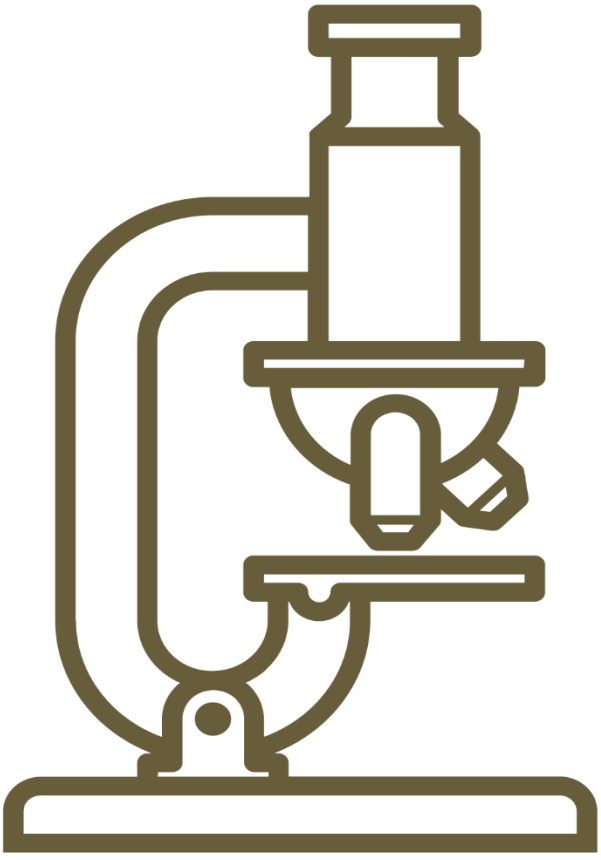
Teejan 2022

HISTOLOGY



SHEET NO.

18

WRITTEN BY: Roaa Ghandi

EDITED BY: Orjwan Al Amaireh

DOCTOR: Ghada Abu El Ghanam

Cell Body (Perikaryon or soma)

It's the biggest part of a neuron, Contains the nucleus and surrounding cytoplasm (has all the organelles (that doesn't mean that an axon doesn't, which we will discuss later)

• It acts as a trophic center. (Support the processes (axon and dendrites) with nutrients they need)

• Most are in contact with a great number of nerve endings conveying excitatory or inhibitory stimuli.

• Large, euchromatic nucleus with a prominent nucleolus (intense synthetic activity) sends neurotransmitters as a language to communicate with a neuron, muscle or a gland

• Nissl bodies NB (Nissl substance, chromatophilic substance): numerous free polyribosomes (ribosomes ماسكين بال MRNA) and highly developed RER.

• The amount of NB varies with the type and functional state of the neuron---abundant in large nerve cells (motor neurons)

• The Golgi apparatus is located only in the cell body.

• Mitochondria can be found throughout the cell and are usually abundant in the axon terminals.

Dendrite

Short, small processes emerging and branching off the soma.

One: bipolar none : psuedounipolar more than 1 : multipolar

• Covered with many synapses.the body and the axon also receive synapses but it depends on how many dendrites we have.

