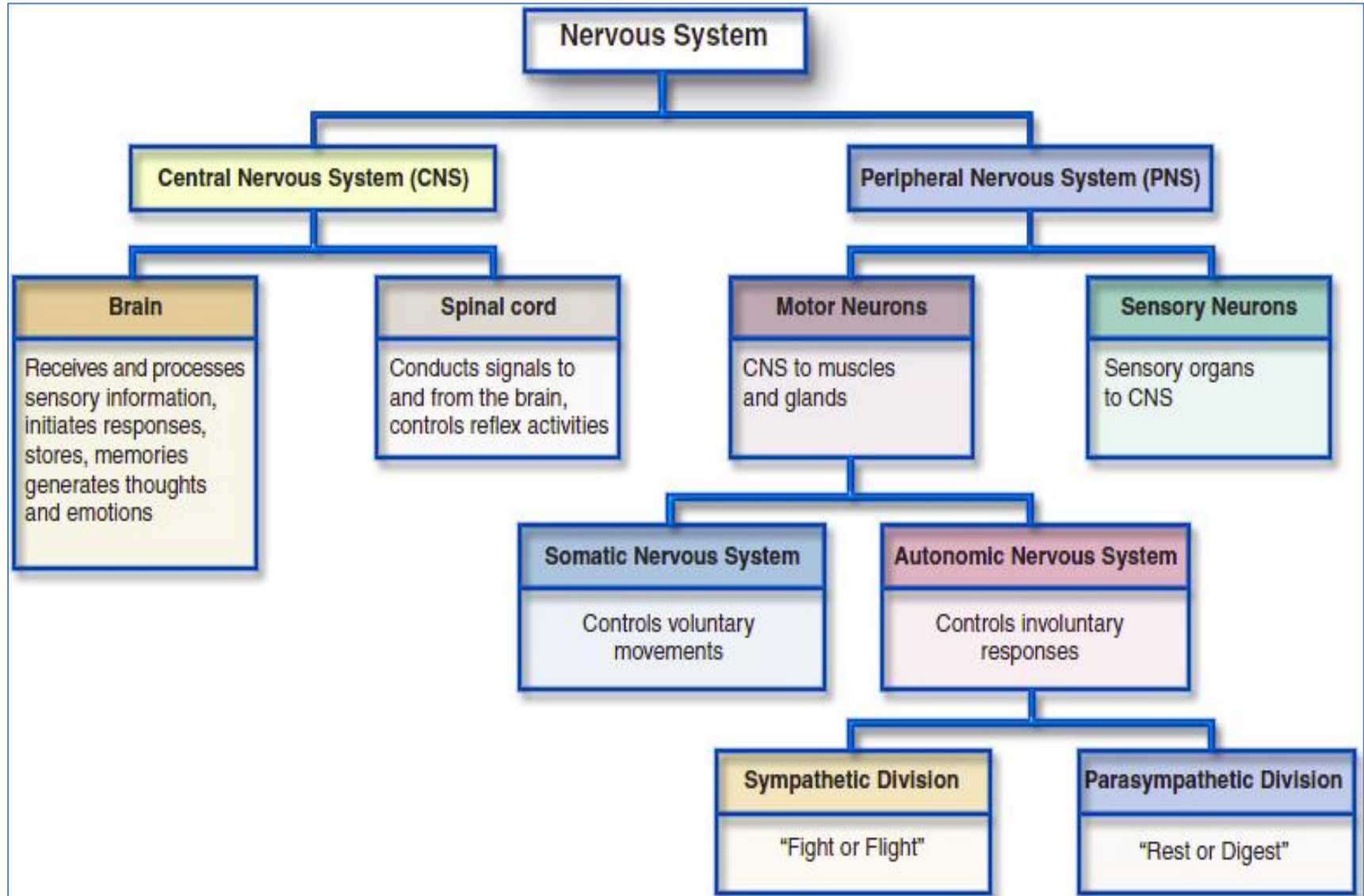


***Human Histology***  
***The Nervous System***

***Dr. Rawaa Salim Hameed***

# The organization of the nervous system

Anatomically, the nervous system is divided into:-



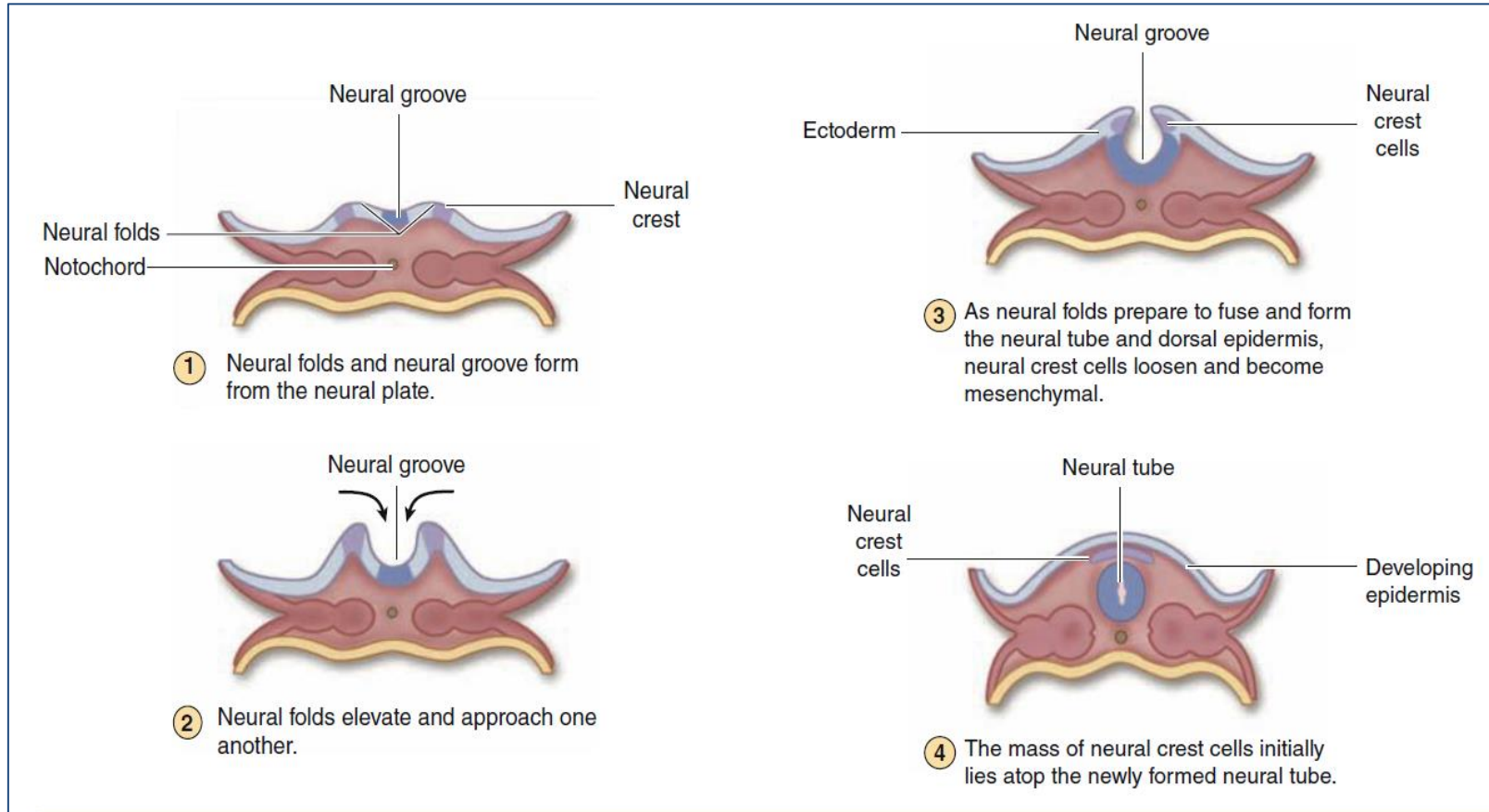
# Neurohistology

- Structurally, nerve tissue consists of two cell types:-

✓ **Nerve cells or neurons**

✓ **Glial cells**

# Development of nerve tissue



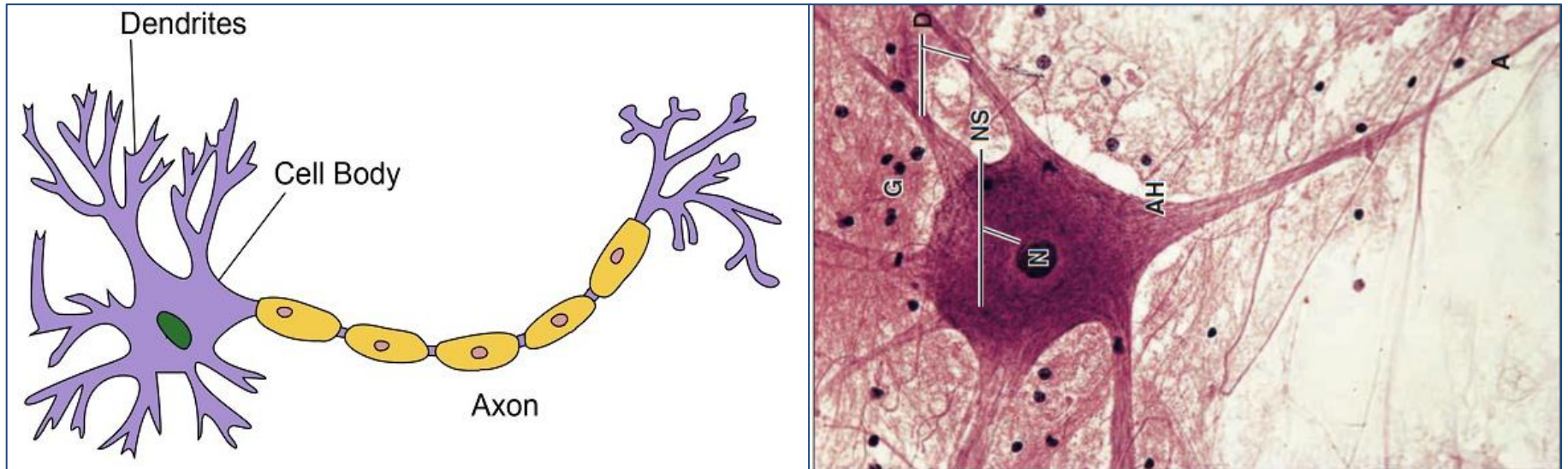
Ectoderm of the embryo thickens to form the epithelial neural plate. The sides fold upward and grow toward each other, within a few days fuse to form the **neural tube** → give rise to the entire CNS

