FIGURE 1-6

Division of the abdominopelvic cavity into four quadrants. Diagram showing relationship of internal organs to the four abdominal quadrants.

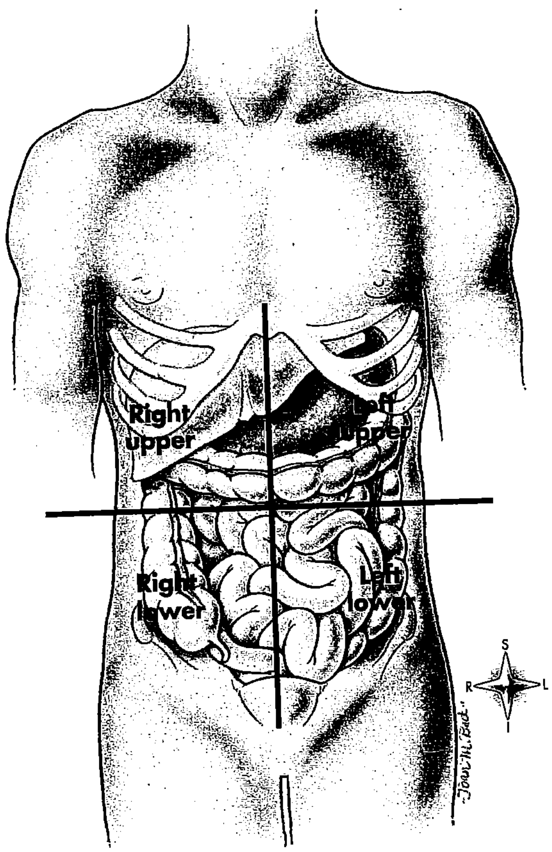


TABLE 1-1

Body Cavities

BODY CAVITY	ORGAN(S)
VENTRAL BODY CAVITY	
Thoracic cavity	
Mediastinum	Trachea, heart, blood vessels
Pleural cavities	Lungs
Abdominopelvic cavity	
Abdominal cavity	Liver, gallbladder, stomach, spleen, pancreas, small intestine, parts of large intestine
Pelvic cavity	Lower (sigmoid) colon, rectum, urinary bladder, reproductive organs
DORSAL BODY CAVITY	
Cranial cavity	Brain
Spinal cavity	Spinal cord

human body if you have access to one. Try to identify the organs in each cavity, and try to visualize their locations in your own body. Study Figures 1-4 and 1-7.

