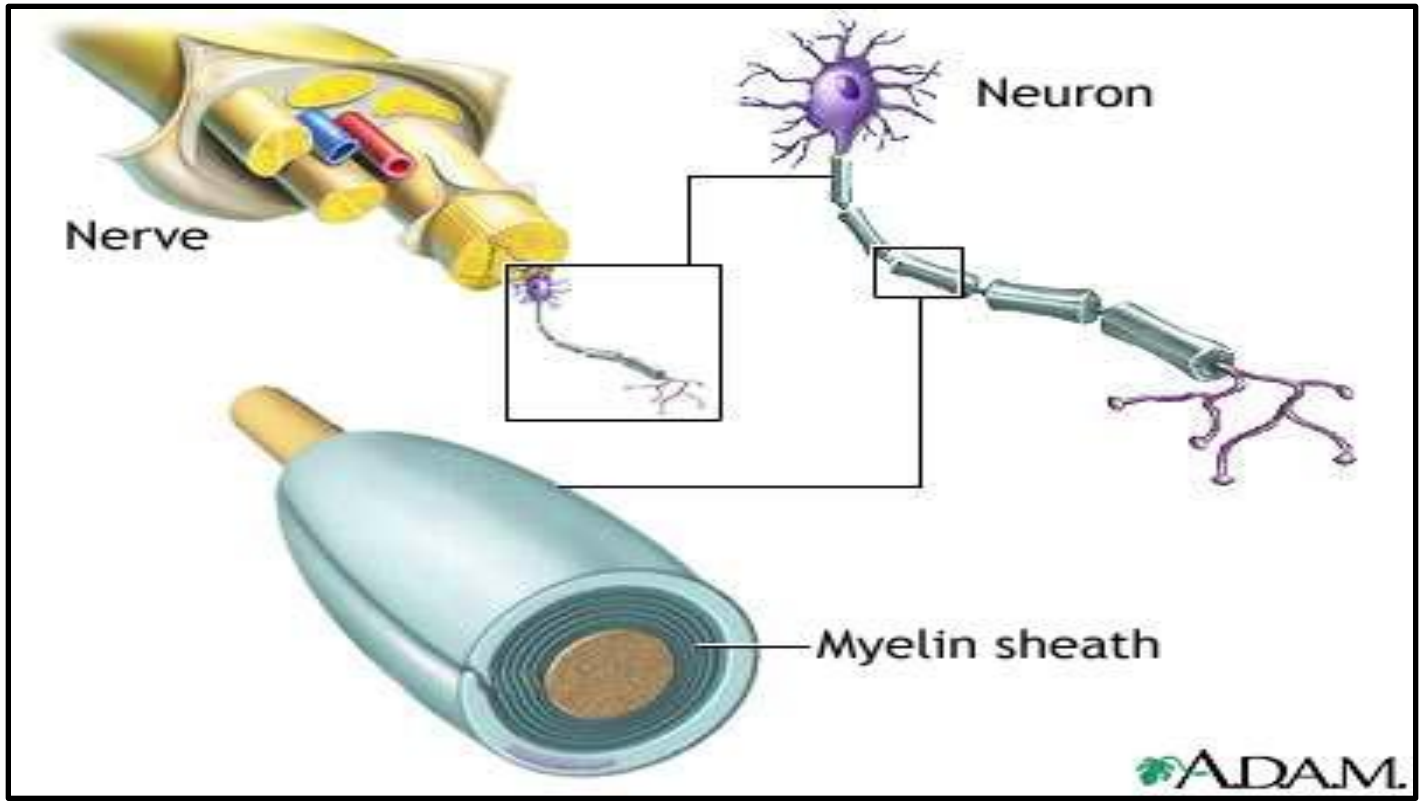
NERVOUS TISSUE-1



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According to the anatomical location, nervous system is divided into:

❑ Central nervous system (C.N.S.)

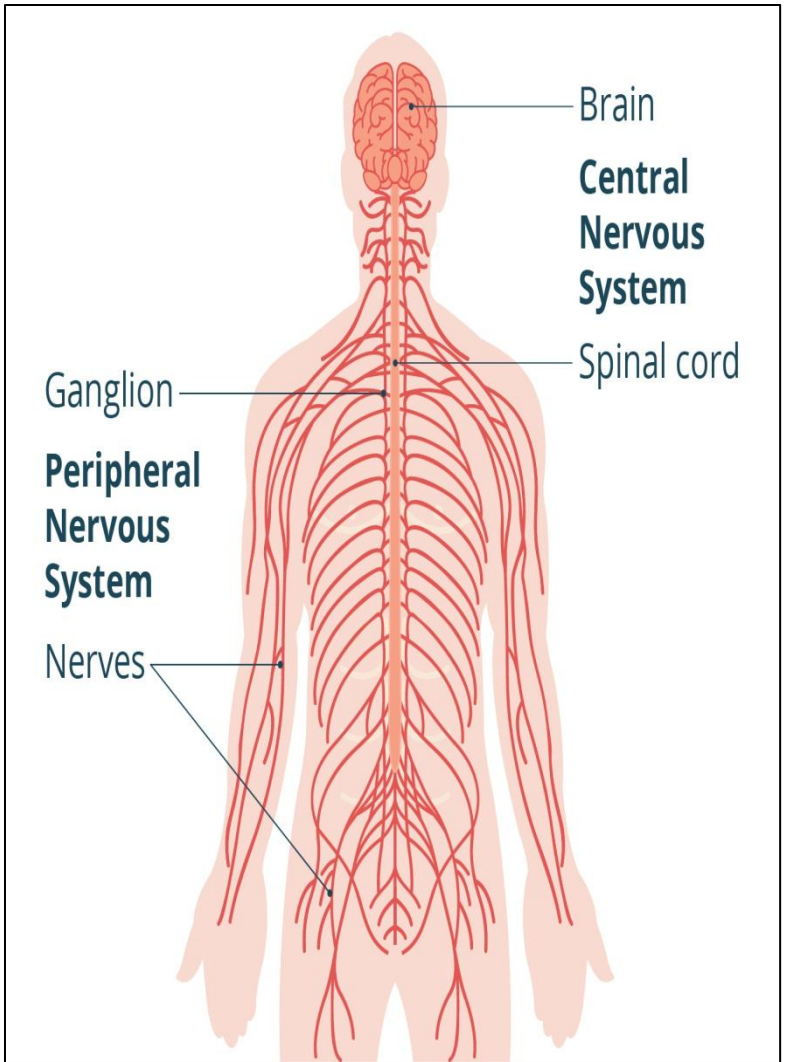
- It is the part of the nervous tissue which is surrounded and protected by bone.
- It consists of :

1. the brain
2. spinal cord.

❑ Peripheral nervous system (P.NS.)

- It is the part of the nervous tissues which is not surrounded by bone.
- It consists of:

1. cranial and spinal nerves
2. ganglia.



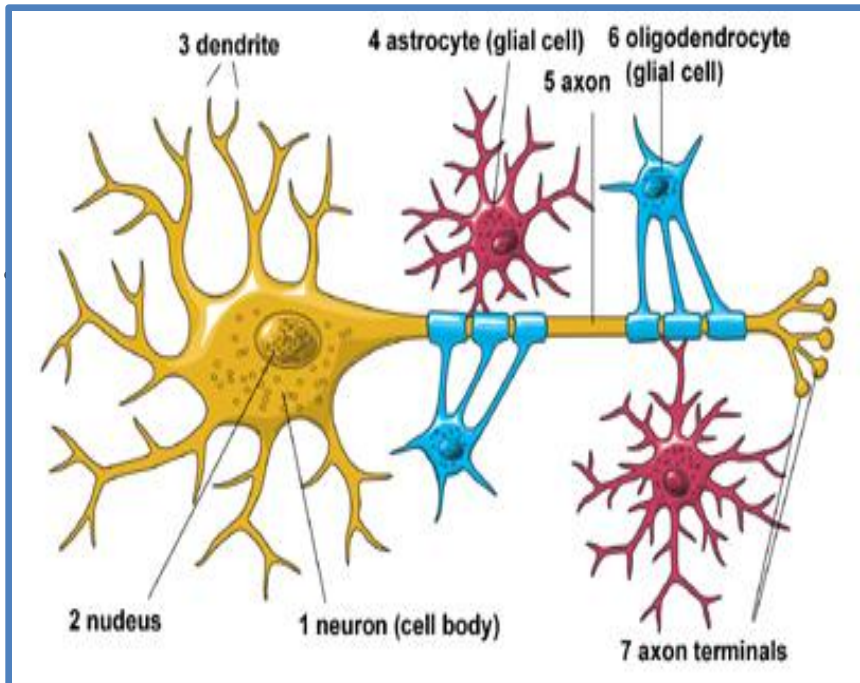
Nervous tissue: is composed of two types of cells:

1) Nerve cells (Neurons):

- it is the **structural and functional units** of the nervous system.
- They *receive stimuli* and *conduct* them to other parts of the system.

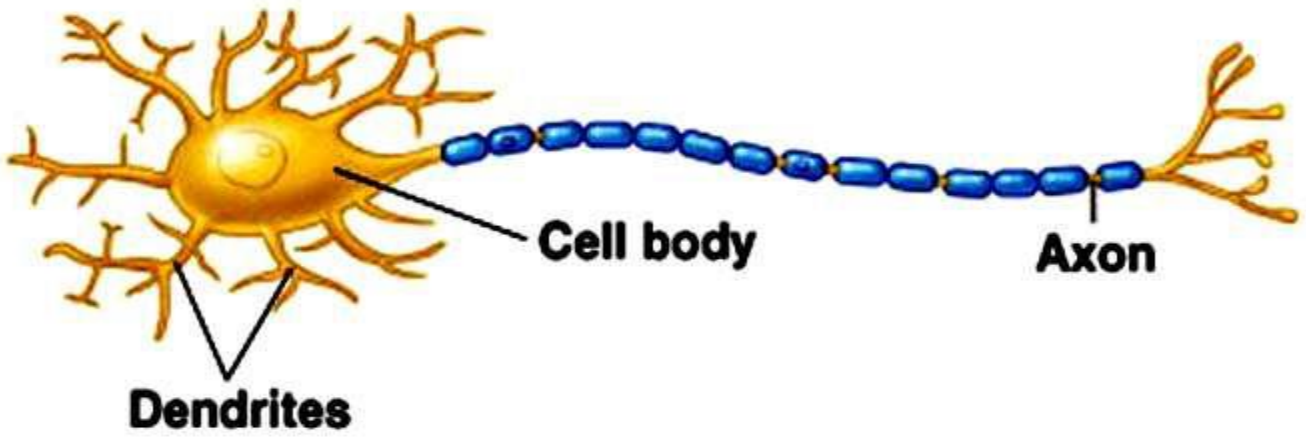
2) Supporting cells (Neuroglia):

- Support and protect the neurons.



