UNIT-I

✱ Nervous System :-

→ Nervous System Consist of a network of Specialised Cells neurons (nerve Cells), which Coordinate all the body functions and transmit Signals blw different parts of body.

→ It receives information from the Senses, processes tham and initiates the ~~metabolic proce~~ reactions.

Example :- moving the muscles on feeling pain, pulling back the hand on touching a hot plate etc.

→ Around 100 billion neurons Constitute the nervous System.

→ Functional unit of nervous System is called neurons. is made up of a cell body and a number of short and long extensions.

→ The shorter extension (dendrites) they receive Signals from the other neurons, and pass them to the cell body.

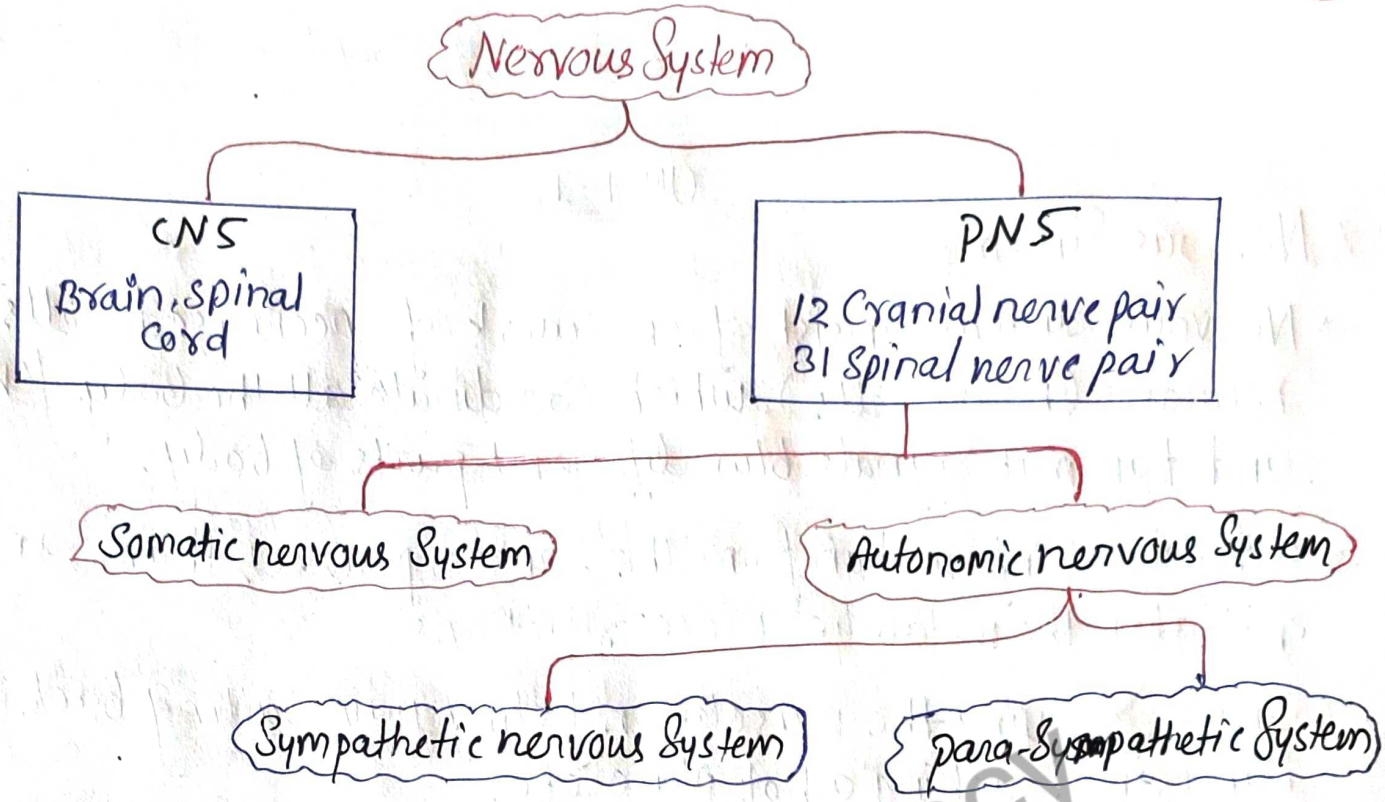
→ The longer extention (axon) further passes the Signals received by dendrites.

Organisation of Nervous System :-

- The ~~nerv~~ whole nervous System is divided into two Subdivision:

① Central nervous System (CNS)

② Peripheral nervous System (PNS)



:- Organisation of the nervous System can be depicted as follows!

① CNS :- This is the most important division which is in-charge of Controlling the entire nervous System.
→ It includes the brain and Spinal Cord.

