

Biology

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Nervous system

The nervous system is responsible for communication between different regions of the body, it is divided into:

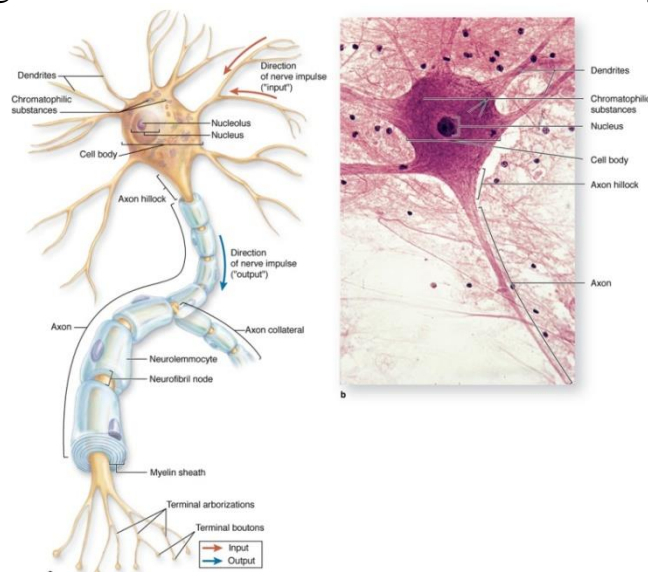
- ❖ **CNS (central nervous system) = brain + spinal cord**
- ❖ **PNS (peripheral nervous system) = nerves running between the CNS & other tissues.**

Nervous tissue consists of two major cell types:
neurons and neuroglia.

The Neuron:

Is the main functional unit of the nervous system, it consists of:

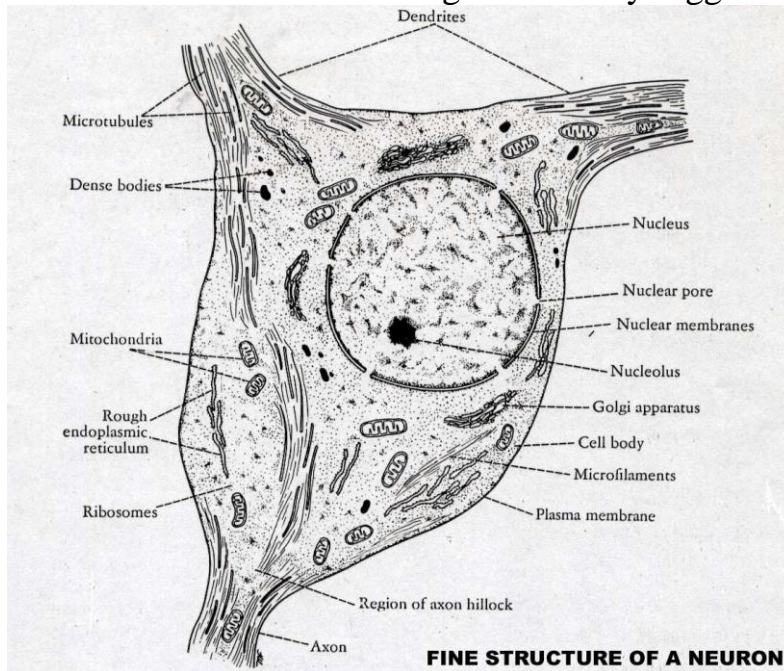
- ❖ **Cell body (perikaryon):** containing the nucleus & most of the organelles.
- ❖ **Axon:** a single long process which conducts the electrical signals from the cell body of the neuron to other cells. Axons can range in length from 1 millimeter to as long as 1 meter. Sometimes axons branch into one or more collateral axons. Each axon may have several small branches at the end; these are called axon terminals. Axons are output channels. The conical region of an axon where it joins the cell body is called the axon hillock, this is the region where the signals that travel down the axon are generated. Near its end, an axon usually divides into several branches, each of which ends in a synaptic terminal. The site of communication between a synaptic terminal and another cell is called a synapse. At most synapses, information is passed from the transmitting neuron (the presynaptic cell) to the receiving cell (the postsynaptic cell) by means of chemical messengers called neurotransmitters.
- ❖ **Dendrites:** Dendrites (from the Greek dendron, tree) are short processes which receive the signals from the axons of other neurons by making synapse which allows a direct communications between the cells. A single neuron can have anywhere from 1 to 20 dendrites, each of which can branch many times. Dendrites are input channels.
- ❖ **Terminal button:** is the branched terminal end of the axon. Many **neurotransmitters** are synthesized and stored in the axon terminals. Some are synthesized in the cell body and transported down the axon to the terminals. When released, neurotransmitters carry chemical messages between neurons and muscle fibers, which they cause to contract. They also carry messages to organs and glands that affect the function of all the body systems.



The neurons are highly metabolically active cells characterized by:

- ❖ Large nucleus & central nucleolus.
- ❖ The cytoplasm contains abundant lysosomes & rough endoplasmic reticulum (RER), Nissl substances (RER and free ribosomes also called chromatophilic substances), well developed Golgi & large no. of mitochondria to provide energy, inclusions of pigmented material such as lipofuscin.

Unlike most other cells, neurons do not divide to reproduce themselves. Also unlike most other cells, neurons are able to transmit an electrochemical signal. Neurons, on the other hand, are irregular in shape and have a number of extensions (sometimes called “processes”) coming off them. This makes them look something like a many-legged spider.

