Anatomy and Physiology

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Introduction and scope of Anatomy and physiology

- ***Anatomy*** *is the branch of science that deals with the study of structures of different organs of human body.*

- ***Subdivision of anatomy***

1. ***Surface anatomy:*** Study of the external structure of the body.
2. ***Gross anatomy:*** Microscopic study of the gross organs of the body.
3. ***Systemic anatomy:*** Structural study of different system of the body such as digestive system, nervous system.
4. ***Reginal anatomy:*** Study of specific region of the body such as thorax, abdomen, chest, head etc.

5. ***Developmental anatomy:*** Study of the structural feature during development of the fertilized egg to adult form.
6. ***Cytology:*** Microscopic study of the structure of cells and cell organelles.
7. ***Histology:*** Microscopic study of the structural features of tissues.
8. ***Embryology:*** Initial eight week developmental study of structure of fertilized egg.

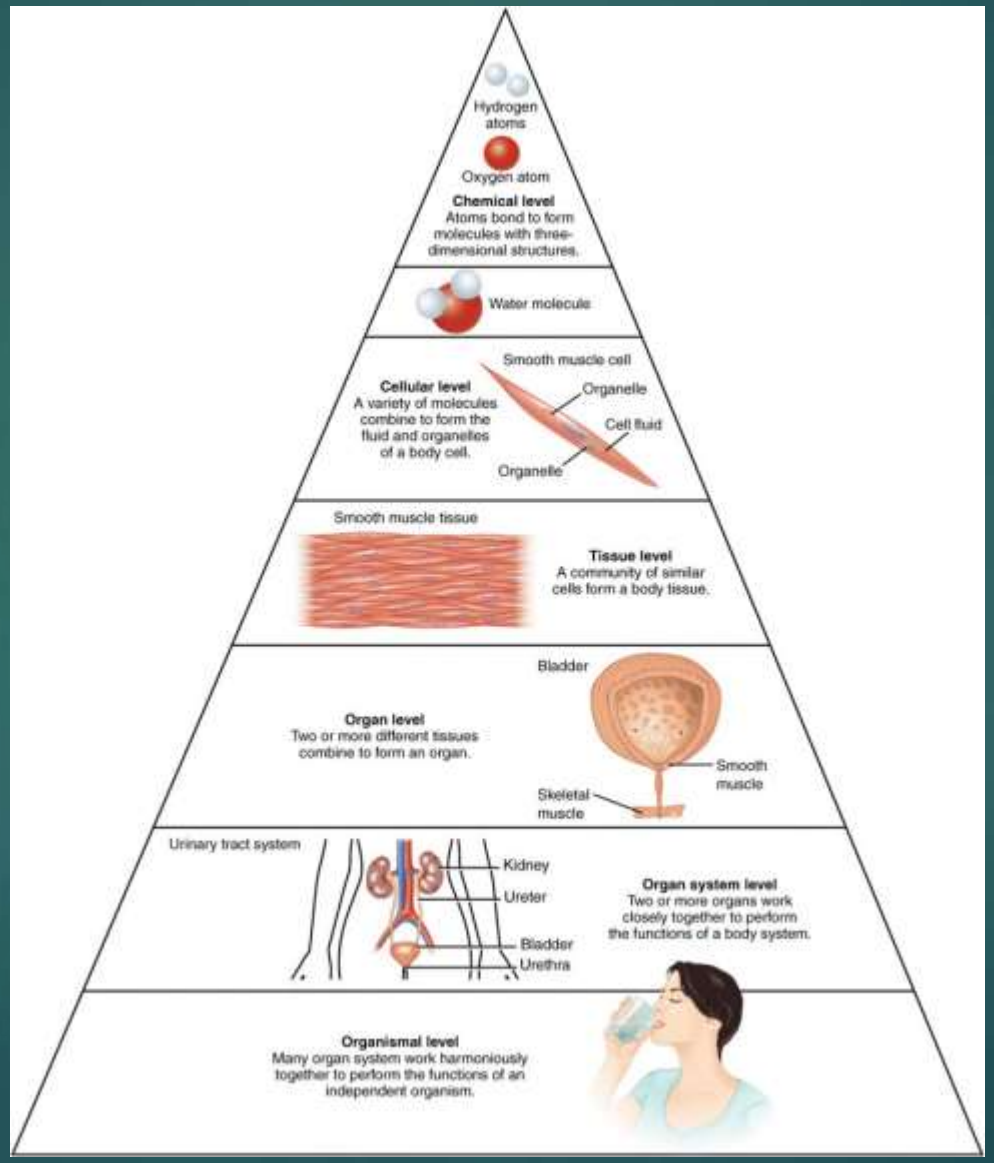
- ***Physiology*** *is the branch of science that deals with the normal functions of living organism and their body parts.*

- ***Subdivision of physiology***

1. ***Cell physiology:*** Deals with the study of different functional characteristics of cell and its organelles.
2. ***Systems physiology:*** Study of the function of different organ system of body.
3. ***Cardiovascular physiology:*** It is the study of functions of heart and blood vessels.
4. ***Renal physiology:*** Deals with the study of the function of kidney.
   Neurophysiology: Study of functional characteristics of the neurons and nervous system.
5. ***Endocrinology:*** Study of functional features of different endocrine glands and hormones.

6. ***Reproductive physiology:*** Study of functions of reproductive organs.
7. ***Respiratory physiology:*** Study of functions of respiratory air passageways and lungs.
8. ***Immunology:*** Study of functional features of the defence system of body.
9. ***Pathophysiology:*** Study of the changes in functions of different body system associated with disease or aging.

Structural Level of Organization



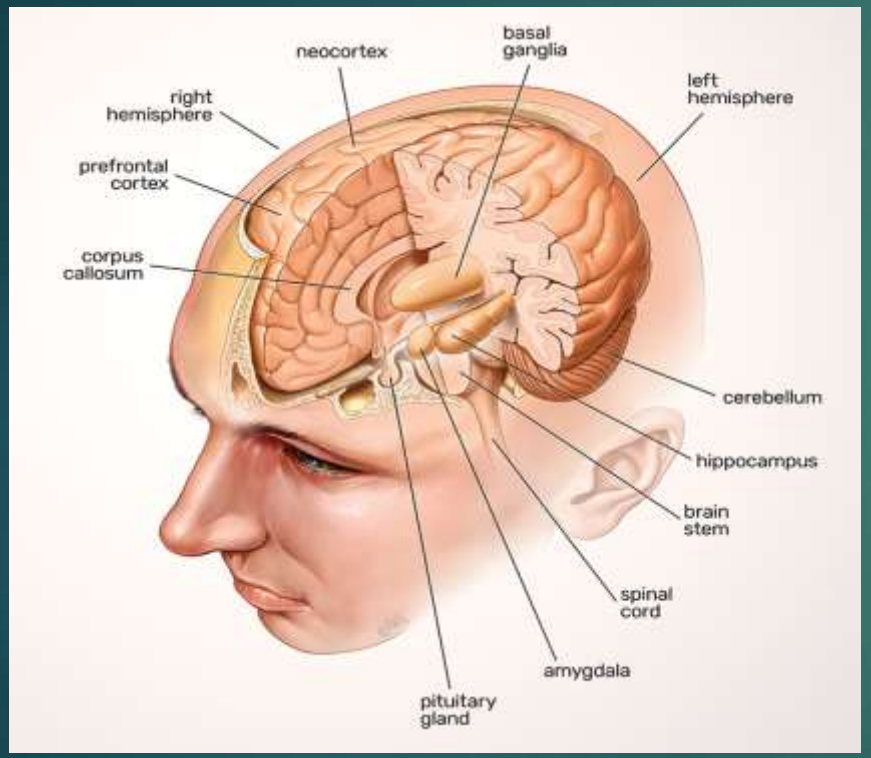
- All matter in the universe is composed of one or more unique pure substances called ***elements,*** familiar examples of which are hydrogen, oxygen, carbon, nitrogen, calcium, and iron.
- The smallest unit of any of these pure substances (elements) is an ***atom.***
- Atoms are made up of subatomic particles such as the proton, electron and neutron.
- Two or more atoms combine to form a ***molecule,*** such as the water molecules, proteins, and sugars found in living things.
- Molecules are the chemical building blocks of all body structures.

