



# **SNS COLLEGE OF TECHNOLOGY**

## **(AN AUTONOMOUS INSTITUTION)**

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## **Department of Biomedical Engineering**

Vision Tit 2

Vision Title 3

**Course Name: 19BMT201 Anatomy & Physiology**

**II Year : III Semester**

**Unit I- Cell and Tissue Structure**

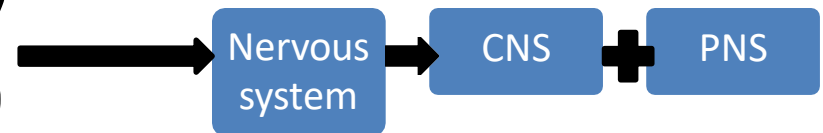
**Topic : Nervous Tissue and its function**

19BMT201/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)





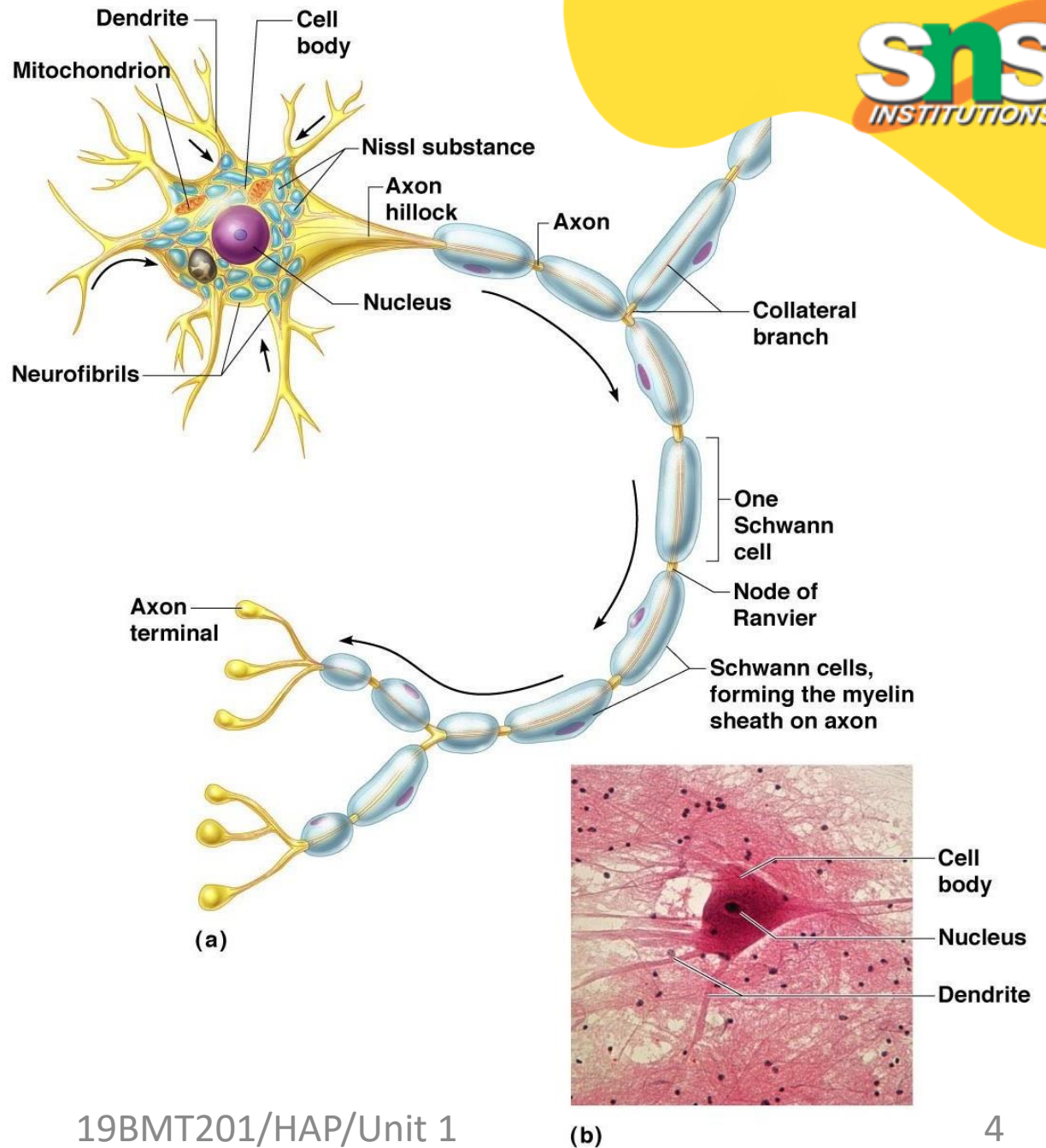
# The Neuron

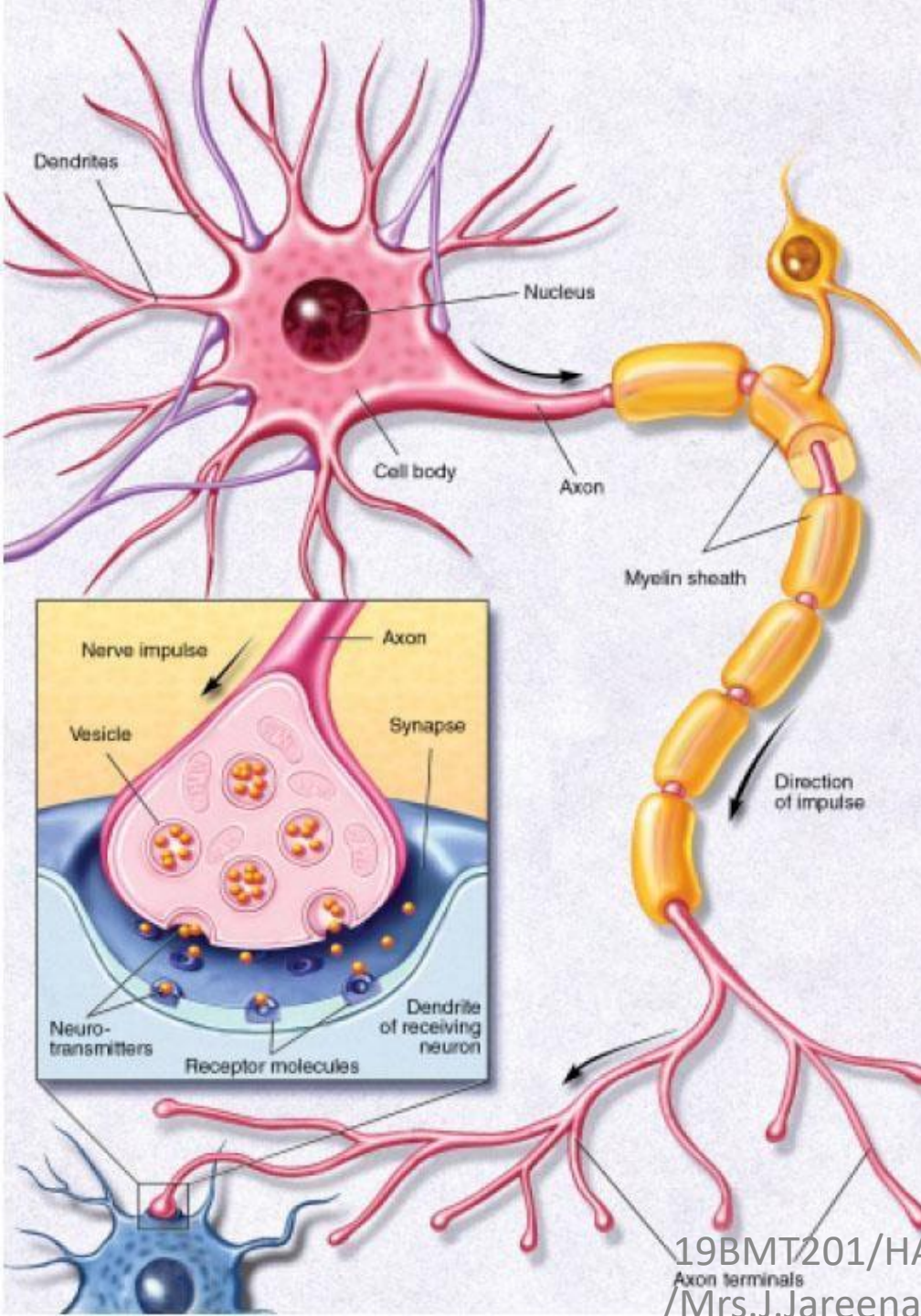


- Excitable, independent anatomic and functional units with complex morphological characteristics.
- Neurons = nerve cells
  - Cells specialized to transmit messages
  - Major parts of neuron:
    - Cell body — nucleus and metabolic center of the cell (main part of nerve cell)
    - Processes — fibers 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



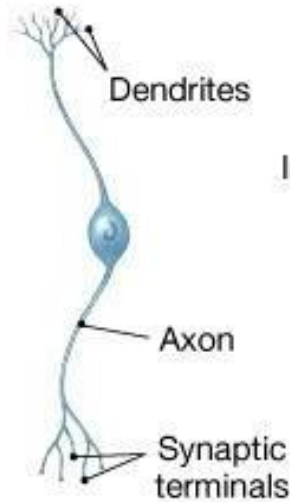
- **Structural:**
  - Multipolar — three or more processes
  - Bipolar — two processes (axon and dendrite)
  - Unipolar (pseudounipolar)— single, short process (usually dendrite)
  - Anaxonic



