



# 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.  
عقل ربا الأكل ينزل المعدة  
والمعدة تتعبت به  
هي؟ فزادت حتى يتكلم هذا  
الأكل.
- \* 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**).  
(which receive impulse)

# 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.)

الخلايا العصبية

# I. CENTRAL NERVOUS SYSTEM

## C.N.S.

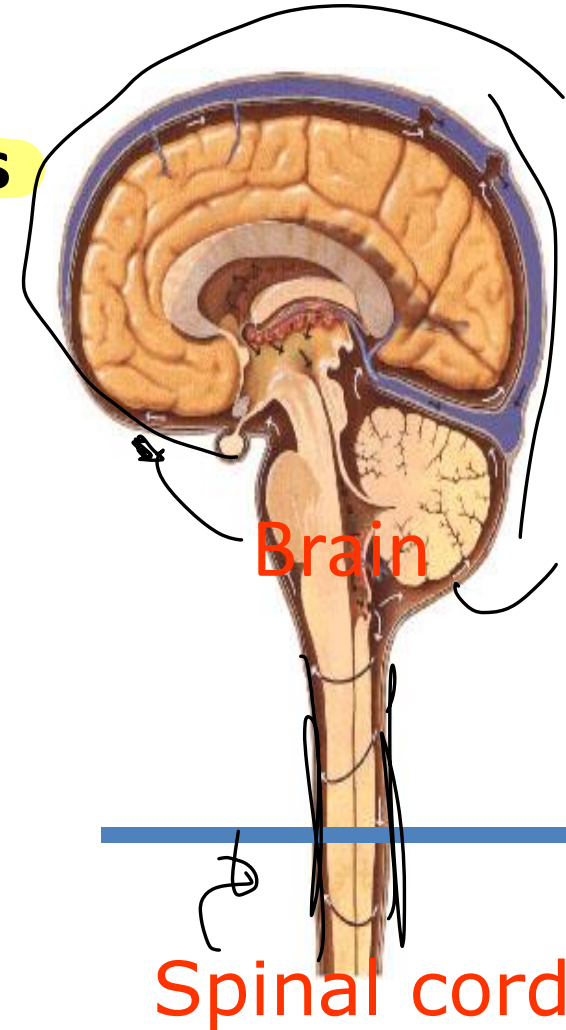
- It is the part of the nervous system which is **protected by bones** & bathed in the cerebrospinal fluid (C.S.F.).  
*يعوم في هذا السائل*  
*بعنه السائل محيطه فيه*

- 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.  
(1) (2) (3)
- It is formed of 2 main parts :
  1. sympathetic system.  
تأج الطوارء
  2. parasympathetic system.  
تأج الرأفة
- It is distributed partly through C.N.S. & partly through P.N.S.

# انواع الخلايا Structure of Nervous Tissue

- It is formed of 2 types of cells :

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

كبيد **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 :

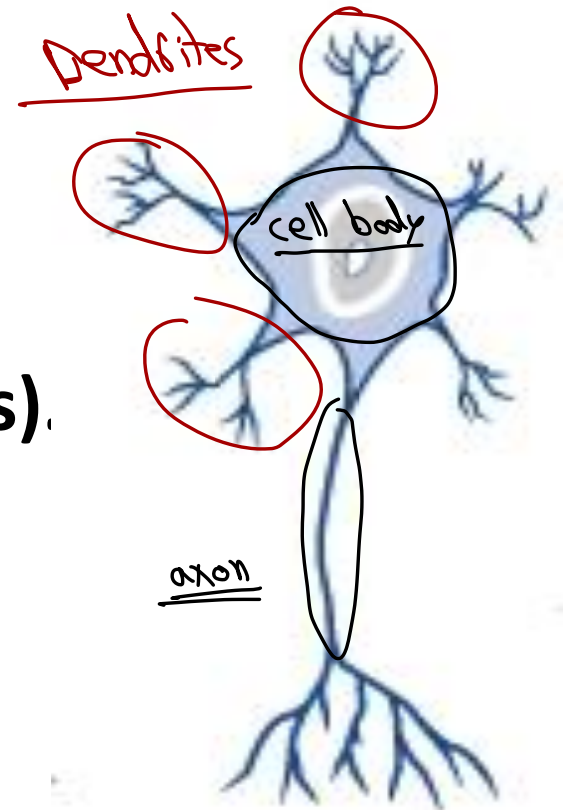
1. Cell body : contains the nucleus & cell organelles.

