

NERVOUS SYSTEM



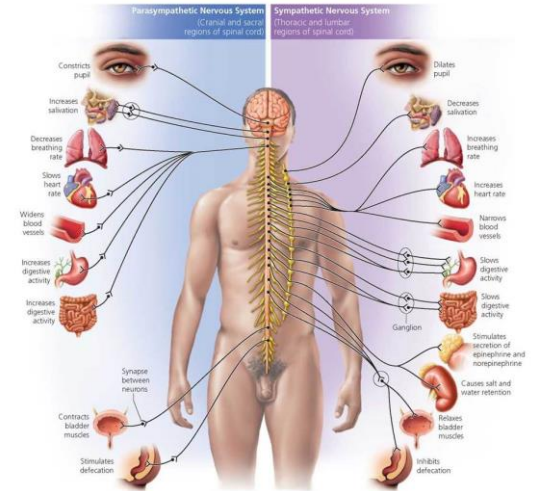
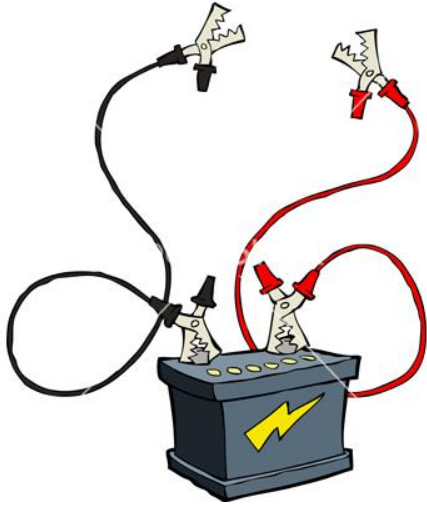
Khaleel Alyahya, PhD, MSs, MEd
King Saud University
College of Medicine
@khaleelya

OBJECTIVES

At the end of the lecture, students should be able to:

- ✓ List the subdivisions of the nervous system.
- ✓ Define the terms: grey matter, white matter, nucleus, ganglion, tract and nerve.
- ✓ Define neurons and neuroglia.
- ✓ List the major parts of the brain.
- ✓ Identify the external and internal features of spinal cord.
- ✓ Enumerate the cranial nerves.
- ✓ Describe the parts and distribution of the spinal nerve.
- ✓ Define the term dermatome.
- ✓ List the structures protecting the central nervous system.

THINKING MINUTE



FUNCTIONS

The nervous system has 3 functions:

➤ **Collection of Sensory Input**

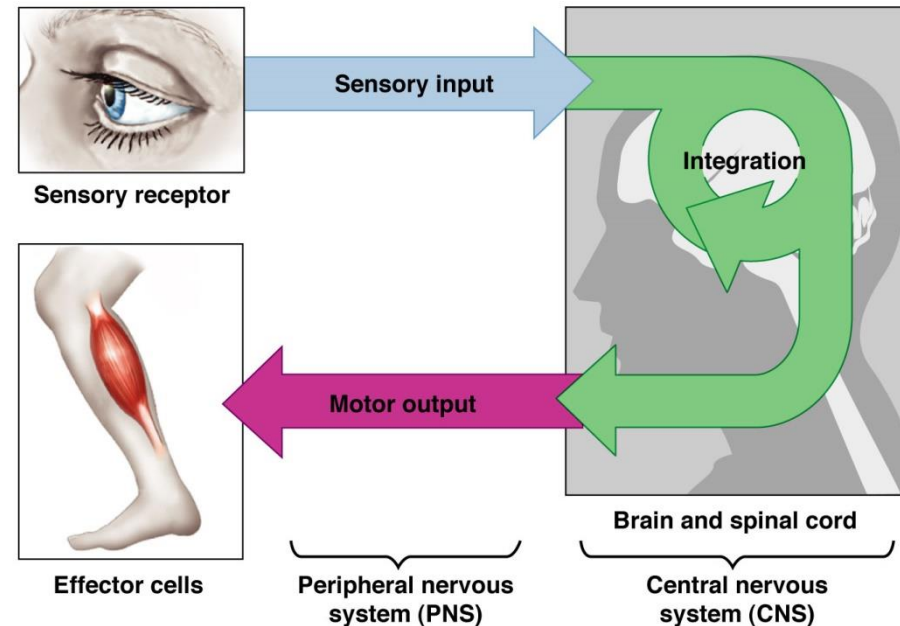
- Identifies changes occurring inside and outside the body by using sensory receptors. These changes are called stimuli

➤ **Integration**

- Processes, analyses & interprets these changes and makes decisions

➤ **Motor Output**

- It then effects a response by activating muscles or glands (effectors) via motor output

