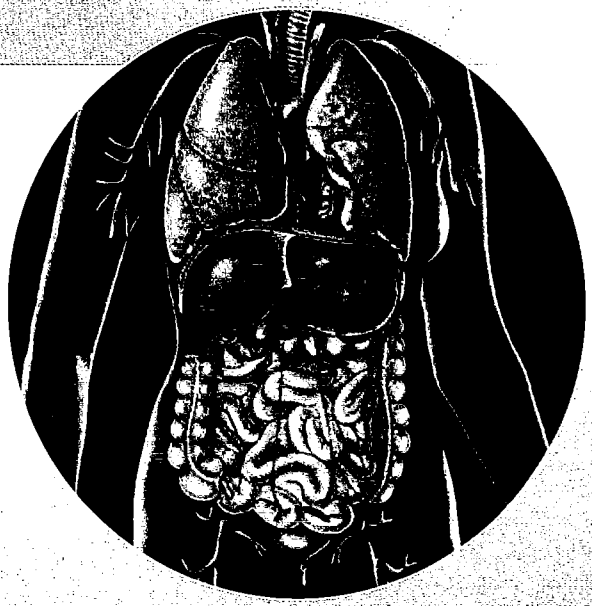
# 1

# An Introduction to the Structure and Function of the Body



## Outline



## Objectives

**AFTER YOU HAVE COMPLETED THIS CHAPTER, YOU SHOULD BE ABLE TO:**

1. Define the terms *anatomy* and *physiology.*
2. List and discuss in order of increasing complexity the levels of organization of the body.
3. Define the term *anatomical position.*
4. List and define the principal directional terms and sections (planes) used in describing the body and the relationship of body parts to one another.
5. List the nine abdominopelvic regions and the abdominopelvic quadrants.
6. List the major cavities of the body and the subdivisions of each.
7. Discuss and contrast the axial and the appendicular subdivisions of the body. Identify a number of specific anatomical regions in each area.
8. Explain the meaning of the term *homeostasis* and give an example of a typical homeostatic mechanism.

*There are many* wonders in our world, but none is more wondrous than the human body. This is a textbook about that incomparable structure. It deals with two very distinct and yet interrelated sciences: **anatomy** and **physiology.** As a science, anatomy is often defined as the study of the structure of an organism and the relationships of its parts. The word *anatomy* is derived from two Greek words that mean "a cutting up." Anatomists learn about the structure of the human body by cutting it apart. This process, called **dissection,** is still the principal technique used to isolate and study the structural components or parts of the human body. Physiology is the study of the functions of living organisms and their parts. It is a dynamic science that requires active experimentation. In the chapters that follow, you will see again and again that anatomical structures seem designed to perform specific functions. Each has a particular size, shape, form, or position in the body related directly to its ability to perform a unique and specialized activity.

## Structural Levels of Organization

Before you begin the study of the structure and function of the human body and its many parts, it is important to think about how those parts are organized and how they might logically fit together into a functioning whole. Examine Figure 1-1. It illustrates the differing levels of organization that influence body structure and function. Note that the levels of organization progress from the least complex (chemical level) to the most complex (body as a whole).

Organization is one of the most important characteristics of body structure. Even the word *organism,* used to denote a living thing, implies organization.

Although the body is a single structure, it is made up of trillions of smaller structures. Atoms and molecules are often referred to as the **chemical level** of organization (see Appendix A). The existence of life depends on the proper levels and proportions of many chemical substances in the cells of the body. Many of the physical and chemical phenomena that play important roles in the life process will be reviewed in the next chapter. Such information provides an understanding of the physical basis for life and for the study of the next levels of organization so important in the study of anatomy and physiology—cells, tissues, organs, and systems.

**Cells** are considered to be the smallest "living" units of structure and function in our body. Although long recognized as the simplest units of living matter, cells are far from simple. They are extremely complex, a fact you will discover in Chapter 2.

**Tissues** are somewhat more complex than cells. By definition a tissue is an organization of many similar cells that act together to perform a common function. Cells are held together and surrounded by varying amounts and varieties of gluelike, nonliving intercellular substances.

**Organs** are more complex than tissues. An organ is a group of several different kinds of tissues arranged so that they can together act as a unit to perform a special function. For instance, the lungs shown in Figure 1-1 are an example of organization at the organ level.

**Systems** are the most complex units that make up the body. A system is an organization of varying numbers and kinds of organs arranged so that they can together perform complex functions for the body. The organs of the respiratory system shown in Figure 1-1 permit air to enter the body and travel to the lungs, where the eventual exchange of oxygen and carbon dioxide occurs. Organs of the respiratory system include the nose, the windpipe or trachea, and the complex series of bronchial tubes that permit passage of air into the lungs.

