



SNS COLLEGE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION)

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Department of Biomedical Engineering

Course Name: 23BMT201 Human Anatomy & Physiology

I Year : II Semester

Unit I- Cell and Tissue Structure

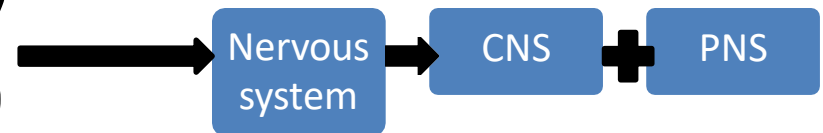
Topic : Nervous Tissue and its function

21BMT201/HAP/Unit 1 /Mrs.J.Jareena /AP/BME



Introduction

- Property of irritability and conductivity
- Respond to various types of stimuli
- Distributed throughout the body as an integrated network
- Made up of 2 cell types:
 - (a) Nerve cells (neurons)
 - (b) Glial cells (neuroglia)





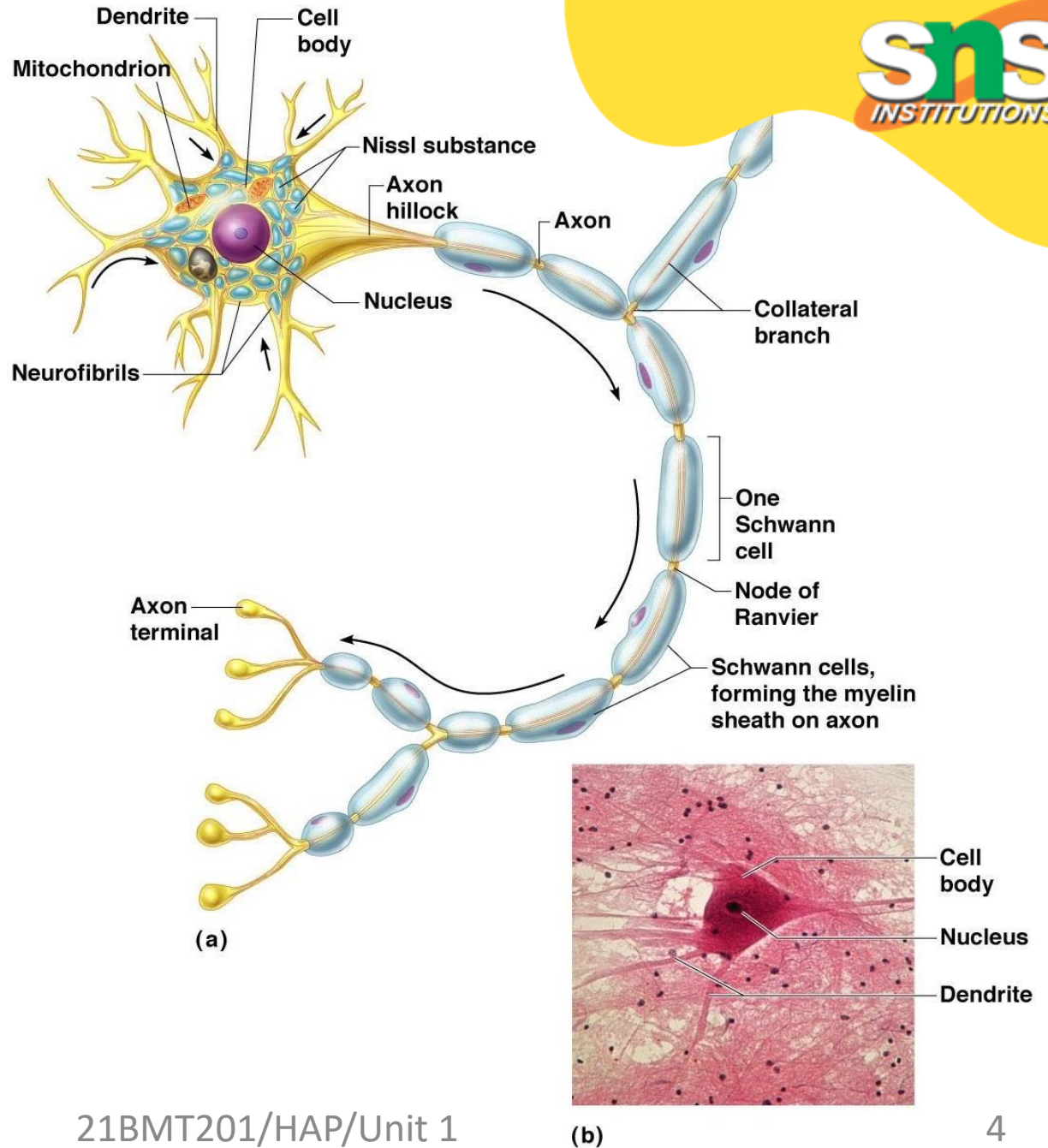
The Neuron

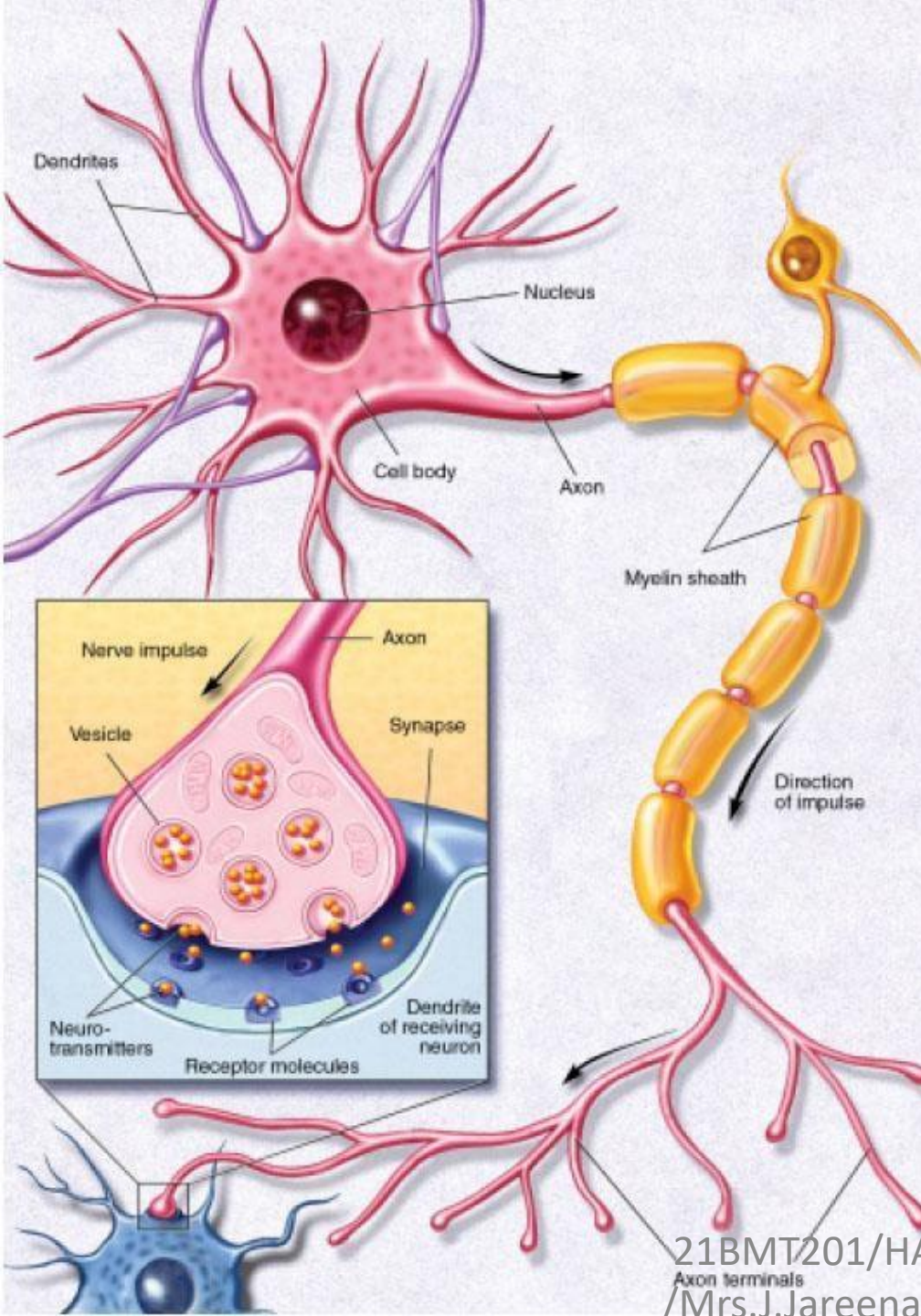


- Excitable, independent anatomic and functional units with complex morphological characteristics.
- Neurons = nerve cells
 - Cells specialized to transmit messages
 - Major parts of neuron:
 - Cell body — nucleus and metabolic center of the cell (main part of nerve cell)
 - Processes — fibers that extend from the cell body
 - can be microscopic or up to 3-4 feet in length



