

# THE HUMAN BODY: AN ORIENTATION

Anatomy & Physiology

Unit 1

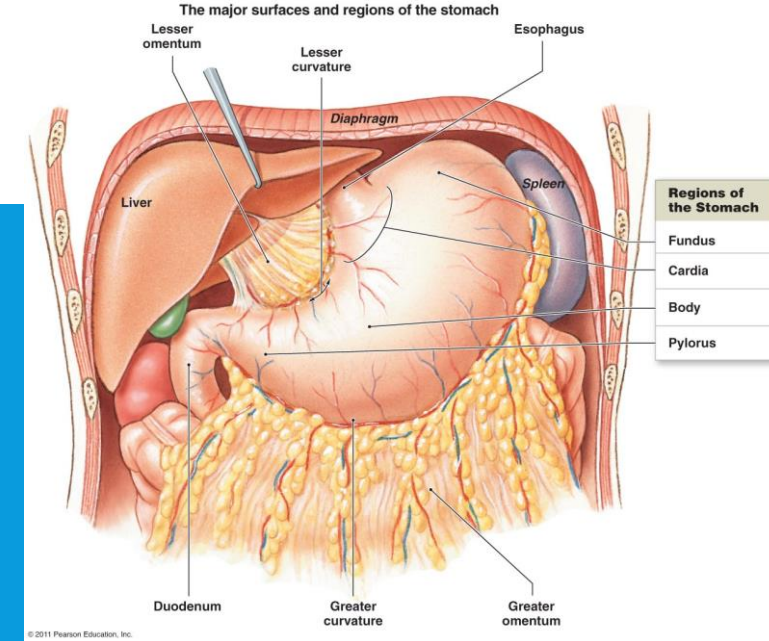
# ANATOMY & PHYSIOLOGY



- Anatomy
  - Greek translation → A Cutting Open
  - Study of the internal and external STRUCTURE of the body and the physical relationships among body parts
    - **FORM**
- Physiology
  - also Greek
  - Study of how organisms perform their vital functions
    - **FUNCTION**

# MACROSCOPIC ANATOMY

- Macroscopic Anatomy
  - Large structures visible with the unaided eye
- Surface Anatomy
  - Study of superficial markings
- Regional Anatomy
  - Organization of specific areas of the body, such as head, neck, or trunk
- Systemic Anatomy
  - Study of the structure of entire organ systems, such as the skeletal system or the muscular system
    - Human body has 11 organ systems

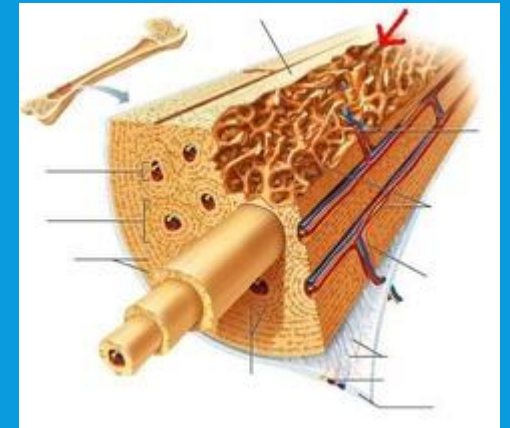


# MACROSCOPIC ANATOMY

- Developmental Anatomy
  - The changes in form that occur during the period between conception and physical maturity
  - The most extensive structural changes occur during the first two months of development is called embryology
- Medical Anatomy
  - Anatomical features that change during illness
- Radiographic Anatomy
  - Structures seen by imaging techniques
- Surgical Anatomy
  - Anatomical landmarks important in surgery

# MICROSCOPIC ANATOMY

- Microscopic Anatomy
  - Structures that cannot be seen without magnification
  - Boundaries are established by the limits of the equipment used
  - Includes two major subdivisions:
    - Cytology
      - Analysis of the structure of individual **CELLS**
    - Histology
      - The examination of **TISSUES**
        - Tissues are groups of specialized cells and cell products that work together to perform specific functions

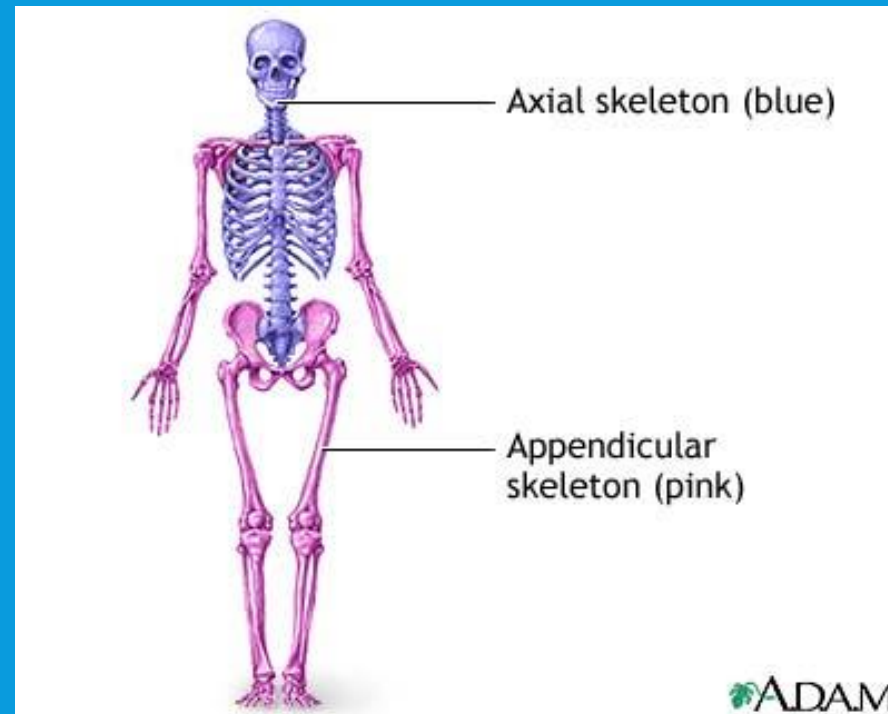


# PHYSIOLOGY

- Human Physiology
  - Study of the functions of the human body
- Cell Physiology
  - Study of the functions of cells organization and control mechanisms of cells and tissues
- Special Physiology
  - Study of the physiology of specific organs
- Systemic Physiology
  - Functioning of specific organ systems
- Pathological Physiology
  - Study of the effects of diseases on organ or organ functions
    - Pathos → Greek for Disease

# GENERAL ORGANIZATION OF THE BODY

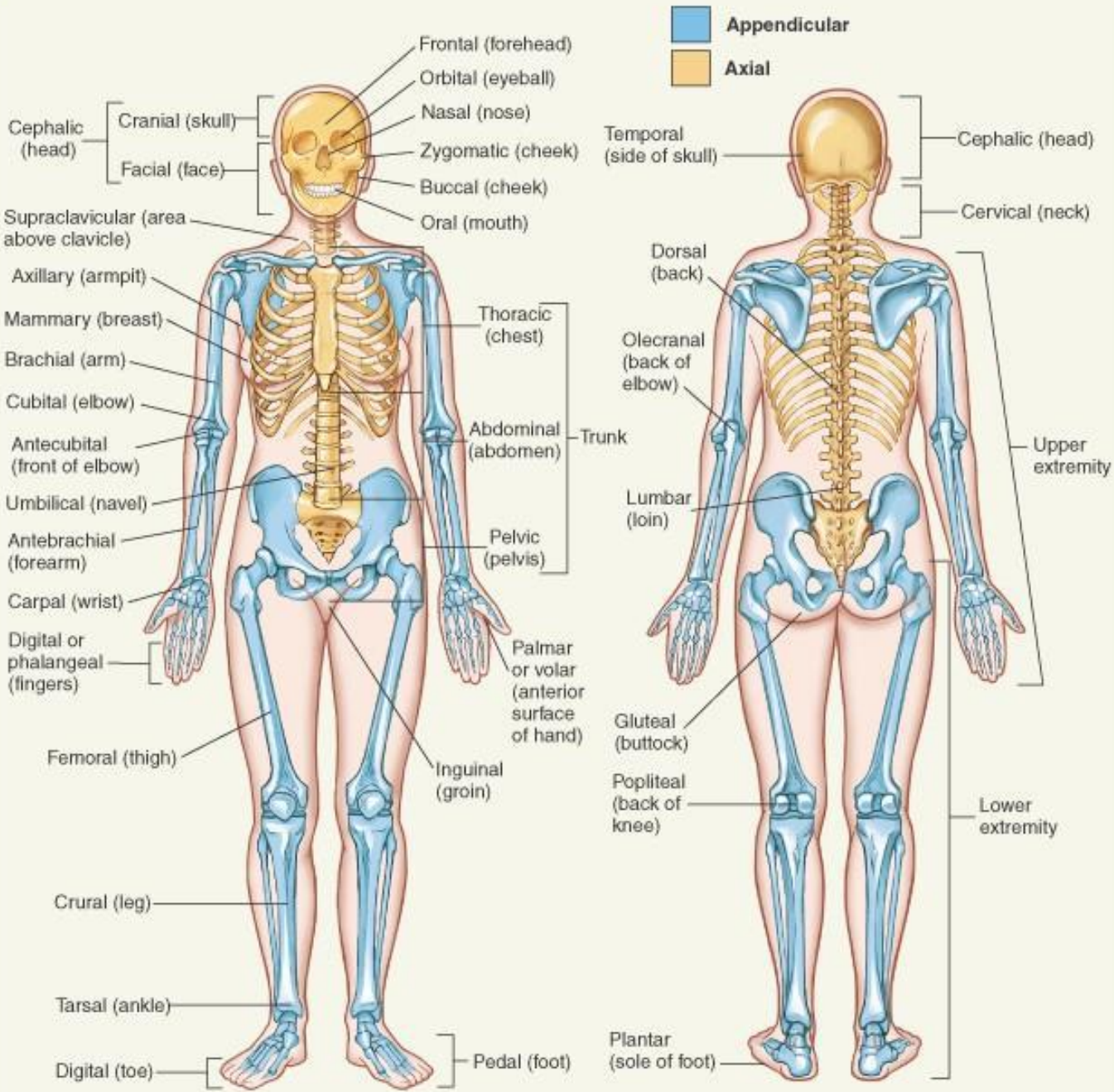
- Axial Position
  - Head, neck, trunk
- Appendicular Portion
  - Arms & legs



VISCERA = internal organs  
“Visceral Organs”

