Anatomy and Physiology

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What is anatomy?

- **Anatomy** is the structure of an organism and the relationships of its parts.

Dissections

- We use dissections to isolate and study the structural components or parts of the human body.
- Gross anatomy- study of body parts visible to the naked eye.
- Microscopic anatomy- study of body parts using a microscope

Parts to microscopic anatomy

- Cytology- study of cells
- Histology- study of tissues

Other studies of anatomy:

- Developmental anatomy- study of human growth and development
- Pathological anatomy- study of diseased body structures
- Systemic anatomy- study of the body by systems

What is physiology?

- **Physiology** is the study of how the body works.

Parts of physiology:

1) Organism involved
2) Organization level studied
3) Systemic function

Characteristics of Life

- Characteristics of life considered most important in humans:

- Responsiveness
- Conductivity
- Growth
- Respiration
- Digestion
- Absorption
- Secretion
- Excretion
- Circulation
- Reproduction

Metabolism

- Metabolism—sum total of all physical and chemical reactions occurring in the living body

Levels of organization

- Atom
- Molecule
- Organelle
- Cell
- Tissue
- Organ
- Organ system
- Organism

Levels of Organization (Figure 1-3)

- Chemical level—basis for life
  - Organization of chemical structures separates living material from nonliving material
  - Organization of atoms, molecules, and macromolecules results in living matter—a gel called cytoplasm

Levels of Organization

- Organelle level
  - Chemical structures organized to form organelles that perform individual functions
  - It is the functions of the organelles that allow the cell to live
  - Dozens of organelles have been identified, including the following:
    - Mitochondria
    - Golgi apparatus
    - Endoplasmic reticulum

Levels of Organization

- Cellular level
  - Cells—smallest and most numerous units that possess and exhibit characteristics of life
  - Cell—nucleus surrounded by cytoplasm within a limiting membrane
  - Cells differentiate to perform unique functions

Levels of Organization

- Tissue level
  - Tissue—an organization of similar cells specialized to perform a certain function
  - Tissue cells surrounded by nonliving matrix
  - Four major tissue types:
    - Epithelial tissue
    - Connective tissue
    - Muscle tissue
    - Nervous tissue

Levels of Organization

- Organ level
  - Organ—organization of several different kinds of tissues to perform a special function
  - Organs represent discrete and functionally complex operational units
  - Each organ has a unique size, shape, appearance, and placement in the body

Levels of Organization

- System level
  - Systems—most complex organizational units of the body
  - System level involves varying numbers and kinds of organs arranged to perform complex functions (Table 1-1):
    - Support and movement
    - Communication, control, and integration
    - Transportation and defense
    - Respiration, nutrition, and excretion
    - Reproduction and development

Levels of Organization

- Organism level
  - The living human organism is greater than the sum of its parts
  - All of the components interact to allow the human to survive and flourish

Anatomical Position (Figure 1-4)

- Reference position
- Body erect with arms at sides and palms forward
- Head and feet pointing forward

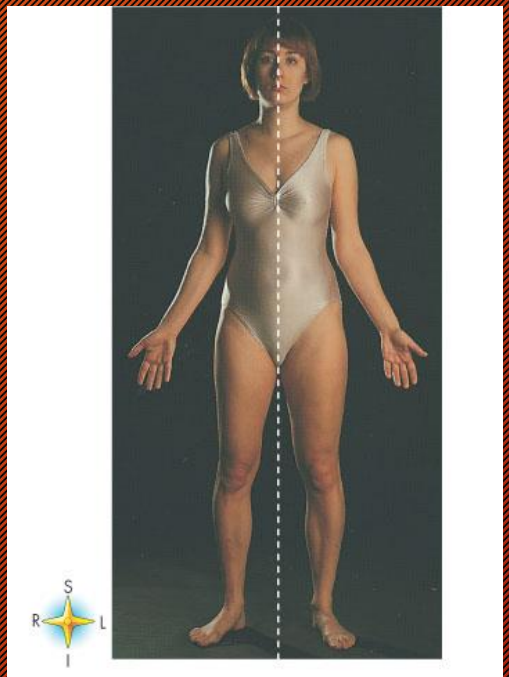


Figure 1-4 ***Anatomical position and bilateral symmetry.*** In the anatomical position, the body is in an erect, or standing, posture with the arms at the sides and palms forward. The head and feet are also pointing forward. The *dotted line* shows the axis of the body's bilateral symmetry. As a result of this organizational feature, the right and left sides of the body are mirror images of each other.