Anatomy of a Neuron







Nerve Cell Body (Perikaryon or Soma)

- Contains the nucleus and a nucleolus
- Major biosynthetic center
- Focal point for the outgrowth of neuronal processes
- Absence of centrioles (hence its amitotic nature)
- Prominent basophilic Nissl bodies (rough ER)
- Contains an axon hillock – cone-shaped area from which axons arise
- Cytoskeleton of neuron is formed by microtubules & neurofilaments



Processes

- Arm like extensions from the soma
- Nerve fibre: term used for nerve cell process
- Two types of processes: axons and dendrites
- Myelinated axons are called **tracts** in the CNS and **nerves** in the PNS



Dendrites

- Short, tapering processes
- Branch extensively to form “Dendritic tree”
- They are the receptive or input regions of the neuron
- Absence of Golgi complexes



Axon

- Slender processes of uniform diameter arising from the axon hillock
- Axon hillock lacks RER, ribosomes & Nissl substance
- Nissl substance is also absent in cytoplasm of axon
- Usually there is only one unbranched axon per neuron
- Axon terminals (terminal boutons)
- Axolemma
- Axoplasm



Axons: Function

- Generate and transmit action potential
- Secrete neurotransmitters from the axonal terminals
- Movement along axons occurs in two ways
 - Anterograde — toward the axon terminal
 - Retrograde — toward the cell body



Classification of Neuron



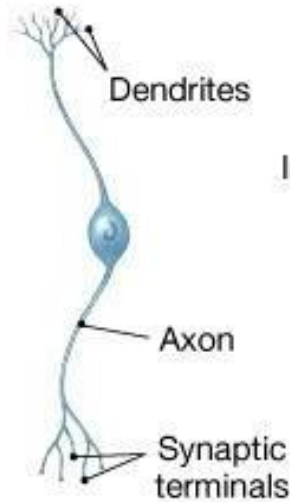
- **Structural:**
 - Multipolar — three or more processes
 - Bipolar — two processes (axon and dendrite)
 - Unipolar (pseudounipolar)— single, short process (usually dendrite)
 - Anaxonic



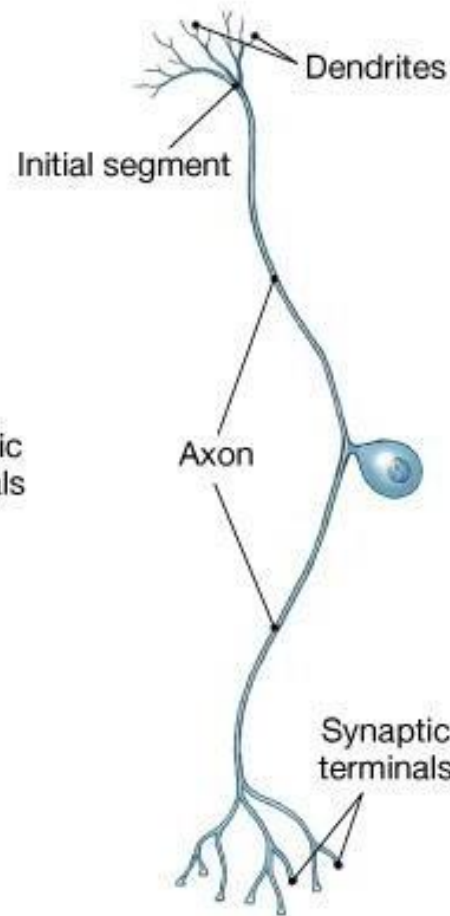
Structural Classification of Neurons



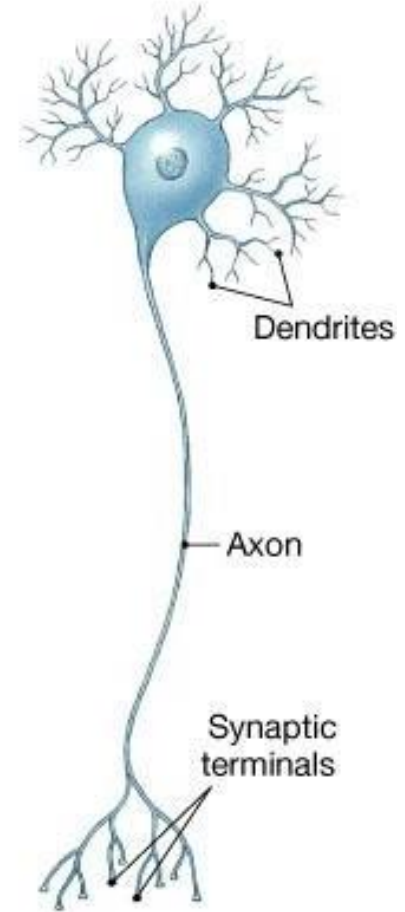
(a) Anaxonic neuron



(b) Bipolar neuron



(c) Unipolar neuron



(d) Multipolar neuron



Classification of Neuron (contd...)

