

## 4-The Nervous System

### Nervous Tissue

The Nervous system has three major functions

**Sensory** -gathers information about changes occurring within( internal ) and around the body( external ); sensory receptors, at ends of peripheral nerves end signals to CNS ( central nervous system ) .

examples – light, oxygen levels, body temperature.

**Integration** – interpretation of sensory information (information processing); complex (higher order) functions .create thoughts, add to memory, make decisions, etc

**Motor** – response to information processed through stimulation of effectors .(sending of signals to muscles and/or glands to elicit a response) .

muscle contraction .-

glandular secretion -

Organs of the nervous system can be divided into two groups:-

**The central nervous system (CNS)** is composed

-Brain

-Spinal cord. These neurons cannot regenerate if damaged .

**The peripheral nervous system (PNS)** is made up of peripheral nerves that connect the CNS to the rest of the body. These neurons can regenerate if damaged .

.31 pairs of spinal nerves

.12 pairs of cranial nerves

PNS can be subdivided into 2 divisions :-

### **1-Autonomic**

-Cranial & spinal nerves connecting CNS to heart, stomach, intestines, glands

-Controls unconscious activities .

### **.2-Somatic**

-Cranial & spinal nerves connecting CNS to skin & skeletal muscles

-Oversees conscious activities .

**Autonomic** division of the nervous system can be subdivided into 2 divisions:-

#### **.1-Parasympathetic**

-Decreases heart rate, bronchiole dilation, blood glucose, blood to skeletal muscle

-Increases digestion, pupil size, urinary output

-”rest and digest“

#### **.2-Sympathetic**

-Decreases digestion, pupil size, urinary output

-Increases heart rate, bronchiole dilation, blood glucose, blood to skeletal muscle

-fight or flight“.

Nervous Tissue is composed of two major cell types:

**1- Neurons    2- neuroglial cells.**

Neurons (Nerve cells) are specialized cells that conduct electrical impulses .

An average human body has about 1 trillion neuron

All neurons have the same basic structure:-

1-Dendrites extend from the cell body .These are fairly short, with lots of branches, and they are the points at which nerve impulses are received by the cell.

2-The cell body (perikaryon) The cell body contains the major portion of the cytoplasm and nucleus of the neuron . Most of the cell bodies of neurons are in the central nervous system (brain and spinal cord), or in the ganglia (which lie just outside the spinal cord) of the peripheral nervous system.

3-The axon: a single nerve 'fiber' which transmits impulses to the distal end. Axons can be very long - around 1 meter, and vary in diameter from 0.2 to 20  $\mu\text{m}$  . Long axons are covered by myelin, a white fatty substance produced by Schwann cells. Narrow gaps in the myelin sheath between Schwann cells are called nodes of Ranvier.

