

Nerve Tissue

Descriptive Histology 272

13 Oct. 2019

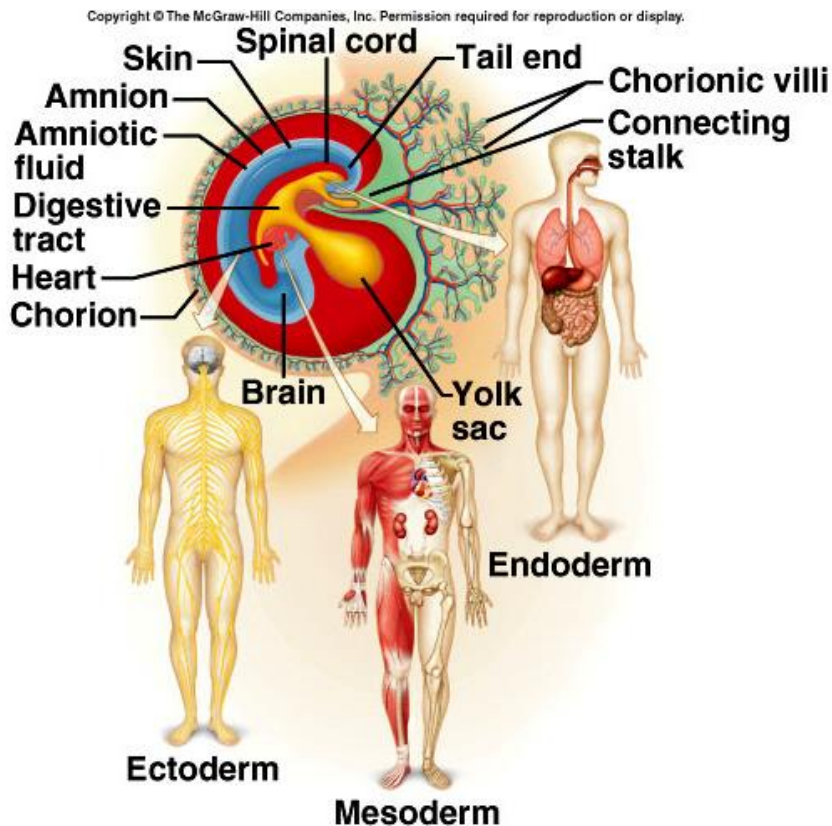
Introduction to Nerve system

- ▶ The human nervous system is the most complex system in the body histologically and physiologically
- ▶ Formed by a network of many billion nerve cells (**neurons**), all assisted by many more supporting **glial cells**.
- ▶ Each neuron has hundreds of interconnections with other neurons forming the body integrated communications network



Development of Nerve Tissue

- ▶ The nervous system develops from the outer embryonic layer, the **Ectoderm**, beginning in the third week of human embryonic life



<https://www.youtube.com/watch?v=cUGuWh2UeMk>



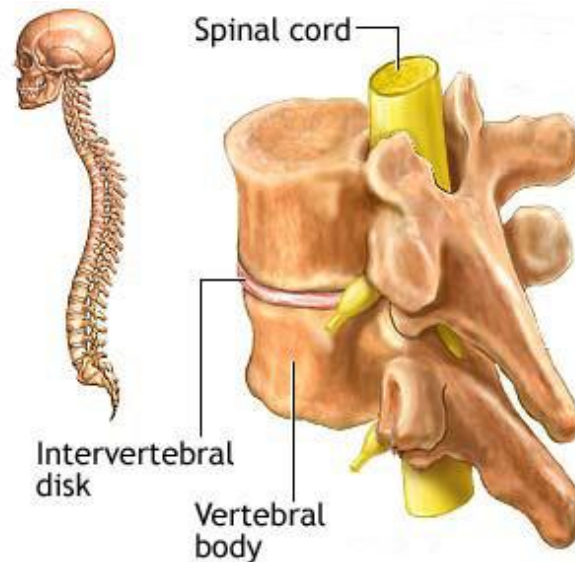
The nervous system divide into

- ▶ **Central nervous system (CNS)**, consisting of the

- ▶ Brain

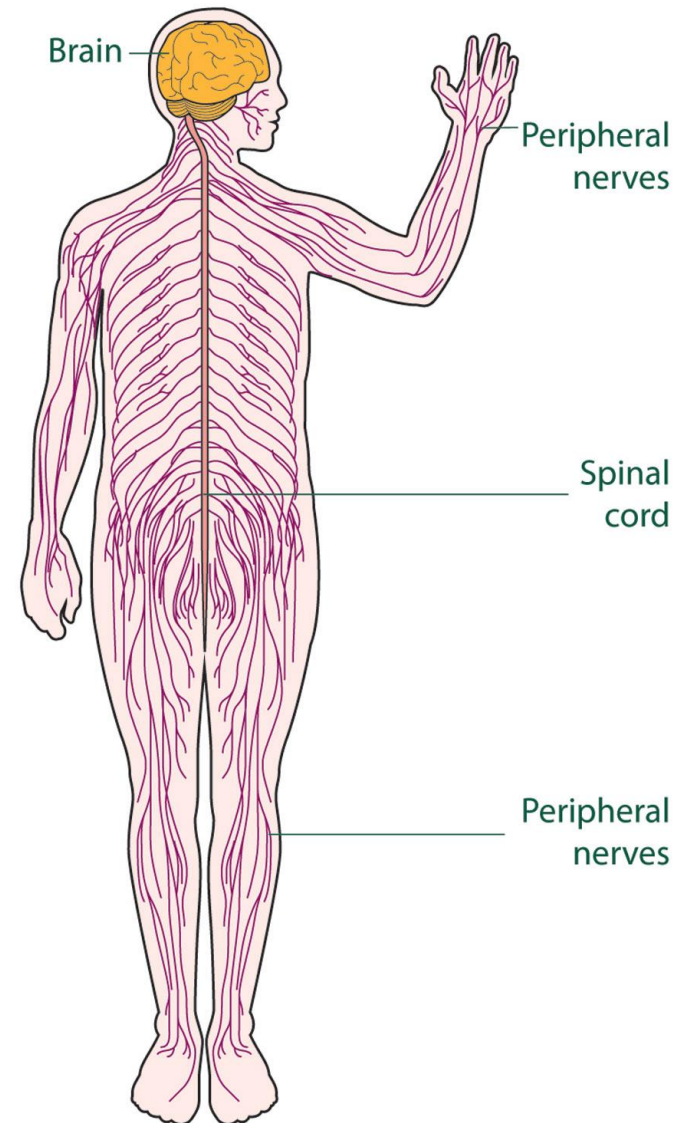


- ▶ Spinal cord



The nervous system divide into

- ▶ **Peripheral nervous system (PNS)**, composed of the cranial, spinal, and peripheral nerves conducting impulses to and from the CNS (motor and sensory nerves respectively) and **ganglia** which are small groups of nerve cells outside the CNS



Structural and functional divisions of the nervous system

Organization	Components	General description
Structural divisions:		
Central nervous system (CNS)	Brain and spinal cord	Overall "command center," processing and integrating information
Peripheral nervous system (PNS)	Nerves and ganglia	Receives and projects information to and from the CNS; mediates some reflexes

