Nervous Tissue

- **Nervous Tissue are ectodermal in origin (Exception:- Microglia develop from mesoderm).**
- **Nervous tissue control and coordinates the activities of the body's cells and organs**
- **Nervous tissue consists of two types of basic cells**

1. Neuron-

- ❖Main Cells
- ❖Structural and functional unit of the nervous system
- ❖Excitable (Generate action potential)

2. Neuroglia cells-

- ❖Supporting Cells
- ❖Nurse cells

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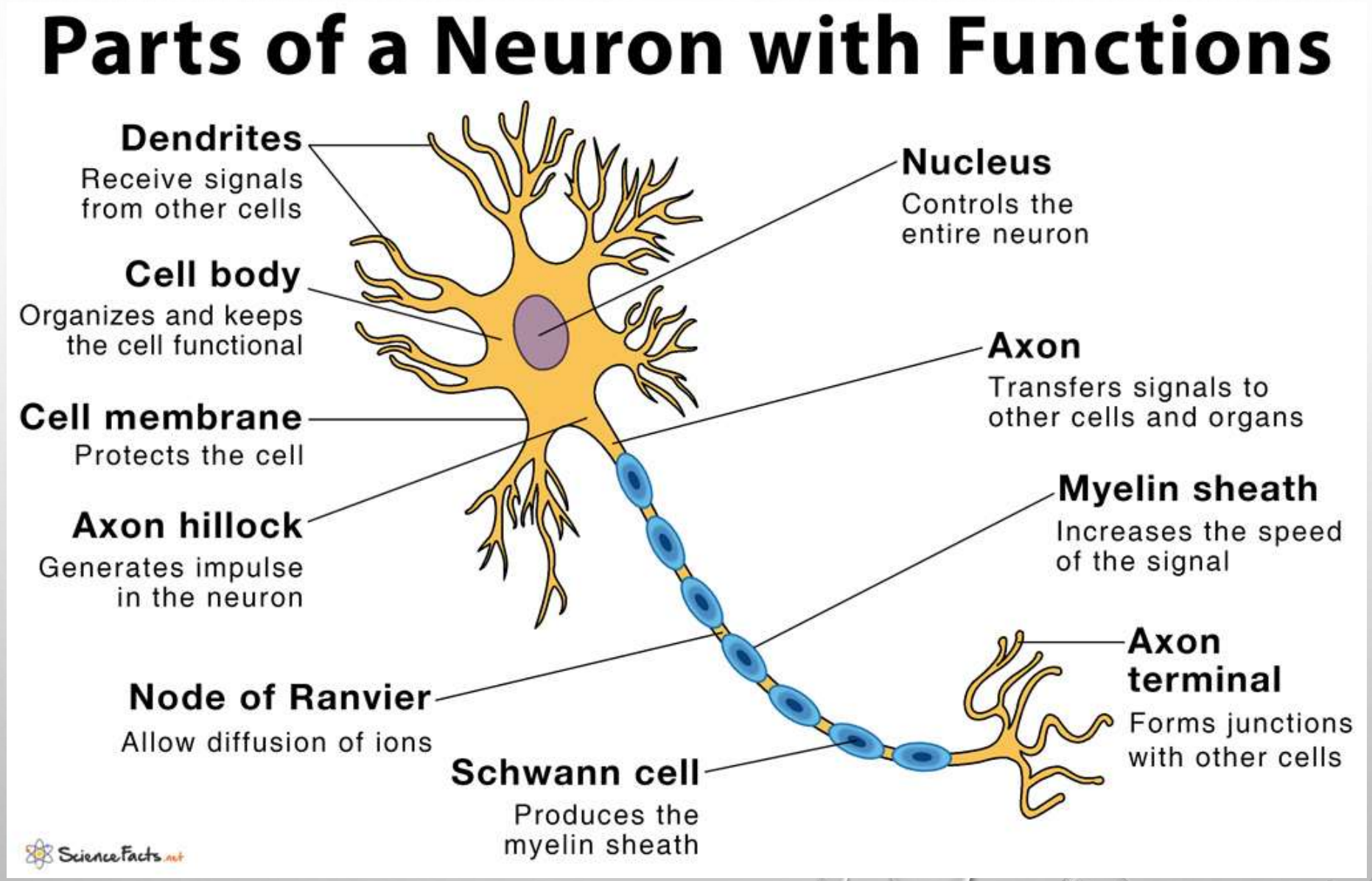
Parts of a Neuron with Functions



Types of neurons according to Morphology of nerve cells

Neurons are classified on the basis of the number of processes extending from the cell body:

Unipolar – 1 axon

Multipolar – 1 axon and 2 or more dendrites

Bipolar – 1 axon and 1 dendrite (site: special sense organs)

Pseudounipolar – one process, the axon, which divides close to the cell body into two long processes (site: spinal sensory ganglia)

Types of neurons according to size

Golgi type I – long axon ranging from few milimeters to a meter (site: pyramidal neurons of cerebral cortex, motor neurons of spinal cord)

Golgi type II – very short axon, that terminates near the cell body (very numerous in cerebral and cerebellar cortex)

Types of neurons according to functions :

Motor (efferent) neurons – carry motor impulses from CNS to peripheral end organs (site: anterior horn of the spinal cord)

Sensory (afferent) neurons – receive impulses from peripheral sensory cells and carry them toward CNS (site: sensory spinal ganglia)

Interneurons (association neurons) – they are short neurons that connect a sensorys and a motor neuron

Axon vs. Dendrite – differences

AXON	DENDRITE
Only one axon is present in a neuron.	Dendrites are usually multiple in number in a neuron.
It is a thin long process of uniform thickness and smooth surface.	These are short multiple processes. Their thickness diminishes as these divide repeatedly. The branches are studded with spiny projections.
The branches of axon are fewer and at right angles to the axon	The dendrites branch profusely and are given off at acute angles.
Axon contains neurofibrils and no Nissl's granules.	Dendrites contain both neurofibrils and Nissl's granules.
It forms the efferent component of the impulse.	Dendrites form the afferent component of the impulse

Neuroglia – supporting cells

Central nervous system

Astrocytes (protoplasmic or fibrous)

Microglia (Hortega´s glia)