- A ***cell*** is the smallest independently functioning unit of a living organism.
- A human cell typically consists of flexible membranes that enclose cytoplasm, a water-based cellular fluid together with a variety of tiny functioning units called **organelles**.
- A ***tissue*** is a group of many similar cells (though sometimes composed of a few related types) that work together to perform a specific function.
- An ***organ*** is an anatomically distinct structure of the body composed of two or more tissue types. Each organ performs one or more specific physiological functions. An **organ system** is a group of organs that work together to perform major functions or meet the physiological needs of the body.

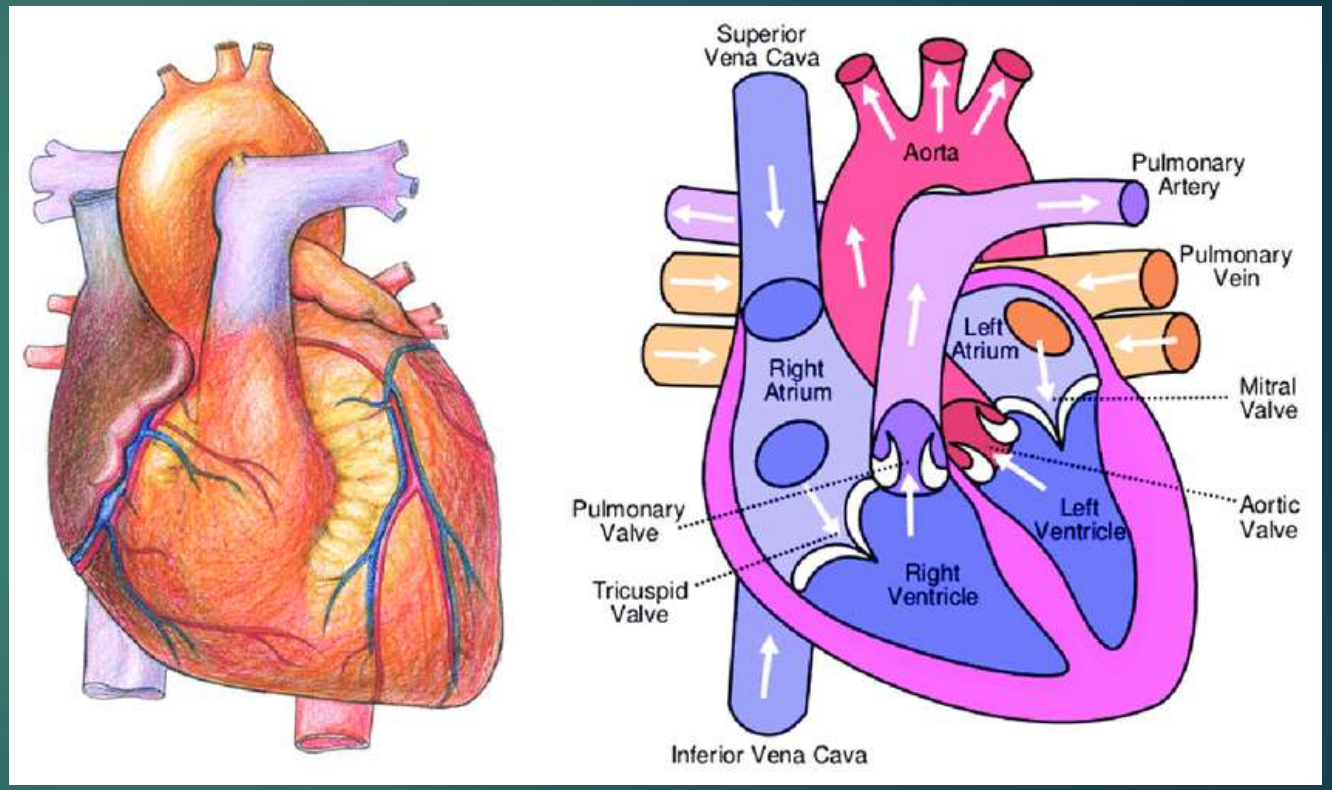
Systems of the human body

1. *Nervous system*
2. *Urinary system*
3. *Cardiovascular system*
4. *Respiratory system*
5. *Digestive system*
6. *Lymphatic system*
7. *Reproductive system.*
8. *Endocrine system*