1. Several body cavities
2. Layers of membranes within cavities
3. Variety of organs and organ systems within cavities

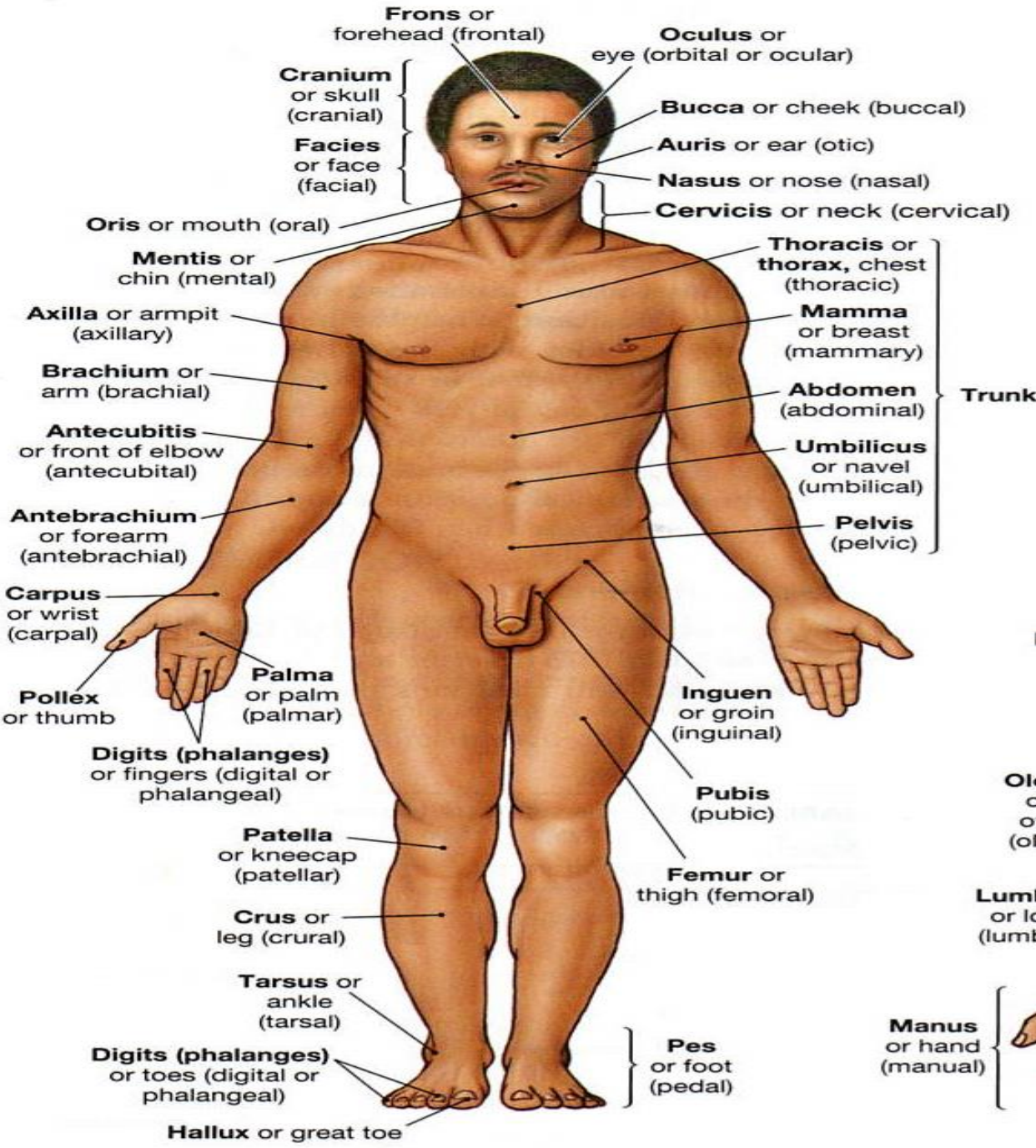
# BODY REGIONS



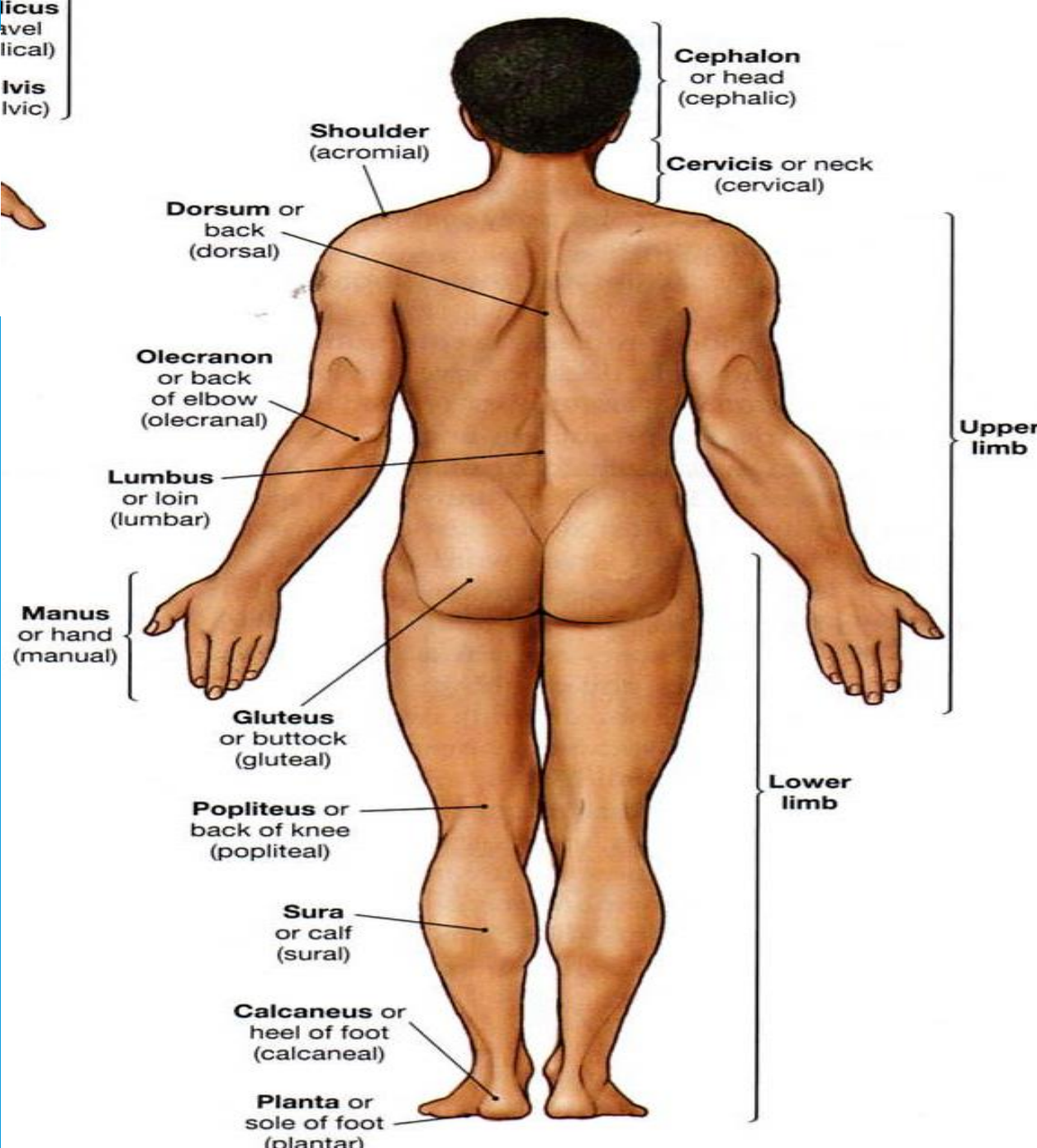
Abdominal  
 Axillary  
 Brachial  
 Antebrachial  
 Carpal  
 Digital  
 Cephalic  
 Cervical

Inguinal  
 Pelvic  
 Pubic  
 Thoracic  
 Gluteal  
 Lumbar  
 Occipital





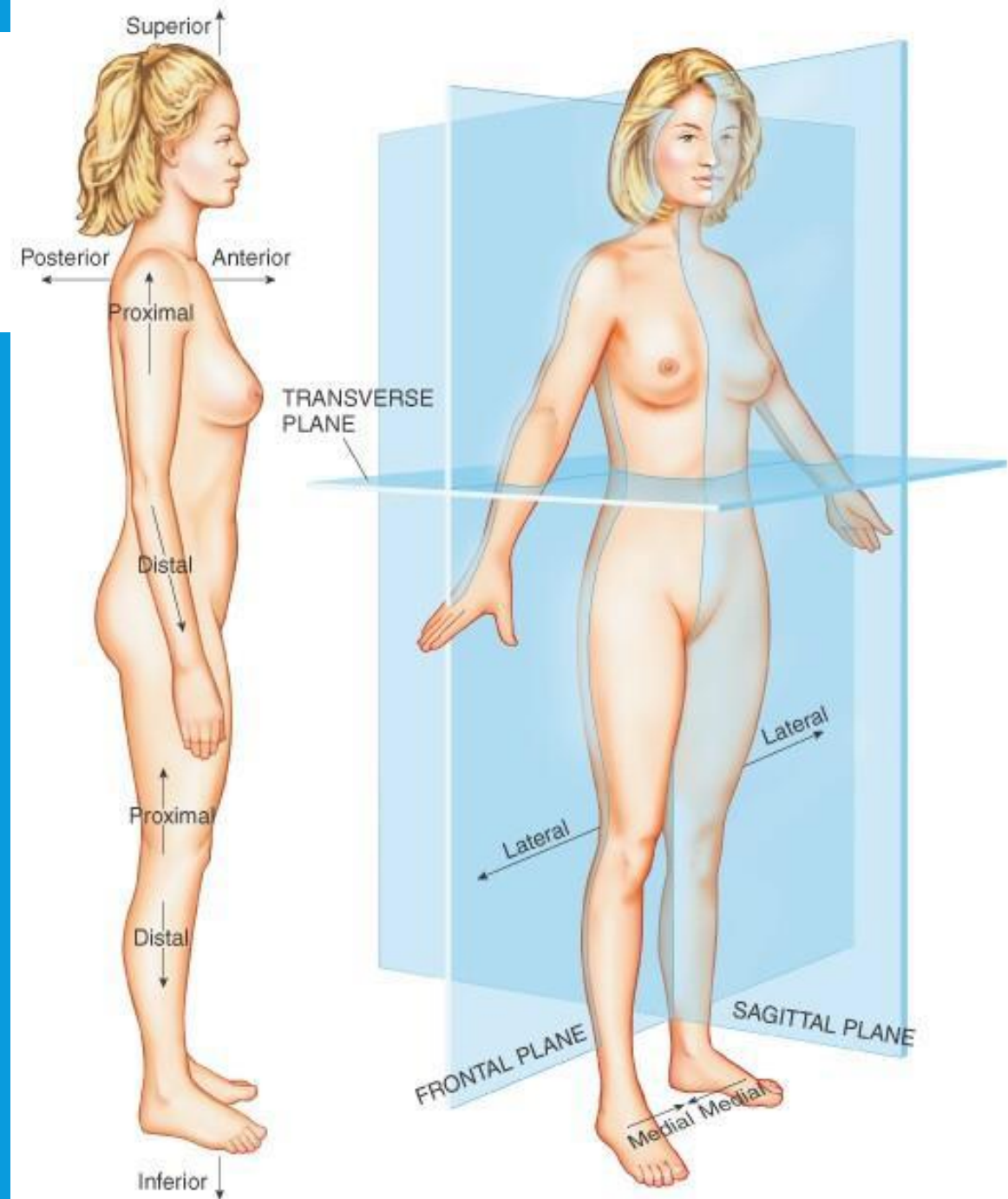
(a) Anterior view

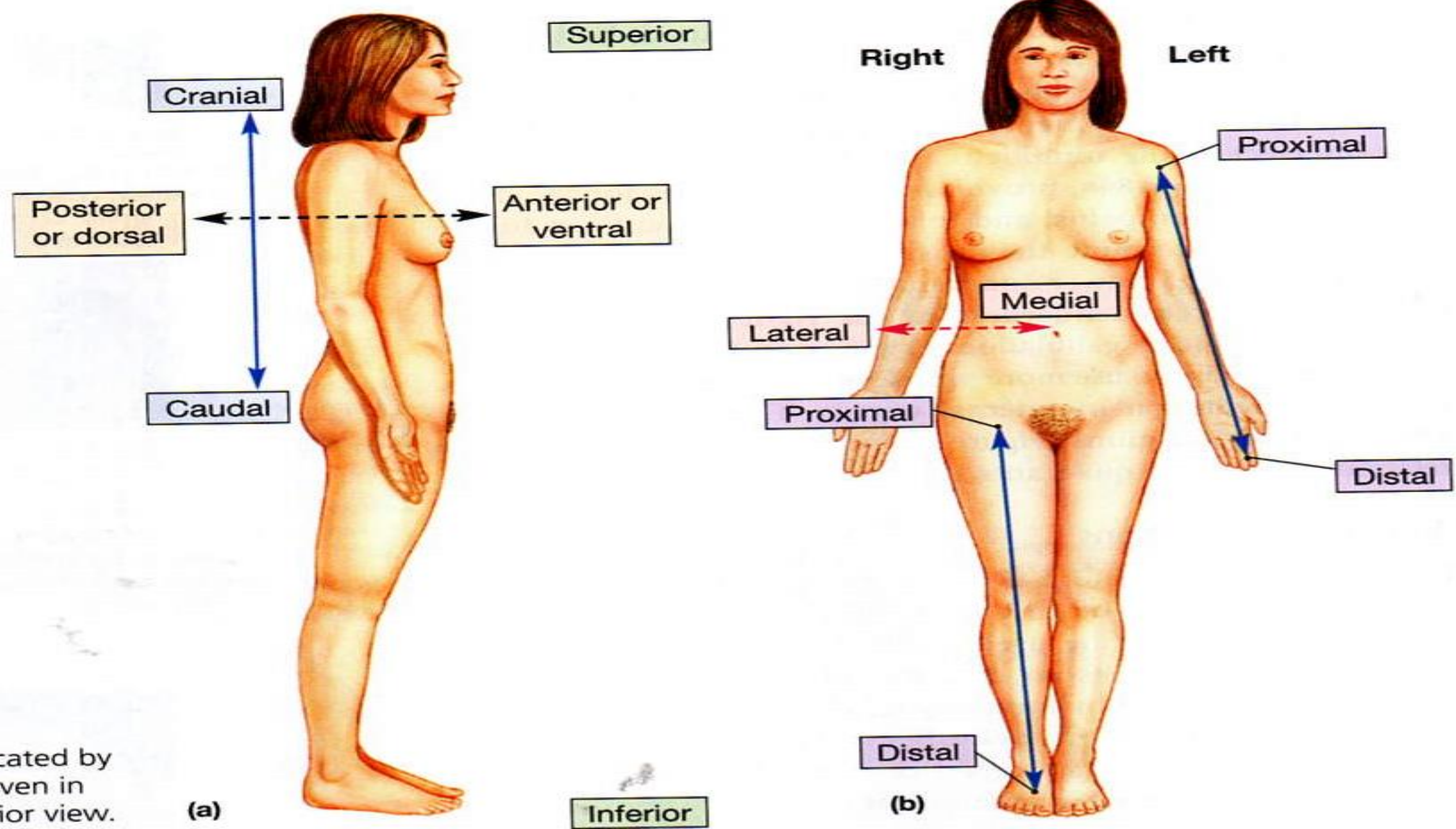


(b) Posterior view

# DIRECTIONAL TERMS

- Superior → toward the head
- Inferior → toward the feet
- Anterior/Ventral → front
- Posterior/Dorsal → back
- Medial → toward the midline
- Lateral → toward the side/away from the midline
- Proximal → toward or nearest the trunk or point of origin
- Distal → away from or farthest from trunk or point of origin
- Superficial → nearest the surface
- Deep → farthest away from the surface