The Neuron

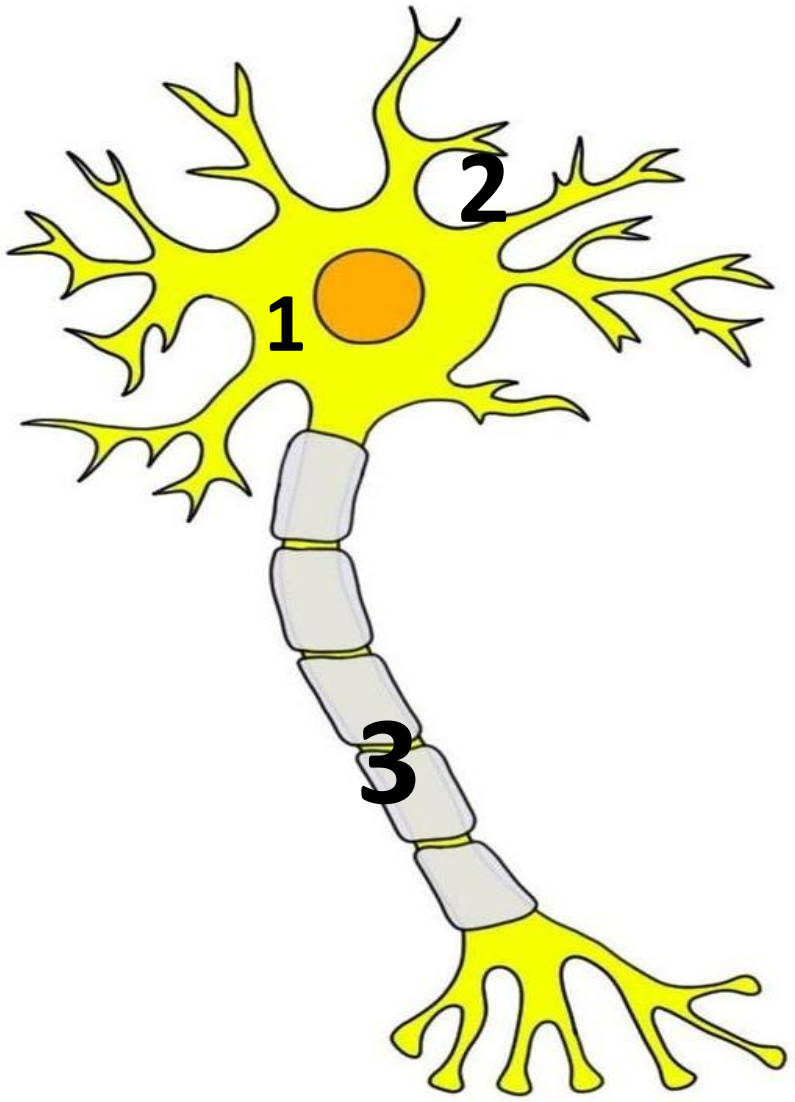
- They are the functional and structural units of the nervous system.
- They are developed from ectoderm.
- There are more than 10 billion neurons in the human nervous system.
- They vary in shape and size.



Structure of neuron

Each neuron consists of 3 parts:

1. **The cell body (perikaryon)**
2. **The dendrites**
3. **The axon**



1) Cell body (Perikaryon)

- ***Definition:***

It is the part of the neuron that **contains** the cytoplasm and nucleus.

Peri= around -karyon=nucleus

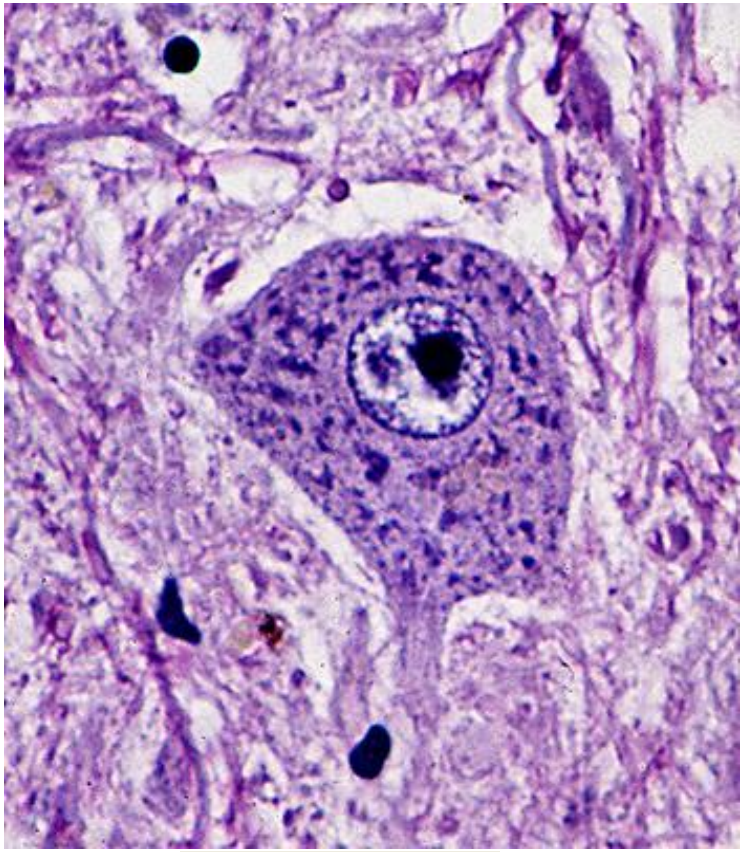
- ***Site:***

Perikaryons are present **only in gray matter of C.N.S** and ganglia in P.N.S.

- ***Size:*** variable
- ***Shape:*** rounded
- ***Structure:***
- **Nucleus:**

-Single

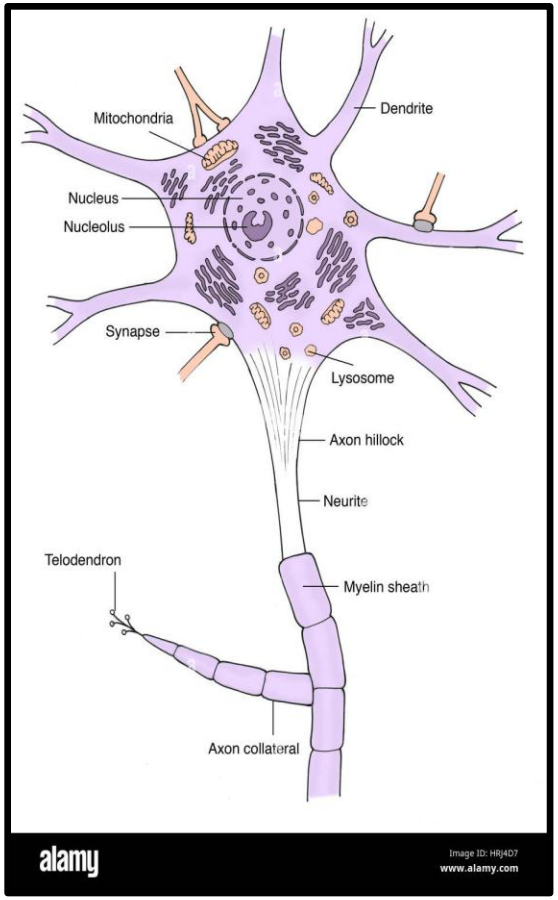
- Spherical
- Large
- Central
- with fine chromatin and prominent nucleolus



Perikaryon

Cytoplasm: It is mildly basophilic

- **containing most of the cell organoids and inclusions.**
- ***1) Nissl's Bodies or Nissl's Granules:***
- ***L/M:*** the cytoplasm **contains large basophilic granules** with spotty distribution.
- ***EM:*** they consist of **highly developed rER arranged in parallel cisternae with free ribosomes.**
- Site: : Nissl's granules are scattered in the perikaryon and extend into the dendrites *but **not in** the axon*.
- Function: perikaryon synthesizes **both** structural proteins and proteins for transport (neurotransmitters).
- ***2) The Golgi complex: consists*** of **multiple stacks around the nucleus.** It can be demonstrated by L/M using silver stain.



***3) Mitochondria*:** are scattered in the cytoplasm of all parts of the neuron. They are abundant in the axon terminals.

4) Lysosomes: 1ry lysosomes, secondary lysosomes and residual bodies.

5) No centrosome is present in mature nerve cell (do not divide)

6) Cell inclusions: Stored food as lipid and glycogen granules.

Pigments as lipofuscin pigments in old nerve

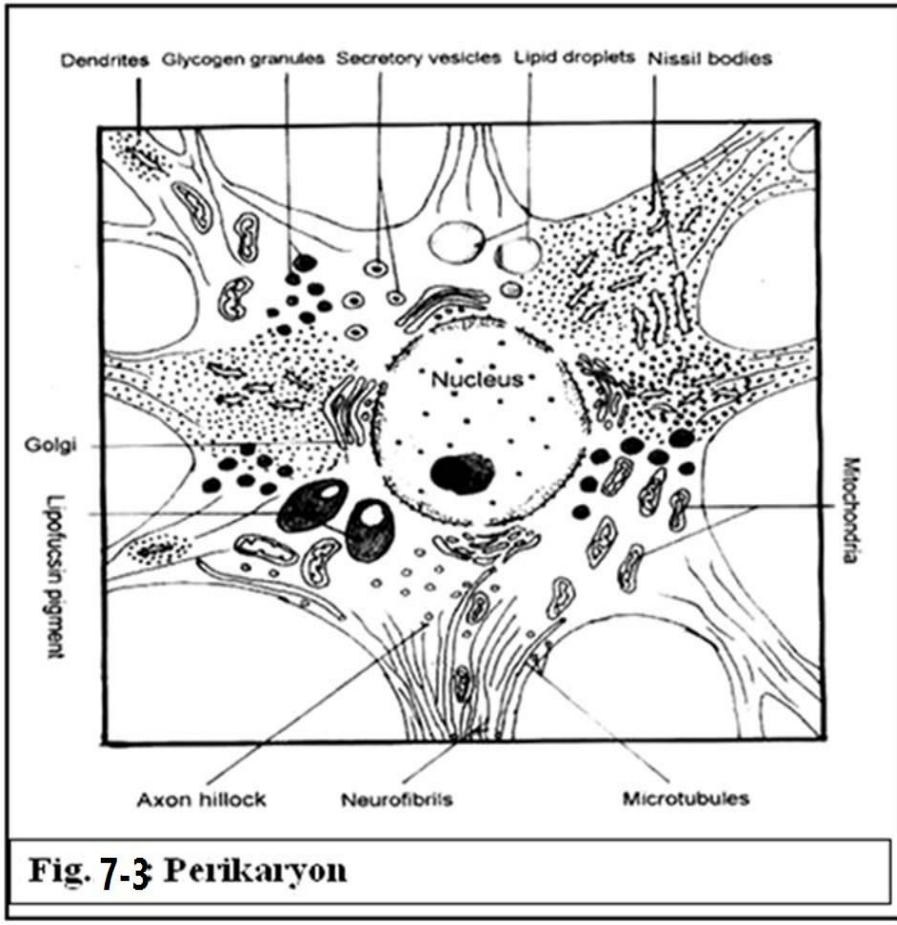


Fig. 7-3 Perikaryon

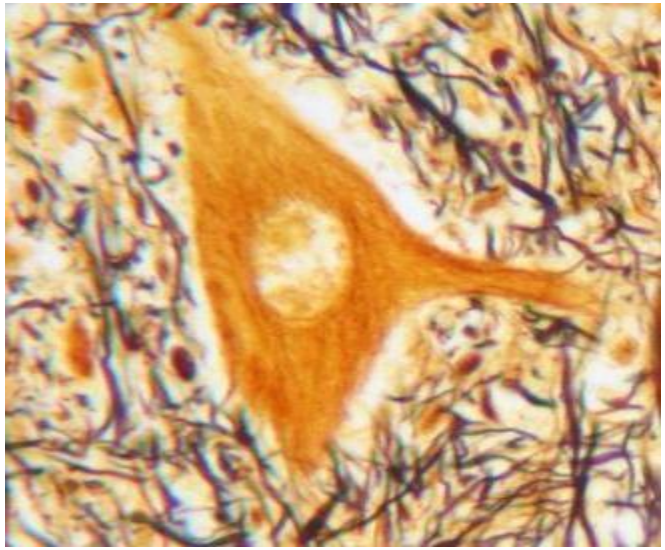
7) Cytoskeleton

- ***Microtubules:*** are present in **perikaryon and cell processes**.

