

Human Anatomy & Physiology

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Human Anatomy & Physiology

- Cell

Human body develops from union of
SPERM + OVUM=FIRST CELL OF HUMAN BODY

Group of cells



Tissues



Organs



Systems

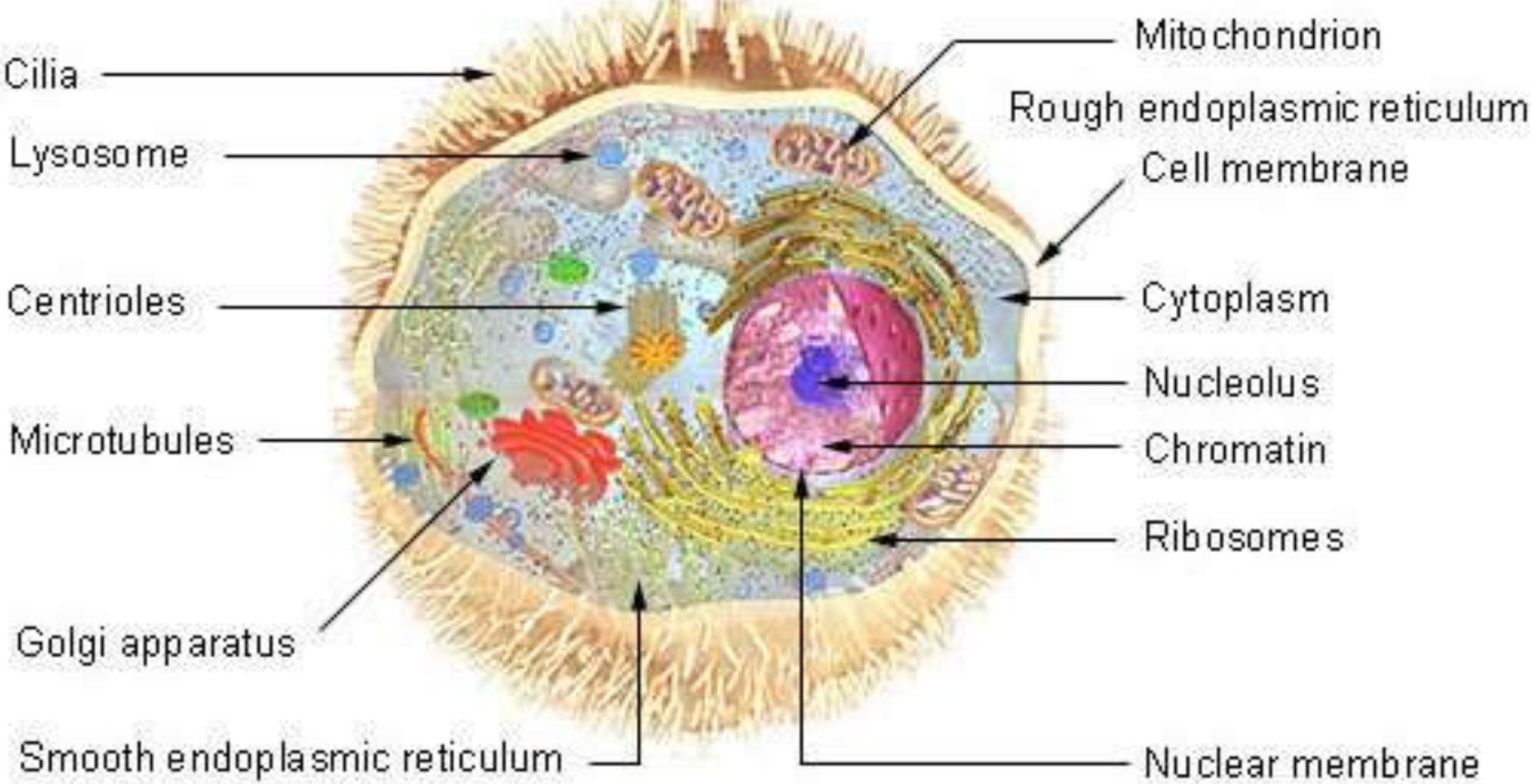
Structure of Cell

- Cell is a structural & Functional unit of human body, capable of carrying out functions of life independently.
 - Nucleus
 - Cytoplasm
 - Cell Membrane

Functions of Cell

- Production of Bio-Energy
- Storage
- Multiplication
- Specific function according to location

Cell Structure

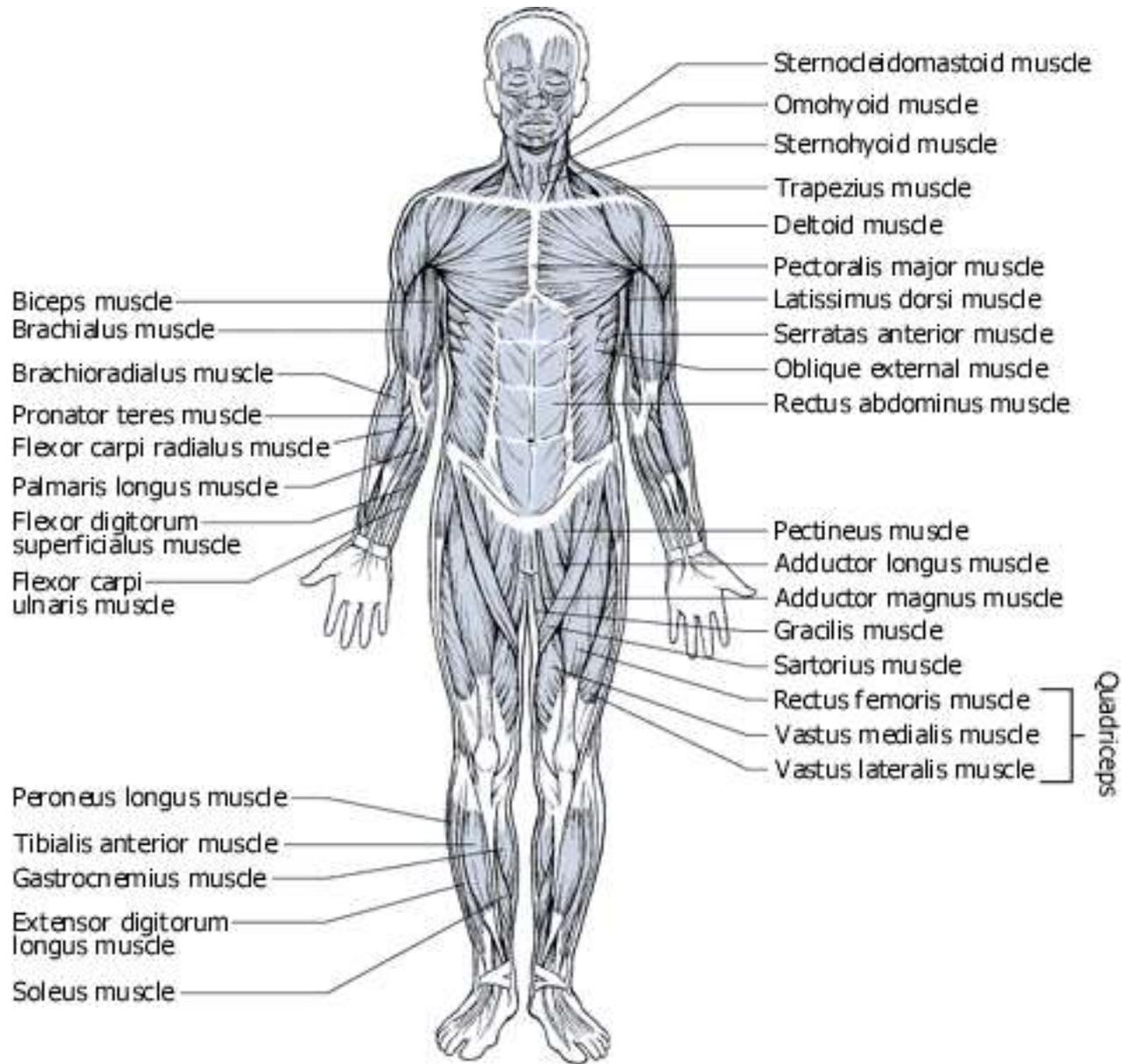


Systems

- Muscular System
- Skeletal System
- Digestive System
- Respiratory System
- Circulatory System
- Excretory System
- Reproductive System (Male & Female)
- Nervous System
- Endocrine System

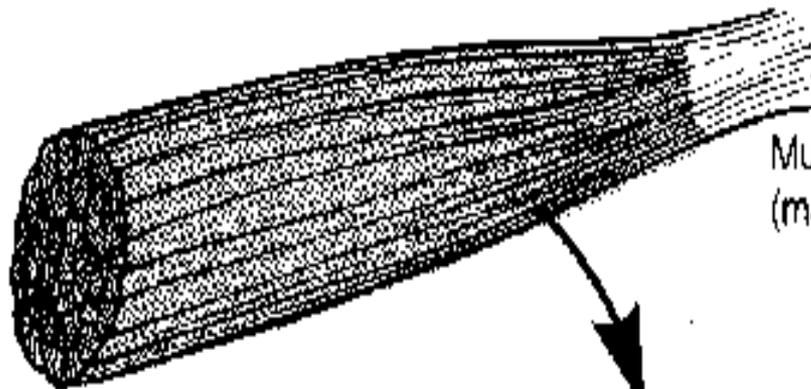
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Muscular System

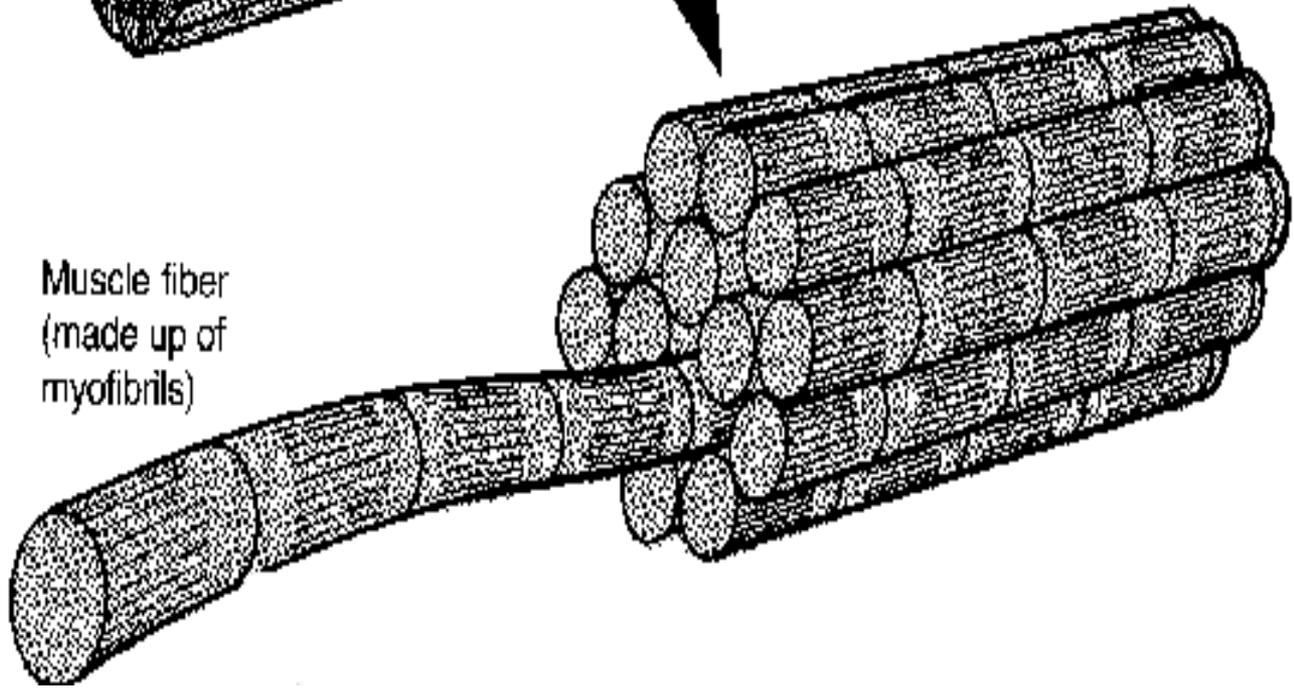


Types of Muscle Fibre

- White Muscle Fibre
 - Predominantly takes part in fast action
 - Requires more Oxygen
 - Heart & Lungs have to work more
- Red Muscle Fibre
 - Predominantly takes part in Slow action
 - Requires less Oxygen
 - Heart & Lungs have to work less
 - Presence of Myoglobin



Muscle fasciculus
(made up of muscle fibers)



Muscle fiber
(made up of
myofibrils)

Types of Muscles

- Striped Muscle (Voluntary Muscle, Skeletal Muscle)
 - Movement controlled by will
 - Attached to bones, ligaments, cartilage & skin
- Unstriped Muscle (Involuntary Muscle, Smooth Muscle)
 - Movements cannot be controlled by will
 - Glands, Blood Vessels, Organs & Tubular structures are made of unstriped muscle
- Cardiac Muscle
 - Involuntary Control
 - Interconnected fibres (forming a web)

Properties of Muscles

- Contraction & Relaxation
- Elasticity
- Muscle tone
- Fatigue

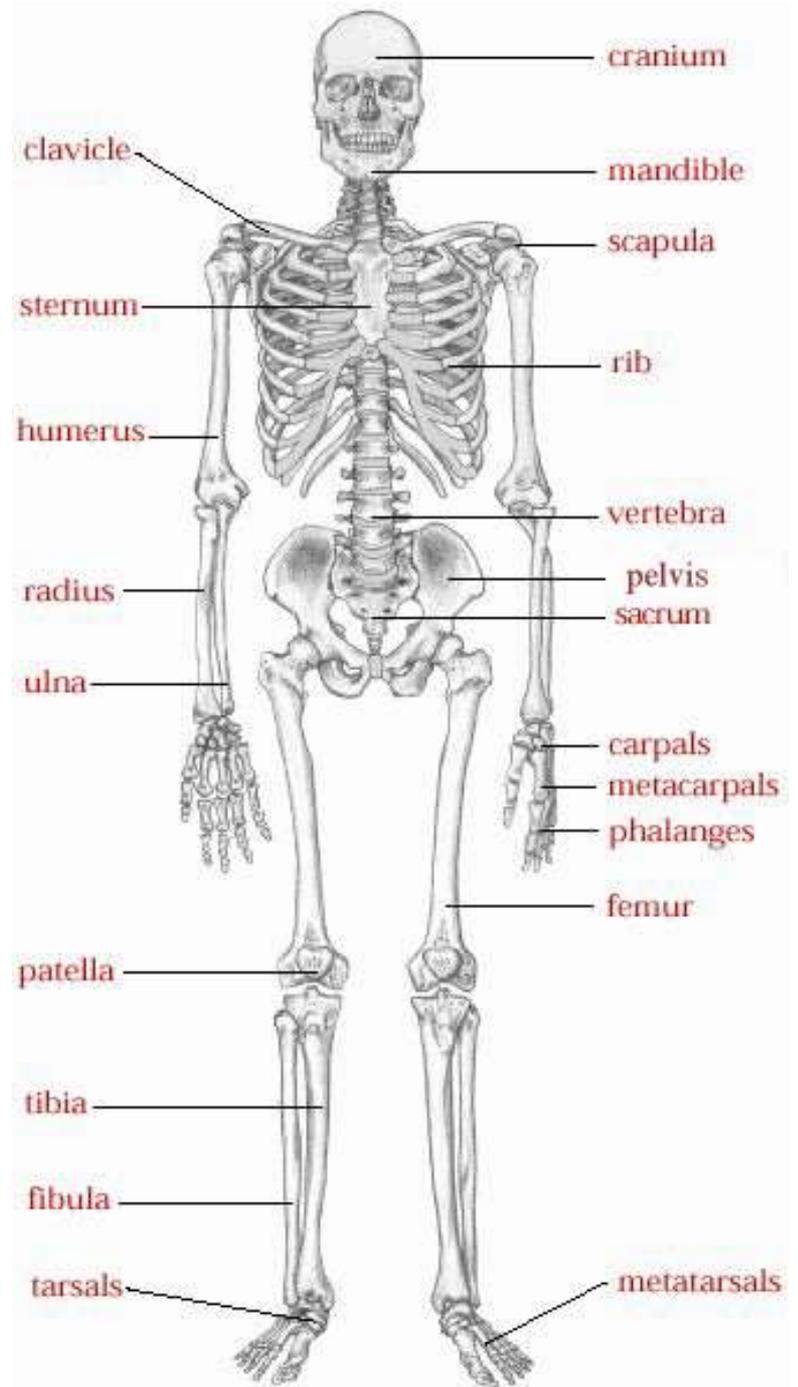
- Work of Muscle depends on
 - Speed of contraction and relaxation
 - Co-ordination of joints and muscle

Type of Work

- Isotonic
 - Tone remains constant
 - Length changes
 - Requires more Oxygen
 - Taking initial state requires more time
- Isometric
 - Length remains constant
 - Tone changes
 - Requires less Oxygen
 - Taking initial state requires less time

