



The Human Body: An Orientation



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Declaration

- The content and the figures of this seminar were directly adopted from the text book “Human Anatomy and Physiology / Ninth edition/ Eliane N. Marieb 2013”

Performance Objectives

- Define Anatomy and Physiology
- Describe the relationship between structure and function
- Define basic directional terms
- Describe the anatomical position
- Describe the major cavities of the body
- Describe the levels of organization of the body and give major characteristics of each level

Performance Objectives

- List the organ systems
- Define homeostasis and explain why it is important
- Describe the negative-feedback system and the positive-feedback system and their relationship to homeostasis
- Name and describe the three major planes of the body or organ.

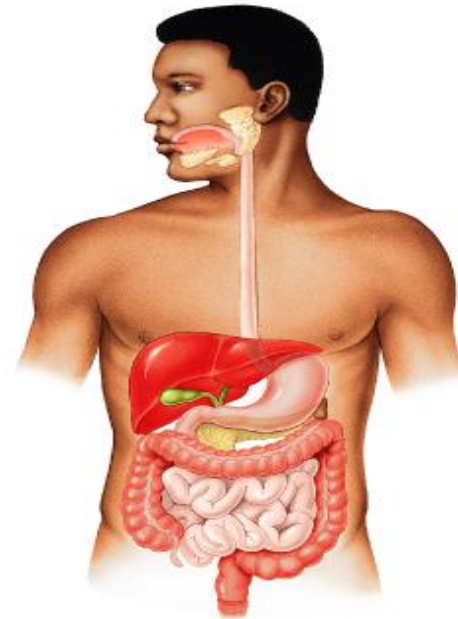
The Human Body : An Orientation

- **Anatomy:** Study of the structure and shape of the body and its parts and their relationships to one another
- **Physiology :** Study of how the body and its parts work or function.
- **Subdivisions of physiology:**
 - Neurophysiology: explains the workings of nervous system
 - Cardiac Physiology : Study the function of the Heart

Anatomy : Levels of Study

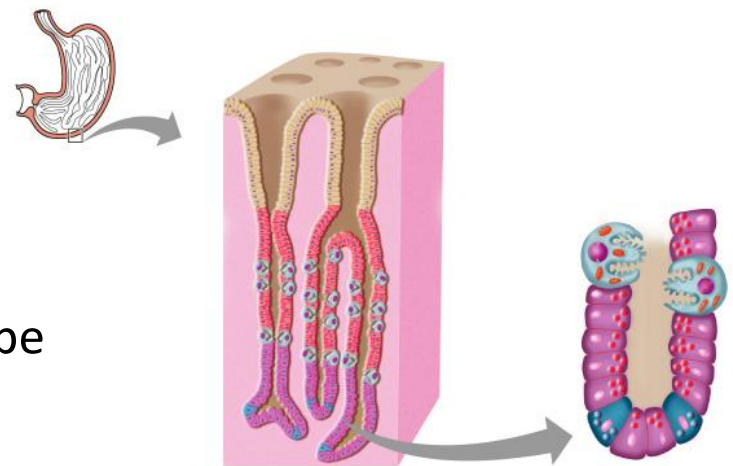
- **Gross Anatomy**

- Large structures
- Easily observable

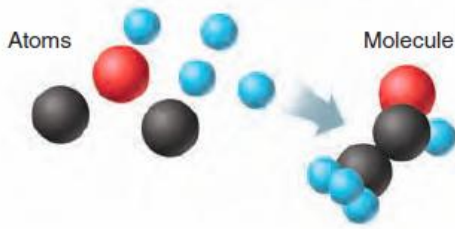


- **Microscopic Anatomy**

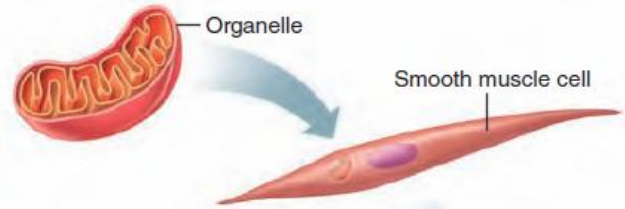
- Very small structures
- Can only be viewed with a microscope



Levels of Structural Organization



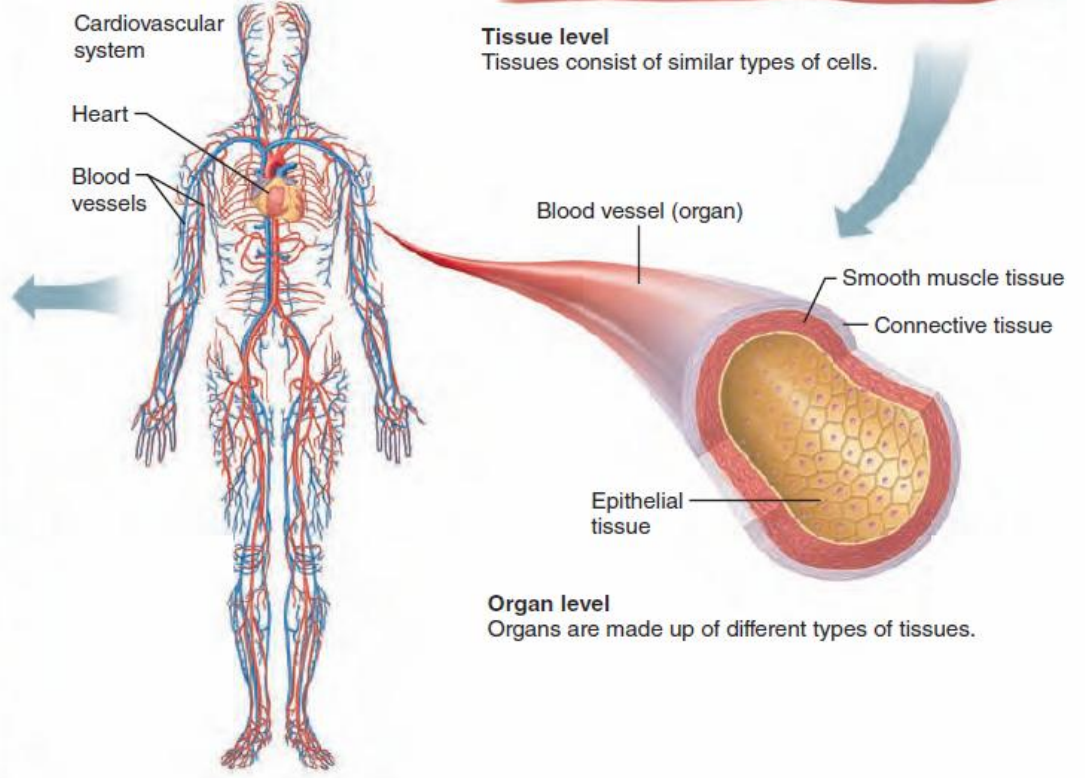
Chemical level
Atoms combine to form molecules.



Cellular level
Cells are made up of molecules.



Tissue level
Tissues consist of similar types of cells.



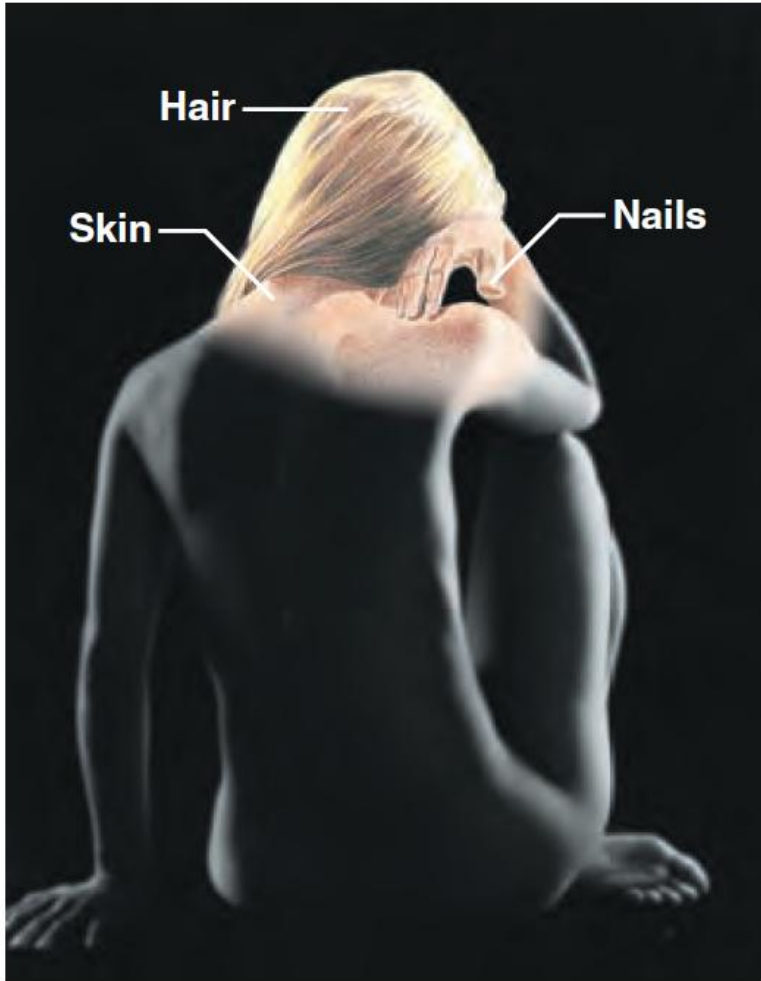
Organ level
Organs are made up of different types of tissues.



Organismal level
The human organism is made up of many organ systems.

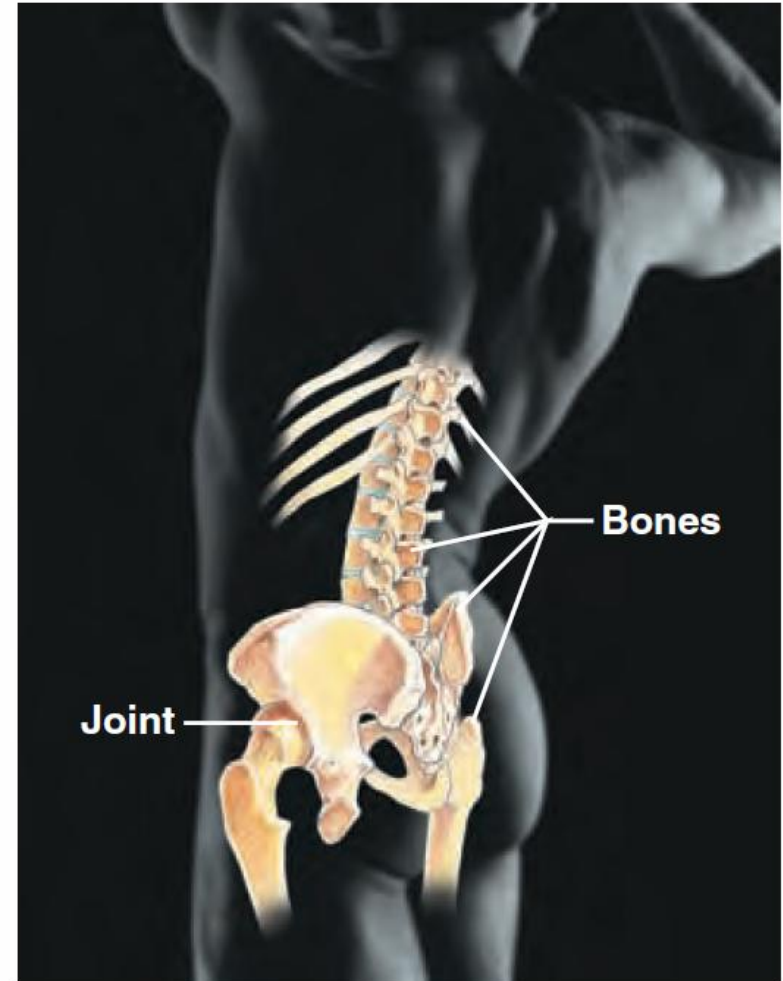
Organ system level
Organ systems consist of different organs that work together closely.

