



Central Nervous System

Lecture 1: Introduction to Neuroanatomy

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Nervous System

- * It is a complex system which monitors the changes in the external & internal environments & starts dealing with them.
- * It is formed of highly specialized nerve cells called the neurons which can receive stimuli from the receptors scattered all over the body, deal with them & finally send the proper impulses to the effectors (muscles or glands).

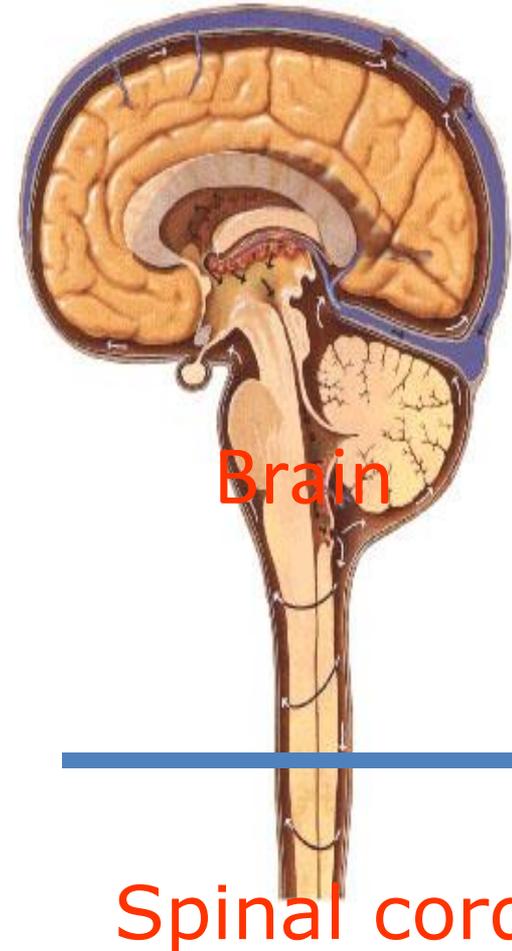
Divisions of the nervous system

- 1. Central nervous system (C.N.S.)**
- 2. Peripheral nervous system (P.N.S.)**
- 3. Autonomic nervous system (A.N.S.)**

I. CENTRAL NERVOUS SYSTEM

C.N.S.

- It is the part of the nervous system which is **protected** by bones & bathed in the cerebrospinal fluid (C.S.F.).
- It **can't regenerate** if injured.
- It includes:
 - 1.The **brain** → protected by the skull.
 - 2.The **spinal cord** → protected by the vertebral column.



II. PERIPHERAL NERVOUS SYSTEM

P.N.S.

- It includes :

1. 12 pairs of cranial nerves; emerging from brain.

2. 31 pairs of spinal nerves ; emerging from spinal cord.

3. Associated ganglia.

III. AUTONOMIC NERVOUS SYSTEM

A.N.S.

- It is responsible for the involuntary control of many structures in the body such as smooth muscles, heart & glands.
- It is formed of 2 main parts :
 1. sympathetic system.
 2. parasympathetic system.
- It is distributed partly through C.N.S. & partly through P.N.S.

Structure of Nervous Tissue

- It is formed of 2 types of cells :

1. Neurons : The neuron is the anatomical, embryological & functional unit of the nervous tissue. It is capable of the transmission of nerve impulses.

2. Neuroglia cells : They help in nutrition, support & protection of the neurons. They are unable for the transmission of nerve impulses.

The Neuron (Nerve Cell)

- It is formed of :

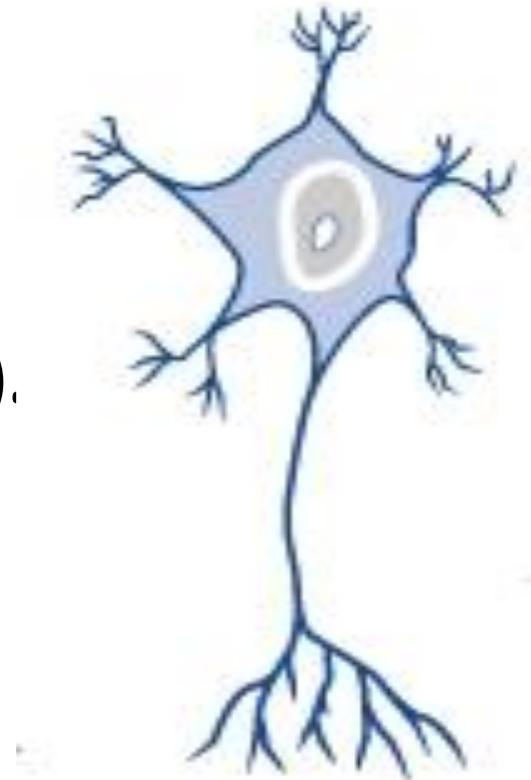
1. Cell body : contains the nucleus & cell organelles.

2. Processes :

a. axon (nerve fiber) :