Oligodendrocytes

Ependymal cells

Peripheral nervous system

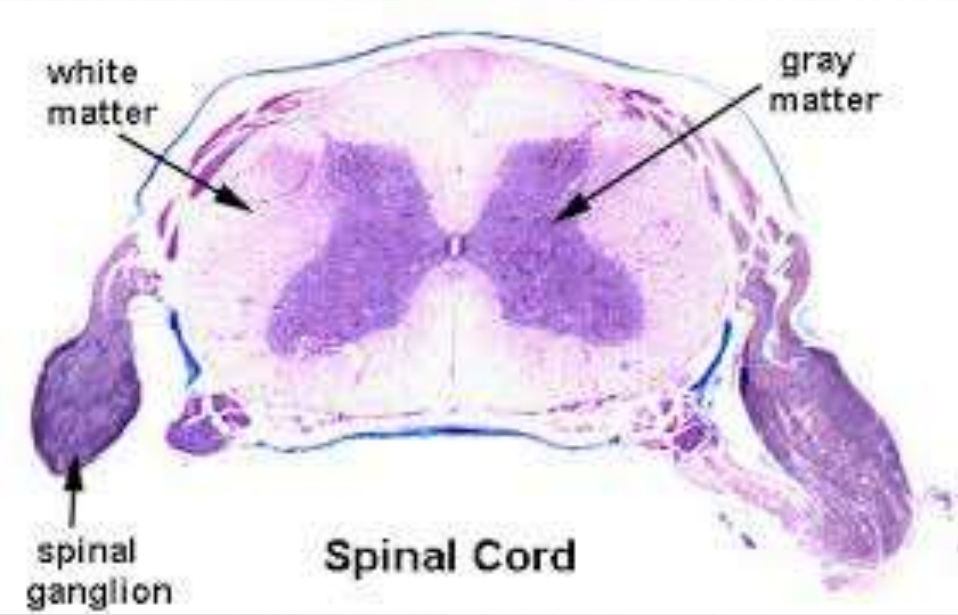
Schwann cells

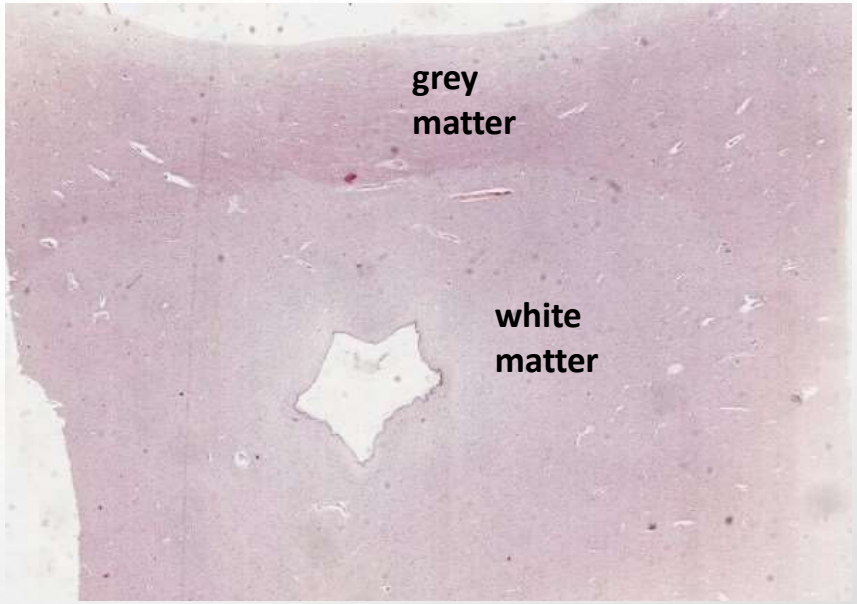
Satelite cells

Functions of neuroglial cells:

- Supporting role in the nervous tissue
- Occupy interneuronal spaces
- Creation of myelin sheaths around nerve fibers
- Nutrition of the nervous tissue
- Phagocytosis
- Healing of defects (glial scars)
- Regulation of stable chemical constitution of cerebrospinal fluid
- Creation of blood-brain barrier (together with the endothelium of capillaries)

the central nervous system (CNS) consists of the brain (cerebrum and cerebellum) and spinal cord





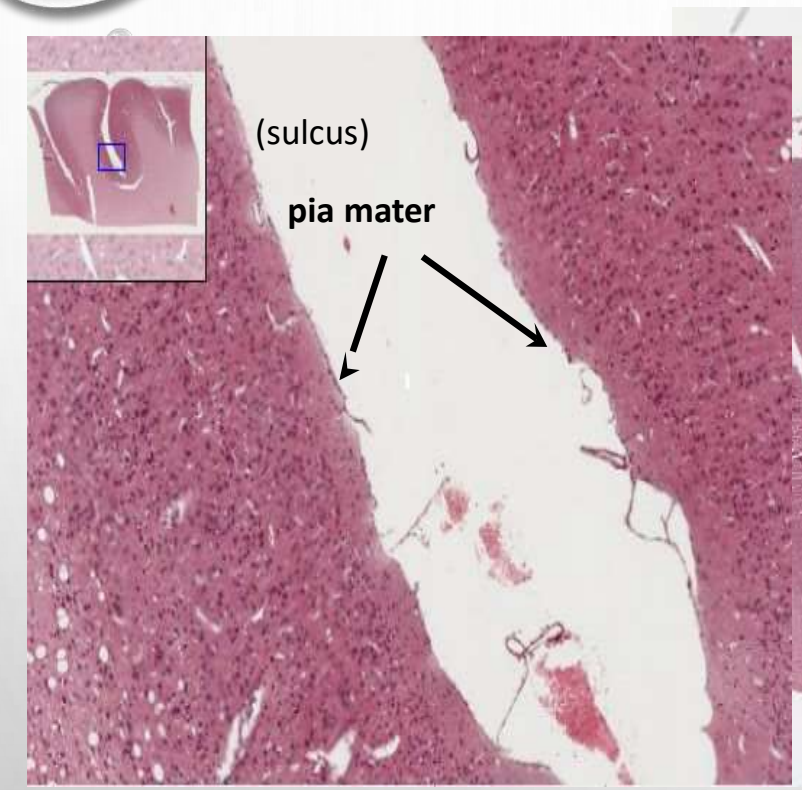
Cerebrum, H&E

the tissue of the CNS is classified as grey matter and white matter based upon appearance

grey matter contains the cell bodies of neurons and associated supportive neuroglial cells

the white matter lacks neuron cell bodies and consists primarily of myelinated axons

in the spinal cord, the grey matter is located in the center and is surrounded by white matter on the outside