Organ System Overview



(a) Integumentary System

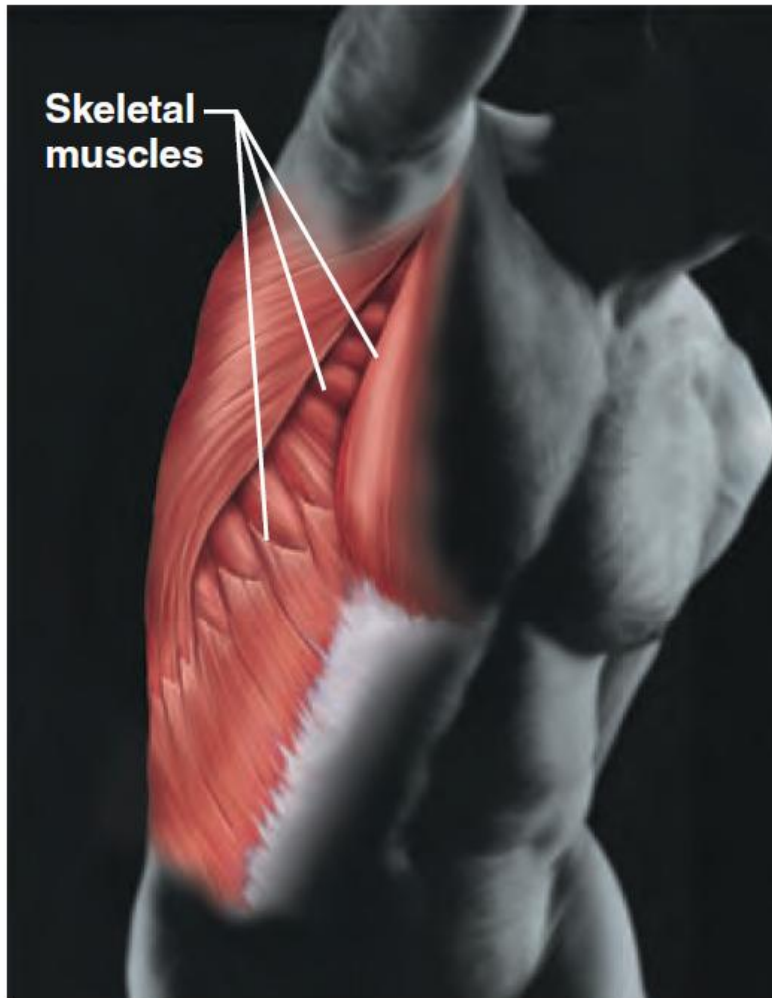
Forms the external body covering, and protects deeper tissues from injury. Synthesizes vitamin D, and houses cutaneous (pain, pressure, etc.) receptors and sweat and oil glands.



(b) Skeletal System

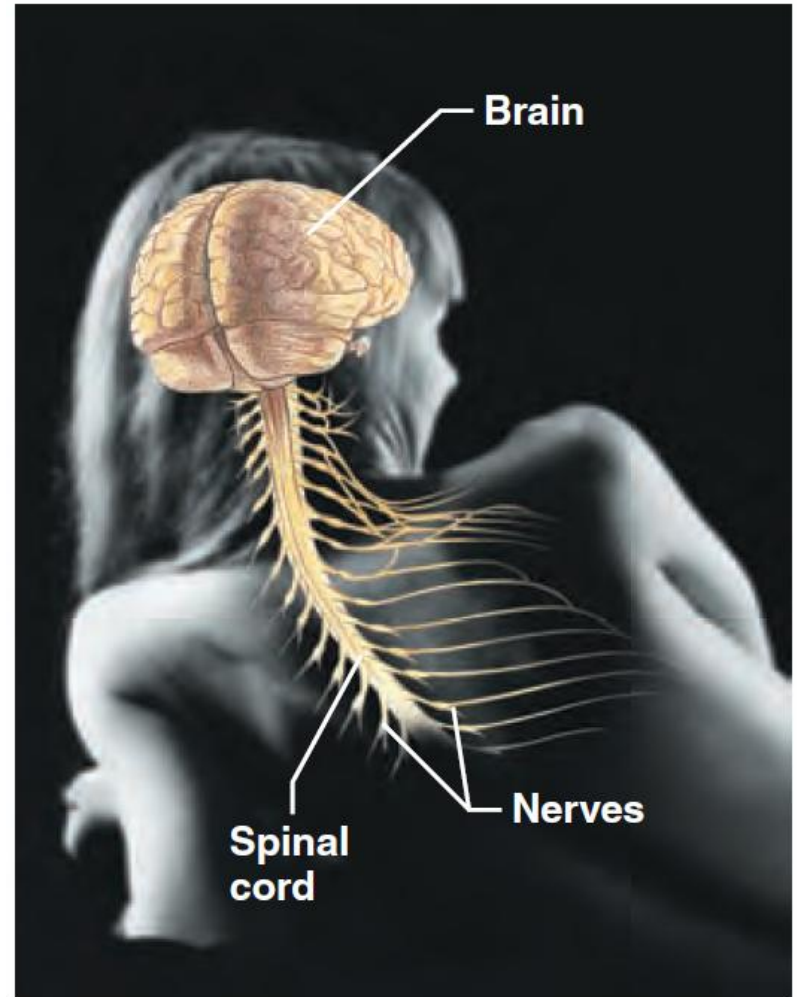
Protects and supports body organs, and provides a framework the muscles use to cause movement. Blood cells are formed within bones. Bones store minerals.

Organ System Overview



(c) Muscular System

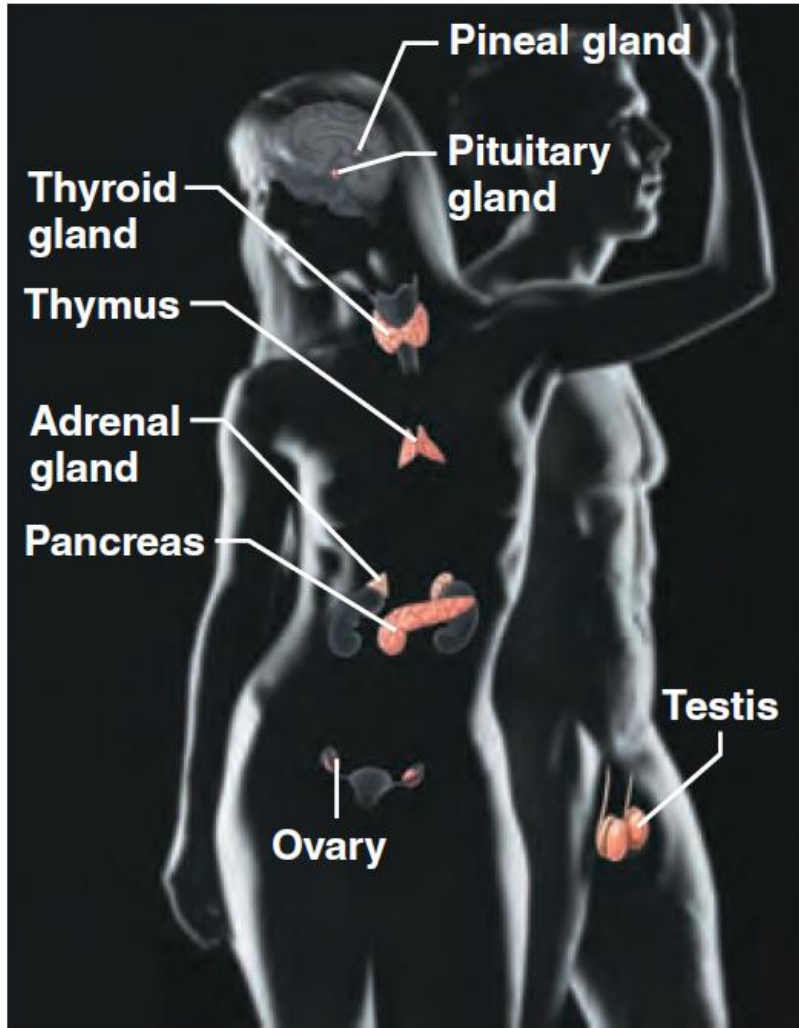
Allows manipulation of the environment, locomotion, and facial expression. Maintains posture, and produces heat.



(d) Nervous System

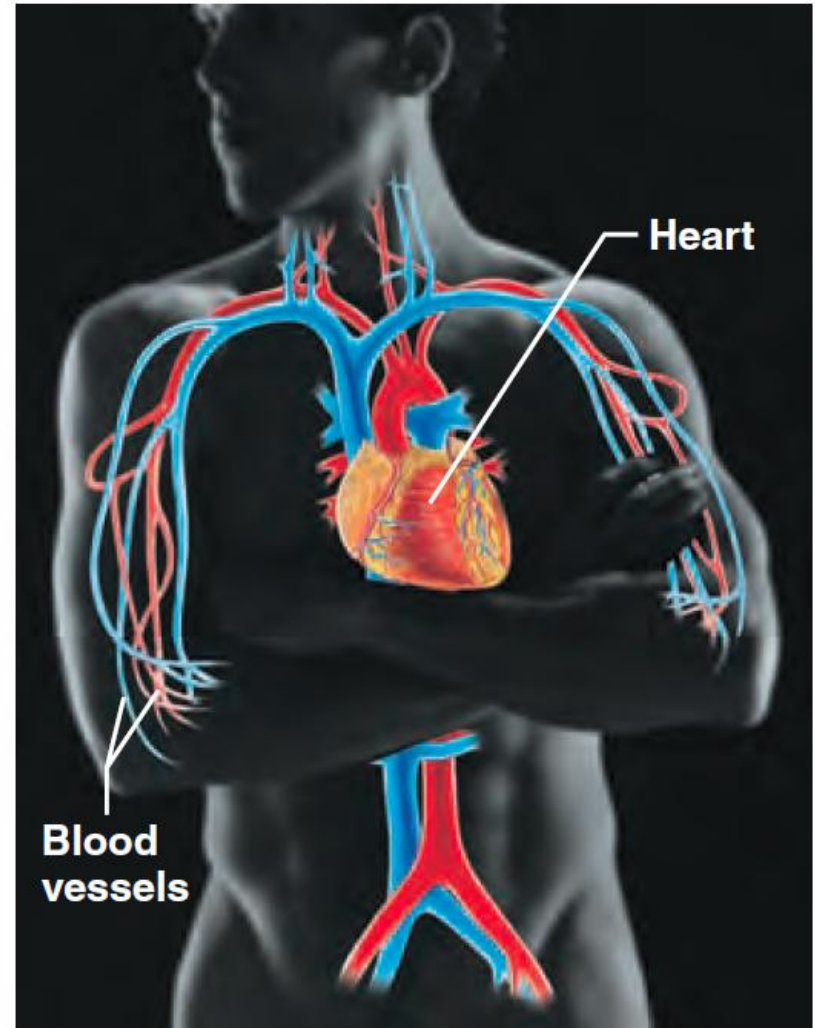
As the fast-acting control system of the body, it responds to internal and external changes by activating appropriate muscles and glands.

