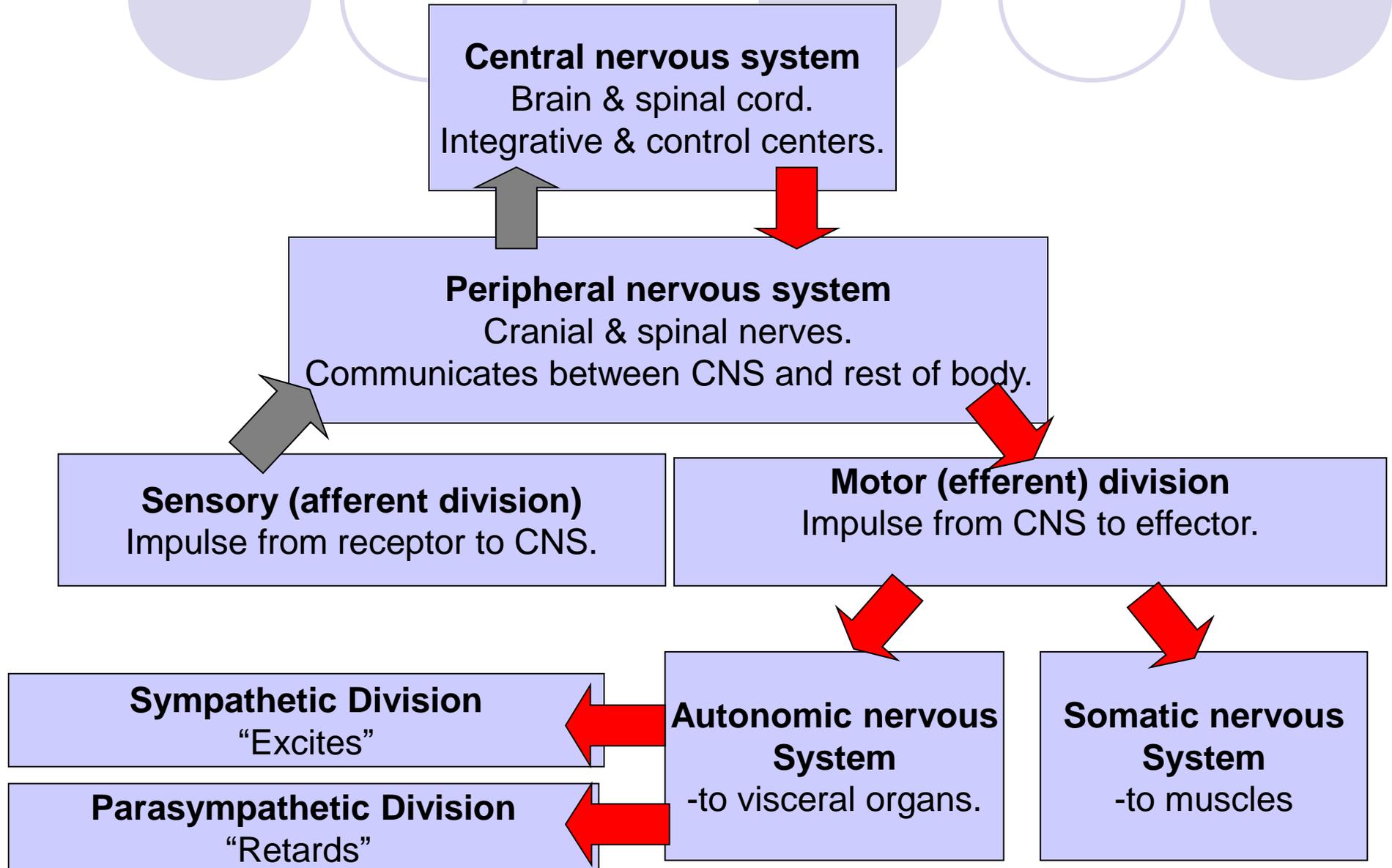


## Nerve Tissue & the Nervous system I

### Nervous Tissue

- 2 cell types:
  - Nerve cells (neurons)
    - receive or transmit impulses
    - interconnections (at least 1000 each)
  - Neuroglial cells
    - more numerous than neurons
    - support neurons in various ways
- Capillaries
- No lymphatics!