The **body as a whole** is all the atoms, molecules, cells, tissues, organs, and systems that you will study in subsequent chapters of this text. Although capable of being dissected or broken down into many parts, the body is a unified and complex assembly of structurally and functionally interactive components, each working together to ensure healthy survival.

## Anatomical Position

Discussions about the body, the way it moves, its posture, or the relationship of one area to another assume that the body as a whole is in a specific position called the **anatomical position.** In this reference position (Figure 1-2) the body is in an erect or standing posture with the arms at the sides and palms turned forward. The head and feet also point forward. The anatomical position is a reference position that gives meaning to the directional terms used to describe the body parts and regions.

**Supine** and **prone** are terms used to describe the position of the body when it is not in the anatomical position. In the supine position the body is lying face upward, and in the prone position the body is lying face downward.

## Anatomical Directions

When studying the body, it is often helpful to know where an organ is in relation to other struc-

**FIGURE 1-1**

**Structural levels of organization in the body.**

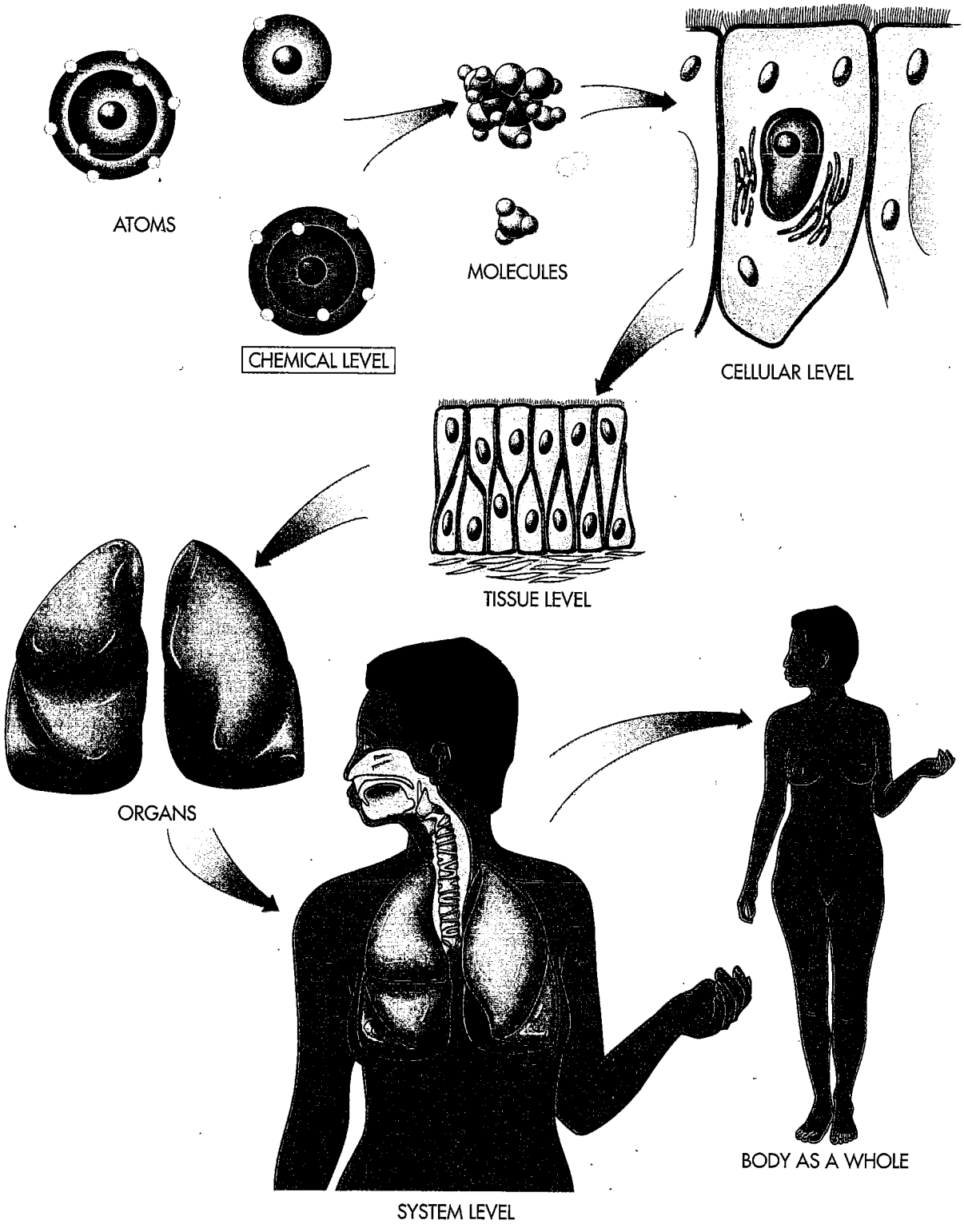
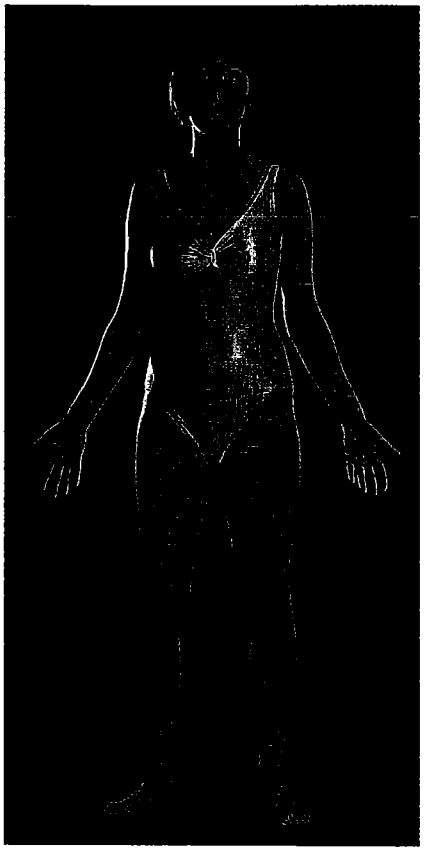