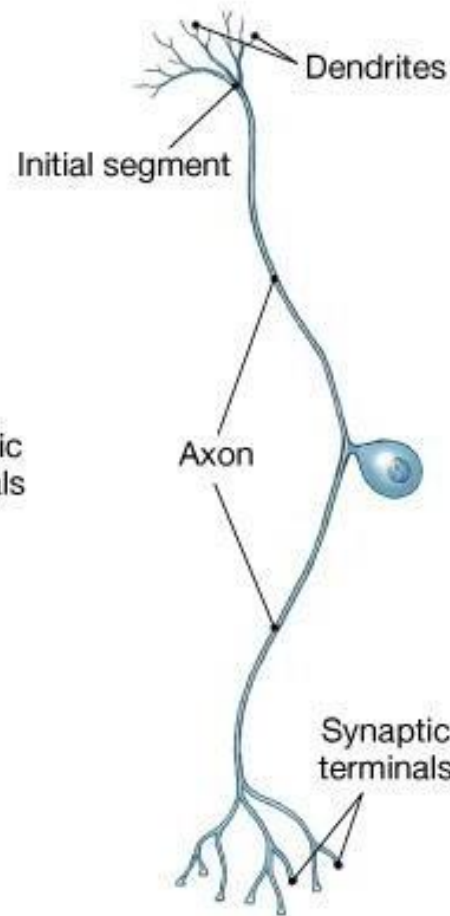
# Structural Classification of Neurons



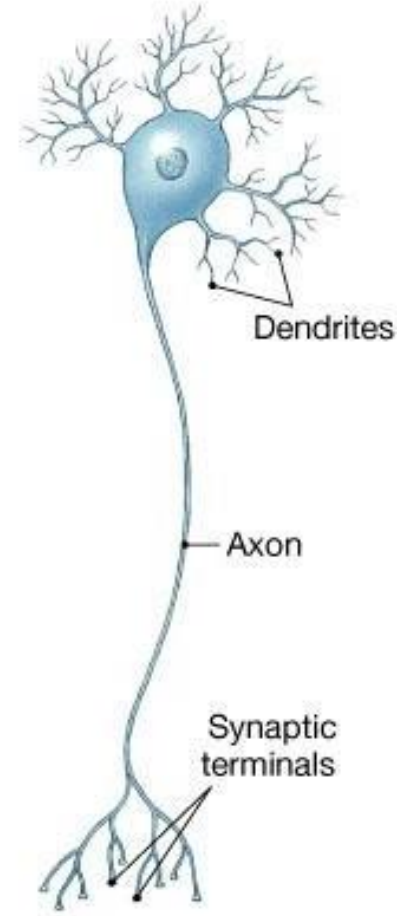
(a) Anaxonic neuron



(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

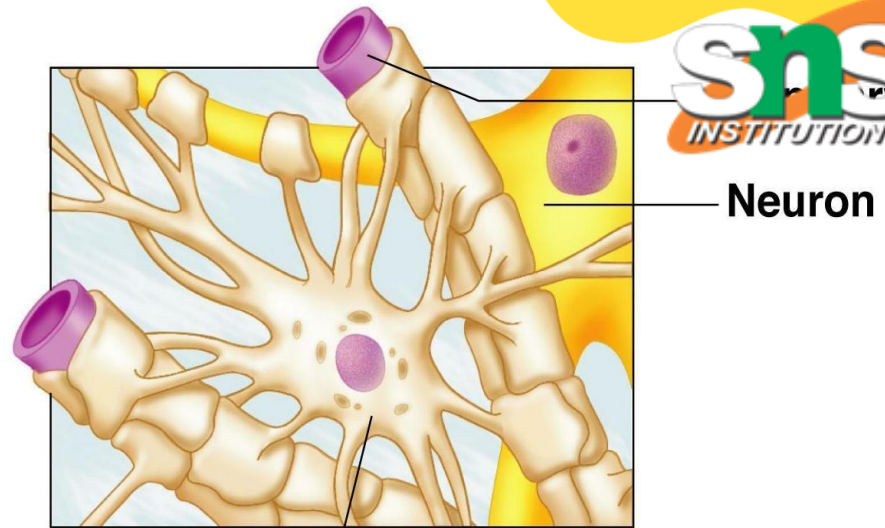
- Supporting cells in the Central Nervous System (CNS) are grouped together as Neuroglia
- Neuroglia literally means “nerve glue”
- The function of neuroglia is to support, insulate, and protect the delicate neurons of the brain
- In H & E staining, only their nuclei can be seen
- Capable of multiplying 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