2. Processes :

a. axon (nerve fiber) : unidirection

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

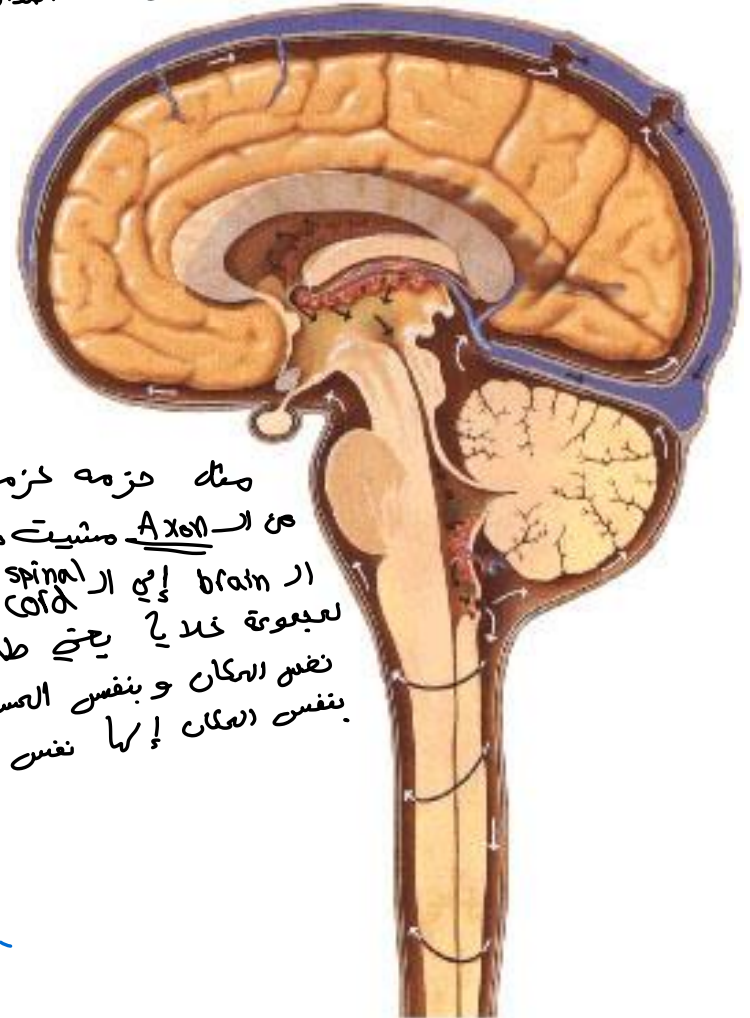
**1. Nucleus** : a group of cell bodies in CNS. Cells have the same function.

منه مجموعة من الخلايا body cell ؛ تجمعت  
و تسمى منه nucleus  
و هي مسؤولة عن إصدار أوامر للخلايا  
motor nucleus

**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.

منه حزمة حزمة  
من الـ Axons مشيية من  
الـ brain إلى الـ spinal cord و  
للمجموعة خلايا يخرج طلع من  
نفس المكان و بنفس المسار و انتهت  
بنفس المكان ؛ لها نفس السطح



الغدة  
التي تسمى و تدعى  
CNS و الثاني  
PNS

Bundle of nerve in PNS

**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**.



يعني لو بدنا نحكي عن احساس الالم بالاصابع هاد الاحساس ينتقل عن طريق ال nerve و يدخل الى ال spinal cord و بعدين الى ال brain هاي الانتقالات ما صارت بمرحلة وحدة انما صارت بمراحل متعددة من ال tract و ال pathway هو المسار اللي تم اتخاذه من مكان الالم الى sensory area in the brain و اللي يكون مكون من اكثر من tract

**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.

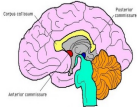
قلنا انه في tract طالعة بال sensation و هي طالعة بطريقها الى الدماغ بتعدي اول اشي بال brain stem و بنطلق على هاي الحزمة من ال ascending fiber الي بتدخل هاد المكان بالاسم هاد



**8. Commissure:** A band of white or grey matter connecting the right & left sides of the CNS across the midline.

هاي بتفرق عن اللي تحتها انه هاي الحزمة كاملة مش بس وخذك

عبارة عن structure ما شي من الجهة اليمين الى اليسار و لما و النقلة اللي بتقطع النص بنسميها commissure ممكن انه تربط بين منطقتين من اليمين الى اليسار



**9. Decussation:** A point at which an ascending or descending tract crosses the midline.

يعني انه احنا عنا tract بدات بال right cerebral hemisphere و هي نازلة بدها تروح لل left half of spinal cord رح تعبر من اليمين للشمال هاد النقلة بنسميها هيك

**10. Afferent:** Input i.e., going towards a certain structure.

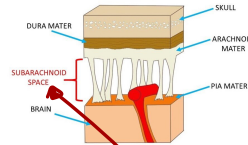
**11. Efferent:** Output i.e., going away from a certain structure.