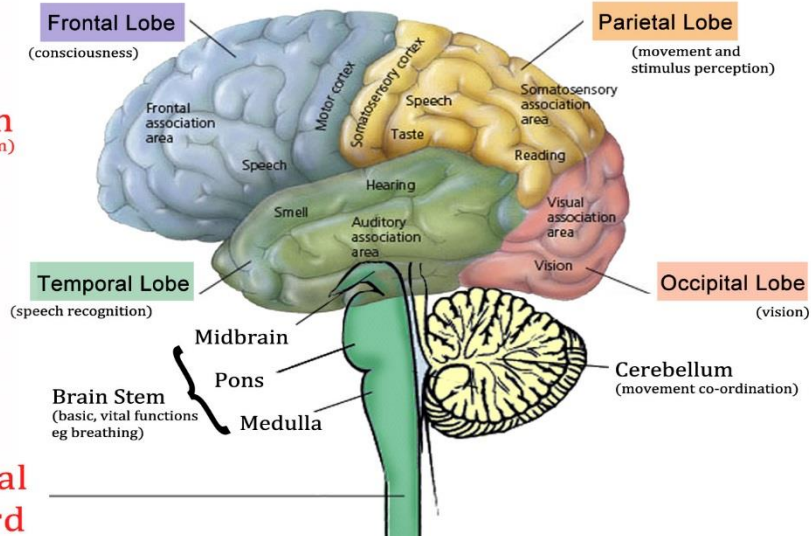


Functional divisions:		
	Components	General description
Sensory nervous system	Some CNS and PNS components	Includes all axons that transmit impulses from a peripheral structure to the CNS
	Somatic sensory	Transmits input from skin, fascia, joints, and skeletal muscles
	Visceral sensory	Transmits input from stomach and intestines (viscera)
Motor nervous system	Some CNS and PNS components	Includes all axons that transmit nerve impulses from the CNS to a muscle or gland
	Somatic motor (somatic nervous system)	Voluntary control of skeletal muscle
	Autonomic motor (autonomic nervous system)	Involuntary control of smooth muscle, cardiac muscle, and glands

The Nervous System

Central Nervous System

Brain
(Cerebrum)



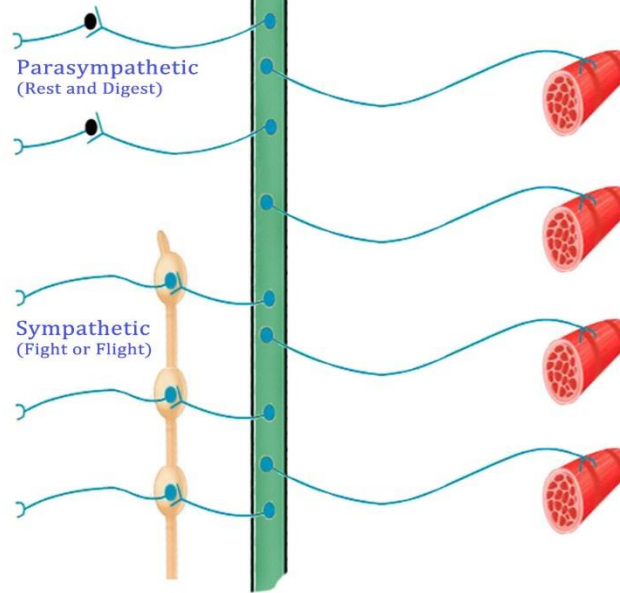
Spinal Chord

Peripheral Nervous System

Autonomic
(Subconscious, control systems)



Somatic
(Voluntary, muscle movement)



Nerve tissue

Nerve tissue consists of two cell types:

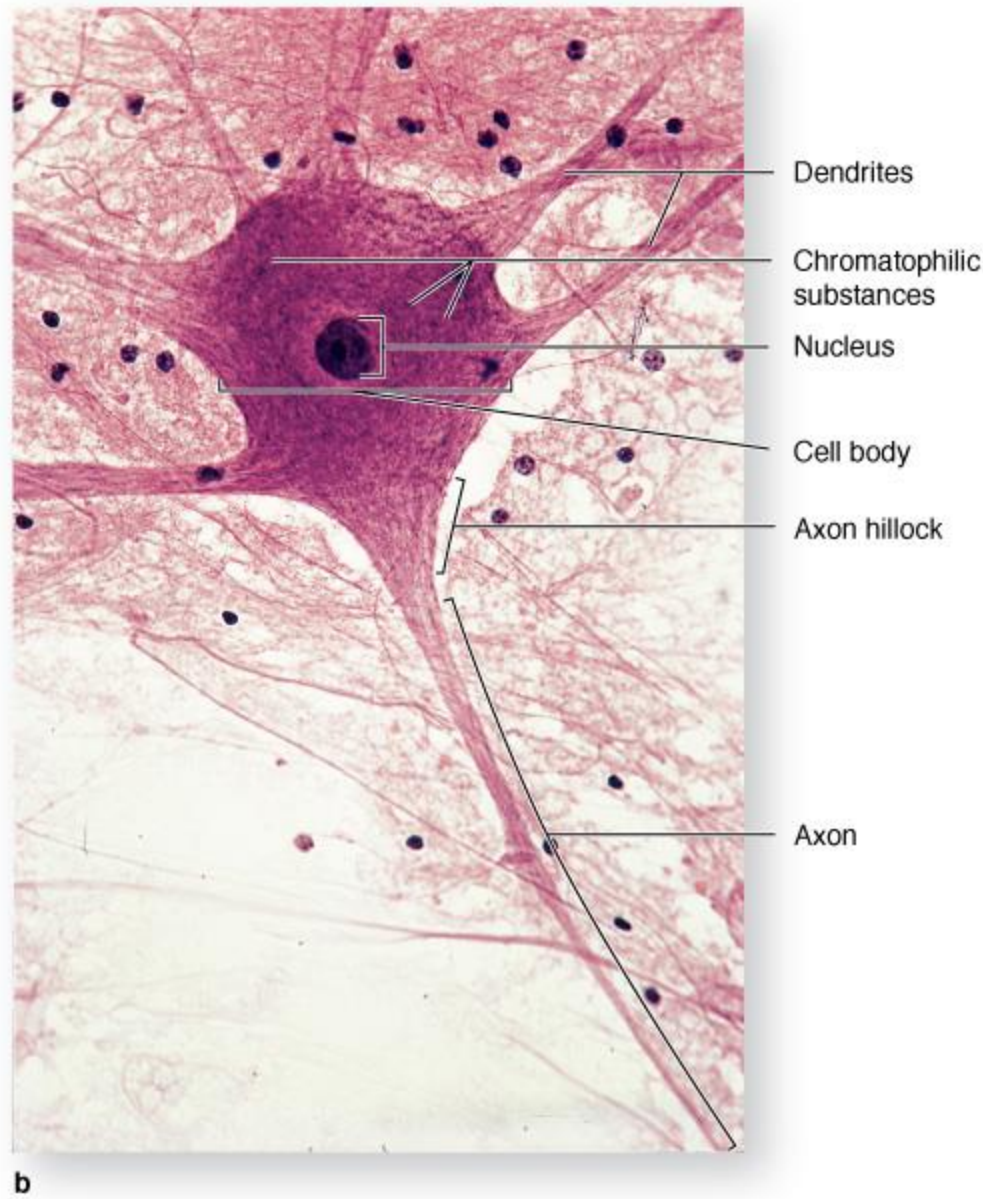
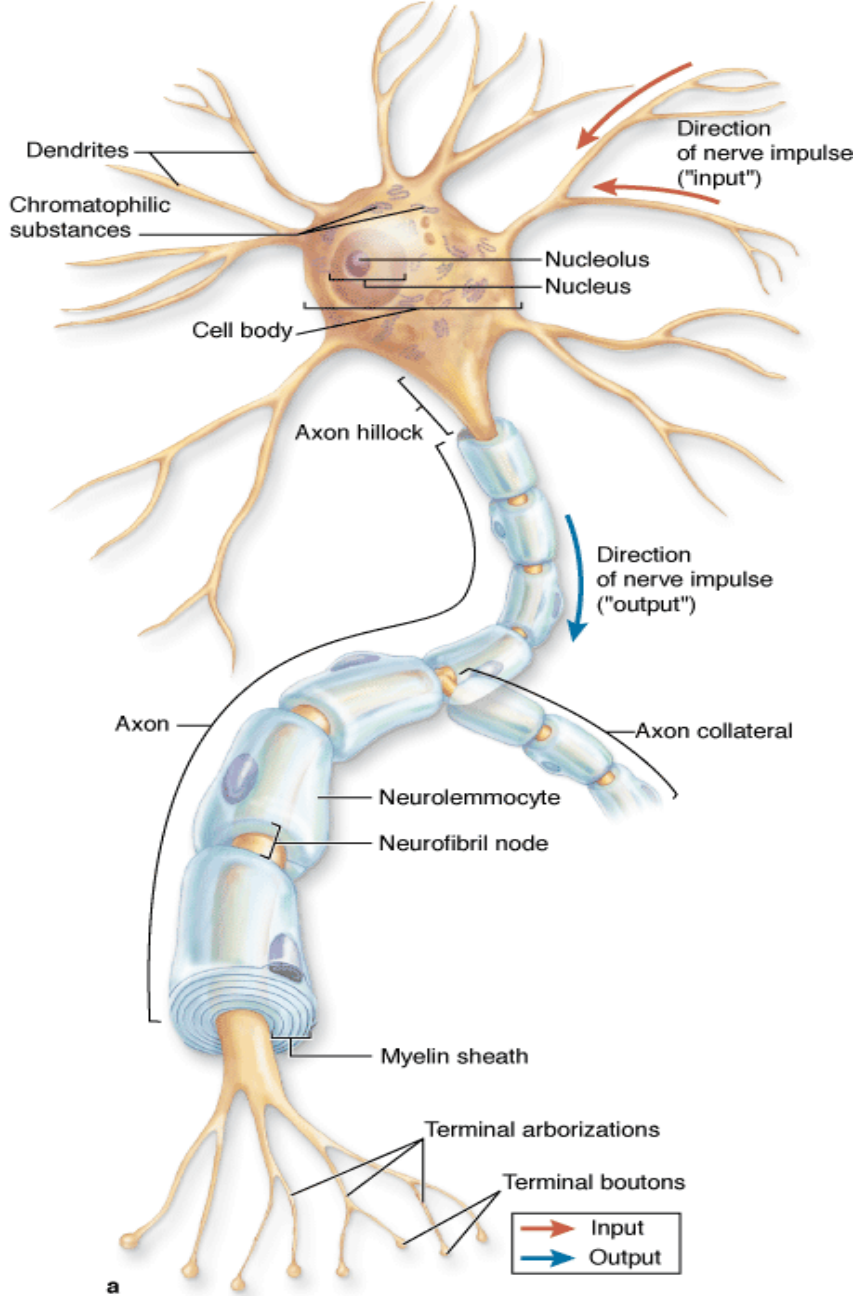
- ▶ **Nerve cells, or neurons**, which usually show numerous long processes
- ▶ **Glial cells** (Gr. *glia*, glue), which have short processes, support and protect neurons, and participate in neural activity, neural nutrition, and defense of cells in the central nervous system.



Neurons

- ▶ The functional unit in both the CNS and PNS is the **neuron or nerve cell**
- ▶ Neuron consist of:
 - ▶ **Cell Body or Perikaryon**
 - ▶ **Dendrites**
 - ▶ **Axon**





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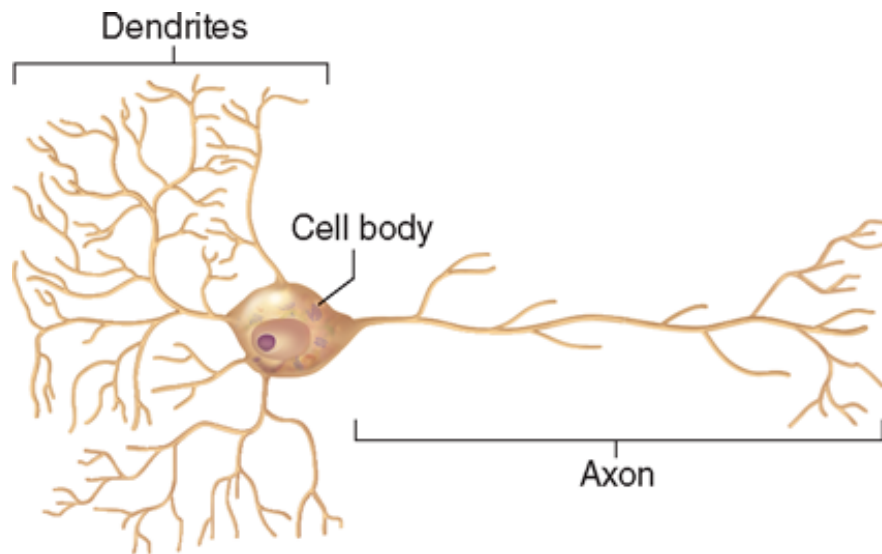
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Neurons Classification

Neurons can be classified according to the number of processes extending from the cell body:

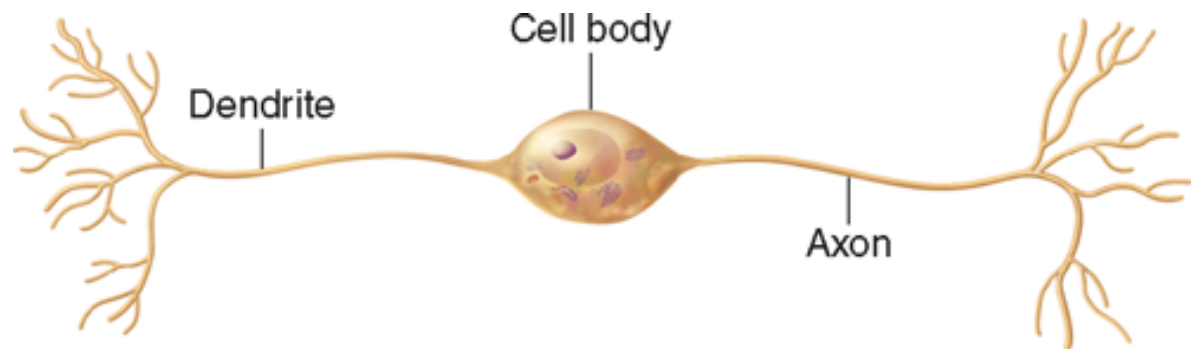
- ▶ **Multipolar neurons**, which have one axon and two or many dendrites;
- ▶ **Bipolar neurons**, with one dendrite and one axon
- ▶ **Unipolar or pseudounipolar neurons**, which have a single process that bifurcates close to the perikaryon, with the longer branch extending to a peripheral ending and the other toward the CNS.
- ▶ **Anaxonic neurons**: with many dendrites but no true axon





