

Medical Biology

COLLEGE OF DENTISTRY

COLLEGE OF DENTISTRY
UNIVERSITY OF BASRAH

Nervous Tissue

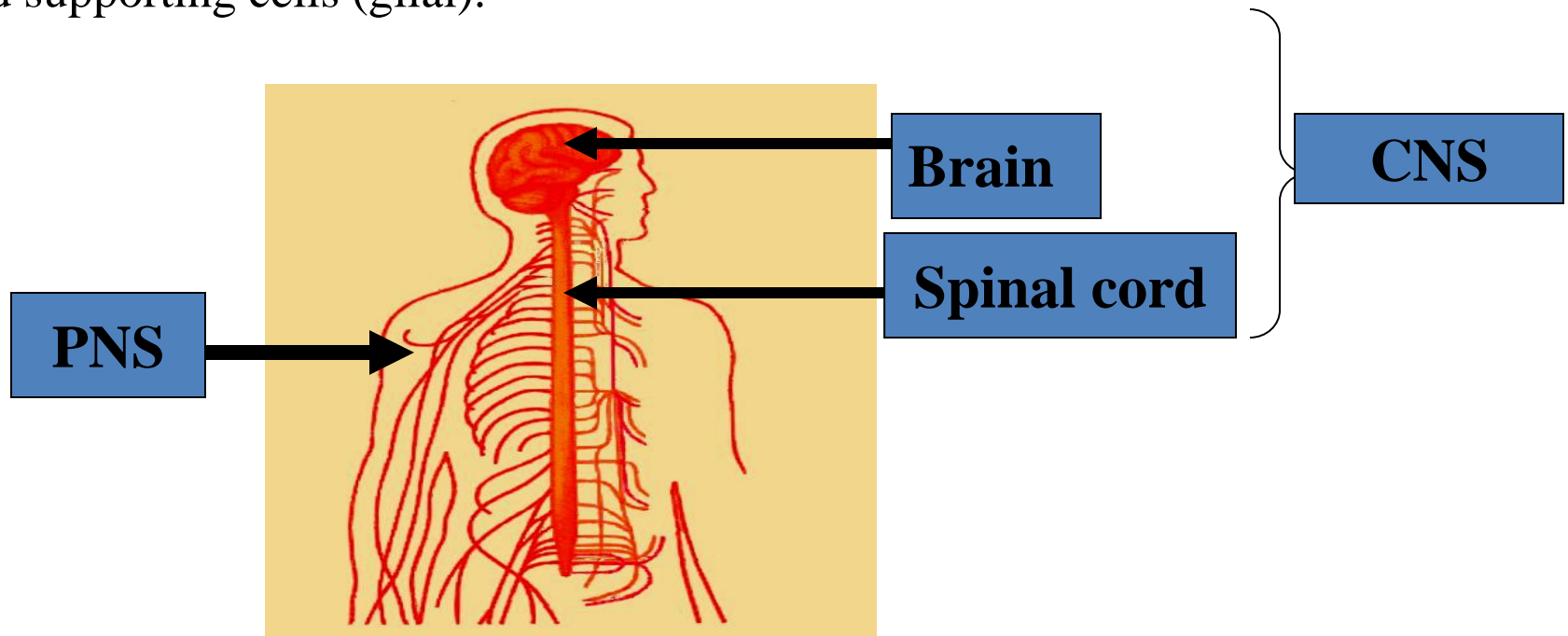
The Nervous tissues:

➤The nervous system consists of all nervous tissue in the body. It is divided anatomically into the central nervous system (CNS) and the peripheral nervous system (PNC). The CNS consists of the brain and the spinal cord, while the PNS consists of all neural tissue outside CNS.

➤The CNS receives and analyze the stimuli from the body, then send a proper signals by the PNS to integrate different activities of the body.

Nervous tissue of the CNS does not contain connective tissue other than that in the meninges and in the walls of large blood vessels.

➤The two types of cells that make up the nervous tissue are nerve cells (neurons) and supporting cells (glial).



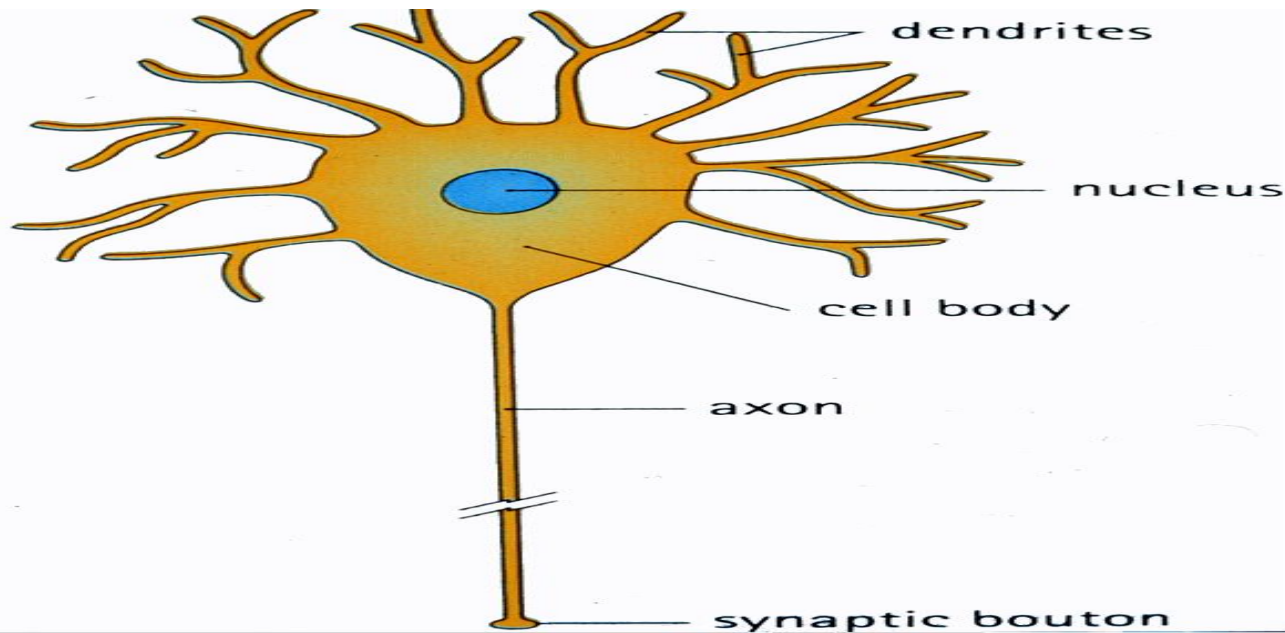
The neuron :

The neuron is the structural and functional unit of the CNS, responsible for receiving and processing the information from the environment and transmit a stimuli for a proper action. The typical neuron consists of the following structures:

1- Soma:- is the cell body which consisting a single large nucleus, perikaryon .

