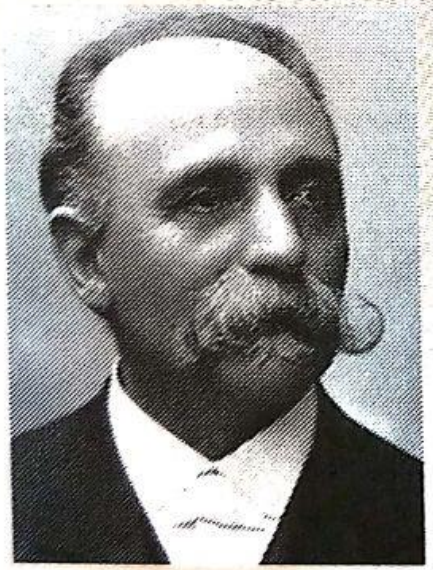
NEURON:
STRUCTURE AND CLASSIFICATION

DR. SHAISTA SAIYAD

(MD, Ph.D., ACME, FAIMER)

Scientists contributed



Camillo Golgi
(1843–1926)

SR y Cajal
(1852–1934)

The **Nobel Prize in Physiology or Medicine, 1906,** was awarded jointly to Italian neurophysiologist and neuroanatomist, Prof. **Camillo Golgi** and neurophysiologist and neuroanatomist of Spain, Prof. **Santiago Ramón y Cajal** *"in recognition of their work on the structure of the neuron and the nervous system".*

Comprehensive textbook of Physiology, Dr. G K Pal.

NERVE CELL BODY

- Mitochondria,
- Golgi apparatus,
- Endoplasmic reticulum,
- Microfilaments, microtubules, neurofibrillae (alzheimer's disease),
- Nucleus with nucleolus,
- Pigment granules
- Nissl's granules (tigroid bodies), *centriole absent*

- CHROMATOLYSIS: ANOXIA, INJURY, TOXINS.

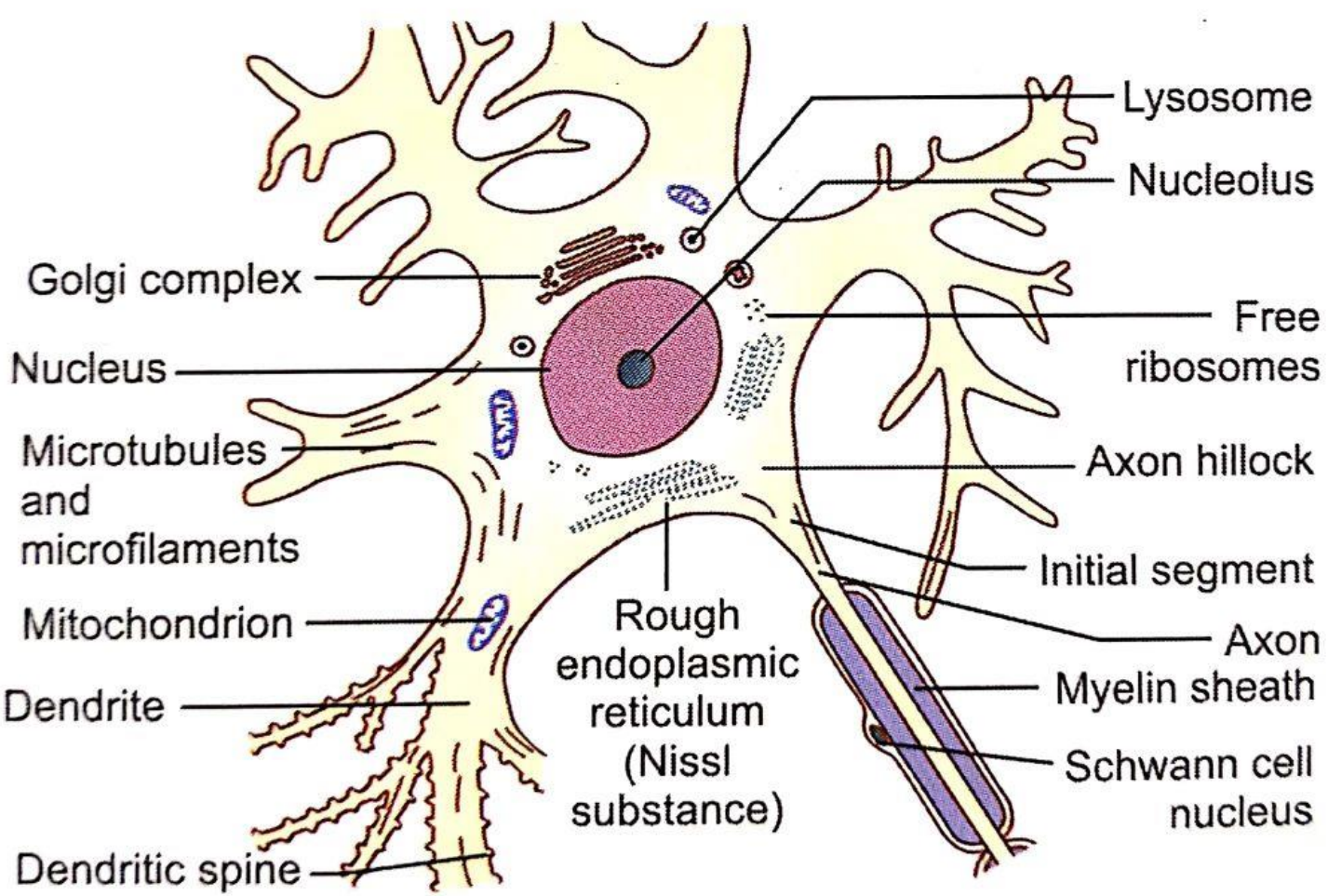


Fig. 22.2: Detailed structure of the proximal part of neuron, highlighting the cell body region.

Comprehensive textbook of Physiology, Dr. G K Pal.

