BP 201T. HUMAN ANATOMY AND PHYSIOLOGY-II (Theory)

45 Hours

Scope: This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.

Objectives: Upon completion of this course the student should be able to:

1. Explain the gross morphology, structure and functions of various organs of the human body.
2. Describe the various homeostatic mechanisms and their imbalances.
3. Identify the various tissues and organs of different systems of human body.
4. Perform the hematological tests like blood cell counts, haemoglobin estimation, bleeding/clotting time etc and also record blood pressure, heart rate, pulse and respiratory volume.
5. Appreciate coordinated working pattern of different organs of each system
6. Appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body.

Course Content:

Unit I **10 hours**

- **Nervous system**

Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters.

Central nervous system: Meninges, ventricles of brain and cerebrospinal fluid.structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts,reflex activity)

Unit II **06 hours**

- **Digestive system**

Anatomy of GI Tract with special reference to anatomy and functions of stomach, (Acid production in the stomach, regulation of acid production through parasympathetic nervous system, pepsin role in protein digestion) small intestine

and large intestine, anatomy and functions of salivary glands, pancreas and liver, movements of GIT, digestion and absorption of nutrients and disorders of GIT.

- **Energetics**

  Formation and role of ATP, Creatinine Phosphate and BMR.

Unit III

- **Respiratory system** **10 hours**

  Anatomy of respiratory system with special reference to anatomy of lungs, mechanism of respiration, regulation of respiration

  Lung Volumes and capacities transport of respiratory gases, artificial respiration, and resuscitation methods.

- **Urinary system**
  Anatomy of urinary tract with special reference to anatomy of kidney and nephrons, functions of kidney and urinary tract, physiology of urine formation, micturition reflex and role of kidneys in acid base balance, role of RAS in kidney and disorders of kidney.

Unit IV **10 hours**

- **Endocrine system**
  Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal
  gland, pancreas, pineal gland, thymus and their disorders.

Unit V **09 hours**

- **Reproductive system**

  Anatomy of male and female reproductive system, Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition

- **Introduction to genetics**

  Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance

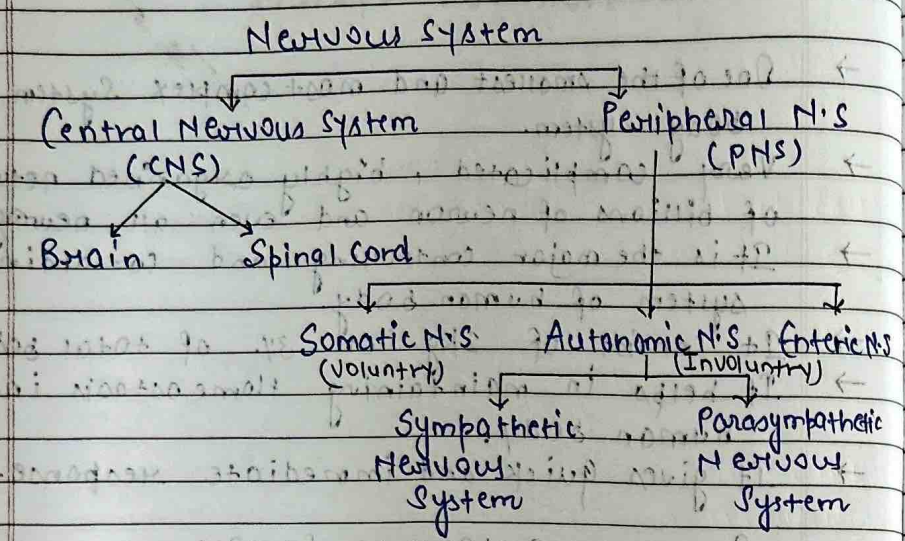
UNIT-1
NERVOUS SYSTEM

→ One of the smallest and most complex System eleven body system.
→ Very complicated, highly organised network of billions of neuron and even all, neuroglial cell
→ It is the major controlling and co-ordinating system of human body.
→ It consist of 2kg or 3% of total body mass
→ It helps in maintaining Homeostasis in human body.
→ It gives quick and immediate response.

FUNCTION OF NERVOUS SYSTEM -

→ Nervous system allow as to sense, various smell.
→ Produce speach.
→ Remember past events.
→ Provide signal that control body moment.
→ Regulate the operation of internal Organ.

ORGANISATION OF NERVOUS SYSTEM



Nervous System is divided into two subdivision.

① Central Nervous System → It consist of Brain and Spinal cord.

② Peripheral Nervous System → It consist of 12 pair of Cranial nerve and 31 pair of spinal nerve and their branches ganglia and enteric plexus and sensory receptors.

→ Components PNS include somatic N·S, Autonomic N·S and enteric N·S.

→ SNS control voluntry movements (walking, talking, writing) skeletal muscle.

→ ANS control involuntry or visceral organ (Respiration, digestion).

It is divided into two parts

- Sympathetic N·S (faiv, fight and flight)
- Parasympathetic N·S (Rest and digest)
- Enteric N·S control operation of GI Tract (contraction of smooth muscle and secretion).

NEURON -

→ Neuron is also kno Nerve cell.

→ It is the structural and functional unit of the nervous system.

→ It generate carry and transmit nerve impulse to other nerve cell, muscles and glands.

→ Neuron have the property of electrical exitibil-ty and are responsible for most unique function of Nervous system, Senseing, thinking, controlling muscle contraction, regulating gland secretion etc.

→ Mostly neurons have 3 parts -

① Cell Body
② Dendrites
③ Axon.

Dendrites

It is tree shape process and main receiving or input region.

Cell Body

→ It contain cell organelles.
(Rough ER, Mitochondria, Lysosome and golgi Body).
→ It is K/a "Soma".
→ These are a mitatic in nature in which cell division not happened (Centrioles are absence).

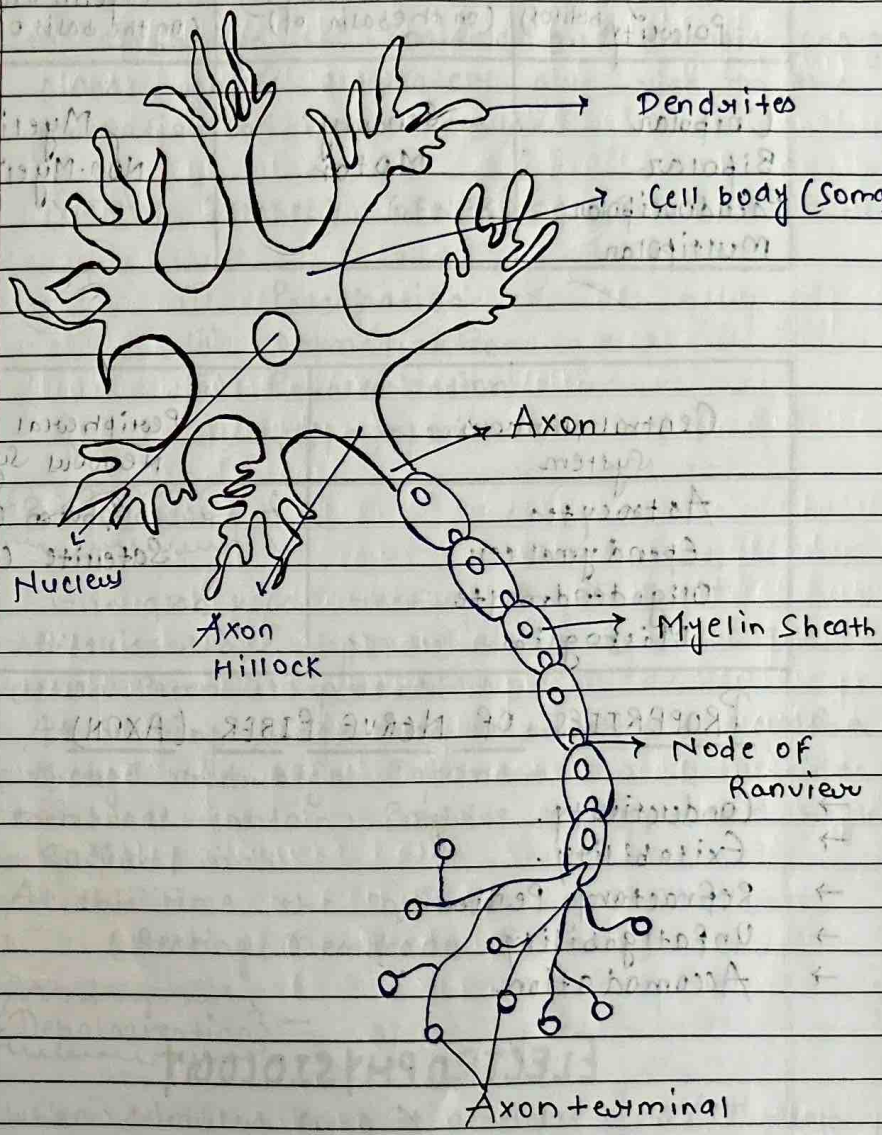
Axon

→ It is an output part which contain axon Hillick.
→ The axon contain mitochondria, microtubules and neurofisrils.
→ The cytoplasm called Axoplasm (Axon).
→ It is surrounded by the plasma membrane called Axolemma.
→ The axon ends into many fine process called axon terminal.
→ Axon contain Schwan cells and it gives protection to axon (outside of Axolemma).

• Myeline Sheath
It is made up of fatty material which instilled message and Provide safety.

• Node of Ranvier
It is a gap present in myelin Sheath.

Neuron Cell Structure



CLASSIFICATION OF NEURON –

①

Structure / Polarity (on the basis of)	Function (on the basis of)	Myelin Sheath (on the basis of)
Unipolar Bipolar Pseudounipolar Multipolar	Sensory Motor	Myelinated Non-Myelinated

Central Nervous System	Peripheral Nervous System
Astrocytes Ependymal cell Oligodendrocyte Microglia	Schwann cell. Satellite cell.

PROPERTIES OF NERVE FIBER (AXON)

→ Conductivity.
→ Exitability.
→ Refractory Period.
→ Unfatigability.
→ Accomodation.

ELECTROPHYSIOLOGY

The study of electrical Properties of neuron is called electrophysiology.

ACTION POTENTIAL

An action Potential is a Potential difference generated across the membrane of neuron due to disbalance of positive and negative charge (ions) which alternately give rise to the generation of nerve impulse.

EVENTS DURING GENERATION OF ACTION POTENTIAL

(i) Polarization
(ii) Depolarization
(iii) Repolarization
(iv) Hyperpolarization

Polarization –

→ It is also k/a resting stage.
→ At this stage, No stimulus come. Hence no action Potential generated.
→ At resting stage inside membrane negative charge and high Potassium ion, Outside membrane contain Positive charge and high Sodium ion.
→ At this time the Potential is -70 m/volt (Resting Membrane Potential).

Depolarization –

→ When stimulus come it deactivate Na^+/K^+ pump.
→ Now Sodium ion continuously increasing inside cell membrane via leakage channel and altimately inside of membrane become positively charged

and this stage is called Depolarization.
(Voltage gated Na^+ channel opens).
→ Membrane Potential rises to +30 m/volt or +20 m/volt.

Repolarization –

→ Now when wave of depolarization passed of one part of membrane to another, voltage gated Na^+ channel again closes and now K^+ voltage gated channel open. Now K^+ ion continuously passing from the cell and become (-ve) charge and this stage is called repolarization.

Hyperpolarization –

→ Although membrane again become repolarize but still Potassium channel (voltage gated) still remain open.
→ Now due to this Potassium ion continuous Passing Out membrane & membrane Potential become -90 m volt which cause as Hyperpolarisation.
→ When Potential reaches -90 m volt K^+ channel also get closes and finely membrane reaches to resting stage.

SYNAPSES

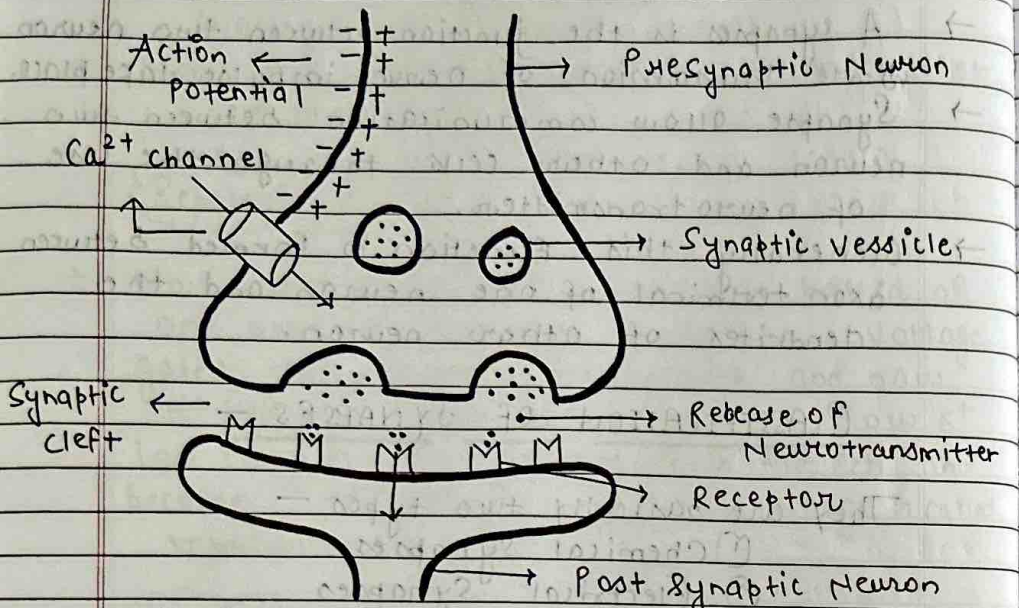
→ A synapses is the junction between two neuron where transmission of nerve impulse take place.
→ Synapse allow communication between two neuron and other cells through the use of neurotransmitter.
→ Generally this function is formed between axon terminal of one neuron and the dendrites of other neuron.