**Nerves** are cable-like bundles of axons .

### **Classification of Neurons**

-:There are three basic shapes to the neurons

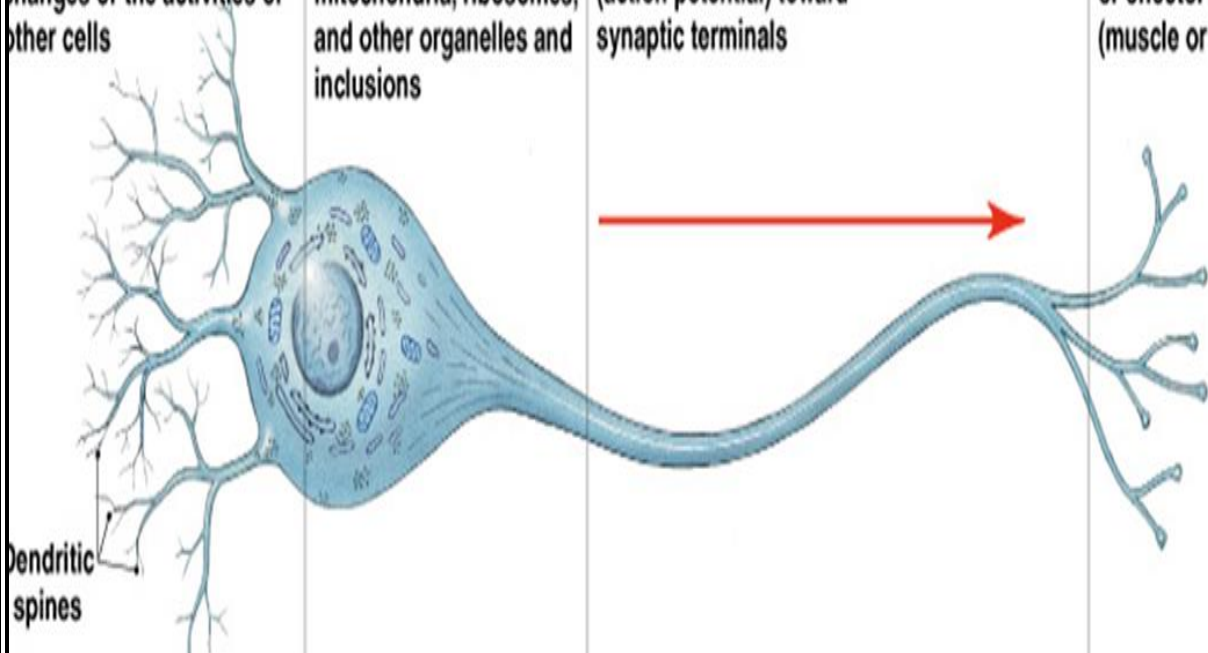
a-Multipolar (the commonest) - most motor neurons are multipolar. Brain or spinal cord

b-Bipolar (single axon and single dendrite) - special neurons in the sensory . pathways for sight, smell and balance

c-unipolar -Single process extends from cell body

-Outside of brain & spinal cord .

Dendrites	Cell body	Axon	Synaptic terminals
Stimulated by environmental changes or the activities of other cells	Contains the nucleus and mitochondria, ribosomes, and other organelles and inclusions	Conducts nerve impulse (action potential) toward synaptic terminals	Affect another neuron or effector organ (muscle or gland)



The diagram illustrates a multipolar neuron. On the left, the dendrites are shown as branching structures, with a label 'Dendritic spines' pointing to small protrusions on one of them. The cell body (soma) is a large, rounded structure containing a prominent nucleus and various organelles. A long, tapering axon extends from the cell body towards the right. At the end of the axon, it branches into synaptic terminals. A red arrow is drawn above the axon, pointing from the cell body towards the synaptic terminals, representing the direction of an action potential.