Organ System Overview



(e) Endocrine System

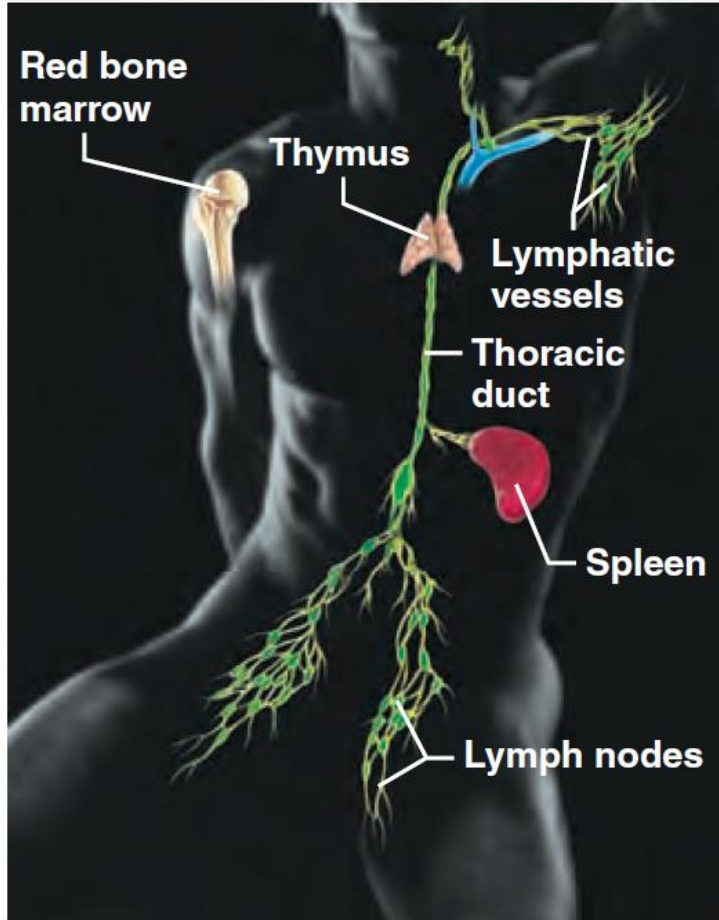
Glands secrete hormones that regulate processes such as growth, reproduction, and nutrient use (metabolism) by body cells.



(f) Cardiovascular System

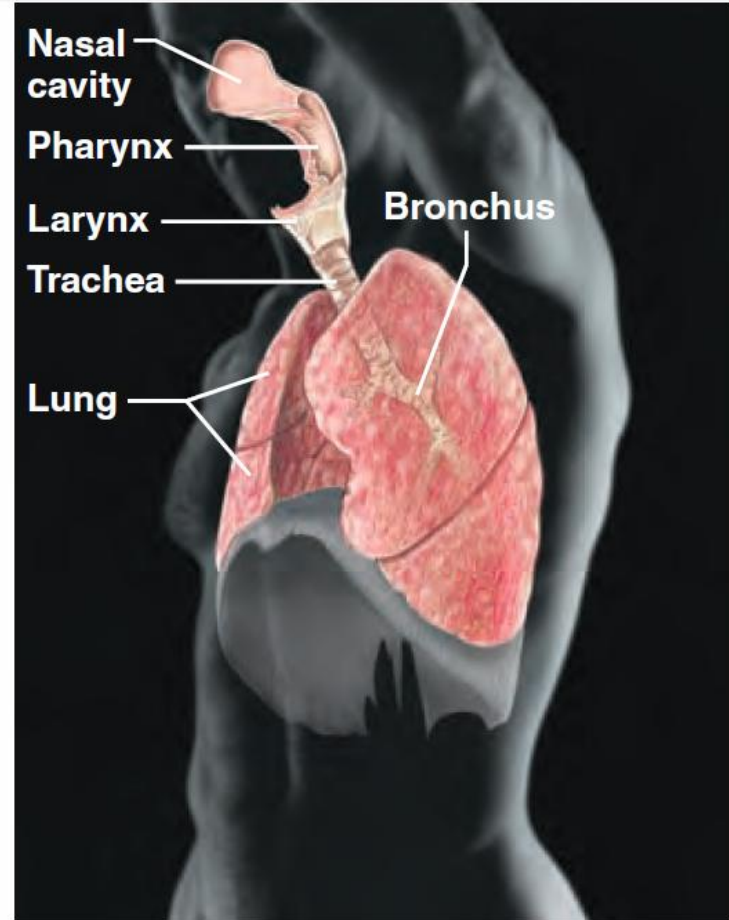
Blood vessels transport blood, which carries oxygen, carbon dioxide, nutrients, wastes, etc. The heart pumps blood.

Organ System Overview



(g) Lymphatic System/Immunity

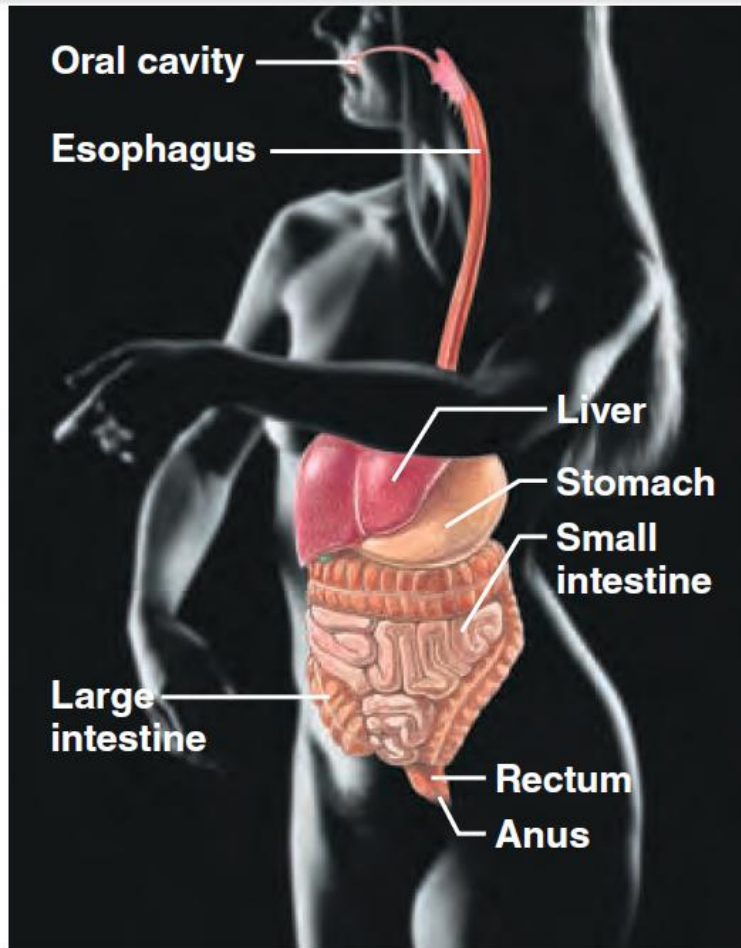
Picks up fluid leaked from blood vessels and returns it to blood. Disposes of debris in the lymphatic stream. Houses white blood cells (lymphocytes) involved in immunity. The immune response mounts the attack against foreign substances within the body.



(h) Respiratory System

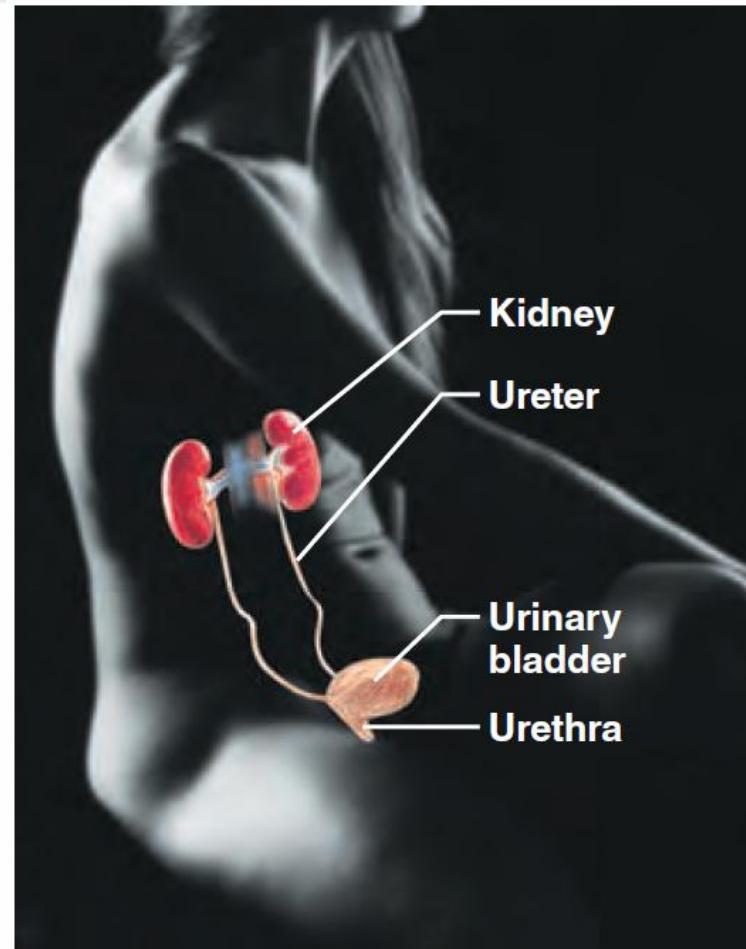
Keeps blood constantly supplied with oxygen and removes carbon dioxide. The gaseous exchanges occur through the walls of the air sacs of the lungs.

Organ System Overview



(i) Digestive System

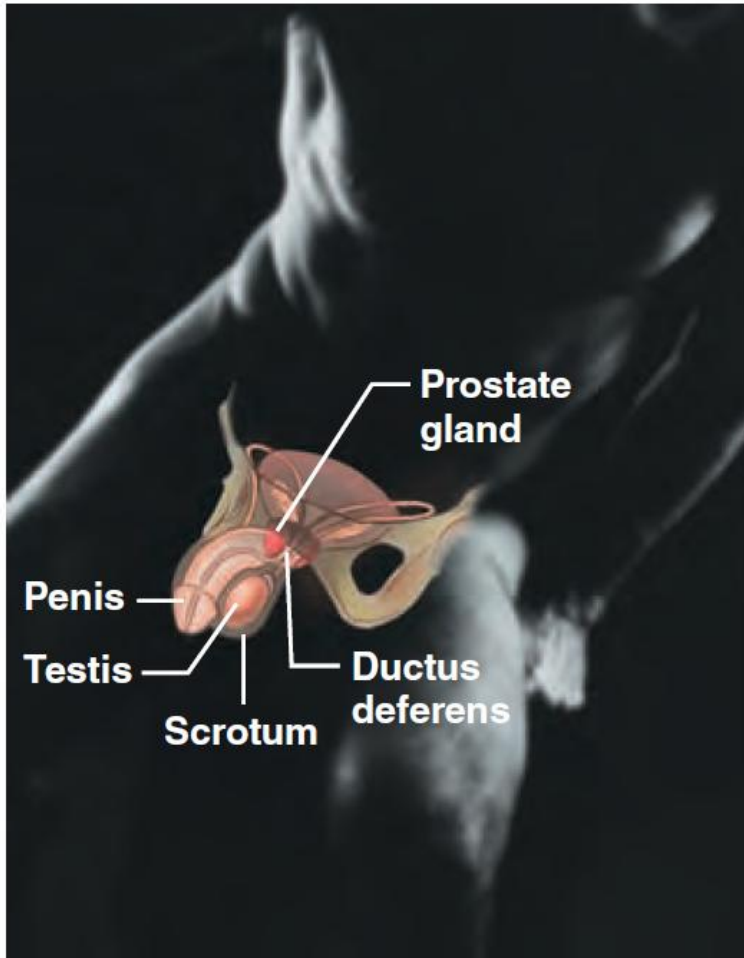
Breaks down food into absorbable units that enter the blood for distribution to body cells. Indigestible foodstuffs are eliminated as feces.