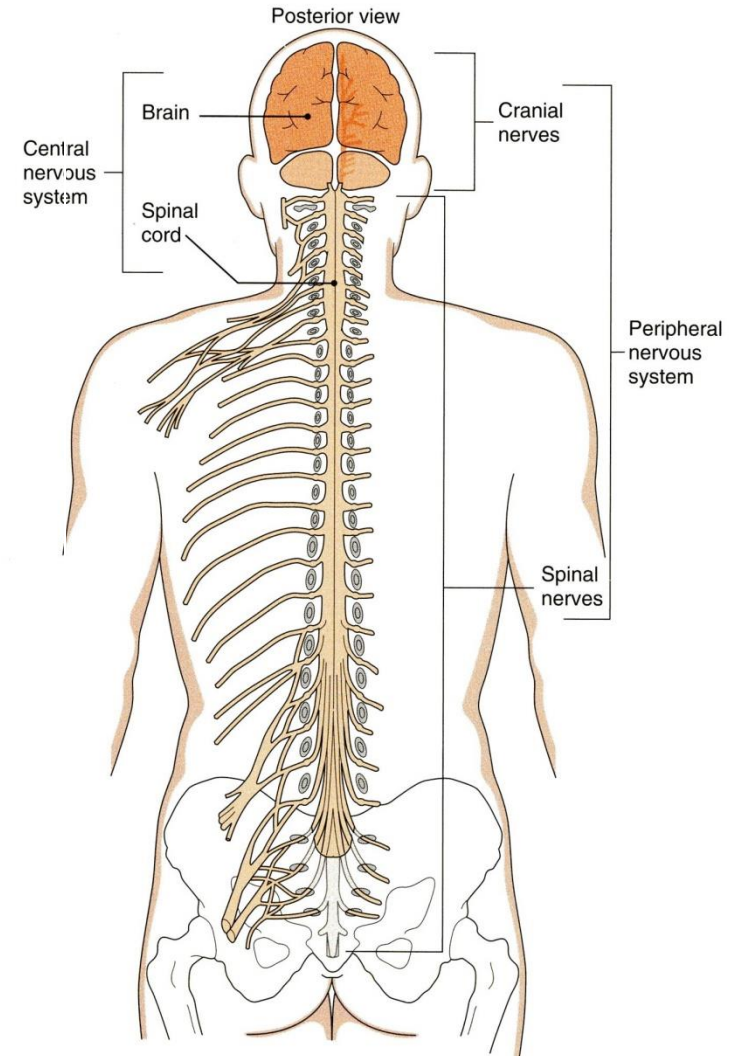


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ORGANIZATION

STRUCTURAL

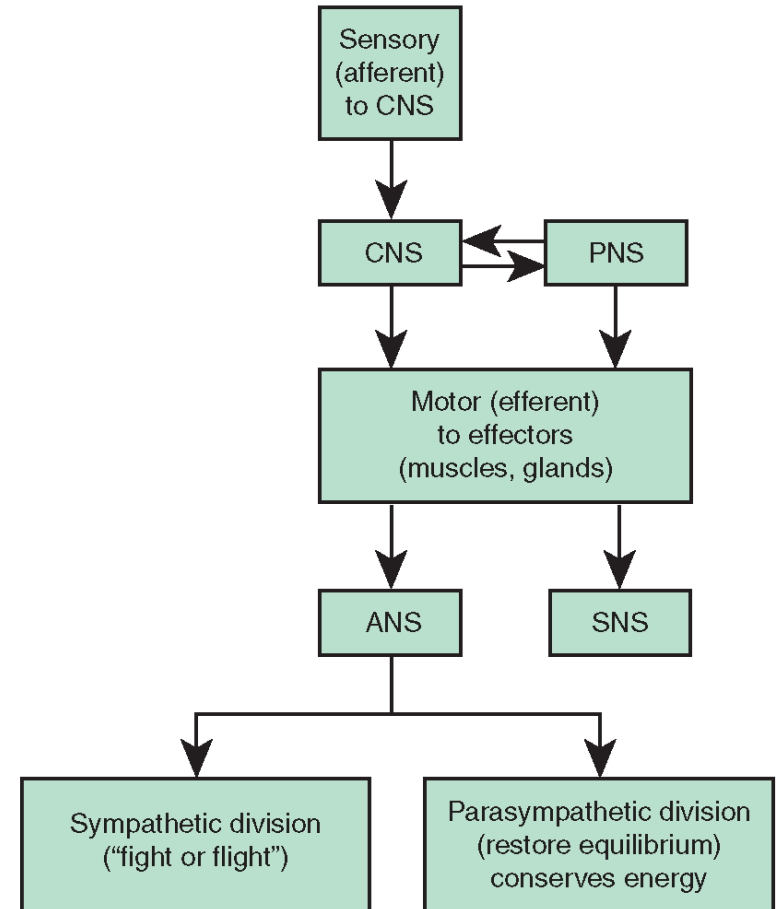
- Central Nervous System (CNS)
 - Brain & Spinal Cord
- Peripheral Nervous System (PNS)
 - Nerves & Ganglia
 - Cranial nerves
 - Spinal nerves



ORGANIZATION

FUNCTIONAL

- Sensory Division (Afferent)
- Motor Division (Efferent)
 - Autonomic
 - Somatic



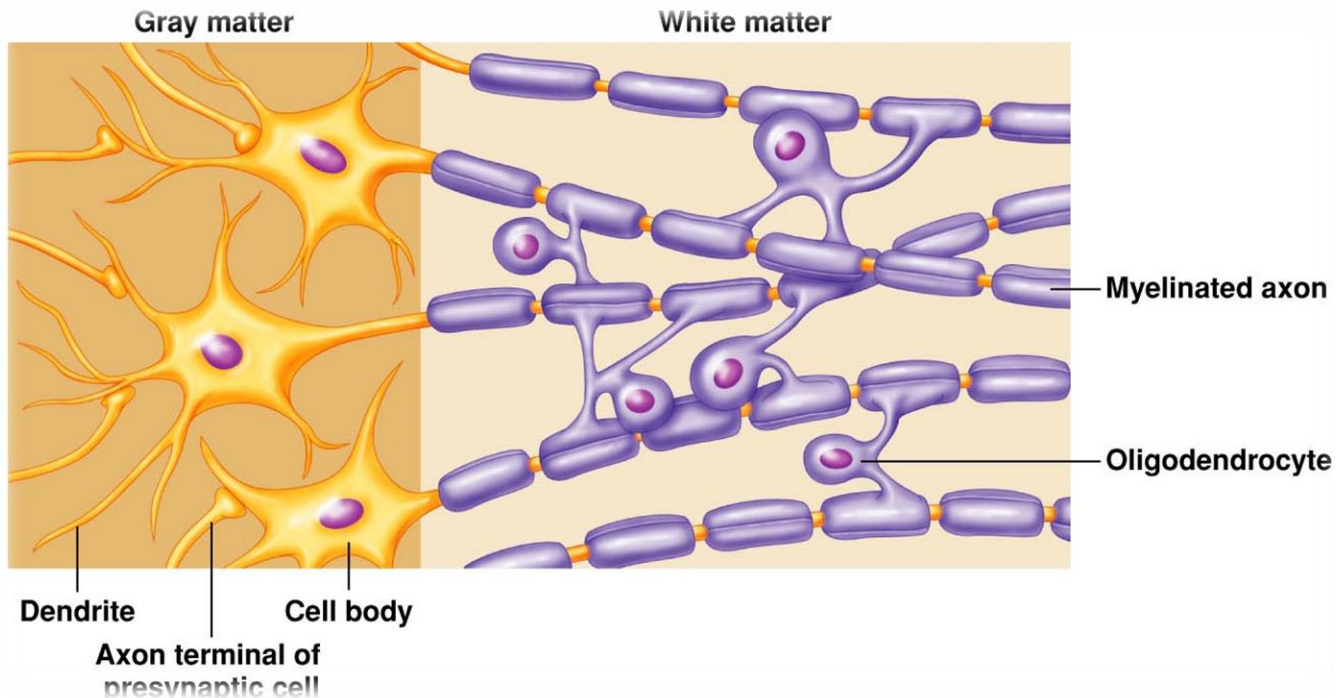
CNS = Central nervous system
PNS = Peripheral nervous system
ANS = Autonomic nervous system
SNS = Somatic nervous system

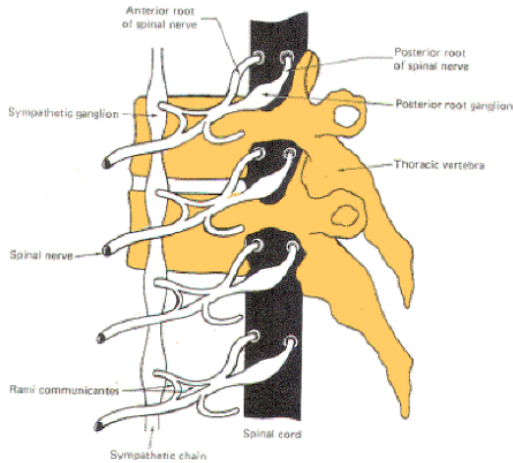
NERVOUS TISSUE

Nervous tissue is organized as:

Grey matter: which contains the cell bodies & the processes of the neurons, the neuroglia and the blood vessels.

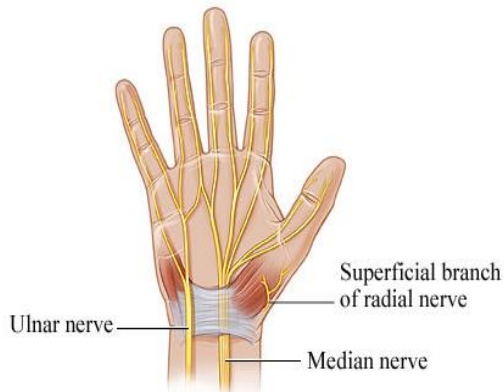
White matter: which contains the processes of the neurons (no cell bodies), the neuroglia and the blood vessels.





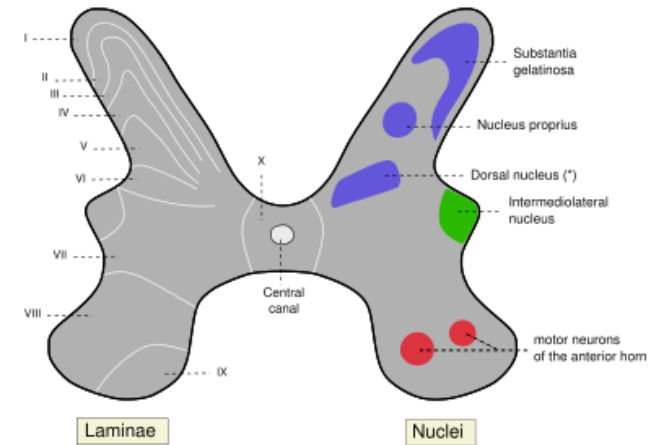
Ganglion

A group of neurons outside the CNS



Nerve

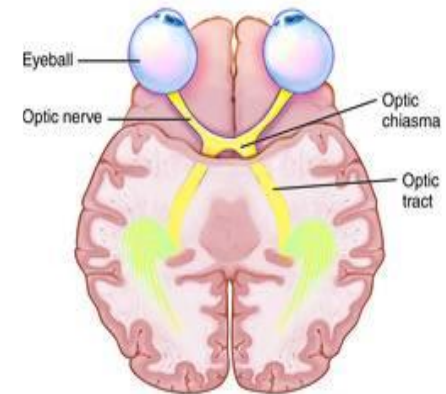
A group of nerve fibers (axons) outside the CNS