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

**a. dura matter.**

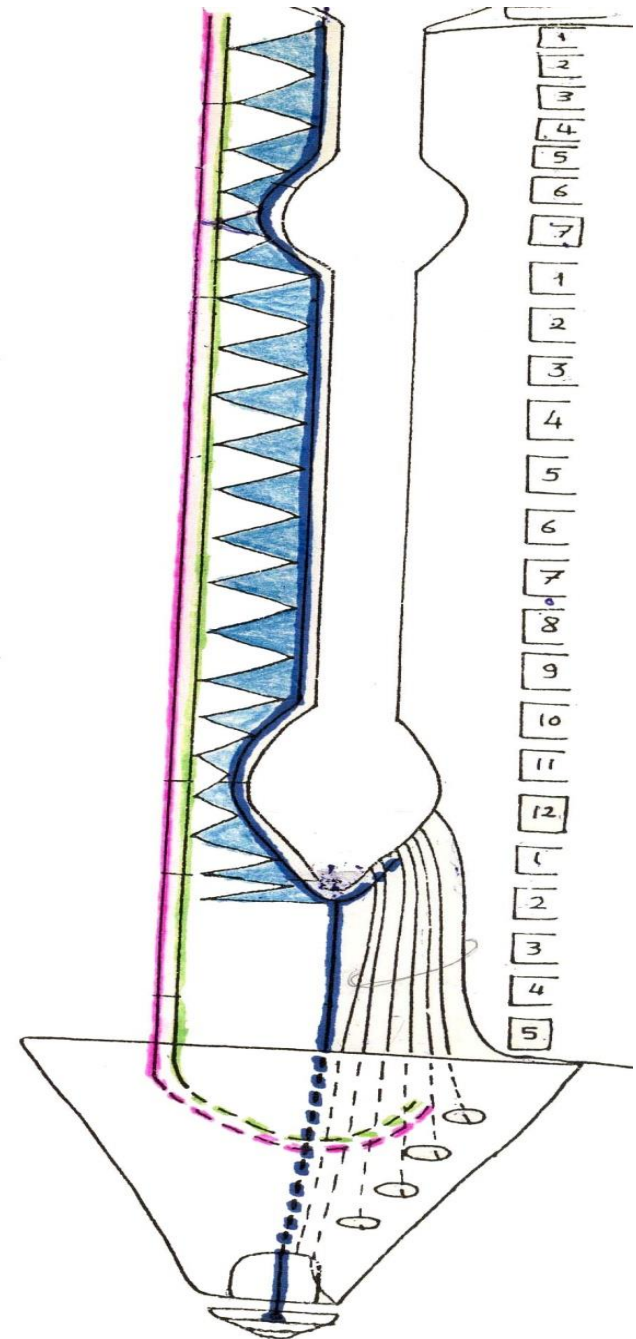
**b. arachnoid matter.**

**c. pia matter.** کازق کایے  
spinal اور brain ل



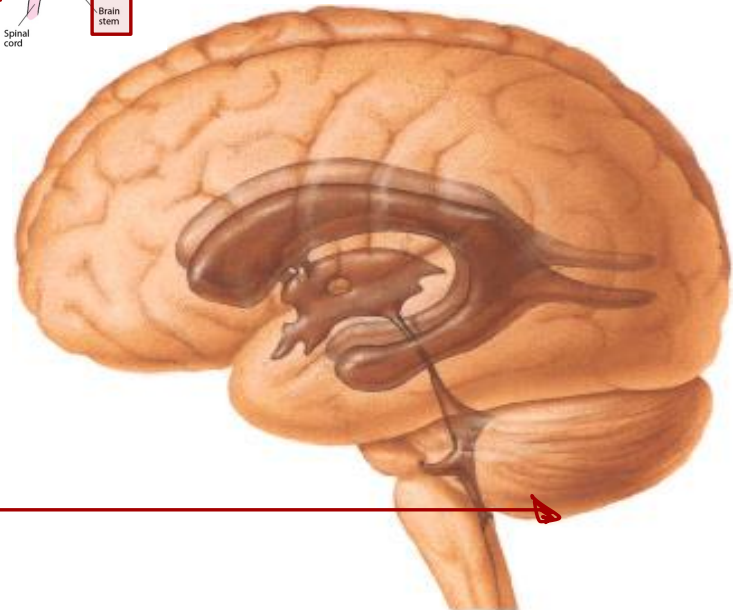
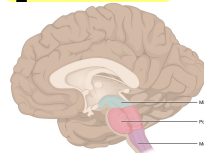
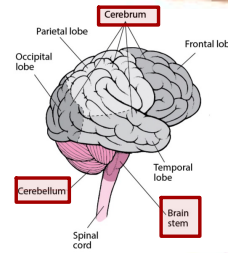
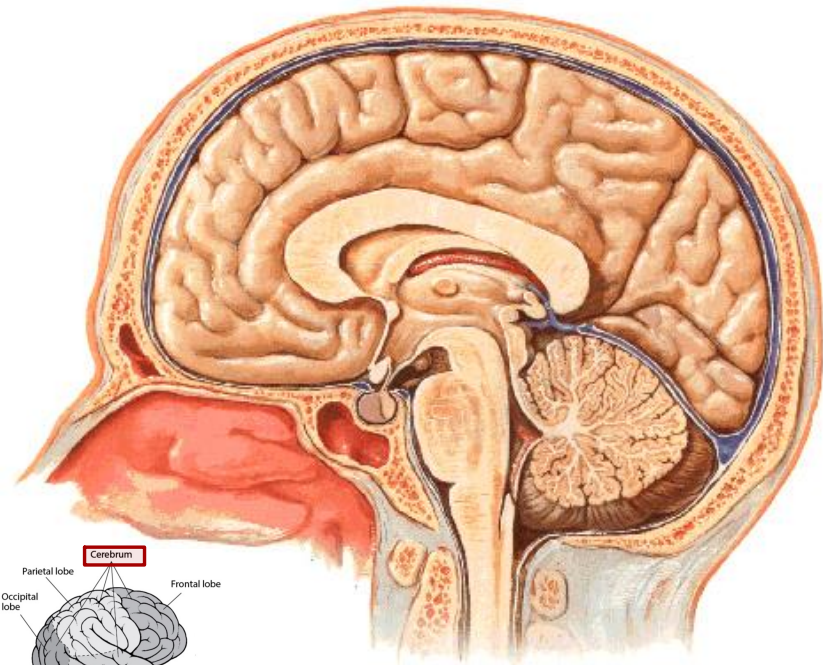
\* Between pia & arachnoid matter lies **subarachnoid space** which contains **cerebro-spinal fluid (CSF)**.

\* 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**.