② PNS :- It primary Comprises of all the nerves Connecting the brain and Spinal Cord to the Sensory receptor, muscles, and glands.

(A) Somatic Nervous System (Voluntary Nervous System) : This divisi's transmits imples from the CNS to Skeletal musels.

(B) Autonomic Nervous System :- This division transmits impules from the CNS to the involuntary organs and Smooth museels of the body.

→ The autonomic nervous System is further divided Pnto two types.

(i) Sympathetic Nervous System (SNS) :-

It is responsible for stimulation or speeding up of activity by the use of energy. by employing nor-epinephrine as a Neurotransmitter.

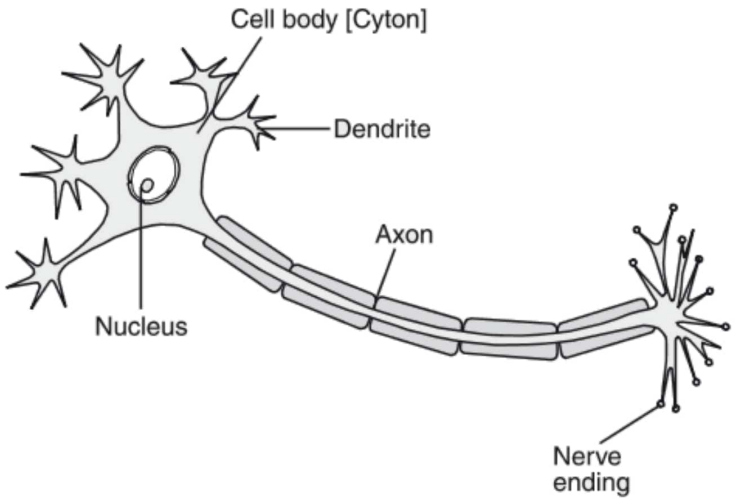
(ii) paraSympathetic Nervous System (PSNS) :-

It is responsible for Stimulation or speeding up of other activities of the body like digestion, urination, and defection.

- PSNS also Slow down or restores other body activities, by employing acetylcholine as a neurotransmitter.

Neuron :-

- Neurons are the fundamental units of the brain and nervous System, the Cells responsible for receiving Sensory input from the external world. for sending Motor Commands to our muscles, and for transforming and relaying the electrical Signals at every step in between.



- Neurons Consist of three main parts:
  1. Cell body
  2. Dendrites
  3. Axon

① **Cell body** :- The body of nerve cell is Consists of nucleus and ribosomes. thus possessing all the essential process for protein Synthesis.

② **Dendrites** :- These are cellular extensions with Several branches and receive inputs from other cell.

③ **Axon** :- These are long, filamentous structures attached to the cell body.

Neuroglia :-

→ Neuroglia Cells are the Supporting Cells of the CNS.
→ The Number of neuroglia Cell is about 10 times more than that of nerve Cells.
→ Neuroglial Cells make up the half of the total volume of brain.
→ There are six type of neuroglia.
→ Four types — ① Osteocytes
② oligodendrocytes
③ Microglia
④ ependymal Cell
→ These all are found in CNS.
→ Remaining two type :- ① Neurolemmocites or Schwann Cell and these Cell exist in PNS.

✱ Classification of nerve fiber :-

① on the basis of Conducting velocity and Diameter Relation :-

(i) **Group A nerve fiber :** Group A nerve fiber are heavily myelinated nerve fiber that are further subdivided in four types.
Ex. Alpha (α), beta (Aβ), Gamma (Aγ), delta (Aδ).

(ii) **Group B nerve fiber :** Group B nerve fiber are less myelinated than group A, but more myelinated than group C nerve fibers.

(iii) **Group C nerve fibers :** Group C nerve fibers are unmyelinated fiber that usually have a smaller diameter and low Conduction velocity.

② on the basis of presence of myelin Sheath :-

① **Myelinated nerve fibers :** Myelinated nerve fibers are Covered by a layer of insulating sheet called myelin sheath.
→ In the PNS, the myelin sheath is formed by the Schwann Cells whereas in the Central Nervous System, the myelin sheaths are formed by the oligodendrocytes

② **Non Myelinated Nerve fibers :-**
Nonmyelinated nerve fibers are Covered by Cytoplasm of schwann Cells but myelin is not secreted in such Cases.
– They are Commonly found in the autonomic nervous System.

③ on the basis Functional Relation to CNS :-

① **Afferent Nerve fibers :** The peripheral nerve fibers receive impulses from different receptor of the body and transmit

them to CNS, these type of fibers are Called afferent nerve fiber.

② Efferent Nerve fibers :-

The fibers that Carry nerve Impulses away from the Central nerveous System to other effector organs Such as glands and muscles are Called efferent nerve fibres.