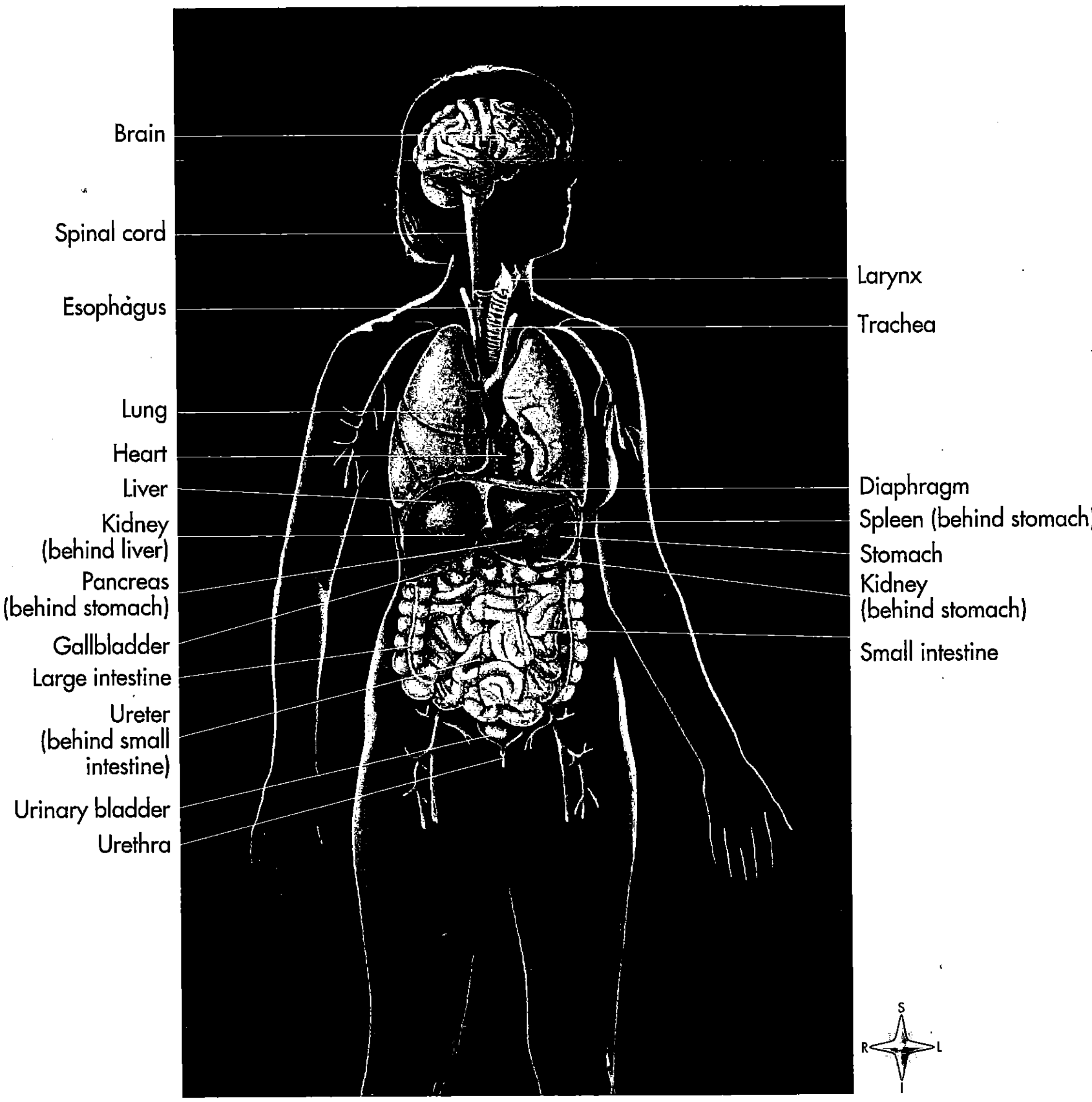
Body Regions

To recognize an object, you usually first notice its overall structure and form. For example, a car is recognized as a car before the specific details of its tires, grill, or wheel covers are noted. Recognition of the human form also occurs as you first identify overall shape and basic outline. However, for more specific identification to occur, details of size, shape, and appearance of individual body areas must be described. Individuals differ in overall appearance because specific body areas such as the face or torso have unique identifying characteristics. Detailed descriptions of the human form require that specific regions be identified and appropriate terms be used to describe them.

The ability to identify and correctly describe specific body areas is particularly important in the health sciences. For a patient to complain of pain in the head is not as specific and therefore not as useful to a physician or nurse as a more specific and localized description. Saying that the pain is facial provides additional information and helps to more specifically identify the area of pain. By using correct anatomical terms such as forehead, cheek, or chin to describe the area of pain, attention can be focused even more quickly on the specific anatomical area that may need attention. Fa-

FIGURE 1-7

Organs of the major body cavities. A view from the front.



miliarize yourself with the more common terms used to describe specific body regions identified in Figure 1-8 and listed in Table 1-2.

The body as a whole can be subdivided into two major portions or components: **axial** and **appendicular.** The axial portion of the body consists of the head, neck, and torso or trunk; the appendicular portion consists of the upper and lower extremities. Each major area is subdivided as shown in Figure 1-8. Note, for example, that the torso is composed of thoracic, abdominal, and pelvic areas, and the upper extremity is divided into arm,

FIGURE 1-8

Axial and appendicular divisions of the body. Specific body regions are labeled. Notice how the axial and appendicular regions of the body frame are distinguished by contrasting colors.

