

Lecture 3

NERVOUS SYSTEM



Color Index:

- Main text
- Boys' Slides
- Girls' Slides
- Important
- Dr's Notes
- Extra

 [Editing File](#)

OBJECTIVES

- › 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 the spinal cord
- › Enumerate the cranial nerves
- › Describe the parts and distribution of the spinal nerves
- › Define the term “dermatome”
- › List the structures protecting the central nervous system
- › Mention the clinical anatomy related to Lumbar Puncture

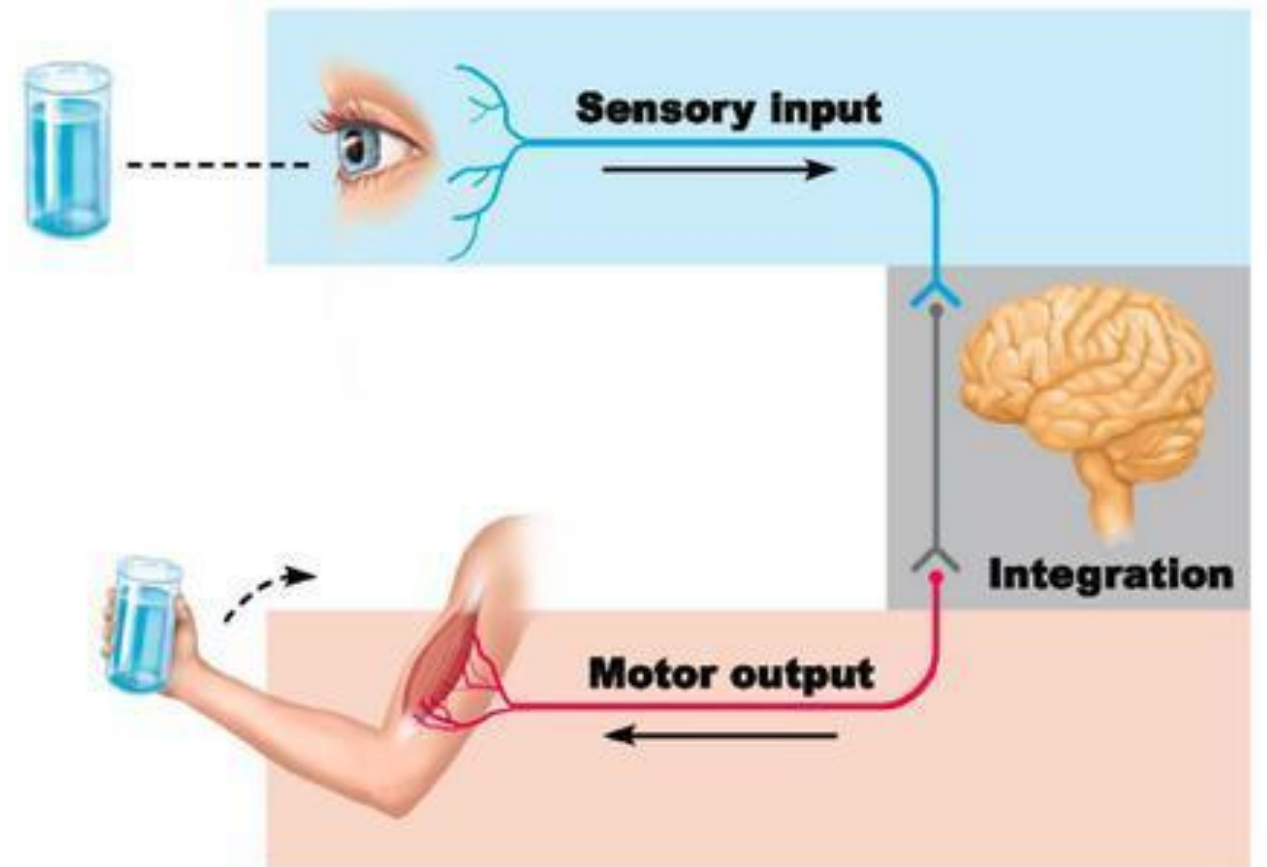
IMPORTANT!