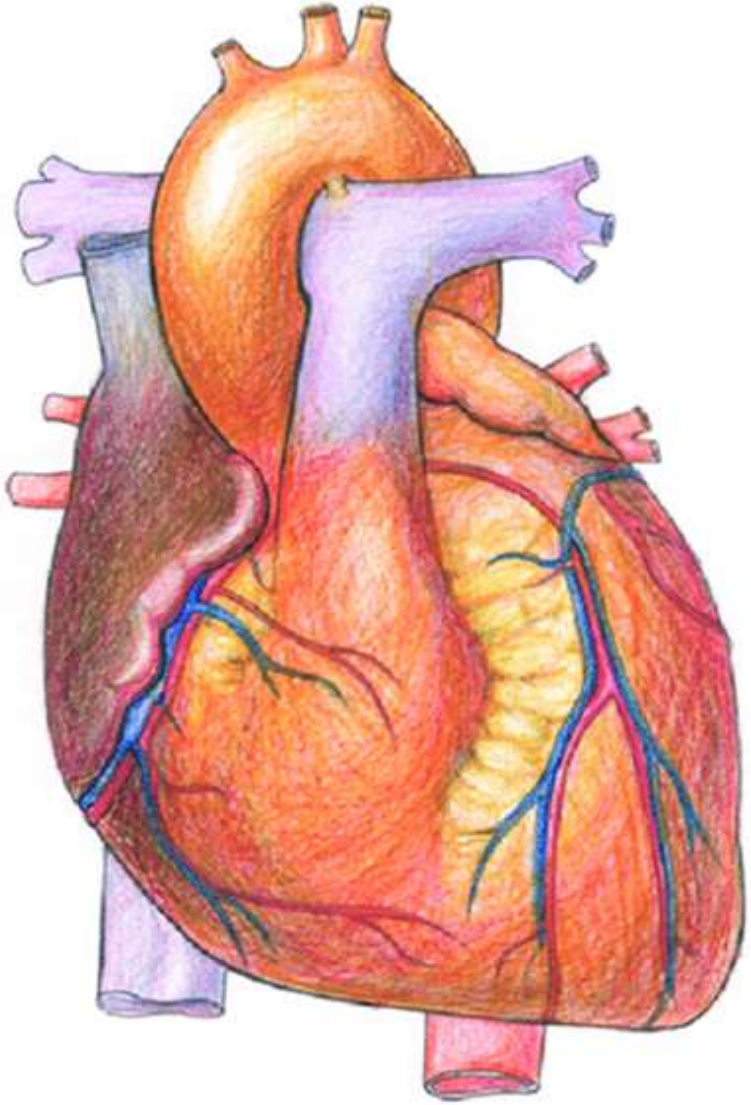
Systems of the human body

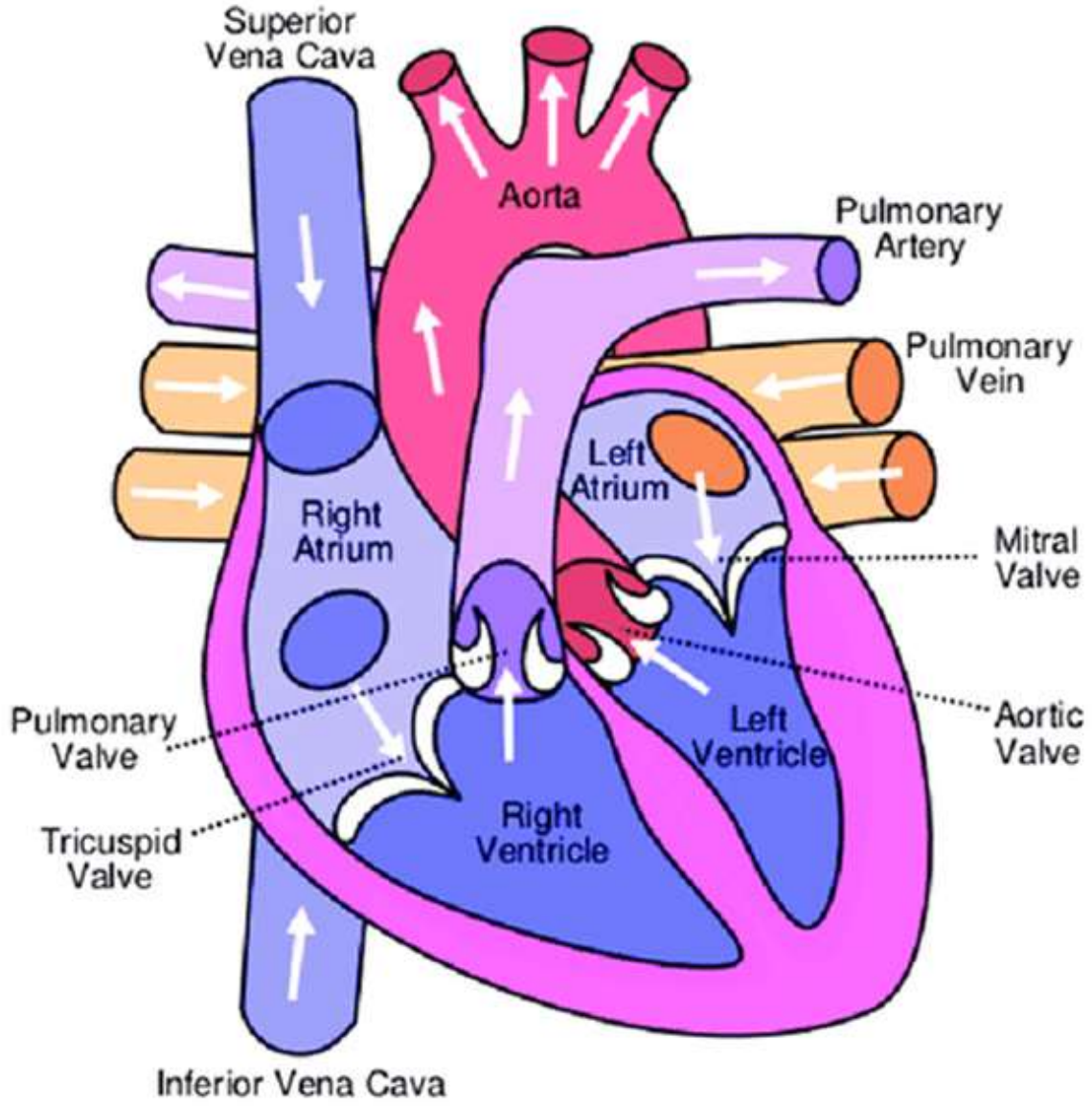


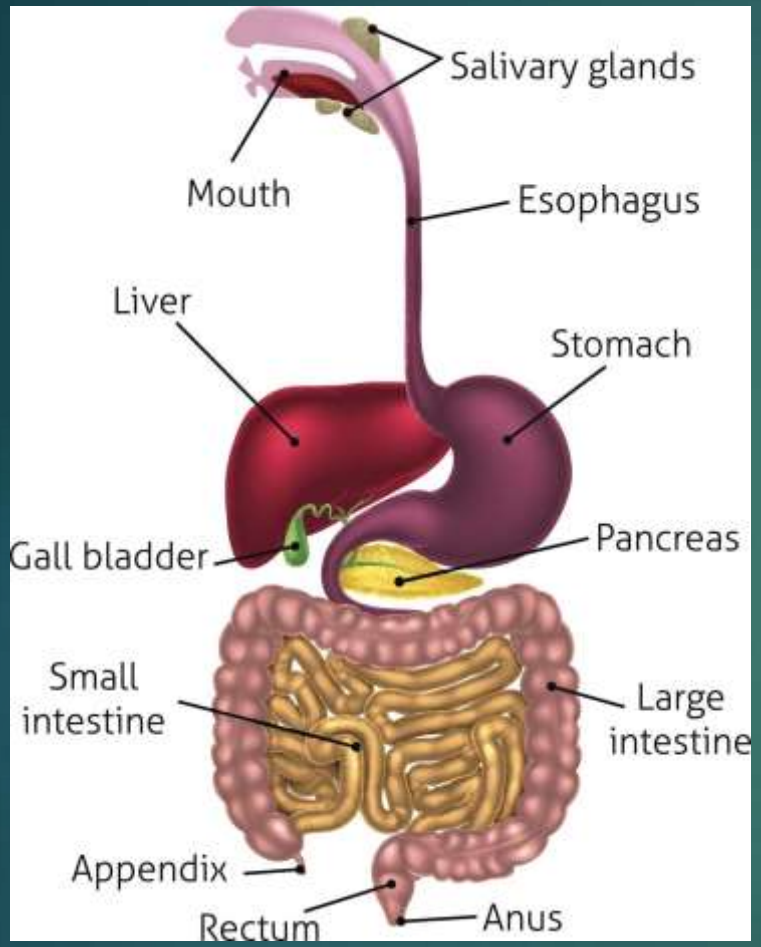
Nervous system



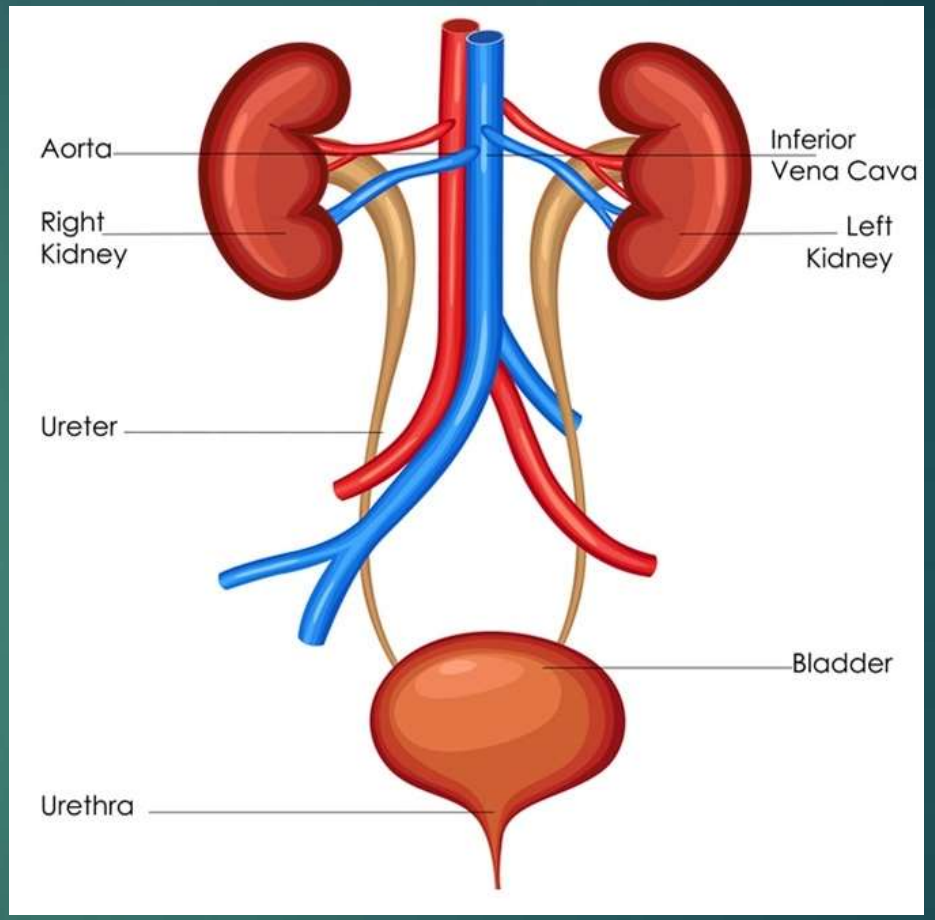
Cardiovascular system