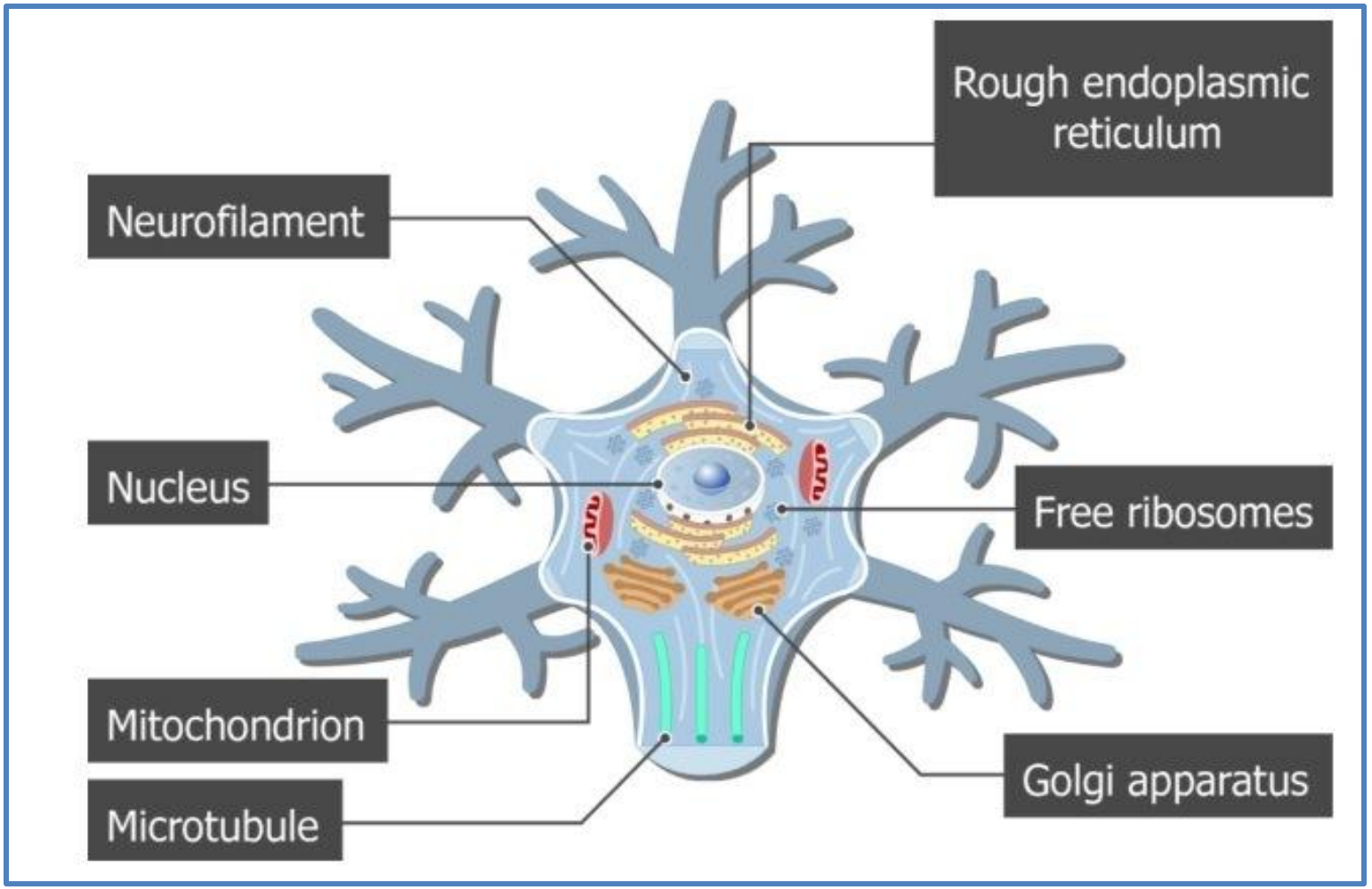
-**supportive** (maintain the shape of the neuron) and share **in transport** of impulses.

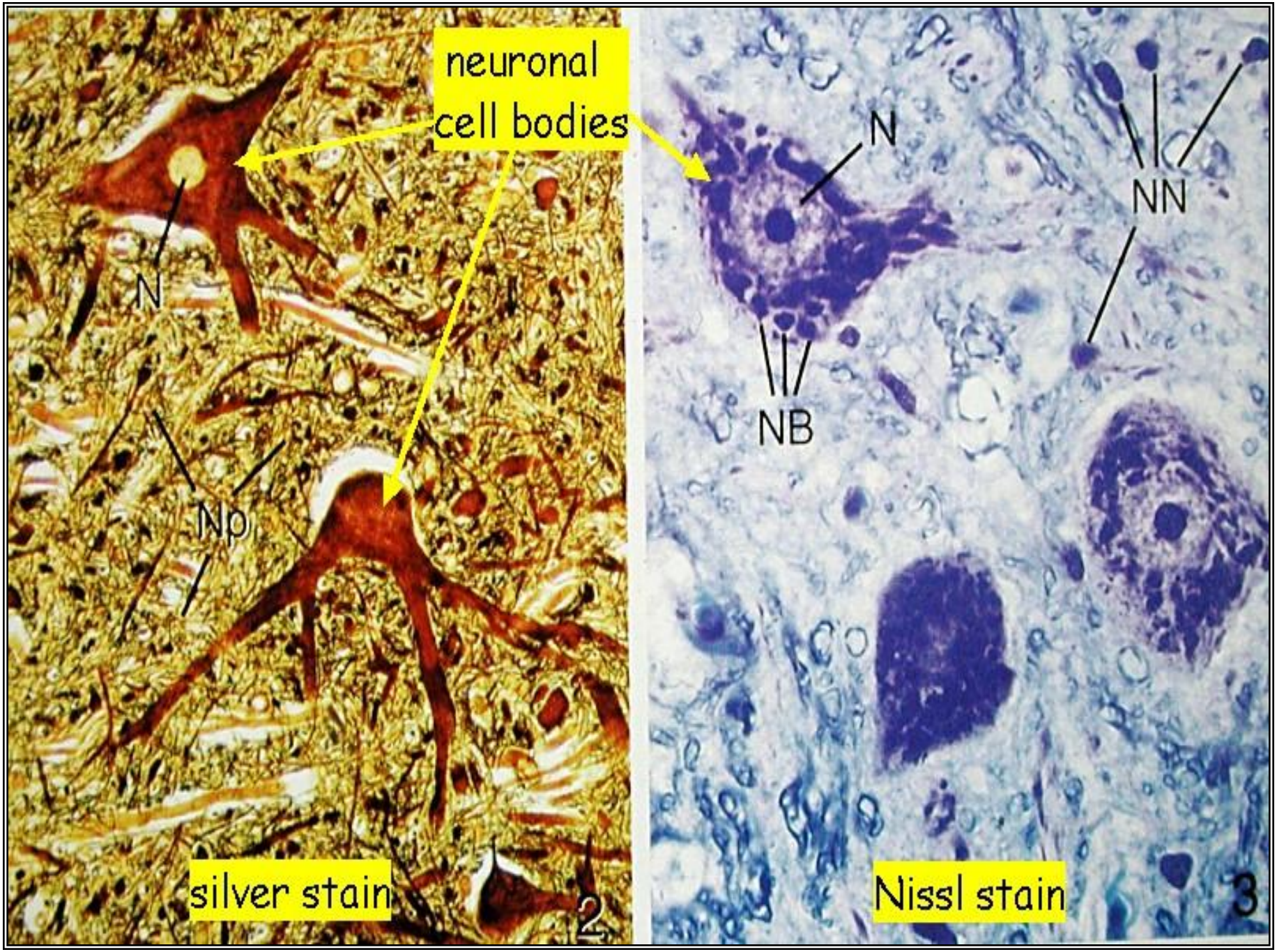
- ***Neurofilaments (intermediate filaments):*** They are **abundant** in perikaryon and in cell processes.

-can be stained with silver.



Cell body (Perikaryon)




neuronal
cell bodies
N
Np
silver stain
2
N
NB
NN
Nissl stain
3

2) Dendrites

- They carry impulses to the nerve cell
- They are usually multiple, short, thick and tapering processes
- contents:

most of the organelles and inclusions e.g.

Nissl granules, neurofibrils, mitochondria, and microtubules.

Golgi apparatus **is not present** in the dendrites.

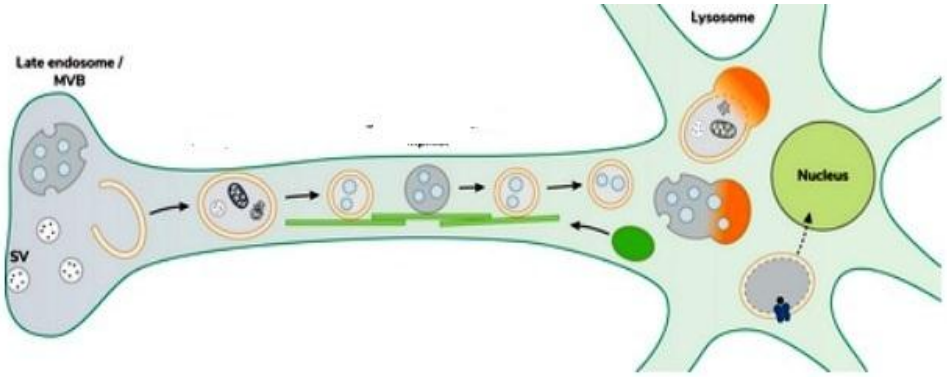
- Function:
- increase receptive area of cell to stimuli.