Properties of nerve fiber :-

Nerve fibers prosses the following Characteristic properties.

1. Excitability :-

The electrical activity of the nerve fiber undergoes a change from in resting State when a Stimulus is applied. The respond to physical, chemical, thermal and electrical Stimuli by initiating nerve implses.

2. Conductivity :-

Nerve fibers underg decrementless Conduction in which they Convey implses along the axon length without changing the amplitude of the action potential.

3. Refractory period :-

It is the duration between an effective Stimulus and the Second applied Stimulus. During this period, the nerve fibres donot produce any response for the Second Stimulus.

4. All or None Low :-

As per this Low, when a tissue is Stimulated with threshold or more than threshold Strength, the amplitude of response remains the Same; but when a stimulus of less than threshold Strength is applied, no response is produced.

5. **Release of chemical Regulators:**
Nerve fibers are responsible for the release of some particular Chemical regulators (eg Acetylcholine, adrenaline, etc).

6. **Constant Number –**
Number of nerve fiber reinvasion Content as they do not have the ability to undergo cell division.

Electrophysiology of Neurons:–

Intro :–

→ Two most important functions of a nerve cell are irritability and Conductivity.

→ Irritability is the property of neuron by which it responds to a Stimulus and change it into a impulse.

→ Conductivity is the property of a neuron by which it transmits impulse to muscles, glands, or other neurons.

→ Impulse transmission is an electrochemical event

→ Neurone are excitable cells.

→ A normal excitable Cell exhibits a membrane potential, indicating,

→ voltage difference across the membrane.

→ Generation of action potential indicates that a cell is transmitting an impulse.

→ Transmission of the impulse is due to movements of ions across the nerve cell membrane.

→ The principal ions involved in the movement are Sodium (Na^+) and Potassium (K^+).

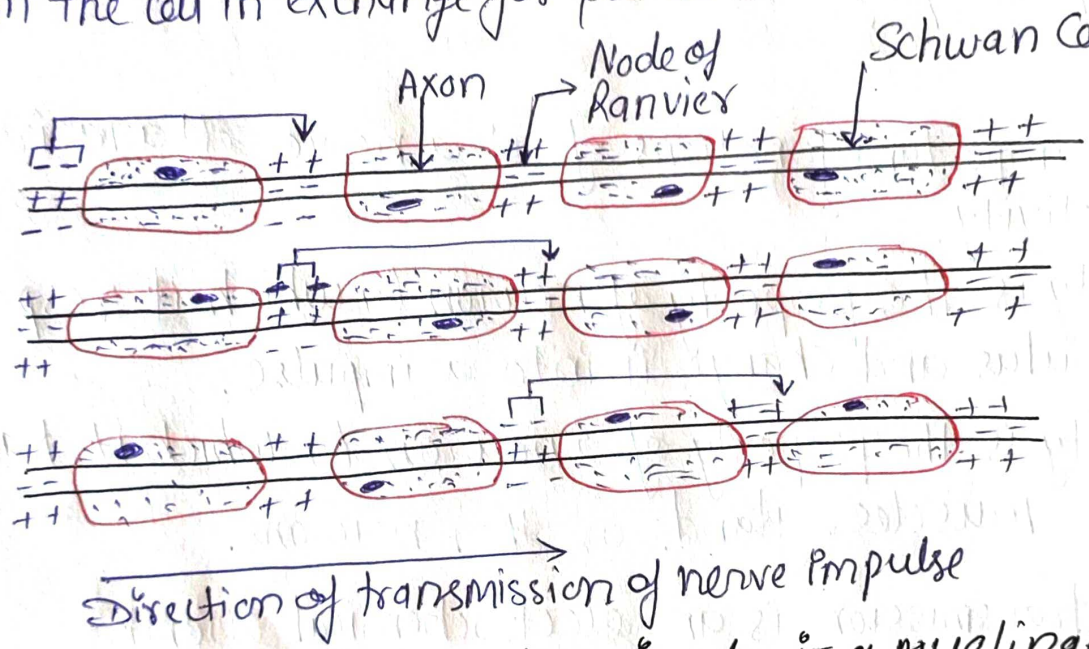
→ On stimulation, Na^+ ions enter into ~~Concentration~~ neurons from the external fluid, K ions come outwards resting into action Potential.

→ Depolarization is very rapid, occuring in a few milliseconds.

→ It passes from the point of Stimulation in one direction only.

→ Following depolarization is termed as refractory period during which restimulation of Cell is not possible.

→ During this Stage action of the Sodium pump expels Sodium from the cell in exchange for potassium.



∴ Saltatory Conduction of an impulse in a myelinated nerve fiber.

✱ Nerve Impulse :-

Neurons are electrically excitable. They Communicate with each other via the following two types of electrical Signals.