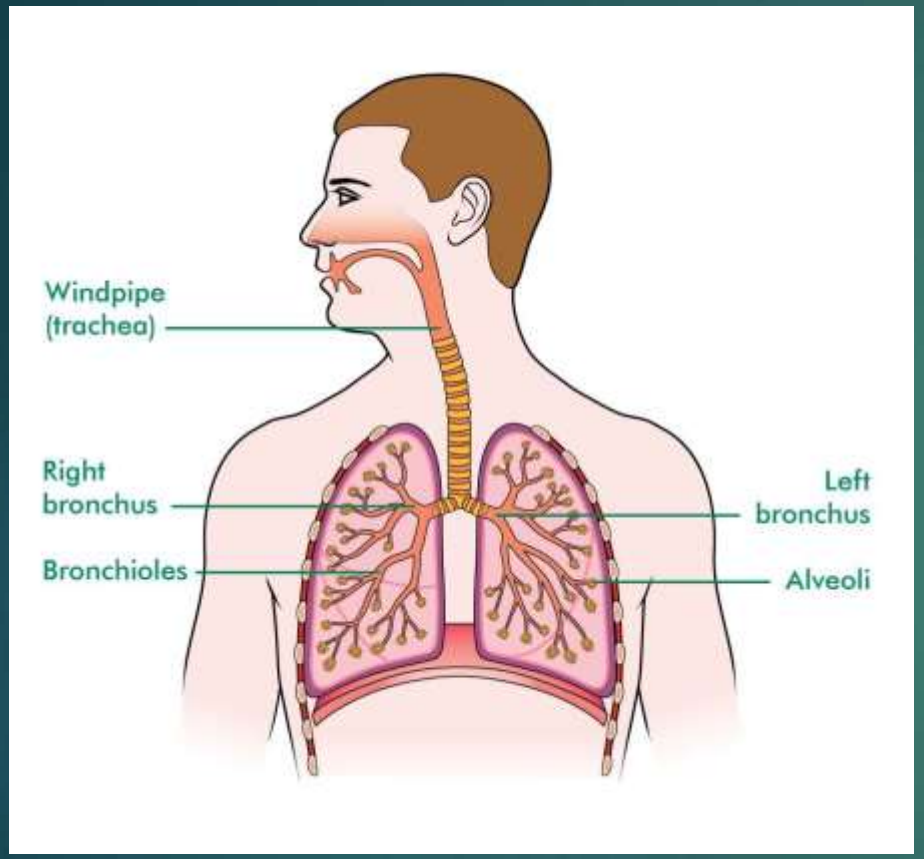

Superior
Vena Cava
Aorta
Pulmonary
Artery
Pulmonary
Vein
Left
Atrium
Right
Atrium
Mitral
Valve
Pulmonary
Valve
Aortic
Valve
Left
Ventricle
Right
Ventricle
Tricuspid
Valve
Inferior Vena Cava