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Skeletal System



Ossification

- A process of bone formation by depositing salts of calcium, magnesium and phosphorous

Membrane



Cartilage



Bone

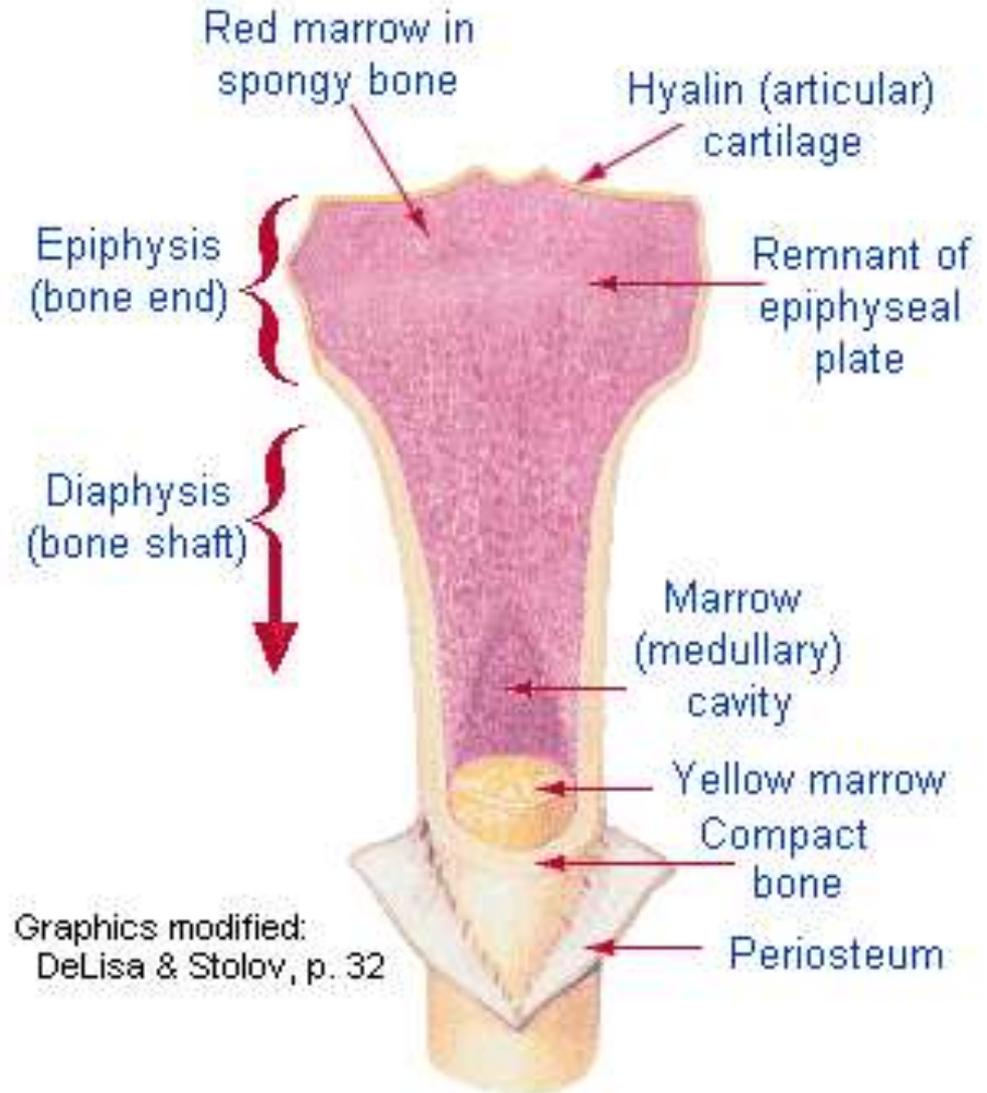
Composition of Bone

- 70% calcium, magnesium & phosphorus salts (Inorganic matter)
- 30% Proteins, Fats, Carbohydrates (Organic matter)

- Children
 - Less amount of inorganic matter
- Old Age
 - Less amount of organic matter

Cavity in bone

- Cavity in bone:
 - Red bone marrow produces RBC
 - Yellow bone marrow is deposits of fats



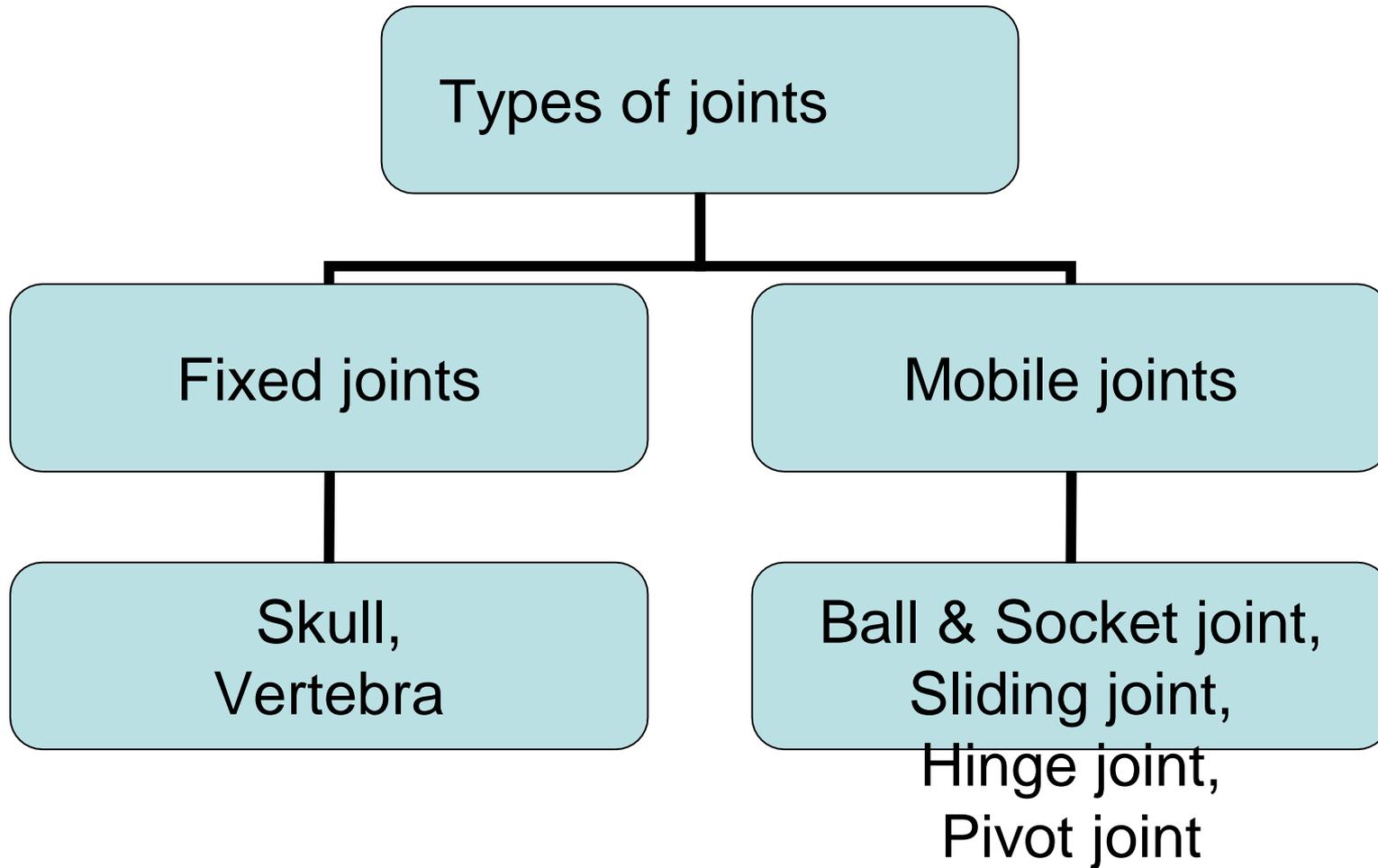
Joints

- Joints
 - Bony ends covered with hyaline cartilage
 - Ligaments bind the bone together
 - Joint cavity enclosed by a capsule-synovial membrane
 - Cavity contains lubricant fluid-synovial fluid