# Organization of the Nervous System



## Introduction:

The nervous tissue is composed of interconnecting network of specialized cells called *neurons* (nerve cells) supported by *neuroglial cells*. There are about 10 million neurons in human beings. The function of neurons is to receive stimuli and conduct them to a central site, the central nervous system (CNS), where they are analysed and integrated to produce a desired response in the effector organs.

### Structure of a neuron:

#### **Cell body/Soma/Perikaryon (5–150 $\mu$ m):**

- The cell bodies of all neurons are situated in the grey matter of the CNS and in the ganglia of PNS.
- The cell body of a neuron contains the nucleus and the following cytoplasmic organelles and inclusions
  - *Nucleus*—is large, euchromatic, spherical and centrally located.
  - *Nissl bodies* or *Nissl substance*—are composed of large aggregations of rough endoplasmic reticulum:

# Table Shows Types Of Glial Cells

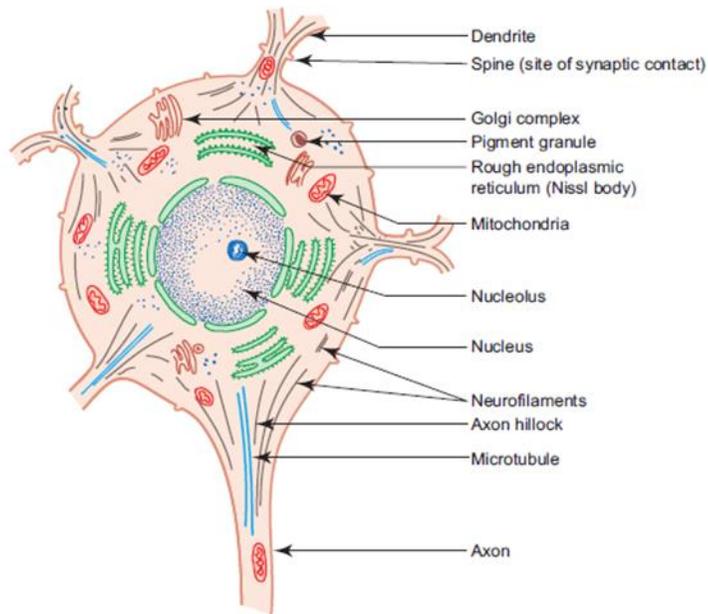
<i>Glial Cell Type</i>	<i>Location</i>	<i>Main Functions</i>
Oligodendrocyte	Central nervous system	Myelin production, electric insulation.
Neurolemmocyte	Peripheral nerves	Myelin production, electric insulation.
Astrocyte	Central nervous system	Blood-brain barrier, metabolic exchanges.
Ependymal cells	Central nervous system	Lining cavities of central nervous system.
Microglia	Central nervous system	Immune-related activity
Satellite Cells	Peripheral nerves	Supportive role.