(a) Multipolar neuron

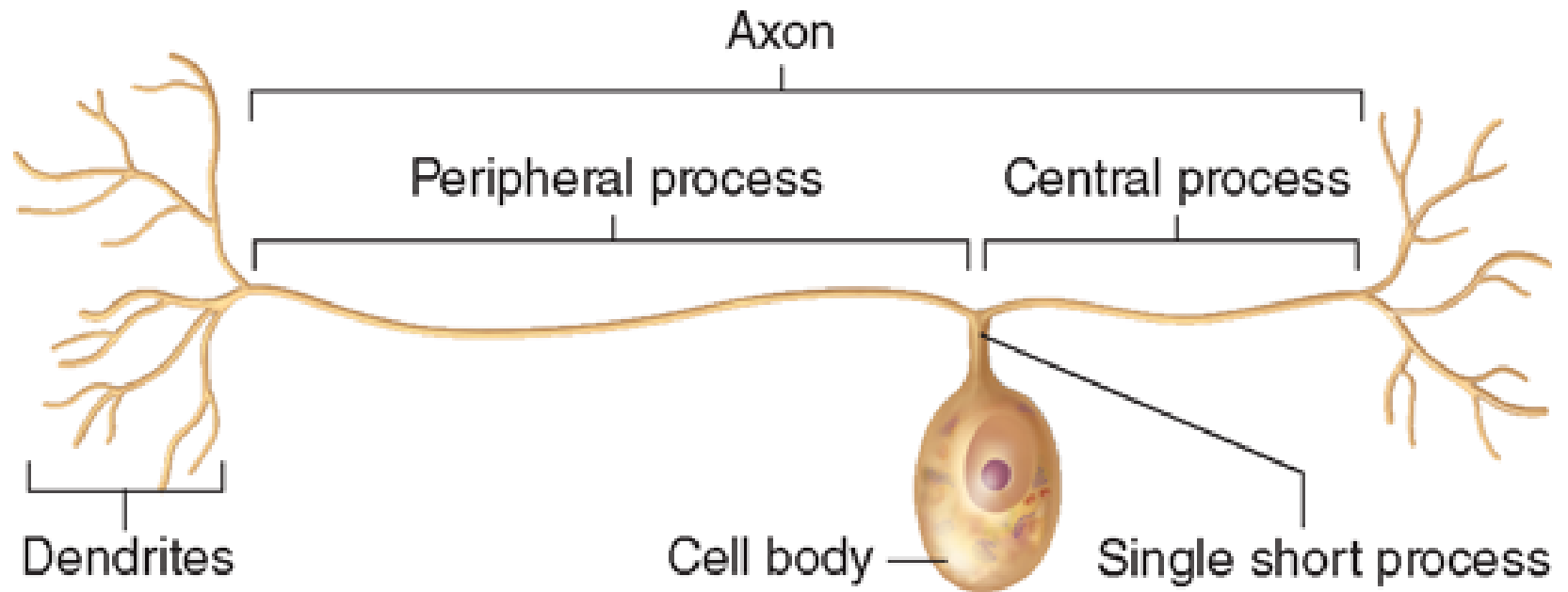
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(b) Bipolar neuron

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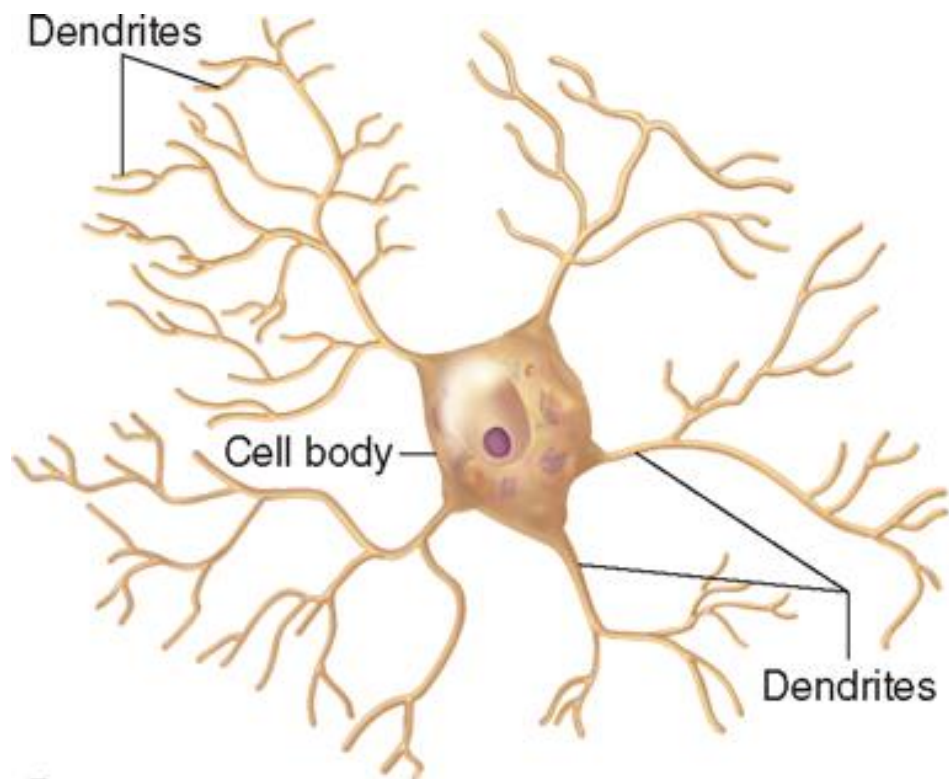




© Unipolar neuron

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d Anaxonic neuron

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Neurons Classification con.

Neurons can also be subdivided according to their functional roles

- ▶ **Sensory (afferent) neurons** are involved in the reception of sensory stimuli from the environment and from within the body.
- ▶ **Motor (efferent) neurons** control effector organs such as muscle fibers and exocrine and endocrine glands.
- ▶ **Interneurons** establish relationships among other neurons, forming complex functional networks or circuits (as in the retina).