Typical synovial joint



Types of Joints



Types of Mobile joints

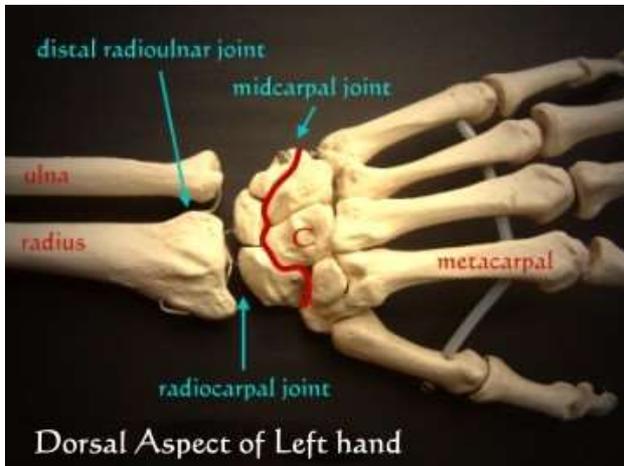
Ball & Socket joint



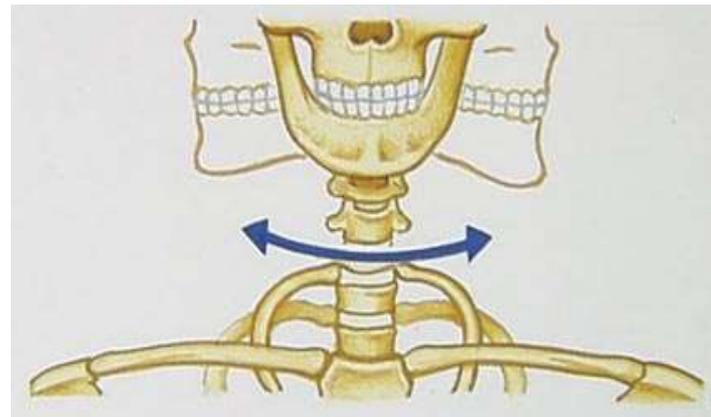
Hinge joint



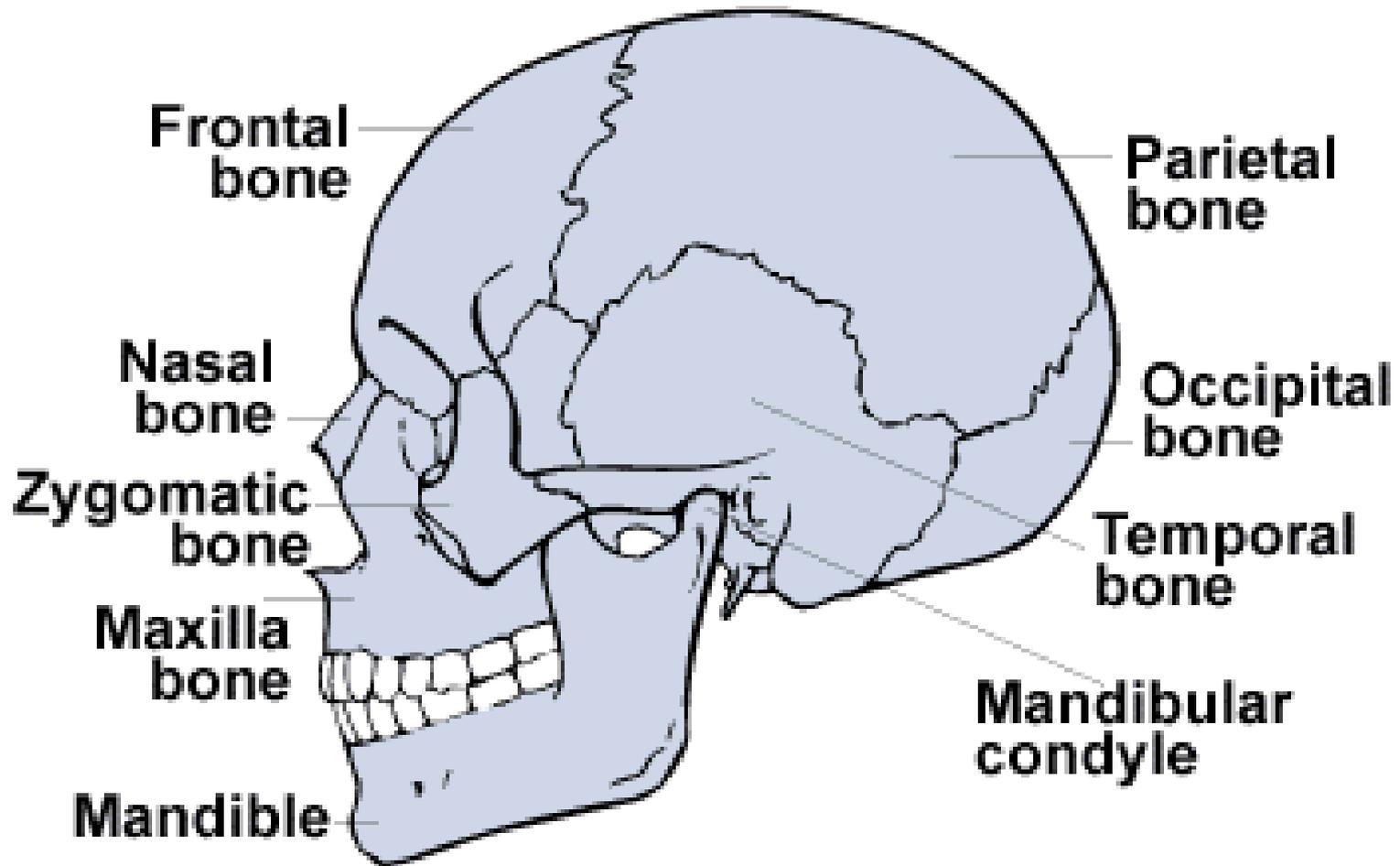
Sliding joint



Pivot joint

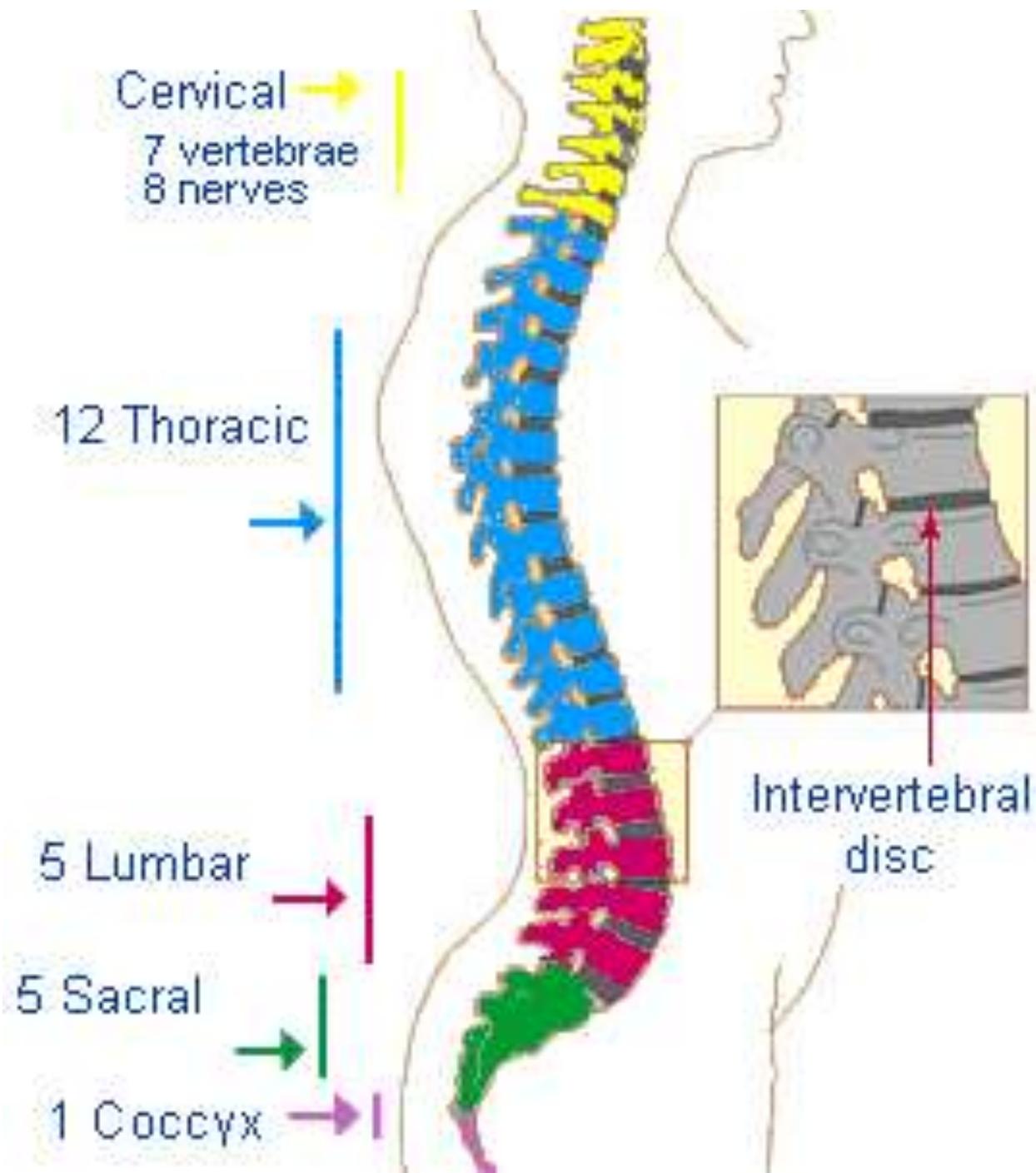


Skull

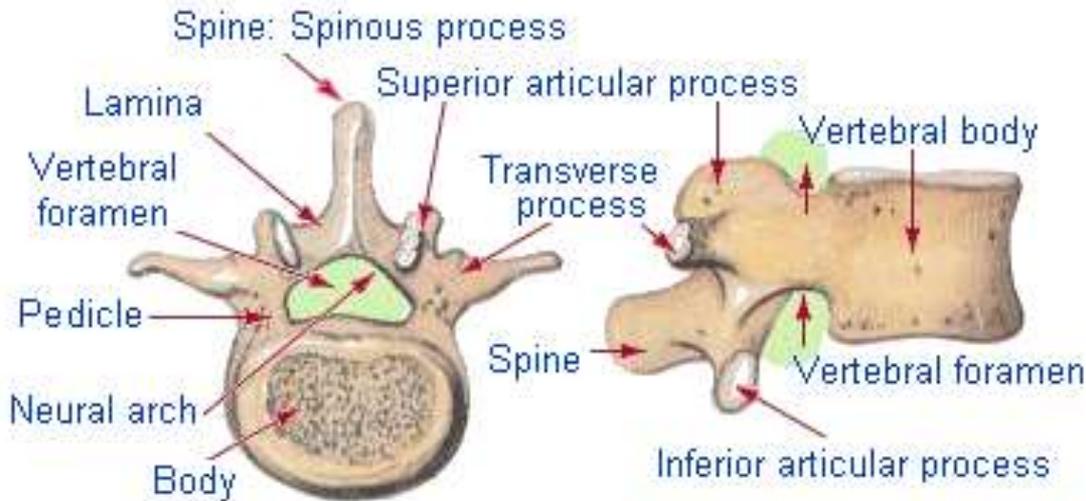


Functions of Skeletal System

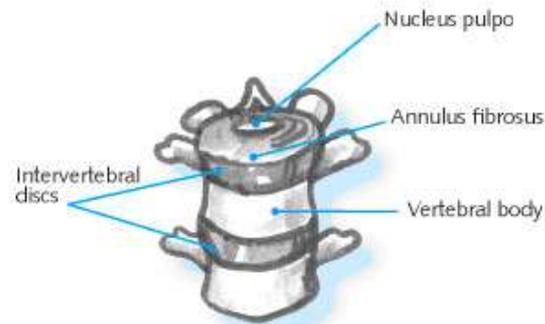
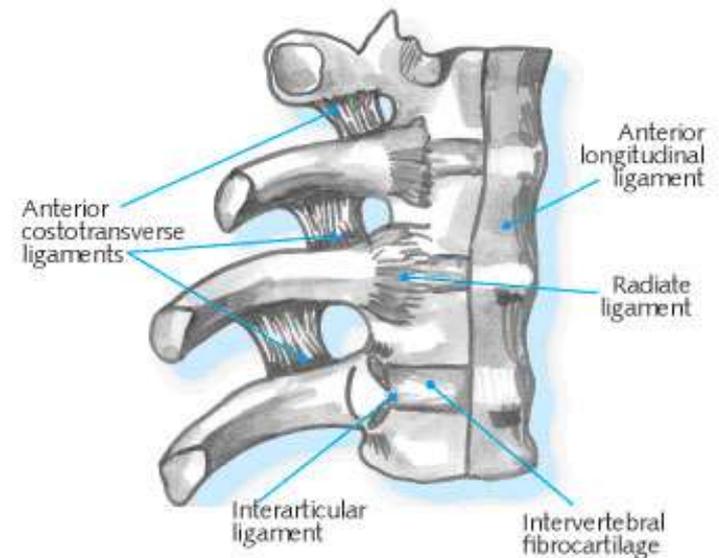
- Supports the body
- Protects the vital organs
- Helps to produce red blood cells
- Acts as levers in locomotion
- Provides surface for muscle attachment
- Storage of salts and minerals



Top (left) and side (right) views of a typical vertebra



The (inter)vertebral foramen contains the spinal cord. Spinal nerves exit vertebral canals through the vertebral foramina.



Graphics modified: DeLisa & Stolov, p. 35

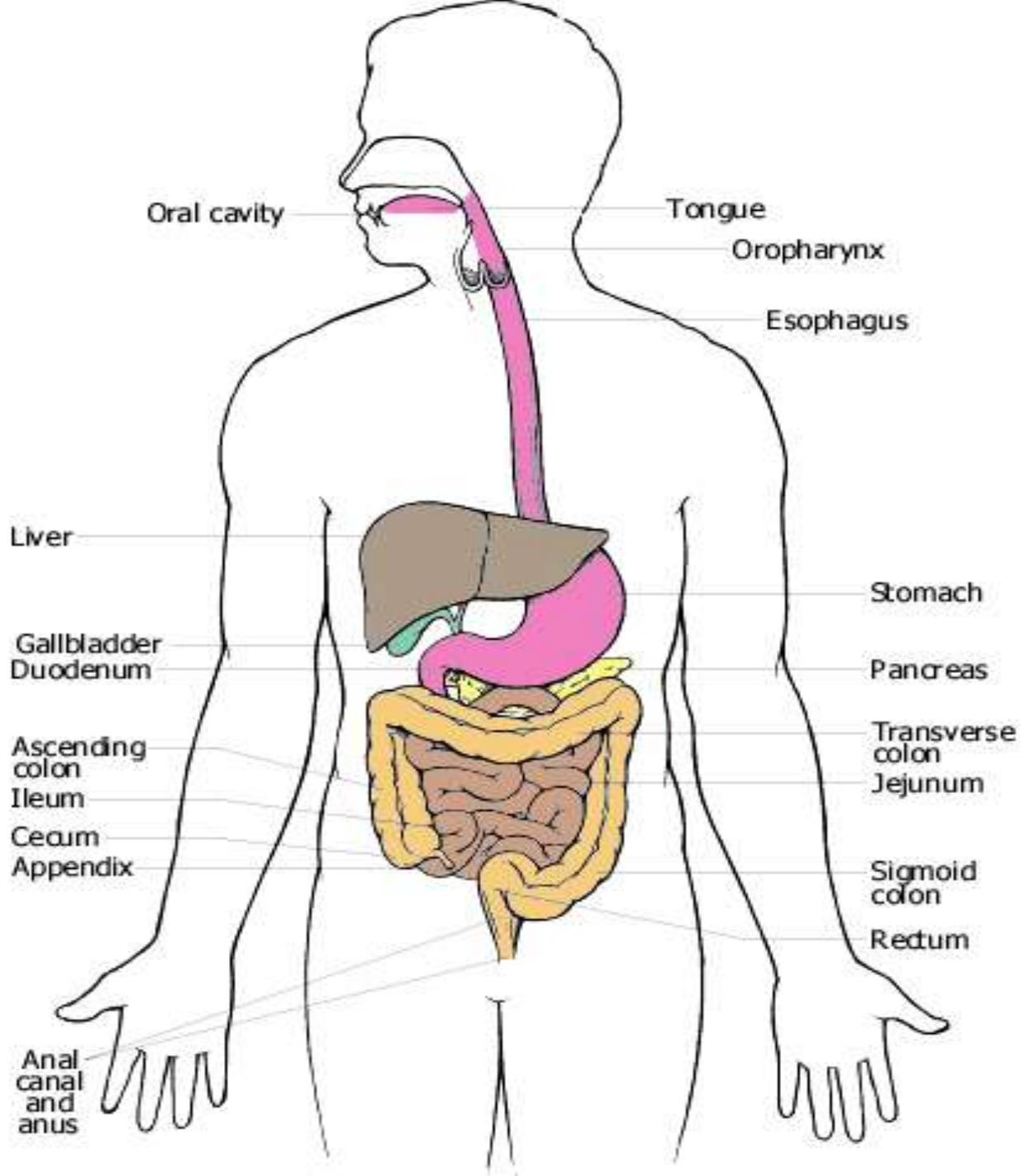
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Digestive System

Digestion is chemical and mechanical process on the ingested food to prepare it for assimilation by the body.

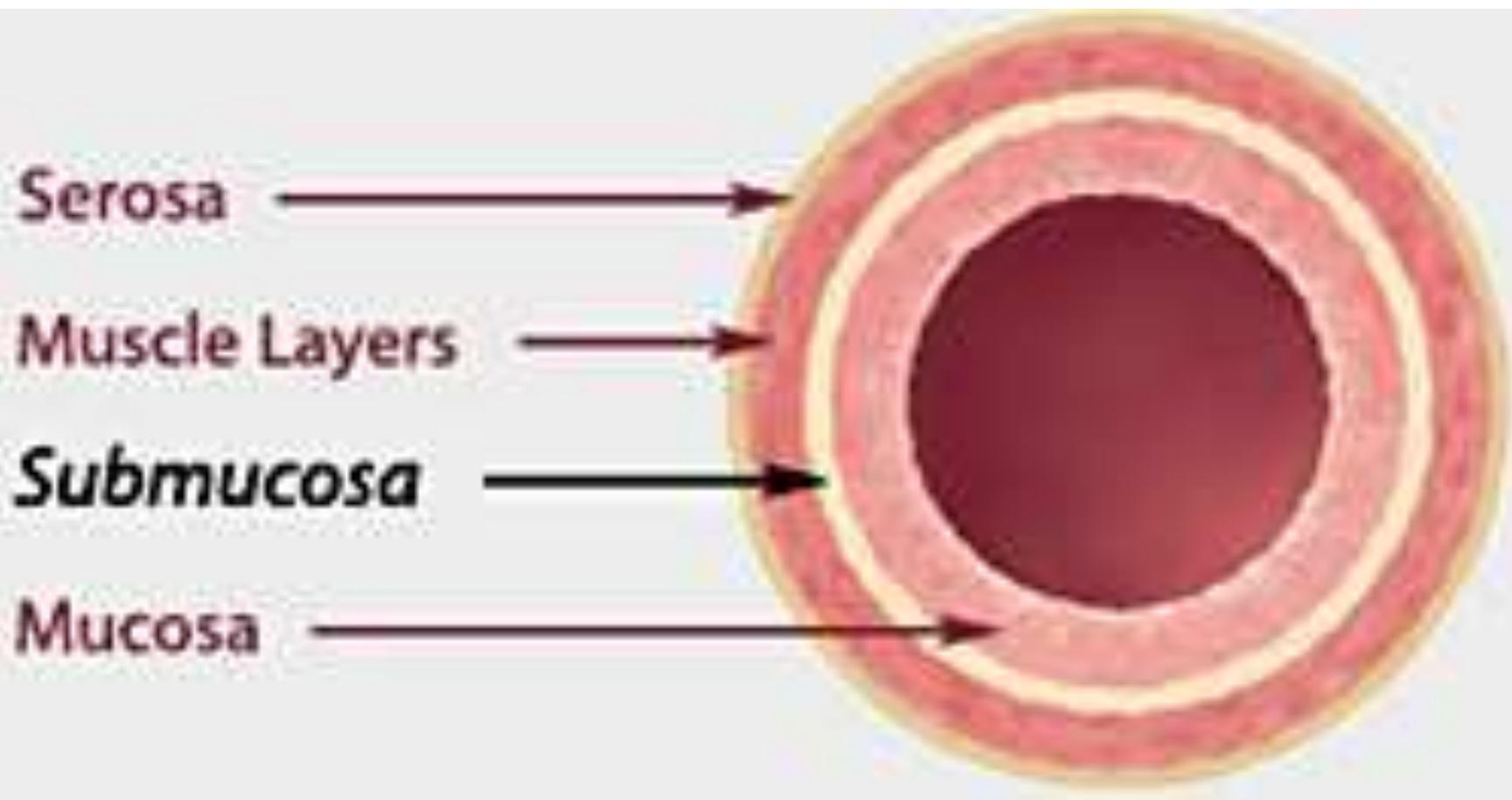
- Function of Digestive System
 - Ingestion
 - Chewing
 - Swallowing
 - Digestion
 - Absorption
 - Excretion of undigested food

- Organs of Digestive System
 - Mouth
 - Pharynx (Throat)
 - Oesophagus (Food tube)
 - Stomach
 - Small intestine
 - Large intestine
 - Rectum



Layers of Digestive System

- Inner Epithelial layer
 - Secretion of enzyme and mucus
 - Soft and pink in colour
- Middle Muscular layer
 - Outer layer (Longitudinal muscles)
 - Inner layer (Circular muscle)
 - Peristalsis (Segmental contraction)
- Outer Serous layer
 - Protective function
 - Diagram



- Mouth
 - Beginning of Digestive system
 - Lips, teeth, gums, tongue.
 - Palate (soft and hard), tonsils
 - Opening of Salivary glands
- Teeth
 - Total 32 in adults
- Tongue
 - Functions
 - Helps in mastication
 - Mixing all saliva with food
 - Swallowing
 - Sensation of taste
 - Speech

- Salivary glands
 - 3 pairs
 - Parotid in front of ear
 - Submandibular below lower jaw
 - Sublingual below tongue
- Saliva
 - Secretion of salivary glands
 - Secreted with ingestion, memory, smell of food
 - Ptyalin converts starch into sugar
- Pharynx (Throat)
 - Posterior of nose, mouth & larynx
 - Musculo membranous tube

- Swallowing
 - Voluntary and Involuntary stages
- Voluntary
 - Bolus formation
 - By movement of tongue and cheeks
 - Bolus pushed into pharynx
- Involuntary
 - Soft palate raised up & closes nasal passage
 - Glottis contracts and closes
 - Larynx lifted upwards and forwards
 - Food passes to Oesophagus
 - Breathing ceases during this step

- Stomach
 - Dilated part of Digestive system
 - Lies in upper abdomen below diaphragm
 - Slightly left to midline
 - Upper opening connected to Oesophagus
 - Lower opening connected to Duodenum
 - Both remain closed during gastric digestion
 - J shaped in standing position
 - Elastic muscular bag with capacity of 2 liters
 - 3 muscular layer- vertical, circular, oblique

- **Functions of the Stomach**
 - Storage of food for 3 hours
 - Partial digestion of proteins and fats
 - Semi digested food from stomach enters the Duodenum
- **Oesophagus**
 - 25cm long muscular tube
 - From pharynx to stomach
 - Behind trachea and in front of vertebral column
 - Major part passes to Thorax
 - Food passes to stomach by active muscular action
 - Solid food reaches stomach in 7 to 8 seconds
 - Liquids reaches stomach in 2 to 3 seconds

- Small intestine
 - 6 to 7 meter long, 2.5cm diameter
 - Lies in center of abdomen
 - Divided into 3 parts
 - First part – Duodenum
 - Second part – Jejunum
 - Third part – ileum
- Alkaline Secretions
 - Protects from acid contents of stomach
- Small intestine
 - Mucosa
 - Deeply folded to increase the surface area
 - Helps in absorption of food.