Neural crest cells migrate and differentiate → to the PNS, as well as a number of other non-neuronal cell types

# The structure of the neuron

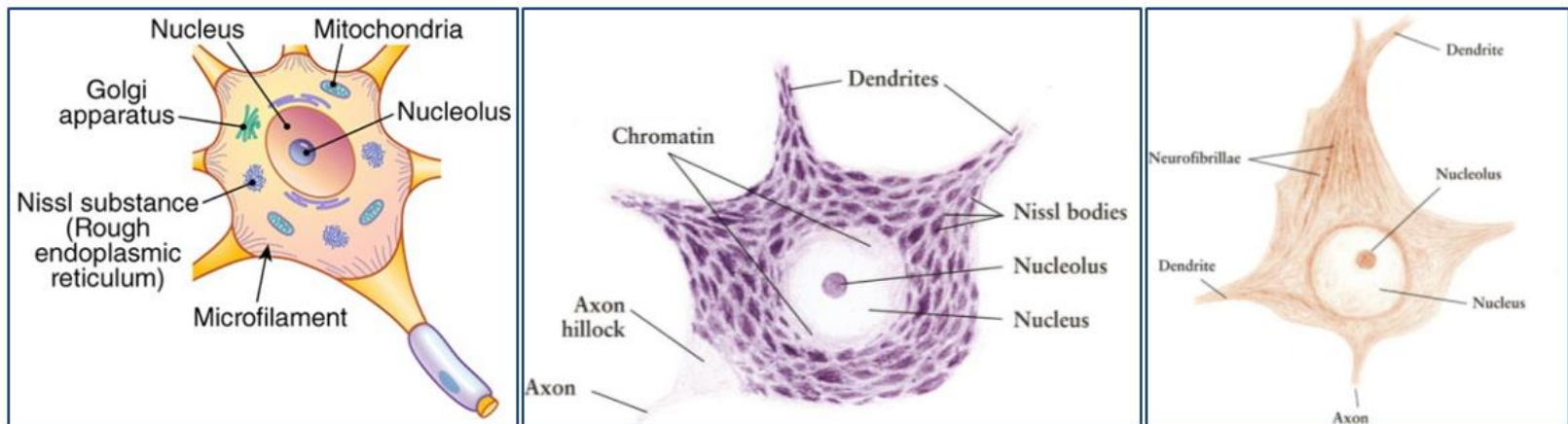
The functional unit in the nervous system is the neuron. Most neurons have three main parts:-

- ✓ **Cell body (perikaryon or soma)**
- ✓ **Dendrites**
- ✓ **Axon**



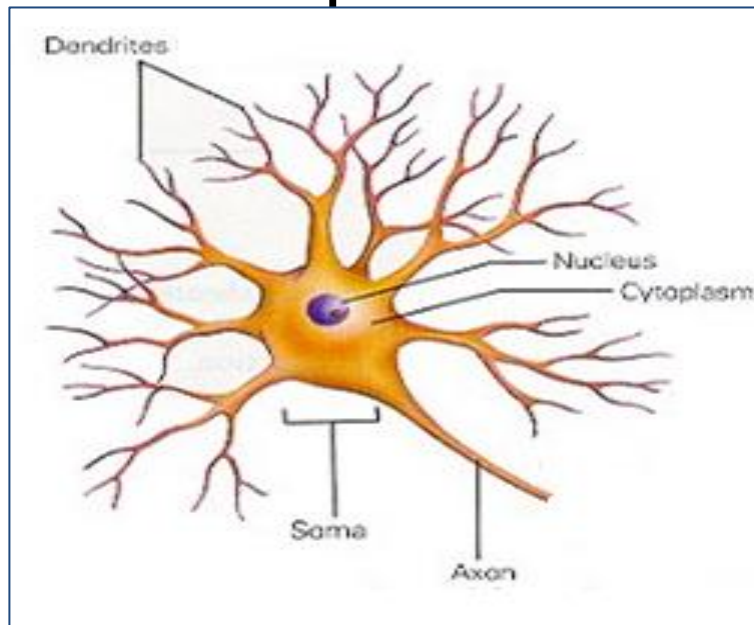
# Features of a neuron cell body

- ✓ Contains the nucleus
- ✓ Contains mitochondria, lysosomes, a Golgi complex
- ✓ Contains Nissl bodies
- ✓ Contains neurofilaments and neurotubules
- ✓ It is a trophic centre