(j) Urinary System

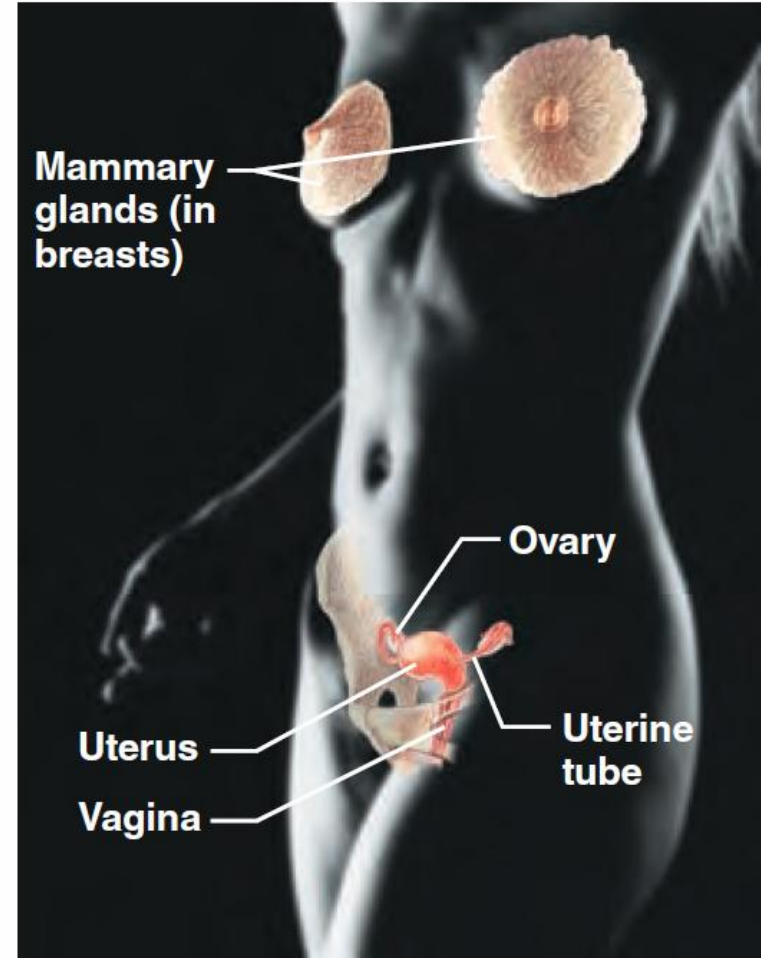
Eliminates nitrogenous wastes from the body. Regulates water, electrolyte and acid-base balance of the blood.

Organ System Overview



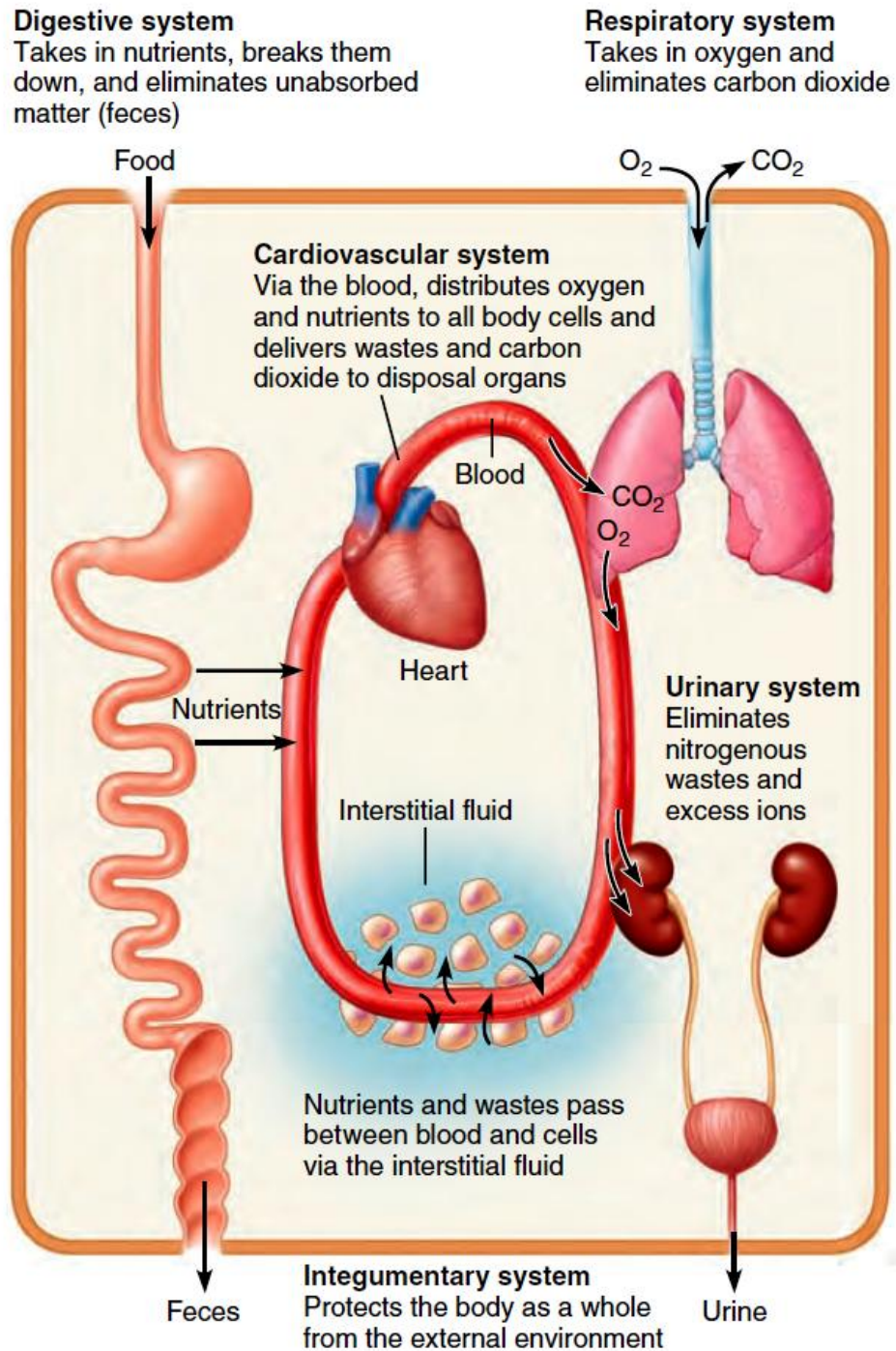
(k) Male Reproductive System

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



(l) Female Reproductive System

Examples of interrelationships among body organ systems.



Necessary Life Functions

1- Maintain Boundaries

- Every living organism must **maintain its boundaries so that** its internal environment remains distinct from the external environment surrounding it.
- All the cells of our body are surrounded by a selectively permeable membrane.

Necessary Life Functions

- The body as a whole is enclosed and protected by the integumentary system (skin)
- **Why skin is so important? it protects our internal organs from:**
 - ✓ Drying out
 - ✓ Pathogens
 - ✓ The damaging effects of heat and sunlight,
 - ✓ The damaging effects of the numerous number of chemicals in the external environment.

Necessary Life Functions

2- Movement

- Locomotion : by Muscular system , and the skeletal system provides the bony framework that the muscles pull on as they work
- Movement of substances such as blood, foodstuffs, and urine are propelled through internal organs of the cardiovascular, digestive, and urinary systems, respectively.

Necessary Life Functions

3- Responsiveness

- Responsiveness, or excitability is the ability to sense changes (which serve as stimuli) in the environment and then respond to them
- E.g. When CO₂ in your blood rises to dangerously high levels, chemical sensors respond by sending messages to brain centers controlling respiration, and you breathe faster.
- Because nerve cells are highly excitable and communicate rapidly with each other via electrical impulses, the nervous system is most involved with responsiveness .
- Generally, all body cells are excitable to some extent.

Necessary Life Functions

4- Digestion

- Is the breaking down of ingested foodstuffs to simple molecules that can be absorbed into the blood.
- The nutrient-rich blood is then **distributed** to all body cells by the cardiovascular System.

5- Metabolism : chemical reactions within the body

- Production of energy
- Making body structures
- Facilitate elimination

Necessary Life Functions

6-Excretion

- Elimination of waste from metabolic reactions, e.g. **Digestive system** eliminate undigested material (feces), and the **urinary system** eliminate nitrogen containing metabolic wastes in urine.

7- **Reproduction** : Production of future generation

8- **Growth**: Increasing of cell size and number

Survival Needs

1- Nutrients

- Chemicals for energy and cell building
- Includes: carbohydrates, proteins, lipids, vitamins, and minerals

2- **Oxygen:** Required for chemical reactions

3- **Water:** 60–80% of body weight Provides a medium for metabolic reaction

Survival Needs

4- **Temperature**: Stable body temperature (for Enzymes that catalyze chemical reaction)

5- **Atmospheric pressure**: Breathing and gas exchange in the lungs depend on *appropriate atmospheric pressure*

Homeostasis

- Homeostasis: describe its ability to **maintain** relatively stable internal conditions even though the outside world changes continuously.
- Although the literal translation of homeostasis is “unchanging,” the term does not really mean a static, or unchanging, state.

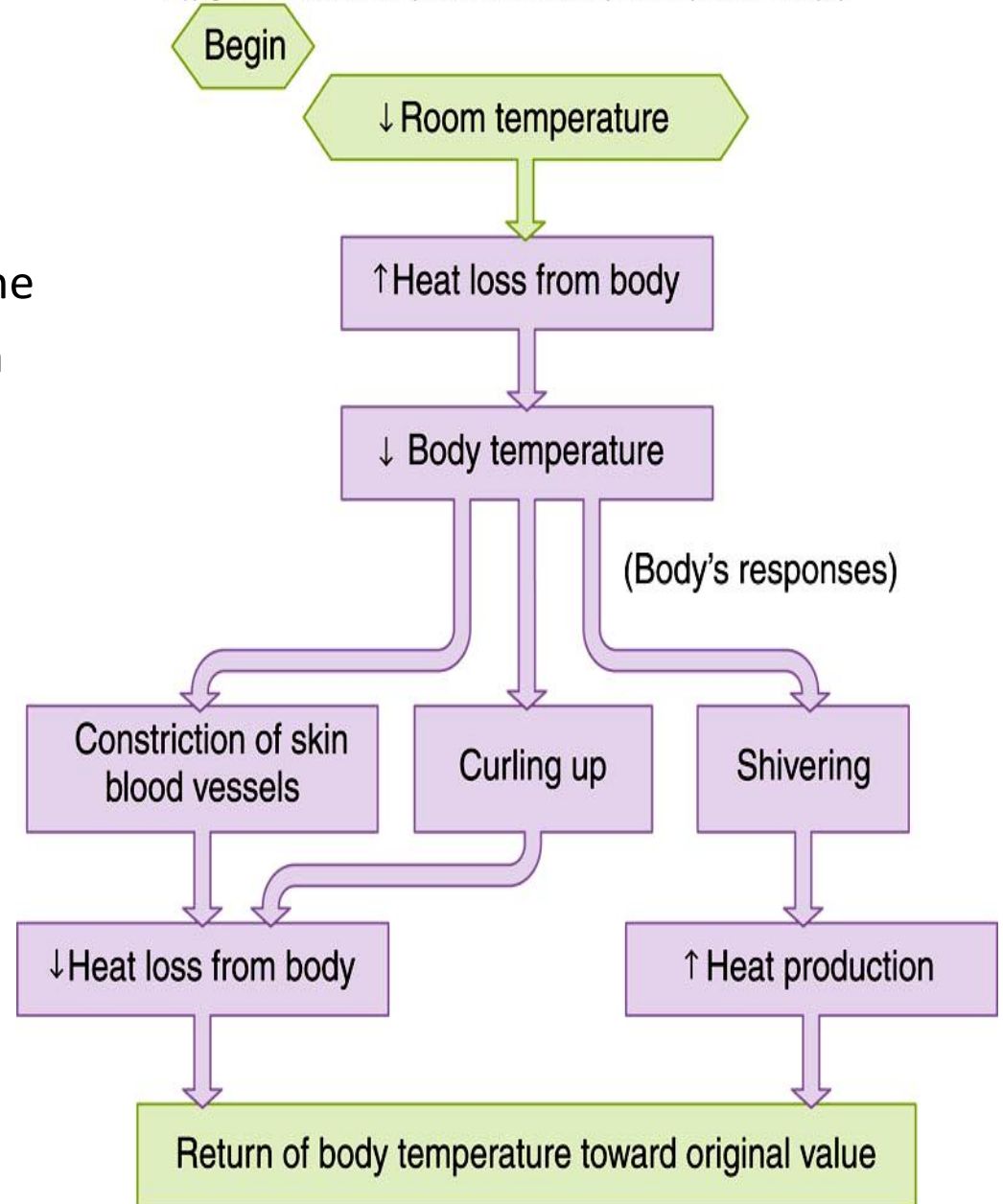
Homeostasis

- Rather, it indicates a *dynamic state of equilibrium, or a balance*, in which internal conditions vary, but always within relatively narrow limits, e.g. body temperature
- Homeostatic imbalance : a disturbance in homeostasis resulting in disease