- Large intestine
 - 1.5meter long, 5 to 6cm diameter
 - Divided into 3 parts
 - Right ascending colon
 - Transverse colon
 - Left descending colon
- Sigmoid Colon & Rectum
 - Temporary storage of faeces
 - Anus is guarded by external & internal sphincters

Liver

- Functions
 - Synthesis of bile
 - Formation of urea
 - Detoxification of drugs
 - Destruction of RBC
 - Storage of excess glucose in form of glycogen
 - Storage of Vitamin A & D
 - Storage of Hemoglobin
 - Manufacturing of blood proteins, albumin & globulin
 - Manufacturing of prothrombin & fibrinogen

- Gall bladder
 - Stores the liver bile (60ml)
- Pancreas
 - Located in upper abdomen behind the stomach
 - Right part in the C of Duodenum
 - Extends to the left up to the spleen
 - Manufactures digestive enzymes
 - Manufactures insulin

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Respiratory System

Importance of Respiratory System

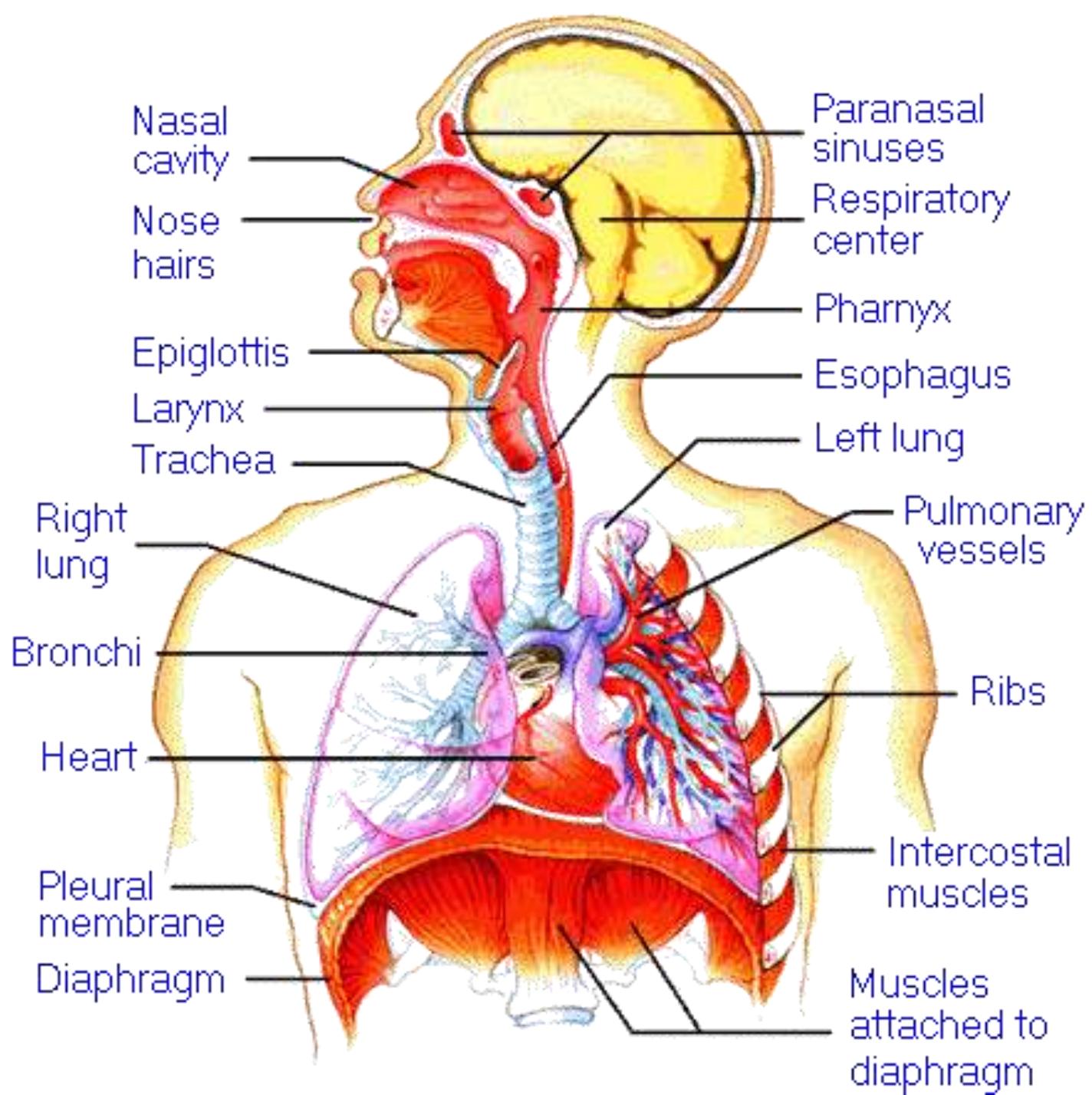
Sign of Life

The most Vital function

Respiration
is

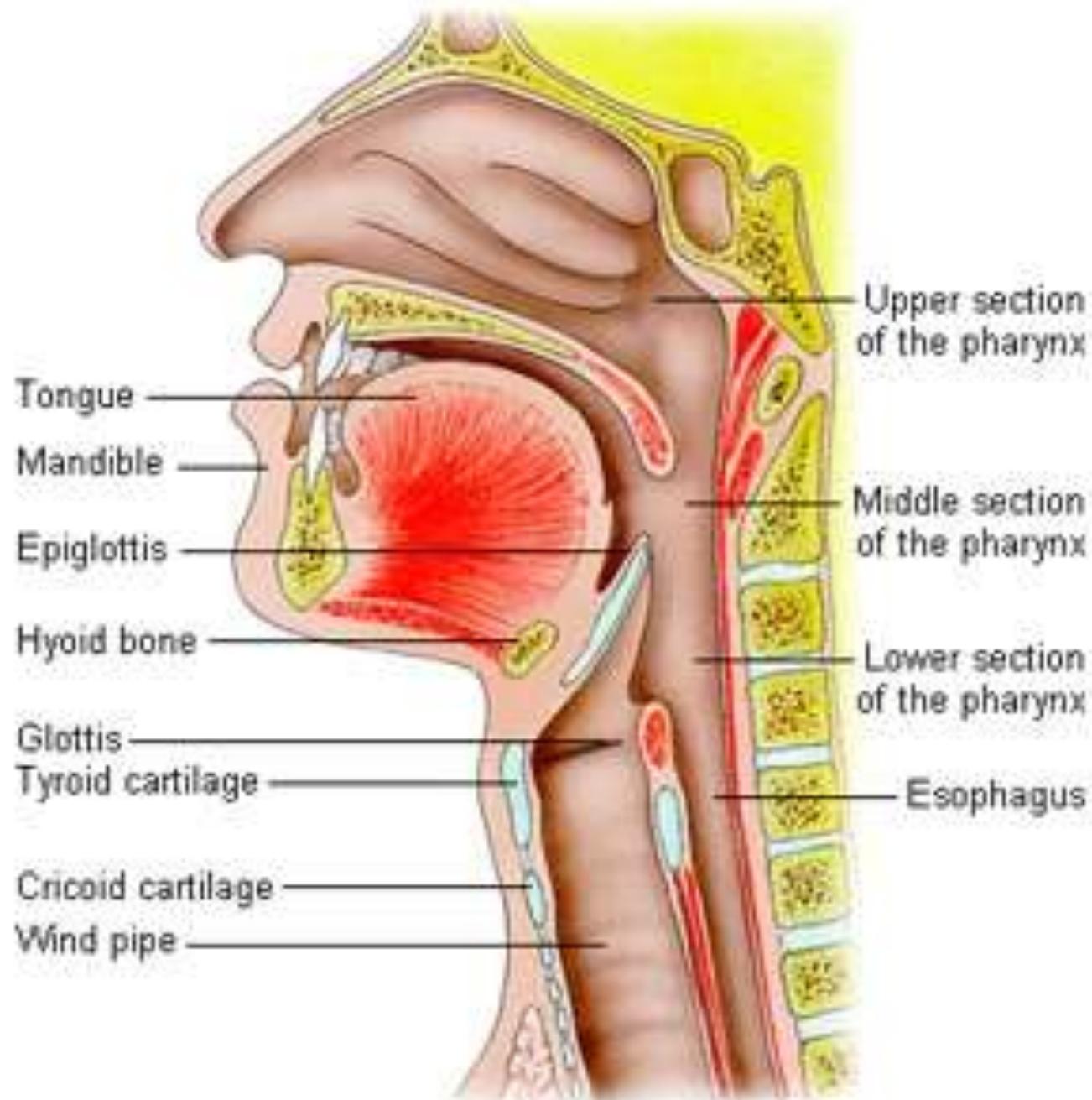
INDEPENDENT

but can be controlled to some extent
(pranayama)



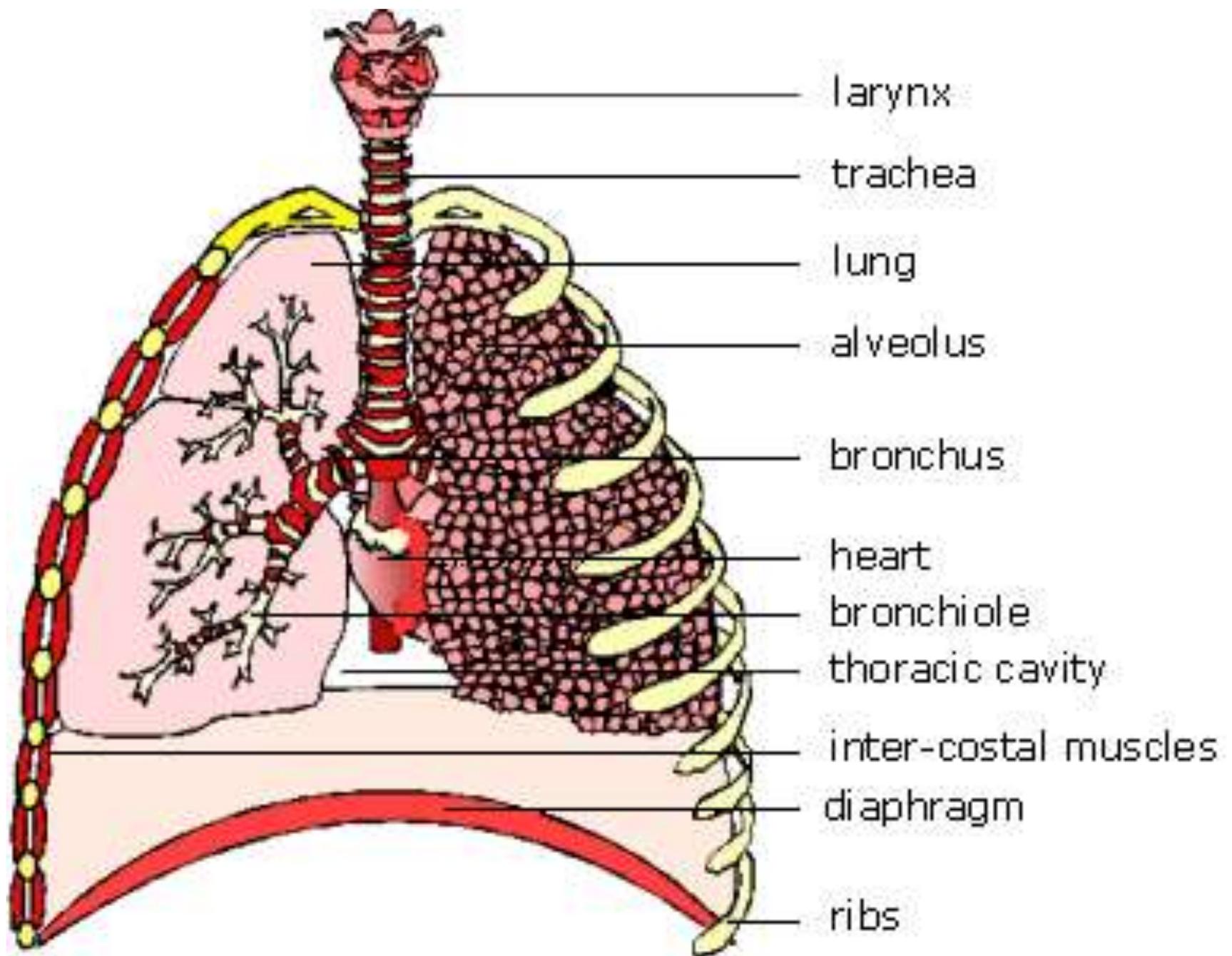
- Functions
 - Supply of Oxygen
 - To remove CO₂ and water vapour
 - Purification of blood
 - Protective function- coughing, sneezing
 - Talking
- Organs of Respiration
 - Nose
 - Throat
 - Larynx
 - Trachea with its branching system
 - lungs
 - (diagram of Respiratory System)

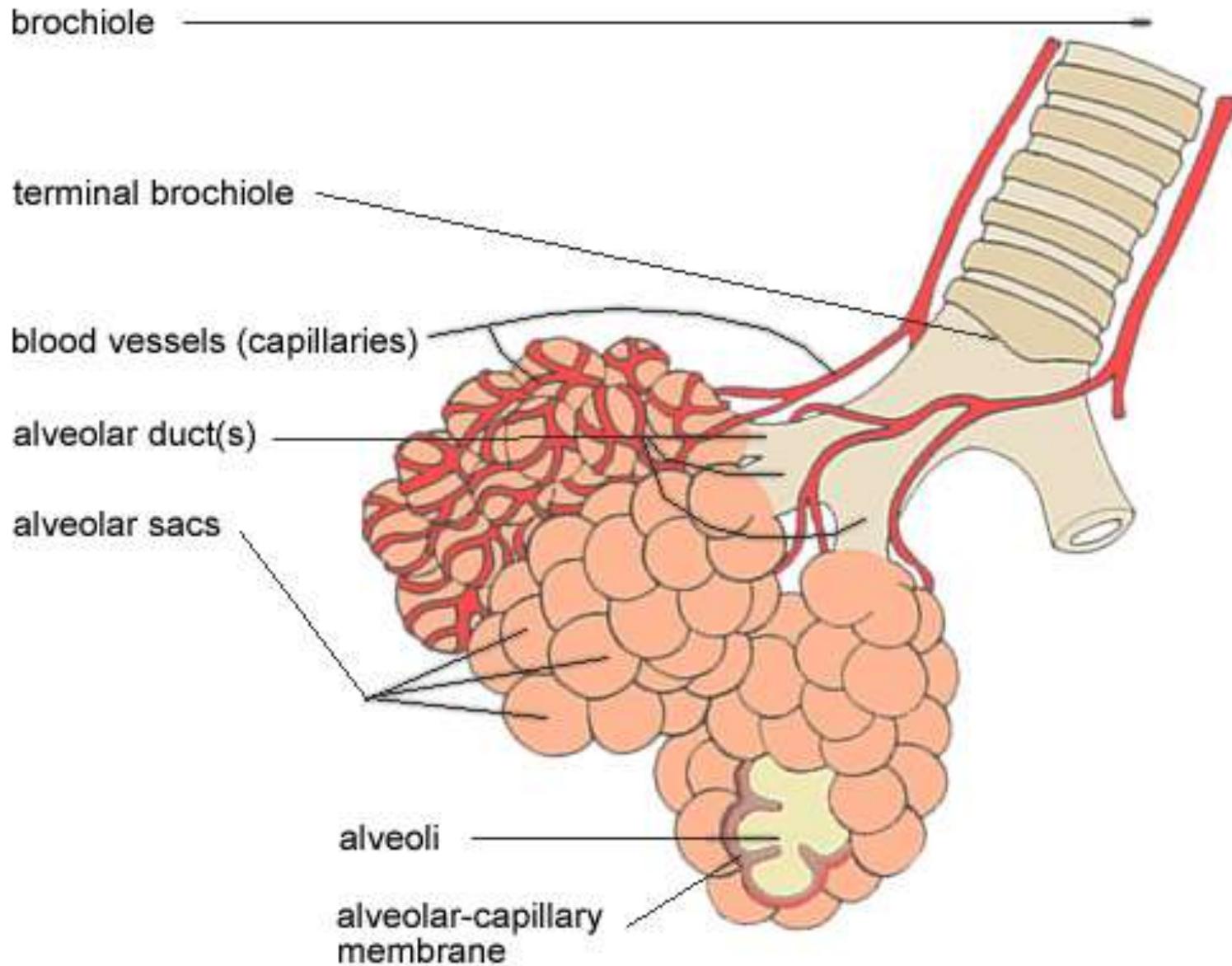
- **Nose**
 - Two nasal cavities separated by nasal septum
 - The Nasal Septum is made up of cartilage & bone
- **Function**
 - Warming of Air
 - Filtration of Air
 - To keep nasal passage moist
 - Sensation of smell



- Throat & Larynx
 - Throat (seven passages)
 - Larynx
 - Oesophagus
 - Mouth
 - Left Eustachian tube
 - Right Eustachian tube
 - Left nostril
 - Right nostril

- Trachea
 - Made up of cartilage and muscles
 - Two main branches- Left and Right bronchus
 - Branching and sub branching ending in alveoli





- Inspiration
 - Active process – by muscular action
 - Contraction of diaphragm
 - Increase in vertical diameter
 - Contraction of intercostals muscles
 - Elevation of ribs and sternum
 - Increase in antero-posterior and transverse diameter
 - Expansion of lungs due to negative pressure
 - Air drawn inwards
- Expiration
 - Passive process
 - Elastic recoil of the lungs due to Relaxation of diaphragm and inter costal muscle.
 - Positive pressure created in lungs
- Control of Respiration
 - Control of Inspiration and Expiration by medulla oblongata

- Lung Volumes

- Tidal capacity : 500c.c.
- Dead space : 150c.c.
- Vital capacity : 4500c.c.
- Total lung capacity : 6000c.c.
- Residual volume : 1350c.c.
- Expiratory reserve : 1500c.c.
- Inspiratory capacity : 3000c.c.