The nervous system has three functions:

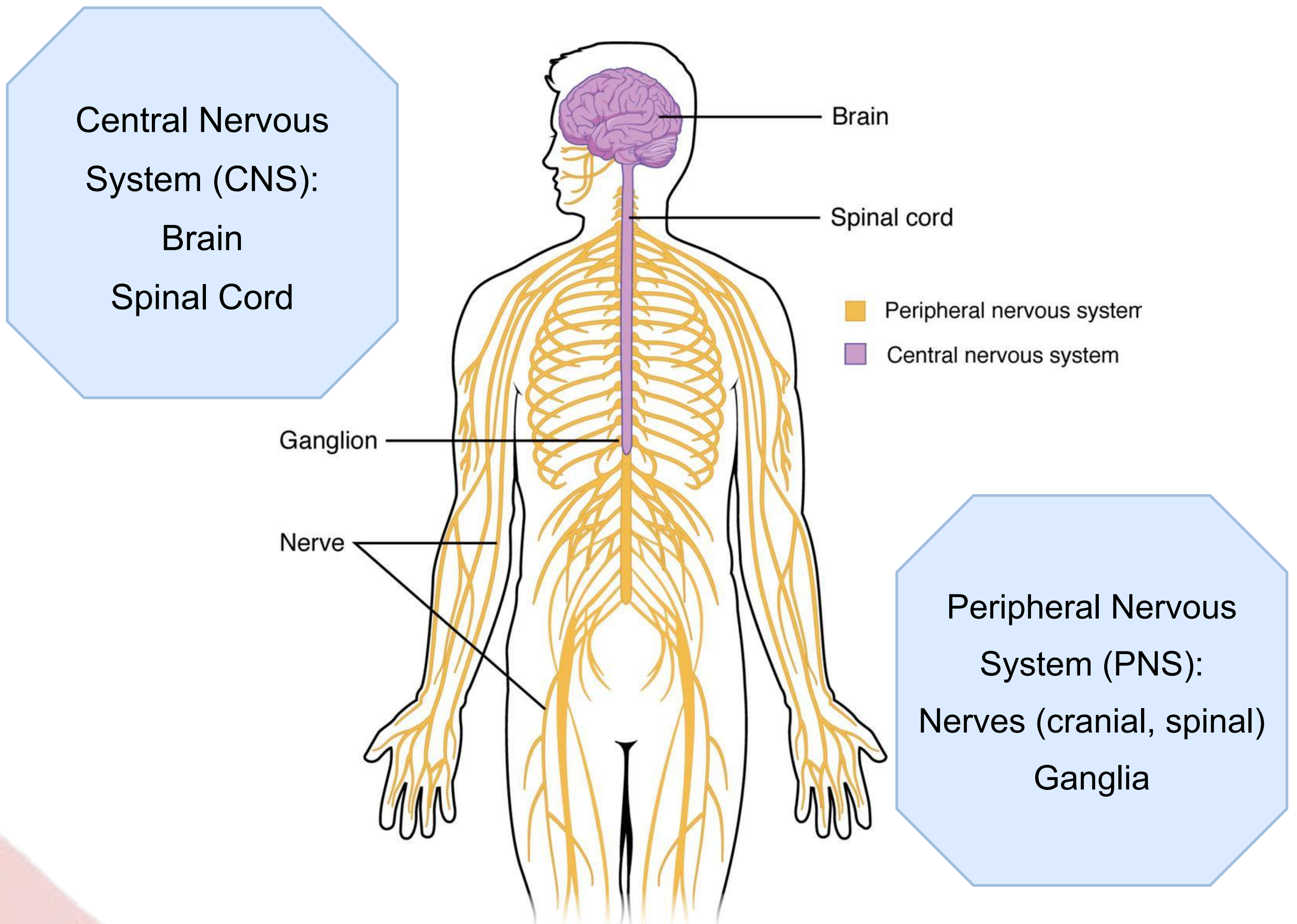
Collection of sensory input: identifies changes occurring inside and outside the body by using sensory receptors. These changes are called stimuli.

Integration: processes, analyses, and interprets these changes and makes decisions.

Effects a response: by activating muscles or glands (effectors) via motor output.