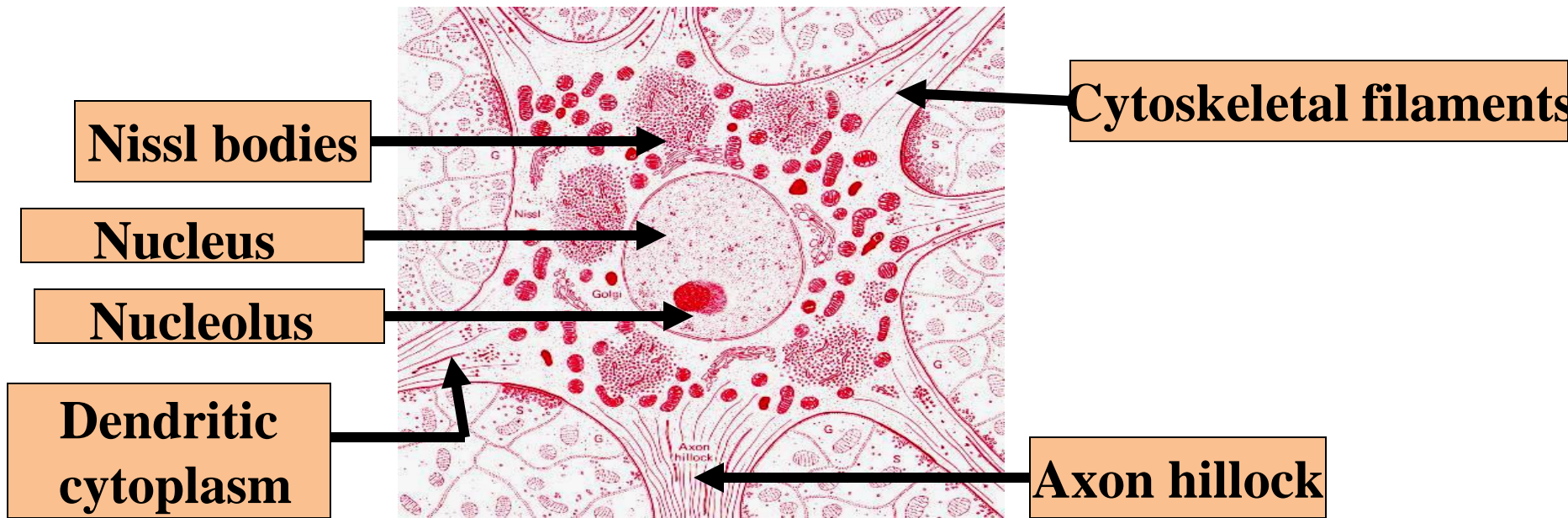
2- Dendrites:- the cytoplacmic processes which are radiated from the body. The dendrites conduct impulses from receptors or other neurons to the cell body .

3- Axon:- is a single long process extends from pyramidal area in the body called axon hillock . The axon conducts nerve impulses from the neuron to the dendrites or cell body of another neuron or to an effectors organ of the body (muscle or gland).



Structure of the neuron :

- 1- Contains the single pale-staining **nucleus** with large distinguished **nucleolus**.
- 2- Absence of **centrioles** (a phenomenon explain why there is no cell division in this type of the cells)
- 3- The cytoplasm contains abundant of basophilic granules known as Nissl bodies (rER), distributed throughout the cytoplasm except in the axon hillock.
- 4- Cytoskeleton of neuron is formed by **microtubules & neurofilaments** are found abundant in the cytoplasm of the soma and denderites as well as the axon to provide structural support and maintain the morphology of the cell.
- 5- The dendritic cytoplasm contain most of the cell organelles except Golgi bodies.
- 6- **axon hillock** – cone-shaped area from which axons arise



Types of the neurons:

According to the mode of branching, the neurons are classified into :

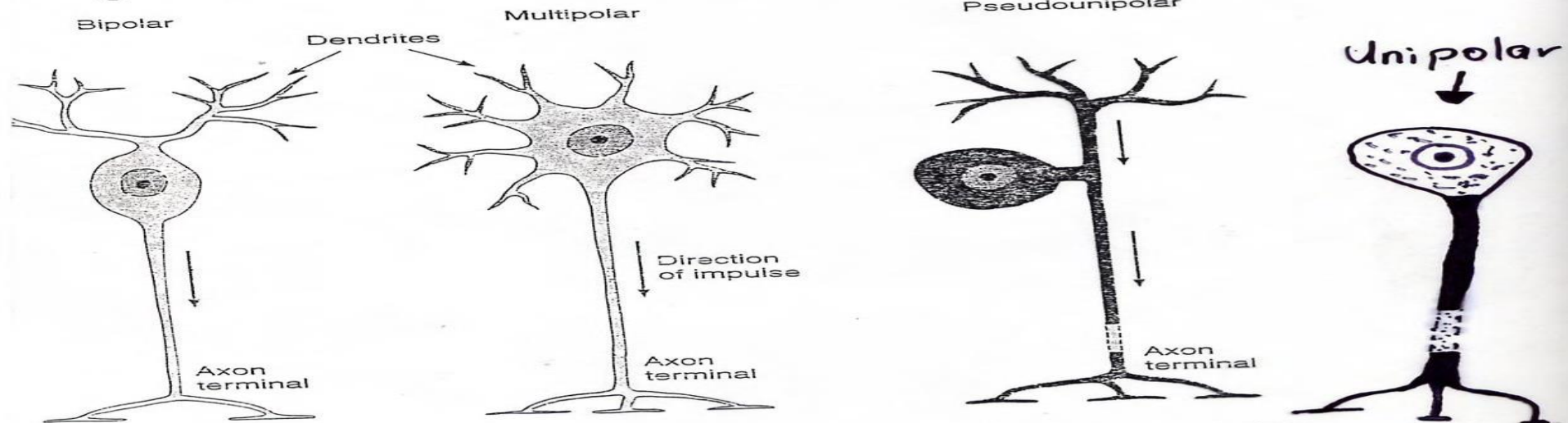
A. Unipolar neurons:- has axon and no dendrites.