NISSL'S GRANULES

- Cell body , dendrites
- absent in axon hillock and axon.
- basophilic granules: rough surfaced endoplasmic reticulum.
- protein synthesis.
- number depends on activity of the neuron.

- **Chromatolysis:** anoxic or damaged- disintegrated into fine dust or disappear.

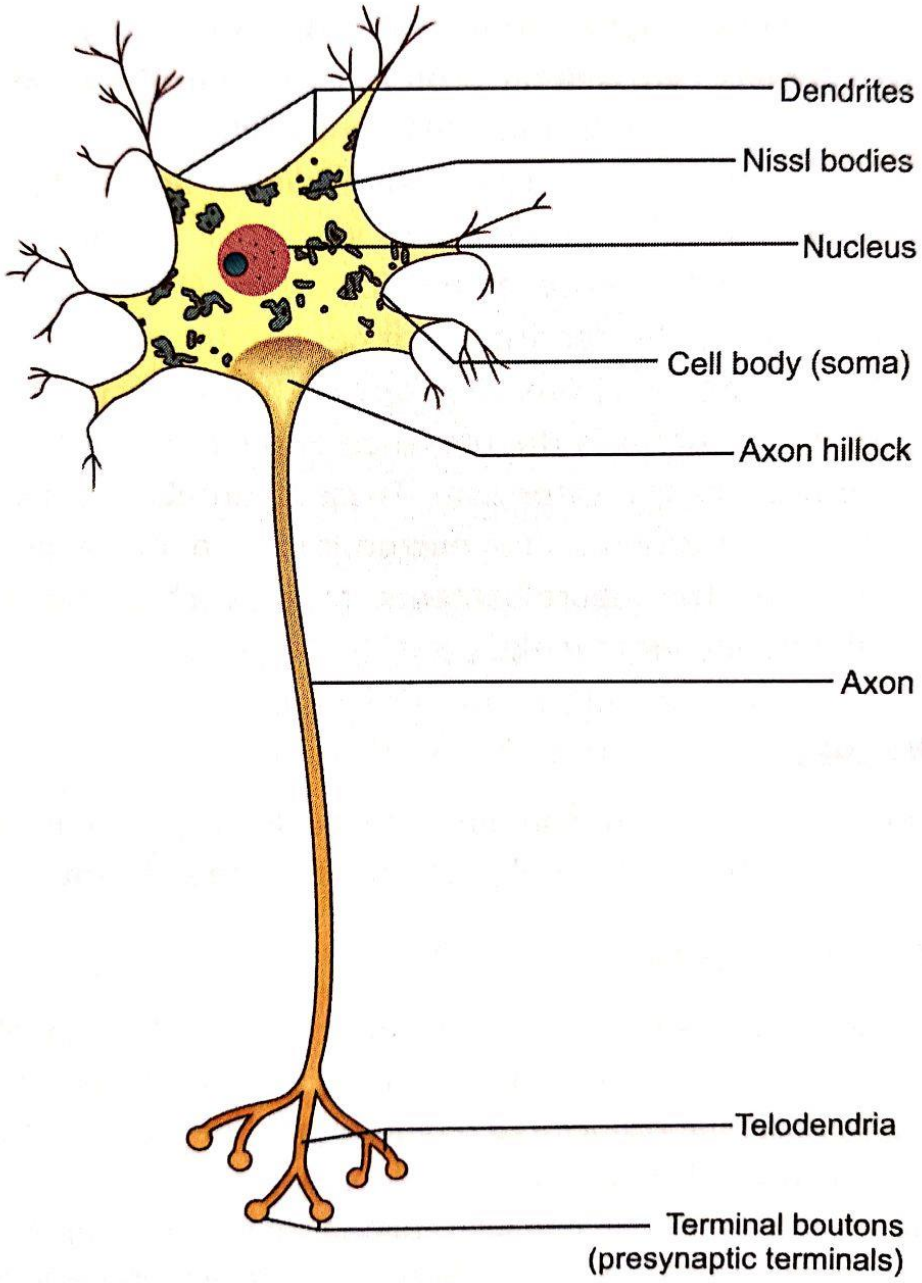


Fig. 22.1: Structure of a neuron.

Comprehensive textbook of Physiology, Dr. G K Pal.

AXON / AXIS CYLINDER / NERVE FIBER

- AXON HILLOCK
- AXOPLASM
- AXOLEMMA
- AXOPLASMIC FLOW

AXOPLASMIC FLOW

- FAST: 200-400 mm/DAY

Antegrade: neurotransmitters, proteins, nerve growth factors: kinesin.

Retrograde: viruses, toxins, nerve growth factor, neurotransmitter products: : dynein.