Bilateral symmetry

- Bilateral symmetry is a term meaning that right and left sides of body are mirror images
  - Ipsilateral structures are on the same side of the body in anatomical position
  - Contralateral structures are on opposite sides of the body in anatomical position

Body Cavities

- **Ventral body cavity**
  - Thoracic cavity
    - Right and left pleural cavities
    - Mediastinum
  - Abdominopelvic cavity
    - Abdominal cavity
    - Pelvic cavity

Body cavity

- **Dorsal body cavity**
  - Cranial cavity
  - Spinal cavity

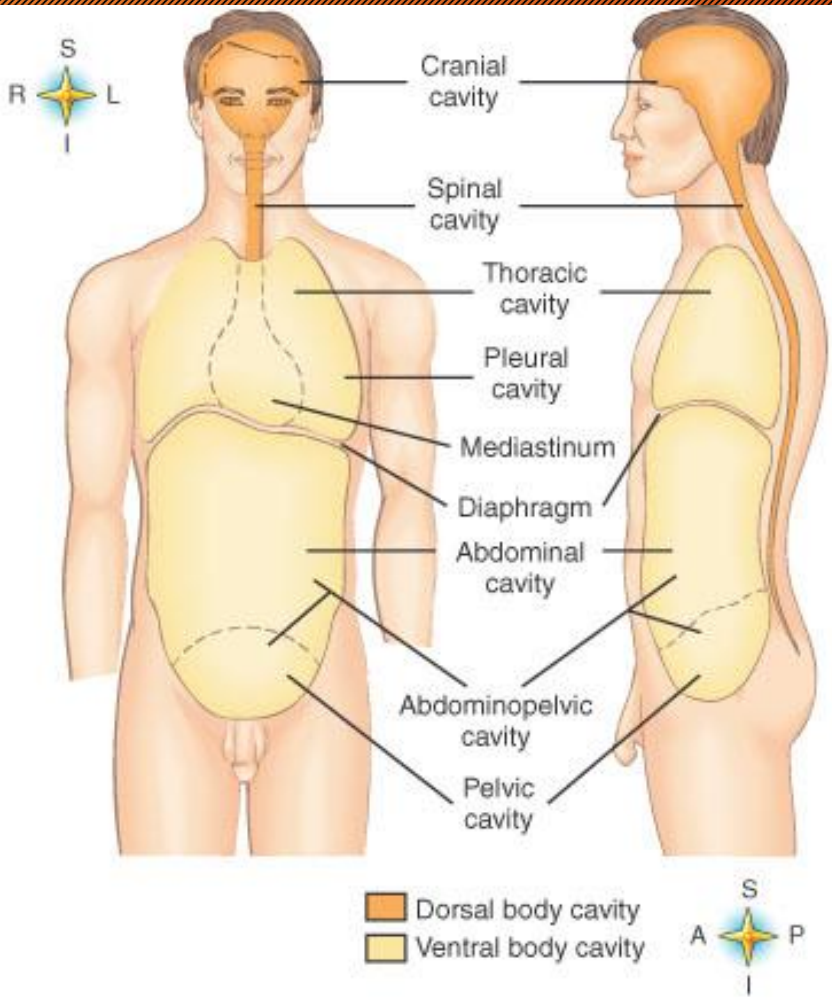


Figure 1-5 ***Major body cavities.*** The dorsal body cavity is in the dorsal (back) part of the body and is subdivided into a cranial cavity above and a spinal cavity below. The ventral body cavity is on the ventral (front) side of the trunk and is subdivided into the thoracic cavity above the diaphragm and the abdominopelvic cavity below the diaphragm. The thoracic cavity is subdivided into the mediastinum in the center and pleural cavities to the sides. The abdominopelvic cavity is subdivided into the abdominal above the pelvis and the pelvic cavity within the pelvis.

Body Regions

- Axial subdivision
  - Head
  - Neck
  - Torso, or trunk, and its subdivisions
- Appendicular subdivision
  - Upper extremity and subdivisions
  - Lower extremity and subdivisions