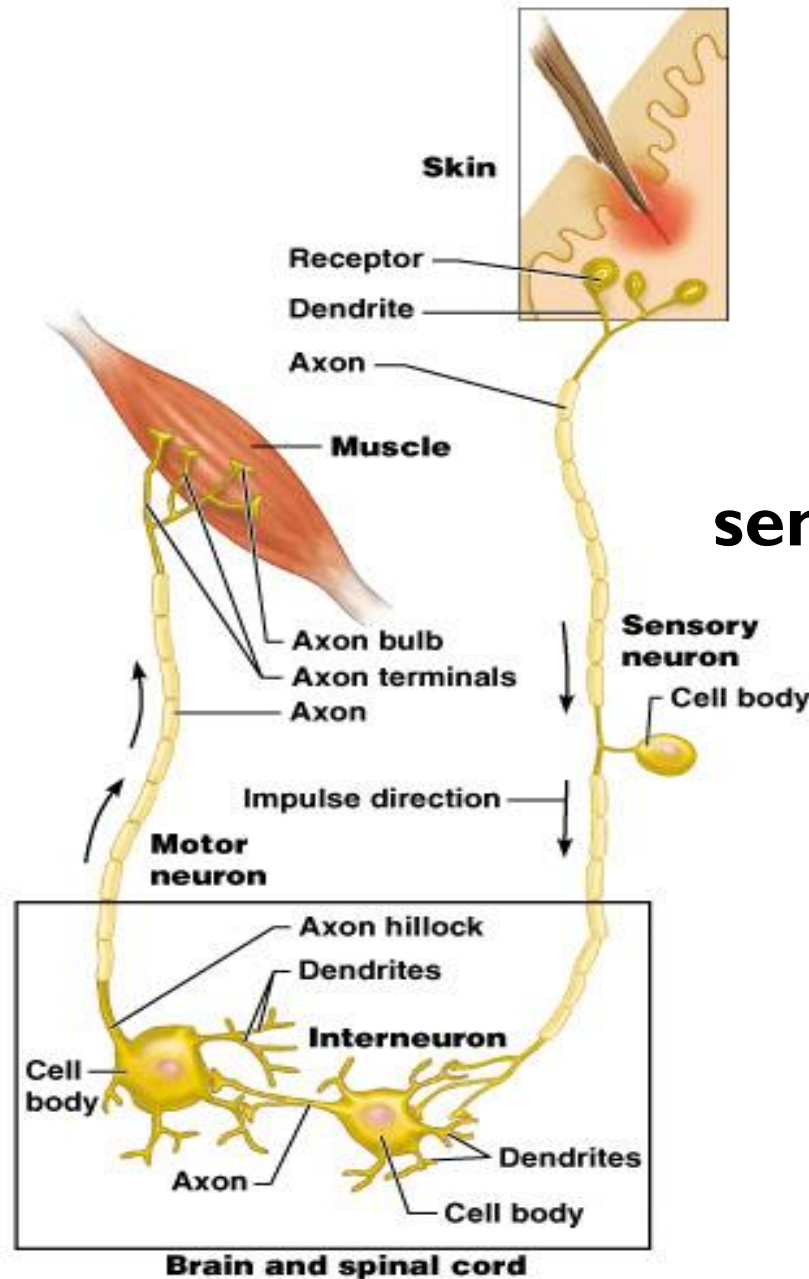
sensory input

motor input

sensory receptor

Effector

integration



Structure of the Neuron

Myelin Sheath

- ▶ a white, multi layered, fatty covering some nerve processes.
- ▶ arranged in segments, separated by Node of Ranvier