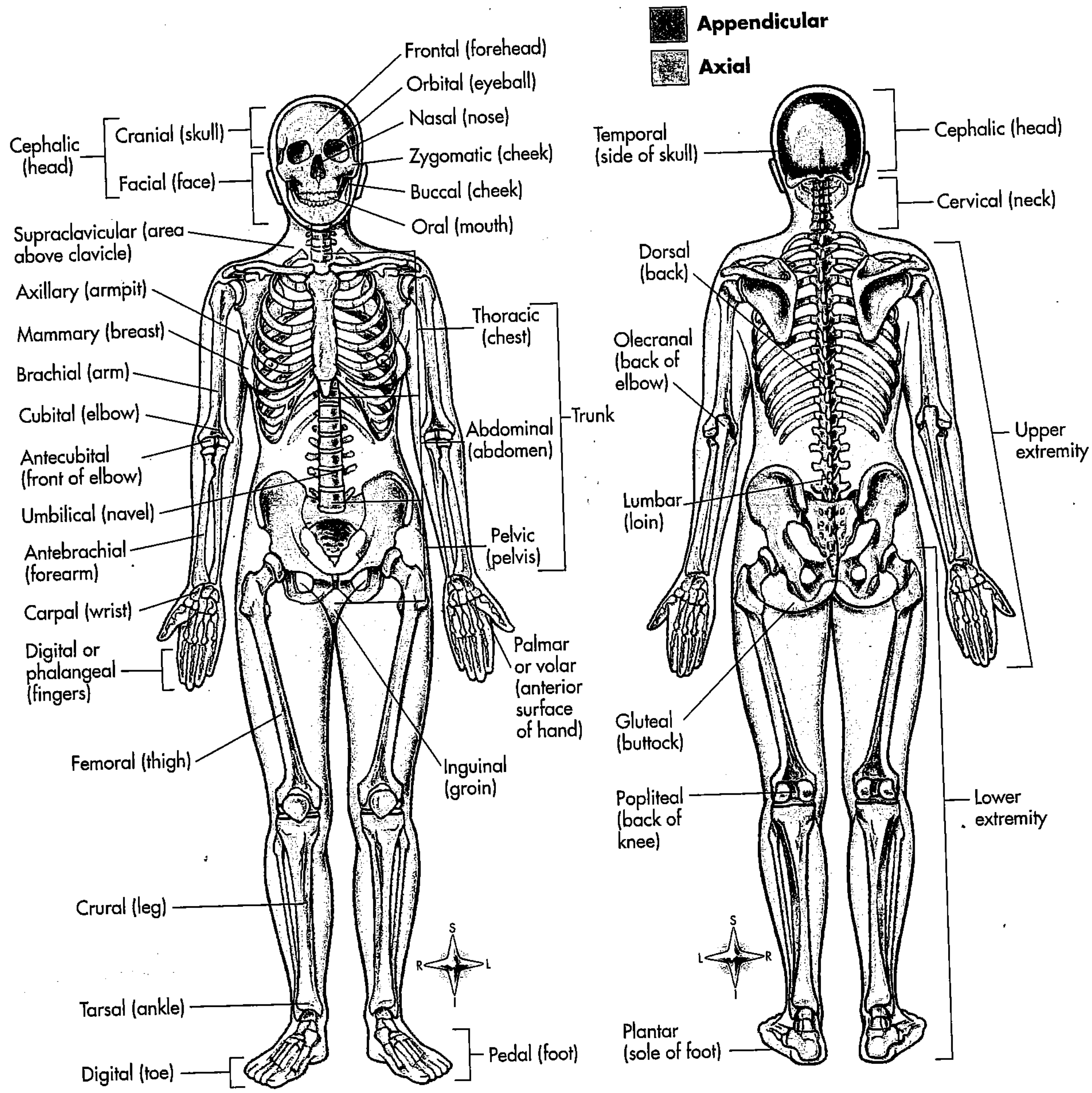


TABLE 1-2

Descriptive Terms for Body Regions

BODY REGION	AREA OR EXAMPLE
Abdominal (ab-DOM-in-al)	Anterior torso below diaphragm
Antebrachial (an-tee-BRAY-kee-al)	Forearm
Antecubital (an-tee-KYOO-bi-tal)	Depressed area just in front of elbow
Axillary (AK-si-lair-ee)	Armpit
Brachial (BRAY-kee-al)	Arm
Buccal (BUK-al)	Cheek
Carpal (KAR-pal)	Wrist
Cephalic (se-FAL-ik)	Head
Cervical (SER-vi-kal)	Neck
Cranial (KRAY-nee-al)	Skull
Crural (KROOR-al)	Leg
Cubital (KYOO-bi-tal)	Elbow
Cutaneous (kyoo-TANE-ee-us)	Skin (or body surface)
Digital (DIJ-i-tal)	Fingers or toes
Dorsal (DOR-sal)	Back
Facial (FAY-shal)	Face
Frontal (FRON-tal)	Forehead
Nasal (NAY-zal)	Nose
Oral (OR-al)	Mouth
Orbital or **ophthalmic** (OR-bi-tal or op-THAL-mik)	Eyes
Facial, cont'd **Zygomatic** (zye-go-MAT-ik)	Upper cheek
Femoral (FEM-or-al)	Thigh
Gluteal (GLOO-tee-al)	Buttock
Inguinal (ING-gwi-nal)	Groin
Lumbar (LUM-bar)	Lower back between ribs and pelvis
Mammary (MAM-er-ee)	Breast
Occipital (ok-SIP-i-tal)	Back of lower skull
Olecranal (oh-LEK-kra-nal)	Back of elbow
Palmar (PAHL-mar)	Palm of hand
Pedal (PED-al)	Foot
Pelvic (PEL-vik)	Lower portion of torso
Perineal (pair-i-NEE-al)	Area (perineum) between anus and genitals
Plantar (PLAN-tar)	Sole of foot
Popliteal (pop-li-TEE-al)	Area behind knee
Supraclavicular (soo-pra-kla-VIK-yoo-lar)	Area above clavicle
Tarsal (TAR-sal)	Ankle
Temporal (TEM-por-al)	Side of skull
Thoracic (tho-RAS-ik)	Chest
Umbilical (um-BILL-ih-kal)	Area around navel or umbilicus
Volar (VO-lar)	Palm or sole