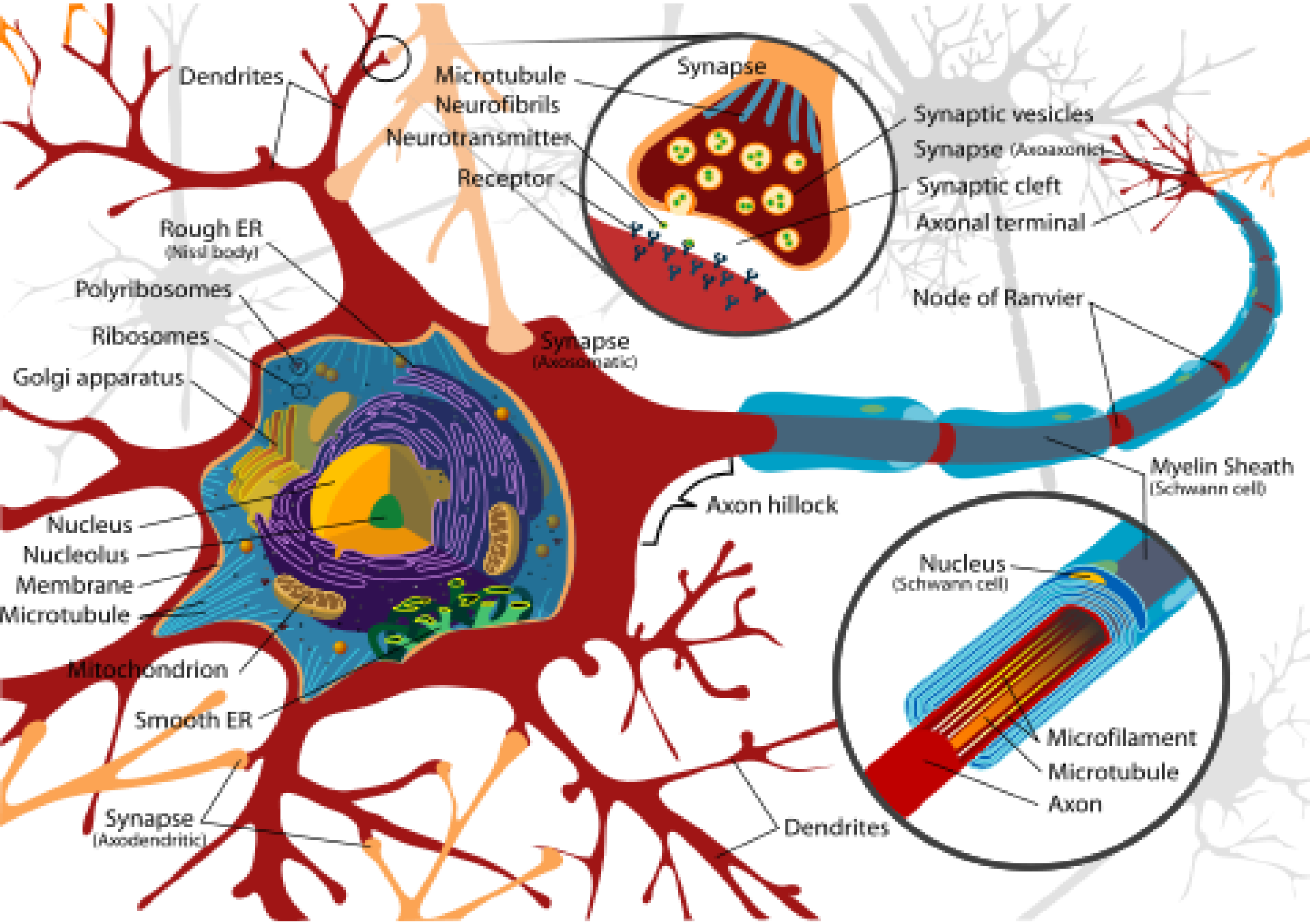
3) Axon

- It is single and long process with constant diameter- branched
- The axon arises from a conical area on the cell body known as **axon hillock**, which is usually **devoid of large cytoplasmic organelles**.
- **Cytoplasm:** is called **axoplasm** ,The plasma membrane, which surrounds the axon, is known as **axolemma.**
- The axon may be naked or covered myelin sheath.
- **EM:** The axon **does not contain dNissl's granules** ribosomes nor Golgi.
- The axon contains **mitochondria, microtubules and** neurofilaments.
- **Function:**

They carry nerve

impulses away from the cell body




Dendrites
Microtubule
Neurofibrils
Neurotransmitter
Receptor
Synapse
Synaptic vesicles
Synapse (Axoaxonic)
Synaptic cleft
Axonal terminal
Rough ER
(Nissl body)
Polyribosomes
Ribosomes
Golgi apparatus
Synapse
(Axosomatic)
Node of Ranvier
Myelin Sheath
(Schwann cell)
Axon hillock
Nucleus
Nucleolus
Membrane
Microtubule
Mitochondrion
Smooth ER
Synapse
(Axodendritic)
Dendrites
Nucleus
(Schwann cell)
Microfilament
Microtubule
Axon

	Dendrites	Axon
Number	multiple	single
length	short	long
Thickness	Thick near cell then tapers away	Thin –constant diameter
Branching	Many branches.	branch at its termination
Organelles	**Contain:** Nissl granules, neurofibrils, mitochondria, and microtubules. **Do not contain:** Golgi apparatus.	**contains** mitochondria, microtubules and neurofilaments **does not contain :** Nissl's granules ribosomes nor Golgi
function	• carry impulses to the nerve • cell increase receptive area of cell to stimuli.	They carry nerve impulses away from the cell body .

Classifications of neuron

1. According to the function.
2. According to the number of processes (polarity).
3. According to length of the axon.

Classifications of neuron

1-According to the function:

❑ Motor neurons:

- Carry motor impulses from the C.N.S or from ganglia to effector oranges (e.g. muscle fibers).
- **Sites:** motor nuclei in anterior horn cells (AHC) of spinal cord.

❑ Sensory neurons:

- receive impulses from peripheral sensory cells and organs and carry them to C.N.S.

❑ Inter-neurons:

- short neurons that connect sensory and motor neurons.
- **Sites:** spinal cord.

2-According to the number of processes (polarity)

❑ Pseudo-unipolar:

the nerve cell has **two** processes which **are adherent to each** other forming **one pole** "so it gives a false impression of being unipolar".

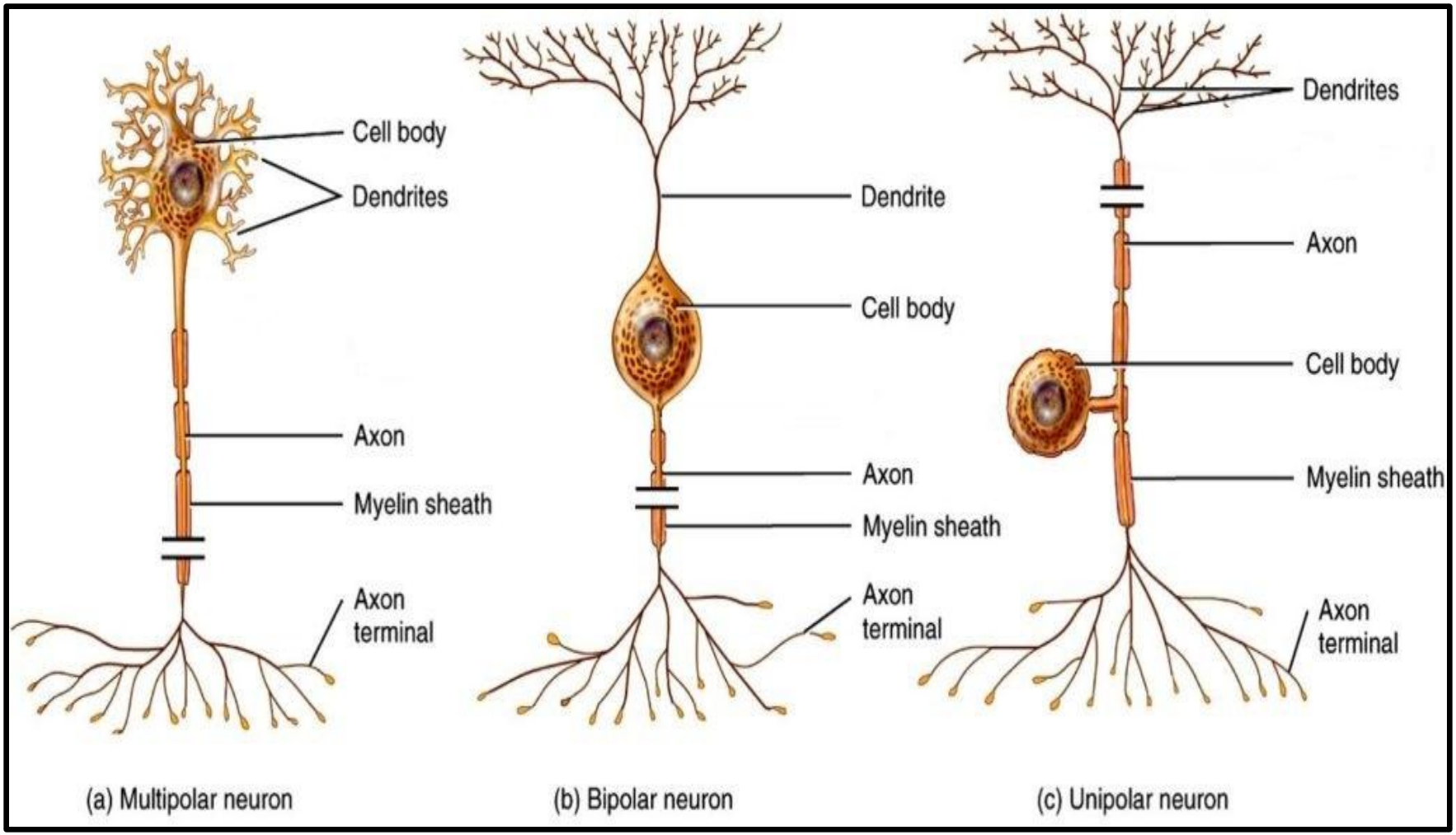
❑ Bipolar neurons:

- The nerve cell body is spindle in shape and has **2 processes** from the **2 poles**

❑ Multipolar neurons:

- have single long axon and many short dendrites.

Nnumber of processes



3-According to length of the axon:

❑Golgi type I:

These neurons **have long axon** i.e. up to one meter or more that form long tracts in the brain and spinal cold.