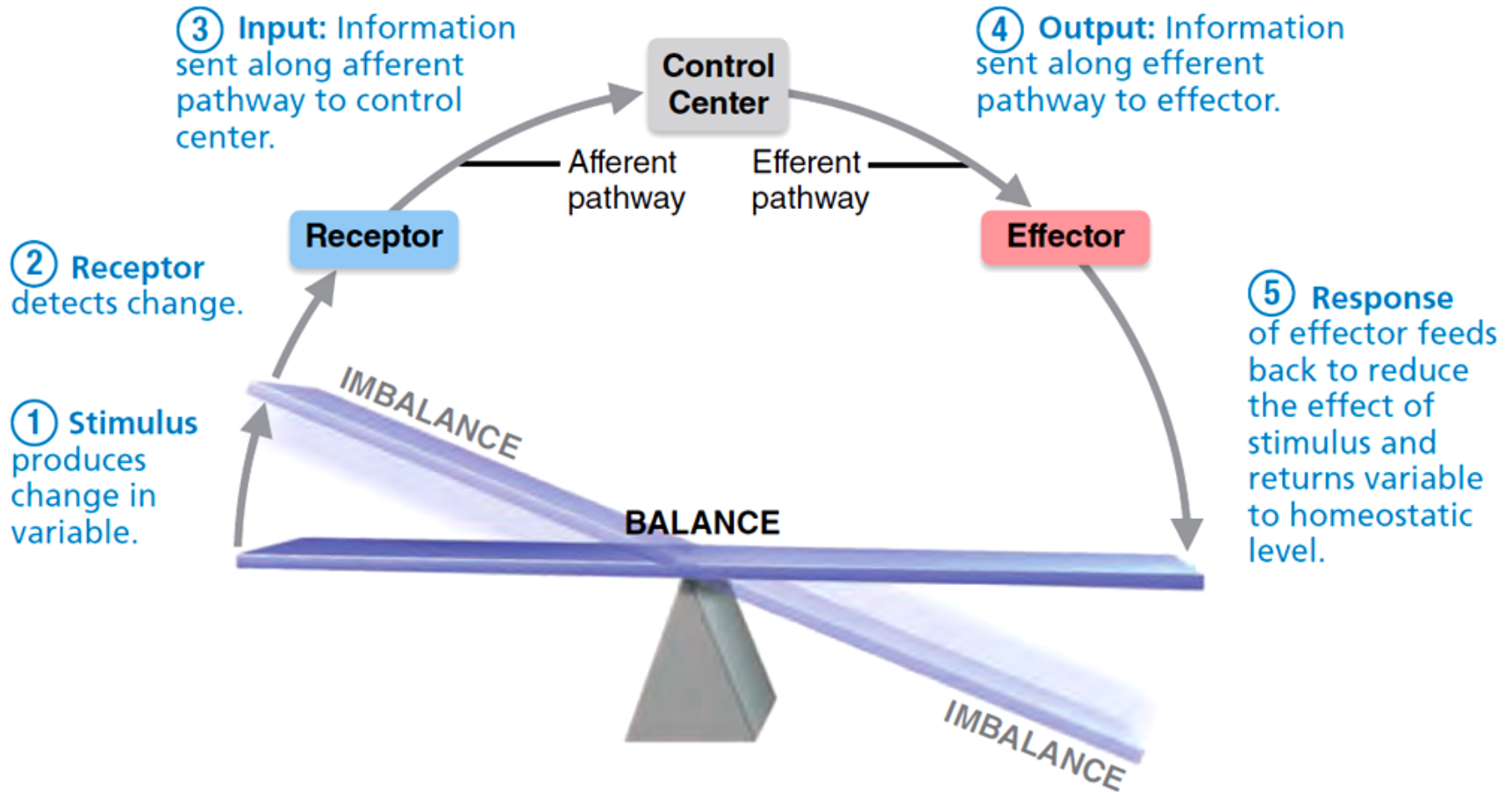
Homeostasis Control

- Communication within the body is essential for homeostasis.
- Communication is accomplished chiefly by the **nervous** and **endocrine systems**, which use neural electrical impulses or blood borne hormones, respectively, as information carriers

Decreased room temperature causes increased heat loss from the body, which leads to a decrease in body temperature, etc.)



Interactions among the elements of a homeostatic control system maintain stable internal conditions



Components of homeostatic control mechanism

1- The receptor:

- is some type of **sensor** that monitors the environment and responds to changes, called stimuli, by sending information (input) to the second component, the control center. Input flows from the receptor to the control center along the so-called afferent pathway.

Components of homeostatic control mechanism

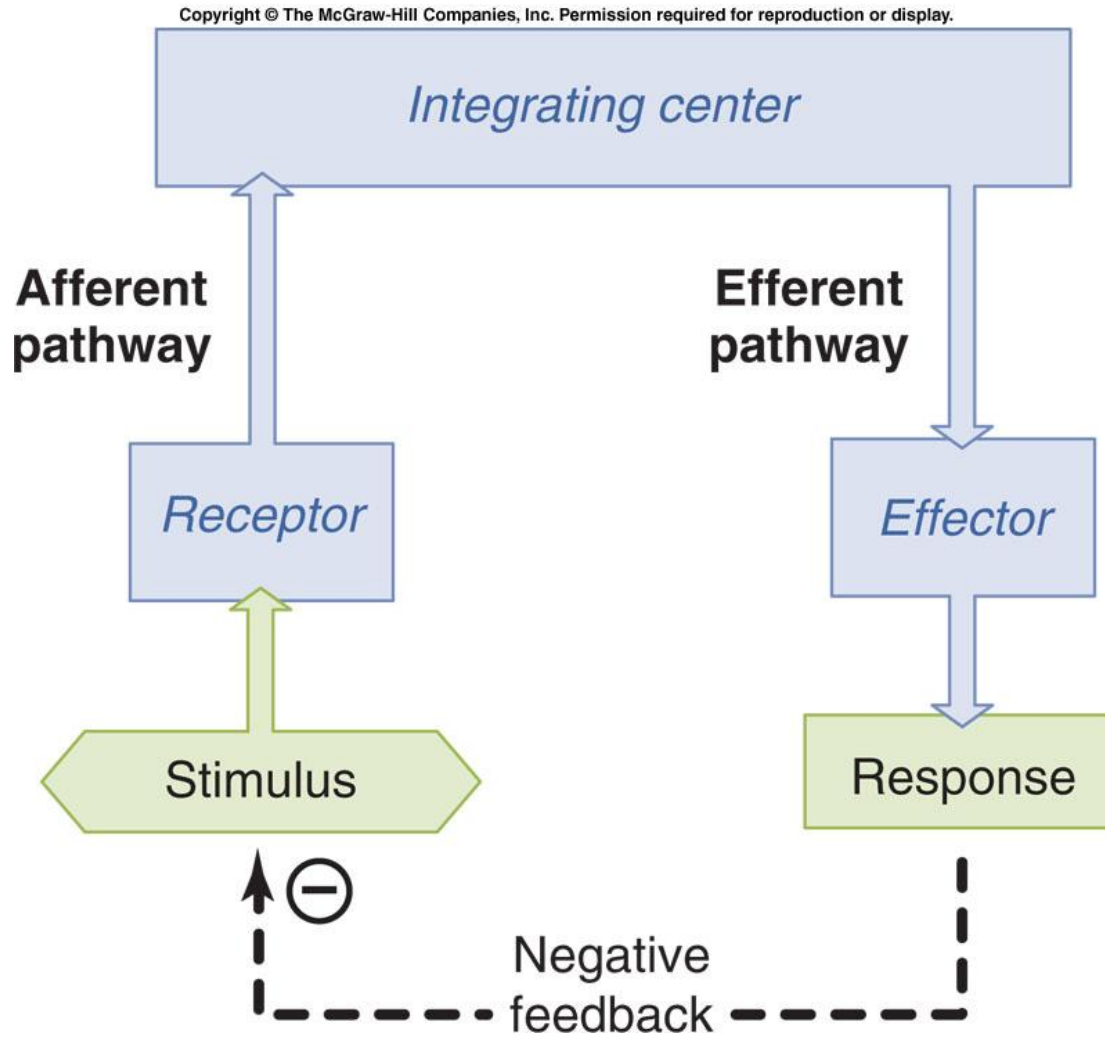
2- The control center:

- **Determines the set point**, which is the level or range at which a variable is to be maintained.
- It also analyzes the input it receives and determines the appropriate response or course of action.
- Information (output) then flows from the control center to the third component, the effector, along the efferent pathway.

Components of homeostatic control mechanism

3- The effector:

- Provides the means for the control center's response (output) to the stimulus.
- The results of the response then feed back to influence the effect of the stimulus, either reducing it (**in negative feedback**) so that the whole control process is shut off, or enhancing it (**in positive feedback**) so that the whole process continues at an even faster rate



Negative feedback system

- In which an increase or decrease in the variable being regulated brings about responses that tend to move the variable in the direction opposite (“negative” to) the direction of the original change.
- Negative feedback may occur at the organ, cellular, or molecular level, and it is not unique to hormonal pathways.

Example on negative feedback system

The production of energy within cells:

- When energy is needed by a cell, glucose molecules are converted into an energy carrying molecule adenosine triphosphate (ATP).
- ATP accumulation in the cell inhibits the activity of some of the enzymes involved in the chemical conversion of glucose to ATP.
- Thus, as ATP levels increase within a cell, further production of ATP is slowed down.
- Conversely, when ATP levels drop within a cell, negative feedback is released and more glucose is consumed to make new ATP.

Positive feedback system

- It accelerates a process, leading to an “explosive” system (move the variable in the same direction (“positive” to) of the original change

Example on positive feedback system

- When a brain cell is stimulated, pore-like channels on the surface of the cell are opened.
- These channels permit the entry of extracellular sodium ions into the cell interior, carrying their positive charges .
- Positive charges inside brain cells cause the opening of more sodium channels.
- This leads to more sodium influx, more channel openings, and so on (positive feedback).

Example on positive feedback system

- The result is a brain cell with altered electrical properties due to the change in the concentration of charged sodium ions across its surface.
- For this process to stop and be reversed, energy must be used by the cell to restore the sodium ions to their original concentrations inside and out side the cell.