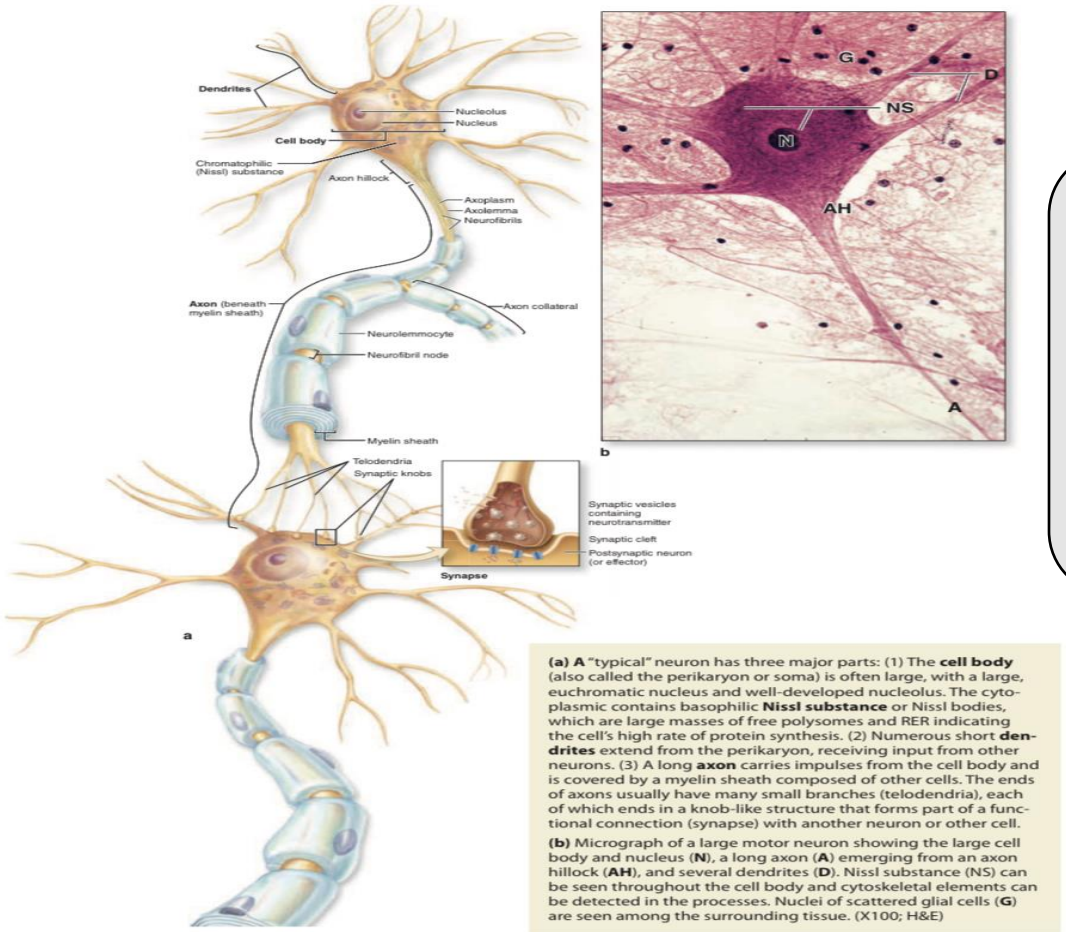
• Are the principal signal reception and processing sites on neurons.

• The large number and extensive arborization--- signals from many other nerve cells.

• Dendrites become much thinner as they branch.

• Unlike axons (بحافظ على ال diameter تاعه الا بس يوصل لل نهايات العصبية)

• Dendritic spines: dynamic membrane protrusions along the dendritic branches where most of the of the synapses occur



(a) A "typical" neuron has three major parts: (1) The **cell body** (also called the perikaryon or soma) is often large, with a large, euchromatic nucleus and well-developed nucleolus. The cytoplasmic contains basophilic **Nissl substance** or Nissl bodies, which are large masses of free polysomes and RER indicating the cell's high rate of protein synthesis. (2) Numerous short **dendrites** extend from the perikaryon, receiving input from other neurons. (3) A long **axon** carries impulses from the cell body and is covered by a myelin sheath composed of other cells. The ends of axons usually have many small branches (telodendria), each of which ends in a knob-like structure that forms part of a functional connection (synapse) with another neuron or other cell.