برضوا معناها رح  
يحتوي على  
nuclei

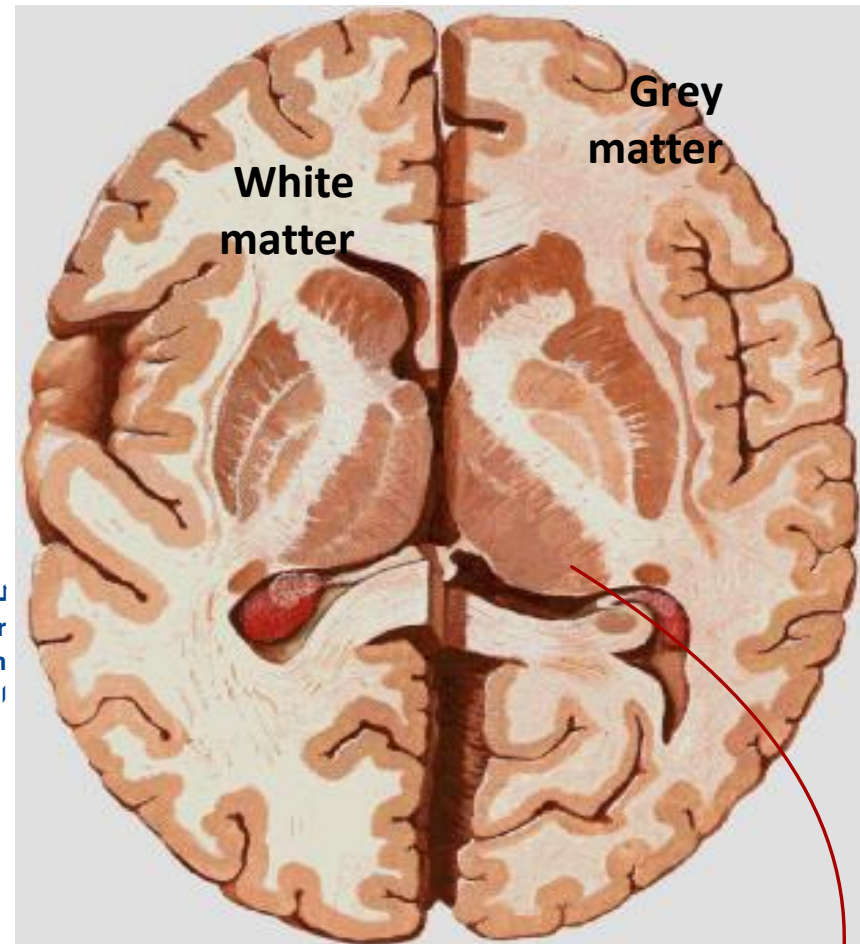
These are dark areas which **contain cell bodies**.

2. Inner core of **white matter**.

These are light areas which **contain nerve fibers**

لونها ابيض لانه ال  
nerve fiber  
مقطيه ب  
myelin و اللي هو لونه  
ابيض

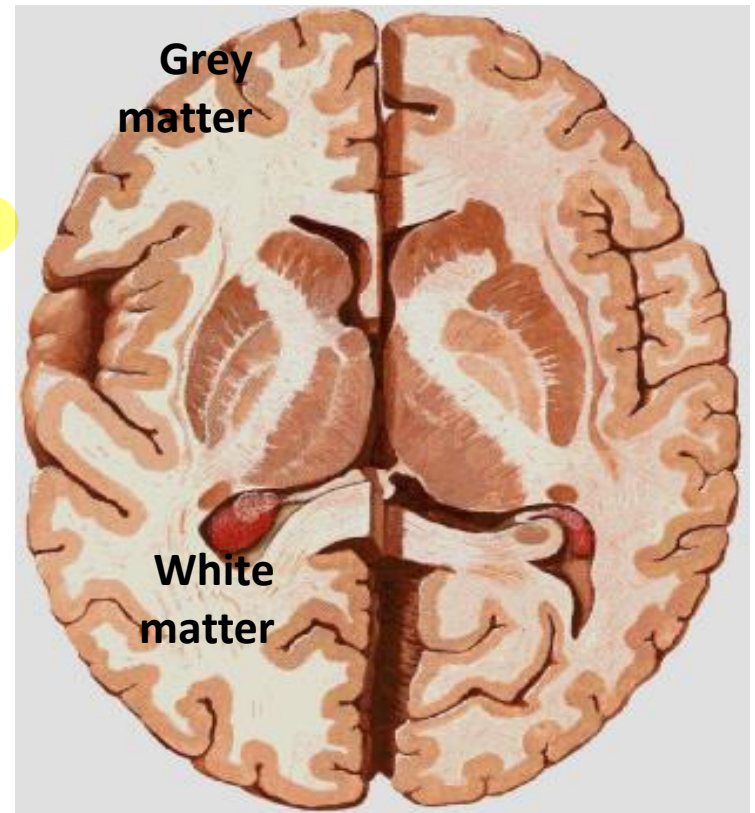
(axons). The fibers run inside the CNS as **bundles, tracts or fasciculi**.



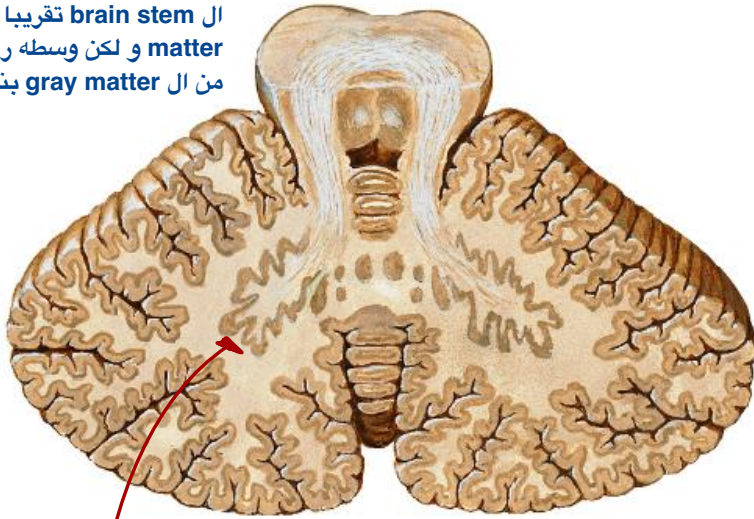
هاد اللون الغامق هو nuclei صغيرة  
موجودة داخل ال brain حنحي عنها  
ان شاء الله لقدام و تسمى basal

nuclei

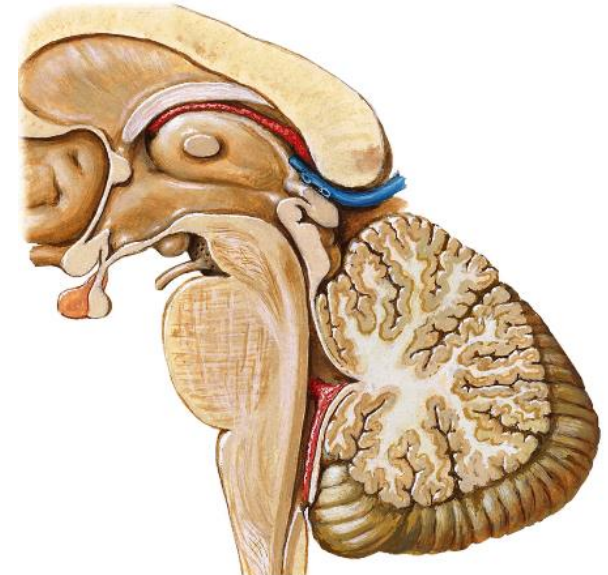
- \* In the brain stem, the grey matter collects into nuclei embedded in the white matter.



