Histology of the Nervous System

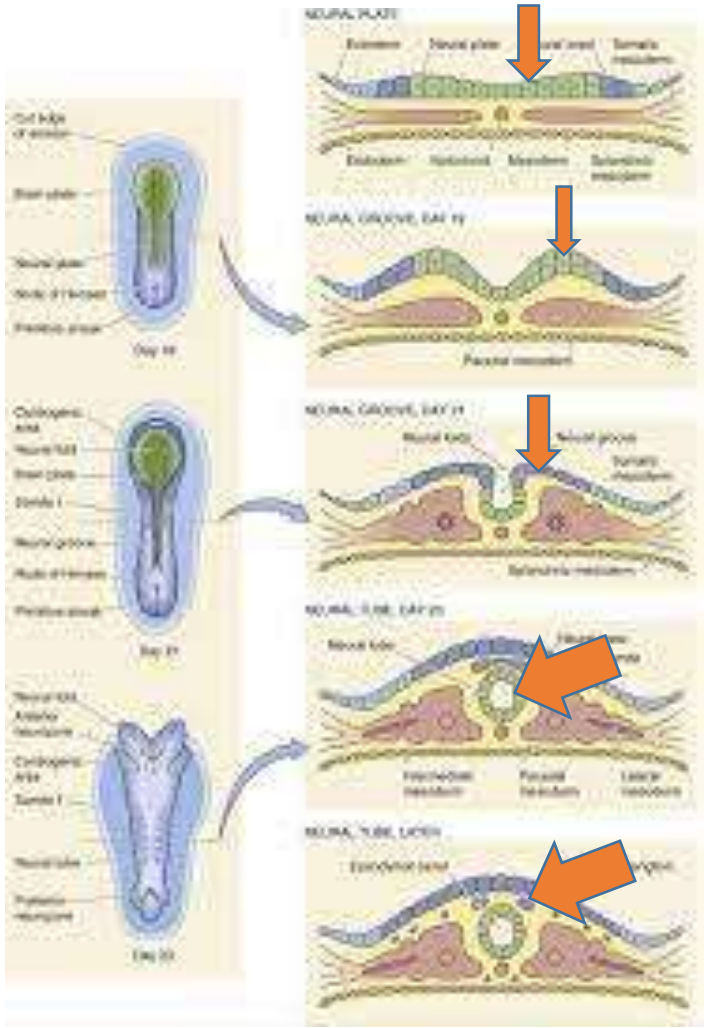
Divisions of the Nervous System

- **Anatomically**
  - **CNS: Brain and Spinal cord**
  - **PNS: Nerves and Ganglia**

- **Histologically**
  - **Nerve cells**
  - **Glial cells**

Development of the Nervous System

- During early development, the embryo is formed of three germ layers
  - Ectoderm
  - Mesoderm
  - Endoderm
- Ectoderm forms most of the nervous system
  - Neural tube
  - Neural crest



Divisions of the Nervous System

- The neuron is the structural and functional unit of the nervous system
- Functions:

  Reception, Processing, and Transmission of nerve stimuli

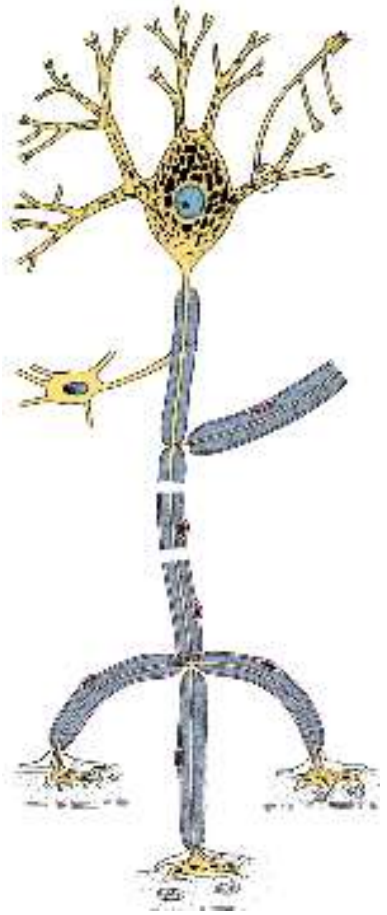
  Triggering certain cell activity

  Release of neurotransmitters
- Parts:

  Cell body (Perikaryon)

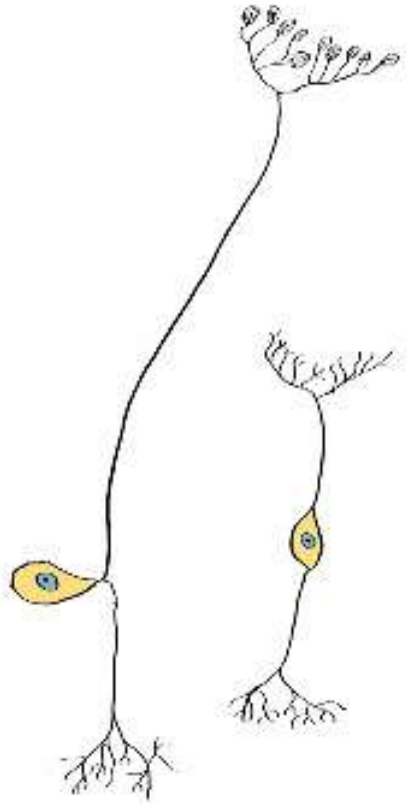
  Dendrites

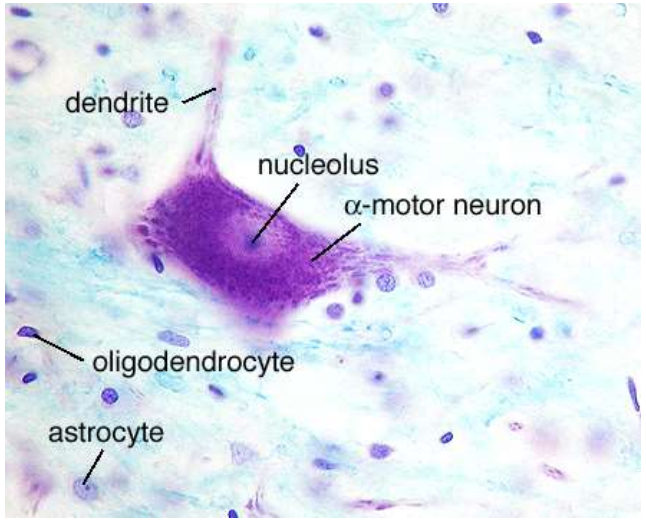
  Axon- Aroriziation, Bouton
- They vary in shape
- They vary in size (5-150 µm)