(b) Micrograph of a large motor neuron showing the large cell body and nucleus (**N**), a long axon (**A**) emerging from an axon hillock (**AH**), and several dendrites (**D**). Nissl substance (NS) can be seen throughout the cell body and cytoskeletal elements can be detected in the processes. Nuclei of scattered glial cells (**G**) are seen among the surrounding tissue. (X100; H&E)

N: nucleus

AH: axon hillock

D: dendrites

A: axon

G: glial cells

Arborization : (branching) how many tiny processes (dendrites) we have

** **more in dendrites than axons**

Cerebellum

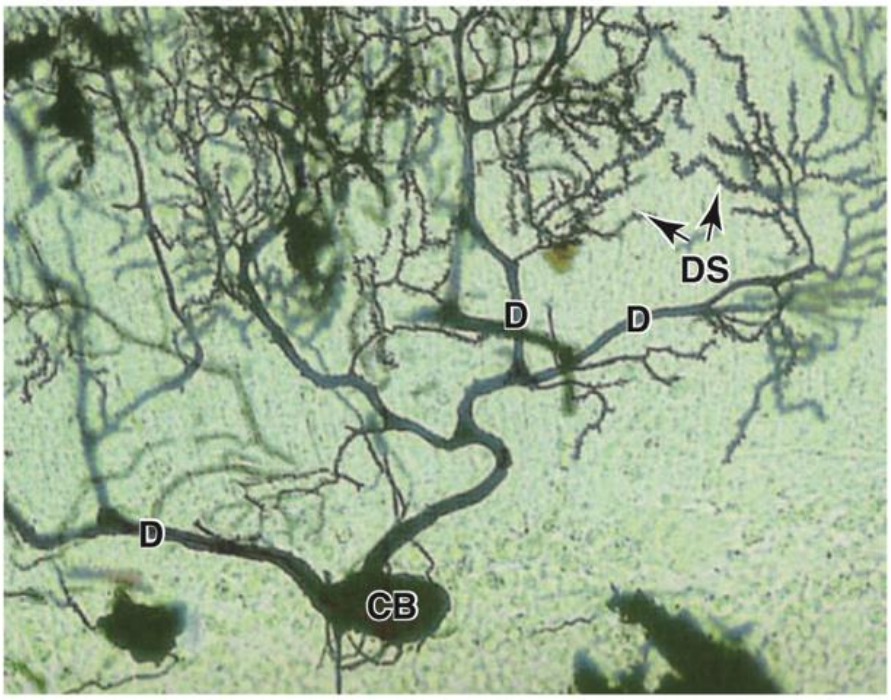
silver stain so we can see the membrane

D: dendrites

DS: dendritic spines

CB: cell body

FIGURE **9–5** **Dendrites and dendritic spines.**



Axon

It's so long that one of the motor ones can send commands from the spinal cord to the muscles of the big toe (1meter)!

• Most neurons have only one axon (some have none (anaxonic))

• Axonal processes vary in length and diameter ---type of neuron. (Which region we are talking about)

• Axolemma: plasma membrane, and axoplasm: its contents.

• Axon hillock: pyramid-shaped region of the perikaryon where axons originate from.

• Initial segment: concentrated ion channels which generate the action potential (initiation of action potential occurs here , but keep in mind that and an Action potential won't happen unless we got a summation of synapses that can start an Action potential)

• Axons branch less than dendrites---but undergo terminal arborization.

• Axons of interneurons and some motor neurons(multipolar) also have major branches called collaterals that end at smaller branches with synapses influencing the activity of many other neurons (effector or target).

• Terminal bouton: Small axonal branch ends with a dilation-- contacts another neuron or non-nerve cell. (rich in neurotransmitters) And the neurotransmitters **type** depend on

1- Part of nervous system
2- Function of a neuron

Lemma: plasma membrane Plasm : cytoplasm	Axons don't usually form highly branched endings , they would make very limited arborization

Dendrites are Actually considered more important than the cell body (many of them→ many synapses) but the body is fixed so it's not gonna lead to much…

- Axoplasm contains mitochondria, microtubules, neurofilaments, (intermediate filaments) and transport vesicles, but very few polyribosomes or cisternae of RER (dependence of axoplasm on the perikaryon).

ال Neurotransmitters وين بنصنعها يا محترمين؟

Inside the cell body so we need a method to transport to the terminals like motor proteins.