CLASSIFICATION OF SYNAPSES –

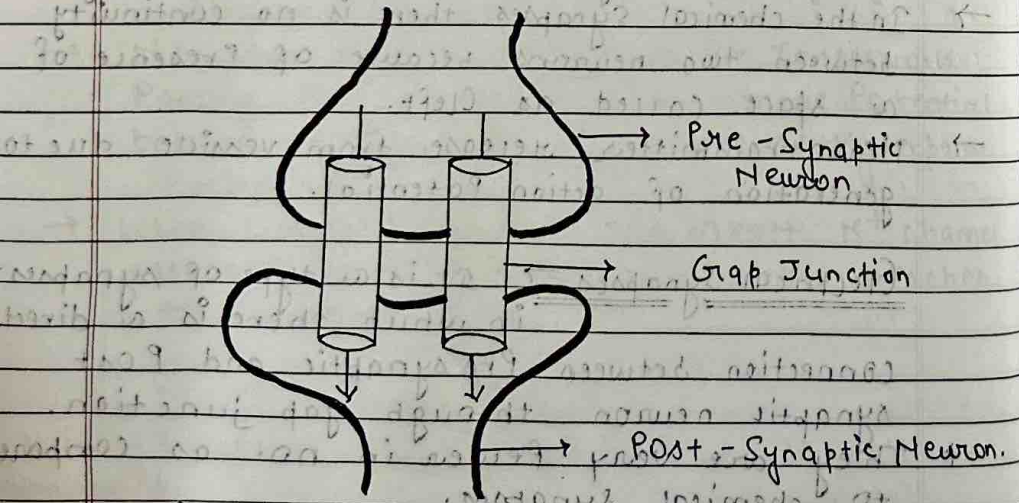
They are basically two types –
① Chemical Synapses
② Electrical Synapses

Chemical Synapses → It is a junction where neurons communicate via chemical messengers called chemical Synapses.
→ In the chemical synapses there is no continuity between two neurons because of Presence of a space called as Cleft.
→ Neurotransmitter release from vessicle due to generation of action Potential.

Electrical Synapses → It is a type of synapses in which there is a direct connection between Presynaptic and Post synaptic neuron through gap junction.
→ They are very fewer in no. as compare to chemical synapses.



CHEMICAL SYNAPSES



ELECTRICAL SYNAPSES

NEUROTRANSMITTER

It is a chemical messenger that transmit signals from one neuron to another across a synapse. Neurotransmitter are generally packed in vesicles. They are very important for rapid transfer of nerve impulse between two neuron.

TYPES OF NEUROTRANSMITTERS –

Neurotransmitters can be classified on the basis of two categories :

- On the basis of Chemical Nature
- On the basis of function.

On the basis of Chemical nature -

Neurotransmitters

Amino Acid	Amines	Others
→ GABA	→ Adrenaline	→ Acetylcholine
→ Glutamate	→ Nor-Adrenaline	→ Nitric Oxide
→ Glycin	→ Histamine	
→ Aspertate	→ Dopamine	

On the basis of function –

1. Excitatory Neurotransmitter.
2. Inhibitory Neurotrammitter.
3. Both.

① Excitatory Neurotransmitters –

→ These neurotransmitters act by stimulating the target neurons.

→ They increase the influx of sodium ions inside the cell and cause depolarization.

Example – Acetylcholine, Adrenaline, Serotonine etc.

② Inhibitory Neurotransmitters –

→ These neurotransmitters act by Inhibiting the target neurons.

→ They increase the Outflux of Potassium ions Outside the cell and cause repolarization.

Example – GABA, Glycine, Serotonine etc.

③ BOth (Excitatory & Inhibitory) –

→ Neurotransmitters which contains both excitatory & inhibitory properties are classified in this group.

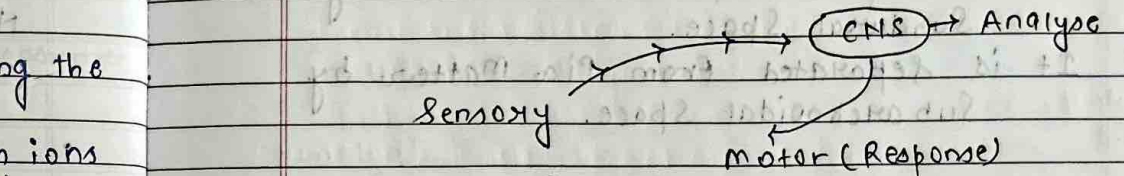
Example – Acetylcholine, dopamine etc.

CENTRAL NERVOUS SYSTEM

→ The central nervous system is mainly consist of → ① Brain
→ ② Spinal Cord

→ It is the major controlling, regulatory and communicating System in our body.

→ The main function of CNS is to control the human body's function by integrating sensory information and respond accordingly.



MENINGES

→ Meninges are the group of three layer that covers the brain and Spinal cord (CNS) and provides protection to them.

→ It also gives Nourishment to brain & Spinal Cord.

Meninges consist of three layers –

① Dura matter (Outermost layer)
② Archnoid matter (middle layer)
③ Pia matter (Innermost layer)

DUra Matter

→ It is the toughest and Outermost layer.

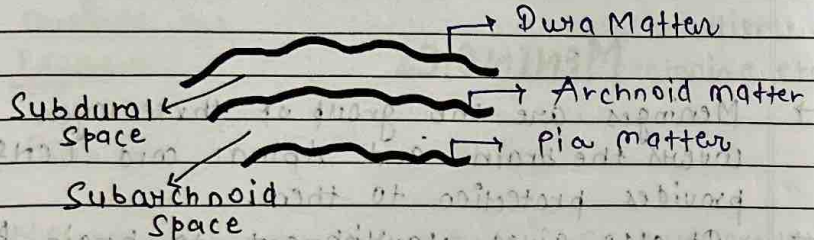
→ It is further divided into two sub layer

↓ ↓

Endosteal layer (Outer layer towards Skull) : Maningeal layer (Inner layer towards Archenoid matter)

Archnoid Matter

→ It is middle fibrous layer.
→ It is separated from dura matter by Subdural Space.
→ It is separated from Pia matter by Subarchnoidal Space.



Pia matter

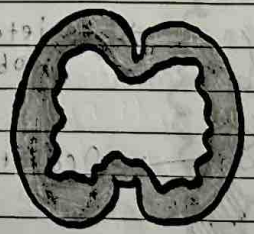
→ It is the innermost layer of Meninges.
→ It carries the blood vessels into brain.
→ It plays major role in formation of Choroid Plexus.

GREY MATTER & WHITE MATTER

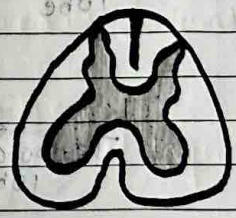
The Organs of CNS i.e ; Brain and Spinal Cord are composed of two kind of tissue :-

① Grey matter
② White matter.

• In Brain	• In Spinal Cord
→ Grey matter Outside	→ Grey matter inside
→ White matter Inside	→ White matter Outside



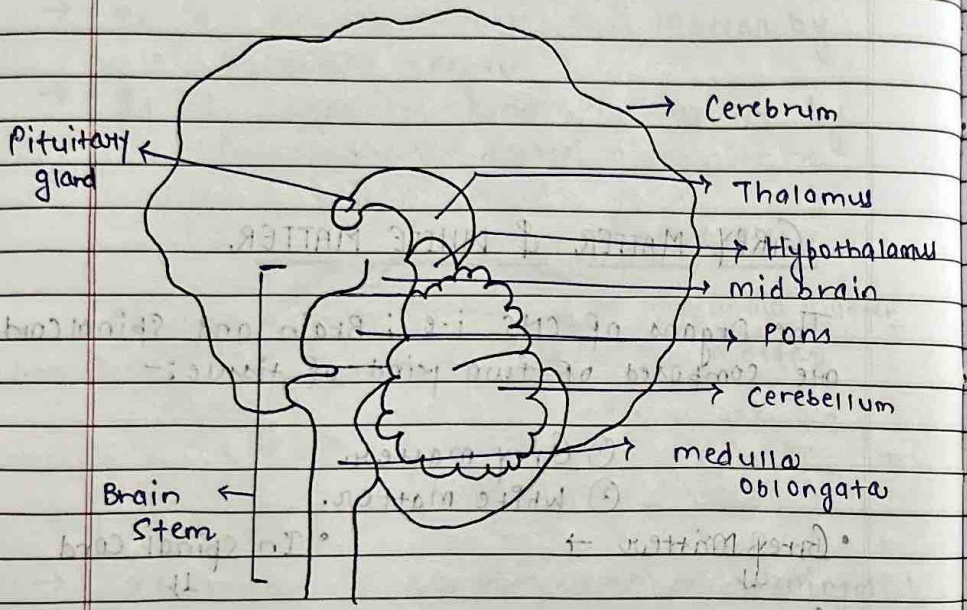
Brain

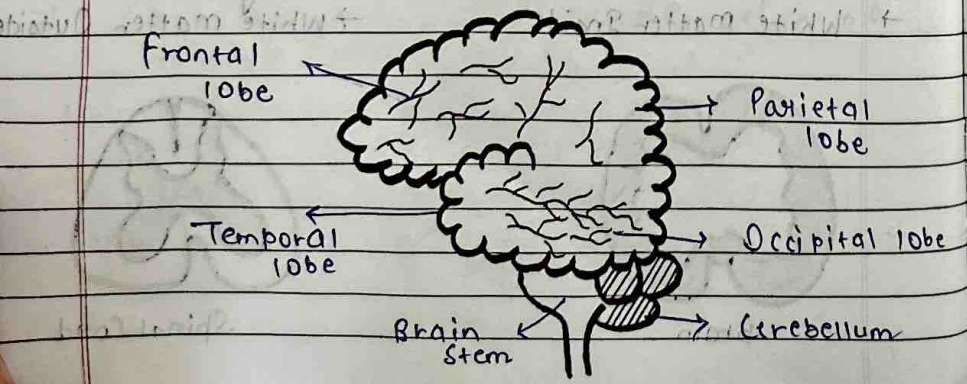


Spinal Cord

THE BRAIN

* The Brain is the controlling Centre of the body.
* In adults human Brain average weight → 1.4 - 1.5 kg.
* male brain avg. weight → 1370 g.
female brain avg. weight → 1200 g.
* Brain is made up of 100 Billion neurons.





CEREBROSPINAL FLUID (CSF)

→ CSF is a clear, colorless and transparent fluid found in the Ventricles, Sub arachnoid Space and central canal of Spinal cord.

→ It is mainly formed by Choroid Plexus of lateral ventricles.

** Choroid Plexus : It is a network of blood vessels lined by ependymal Cells that Produces CSF.

→ The volume of CSF is approx 100 - 150 mL.
→ It secrete at a rate of 0.5 ml/min or 500 - 700 ml/day.
→ It's pH is slightly alkaline 7.3.

COMPOSITION OF CSF

It is composed of:-
- 99 % water
- 1 % Solid Substance.

Inorganic Solid Substance	Organic Solid Substance
Sodium, Potassium, Calcium, Magnesium, Bicarbonates, Chlorides etc.	Proteins, Sugars, Uric acid etc.

FUNCTION OF CSF

1. It support and protect the CNS.
2. It provide nutrients to brain & spinal cord.

VENTRICLES OF BRAIN

→ The Ventricles are cavities (hollow space) filled with Cerebrospinal fluid.
→ There are four ventricles in our brain that are interconnected to each other.
→ Each ventricles is lined by Ependemal cell which forms Choroid plexus that produce Cerebrospinal fluid.

Four Ventricles of Brain –
① Right lateral Ventricles
② left lateral Ventricles.
③ Third Ventricles
④ fourth ventricles.

Lateral Ventricles (Right & left)

→ There are 2 lateral ventricle in our body located in each hemisphere of brain (right hemisphere & left hemisphere).
→ They are roughly C shaped.
→ They are lined by ependymal cells and filled with CSF.

Third Ventricles

→ It is located Below lateral Ventricles.
→ It is narrow funnel shaped cavity of brain filled with CSF.
→ It is connected with 4th Ventricle by Cerebral aqueduct.

fourth Ventricle

→ It is diamond shaped Cavity located below third Ventricle.
→ It is connected with 3rd Ventricle by Cerebral aqueduct.

PARTS OF BRAIN

The Brain can be divided into 4 major parts:
- Cerebrum
- Cerebellum
- Brain stem
- Diencephalon.

CEREBRUM

→ It is the largest Portion of brain.
→ It is divided into two cerebral hemisphere

Right hemisphere Left hemisphere

→ It is located in the upper portion of brain responsible for learning & Senses.
→ Both hemisphere is Connected by Corpus Callosum.
- Right hemisphere : Control left side of body.
- left hemisphere : Control right side of body.