forearm, wrist, and hand components. Although most terms used to describe gross body regions are well understood, misuse is common. The word *leg* is a good example: it refers to the area of the lower extremity between the knee and ankle and not to the entire lower extremity.

The structure of the body changes in many ways and at varying rates during a lifetime. Before young adulthood, it develops and grows; after young adulthood, it gradually undergoes degenerative changes. With advancing age, there is a generalized decrease in size or a wasting away of many body organs and tissues that affects the structure and function of many body areas. This degenerative process is called **atrophy.** Nearly every chapter of this book will refer to a few of these changes.

THE BALANCE OF BODY FUNCTIONS

Although they may have very different structures, all living organisms maintain mechanisms that ensure survival of the body and success in propagating its genes through its offspring.

Survival depends on the body maintaining relatively constant conditions within the body. **Homeostasis** is what physiologists call the relative constancy of the internal environment. The cells of the body live in an internal environment made up mostly of water combined with salts and other dissolved substances. Like fish in a fishbowl, the cells are able to survive only if the conditions of their watery environment remain stable. The temperature, salt content, acid level (pH), fluid volume and pressure, oxygen concentration, and other vital conditions must remain within acceptable limits. To maintain constant water conditions in a fishbowl, one may add a heater, an air pump, and filters. Likewise, the body has mechanisms that act as heaters, air pumps, and the like, to maintain conditions of its internal fluid environment.