# Dendrites

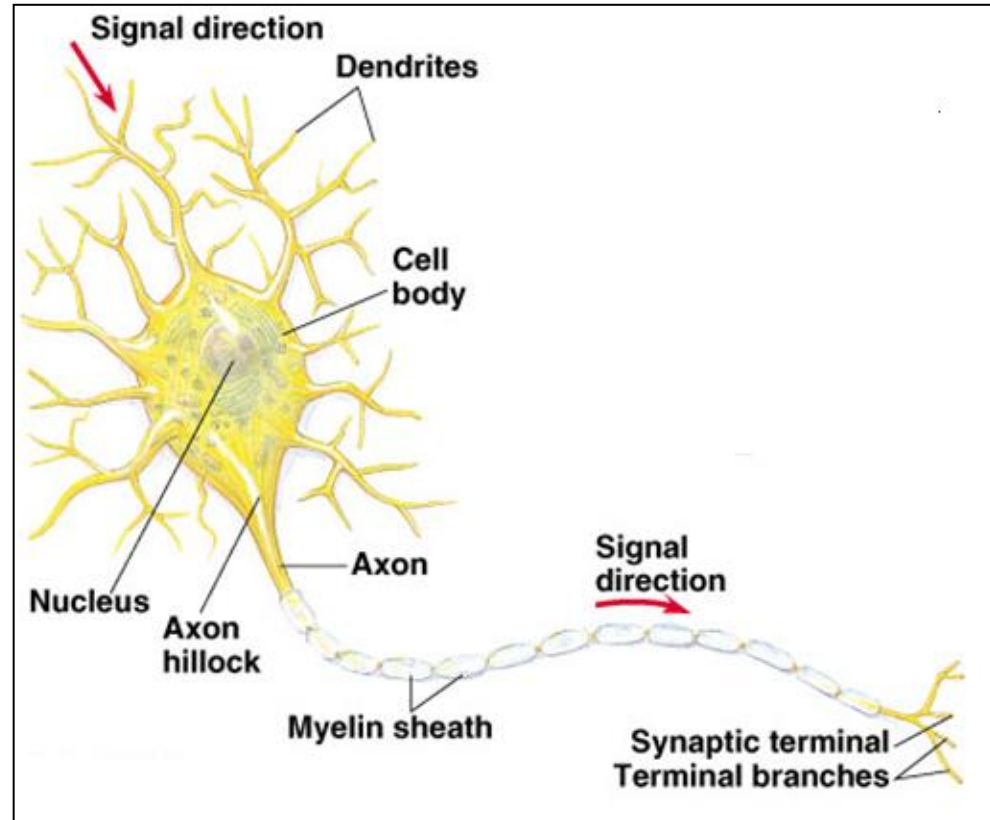
- ✓ Short and divide like the branches of a tree
- ✓ The composition of dendritic cytoplasm is similar to that of the soma
- ✓ Devoid of Golgi complexes
- ✓ Increase the receptive area of the cell





# Axon

- ✓ Axon is a single process
- ✓ Originate from axon hillock
- ✓ Its plasma membrane called the **axolemma**
- ✓ Its contents called **axoplasm**
- ✓ Wrapped by a fatty sheath called **myelin**
- ✓ Generating or conducting nerve impulses to other cells



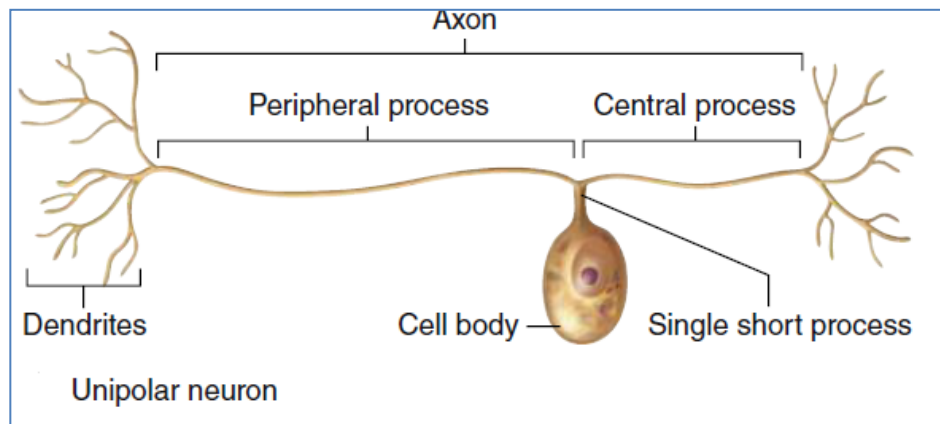


# Different types of neurons

- Neurons are variable in:-
  - ✓ **Size** (5-150  $\mu\text{m}$ )
  - ✓ **Shape** (spherical, angular)
  - ✓ **Functions** (sensory, motor and interneuron)