LOBES OF CEREBRUM

The cerebrum of brain is divided into 4 lobes-

1. Frontal lobe
2. Parietal lobe
3. Temporal lobe
4. Occipital lobe.

Frontal Lobe

→ Also k/a "motor cortex."
→ It controls motor function like-
- Personality
- movement
- Planning
- decision making
- Concentration
- thoughts etc.

Parietal Lobe

→ Also k/a "Sensory cortex".
→ It controls sensory function like-
- Direction.
- Distance recognition.
- Storage of language. etc.

Temporal Lobe

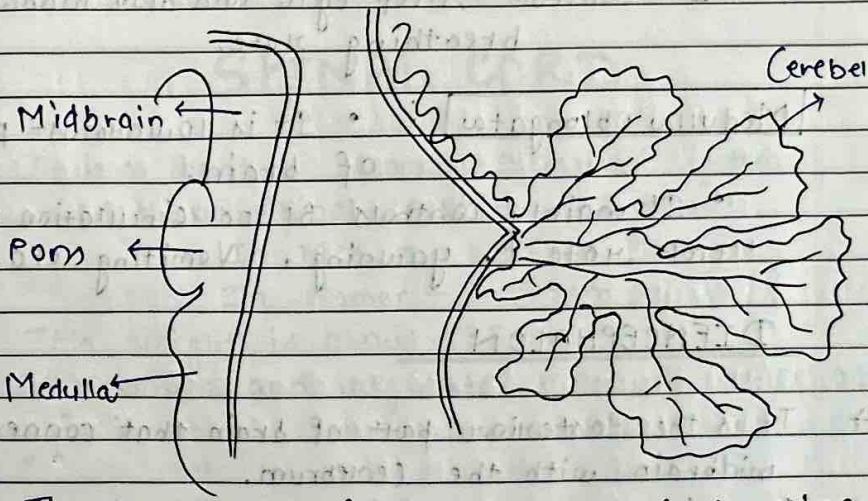
→ Also k/a "Auditory cortex".
→ It controls - Hearing
- Smell
- dreams etc.

Occipital Lobe

→ Also k/a Visual cortex.
→ It receive input from eyes and control vision.

CEREBELLUM

→ The cerebellum is the part of brain.
→ It is present at the back side of brain, below the cerebrum.
→ It has two halves called hemisphere.
→ The middle part joined them is called Vermis
→ Inside it there is a white matter that looks like a tree called Arbor Vitae.



→ The cerebellum controls muscle contraction.
→ It helps in smooth movement of muscle.
→ maintain body posture.
→ Coordinate voluntry movement (Walking, Writing etc).
→ Play major role in learning.

BRAIN STEM

→ The brain stem is the stem like part of brain that is connected withe spinal cord.

→ It is mainly composed of Midbrain, Pons and medulla oblongata.

Midbrain : • It is one of the smallest portion of brain.
• It mainly controls the function of eye & ear.

Pons : • It means bridge: It connect Cerebellum with brain.
• It controls sleep cycle and also manage breathing rate.

Medulla oblongata : • It is lowermost part of brain.
• It mainly controls Blood circulation, Heart rate, yawning, Vomiting etc.

DIENCEPHALON

→ It is the posterior part of brain that connects midbrain with the cerebrum.
→ It mainly composed of Thalamus, Hypothalamus and Epithalamus.

Thalamus • it receives information from all the sensory nerves and sends to different regions of brain.

Hypothalamus • it is also k/a master of master gland i.e Pituitary gland.
• Hypothalamus is small but one of the most important portion of brain.
• It is responsible for nearly all type of feelings & emotions like anger, fear, love, Hate, happiness, hunger, thurst etc.

Epithalamus • It consist of Pineal gland which is an endocrine gland that secretes Melatonin.

SPINAL CORD

→ It is a part of central Nervous System.
→ Length of Spinal cord:—
In Men - 45 cm
In Women - 43 cm
→ It's weight is about 35 gm.
→ It controls and regulate most of reflex action.

COVERING OF SPINAL CORD

It is covered by three layer of tissue called meninges and bones of vertebral column.

Meninges

like brain, spinal cord is also protected by three layer of membrane called Meninges.

1. Dura matter
2. Archnoid matter
3. Pia matter.

Vertebral Column

→ It is also k/a backbone.
→ The bones of vertebral column are called 'vertebrae'
→ They provide protection to spinal cord.
→ They are divided into 5 different parts —

①	Cervical vertebrae	: 7	(C_1 to C_7)
②	Thoracic vertebrae	: 12	(T_1 to T_{12})
③	Lumbar vertebrae	: 5	(L_1 to L_5)
④	Sacrum	: 5	(fused)
⑤	Coccyx	: 4	(fused)

SPINAL CORD SEGMENTS

31 Segments.

①	Cervical Segment / Cervical nerve	: 8
②	Thoracic Segment / Thoracic nerve	: 12
③	Lumbar Segment / Lumbar nerve	: 5
④	Sacral Segment / Sacral nerve	: 5
⑤	Coccygeal Segment / Coccygeal nerve	: 1

SPINAL CORD ENLARGEMENTS

There are two major enlargements in the spinal cord :

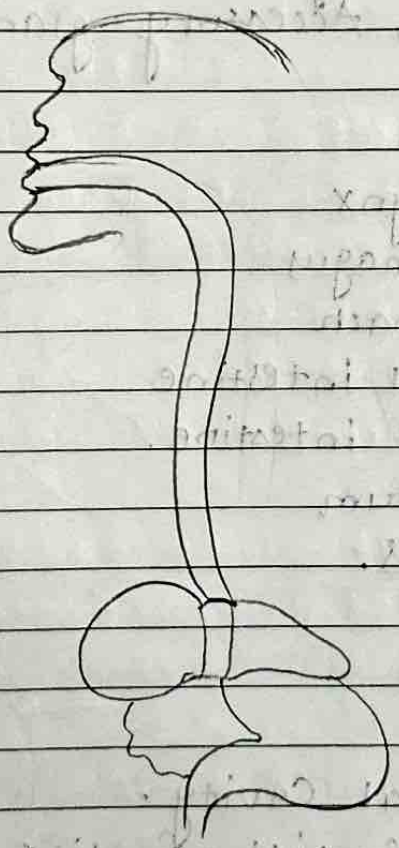
1. Cervical Enlargement.
2. Lumbar Enlargement.

UNIT - 02

DIGESTIVE SYSTEM

→ The digestive system is the part of our body that helps breakdown of food into simple substance and absorb nutrients for energy and growth.

→ Digestive system simply breakdown the food into nutrients.



Stages of Digestion / function of Digestion -

(i) Ingestion : food enters the mouth.
(ii) Propulsion : movement of food
(iii) Digestion : Mechanical (chewing) & chemical breakdown.
(iv) Absorbtion : Absorbtion of Nutrients.
(v) Excretion : Excretion / removal of food.

PARTS OF DIGESTIVE SYSTEM.

The digestive is mainly consist of GIT & Digestive glands also K/a Accessory glands.

1. Mouth
2. Pharynx
3. Oesophagus
4. Stomach
5. Small intestine
6. large intestine.
7. Rectum
8. Anus.

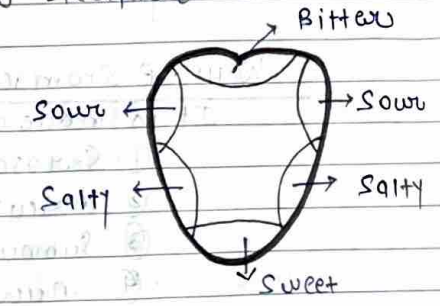
① MOUTH

→ It is also K/a buccal cavity.
→ The mouth mainly consist of lips, cheeks, gum, teeth, Salivary glands & tongue.
→ The space b/w gums & cheeks is K/a Vestibule.
→ The roof of buccal cavity is K/a Palate.
→ Palate are of two types :
Soft Palate & Hard Palate.

Teeth : They breakdown the food into smaller pieces.

There are 32 Teeth in adult mouth.
(i) incisors : 8
(ii) canines : 4
(iii) Premolar : 8
(iv) Molars : 12

Tongue : It is attached with hyoid bone.
It mixes saliva into food & Convert into bolus.
It contains taste receptor.
(i) Sweet
(ii) Salty
(iii) Sour
(iv) Bitter.



② PHARYNX

→ It is the common Pathway for digestive & respiratory tract.
→ It lies b/w mouth & oesophagus.
→ Also K/a "throat".
→ It passes the bolus into oesophagus.

③ OESOPHAGUS

also K/a food Pipe. (25cm long)

→ It is a hollow tube like structure that carries food (bolus) from Pharynx to stomach.

→ No digestion takes place in oesophagus. digestive enzyme are absent.
→ Oesophagus opens into stomach.

④ Stomach

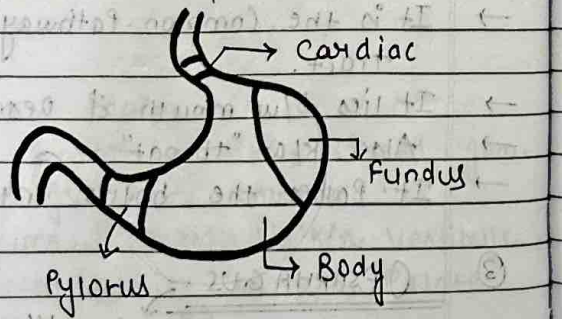
→ It is a "j" shaped Pouched like Structure.
→ It lies in the left side of Abdominal Cavity.
→ Capacity : 30ml - 1.5 ltr.
→ It Secrete digestive fluids called Gastric Juice.
→ It secretes gastric juice into bolus & convert into Chyme.

Wall of Stomach

It is made up of 4 layers:
① Serosa
② Muscularis
③ Submucosa
④ Mucosa.

Parts of Stomach

it is divided into 4 parts:
① Cardiac
② fundus
③ Body
④ Pylorus



Cardiac : → It is the uppermost part of Stomach.
→ It is attached with lower end of Oesophagus.
→ It prevent backflow of food from stomach to oesophagus otherwise it can cause heartburn.

Fundus : → It contains special type of cell K/a Chiefcells and Parietal cells.
→ CHIEF CELLS : Produce various enzyme like-
① Pepsin
② Renin
③ Lipase.
→ PARIETAL CELLS : Produce HCl.

Body : → It is the largest Part of Stomach.
→ It digest Protein and stores food until it reaches into small intestine.

Pylorus : → It is the lower part of Stomach.
→ It is connected with duodenum of small intestine.
→ It tranfers the food from stomach to small intestine.
→ It contains special types of G-CELLS.
→ G-cell secrete Gastrin Hormone.

Role Of Gastric HCl

→ The HCl Plays major role in digestion of food in the stomach.
→ It is secreted by Parietal cells of stomach.
→ It helps to convert bolus into chyme.
→ It converts pepsinogen into pepsin that helps in protein digestion.

Function of Stomach

→ It stores the food for a long time and after that transferred into small intestine slowly & it provides enough time for digestion & absorbtion of food in small intestine.

→ Storage Time :

(i) Fat : 6-8 hr.
(ii) Proteins : 4-5 hr.
(iii) Carbohydrates : 1-2 hr.

→ It helps in the chemical breakdown of food.
→ Gastric juice mainly helps in the digestion of Protein.
→ *It secretes mucosa that Protects the stomach from Hcl.

⑤ SMALL INTESTINE

→ It is a long & narrow tube whose upper part is attached to stomach while lower part is attached with large intestine.
→ It is about 6-7 meter long.
→ It is further divided into three parts
① Duodenum.
② Jejunum.
③ Ileum.

Duodenum

→ Duodenum accepts only Alkaline food.
→ It is approx 10-11 inches long.
→ It receives bile juice, Pancreatic juice and food from liver, Pancreas and stomach respectively.
→ Secretion of duodenum :
(i) Enteriogastrone
(ii) Secretin
(iii) Pancreoenzyme
(iv) Cholecystokinin

Jejunum

→ It is about "4-8 feet long".
→ final breakdown of food complete here.
→ Secretion of Jejunum :
Intestinal Juice.

Ileum

→ It is last part of small intestine connected with the Cecum.
→ It is about "10-11 feet long."
→ It is the largest section of small intestine.

Enzymes Responsible for Digestion

- Enterokinase : Convert trypsinogen into trypsin.
- Erepsin : Convert Polypeptide into amino acids.
- Sucrase, Maltose & lactase : Converts disaccharides into monosaccharides.

Absorption in Small Intestine

→ The absorption in small intestine mainly occurs through villi & microvilli.
→ Villi :→ finger like Projection.
→ Microvilli :→ Tiny hair like structures on villi.

⑥ LARGE INTESTINE

→ It starts from ileum & ends on rectum.
→ It is approx 1.5 m long.
→ It is further divided into 5 parts.
(i) Cecum.
(ii) Ascending Colon
(iii) Descending Colon
(iv) Transverse Colon
(v) Sigmoid Colon.

⑦ RECTUM

→ It stores the remaining waste of food.
→ It opens Outside through anus.

⑧ ANUS

→ The undigest and unabsorbed food that is simply kla faeces excreted out from body through anus and it is a voluntry Process.
→ Two types of Sphincter muscle found in anus-
- Internal : Involuntry.
- External : Voluntry.

DIGESTIVE GLANDS

→ Digestive glands are the accessory glands of digestive system that helps in the process of digestion.
→ They mainly includes :-
(i) Salivary glands
(ii) Liver
(iii) Gall Bladder.
(iv) Pancreas.