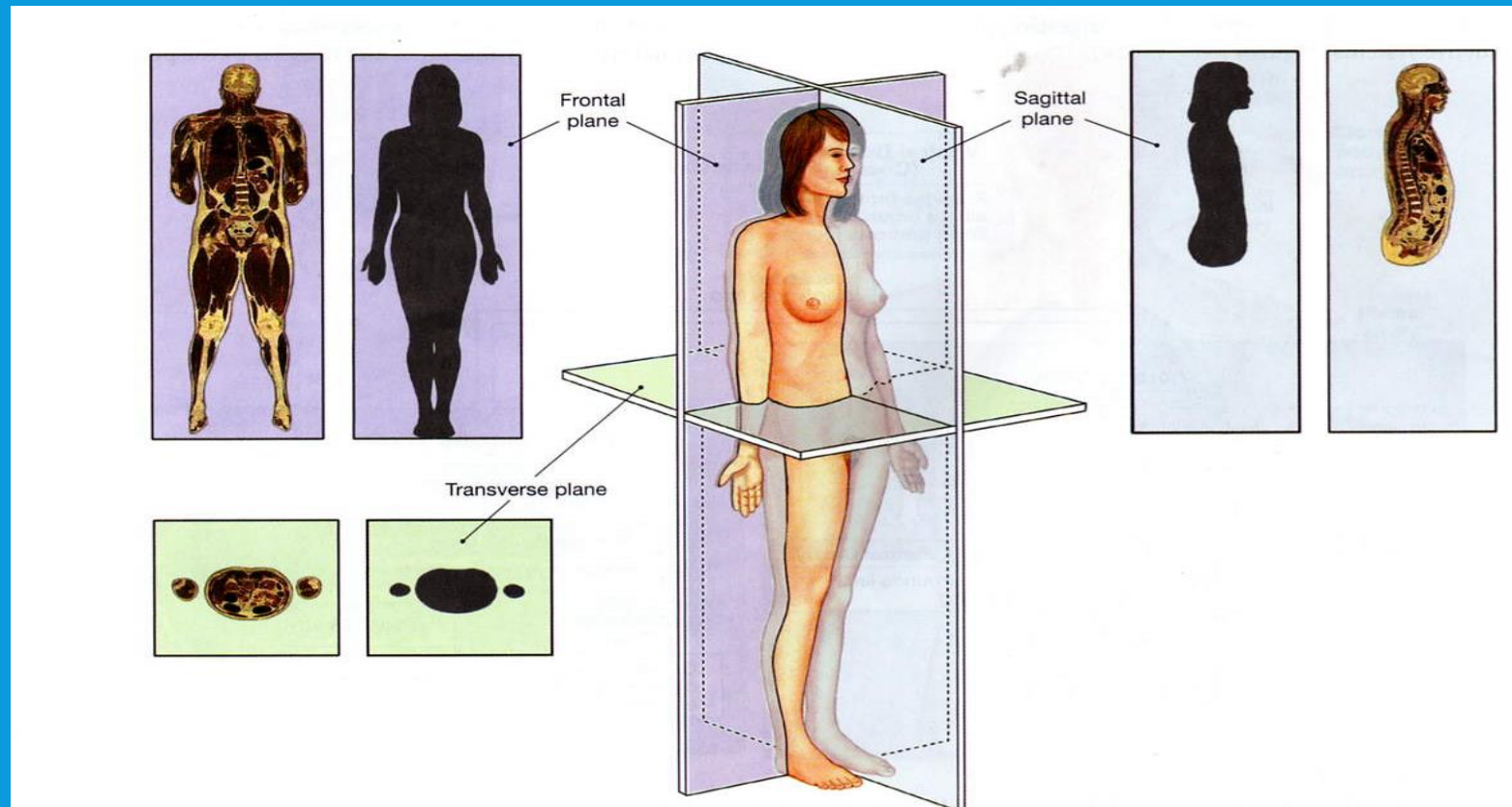


**TABLE 1-3 DIRECTIONAL TERMS (SEE FIGURE 1-9)**

Term	Region or Reference	Example
<b>Anterior</b>	The front; before	The navel is on the <i>anterior</i> surface of the trunk.
<b>Ventral</b>	The belly side (equivalent to anterior when referring to human body)	The navel is on the <i>ventral</i> surface.
<b>Posterior</b>	The back; behind	The shoulder blade is located <i>posterior</i> to the rib cage.
<b>Dorsal</b>	The back (equivalent to posterior when referring to human body)	The <i>dorsal</i> body cavity encloses the brain and spinal cord.
<b>Cranial or cephalic</b>	The head	The <i>cranial</i> , or <i>cephalic</i> , border of the pelvis is on the side toward the head rather than toward the thigh.
<b>Superior</b>	Above; at a higher level (in human body, toward the head)	In humans, the cranial border of the pelvis is <i>superior</i> to the thigh.
<b>Caudal</b>	The tail (coccyx in humans)	The hips are <i>caudal</i> to the waist.
<b>Inferior</b>	Below; at a lower level	The knees are <i>inferior</i> to the hips.
<b>Medial</b>	Toward the body's longitudinal axis; toward the midsagittal plane	The <i>medial</i> surfaces of the thighs may be in contact; moving medially from the arm across the chest surface brings you to the sternum.
<b>Lateral</b>	Away from the body's longitudinal axis; away from the midsagittal plane	The thigh articulates with the <i>lateral</i> surface of the pelvis; moving laterally from the nose brings you to the cheeks.
<b>Proximal</b>	Toward an attached base	The thigh is <i>proximal</i> to the foot; moving proximally from the wrist brings you to the elbow.
<b>Distal</b>	Away from an attached base	The fingers are <i>distal</i> to the wrist; moving distally from the elbow brings you to the wrist.
<b>Superficial</b>	At, near, or relatively close to the body surface	The skin is <i>superficial</i> to underlying structures.
<b>Deep</b>	Farther from the body surface	The bone of the thigh is <i>deep</i> to the surrounding skeletal muscles.

# BODY PLANES

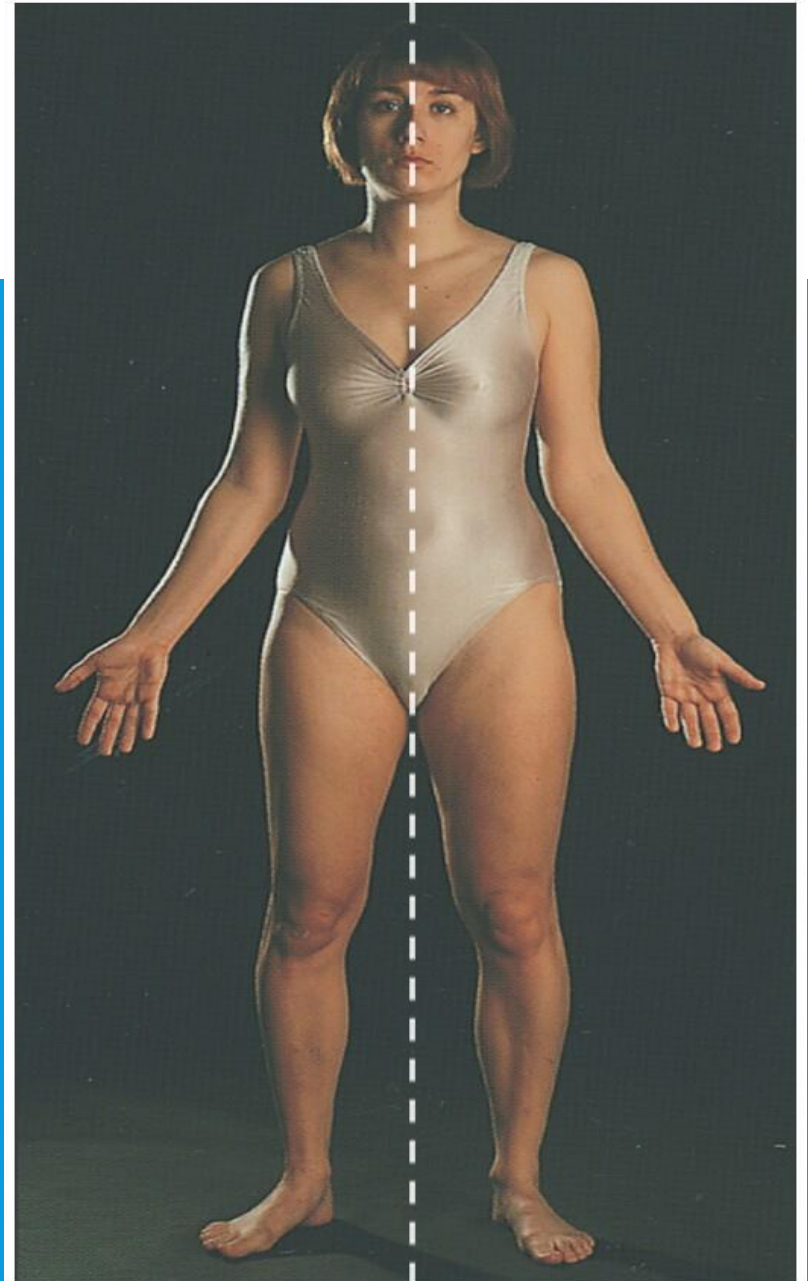
- Sagittal
  - Lengthwise, front to back, divides body into left and right sides
  - Midsagittal → Sagittal section in middle
- Coronal/Frontal
  - Lengthwise, side to side, divides body into anterior and posterior portions
  - Frontal plane
- Transverse
  - Crosswise, divides body or parts into upper and lower parts
  - Horizontal plane



Orientation of Plane	Plane	Directional Reference	Description
Perpendicular to long axis	Transverse or horizontal	Transversely or horizontally	A <i>transverse, or horizontal, section</i> separates superior and inferior portions of the body.
Parallel to long axis	Sagittal	Sagittally	A <i>sagittal section</i> separates right and left portions. You examine a sagittal section, but you section sagittally.
	Midsagittal		In a <i>midsagittal section</i> , the plane passes through the midline, dividing the body in half and separating the right and left sides.
	Parasagittal		A <i>parasagittal section</i> misses the midline, separating right and left portions of unequal size.
	Frontal or coronal	Frontally or coronally	A <i>frontal, or coronal, section</i> separates anterior and posterior portions of the body; coronal usually refers to sections passing through the skull.

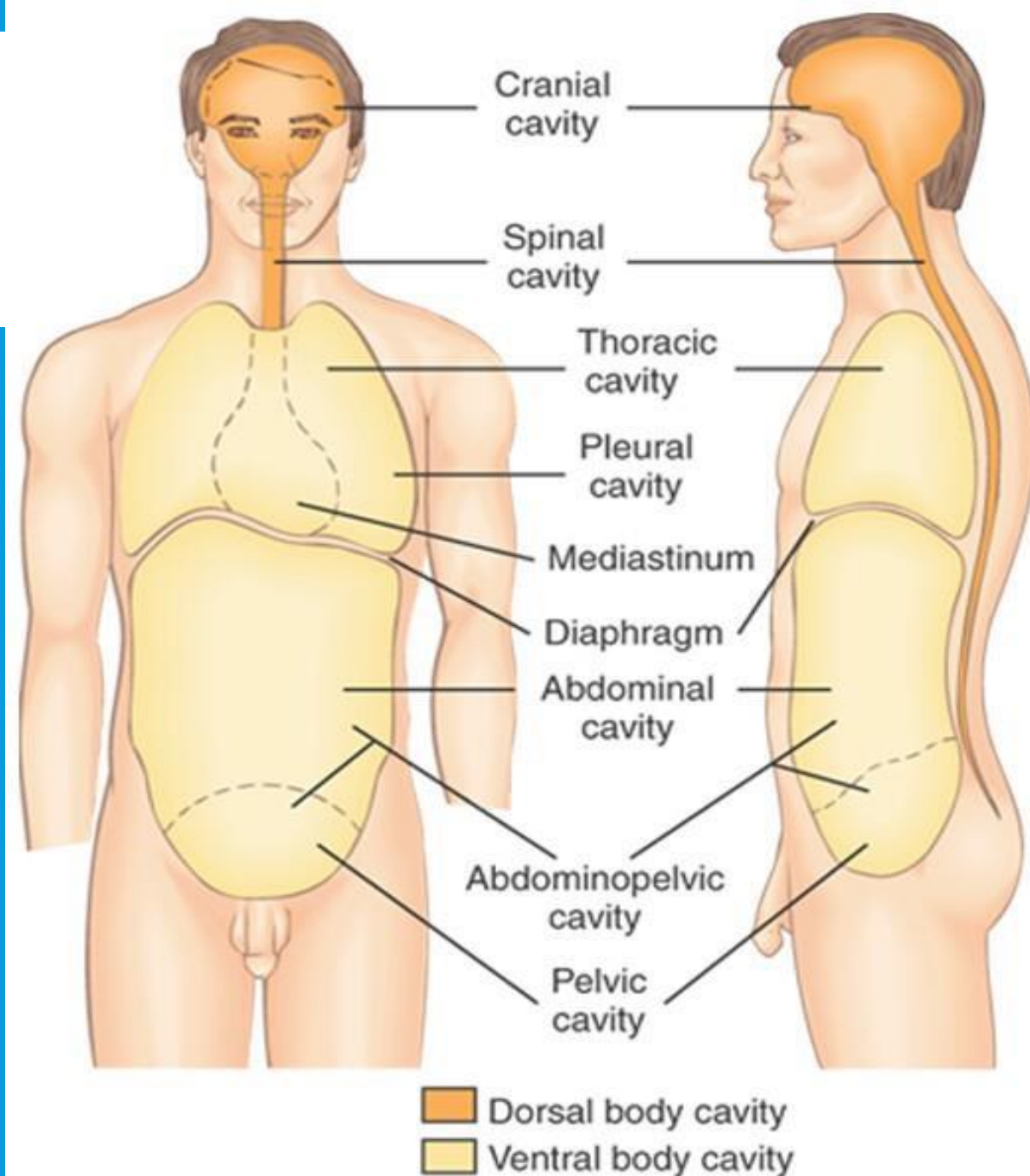
# ANATOMICAL POSITION/ BILATERAL SYMMETRY

- Anatomical Position
  - Erect
  - Palms, head and feet forward
- Bilateral Symmetry
  - Right and left sides are mirror images
- Ipsilateral
  - Same side
- Contralateral
  - Opposite side



# BODY CAVITIES

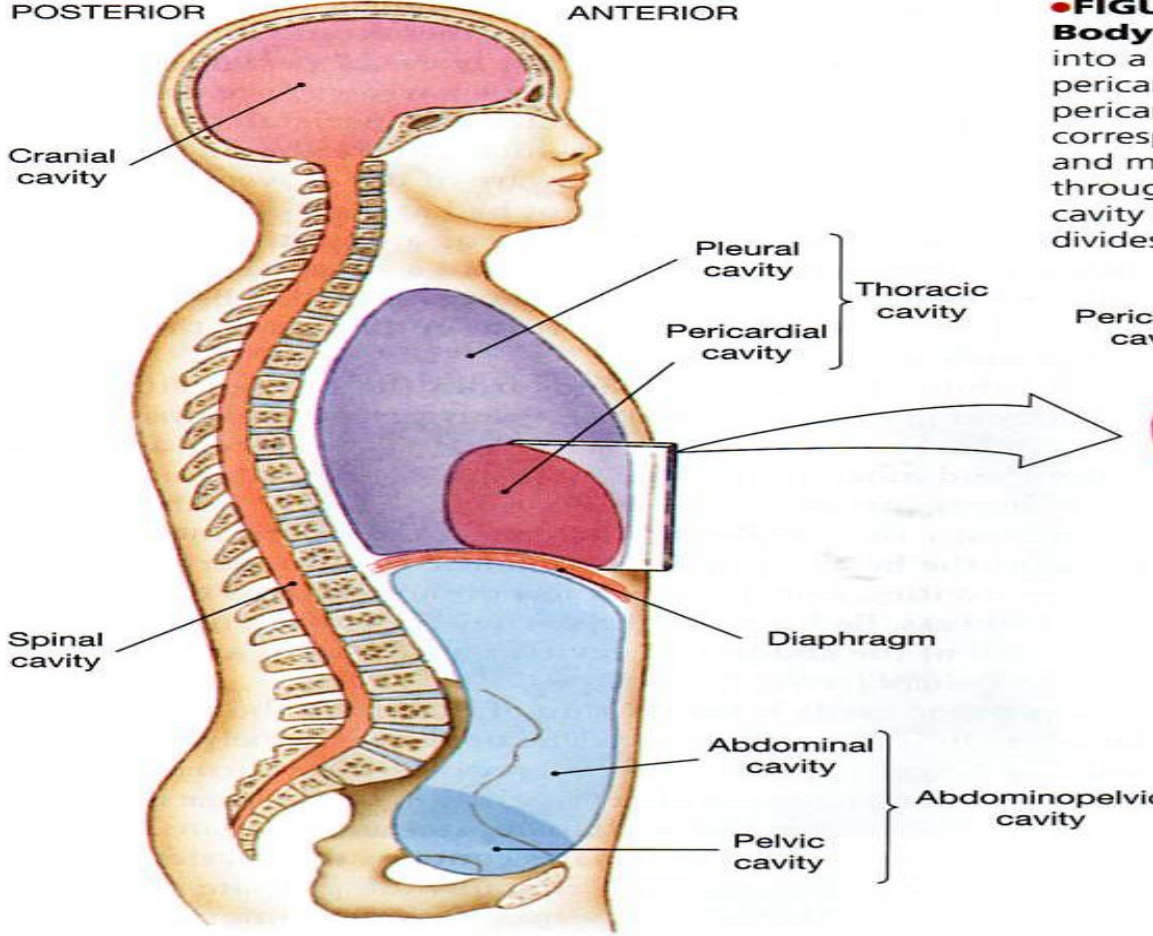
- Posterior/Dorsal (back)
  - Cranial
  - Spinal
- Anterior/Ventral (front)
  - Thoracic
    - Mediastinum
    - Pleural
  - Abdominopelvic
    - Abdominal
    - Pelvic



