The Nervous System

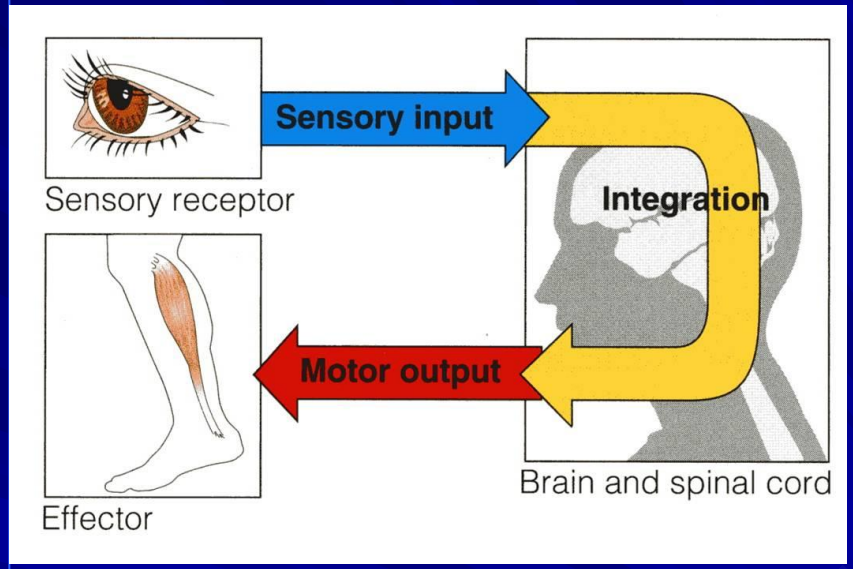
DR JAMILA EL MEDANY

Objectives

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

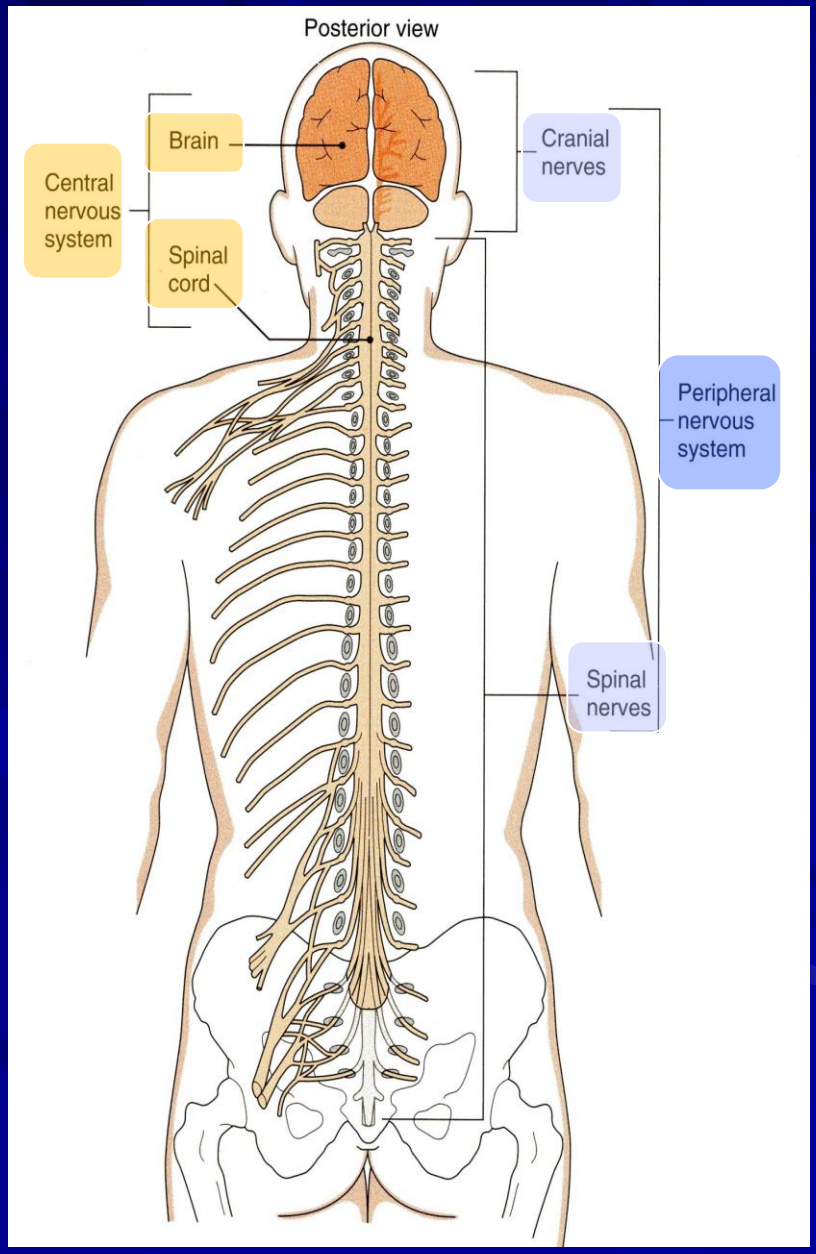
- List the subdivisions of the nervous system
- Define the terms: grey matter, white matter, nucleus, ganglion, tract and nerve.
- List the parts of the brain.
- Identify the external and internal features of spinal cord.
- Enumerate the cranial nerves
- Describe the parts and distribution of the spinal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

- The nervous system has **three 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 and interprets these changes and makes decisions
  - **Effects a response** by activating muscles or glands (effectors) via **motor output**