**FIGURE 1-2**

**Anatomical position.** The body is in an erect or standing posture with the arms at the sides and the palms forward. The head and feet also point forward. The anatomical compass rosette is explained at the bottom of the second column on this page.




tures. The following directional terms are used in describing relative positions of body parts:

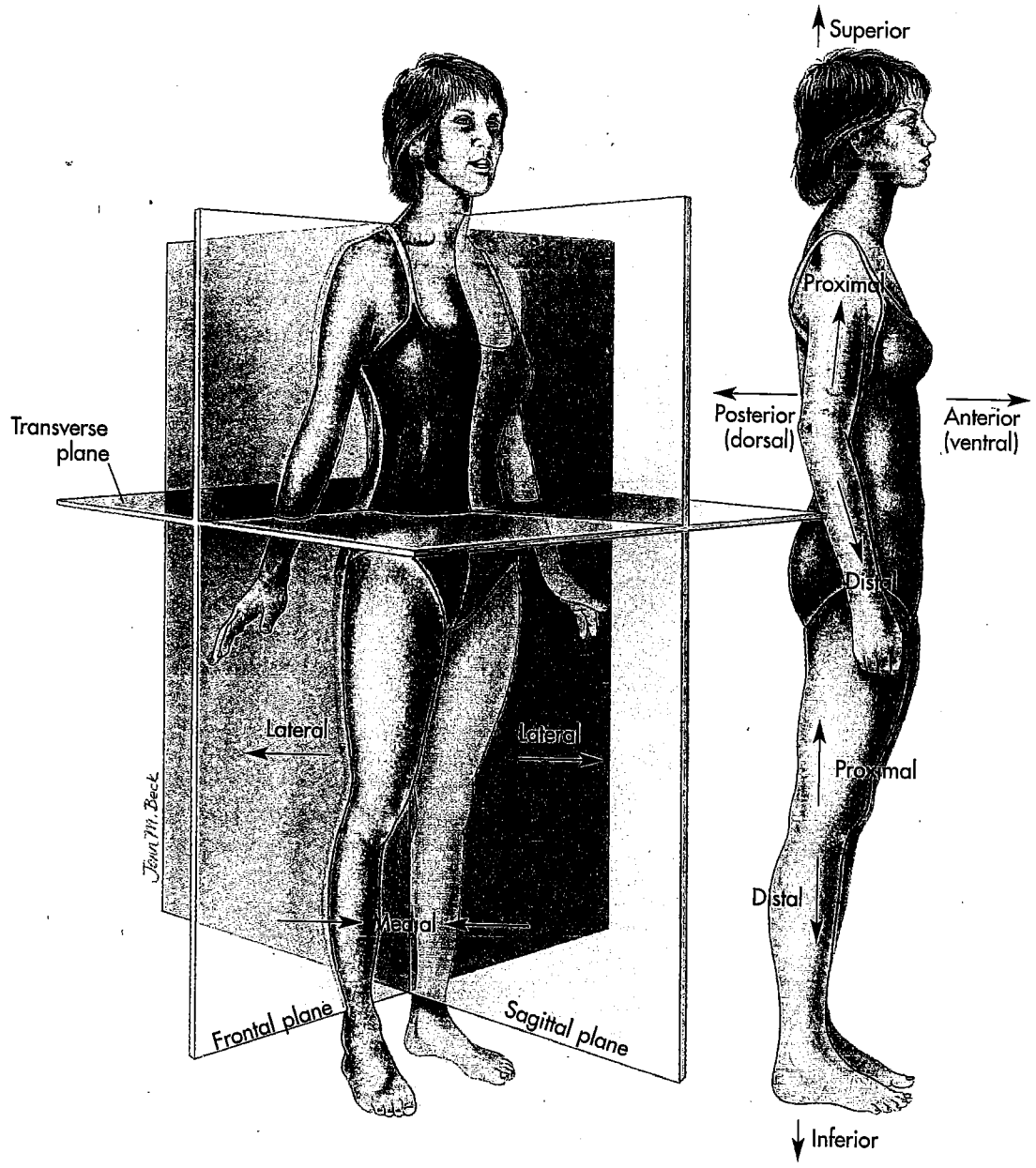
1. **Superior** and **inferior** (Figure 1-3)—*superior* means "toward the head," and *inferior* means "toward the feet." *Superior* also means "upper" or "above," and *inferior* means "lower" or "below." For example, the lungs are located superior to the diaphragm, whereas the stomach is located inferior to it (check Figure 1-7 if you are not sure where these organs are).
2. **Anterior** and **posterior** (Figure 1-3)—*anterior* means "front" or "in front of"; *posterior* means "back" or "in back of." In humans, who walk in an upright position, *ventral* (toward the belly) can be used in place of anterior, and *dorsal* (toward the back) can be used for posterior. For example, the nose is on the anterior surface of the body, and the shoulder blades are on its posterior surface.
3. **Medial** and **lateral** (Figure 1-3)—*medial* means "toward the midline of the body"; *lateral* means "toward the side of the body or away from its midline." For example, the great toe is at the medial side of the foot, and the little toe is at its lateral side. The heart lies medial to the lungs, and the lungs lie lateral to the heart.
4. **Proximal** and **distal** (Figure 1-3)—*proximal* means "toward or nearest the trunk of the body, or nearest the point of origin of one of its parts"; *distal* means "away from or farthest from the trunk or the point of origin of a body part." For example, the elbow lies at the proximal end of the lower arm, whereas the hand lies at its distal end.
5. **Superficial** and **deep**—*superficial* means nearer the surface; *deep* means farther away from the body surface. For example, the skin of the arm is superficial to the muscles below it, and the bone of the upper arm is deep to the muscles that surround and cover it.