Because the activities of cells and external disturbances are always threatening internal stability, or homeostasis, the body must constantly work to maintain or restore that stability. To accomplish this self-regulation, a highly complex and integrated communication control system is required. The basic type of control system in the body is called a **feedback loop.** The idea of a feedback loop is borrowed from engineering. Figure 1-9, *A*, shows how an engineer would describe the feedback loop that maintains stability of temperature in a building. Cold winds outside a building may cause a decrease in building temperature below normal. A **sensor,** in this case a thermometer, detects the change in temperature. Information from the sensor *feeds back* to a **control center**—a thermostat in this example—that compares the actual temperature to the normal temperature and responds by activating the building's furnace. The furnace is called an **effector** because it has an effect on the controlled condition (temperature). Because the sensor continually feeds information back to the control center, the furnace will be automatically shut off when the temperature has returned to normal.

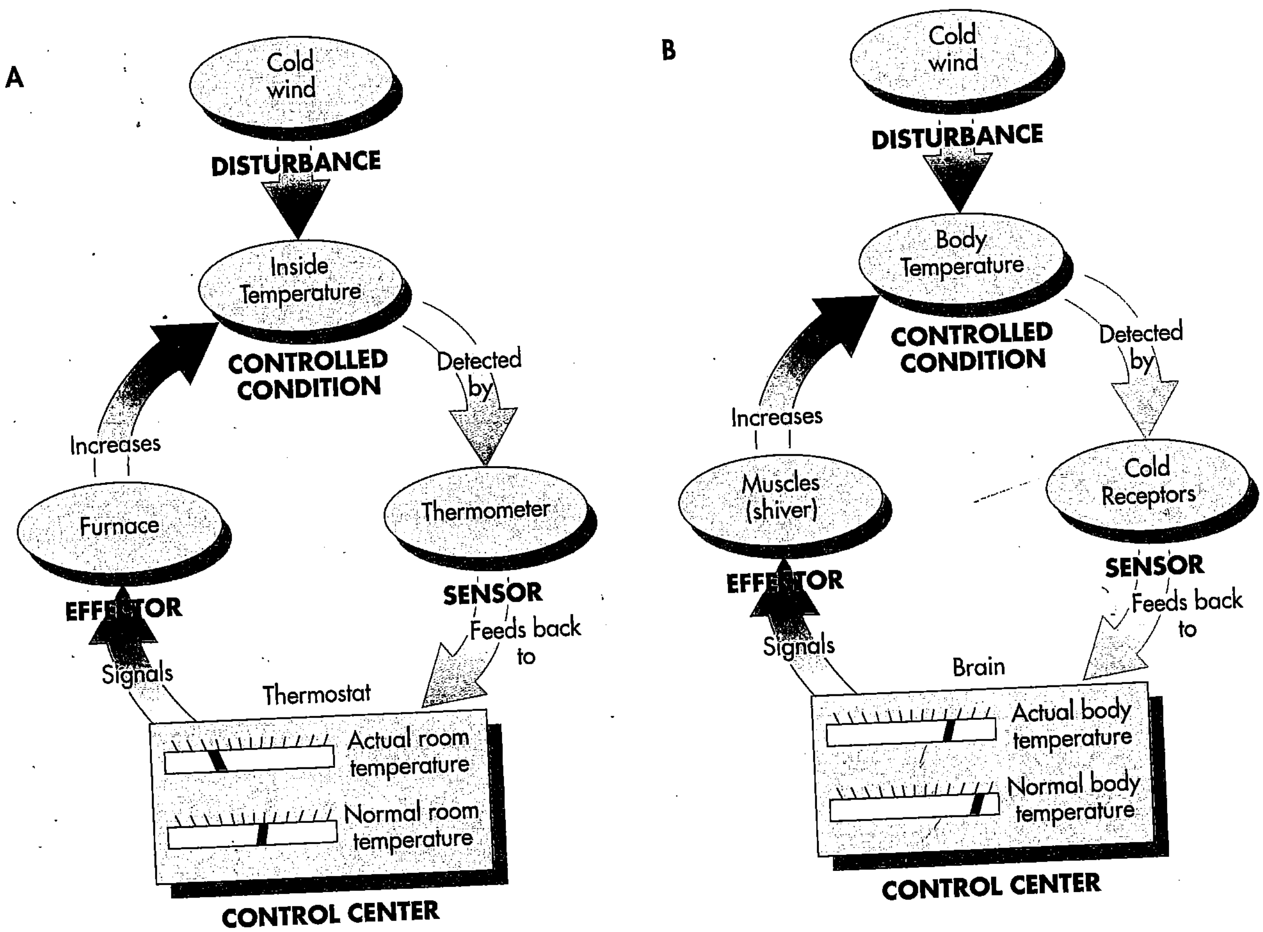
As you can see in Figure 1-9, *B*, the body uses a similar feedback loop in restoring body temperature when we become chilled. Nerve endings that act as temperature sensors feed information to a control center in the brain that compares actual body temperature to normal body temperature. In response to a chill, the brain sends nerve signals to muscles that shiver. Shivering produces heat that increases our body temperature. We stop shivering when feedback information tells the brain that body temperature has increased to normal.