* SLOW: 2-4 mm/DAY

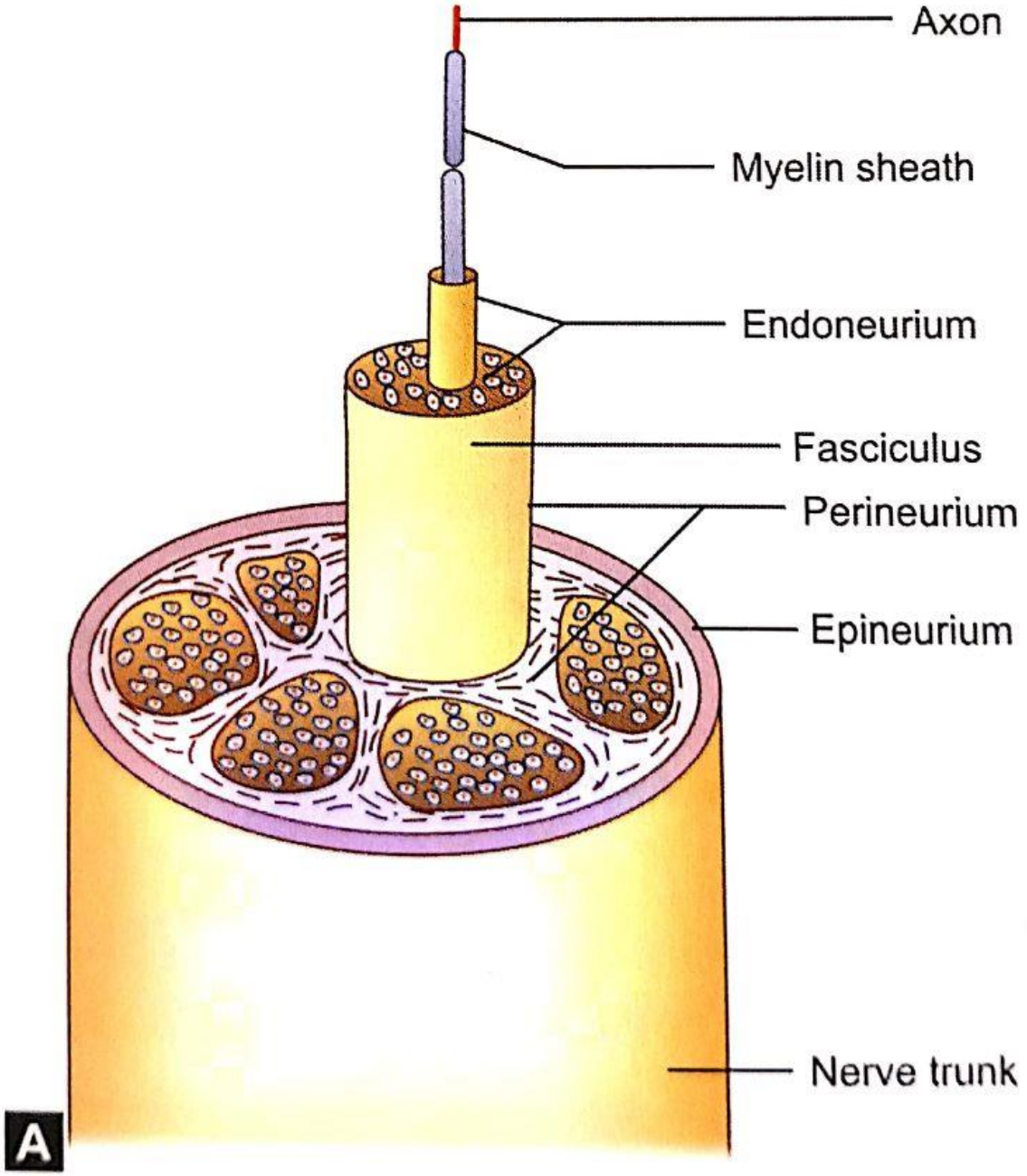
- **AXON TERMINALS**

(TERMINAL BUTTONS OR AXON TELODENDRIA):

- Terminal Divisions Of An Axon.
  Myelin sheath is Absent.
- Also Called As Synaptic Knobs.
- Contain Granules Or Vesicles Containing Neurotransmitters.