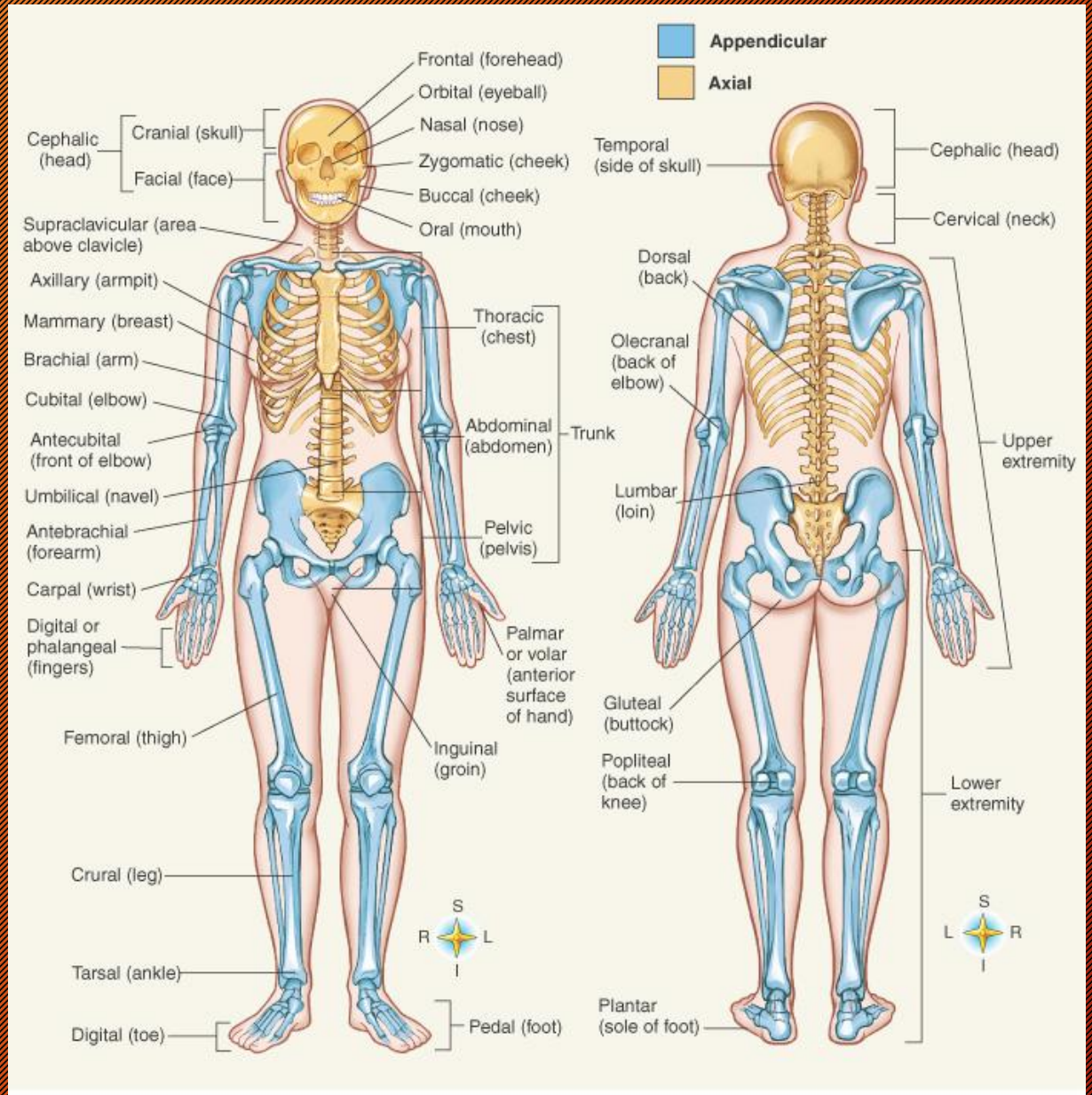


Figure 1-6 ***Specific body regions.*** Note that the body as a whole can be subdivided into two major portions: axial (along the middle, or *axis*, of the body) and appendicular (the arms and legs, or *appendages*). Names of specific body regions follow the Latin form, with the English equivalent in parentheses.

Abdominal regions

- Right hypochondriac region
- Epigastric region
- Left hypochondriac region
- Right lumbar region
- Umbilical region
- Left lumbar region
- Right iliac (inguinal) region
- Hypogastric region
- Left iliac (inguinal) region

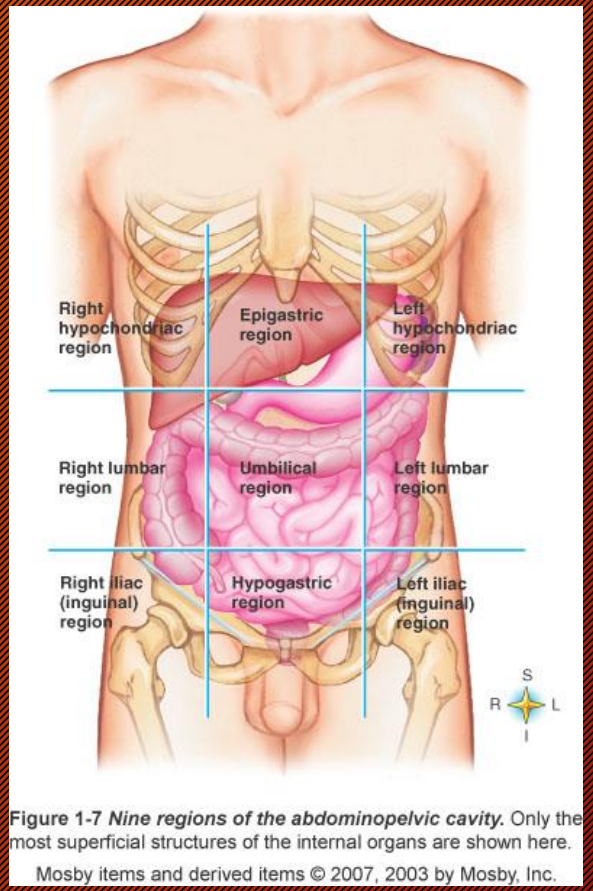


Figure 1-7 ***Nine regions of the abdominopelvic cavity.*** Only the most superficial structures of the internal organs are shown here.