- Analysis of gases in respiration

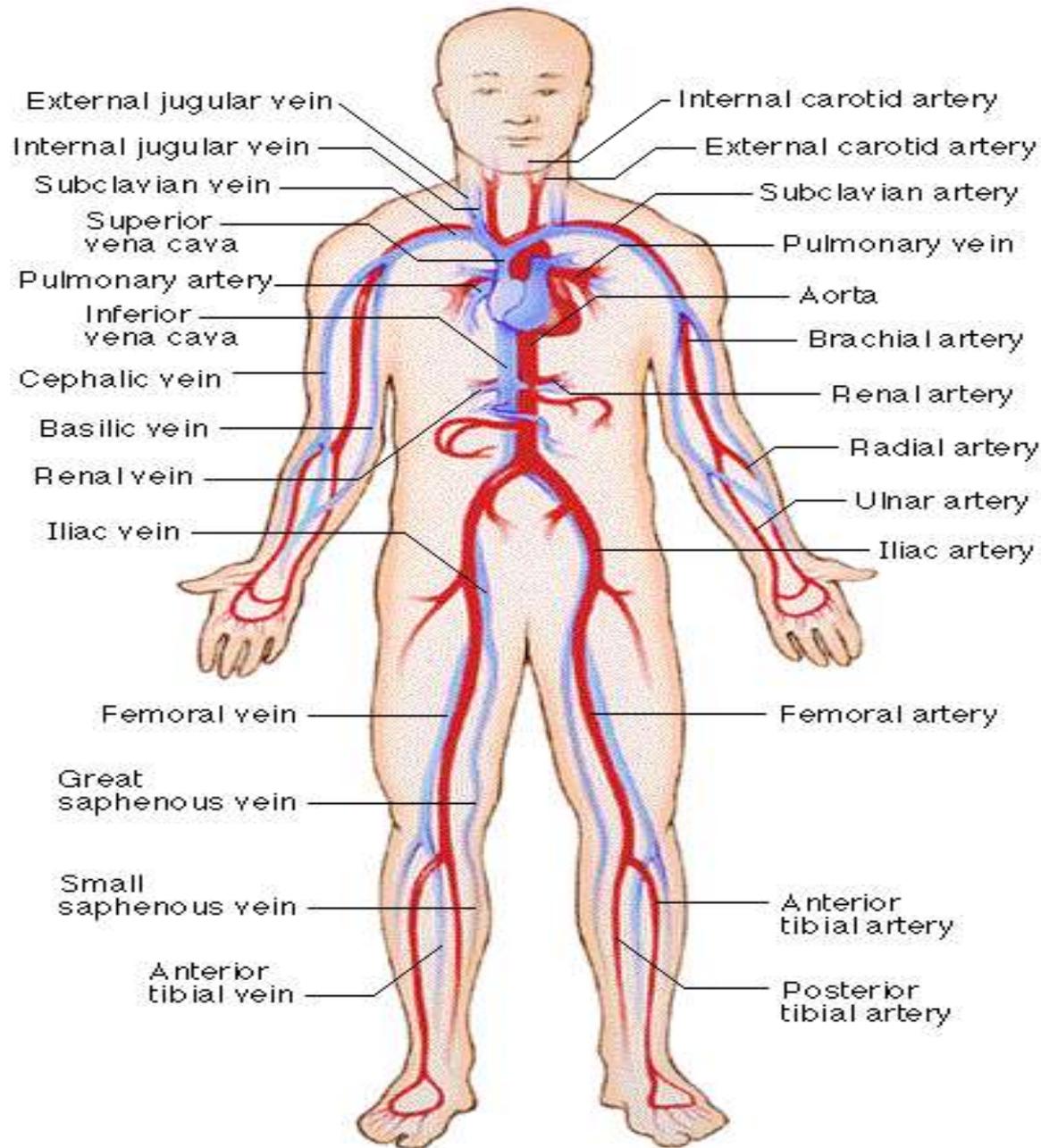
	O ₂	N ₂	CO ₂
Inspired air	21%	79%	-
Exhaled air	16%	79%	5%

- Effects of Pranayama

- More oxygenation of blood
- Improvement in function of all organs
- Life span increases because of more supply of oxygen

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Circulatory System



Components of blood

- Total volume of blood – 5 to 6 liters
- Components
 - Plasma 55-60 %
 - Blood cells 40-45 %
 - RBC
 - WBC
 - Platelets

- R.B.C. (Red blood cells)
 - Colour of blood due to RBC
 - 4 to 5 millions / c.c.
 - Hemoglobin carry 90% Oxygen
 - Dumbbell shaped cells with no nucleus
- W.B.C. (White blood cells)
 - White colored
 - 6000 to 9000 / c.c.
 - Kills the bacteria (protective role)
 - No specific shape, with central nucleus

- Platelets

- 1,00,000 to 2,00,000 / c.c.
- Helps in clotting of blood (Enzyme Thrombokinase)
- Circular shape

- Plasma

- 90 to 92 % water
- 8 to 10 % dissolved organic & inorganic matter (proteins, glucose, salts & hormones)
- Presence of antibodies

Functions of Blood

- To carry Oxygen from lungs to cells and to carry CO₂ from cells to lungs
- To carry nutrients from Digestive system to cells
- To carry excretory products (waste material) from cells to excretory organs
- To carry hormones
- To maintain water balance in the body
- To maintain body temperature
- To protect the body from infections
- Clotting the blood after injury

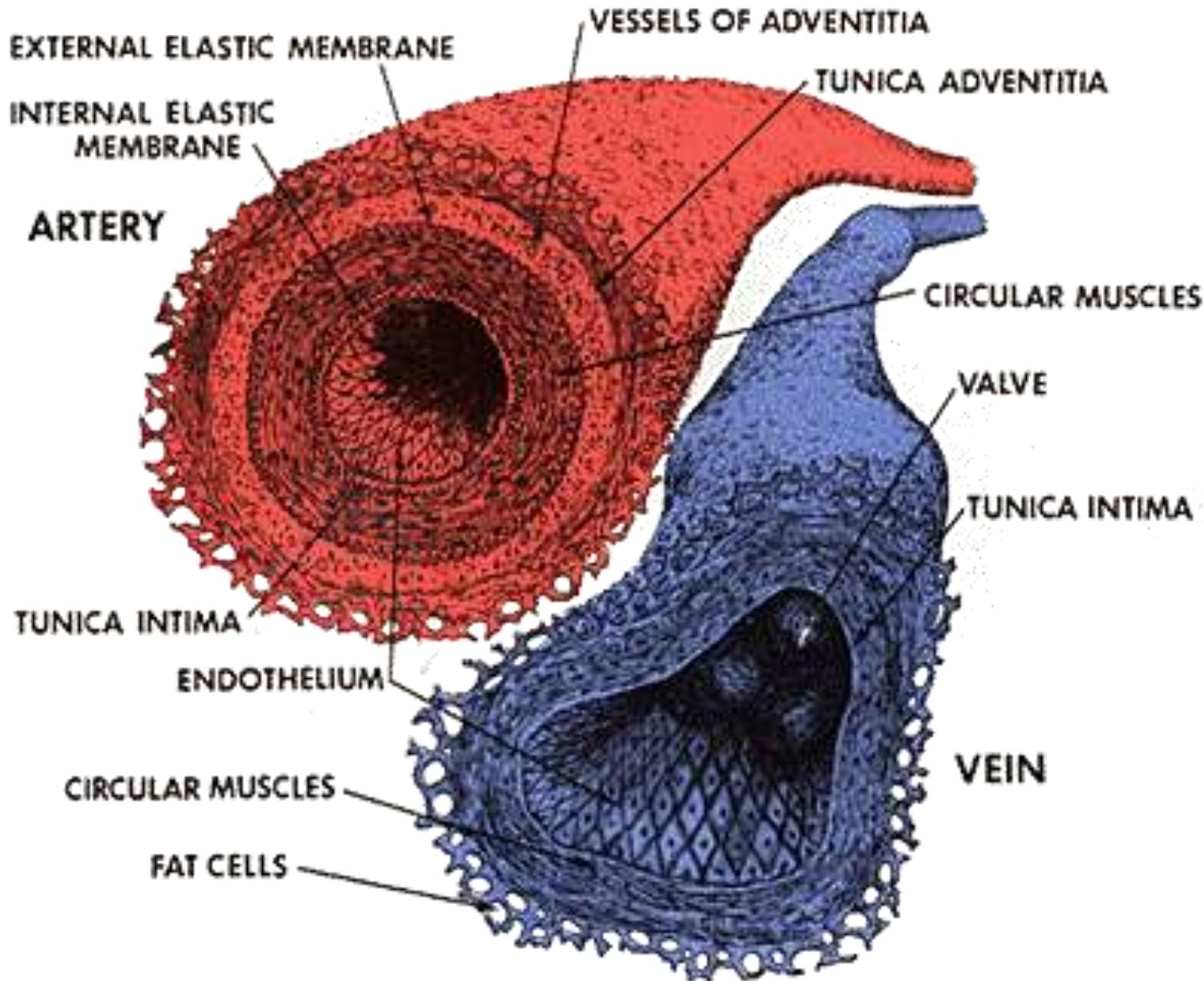
Difference between Arteries & Veins

- Arteries

- Carry blood from heart to other organs
- Carry oxygenated blood
- Have thick walls
- Do not have valves

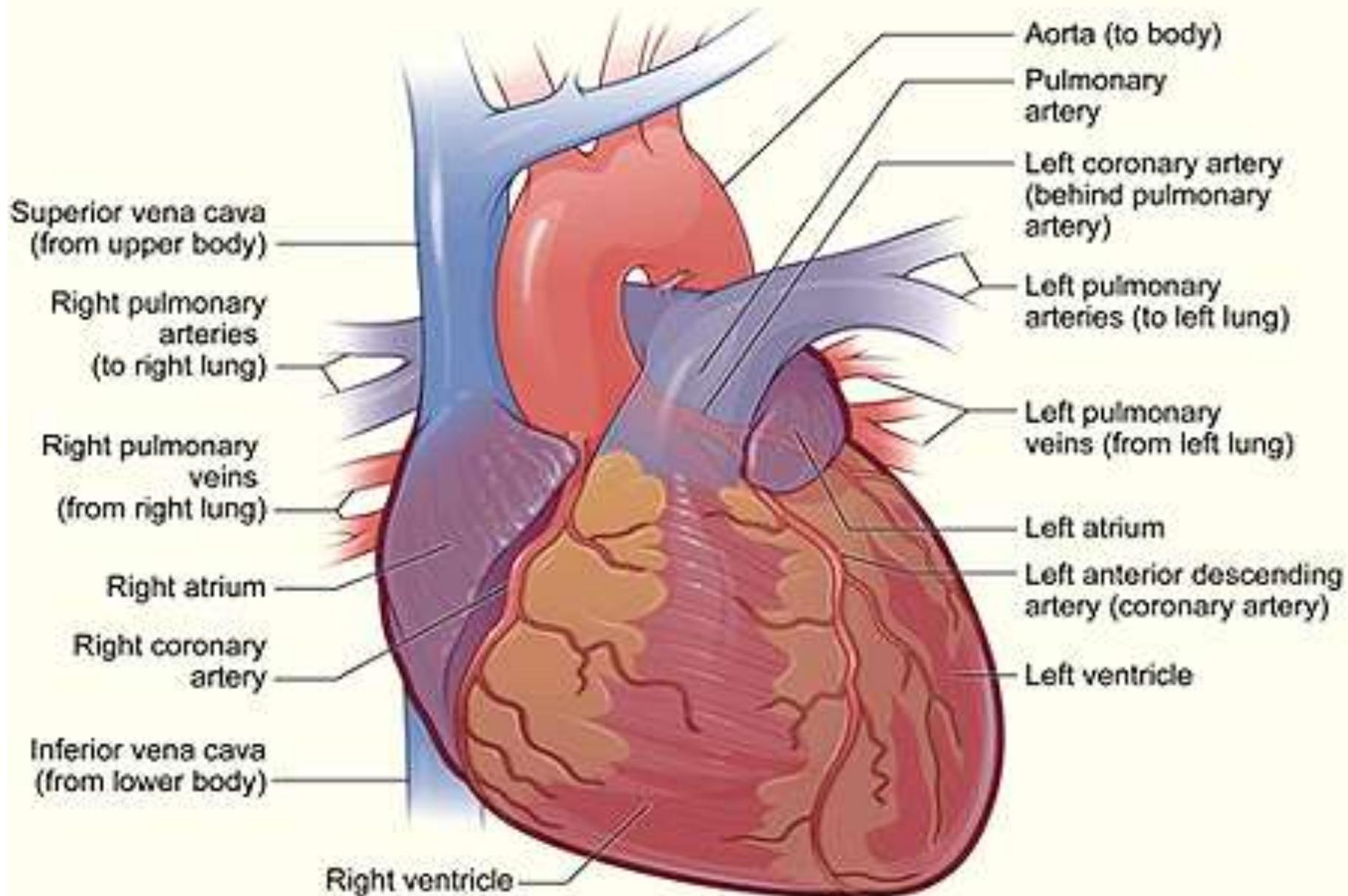
- Veins

- Carry blood from other organs to heart
- Carry de-oxygenated blood
- Have thin walls
- Presence of valves

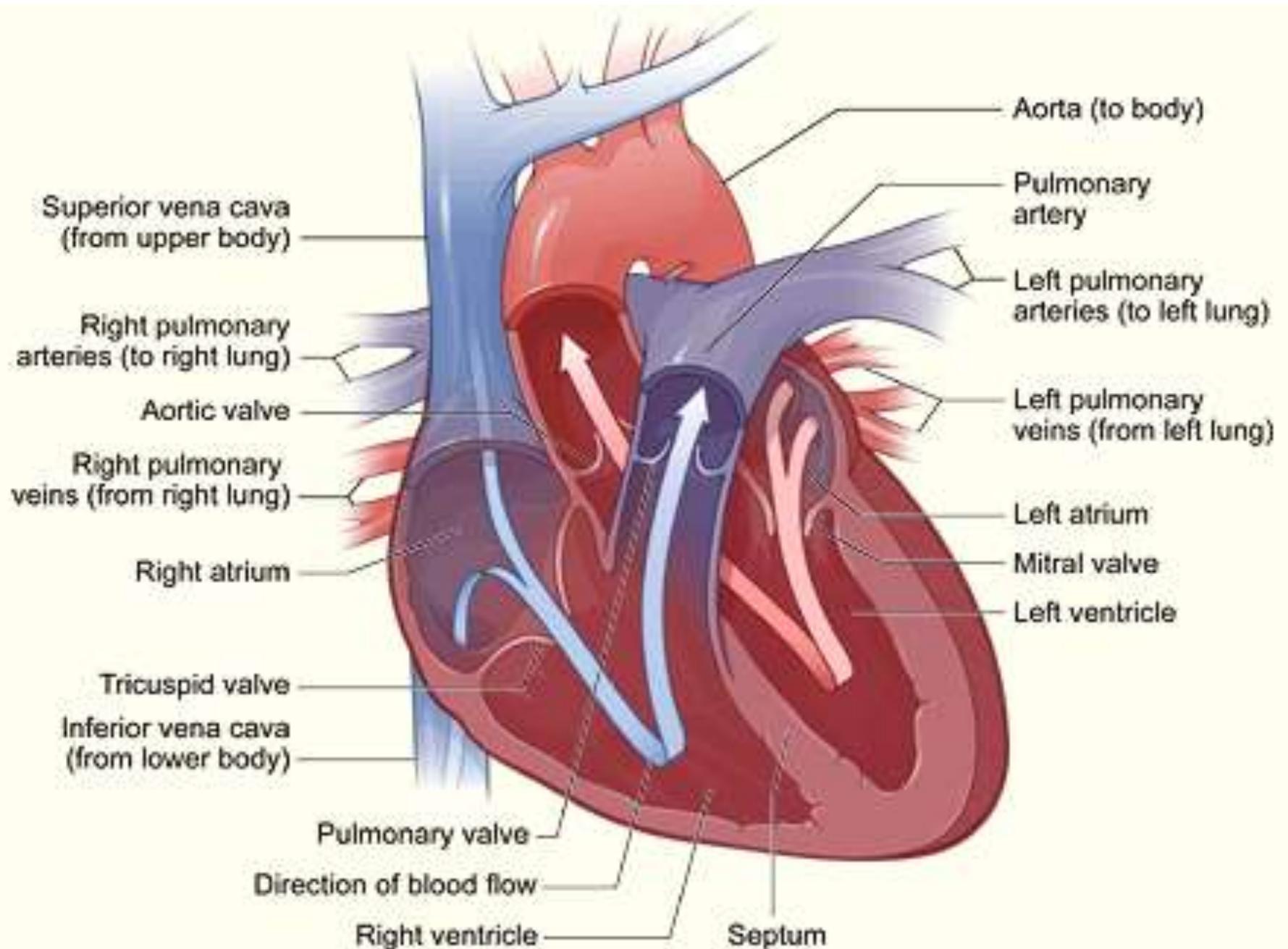


- Heart

- Situated in the rib cage of chest on the left side
- Embedded in lungs
- Size of heart is equal to the size of clenched fist
- Connected with many big (giant)blood vessels
- Made up of involuntary muscle
- Heart starts beating from 4th month of IU life.
- Duration of one heart beat is 0.8sec.