- **Functional:**
 - Sensory (afferent) — transmit impulses toward the CNS
 - Motor (efferent) — carry impulses toward the body surface
 - Interneurons (association neurons) — any neurons between a sensory and a motor neuron



Synapse

- Specialized region of contact between two neurons
- Nerve impulse is transmitted from one neuron to other through neurotransmitters
- 3 varieties: axodendritic, axosomatic, axoaxonic
- Parts: presynaptic part, synaptic cleft, postsynaptic part





Myelin

- Myelin sheath — whitish, fatty material covering axons
 - protects/insulates the cells and increases the transmission rate of nerve impulses
- Myelin is produced by Schwann cells in PNS and Oligodendrocytes in CNS
- Nodes of Ranvier — gaps in myelin sheath along the axon



The Neuroglia

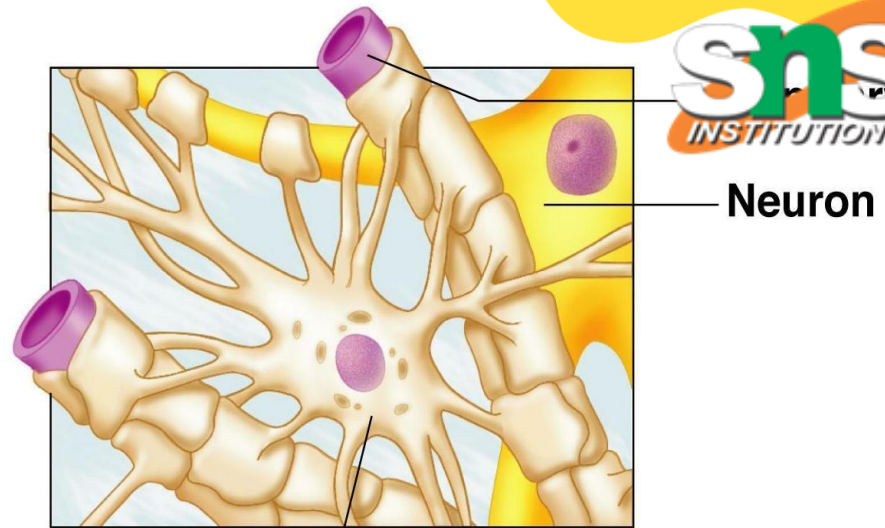
- Supporting cells in the Central Nervous System (CNS) are grouped together as Neuroglia
- Neuroglia literally means “nerve glue”
- The function of neuroglia is to support, insulate, and protect the delicate neurons of the brain
- In H & E staining, only their nuclei can be seen
- Capable of multiplying in mature nervous tissue
- Cannot generate or transmit the impulse



Types of Neuroglia in CNS

- **Astrocytes**

- Star-shaped cells
- Processes have expanded ends that attach to the walls of blood capillaries
- 2 types: Protoplasmic (in grey matter) and fibrous (in white matter)
- Control the chemical environment of the brain (forming blood-brain barrier)



(a) Astrocyte



Microglia

Neuron



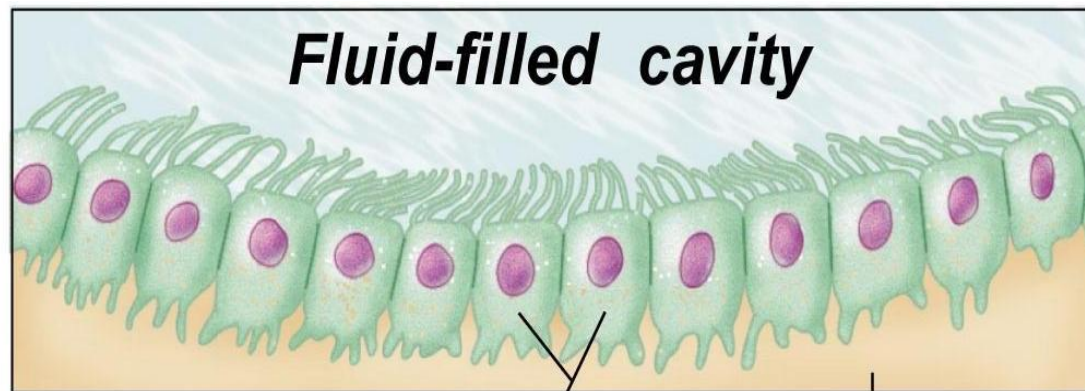
(b) Microglial cell

- Spiderlike phagocytes (white blood cells)
- Dispose of debris like dead brains cells and bacteria