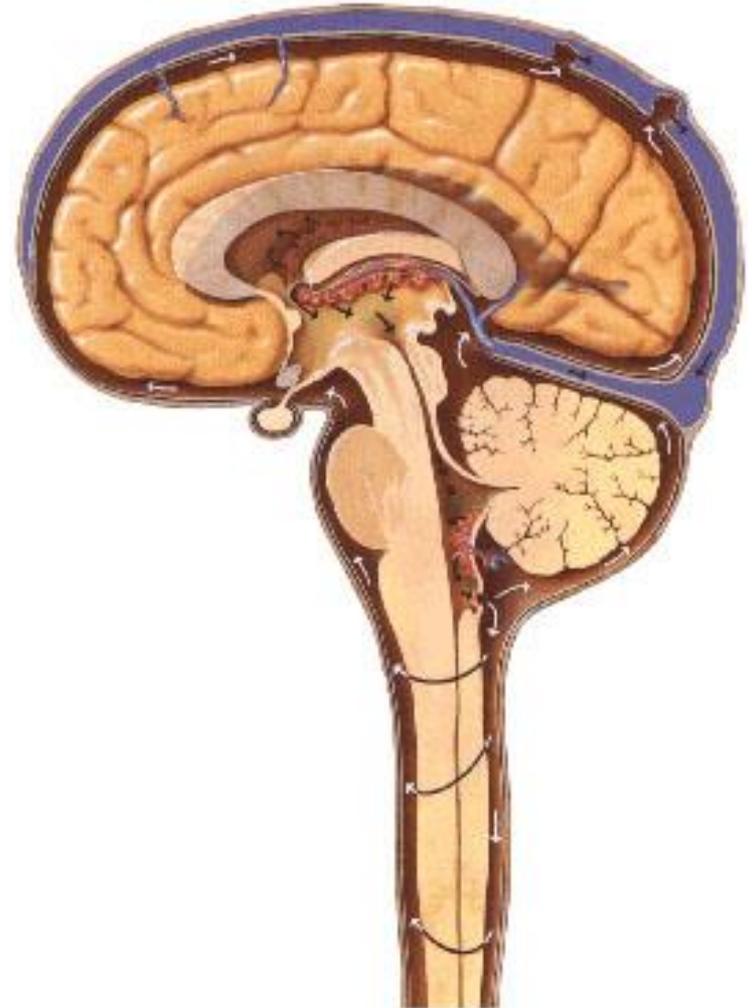
A single long process which carries nerve impulse away from cell body (conducting outputs).

b. Dendrites : short multiple processes which carry nerve impulses towards cell body (receive inputs).

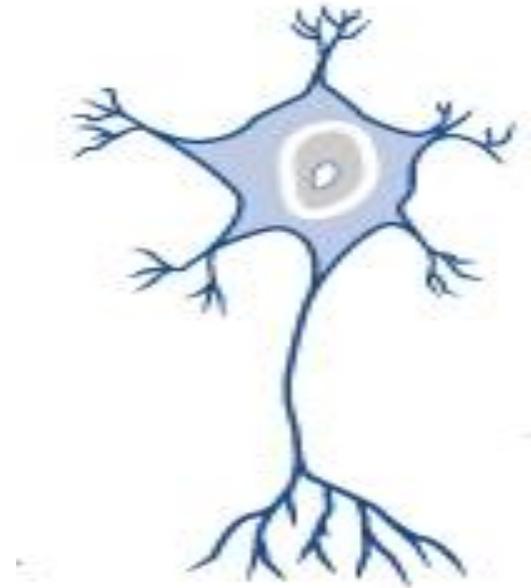
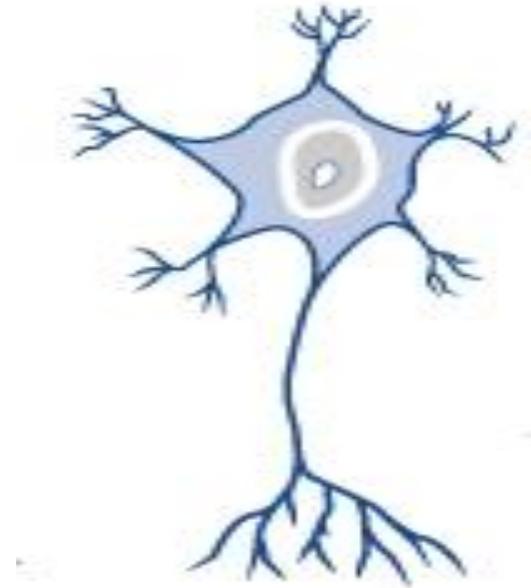


Important Definitions

- 1. Nucleus** : a group of cell bodies in CNS. Cells have the same function.
- 2. Ganglion** : a group of cell bodies in PNS.
- 3. Tract (fasiculus)** : a group of nerve fibers in CNS. They have the same origin, termination & function.
- 4. Nerve** : a group of nerve fibers in PNS.



5. Synapse : it is the site of contact between the axon of one neuron & the dendrites of another neuron. It is also the where a nerve impulse passes from one neuron to another neuron.



- 6. Pathway:** A chain of successive tracts having the same function (e.g. carrying pain sensation).
- 7. Lemniscus:** A collection of ascending fibers in the brain stem.
- 8. Commissure:** A band of white or grey matter connecting the right & left sides of the CNS across the midline.
- 9. Decussation:** A point at which an ascending or descending tract crosses the midline.
- 10. Afferent:** Input i.e., going towards a certain structure.
- 11. Efferent:** Output i.e., going away from a certain structure.