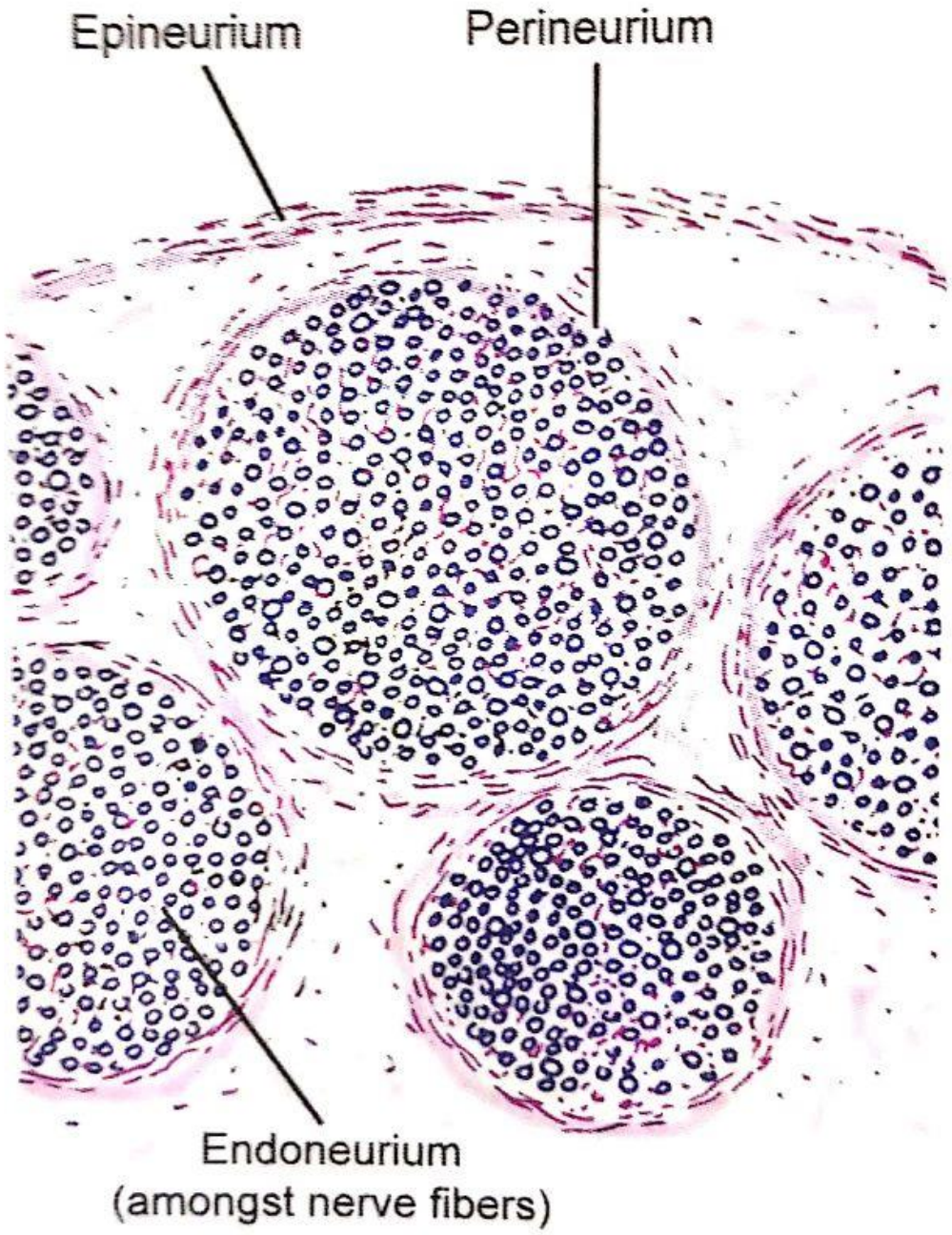
COVERINGS OF NEURON

- ENDONEURIUM
- PERINEURIUM
- EPINEURIUM



Figs. 22.9A and B: Placement of nerve fiber and axon in nerve trunk.

Comprehensive textbook of Physiology, Dr. G K Pal.



Comprehensive textbook of Physiology, Dr. G K Pal.

DENDRITES

- SMALLER EXTENSIONS OF THE CELL BODY.
- RECEPTIVE PROCESSES OF A NEURON.
- RECEIVE SIGNALS FROM THE PREVIOUS NEURON.
- LOOK THORNY DUE TO NUMEROUS MINUTE PROJECTIONS CALLED SPINES PRESENT ON THEIR SURFACE.
- THESE SPINES ARE SITES OF SYNAPTIC CONTACT.

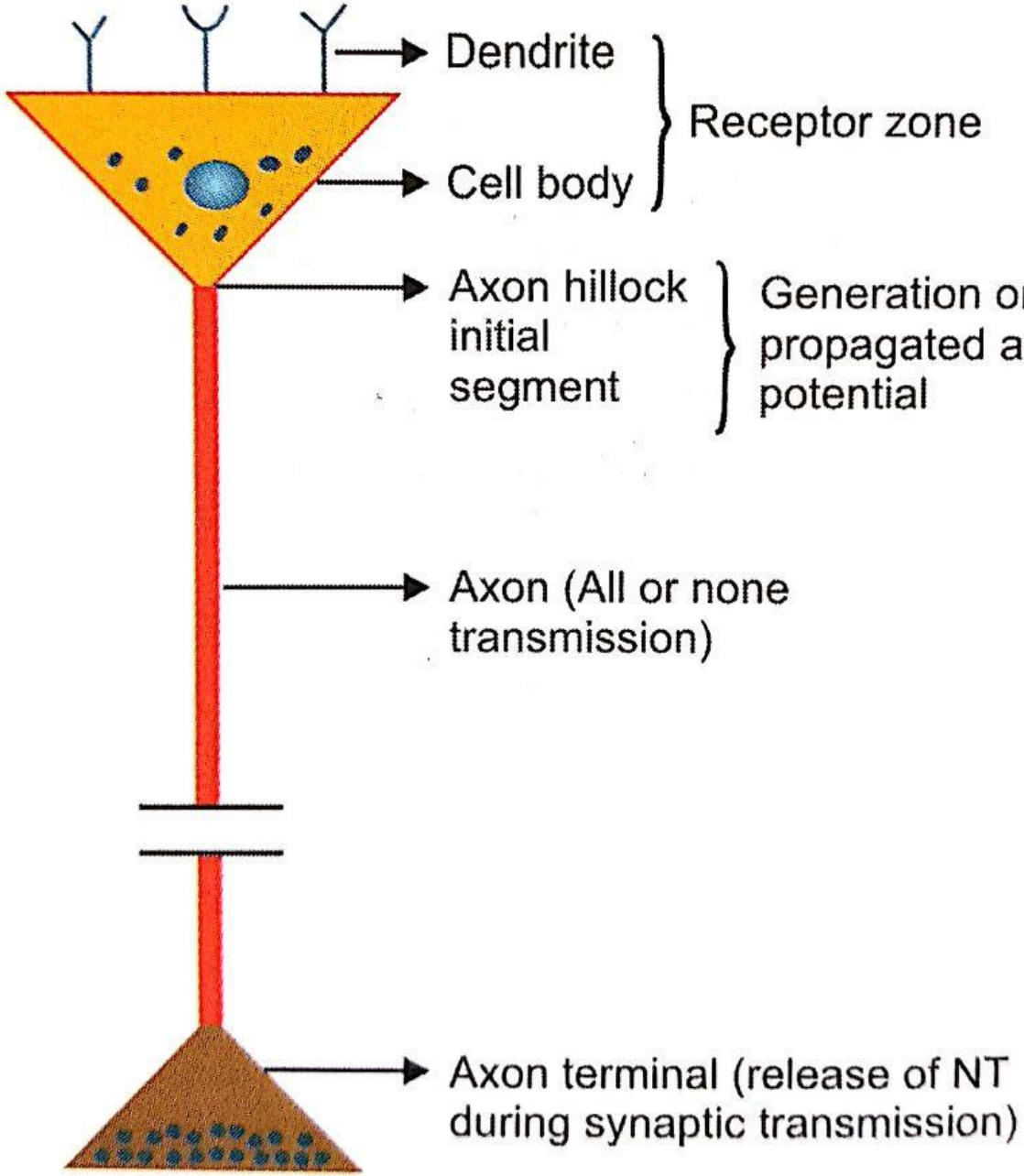


Fig. 22.7: Functions of different parts of the neuron.

