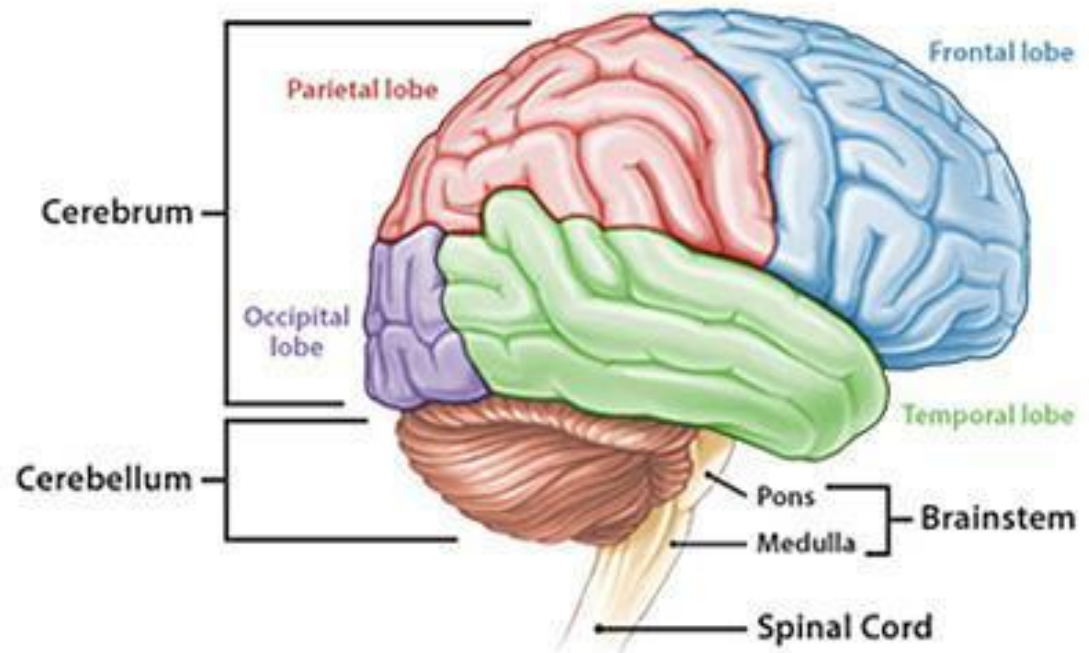
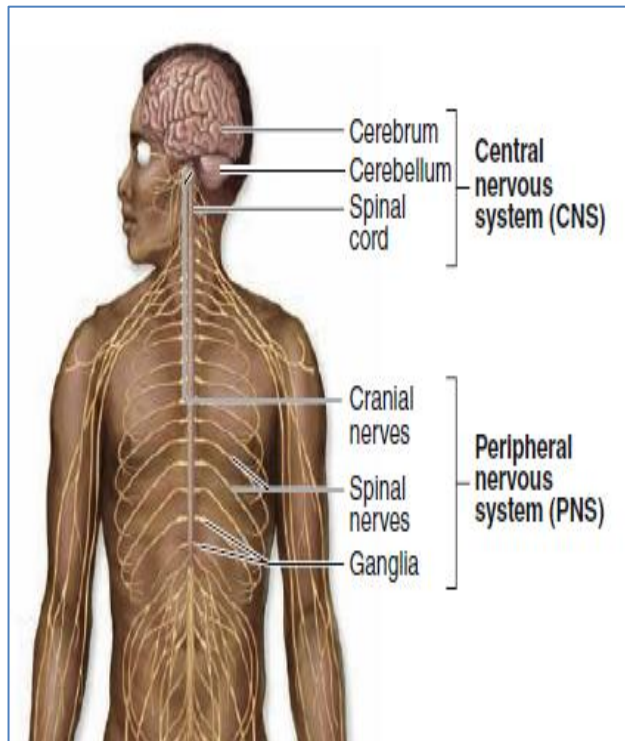


Nervous system

Dr. Rawaa Salim Hameed

Central nervous system (CNS)

- CNS consists of the brain (**cerebrum, cerebellum, and brainstem**) and spinal cord
- CNS is covered by connective tissue layers, the **meninges**
- Show organized areas of **white matter** and **gray matter**



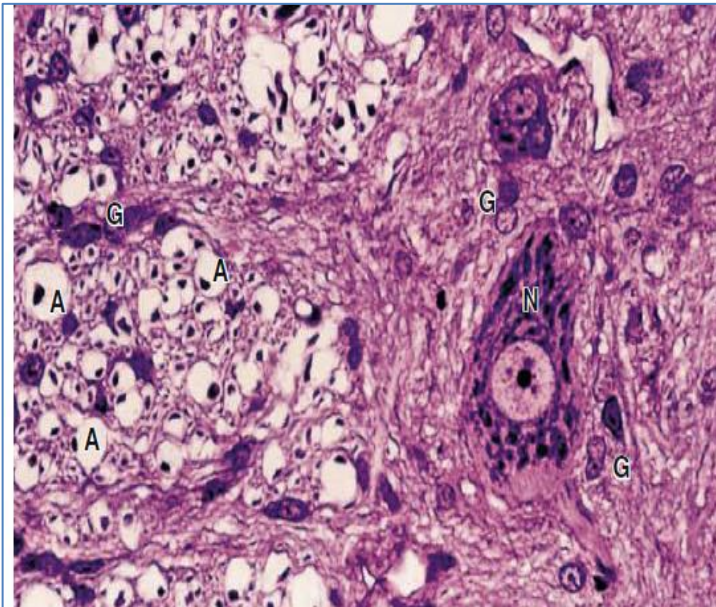
CNS (Brain)

❖ White matter are **myelinated axons**

1. Contains **oligodendrocytes, astrocytes** and **microglia** cells
2. Contains **cerebral nuclei** (neuronal cell bodies).
3. Found in deeper regions