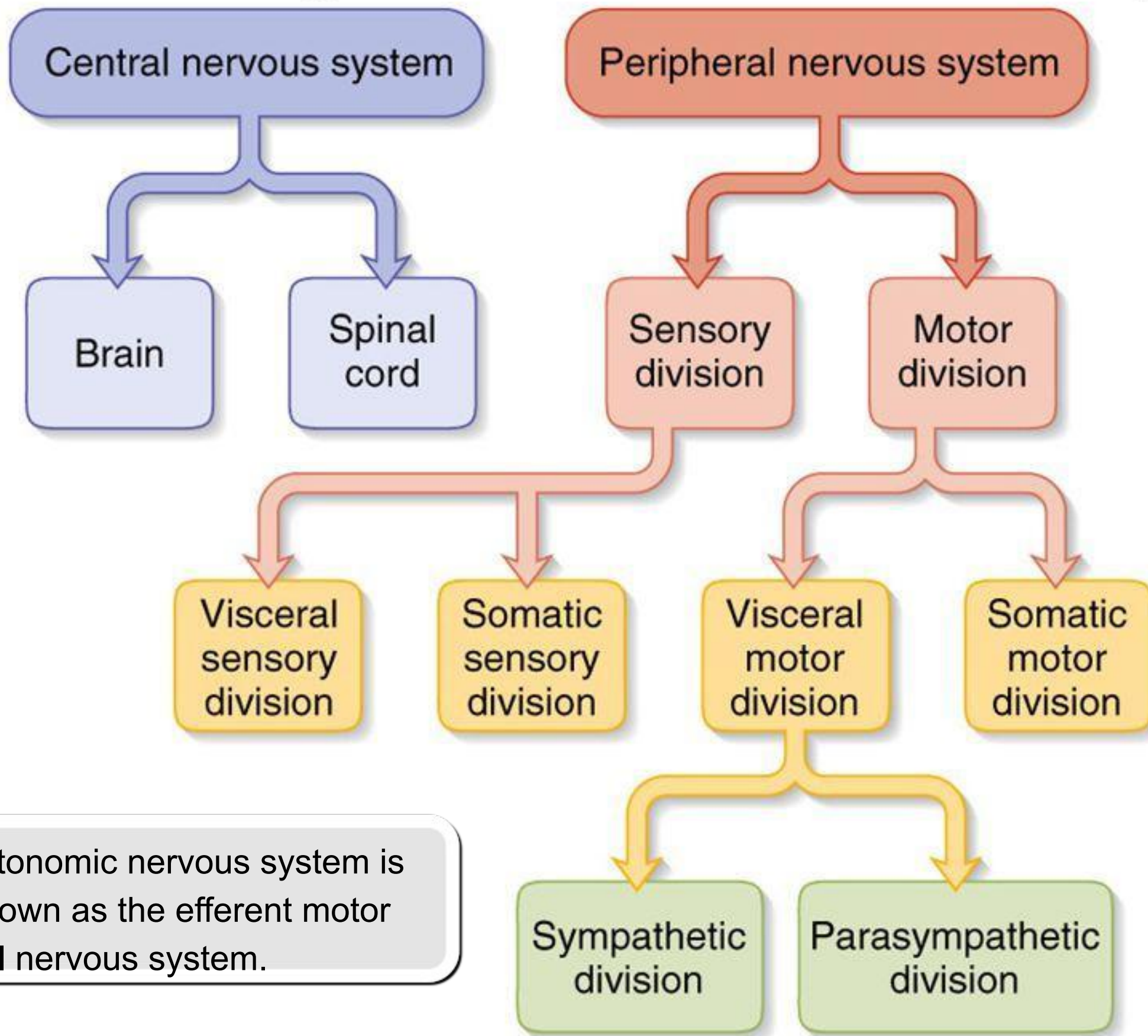


Structural Organization



IMPORTANT!