Ependymal cells

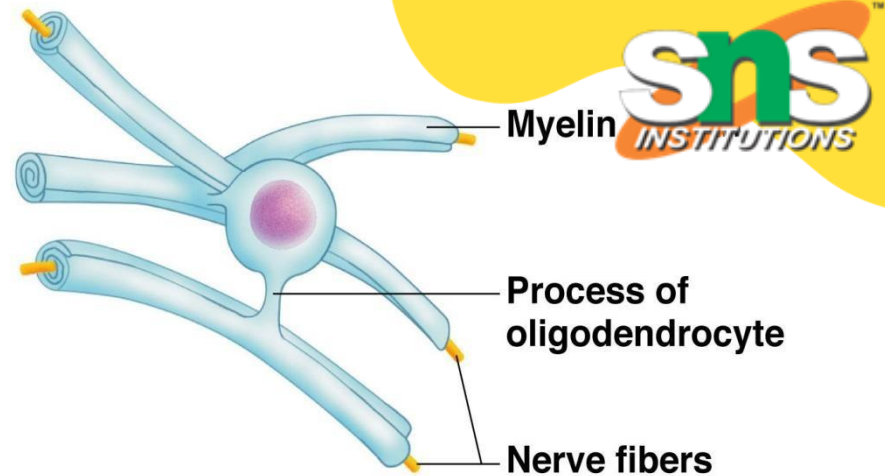
- Lines the cavities of the brain and spinal cord
- Circulate cerebrospinal fluid by beating their cilia
- Arranged in a single layer
- Ciliated cuboidal or columnar shaped



(c) Ependymal cells — Brain or spinal cord tissue



Oligodendrocytes



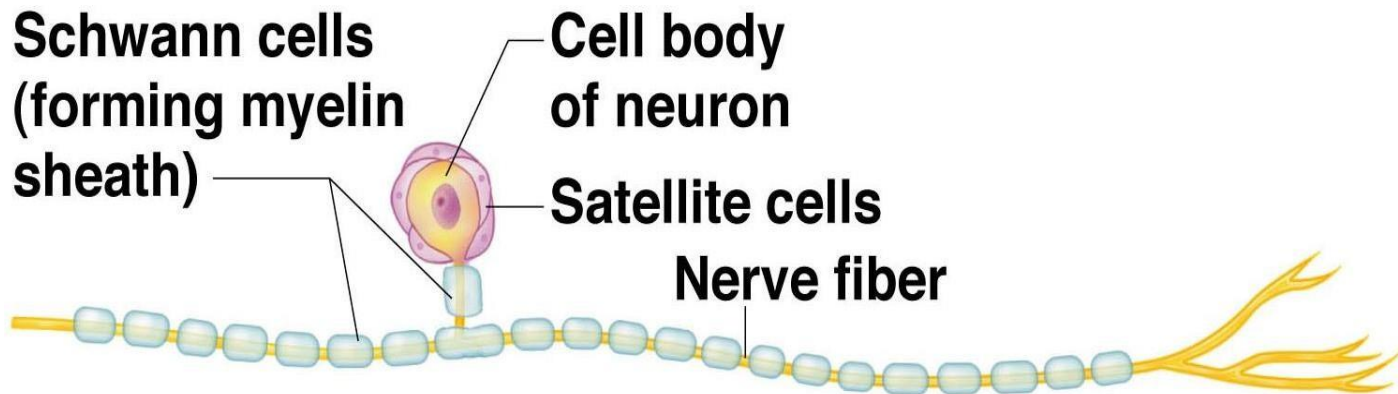
(d) Oligodendrocyte

- Small, round cells with few cytoplasmic processes
- Produce myelin sheaths
- Myelin is a fatty, insulation covering the nerve cells; allows the electrical signal to transmit faster (like wire coating)