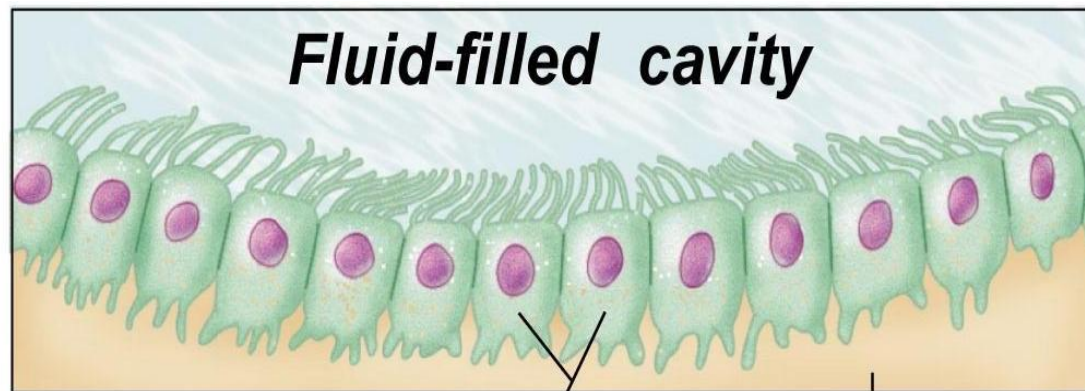
**(b) Microglial cell**

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



# Ependymal cells

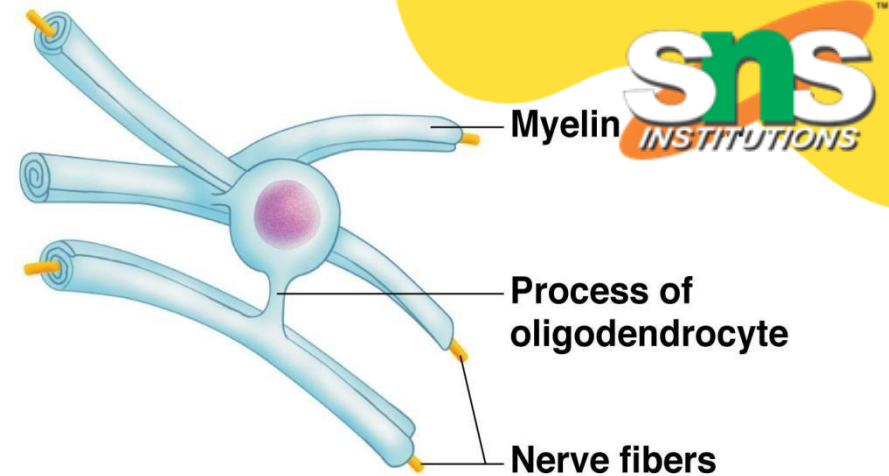
- Lines the cavities of the brain and spinal cord
- Circulate cerebrospinal fluid by beating their cilia
- Arranged in a single layer
- Ciliated cuboidal or columnar shaped



(c) Ependymal cells — Brain or spinal cord tissue



# Oligodendrocytes



(d) Oligodendrocyte

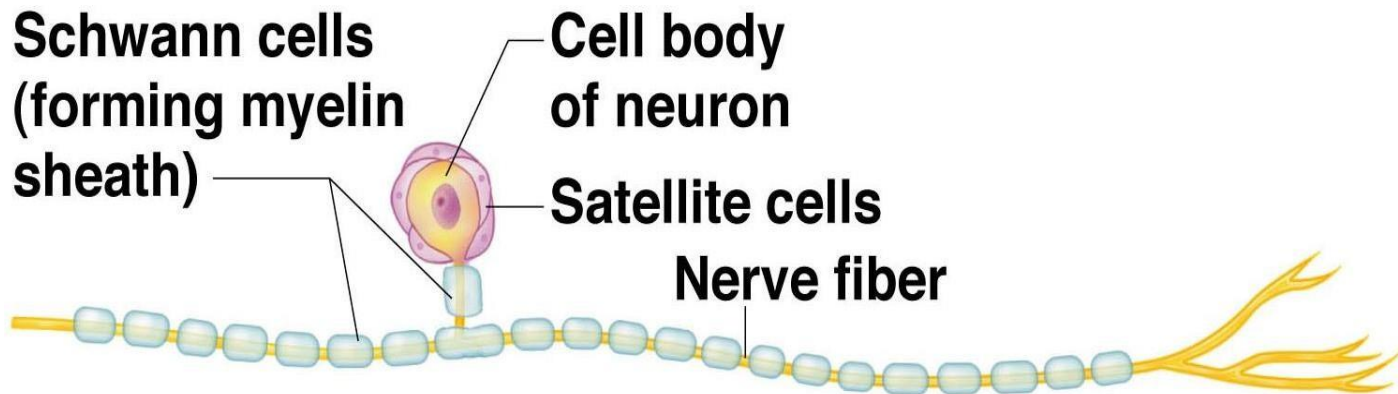
- Small, round cells with few cytoplasmic processes
- Produce myelin sheaths
- Myelin is a fatty, insulation covering the nerve cells; allows the electrical signal to transmit faster (like wire coating)