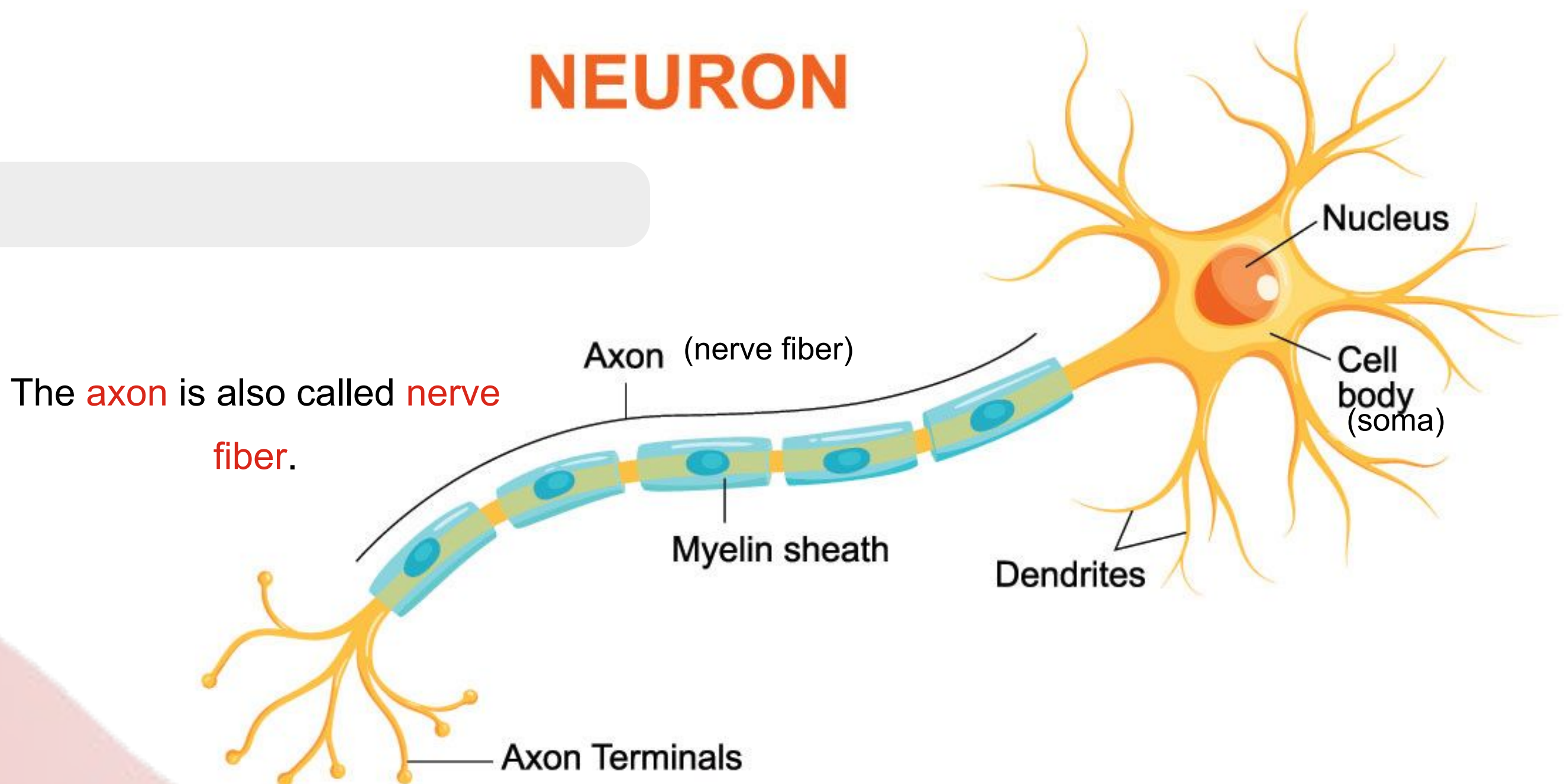
Functional Organization of the Nervous System



The autonomic nervous system is also known as the efferent motor visceral nervous system.