12. Meninges : These are the 3 membranes which cover the brain & spinal cord. These are from outside inwards;

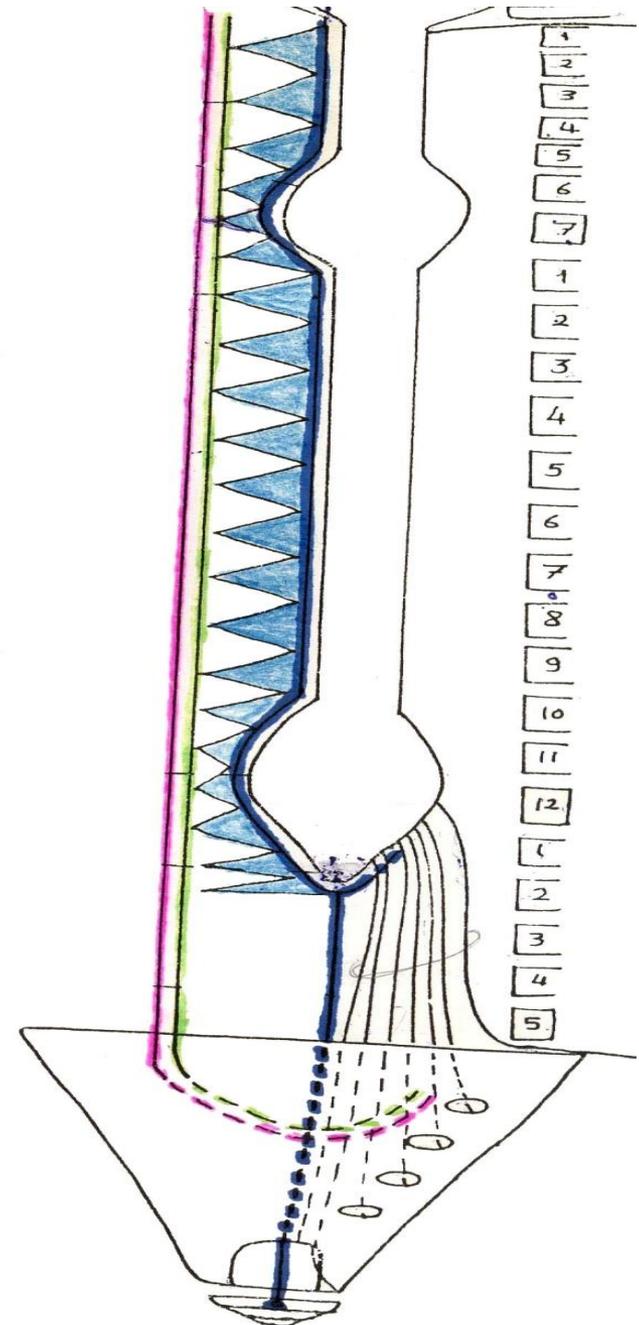
a. dura matter.

b. arachnoid matter.

c. pia matter.

* Between pia & arachnoid matter lies **subarachnoid space** which contains **cerebro-spinal fluid (CSF)**.

* Between dura & arachnoid matter lies **subdural space**.



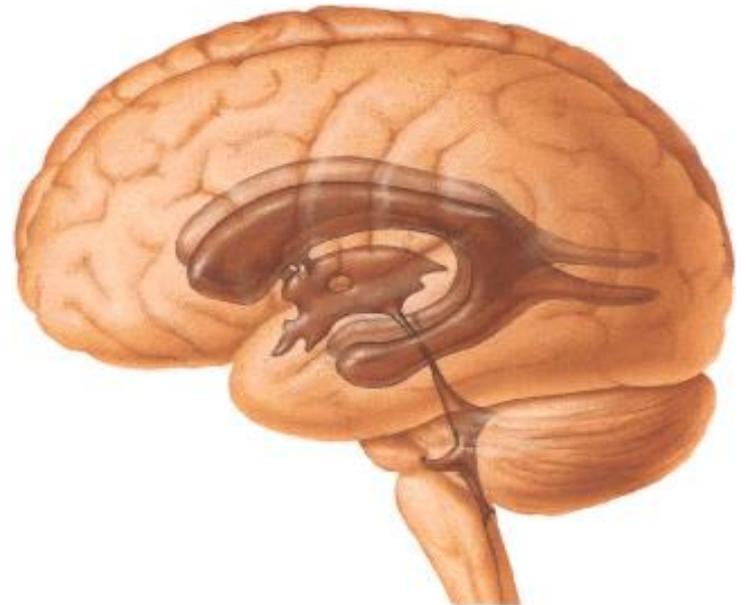
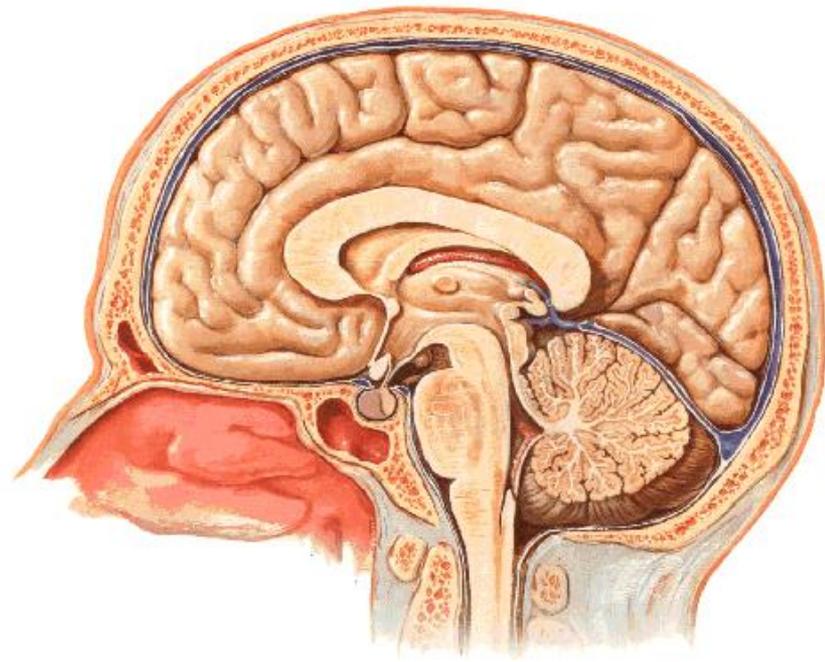
BRAIN

- The brain is formed of :