# Structural classes of neurons

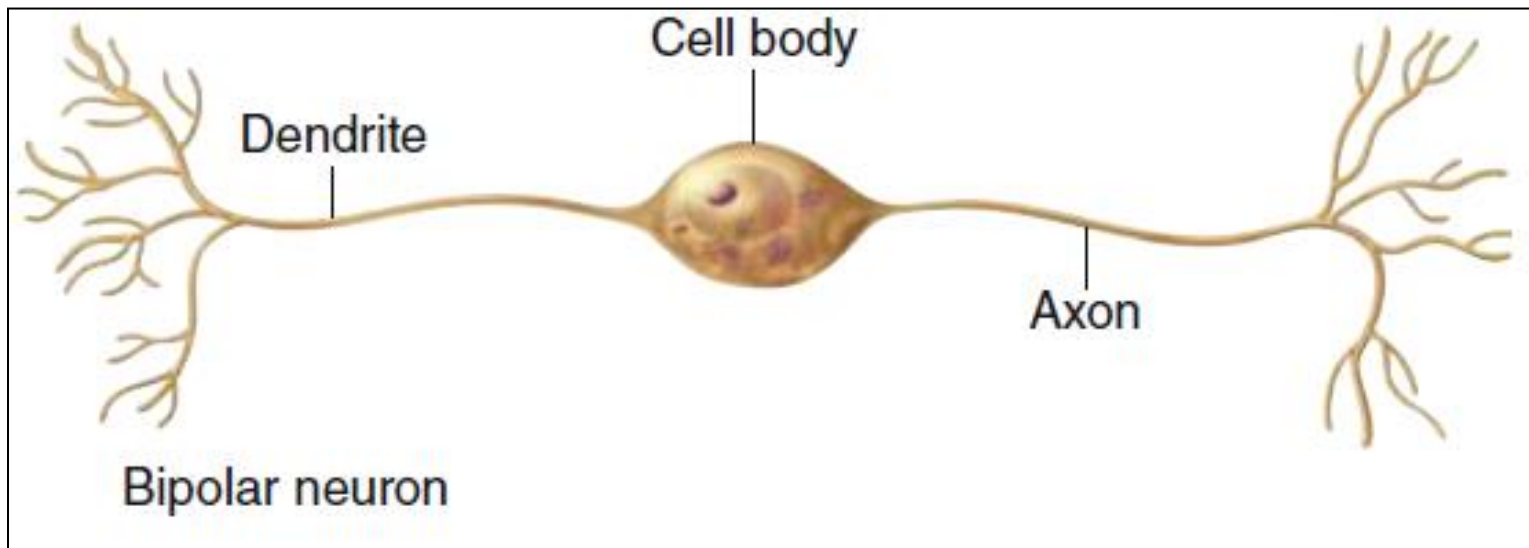
- **Unipolar (pseudounipolar)**
  - ✓ One process that is close to the soma and divides into two branches.
  - ✓ The process then forms a T shape with one branch extending to a peripheral ending and the other toward the central nervous system



- **Bipolar**

- ✓ One dendrite and one axon

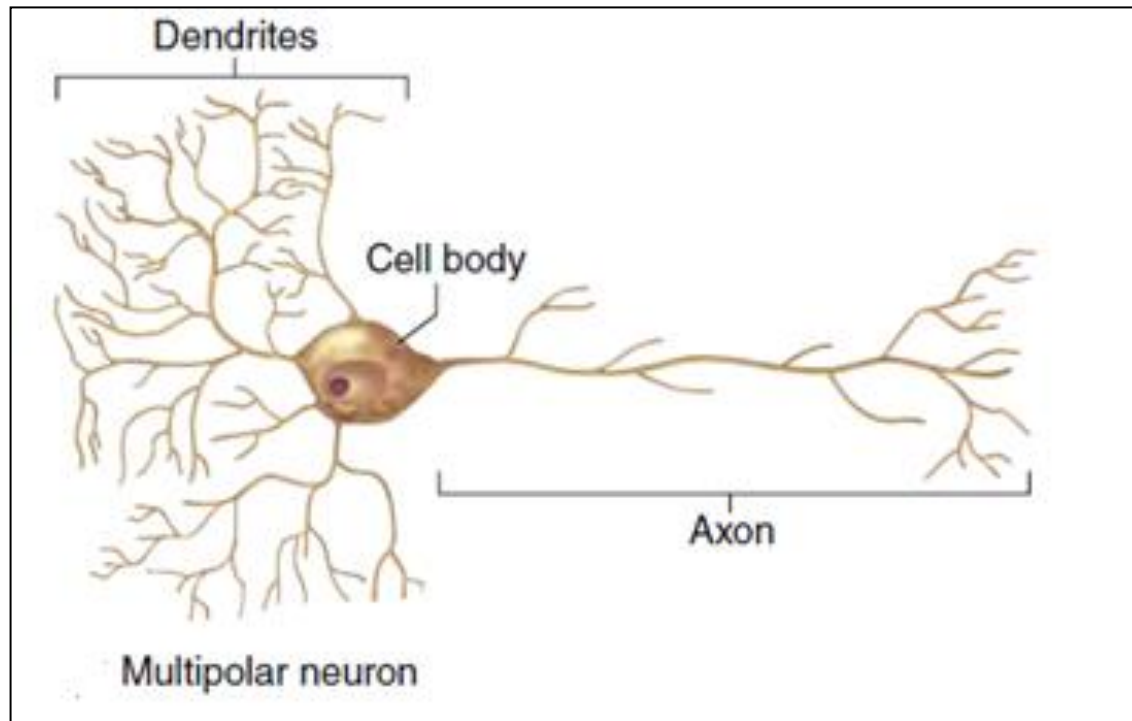
- ✓ Found in the ear and retina of the eye



- **Multipolar**

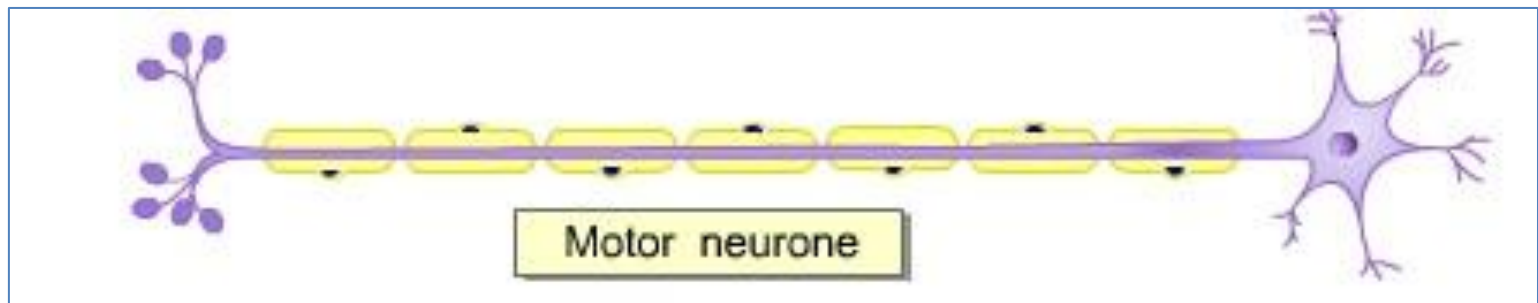
- ✓ Many dendrites from cell body and one axon

- ✓ Commonly located in the brain and spinal cord.