# Types of Neuroglia in PNS

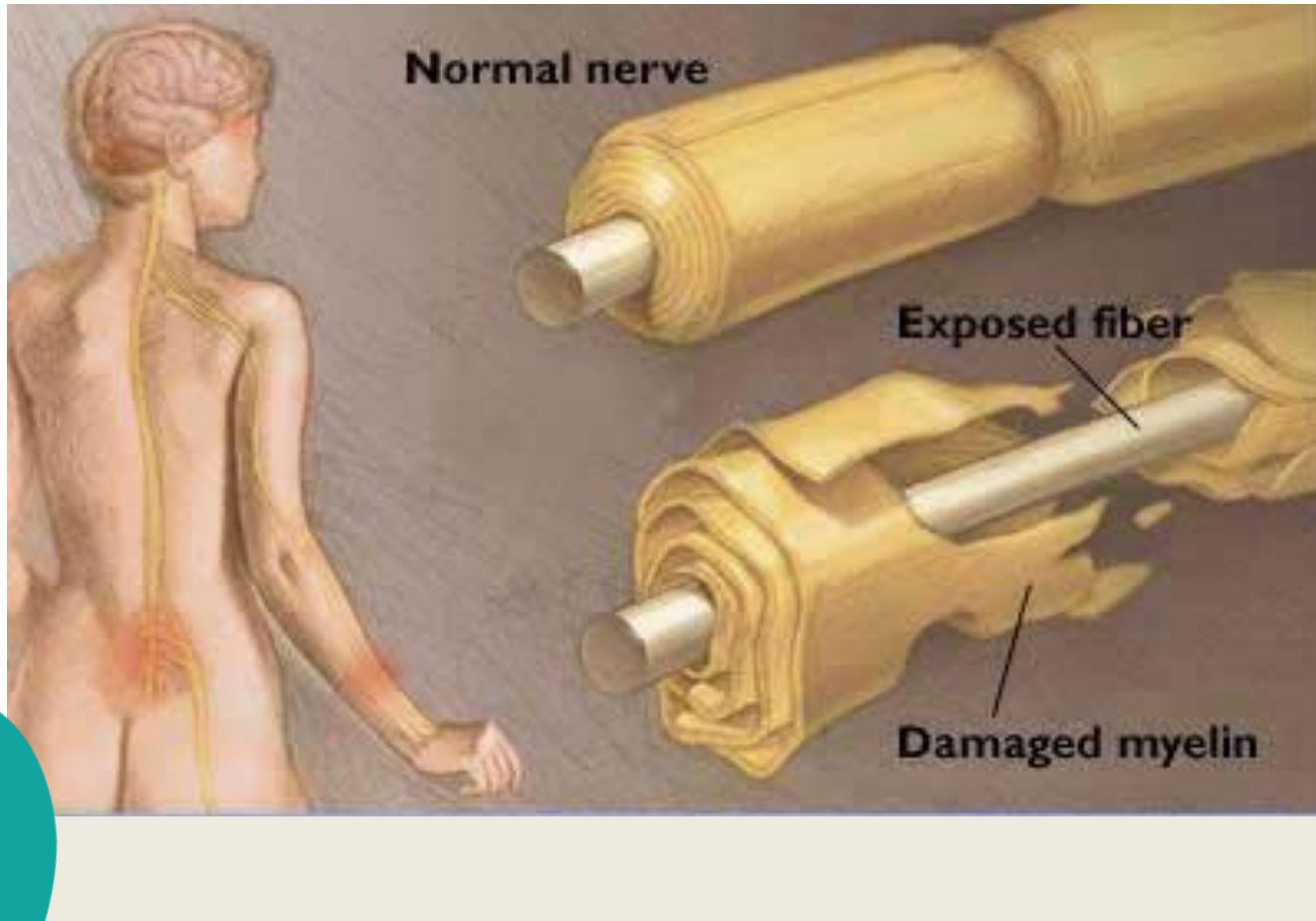
- **Satellite cells**
  - Surround the nerve cells of ganglia
  - Flattened cells with prominent nuclei
  - Insulate & support neurons of ganglia
- **Schwann cells**
  - Form myelin sheath in the peripheral nervous system
  - Flattened cells with flattened nucleus