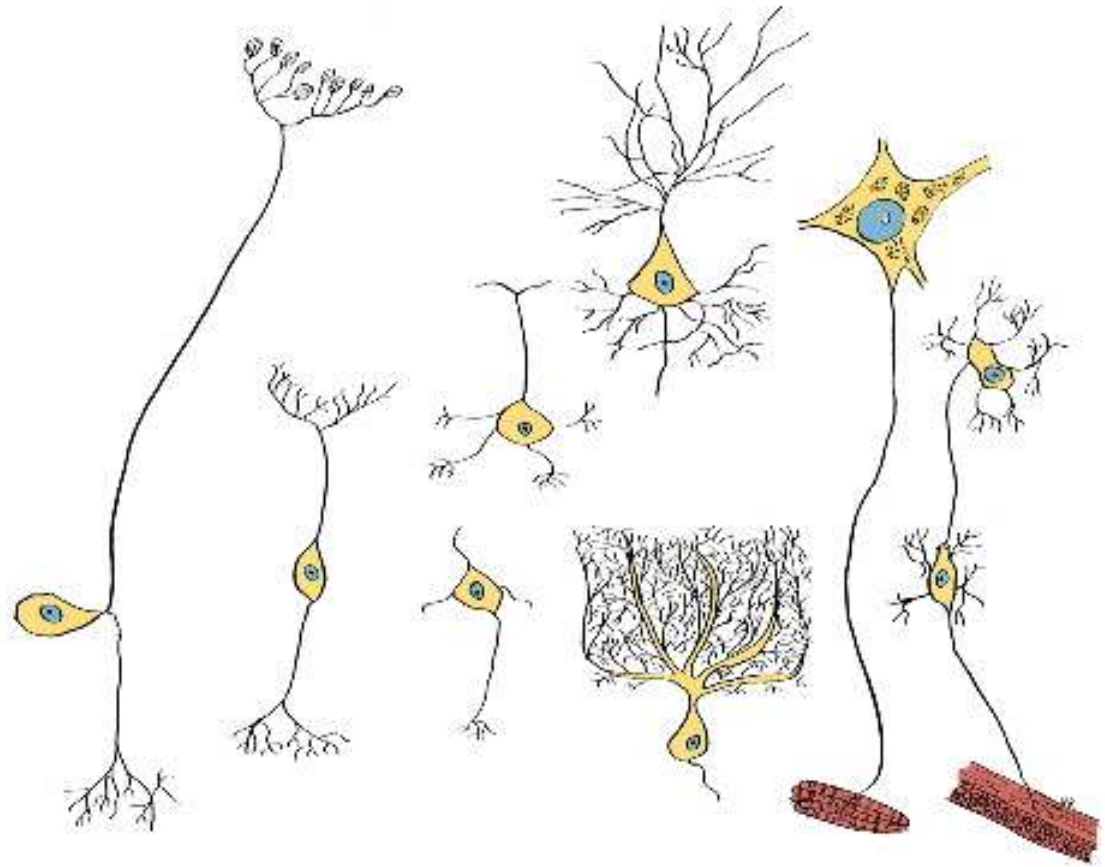


Classification of Neurons

- **Morphologically:**
  - Multipolar
  - Bipolar
  - Unipolar (Pseudounipolar)
- **Functionally:**
  - Motor (Somatic and Autonomic)
  - Sensory
  - Interneurons