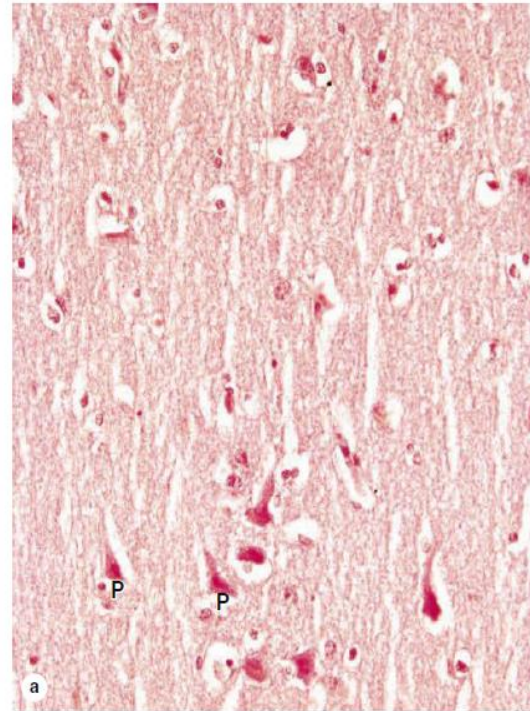
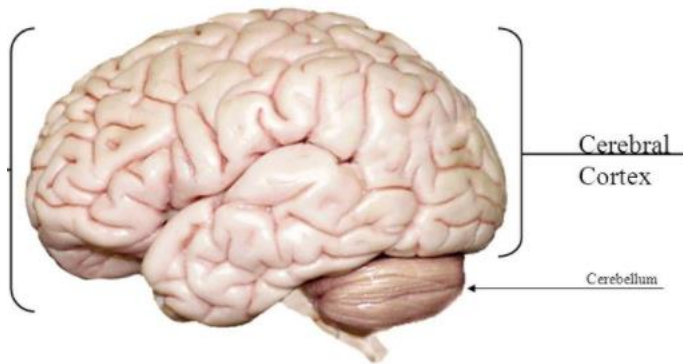
❖ Grey matter are **neuronal cell bodies**

1. Contains **Dendrites, astrocytes, and microglial cells**
2. makes up the thick **cortex** of both the **cerebrum** and the **cerebellum**

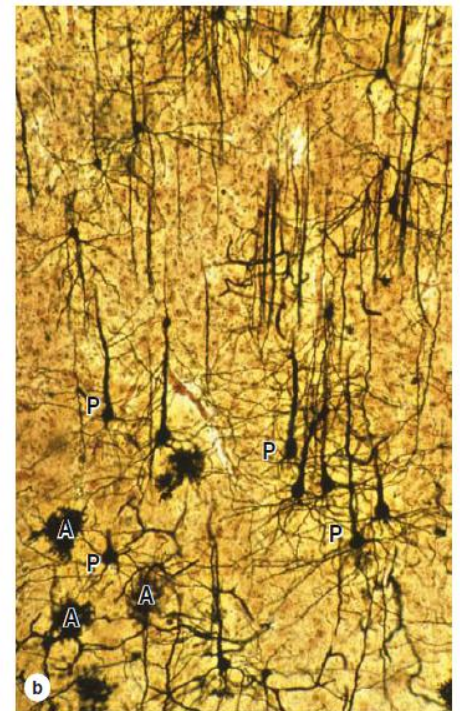


A cross section of H&E-stained spinal cord shows the transition between white matter (left region) and gray matter (right). The gray matter has many glial cells (G), neuronal cell bodies (N), and neuropil; white matter also contains glia (G) but consists mainly of axons (A) whose myelin sheaths were lost during preparation, leaving the round empty spaces shown. Each such space surrounds a dark-stained spot that is a small section of the axon. (X400)

- Cerebral cortex consists of **six layers of neurons** with different sizes and shapes
- The most important of these cells are the **efferent pyramidal neurons**
- Neurons of the cerebral cortex **function** in the integration of sensory information and the initiation of voluntary motor responses



(a) Important neurons of the cerebrum are the pyramidal neurons (P), which are arranged vertically and interspersed with numerous smaller glial cells, mostly astrocytes, in the eosinophilic neuropil. (X200; H&E)

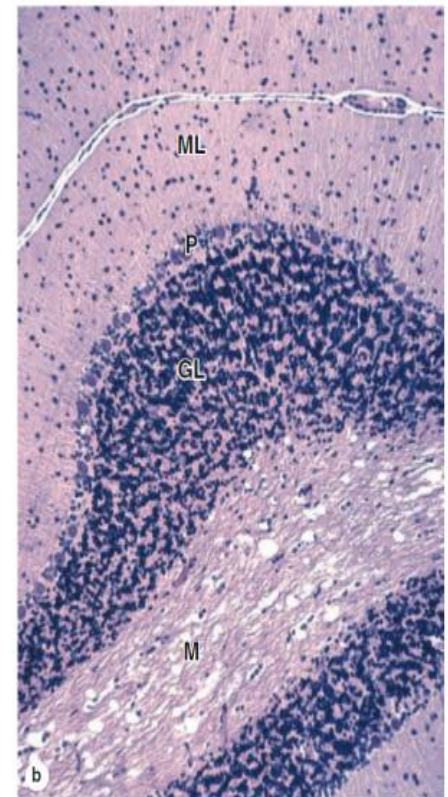
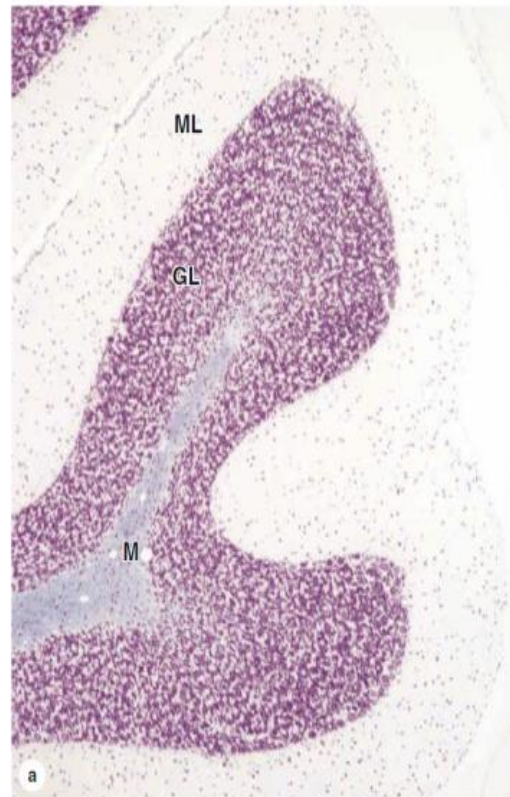


(b) From the apical ends of pyramidal neurons (P), long dendrites extend in the direction of the cortical surface, which can be best seen in thick silver-stained sections in which only a few other protoplasmic astrocytes (A) cells are seen. (X200; Silver)

- **Cerebellar cortex** consists of three layers:-
- **Molecular layer:** A thick outer has much neuropil and scattered neuronal cell bodies.
- **Purkinje cells:** A thin middle layer consists only of very large neurons. Their dendrites extend throughout the molecular layer as a branching basket of nerve fibres.
- **Granular layer:** A thick inner contains various very small, densely packed neurons.