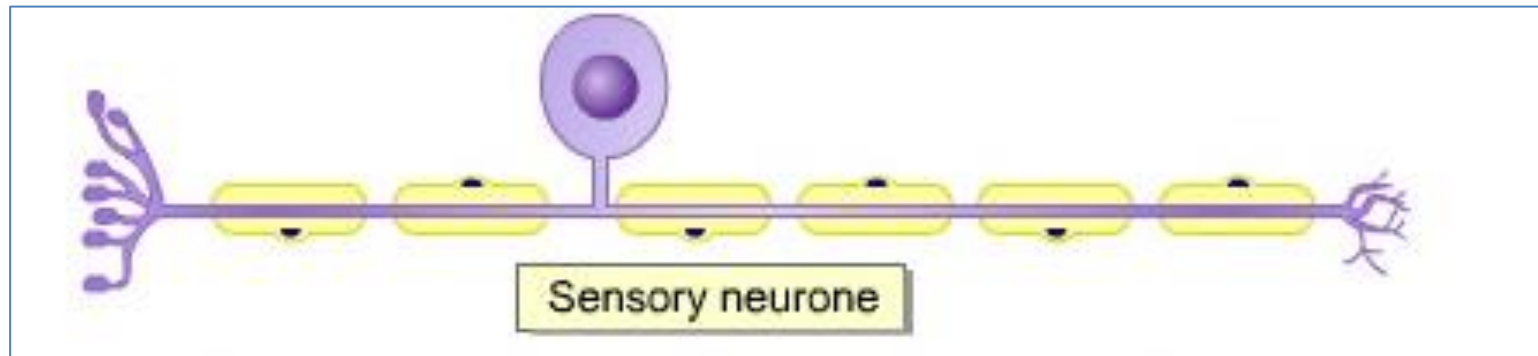
# Functional classes of neurons

**1- Motor neurons (efferent neurons)** carry impulses away from the brain and spinal cord to the muscles and glands.



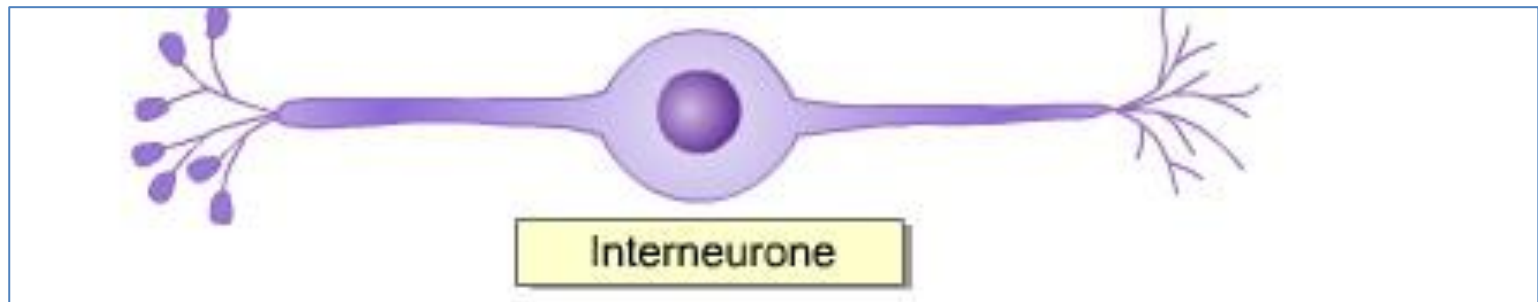
# Functional classes of neurons

**2- Sensory neurons (afferent neurons)** carry impulses into the brain and spinal cord from sense organs or receptors such as eyes or ears



# Functional classes of neurons

**3- Interneurons** serve to connect sensory neurons to the motor neurons. They are found within the brain and spinal cord.