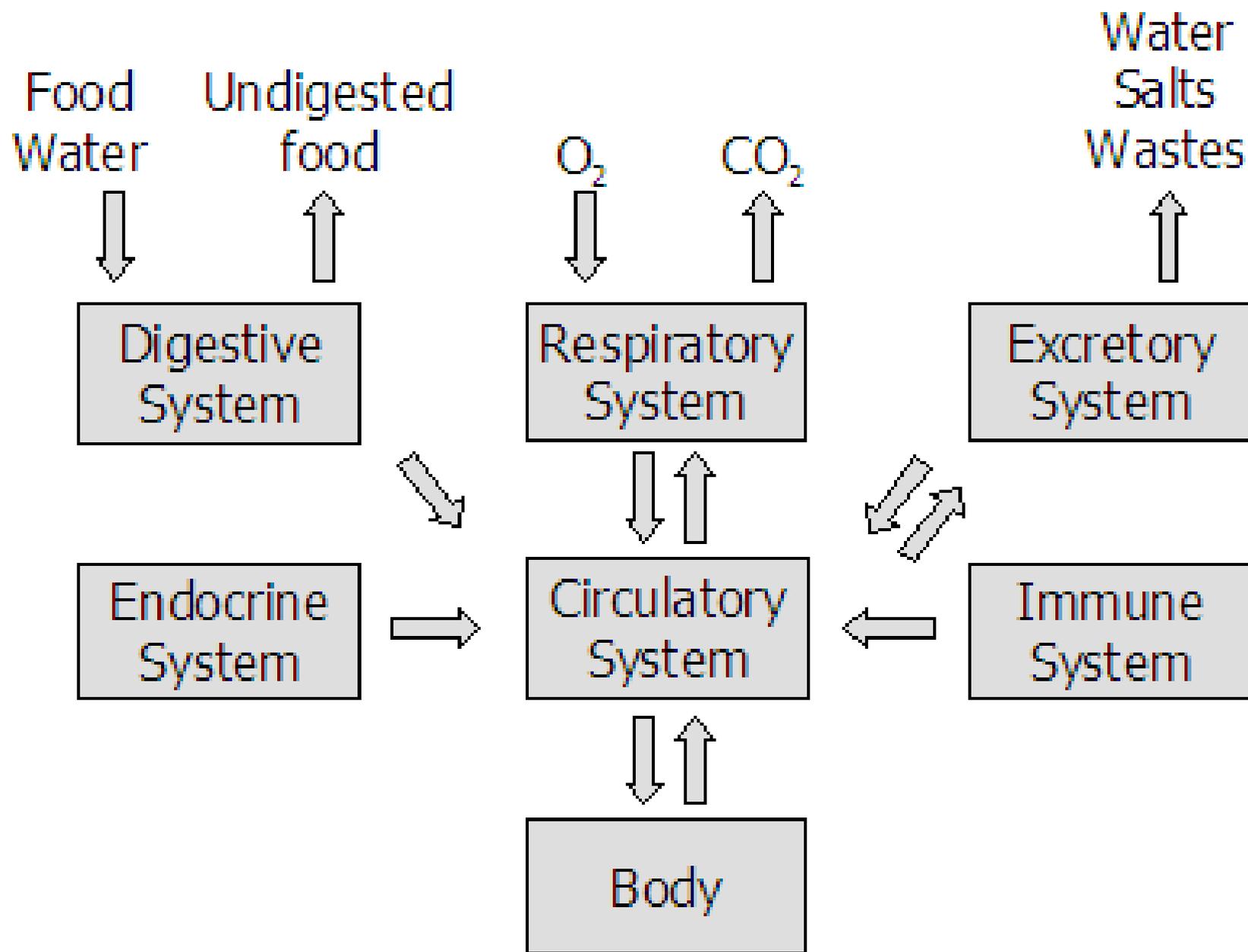


- 4 Chambers of Heart
 - Auricles to receive blood
 - Ventricles to pump blood
 - Left side oxygenated blood
 - Right side deoxygenated blood



- Circulation of Blood
 - Continuous circulation
 - Force of circulation due to pumping action of heart
 - From left ventricle → Aorta → Branches & Sub branches → Artery → Small artery → Arteriole → Capillaries → CELLS → Venouls → Small veins union of many veins → Superior & Inferior venacava → Right auricle → Right ventricle → Pulmonary artery → Lungs (oxygenation) → Pulmonary veins → Left auricle → Left ventricle

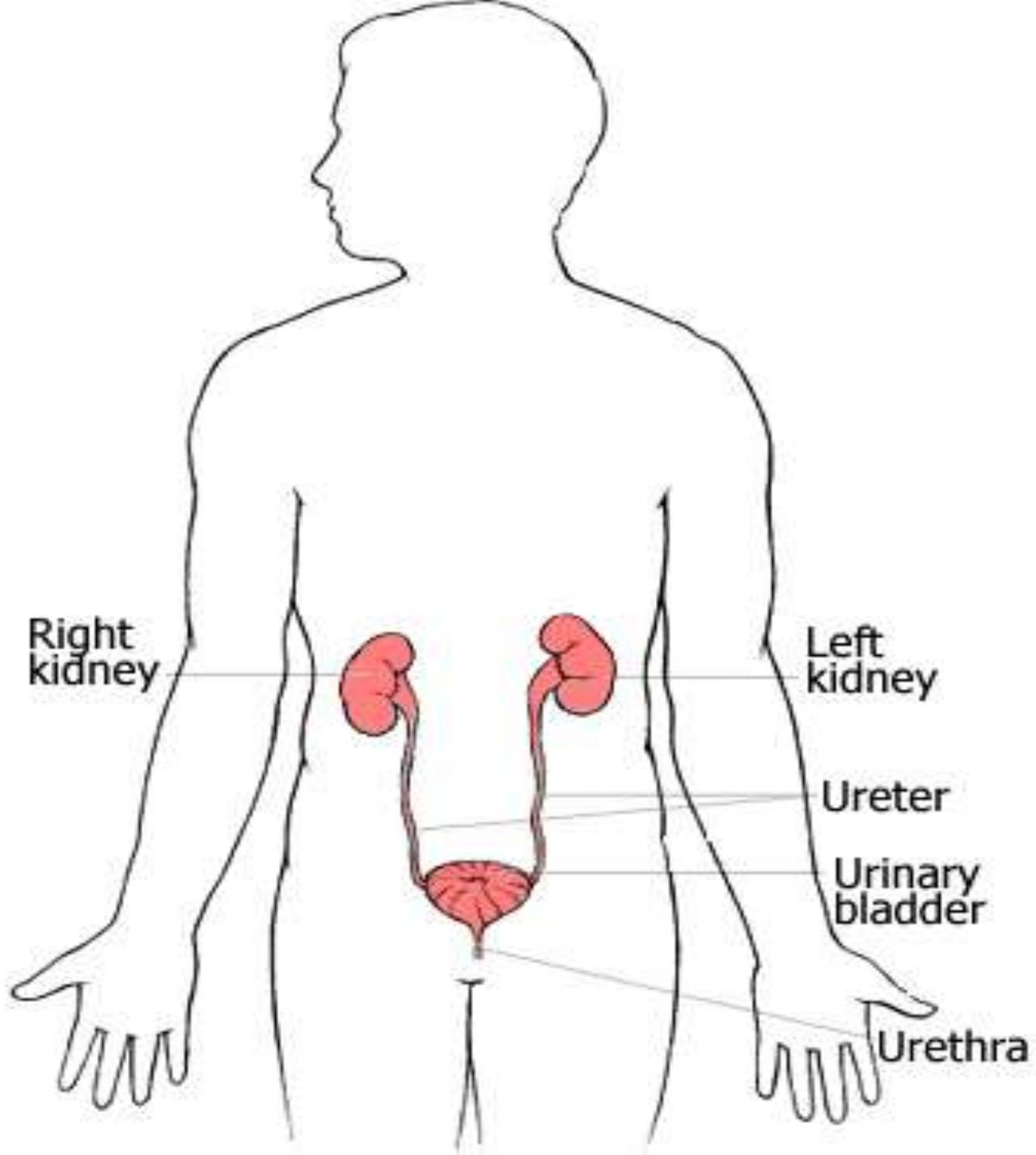
- Spleen
 - Situated in abdominal cavity
 - Left hypochondriac region, below the ribs
 - Weight 100gm
- Function of Spleen
 - Production of blood cells
 - Storage of blood
 - Destruction of platelets
 - To transport hemoglobin to liver
 - Seat of some antibodies
 - Extracts bacteria and dead cells from blood.



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Excretory System

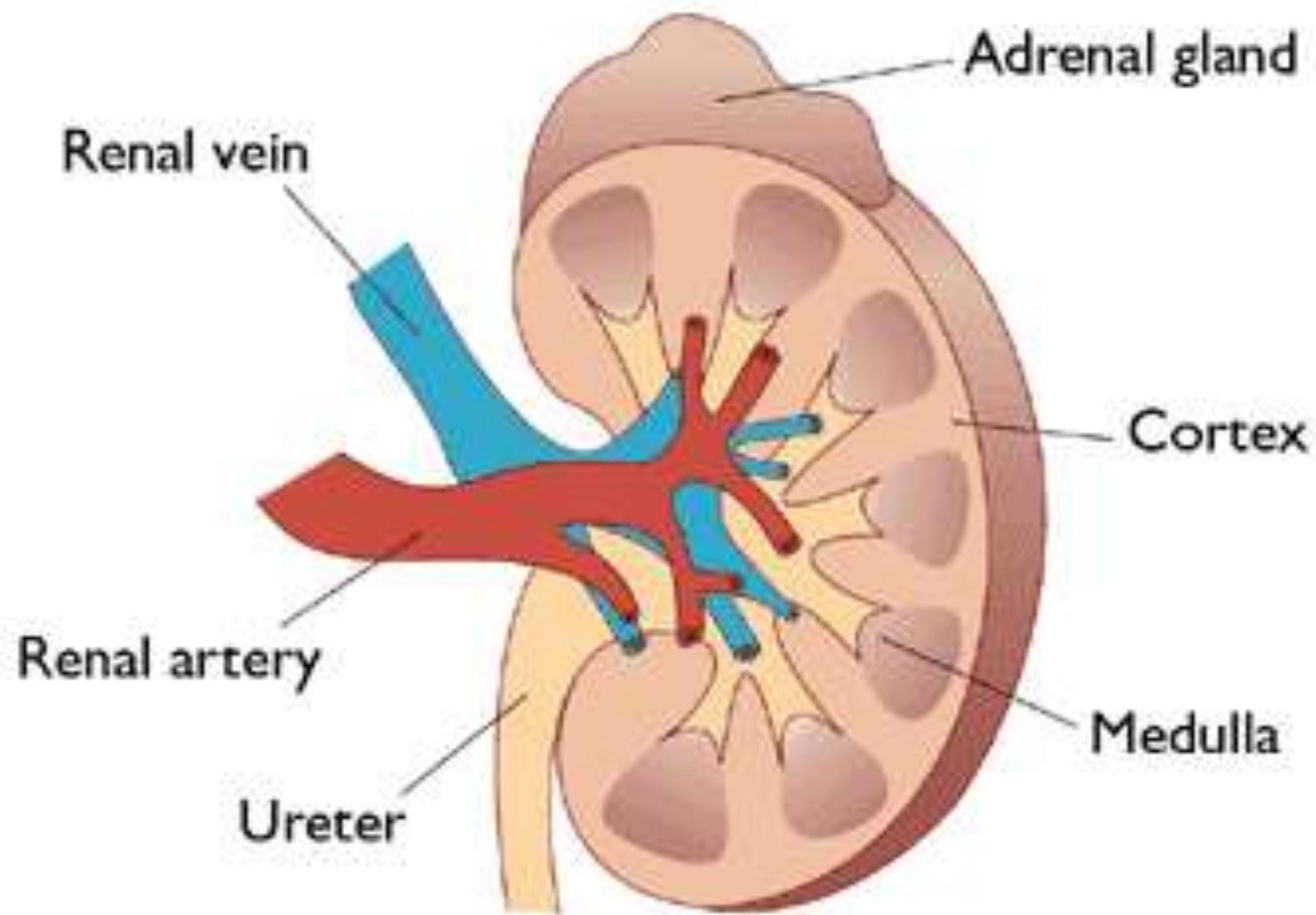
- Excretion
 - The process of expulsion of waste products & toxins out of the body
- Excretory organs
 - Urinary system
 - Skin
 - Large intestine
 - Lung
- Organs of Urinary system
 - Two kidneys
 - Two ureters
 - Urinary bladder
 - Urethra



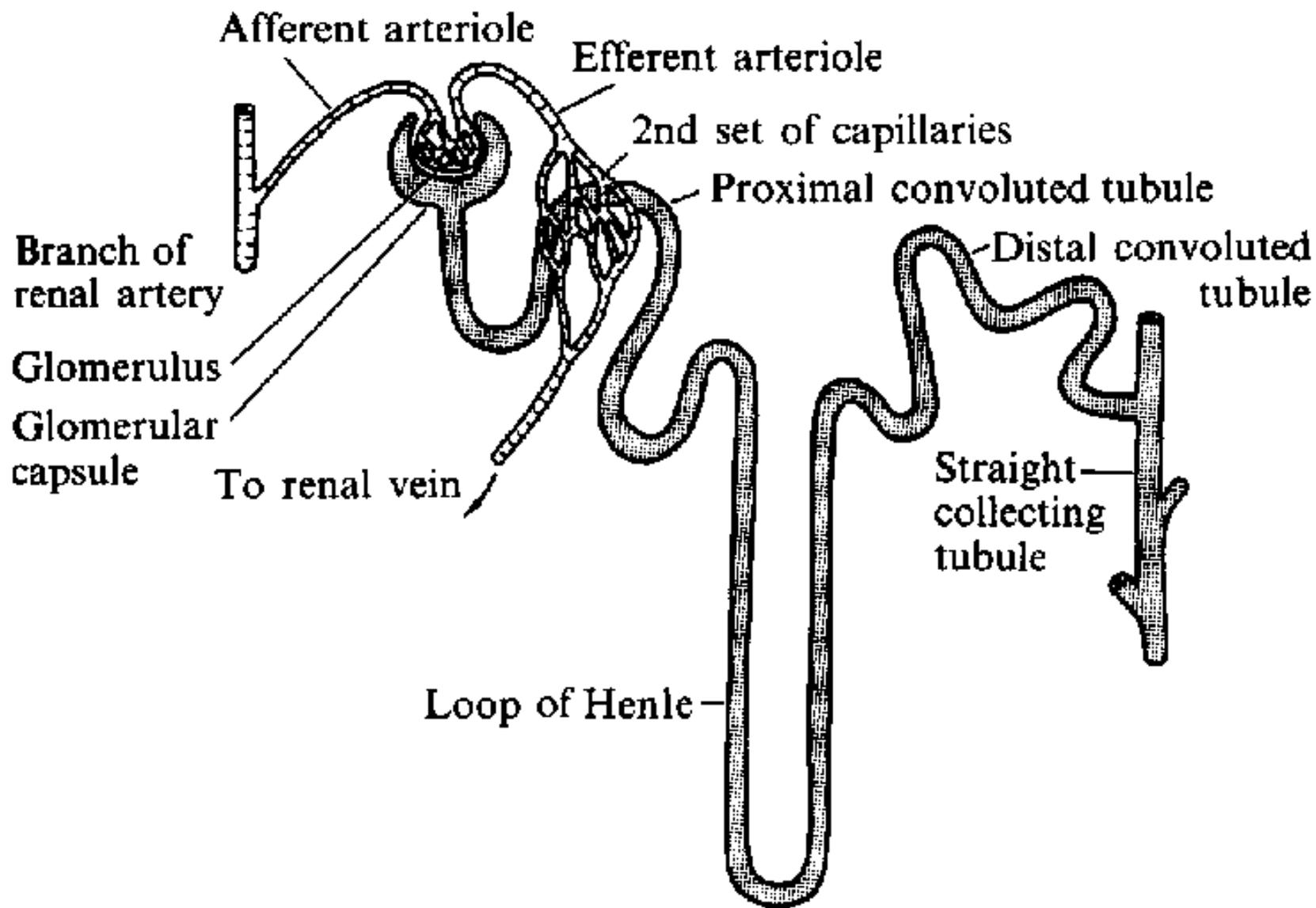
- Kidney

- Located at the backside of abdominal cavity, on either side of vertebral column
- Bean shape
- Size- length 13cm, breadth 6cm,thickness 3cm
- Weight- 150gm

Diagram of Kidney



- **Functions of kidney**
 - Expulsion of waste products and toxins
 - Maintenance of water level in body
 - To maintain reaction of blood
 - Expulsion of toxic medicine
 - To maintain balance of salts and minerals
- **Functional unit of kidney – Nephron**
 - 10,00,000 in each kidney
- **Ureters**
 - Starts from hilum up to urinary bladder
 - 25cms long, 4mm wide
 - Carries urine to urinary bladder by peristalsis



- Urinary bladder
 - Muscular bag
 - In the pelvis anterior to rectum in case of male
 - In the pelvis anterior to uterus in case of female
 - Collection of urine
 - Sphincter of bladder voluntary control
 - 300 to 900 ml storage capacity
 - After 1000 ml voluntary control is lost
- Urethra
 - Male urethra passes through penis, length 25cm
 - Female urethra opens anterior to vagina, length 2.5 cm

- Contents of urine

	Daily filtration	Actual excretion
Water	180 liter	1.5 liter
Salts	700 gm	15 gm
Glucose	170 gm	0
Urea	50 gm	30 gm