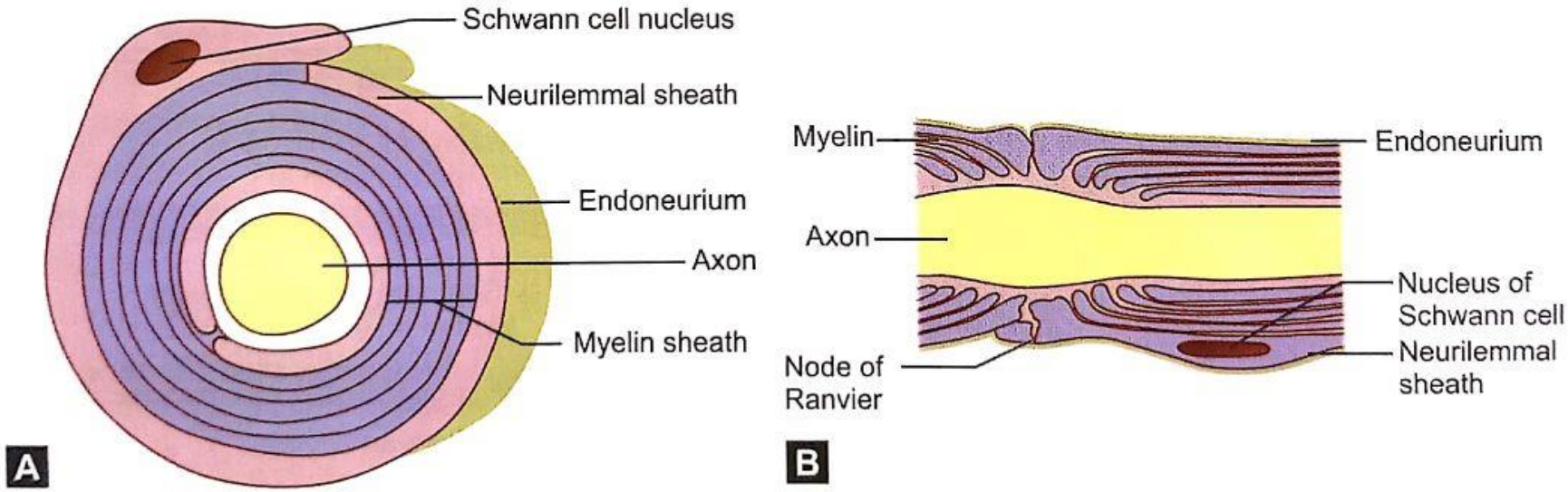
Comprehensive textbook of Physiology, Dr. G K Pal.

Nerve cell body

- GRAY MATTER OF BRAIN
- NUCLEI OF BRAIN EG. BASAL GANGLIA.
- GANGLIA OF CENTRAL NERVOUS SYSTEM

MYELINATION: MYELINOGENESIS

- Schawann cell in peripheral nervous system and oligodendrocytes in CNS.
- Nodes of ranvier
- Starts at 4th month of pregnancy, continues upto 2 yrs of age.



Figs. 22.3A and B: Myelin sheath, shown in transverse section (A) and longitudinal section (B) of the axon.

Comprehensive textbook of Physiology, Dr. G K Pal.

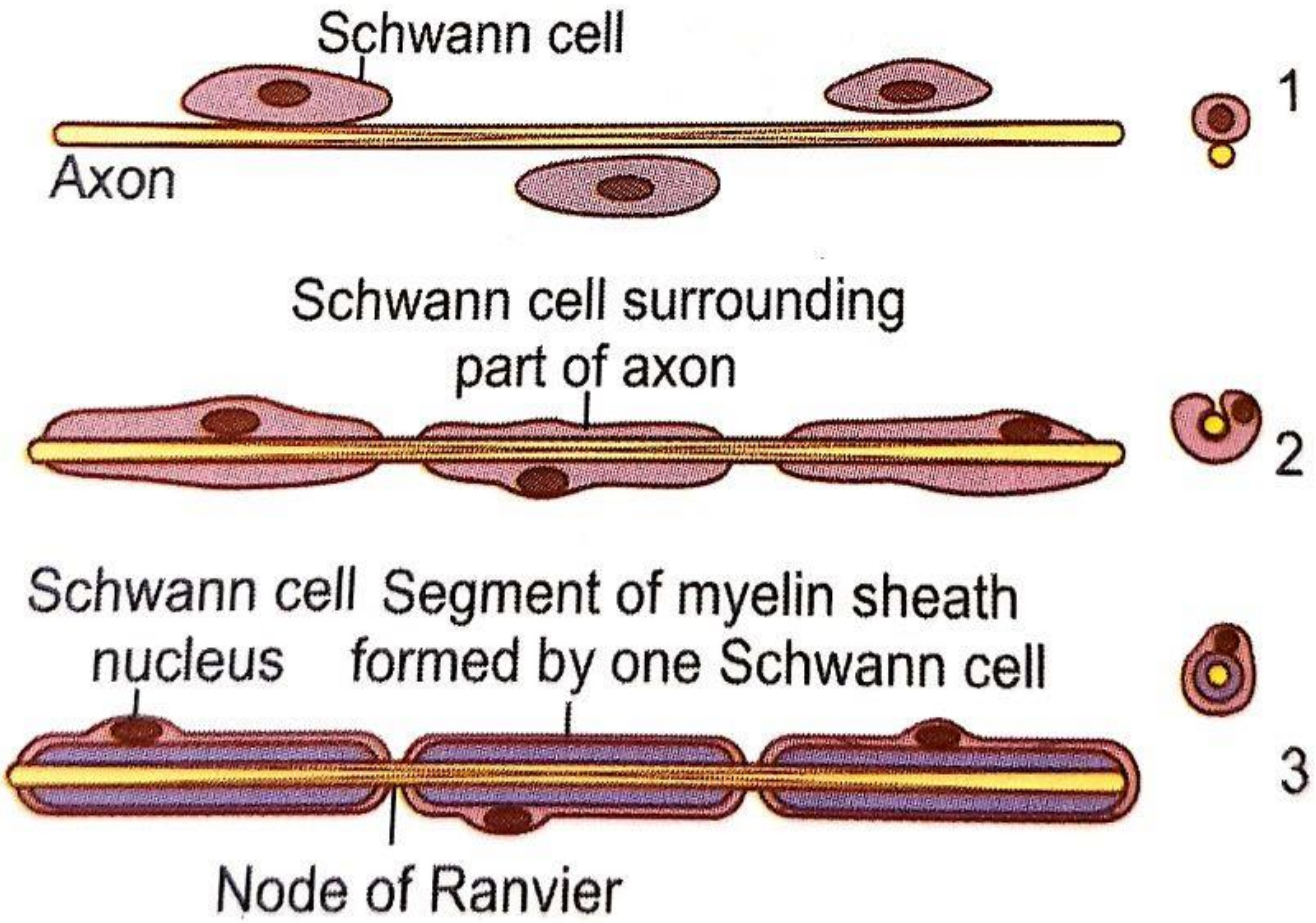


Fig. 22.5: Segmentation of myelin sheath. One Schwann cell forms a small segment. Gap between the segment is called node of Ranvier.