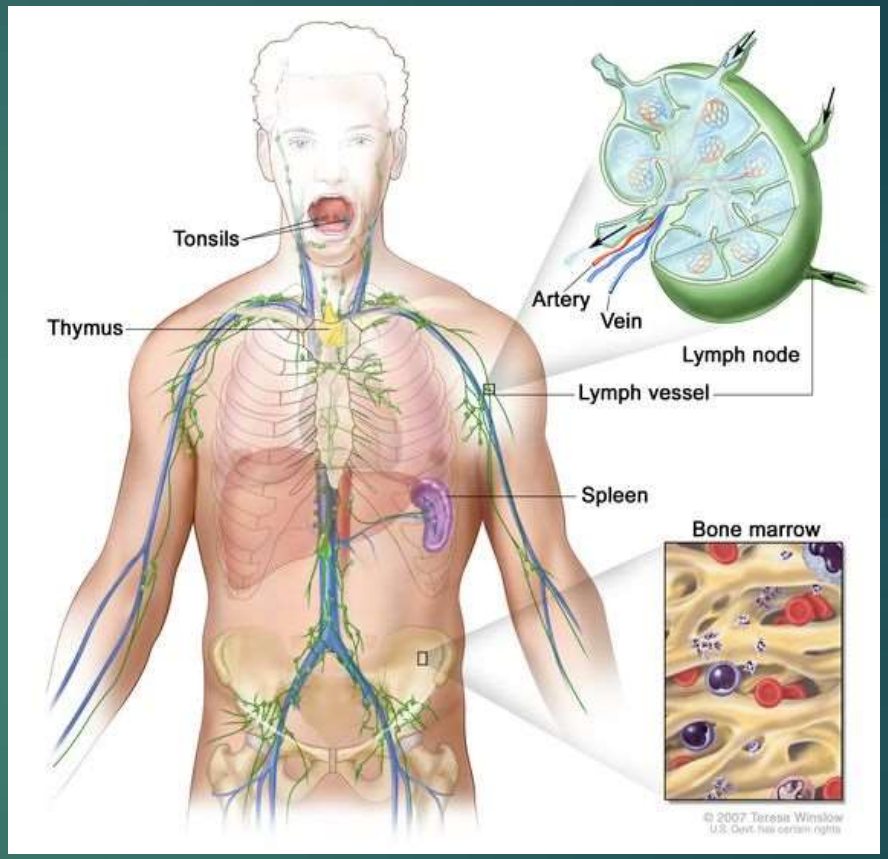
Digestive system



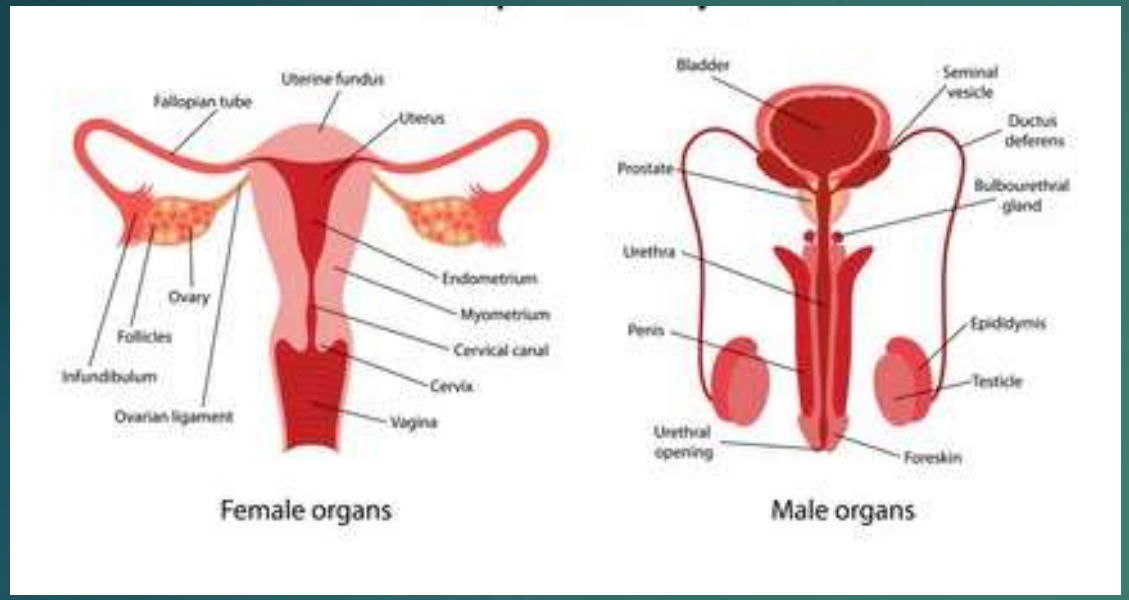
Urinary system



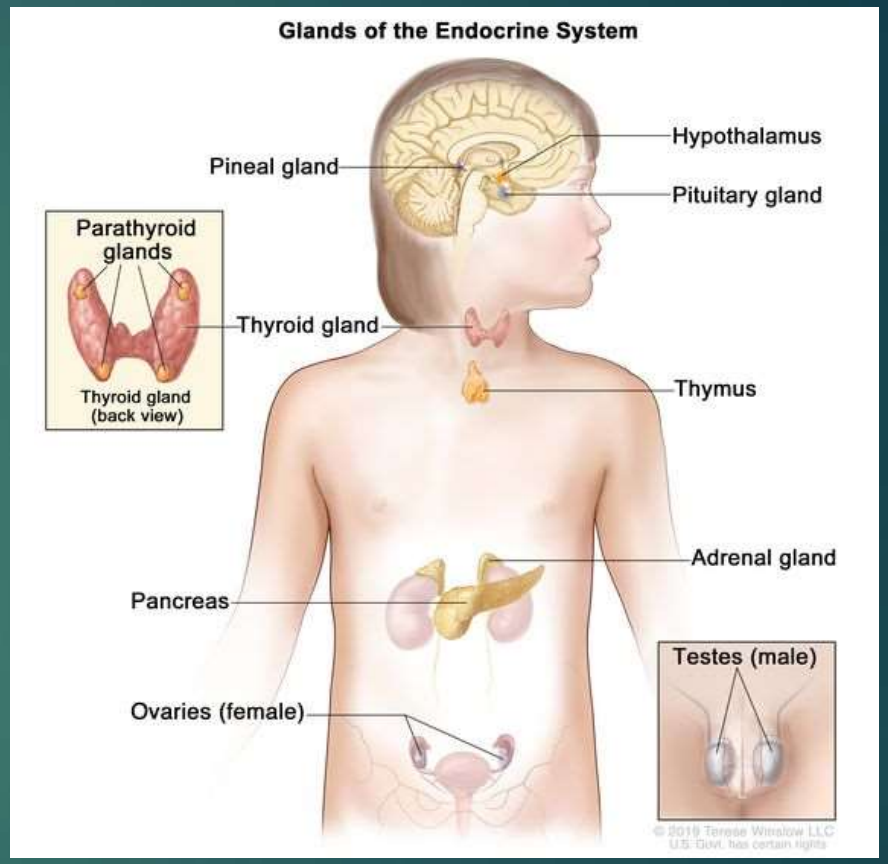
Respiratory system



Lymphatic system



Reproductive system.



Endocrine system

Basic Life Process

The basic processes of life include organization, metabolism, responsiveness, movements, and reproduction. In humans, who represent the most complex form of life, there are additional requirements such as growth, differentiation, respiration, digestion, and excretion. All of these processes are interrelated.

The following are a brief description of the life process:

1. Organization: At all levels of the organizational scheme, there is a division of labor. Each component has its own job to perform in cooperation with others. Even a single cell, if it loses its integrity or organization, will die.

2. Metabolism: Metabolism is a broad term that includes all the chemical reactions that occur in the body. One phase of metabolism is catabolism in which complex substances are broken down into simpler building blocks and energy is released.

3. Responsiveness: Responsiveness or irritability is concerned with detecting changes in the internal or external environments and reacting to that changes. It is the act of sensing a stimulus and responding to it.

4. Movement: There are many types of movement within the body. On the cellular level, molecules move from one place to another. Blood moves from one part of the body to another. The diaphragm moves with every breath. The ability of muscle fibers to shorten and thus produce movement is called contractility.

5. Reproduction: For most people, reproduction refers to the formation of a new person, the birth of a baby. In this way, life is transmitted from one generation to the next through reproduction of the organism. In a broader sense, reproduction also refers to the formation of new cells for the replacement and repair of old cells as well as for growth. This is cellular reproduction. Both are essential to the survival of the human race.

6. Growth: Growth refers to an increase in size either through an increase in the number of cells or through an increase in the size of each individual cell. In order for growth to occur, anabolic processes must occur at a faster rate than catabolic processes.

7. Differentiation: Differentiation is a developmental process by which unspecialized cells change into specialized cells with distinctive structural and functional characteristics. Through differentiation, cells develop into tissues and organs.

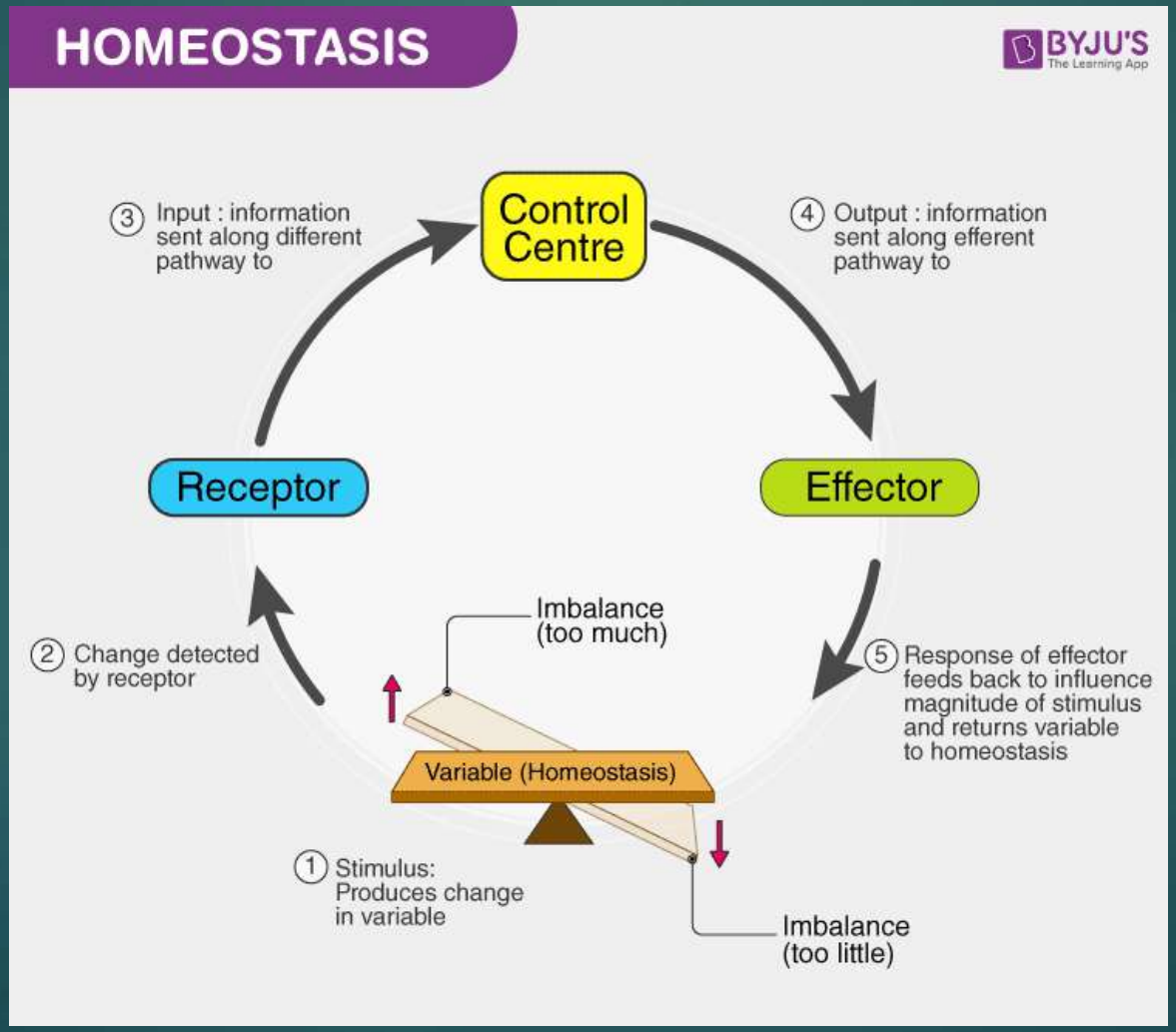
8. Respiration: Respiration refers to all the processes involved in the exchange of oxygen and carbon dioxide between the cells and the external environment. It includes ventilation, the diffusion of oxygen and carbon dioxide, and the transport of the gases in the blood. Cellular respiration deals with the cell's utilization of oxygen and release of carbon dioxide in its metabolism.