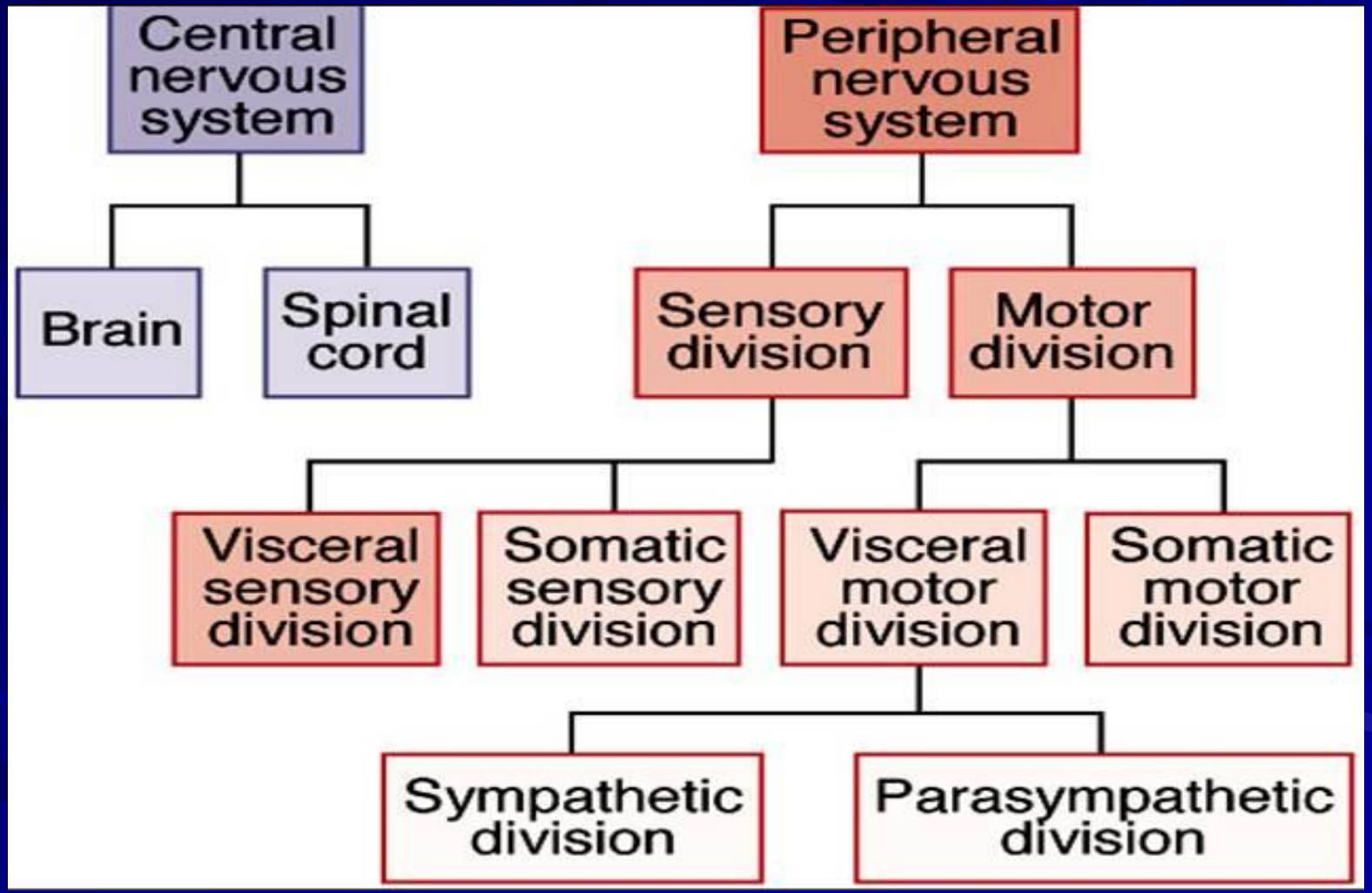
Structural Organization

- **Central Nervous System (CNS):** Brain & Spinal cord
- **Peripheral Nervous System (PNS):** Nerves (cranial, spinal) & ganglia

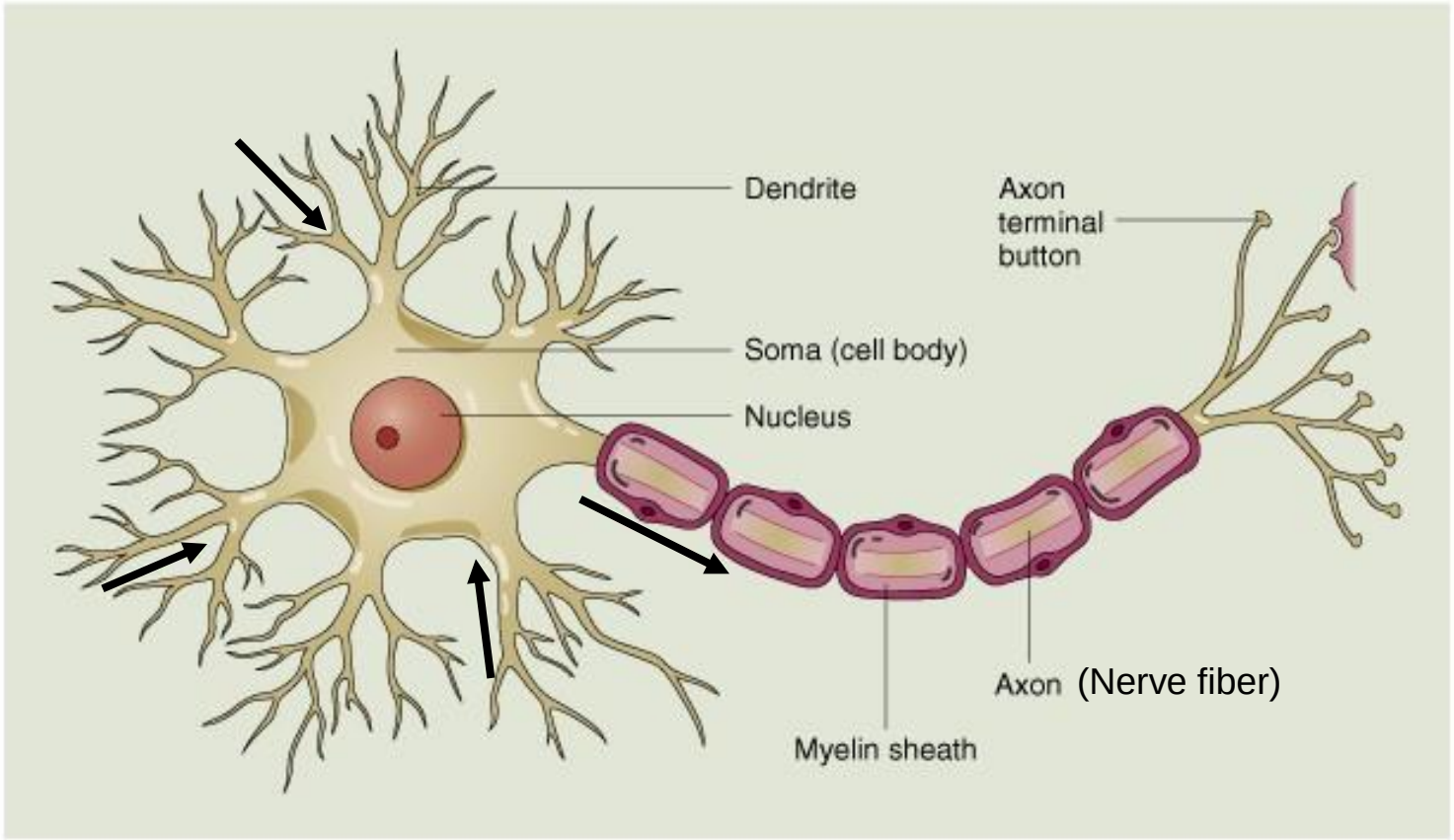


Functional Organization

- Sensory/Motor division
- Somatic/Autonomic (Visceral) division



Nervous tissue consists of nerve cells (neurons) and supporting (neuroglia) cells

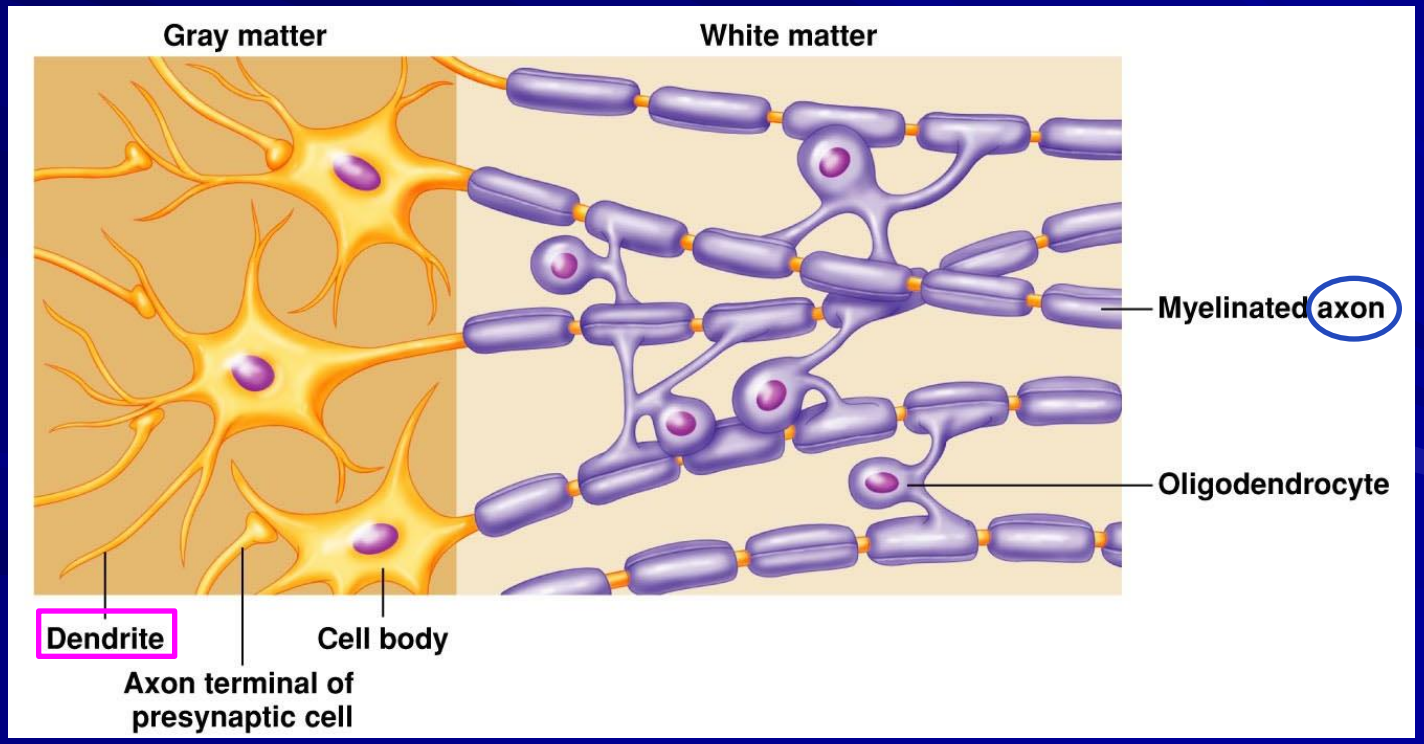


A typical multipolar neuron

Nervous tissue is organized as:

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

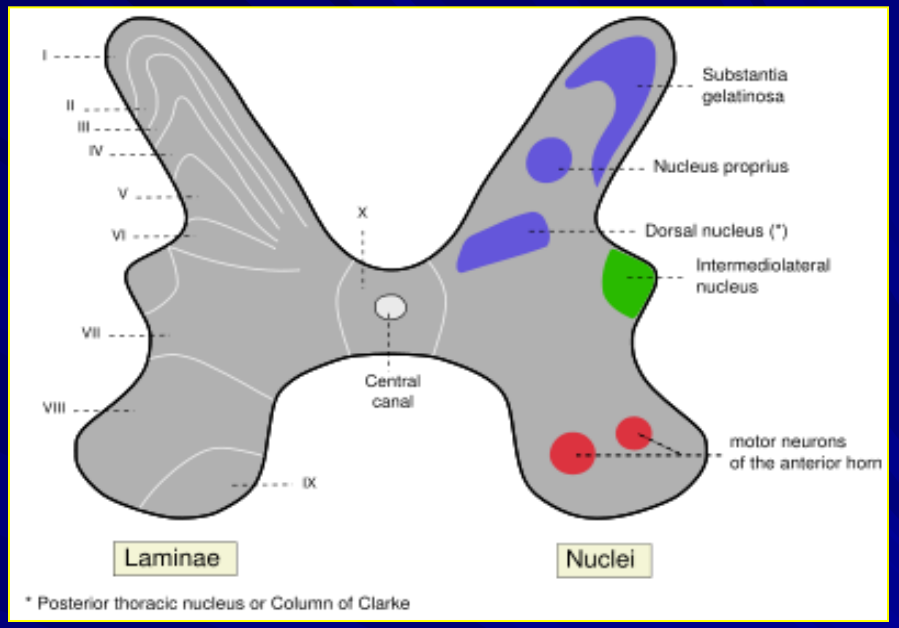
White matter: which contains the long processes of the neurons (no cell bodies), the neuroglia and the blood vessels



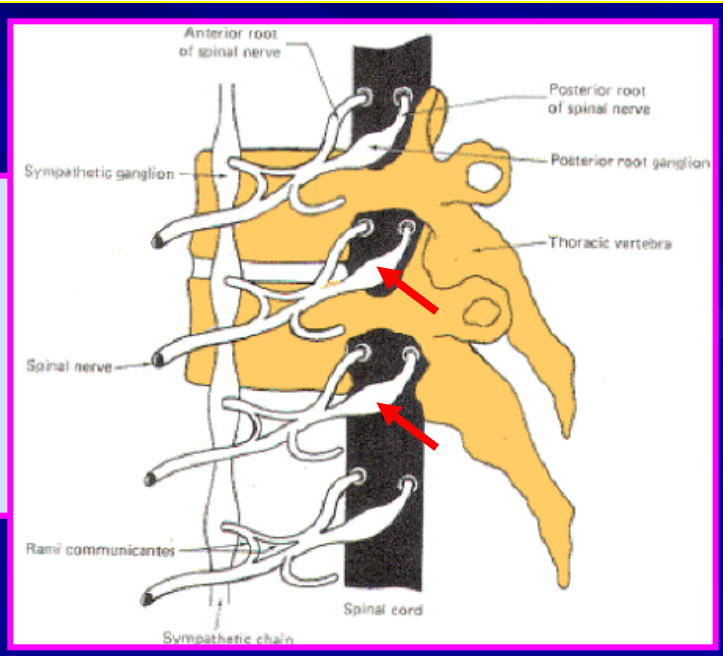
Remember

...

A group of neurons within the CNS is called a **nucleui**



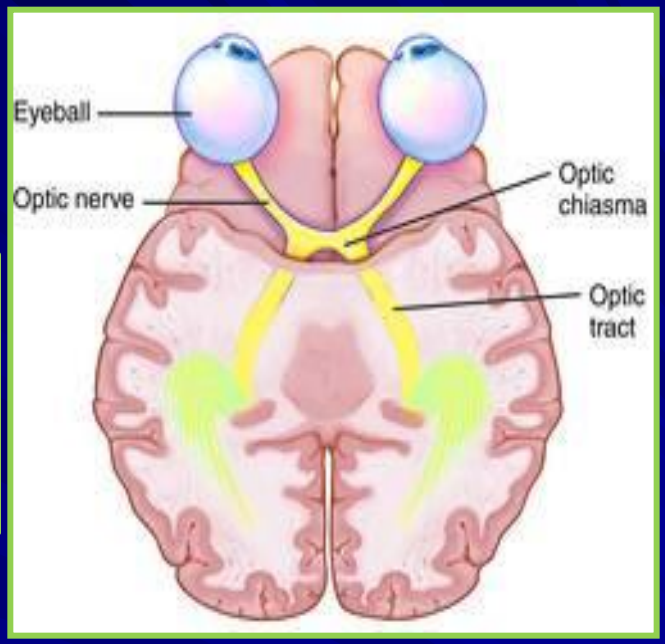
A group of neurons outside the CNS is called a **ganglia**



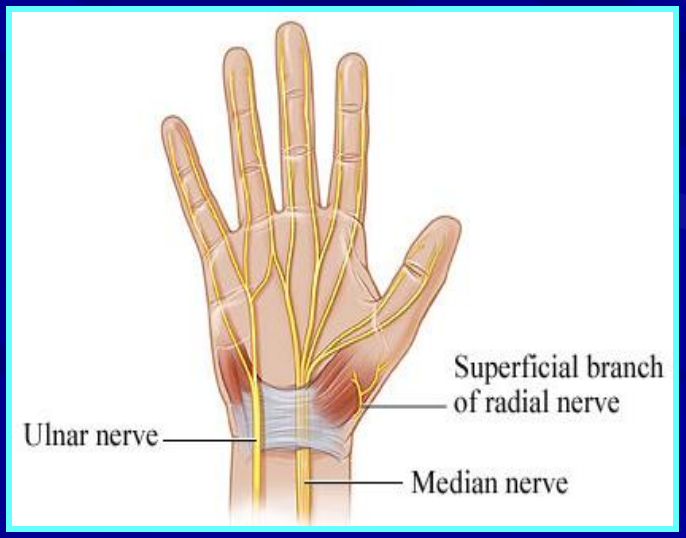
Remember

...

A group of nerve fibers (axons) within the CNS is called a **tract**



A group of nerve fibers (axons) outside the CNS is called a **nerve**

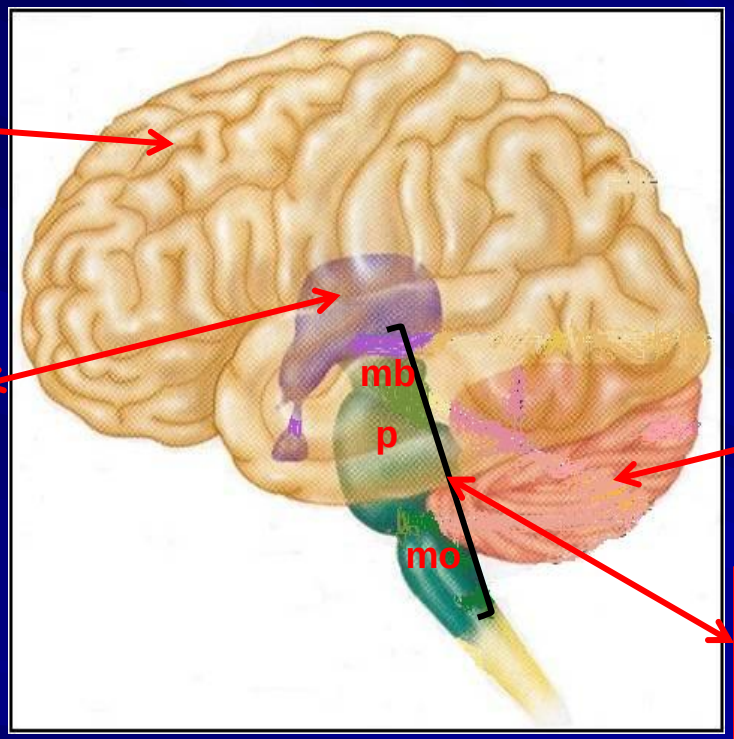


The Brain

The brain is a large mass of nervous tissue located in the cranial cavity. It has four major regions