1. Cerebrum → formed of 2 cerebral hemispheres with diencephalon (interbrain) in between.

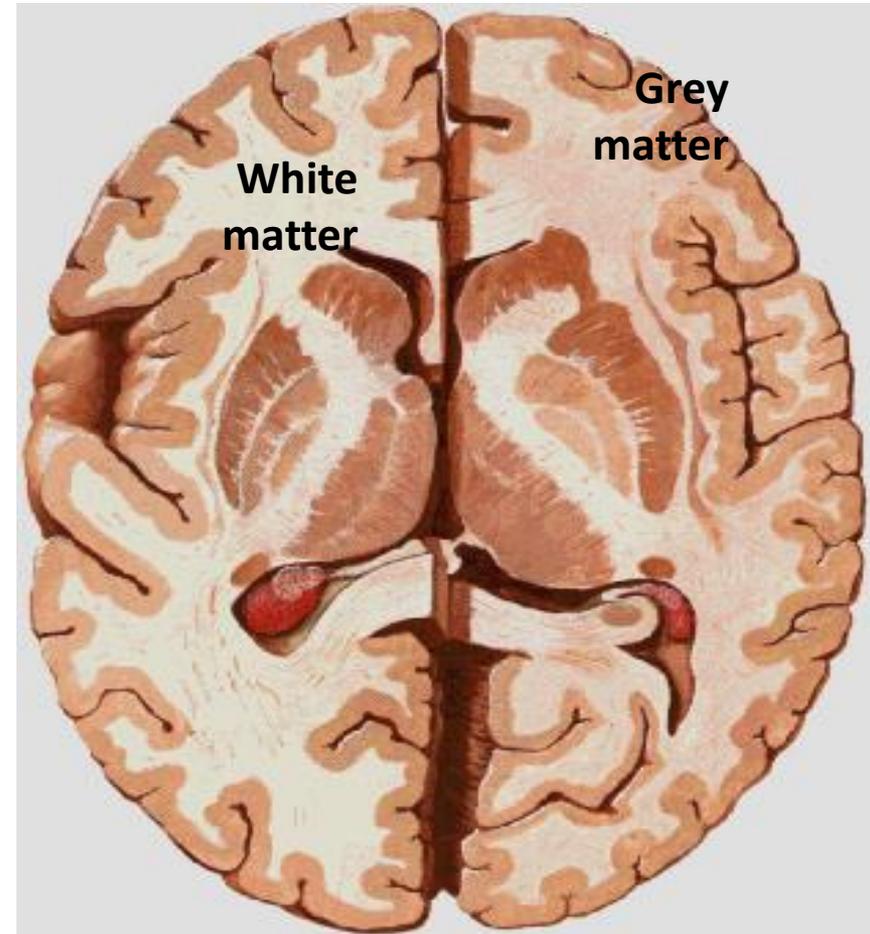
2. Brain stem: Which is formed of : midbrain, pons & medulla oblongata; from above downwards.

3. Cerebellum.

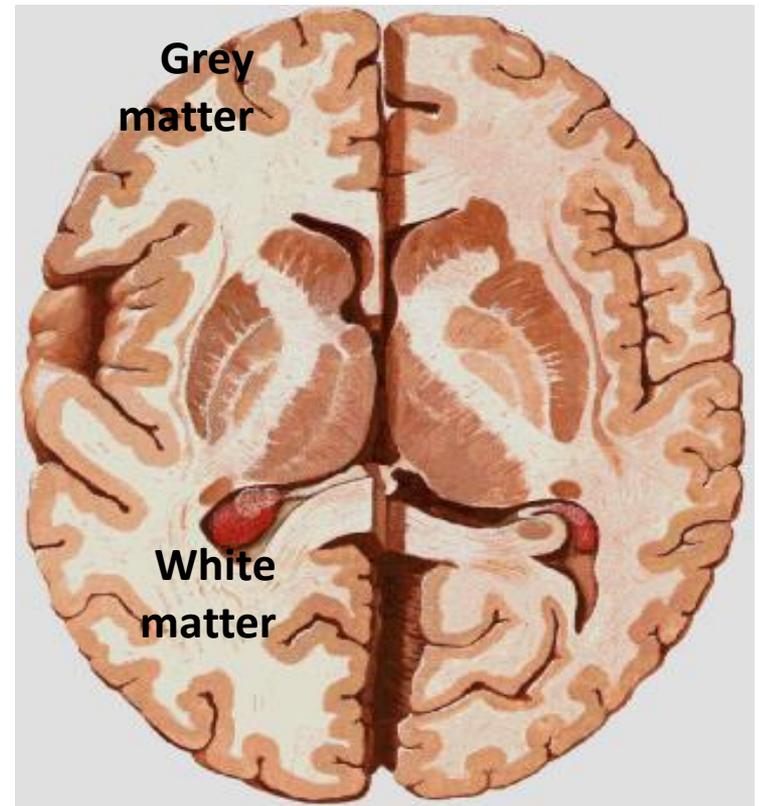


* In cross section, the brain shows:

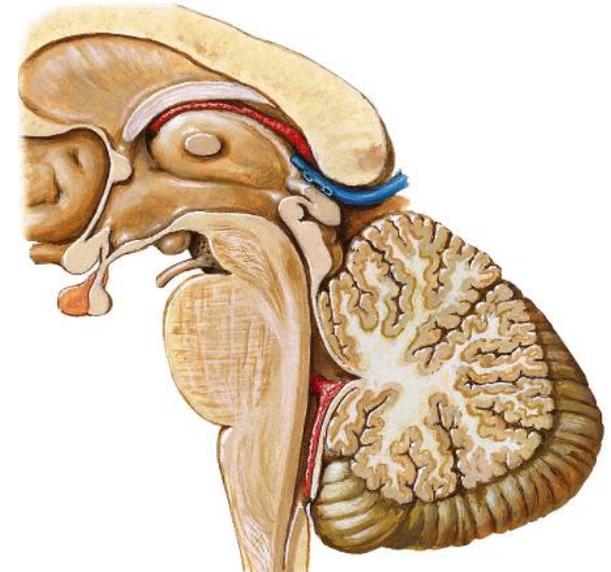
1. Outer layer of **grey matter** called cerebral cortex. These are dark areas which contain cell bodies.
2. Inner core of **white matter**. These are light areas which contain nerve fibers (axons). The fibers run inside the CNS as bundles, tracts or fasciculi.