Structure of the Neuron

Cell body: the trophic center

Dendrites: Receive and process signals

Many arborizations

Dendritic spines

Dendritic transport

Axon: Structure

Anterograde flow-

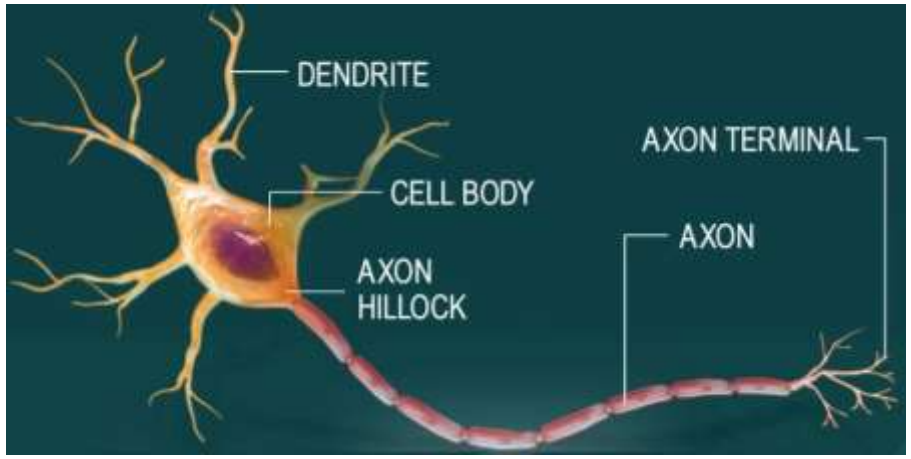
Slow for proteins and actin,tubulin

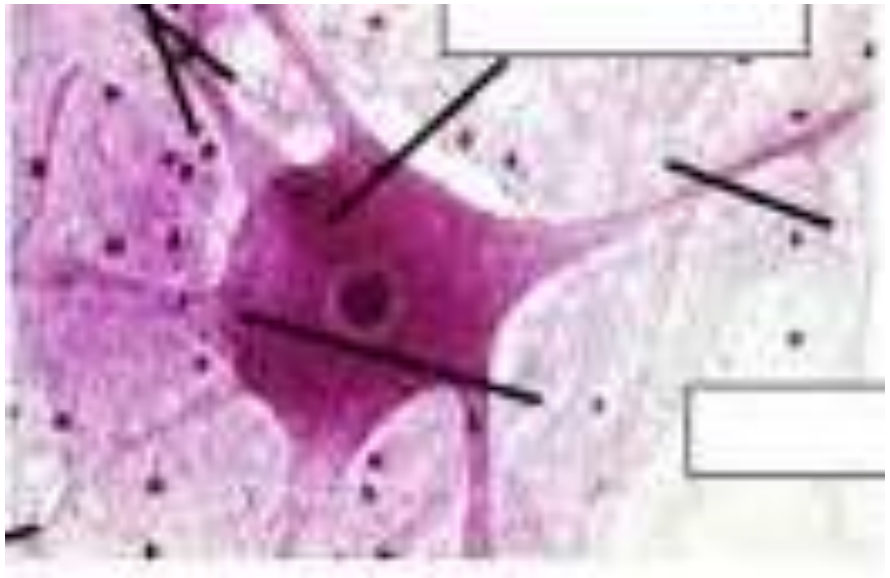
Medium for mitochondria

Fast for neurotransmitters,AA, vesicles

Retrograde flow

Motor proteins- Kinesin and Dyenin





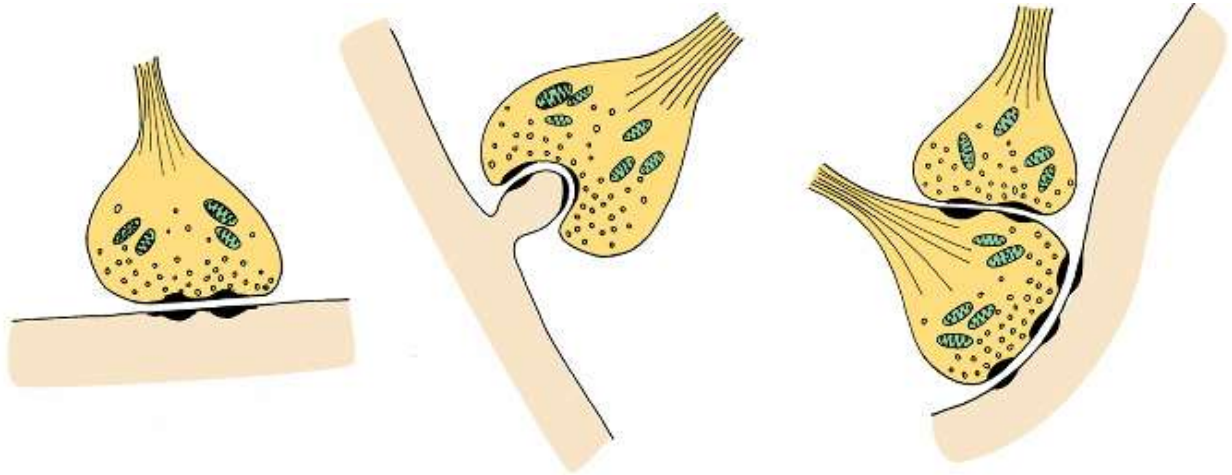
Synapses

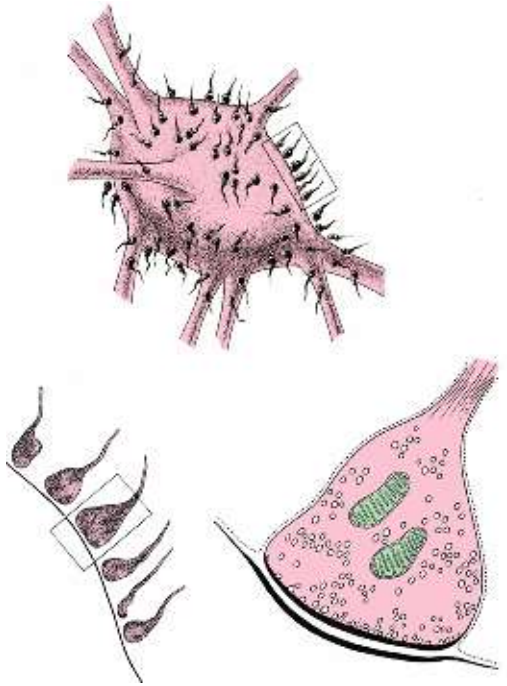
Types:

Chemical and Electrical (Acetyle Choline)

Excitatory and Inhibitory (Na and Cl channels)

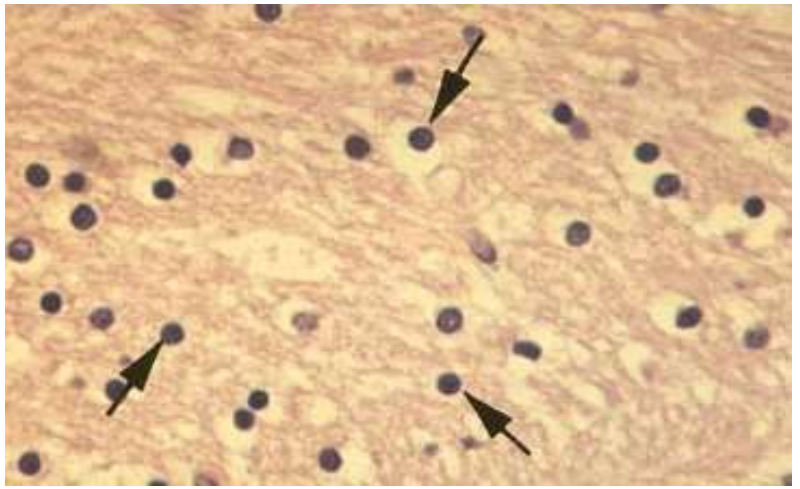
Symmetrical and asymmetrical

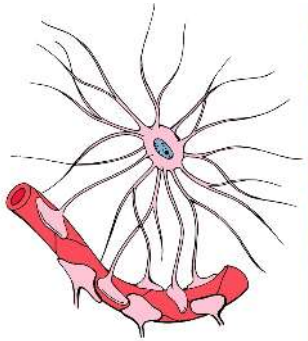


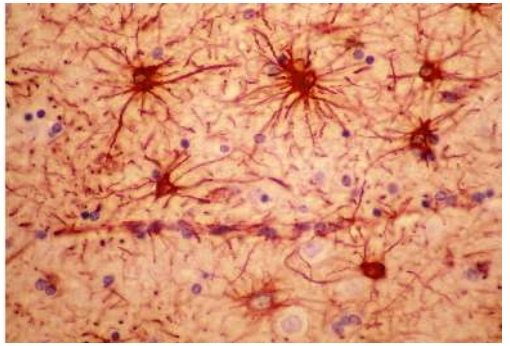


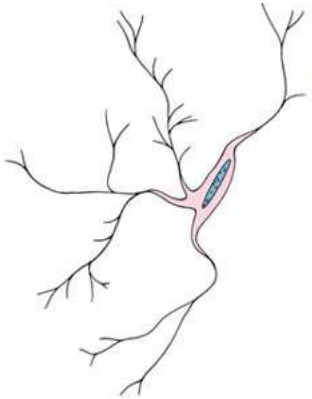
Glial Cells

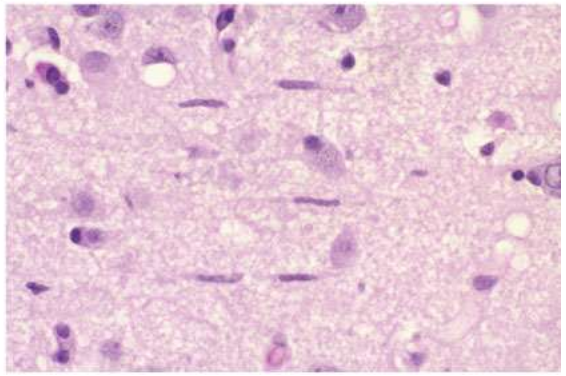
- Oligodendrocytes
- Astrocytes (Fibrous and Protoplasmic)
- Ependymal cells
- Microglia
- Schwann cells
- Satellite cells