ال brain stem تقريبا كله white matter و لكن وسطه رح نلاقى تجمعات من ال gray matter بنسبها nuclei

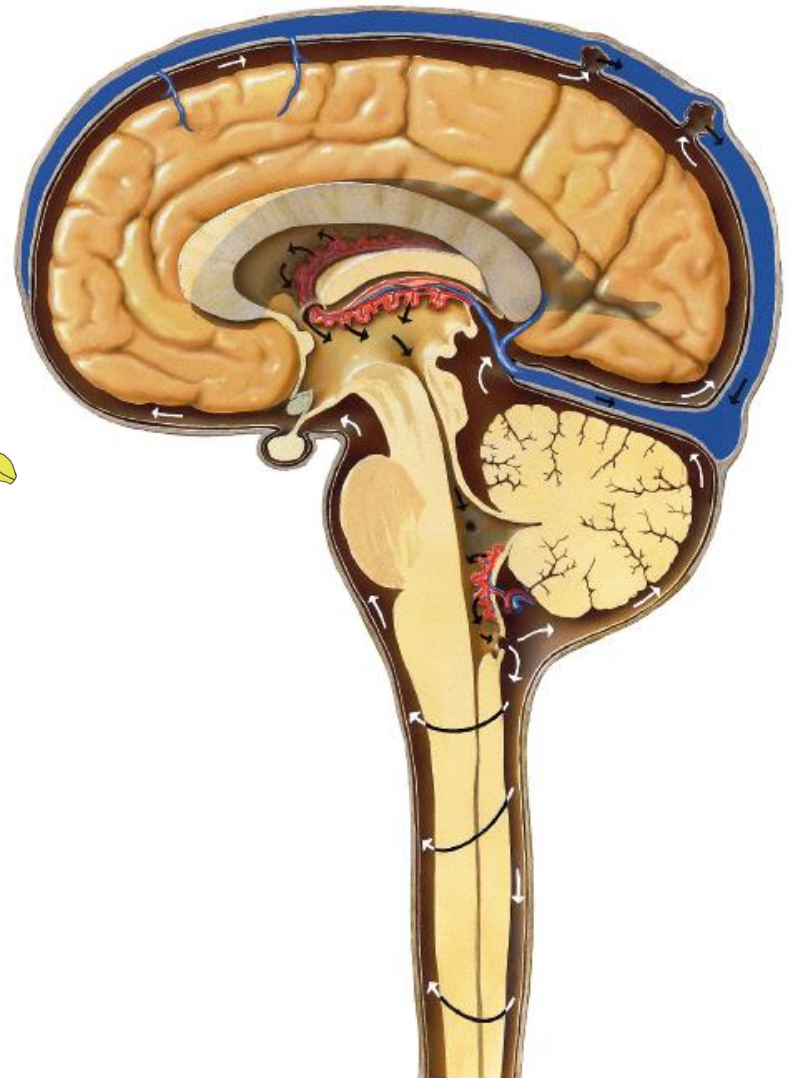
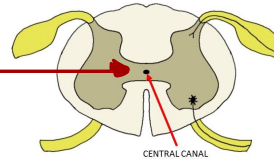


- \* In the cerebral hemispheres and the cerebellum, part of the grey matter collects into Small deep nuclei and another part spreads on the surface forming the cortex.

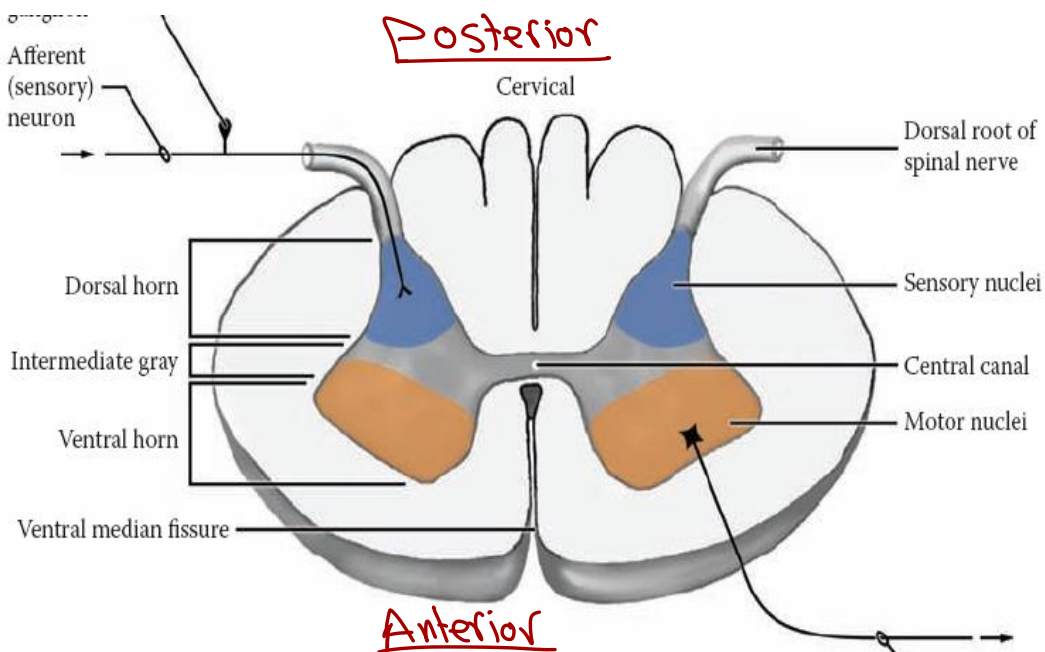


# Spinal Cord

- \* It is the downward continuation of the **medulla oblongata**. *which end in Foramen magnum*
- \* 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:

And inner layer of gray matter  
وهاد الحكي عكس ال brain

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.