* Posterior thoracic nucleus or Column of Clarke

Nucleus

A group of neurons within the CNS

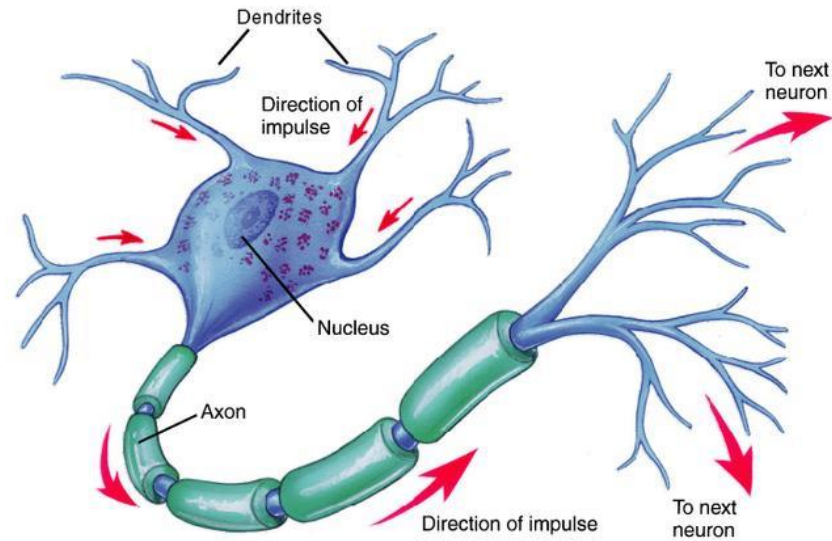


Tract

A group of nerve fibers (axons) within the CNS

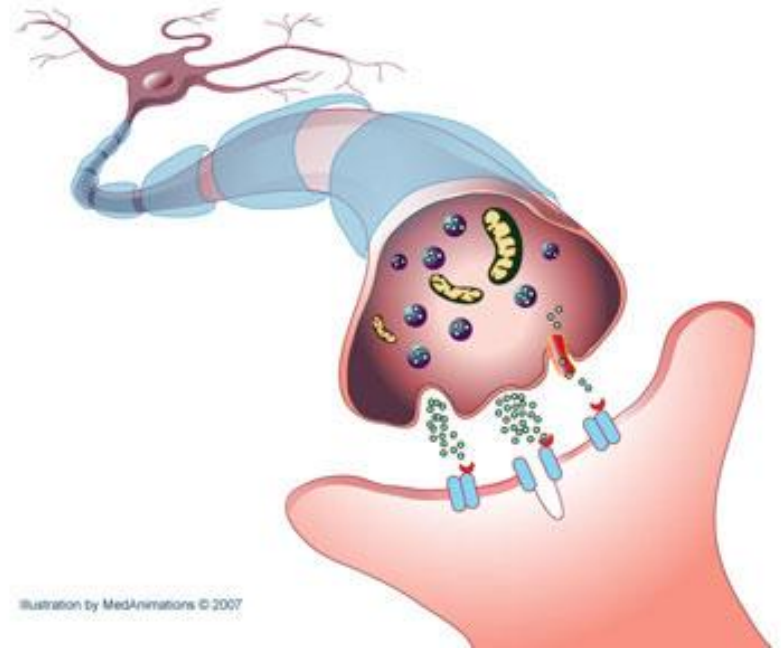
NEURONS

- It is the basic structural (anatomical), functional and embryological unit of the nervous system.
- The human nervous system is estimated to contain about 10^{10} .
- The functions of the neuron is to receive incoming information from sensory receptors or from other neurons and to transmit information to other neurons or effector organs.



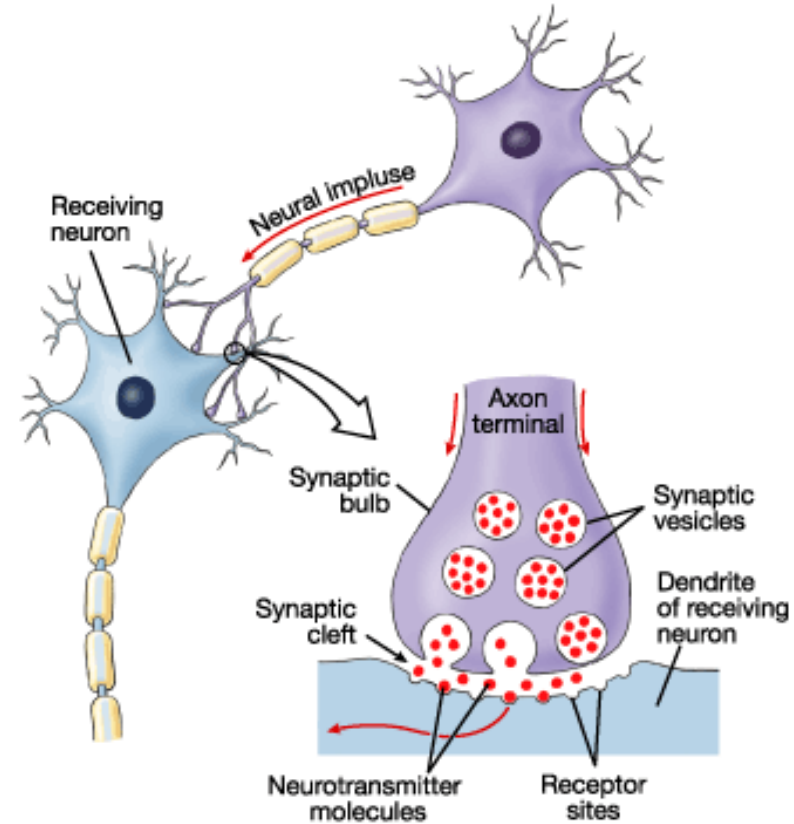
NEURONS

- Information is passed between neurons at specialized regions called synapses
- There is a single cell body from which a variable number of branching processes emerge.
- Most of these processes are receptive in function and are known as dendrites.
- One of the processes leaving the cell body is called the axon which carries information away from the cell body.
- At the end of the axon, specializations called terminal buttons occur.
- Here information is transferred to the dendrites of other neurons.



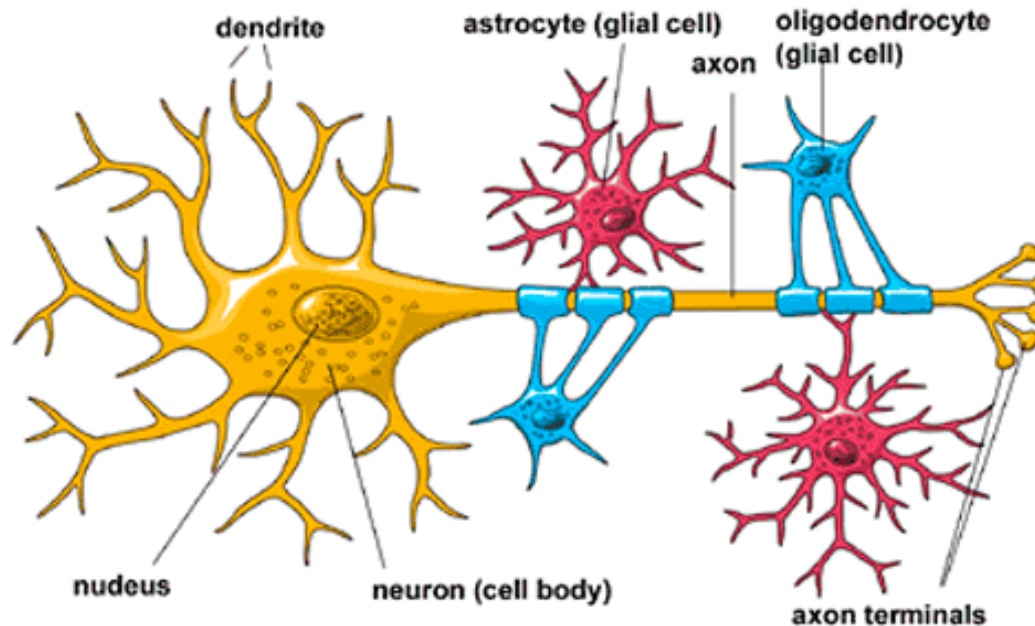
NEURONS

- Transmission of information between neurons almost always occurs by chemical rather than electrical means.
- Action potential causes release of specific chemical that are stored in synaptic vesicles in the presynaptic ending.
- These chemicals are known as neurotransmitters and diffuse across the narrow gap between pre- and postsynaptic membranes to bind to receptors on the postsynaptic cell.