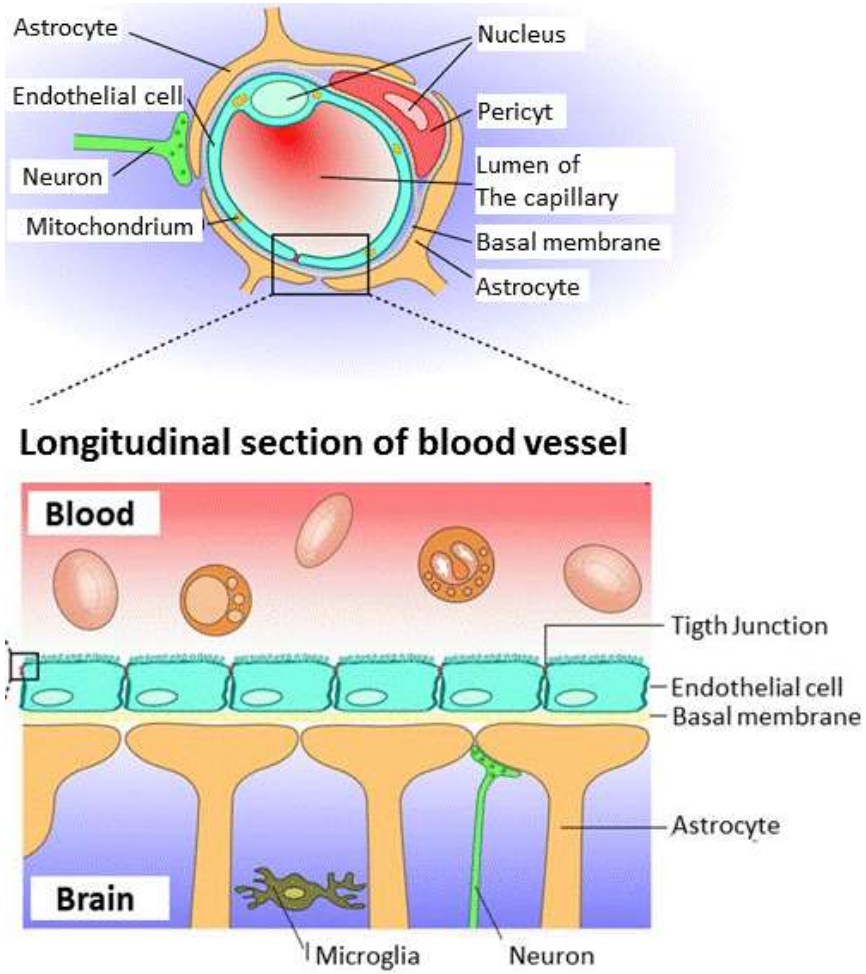


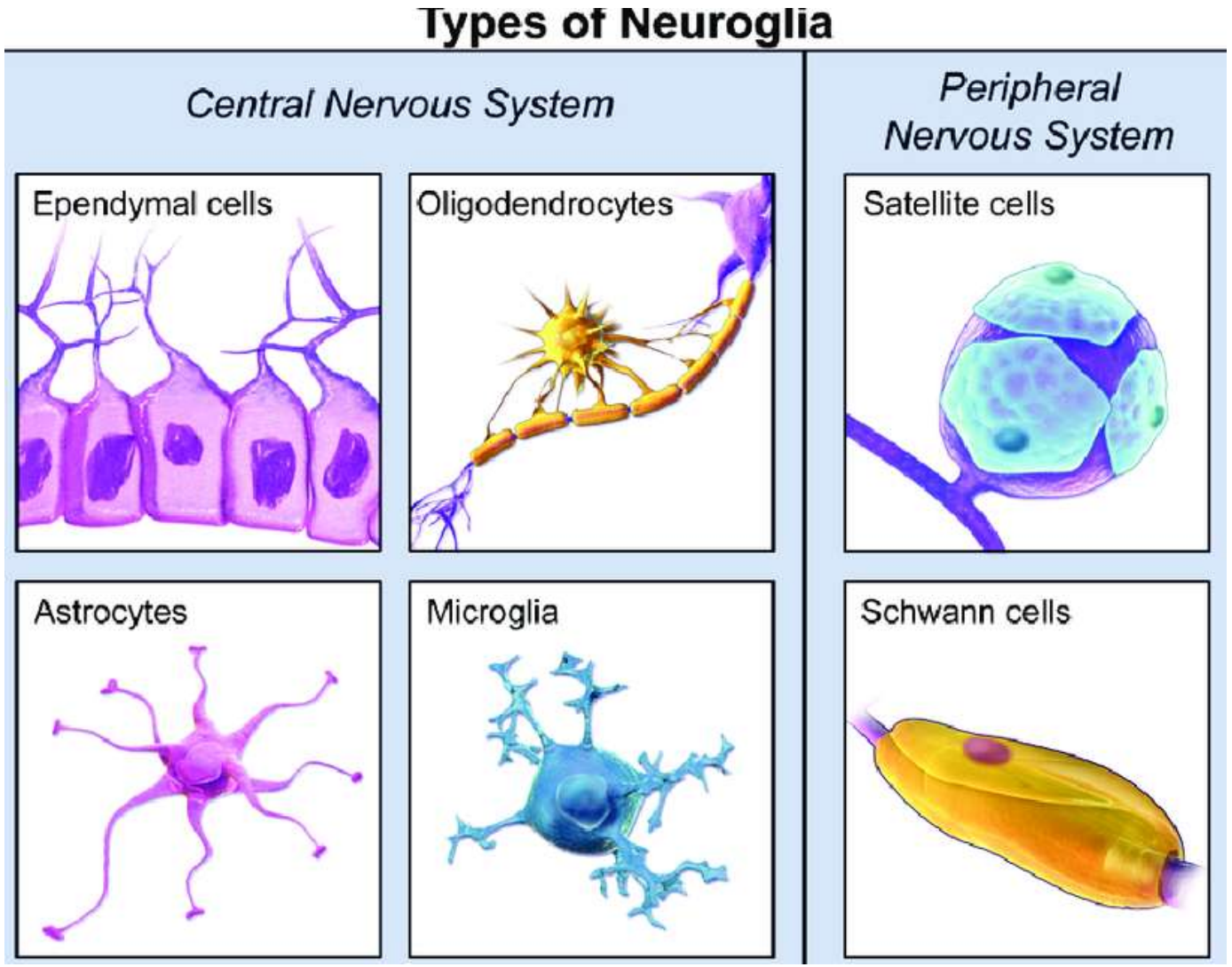






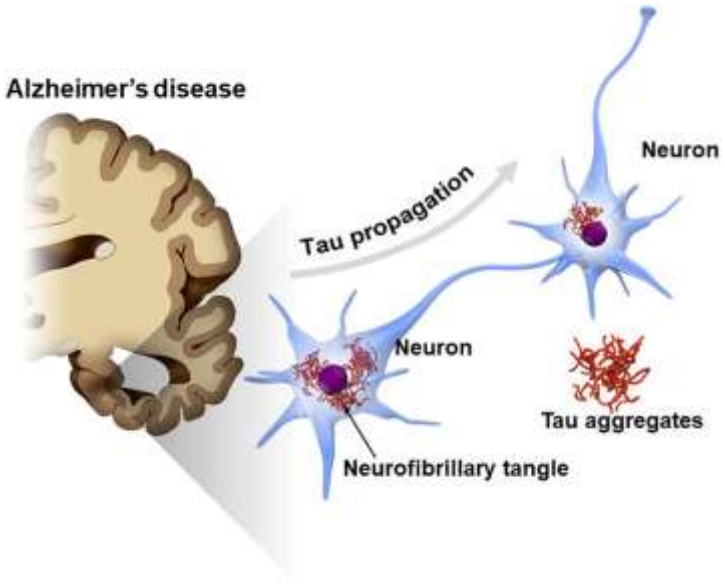
- **Blood Brain Barrier (BBB)**

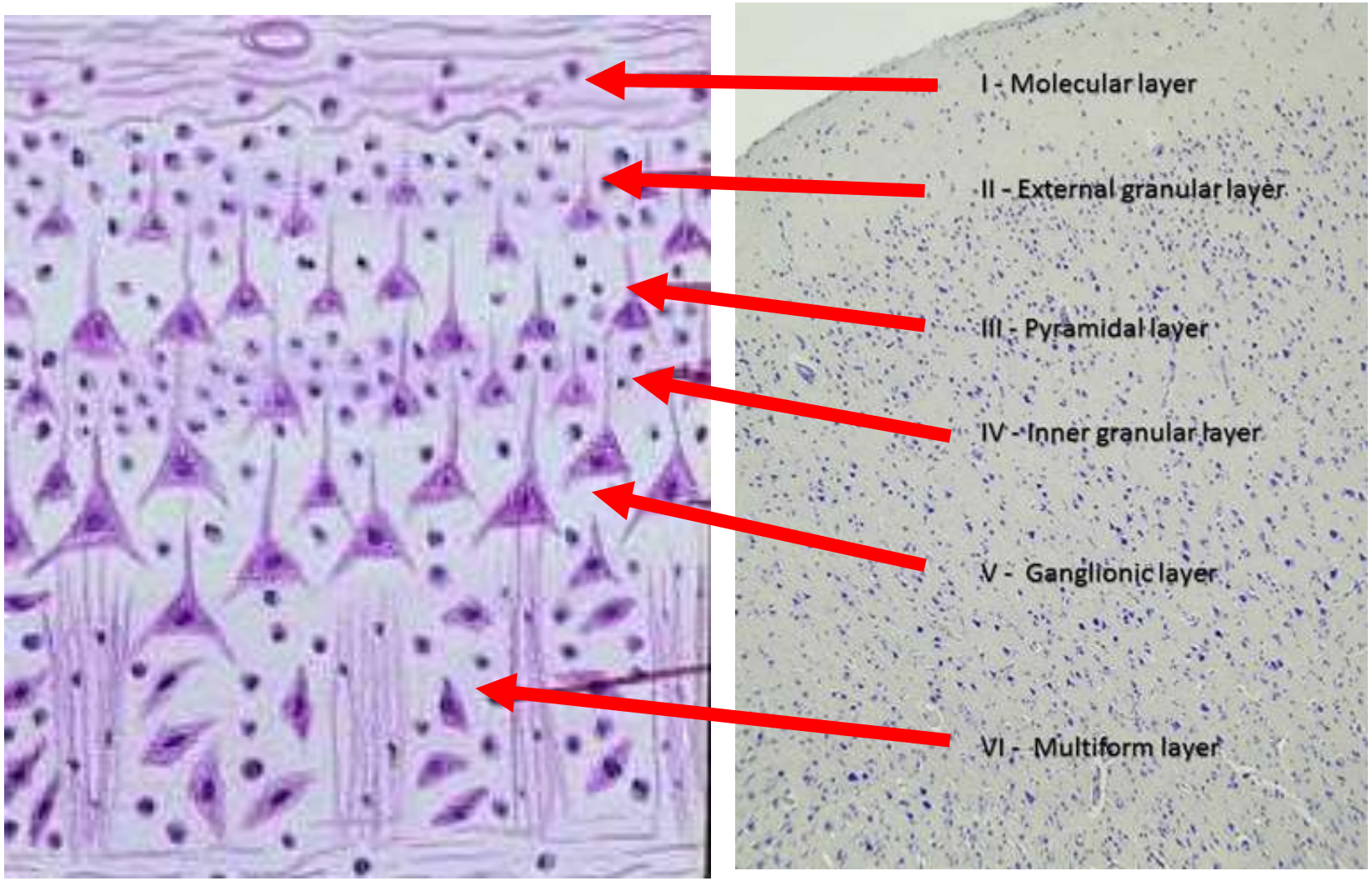