(i) Graded potential : These are used for short-distance Communication

(iii) Action potential :-
These are used for both short-distance Communication.

- Action potential within a muscle fiber is ~~termed~~ termed Muscle action potential.
- While action potential within a neurone is termed nerve action potential (nerve impulse).

→ Graded and action potentials occurs because the membranes of neurons Contain many different kinds of ~~ion~~ ion channels that open or close in response to specific stimuli.

Ion channels :-

- on the neural membrane, ion channels are present which are selectively permeable to different ions.

→ Due to the presence of ion channek, neural membrane developes a potential (Membrane potential) which helps in the Conduction of impulse.

→ only some specific ions move across the plasma membrane through open ion channels.

→ Type of ion channel.

① Leakage channel
② Voltage-Gated channel
③ Ligand-Gated Channel

Resting membrane potential (RMP) :-

The electrical potential difference across the resting plasma membrane of excitable cells is called

★ **Receptor :-** A receptor is a protein molecule usually found embedded within the plasma membrane, surface of a cell that receives chemical signals from outside the cell and when such chemical signals bind to a receptor, they cause some form of cellular / tissue response.

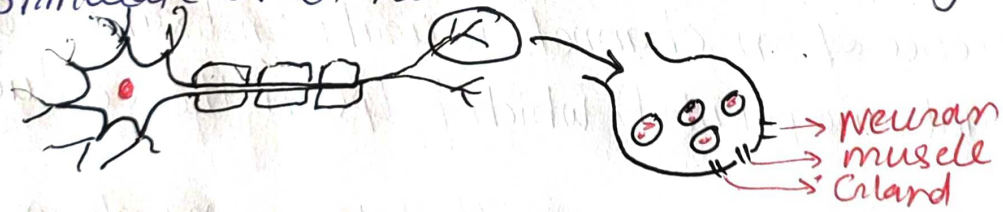
★ **Synapse :-**

Synapse, also called neuronal junction, the site of transmission of electric nerve impules between two nerve cells (neurons) or between a neuron and a gland or muscle cell (effector).

→ A synaptic connection between a neuron and a muscle cell is called a neuromuscular junction.

★ **Neurotransmitters :-**

Neurotransmitters are also called chemical transmitter or chemical messenger are released by neurons (nerve cells) to stimulate other neurons or muscle or gland cell



→ Neurotransmitter may be either excitatory or inhibitory

① **Excitatory neurotransmitter :-**

- It is the chemical substances which is responsible for the conduction of impulse from presynaptic neurons to to post synaptic neurons.

② **Inhibitory neurotransmitter** :-

It is the Chemical Substance which Inhibits the Conduction of impulse from the presynaptic neuron to the post Synaptic neuron.

#Example of neurotransmitter :-

① **Adrenaline** :-

→ Adrenaline is primary hormone released by the adrenal gland, but Some neurons may Secrete it as neurotransmitter.
→ It increase heart rate and blood flow.
→ It is produce during stressfull or exciting Situation.

② **Acetocholine** :-

- It involved in thought, Learning & memory within the brain.
- Activates muscle Contraction in the body.

③ **Dopamine** :-

- It is primary responsible for feeling of pleasures but it is also involved in movement & motivation
- people tend to repeat behaviour that leads to addiction

(4) **Serotonin** :-

- In the brain, it acts as Inhibitory neurotransmitter that regulates mood, fears, felling of relaxation, mental focus.
- In the Gut, it act as hormonal messenger that regulates Digestion, nutrition absorption.

Central nervous System (CNS):-

Intro:-

Central nervous System (CNS) Consists of the brain (in the Cranial Cavity) and the Spinal Cord (in the vertebral Column)

→ It is Safely Contained within the Skull and vertebral Canal of the Spine.

→ The neural tube inside the embryo develops into a nervous System.

→ The neural tube has three expansions at its head end, which arise because of unequal growth rates.

→ These expansions take the form of forebrain, midbrain, and hindbrain.

① **Forebrain**: This develops into:
- (i) Cerebral hemispheres
- (ii) Basal ganglia
- (iii) Thalamus
- (iv) Hypothalamus.

② **Midbrain**: The parts of the midbrain are
- (i) Tectum,
- (ii) Tegmentum
- (iii) Cerebral peduncles

③ **Hindbrain**: This develops into.
- (i) Cerebellum
- (ii) pons,
- (iii) Medulla

The rest of the neural tube becomes the Spinal Cord.

Meninges of brain :-

- Meninges are protective Covering of brain & Spinal Cords (CNS).
- Meninges Contains three Layers.
  (i) Outer Layer Called Dura mater.
  (ii) Middle layer Called Arachnoid mater.
  (iii) Inner most Layer Called pia mater.