- * In the brain stem, the grey matter collects into nuclei embedded in the white matter.

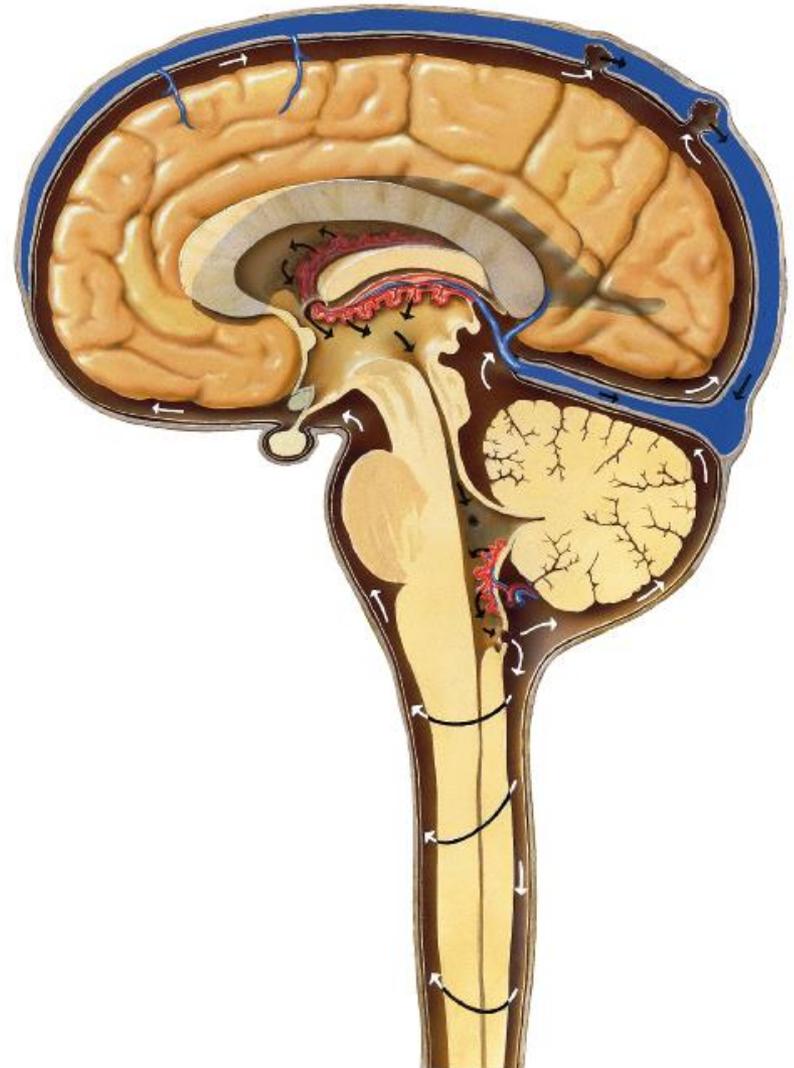


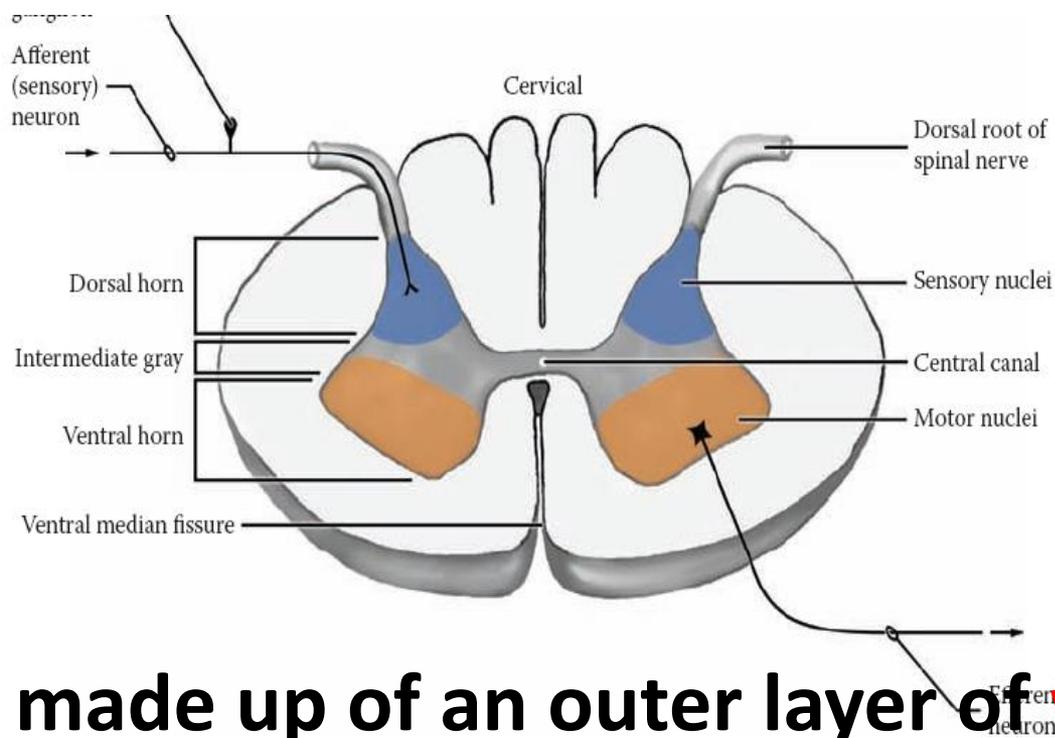
- * In the cerebral hemispheres and the cerebellum, part of the grey matter collects into deep nuclei and another part spreads on the surface forming the cortex.



Spinal Cord

- * It is the downward continuation of the medulla oblongata.
- * It has a narrow cavity called the central canal.
- * It is covered with the 3 meninges like the brain.