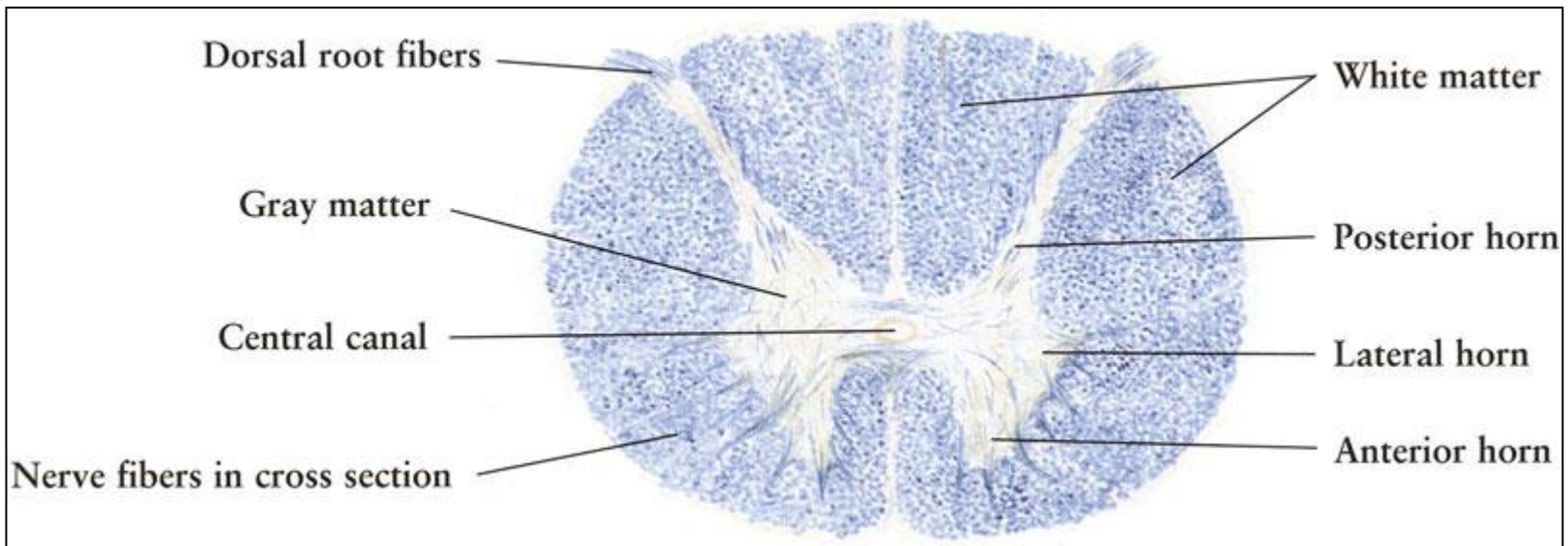


Cerebellar cortex



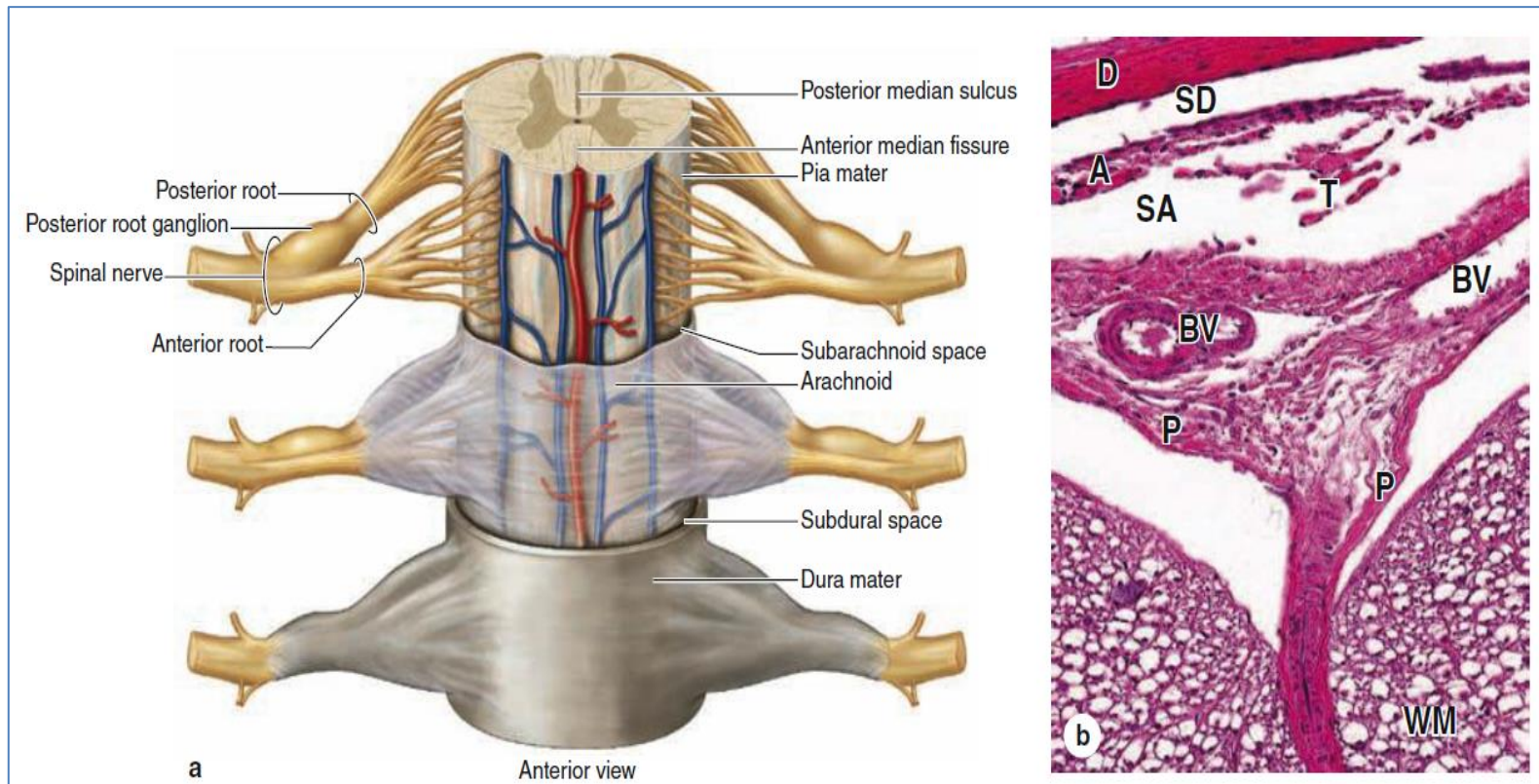
Spinal Cord

- **White matter** is peripheral
- **Gray matter** forms a deeper
- **Anterior horns** contain cell bodies of motor neurons
- **Posterior horns** contain interneurons
- Gray matter surrounds a small **central canal** (in the middle of the cord)