B- Pseudounipolar neuron :- has T-shaped branched axon, but no dendrites.

C. Multipolar neurons:- have many dendrites and one axon extending from the cell body. This is the most common type of neuron in the human body.

D. Bipolar neurons :- have two processes extending from the body: one axon and one dendrite, These are rare and found only in special sense organs.

Diagram 4B MAIN TYPES OF NEURONS



Simplified view of the three main types of neurons, according to their morphology.

Neuroglial cells:

➤ Supporting cells in the Central Nervous System (CNS) are grouped together as Neuroglial cell . The function of neuroglial is to support, insulate, and protect the delicate neurons of the brain

➤ Can multiplying in mature nervous tissue

➤ Cannot generate or transmit the impulse

There are four basic types of neuroglial, based on morphological and functional features.

- Astrocytes**
- Oligodendrocytes**
- Microglia**
- Ependymal cells**

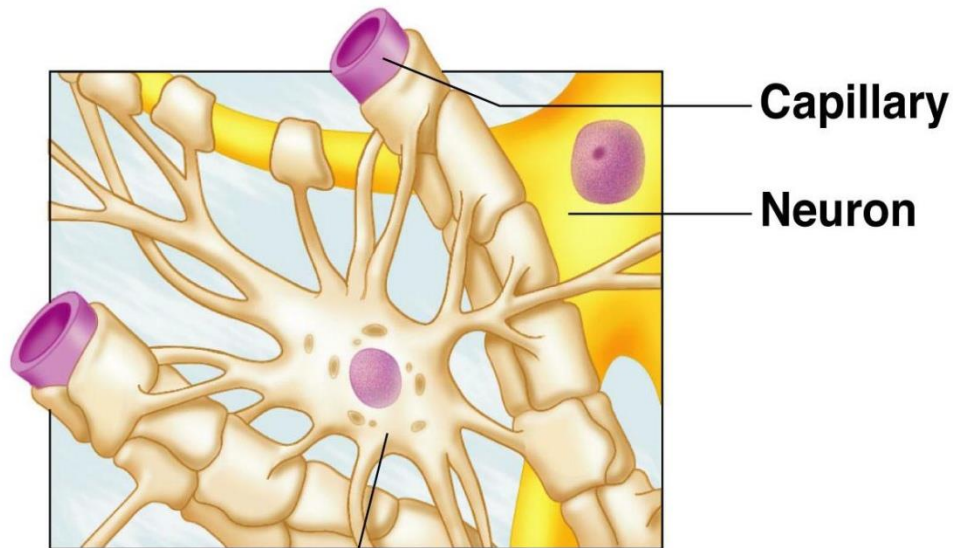
Astrocytes :

They are star-shaped cells present only in the CNS. They are the largest of the neuroglial and have many long processes, that attach to the walls of blood capillaries.

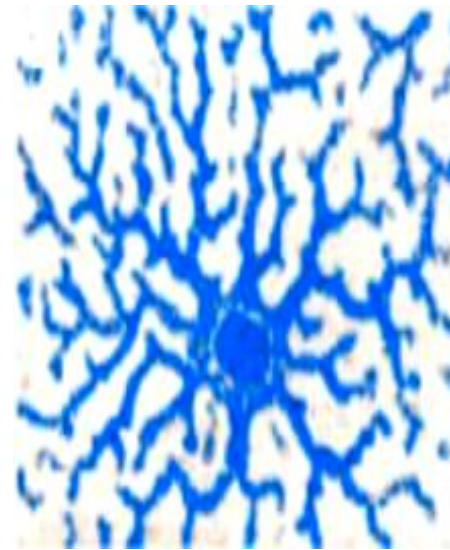
Astrocytes provide physical and metabolic support to the neurons of the CNS. They participate in the maintenance of the composition of the extracellular fluid.

There are two types of astrocytes:

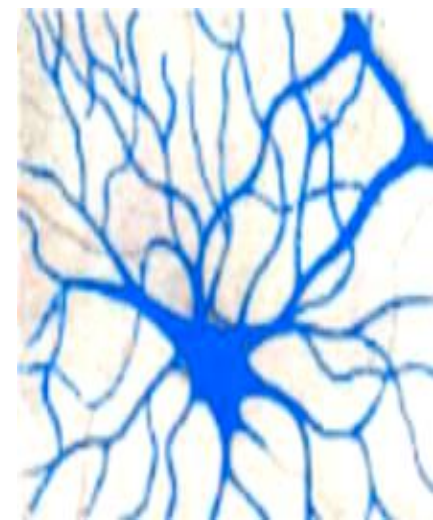
- **Protoplasmic astrocytes**:- These are present in the gray matter of the brain and spinal cord. Their processes are thick.
- **Fibrous astrocytes**:- These are present in the white matter of the CNS. Their processes are much thinner than those of the protoplasmic astrocytes.