Abdominopelvic quadrants

- Right upper quadrant
- Left upper quadrant
- Right lower quadrant
- Left lower quadrant

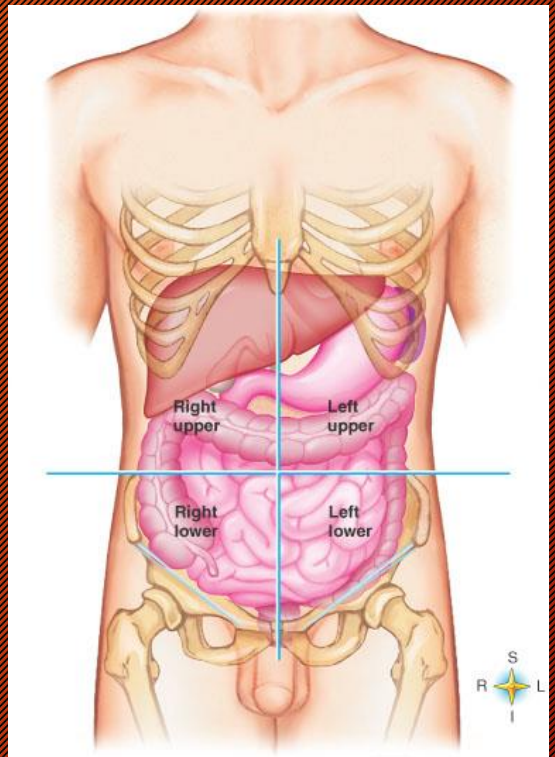


Figure 1-8 ***Division of the abdomen into four quadrants.*** The diagram shows the relationship of internal organs to the four abdominopelvic quadrants.

Terms Used in Describing Body Structure

- Directional terms
  - Superior
  - Inferior
  - Anterior (ventral)
  - Posterior (dorsal)
  - Medial
  - Lateral
  - Proximal
  - Distal
  - Superficial
  - Deep

Body Planes and Sections

- Planes are lines of orientation along which cuts or sections can be made to divide the body, or a body part, into smaller pieces
- There are 3 planes:

1) Saggital plane
2) Frontal (coronal) plane
3) Transverse (horizontal) plane

Body Planes and Sections

- There are three major planes, which lie at right angles to each other:
  - Sagittal plane runs front to back so that sections through this plane divide body (or body part) into right and left sides
    - If section divides body (or part) into symmetrical right and left halves, the plane is called midsagittal or median sagittal
  - Frontal (coronal) plane runs lengthwise (side to side) and divides body (or part) into anterior and posterior portions
  - Transverse (horizontal) plane is a “crosswise” plane—it divides body (or part) into upper and lower parts

Body Type and Disease

- **Somatotype**—category of body build or physique
- Three somatotype:

1) Endomorph
2) Mesomorph
3) Ectomorph

Somatotypes:

- **Endomorph**—heavy, rounded physique with accumulation of fat
  - "Apple-shaped" endomorph has more accumulation of fat in the waist than hip
    - Waist-to-hip ratio >0.9 for women and >1.0 for men
    - Higher risk for health problems than "pear shape"
  - "Pear-shaped" endomorph has more accumulation of fat in hips than in waist

Somatotypes Cont.

- **Mesomorph**—muscular physique
- **Ectomorph**—thin, often fragile physique with little fat