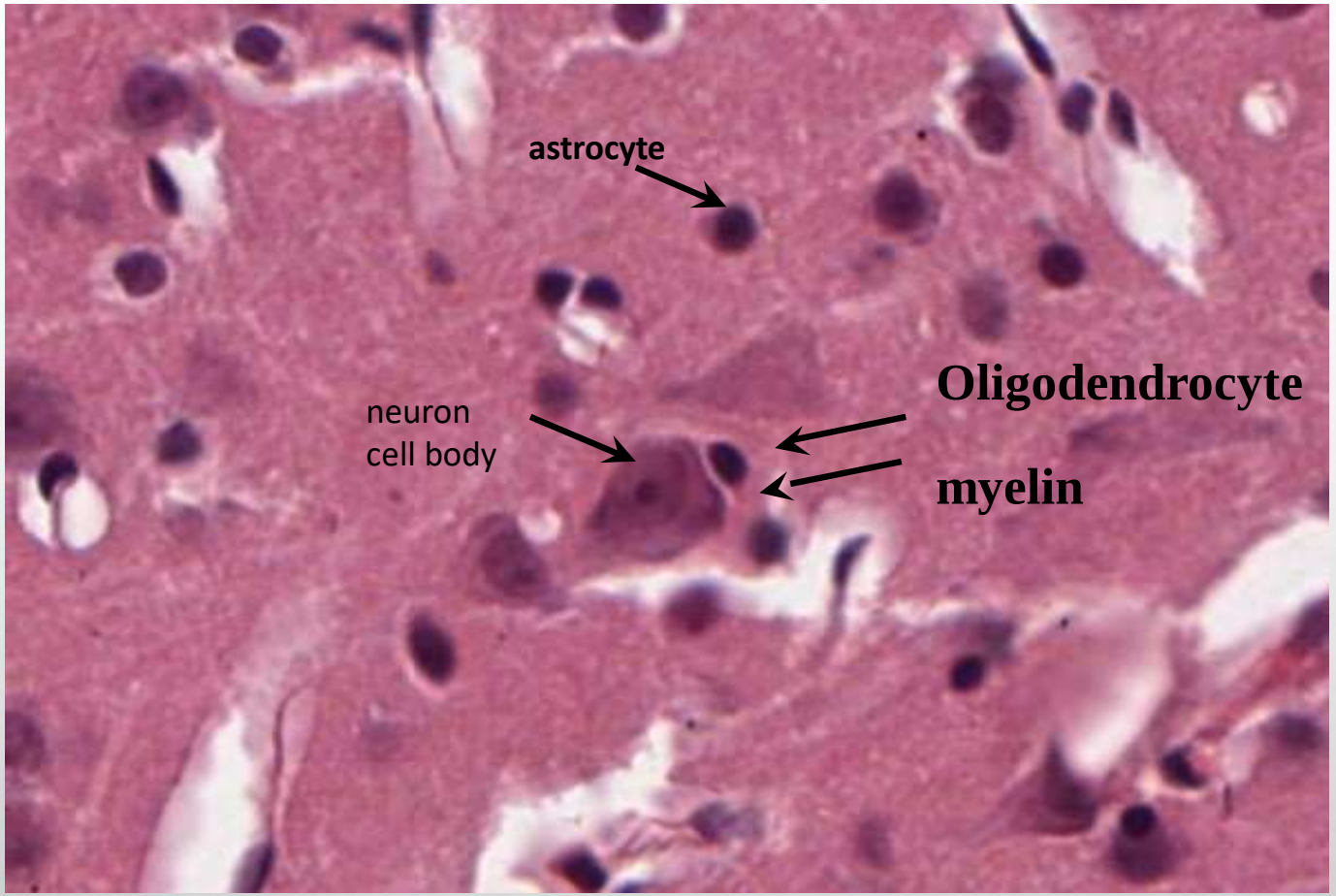


➢ The arachnoid and pia are normally highly interconnected by trabeculae

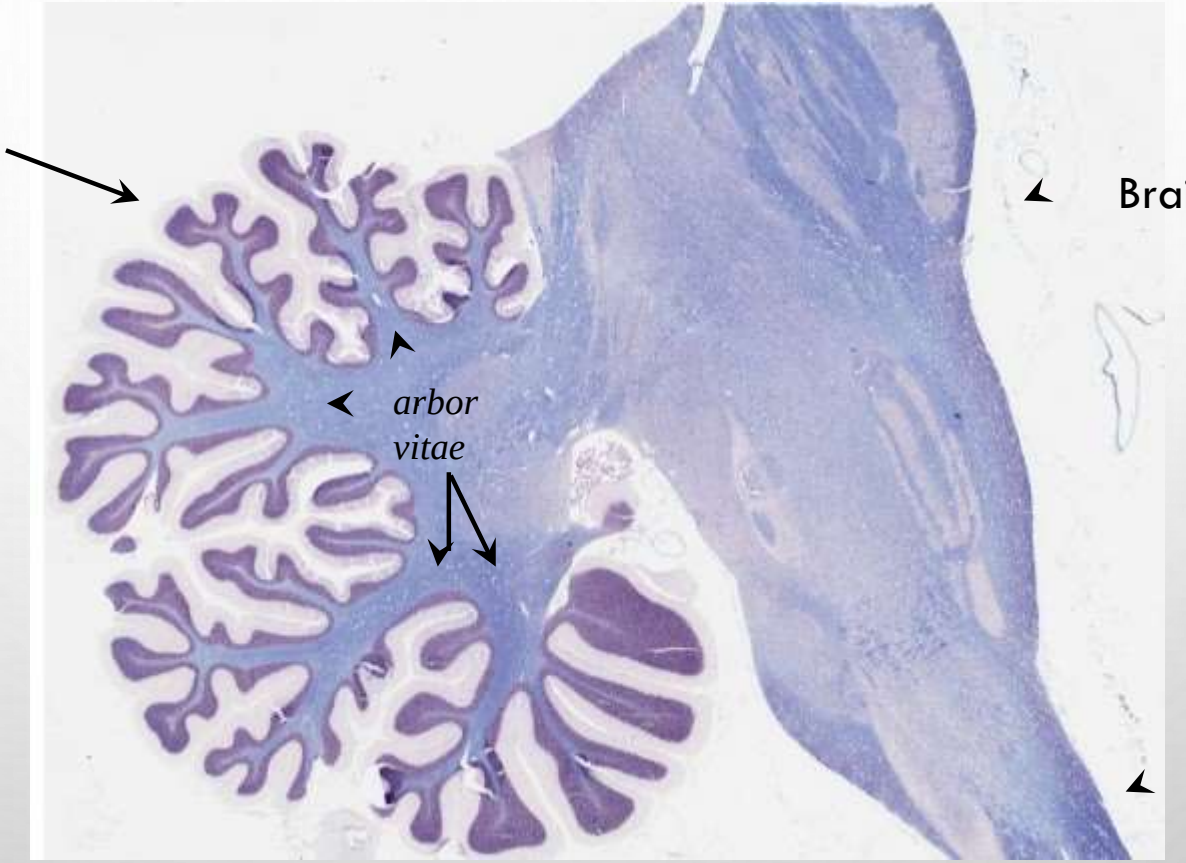
Cerebrum, H&E

➢The orientation is opposite in the cerebellum and cerebral cortex (outer portion of the cerebrum) where the grey matter is located on the outside and surrounds the inner white matter

