greater omentum Stomach Heart Thyroid gland Trachea Inferior vena cava Ureters Kidneys

Large intestine

Liver

Figure 2.7 Human torso model.

Urinary bladder

<b>4.</b> Now, assign each of the organs to one of the organ systems listed below.	Endocrine:
Digestive:	Reproductive:
Digostivo.	Respiratory:
	Lymphatic/Immunity:
Urinary:  Cardiovascular:	Nervous:

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# **Group Challenge**

# **Odd Organ Out**

Each of the following sets contains four organs. One of the listed organs in each case does not share a characteristic that the other three do. Work in groups of three, and discuss the characteristics of the four organs in each set. On a separate piece of paper, one student will record the characteristics of each organ in the set. For each set of four organs, discuss the possible candidates for the "odd organ" and which characteristic it lacks,

based on your recorded notes. Once you have come to a consensus among your group, circle the organ that doesn't belong with the others, and explain why it is singled out. Include as many reasons as you can think of, but make sure the "odd organ" does not have the key characteristic. Use the overview of organ systems (Table 2.1) and the pictures in your lab manual to help you select and justify your answer.

1. Which is the "odd organ"?	Why is it the odd one out?
Stomach Teeth Small intestine Oral cavity	
2. Which is the "odd organ"?	Why is it the odd one out?
Thyroid gland Thymus Spleen Lymph nodes	
3. Which is the "odd organ"?	Why is it the odd one out?
Ovaries Prostate gland Uterus Uterine tubes	
4. Which is the "odd organ"?	Why is it the odd one out?
Stomach Small intestine Esophagus Large intestine	

# EXERCISE 2

# REVIEW SHEET Organ Systems Overview

laı	me	LabTime/Date
1.		e the body systems that perform the following functions for the body; note that some n once.Then, circle the organ systems (in the key) that are present in all subdivisions of
	Key: a. cardiovascular b. digestive c. endocrine	d. integumentary g. nervous j. skeletal e. lymphatic/immunity h. reproductive k. urinary f. muscular i. respiratory
		1. rids the body of nitrogen-containing wastes
		2. is affected by removal of the thyroid gland
		3. provides support and the levers on which the muscular system acts
		4. includes the heart
		5. has a menstrual cycle in females
		6. protects underlying organs from drying out and from mechanical damage
		7. protects the body; destroys bacteria and tumor cells
		8. breaks down ingested food into its building blocks
		9. removes carbon dioxide from the blood
		10. delivers oxygen and nutrients to the tissues
		11. moves the limbs; facilitates facial expression
		12. conserves body water or eliminates excesses
		and 13. facilitate conception and childbearing
		14. controls the body by means of chemical molecules called hormones
		15. is damaged when you cut your finger or get a severe sunburn
2.	Using the above key, choos belongs.	e the organ system to which each of the following sets of organs or body structures
	1. thymus	spleen, lymphatic vessels 5. epidermis, dermis, and cutaneous sense organs
	2. bones,	cartilages, tendons 6. testis, ductus deferens, urethra
	3. pancre	s, pituitary, adrenals 7. esophagus, large intestine, rectum
	4. trachea	bronchi, lungs  8. muscles of the thigh, postural muscles

1	Key: a.	abdomir	nopelvic	D.	cranial	C	. spina	ıl	d.	thorac	cic		
-			1. stomac	ch _		4.	liver		_			. 7.	heart
-			2. esoph	agus _		5.	spinal o	cord	_			8.	trache
-			3. large i	ntestine _		6.	urinary	bladder	_			9.	rectui
	Using the	_	sted in que	estion 3 above	, record, by n	umber, \	which wo	ould be fo	ound in	the abd	ominop	elvic	regions
-			1. hypoga	astric region				4.	epigas	tric reg	ion		
_			2. right lu	ımbar region				5.	left ilia	ıc regio	n		
-			3. umbilio	cal region				6.	left hy	pochon	driac re	gion	
-	The level	s of orgar	ization of a	ı living body i	nclude								,
_				·		, and	organisı	m.					
[	Define <i>or</i>	rgan											
·	Using the	e terms pr	ovided, cor	rectly identify	all of the boo	dy organ	s provide	ed with le					shown
Į k	Using the	e terms pr nen name ood vessel	ovided, cor the organ s		all of the boo	dy organ me of ea	s provide ch on the	ed with le	blank b	elow ea ure		ing.	
Į k	Using the below.Th	e terms pr nen name ood vessel	ovided, cor the organ s	rectly identify systems by en	all of the boo tering the nar nerves	dy organ me of ea	s provide ch on the	ed with le e answer spinal co	blank b	elow ea ure	ach draw ethra	ing.	