

Nerves system: consist of two types' **Central nervous system (CNS)** and **Peripheral nervous system (PNS)**.

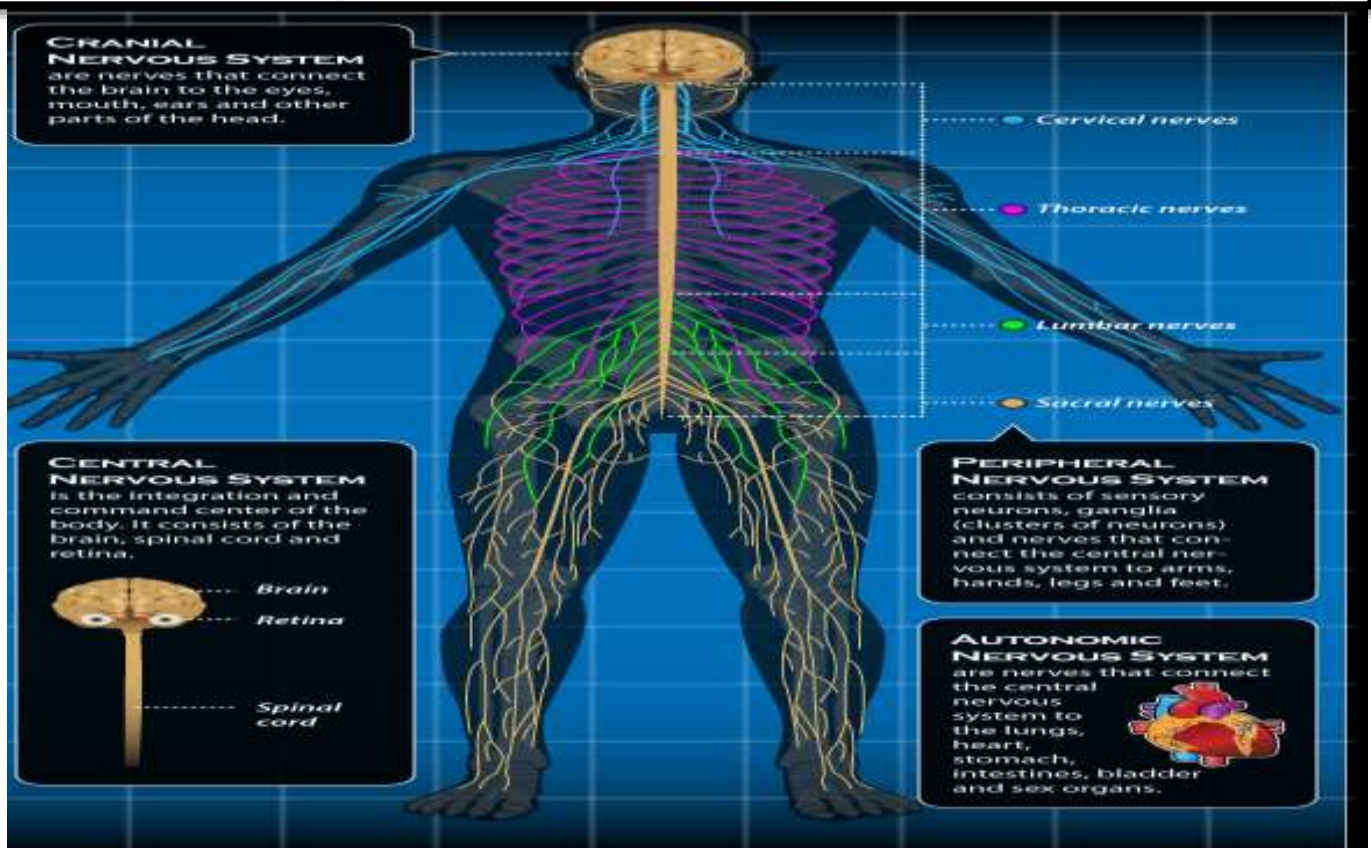
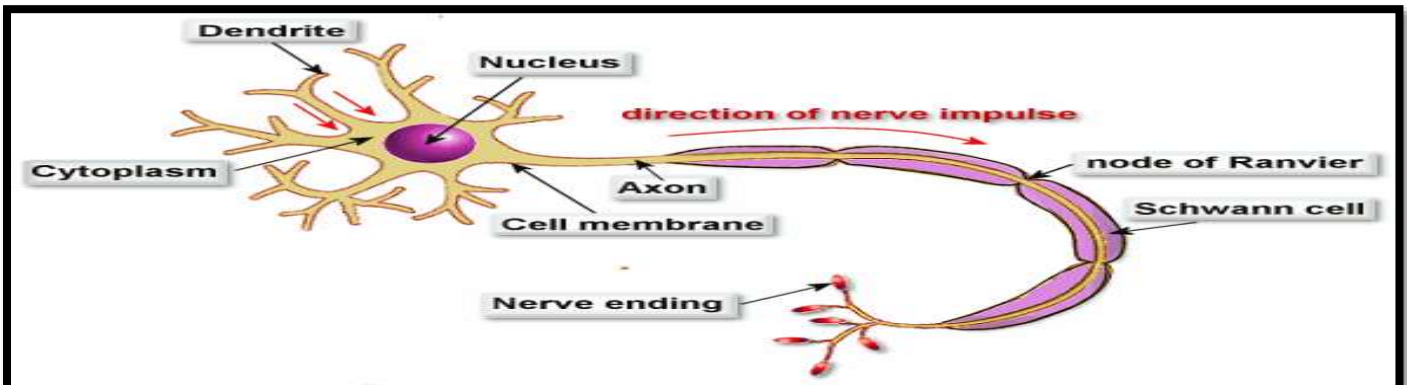
General features of nervous system