NEUROGLIA

- **Neuroglia**, or glia cells constitute the other major cellular component of the nervous system.
- It is a specialized **connective tissue** for the nervous system.
- Unlike neurones, **neuroglia** do not have a direct role in information processing but they are essential for the normal functioning of nerve cells.



NEUROGLIA

Three main types of neuroglial cell are recognized:

- **Oligodendrocytes**

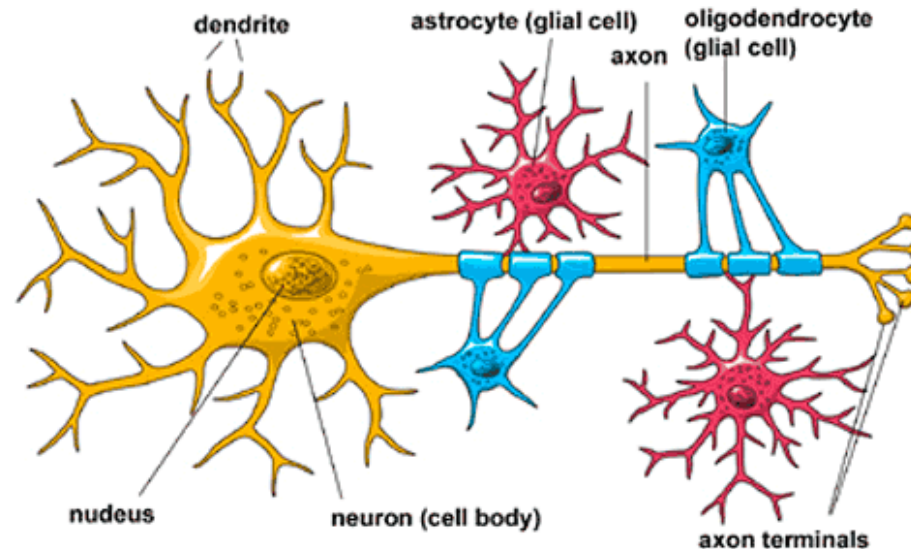
- they form the myelin sheath that surrounds many neuronal axons, which increase the rate of conduction.

- **Microglia**

- have a phagocytic role in response to nervous system damage.

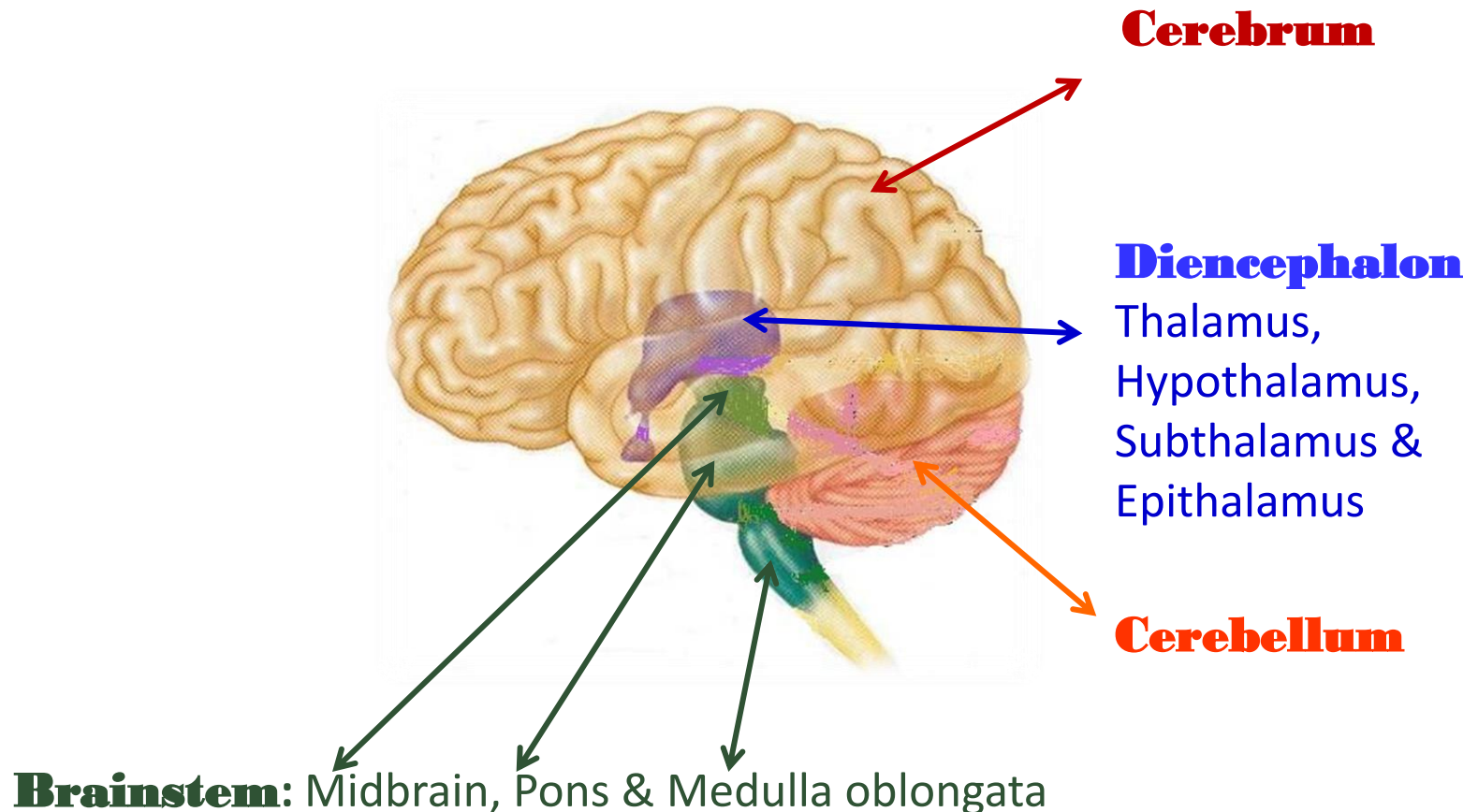
- **Astrocytes**

- provide biochemical support for endothelial cells that form the blood–brain barrier



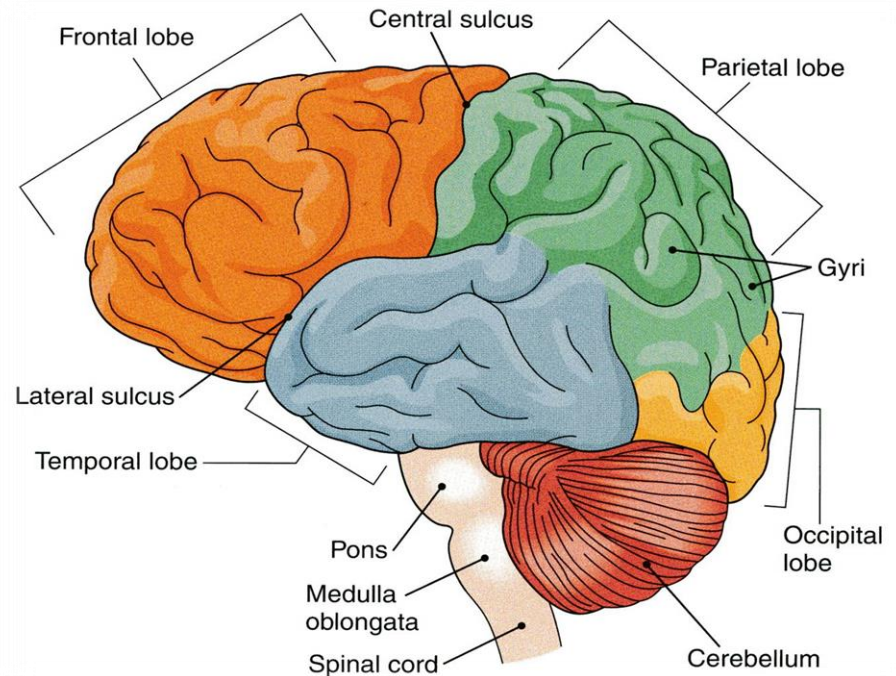
THE BRAIN

- **Large mass of nervous tissue located in the cranial cavity.**
- **Has four major regions.**