❑Golgi type II:

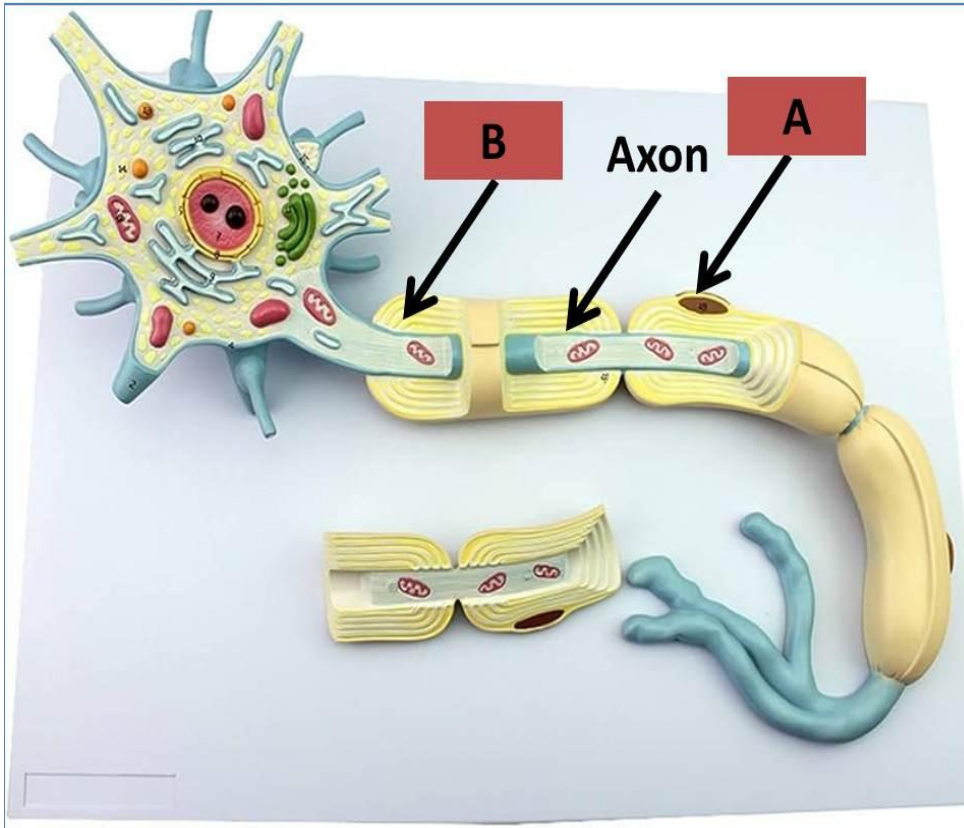
These neurons have **very short axons** e.g. in cerebellum, cerebral cortex.

Nerve Fibers

- They consist of **axon** enveloped by **special sheathes.**
- Axons enveloped by 1 or 2 ectodermal sheaths.
  - A) Cellular sheath (Neurolemmal sheath)
  - B) Non cellular sheath (Myelin Sheath)

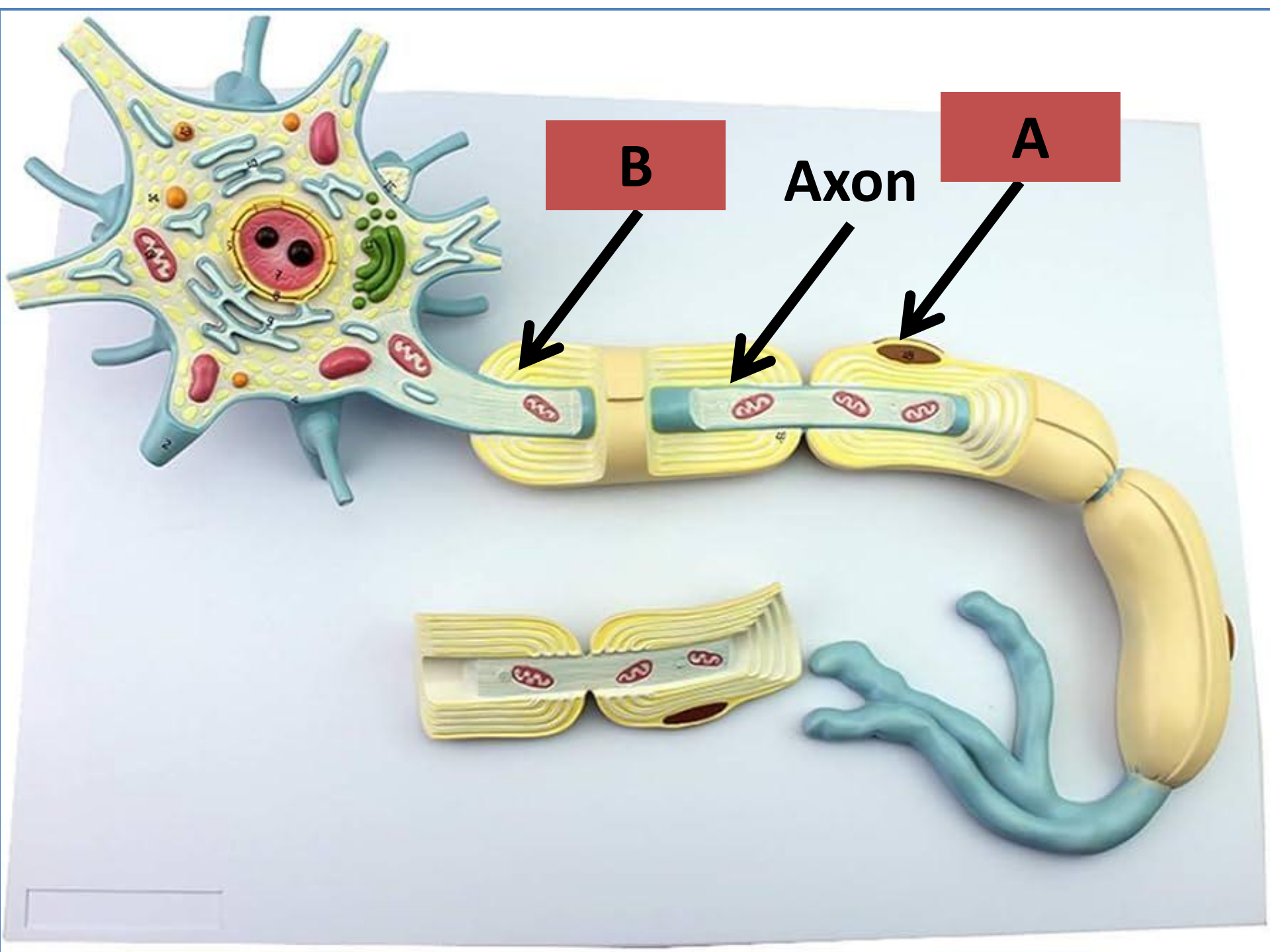
Nerve fibers:

- Myelinated nerve fibers.
- Unmyelinated nerve fibers.



Group of nerve fibers form:

1. Tracts of CNS
   (brain and spinal cord).
1. Peripheral nerves.


B
Axon
A

A) Cellular (Neurolemmal sheath)

- cellular tube surrounds axon outer to myelin sheath.

- In PNS, formed of *Schwann's cells.*
- In CNS, formed of *oligodendrocytes.*

❑ **Functions**:

- Form myelin sheath to insulate nerve fibers.
- Regeneration of nerve fibers after trauma.

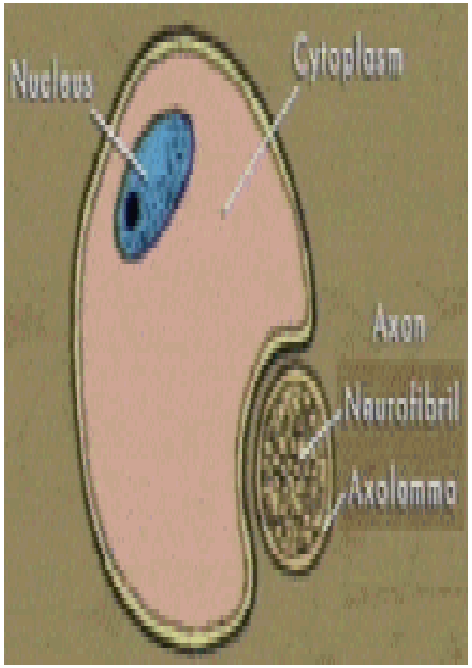
B) Non cellular (Myelin Sheath)

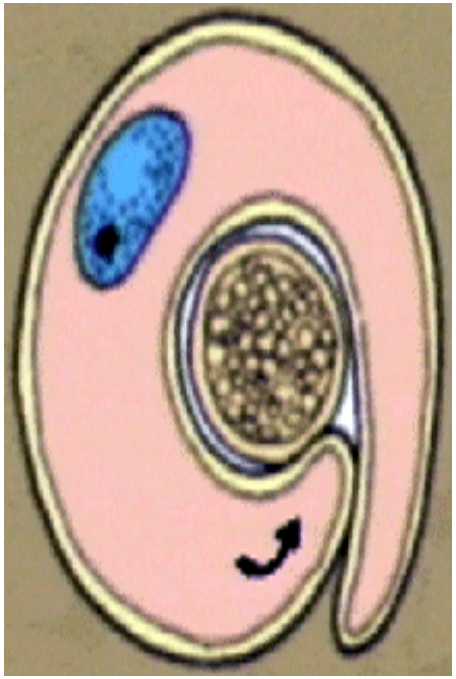
- Interrupted fatty tube directly surrounds axons.
- **Myelin sheath:** Consists of cholesterol, phospholipids and fatty acids.
- White in fresh state.
- Formed by Schwann's cells in PNS.
- Formed by oligodendrocytes in CNS where one cell can form myelin of several axons.

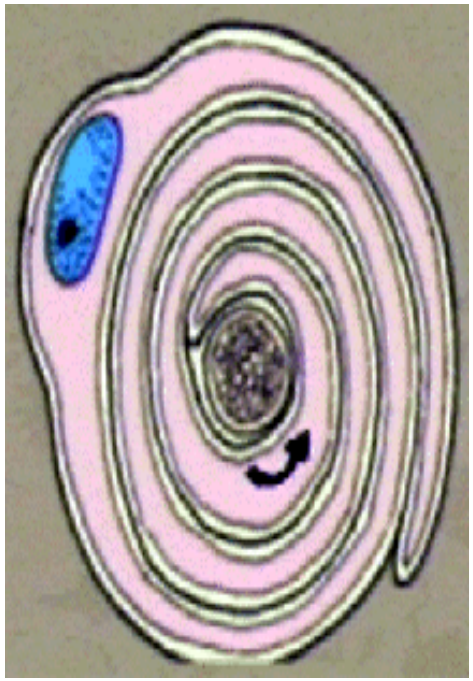
- **Functions**: Protection, conduction and insulation of impulses.