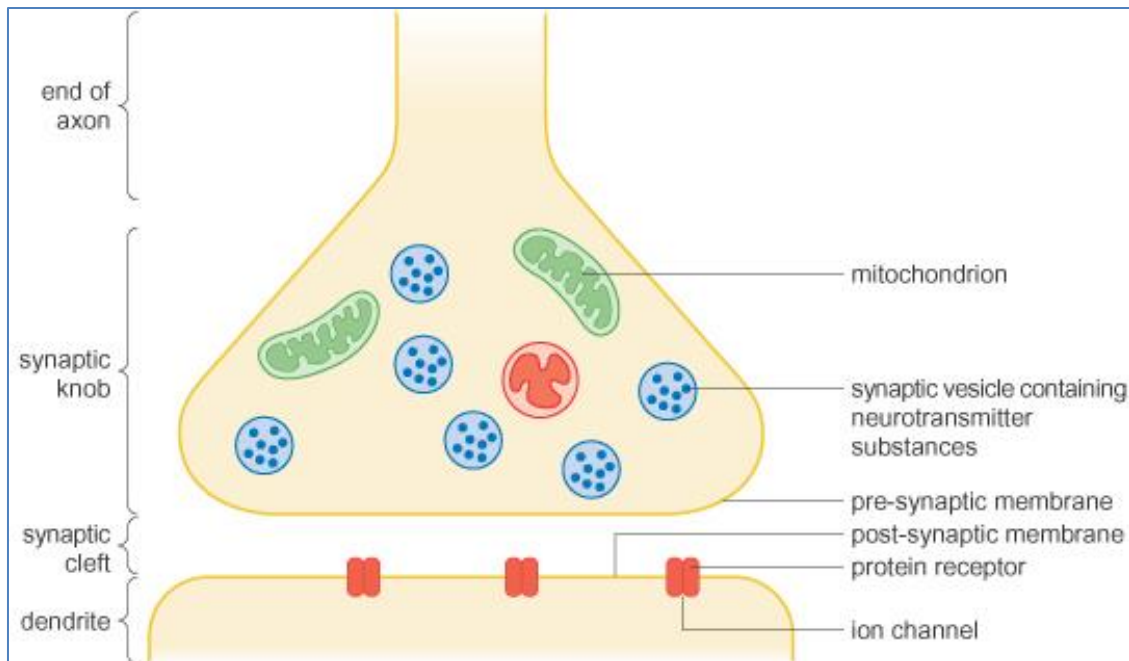


# Synaptic communication

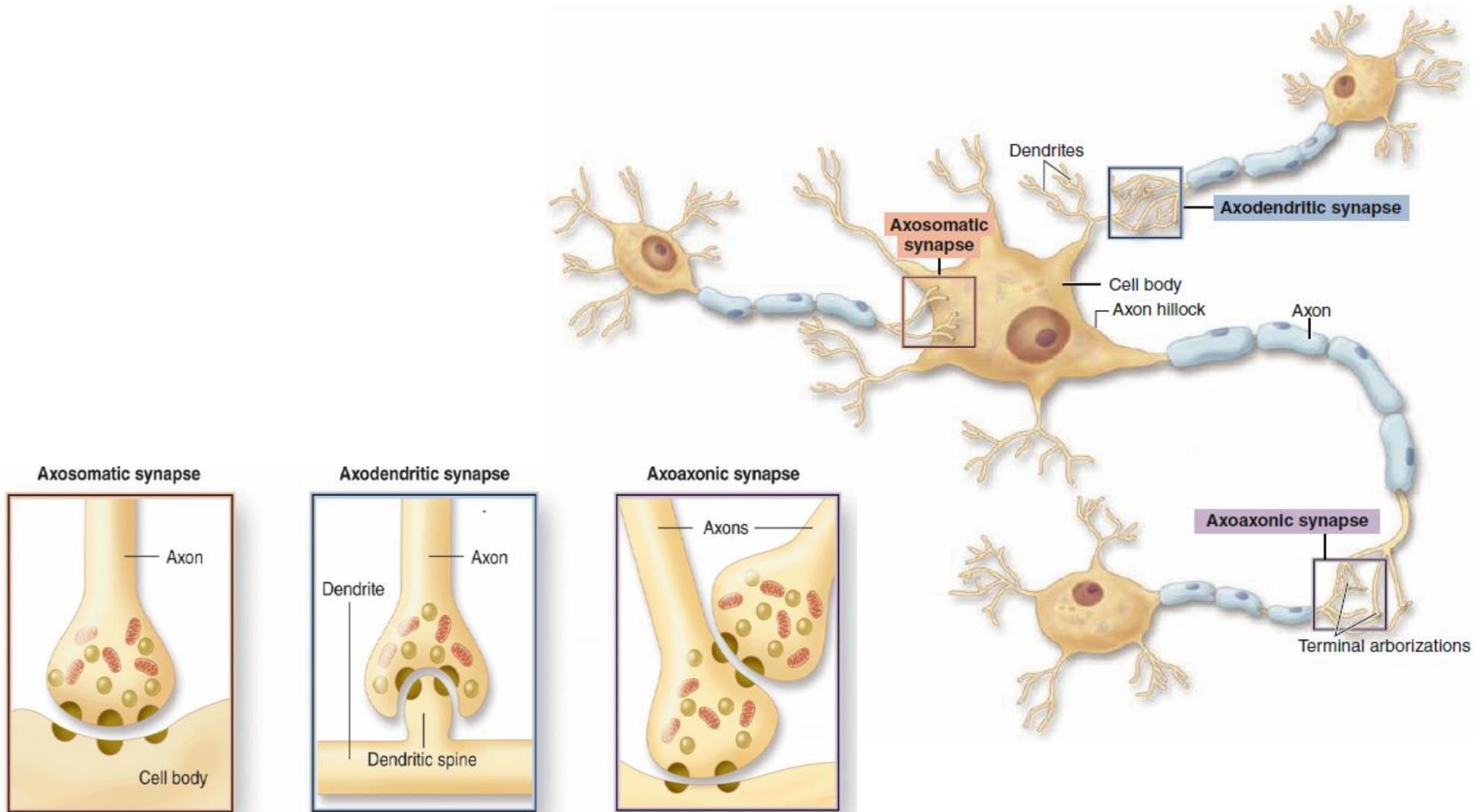
- ❖ **Synapses** are the sites where contact occurs between neurons or between neurons and other effector cells (muscle and gland cells)
- ❖ Most synapses transmit the impulse by releasing **neurotransmitters** at the axon terminal

# Major components of a synapse

- **Presynaptic terminal:** an axon terminal that delivers the impulse
- **Postsynaptic terminal:** a part of another cell where a new impulse is generated
- **Synaptic cleft:** a thin intercellular space



- If an axon synapses with a cell body it is called an **axosomatic** synapse; with a dendrites, **axodendritic**; or with an axon, **axoaxonic**.

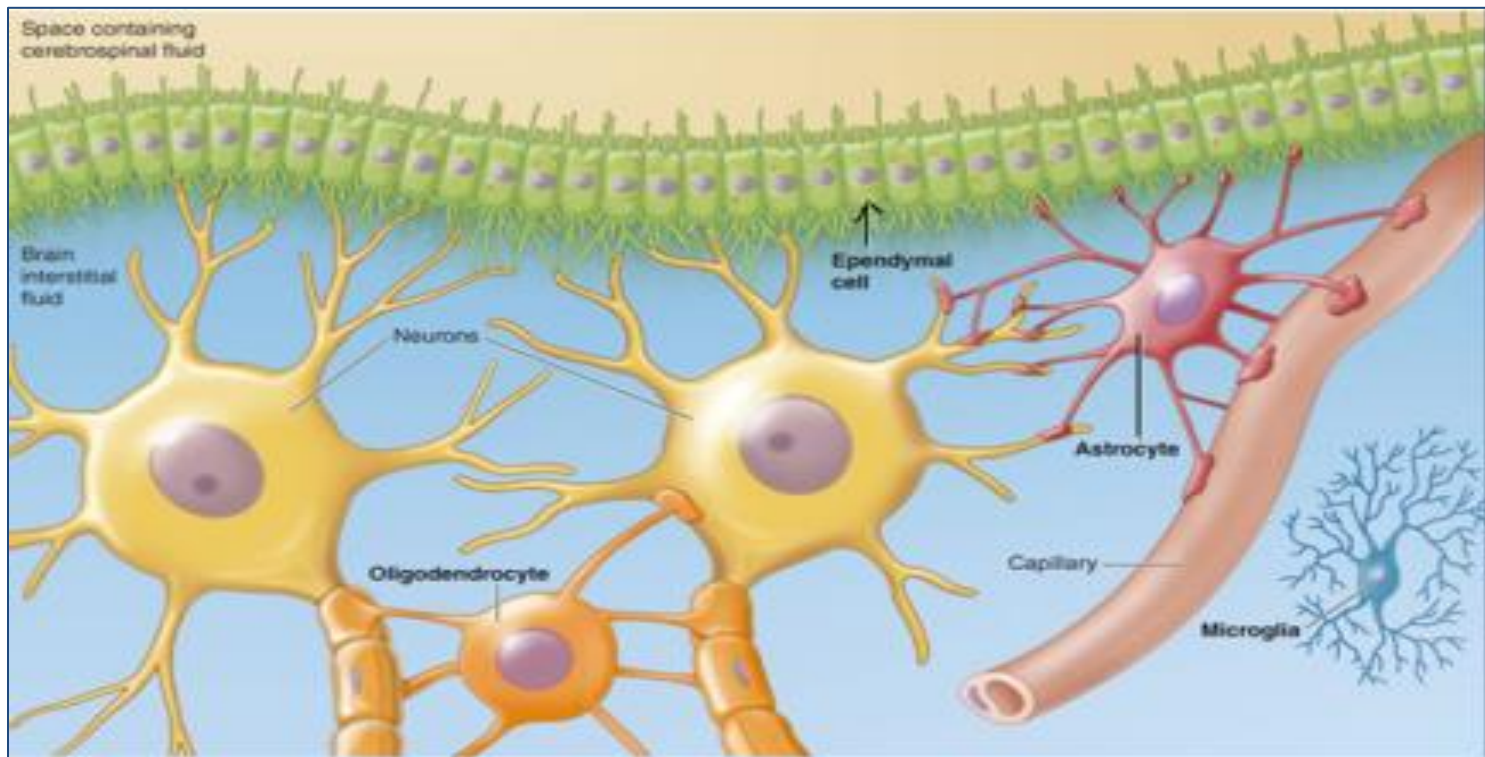


# Types of synapse

- Most synapses are **chemical synapses** and transmit nerve impulses through **neurotransmitters**.
- A very few synapses transmit the impulses through **gap junctions** that cross the pre- and postsynaptic membranes, ion do pass freely through these gap junctions and conduct the nerve impulses directly called **electric synapses**

# Glial cells

- They have short processes
- They support and protect neurons, and participate in many neural activities, neural nutrition, and defence of cells in the CNS