SALIVARY GLANDS

→ Salivary glands are exocrine glands present in the mouth that secretes saliva in ORIT.
→ Human salivary glands produces "0.5 L to 1.5 L" Saliva dily.
→ Saliva contains digestive enzyme mainly Salivary Amylase which helps in the carbohydrate digestion.
→ It also have antibacterial effect of fighting off bacteria.

Types of Salivary Glands -

3 types of salivary gland present in human.
① Parotid glands.
② Submandibular Glands.
③ Sublingual glands.

Parotid Glands :-
- These are the largest salivary gland.
- Located near ear (cheek area).
- Secretes watery saliva

Submandibular Glands :-

- Second largest salivary gland (Smaller than Parotid & bigger than Sublingual).
- located below lower jaw (mandible).
- Secrete Mixed saliva

Sublingual Glands :-

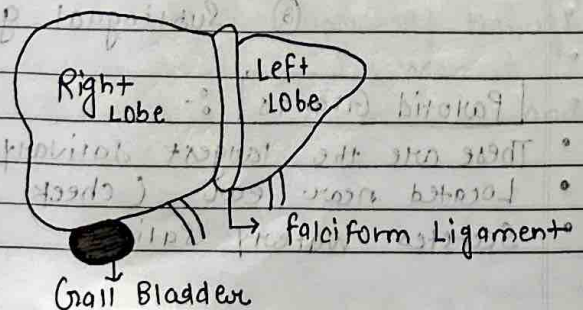
- Smallest salivary gland.
- located Under the tongue.
- Secrete thick (mucus) saliva.

LIVER

→ Liver is the largest gland or Organ of Our body.
→ It's weight is about 1.5 kg.
→ Liver Performs maximum number of functions in Our body.
→ It is reddish-brown colour in human.

Surface of liver:

Liver have four Surface:
① Superior Surface
② Inferior Surface
③ Anterior Surface.
④ Posterior Surface.

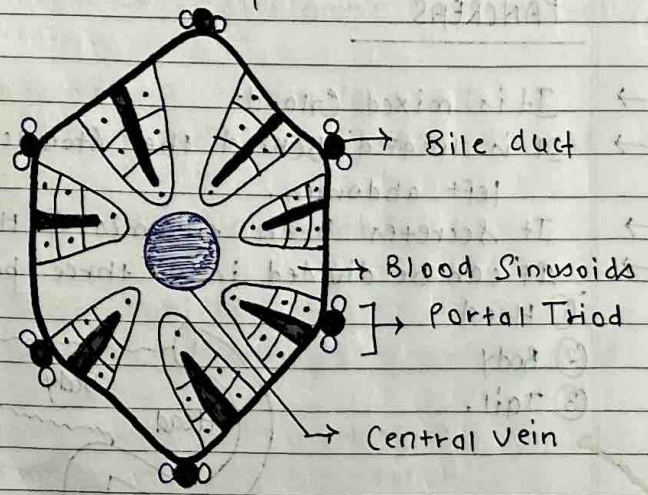


Lobes of Liver

Liver contains two lobes -
① Right lobe
② left lobe
→ Right lobe is larger than left lobe.
→ Right & left lobes are separated by falciform ligament.

Internal Structure of liver

→ The liver is made up of small hexagonal Units Present in large number in liver.
→ Each lobule has a central vein surrounded by several Portal triads.
→ The Portal triad is consist of
① Portal vein
② Bile duct
③ Hepatic Artery.



* Gall bladder stores [illegible] juice secreted by liver.

Function of Liver

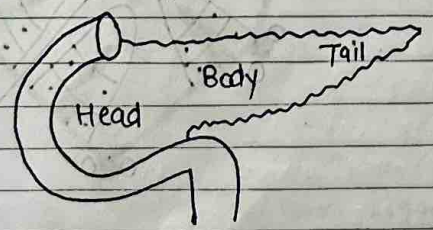
1. Secrete bile juice.
2. Synthesis of Urea.
3. Metabolism of Carbohydrate, Fats & Protein.
4. Vitamins & minerals storage.
5. Synthesis of Heparin
6. Synthesis & storage of glycogen.
7. Blood Sugar regulation.
8. Detoxification & Purification of blood.

GALL BLADDER

→ Gall bladder lies below the right lobe of liver.
→ It stores and concentrate the bile from liver.
→ Gall bladder contains Cystic duct.
→ Microvilli on gall bladder absorbs moisture from bile & makes it concentrate.

PANCREAS

→ It is mixed Gland.
→ It is located behind the stomach in upper left abdomen.
→ It secretes both enzymes & Hormones.
→ It can be divided into three parts:
① Head
② Body
③ Tail.



Enzyme Secretion by Pancreas

- Lipase : Convert fat into fatty acid & glycerol.
- Amylase : Convert starch into maltase
- Trypsin : Convert Peptones into Amino acids (aa)

Hormones Secretion by Pancreas

Islets of langerhans contains mainly 3 types of cells that secrete following hormones:

- Alpha cells : Glucagon
- Beta cells : Insulin
- Delta cells : Somatostatin.

ACID PRODUCTION IN STOMACH

food enters stomach
↓
Brain + Vagus nerve get activated
↓
Release of 3 stimulators:
Gastrin + Histamine + Acetylcholine
↓
Parietal Cell activated
↓
Inside Parietal cell:
$CO_2 + H_2O \longrightarrow H_2CO_3$ (carbonic acid)
↓
$H_2CO_3 \longrightarrow H^+ + HCO_3^-$
↓
H^+ Pumped into stomach by Proton Pump.

* HCl secreted by parietal cell

↓

Cl^- also enters stomach.

↓

$H^+ + Cl^- \longrightarrow HCl$ (acid)

↓

Acid helps in digestion.

ROLE OF PEPSIN IN PROTEN DIGESTION

ENERGETICS

Energetics → It is the study of energy and its distribution in chemical, physical or biological activities.

Energy → It is act as a currency for our body, which is used to perform function in our body.

→ It is measured & express in Joules (unit of work) or kilocalories (unit of heat).

→ In a human body, 3 million Kcal of energy per day is produced through metabolic reactio

1 Kcal = 4184 Joule (J) = 4.184 KiloJoule (KJ

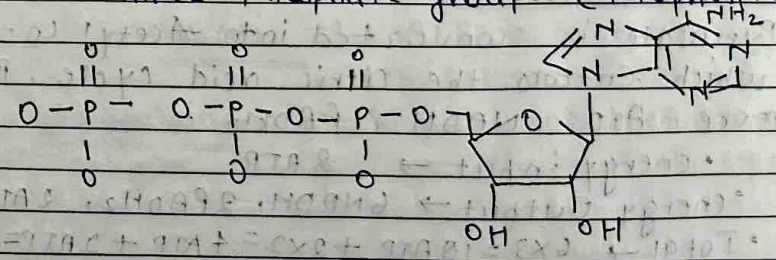
ATP

→ ATP stand for Adenosine Triphosphate.

→ It is also kla energy currency of cell.

→ It is made up of :-

- Adenine (nitrogenous base)
- Ribose (five-carbon sugar)
- Three Phosphate group (triphosphate).



FORMATION OF ATP

→ It is formed through a process called Cellular respiration, which involves the breakdown of glucose & other organic molecules to produce energy.

→ There are main three stages of cellular respiration
1. Glycolysis
2. Krebs cycle / citric acid cycle.
3. Oxidative Phosphorylation / ETC.

GLYCOLYSIS

It involves →
- → Carbohydrate metabolism.
- → Occurs in Cytosol.
- → Glucose is converted into Pyruvate.
- → Producing a amount of ATP & NADH.

- energy input → 2 ATP
- energy output → 4 ATP (gain) + 2 NADH (gain)
- Total → 2 ATP, 2 NADH (6 ATP) → 8 ATP

KREB'S CYCLE

Pyruvate is converted into Acetyl Co-A, which enters the citric acid cycle, Producing more ATP, NADH, $FADH_2$.
- energy input → 2 ATP
- energy Output → 6 NADH, 2 $FADH_2$, 2 ATP
- Total → 6 × 3 = 18 ATP + 2 × 2 = 4 ATP + 2 ATP = 24 ATP

Profit = 24 - 2 = 22 ATP from 2 mol. of Acetyl CoA

OXIDATIVE PHOSPHORYLATION

The electron from NADH & $FADH_2$ are passed through a series of protein complex in the mitochondrial inner membrane, Producing a proton gradient.
ATP Synthesis uses this gradient to produce ATP.

- Total energy yield → 32 – 34 ATP approx.

ROLE OF ATP

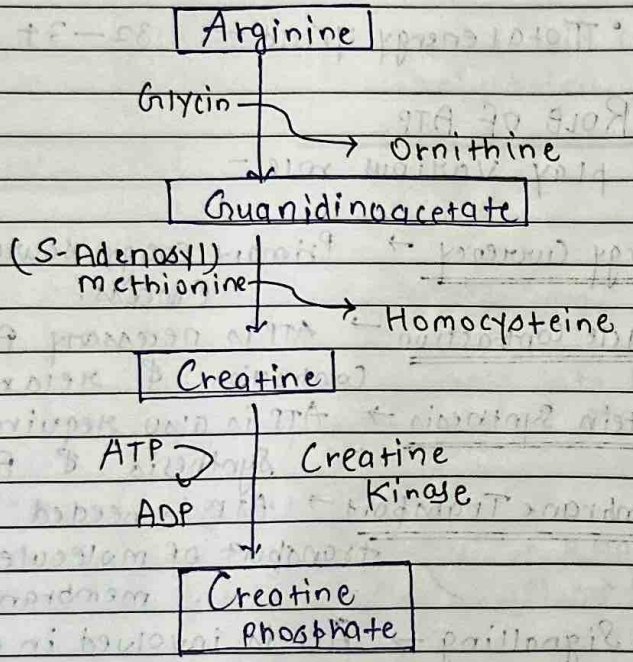
It play various role :-

- **Energy Currency** → Primary energy source for cellular Process.
- **Muscle Contraction** → ATP is necessary for muscle contraction & relaxation.
- **Protein Synthesis** → ATP is also required for Protein Synthesis & folding.
- **Membrane Transport** → ATP is needed for active transport of molecule across cell membrane.
- **Cell Signalling** → ATP is involved in cell Signalling Pathway.
- **DNA Synthesis** → ATP is necessary for DNA replication & repair.
- **Cell division** → ATP is required for cell division & cytokinesis.

CREATININE PHOSPHATE

→ It is also known phosphocreatine.
→ It gives its phosphate to ADP.
→ ADP becomes ATP (energy)
→ It is storage form of energy in the muscle.

FORMATION OF CREATININE PHOSPHATE



ROLE OF CREATININE PHOSPHATE

- ATP Regeneration → donate its phosphate group to ADP, to reform ATP.
- Helps in muscle contraction, especially for high-intensity activities.

BMR

→ BMR → Basal metabolic Rate.
→ It is the minimum energy requirement to maintain the basic body function, when body is in rest condition.
- it includes —
  - Working of heart & other organs.
  - Conduction of nerve impulse.
  - Ions transport across cell membrane.
  - GI motility.

Normal Value →
- Adult man → 1600 cal/day.
- Adult woman → 1400 cal/day.

Normal → −15% to ±20% variation.

FACTOR AFFECTING BMR

① Age → BMR decreases with Age.
② Sex → Men generally have a higher BMR than woman.
③ Weight → BMR increase with body weight.
④ Height → Taller individuals have generally high BMR than short.
⑤ Physical activities → BMR increase with regular Exercise.
⑥ Starvation → During starvation, A decrease in BMR upto 50% has been reported.

ROLE OF BMR

→ BMR is important to calculate caloric requirement of an individual.
→ BMR changes can indicate underlying heath issue.
→ BMR is below normal in starvation → Under nutrition
→ BMR is above normal in fever, diabetes patient, and leukemia.

RESPIRATORY SYSTEM

→ Respiratory System is a group of organ & tissue which help us in breathing or respiration.
→ The inhalation of O_2 & excretion of CO_2 occurs only through Respiration & the system that performs respiration is called respiratory System.

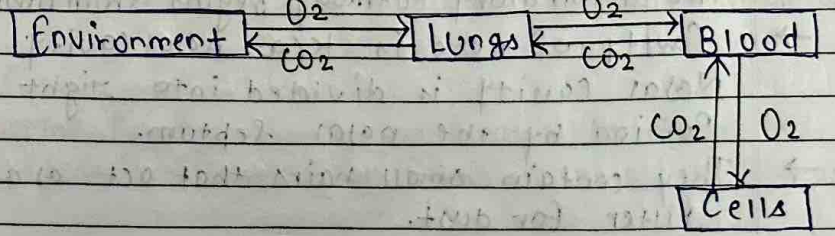
STAGES OF RESPIRATION

There are basically 3 Stages of Respiration:
1. Breathing
2. Internal Respiration
3. Cellular Respiration.

Breathing : It is simply defined as the exchange of Gases b/w environment & lungs.

Internal Respiration : It is simply defined as exchange of gases b/w lungs & blood

Cellular Respiration : It is simply defined as exchange of gases b/w blood & body tissue (Cells).



TYPES OF RESPIRATION

There can be of Two types —
① Aerobic Respiration.
② Anaerobic Respiration.

Aerobic Respiration	Anaerobic Respiration
→ Occurs in the Presence of Oxygen.	→ Occurs in the absense of Oxygen
→ This Process Produce much more energy	→ It produce less Energy.