### **Dendrites: Fig.(2)**

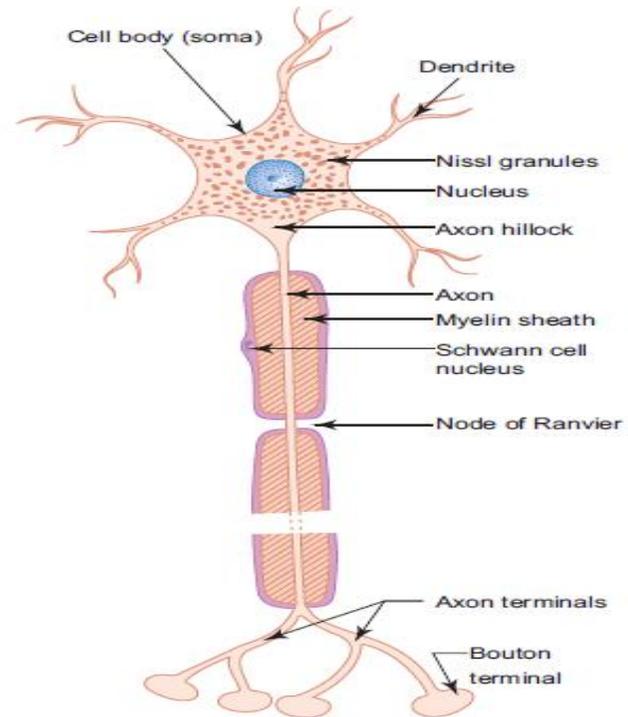
- Are highly branched, tapering processes of a neuron. So their diameter is not uniform.
- Are covered by thorny spines (gemmules) which are sites of synaptic contact.
- Receive stimuli from sensory cells and other neurons and transmit them towards the soma. So they can be regarded as major sites of information input into neuron.

### **Axon: Fig.(2)**

- Single, long, cylindrical process of a neuron. So its diameter is uniform.
- Does not branch profusely; but may give rise to collaterals.
- Arises from a cone-shaped portion of the cell body called *axon hillock*, which is devoid of Nissl bodies, but contains bundles of microtubules.
- The cytoplasm of the axon is called *axoplasm* and the plasma membrane is called *axolemma*.
- Terminates by dividing into many small branches, *axon terminals*, ending in small swellings—*terminal buttons*.
- Conducts impulses away from the cell body to the axon terminals from which impulses are transmitted to another neuron or another target cell.
- Axons are commonly referred to as *nerve fibers*.
- Are often surrounded by *myelin sheath*, which is derived either from Schwann cells (PNS) or oligodendrocytes (CNS).
- When an axon is cut, peripheral part degenerates.
- Regeneration of the axon is possible only when the cell body of the neuron is intact.