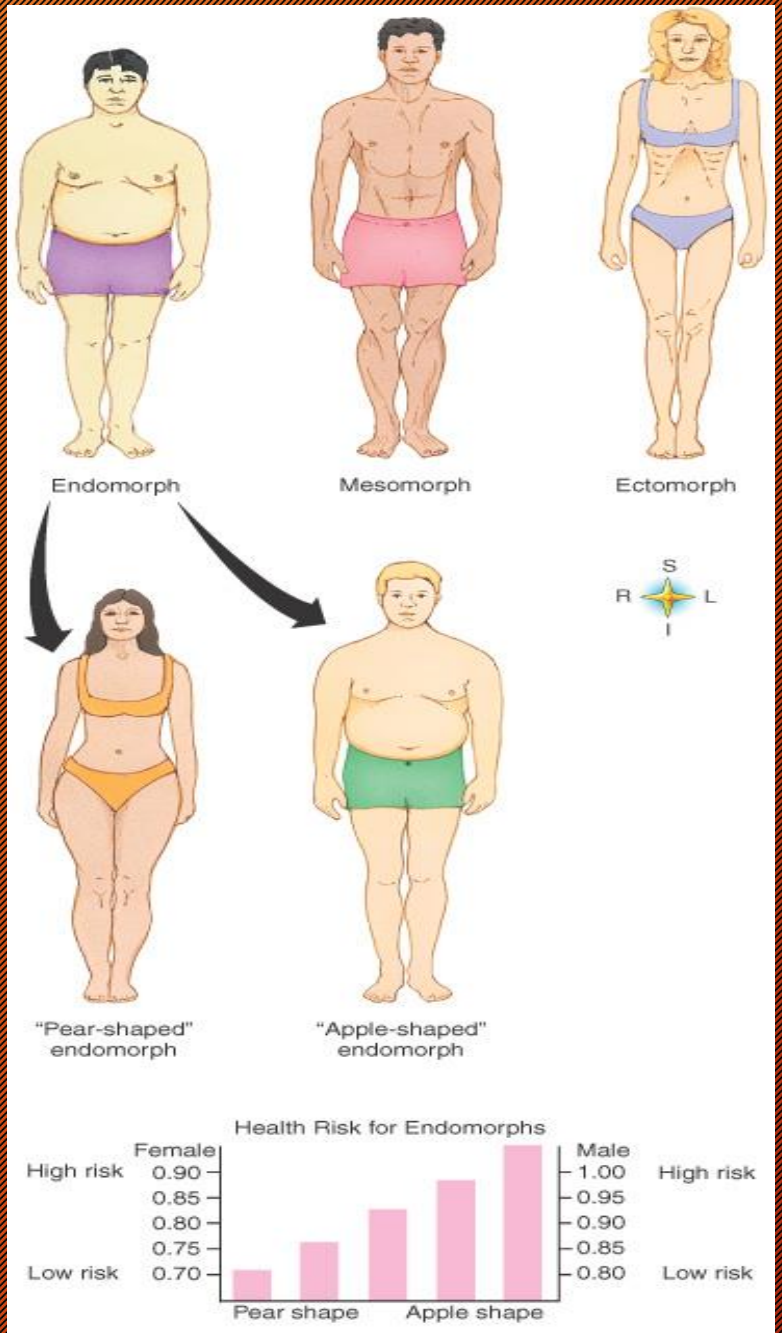


Figure 1-11 ***Body types and health risks.***

Homeostasis

- **Homeostasis** is the term used to describe the relatively constant states maintained by the body—internal environment around body cells remains constant