Cerebrum (2 Cerebral hemispheres)

Diencephalon:
Thalamus,
Hypothalamus,
Subthalamus &
Epithalamus



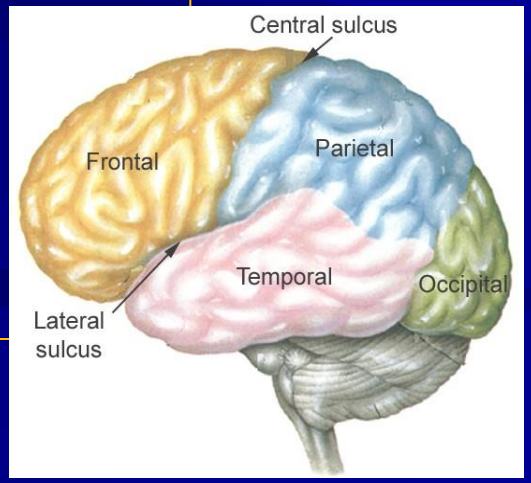
Cerebellum

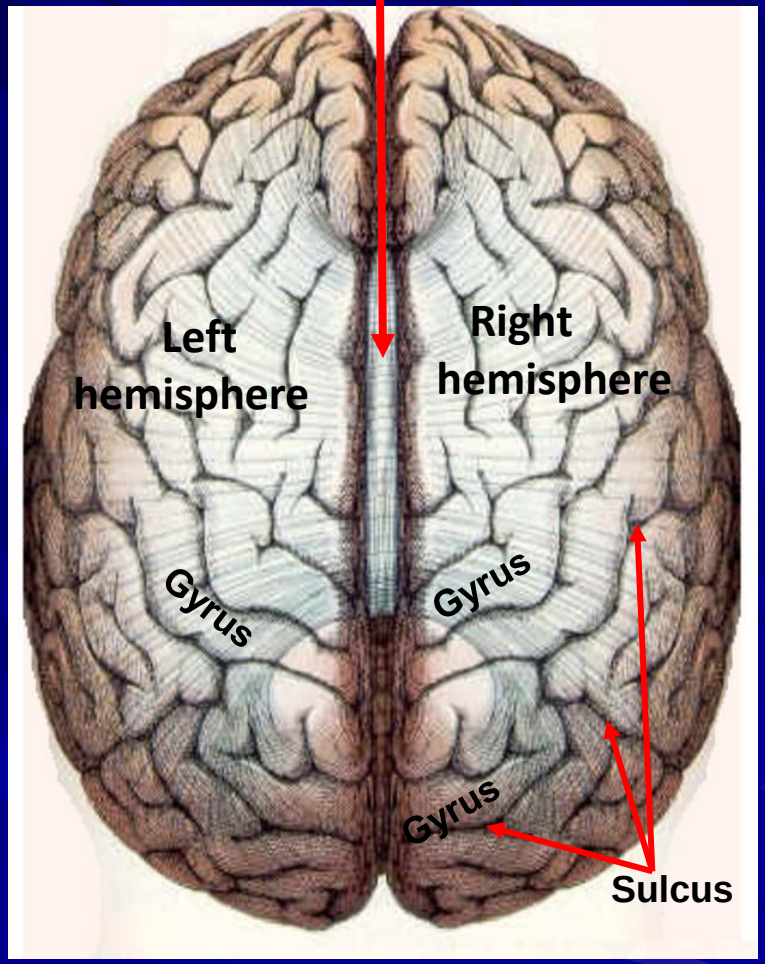
Brainstem:
Midbrain
Pons
Medulla oblongata

CEREBRUM

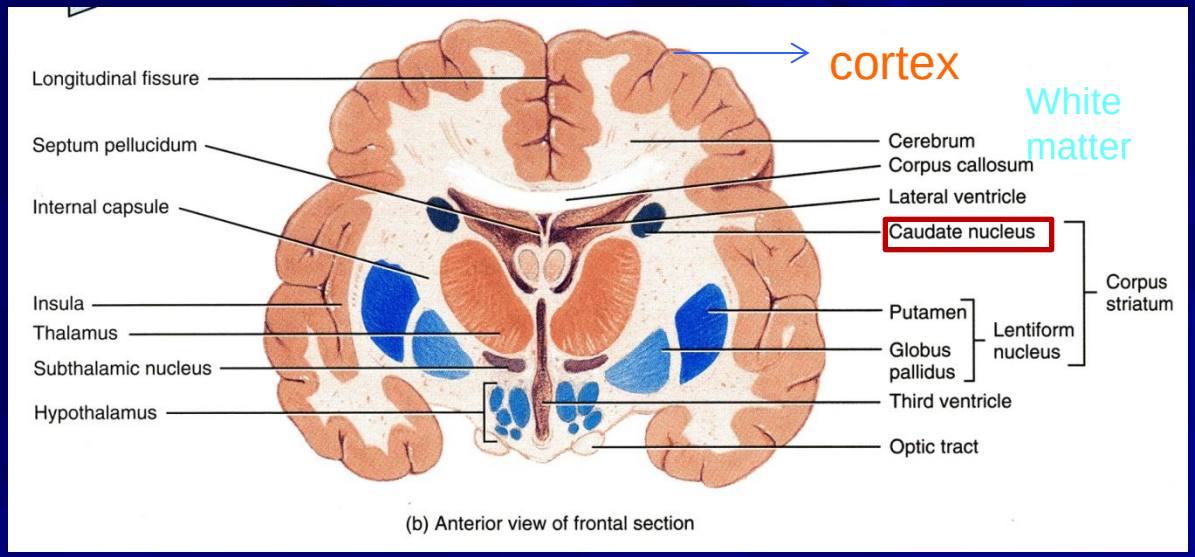
- The largest part of the brain, has two hemispheres
- The cerebral hemispheres are connected by a thick bundle of nerve fibers called **corpus callosum**
- The surface shows ridges of tissue, called **gyri,** separated by grooves called **sulci**

- Divided by deeper sulci, into **4 lobes:**
  - Frontal
  - Parietal
  - Temporal
  - Occipital