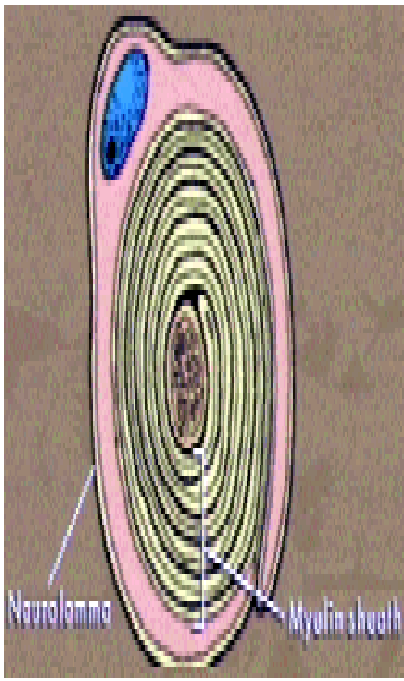
Myelinated nerve fibers in P.N.S

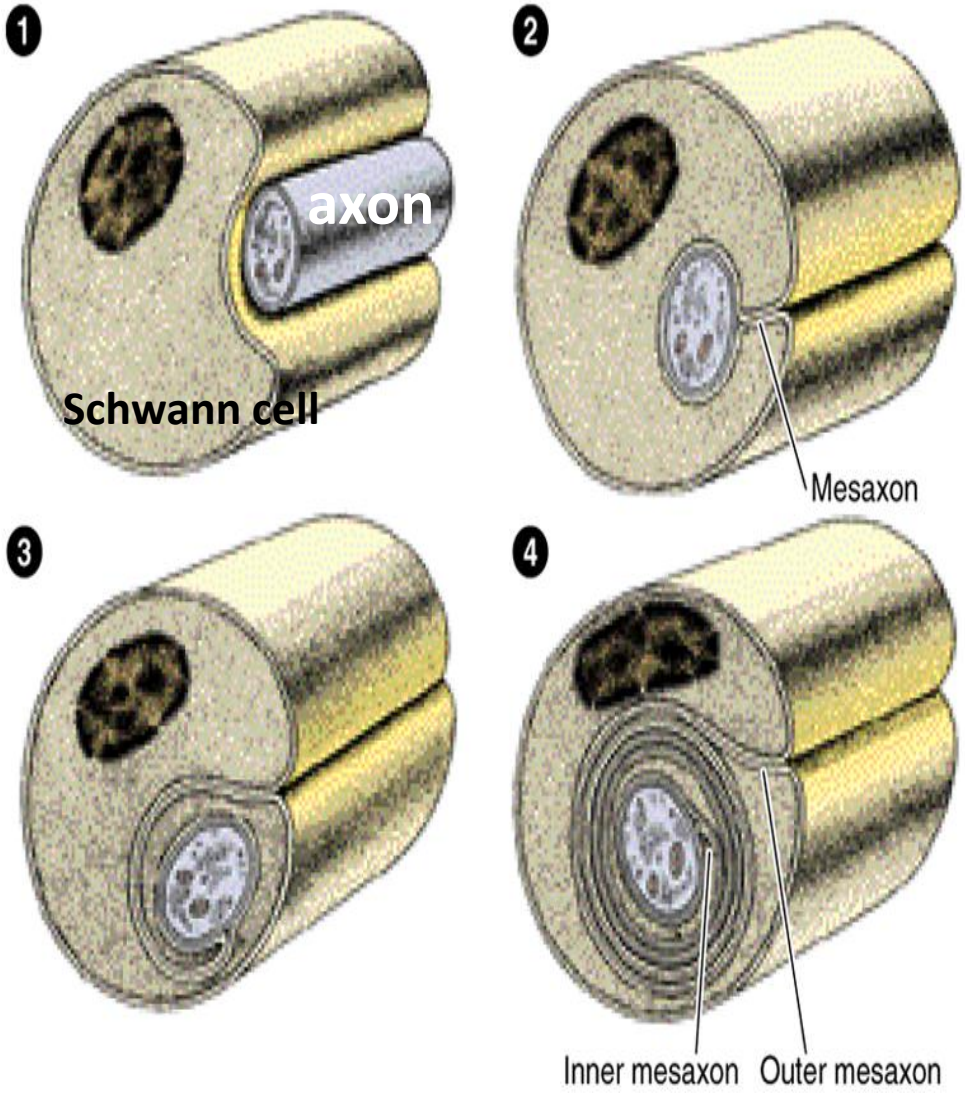
- plasmalemma of Schwann cells winds around axon.
- layers of membranes unite forming myelin sheath.
- The myelin sheath is composed of multiple layers of Schwann cell membrane wrapped concentrically around the axon.