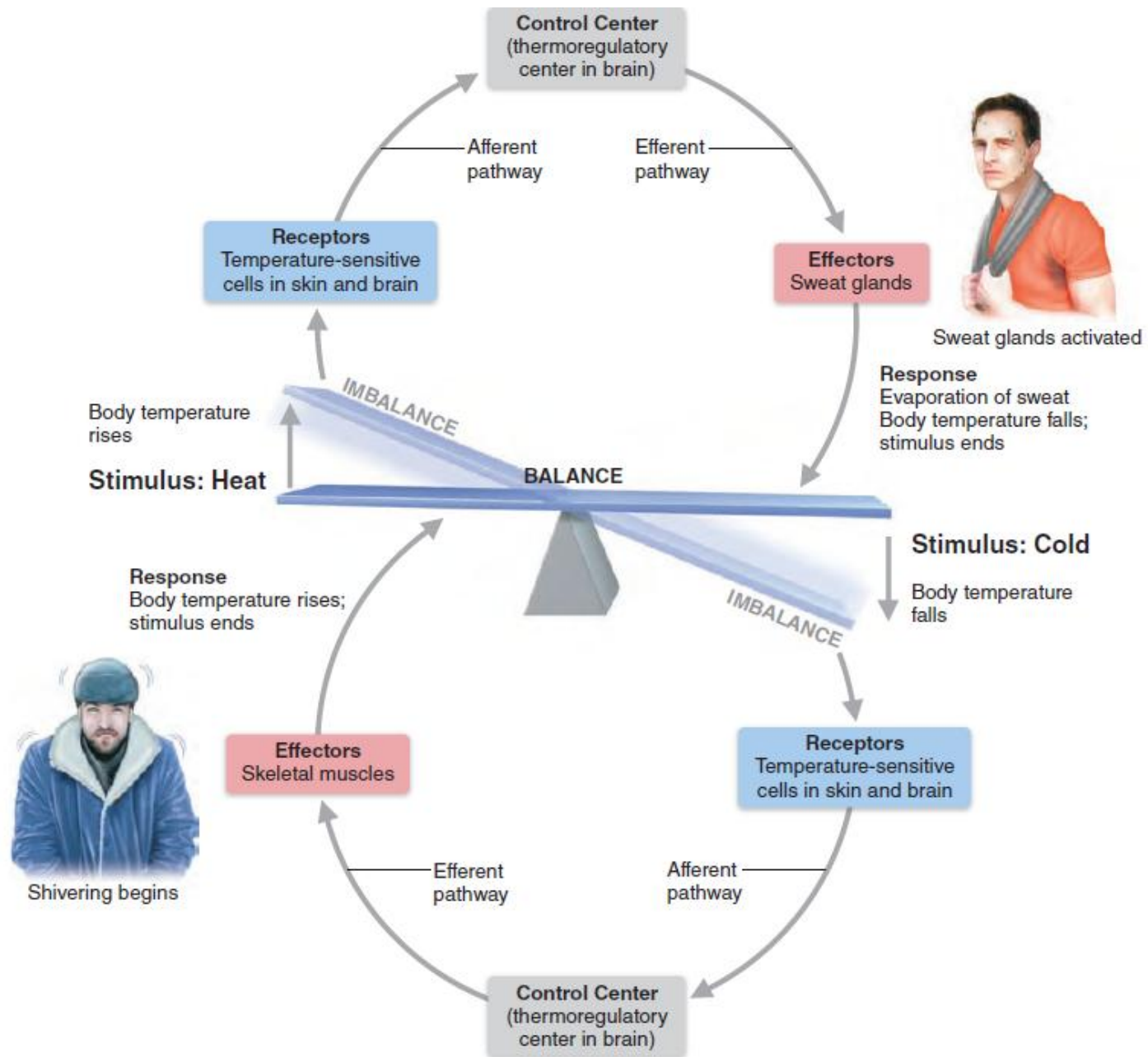
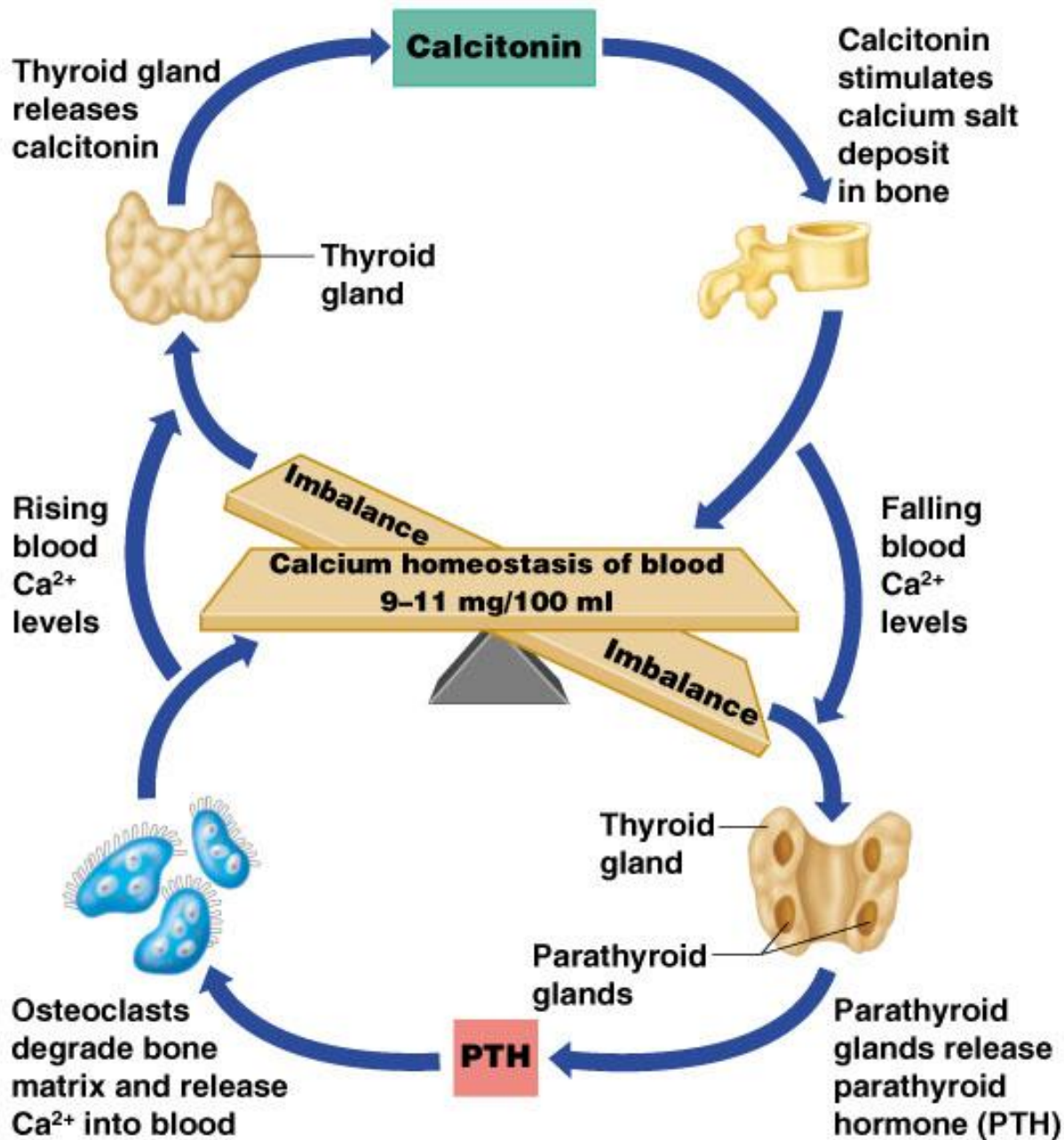


Figure 1.5 Body temperature is regulated by a negative feedback mechanism.



The Language of Anatomy

- Special terminology is used to prevent misunderstanding
- **Exact terms are used for:**
 - Position
 - Direction
 - Regions
 - Structures

Table 1.1 Orientation and Directional Terms

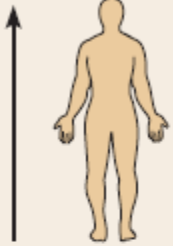
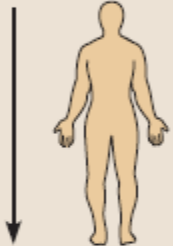
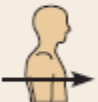
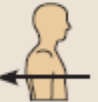
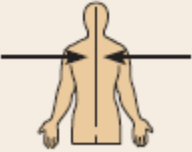
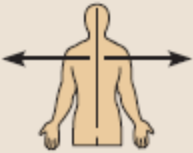





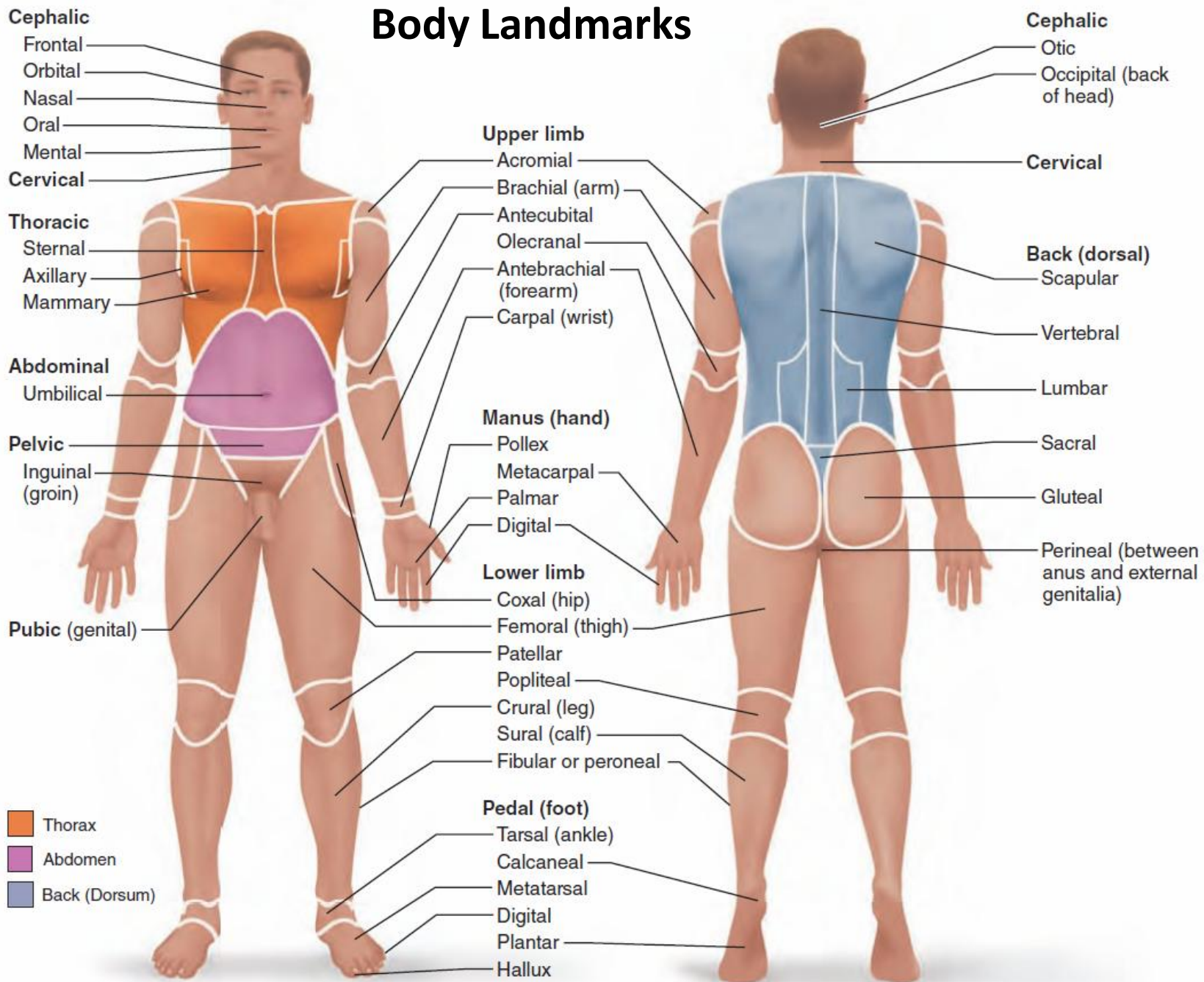
TERM	DEFINITION	EXAMPLE	
Superior (cranial)	Toward the head end or upper part of a structure or the body; above		The head is superior to the abdomen.
Inferior (caudal)	Away from the head end or toward the lower part of a structure or the body; below		The navel is inferior to the chin.
Ventral (anterior)*	Toward or at the front of the body; in front of		The breastbone is anterior to the spine.
Dorsal (posterior)*	Toward or at the back of the body; behind		The heart is posterior to the breastbone.
Medial	Toward or at the midline of the body; on the inner side of		The heart is medial to the arm.
Lateral	Away from the midline of the body; on the outer side of		The arms are lateral to the chest.