(i) Dura mater :-

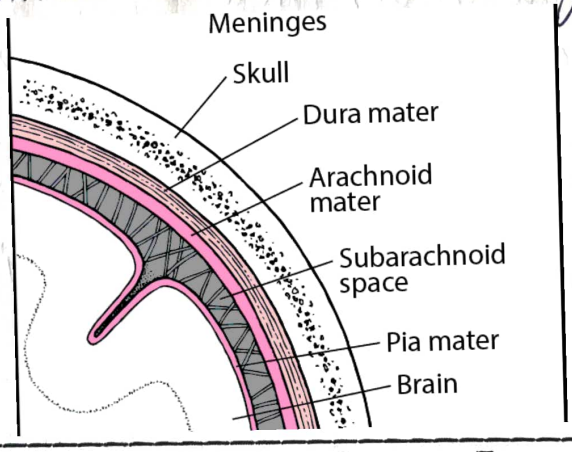
- It Consists of two Layers of fibrous tissue.
- The outer layer is on the inner Surface of skull bones and the Inner layer provides protective Covering for the brain.

(ii) Arachnoids mater :-

- This is a layer of fibrous tissue.
- It Contains Collagen helps in Shock absorption.
- The Subarachnoid Space (inside the arachnoid) Contains blood vessels & Cerebro Spinal fluid (CSF).

(iii) Pia mater :-

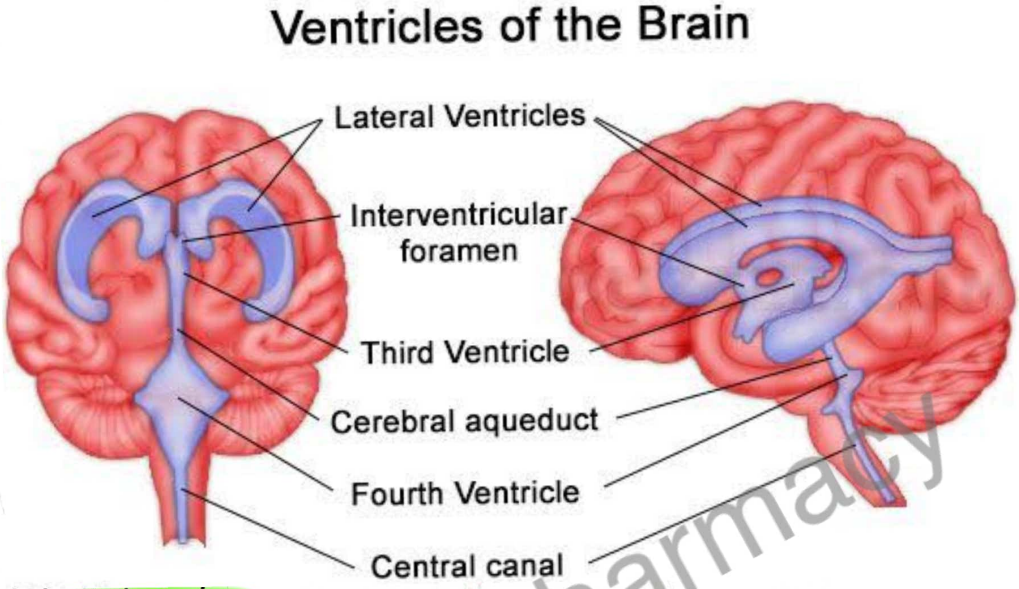
- The pia mater tightly Covers the brain & Spinal Cord.
- It is a fine Connective tissue Containing many minute blood vessels.



Ventricles of the brain :-

Within the brains there are four irregular-shaped Cavities Called as ventricles of the brain. they are -

① Right and Left Lateral ventricles
② Third ventricle
③ Fourth ventricle.



① The Lateral Ventricles :-

- These Cavities lie within the Cerebral hemispheres, one on each side of the median plane just below Corpus Callosum.
- They are Connected to the third ventricle by Interventricular foramina.

② Third ventricle :-

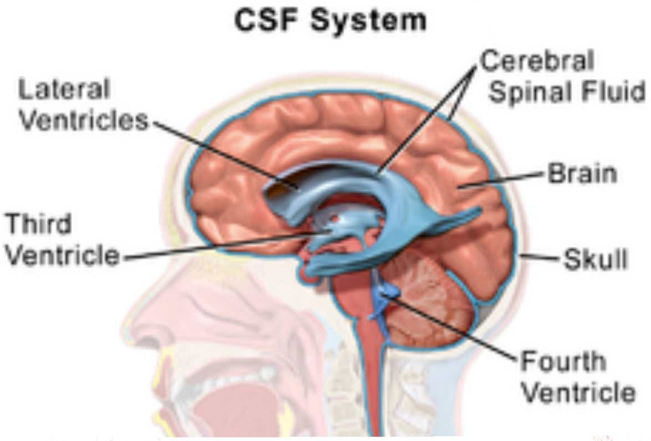
- It is a Cavity Situated below the Lateral ventricles between the two parts of the thalamus.
- It Connected to fourth ventricle by a canal, the Cerebral aqueduct or aqueduct of the midbrain.