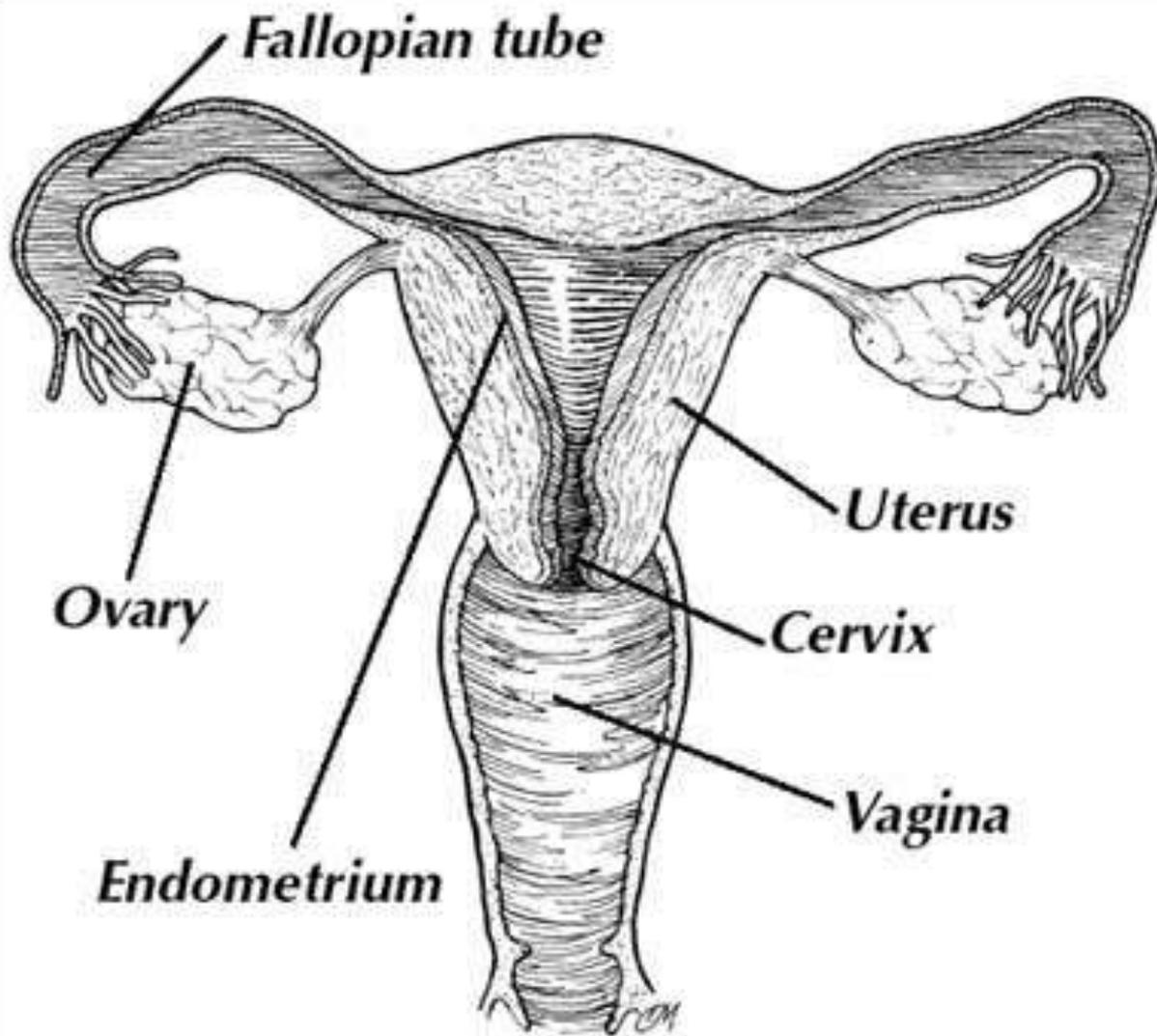
- Urine

- Daily output 1200 to 1500 ml
- 95 % water, 5 % salts & organic matter
- Urea, uric acid, salts of potassium, magnesium and calcium

- Functions of skin
 - Protection from injury
 - Sensation of touch
 - Regulation of body temperature
 - Absorption of oil, ointments
 - Excretion
 - Regulation of water balance
 - Production of Vitamin D
 - To keep the skin & hair smooth, silky & shin

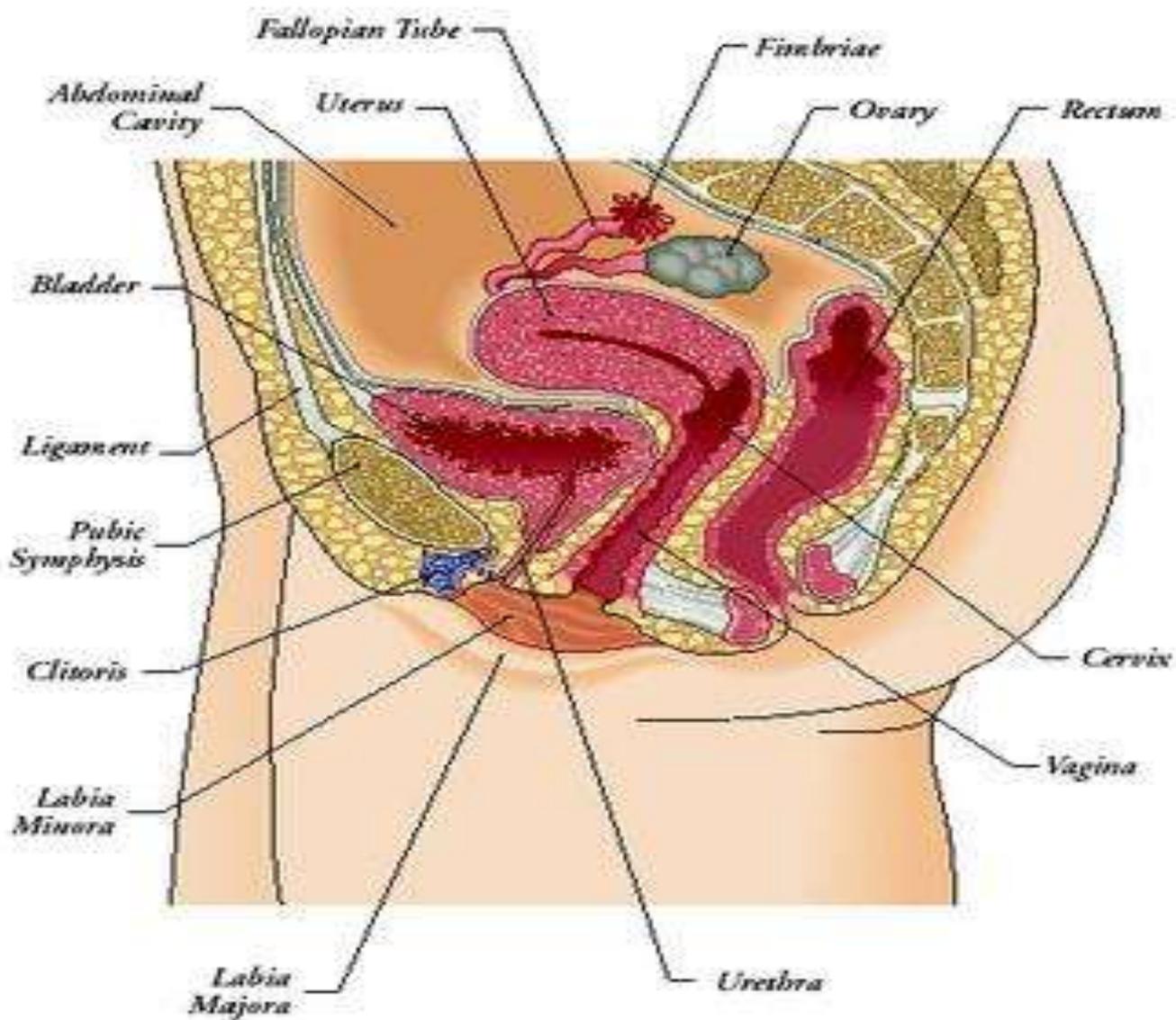
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Reproductive System

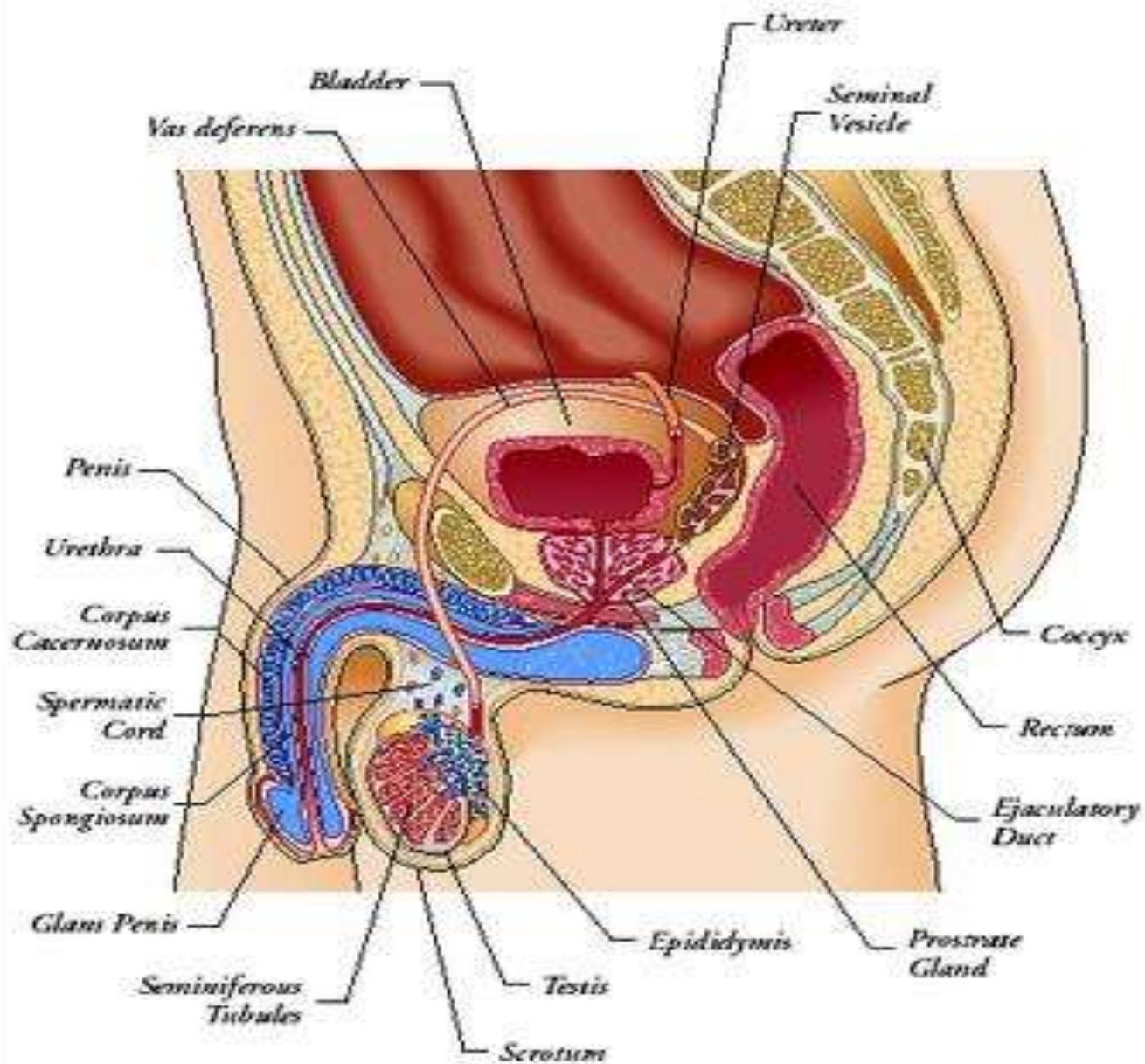


A front view of the female reproductive organs.

Female Reproductive System

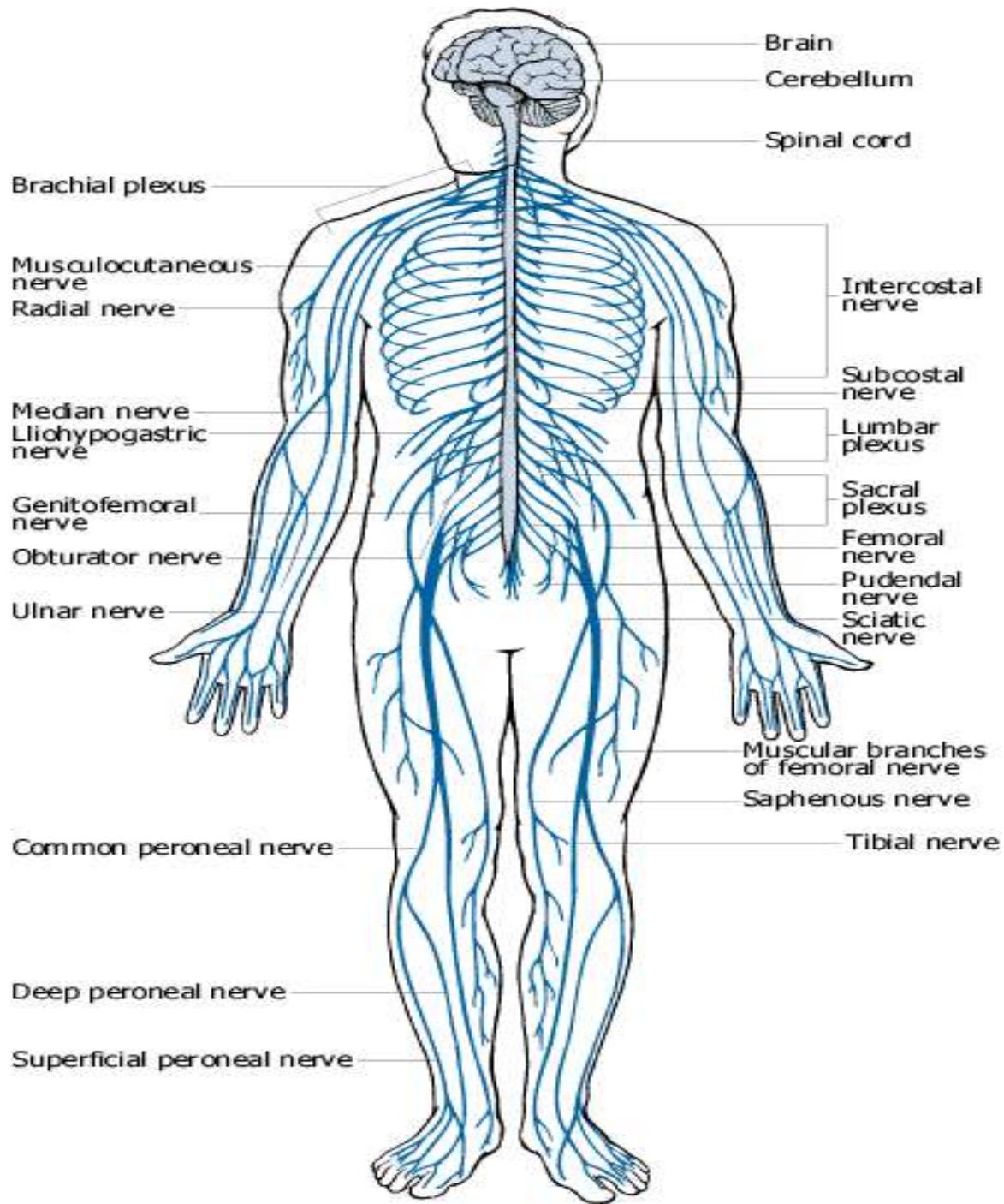


Male Reproductive System



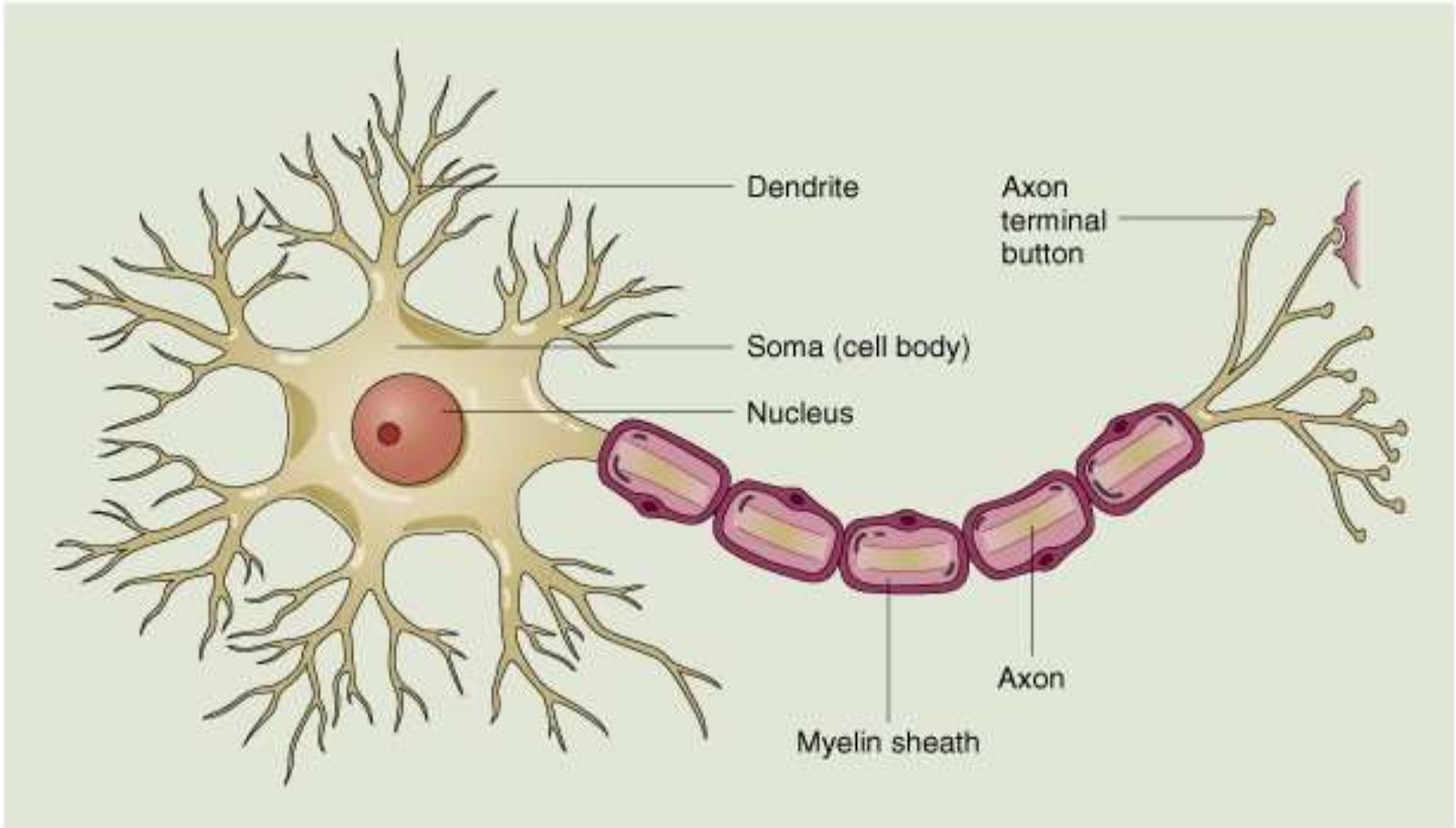
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Nervous System