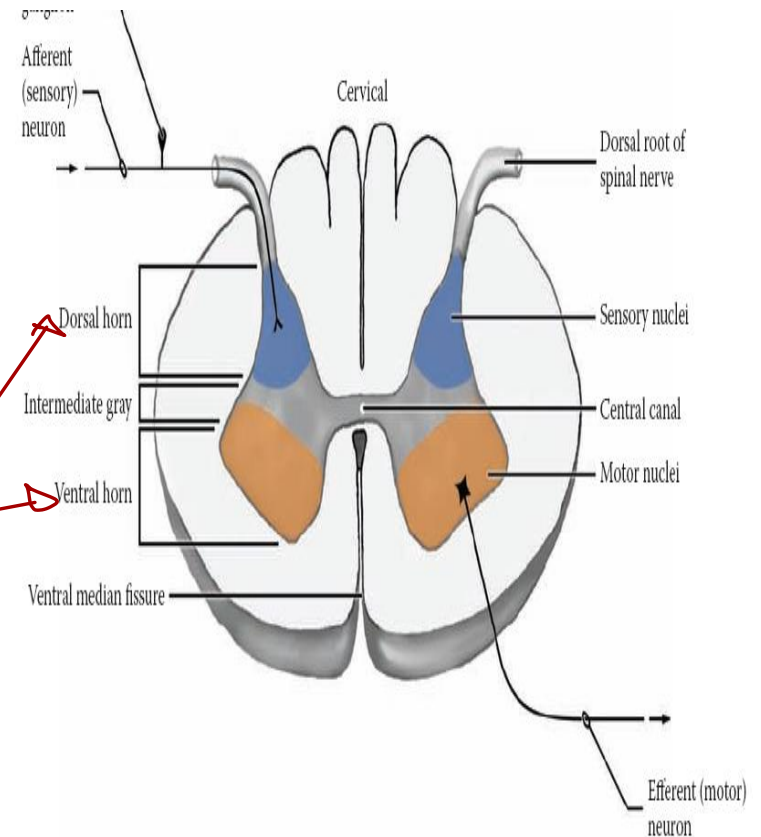
1. The 2 anterior limbs

→ **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<sup>①</sup>).

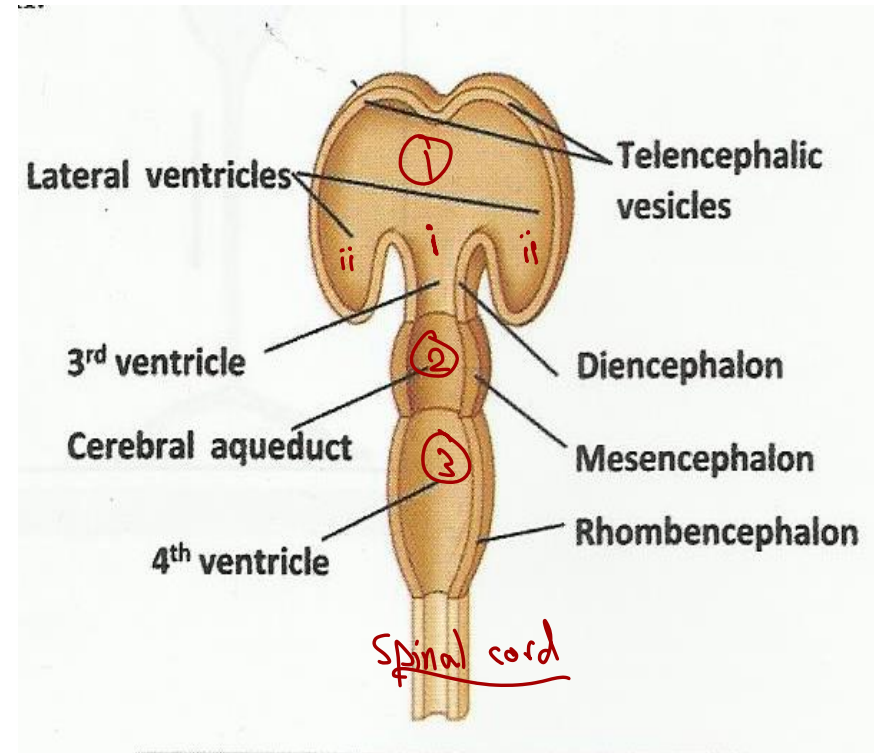
## 1. Forebrain (prosencephalon):

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.