• Anterograde transport: away from cell body. Organelles and macromolecules synthesized in the cell body move along axonal microtubules(neurofilaments) via kinesin from the perikaryon to the synaptic terminals.

• Retrograde transport: (bouton → cell body) toward cell body. in the opposite direction along microtubules via dynein carries certain other macromolecules---endocytosis (including viruses and toxins). ليه مش بكتيريا؟ /// it's huge :)

• Anterograde and retrograde transports: 50-400 mm/d.

**anterograde is faster than retrograde **

الدكتورة حكت شوفوا مرض shingles بس ما أتوقع عندكم وقت 🥺

Synapses

• **factors**

Presynaptic cell (حتما Neuron)

Presynaptic axon terminal (terminal bouton) Neurotransmitter (synaptic vesicles)
Neuron kinesen on neurofilaments

Ca^{2+} !!!

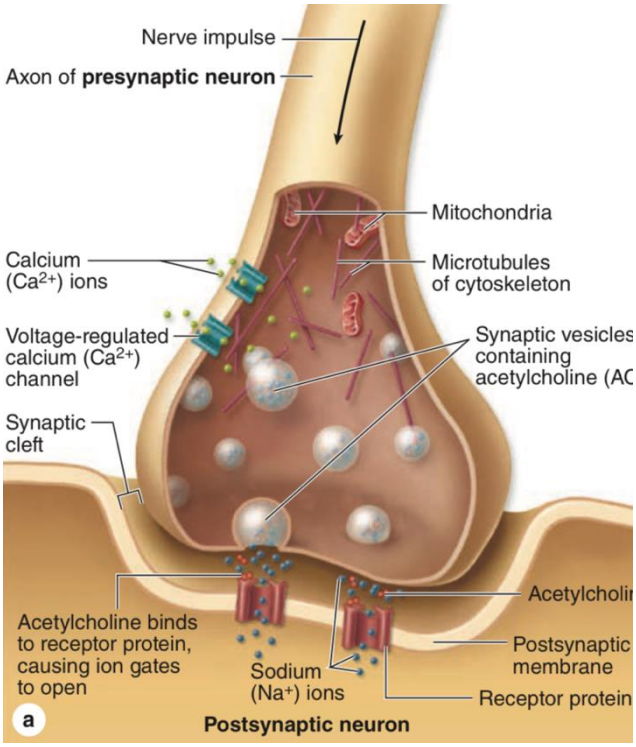
• Synaptic cleft

20- to 30-nm-wide intercellular space مكتوب فوق يسعد مساكم

• Postsynaptic cell (muscle, Neuron, Gland) Postsynaptic cell membrane

We took it physiology but we will not get into details : **vesicles have NT , when shall the vesicles fuse with the bouton? That depends on the arrival of The Action potential→depolarization in this region will lead to the opening of calcium channels and the ca+2 influx in the bouton → fusion of vesicles→ release of NT → synaptic cleft → binding to receptors→ opening of ion channels gates → Excitatory or inhibitory??**

حيتفصل كمان شوي لا تقلقوا ....



In this example we have acetylcholine but Remember it depends.. Neurotransmitters