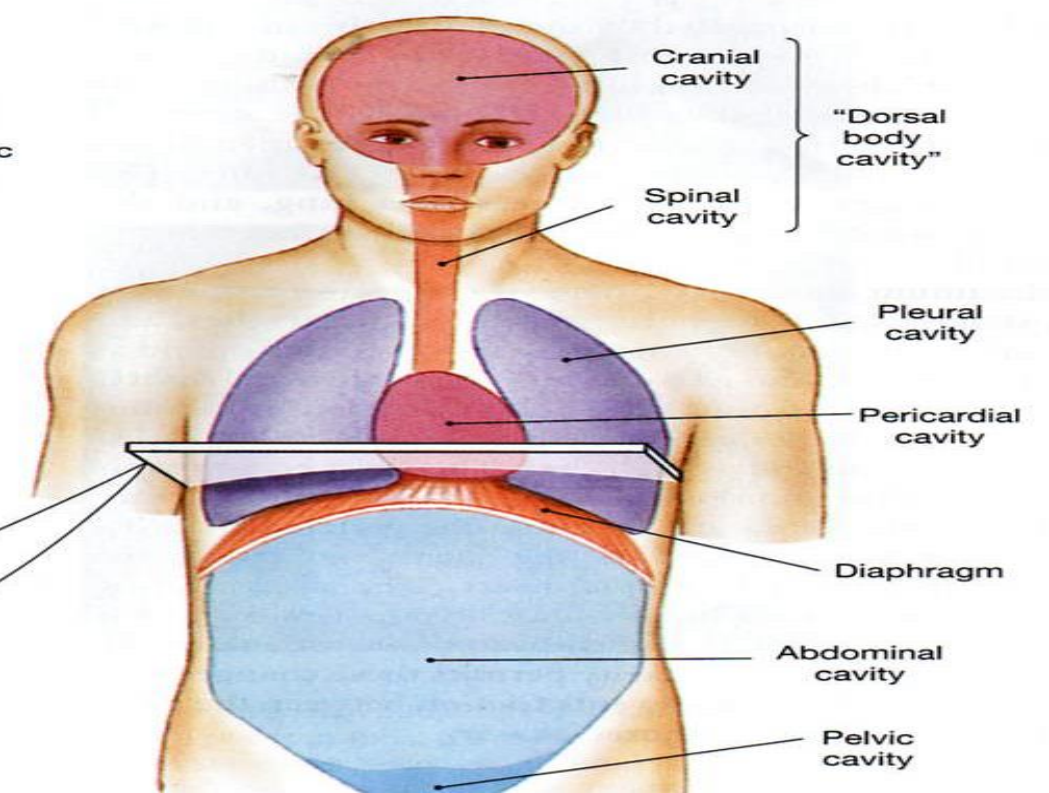
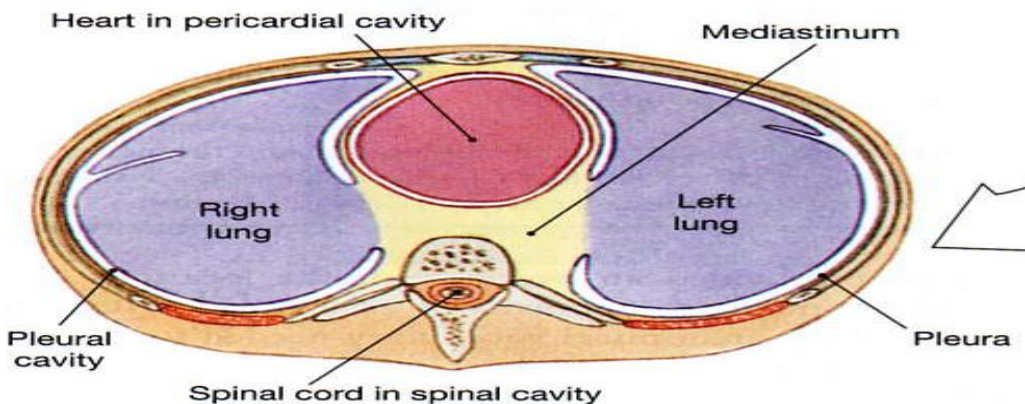
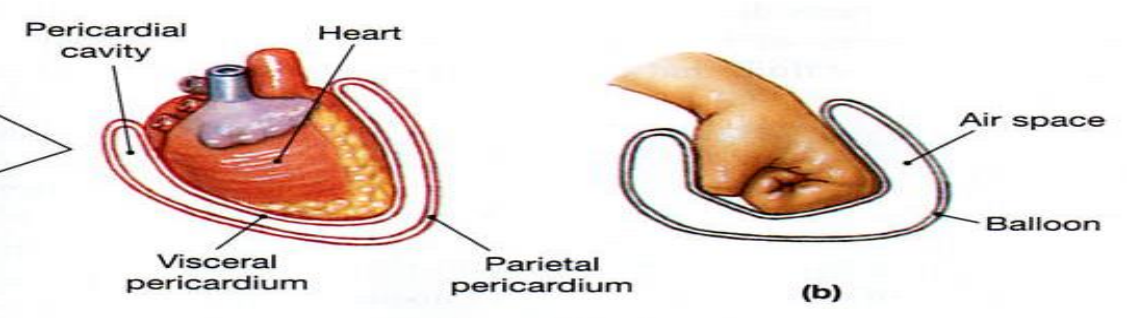


# BODY CAVITY LININGS

- Parietal
  - Wall of a body cavity or lining membrane that covers the surface
    - *Parietal Peritoneum*
      - Membrane lining the inside of the abdominal cavity
- Visceral
  - Thin membrane that covers the organs within a cavity
    - *Visceral Peritoneum*
      - Membrane that covers the organs within the abdominal cavity



**Body Cavities.** (a) The muscular diaphragm divides the ventral body cavity into a superior thoracic (chest) cavity and an inferior abdominopelvic cavity. The pericardial cavity is inside the chest cavity. (b) The heart is suspended within the pericardial cavity like a fist pushed into a balloon. The attachment site, corresponding to the wrist of the hand, lies at the connection between the heart and major blood vessels. (c) An anterior view of, and (d) a transverse section through, the ventral body cavity, showing the central location of the pericardial cavity within the chest cavity. The sectional plane shows how the mediastinum divides the thoracic cavity into two pleural cavities.



## **Ventral Body Cavity (Coelom)**

Provides protection;  
allows organ movement;  
lining prevents friction

*separated by diaphragm into*

### **Thoracic Cavity**

Surrounded by chest wall and diaphragm

*subdivided into*

#### **Right Pleural Cavity**

Surrounds right lung

#### **Mediastinum**

Contains the trachea, esophagus, and major vessels

#### **Left Pleural Cavity**

Surrounds left lung

*also contains*

#### **Pericardial Cavity**

Surrounds the heart

### **Abdominopelvic Cavity**

Contains the peritoneal cavity

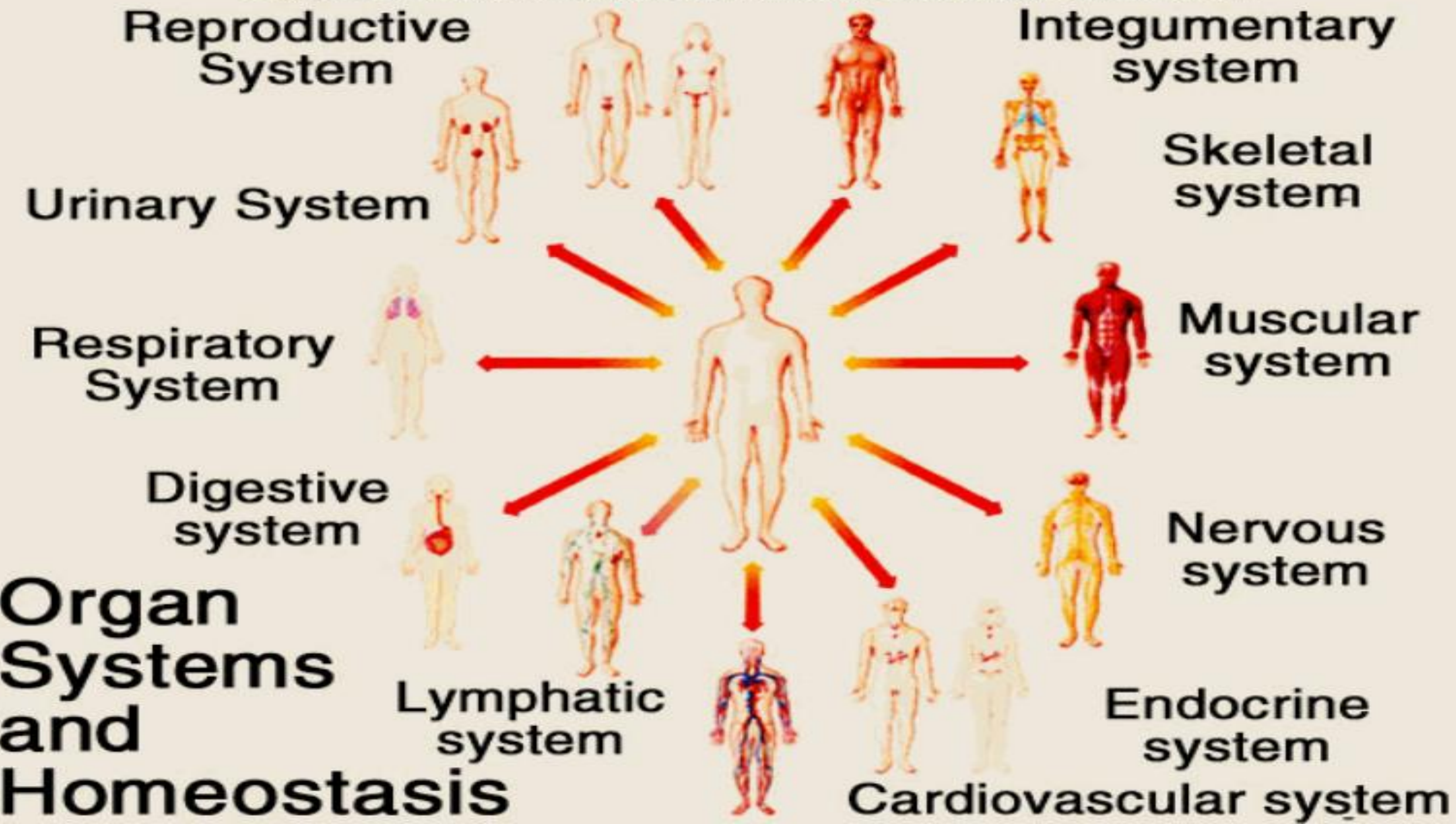
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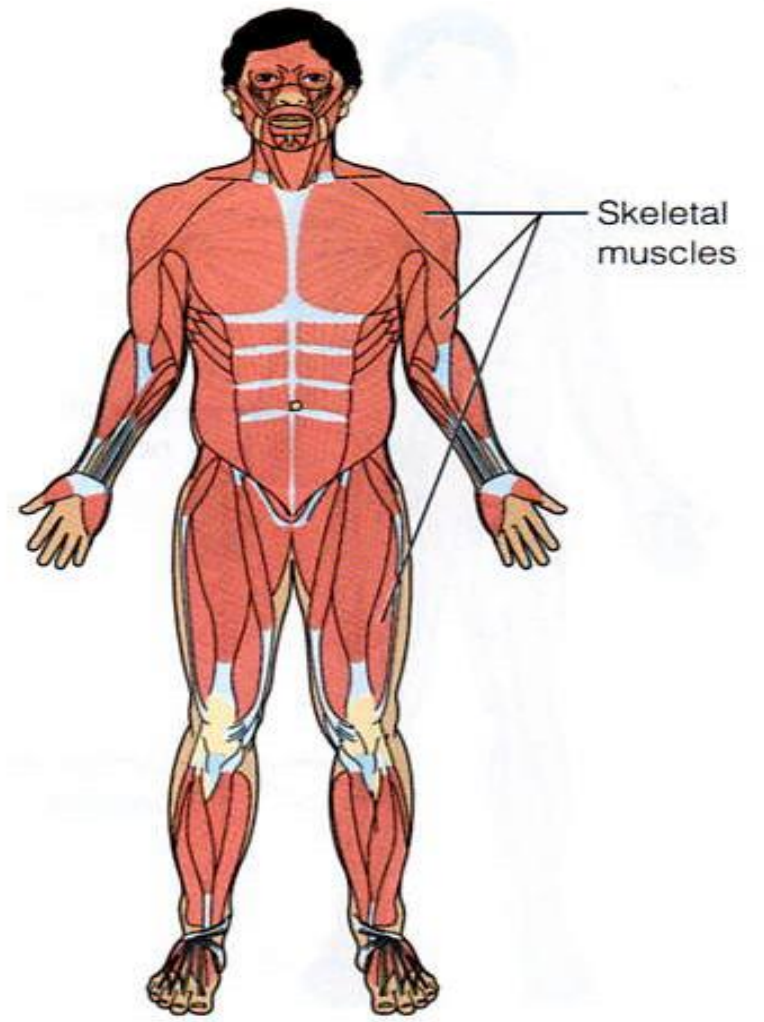
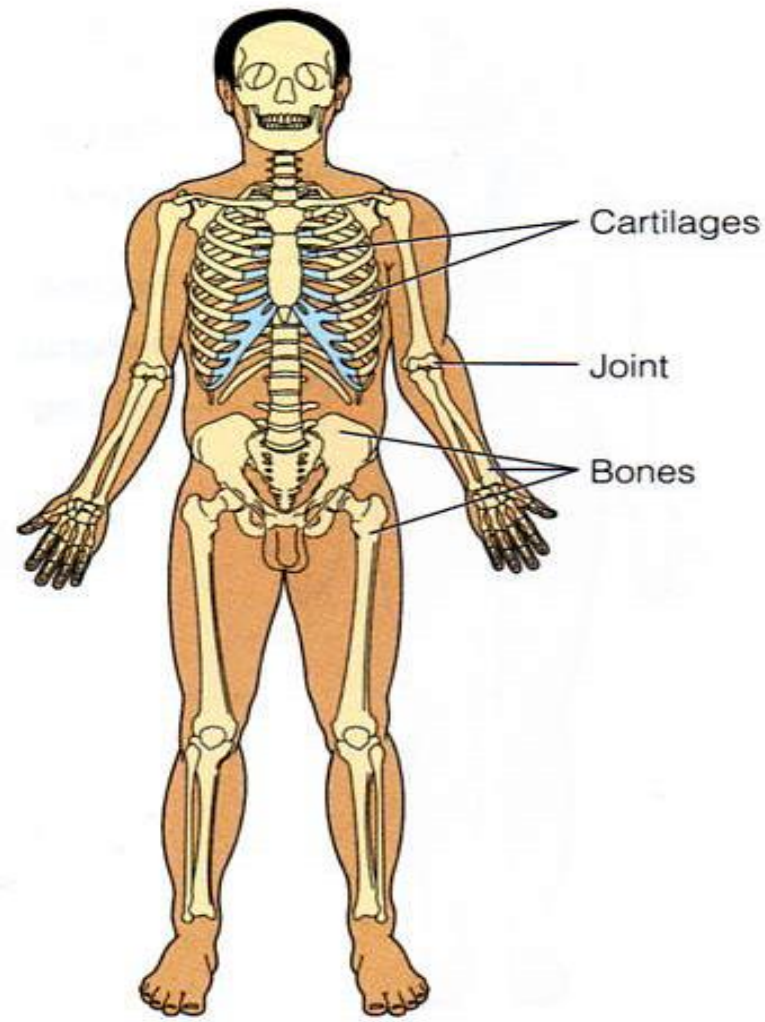
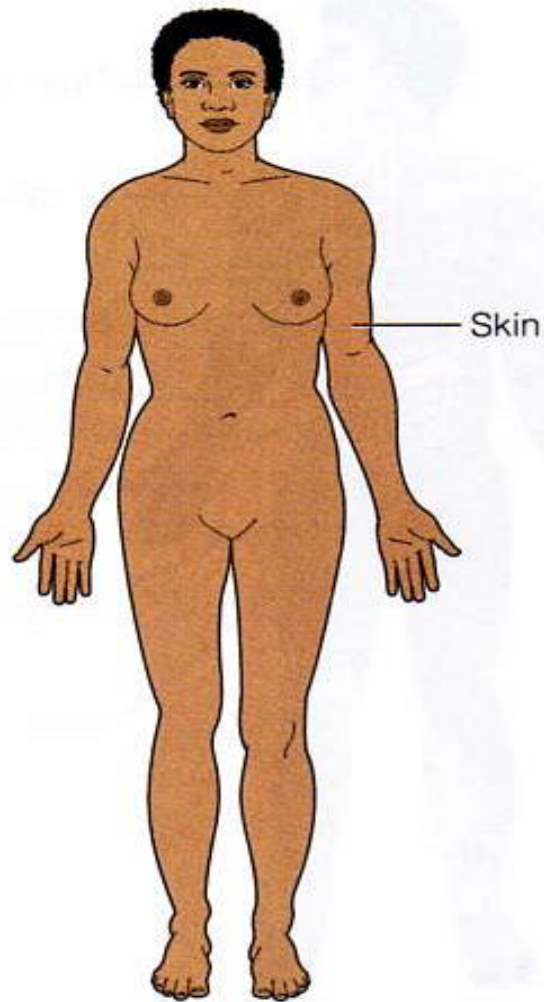
#### **Abdominal Cavity**