Feedback loops such as those shown in Figure 1-9 are called **negative feedback loops** because they oppose, or negate, a change in a controlled condition. Most homeostatic control loops in the body involve negative feedback because reversing changes back toward a normal value tends to stabilize conditions—exactly what homeostasis is all about. An example of a negative feedback loop occurs when decreasing blood oxygen concentration caused by muscles using oxygen during exercise is counteracted by an increase in breathing to bring the blood oxygen level back up to normal. Another example is the excretion of larger than usual volumes of urine when the volume of fluid in the body is greater than the normal, ideal amount.

Although not common, **positive feedback loops** exist in the body and are involved in normal function. Positive feedback control loops are stimulatory. Instead of opposing a change in the internal environment and causing a "return to normal," positive feedback loops temporarily amplify the change that is occurring. This type of feedback loop causes an ever-increasing rate of events to occur until something stops the process. An example of a positive feedback loop includes

FIGURE 1-9

Negative feedback loops. A, An engineer's diagram showing how a relatively constant room temperature *(controlled condition)* can be maintained. A thermostat *(control center)* receives feedback information from a thermometer *(sensor)* and responds by counteracting a change from normal by activating a furnace *(effector).* **B,** A physiologist's diagram showing how a relatively constant body temperature *(controlled condition)* can be maintained. The brain *(control center)* receives feedback information from nerve endings called cold receptors *(sensors)* and responds by counteracting a change from normal by activating shivering by muscles *(effectors).*



the events that cause rapid increases in uterine contractions before the birth of a baby. Another example is the increasingly rapid sticking together of blood cells called *platelets* to form a plug that begins formation of a blood clot. In each of these cases, the process increases rapidly until the positive feedback loop is stopped suddenly by the birth of a baby or the formation of a clot. In the long run, such normal positive feedback events also help maintain constancy of the internal environment.

It is important to realize that homeostatic control mechanisms can only maintain a *relative* constancy. All homeostatically controlled conditions in the body do not remain absolutely constant. Rather, conditions normally fluctuate near a normal, ideal value. Thus body temperature, for example, rarely remains exactly the same for very long; it usually fluctuates up and down near a person's normal body temperature.

Because all organs function to help maintain homeostatic balance, we will be discussing negative and positive feedback mechanisms often throughout the remaining chapters of this book.