ORGANS OF RESPIRATORY SYSTEM

→ Nose & nasal cavity.
→ Pharynx
→ Larynx
→ Trachea
→ Bronchi
→ Bronchioles
→ Alveoli
→ lungs.

NOSE / NASAL CAVITY

→ The respiratory Pathway begins from nose.
→ Cavity of nose is K/a nasal cavity. Nasal cavity is divided into right & left Portion by the nasal Septum.
→ They contain small hairs that act as a filter for dust.

functions:
① Allow air to enter into your body.
② filter & clean air.
③ Provide a Sense of smell.

PHARYNX

→ It is the common Pathway for Respiratory Tract & Gastrointestinal tract.
→ It is about 12 cm long.
→ It is further divided into three parts:
① Nasopharynx
② Oropharynx
③ laryngopharynx.

functions:
① It helps in movement of food to oesophagus.
② Pharynx amplifies the Sound Produced by Larynx

LARYNX

→ It lies between Pharynx & trachea.
→ It is made up of following cartilage.
① Thyroid Cartilage.
② Cricoid Cartilage.
③ Arteroid Cartilage.
→ It contains Epiglottis that makesure that food must be enter into esophagus instead of trachea.

functions:
① Larynx Produce Sound, hence also K/a Sound box.
② Epiglottis Prevent food from entering into trache

TRACHEA

→ It is a cylindrical tube like structure which is 12 cm long & 2.5 cm in diameter.
→ It is made up of 16-20 C shaped incomplete rings.

function:
① Small hairs are present in the inner wall of trachea that catches dust & other impurities from inhaled air.

BRONCHI

→ The trachea ends up by dividing into two bronchi named right & left bronchi.
→ The right bronchus is shorter & wider than left.

function:
① It connects windpipe with lungs.
② allow air to pass into lungs.

BRONCHIOLES

→ Bronchi of lung further divided into smaller branches k/a Bronchioles.
→ They are lined by cuboidal epithelium.

function:
① It play a major role in pathway of air from bronchi to alveoli.

ALVEOLI

→ Alveoli are also k/a functional unit of lungs & consist of small hollow area for gaseous exchang
→ They are approximately 300 million alveoli presen in both lungs.
→ They are rich in blood supply.
→ They contain two type of cells:
① Pneumocytes.
② Alveolar macrophage.

functions:
① Alveoli is site where exchange of oxygen and CO_2 occurs during the process of breathing.

LUNGS

→ Lungs are the Principle organ of Respiration.
→ They are present in pair i.e left lung & right lung located on either side of chest.
→ It is covered by a double membrane k/a Pleural membrane.
→ Outer Membrane: Parietal Pleura.
→ Inner membrane: Visceral Pleura.
→ The left lung is slightly smaller than right lung.
→ Right lung has three lobes while left lung has only 2 lobes.

Surface of lungs

it is divided into 4 parts –

1. Apex: Narrow Superior portion.
2. Base: Broad Inferior portion.
3. Costal: Surface against ribs.
4. Surface: Lateral Boundry of mediastinum.

lobes of lungs

Lungs of each side contains different no. of lobes

RIGHT LUNG : Right lung is subdivided into 3 lobes :
- Superior lobe
- middle lobe
- Inferior lobe.

LEFT LUNG : left lung is subdivided into 2 lobes :
- Superior lobe
- Inferior lobe

MECHANISM OF RESPIRATION

Mechanism of respiration involves two major step.
(i) Breathing mechanism.
(ii) Exchange of Gases.

Breathing mechanism –

→ The Process in which air moves in & out of the lungs is k/a Breathing.

→ The breathing mechanism involved two major Process :.

Inspiration / inhalation	Expiratin / Exhalation
• In this process air moves from atmosphere to lungs.	• In this process air moves from lungs to atmosphere.
• It is an active Process (Require energy).	• It is a passive Process. (doesn't require energy)

Inspiration Mechanism

Contraction of Diaphragm muscle
↓
Enlargement of Thoracic Cavity
↓
Decrease in Pressure inside thoracic Cavity
↓
filling of air inside the lungs.

Expiration Mechanism

Relaxation of Diaphragm muscle
↓
Decrease in Volume of Thoracic Cavity
↓
Increase in Pressure inside thoracic Cavity
↓
Exhalation of air.

Exchanges of Gases –

→ The gaseous exchange occurs in alveoli of the lungs.
→ Exchange of gases takes place in following manner:
(i) Transport of O_2
(ii) Cellular respiration.
(iii) Transport of CO_2

Transport of O_2

When O_2 is transferred from alveoli to blood then it is carried by Haemoglobin & then it is further transported to cells for cellular respiratn.

Cellular Respiration

In this Process the cells uses O_2 to breakdown the glucose into CO_2 & energy should be Produced.

Transport of CO_2

Now CO_2 is a waste Product hence it is further transferred from cells to blood and then blood to lungs & then finally exhaled out.

LUNG VOLUME / RESPIRATORY VOLUME

It is defined as the amount of air in the lungs during different stage of breathing.

(1) Tidal Volume (TV) → The amount of air inhaled & exhaled during normal breathing.
- Approximately 500 ml.

(2) Inspiratory Reserve Volume (IRV) → It is the additional air that can be inhaled after normal inhalation.
- Approximately 2500 – 3000 ml.

(3) Expiratory Reserve Volume (ERV) → It is the additional air that can be exhaled after normal inhalation.
- Approximately 1000 – 1200 mL.

(4) Residual volume (RV) → It is the amount of air remaining in the lungs after maximum exhalation.
- Approximately 1200 ml.

LUNG CAPACITY

It is defined as the total amount of air in the lungs after maximum inhalation.

① Total lung capacity (TLC) →

TLC → TV + IRV + ERV + RV

• Approx 6000 ml.

② Vital capacity (VC) →

VC → TV + IRV + ERV

500 + 3000 + 1200 = Approx 4700 ml

③ Functional Residual Capacity →

FRC → ERV + RV

1200 + 1200 = Approx 2400 ml.

④ Inspiratory Capacity (IC) →

IC → TV + IRV

500 + 3000 = Approx 3500 ml

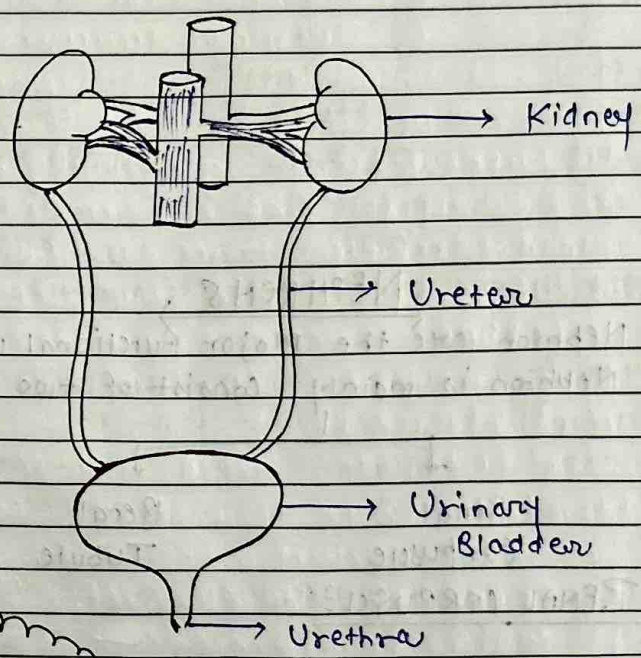
URINARY SYSTEM

→ Excretion is the process by which unwanted substance and metabolic waste are eliminated from the body.

→ Urinary System is also k/a Renal System.

Parts of Urinary System —

① A pair of Kidney
② Ureters
③ Urinary Bladder
④ Urethra.



KIDNEY → They are present in a pair in our body.
→ Kidney are two bean shaped organ located on each side of vertebral column.
→ It is reddish brown in colour.

→ It is about 10-12 cm long & 5-7 cm wide.
→ Its weight is about 120-170 gram.

Layers of Kidney

Kidney mainly Contains 3 layers :-

1. Outer cortex
2. Inner medulla
3. Renal Pelvis.

NEPHRONS

→ Nephron are the major functional unit of kidney.
→ Nephron is mainly consist of two parts

- Renal Corpuscle
- Renal Tubule

RENAL CORPUSCLE

→ It is present in the Cortex of Kidney.
→ The major Function of Renal Corpuscle is filteration of blood.

→ It can be further subdivided into two portions

- Glomerulus — Bunch of Capillaries
- Bowman's Capsule — Upper end of renal tubule

RENAL TUBULE

→ It is tube like structure & the continuation of Bowman's Capsule.
→ Renal Tubule mainly consist of 3 parts :-

- Proximal Convoluted Tubule (PCT) (Present in Cortex)
- Distal Convoluted Tubule (PCT) (Present in Cortex)
- Loop of Henle (Present in medulla).

Loop of Henle is further divided into two parts.

- Descending Limb
- Ascending Limb

PHYSIOLOGY OF URINE FORMATN

→ Urine formation is a blood cleansing function.
→ Normally about 1300ml of blood enters into the kidney.
→ Kidney excreted the unwanted substance from the blood as Urine.
→ Normal Urine output is 1-1.5 litre/day.

Formation of Urine

It mainly involves 3 steps :-
① Glomerular filteration.
② Tubular Reabsorbtion.
③ Tubular Secretion.

Glomerular filteration :

→ It takes place in glomerulus.
→ It is a first step of Urine formation
→ Blood Pressure forces water & small solutes out of the blood into Bowman's Capsule.
→ Large molecule like Protein & Blood Cells are not filtered.
→ The filterate formed is called "glomerular filtrate".

Glomerular filteration rate (GFR)

GFR is defined as — Total quantity of filterate formed in all the nephrons of both the kidney in the given unit of time.

Normal GFR is — 125 ml / minute in adults.

Tubular Reabsorbtion :

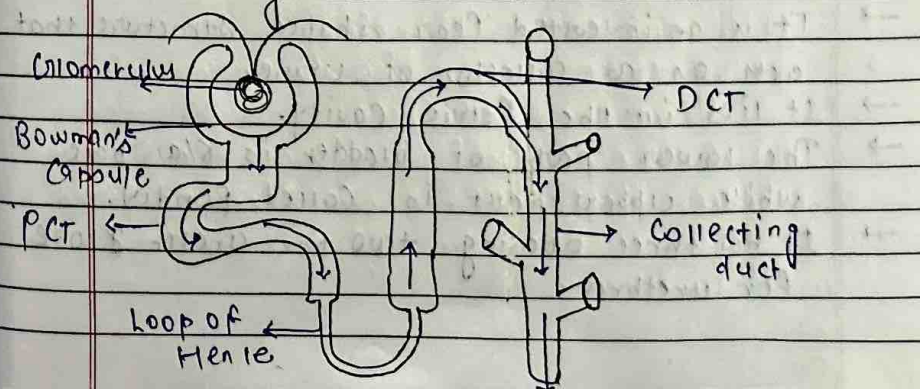
→ It takes place in the Proximal Convoluted Tubule, loop of henle & distal CT.
→ It is the process by which useful substance such as glucose, water, aa are reabsorbed from Renal tubule to blood.
→ Essential substance are reabsorbed while unwanted substance excreted out from body.

TUBULAR Secretion :

→ It is a prosess in which substance are transported from blood to Renal tubule.
→ It takes place mainly in the DCT & Collecting duct.
→ It helps in maintaining PH.

Substance Secreted in different Segment of renal tubule —

→ PCT :- Potassium, Ammonia, H^+ ions.
→ DCT :- Potassium, H^+ ions.
→ Loop of Henle :- Urea.
→ Collecting Duct :- Potassium.



FUNCTION OF KIDNEY

1. It help in the excretion of waste Product.
2. It maintains water electrolyte Balance.
3. It maintains acid-base balance.
4. It Secretes renin, Prostaglandin hormone.
5. It also help in the Regulation of Blood Pressure.
6. It also regulate blood Calcium level.
7. It also helps in the Pmcess of erythropoeisis by Secreting erythropocitin & also in thrombopoeisis by Secreting Thrombopoeitin.

URETER -

→ They are Paired tube like Structure.
→ They carry urine from Kidney to Urinary bladder.
→ The walls of ureter is made up of 3 layer.
  1. Innere mucosy layer
  2. Outer fibrous layer.
  3. Middle muscular layer.

URINARY BLADDER -

→ It is an inverted Pear Shaped Structure that acts as a collector of urine.
→ It lies in the Pelvic cavity.
→ The lower part of bladder is K/a base while upper part is called fundus.
→ It has three opening two for ureter & one for urethra.

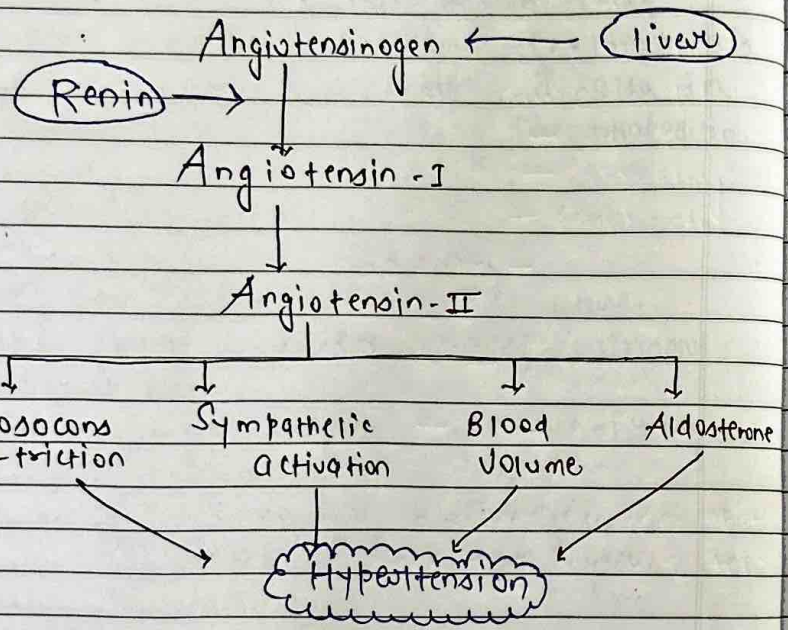
URETHRA -

→ It is a canal through which urine passes from bladder to outside.
→ It is different in males & females.