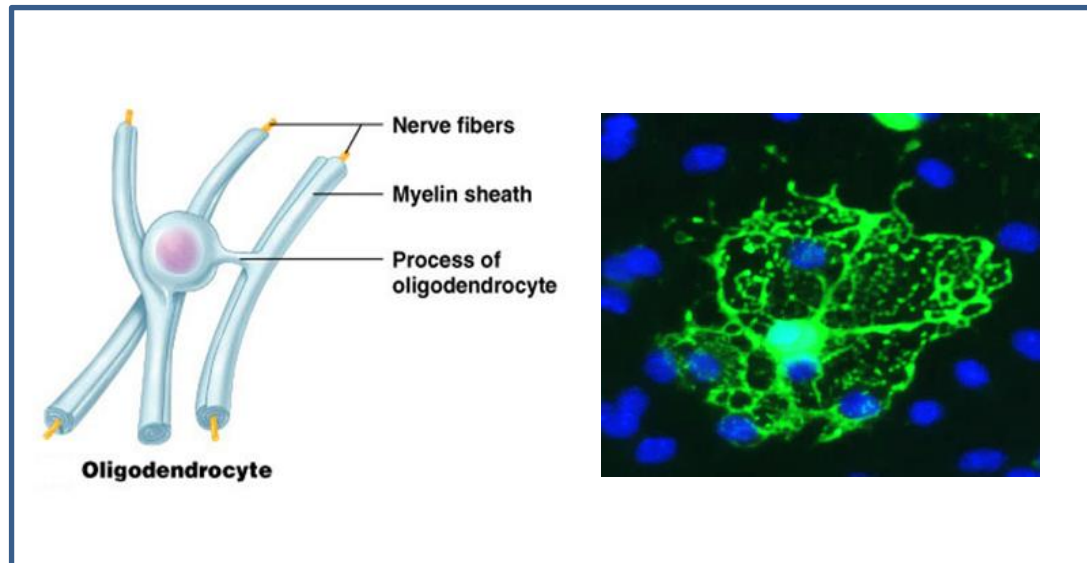


# Oligodendrocytes

(Gr. oligos, small, few + dendron, tree + kytos, cell)

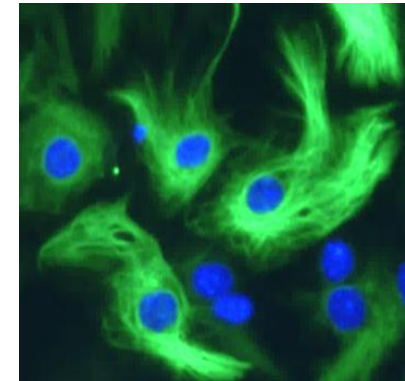
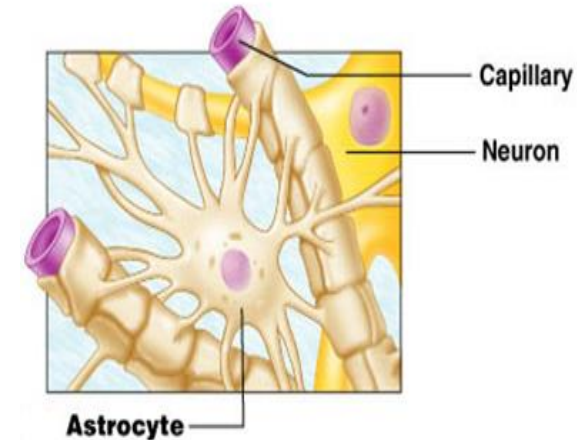
**1-** Myelinates and insulates axons

**2-** Allows faster action potential propagation along axons in the CNS



# Astrocytes

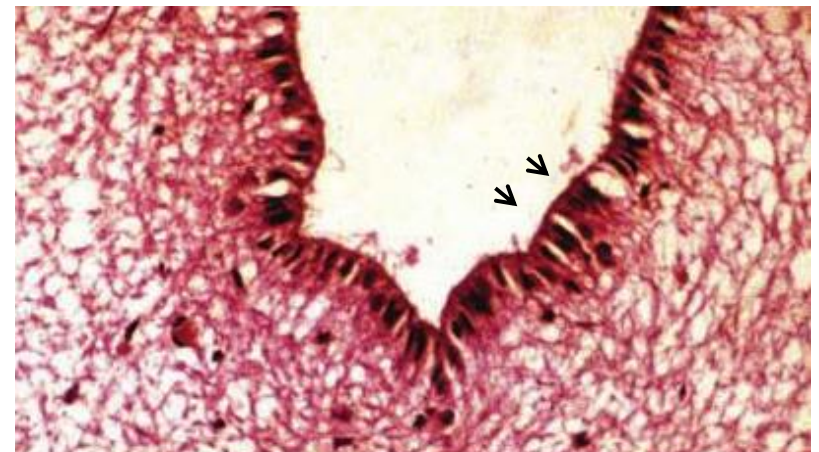
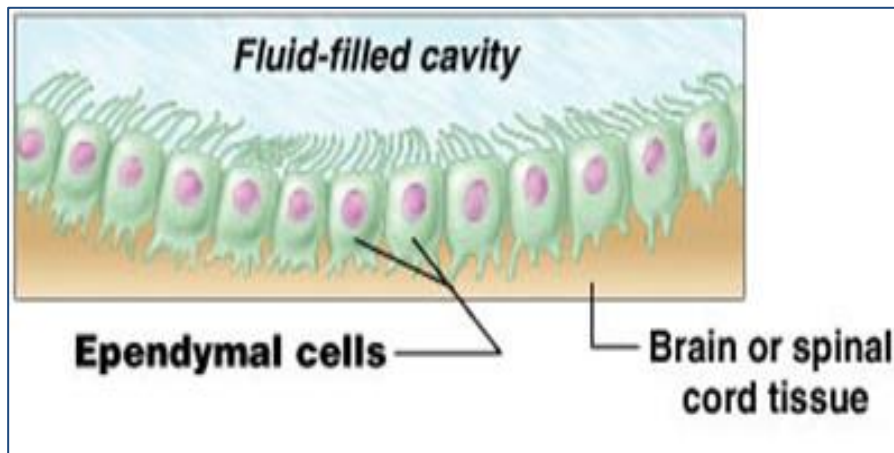
- Star shaped cells
  - Have multiple radiating processes
  - Have bundles of intermediate filament made of glia fibrillary acid protein that reinforce their structure
  - Astrocytes with few long processes are called **fibrous astrocytes** and located in the **white matter**
  - Astrocytes with many short branched processes are called **protoplasmic** and found in the **gray matter**
1. Helps form the blood-brain barrier (BBB)
  2. Bind neurons to capillaries and to pia mater
  3. Provides structural support and organization to the CNS
  4. Replicates to occupy space of dying neurons