***Fig 1: Ultrastructure of neuron***



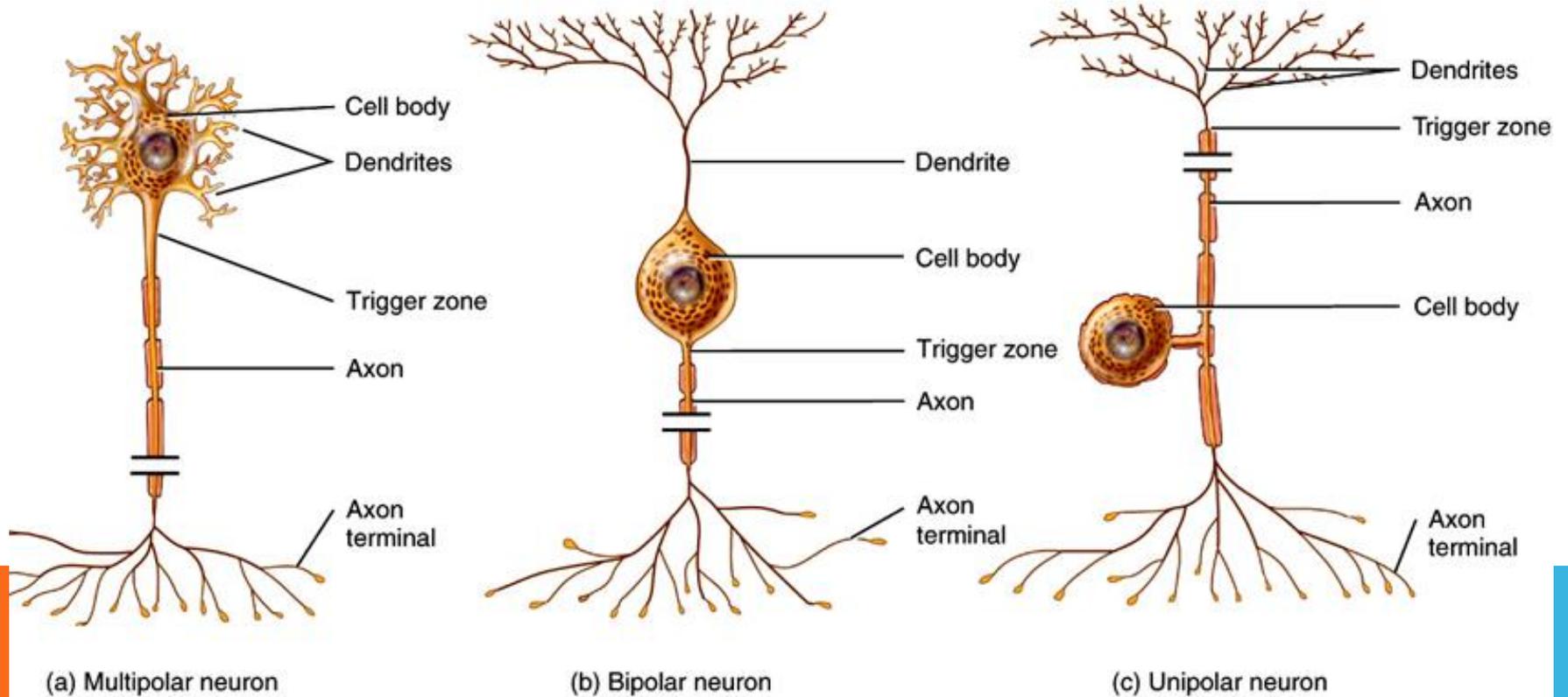
***Fig.(2): Structure of a neuron***

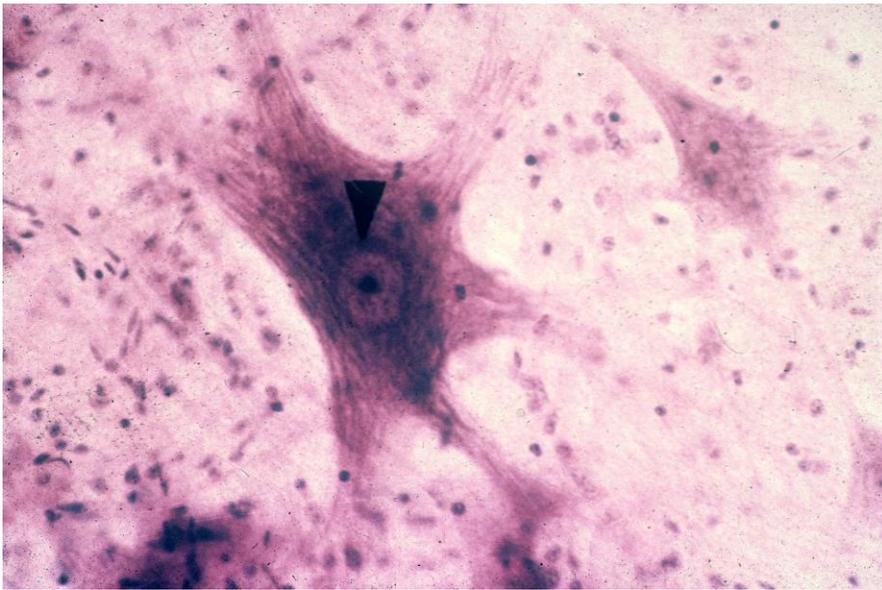
## Classification of Neurons:

### ***A. Morphological (based on the number of processes)***

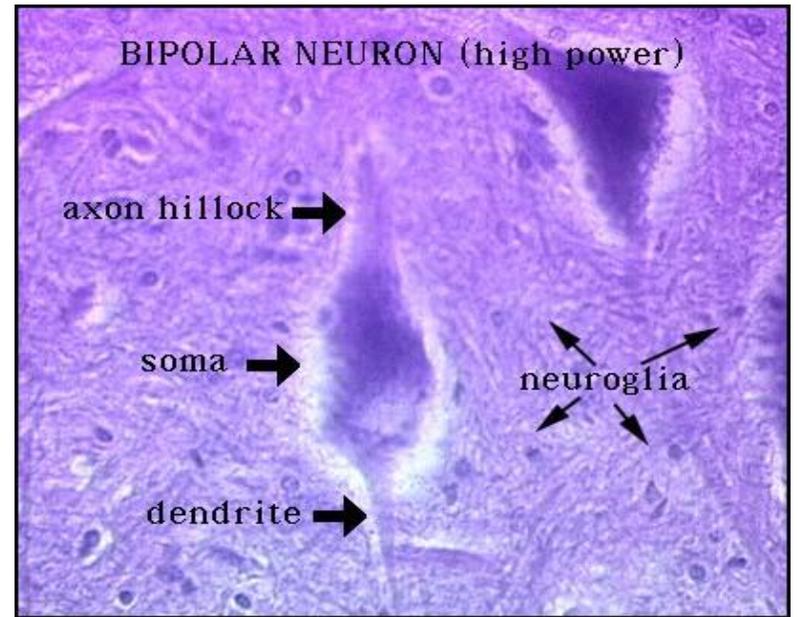
- 1. Unipolar neuron***—has a single process (rare), e.g. *mesencephalic nucleus of V cranial nerve*.
- 2. Bipolar neuron***—has two processes (an axon and a dendrite; fig.(3)), e.g. *spiral ganglion*, bipolar cells in *retina* .
- 3. Multipolar neuron***—has many processes (an axon and many dendrites; Fig. (4)), e.g. *autonomic ganglia* *motor neurons*
  
- 4. Pseudo-unipolar neuron***—has a single process that divides into an axon (central process) and a dendrite (peripheral process; Fig. (5)), e.g. *cranial* and *spinal ganglia* (*sensory neurons*)