(a) Astrocyte



Cytoplasmic astrocytes



Fibrous astrocytes

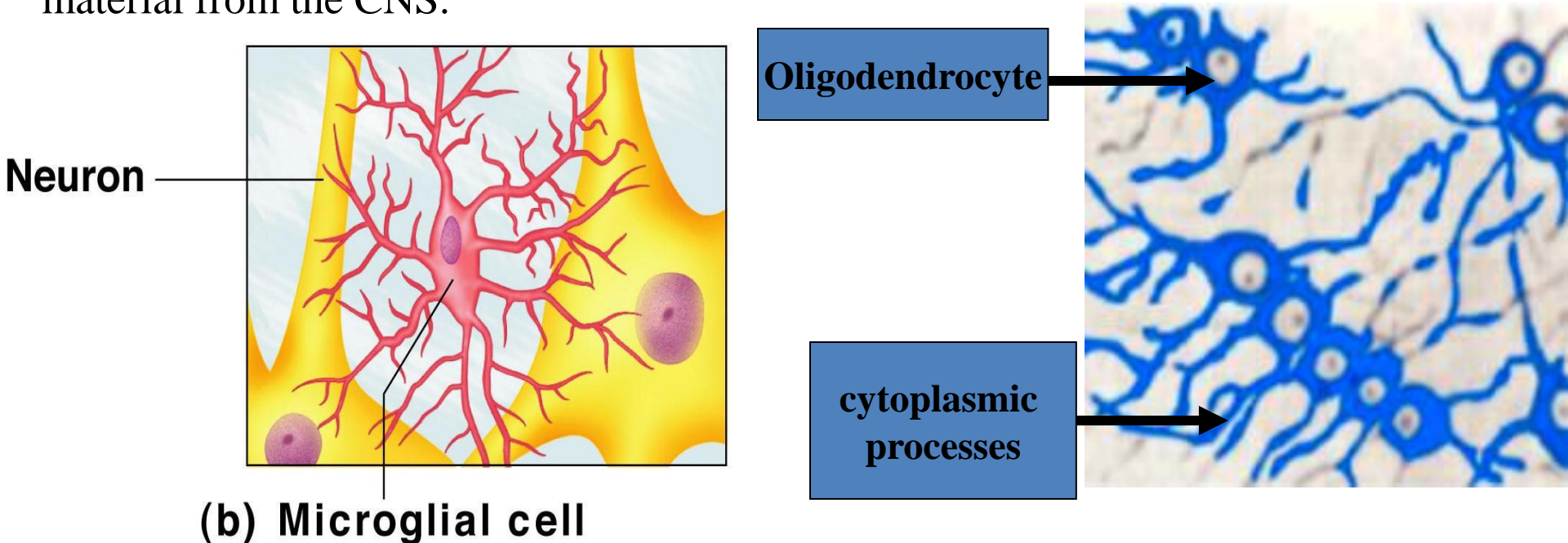
Oligodendrocytes

Small, rounded cells with few cytoplasmic processes . Oligodendrocytes form myelin sheath around axons in the white matter of CNS , Myelin is a fatty, provide insulation between the nerve fibers and allows the electrical signal to transmit faster.

Microglia

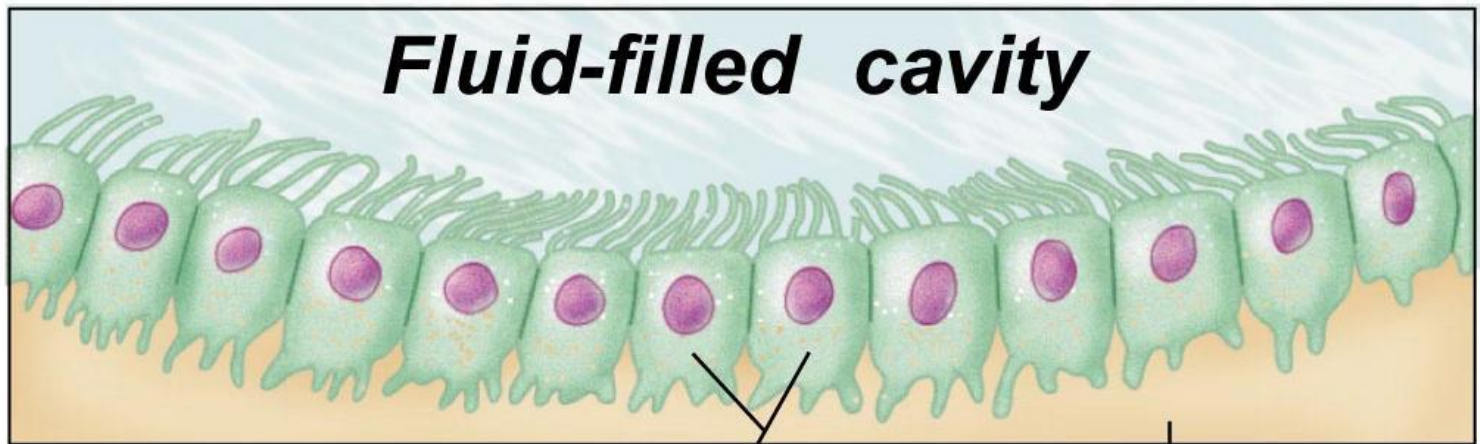
Spiderlike phagocytes, widely distributed throughout the gray and white matter of the CNS . Develops from monocyte .

These cells are involved in clearing the cellular debris and the damaged myelin material from the CNS.



Ependymal cells

- The ependymal cells are columnar ciliated epithelium, that line the internal cavities (ventricles) of the brain and spinal cord (central canal).
- These cells are involved in formation of the cerebrospinal fluid.



(c) Ependymal cells

Brain or spinal
cord tissue

Synapses:

- ❑ The synapses (Greek= Union) are sites through which the impulses are transmitted in one direction between the neurons or to another effected cells, as muscle fibers or glands.
- ❑ Most synapses are of chemical synapses, transmit impulses by releasing of neurotransmitters substance called acetylcholine.
- ❑ Others are electric synapses, conduct the impulses directly between the nerve cells.

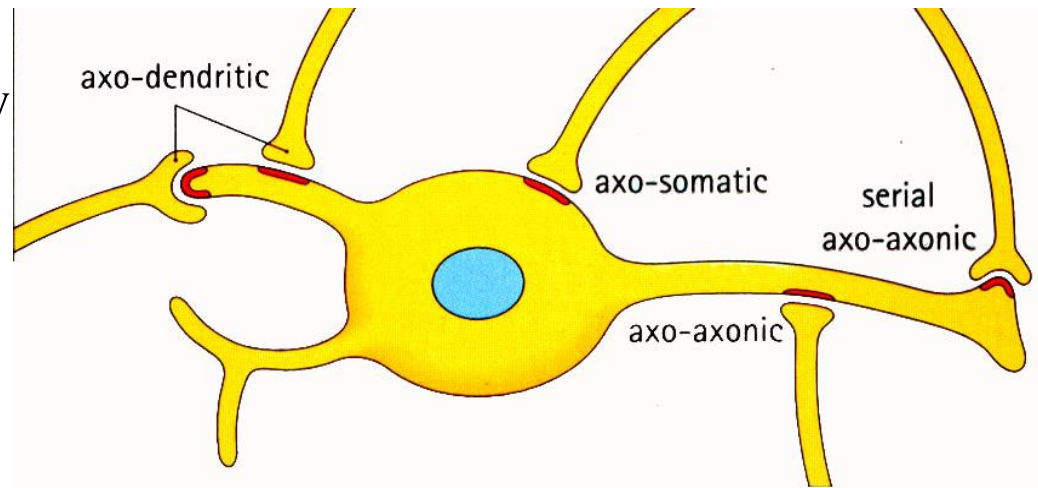
Types of the synapses :