- **Central canal** is lined by ependymal cells and contains CSF



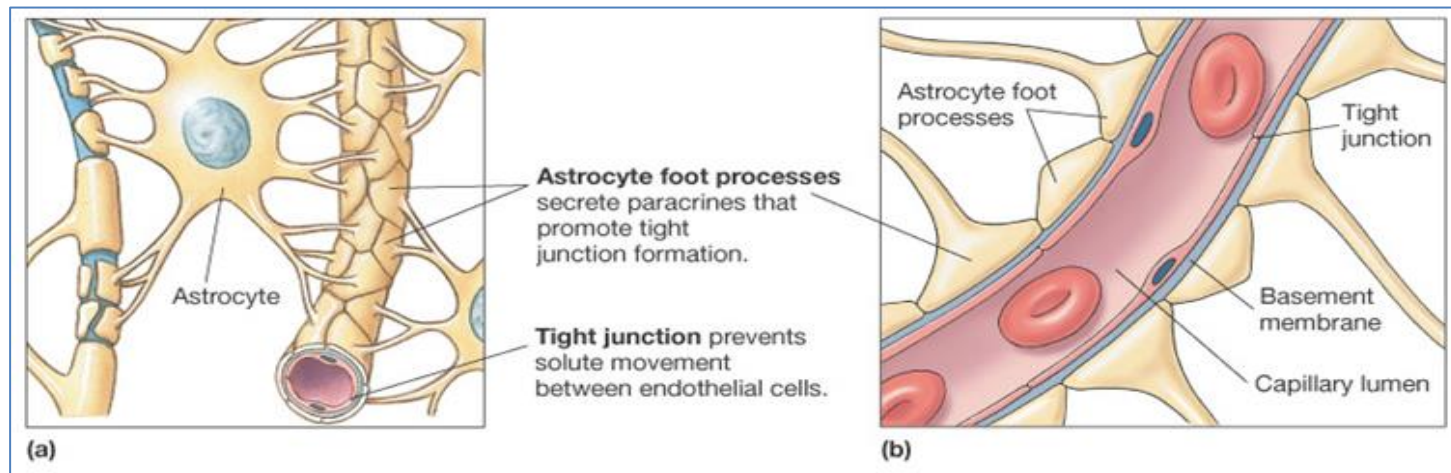
Meninges

- The skull and the vertebral column protect the CNS
- Between the bone and nervous tissue are membranes of connective tissue called the **meninges**.
- Three meningeal layers are distinguished
- **Dura, arachnoid, and pia maters**



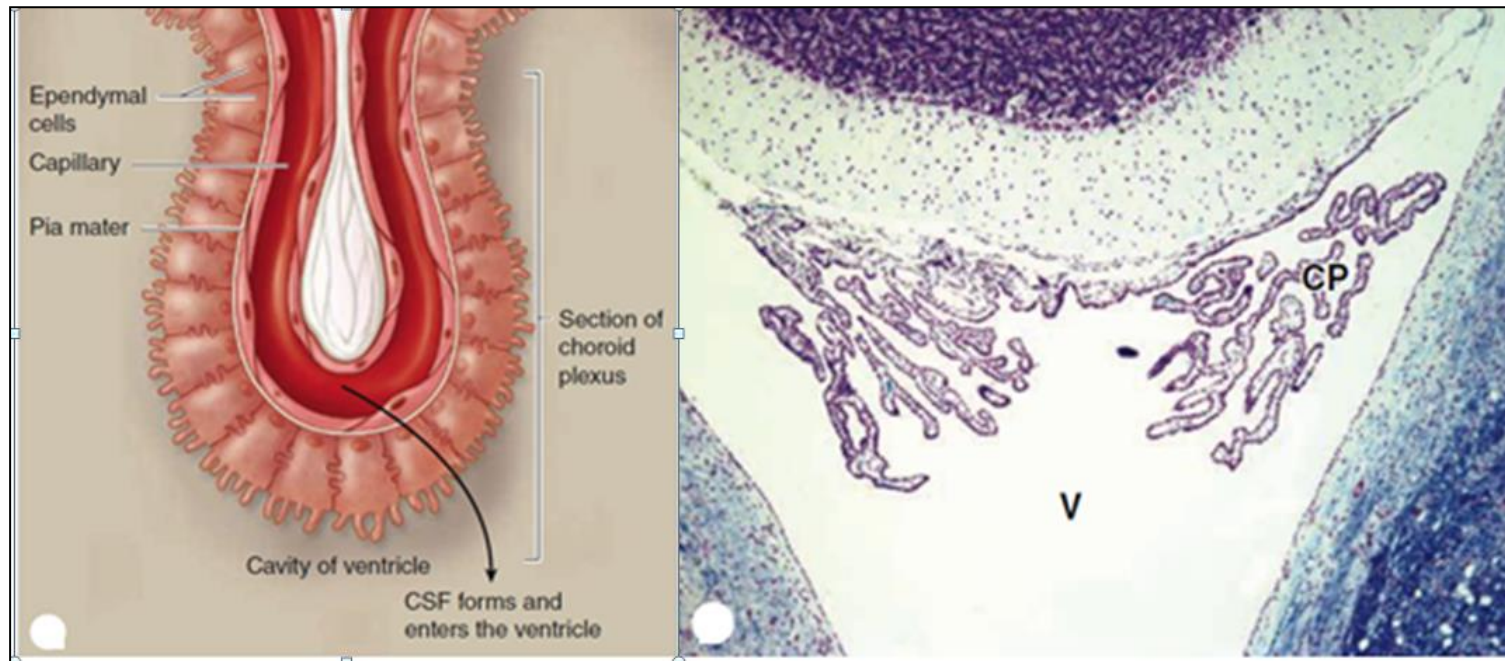
Blood brain barrier (BBB)