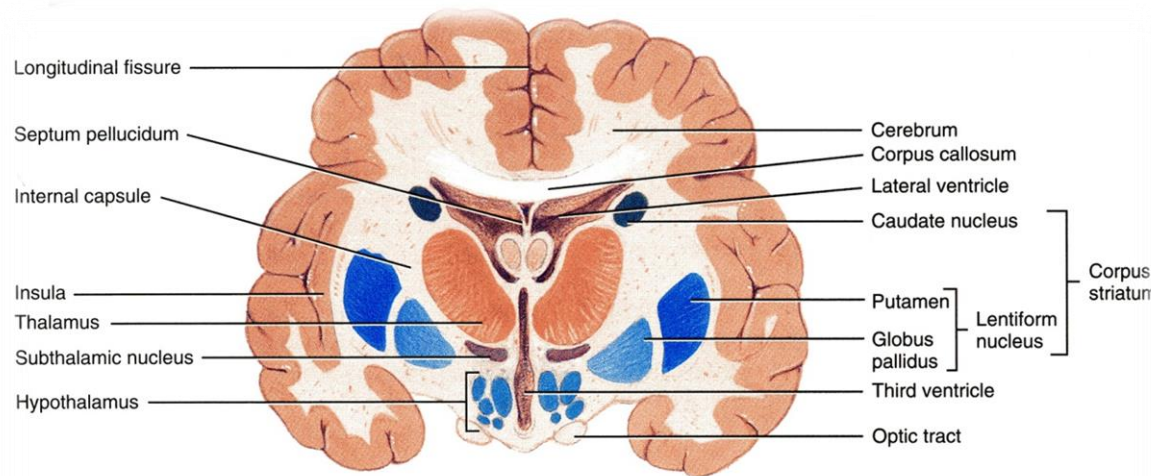


CEREBRUM

- The largest part of the brain, and has two **hemispheres**.
- The cerebral hemispheres are connected by a thick bundle of nerve fibers called **corpus callosum**.
- The surface shows ridges of tissue, called **gyri**, separated by grooves called **sulci**.
- Divided into **4 lobes** by deeper grooves.



Tissue of Cerebral Hemispheres



(b) Anterior view of frontal section

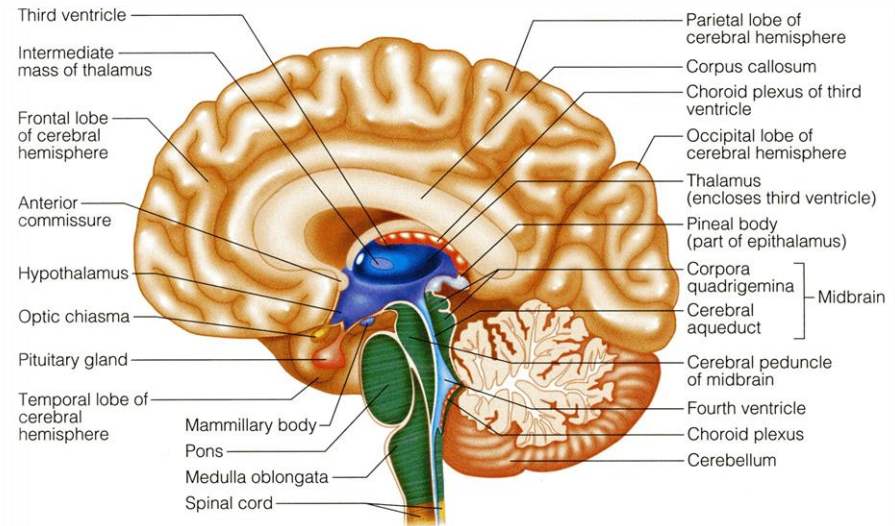
- The outermost layer is called gray matter or cortex.
- Deeper is located the white matter, composed of fiber tracts (bundles of nerve fibers)
 - Carrying impulses to and from the cortex.
- Located deep within the white matter are masses of grey matter called the basal nuclei .
 - They help the motor cortex in the regulation of voluntary motor activities

CEREBELLUM

- The **cerebellum** has 2 hemispheres and a convoluted surface.

- It has an outer cortex made from gray matter and an inner region of white matter.

- It provides **precise coordination** for body movements and helps maintain **equilibrium**.



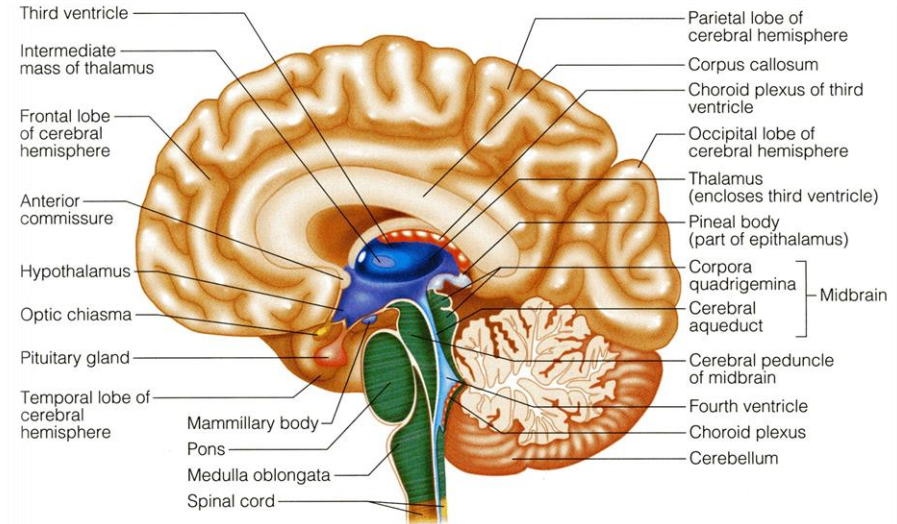
DIENCEPHALON

Consists of four parts;

- **Thalamus**
- **Hypothalamus**
- **Subthalamus**
- **Epithalamus**

Lies between the cerebrum and the brain stem.

Regulates visceral activities and the autonomic nervous system.



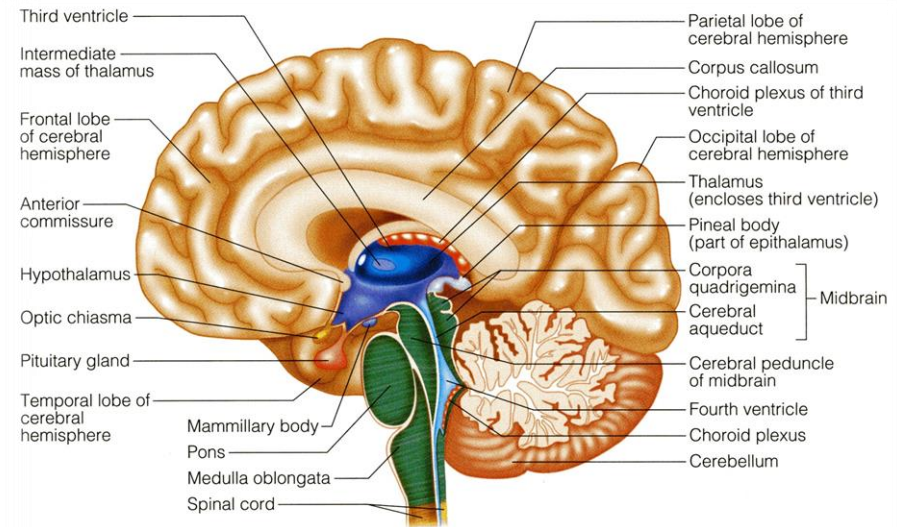
BRAIN STEM

Consists of three parts;