- The central nervous system (CNS) is made up of the **brain** and **spinal cord**. Brain consists of two parts: **cerebrum** and **cerebellum**.
- The peripheral nervous system (PNS) is made up of the **Ganglion** and **nerve fibers** that branch off from the spinal cord and extend to all parts of the body, including the neck, arms, torso, legs, skeletal muscles and internal organs.
- Nerves that transmit signals from the brain are called **motor or efferent** nerves, while those nerves that transmit information from the body to the CNS are called **sensory or afferent**. Most nerves serve both functions and are called **mixed** nerves.
- The PNS is divided into **somatic** and **autonomic**, and the **enteric** nervous system.
- **Somatic nerves** mediate voluntary movement.
- The **autonomic nervous** system is further subdivided into the sympathetic and the parasympathetic nervous systems. The sympathetic nervous system is activated in cases of emergencies to mobilize energy, while the parasympathetic nervous system is activated when organisms are in a relaxed state.
- The **enteric nervous** system functions to control the gastrointestinal system.
- Both **autonomic** and **enteric** nervous systems function involuntarily. Nerves that exit from the cranium are called cranial nerves while those exiting from the spinal cord are called spinal nerves.
- Cells in both central and peripheral nerve tissue are of two kinds: **nerve cells**, or **neurons**, which usually show numerous long processes; and various **glial cells**.



Nerve cell (neuron): The basic working unit of the nervous system. The human brain contains about 100 billion neurons. A neuron consists of:

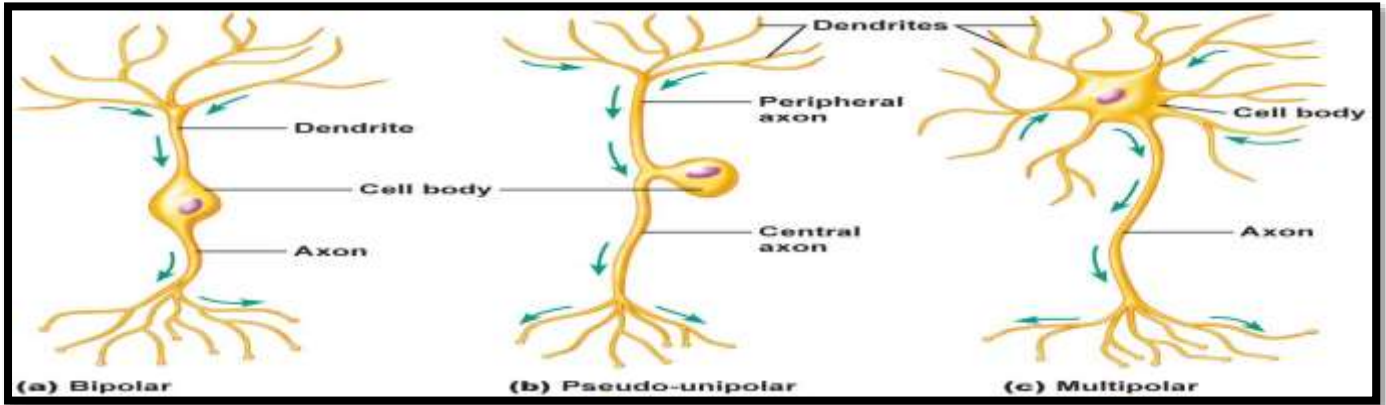
1. **A cell body or perikaryon or soma:** containing the nucleus, nissl granules and organelles.
2. **Protoplasm processes:** consist of two types
 - A. **Dendrites** received action potential (**nerve impulse**) and send them to the cell body, it shorter than axon.
 - B. **Axons** conduct signals (**nerve impulse**) away from cell body, it longer than dendrites.