FUNCTION OF URINARY TRACT

ROLE OF 'RAS' IN KIDNEY

→ 'RAS' stand for Renin Angiotensin System.
→ Renin is a hormone secreted by Juxtaglomerular apparatus.
→ Angiotensinogen is a plasma protein released by liver.

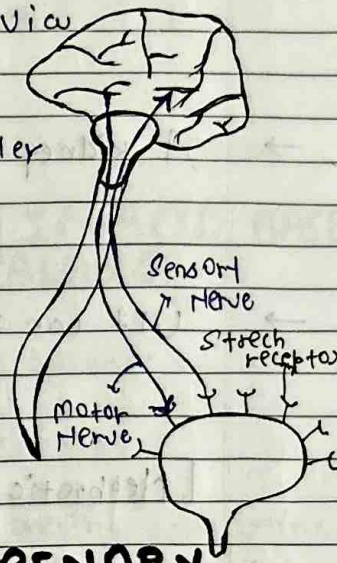


MICTURITION

→ It is also K/a "Urination."
→ It is the Process of Emptying of Urinary bladder.
→ It is the Process by which the Urinary-bladder empties when it becomes filled.

It involves several steps —

Filling of Urinary bladder
↓
Activation of Stretch receptor
↓
Send Signal to brain via Sensory Nerve
↓
Command receive by bladder via motor nerve
↓
Contraction of bladder muscle occur
↓
Emptying of Bladder.



DISORDER OF URINARY SYSTEM

1. Polycystic Kidney Disease.
2. Urinary Tract infection
3. Nephrolitic Syndrome
4. Urinary incontinence
5. Kidney Stone.

Polycystic Kidney Disease —

It is a genetic disorder in which Multiple fluid-filled cysts develop in the kidney, that cause enlarg & loss function over time.

Urinary Tract infection –

→ UTI are generally caused by harmful microorganism in Urinary Tract.

→ UTI are generally more common in females.

→ Bladder infection leads to –
- Pain with Urination
- blood in the Urine
- Increased Urge to Urinate.

→ A kidney infection may cause - back pain
- nausea
- vomiting
- fever etc.

→ UTI can be of two types –
① Upper UTI
② Lower UTI.

Nephrotic Syndrome –

→ Nephrotic Syndrom is a kidney disorder that cause your body to pass too much Protein in your urine.

→ It generally occur due to increased glomerular Permeability.

Urinary Incontinence –

→ It is a common Problem in which bladder control gets lost.

→ In this - The Urge of Urination gets so strong that you can't control without discharge.

Kidney Stone –

→ Kidney stone are hard deposition of mineral & salt that forms inside your kidney.

→ It can be occure due to-

① Drinking too little water.
② Obesity
③ Weight loss
④ Eating food with too much salt & Sugar.

ROLE OF KIDNEY IN ACID BASE BALANCE

→ The kidney control acid-base balance by

↓

excreting either acid or base

Excreting acidic urine remove acid from extracellular fluid.

Excreting basic urine removes base from extracellular fluid.

ENDOCRINE SYSTEM

→ Endocrine System is a group of ductless gland that regulates the body process by secreting Hormones.

→ They secretes hormones directly into the Blood Stream.

The endocrine system consist of number of endocrine glands as follows :-

1. Pituitary gland
2. Pineal gland
3. Thyroid gland
4. Parathymid gland
5. Thymus gland
6. Adrenal gland
7. Pancreatic Islet
8. Ovaries (female)
9. Testes (males)

HORMONES

→ Hormones are nothing but a type of chemical Messenger Produced by Endocrine glands.

→ They travels through the body to control and co-ordinate the body function.

Types of Hormones –

1. Steroid Hormone
2. Non-Steroid Hormone

Steroid Hormone	Non Steroid Hormone
1. Made from cholesterol	1. made from amino acids
2. fat Soluble / lipid soluble	2. water Soluble
3. Easily cross the Plasma membrane	3. Cannot cross easily the Plasma Membrane.
4. Example :- Estrogen, Testostosterone	4. Example :- Insulin, Adrenaline.

MECHANISM OF HORMONE ACTION

Hormones shows their action on target cell by binding on specific receptors present either on surface or inside of that cell.

Hormones mainly shows their action by following mechanism –

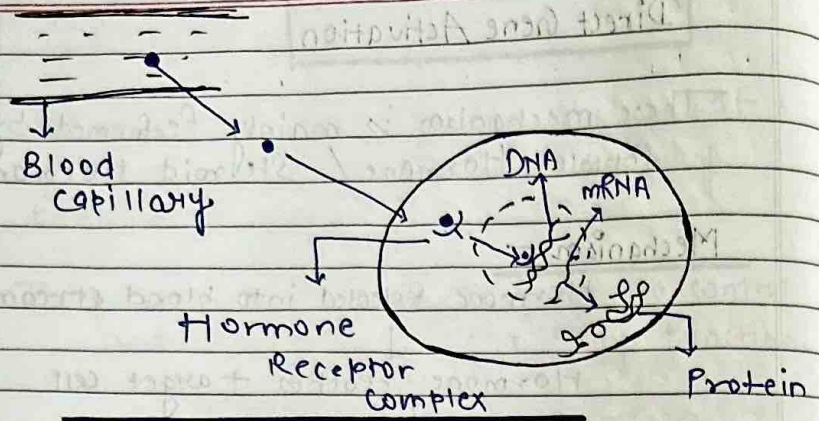
1. Direct gene Activation
2. Second Messenger Activation

Direct Gene Activation

These mechanism is mainly performed by lipid soluble Hormone / Steroid Hormone.

Mechanism –

Hormone Released into blood stream
↓
Hormone reaches target cell
↓
Hormone enter cell
↓
Binds with intracellular receptor
↓
Hormone receptor complex formed
↓
Complex enter nucleus
↓
Binds to DNA
↓
mRNA synthesis
↓
Protein Synthesis
↓
Final Response

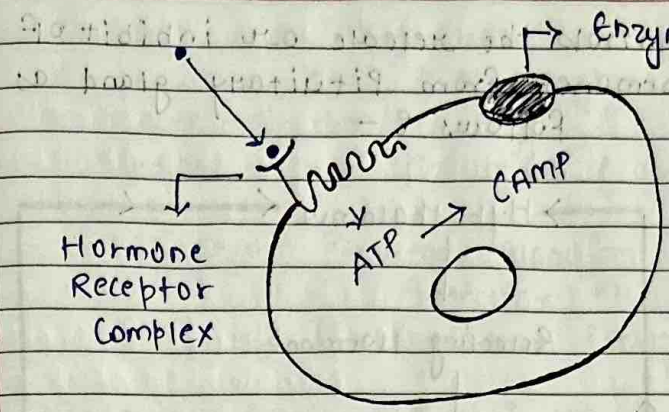


Second Messenger activation

These mechanism is mainly performed by water soluble Hormone / Non steroid Hormone.

Mechanism —

Receptor - Hormone Complex
↓
Enzyme Activation
↓
Conversion of ATP to cAMP
↓
cAmp (2° messenger)
↓
Biochemical Response



PITUITARY GLAND

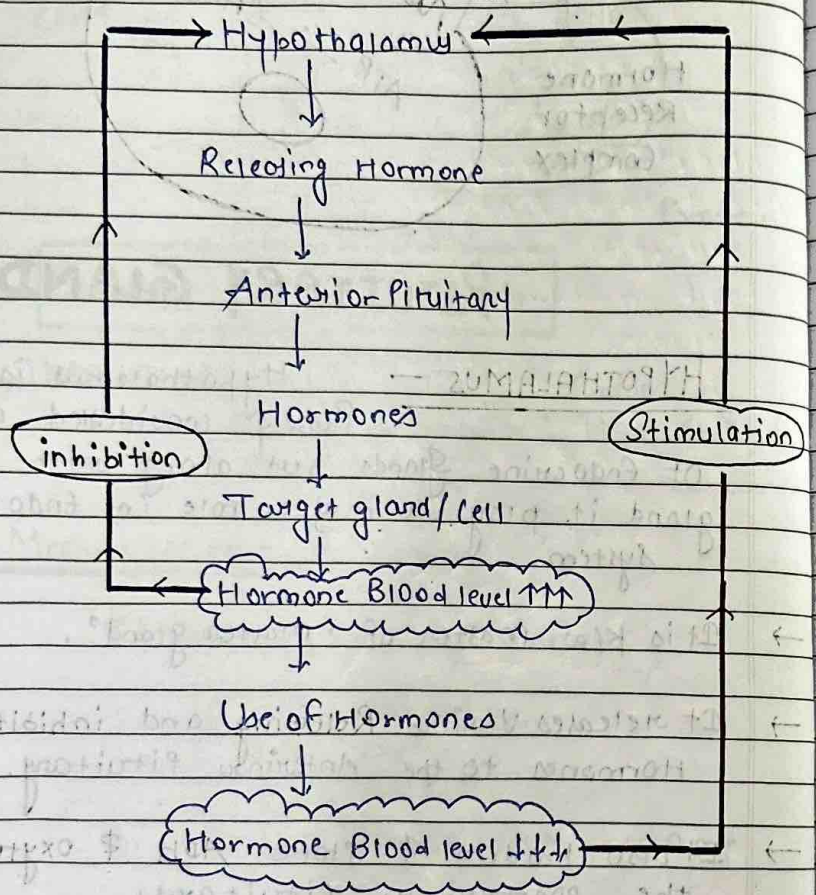
HYPOTHALAMUS — Hypothalamus is not purely considered as part of Endocrine glands but along with Pituitary gland it play a major role in Endocrine system.

→ It is k/a master of 'master gland'.

→ It releases various Releasing and inhibiting Hormones to the Anterior Pituitary.

→ It also produce & store ADH & oxytocin in the posterior pituitary.

It controls the release or inhibit of hormones from Pituitary gland as follows :-



PITUITARY GLAND -

→ Pituitary gland is very small gland also K/a hypophysis.

→ It is almost a Pea sized gland & its weight is about 500 mg.

→ It joints with hypothalamus through infundibulum

→ It is also K/a Master gland of our body as it control the activity & function of Various other endocrine glands.

Part of Pituitary gland :-

1. Anterior Pituitary
2. Posterior Pituitary

Anterior Pituitary & their Hormones with function :-

→ Anterior Pituitary is also K/a Adenohypophysis.

→ It can be further divided into two parts.

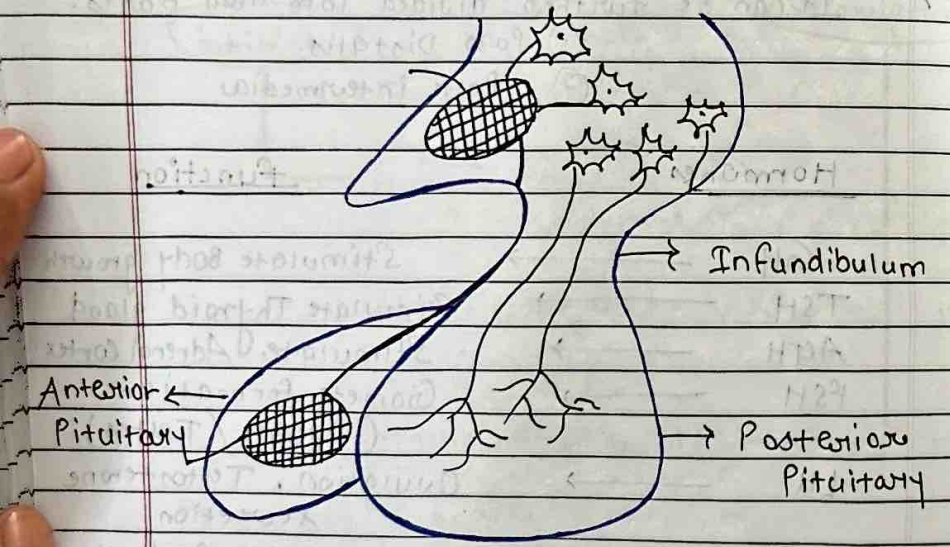
1. Pars Distalis
2. Pars intermedia

Hormones		function
GH	→	Stimulate Body growth
TSH	→	Stimulate Thyroid gland
ACTH	→	Stimulate Adrenal Cortex
FSH	→	Gamete formation (Ovaries / Testes)
LH	→	Ovulation, Testosterone secretion
Prolactin	→	Milk Production

Posterior Pituitary & their Hormones with function :-

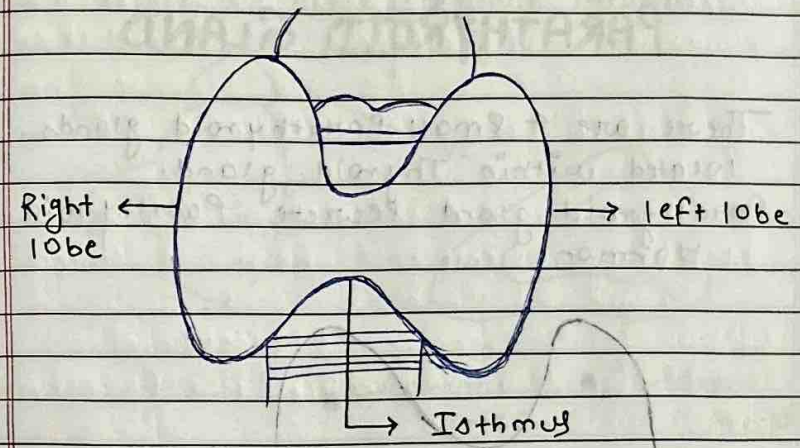
→ Posterior Pituitary is also K/a Neurohypophysis

Hormones	function
Oxytocin	Uterine Contraction (labour Pain) & milk ejection
ADH (Antidiuretic Hormone)	maintain Blood Pressure



THYROID GLAND

→ It is the largest endocrine gland in our body.
→ Its shape looks like butterfly.
→ It consist two lobes connected with Isthmus.
→ It Composed of hollow structure K/a 'follicles'
It secretes 2 Hormones :-
① Thyroid.
② Calcitonin.