## Neuroglia (glial cells)

**CNS neuroglia:-**microglia , oligodendrocytes , astrocytes , ependymal cells

**PNS neuroglia:-**Schwann cells (neurolemmocytes) , satellite cells.

### -Microglia “brain macrophages”

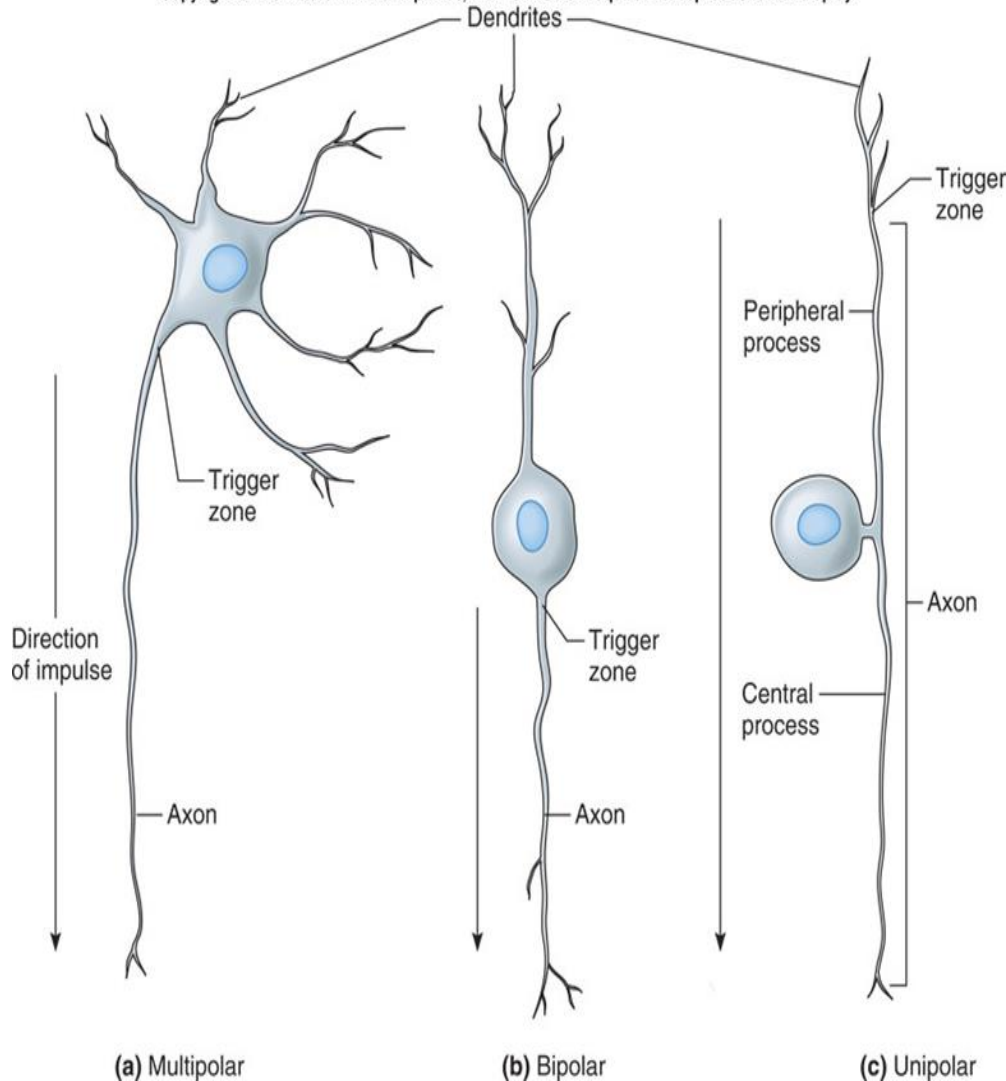
These types of cell are less common. They have a role in immune defense and become phagocytic( engulf bacteria ) in response to infections or tissue damage ,supporting neurons .

### -Oligodendrocytes

Myelin is formed by oligodendrocytes in the CNS brain , (and by Schwann cells. in the PNS Myelinated axons transmit impulses faster than

## unmyelinated axons

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### -Astrocyte

These cells are the most common type of supporting cell. They are involved in metabolic exchange between neurons and blood provide nutrients to neurons and produce hormone known as glial cell –derived growth factor, which is being study as possible treatment for Parkinson disease and other diseases caused by neuron degeneration .stimulate the formation of scar tissue secondary to CNS injury ..

**-Ependymal cells.** These cells line the ventricles of brain and central canal of spinal canal

They have cilia on their luminal surface produce, monitor & help circulate CSF (cerebrospinal fluid) ..

## **Peripheral nervous system**

In the peripheral nervous system, there are :-

- **Schwann** cells surround all axons of neurons in the PNS creating a neurilemma around them. Neurilemma allows for potential regeneration of damaged axons

creates myelin sheath around most axons of PNS --

- **Satellite cells** - support groups of cell bodies of neurons within ganglia of the PNS.

## **Synapses**

Synapses are formed between two neurons, or between a neuron and a target cell, such as a muscle cell.