Parasympathetic:Acetylcholine

Somatic motor : Acetylcholine

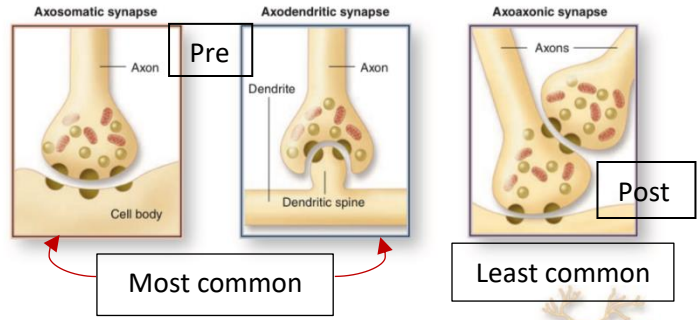
Sympathetic motor : Norepinephrine

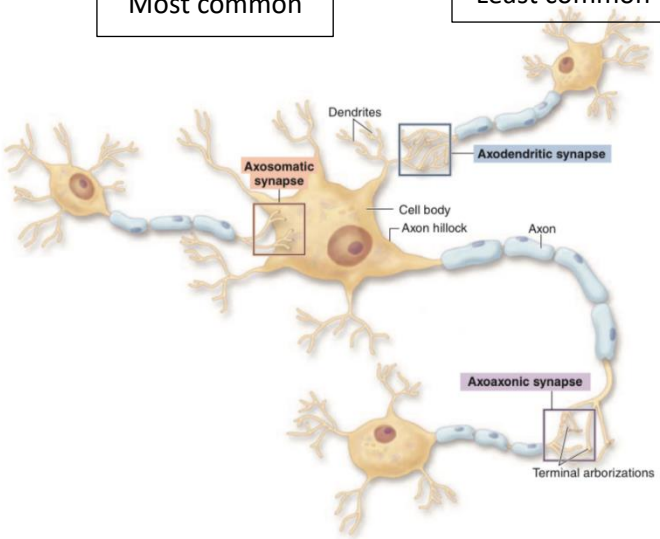
CNS

GABA or serotonin

So important….

Types of synapses





The diagrams show three common morphologic types of synapses. Branched axon terminals usually associate with and transmit a nerve impulse to another neuron's cell body (or soma) or a dendritic spine. These types of connections are termed an **axosomatic synapse** and an **axodendritic synapse**, respectively. Less frequently, an axon terminal forms a synapse with an axon terminal of another neuron; such an **axoaxonic synapse** functions to modulate synaptic activity in the other two types.

All three morphologic types of synapses have the features of all true synapses: a presynaptic axon terminal that releases a transmitter; a postsynaptic cell membrane with receptors for the transmitter; and an intervening synaptic cleft.

Synaptic structure usually cannot be resolved by light microscopy, although components such as dendritic spines may be shown with special techniques (Figure 9–5).

Notes about the axoaxonic :

**** discovered recently// not frequent that's why they neglected it وما انتبهولها// More frequent in the CNS**

 # Regulatory يعني it already has an Action potential , shall we let the action potential go or no?

Extra synapses will decide, يعني لو كان Inhibitory مش حيصير عنا releasing لل neurotransmitters

•Excitatory synapses cause postsynaptic Na+ channels to open--- depolarization wave in the postsynaptic neuron (or effector).

•Inhibitory synapses neurotransmitters open Cl- (or other anion), (more negative so there is no way an action could happen ☹) causing ---influx of anions ----- hyper-polarization--- membrane potential more negative--- resistant to depolarization.

• The response in postsynaptic neurons is determined by the **summation** of activity at hundreds of synapses on that cell.

Excitatory > inhibitory ———-> **propagation of an Action potential** 😭

Neurotransmitters

• Acetylcholine (Ach) (we saw it in the neuromuscular junction) in specific synapses it's used in CNS

• Monoamines (serotonin), catecholamines (dopamine)

• Amino-acids (GABA) (modified Amino-acids)

• Polypeptides (endorphins)(a bit Rare)

Glial cells

** They (act) as The connective tissue of the 😂 brain بس مش حتلاقي 😂

collagen fiber حول Neuron 😱 **

• Support neuronal survival and activities. (nourish)

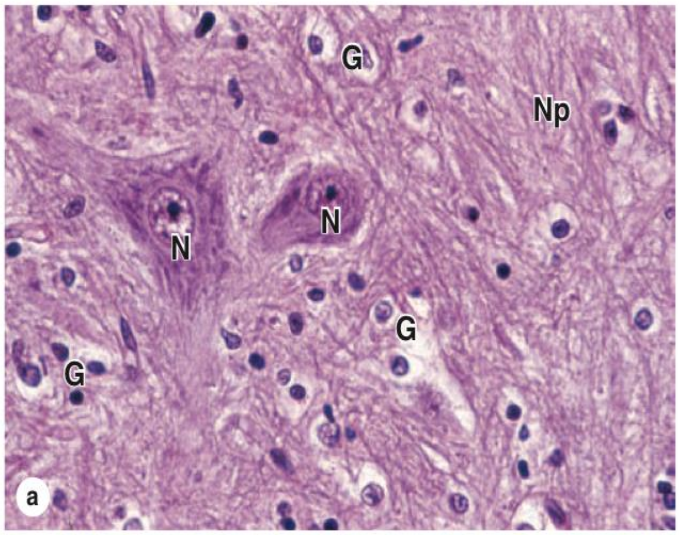
• Ten times more abundant.