Types of Neuroglia in PNS

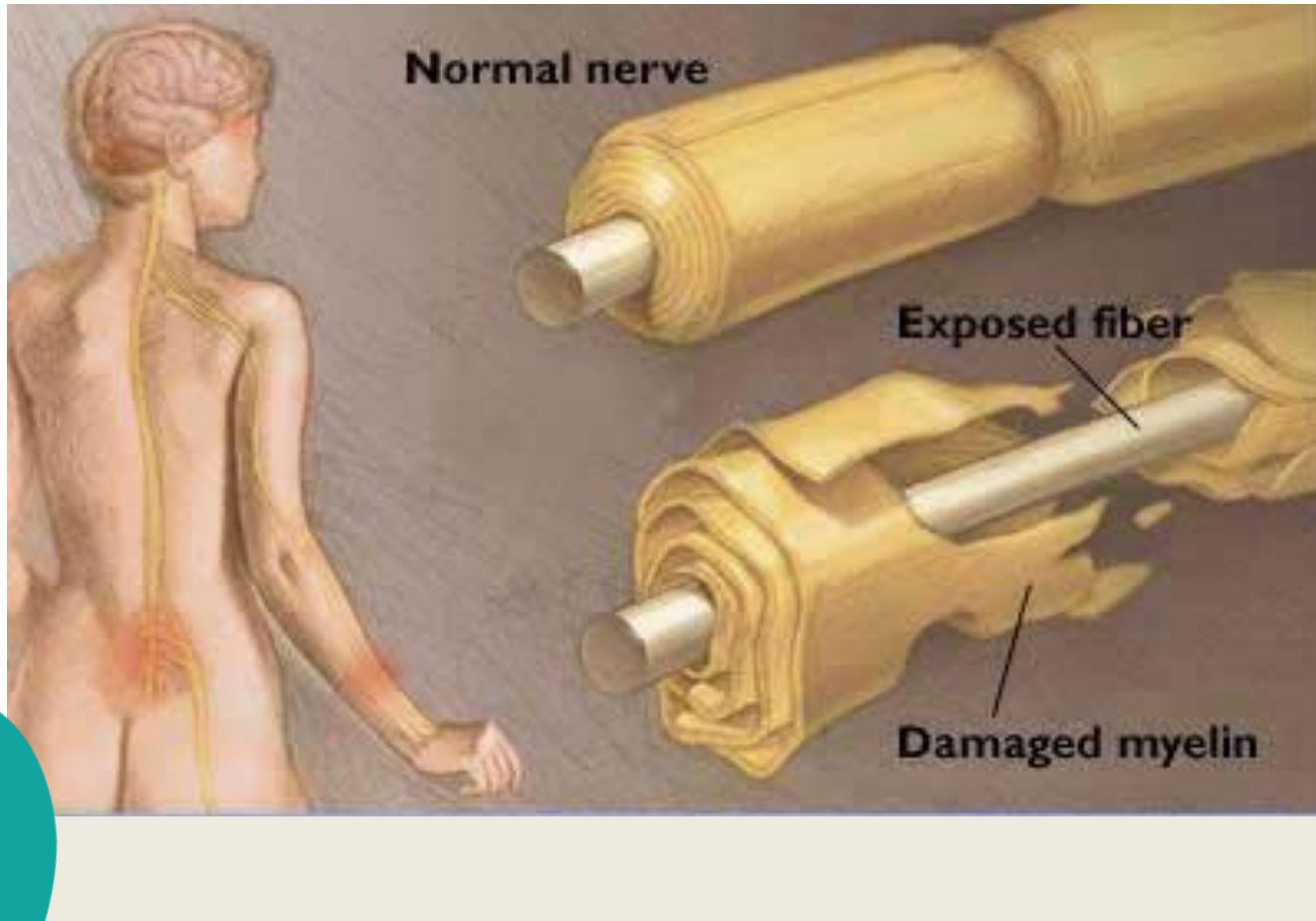
- **Satellite cells**
 - Surround the nerve cells of ganglia
 - Flattened cells with prominent nuclei
 - Insulate & support neurons of ganglia
- **Schwann cells**
 - Form myelin sheath in the peripheral nervous system
 - Flattened cells with flattened nucleus