Table 1.1 Orientation and Directional Terms

TERM	DEFINITION	EXAMPLE
Intermediate	Between a more medial and a more lateral structure	 <p>The collarbone is intermediate between the breastbone and shoulder.</p>
Proximal	Closer to the origin of the body part or the point of attachment of a limb to the body trunk	 <p>The elbow is proximal to the wrist.</p>
Distal	Farther from the origin of a body part or the point of attachment of a limb to the body trunk	 <p>The knee is distal to the thigh.</p>
Superficial (external)	Toward or at the body surface	 <p>The skin is superficial to the skeletal muscles.</p>
Deep (internal)	Away from the body surface; more internal	 <p>The lungs are deep to the skin.</p>

*The terms *ventral* and *anterior* are synonymous in humans, but this is not the case in four-legged animals. *Anterior* refers to the leading portion of the body (abdominal surface in humans, head in a cat), but *ventral* specifically refers to the “belly” of a vertebrate animal, so it is the inferior surface of four-legged animals. Likewise, although the dorsal and posterior surfaces are the same in humans, the term *dorsal* specifically refers to an animal’s back. Thus, the dorsal surface of four-legged animals is their superior surface.

Body Landmarks



(a) Anterior/Ventral

(b) Posterior/Dorsal

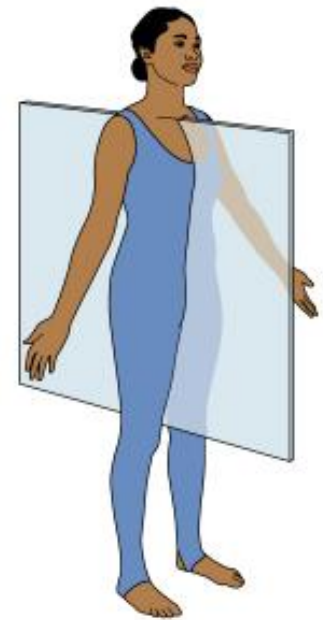
Body Planes and Sections

- For anatomical studies, the body is often cut, or *sectioned*, along a flat surface called a *plane*.
- *The most frequently used body planes are **sagittal, frontal, and transverse planes***, A section is named for the plane along which it is cut.
- Thus, a cut along a sagittal plane produces a sagittal section.

Body Planes and Sections

1- A sagittal plane :

- It is a vertical plane that divides the body into **right and left parts**.
- A sagittal plane that lies exactly in the midline is the median plane, or midsagittal plane.
- All other sagittal planes, offset from the midline, are parasagittal planes.

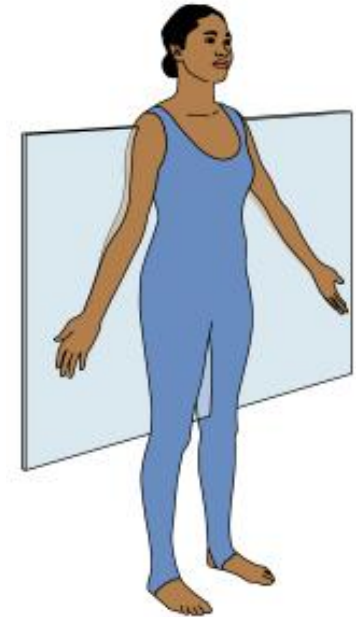


(a) Median (midsagittal)

Body Planes and Sections

2- Frontal planes:

- like sagittal planes, lie vertically.
- Frontal planes, however, divide the body into anterior and posterior parts.
- A frontal plane is also called a coronal plane

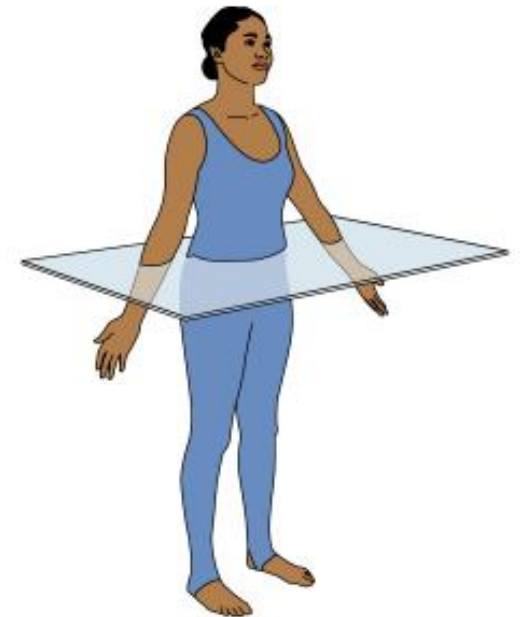


(b) Frontal (coronal) plane

Body Planes and Sections

3- Transverse (horizontal) planes:

- A plane runs horizontally from right to left, dividing the body into superior and inferior parts
- Many different transverse planes exist at every possible level from head to foot.
- A transverse section is also called a cross section

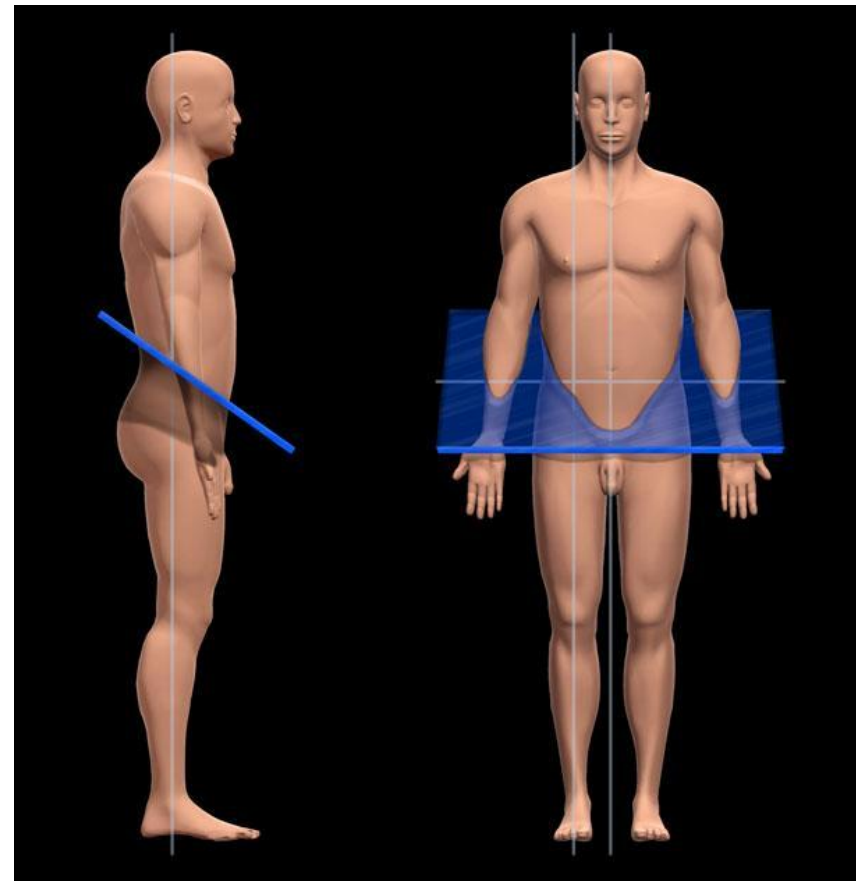


(c) Transverse plane

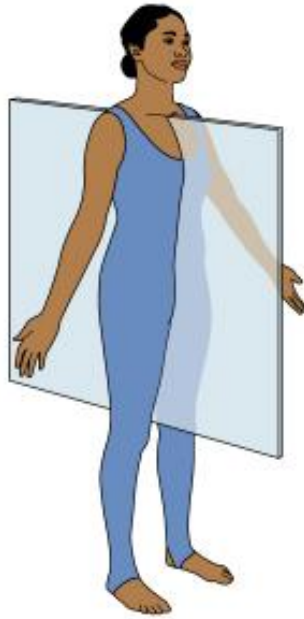
Body Planes and Sections

4- Oblique sections:

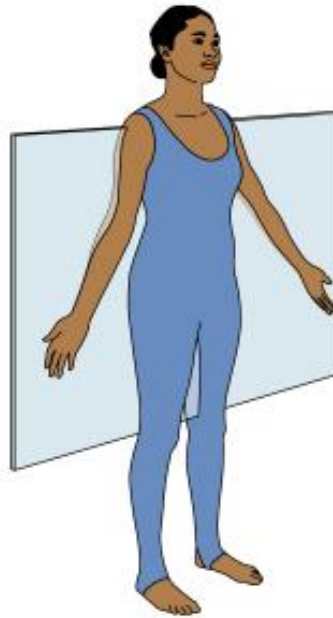
- are cuts made diagonally between the horizontal and the vertical planes.
- Because oblique sections are often confusing and difficult to interpret, they are seldom used.



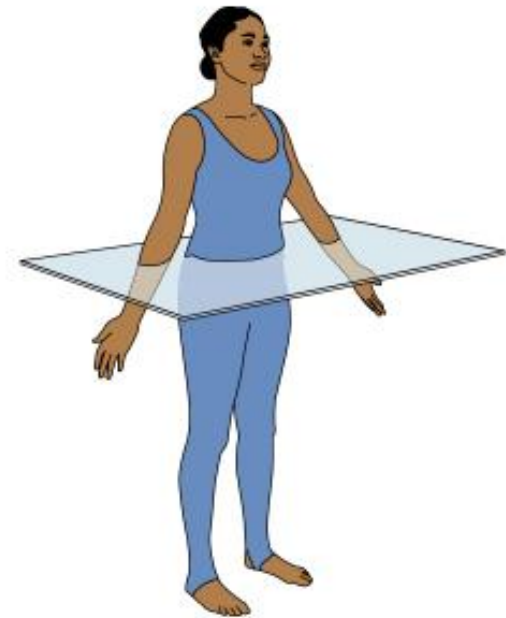
Body Planes



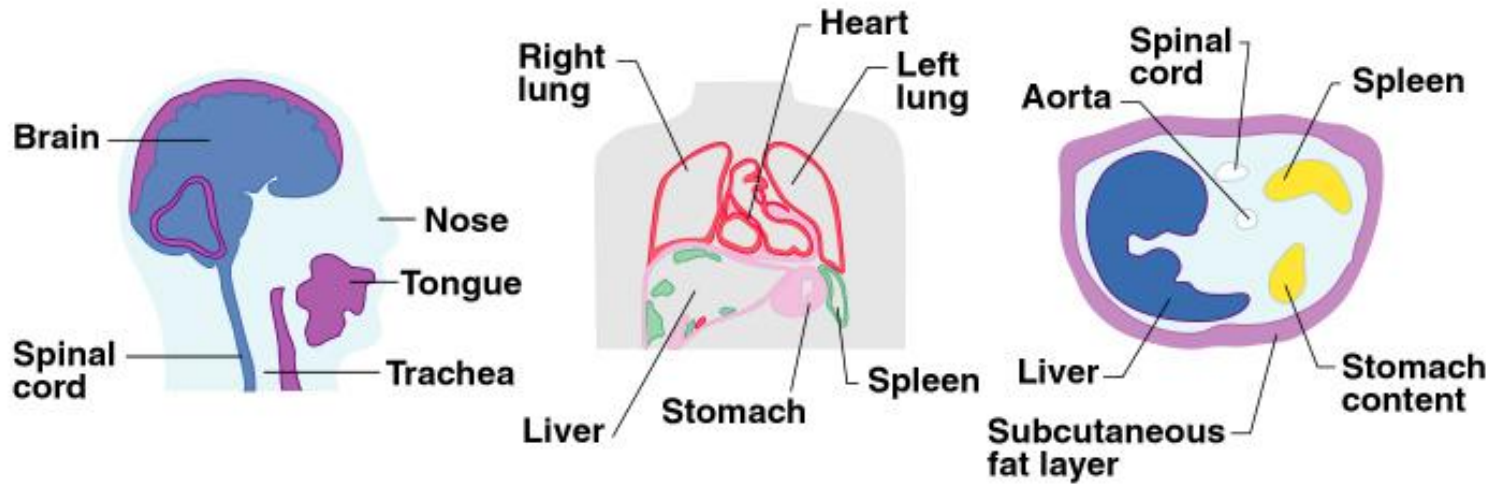
(a) Median (midsagittal)