According to the termination of the axon, synapses are classified into three types:

1- Axodendritic = axon to dendrite

2- Axosomatic = axon to cell body

3- Axoaxonic = axon to axon



Structure of the chemical synapses:

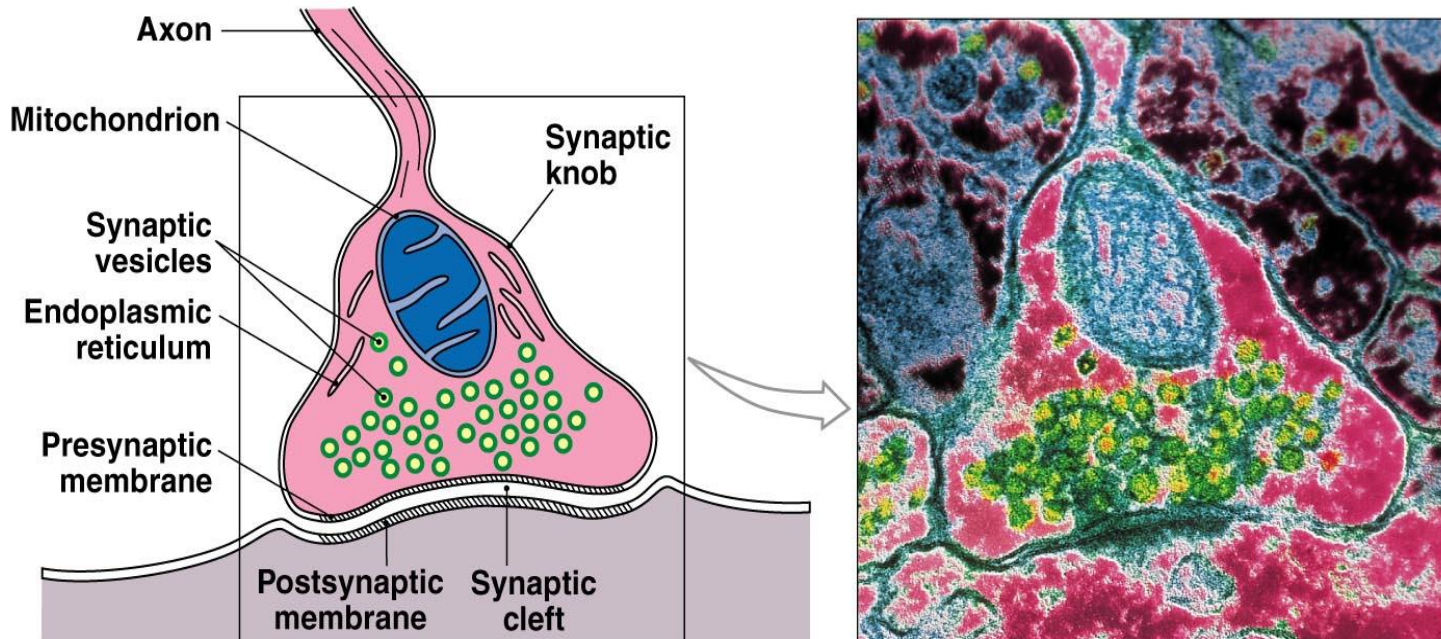
The synapse is formed of the following structures:

1- presynaptic :- is the terminal part of the axonal neuron delivers impulse by large number of neuro-vesicles contain the acetylcholine neurotransmitter substances.

Neurotransmitter = chemical substance, transmits signal from pre- to post- synaptic cell across synaptic cleft

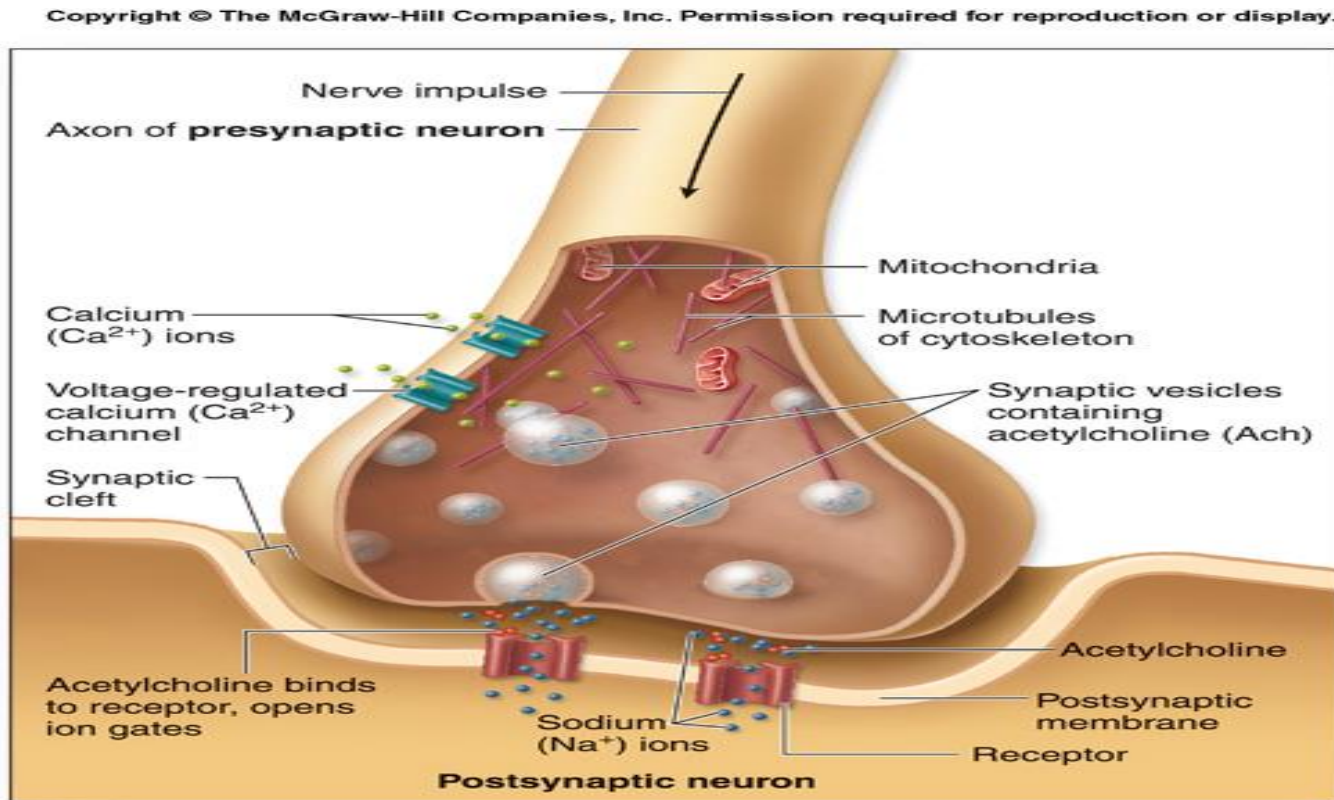
2-postsynaptic :- is part of the another cell (neuron or muscle), where the impulse is generated.