Between two neurons, synapses can form between :-

an axon and a dendrite (axodendritic)

an axon and an axon (axoaxonic)

an axon and a cell body (axosomatic)

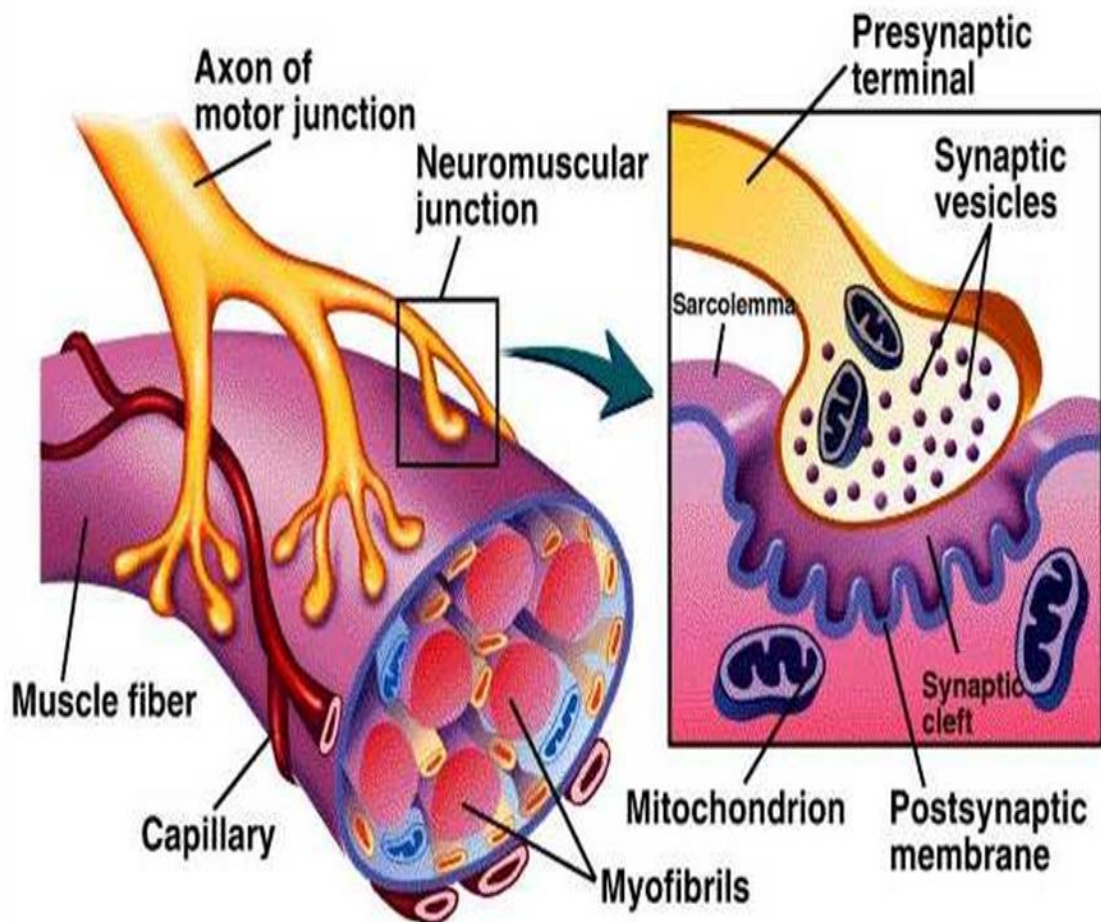
## **Chemical synapses are common**

presynaptic terminal - part which delivers the nerve impulse

postsynaptic terminal - part which receives the impulse

synaptic cleft - gap between the pre- and post synaptic membranes.

# Neuromuscular Junction



## References:

- 1-Textbook of histology .2017.4<sup>th</sup> edition.
- 2-From Cells to Organs: A Histology Textbook and Atlas. 2003, 1<sup>st</sup> edition.