# STRUCTURAL CLASSIFICATION OF NEURON

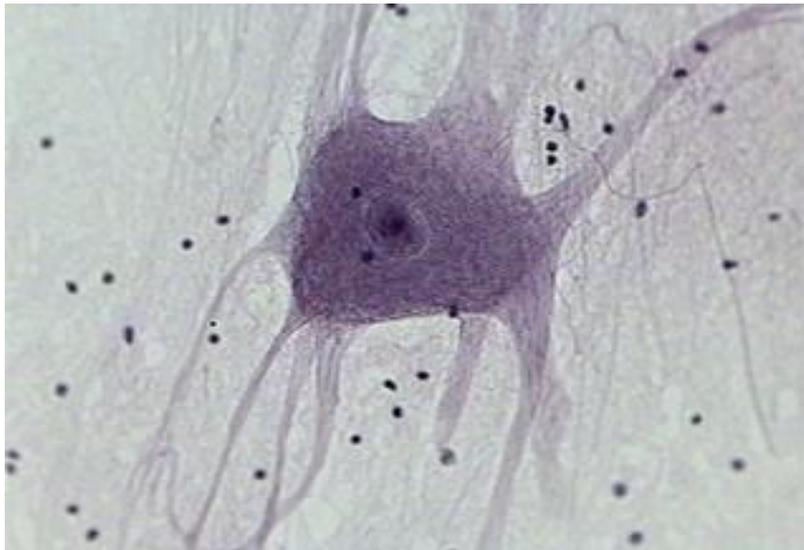




Nerve Cell Body with dark staining Nissl



Bipolar Neuron



Multipolar

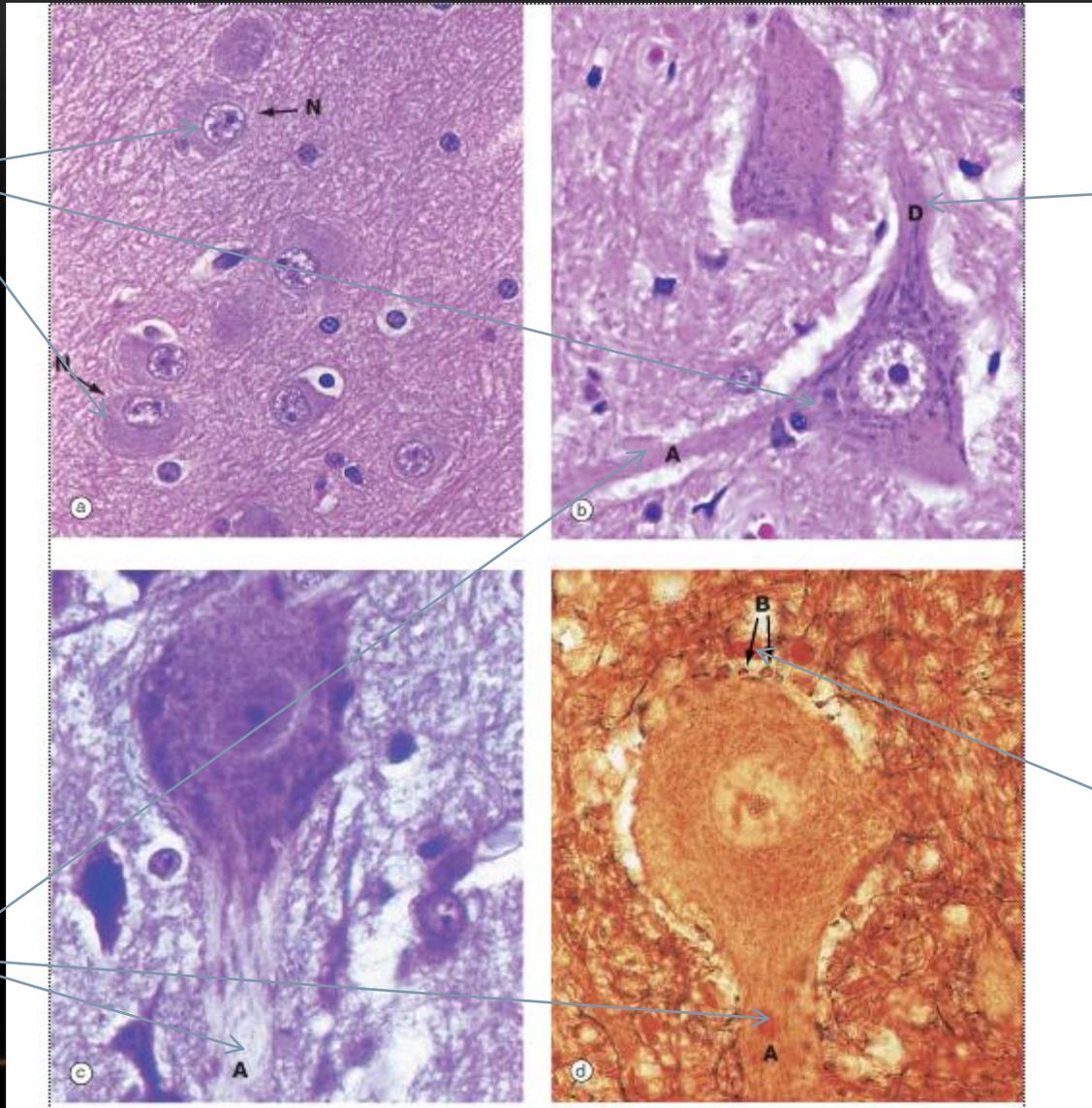
# Neurons with different staining methods

Neuron N

Dendrite D

Axon A

Terminal bouton B



## ***B. Functional (based on the function performed):***

- 1. Sensory neuron**—receives stimuli from receptors and conducts impulses to CNS, e.g. *sensory ganglia*.
- 2. Motor neuron**—conducts impulses from CNS to effector organs (muscles), e.g. *ventral horn cells*.
- 3. Interneuron**—connects sensory and motor neurons and completes the functional circuit.