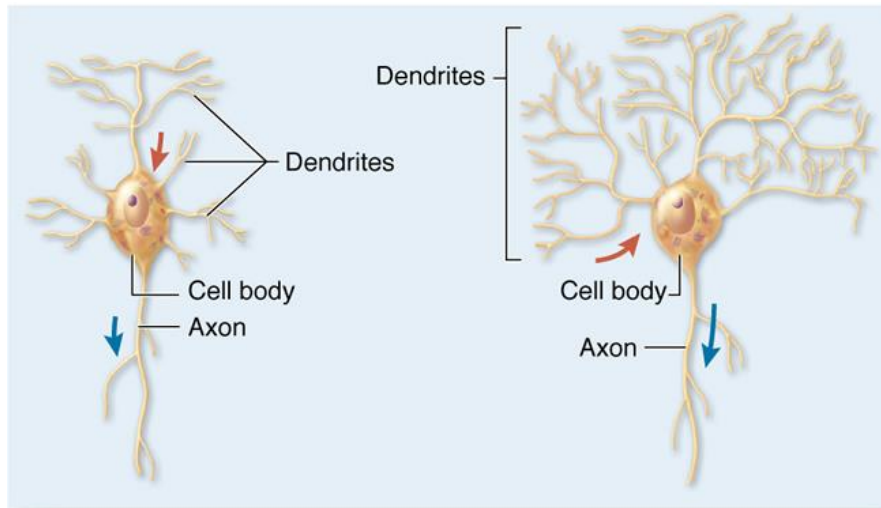


Types of the Neurons:

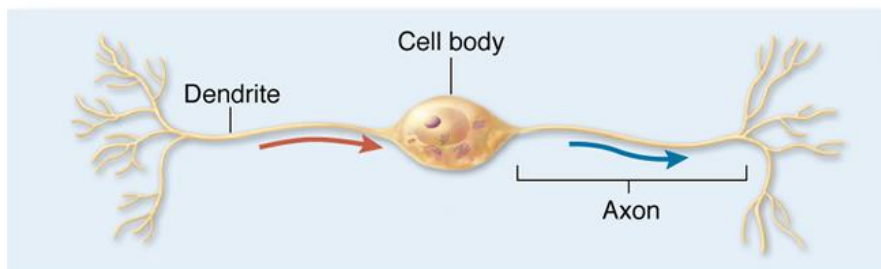
- ❖ **Multipolar (motor) neurons** : have large cell body + large axon + many dendritic processes.
- ❖ **Unipolar (pseudounipolar) (sensory)** : cell body + one large process divided into 2 branches, one is axon & other is dendrite.
- ❖ **Bipolar** : simple cells provide local communications within the CNS having 2 main processes of equal size one axon & other dendrite.

Neurons can be grouped into three general types:

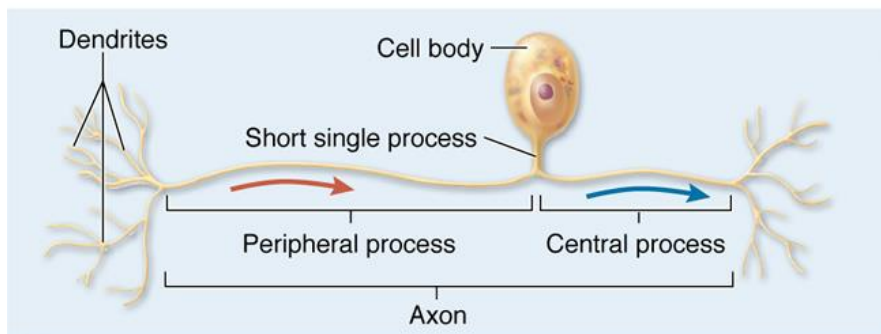
1. Sensory neurons (afferent): transmit impulses from receptors to the CNS (such as somatic afferent fibers that transmit sensations of pain, temperature, touch & pressure from body surface). While visceral afferent transmit pain impulses from internal organs, mucous membranes, glands & blood vessels.
2. Motor neurons (efferent): transmit impulses from the CNS or ganglia to effectors cells. Somatic efferent neurons send voluntary impulses to skeletal muscles, while visceral efferent neurons transmit involuntary impulses to smooth muscle, cardiac conducting cells & glands.
3. Interneurons: form communicating & integrating network between the sensory & motor neurons, it is estimated that 99.9% of all neurons belong to this integrating network.



a Multipolar neurons



b Bipolar neuron



c Unipolar neuron



Synapses:

Synapses are the sites where 2 neurons contact each other. At synapses information are transmitted (in a unidirectional way) in the form of action potentials between two neurons (or between one neuron & other effector cell such as muscle or glandular cells). Synapse is formed by axonal terminal (presynaptic terminal) that delivers the signal, a region on the surface of another cell at which a new signal is generated (postsynaptic terminal) & a thin intercellular space between them (synaptic cleft). An axon terminal may synapse with a cell body (axosomatic synapse), a dendrite (axodendritic synapse), or another axon (axoaxonic synapse). In humans, synapses work by chemical molecules (neurotransmitters) released from presynaptic neuron terminal & affect the postsynaptic cell. This type is called chemical

synapse. On the other hand, action potentials may be transmitted directly from the presynaptic cell to postsynaptic cell through gap junctions (electrical synapse) which is extremely rare in human.