Central Nervous system (Cerebrum)

- White matter
- Gray matter
- Alzheimer Disease





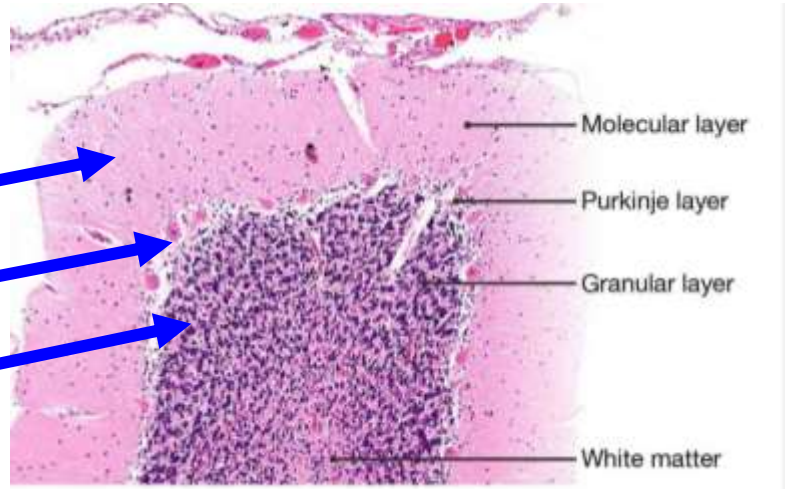
Central Nervous system (Cerebellum)