9. Digestion: Digestion is the process of breaking down complex ingested foods into simple molecules that can be absorbed into the blood and utilized by the body.

10. Excretion: Excretion is the process that removes the waste products of digestion and metabolism from the body. It gets rid of by-products that the body is unable to use, many of which are toxic and incompatible with life.

Homeostasis

"Homeostasis is the state of steady internal chemical and physical conditions maintained by living systems."



Regulation of Homeostasis

- The regulation of homeostasis depends on three mechanisms:

1. ***Effector.***
2. ***Receptor.***
3. ***Control Center.***

Receptor:

As the name suggests, the receptor is the sensing component responsible for monitoring and responding to changes in the external or internal environment.

Control Center

The control center is also known as the integration center. It receives and processes information from the receptor.

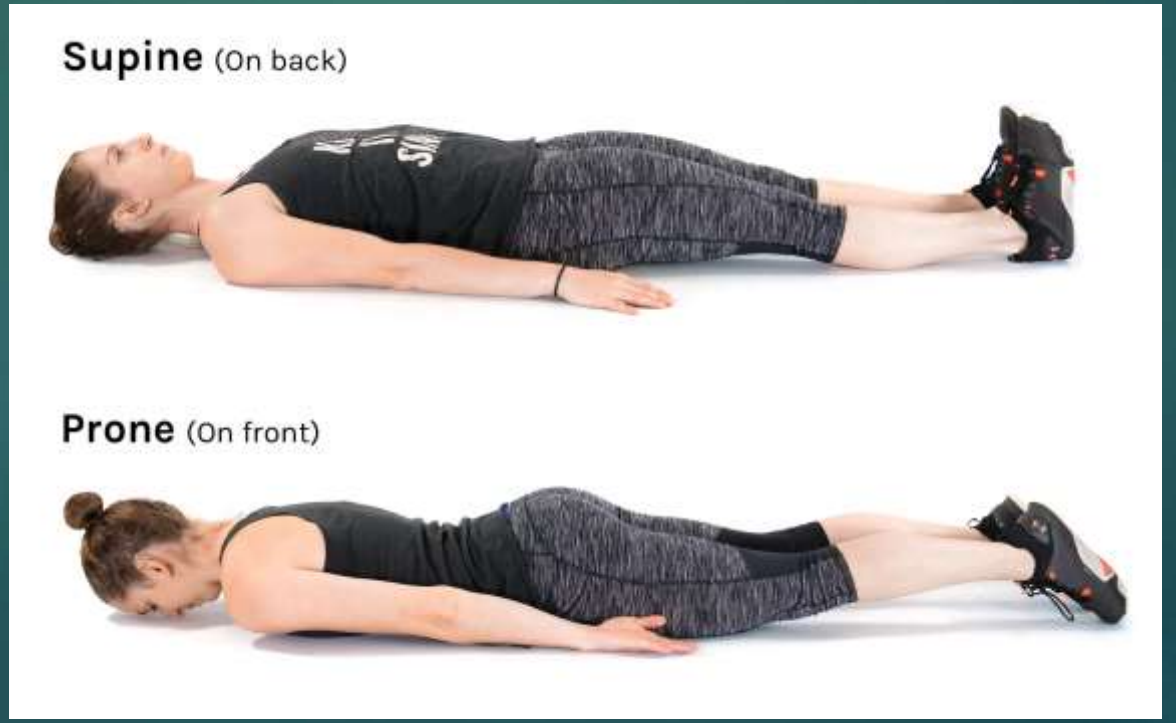
Effector

The effector responds to the commands of the control center. It could either oppose or enhance the stimulus.

Basic Anatomical Terminologies

1. **BODY POSITION –**

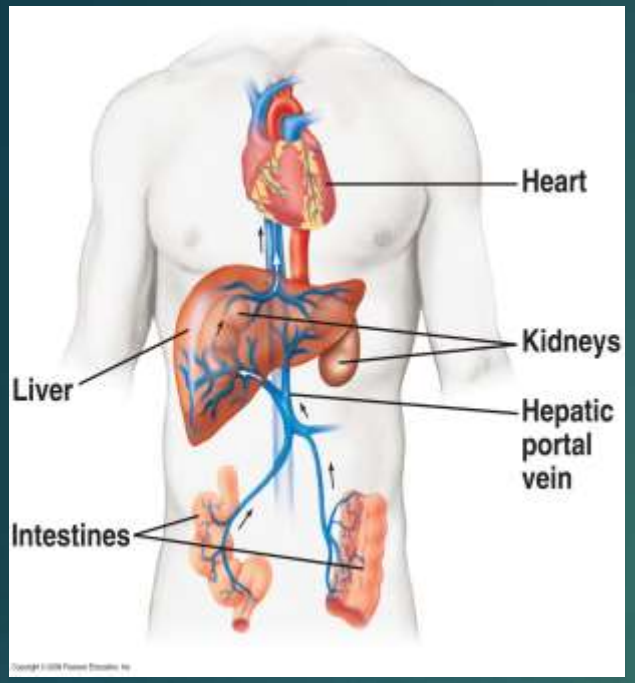
- ***Supine position:*** Body laying flat on back with knees straight and arms at sides.
- ***Prone position:*** Body laying flat on stomach with knees straight, arms either under head or at sides.

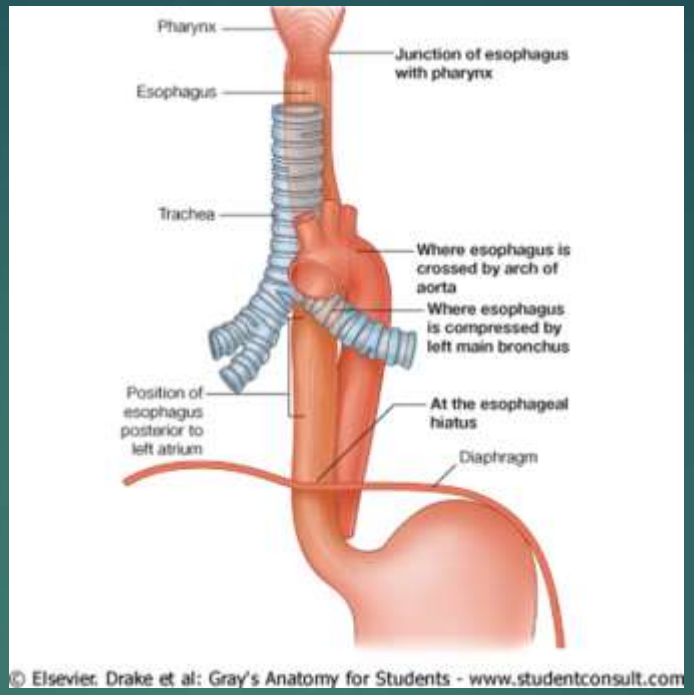


DIRECTIONAL TERMS -

Directional terms describes the position of one body part relative to another body part.