3- synaptic cleft :- is a thin intercellular space found between the presynaptic and post synaptic elements .



Mechanism of transmission of the impulses :

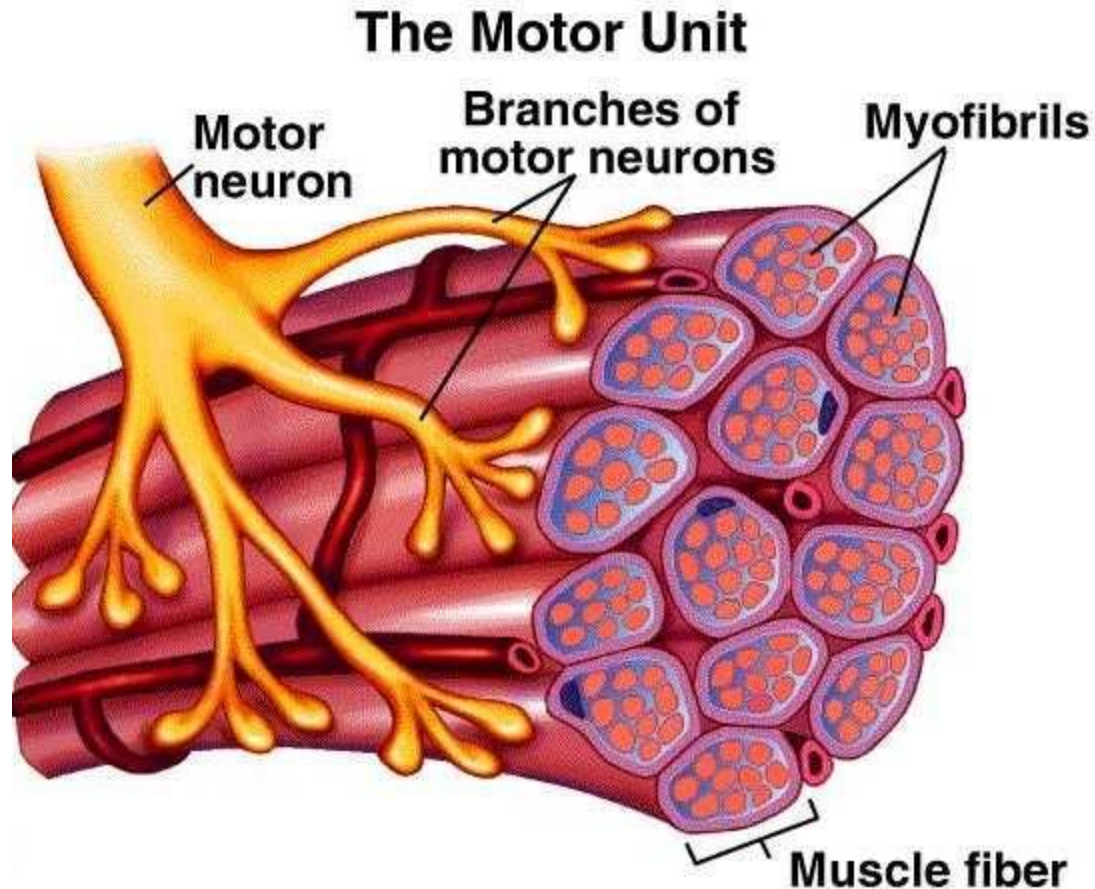
On stimulation, the neurotransmitter acetylcholine molecules are released from the vesicles of the presynaptic element to the synaptic cleft. Combination of the neurotransmitter molecules with the receptors of the plasma membrane of the postsynaptic neuron leads to activation of the impulse which is transmitted in the postsynaptic part of a neuron.



(b) Chemical synapse

Neuromuscular junction:

- ❑ The neuromuscular junction is another type of synapses
- ❑ Junction between motor neuron and muscle fiber
- ❑ The axonal ending and the muscle fiber are so close together, but they are not touched each other and remained separating by synaptic cleft(Neuromuscular cleft).



The central nervous system (CNS) :

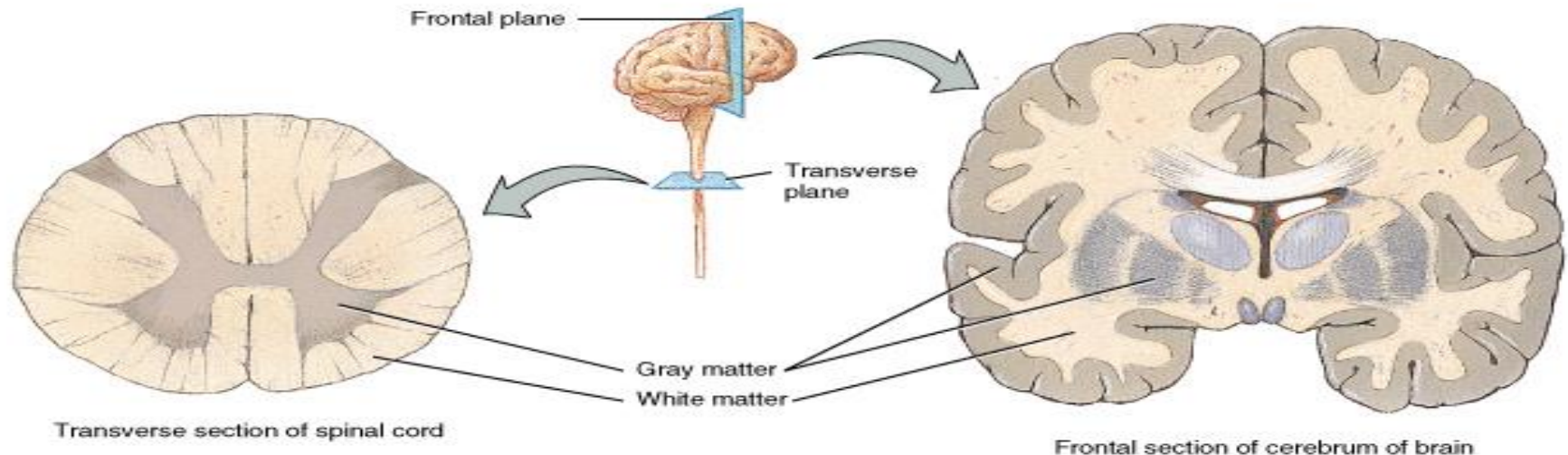
The central nervous system is the control center for the body. It regulates organ function, higher thought, and movement of the body. The central nervous system consists of the brain and spinal cord.