Before leaving this brief introduction to physiology, we must pause to state the important principle that maintaining the balance of body functions is related to age. During childhood, homeostatic functions gradually become more and more efficient and effective. They operate with maximum efficiency and effectiveness during young adulthood. During late adulthood and old age, they gradually become less and less efficient and effective. Changes and functions occurring during the early years are called *developmental processes;* those occurring after young adulthood are called *aging processes.* In general, developmental processes improve efficiency of functions; aging processes usually diminish it.

HEALTH & WELL-BEING

Exercise Physiology

Exercise physiologists study the effects of exercise on the body organ systems. They are especially interested in the complex control mechanisms that preserve or restore homeostasis during or immediately after periods of strenuous physical activity. Exercise, defined as any significant use of skeletal muscles, is a normal activity with beneficial results. However, exercise disrupts homeostasis. For example, when muscles are worked, the core body temperature rises and blood CO_2 levels increase. These and many other body functions quickly deviate from "normal ranges" that exist at rest. Complex control mechanisms must then "kick in" to restore homeostasis.

As a scientific discipline, exercise physiology attempts to explain many body processes in terms of how they maintain homeostasis. Exercise physiology has many practical applications in therapy and rehabilitation, athletics, occupational health, and general wellness. This specialty concerns itself with the function of the whole body, not just one or two body systems.

Outline Summary

STRUCTURAL LEVELS OF ORGANIZATION (Figure 1-1)

A Organization is an outstanding characteristic of body structure
B The body is a unit constructed of the following smaller units:
  1 Cells—the smallest structural units; organizations of various chemicals
  2 Tissues—organizations of similar cells
  3 Organs—organizations of different kinds of tissues
  4 Systems—organizations of many different kinds of organs

ANATOMICAL POSITION (Figure 1-2)

Standing erect with the arms at the sides and palms turned forward

ANATOMICAL DIRECTIONS

A Superior—toward the head, upper, above
  Inferior—toward the feet, lower, below
B Anterior—front, in front of (same as ventral in humans)
  Posterior—back, in back of (same as dorsal in humans)
C Medial—toward the midline of a structure
  Lateral—away from the midline or toward the side of a structure
D Proximal—toward or nearest the trunk, or nearest the point of origin of a structure
  Distal—away from or farthest from the trunk, or farthest from a structure's point of origin
E Superficial—nearer the body surface
  Deep—farther away from the body surface

PLANES OR BODY SECTIONS (Figure 1-3)

A Sagittal plane—lengthwise plane that divides a structure into right and left sections
B Midsagittal—sagittal plane that divides the body into two equal halves
C Frontal (coronal) plane—lengthwise plane that divides a structure into anterior and posterior sections
D Transverse plane—horizontal plane that divides a structure into upper and lower sections

BODY CAVITIES (Figure 1-4)

A Ventral cavity
  1 Thoracic cavity
    a Mediastinum—midportion of thoracic cavity; heart and trachea are located in mediastinum
    b Pleural cavities—right lung located in right pleural cavity, left lung is in left pleural cavity
  2 Abdominopelvic cavity
    a Abdominal cavity contains stomach, intestines, liver, gallbladder, pancreas, and spleen
    b Pelvic cavity contains reproductive organs, urinary bladder, and lowest part of intestine
    c Abdominopelvic regions (Figures 1-5 and 1-6)
      (1) Nine regions
      (2) Four quadrants
B Dorsal cavity
  1 Cranial cavity contains brain
  2 Spinal cavity contains spinal cord

BODY REGIONS (Figure 1-8)

A Axial region—head, neck, and torso or trunk
B Appendicular region—upper and lower extremities

THE BALANCE OF BODY FUNCTIONS

A Survival of the individual and of the genes is the body's most important business
B Survival depends on the maintenance or restoration of homeostasis (relative constancy of the internal environment; Figure 1-9); the body uses negative feedback loops and, less often, positive feedback loops to maintain or restore homeostasis
C All organs function to maintain homeostasis
D Body functions are related to age; peak efficiency is during young adulthood, diminishing efficiency occurs after young adulthood