Directional terms	Definition	Example
Superior	Toward the head or upper part of the body.	Heart is superior to the liver.
Inferior	Away from the head, or lower part of the body.	Stomach is inferior to the lungs.
Anterior	Nearer to or at the front of the body.	Sternum is anterior to the heart.
Posterior	Nearer to or at the back of the body.	Oesophagus is posterior to the trachea.
Medial	Nearer to the midline	Ulna is medial to the radius.


Heart
Kidneys
Liver
Hepatic portal vein
Intestines


Pharynx
Junction of esophagus with pharynx
Esophagus
Trachea
Where esophagus is crossed by arch of aorta
Where esophagus is compressed by left main bronchus
Position of esophagus posterior to left atrium
At the esophageal hiatus
Diaphragm
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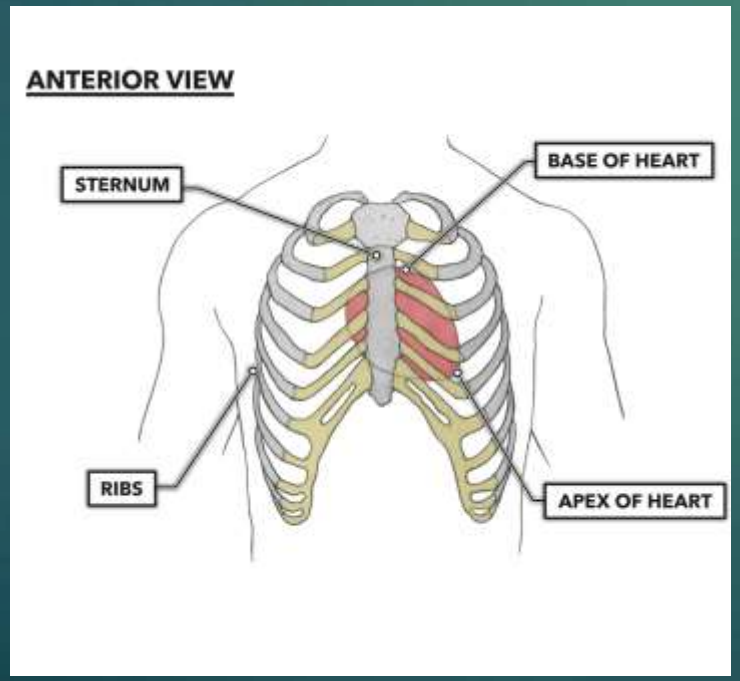
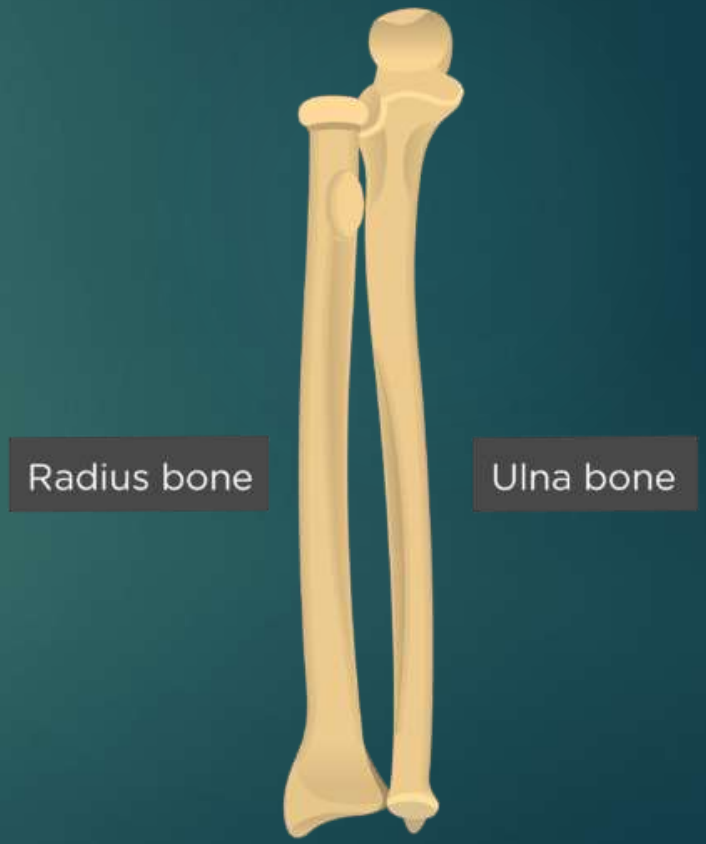

ANTERIOR VIEW
STERNUM
BASE OF HEART
RIBS
APEX OF HEART


Radius bone
Ulna bone

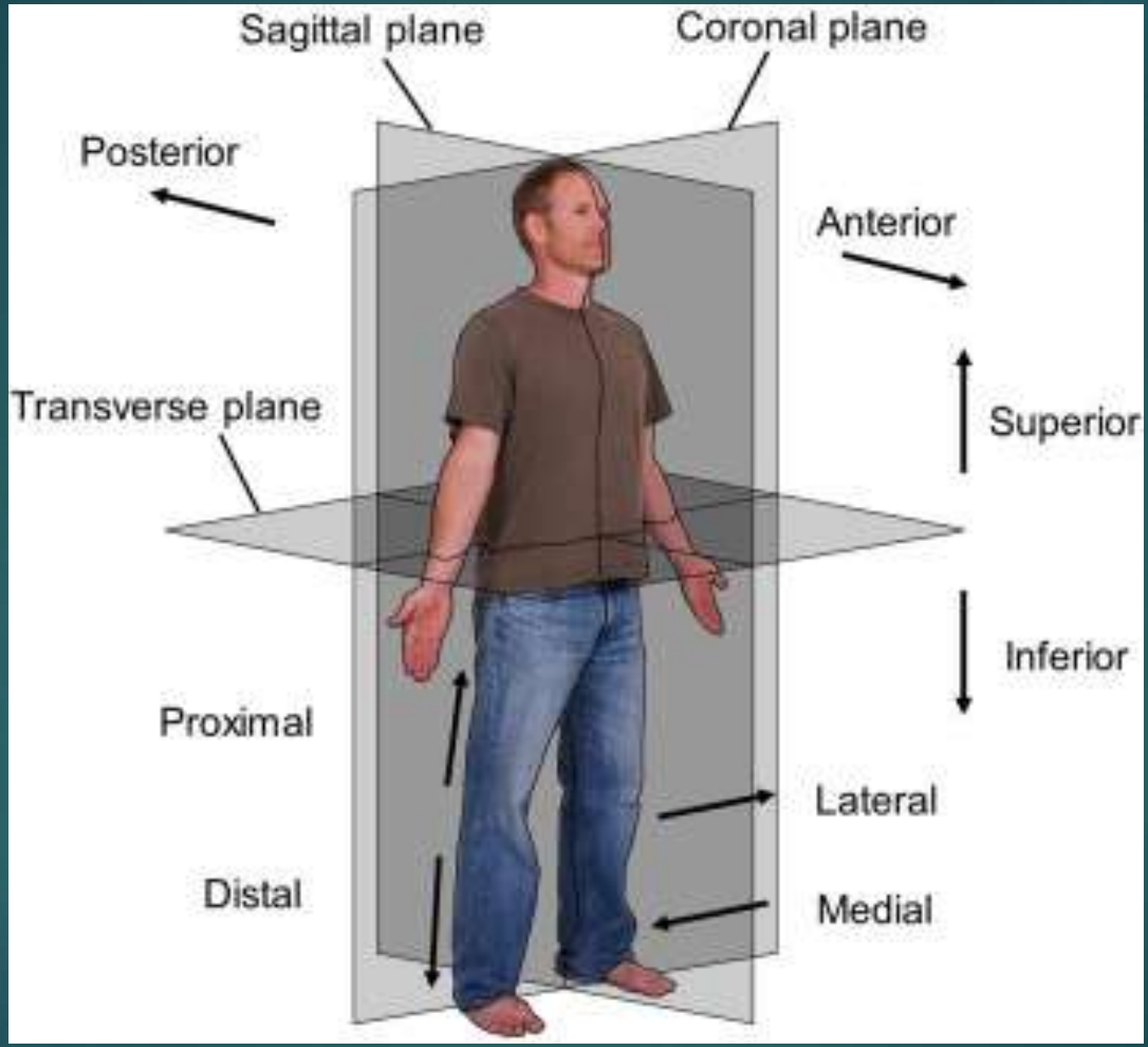
Lateral	Away from the midline	Lungs are lateral to the heart.
Intermediate	Between two structures	Transverse colon is intermediate between the ascending and descending colons.
Proximal	Nearer to the attachment of a limb to the trunk	Humerus is proximal to the radius.
Distal	Away from the attachments of a limb to the trunk	Phalanges are distal to the carpals.
Superior	Toward or on the surface of the body	Ribs are superficial to the lungs
Deep	Away from the surface of the body	Ribs are deep to the skin