Contains many digestive glands and organs

#### **Pelvic Cavity**

Contains urinary bladder, reproductive organs, last portion of digestive tract





○ **(a) Integumentary system**

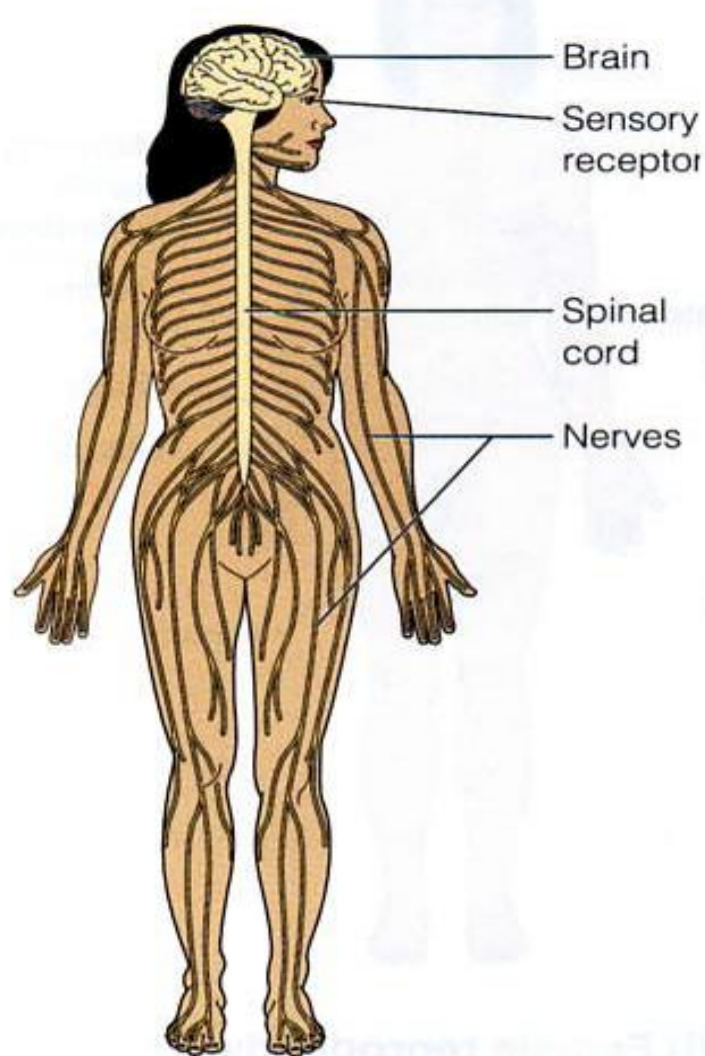
Forms the external body covering; protects deeper tissue from injury; synthesizes vitamin D; location of cutaneous (pain, pressure, etc.) receptors; and sweat and oil glands.

● **(b) Skeletal system**

Protects and supports body organs; provides a framework the muscles use to cause movement; blood cells are formed within bones; stores minerals.

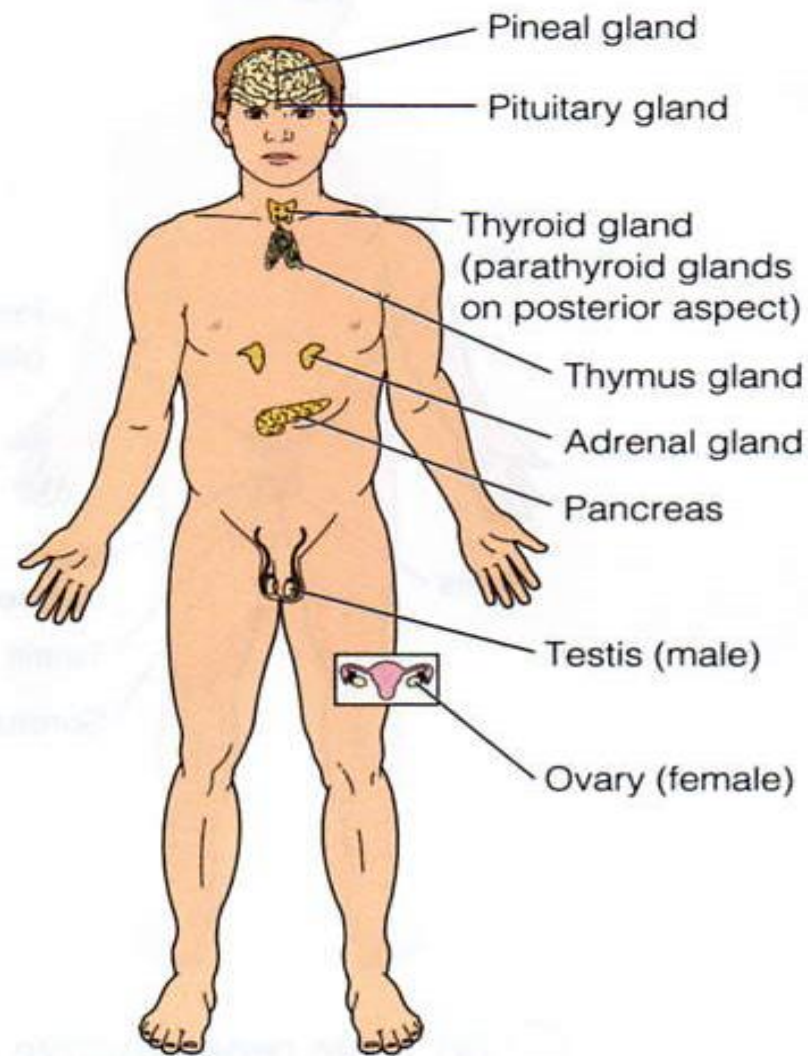
● **(c) Muscular system**

Allows manipulation of the environment, locomotion, and facial expression; maintains posture; produces heat.



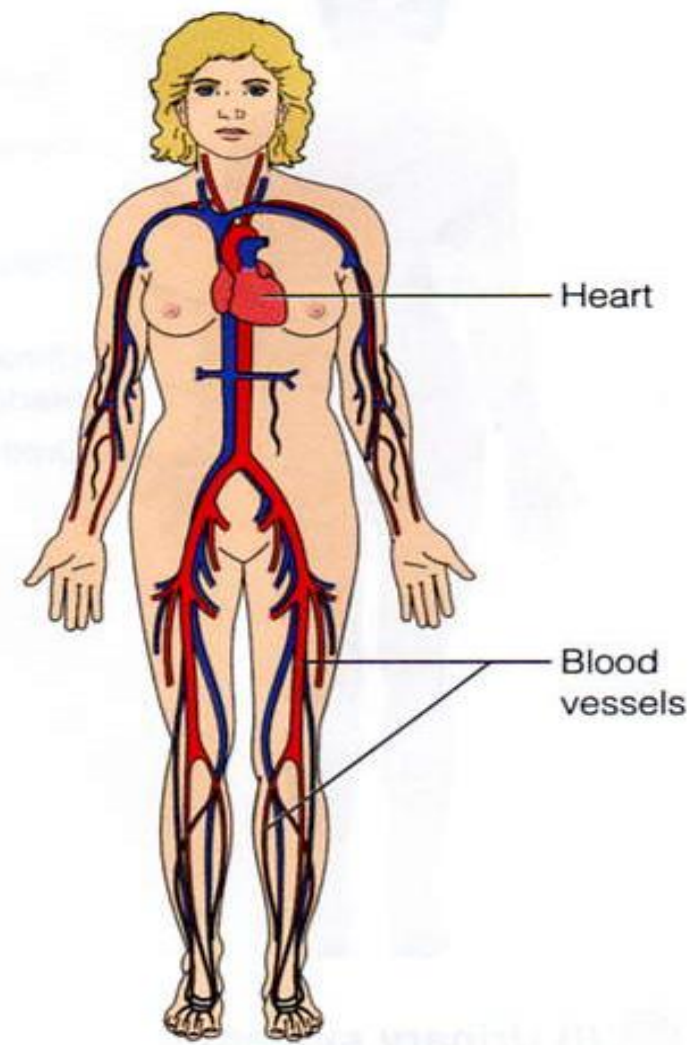
**(d) Nervous system**

Fast-acting control system of the body; responds to internal and external changes by activating appropriate muscles and glands.



**(e) Endocrine system**

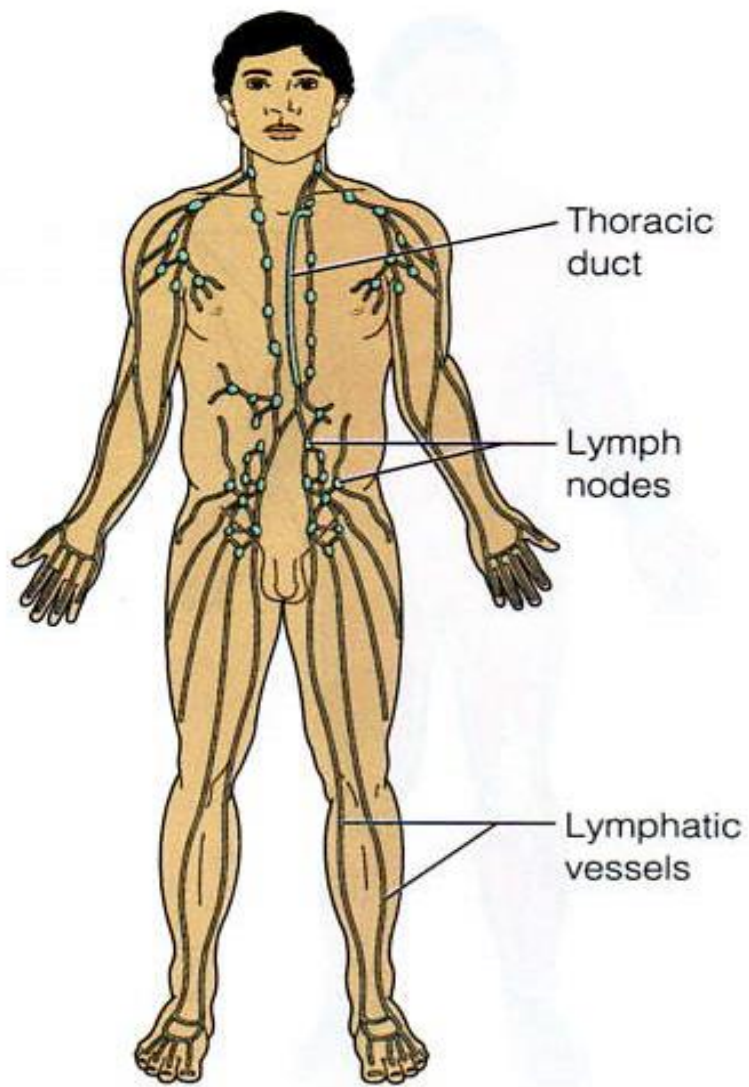
Glands secrete hormones that regulate processes such as growth, reproduction, and nutrient use (metabolism) by body cells.