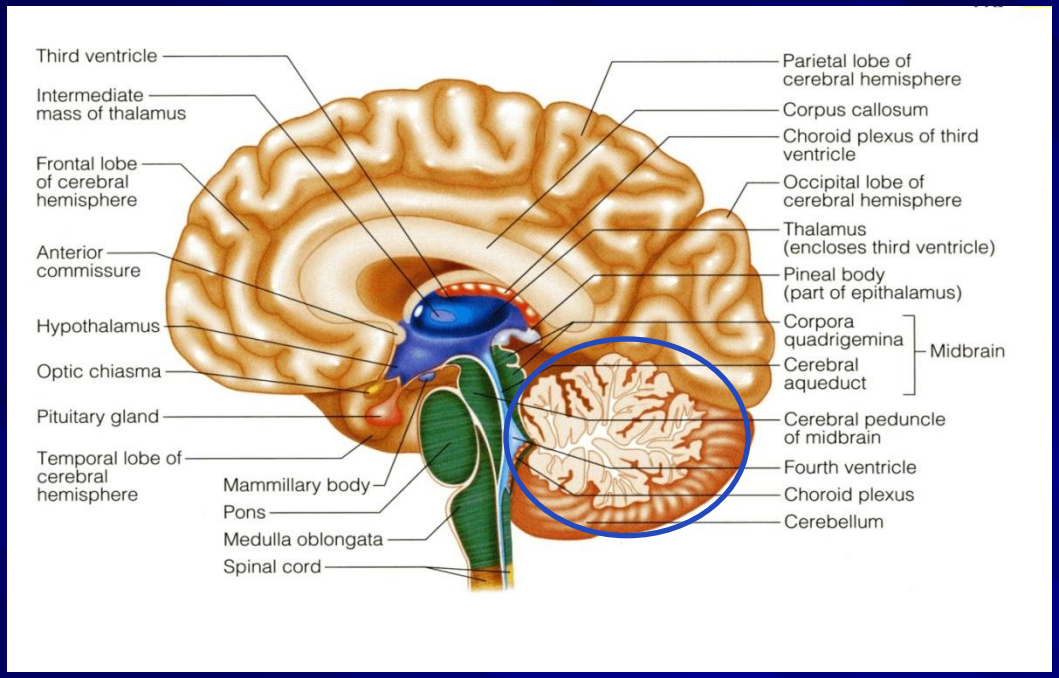


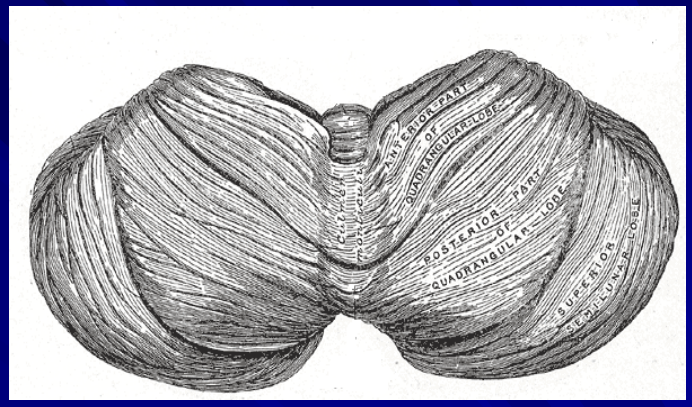
TISSUE OF THE CEREBRAL HEMISPHERES

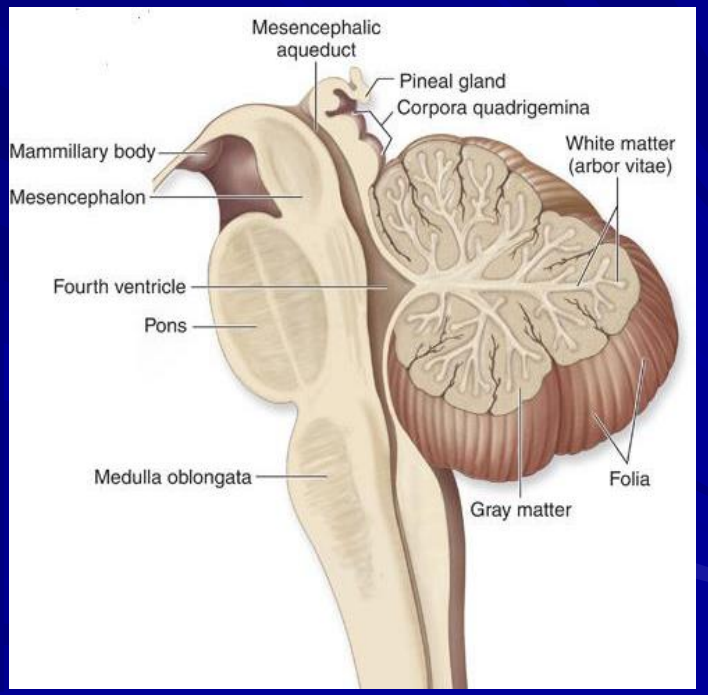


- The outermost layer is called **gray matter** or **cortex**
- Deeper is located the **white matter**, composed of fiber tracts (bundles of nerve fibers), carrying impulses to and from the cortex
- Located deep within the white matter are masses of grey matter called the **basal nuclei** . They help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

CEREBELLUM



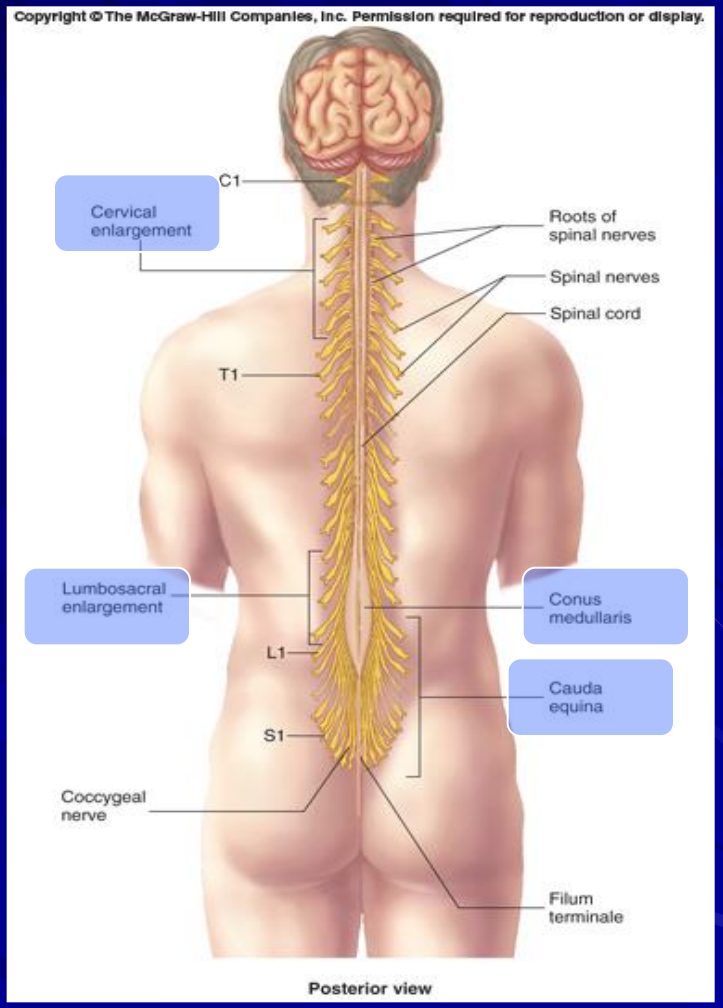




The **cerebellum** has 2 hemispheres and a convoluted surface. It has an outer cortex of gray matter and an inner region of white matter. It provides **precise coordination for body movements and helps to maintain equilibrium.**