- It is mainly composed of **capillary endothelial cells** are tightly sealed together with well-developed **occluding junctions**, and surrounded by the basement membrane.
- **Astrocytes** develops processes with expanded end-feet that are linked to the endothelial cells by junctional complexes
- BBB prevents the passage of some substances such as antibiotic and chemical and bacterial toxic matter from the blood to nerve tissue



Choroid plexus

- It is a **vascular** structure
- Found in the roofs of the third and fourth ventricles and in parts of the lateral ventricular walls, all regions in which the ependymal lining directly contacts the pia mater
- Its main function is to remove water from blood and release it as the CSF



Peripheral Nervous System (PNS)

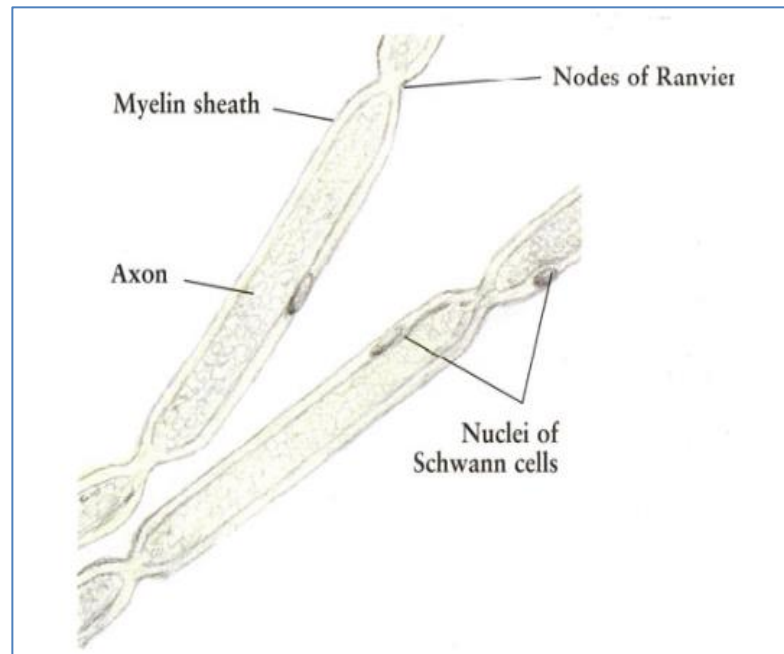
- PNS consists of the **nerves**, **ganglia**, and **nerve endings**.
- **Nerves** are bundles of nerve fibres (**axons**) surrounded by Schwann cells and layers of connective tissue.
- **Ganglia** are ovoid structures containing **neuronal cell bodies**, each ganglion cell body is surrounded by a layer of flat **satellite cells** and connective tissue (**capsule**)

Nerve Fibres

- Nerve fibres are containing **axons** enclosed within sheaths of **glial cells** specialized to facilitate axonal function
- In peripheral nerve fibres, axons are sheathed by **Schwann cells**
- The sheath may or may not form **myelin** around the axons, depending on their diameter.

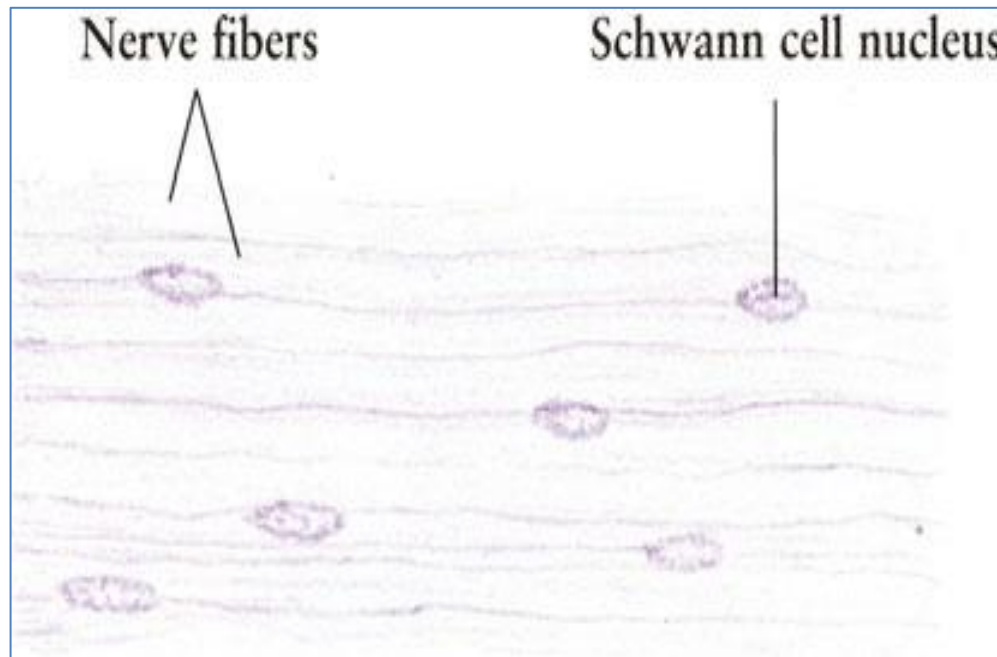
Myelinated fibres

- **Schwann cell** winds and wraps around the axon to form **myelin**
- **Myelin** consists of a higher proportion of **lipids**
- The myelin sheath shows gaps along its path called the **nodes of Ranvier**
- The distance between two nodes is called an **internode** and consists of one Schwann cell