- **Midbrain**
- **Pons**
- **Medulla Oblongata**

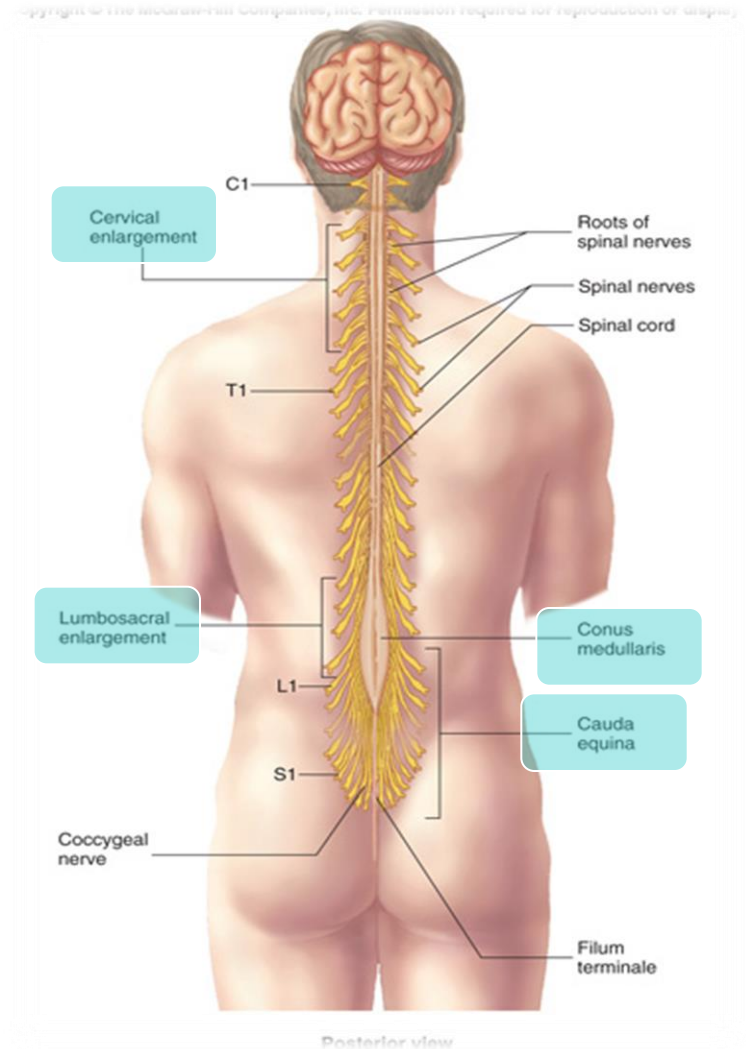
Produces the rigidly programmed, autonomic behaviors necessary.

Provides the pathway for fibers tracts running between higher and lower neuronal centers.



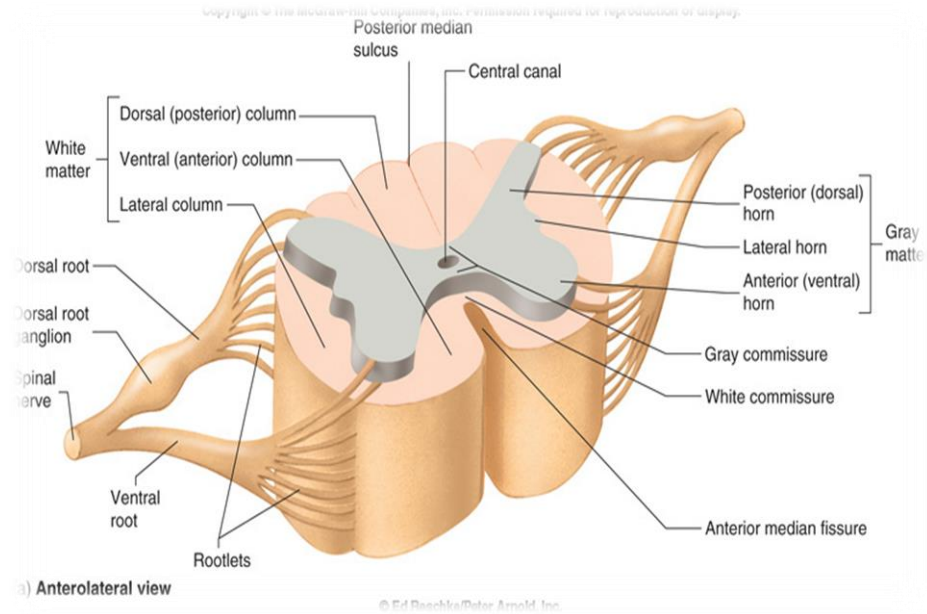
SPINAL CORD

- It is a two-way conduction pathway to the brain & a major reflex center
- 42-45 cm long, cylindrical in shape, lies within the vertebral canal.
- Extends from **foramen magnum** to **L2 vertebra**
- Continuous above with medulla oblongata
- Caudal tapering end is called **conus medullaris**
- Has 2 enlargements: **cervical** and **lumbosacral**
- Gives rise to 31 pairs of **spinal nerves**
- Group of spinal nerves at the end of the spinal cord is called **cauda equina**



CROSS SECTION OF SPINAL CORD

- The spinal cord is incompletely divided into two equal parts, **anteriorly** by a short, shallow median fissure and **posteriorly** by a narrow septum, the posterior median septum.
- Composed of **grey matter** in the centre surrounded by **white matter**.
- The arrangement of grey matter resembles the shape of the letter H, having two posterior, two anterior and two lateral horns/columns.



Which statement(s) of the following is TRUE?

1. Nucleus is a group of neurons within the PNS
2. In the Brain, grey matter located in the centre and surrounded by white matter.
3. Oligodendrocytes they form the myelin sheath that surrounds many neuronal axons, which increase the rate of conduction.
4. Diencephalon provides the pathway for fibers tracts running between higher and lower neuronal centers.
5. Information is passed between neurons at specialized regions called synapses
6. Cerebrum provides precise coordination for body movements and helps maintain equilibrium.



PERIPHERAL NERVES

- May be **SENSORY**, may be **MOTOR** or could be **MIXED**
- **Two TYPES:**



❖ **Cranial:** **12** pairs, attached to brain, named, and numbered from 1-12

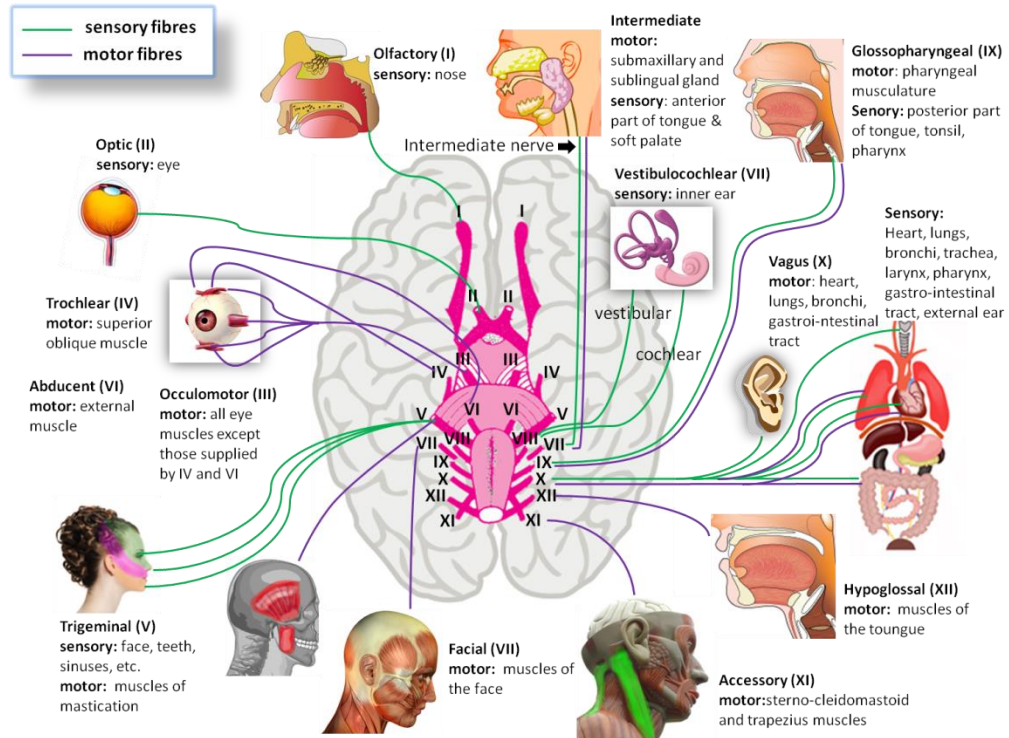


❖ **Spinal:** **31** pairs, attached to spinal cord named and numbered according to the region of the spinal cord