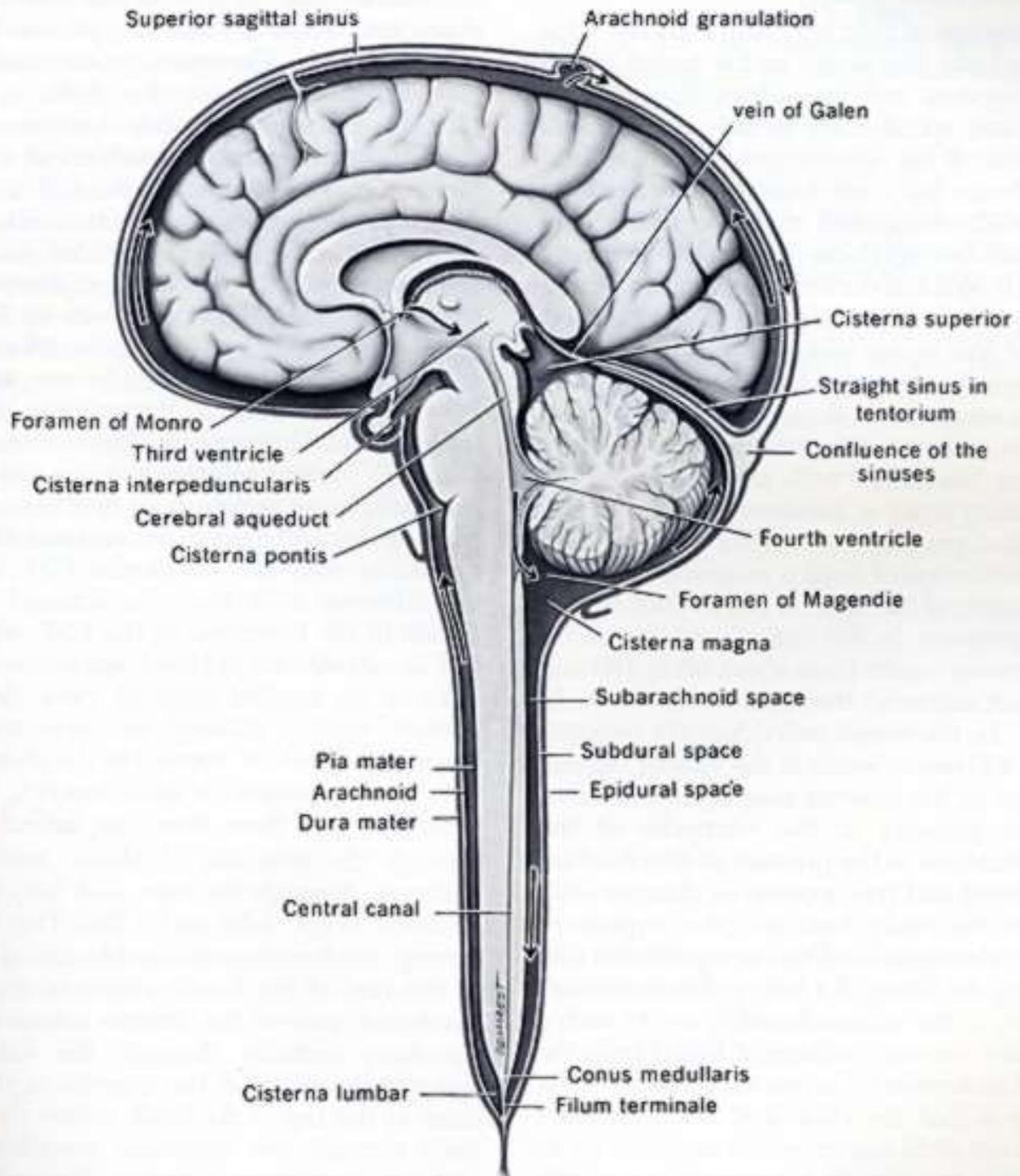
- Nervous system
 - Central processing unit of body. Controls and balance of body functions.
- Divisions
 - Central nervous system (CNS)
 - Peripheral nervous system (PNS)
 - Autonomic nervous system (ANS)
- Components
 - Nerve cell
 - Sensory nerve
 - Brain
 - Motor nerve
 - End organ

- Functions of Nervous system
 - Control over voluntary and involuntary functions / actions.
 - To control body movements, respiration, circulation, digestion, hormone secretion, body temperature
 - To receive stimuli from sense organs, perceive them and respond accordingly
 - Higher mental functions like memory, receptivity, perception & thinking.



- Parts of CNS
 - Cerebrum
 - Cerebellum
 - Mid brain
 - Pones
 - Medulla oblongata
 - Spinal cord

- Brain
 - Protected by skull
 - Three coverings of brain called meninges
 - Dura
 - Arachnoid
 - Pia matter
 - Cerebro spinal fluid (CSF) between the Pia mater and Arachnoid
 - CSF acts as a shock absorber and provides nutrition to the brain

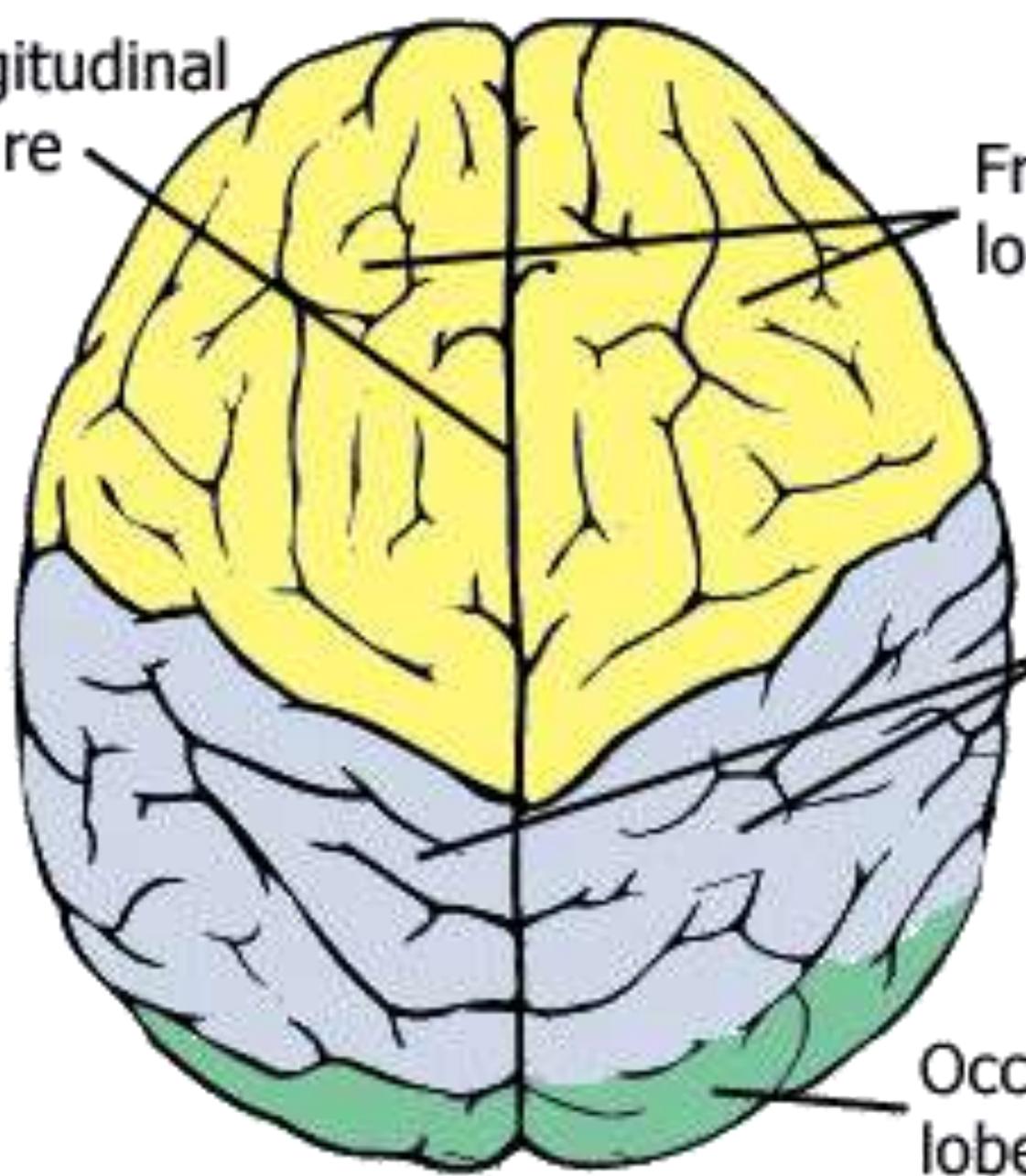


Longitudinal
fissure

Frontal
lobe

Parietal
lobe

Occipital
lobe



- Cerebrum
 - Biggest part of brain, divided into two hemispheres
 - Contra lateral control
 - Outer surface is grey due to cells
 - Internally white due to fibers
 - Surface is folded to increase the area
- Functions of cerebrum
 - Intellect, memory, will power, imagination, emotion & other psychological functions
 - Receive and perceive the stimuli
 - To give command for reaction with the help of past experience
 - To control over other parts of nervous system

- Cerebellum
 - Situated below and behind the cerebrum
- Functions of cerebellum
 - Controls tone muscles
 - Helps coordination of body movements
 - Helps balancing the body
- Mid brain
 - Underneath the cerebrum and above pons
- Functions of mid brain
 - To control involuntary functions

- Pons
 - Below mid brain
- Functions of pons
 - Control of consciousness
 - Control level of concentration
- Medulla oblongata
 - Lowest part of CNS just above the spinal cord
- Functions of Medulla oblongata
 - Control of respiration
 - Control of circulation
 - Control of swallowing and vomiting

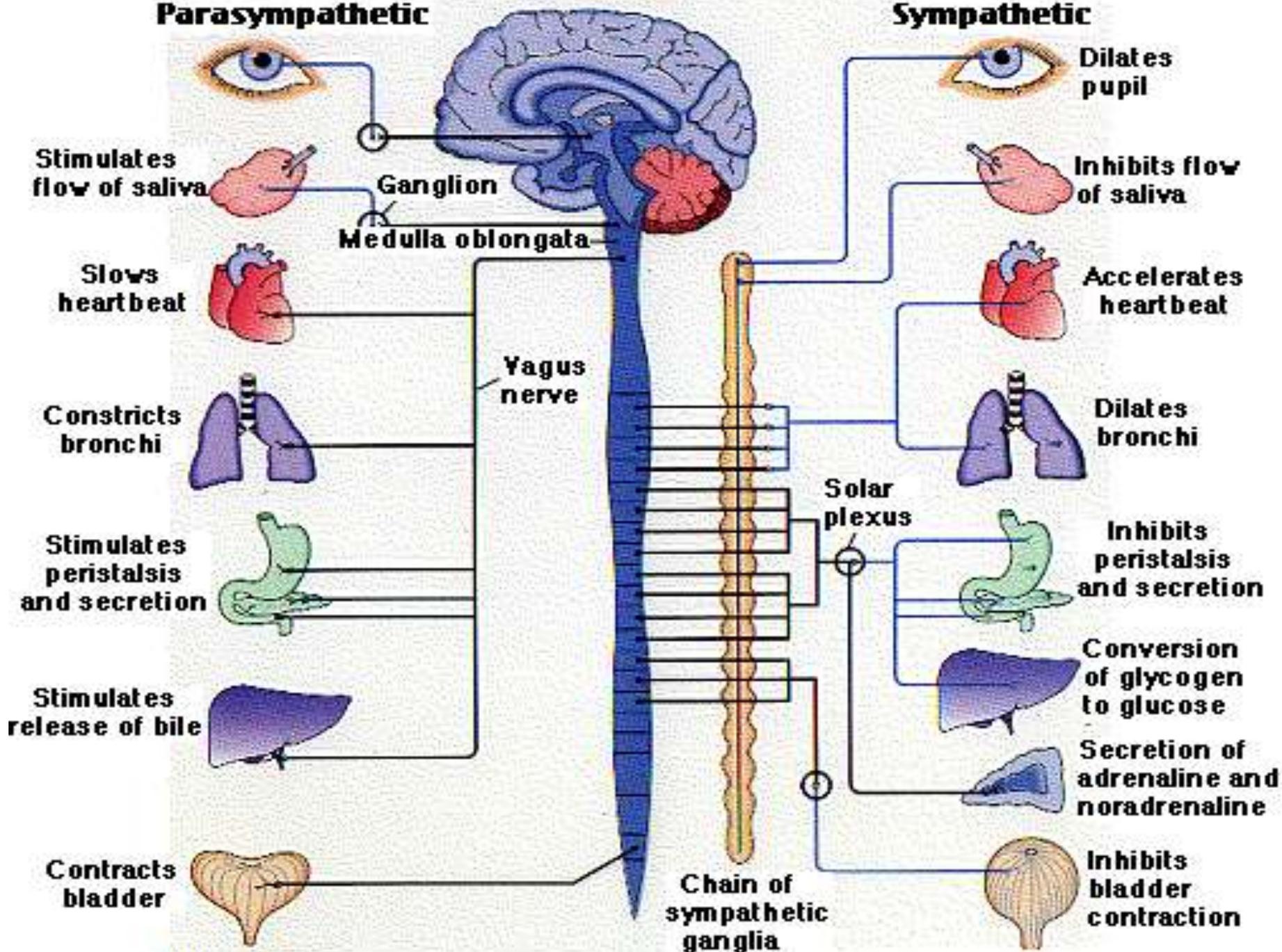
- Spinal cord
 - Located safely in spinal canal
 - Length is 45cm, which extends up to first lumbar vertebra
 - 31 pairs of peripheral nerves starts from spinal cord
- Functions of spinal cord
 - To propagate sensory stimuli from organs to the brain
 - To carry commands from the brain towards the organs
 - Reflex action

- Reflex action
 - Protective function of the spinal cord
 - Sensory organ
 - Afferent nerve
 - Sensory cell in posterior horn of spinal cord
 - Connector nerve
 - Motor cell in anterior horn of spinal cord
 - Efferent nerve
 - End organ of reaction

- Autonomic nervous system
(Involuntary nervous system)
 - It has control over
 - Digestion
 - Respiration
 - Circulation
 - Hormone secretion
 - Maintenance of body temperature
 - Maintenance of water balance
- Peripheral nervous system
 - 12 pairs of cranial nerves from brain (cranial nerves)
 - 31 pairs of spinal nerves from spinal cord (spinal nerves)

Parasympathetic

Sympathetic



- Billions of nerve cells
- Billions of connections

- Maximum utilization of brain is 10%
- 90 % brain is in dormant state

- Yoga can activate 100% of brain

- Hari om