* The SC is made up of an outer layer of **white matter**. It contains:

1. **Ascending fibers (sensory tracts)** that carry sensations to the brain.
2. **Descending tracts (motor tracts)** that carry motor orders from the brain.

* The inner layer of SC
is the grey matter which

is H-shaped.

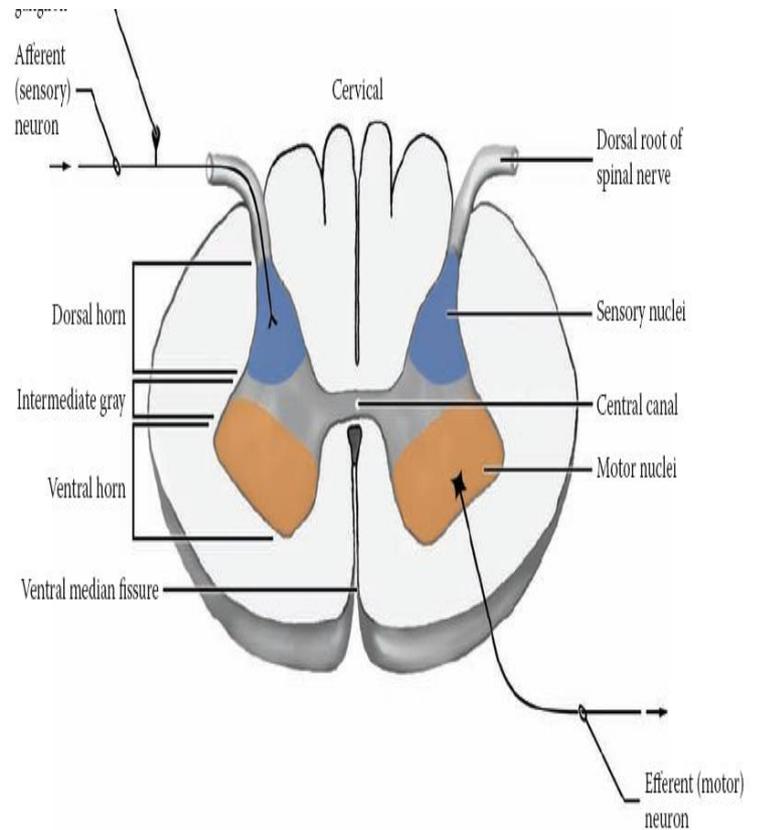
1. The 2 anterior limbs

→ **anterior horns.**

2. The 2 posterior limbs

→ **posterior horns.**

3. The horizontal connecting region → **grey commissure** through which runs the central canal.



Physiological Classification of Nervous System

1. Somatic nervous system: which is voluntary and includes a motor system and a sensory system.
2. Autonomic (visceral): nervous system which is involuntary and includes a sympathetic system and a parasympathetic system.

Embryological Classification of Nervous System

*The neural tube gives the spinal cord and three brain vesicles):

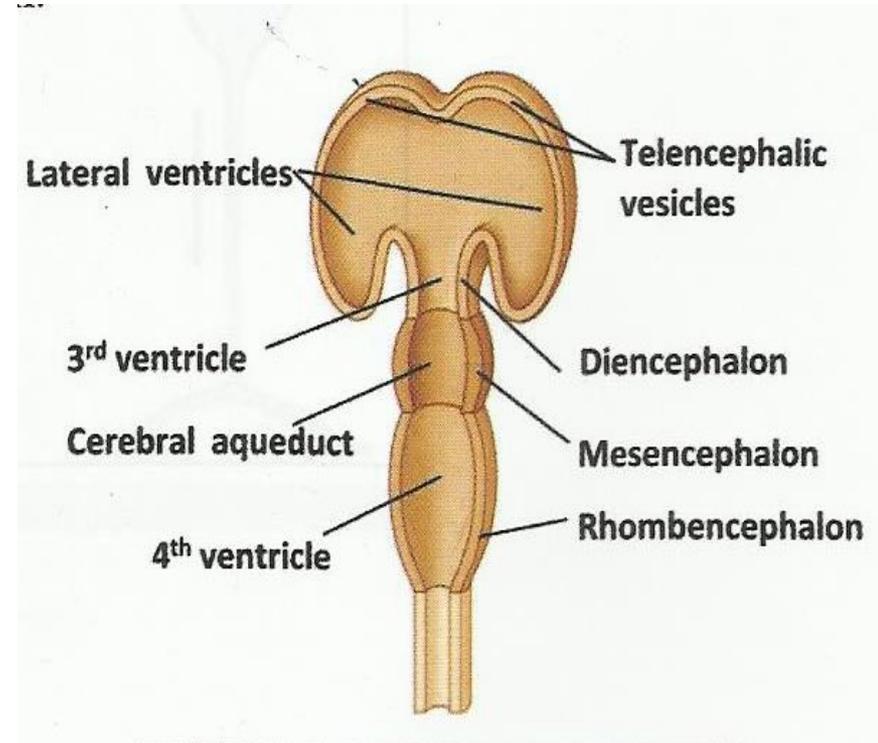
1. Forebrain (prosencephalon):

which gives:

- i. a median **diencephalon** (its cavity is the 3rd ventricle).
- ii. 2 **telencephalons** or cerebral hemispheres (each contains a cavity → the lateral ventricle).