Comprehensive textbook of Physiology, Dr. G K Pal.

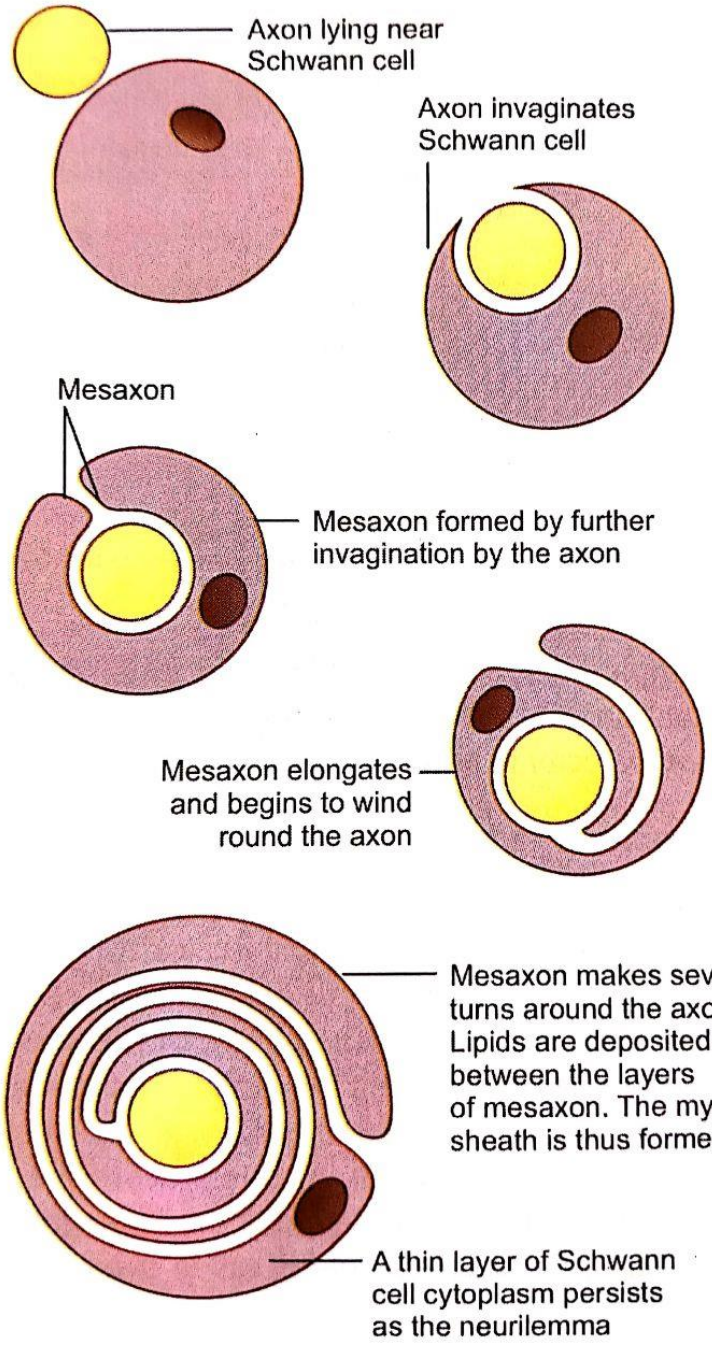


Fig. 22.4: Stages of formation of myelin sheath by Schwann cell.

Comprehensive textbook of Physiology, Dr. G K Pal.