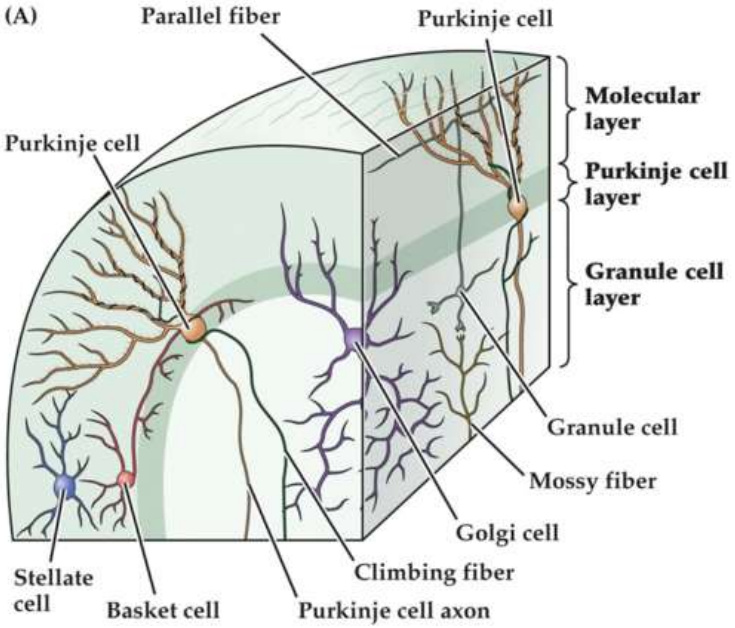
- White matter
- Gray matter

  Molecular layer

  Purkinje layer

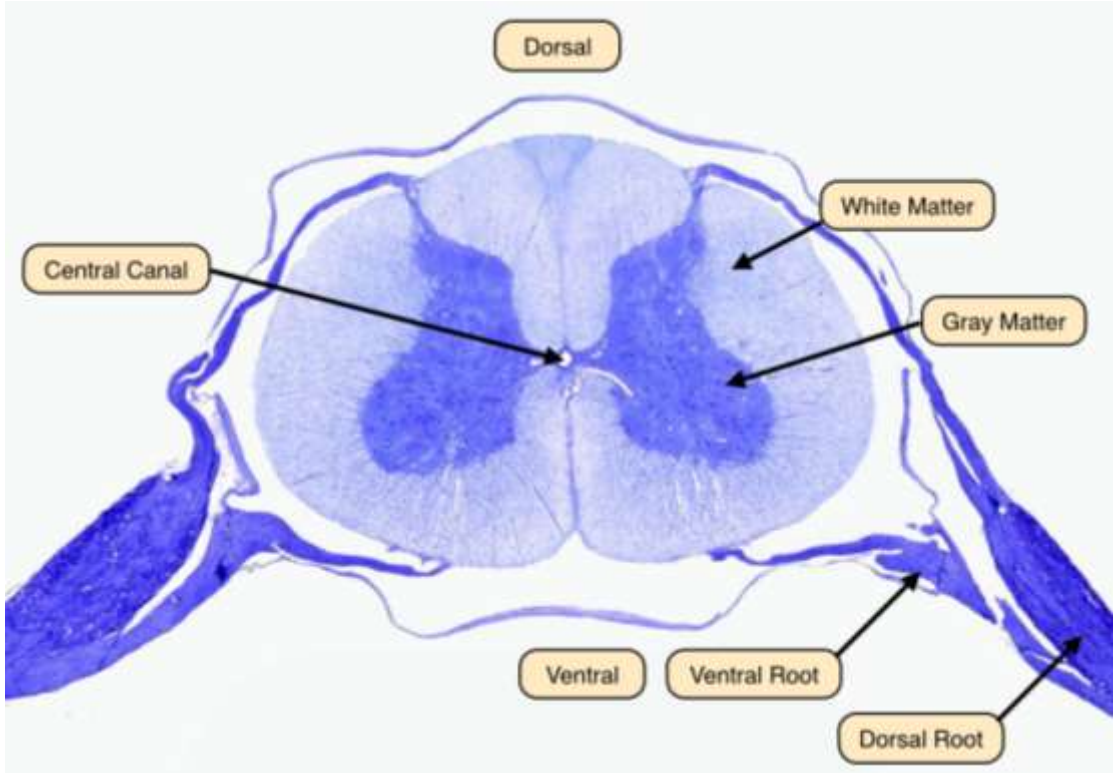
  Granular layer





Central Nervous system (Spinal Cord)

- White matter
- Gray matter
- Anterior horn
- Posterior horn
- Intermediate horn
- Central canal

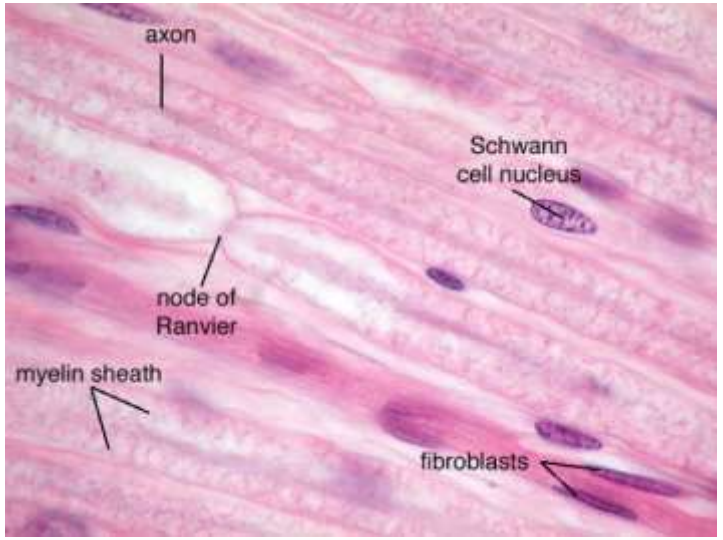


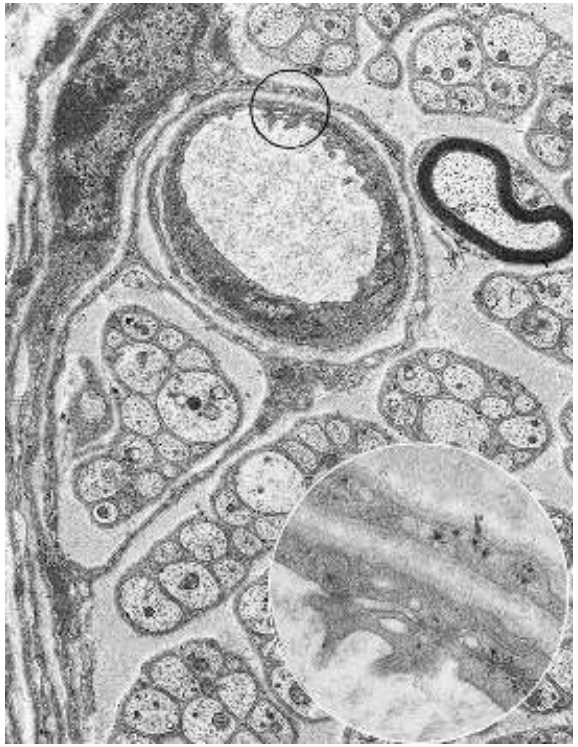
Peripheral Nervous System

Consists of Nerves, Ganglia, and verve endings

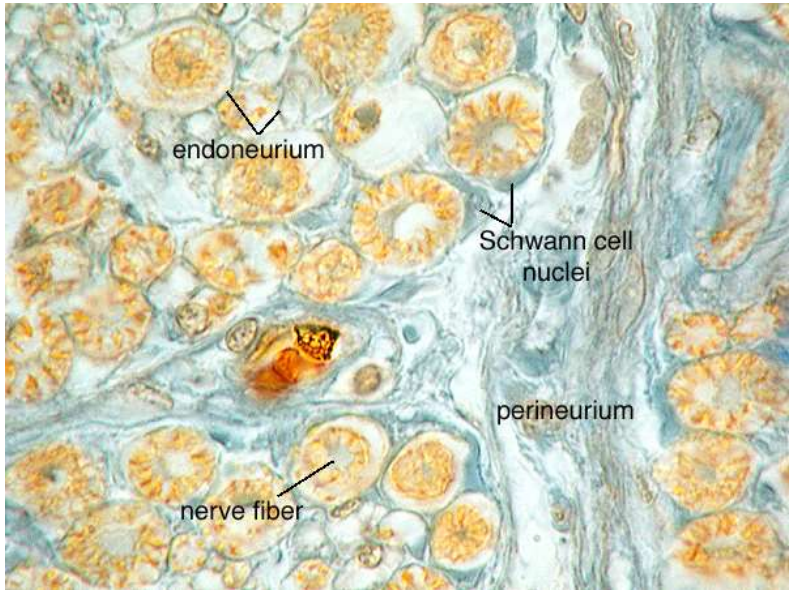
Nerves

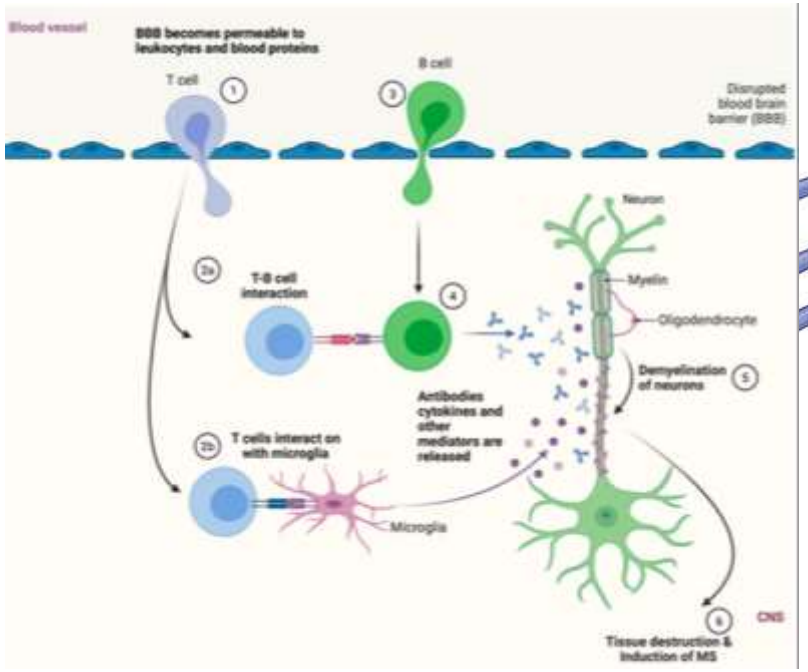
- **Nerve fibers**
  - **Myelinated with Node of Ranvier**
  - **Unmyelinated**