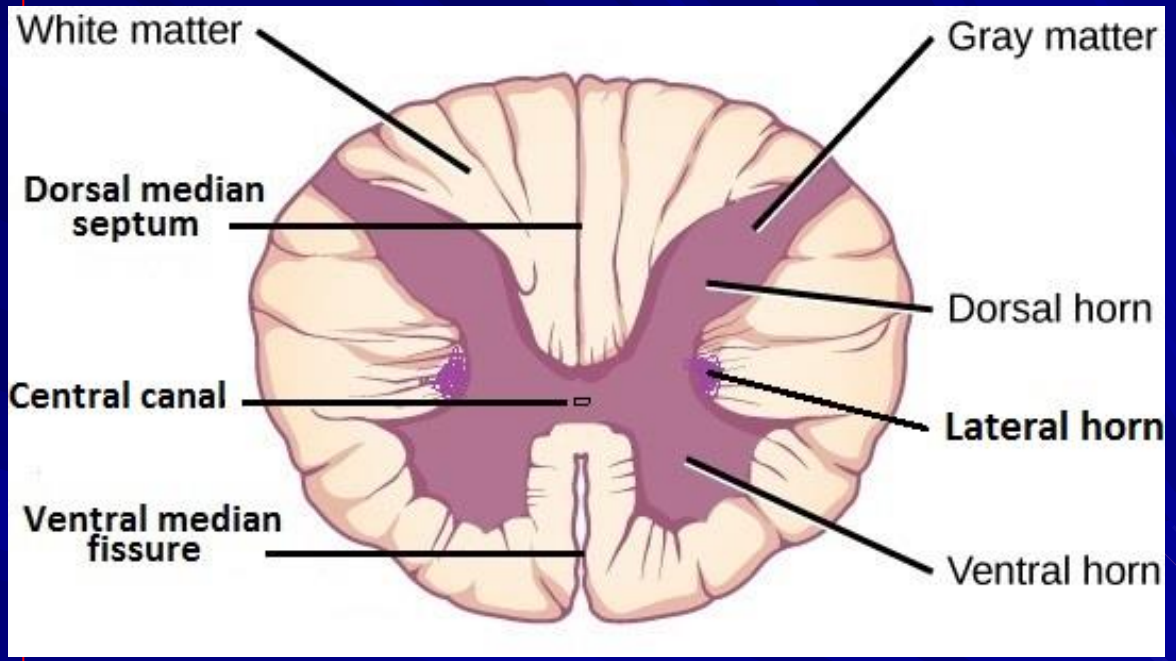
Spinal Cord

- 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**



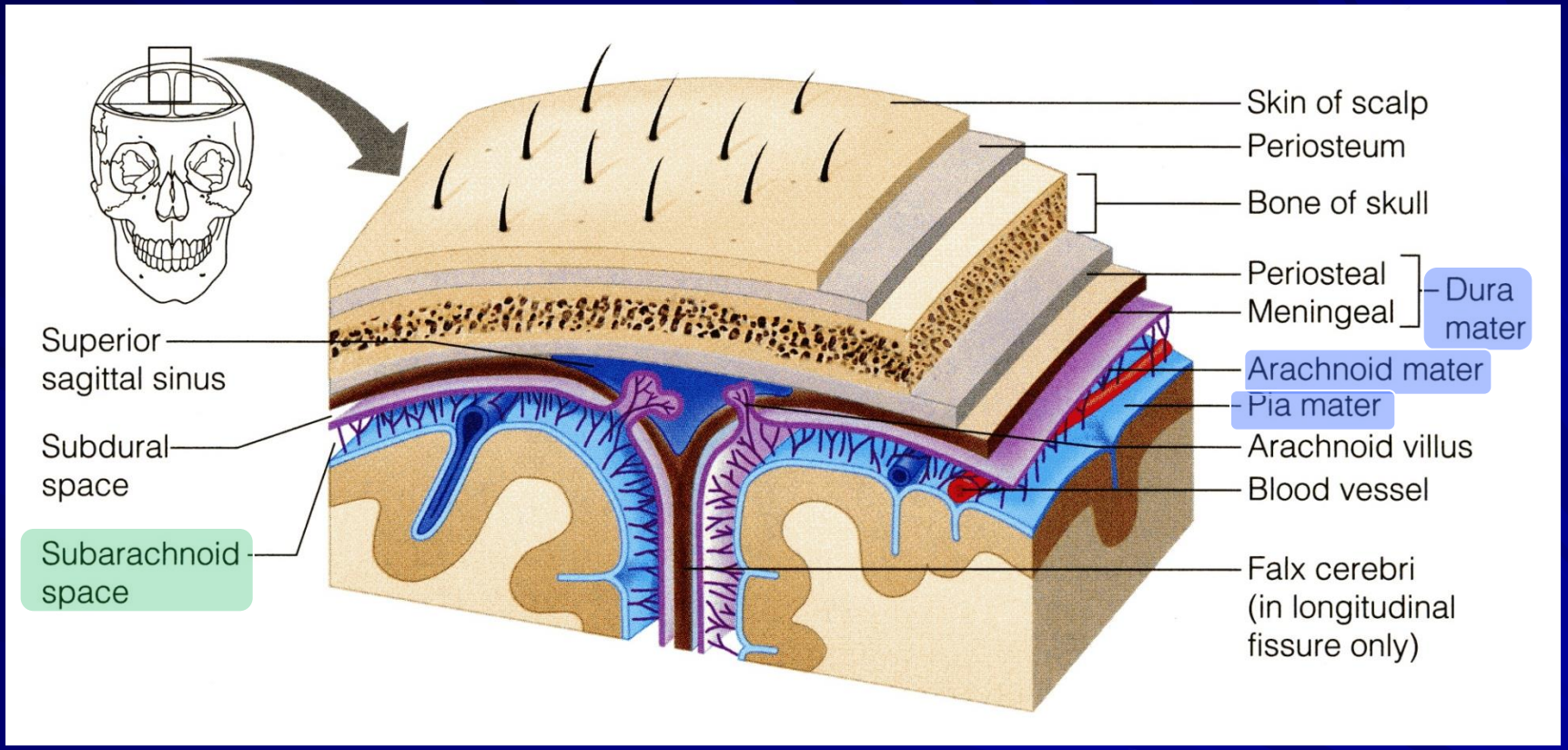
Cross Section of Spinal Cord

- The spinal cord is incompletely divided into two equal parts, anteriorly by a short, shallow **median fissure** and posteriorly by a deep narrow **median septum.**
- It is 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.

PROTECTION OF THE CNS

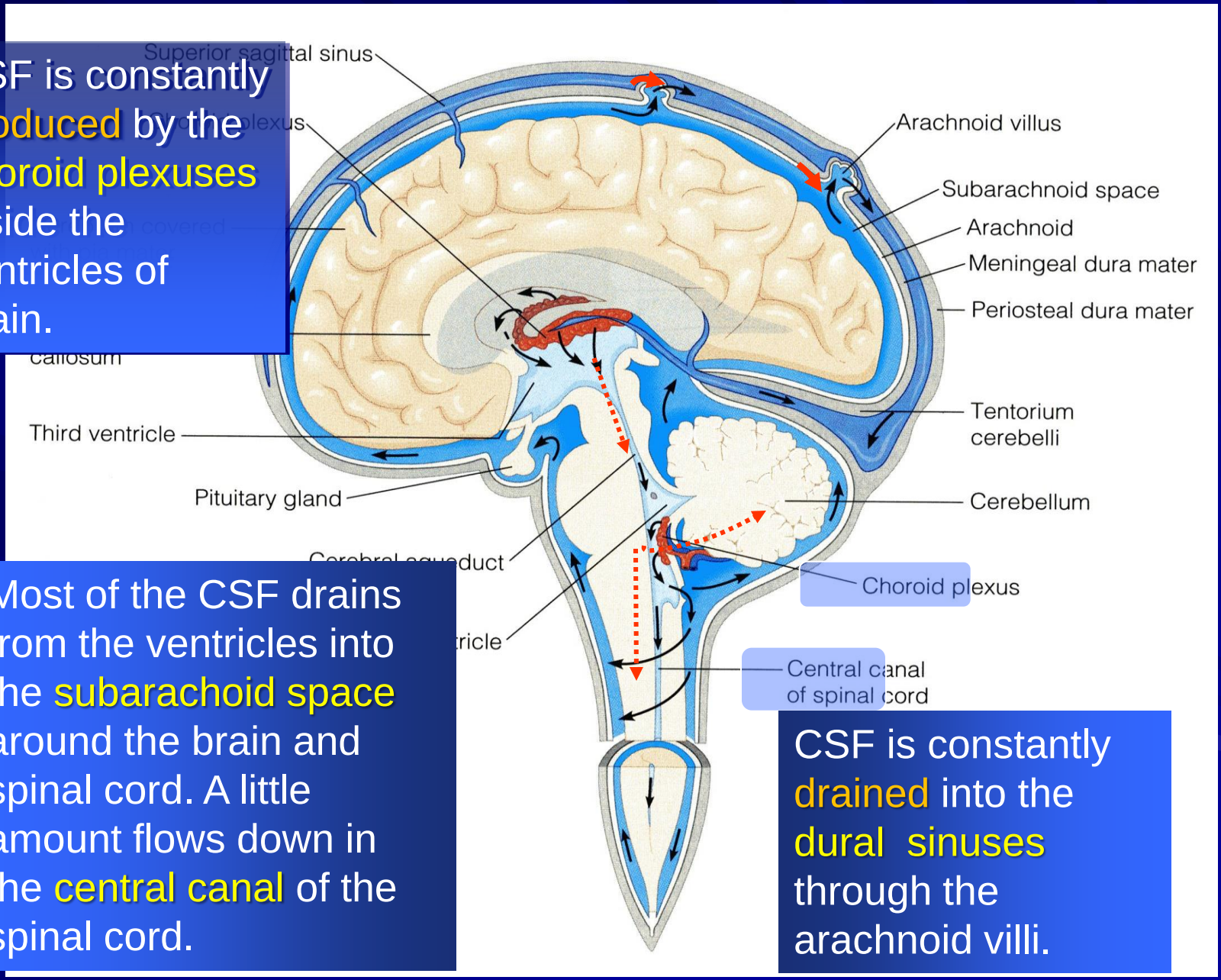


THE CNS IS PROTECTED BY:

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

CEREBROSPINAL FLUID

CSF is constantly produced by the choroid plexuses inside the ventricles of brain.



