

CHAPTER 1

Nervous Tissue

By the end of this chapter, the student should be able to:

1. Describe the different classifications of neurons.
2. Describe the histological structure of the neuron.
3. Compare between dendrites and axon at structural and functional levels.
4. Differentiate between spinal and sympathetic ganglia.
5. Describe the degeneration and the process of regeneration of nerve fibres and state the stains used to observe degeneration.
6. Describe some clinical considerations related to structure of nervous tissue.
7. Classify synapses and discuss their histological structure.
8. Describe histological structure and functions of neuroglial cells.
9. Describe nerve endings in epithelial, connective, and muscular tissues.

- ✚ Nervous tissue is the tissue specialized to **receive** information from external and internal stimuli, **integrating** and **analyzing** it to produce a proper **response**.
- ✚ It consists of **nerve cells** (neurons) and **glial cells** (neuroglial cells).
- ✚ Reception of stimuli is the function of the **sensory** component of **peripheral nervous system (PNS)**.
- ✚ The processes of integration, analysis and response are performed by **central nervous system (CNS)**.
- ✚ The transmission of the response to the effector organ is carried by the **motor component of the PNS**.

Neurons

Definition:

Structural and functional unit of nervous system, constitute >100 million cells.

Histological Structure: Most of neurons consist of 2 parts;

A- Cell body (Perikaryon) is a part of the neuron receptive to stimuli and is containing nucleus and surrounding cytoplasm.

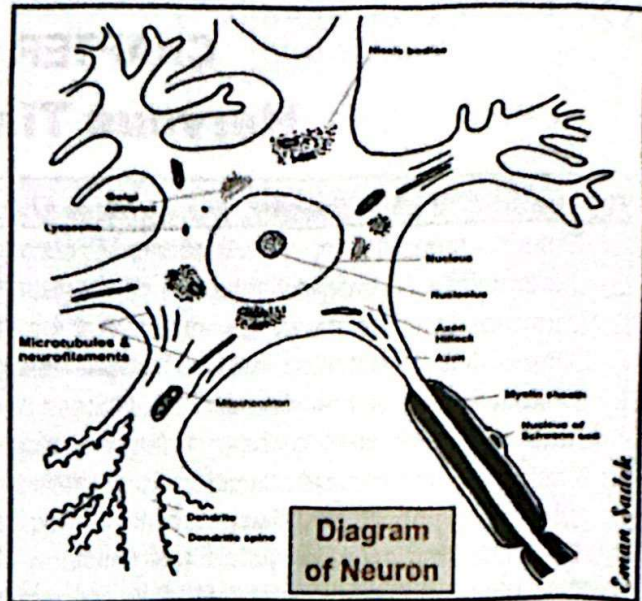
Size: varies from **4µm** as in **granular cells in cerebellar cortex** to **100µm** as in **motor neurons in spinal cord**.

Shape: depends on the number of cell processes; Unipolar is **globular** shape, bipolar is **fusiform** shape as well as multipolar is **stellate**, **pyramidal** or **pyriform** shape.

Nucleus: It is usually large, spherical, pale with a prominent nucleolus reflecting intense synthetic activity.

Cytoplasm: I. Organelles:

1. Highly developed rough endoplasmic reticulum and numerous free ribosomes (synthesize both structural proteins and proteins for transport). Under light microscope, they appear as basophilic granular areas called **Nissl bodies**. Their number varies according to neuronal type & function.

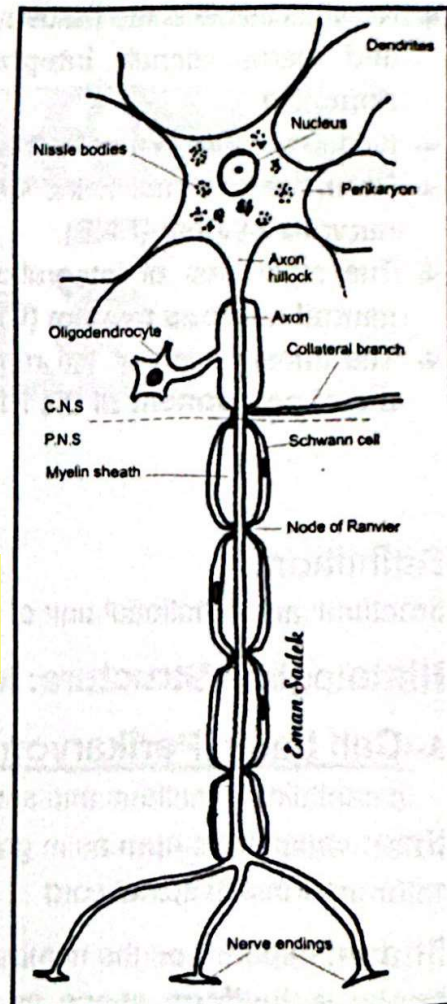


2. **Golgi complex:** present around nucleus.
3. **Mitochondria:** are scattered in cytoplasm
4. **Neurofilaments:** intermediate filaments (10nm in diameter) are abundant in perikaryon and processes. They bundle together by action of **fixatives** to form neurofibrils (2µm in diameter) that are visible by light microscope (stained brown by Ag). They provide structural support.
5. **Microtubules:** (20-28 nm in diameter) are arranged in parallel bundles in perikaryon and processes. They are involved in axonal transport of neurotransmitter substances, enzymes and other constituents.

6. **Centrioles:** Not seen as neurons cannot divide.

II. Inclusions in form of:

- **Lipofuscin pigment** (golden brown) is a residue of undigested material by lysosomes. It increases with aging.
- **Melanin pigment** (dark brown or black) is found in some neurons.
- **Lipid droplets** in cytoplasm as energy reserve or products of abnormal metabolism.



B-The processes:

- **Dendrites** are multiple processes that receive stimuli from the environment or other neurons and carry it to the cell body.
- **Axon** is a single process that conveys information away from the cell body to other neurons or effector cells as the muscle cell.

Both dendrites and axon have mitochondria, neurofibrils and microtubules.

| Dendrites | Axon |
|--|---|
| 1. Usually numerous. | 1. Single originates from axon Hillock. |
| 2. Short. | 2. Long. |
| 3. Thick. | 3. Thin. |
| 4. Branching like a tree. Branches arise at acute angle . | 4. Not branching except at the end. It may give collateral branches near cell body that arise at right angle . |
| 5. Become thinner as they subdivide into branches. | 5. Has a constant diameter. |
| 6. Contain Nissl bodies. | 6. Does not contain Nissl granules. |

Classification of neurons:**A-They are classified according to number of processes into:**

1. **Unipolar:** have a single process that is divided into 2 structurally similar branches to form a T shape, with one branch extending to a peripheral ending to act functionally as a dendrite and the other towards the central nervous system to represent the axon. The stimuli that are picked by dendrites travel directly to the axon without passing through the perikaryon.
 - Found in **spinal ganglia and mesencephalic nucleus of trigeminal nerve**.
2. **Bipolar:** have one dendrite and one axon. This type is present in **cochlear** and **vestibular** ganglia in ear, **retina** in eye and the **olfactory** mucosa in nose.
3. **Multipolar:** have one axon and many dendrites. They take different forms:
 - Stellate as **anterior horn cells in spinal cord and sympathetic ganglion**.
 - Pyramidal as **pyramidal cells in cerebral cortex**.
 - **Pyriform as purkinje cells in cerebellar cortex**.