**(f) Cardiovascular system**

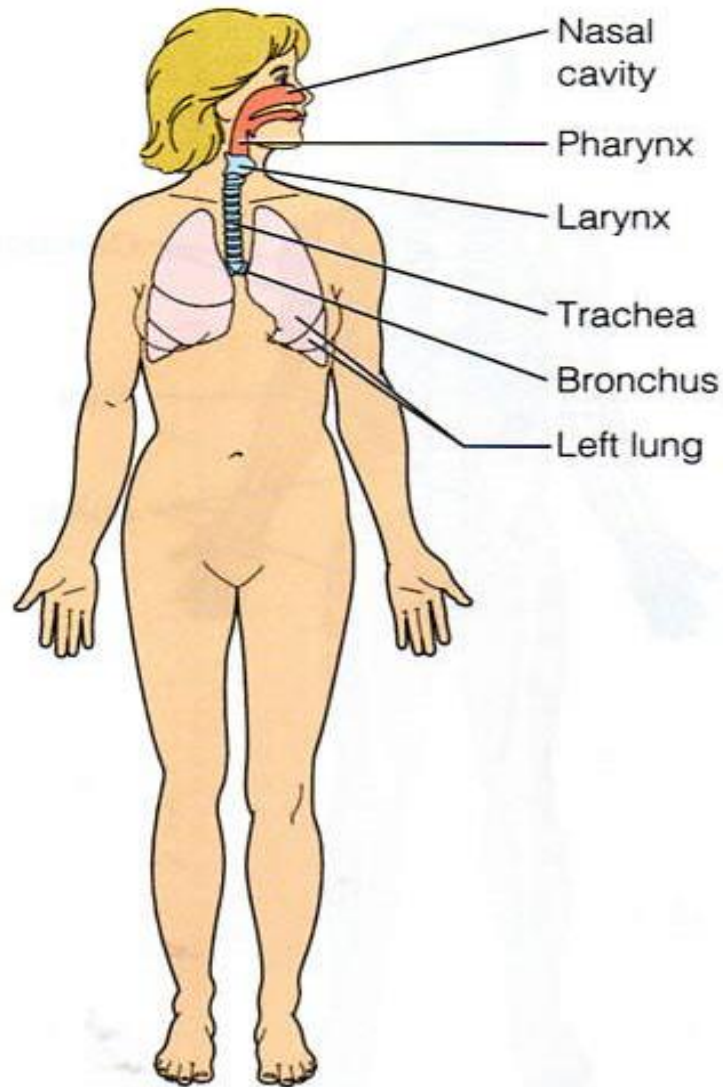
Blood vessels transport blood which carries oxygen, carbon dioxide, nutrients, wastes, etc.; the heart pumps blood.





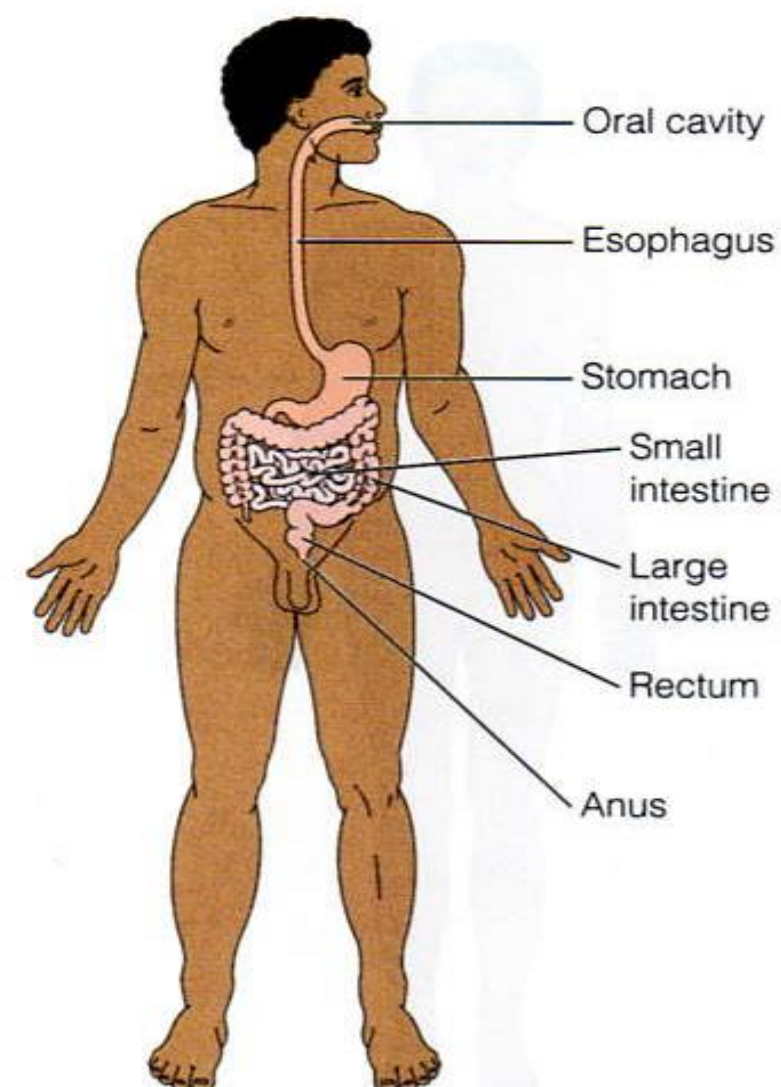
**(g) Lymphatic system**

Picks up fluid leaked from blood vessels and returns it to blood; disposes of debris in the lymphatic stream; houses white blood cells involved in immunity.



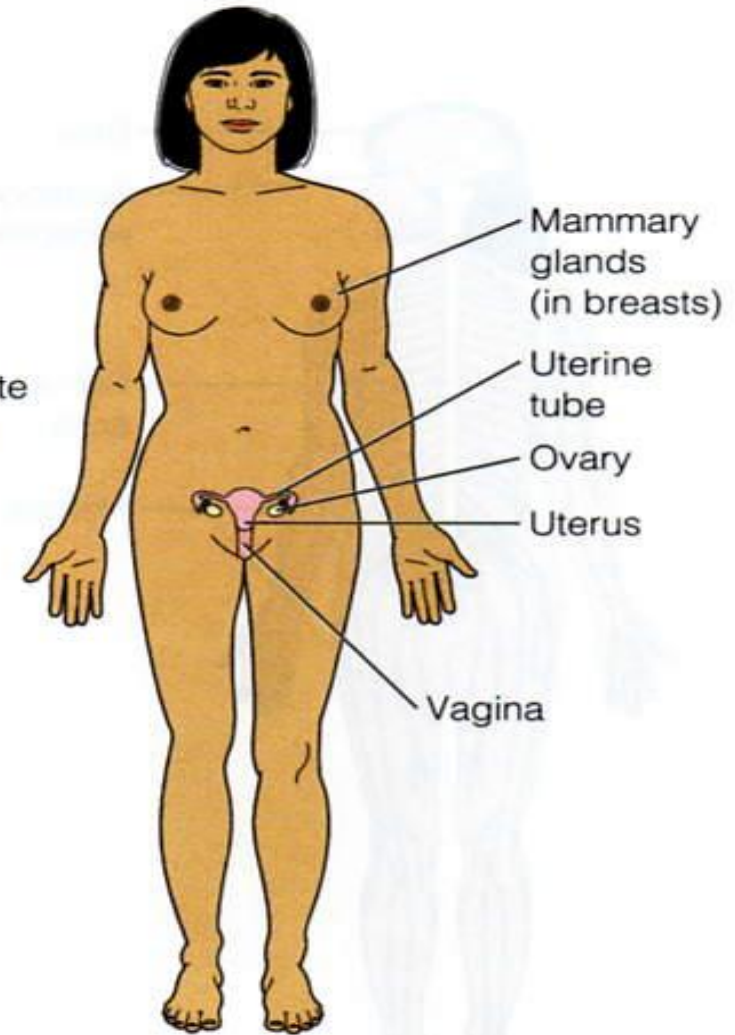
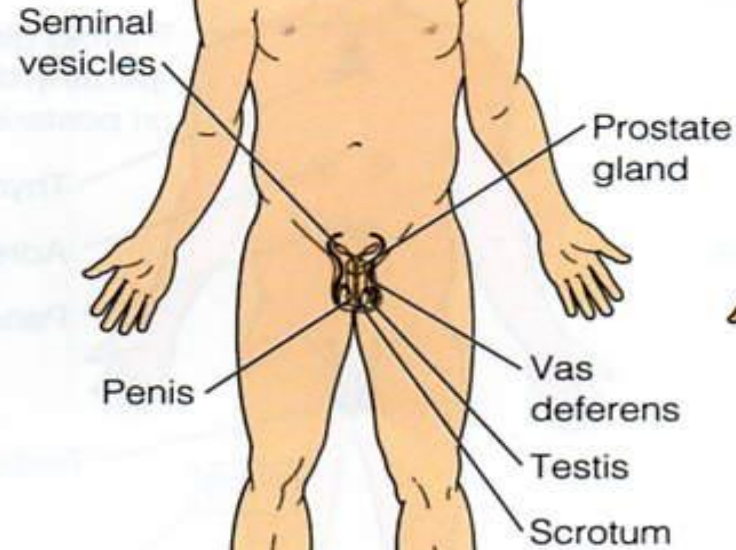
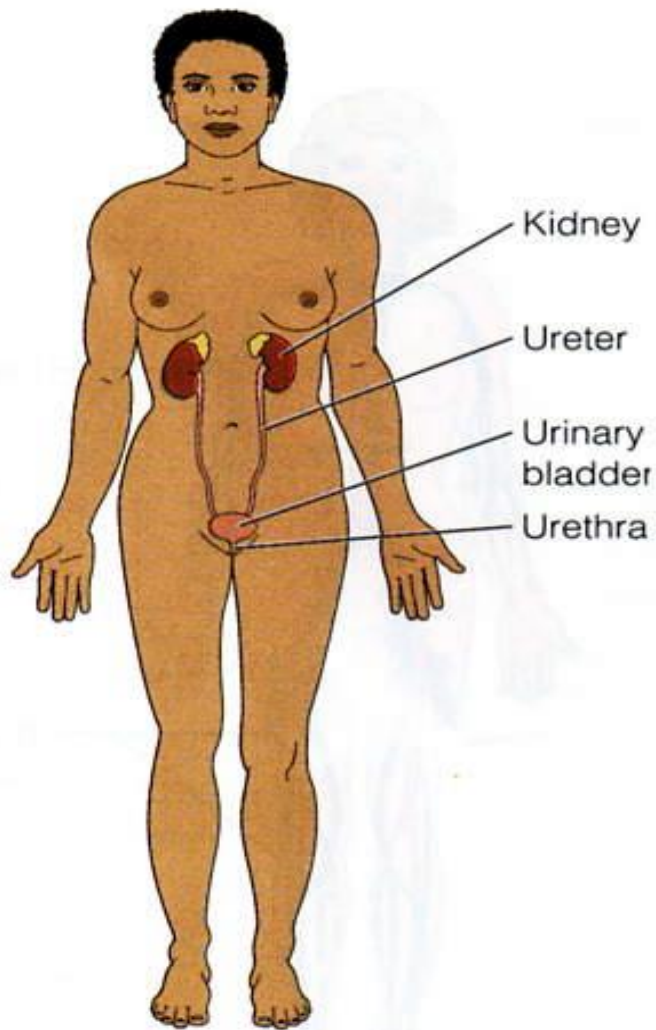
**(h) Respiratory system**

Keeps blood constantly supplied with oxygen and removes carbon dioxide; the gaseous exchanges occur through the walls of the air sacs of the lungs.



**(i) Digestive system**

Breaks down food into absorbable units that enter the blood for distribution to body cells; indigestible food stuffs are eliminated as feces.



**(j) Urinary system**

Eliminates nitrogenous wastes from the body; regulates water, electrolyte, and acid-base balance of the blood.

**(k) Male reproductive system**

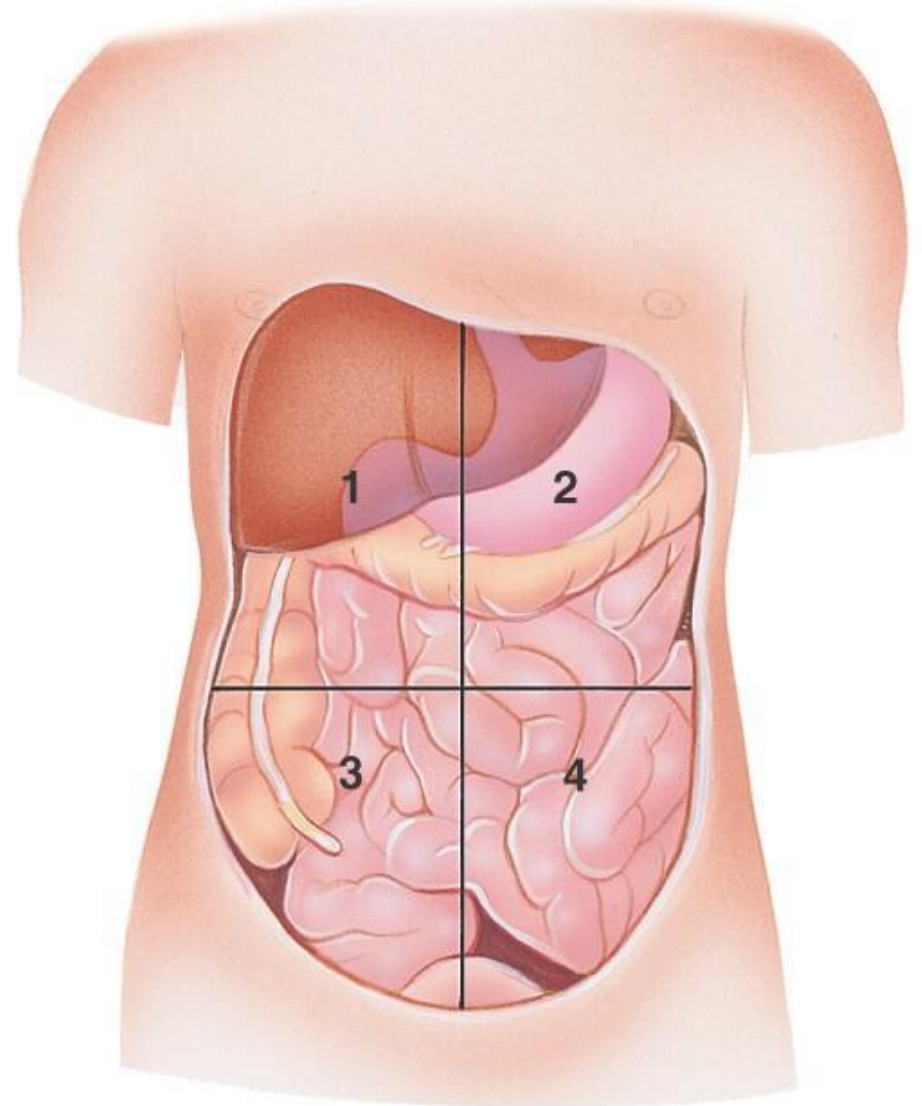
**(l) Female reproductive system**

Overall function of the reproductive system is production of offspring. Testes produce sperm and male sex hormone; ducts and glands aid in delivery of viable sperm to the female reproductive tract. Ovaries produce eggs and female sex hormones; remaining structures serve as sites for fertilization and development of the fetus. Mammary glands of female breast produce milk to nourish the newborn.