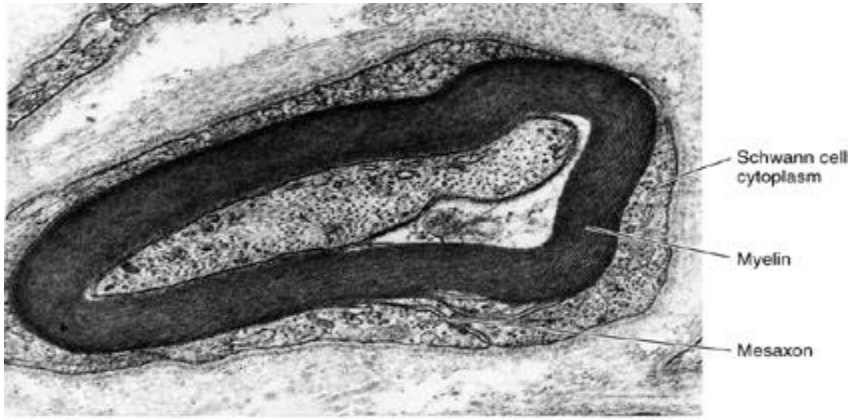


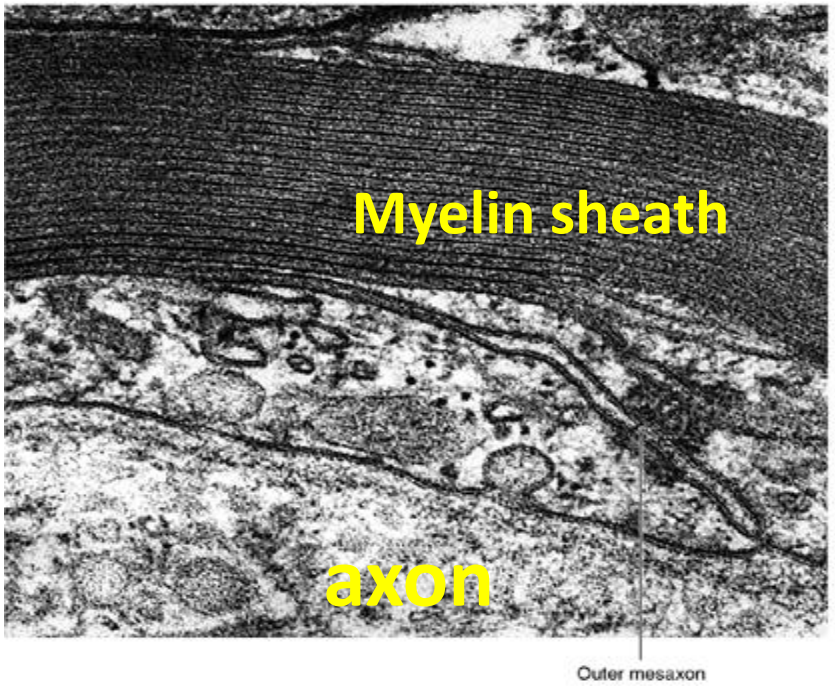






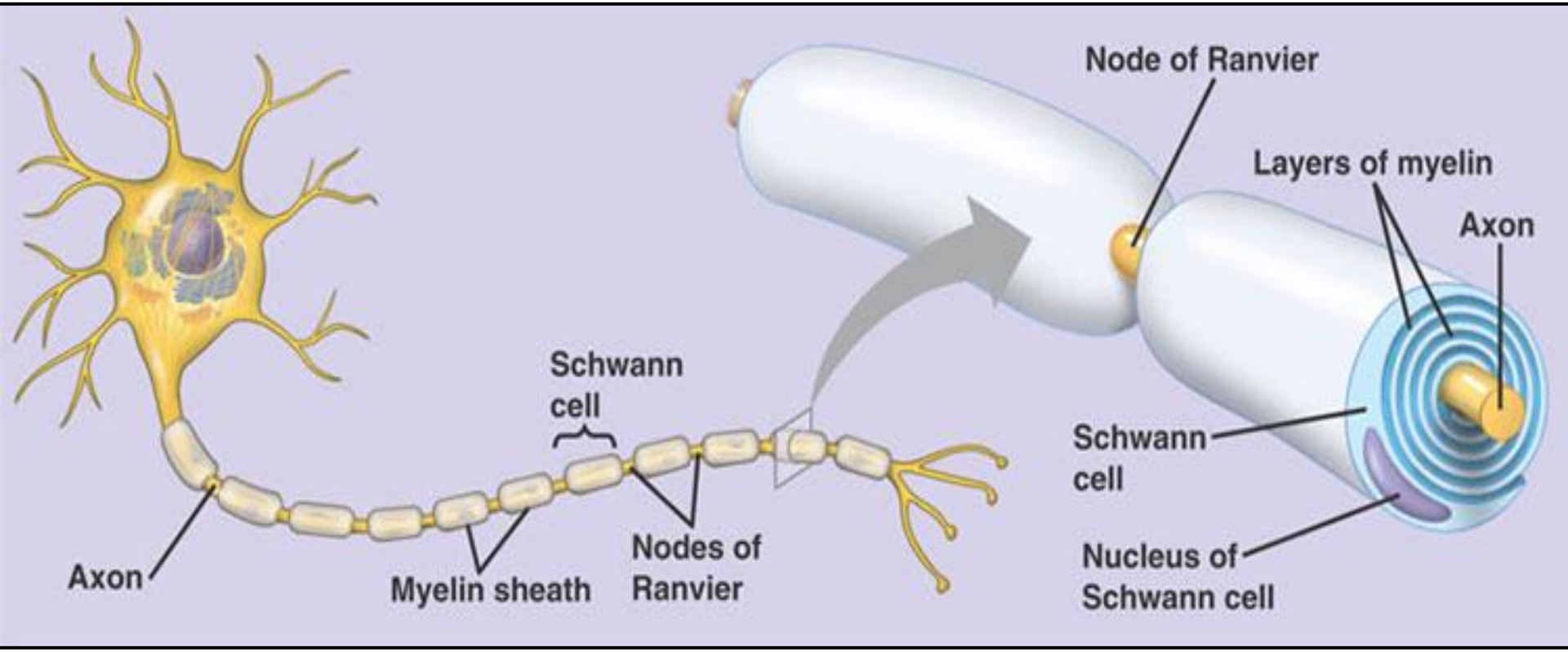




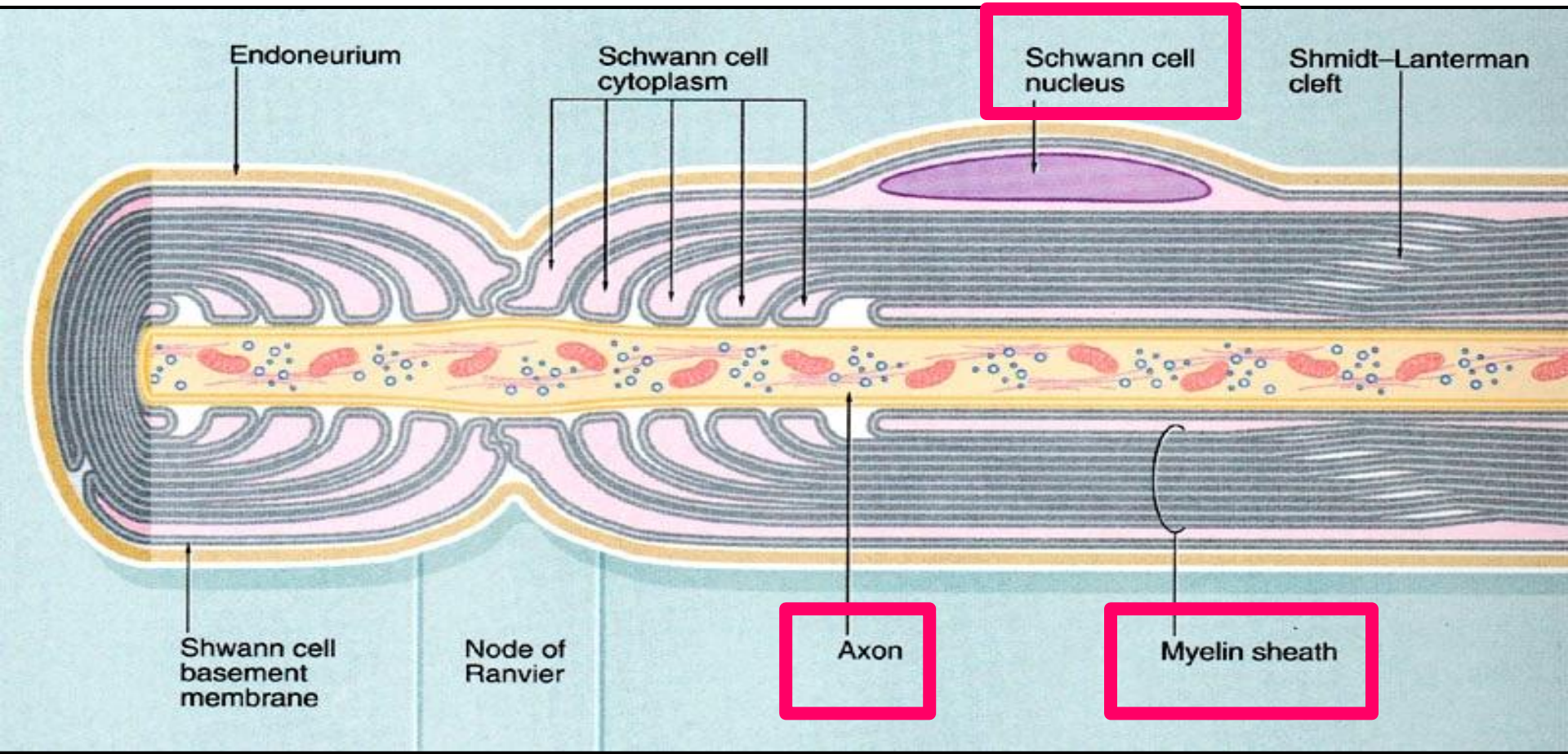


Schwann cells in P.N.S. The cell has elongated nucleus parallel to the axon.

- Each axon surrounded by myelin formed by series of Schwann cells.
- Myelin sheath shows gaps: *nodes of Ranvier.*
- Distance between 2 nodes: *internode segment* (one Schwann cell).

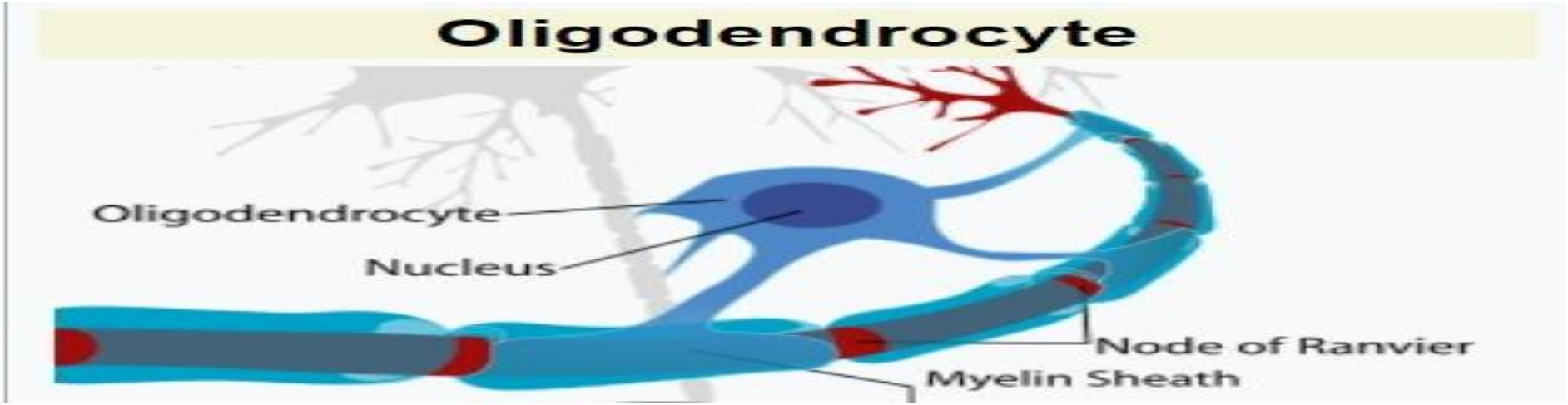


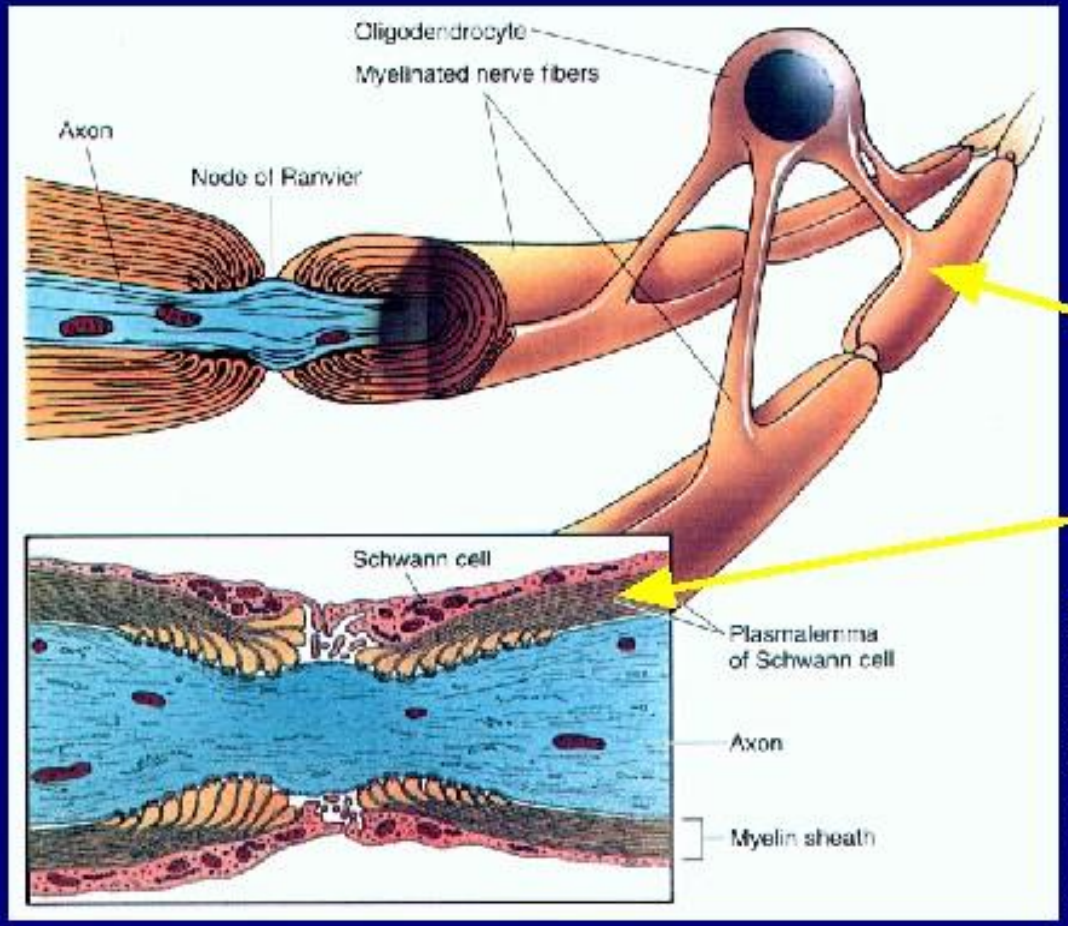
- External to the myelin sheath is a layer of **Schwann cell cytoplasm** contains the nucleus and most of its organelles called sheath of Schwann or neurolemmal sheath.