Calcitonin :-
→ It acts on bone and kidney to reduce blood calcium level when increased.
→ It basically decreases blood calcium level.

Thyroid :-
→ There are mainly 2 types of thyroid Hormones.
① T_3
② T_4
→ Iodine is most essential for formation of Thyroid hormone.

→ The release of T_3 and T_4 is stimulated by TSH.

→ T_3 and T_4 are essential for normal growth & development especially skeleton and Nervous System.

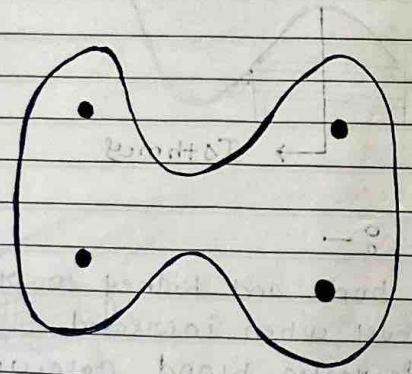
→ It also regulate menstrual cycle.

→ Thyroid Hormones can also affect mood and their imbalance lead to mood swing, anxiety and depression.

PARATHYROID GLAND

→ There are 4 small Parathyroid glands, located within Thyroid gland.

→ Parathyroid gland secrete Parathyroid Hormone.



Function of Parathormone :-

→ The Parathyroid hormone regulates or increased the blood calcium level, when it is low.

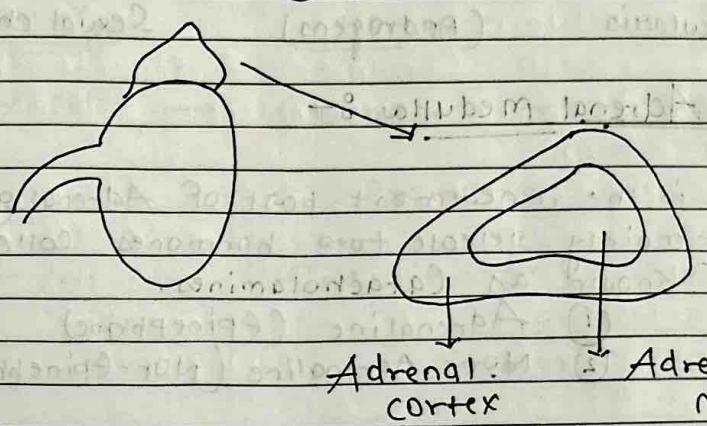
→ Parathormone and Calcitonin from thyroid gland act in complementary manner to maintain blood Calcium level in normal range.

ADRENAL GLAND

→ There are two adrenal glands in our body at top of both kidneys.

→ They are around 4cm long, 3cm thick & 4gram in weight.

→ They can be further subdivided into 2 parts-
1. Adrenal Cortex
2. Adrenal Medulla



Adrenal Cortex :-

→ It is the Outer part of Adrenal gland.

→ Adrenal Cortex Produces three groups of steroid Hormones collectively known Corticoids. The adrenal cortex has 3 layers :-

1. Zona Glomerulosa
2. Zona fasciculata
3. Zona reticularis

Layer	Hormone Produce	function
① Zona Glomerulosa	→ Mineralocorticoid (Aldosterone)	→ Control Salt and water
② Zona fasciculata	→ Glucocorticoids (cortisol)	→ Control metabolism & Stress.
③ Zona Reticularis	→ Sex hormones (Androgens)	→ Helps in Secondary Sexual character

Adrenal Medulla :-

→ It is the innermost part of Adrenal gland.
→ It mainly release two hormones collectively known as Catacholamines.
  (1) Adrenaline (Epinephrine)
  (2) Nor-Adrenaline (Nor-Epinephrine).

These hormones prepare the body for emergency Situation called fight or flight response.

function of Adrenal medulla —
- Increased heart rate
- Increased Blood Pressure.
- Pupil dilation
- Increase Breathing rate
- fight or flight response
- Bronchiodilation

PANCREATIC ISLETS

→ Pancreatic islets or Islets of langerhans are small group of endocrine cells present in the pancreas.

→ They secretes hormones that regulat blood glucose level.

Types of Cells and Hormones :-

Cell Type	Hormone	function
① α-cell	→ Glucagon	→ increase blood glucose level by Promoting Gluconeogenesis.
② β-Cell	→ Insulin	→ decrease blood glucose level by Promoting Glycogenesis
③ δ-Cell	→ Somatostatin	→ Inhibit both (Glucagon & insulin) Hormone

PINEAL GLAND

→ Pineal gland is considered to the smallest endocrine gland Present in the brain.

→ It Secrete the hormone Melatonin which control the sleep - wake Cycle.

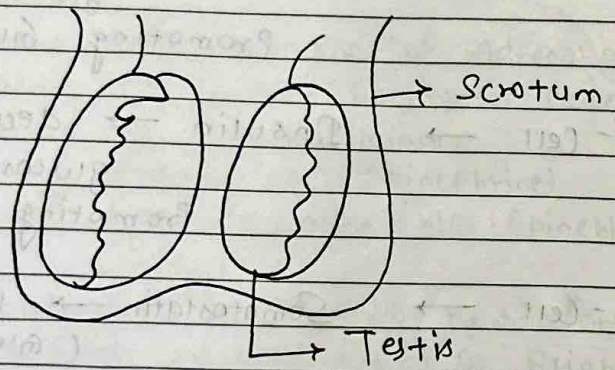
→ It is located between the two cerebral hemesphere of the brain.

function of Melatonin :-

→ Helps the body sleep at night.
→ Control day & night cycle.
→ Reduce stress & calm the body.
→ Influence reproductive Hormones.

TESTES

→ The testes are male reproductive organs present in pouch like structure called Scrotum.
→ They produce Sperms and secrete the male hormone testosterone.



function of Testosterone :-

Helps in development of male reproductive Organ.
→ Stimulates Sperm Production.
→ Cause secondary sexual characters :
- Deep voice.
- Beard and mowtache growth
- Hair on body
- Broad shoulders.

→ Increases muscle and bone growth.
→ maintain sexual desire (libido).
→ Helps in normal growth during puberty.

OVARIES

→ Ovaries are a pair of female reproductive Organs present on both side of uterus.
→ They produce ova (eggs) and female sex hormones like estrogen and Progesterone.

function of Estrogen :-

→ Development of female secondary sexual characters :
- Enlargement of breast
- Pimple
- Pelvic Girdle widening
- Growth of Pubic hair.

→ It helps to regulate menstrual cycle.
→ It helps a female to prepare for pregnancy.

· Function of Progesterone :-

→ It is also known as Pregnancy maintaining Hormone.

→ It prepares the uterus for Pregnancy by thickening its lining.

→ It support the growth of foetus during Pregnancy.

REPRODUCTIVE SYSTEM

FEMALE REPRODUCTIVE SYSTEM

External Genitalia	Internal Genitalia
→ labia majora	→ Vagina
→ labia minora	→ Cervix
→ Clitoris	→ Uterus
→ vestibular glands	→ fallopian tube
	→ Ovaries

External Genitalia — The external Genitalia organs are collectively k/a Vulva.

① Labia majora —

→ Also k/a Upper lip.

→ It is two thick, large folds of skin & fat that enclosed & protect other external organ.

→ They contain two Bartholin gland that help in lubrication during intercourse.

② Labia minora –

→ Also K/a inner lip.
→ It is two delicate skin folds located inside the labia majora.
→ It surrounded the Vaginal & Urethral opening.
→ Typically pink or reddish brown in color.

③ Clitoris –

→ Clitoris is a highly sensitive & erectile organ. anatomically to the Penis in male.
→ It play a crucial role in sexual stimulation & excitement in females.

④ Vestibular Glands –

→ It is the glands located near the Vaginal opening that Produce mucus to lubricate the area.

Internal Genitalia

① Vagina :–

→ Vagina is a short tubular structure.
→ It receive Penis during the intercourse.
→ It also serves as a birth canal during childbirth.

② Uterus –

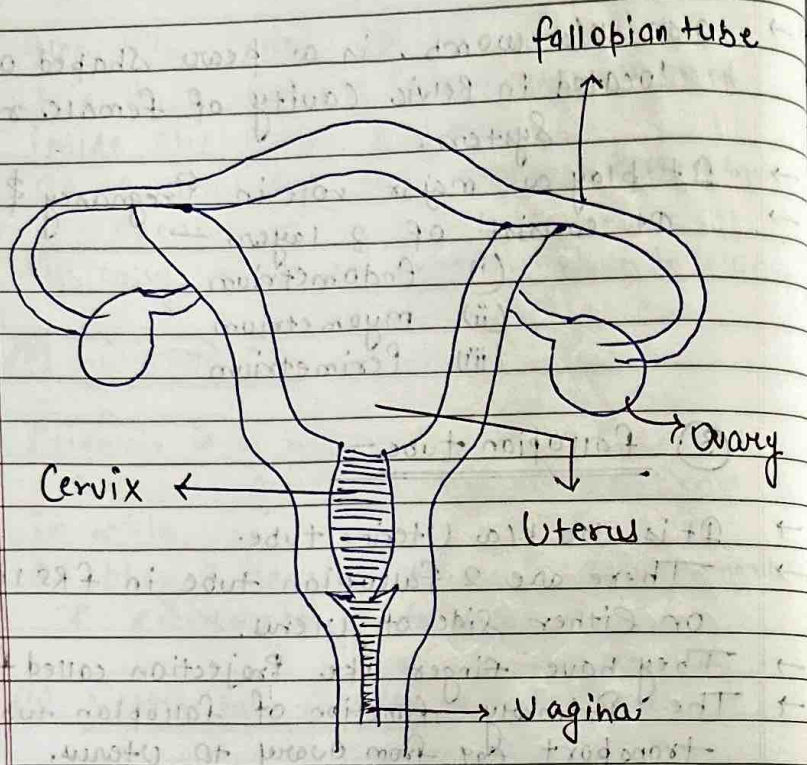
→ also K/a womb, is a pear shaped organ located in Pelvic Cavity of female reproductive System.
→ It play a major role in Pregnancy & childbirth
→ It consist of 3 layer –
  (i) Endometrium
  (ii) myometrium
  (iii) Perimetrium

③ fallopian tube –

→ It is also K/a Uterine tube.
→ There are 2 fallopian tube in FRS located on either side of Uterus.
→ They have finger like Projection called fimbrae.
→ The Primary function of fallopian tube is to transport egg from ovary to Uterus.

④ Ovaries –

→ These are two small, Ovoi glands that produce egg (ovum) & Hormones.
→ They are located either side of uterus.



function of female Reproductive System:-

1. Ovaries make female eggs (ova)
2. It produce hormone like estrogen & Progesterone which control growth & Menstruation
3. The uterus help the baby grow.
4. The vagina help in delivery of baby.
5. Breast make milk for feeding the baby.

MALE REPRODUCTIVE SYSTEM

External Genital Organ
- → Penis
- → Scrotum

Internal Genital Organ
- → Testes
- → Epididymis
- → Vas deferens
- → Accessory glands & ducts
  - Seminal Vesicle
  - Prostate Gland
  - Cowper's Gland
  - Ejaculatory duct

External Genital Organ

① **Penis** —

Penis is a complex Organ in males with both reproductive & Urinary function. It consist of following parts :-

- **Shaft** : It is long Cylindrical Part of Penis.
- **Glans Penis** : It is enlarge tip of Penis.
- **Urethra** : It is tube like structure that transport both Urine & Semen.
- **Corpora Cavernosa** : They fill with blood during Sexual excitement & help the penis become hard
- **Corpora Spongiosum** : It helps to protect the urethra and also fill with blood during erection.

② Scrotum –

→ Scrotum is sac like structure that hangs outside the body & holds the testes.
→ It maintain the temperature of 34°C that requires for sperm formation.
→ It provide a protective environment for testicles.