Cerebrum, H&E

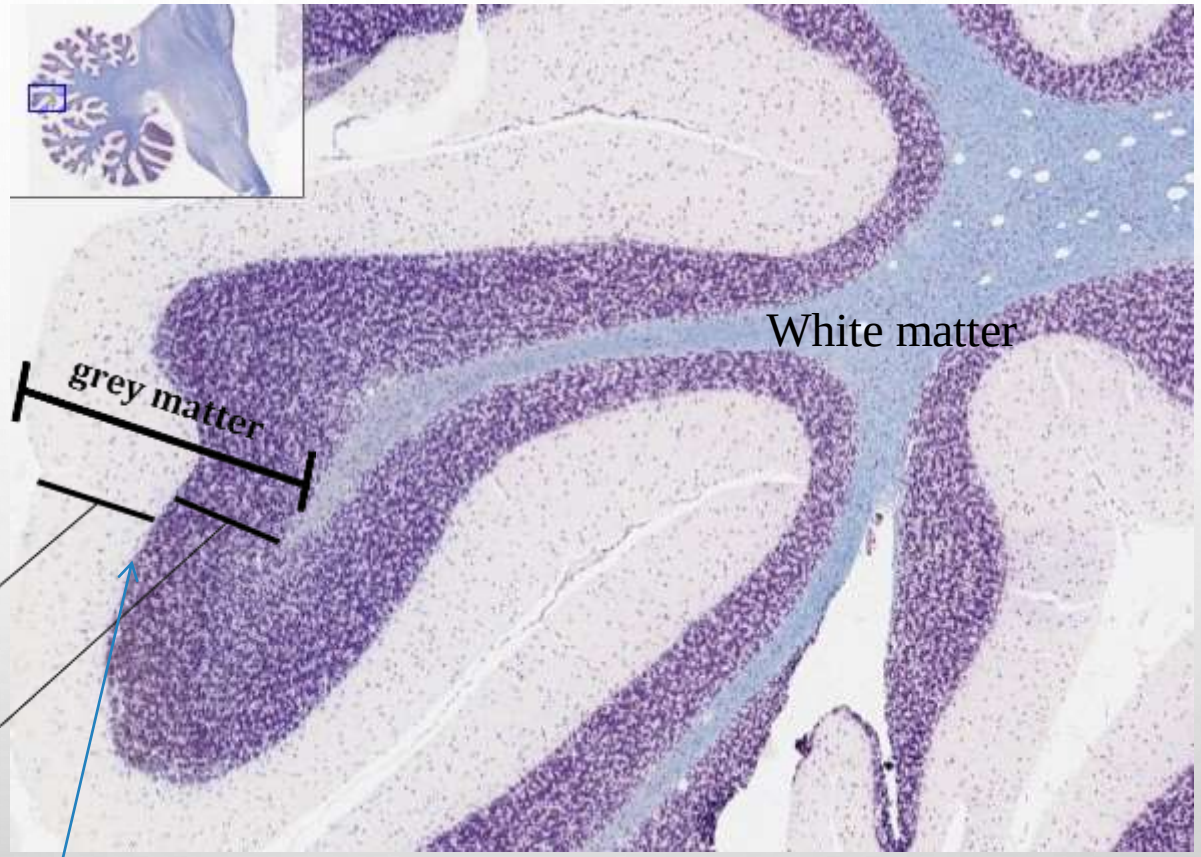

astrocyte
neuron
cell body
Oligodendrocyte
myelin

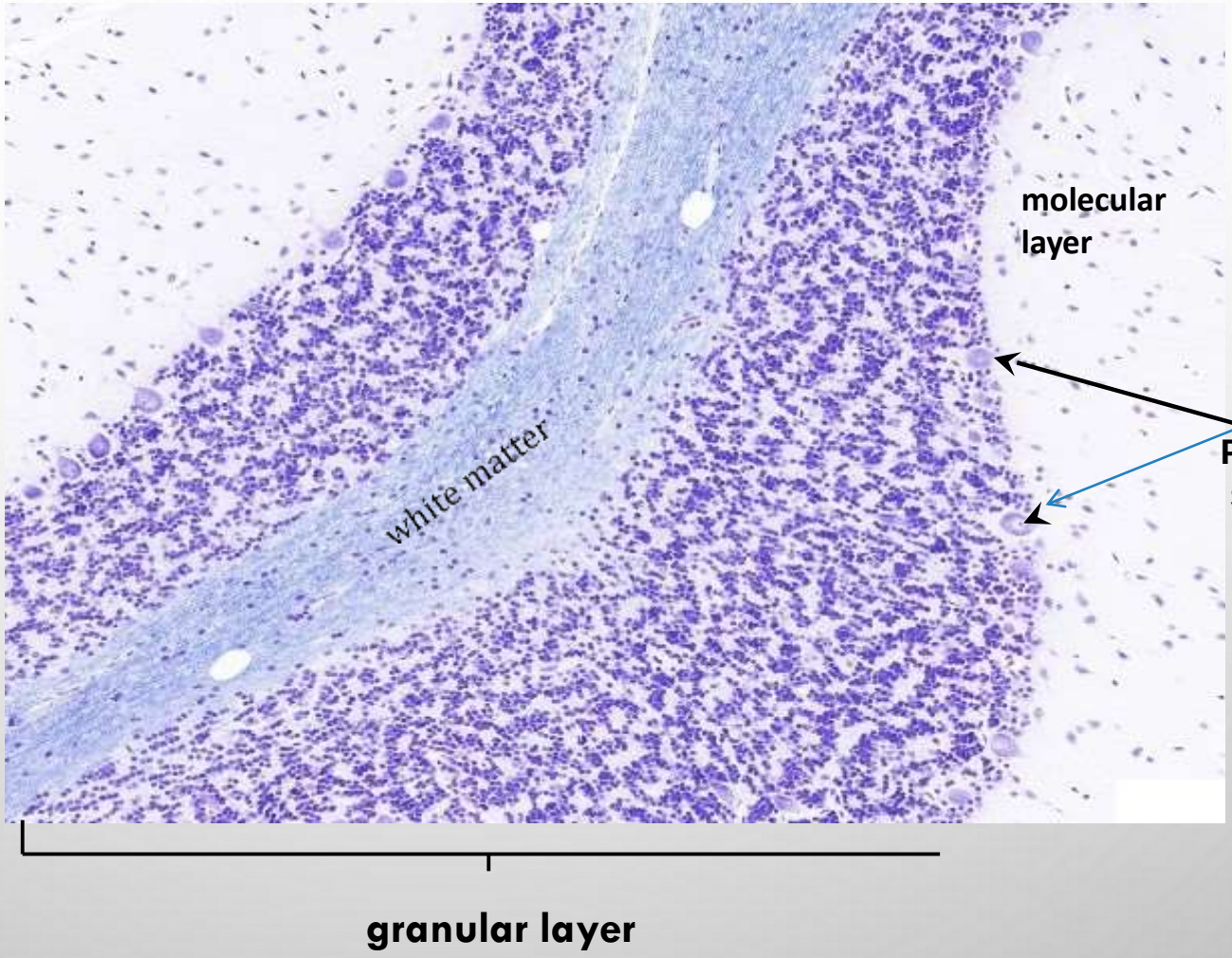
cerebellum

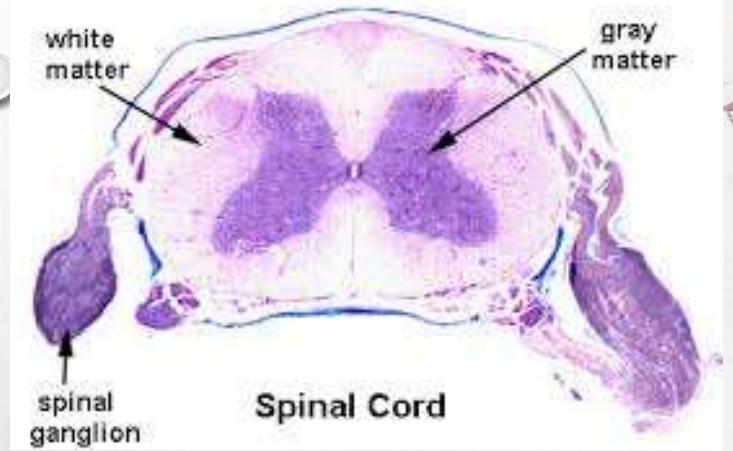


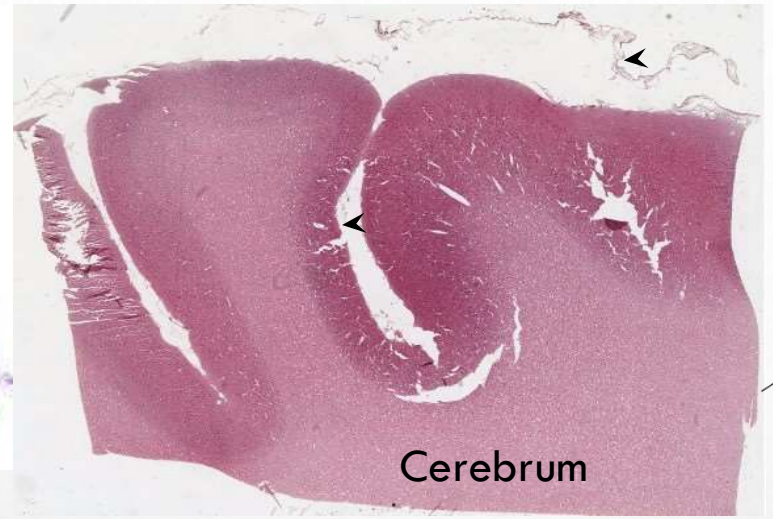
Brain Stem