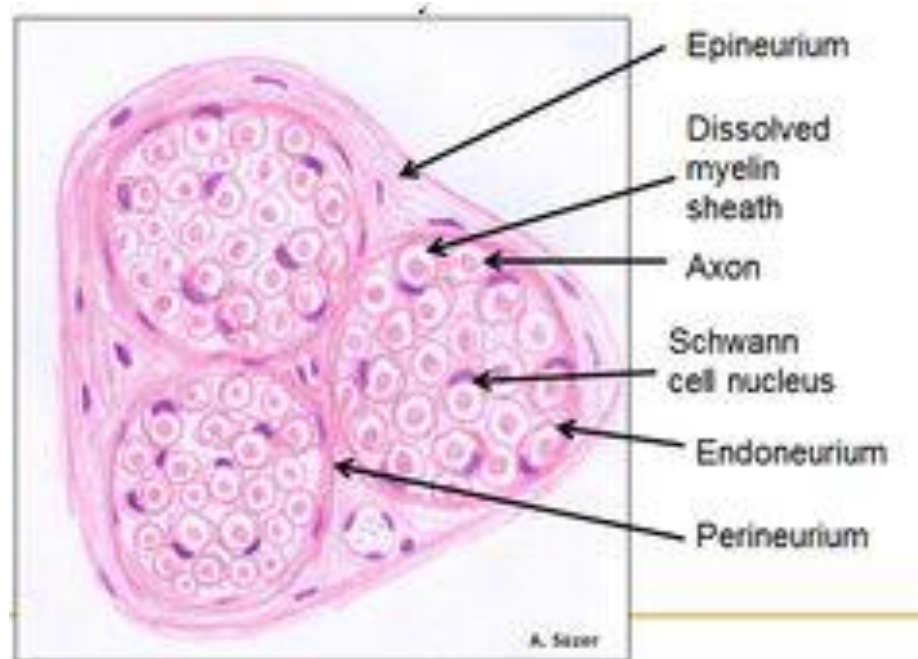
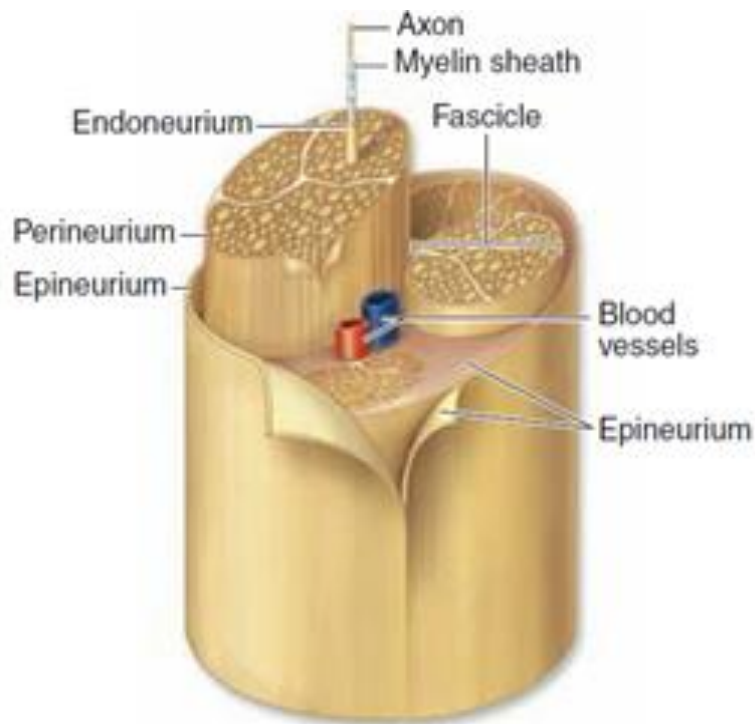
Unmyelinated fibres

- The glial cell **does not** form the multiple wrapping of a myelin sheath
- Unmyelinated fibres in the CNS are completely **naked** axons
- In the PNS they are surrounded by **Schwann cell cytoplasm**.
- Nodes of Ranvier are **not seen** along unmyelinated nerve fibres