(b) Frontal (coronal) plane

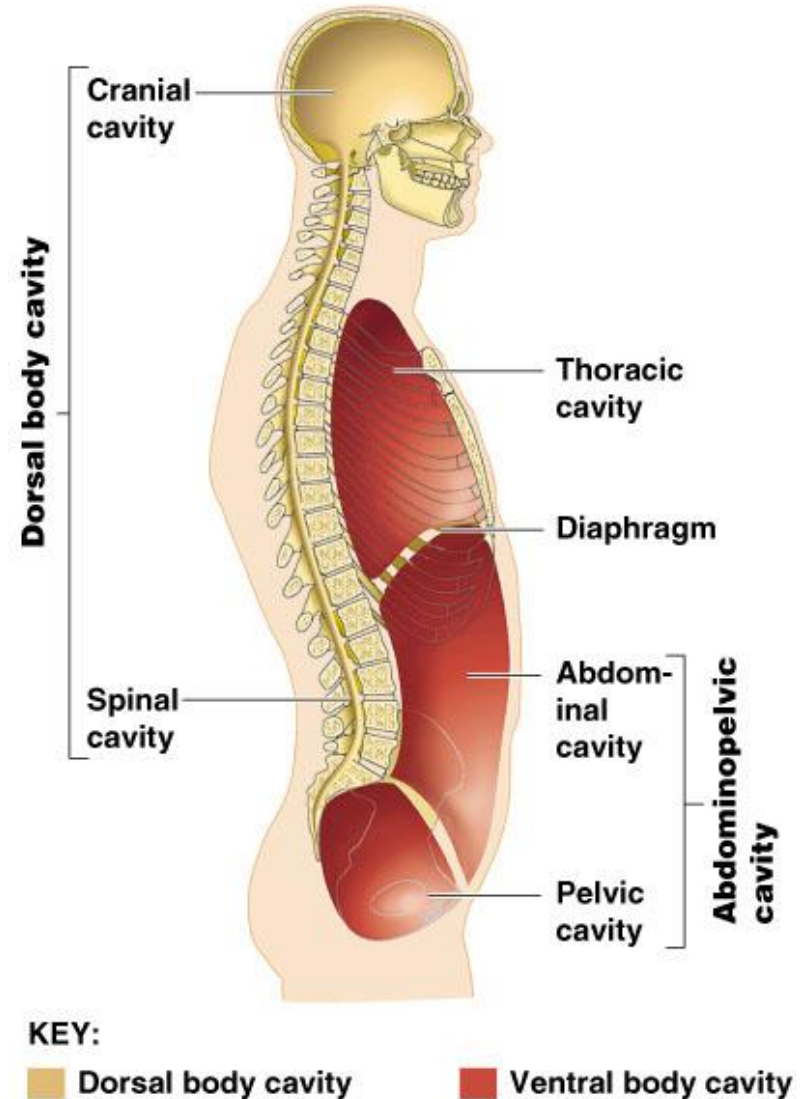


(c) Transverse plane



Body cavities

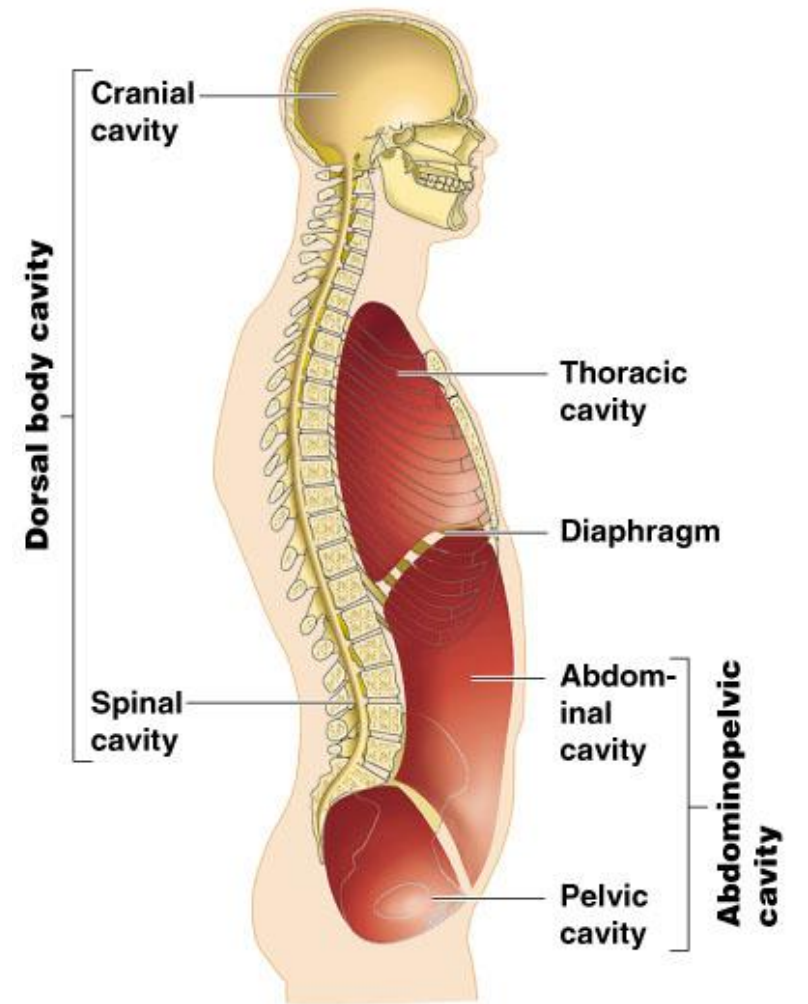
- They are two sets of internal body cavities called the dorsal and ventral body cavities.
- These cavities are closed to the outside and provide different degrees of protection to the organs contained within them.



Body cavities

1- Dorsal Body Cavity:

- Protects the fragile nervous system organs.
- It has two subdivisions, **the cranial cavity, in the skull**, encases the brain, **the vertebral, or spinal, cavity**, which runs within the bony vertebral column, encloses the delicate spinal cord.



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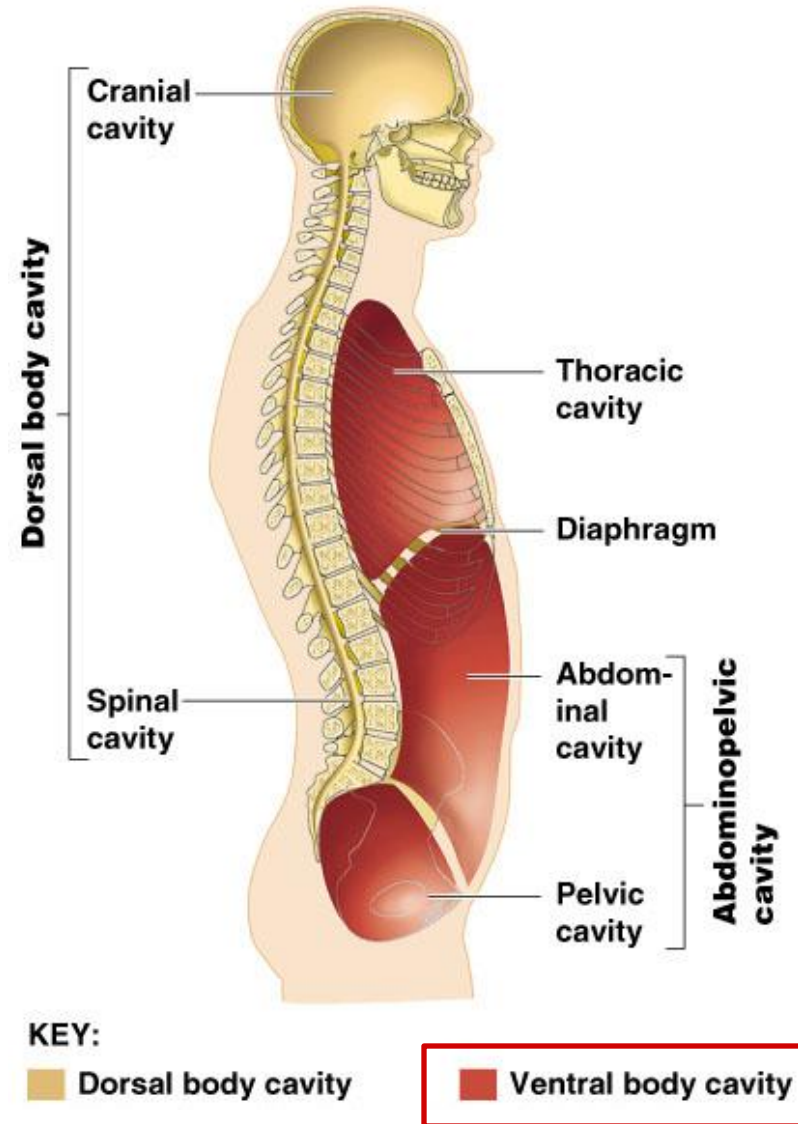
Dorsal body cavity

Ventral body cavity

Body cavities

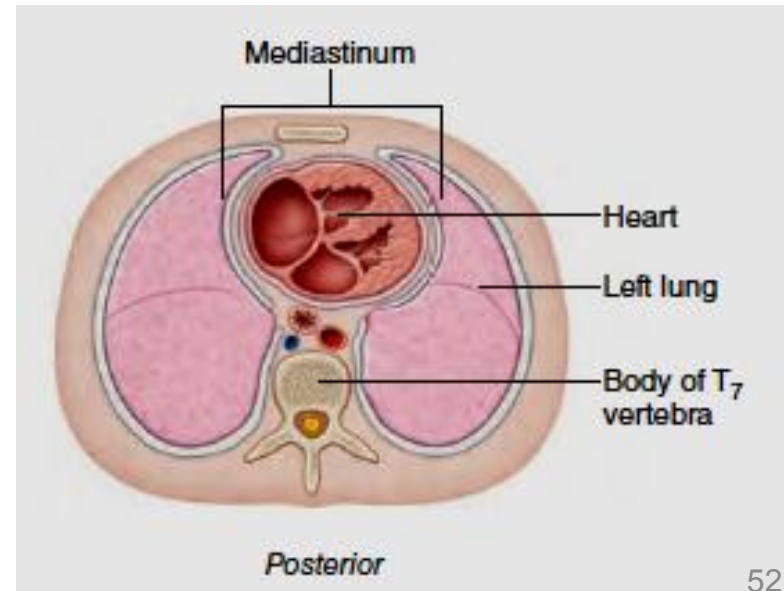
2- Ventral Body Cavity :

- The more anterior and larger of the closed body cavities
- Like the dorsal cavity, it has two major subdivisions, **the *thoracic cavity* and the *abdominopelvic cavity***.
- *The ventral body cavity houses internal organs collectively called the viscera or visceral organs.*
- The superior subdivision, the thoracic cavity is surrounded by the ribs and muscles of the chest.



Body cavities

- The thoracic cavity is further subdivided into lateral **pleural cavities**, each enveloping a lung, and the medial **mediastinum**.
- The mediastinum contains the pericardial, which encloses the heart, and it also surrounds the remaining thoracic organs (esophagus, trachea, and others).



Body cavities

- The thoracic cavity is separated from the more inferior abdominopelvic cavity by the diaphragm (a dome-shaped muscle important in breathing).
- **The abdominopelvic cavity, has two parts:**
 - The superior portion, the **abdominal cavity**, contains the stomach, intestines, spleen, liver, and other organs.
 - The inferior part, the **pelvic cavity, lies in the bony pelvis and** contains the urinary bladder, some reproductive organs, and the rectum
- These regions are not physically separated by a muscular or membrane wall.