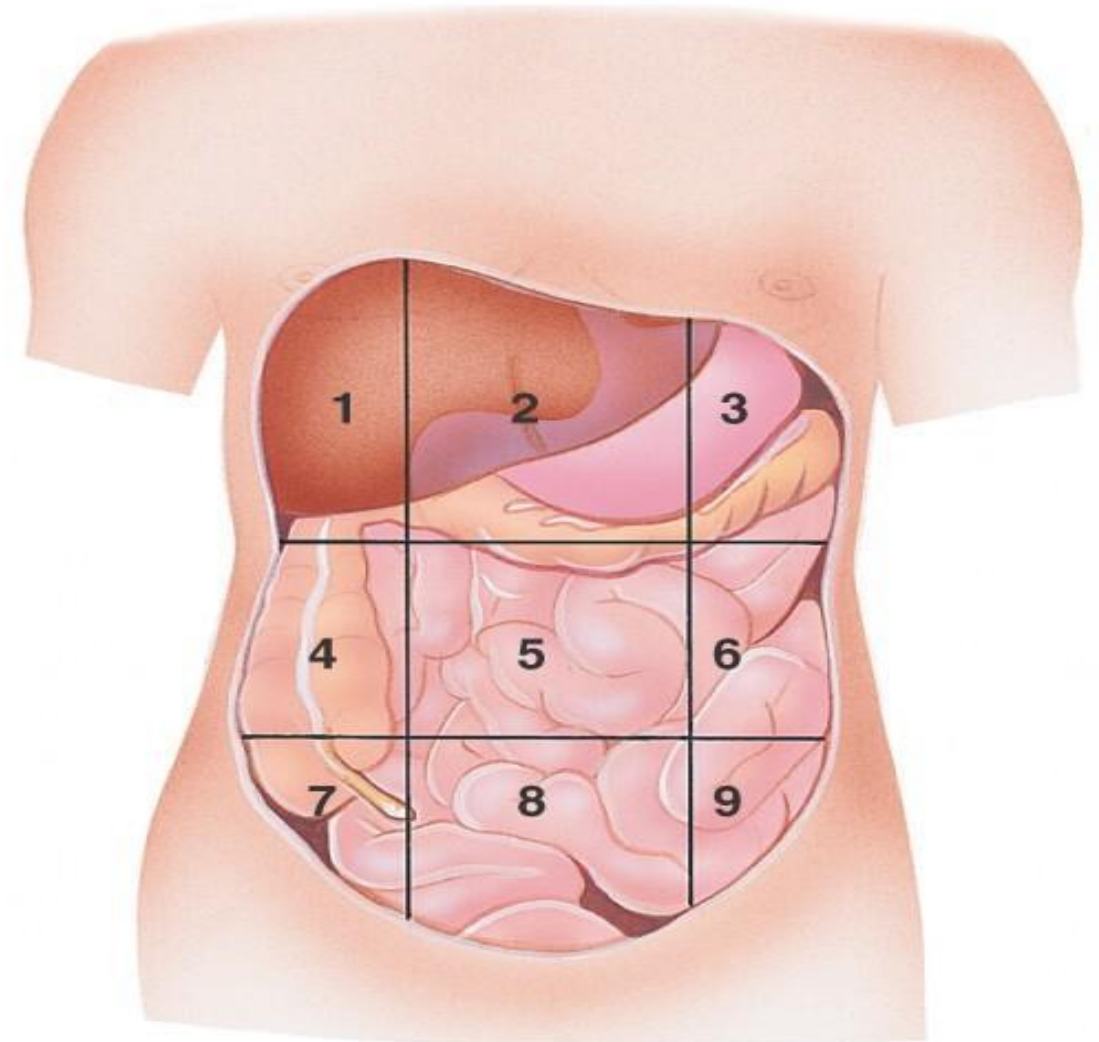
# ABDOMINOPELVIC REGIONS – 4 QUADRANTS

- Doctors divide torso into quadrants to describe the site of pain and/or internal pathology
- 1. Right upper quadrant (RUQ)
- 2. Left upper quadrant (LUQ)
- 3. Right lower quadrant (RLQ)
- 4. Left lower quadrant (LLQ)



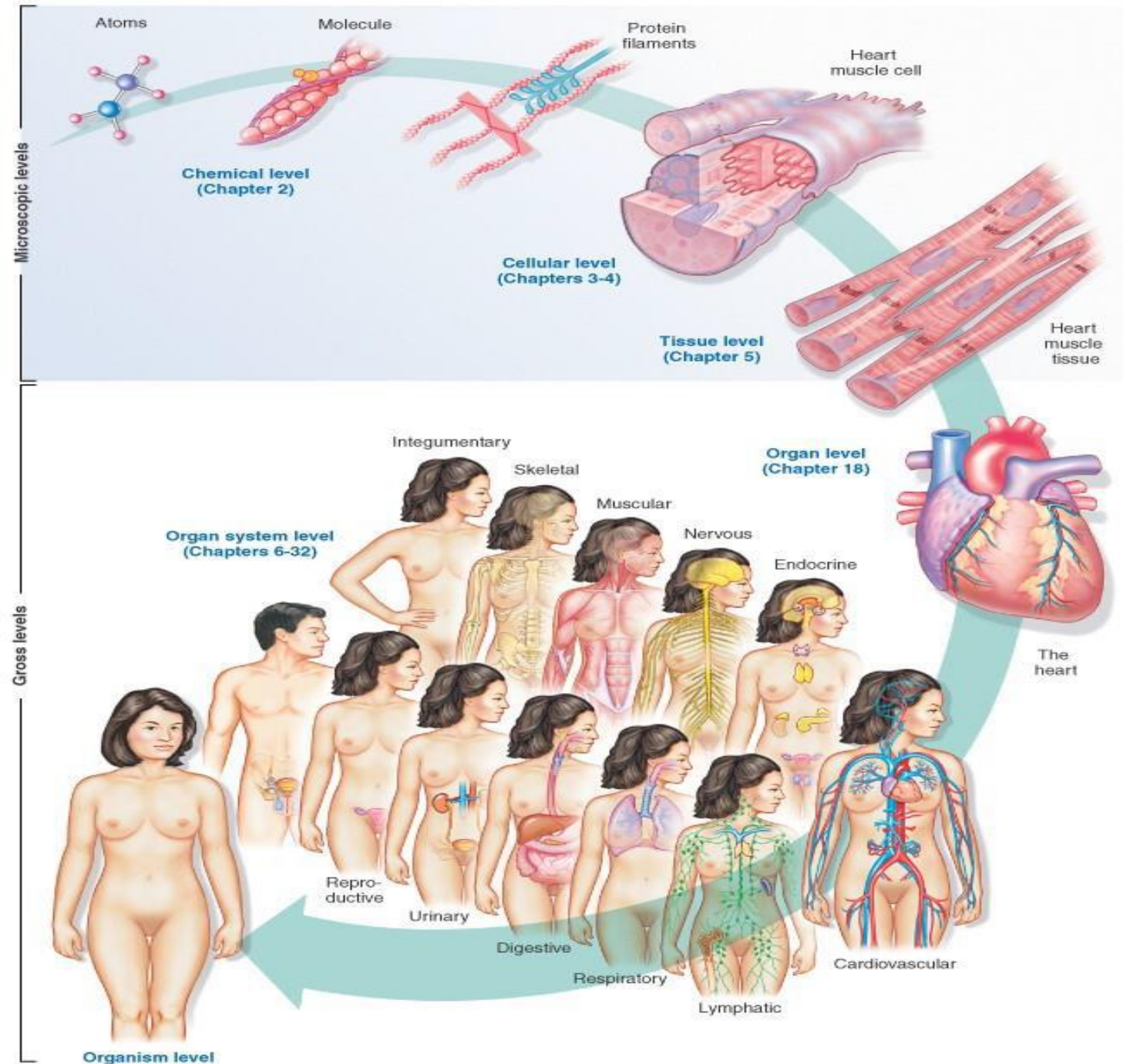
# ABDOMINAL REGIONS – SUPERFICIAL ORGANS

1. Right Hypochondriac → Right lobe of liver, gallbladder
2. Epigastric → Right and left lobes of liver, stomach
3. Left Hypochondriac → Stomach, large intestine
4. Right Lumbar → Large and small intestine
5. Umbilical → Transverse colon, small intestine
6. Left Lumbar → Small intestine, colon
7. Right Iliac → Cecum, small intestine
8. Hypogastric → Small intestine, bladder, appendix
9. Left Iliac → Colon, small intestine



# LEVELS OF ORGANIZATION

1. Atom (smallest)
2. Molecule
3. Macromolecule
4. Cell
5. Tissue
6. Organ
7. Organ System
8. Organism (largest)



# LEVELS OF ORGANIZATION

## 1. Chemical (Atoms → Molecules → Macromolecules)

- Basis for life
- More than 100 different atoms (chemical building blocks of nature)

## 2. Organelle

- Structure made of molecules organized so that it can perform a certain function
- Cannot survive outside the cell
- “Tiny organs” that allow each cell to live

## 3. Cellular

- Cells → smallest and most numerous structural units that possess and exhibit the basic characteristics of living matter
- 150 lb adult =  $1 \times 10^{14}$  cells (100 trillion)
- Membrane, nucleus, cytoplasm, organelles
- Cells specialize/differentiate to perform unique functions

# LEVELS OF ORGANIZATION

## 4. Tissue

- Group of similar cells that develop together from the same part of the embryo
- Specialized to perform certain functions
- Surrounded by varying amounts and kinds of nonliving, intercellular substances, or matrix
- Four major tissues:
  1. Epithelial
  2. Connective
  3. Muscle
  4. Nervous

## 5. Organ

- Structure made up of several different kinds of tissues to perform a certain function
- Each one has a unique shape, size, appearance, and placement in the body
- Identified by tissue pattern that it forms

# LEVELS OF ORGANIZATION

## 6. System

- Most complex organizational unit of the body
- Involves varying numbers and kinds of organs to perform complex functions
- 11 major systems

## 7. Organism

- Interactive structures able to survive in hostile environments
- Permit homeostasis

Atoms → Molecules → Macromolecules → Organelles → Cells → Tissues → Organs → Organ Systems → Organism

# CHARACTERISTICS OF LIFE

## 1. Responsiveness

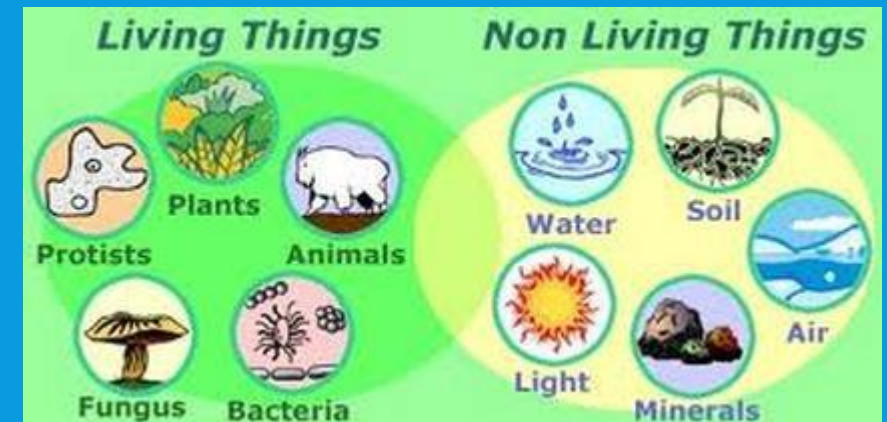
- Permits an organism to sense, monitor, and respond to changes in its external environment
- Highly developed in nerve and muscle cells

## 2. Conductivity

- Capacity of living cells and tissues to selectively transmit or propagate a wave of excitation from one point to another within the body
- Highly developed in nerve and muscle cells

## 3. Growth

- Normal increase in size or number of cells
- Produces an increase in size (person, organ, part)
- Little change in the shape



# CHARACTERISTICS OF LIFE

## 4. Respiration

- Involves the process in absorption, transport, utilization, or exchange of respiratory gases between an organism and its environment
- Internal vs. external

## 5. Digestion

- Complex food products are broken down into simpler substances that can be absorbed and used by the organism

## 6. Absorption

- Movement of digested nutrients through the wall of the digestive tube and into body fluids for transport to cells

## 7. Secretion

- Production and delivery of specialized substances (digestive juices, hormones) for diverse body functions



# CHARACTERISTICS OF LIFE

## 8. Excretion

- Removal of wastes produced during body functions (breakdown and use of nutrients in the cell)

## 9. Circulation

- Movement of body fluids and many other substances (nutrients, hormones, waste products) from one body area to another

## 10. Reproduction

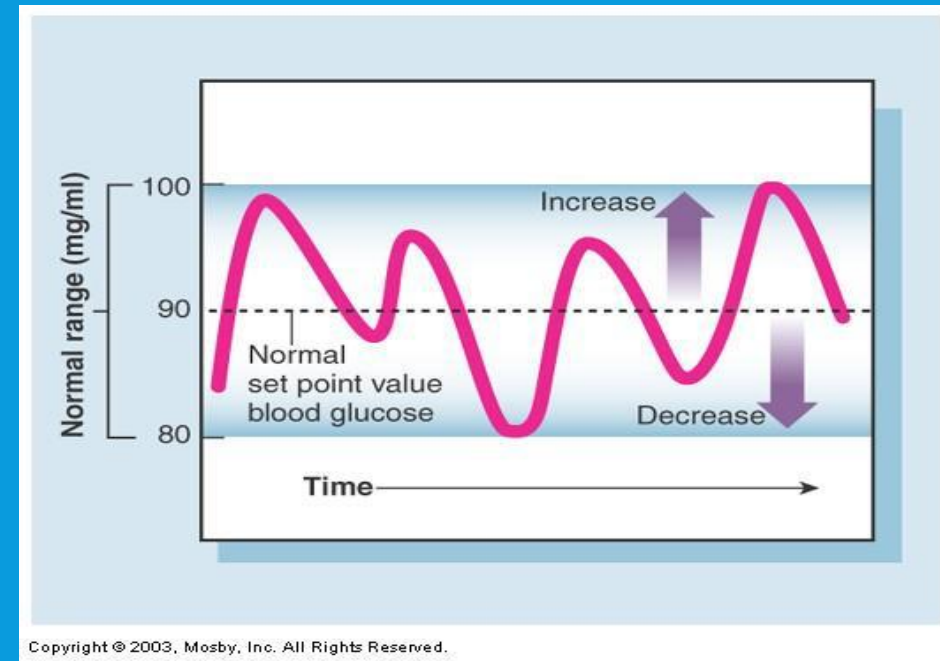
- Formation of new individual and new cells (cell division)
- Permits growth, wound repair, and replacement of dead/aging cells

## 11. Metabolism

- Describes the various processes by which life is made possible
- Breakdown of nutrients
- Produce energy
- Transform one material into another
- Required to make complex compounds out of simple compounds

# HOMEOSTASIS

- A relatively constant state maintained by the body
- Ability of the body to maintain its internal environment (cellular environment) as the external environment constantly changes
  - Internal environment = body temperature, pH level, glucose level
  - External environment = weather, fluid surrounding cells
- Every regulatory mechanism of the body exists to maintain homeostasis of the body's internal fluid environment
  - Regulatory mechanisms control homeostasis