CRANIAL NERVES

12 Pairs

- **4 pairs are mixed**
 - **trigeminal n. (5th)**
 - **facial n. (7th)**
 - **glossopharyngeal n. (9th)**
 - **vagus n. (10th)**
- **5 pairs are motor**
 - **occulomotor n. (3rd)**
 - **trochlear n. (4th)**
 - **abducent n. (6th)**
 - **accessory n. (11th)**
 - **hypoglossal n. (12th)**
- **3 pairs are sensory**
 - **olfactory n. (1st)**
 - **optic n. (2nd)**
 - **vestibulocochlear n. (8th)**

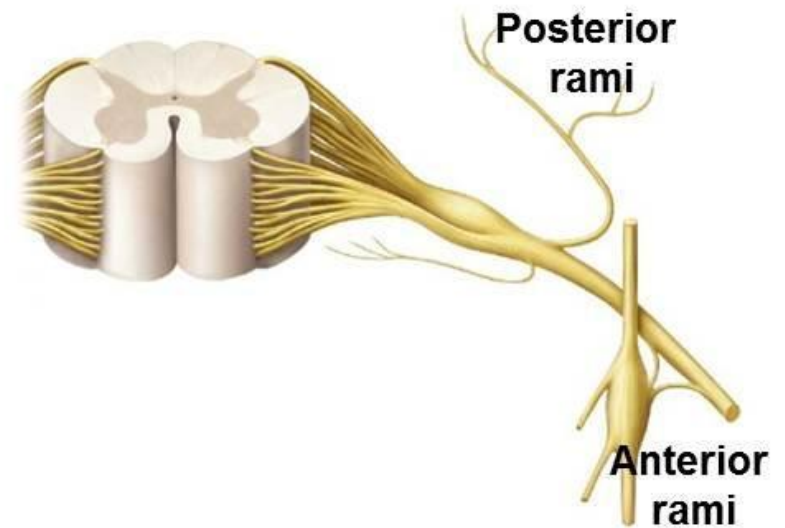
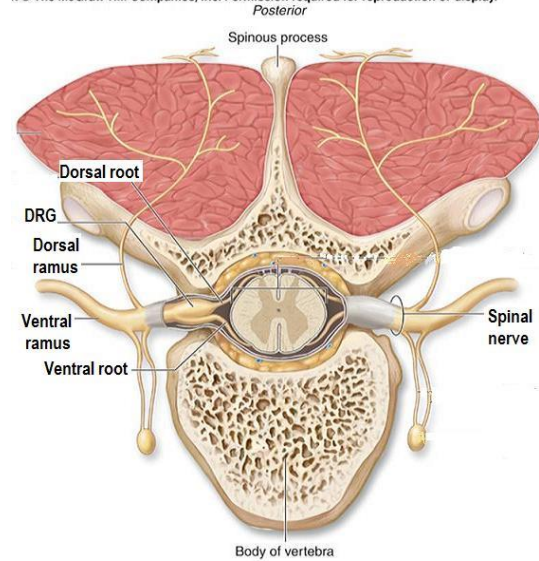


SPINAL NERVES & NERVE PLEXUSES

❖ 31 Pairs

- Each spinal nerve is attached by two roots:
 - **Dorsal (sensory)**
 - **Ventral (motor)**
 - ✓ **Dorsal root bears a sensory ganglion**
- Each spinal nerve exits from the intervertebral foramen and divides into a dorsal and ventral ramus
- The rami contain both sensory and motor fibers

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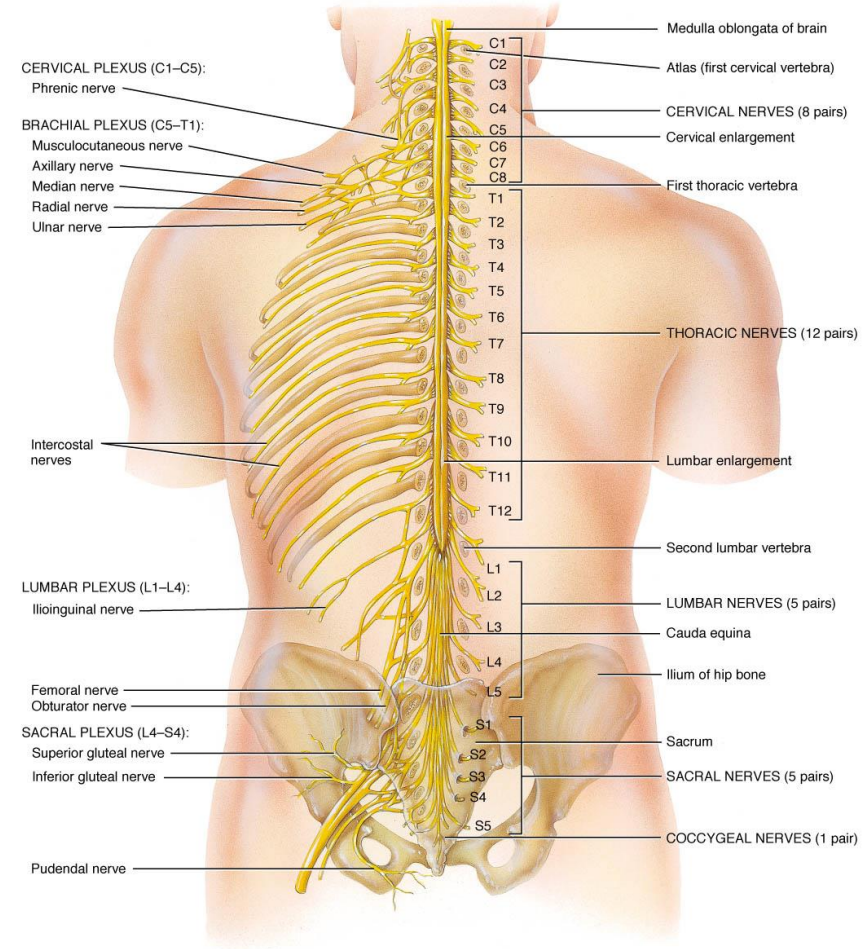
SPINAL NERVES & NERVE PLEXUSES

- The **dorsal rami** are distributed individually.