Most of the CSF drains from the ventricles into the subarachoid space around the brain and spinal cord. A little amount flows down in the central canal of the spinal cord.

CSF is constantly drained into the dural sinuses through the arachnoid villi.

Peripheral Nerves

- May be sensory, motor or mixed
- Two types:

- **Cranial**:
  - 12 pairs,
  - attached to brain
  - named & 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)

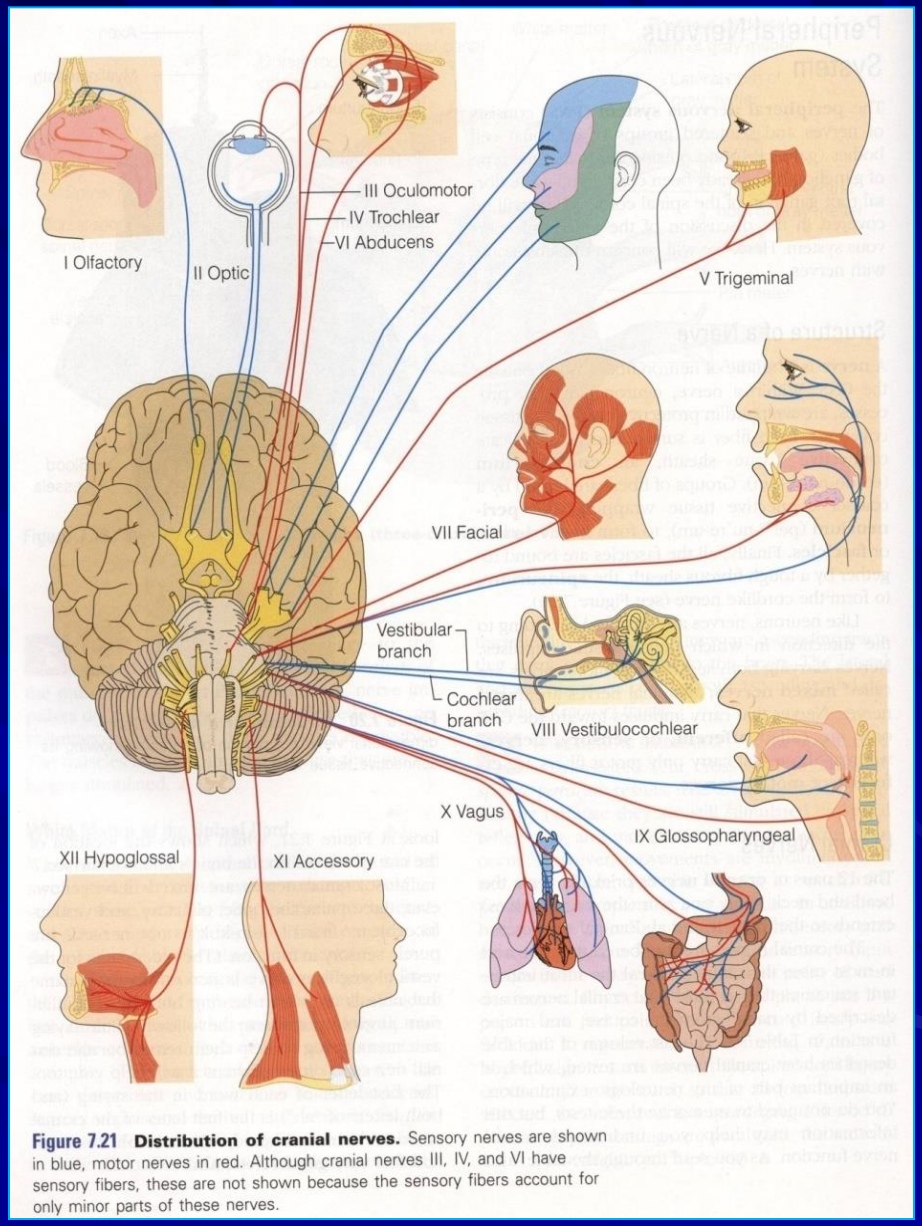
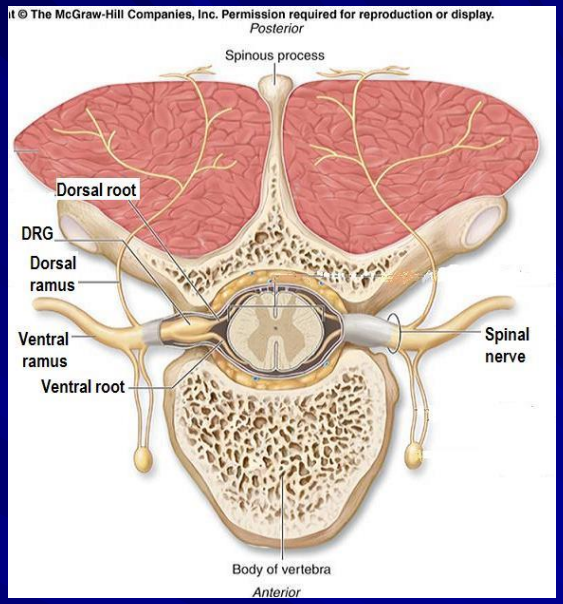
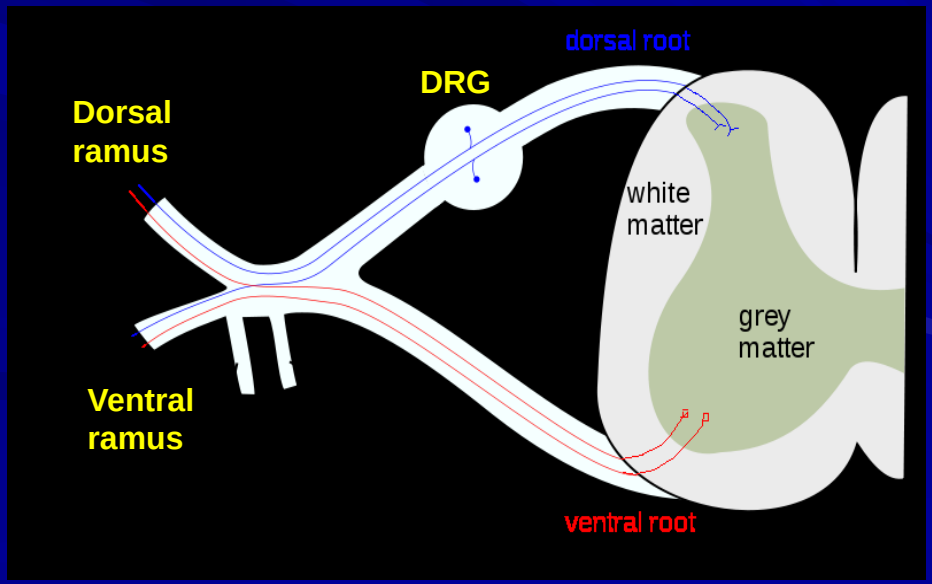


Figure 7.21 Distribution of cranial nerves. Sensory nerves are shown in blue, motor nerves in red. Although cranial nerves III, IV, and VI have sensory fibers, these are not shown because the sensory fibers account for only minor parts of these nerves.