# HOMEOSTASIS

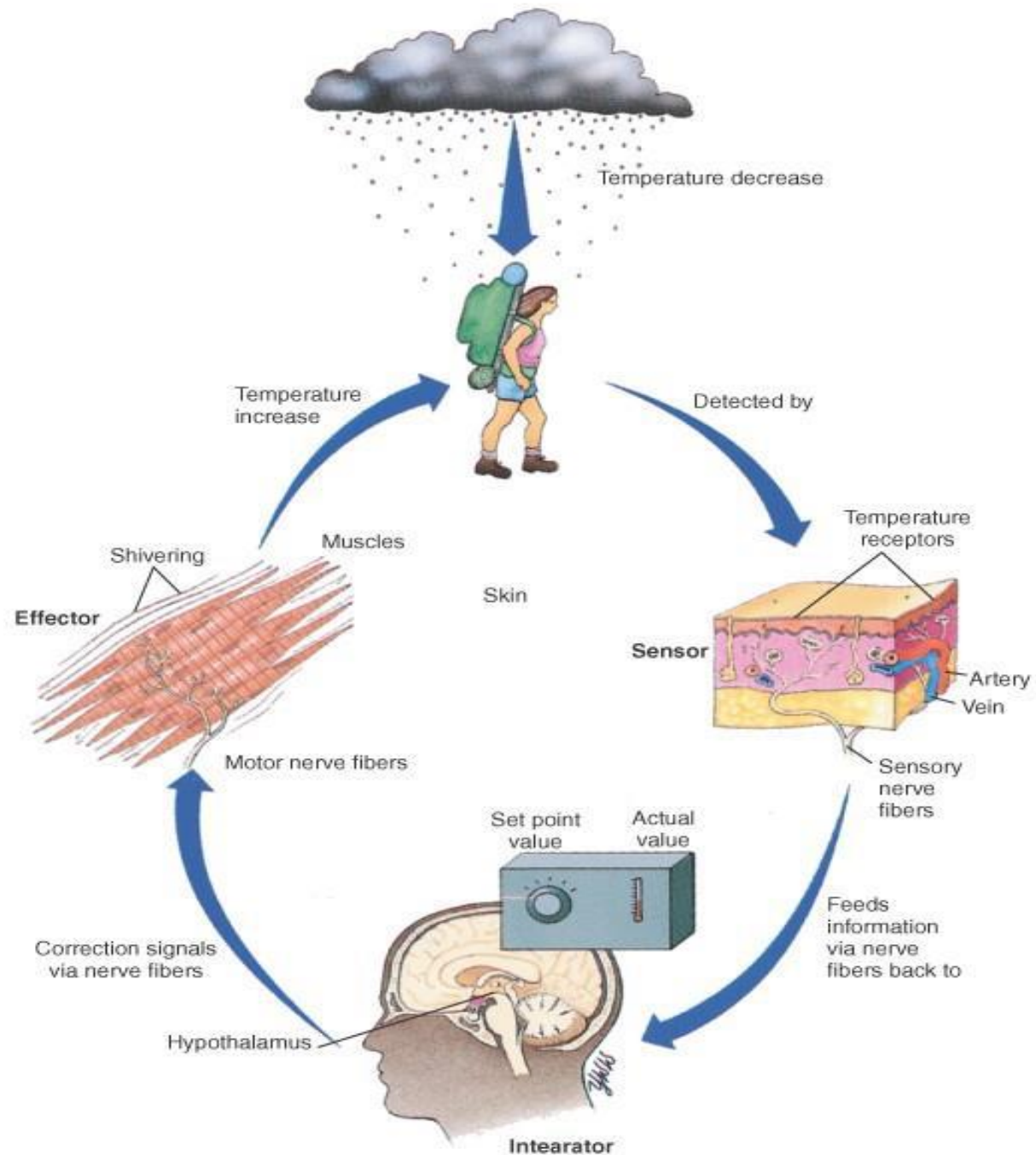
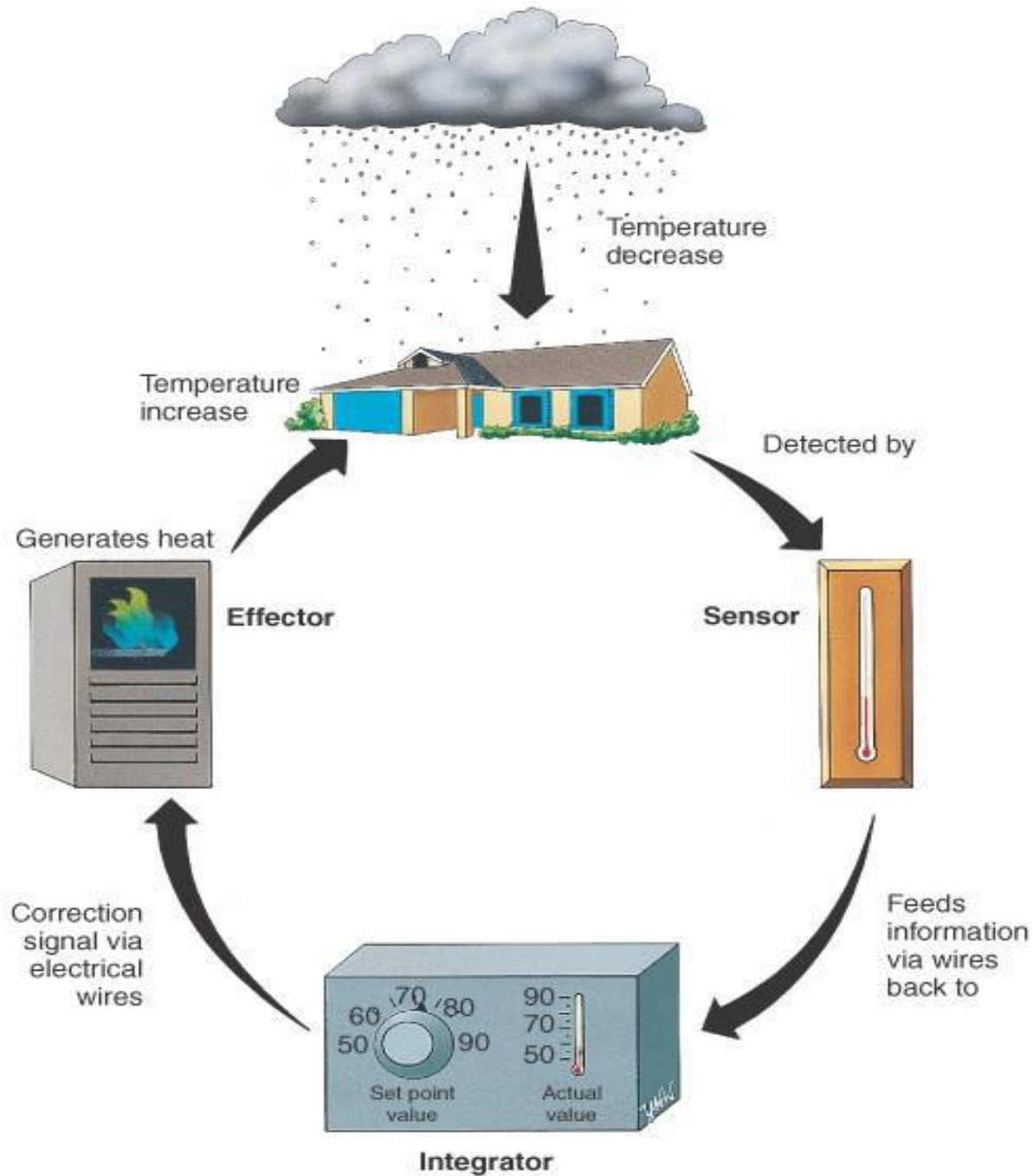
- Two general mechanisms are involved in homeostatic regulation:
  1. Autoregulation
    - Intrinsic Regulation
    - A cell, tissue, organ, or organ system adjusts automatically in response to some environmental change
      - Example – oxygen decreases → cells release chemicals → dilate blood vessels
  2. Extrinsic Regulation
    - Nervous system or endocrine system control or adjust the activities of many systems
      - Example – exercise → nervous system increases heart rate and nervous system reduces blood flow to less active organs like the digestive system

# HOMEOSTASIS

- More on extrinsic regulation:
  - Nervous system directs rapid, short-term and very specific responses, such as a hand on a hot stove
  - Endocrine system releases chemical messengers, called hormones, that affect tissues and organs throughout the body
  - Responses may not be immediately apparent, but may persist for days or weeks
    - Example – regulation of blood volume and composition (starvation)
  - Endocrine system plays a major role in growth and development

# HOMEOSTASIS

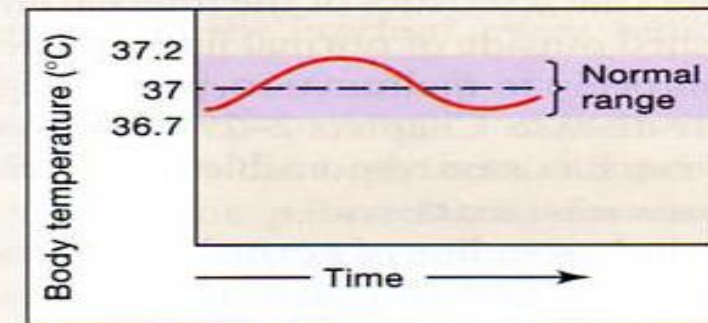
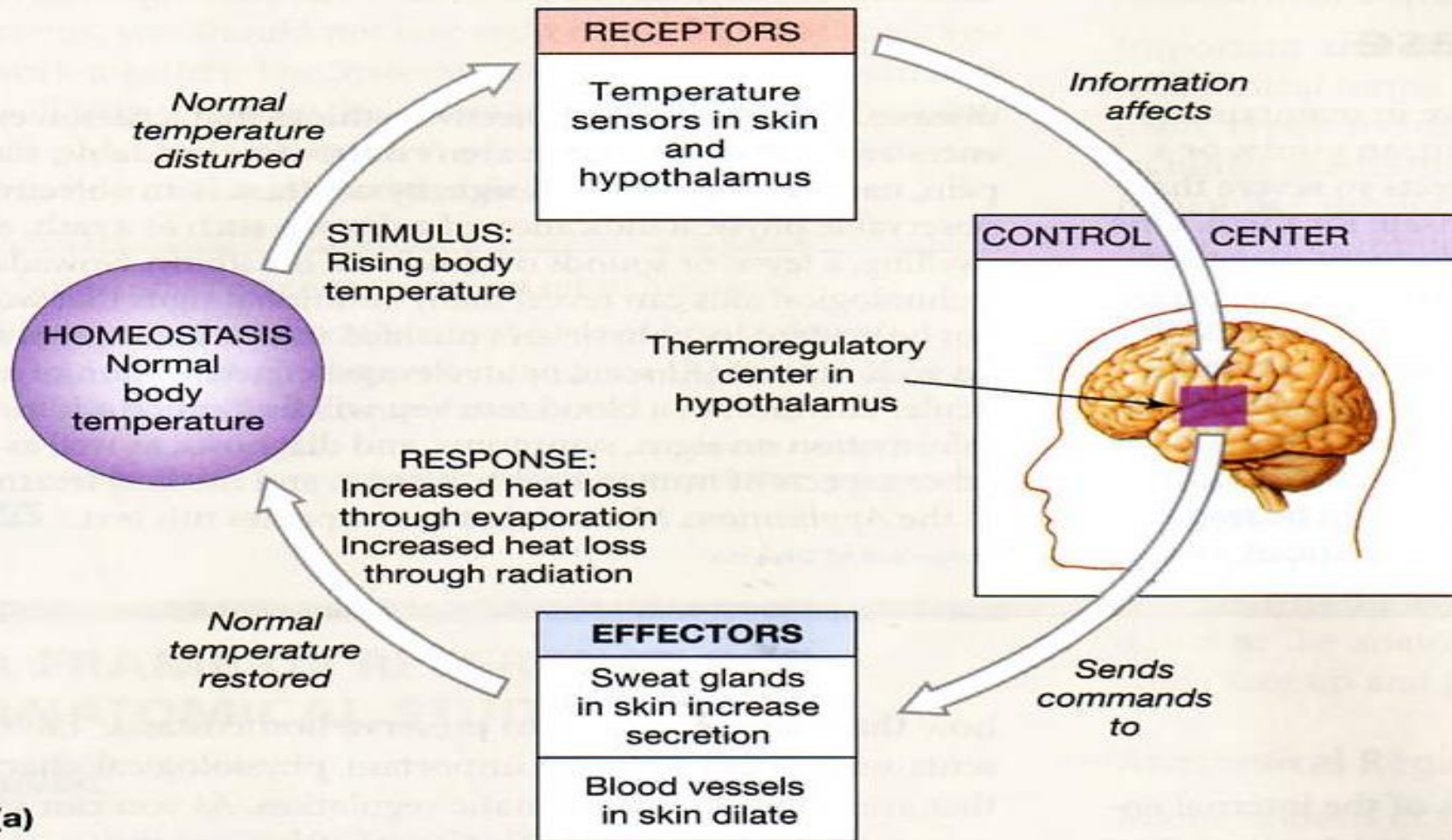
- Feedback Control Loop
  - Highly complex and integrated communication control system in order to accomplish self-regulation
    - Examples: blood/carbon dioxide level, temperature, heart rate, sleep cycle, thirst
- Homeostatic regulatory mechanism consists of 4 parts:
  1. Receptor
    - Sensor that is sensitive to a particular environmental change or *stimulus*
  2. Control Center or Integration Center
    - Receives and processes the information supplied by the receptor
  3. Effector
    - A cell or organ that responds to the commands of the control center and whose activity either opposes or enhances the stimulus
  4. Feedback



# NEGATIVE FEEDBACK

- *Inhibitor*
- Opposes change by creating response opposite in direction of initial disturbance
  - Example:
    - Change = drop in temperature
    - Response = heat production
    - Initial disturbance = temperature falls below normal set point
- Stabilizes physiological variables
- Maintain constant internal environment
  - Examples:
    - Goosebumps
    - Sweating

# NEGATIVE FEEDBACK



(b)

(a)



# POSITIVE FEEDBACK

- *Stimulatory*
- Amplifies/reinforces change which can be harmful or disastrous
- Causes instability and disrupts homeostasis
  - Example – Continual temperature increase
- Examples:
  - Sneezing
  - Birth of baby
  - Immune response to infection
  - Blood clot

# POSITIVE FEEDBACK

## ● FIGURE 1-6

**Positive Feedback: Blood Clotting.** Positive feedback loops are important in accelerating processes that must proceed to completion rapidly. In this example, positive feedback accelerates the clotting process until a blood clot forms and stops the bleeding.