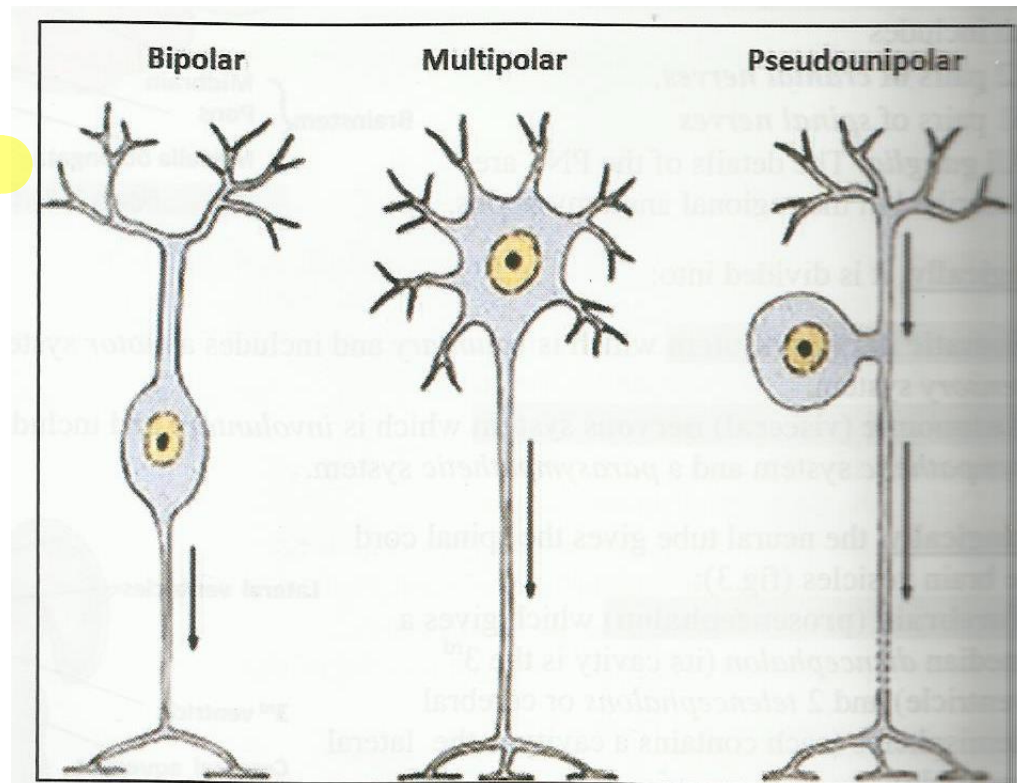
# Types of neurons

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

**1. Unipolar (pseudounipolar):** as in posterior root ganglion.

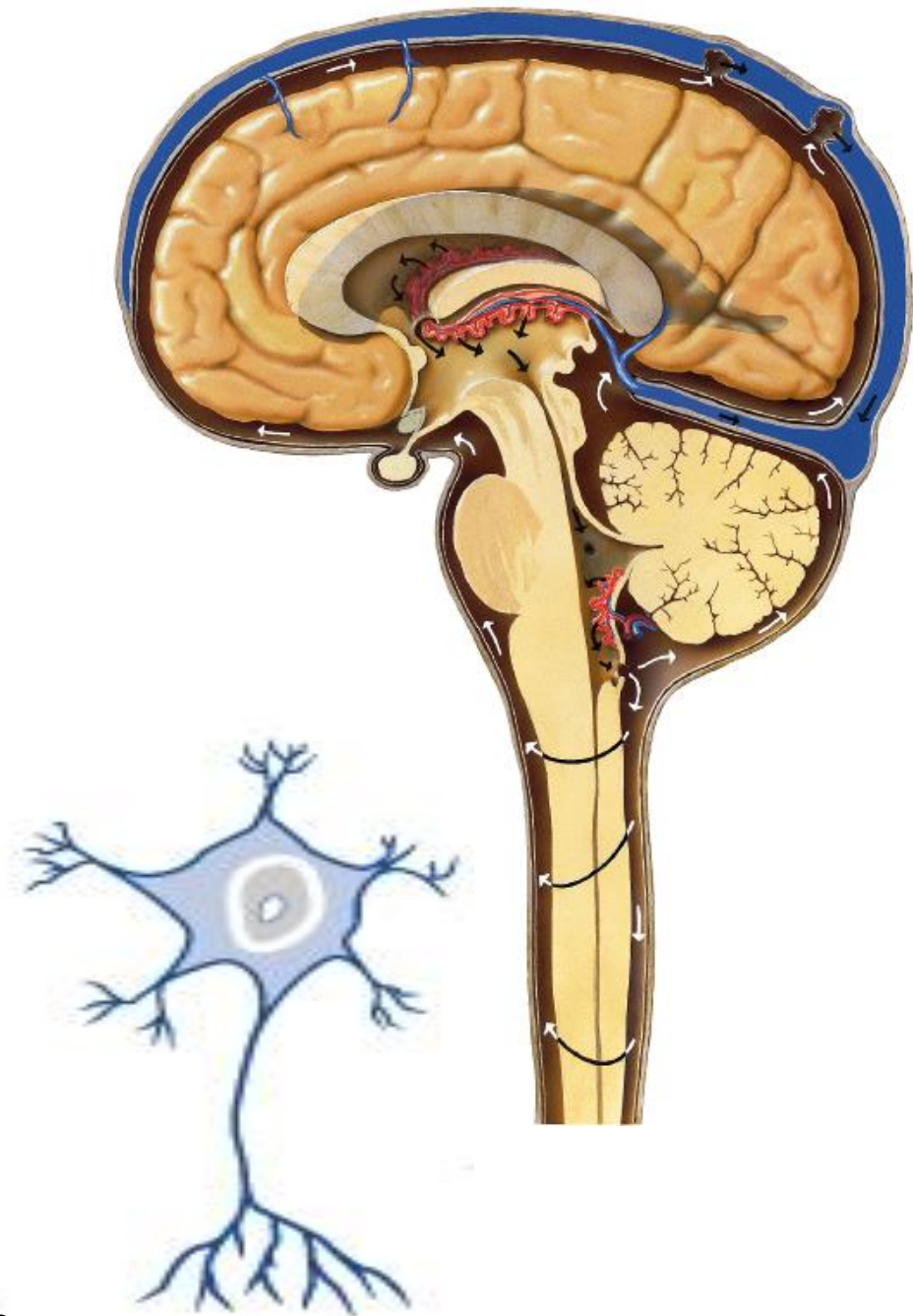
**2. Bipolar:** as in the <sup>الشبكية</sup>retina, <sup>بالإذن</sup>cochlear & vestibular ganglia.