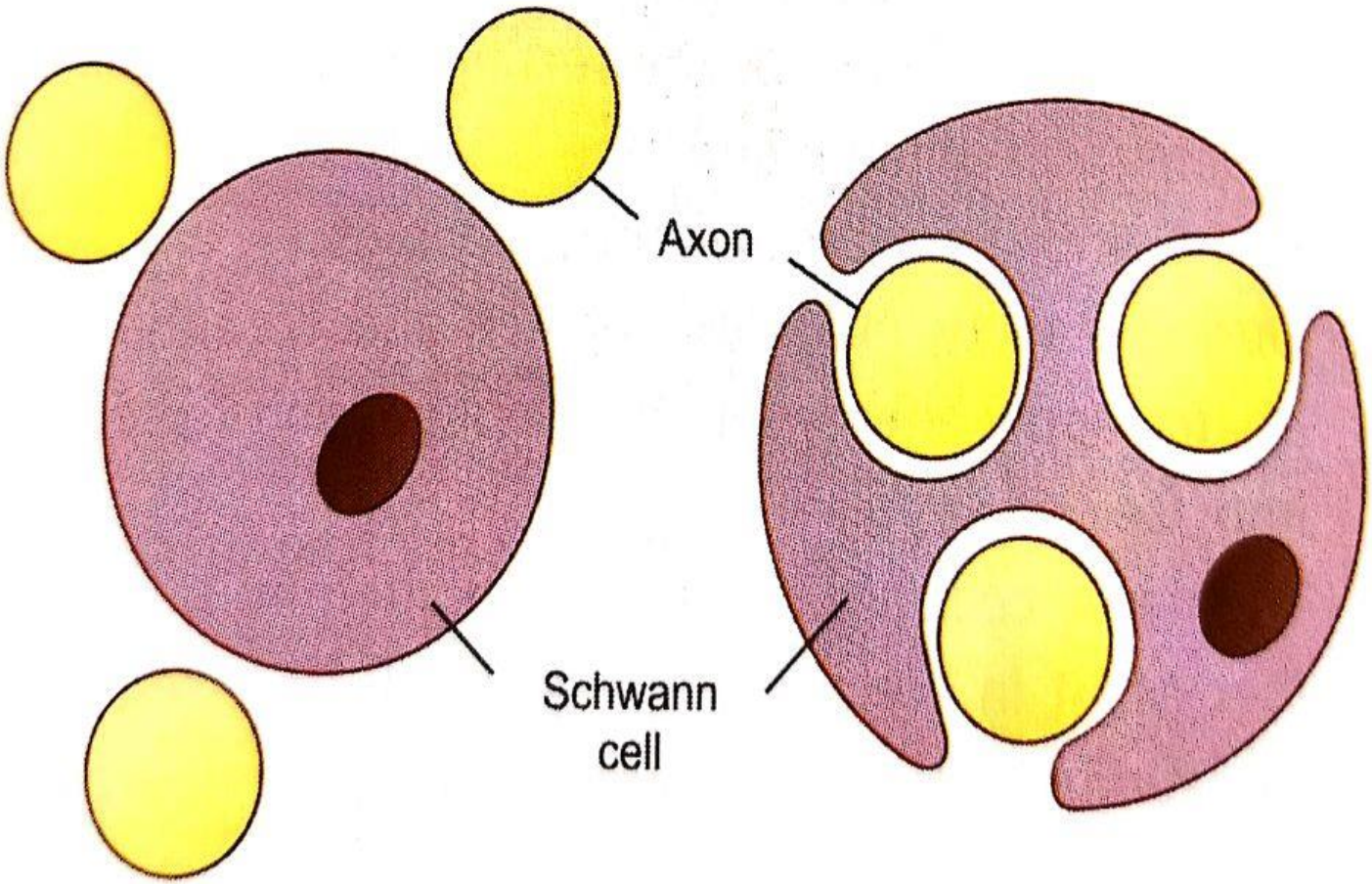


Fig. 22.6: Relation of unmyelinated fibers with Schwann cells. Mesaxons do not totally spiral around the axon.

Comprehensive textbook of Physiology,
Dr. G K Pal.

IMPORTANCE

- increased speed of conduction: saltatory conduction
- reduces energy expenditure
- Protection
- Regeneration
- prevents conduction bet. two nearby neurons

Table 22.2: Difference between myelinated and unmyelinated nerves.

Myelinated nerves	Unmyelinated nerves
1. Have axons of large diameter.	Have axons of small diameter.
2. Axons surrounded by concentric layers of Schwann cell plasma membrane.	Axons surrounded by cytoplasm of Schwann cells.
3. Nerve impulse jumps from one node to the other node, which is called saltatory conduction.	Nerve impulse travels uniformly along the axolema.
4. Density of voltage gated Na^+ channels are more (about 350 to 500/μm^2 at initial segment, and 2,000 to 12,000/μm^2 in node of Ranvier).	Na^+ channels are less in axons (about 110 /μm^2).
5. Saltatory conduction seen in Myelinated nerves is fast and consumes less energy.	Conduction seen in unmyelinated nerves is slow and consumes more energy.
6. Examples: All preganglionic fibers in ANS. In PNS, fibers more than 1 µm in diameter.	All post-ganglionic fibers in ANS. In PNS, fibers less than 1 µm in diameter.

Comprehensive textbook of Physiology, Dr. G K Pal.

NEUROGLIA

- ASTROCYTES: STAR SHAPED
  1) FIBROUS ASTROCYTES
  2) PROTOPLASMIC ASTROCYTES
  fn.:
  * supporting network in brain and spinal cord
  * form blood brain barrier
  * electrically insulate synapses
  * produce growth factors for nvs