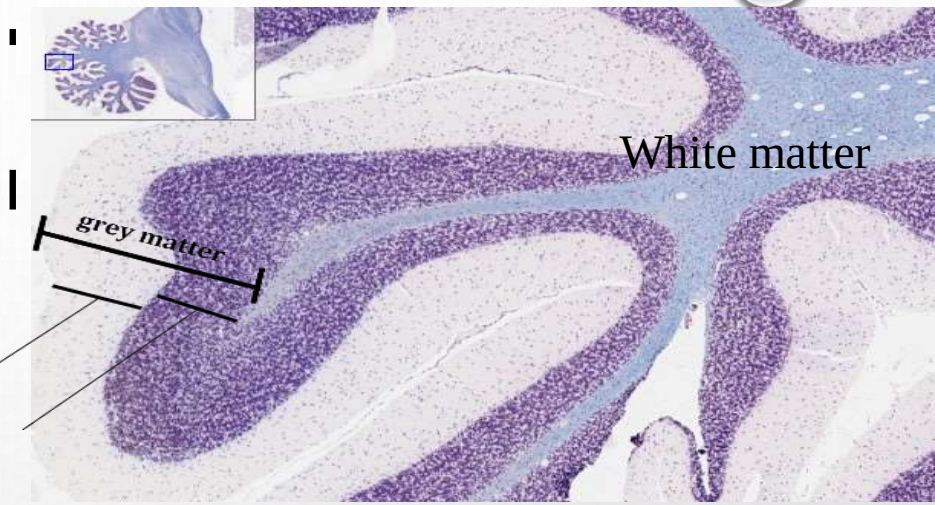
Spinal cord

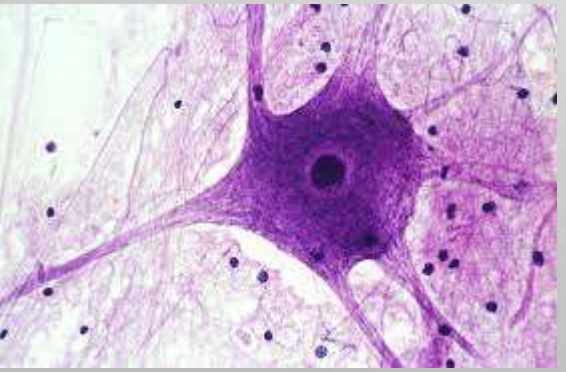

White matter
grey matter
molecular layer
granular layer
Purkinje cell layer


molecular layer
white matter
Purkinje cells
separate the two layers
granular layer