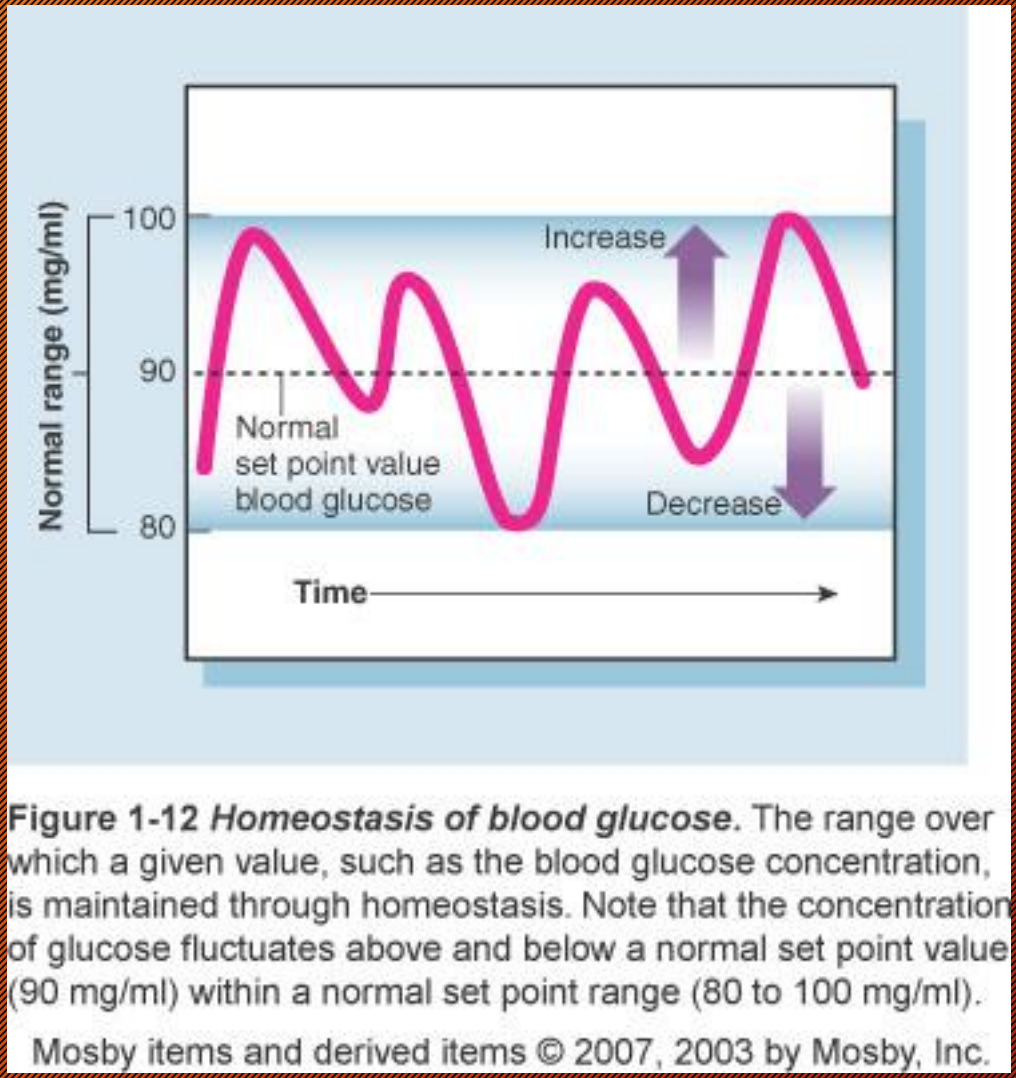


Figure 1-12 ***Homeostasis of blood glucose.*** The range over which a given value, such as the blood glucose concentration, is maintained through homeostasis. Note that the concentration of glucose fluctuates above and below a normal set point value (90 mg/ml) within a normal set point range (80 to 100 mg/ml).

Homeostasis

- Body adjusts important variables from a normal “set point” in an acceptable or normal range
- Examples of homeostasis:
  - Temperature regulation
  - Regulation of blood carbon dioxide level
  - Regulation of blood glucose level

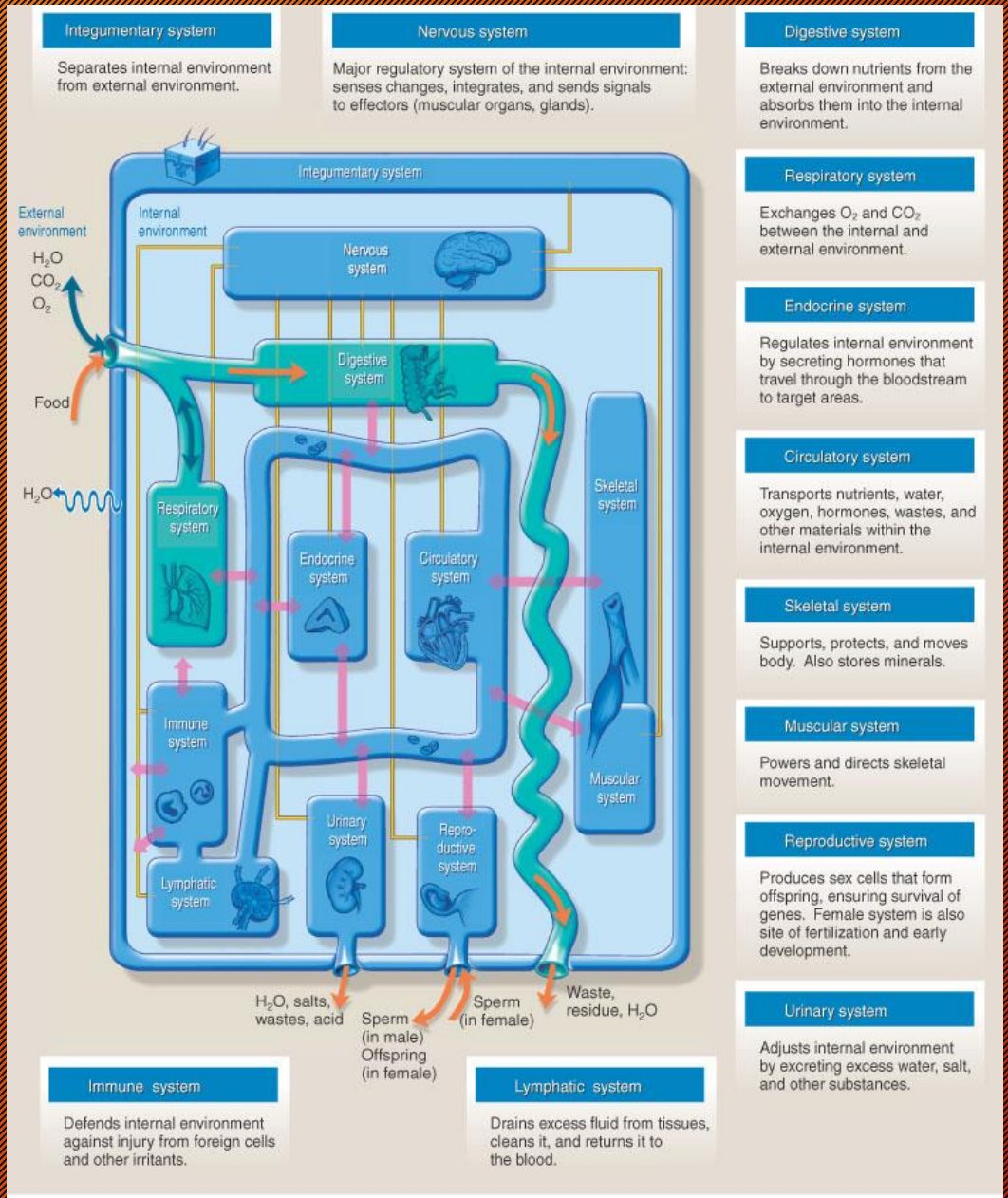


Figure 1-13 ***Diagram of the body's internal environment.*** The human body is like a bag of fluid separated from the external environment. Tubes, such as the digestive tract and respiratory tract, bring the external environment to deeper parts of the bag where substances may be absorbed into the internal fluid environment or excreted into the external environment. All the "accessories" somehow help maintain a constant environment inside the bag that allows the cells that live there to survive.