There are two general types of tissue in the CNS:

Gray matter consists of nerve cell bodies, dendrites, and axons.

White matter consists mostly of axons, causing it to look white due to the myelin sheathing of the axons.

Both tissues include a number of [glial](#) cells (although the white matter contains more), which are often referred to as supporting cells of the central nervous system.

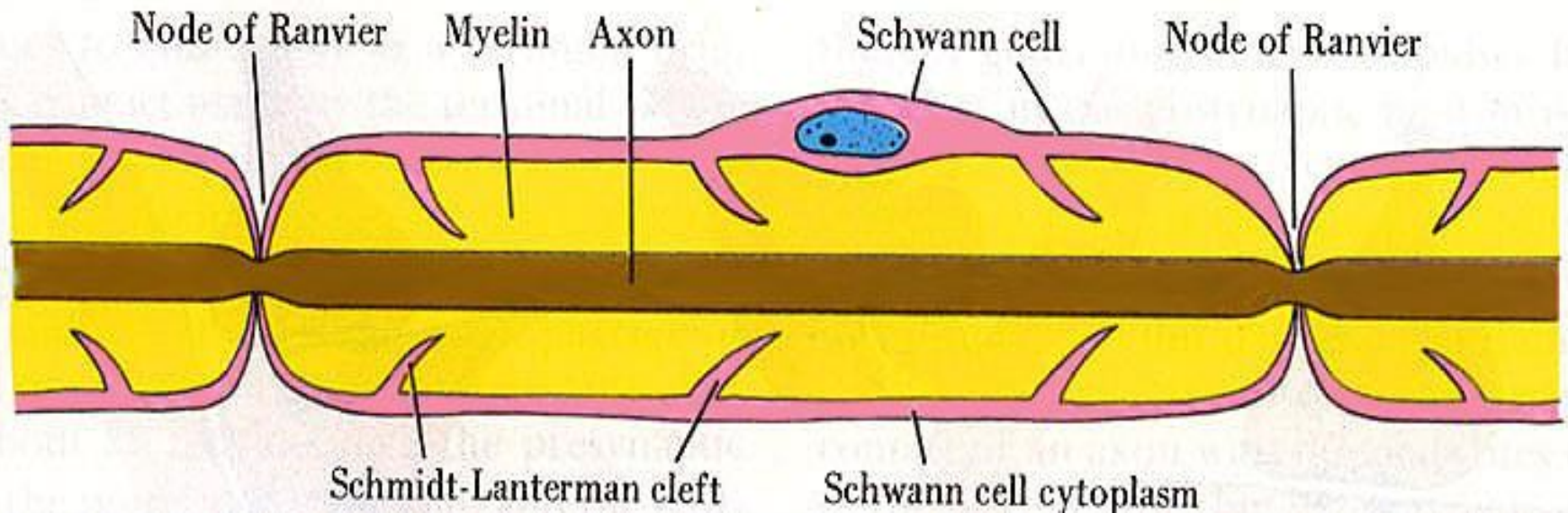


The nerve fibers:

➤ Consists of an axon and myelin sheath in the nervous system. There are nerve fibers in the central nervous system and peripheral nervous system. A nerve fiber may be myelinated and/or unmyelinated. In the central nervous system (CNS), myelin is produced by oligodendroglia cells. Schwann cells form myelin in the peripheral nervous system (PNS). Schwann cells can also make a thin covering for an axon which does not consist of myelin (in the PNS).

➤ In PNS, the myelin sheath of a nerve fiber is interrupted by a depressions known as nodes of Ranvier.

➤ The myelin sheath acts as insulator between the adjacent axons and it is greatly influences the ability of the axons to conduct impulses.



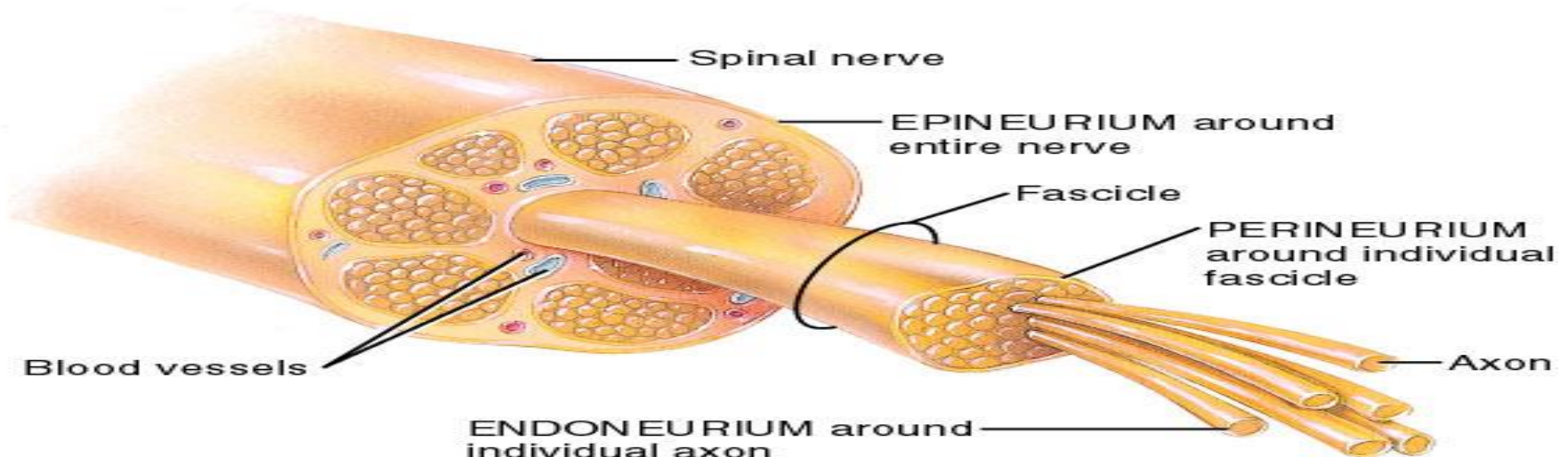
The peripheral nerves:

The peripheral nerves are part of the PNS, composed of bundles of nerve fibers surrounded by layers of C.T

1- Epineurium dense layer of connective tissue covering the external surface of the nerve, connects the nerve to the surrounding tissues.