white matter
gray matter
spinal ganglion
Spinal Cord

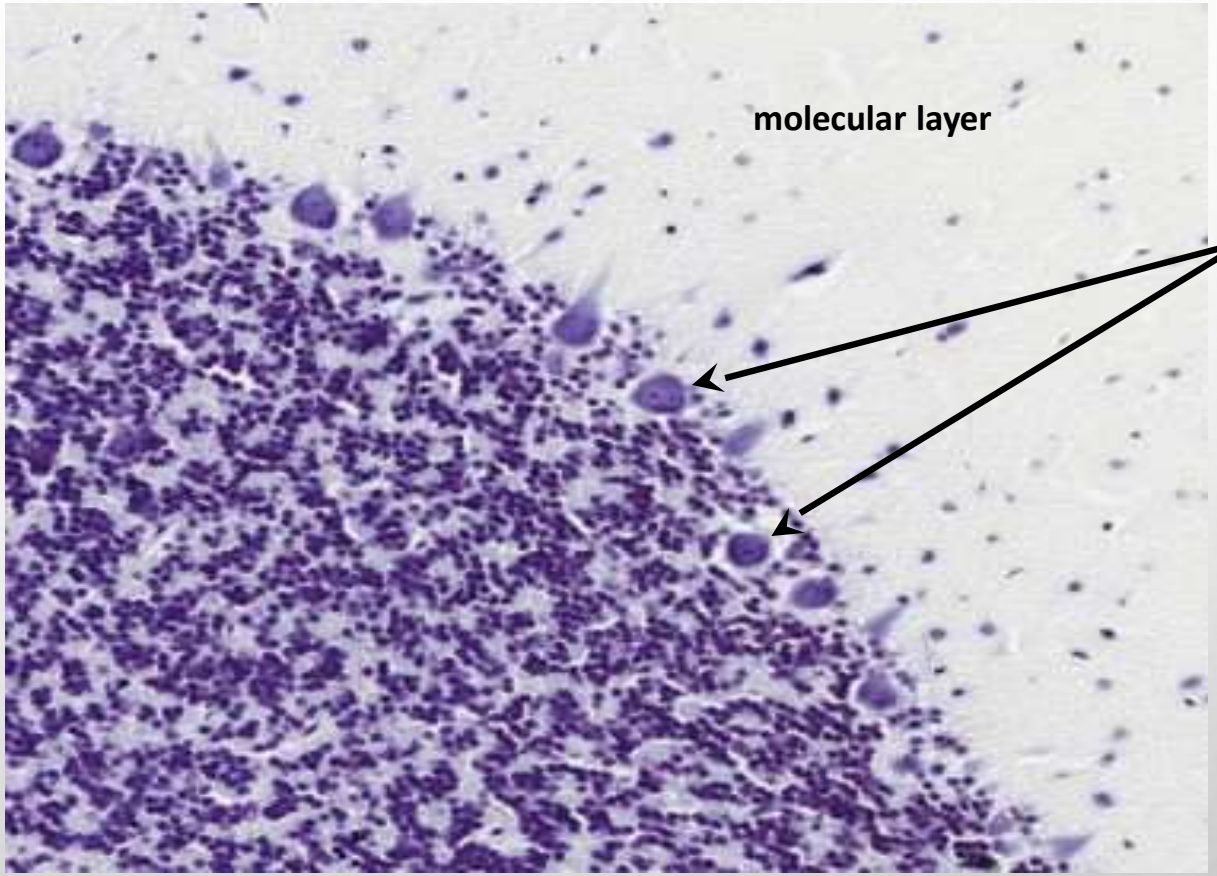

Cerebrum

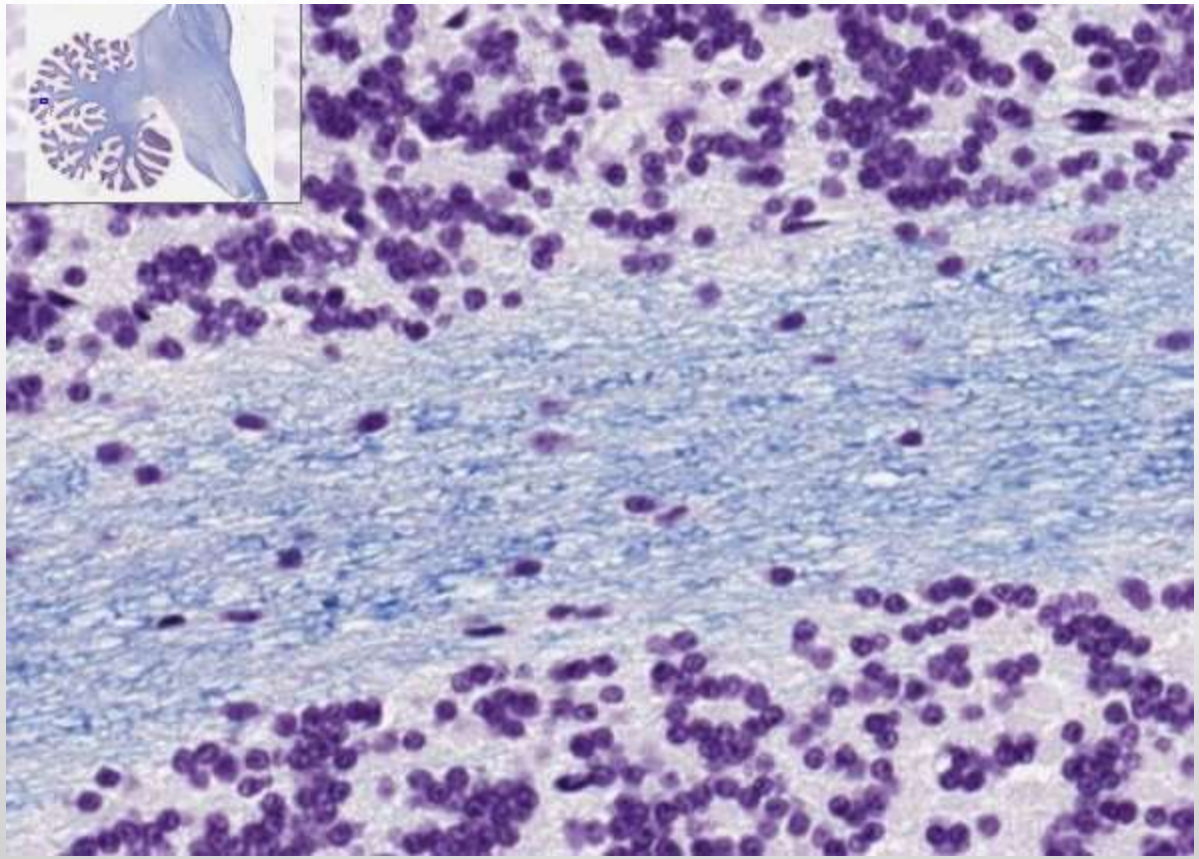

White matter
grey matter



Cerebellum (Cresyl Violet)