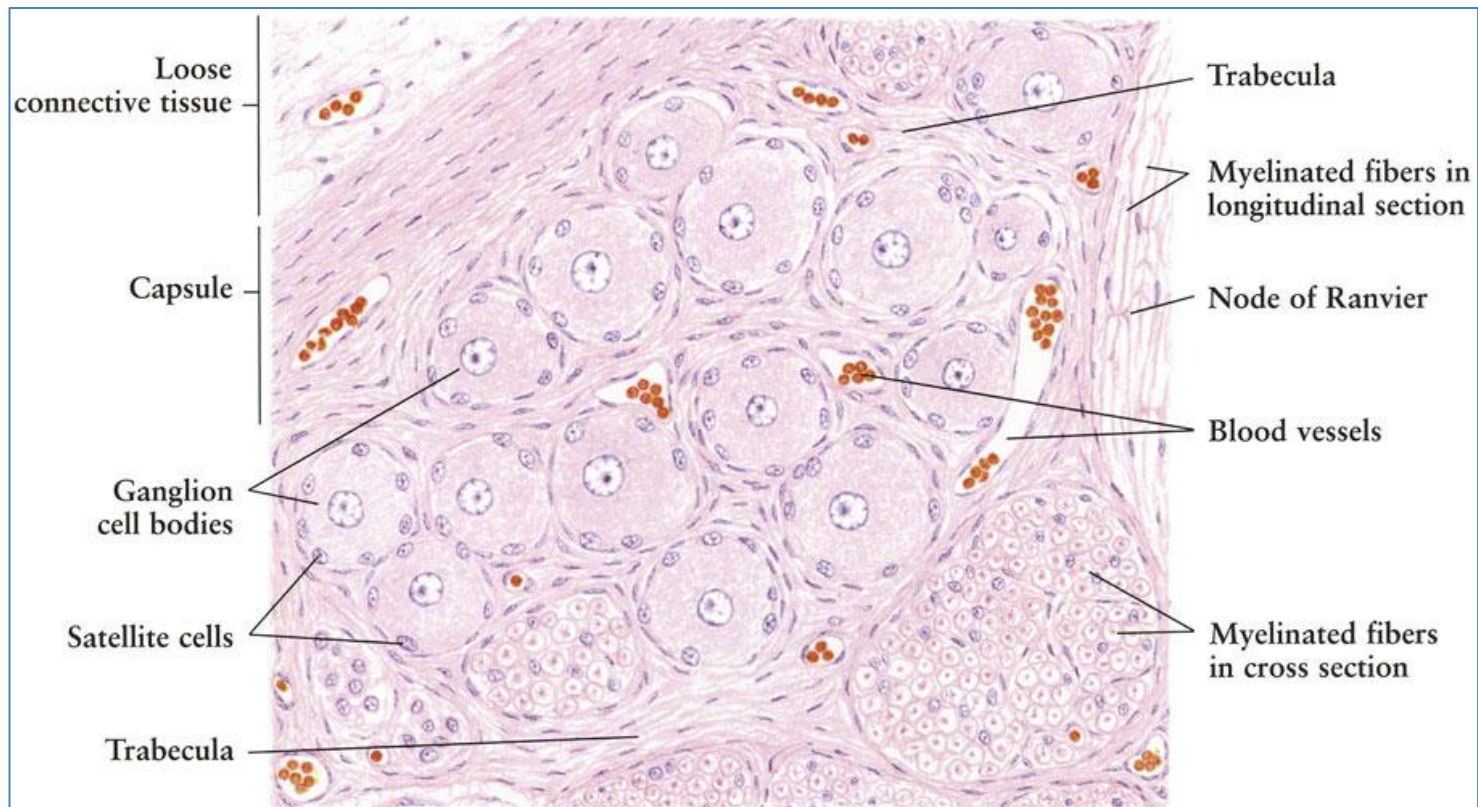
Nerve Organization

- Nerves are enclosed within layers of connective tissue:-
- **Epineurium, Perineurium and Endoneurium**



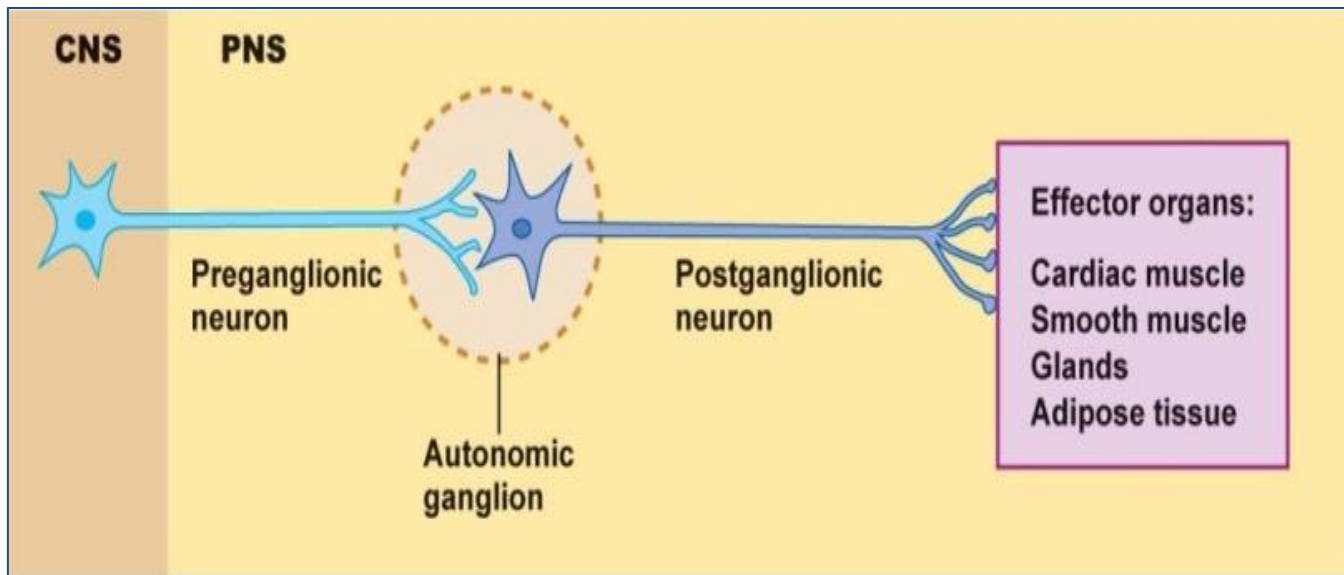
Ganglia

- Ovoid structures containing **neuronal cell bodies**
- Each ganglion cell body is surrounded by a layer of flat **satellite cells**
- The ganglion is enclosed by loose and a dense connective tissue **capsule**, which divides into **trabeculae**



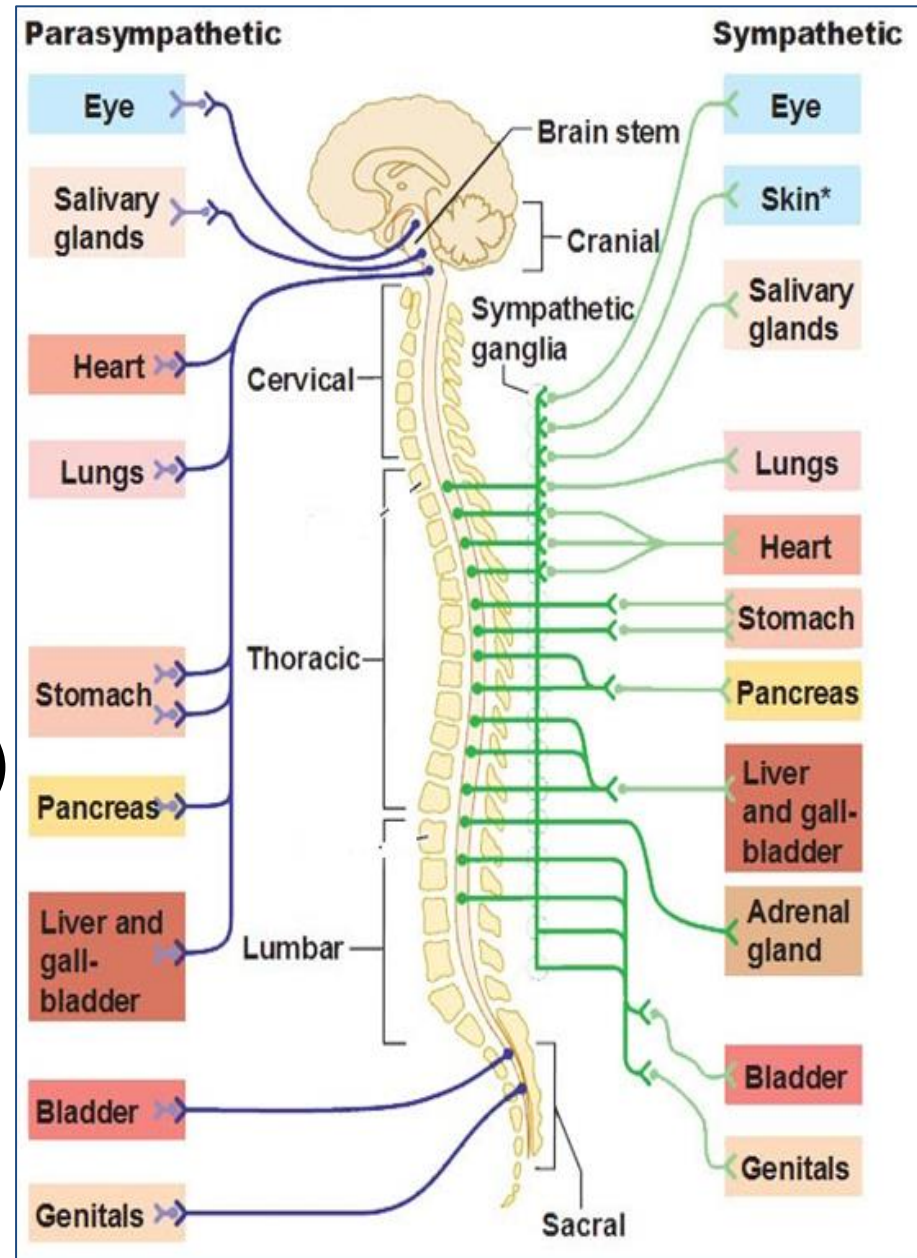
Autonomic nervous system (ANS)