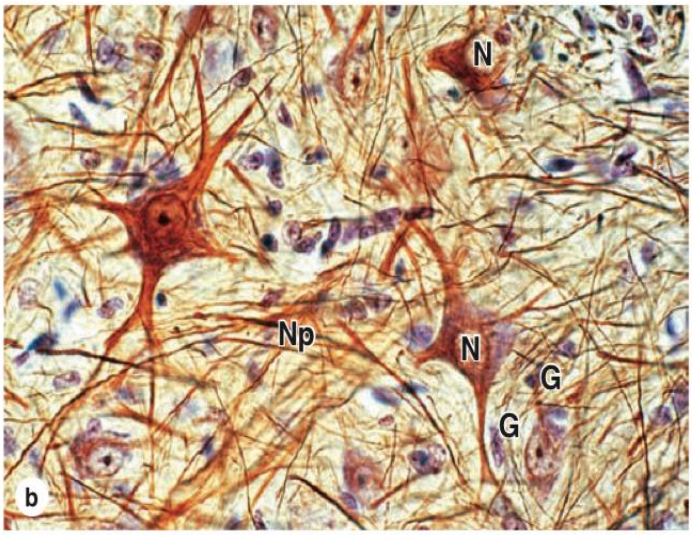
• Most glial cells develop from neural plate cells.

• In the CNS surrounds both the cell bodies and the processes of axons and dendrites (occupying the spaces between neurons). (look at figure 9-9)

• Substitute for cells of connective tissue creating immediately around those cells micro-environments that are optimal for neuronal activity.

• **Neuropil!!**





هاد اول اشي ممكن تفكره CT بس ال processes تاعت الglia وال collagen type 1 but it's not ☺ ال زي appearance بتعطي dendrites