③ Fourth ventricle :-

It is Cavity Situated below and behind the third ventricle, between the Cerebellum and pons varolli.

Cerebrospinal fluid (CSF)

- The fluid Secreted into each ventricle of the brain by Choroid plexuses.
- The Composition of CSF is – water
  - mineral Salts
  - Glucose
  - plasma proteins
  - few Leucocytes



The CSF Continuously Secretes at rate of 0.5 ml/min i.e 720 ml/day

The CSF pressure measured by using a ventricle tube attach to lumber puncture needle.

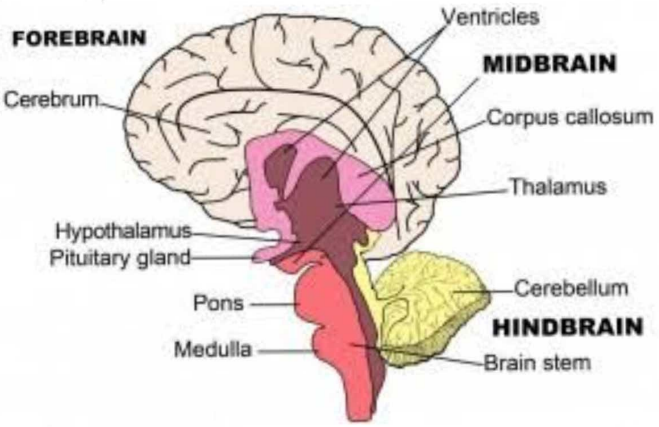
Functions of CSF :-

⇒ It Supports & protect the brain & Spinal Cord.
⇒ It acts as Shock absorber blw brain & the Skull.
⇒ It keeps the brain & Spinal Cord moist.
⇒ It also provides nutrients and oxygen.

BRAIN :-

- The brain Lies within the Cranial Cavity. It Constitutes about 1/5th of the body weight. It is Composed of the following parts :-

① Cerebrum or forebrain
② Midbrain } brainstem
③ Pons varolli }
④ Medulla oblongata
⑤ Cerebellum or hindbrain

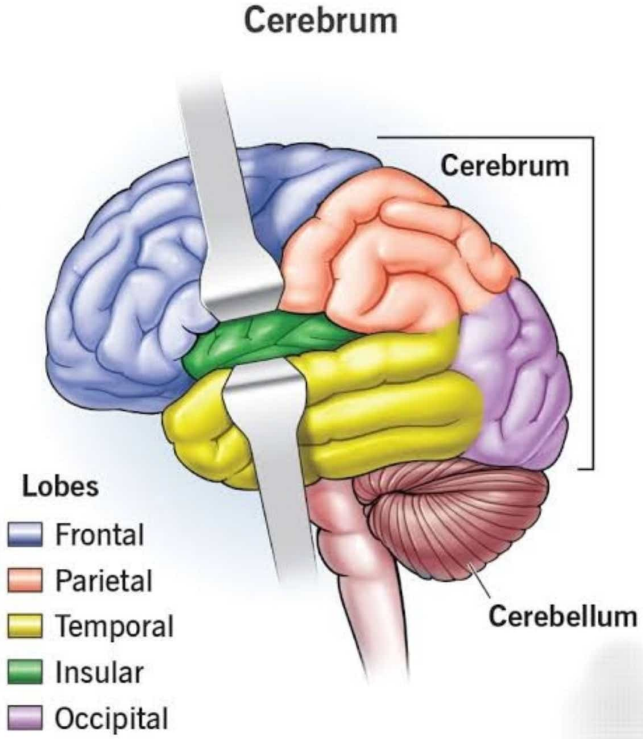


① Cerebrum :-

→ It is the Largest part of the brain
→ It is Consists of two Cerebral hemispheres, which develop from the embryonic forebrain.
→ These hemispheres have an outer Convoluted Layer of gray matter – the Cerebral Cortex – and an inner layer of White matter.
– The two halves are linked by the Carpus Callosum –
– Each hemisphere of Cerebrum is Subdivided into four lobes, visible from outside. They are.

① Frontal
② parietal
③ occipital
④ Temporal Lobes

– The Cerebrum is integrating Centre for.
– memory
– Learning.
– emotions
– To plan and organise
– To feel the touch Sensation.