2. Midbrain (mesencephalon): its cavity is the cerebral aqueduct of Sylvius.

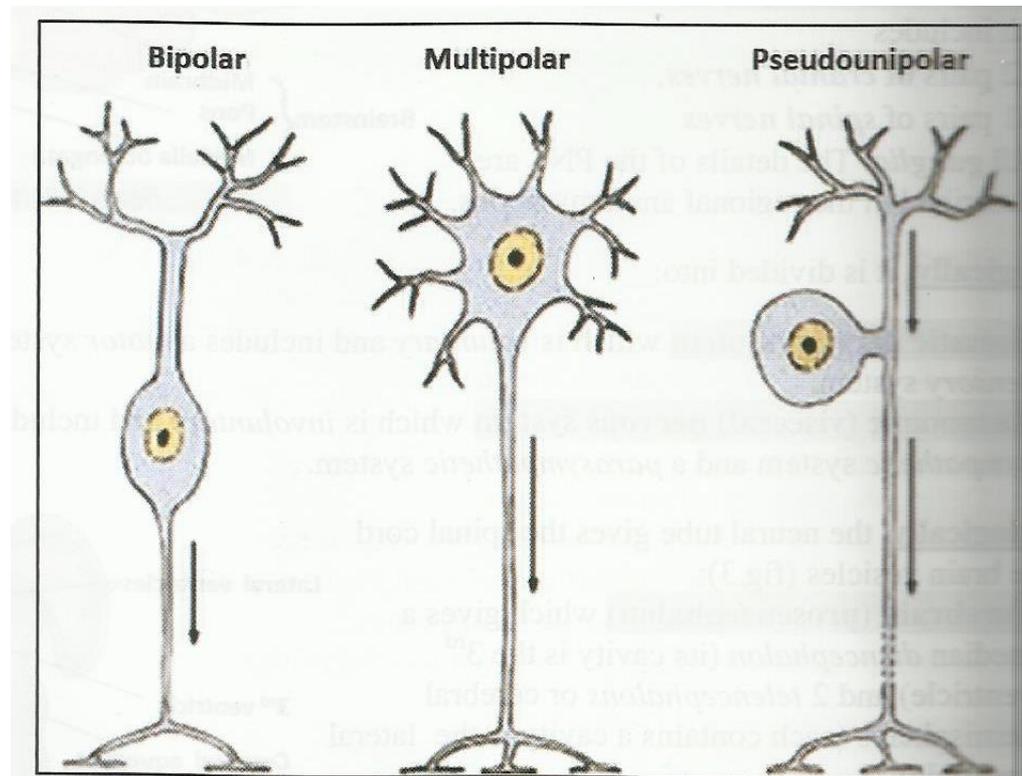
3. Hind brain (rhombencephalon): which includes the pons, medulla oblongata and cerebellum. Its cavity is the 4th ventricle.



Types of neurons

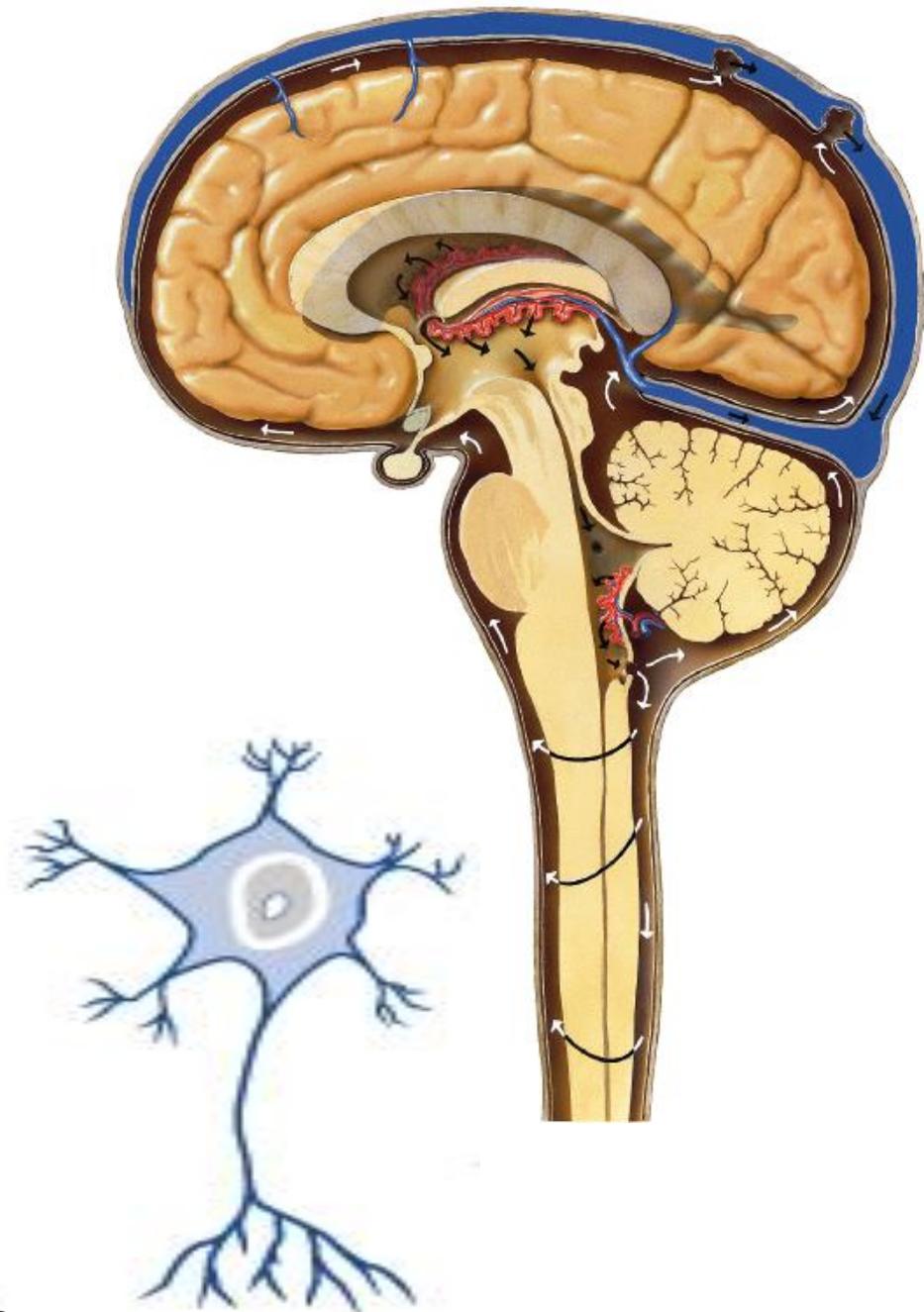
**** According to the number of processes:**

- 1. Unipolar (pseudounipolar):** as in posterior root ganglion.
- 2. Bipolar:** as in the retina, cochlear & vestibular ganglia.
- 3. Multipolar:** as in most parts of the brain & spinal cord.