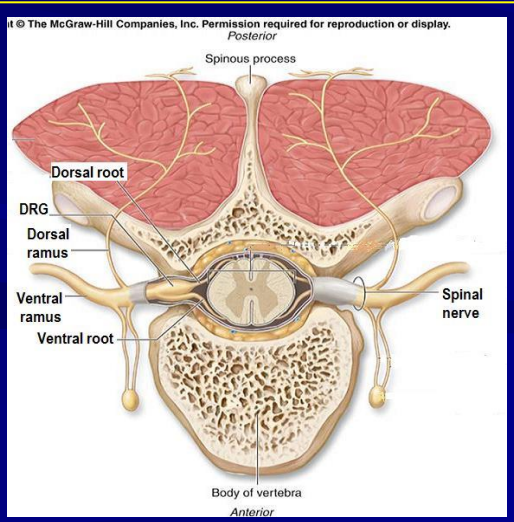
Spinal Nerves and Nerve Plexuses

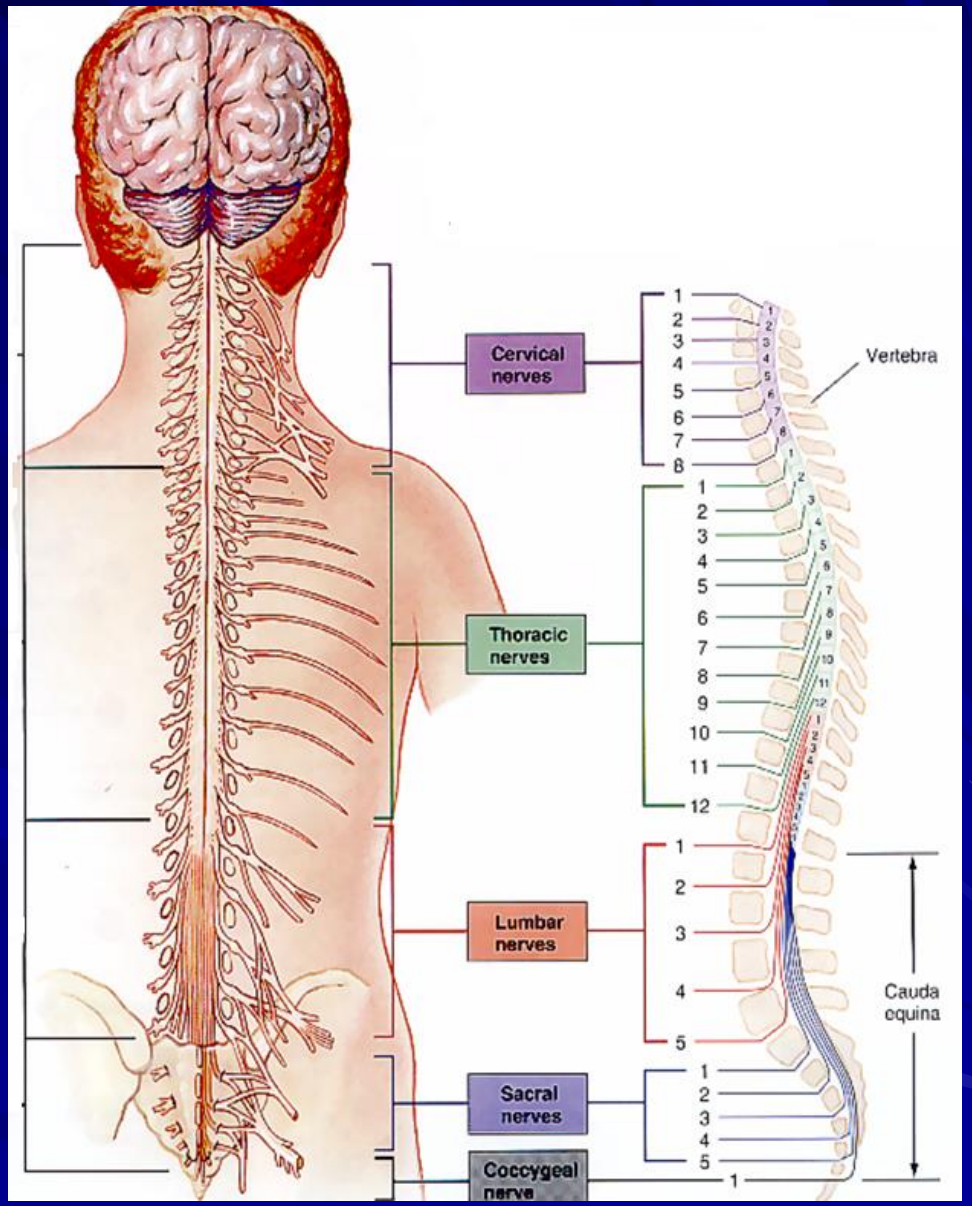
- 31 pairs
- Each spinal nerve is attached by **two roots: dorsal (sensory)** & **ventral (motor)**
- **Dorsal root bears a sensory ganglion (DRG)**
- Each spinal nerve exits from the intervertebral foramen and divides into a **dorsal and ventral ramus**
- The rami contain both sensory and motor fibers





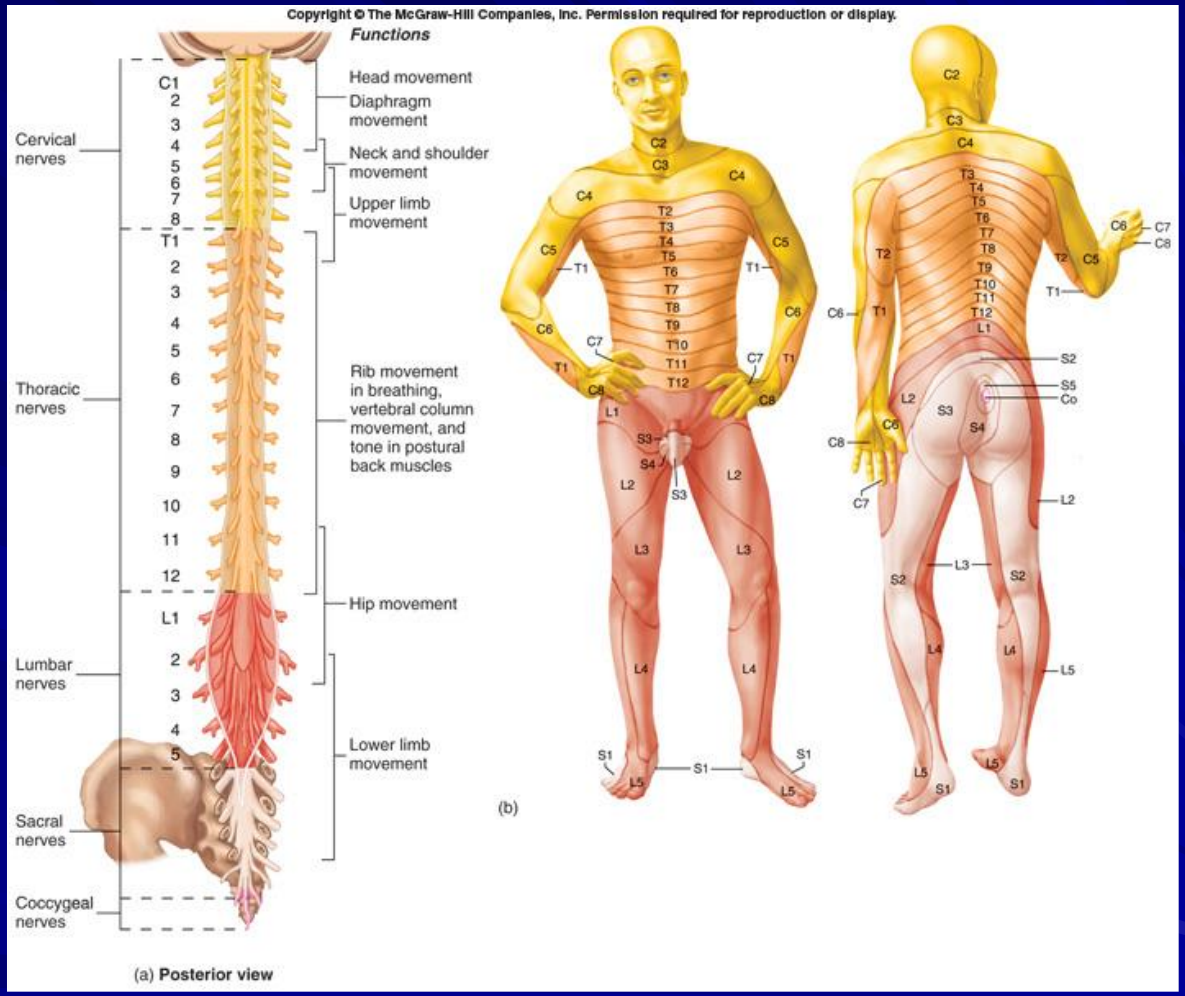
- The **dorsal rami** are distributed individually, supply the skin and muscles of the back
- the **ventral rami** form **plexuses (**except in thoracic region where they form the **intercostal nerves**), and supply the anterior part of the body





Dermatomes

- The segment of skin supplied by a **segmental spinal nerve** is called a '**Dermatome**'




Thank U & Good luck