**Gold staining to axons figure (b)

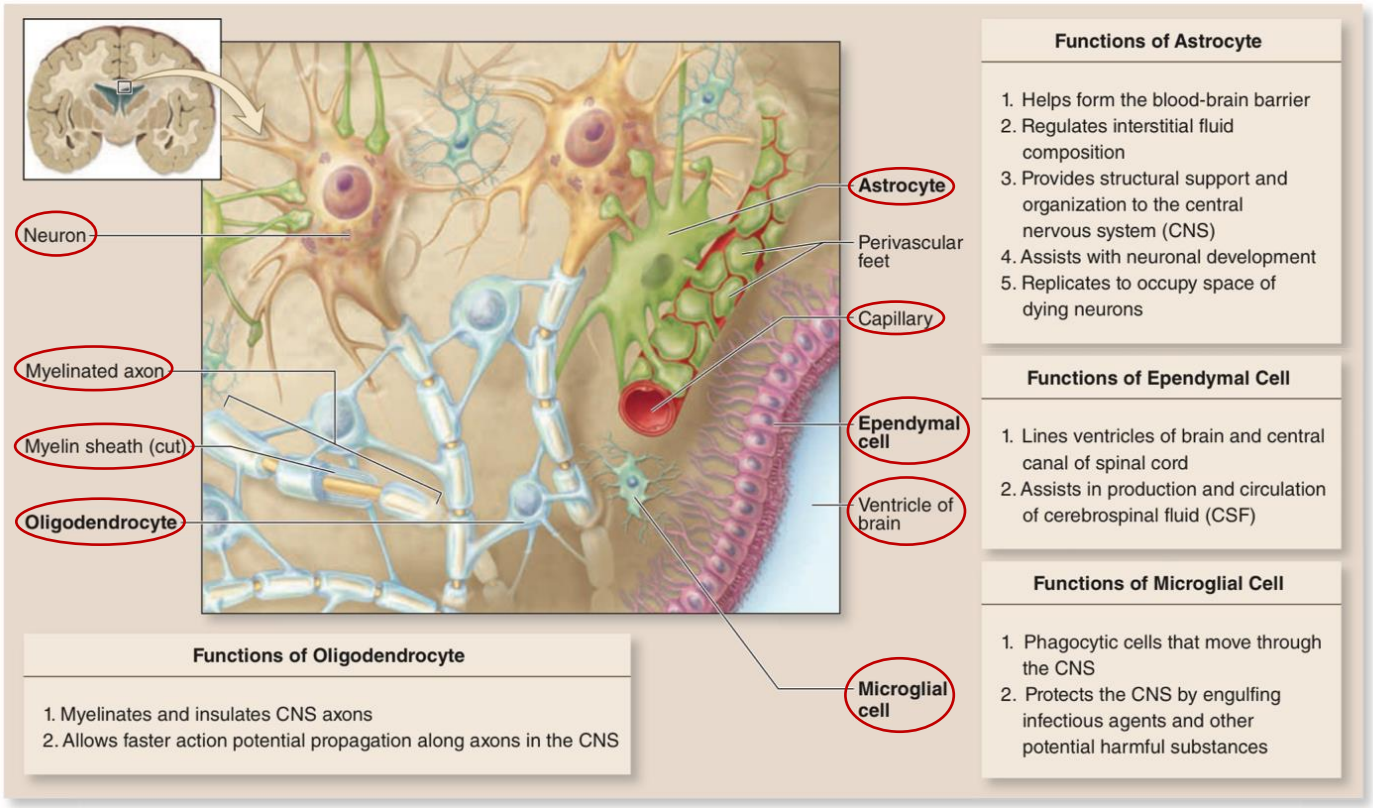
** figure (A) notice the difference in neurons and glial cells (neurons are a lot bigger than glial)

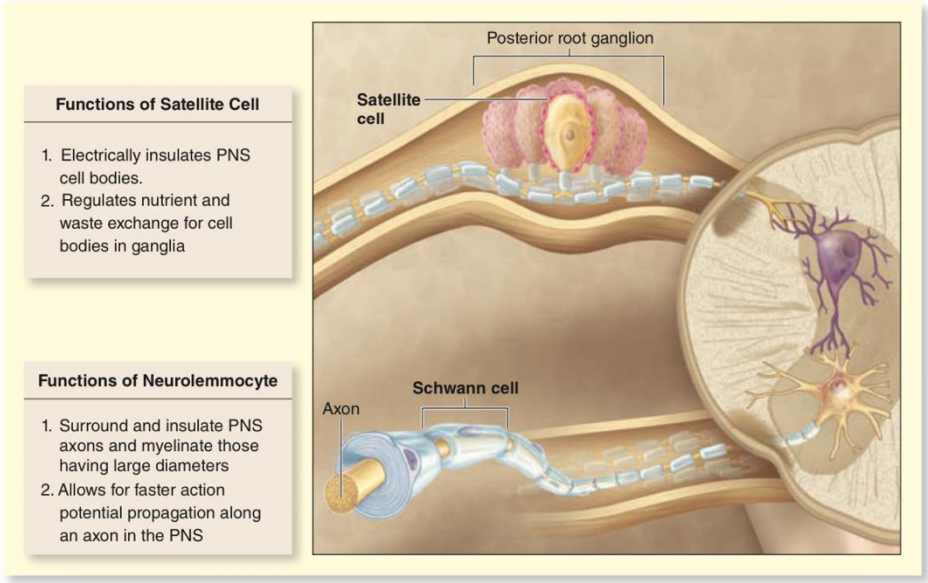
** N: Neural cell body

G: glial cells

Np: neuropil

FIGURE 9–9 Glial cells of the CNS and PNS.