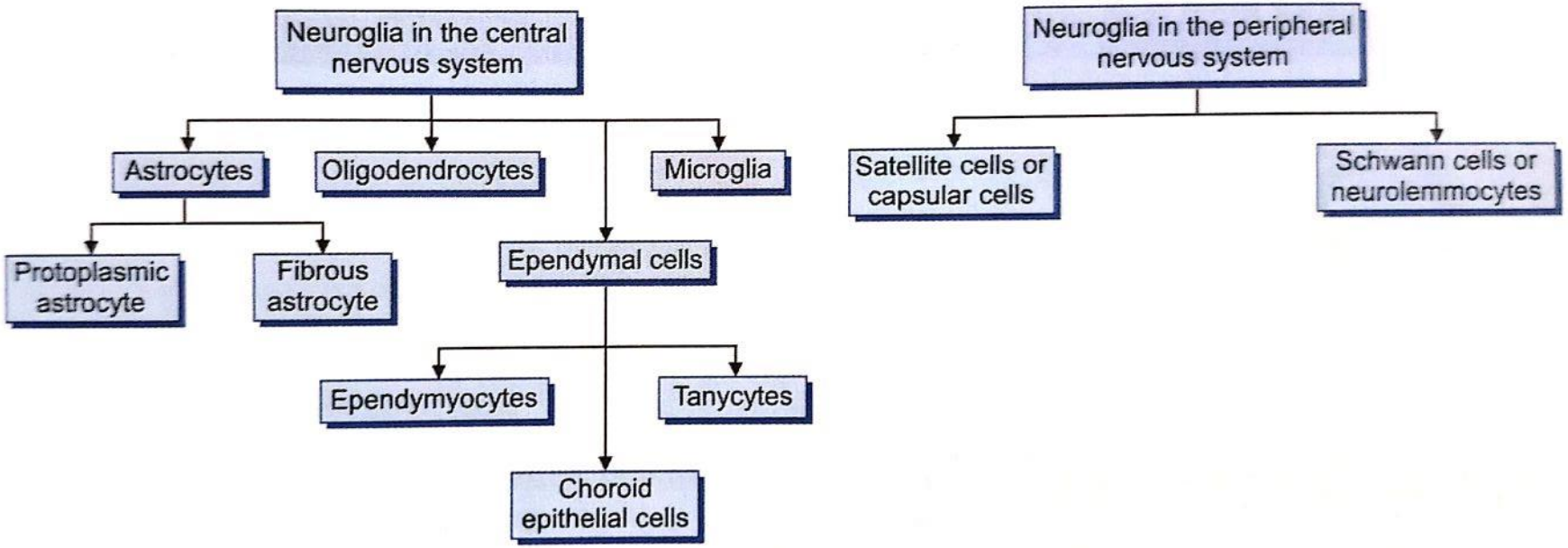
OLIGODENDROCYTES

- RESPONSIBLE FOR MYELINATION OF NEURONS IN CENTRAL NERVOUS SYSTEM

MICROGLIA

- SMALLEST CELLS IN NERVOUS SYSTEM
- SCAVANGER CELLS
- BECOME ENLARGED AND BECOME MONONUCLEAR PHAGOCYTES TO ELIMINATE DEBRIS AND ORGANISMS.

Flowchart 22.1: Types of neuroglia in the nervous system (PNS and CNS).



(PNS: Peripheral neurons system; CNS: Central neurons system).

Comprehensive textbook of Physiology, Dr. G K Pal.

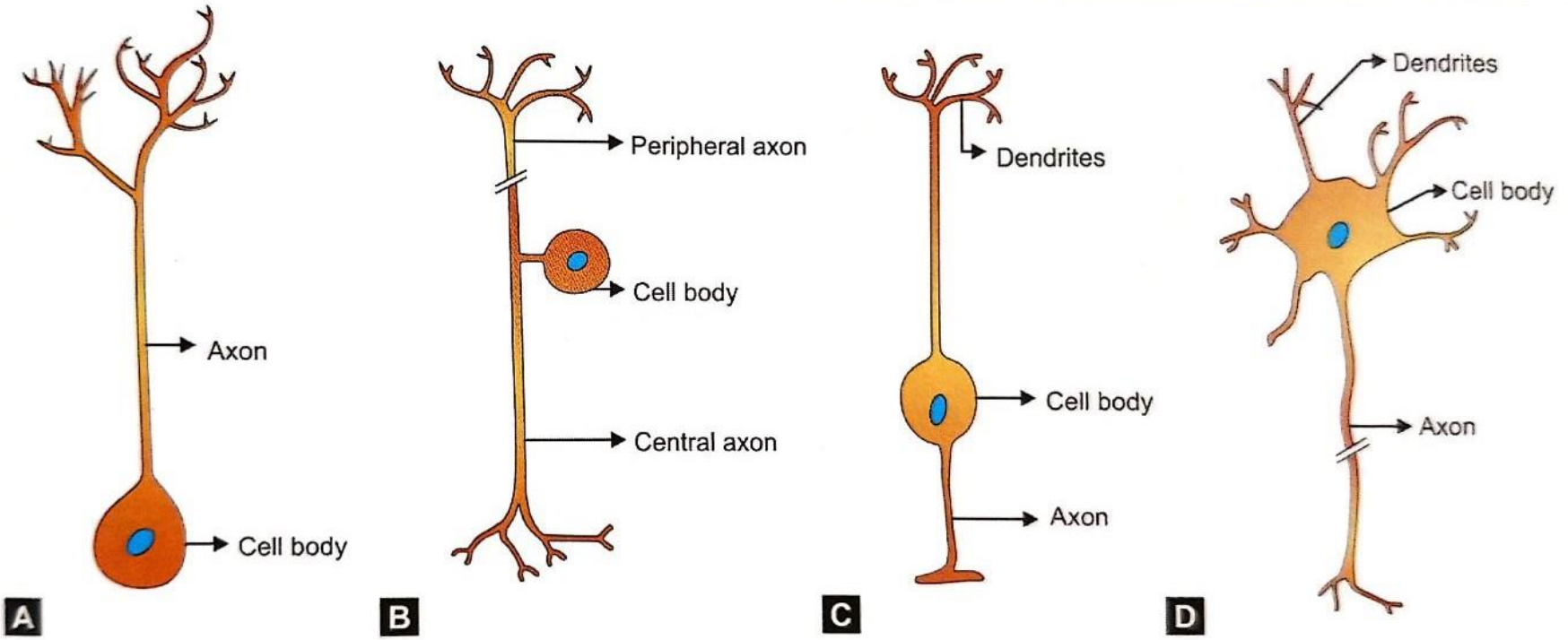
APPLIED: GLIOMAS

- EXCESSIVE MULTIPLICATION OF GLIAL CELLS: MALIGNANT TUMOUR OF BRAIN.

TYPES OF NEURONS

- A) ACCORDING TO ARRANGEMENT OF AXON OR PROCESSES:

1) unipolar neuron eg. in ANS
2) pseudounipolar neuron eg. DRG
3) bipolar neuron eg. in retina
4) multipolar neuron eg. spinal motor neuron



Figs. 22.8A to D: Types of neurons based on arrangement of axon. (A) Unipolar neuron; (B) Pseudo-unipolar neuron; (C) Bipolar neuron; (D) Multipolar neuron.

Comprehensive textbook of Physiology, Dr. G K Pal.

B) ACCORDING TO LENGTH OF NEURON:

- GOLGI TYPE 1: NEURONS WITH LONG AXONS
- GOLGI TYPE II: NEURONS WITH SHORT AXONS: MOTOR NEURONS

C) ACCORDING TO FUNCTION:

- SENSORY / AFFERENT NEURONS
- MOTOR / EFFERENT NEURONS

D) ACCORDING TO DENDRITIC PATTERN

- PYRAMIDAL CELLS
- STELLATE CELLS

THANK YOU