To make the reading of anatomical figures a little easier for you, we have used an anatomical compass rosette throughout this book. On many figures, you will see a small compass rosette like you might see on a geographical map. Instead of being labeled **N, S, E,** or **W,** the anatomical rosette is labeled with abbreviated anatomical directions. For example, in Figure 1-2, the rosette is labeled **S** (for superior) on top and **I** (for inferior) on the bottom. Notice that in Figure 1-2 the rosette shows **R** (right) on the subject's right—not your right. Here are the directional abbreviations used with the rosettes in this book:

A = Anterior
D = Distal
I = Inferior
L (opposite M) = Lateral
L (opposite R) = Left
M = Medial
P (opposite A) = Posterior
P (opposite D) = Proximal
R = Right
S = Superior

**FIGURE 1-3**

**Directions and planes of the body.**



## Planes or Body Sections

To facilitate the study of individual organs or the body as a whole, it is often useful to subdivide or "cut" it into smaller segments. To do this, body planes or sections have been identified by special names. Read the following definitions and identify each term in Figure 1-3.

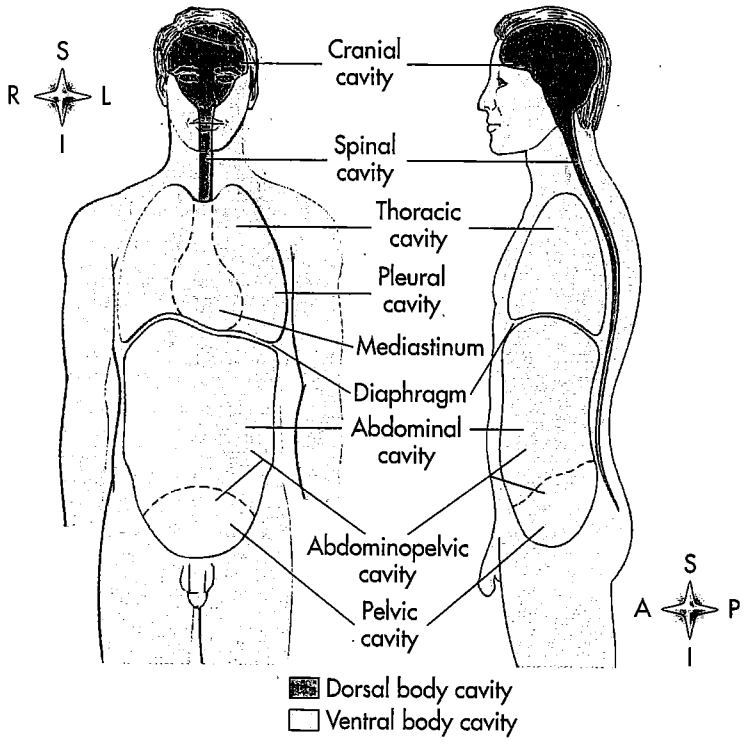
1. **Sagittal**—a sagittal cut or section is a lengthwise plane running from front to back. It divides the body or any of its parts into right and left sides. The sagittal plane shown in Figure 1-3 divides the body into two *equal halves.* This unique type of sagittal plane is called a **midsagittal plane.**
2. **Frontal**—a frontal *(coronal)* plane is a lengthwise plane running from side to side. As you can see in Figure 1-3, a frontal plane divides the body or any of its parts into anterior and posterior (front and back) portions.
3. **Transverse**—a transverse plane is a horizontal or crosswise plane. Such a plane (Figure 1-3) divides the body or any of its parts into upper and lower portions.

## Body Cavities

Contrary to its external appearance, the body is not a solid structure. It is made up of open spaces or cavities that in turn contain compact, well-ordered arrangements of internal organs. The two major body cavities are called the **ventral** and **dorsal body cavities.** The location and outlines of

**FIGURE 1-4**

**Body cavities.** Location and subdivisions of the dorsal and ventral body cavities as viewed from the front (anterior) and from the side (lateral).



the body cavities are illustrated in Figure 1-4. The ventral cavity includes the **thoracic cavity,** a space that you may think of as your chest cavity. Its midportion is a subdivision of the thoracic cavity, called the **mediastinum;** its other subdivisions are called the right and left **pleural cavities.