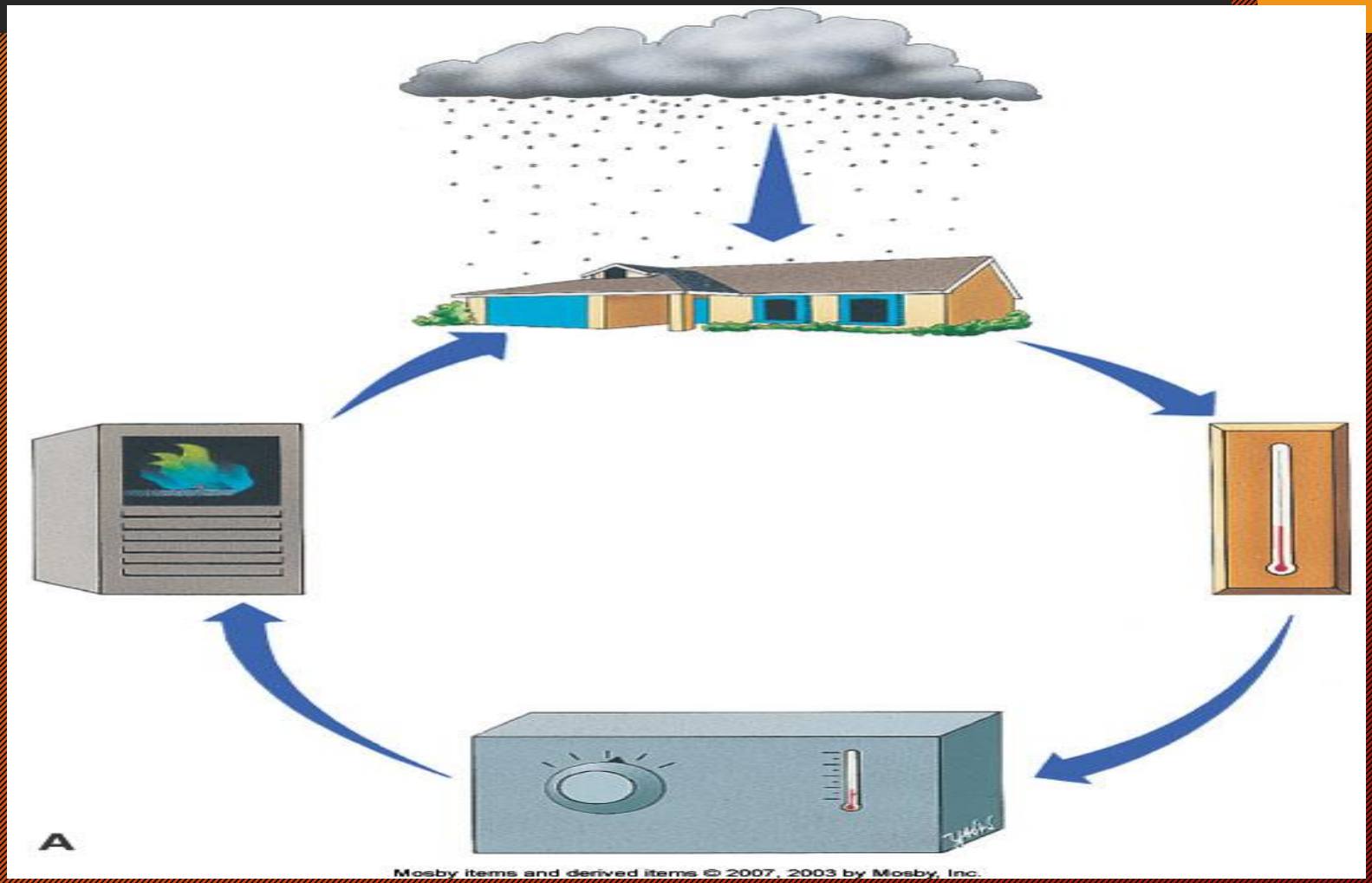
Homeostatic Control Mechanisms

- Devices for maintaining or restoring homeostasis by self-regulation through feedback control loops

Homeostatic Mechanisms

- Basic components of control mechanisms
  - Sensor mechanism—specific sensors detect and react to any changes from normal
  - Integrating, or control, center—information is analyzed and integrated, and then, if needed, a specific action is initiated
  - Effector mechanism—effectors directly influence controlled physiological variables
  - Feedback—process of information about a variable constantly flowing back from the sensor to the integrator