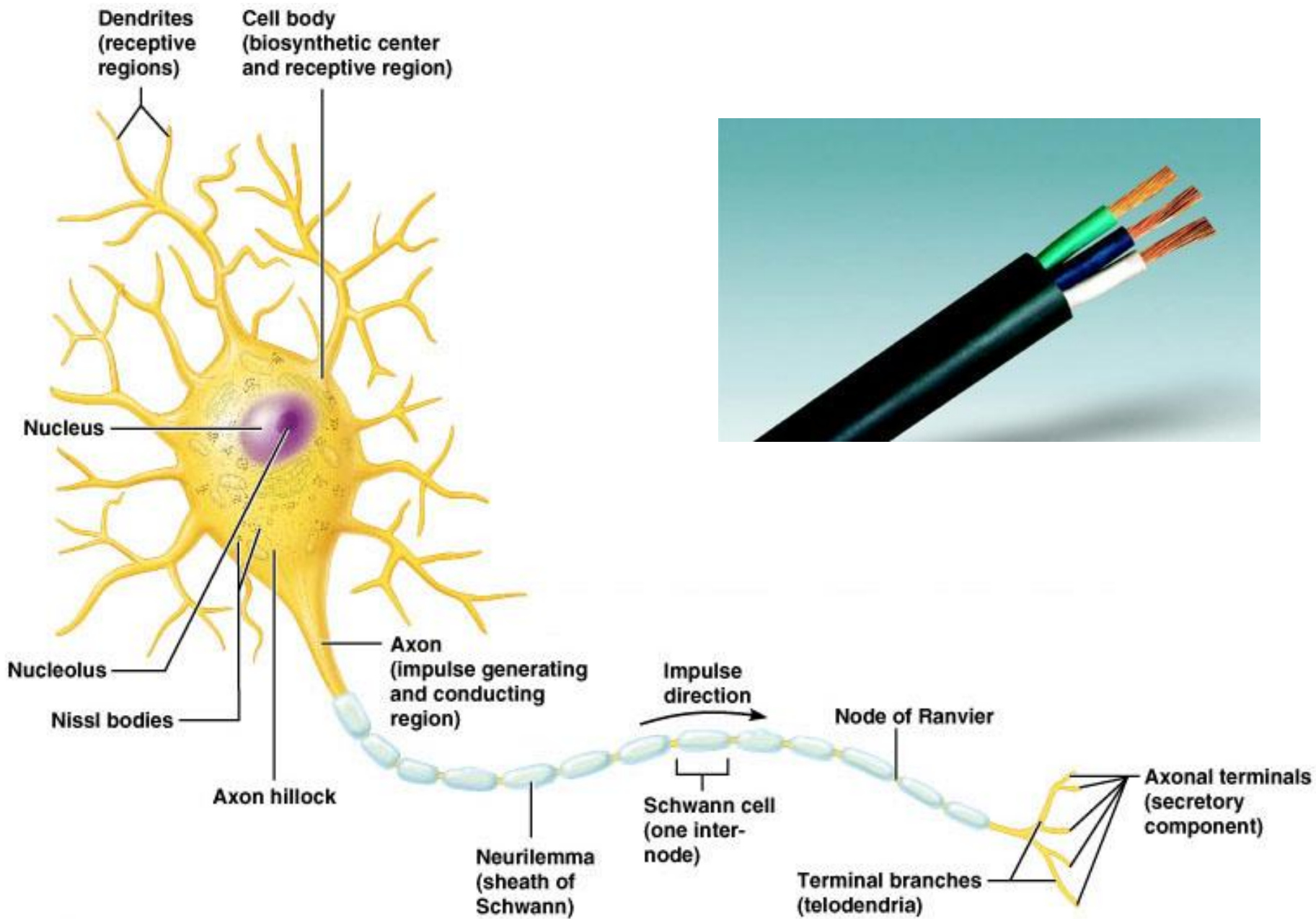
Function

- ▶ Insulation of nerve process
- ▶ Increased speed of conduction

Neurilemma

- ▶ outer layer of myelin sheath
 - ▶ essential for regeneration
-



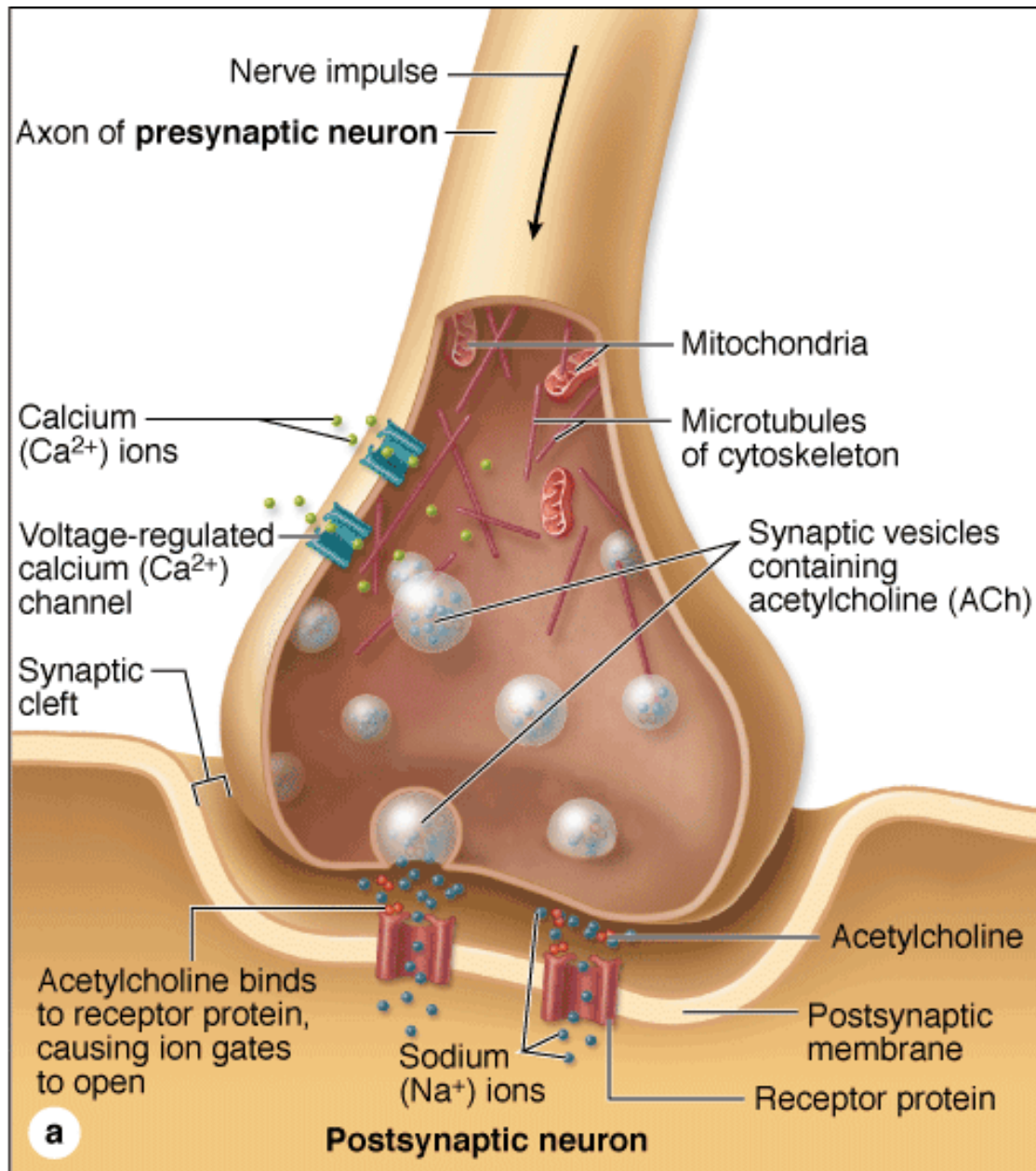


Synaptic Communication

Synapse has the following structure:

- ▶ Presynaptic axon terminal (**terminal bouton**) from which neurotransmitter is released,
- ▶ Postsynaptic cell membrane with receptors for the transmitter and ion channels or other mechanisms to initiate a new impulse,
- ▶ 20–30 nm wide intercellular space called the **synaptic cleft** separating the presynaptic and postsynaptic membranes.





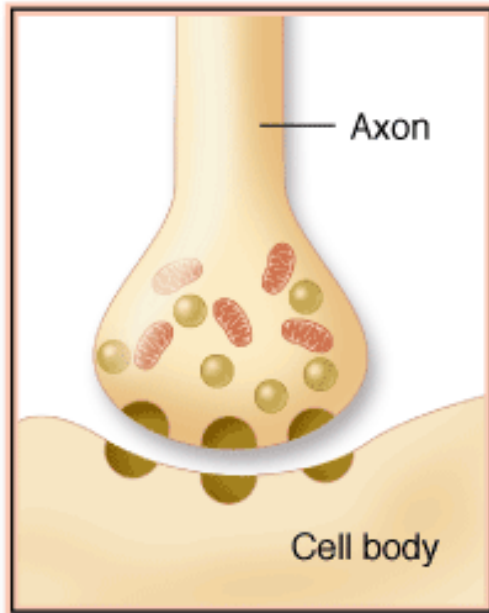
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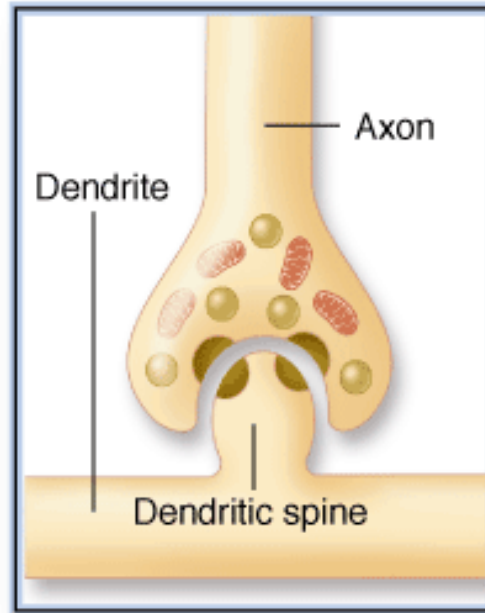
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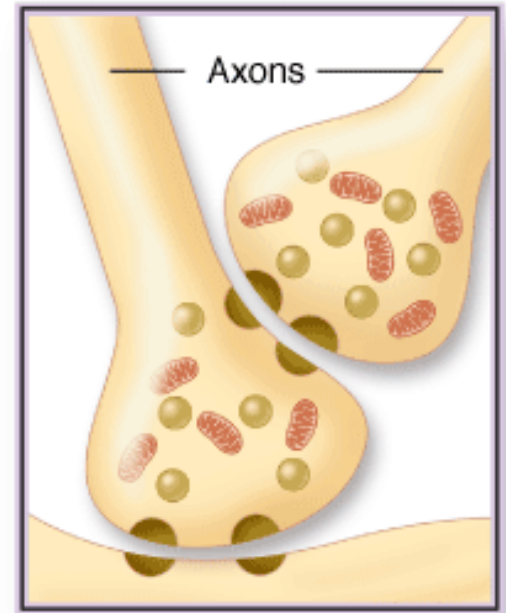
Axosomatic synapse