(e) Sensory neuron with Schwann cells and satellite cells



Myelin

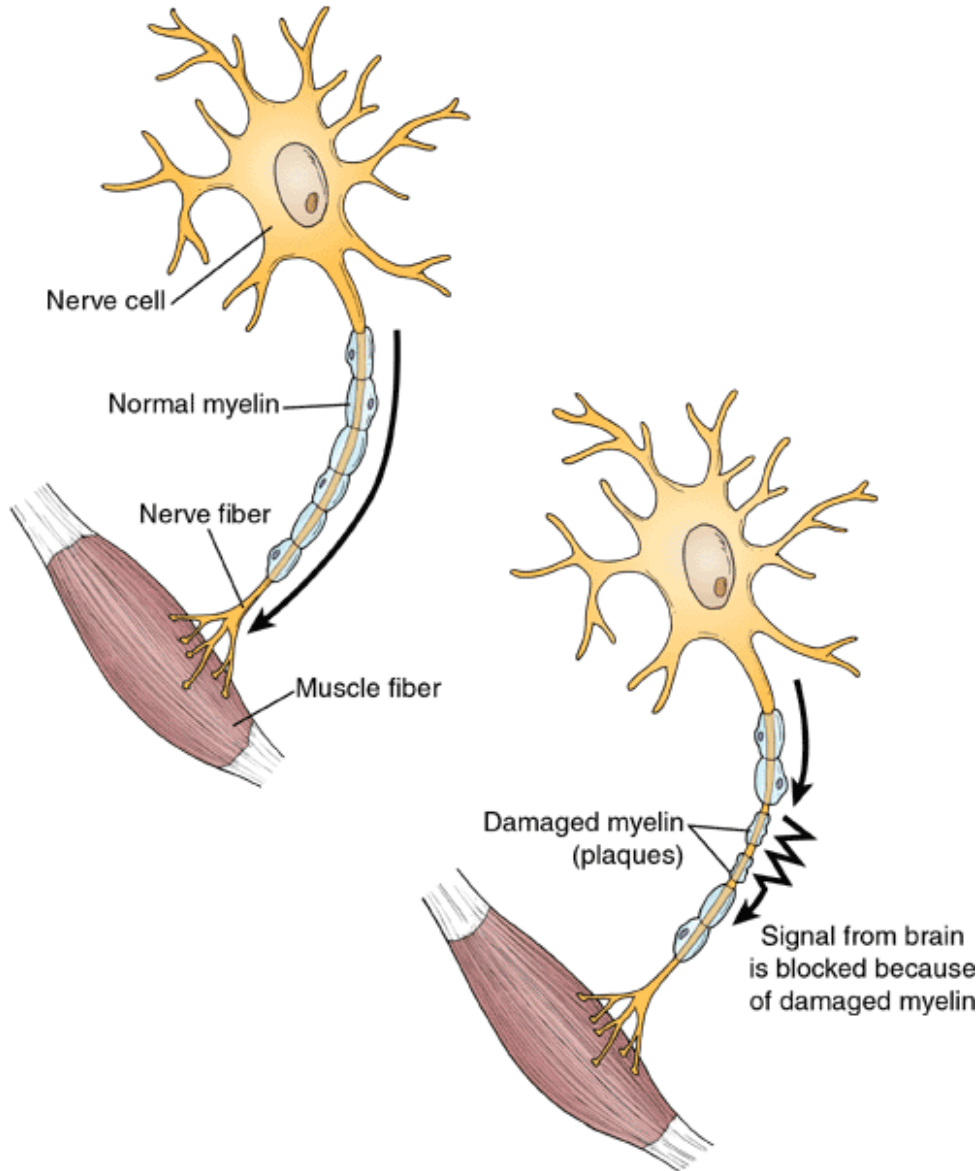




Clinical Application

- Gliomas
- Schwannoma
- Medulloblastoma

Damaged Myelin in Multiple Sclerosis



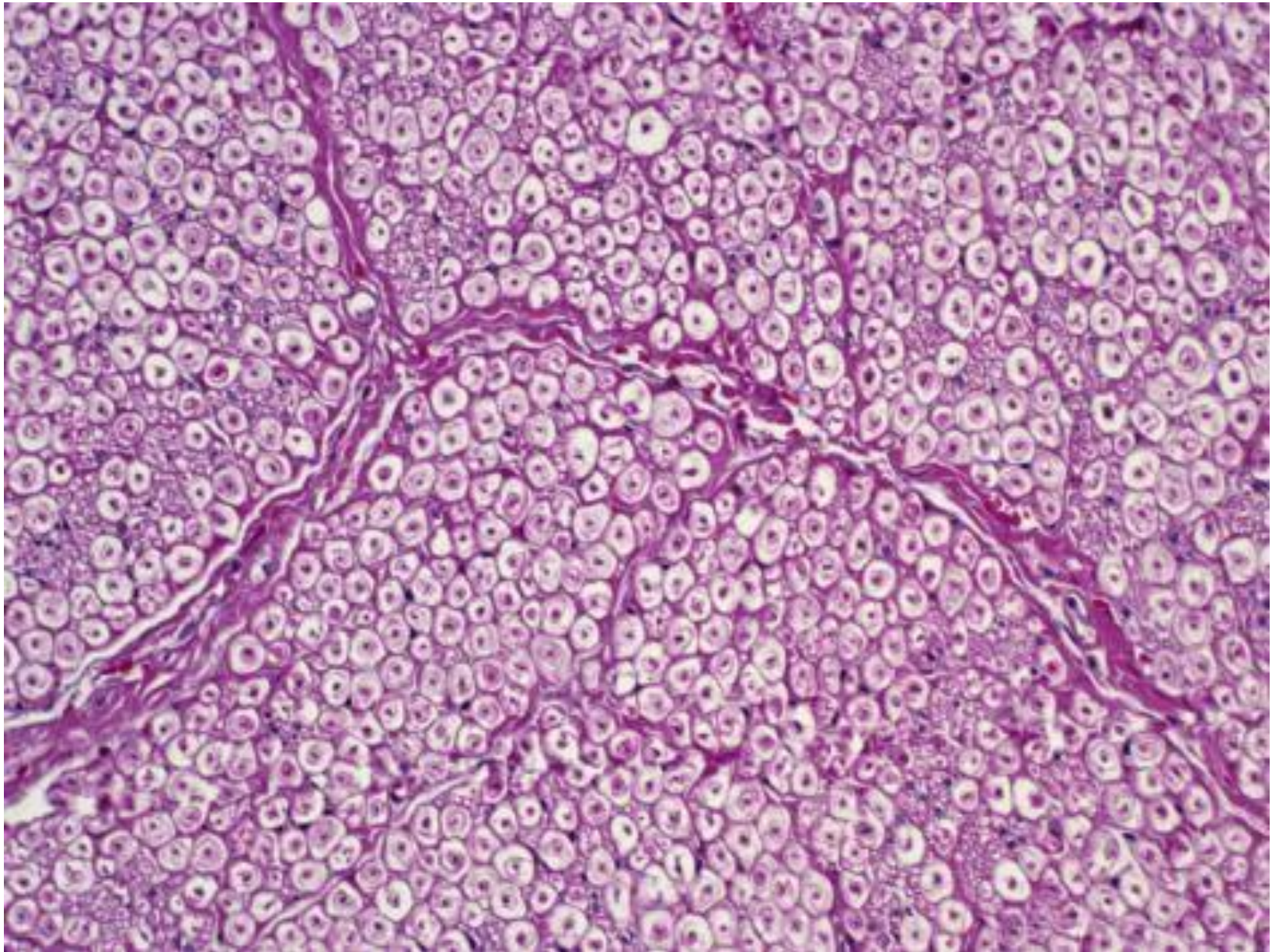
Multiple Sclerosis

- Affects the ability of nerve cells in the brain and spinal cord to communicate with each other.
- The body's own immune system attacks and damages the myelin.



Nerve fibres

- Axon enveloped by special ectodermal sheaths
- Surrounding plasma membrane is termed the axolemma
- Structurally, surrounded by 3 connective tissue sheaths:
Endoneurium, perineurium and epineurium



References

1. diFiore's Atlas of Histology with functional Correlations, 12th Edition.
2. Essentials of Anatomy for Dentistry Students. DR Singh, 1st Edition.
3. Textbook of Histology. GP Pal, 3rd Edition.



MCQ

- The structural and functional unit of nervous system:
 1. Nerve cell
 2. Dendrites
 3. Axon
 4. Neuroglia



MCQ

- Nissl bodies are aggregation of:
 1. Mitochondria
 2. Rough endoplasmic reticulum
 3. Smooth endoplasmic reticulum
 4. Golgi apparatus



MCQ

- The cell responsible for formation of blood-brain barrier is:
 1. Astrocyte
 2. Oligodendrocyte
 3. Ependymal cells
 4. Microglia



MCQ

- The cell responsible for formation of myelin sheath in peripheral nervous system:
 1. Schwann cell
 2. Ependymal cell
 3. Oligodendrocyte
 4. Satellite cells



MCQ

- The phagocytic activity is a feature of:
 1. Astrocyte
 2. Oligodendrocyte
 3. Microglia
 4. Schwann cell