Label the Homeostatic Mechanisms



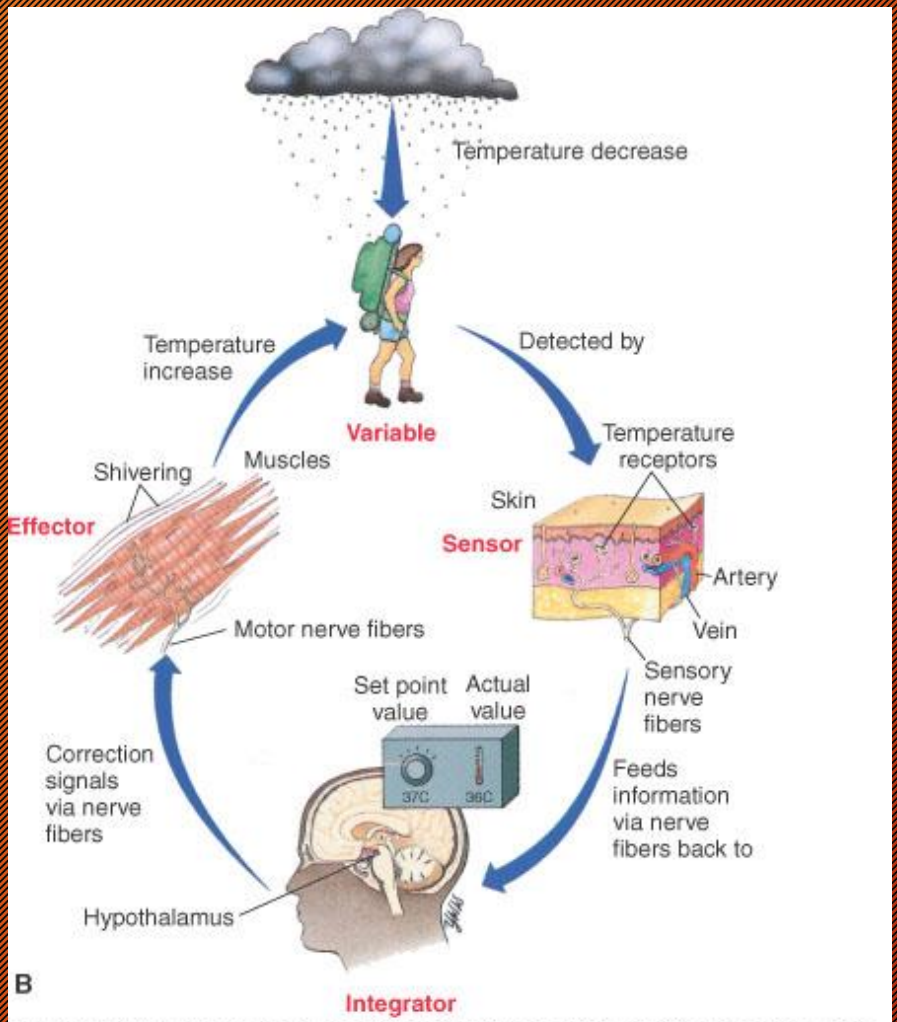


Figure 1-14B ***Basic components of homeostatic control mechanisms.*** **A,** Heat regulation by a furnace controlled by a thermostat. **B,** Homeostasis of body temperature. Note that in both examples A and B a stimulus (drop in temperature) activates a sensor mechanism (thermostat or body temperature receptor) that sends input to an integrating, or control, center (on-off switch or hypothalamus), which then sends input to an effector mechanism (furnace or contracting muscle). The resulting heat that is produced maintains the temperature in a "normal range." Feedback of effector activity to the sensor mechanism completes the control loop.

Homeostatic Control Mechanisms

- **Negative feedback control systems**
  - Are inhibitory
  - Stabilize physiological variables
  - Produce an action that is opposite to the change that activated the system
  - Are responsible for maintaining homeostasis
  - Are much more common than positive feedback control systems

Homeostatic Control Mechanisms

- **Positive feedback control systems**
  - Are stimulatory
  - Amplify or reinforce the change that is occurring
  - Tend to produce destabilizing effects and disrupt homeostasis
  - Bring specific body functions to swift completion
- Feed-forward occurs when information flows ahead to another process or feedback loop to trigger a change in anticipation of an event that will follow

Homeostatic Control Mechanisms

- Levels of control
  - Intracellular control
    - Regulation within cells
    - Genes or enzymes can regulate cell processes
  - Intrinsic control (autoregulation)
    - Regulation within tissues or organs
    - May involve chemical signals
    - May involve other “built-in” mechanisms
  - Extrinsic control
    - Regulation from organ to organ
    - May involve nerve signals
    - May involve endocrine signals (hormones)

THANK YOU