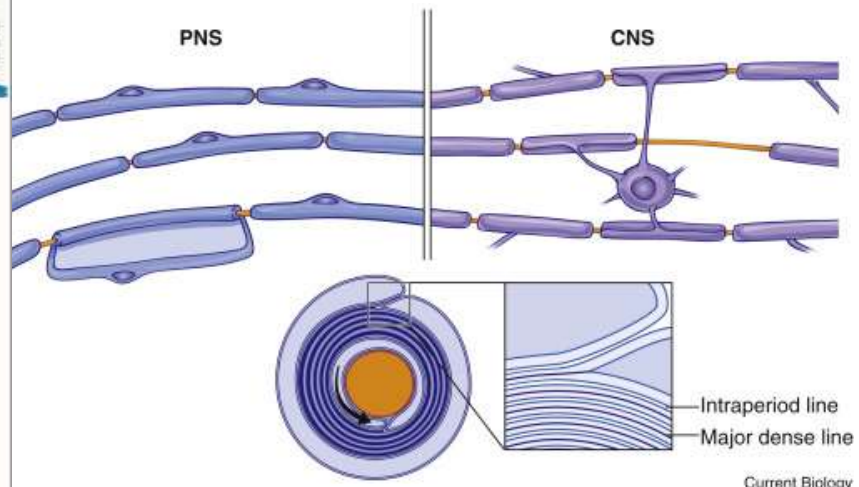


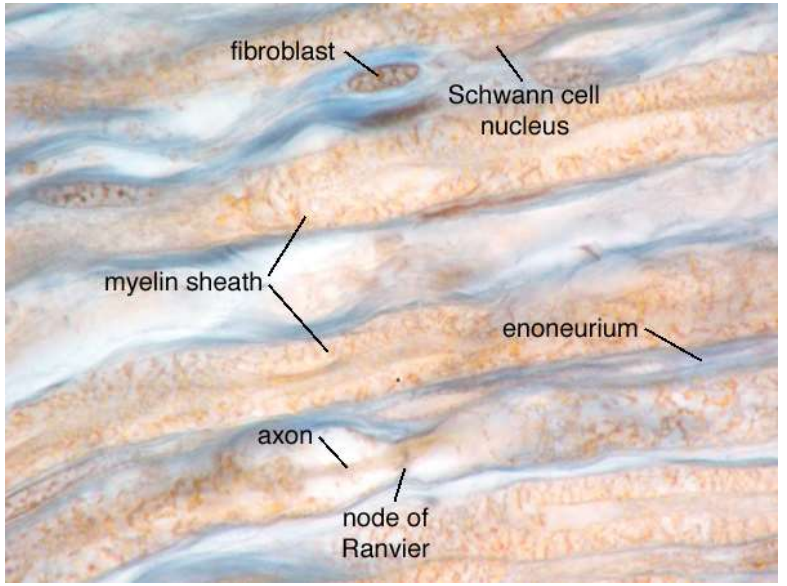


- **Myelinated fibers**
- **Multiple sclerosis**









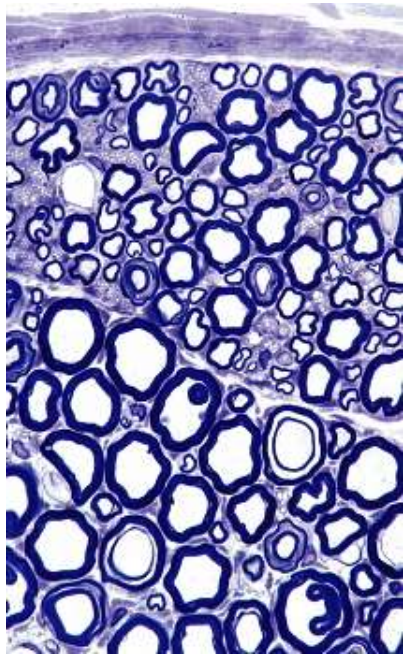
Nerve Organization

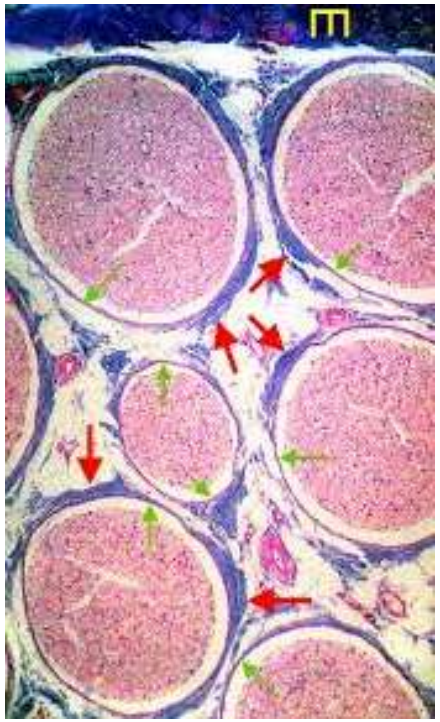
- In the peripheral nervous system, nerve fibers are grouped in bundles to form nerves
- Consists of nerve fibers