### **Synaptic Communication:**

- The synapse( Gr. Synapsis , union) is responsible for the transmission of nerve impulses from neuron to another cell and insure that transmission is unidirectional.
- The function of the synapse is to convert an electrical signal (impulse) from the pre synaptic cell into a chemical signal that acts on the postsynaptic cell. Most synapses transmit information by releasing neurotransmitters.

#### ***A synapse has the following structure:***

Presynaptic axon terminal (terminal button) from which neurotransmitter is released,

- Postsynaptic cell membrane with receptors for the transmitter and ion channels or other mechanisms to initiate a new impulse.
- synapses between neurons may be classified morphologically as:
  - ***axodendritic***, occurring between axons and dendrites;
  - ***axosomatic***, occurring between axons and the cell body
  - ***axoaxonic***, occurring between axons and axons

1-Neurons



2-Muscle



3-Glands

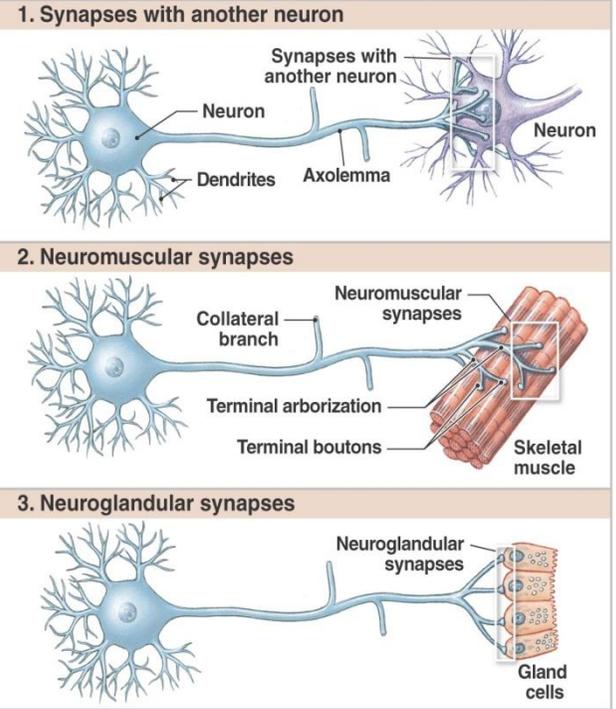


Fig.( 6)

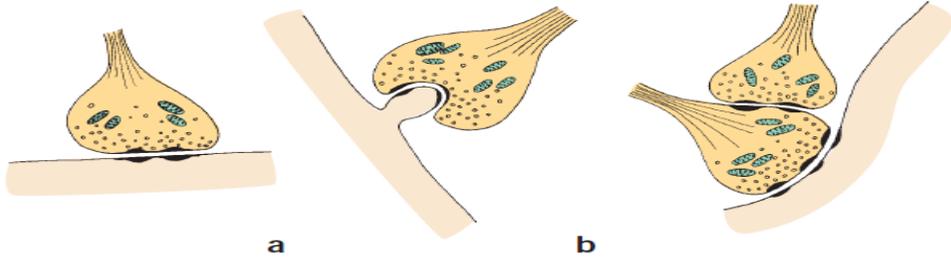


Fig.(Types of Neuroneural Synapses)

## CONT.

- The neurotransmitter carries the impulse across the space (the synapse) and onto the next neuron, or onto the organ the impulse is meant to stimulate.
- Some examples of neurotransmitters are :
  - Acetylcholine .
  - Dopamine , endorphins
  - Serotonin ,and
  - Norepinephrine .

*These neurotransmitters have a variety of functions, including muscle movement, mood, and stress release.*

## المشبكة العصبية العظمية