Type of neuron according their shapes

1. **Multipolar neuron:** multiple dendrites and 1 axon.
2. **Bipolar neuron:** 1 dendrite and 1 axon.

3. Pseudo-unipolar neuron: single process but differ in origin divided in to two branched form a T shape, to give 1 dendrite and 1 axon.



Glial cells sometimes called **Neuroglia**, that maintain homeostasis, form myelin, and provide support and protection for neurons in the central and peripheral nervous systems. In the central nervous system, glial cells include **oligodendrocytes**, **astrocytes**, **ependymal cells** and **microglia**, and in the peripheral nervous system glial cells include **Schwann cells** and **satellite cells**.

Types of Neuroglia

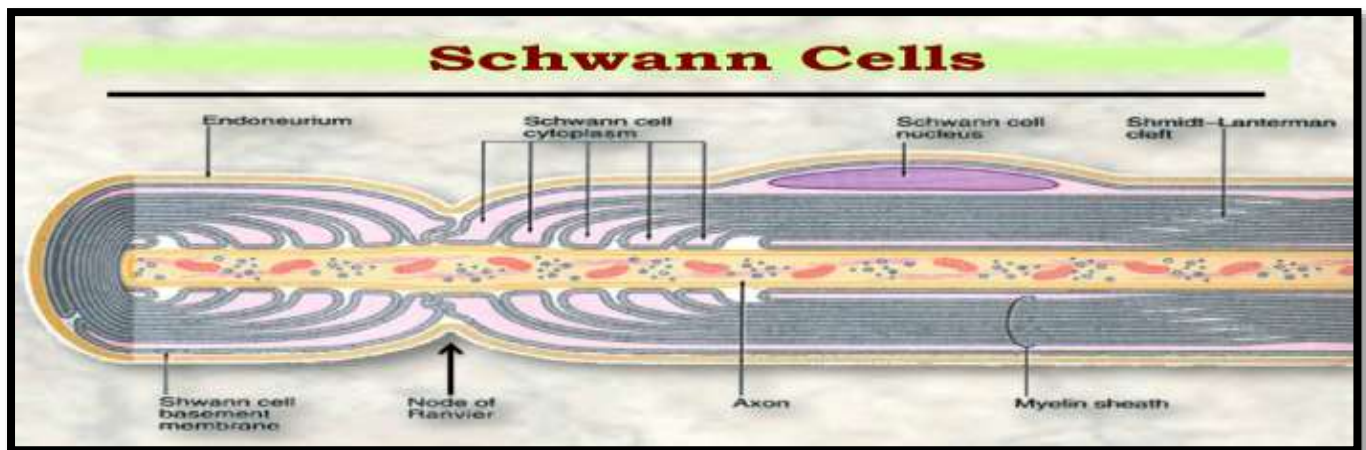
	<i>Location</i>	<i>Shape</i>	<i>Function</i>
<i>Microglia</i>	CNS		Phagocytic
<i>Astrocytes</i>	CNS		Support, repair, blood-brain barrier
<i>Ependymal Cells</i>	CNS		Lining cavities of CNS.
<i>Oligodendrocytes</i>	CNS		Myelin Formation
<i>Schwann Cells</i>	Peripheral nerves		Myelin Formation

Nerve fiber: there are two type of nerve fiber

A. Myelinated axon (Myelinated nerve fiber)

- **Axis cylinder** forms the central core of the fiber. It consists of axoplasm covered by axolemma.