2- Perineurium the thin layer of connective tissue surrounding the individual bundles (fascicle)

3- Endoneurium a layer of loose connective tissue surrounded the nerve fiber within a fascicle.

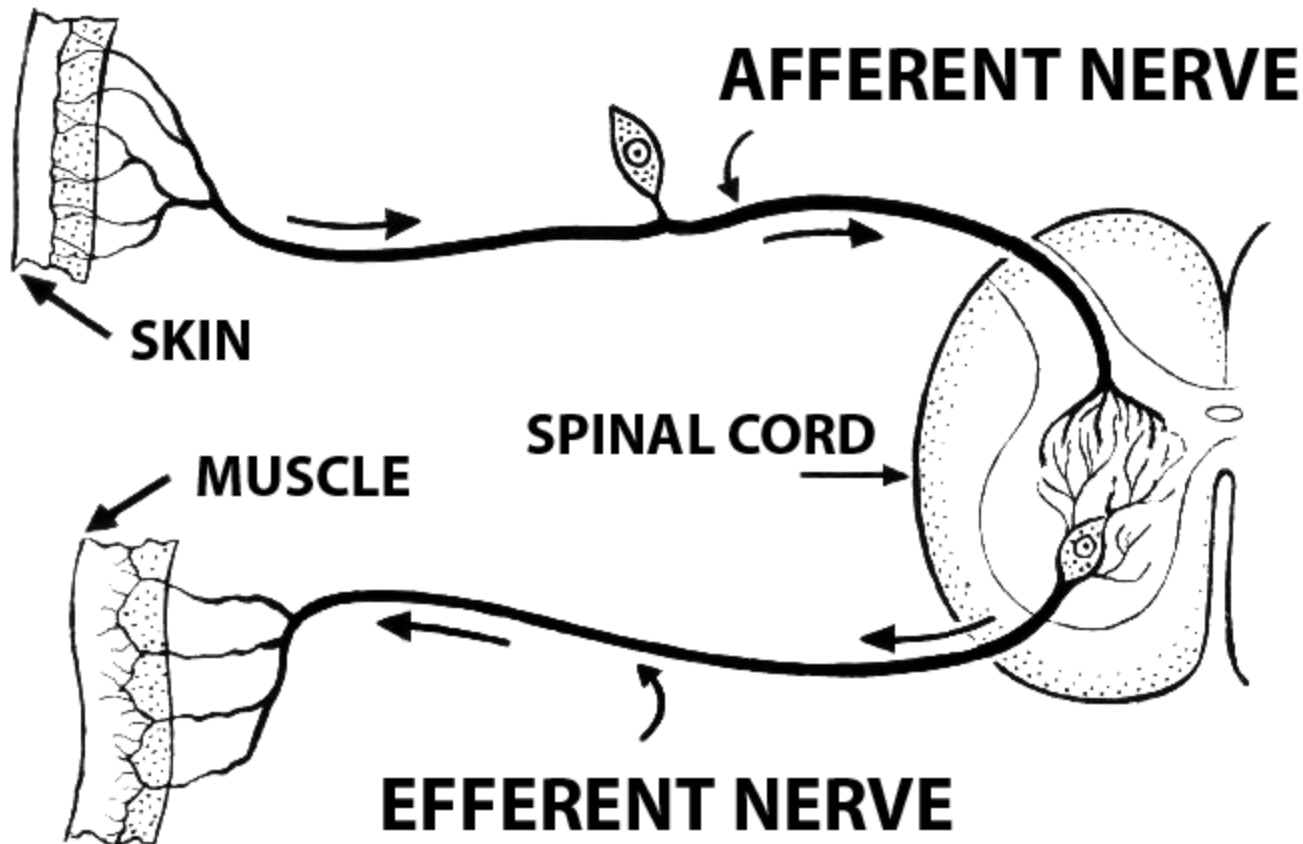


(a) Transverse section showing the coverings of a spinal nerve

In the peripheral nervous system, neurons can be functionally divided into:

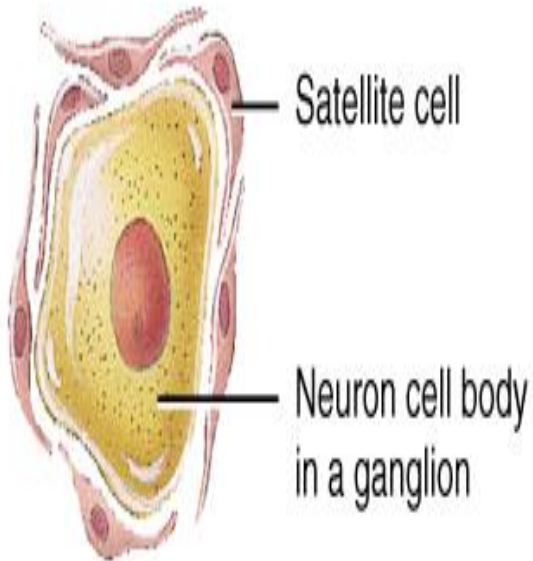
Sensory (afferent) fiber - carry information from the body (skin) and the environment to the CNS.

motor (efferent) fiber - carry a proper impulses from the CNS to the effectors organs, for a suitable response.



Ganglia

- The ganglia are aggregations of neuronal cell bodies encapsulated by a dense layer of connective tissue and located just outside the CNS.
- The ganglion neurons consist of large nucleus with distinguish nucleolus, surrounded by a cytoplasm lacking of Nissl bodies, but contain clumps of lipofuscin pigmented granules.
- The neurons of a ganglion are supported by small satellite cells, surrounded by a capsule of connective tissue.



Neurons

Satellite cells