- Consists of two-neuron network linked by a **ganglion (Autonomic ganglion)**
- **Preganglionic** starts with the CNS and runs out to the ganglion
- **Postpreganglionic** has its cell body within the ganglion and its axon runs to the organ.



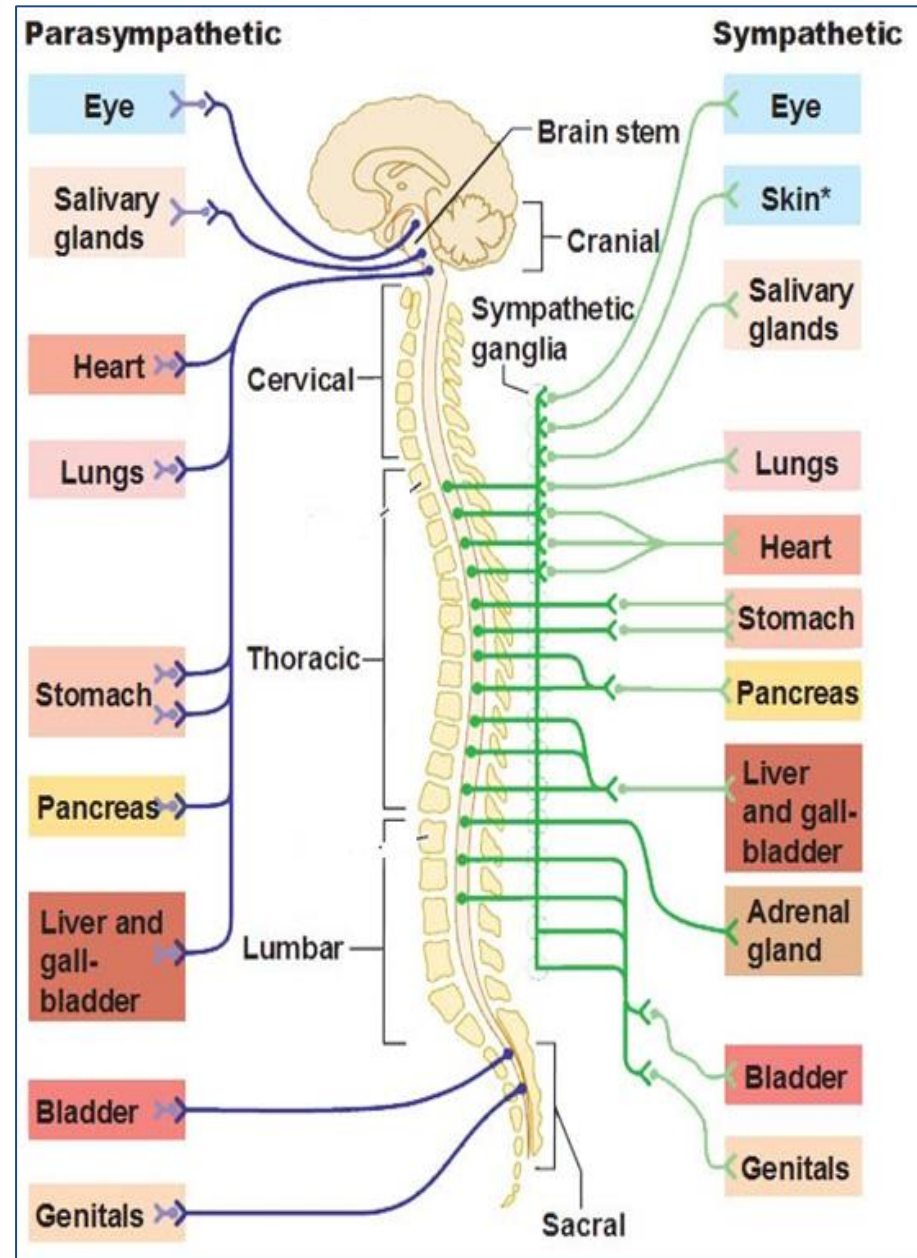
Sympathetic system

- Originate from the **middle region** of the spinal cord
- **Preganglionic** nerve axon is very **short**
- **Postganglionic** nerve axon is much **longer**
- At the nerve endings of the **postganglionic** fibres a neurotransmitter called **noradrenalin (norepinephrine)**
- The preganglionic fibres employ **acetylcholine** as a neurotransmitter
- Its function is to prepare the body for emergencies



Parasympathetic system

- Originate from the **base** of the **brain** and from the **bottom** region of the **spinal cord**
- **Preganglionic** nerve axon is very **long**
- **Postganglionic** nerve axon is much **short**
- At the nerve endings of the **postganglionic** fibres a neurotransmitter called **acetylcholine**
- The preganglionic fibres employ **acetylcholine** as a neurotransmitter
- Its function is to maintain the body in a resting “normal” state



Thank you for your attention
Any questions?