Myelinated nerve fibers in C.N.S

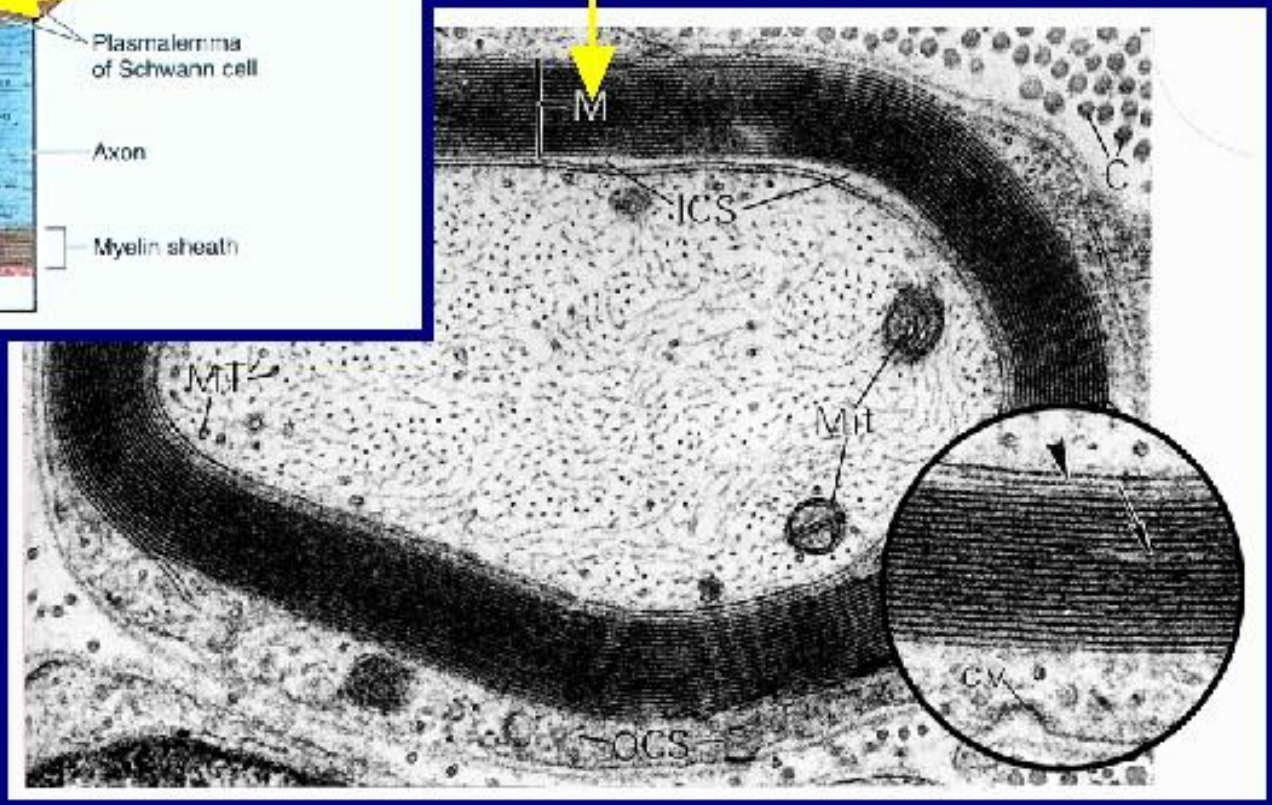
- The myelin sheath in C.N.S is formed by the processes of the oligodendrocytes.
- Oligodendrocytes differ from Schwann cells in that the processes of one cell can envelope segments of several axons.
- The myelinated axons of C.N.S have no neurolemmal sheath.





One oligodendrocyte myelinates many axons.

CNS myelin closely resembles PNS myelin.



Unmyelinated nerve fibers

- **IN P.N.S:**

All unmyelinated axons are enveloped within Schwann cells, so they have only Schwann cell sheath (i.e. neurolemmal sheath).

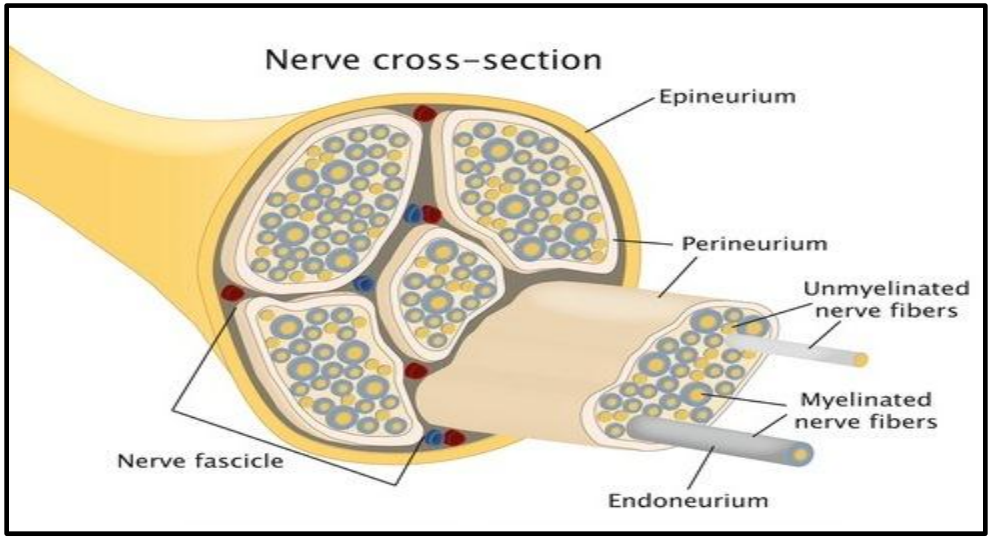
- **IN C.N.S.:**

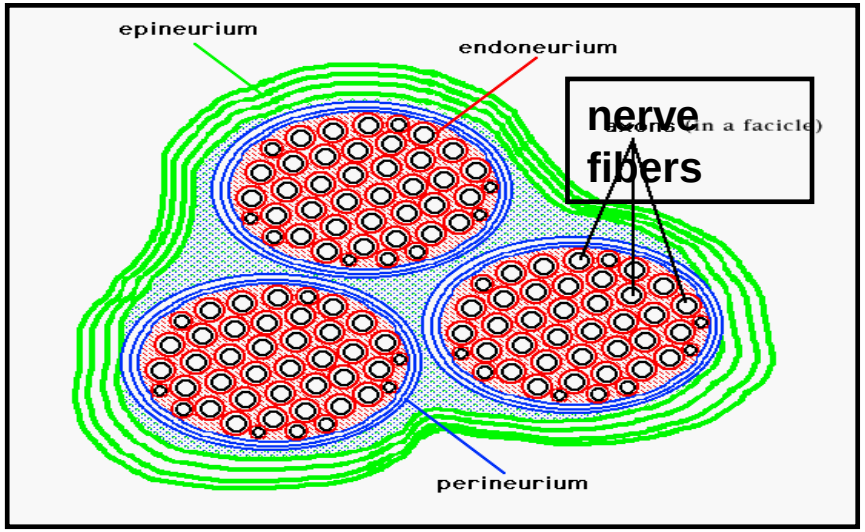
C.N.S is rich in unmyelinated axons .

The Nerve Trunk

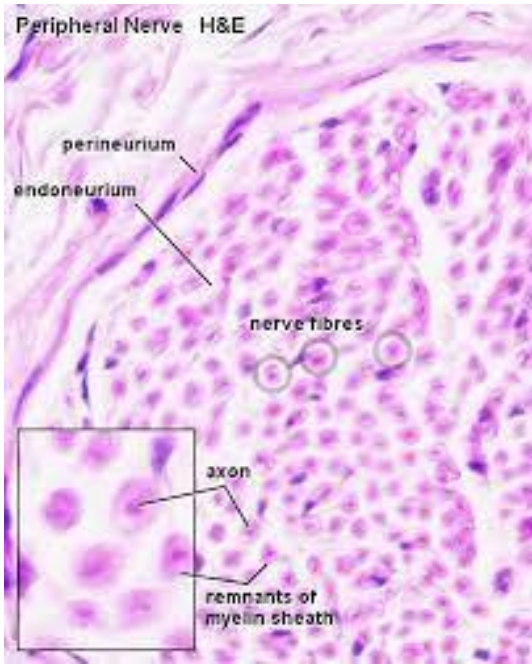
Longitudinal parallel myelinated nerve fibers grouped in bundles.

- Each trunk surrounded by dense C.T: *epineurium.*
- Each bundle surrounded by dense C.T: *perineurium.*
- Each fiber surrounded by loose C.T : *endoneurium.*





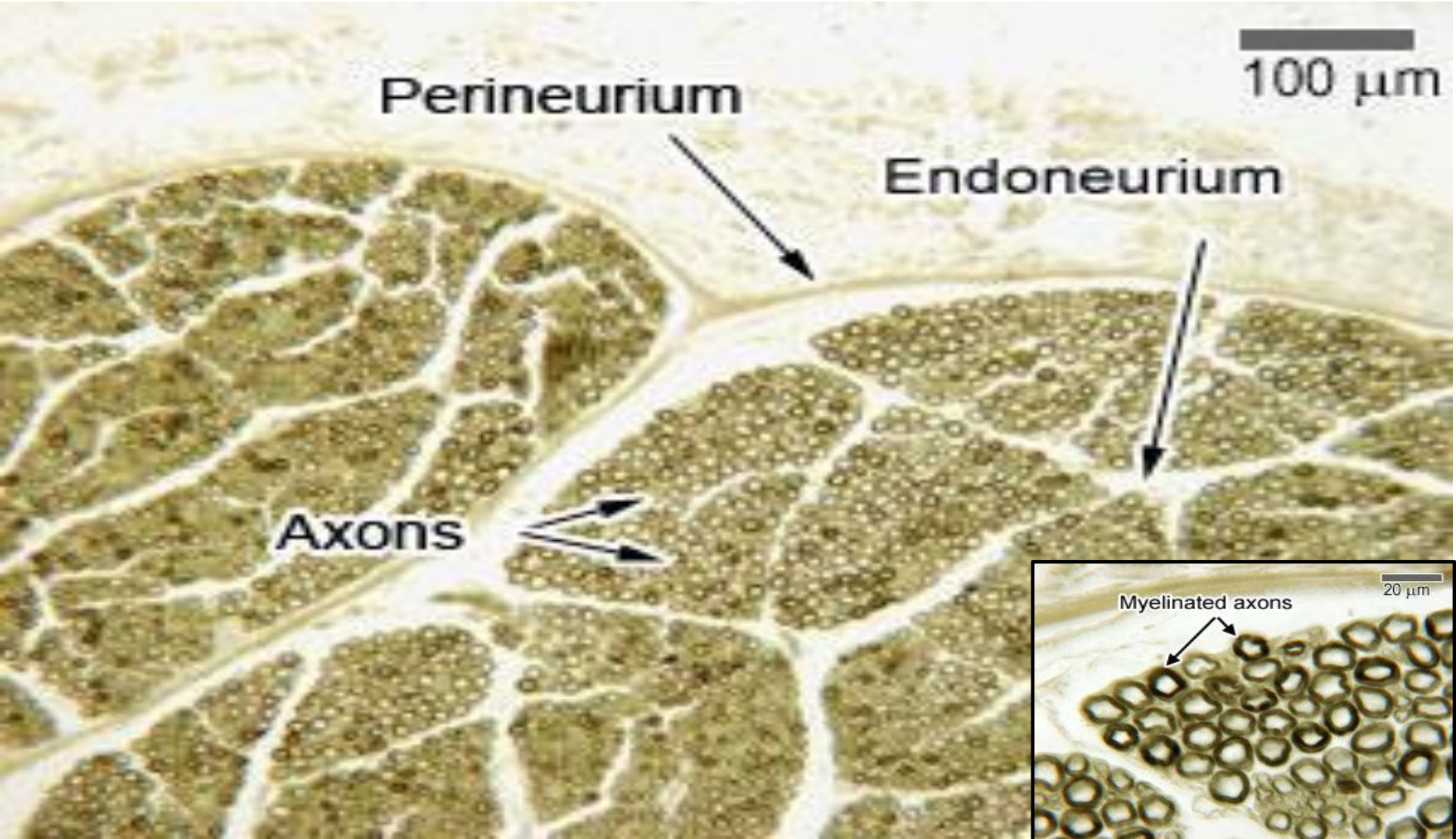
T.S in nerve trunk stained with HX&E.



Each nerve fiber shows acidophilic axon in the center surrounded by thin acidophilic neurolemmal sheath because myelin sheath is dissolved during staining.

The Nerve trunk

section stained with osmic acid myelin sheath appears as rounded black circles.



Thank you