- **Myelin sheath**, derived from Schwann cells, surrounds the axis cylinder. It is made up of lipids and proteins.
- Myelin sheath is interrupted at regular intervals called the **nodes of Ranvier** where: the adjacent Schwann cells meet. Each internode is myelinated by one Schwann cell.
- Oblique clefts in the myelin, called incisures of **Schmidt Lantermann**, provide conduction channels for metabolites into the depth of the myelin and to the subjacent axon. Myelin sheath acts as an insulator for the nerve fibers.
- **Endoneurium** is a delicate connective tissue sheath which surrounds the neurolemma sheath.



B. Unmyelinated axon

Peripheral axons that are surrounded by Schwann cells but are not unwrapped by rolls of Schwann cell membrane; extensions of the Schwann cells isolate unmyelinated axons from each other. Unmyelinated axons are small in diameter and transmit signals more slowly than myelinated axons.

Synapse

- ❖ The site by contact between neuron or between neuron and other effector cell (e.g. muscle or gland cells).
- ❖ It is responsible for the unidirectional transmission of nerve impulses.
- ❖ Most synapses release chemical messengers during the signaling process.

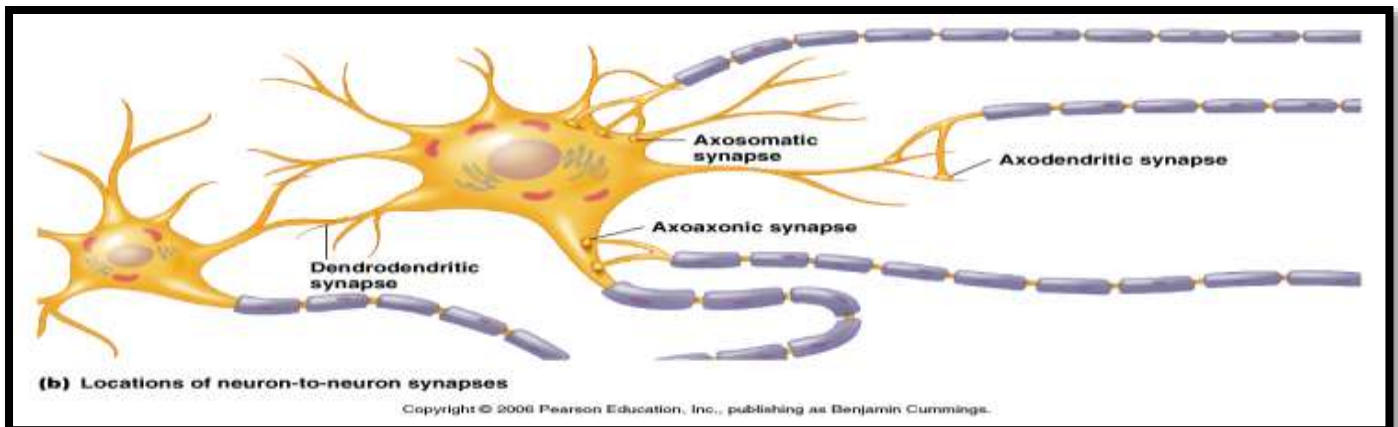
- ❖ Most important transmitter such as (acetylcholine, catecholamine, norepinephrine, dopamine, serotonin, glutamate and glycine ect).

Synapse component: it composed from three parts:

1. Presynaptic membrane
2. Synaptic cleft
3. postsynaptic membrane

Types of Synapse according to site of contact: there are four types of synapses:

- A. Axodendritic Synapse
- B. Axosomatic Synapse
- C. Dendrodendritic Synapse
- D. Axoaxonic Synapse



Types of Synapse according to the type of conduction: there are two types of synapses:

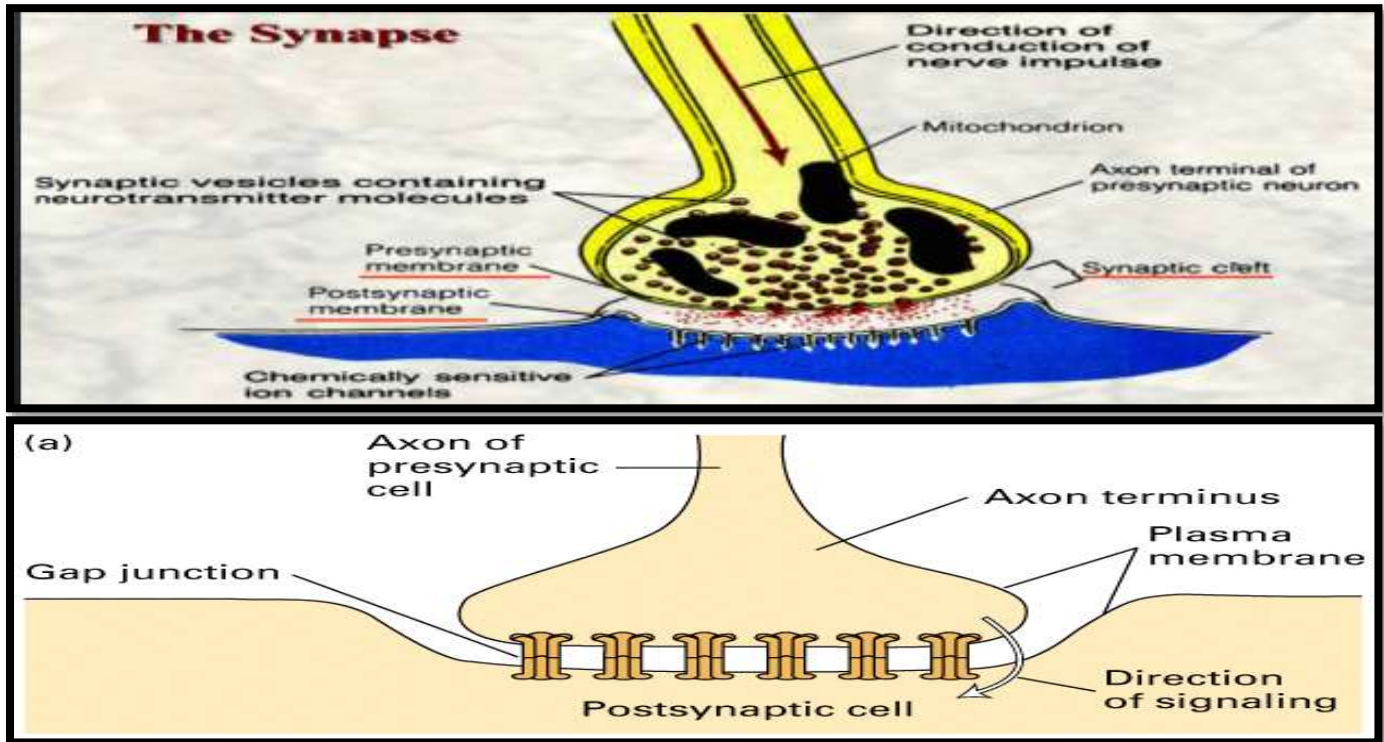
1. **Electrical synapses:** the most common characters of it :

- **Direct electrical coupling** between two cells mediated by **gap junctions**, which are pores constructed of **connexin** proteins.
- Gap junction links the cytosol of two cells and provides a passageway for movement of very small molecules and ions between the cells.
- Membranes are separated by 2 nm.
- **very rapid** (no synaptic delay)
- **passive process** (signal can degrade with distance)
- **bidirectional** i.e., "post"synaptic cell can actually send messages to the "pre"synaptic cell

2. Chemical synapses

- Most common types of synapse, separated between membrane 20-30 nm
- **Slow**
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- **Active** (require ligand-gated channels)
- Neurotransmitters releases and diffuse from presynaptic membrane then bind with specific receptors on postsynaptic membrane through synaptic cleavage.



Ganglia: are typically ovoid structures containing neuronal cell bodies and their surrounding glial satellite cells supported by delicate connective tissue. There are two types of Ganglia:

- 1. Sensory Ganglia:** receive afferent impulses that go to the CNS. The large neuronal cell bodies of ganglia are associated with thin, sheet like extensions of small glial satellite cells; there are two types of Sensory ganglia
 - A. Cranial ganglia: associated with cranial nerves
 - B. Spinal ganglia: associated with the dorsal roots of the spinal nerves
- 2. Autonomic Ganglia:** nerves effect the activity of smooth muscle, the secretion of some glands, heart rate, and many other involuntary activities by which the body maintains a constant internal environment (homeostasis).