Axodendritic synapse



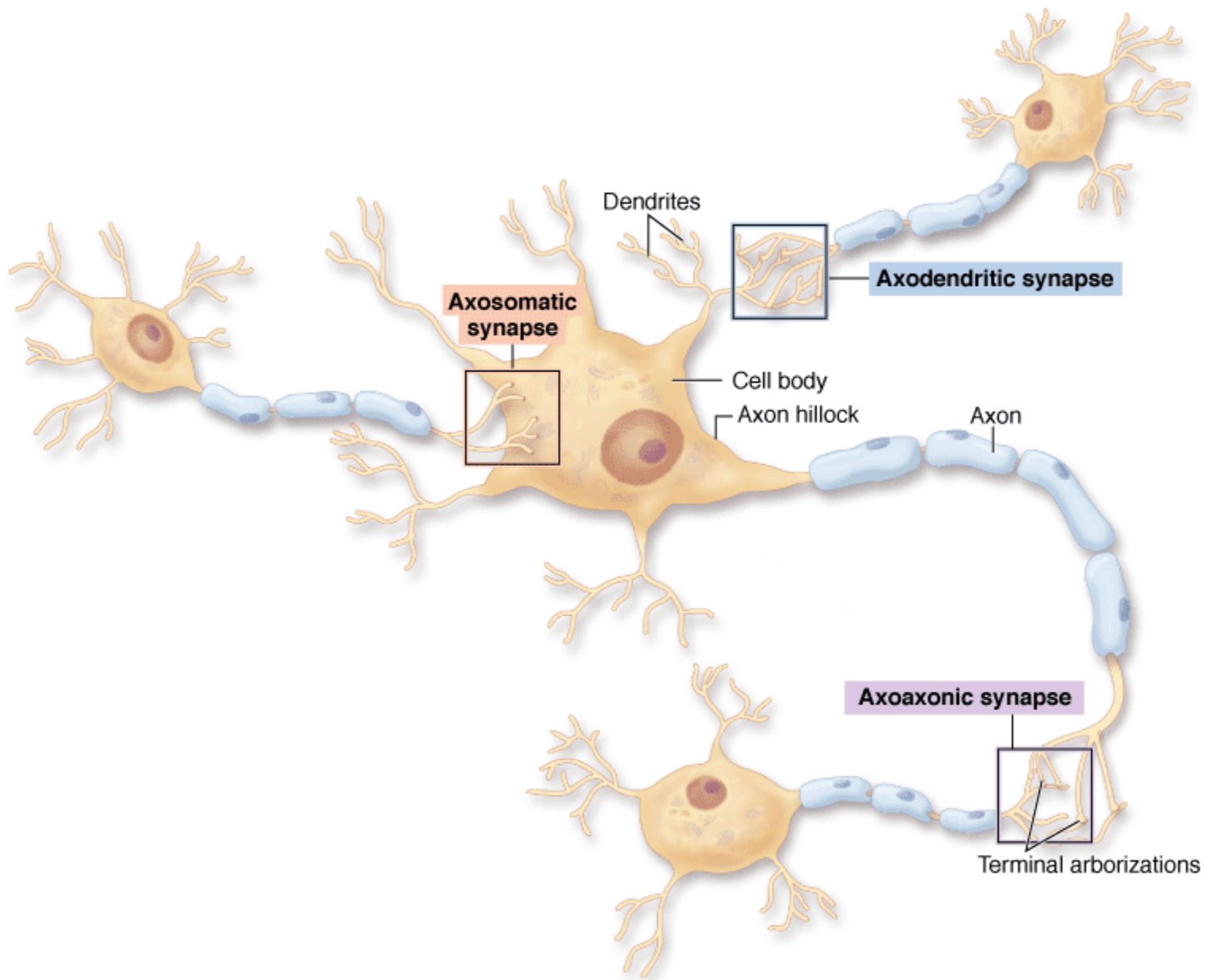
Axoaxonic synapse



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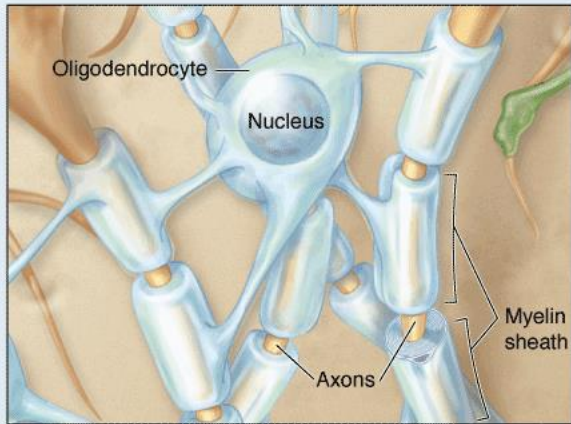
Glial Cells & Neuronal Activity

Origin and principal functions of neuroglial cells.

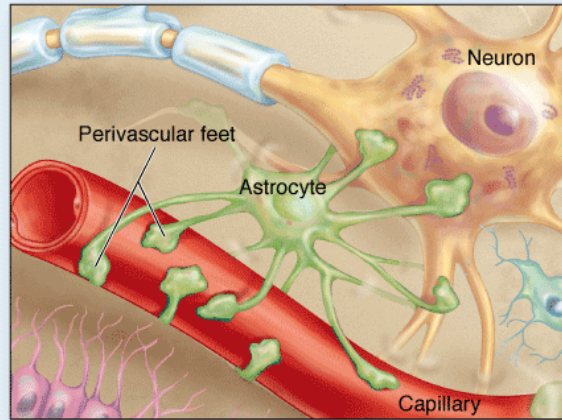
Glial Cell Type	Origin	Location	Main Functions
Oligodendrocyte	Neural tube	CNS	Myelin production, electrical insulation
Schwann cell (Neurolemmocyte)	Neural crest	Peripheral nerves	Myelin production, electrical insulation
Astrocyte	Neural tube	CNS	Structural and metabolic support of neurons; BBB; repair processes
Satellite cells (of ganglia)	Neural crest	Peripheral ganglia	Structural and metabolic support for neuronal cell bodies
Ependymal cell	Neural tube	Line ventricles and central canal of CNS	Aid production and movement of CSF
Microglia	Bone marrow (monocytes)	CNS	Defense and immune-related activities