(b)

We have in our brain spaces called ventricles which have the fluid (cerebrospinal fluid) and lined with glial cells.

The cells responsible for CSF secretion are the **Ependymal cells.**

(a) There are four major kinds of glial cells in the CNS: **oligodendrocytes, astrocytes, ependymal cells, and microglial cells**. The interrelationships and major functions of these cells are shown diagrammatically here.

(b) Two glial cells occur in the PNS: **Schwann cells** (sometimes called neurolemmocytes), which surround peripheral nerve fibers, and **satellite cells**, which surround the nerve cell bodies and are thus found only in ganglia. Major functions of these cells are indicated.

TABLE 9–2 Origin, location, and principal functions of neuroglial cells.

Glial Cell Type	Origin	Location	Main Functions
Oligodendrocyte	Neural tube	CNS	Myelin production, electrical insulation
Astrocyte	Neural tube	CNS	Structural and metabolic support of neurons, especially at synapses; repair processes
Ependymal cell	Neural tube	Line ventricles and central canal of CNS	Aid production and movement of CSF
Microglia	Bone marrow (monocytes)	CNS	Defense and immune-related activities
Schwann cell	Neural crest	Peripheral nerves	Myelin production, electrical insulation
Satellite cells (of ganglia)	Neural crest	Peripheral ganglia	Structural and metabolic support for neuronal cell bodies

Astrocytes send their processes to wrap the blood vessel , we have something Called the BBB (Blood Brain Barrier) // the endothelial cells of the BV have extra junction with each other and the thing that can pass will face the Astrocytes

The Blood Brain Barrier choose what can pass to the brain and what can't for example It doesn't allow some antibiotics to reach the brain so if we got an infection in the Brain so what can pass the plasma membrane? Any lipid-soluble substance such as alcohol .. So, we need special antibiotic to treat the infection.

Central Neuroglia

Astrocytes

- **Have a large number of long radiating, branching processes**
- **Terminal processes of a single astrocyte associate with over a many synaptic sites.**
- **Astrocytes originate from neural tube cells.**
- **Most numerous glial cells of the brain.**
- **Most diverse structurally and functionally.**
- **Fibrous astrocytes--- white matter ---- long delicate processes**
- **Protoplasmic astrocytes--- gray matter----- shorter processes.**
- **Astrocytes communicate directly with one another via gap junctions**

Astrocytes proliferate to fill the gap of any dead neural cells

(remember neural cells can't regenerate themselves)

Oligodendrocytes

- Extend many processes---sheet-like and wraps repeatedly around a portion of a nearby CNS axon (myelin: electrical insulation—rabid transmission of impulses)
- Many oligodendrocytes for axon's full length (And can wrap more than one axon)
- Are the predominant glial cells in white matter.
- Appear as small cells with rounded, condensed nuclei and unstained cytoplasm.

Ependymal cells

- Columnar or cuboidal cells that line the ventricles of the brain and the central canal of the spinal cord.

Microglia (monocytes and macrophage of the brain which remove any debris)

- Less numerous.
- Throughout gray and white matter
- Microglia migrate, with their processes
- Constitute the major mechanism of immune defense in the CNS, • Originate from circulating blood monocytes

Peripheral Neuroglia

Schwann cells(every cell wraps one axon)

- Are found only in the PNS
- Differentiate from precursors in the neural crest.
- Are the counterparts to oligodendrocytes of the cns,
- Having trophic interactions with axons and most importantly forming their myelin sheathes. • Forms myelin around a portion of only one axon.

Satellite cells of ganglia

- Derived from the embryonic neural crest,
- Form a thin glial layer around neuronal cell body in the ganglia.

THE END OF SHEET #18

هاد اول شيت الي 😊 فإن أصَبت فمن الله وإن أخطأت فمنّي .. الله يوفقكم يا دفعة. ❤