② Brain Stem:-

- Brainstem is the bottom, stalklike portion of your brain.
- It Connects your brain to your Spinal Cord.
- your brainstem sends message to the rest of your body to regulate balance, breathing, heart rate and more.

→ It is Composed of three Sections in descending order.

① Midbrain
② pons,
③ medulla oblongata.

① midbrain:-

The midbrain is the ~~most~~ topmost part of the brainstem, the Connection Central between the brain and the Spinal Cord.

- There are three main parts of the mid brain -
  - Colliculi, tegmentem and cerebral peduncles.

② pons:-

It is Situated in front of the Cerebellum, below the midbrain and above the medulla oblongata.

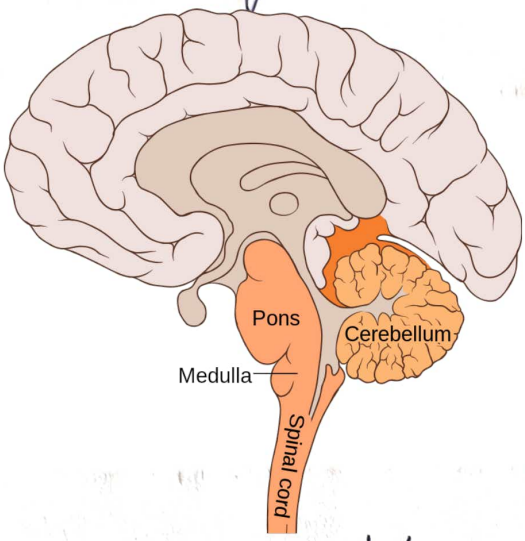
→ It Coordinates facial movements, hearing and balance

③ medulla oblongata:-

- ~~The~~ It is the Connection blw the brainstem and the Spinal Cord, Carring inultiple important functional Centers.
- It is Comprised of the Cardiovascular - respiratory regulation System, descending motor tracts, ascending Sensory tract, and origin of Cranial nerves IX, X, XI and XII.

(3) Cerebellum:-

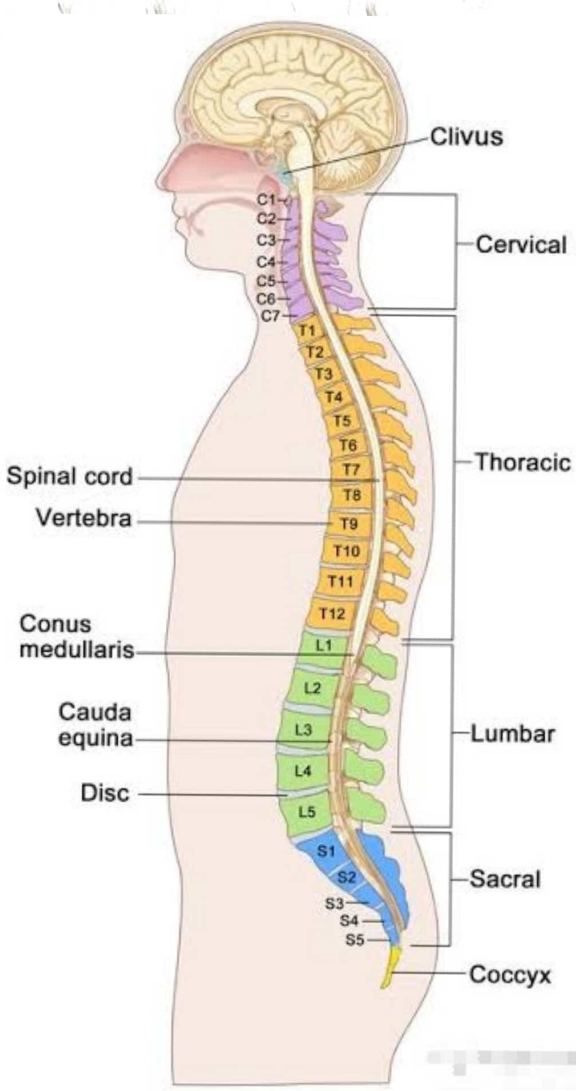
- It is situated behind the pons varolli and immediately below the posterior portion of cerebrum occupying the posterior cranial fosse.



- It has two hemispheres, separated by narrow median strip called as vermis.
- On the surface of the cerebellum lies grey matter, while the white matter lies deep inside.
- The cerebellum has got the following functions.
  - It is concerned with the co-ordination of voluntary muscular movement, posture and balance.
  - It controls and co-ordinates the movement of various groups of muscles ensuring smooth, even, precise action.
  - It co-ordinates activities associated with the maintenance of the balance and equilibrium of the body.