**(e) Sensory neuron with Schwann cells and satellite cells**



# Myelin

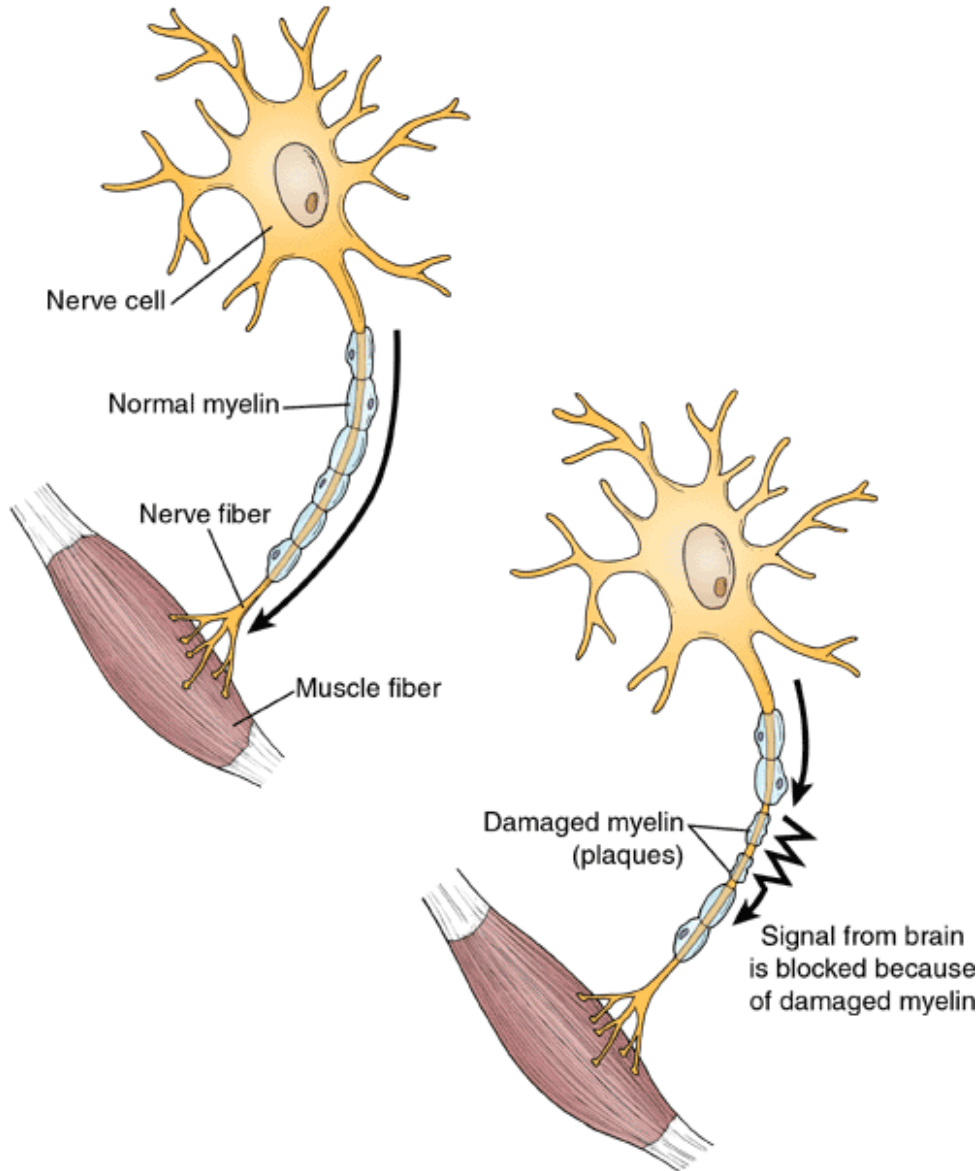




# Clinical Application

- Gliomas
- Schwannoma
- Medulloblastoma

## Damaged Myelin in Multiple Sclerosis



# Multiple Sclerosis

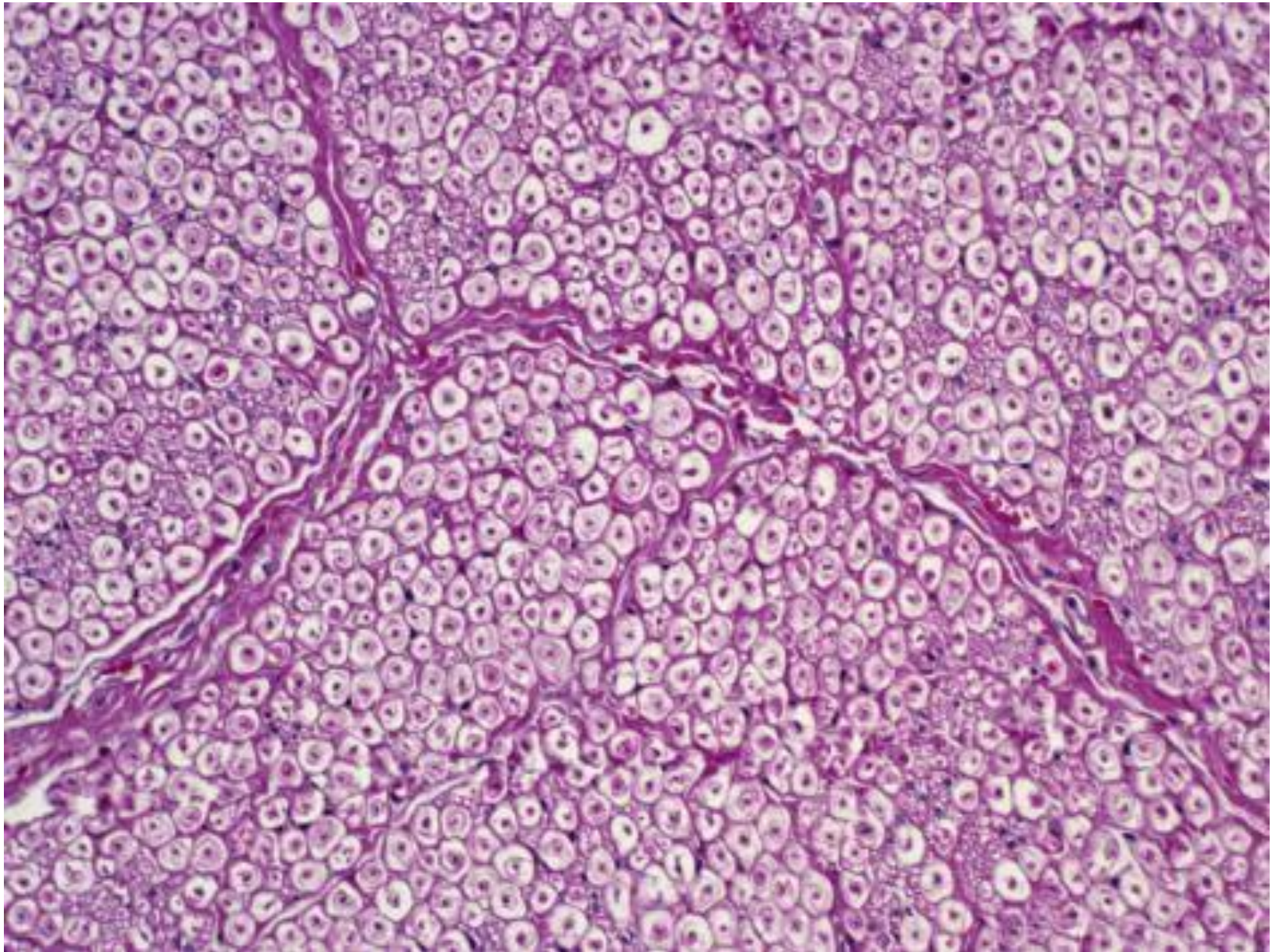
- Affects the ability of nerve cells in the brain and spinal cord to communicate with each other.
- The body's own immune system attacks and damages the myelin.



# 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, 12<sup>th</sup> Edition.
2. Essentials of Anatomy for Dentistry Students. DR Singh, 1<sup>st</sup> Edition.
3. Textbook of Histology. GP Pal, 3<sup>rd</sup> 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