- Supply the skin and muscles of the back

- The **ventral rami** form **plexuses**

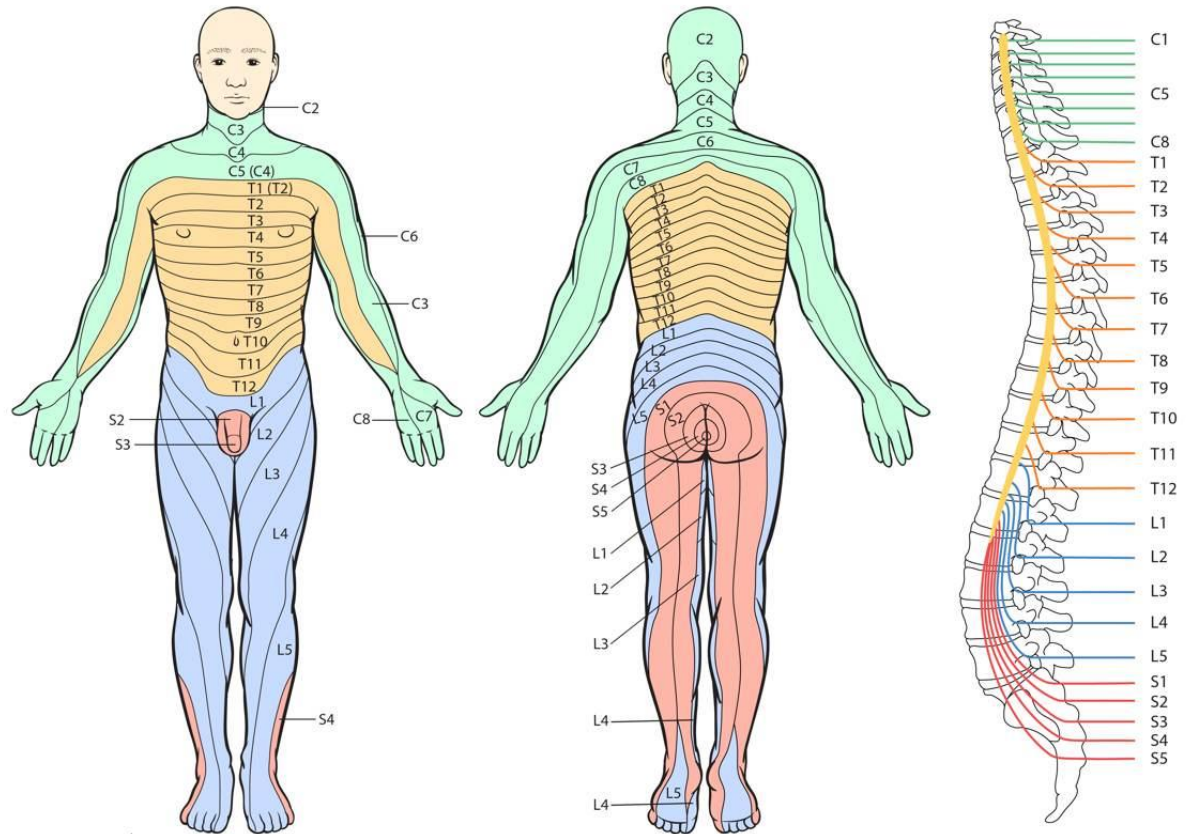
- Except in thoracic region where they form the intercostal nerves
- Supply the anterior part of the body



Posterior view of entire spinal cord and portions of spinal nerves and their branches

DERMATOME

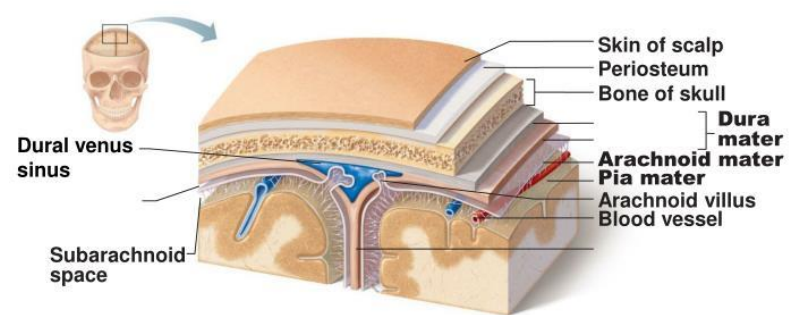
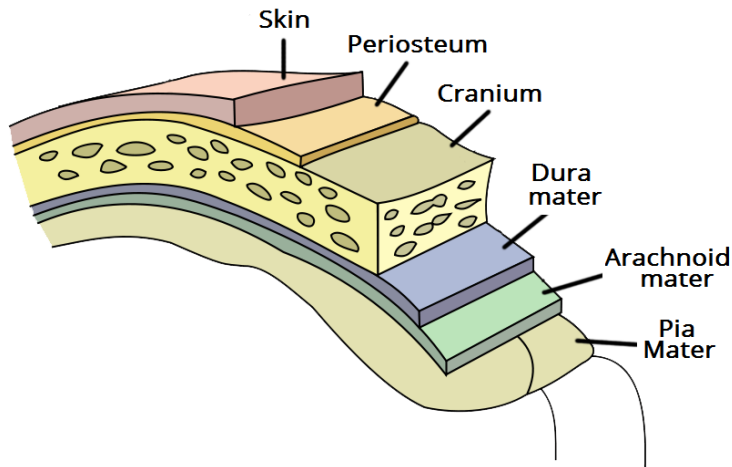
Dermatome is a segment of skin supplied by one spinal nerve.



PROTECTION OF CNS

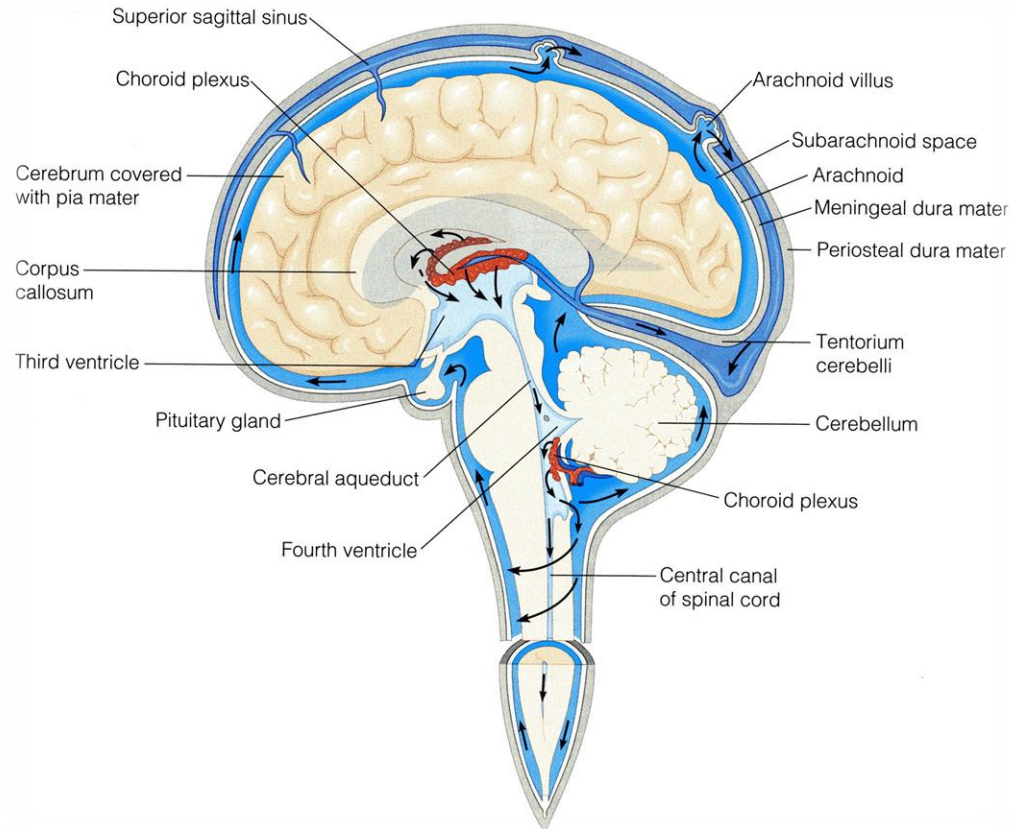
THE CNS IS PROTECTED BY:

- **Skull** and the **vertebral column** (bone)
- **Meninges** (membranes): 3 layers
 - dura mater (outermost)
 - arachnoid mater (middle)
 - pia mater (innermost)
- **Cerebrospinal fluid** in the subarachnoid space



CEREBRAL FLUID

- **CSF** is constantly produced by the **choroid plexuses** inside the ventricles of brain.
- **CSF** is constantly drained into the **dural sinuses** through the arachnoid villi.
- Most of the **CSF** drains from the **ventricles** into the subarachnoid space around the brain and spinal cord. A little amount flows down in the central canal of the spinal cord.



Which statement(s) of the following is FALSE?

1. Each spinal nerve exits from the intervertebral foramen and divides into a dorsal and ventral ramus.
2. The dorsal rami form plexuses .
3. Dermatome is a segment of skin supplied by one spinal nerve.
4. CSF is produced by the choroid plexuses inside the ventricles of brain.
5. The rami contain only sensory fibers.
6. CSF is drained into the dural sinuses through the arachnoid villi.



QUESTIONS?