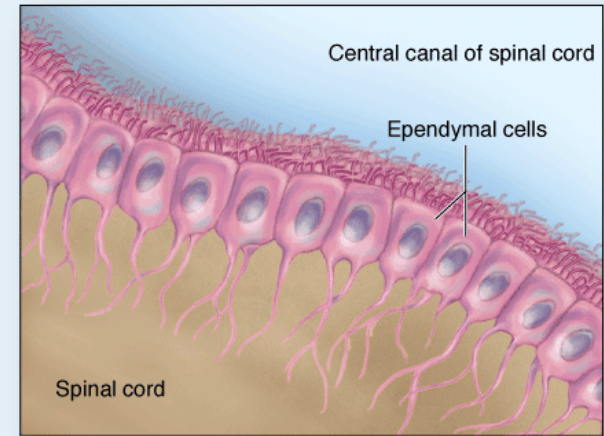
CNS Glial Cells



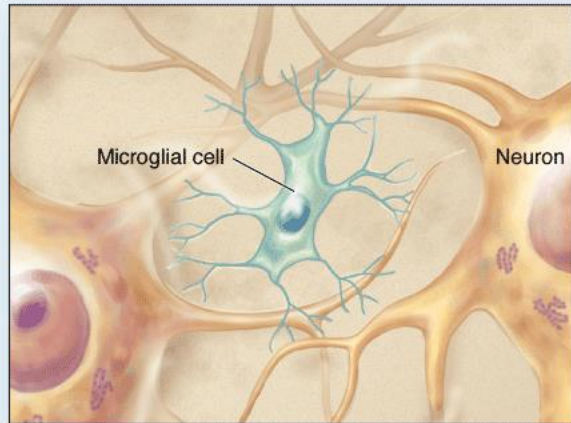
a Oligodendrocyte



b Astrocyte

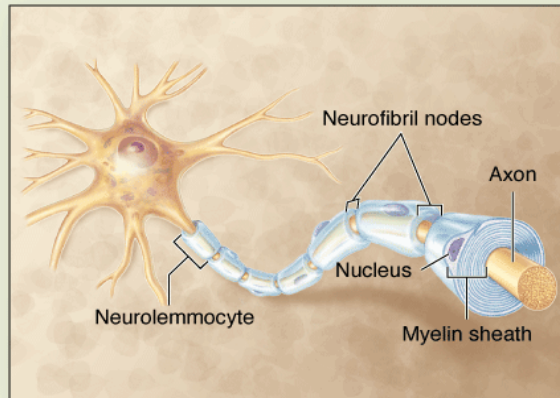


c Ependymal cells

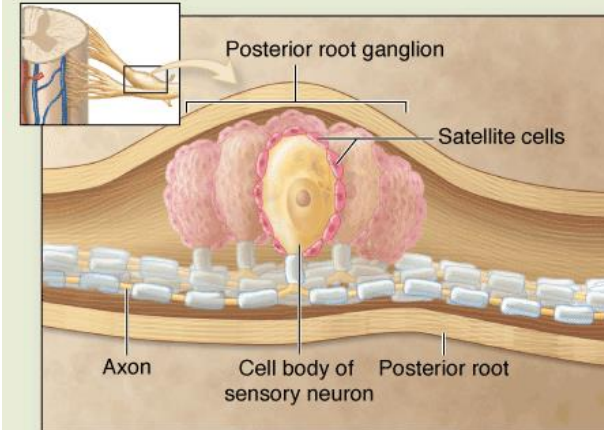


d Microglial cell

PNS Glial Cells



e Neurolemmocytes

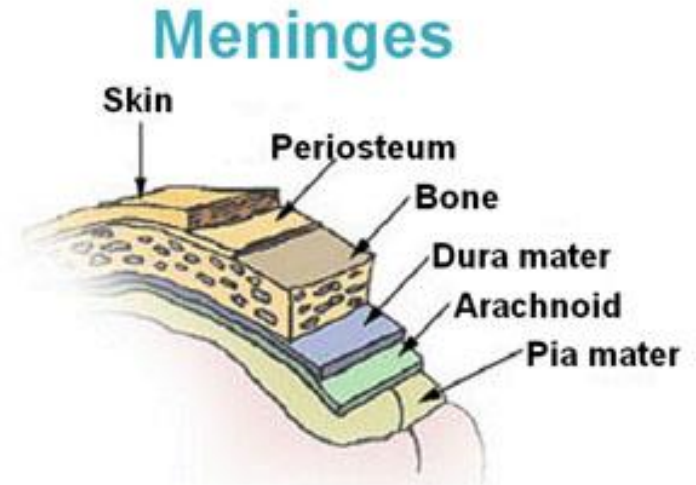


f Satellite cells



Meninges

The **meninges** are three layers of protective tissue called the **dura mater**, **arachnoid mater**, and **pia mater** that surround the **neuraxis**.

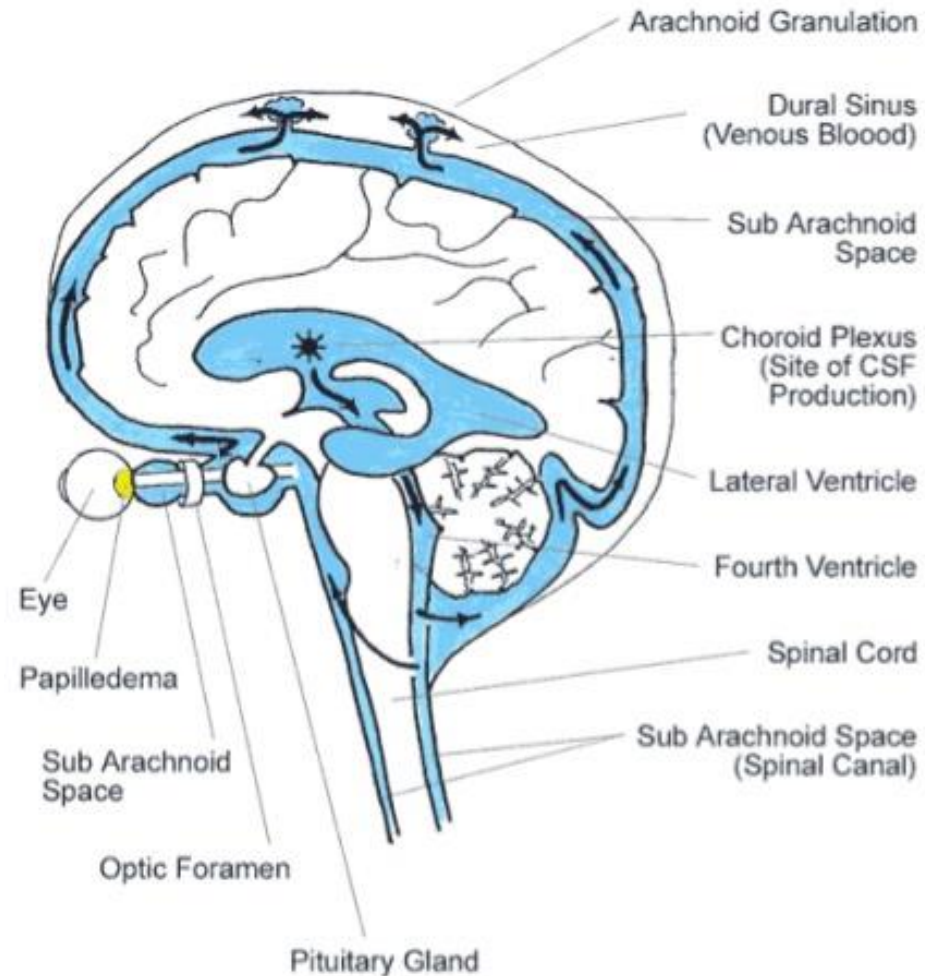


Dura mater -- outer layer lining skull
Arachnoid (mater) -- contains blood vessels
 Subarachnoid space -- filled with CSF
Pia mater -- covers brain



Cerebrospinal fluid

Cerebrospinal fluid (CSF) is **found** in the subarachnoid space of the brain (within the ventricles) and **spinal** canal. It is produced by the choroid plexus in the ventricles of the brain and the **cerebral** vessels, at the rate of 500 ml/day.



http://www.youtube.com/watch?v=7-JHh5a_owc