Internal Genital Organs

① Testes –

→ Testes are Primary male reproductive Organ located in Scrotum.
→ They are present in pair.
→ They are responsible for both sperm production & hormone secretion.
→ Spermatogenesis require 2-2.5°C less temperature than body temp. thats why testis lies outside of body.

② Epididymis –

→ Epididymis is a small coiled tube attached to each testis.
→ It stores the sperms.
→ It helps sperms to mature.
→ It carries sperms from testis to vas deference.

③ Vas Deference –

→ It is a crucial component of male reproductive Organ.
→ It carries sperms from Epididymis to the urethra during ejaculation.

ⓐ Seminal Vesicle –

→ Seminal vesicles are two small sacs found in male body.
→ Seminal vesicle joints with vas deference to form Ejaculatory duct.
→ They make a fluid that help in the formation of Semen.

ⓑ Prostate Gland –

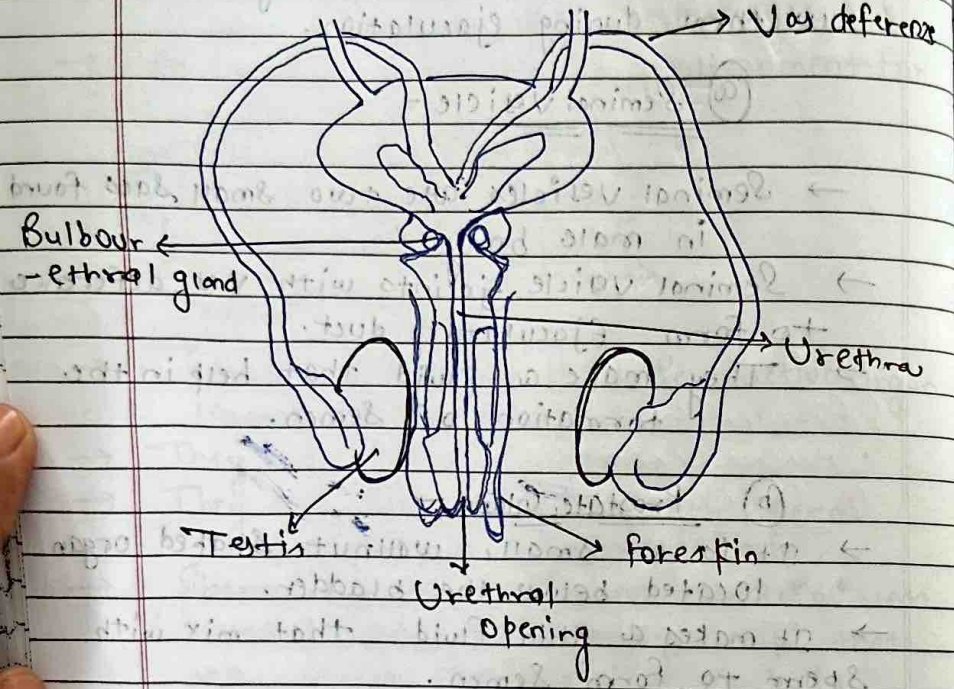
→ It is a small, walnut shaped organ located below the bladder.
→ It makes a thin fluid that mix with sperm to form Semen.

ⓒ Cowper's gland –

→ It is also k/a Bulbourethral gland, are two small glands located just below Prostate gland in males.
→ It helps to lubricate the Urethra & tip of Penis which can reduce friction during sexual intercourse.

④ Ejaculatory duct

→ It transport Sperm from Vas deference and Seminal fluid from Seminal Vesicle into Urethra.



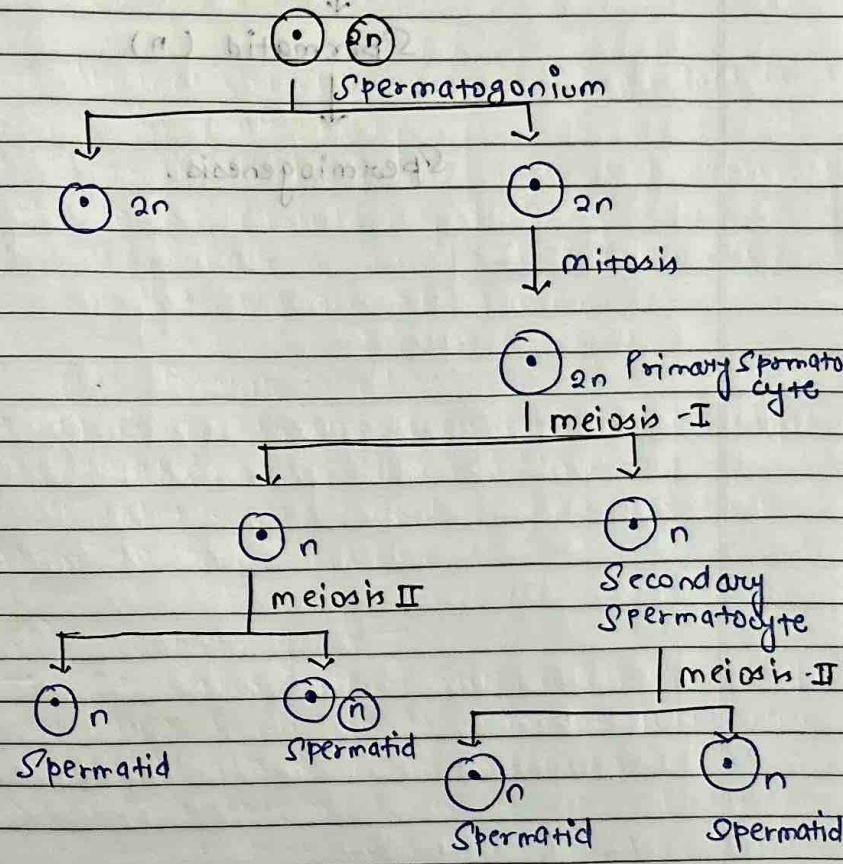
* function of male Reproductive System :-

1. It Produce Sperms for reproduction.
2. Sperms are kept safe until they are need.
3. Tubes & organs help Sperm moves out during ejaculation.
4. It produce hormones like testosterone which help in male body growth.
5. It helps Sperm reach to the female body for fertilization.

SPERMATOGENESIS

→ Spermatogenesis is the process of making Sperms in the testes.

→ Spermatogenesis requires 3°C below normal body temperature.



Spermatogonium (2n)

↓ mitosis

Primary Spermatocyte (2n)

↓ meiosis I

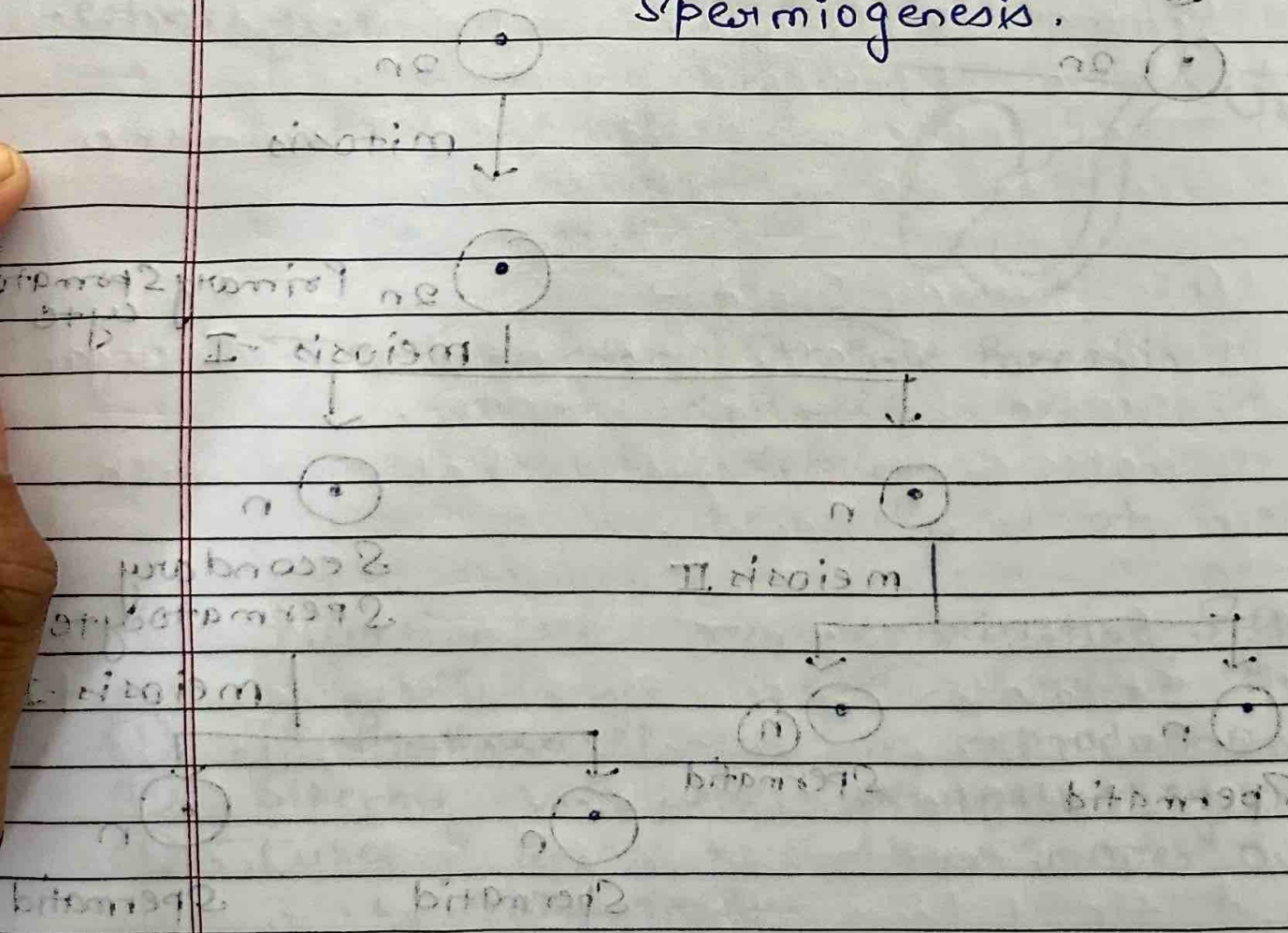
Secondary Spermatocyte (n)

↓ meiosis II

Spermatid (n)

↓

Spermiogenesis.



CARDIOVASCULAR SYSTEM

→ Heart pumps the blood into blood vessels & blood vessels circulate the blood throughout the whole body.

→ Cardiovascular System + Lymphatic System

↓

Circulatory System.

HEART

→ Heart is a hollow muscular organ that pumps the blood throught the blood vessels.

Shape : Cone shaped

Dimension : 12 cm × 9 cm × 6 cm

Location : mediastinum (Space between lungs)

Weight : • about 250 g in females
• about 300 g in males

LAYERS OF HEART

Three layers :

(1) Pericardium : Uppermost layer.
(2) myocardium : Middle layer.
(3) Endocardium : Innermost layer.

CHAMBER OF THE HEART

The heart mainly consist of 4 chambers:

1. Right atrium.
2. left Atrium.
3. Right ventricle.
4. left ventricle.

Right atrium :—

→ It is present on the upper right side of the heart.
→ It receives deoxygenated blood from the body.

Right Ventricle :—

→ It is present below the right atrium
→ It receives deoxygenated blood from the right atrium.

Left Atrium :—

→ It is present on the upper left side of heart.
→ It receives oxygenated blood from lungs.

Left Ventricle :—

→ It is present below the left atrium.
→ It receives Oxygenated blood from left atrium.

VALVES OF HEART

The heart consist of 4 types of Valves:

1. Tricuspid valve
2. Bicuspid valve
3. Pulmonary valve
4. Aortic valve.

Tricuspid Valve :-

→ It is also k/a Right atrioventricular valve
→ It separates the right atrium from right ventricle.
→ It Prevent backflow of blood into atrium.

Bicuspid Valve :-

→ It is also k/a left atrioventricular valve.
→ It separate the left atrium from left ventricle.
→ It prevent backflow of blood into atrium.

Pulmonary valve :-

→ It is also k/a Semilunar valve.
→ It separate the right ventricle from pulmonary artery.
→ It prevent backflow of blood into pulmonary artery.

Aortic valve :-

→ It is also k/a Semilunar valve.
→ It separate the aorta from left ventricle.
→ It prevents backflow of blood into Aorta.

BLOOD VESSELS

Blood vessels are of mainly 3 types:

1. Arteries
2. Veins
3. Capillaries.

1. Arteries:

→ It is the blood vessels that carry blood away from the heart & supply to whole body.

→ They generally carry Oxygenated blood (except pulmonary artery).

→ They are composed of 3 layers:

- Tunica Intima
- Tunica media
- Tunica Externa

→ According to their shape and size they can be further divided into two classes.

AORTA: Largest artery of the body.

ARTERIOLES: Smaller sub branches of arteries.

2. Veins:

→ These are the blood vessels that carry blood from body to heart.

→ They generally carry deoxygenated blood (except Pulmonary vein).

→ They are also composed of 3 layers:

- Tunica Intima
- Tunica media
- Tunica Externa

→ According to their shape and size they can also further divided into two classes.

VENA CAVA: largest vein of the body.

VENULES: Smaller sub branches of vein.

3. Capillaries:

→ These are the smallest blood vessels that forms when arterioles and venules further subdivided into smallest branches.

→ These are the smallest vessels that connect arterioles to venules.

BLOOD CIRCULATION

(1) Systemic Circulation.
(2) Pulmonary circulation.