☆ Spinal Cord :-

- It is the elongated and almost cylindrical part extending from brain just below Medulla oblongata.
- It is Suspended in the vertebral canal and is Surrounded by meninges and cerebrospinal fluid
- Spinal Cord forms the pathway for Sensory input to the brain and motor output from the brain.
- A total of 31 pairs of spinal nerves arise from the Spinal Cord. Spinal cord and Spinal nerve help in the maintenance of homeostatis by providing quick reflexive ~~rep~~ respones to many Stimuli.



Functions :-

① Receives afferent fibers from Sensory receptors of the trunk and Limbs.
② Control movement of the trunk and Limbs.
③ provide autonomic innervation for most of the viscera.
④ Responsible for many loop reflexes.
⑤ It Conveys afferent information to higher Centers and mediate their Controlling influence over spinal mechnisms.

Spinal tracts :-

→ Sensory and motor nerve fibers make up most of the nerves of the PNS.

→ The Sensory nerve fibers Convey efferent impulses from the Sensory end organs to the brain, while the motor nerve fibers Convey efferent impulse from the brain to the effector organs. through the Spinal Cord
Ex. Skeletal muscles, Smooth muscles, and glands.

- spinal tracts may be Classified into:

(i) Sensory Tracts : These tract are also known as ascending or afferent nerve tract. They are responsible for Conduction of nerve impules and gland.

(ii) Motor Tract :- These tracts are also known as descending or efferent nerve tract. They are responsible for Conduction of nerve impulses from the brain towards the effector organs.

Functions

Afferent Nerves

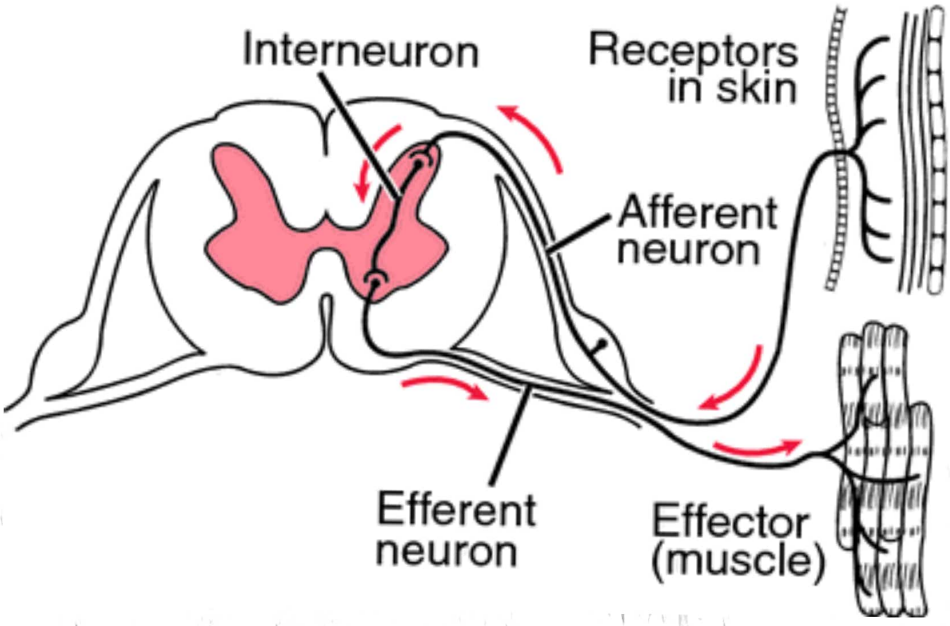
① Sensory Nerves
② Receive Information
③ Transmit Sensory information gathered from the skin, muscles and joint to the CNS

Efferent Nerves

① Motor nerve
② Send information on
③ Carries information from the CNS out to the muscles and glands.

☆ Reflex Activity :-

- Normally the body activity are controlled by the CNS (brain and Spinal Cord) as a result of Conscious (voluntary) responses.
- But in an emergency Condition the body needs quick and immediate action.
- In Such Conditions the response becomes unconcious (involuntary) i.e not according to our will.
- Such response which are of involuntary nature are known as reflexes or reflex action.
- The reflexes initiated by brain are Called Cranial reflexes and those initiated by Spinal Cord are Called Spinal reflexes.



- Each reflex is produced by the flow of nerve impulse along a specific pathway. The specific pathway of impulses in a reflex actions is called reflex arc.

- The reflex are Consists of.

1. A receptor organ: A sensory Cell or Sensory organ receiving the Stimulus.
2. A sensory (afferent) neuron: It receives impulses from the Sense organ and transmits to CNS.
3. An intermediate neuron (Connector neuron). It Connects the Sensory and motor neuron.
4. A motor neuron (efferent neuron): It Conducts the impulse from the CNS to effector organ.
5. An effector organ: It is a muscle or gland which responds to the impulse.