**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** ① cells of cerebral cortex, ② **Purkinje cells** of cerebellar cortex & ③ **motor cells** of spinal cord).
- 2. Golgi type II neuron:** of **short axon** (inhibitory in function), numerous in all parts of the CNS.





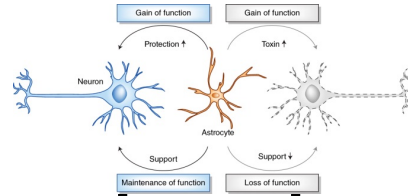
هذو ٲى كٲىء ار neuron ٲىء ٲءوٲه  
و ٲسءءوٲه

# Glial Cells

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

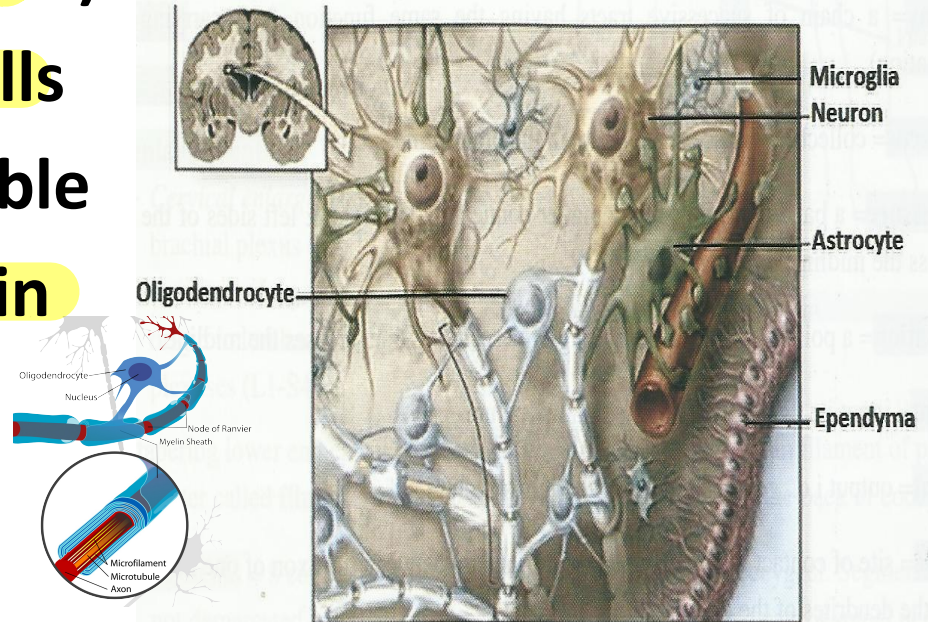
\*\* 1/2 total volume of CNS.

\*\* Four types:



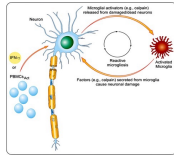
1. Astrocytes: Cells with many branches - main support for nerve cells & nerve fibers - electrical insulators - of 2 types (fibrous <sup>1</sup> & protoplasmic <sup>2</sup>). عزل و ٲسءءوٲه

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

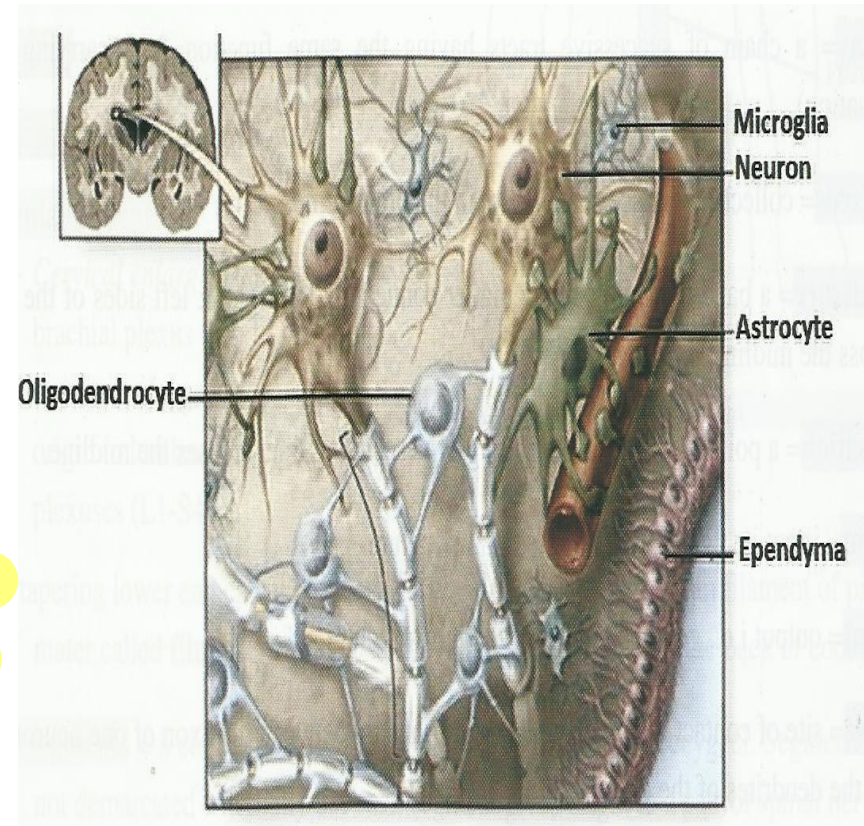


# Glial Cells (contd)

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**.





**THANK**

THANK

**YOU**

YOU