**** According to the length of the axon:**

- 1. Golgi type I neuron:** of **long axon** as in long tracts of brain & spinal cord (as in pyramidal cells of cerebral cortex, Purkinje cells of cerebellar cortex & motor cells of spinal cord).
- 2. Golgi type II neuron:** of **short axon** (inhibitory in function), numerous in all parts of the CNS.



Glial Cells

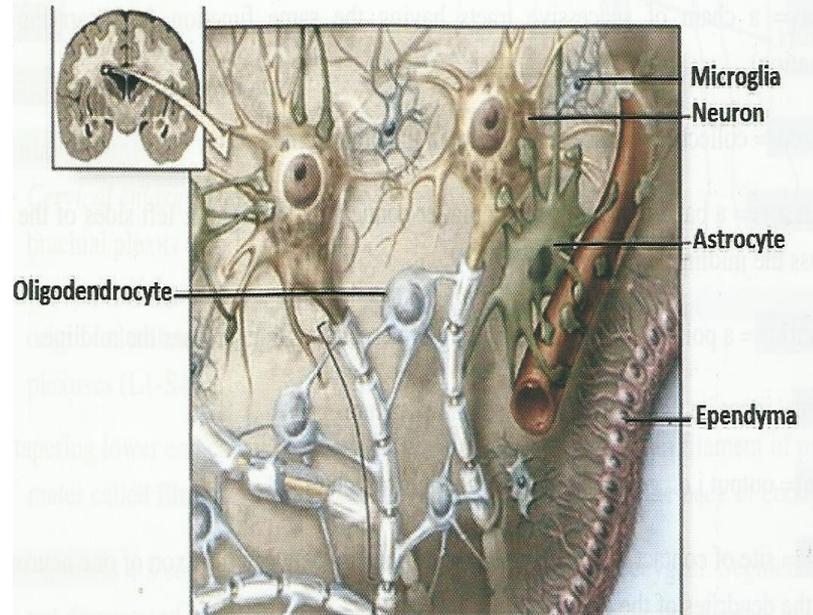
** Non-excitabile, supporting, protecting & nourishing cells.

** ½ total volume of CNS.

** Four types:

1. Astrocytes: Cells with many branches - main support for nerve cells & nerve fibers - electrical insulators - of 2 types (fibrous & protoplasmic).

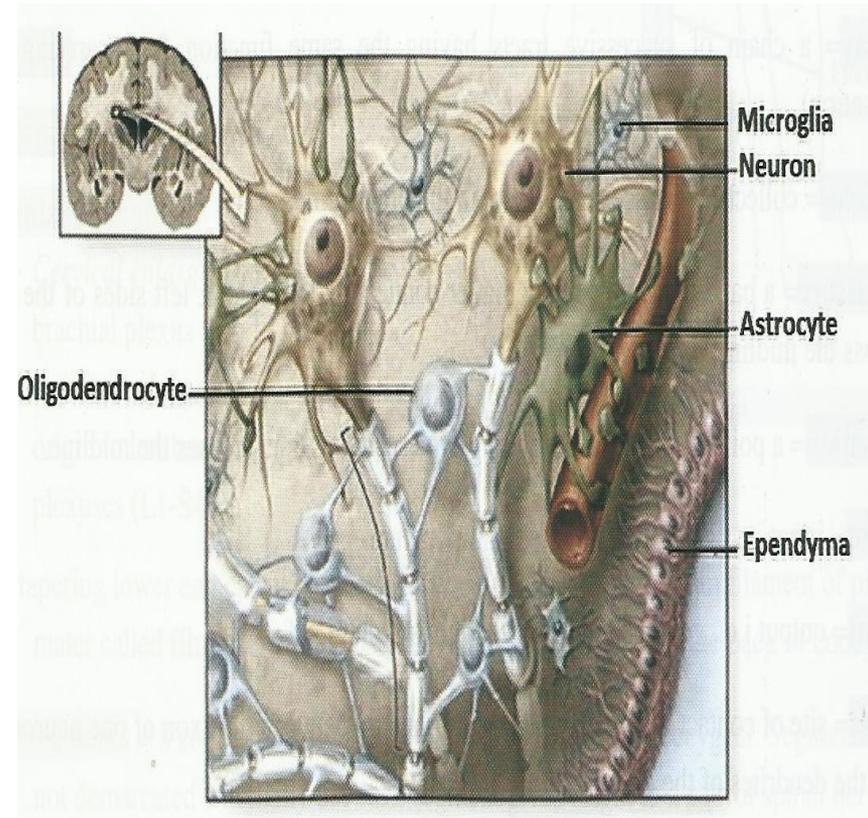
2. Oligodendrocytes: Small cells with few processes - responsible for the formation of the myelin sheath of the nerve fibers of the CNS.



Glial Cells (contd)

3. **Microglia**: The smallest glial cells - the only glial cells of **mesodermal origin** (while other glial cells are of ectodermal origin) - act as **phagocytes** in degenerative and inflammatory conditions.

4. **Ependyma**: Cuboidal ciliated cells that line the cavities of the brain & spinal cord. They also form the cells of choroid plexus. They assist in the formation of CSF.



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