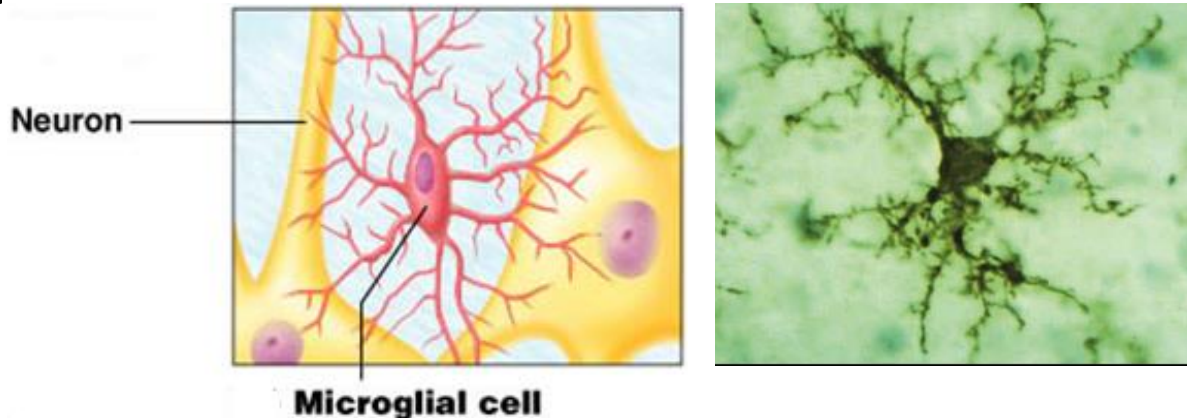
# Ependymal cells

- These cells are low columnar ciliated epithelial cells that line the cavities of the CNS.
- 1-** Line ventricles of the brain and central canal of the spinal cord
  - 2-** Assists in production and circulation of cerebrospinal fluid (CSF)



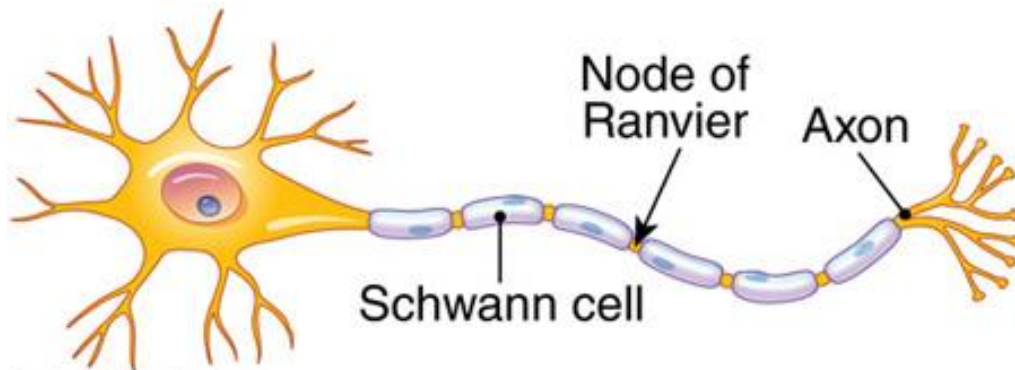
# Microglia

- Small elongated cells with short irregular processes
- They have elongated nuclei that contrast with the spherical nuclei of other glial cells.
- Microglia, phagocytic cells that represent the mononuclear phagocytic system in nervous tissue, they are involved with inflammation and repair in adult CNS

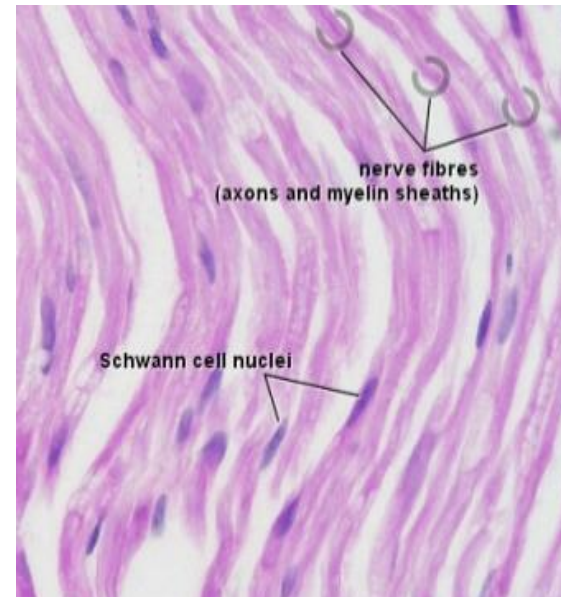


# Schwann cells

- Derived from the embryonic **neural crest**
- Located around axons in the PNS
- One Schwann cell forms myelin around one axon, in contrast to the ability of oligodendrocytes to branch and serve more than one neuron and its processes.



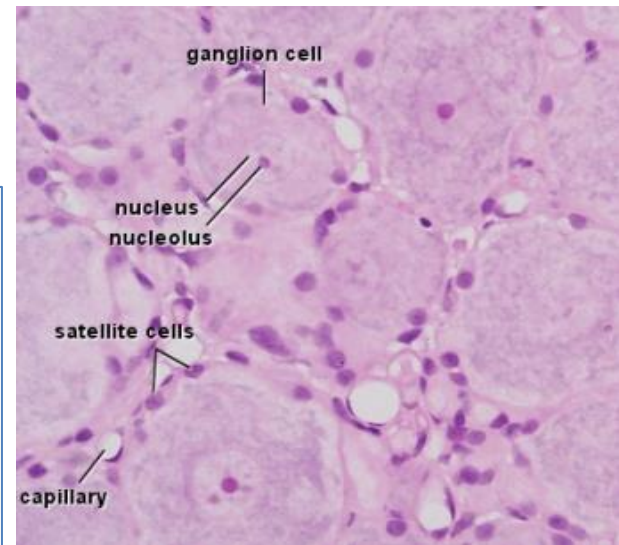
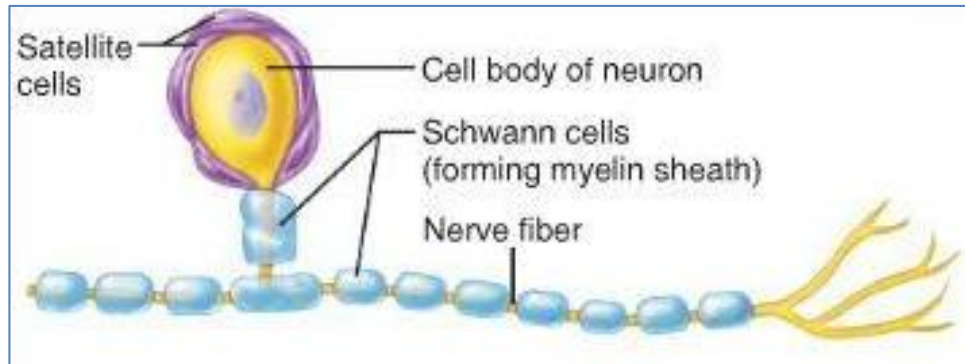
Courtesy Weaker/F.A. Davis



# Satellite cells

- Derived from the embryonic neural crest
- Located around the neuronal cell body in the ganglia of the PNS.

❖ Regulates nutrient and waste exchange for cell bodies in ganglia



# Quick questions

- What are the supporting cells in the central nervous system called?
- What is the cell body of a neuron called?
- Which cell is a macrophage found in the central nervous system?
- What are most neurons in the body?
- Name the cell that contributes to maintenance of the blood-brain barrier?
- List (2) types of cells populations that make up nervous tissue.
- What are the function of the ependymal cells?
- Name the two cells that responsible of myelin formation in the nervous system?

**Thank you for your attention**  
**Any questions?**