Purkinje cells (*not Purkinje fibers, which are found in the heart*) separate the molecular and the granular layers





granular layer of grey matter

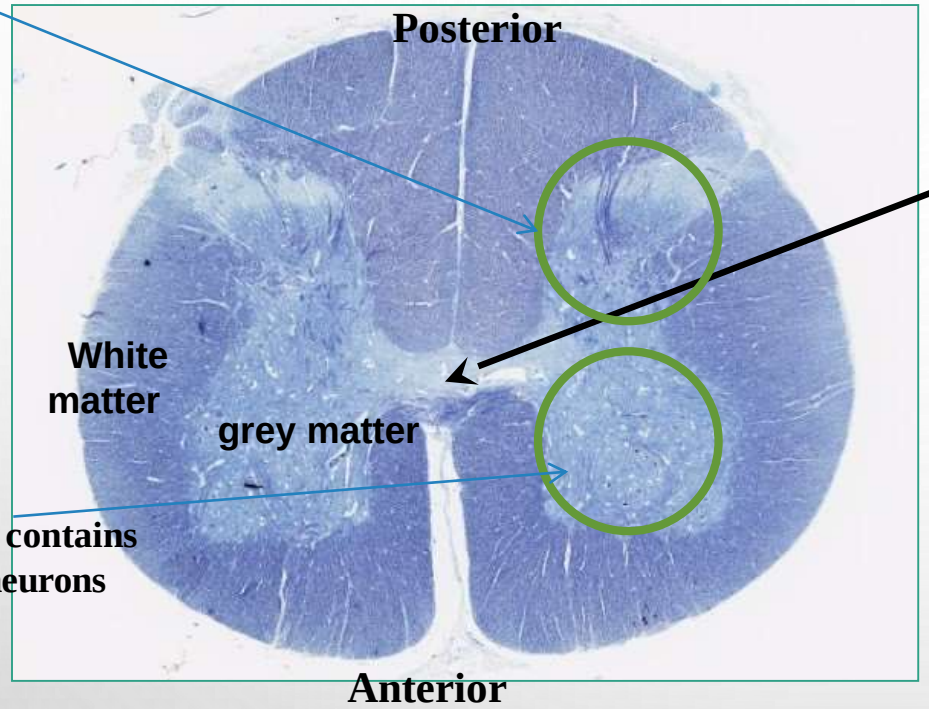
white matter

granular layer of grey matter

The **white matter** of the cerebellum consists primarily of a few glial cells (oligodendrocytes) and **myelinated axons** traveling to and from the grey matter

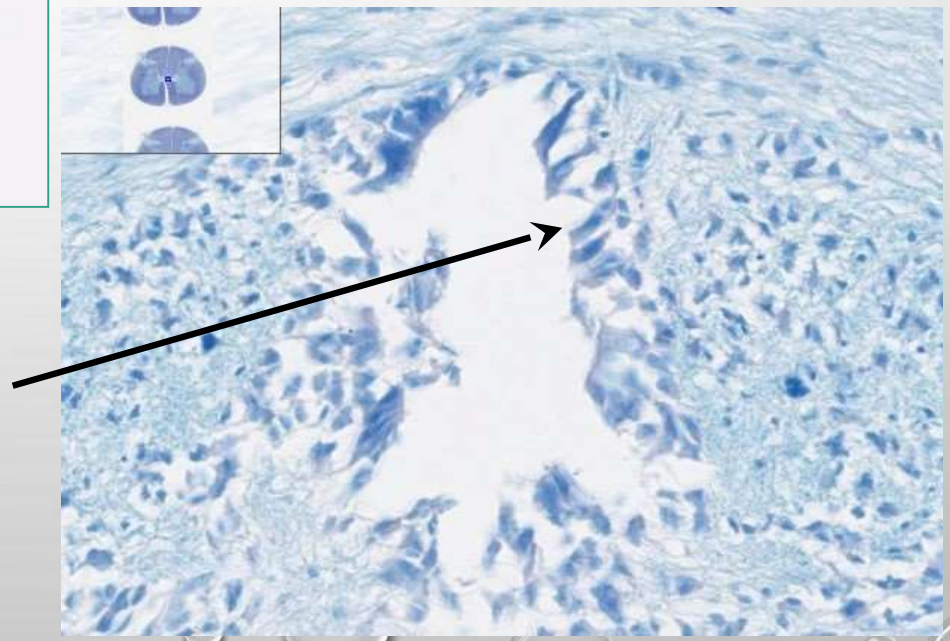
Spinal Cord, Myelin Stain

Dorsal (posterior) horn contains the cell bodies of *sensory* neurons



Ventral (anterior) horn contains the cell bodies of *motor* neurons

The **central canal** is the CSF-filled space ,that runs longitudinally through the length of the entire spinal cord; in the medulla of the brainstem, the fourth ventricle narrows to become the central canal; the canal is the vestige of the embryologic neural tube and is considered functionless



The **central canal**, like the *ventricles* in the brain, is lined by **ependymal cells**; they are epithelial-like cells which lack a basement membrane

- A ganglion (pl. Ganglia) is a collection of nerve cell bodies outside of the CNS

There are two major types based upon the function of their neurons

Sensory ganglia:- contain sensory neurons and are located along the dorsal roots of the spinal cord

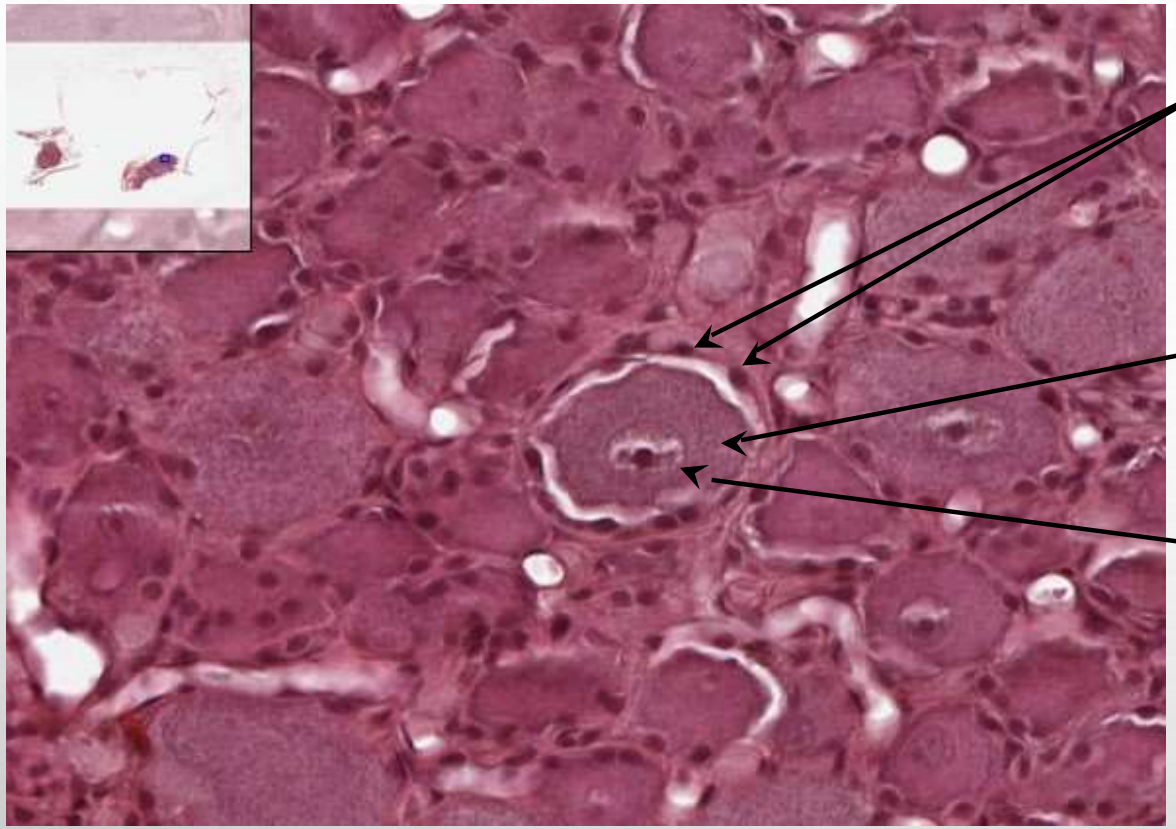
Autonomic ganglia contain motor neurons and are located either in the *sympathetic trunk*, adjacent to the vertebral bodies, or in, or near, the organs they innervate (*parasympathetic*)