** The ventral cavity in Figure 1-4 is broken down into an **abdominal cavity** and a **pelvic cavity.** Actually, they form only one cavity, the **abdominopelvic cavity,** because no physical partition separates them. In Figure 1-4 a dotted line shows the approximate point of separation between the abdominal and pelvic subdivisions. Notice, however, that an actual physical partition, represented in the figure as a wide band, separates the thoracic cavity from the abdominal cavity. This muscular partition is the **diaphragm.** It is dome-shaped and is the most important muscle for breathing.

To make it easier to locate organs in the large abdominopelvic cavity, anatomists have divided the abdominopelvic cavity into the nine regions shown in Figure 1-5 and defined them as follows:

1. Upper abdominopelvic regions—the **right** and **left hypochondriac regions** and the **epigastric region** lie above an imaginary line across the abdomen at the level of the ninth rib cartilages.
2. Middle regions—the **right** and **left lumbar regions** and the **umbilical region** lie below an imaginary line across the abdomen at the level of the ninth rib cartilages and above an imaginary line across the abdomen at the top of the hip bones.
3. Lower regions—the **right** and **left iliac** (or **inguinal**) **regions** and the **hypogastric region** lie below an imaginary line across the abdomen at the level of the top of the hip bones.

Another, perhaps easier, way to divide the abdominopelvic cavity is shown in Figure 1-6. This method is frequently used by health professionals and is useful for locating pain or describing the location of a tumor. As you can see in Figure 1-6, the midsagittal and transverse planes, which were described in the previous section, pass through the navel (umbilicus) and divide the abdominopelvic region into the following **four quadrants:** right upper or superior, right lower or inferior, left upper or superior, and left lower or inferior.

The dorsal cavity shown in Figure 1-4 includes the space inside the skull that contains the brain; it is called the **cranial cavity.** The space inside the spinal column is called the **spinal cavity;** it contains the spinal cord. The cranial and spinal cavities are **dorsal cavities,** whereas the thoracic and abdominopelvic cavities are **ventral cavities.**

Some of the organs in the largest body cavities are visible in Figure 1-7 and are listed in Table 1-1. Find each body cavity in a model of the

**FIGURE 1-5**

**The nine regions of the abdominopelvic cavity.** The most superficial organs are shown. Look at Figure 1-7 (p. 9). Can you identify the deeper structures in each region?