3. **PLANES:**

- Body planes are imaginary flat surface that pass through the body parts.
- ***Sagittal plane*** – It is a vertical plane that divides the body or an organ into right and left halves.
- ***Frontal plane*** – It divides the body or an organ into anterior and posterior portions.
- ***Transverse plane*** – It divides the body or an organ into superior and inferior portions.
- ***Oblique plane*** – It passes through the body or an organ at an angle between a transverse plane and a sagittal plane or between a transverse plane and a frontal plane.

4. **SECTIONS:**

- A section is a cut made on the body or organ along one of the planes.
- ***Transverse section***: A section formed by a transverse plane cutting through an object, usually at right angles to an axis.
- ***Frontal section***: A section formed by a frontal plane cutting through an object, dividing the body into dorsal and ventral portions.
- ***Midsagittal section***: A section formed by a frontal plane cutting through an object, dividing the body into right and left halves.

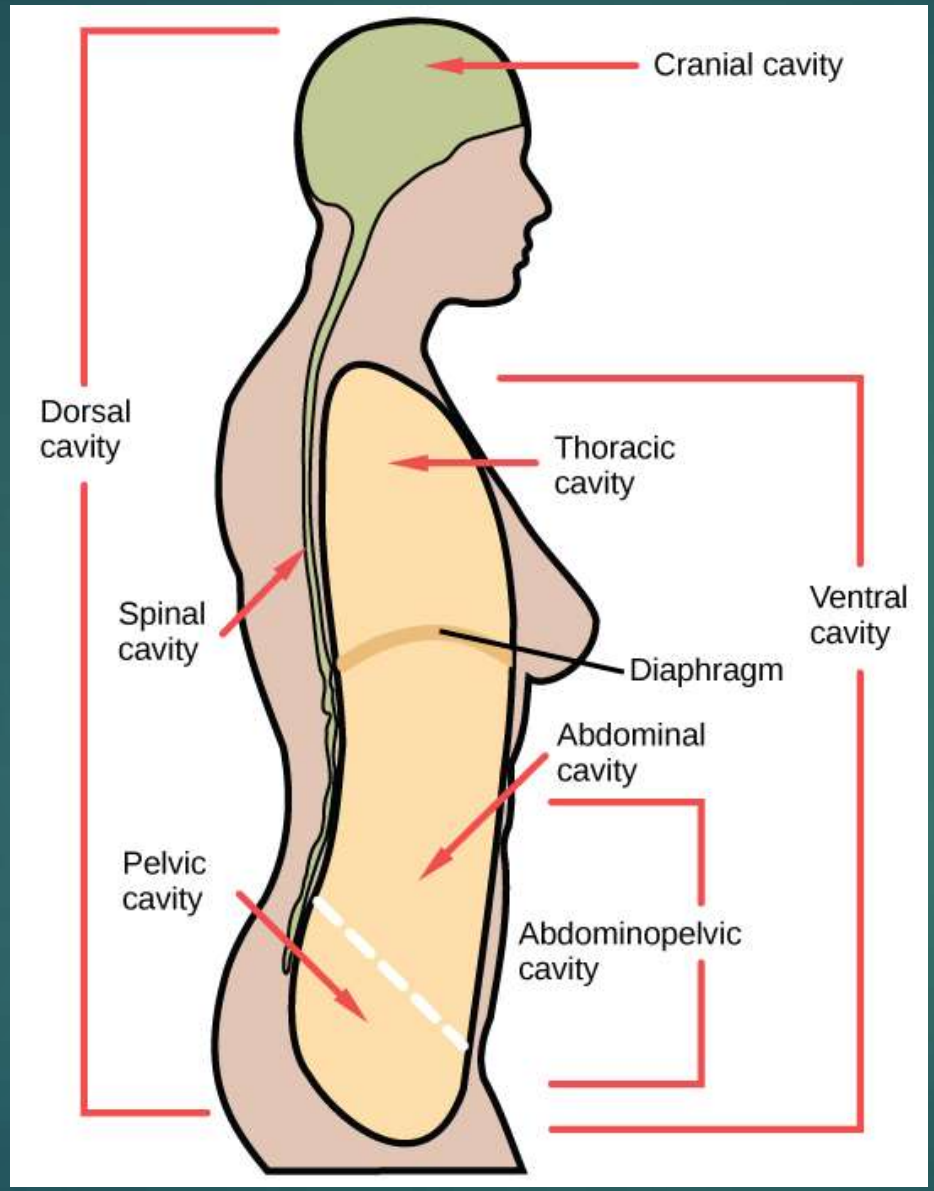


Planes and sections of the body

BODY CAVITIES

Body cavities are spaces within the body that helps to protect, separate and support internal organs.

Cavity	Description
Dorsal cavity	It contains organs that are posteriorly positioned in the body.
Cranial cavity	It is formed by cranial bones and contains brain.
Vertebral canal	It is formed by vertebral column and it contains spinal cord and spinal nerves.
Ventral cavity	It contains thoracic and abdominopelvic cavity.
Thoracic cavity	It is called as chest cavity.
Pleural cavity	It surrounds the lungs and the serous membrane of each pleural cavity is called pleura.
Pericardial cavity	It surrounds the heart and the serous membrane of pericardial cavity is called pericardium.
Abdominal cavity	It contains stomach, spleen, liver, gall bladder, small intestine and large intestine. The serous membrane of the abdominal cavity is called peritoneum.
Pelvic cavity	It contains urinary bladder, portion of large intestine and organs of reproduction.



Body cavities

Exam Oriented Question

1. Define anatomy and physiology. (3M)
2. Enlist major body cavities along with their location. (5M)
3. Explain different directional planes in human body.(5M)
4. Enlist different systems of human body and give their components and functions. (10M)
5. Write a Note on homeostasis and feedback system. (10M)
6. Explain different level of structural organization (5M)
7. Explain different body processes. (5M)
8. Comment on positive and negative feedback system. (5M)

Reference

1. DK Ingawale, SK Mandlik, Human anatomy and physiology,3rd edition, Nirali Prakashan, pp. 1-15.