Microglia are mobile phagocytic cells of neural tissue; they are the resident immune cells of the CNS, which otherwise is limited in mounting immune responses due to the restrictiveness of the blood-brain barrier; microglia are the smallest and least numerous of the neuroglial cells, but upon stimulation the cells can proliferate and change morphology

➢**Astrocytes** are the most abundant neuroglial cells of grey matter; they generally appear larger than oligodendrocytes and may be distinguished by not being directly associated with neurons and by having more darkly-stained cytoplasm

➢**Oligodendrocytes**, which each may be associated with 50 or more neurons, are responsible for producing myelin in the CNS by wrapping processes (lipid sheaths) around neurons and their axons

Dorsal Root Ganglia, H&E

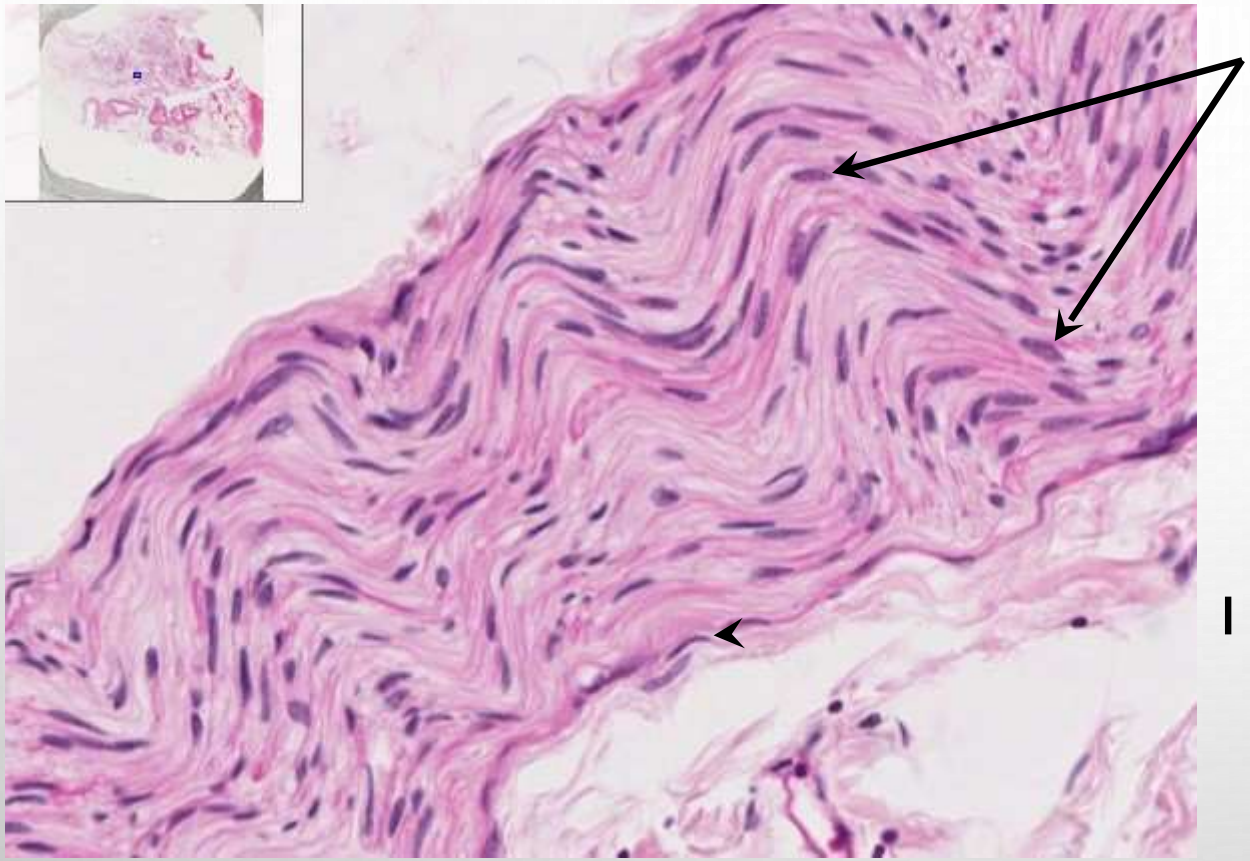


satellite cells
are neuroglial cells that surround and support neuron cell bodies in ganglia
note that both "s" neuroglial cells (satellite and Schwann) are found in the PNS

neuron cell body
sensory neurons are *pseudo- unipolar* so are able to pack tightly together

nucleus of neuron with prominent nucleolus; the nuclei of many of the neurons are not visible due to sectioning

CT and Autonomic Ganglia, H&E



Schwann cells are the principal support cells (neuroglial cells) of the PNS; they enclose all axons in the PNS, and around large axons they produce myelin sheaths; they generally have a larger, more ovoid nucleus than fibroblasts and surround the paler-staining nerve axons

Nodes of Ranvier (ron-vee-ay) are small gaps occurring along the length of an axon at the edges of two myelin sheaths from different **Schwann cells**; these small myelin-free areas along the axon permit ion exchange and fast impulse propagation