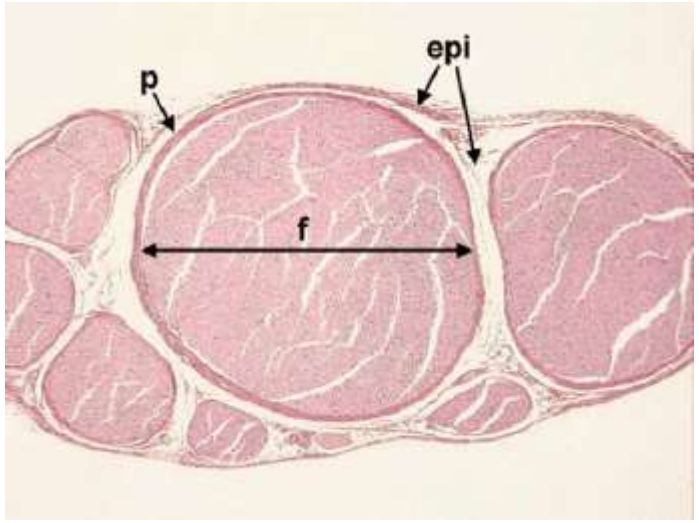
  Endoneurium

  Perineurium

  Epineurium







Ganglia

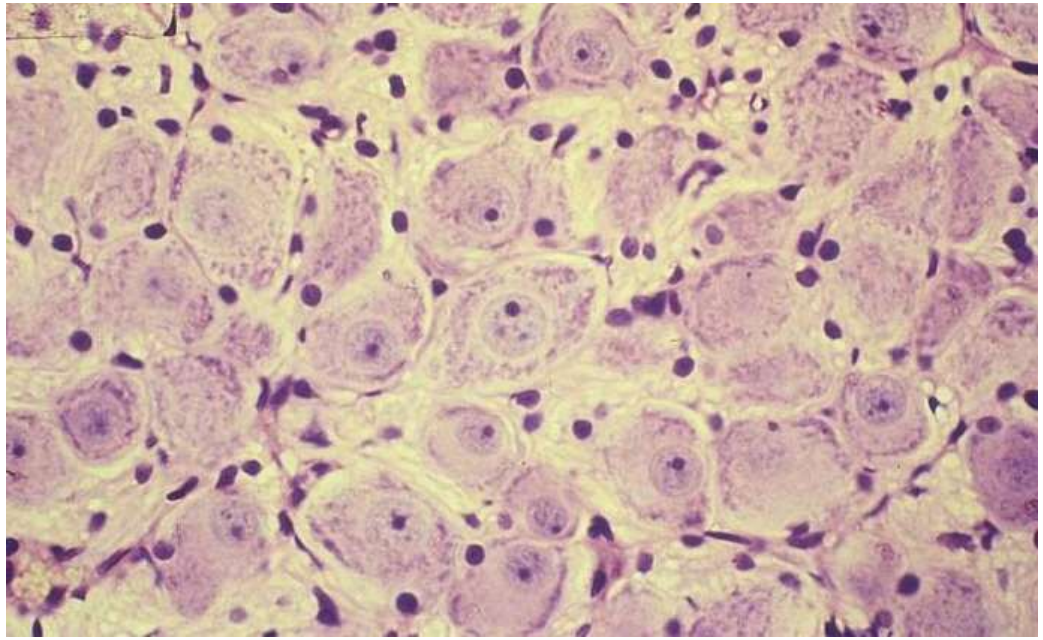
- **Structure:**

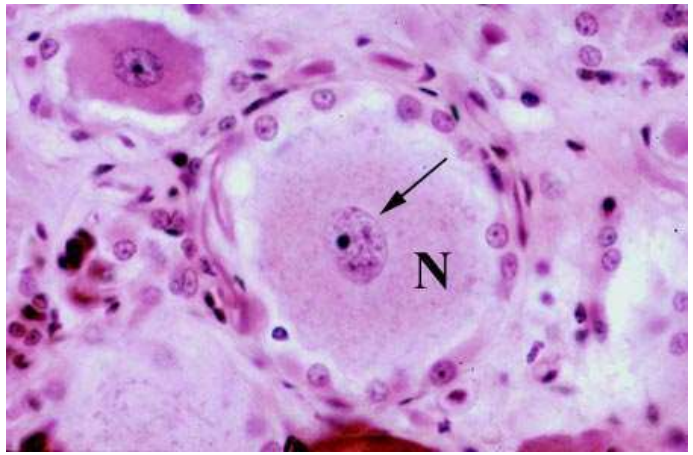
  Cells, axons, Satellite cells

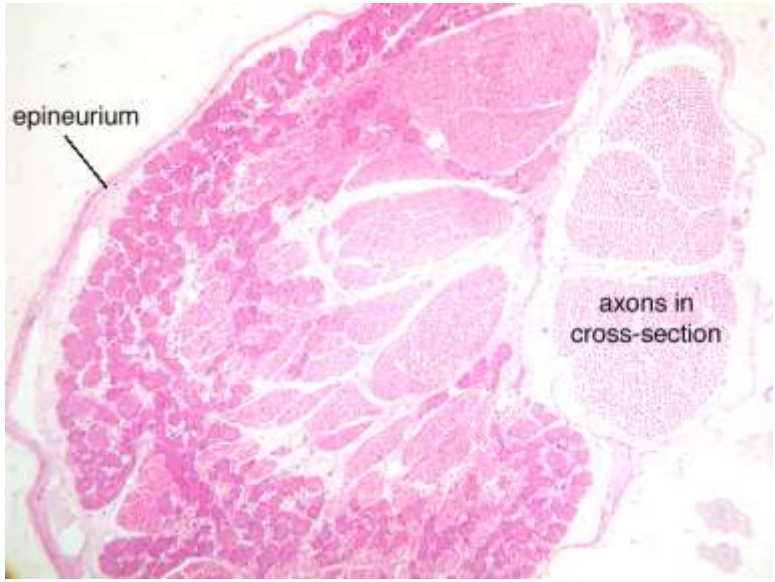
- **Types:**

  Sensory

  Autonomic







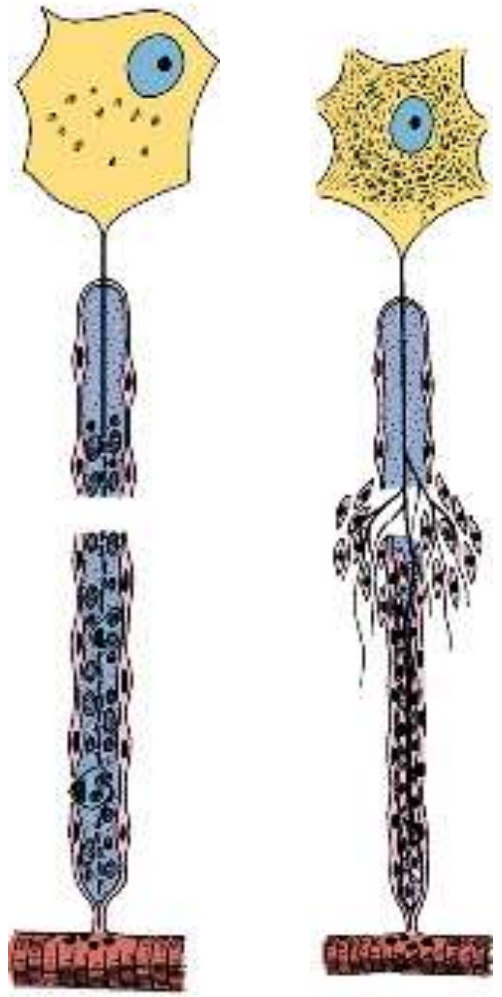
Regeneration and Degeneration

- **Destroyed processes and nerve fibers can regenerate to a certain extent.**
- **The dead neuron will not affect neurons in the vicinity except if one neuron is in contact with a dead one**

  (Transneuronal degeneration)

Axon Transection

1. The proximal segment regenerates while the distal one degenerate
2. Perikaryon undergoes chromatolysis
3. The proximal segment first degenerates and then start regeneration
4. Distally, axon and myelin sheath degenerate and removed by macrophage except for the surroundings Schwann cells



Axon Transection Cont.,

5. Schwann cells proliferate giving solid cellular columns which direct the sprouting nerve
6. Proximal end grows and branches giving many filaments that progress in the direction of Schwann cell columns
7. Neuroma: a mass of growing nerve tissue fails to meet the distal segment

Clinical Application

Multiple Sclerosis and Guillain-Barre syndrome

Nerve Tissue Tumors

- **Medulloblastoma**
- **Glioma (Astrocytoma)**
- **Schwannoma**