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

NEURON

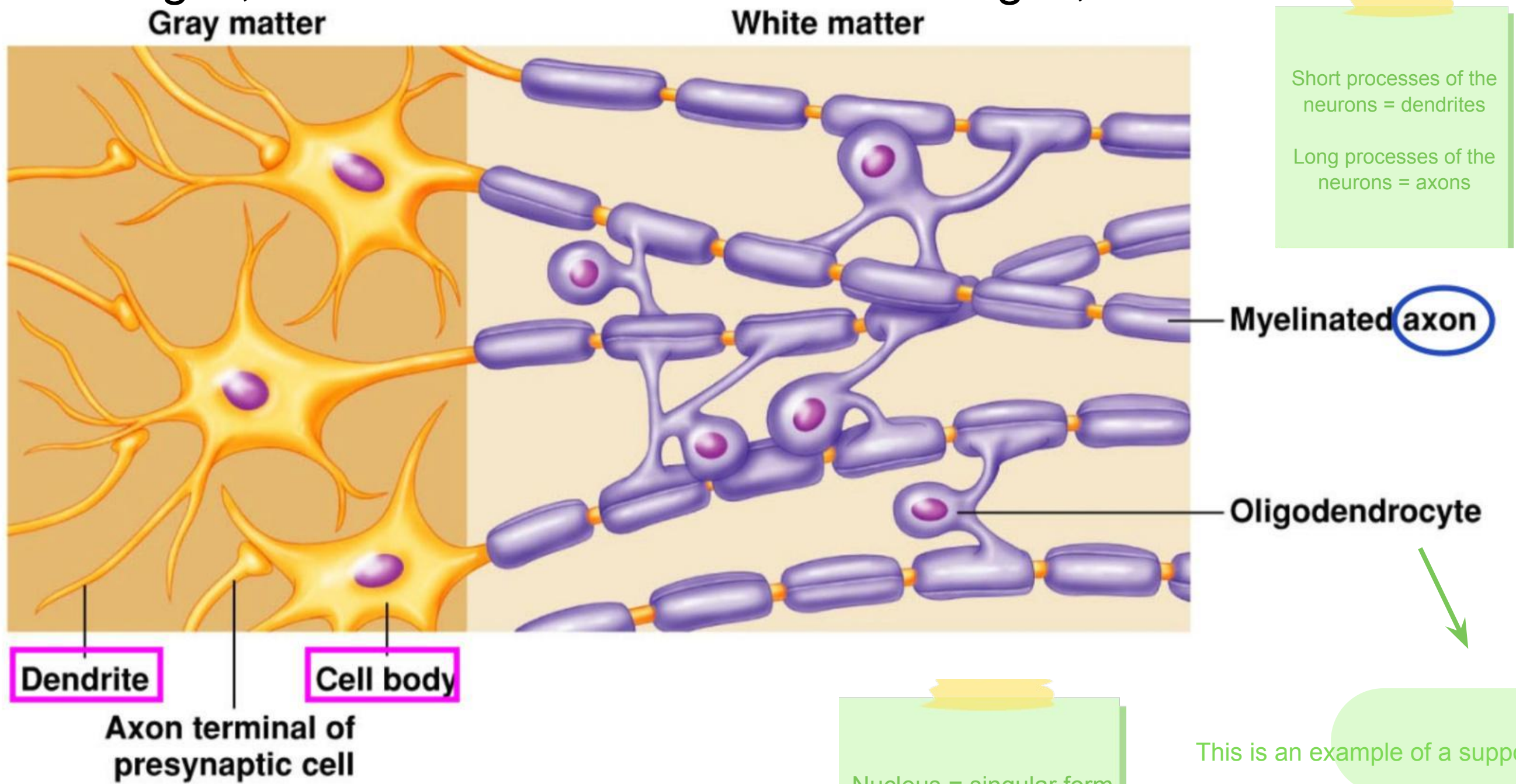


IMPORTANT!

Nervous tissue is organized as:

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

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



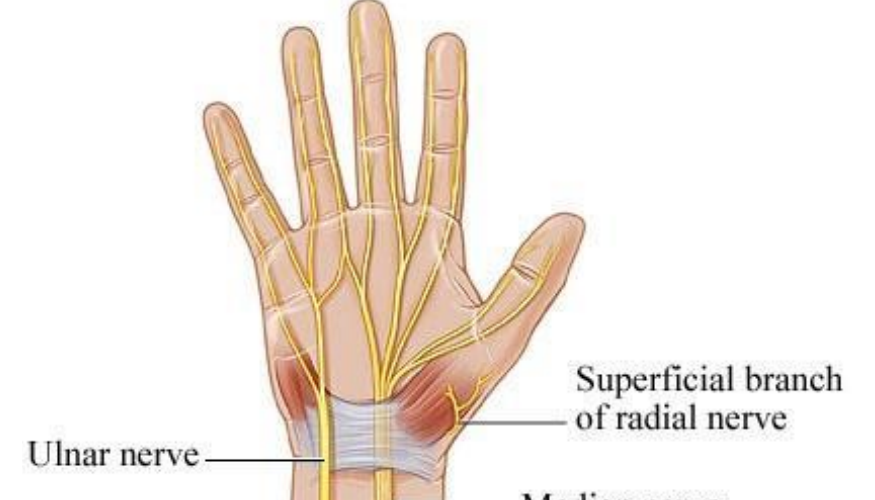
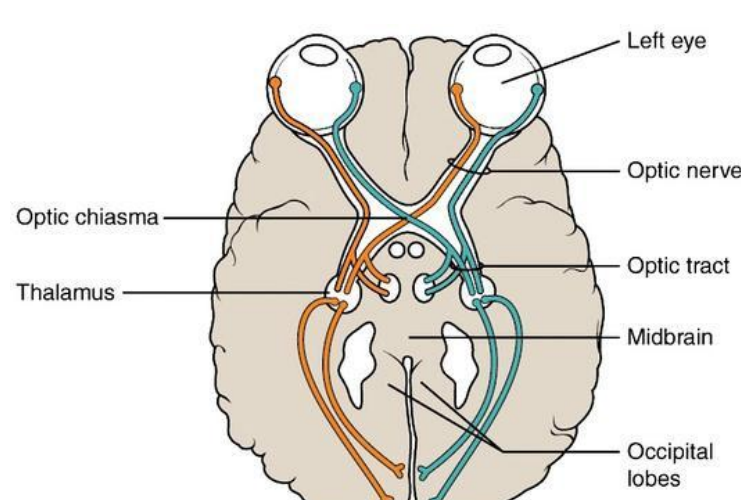
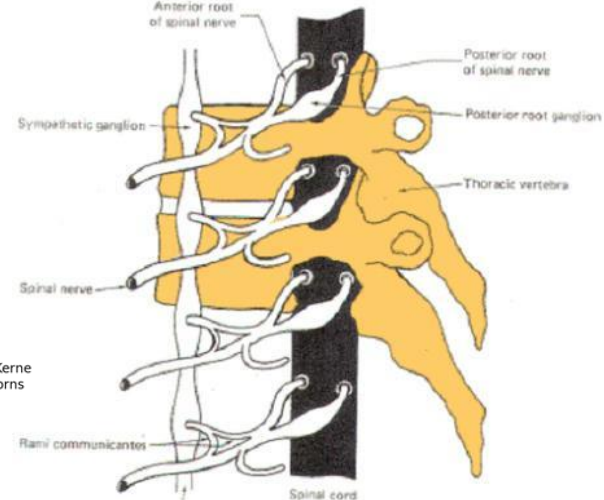
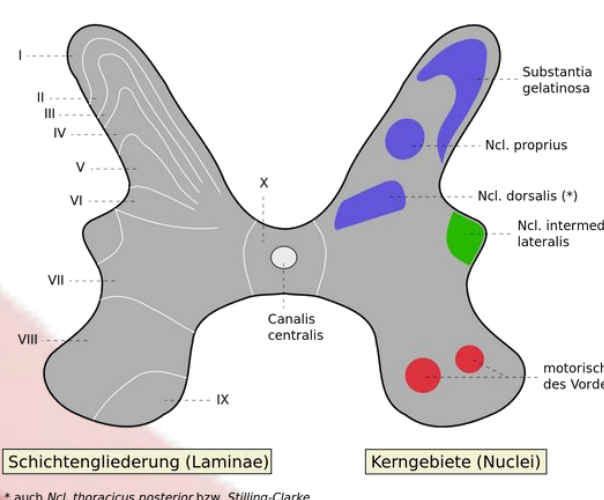
Remember...

A group of **neurons** within the **CNS** is called **nuclei**.

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

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. It has four major regions:

Cerebrum

two cerebral hemisphere

s

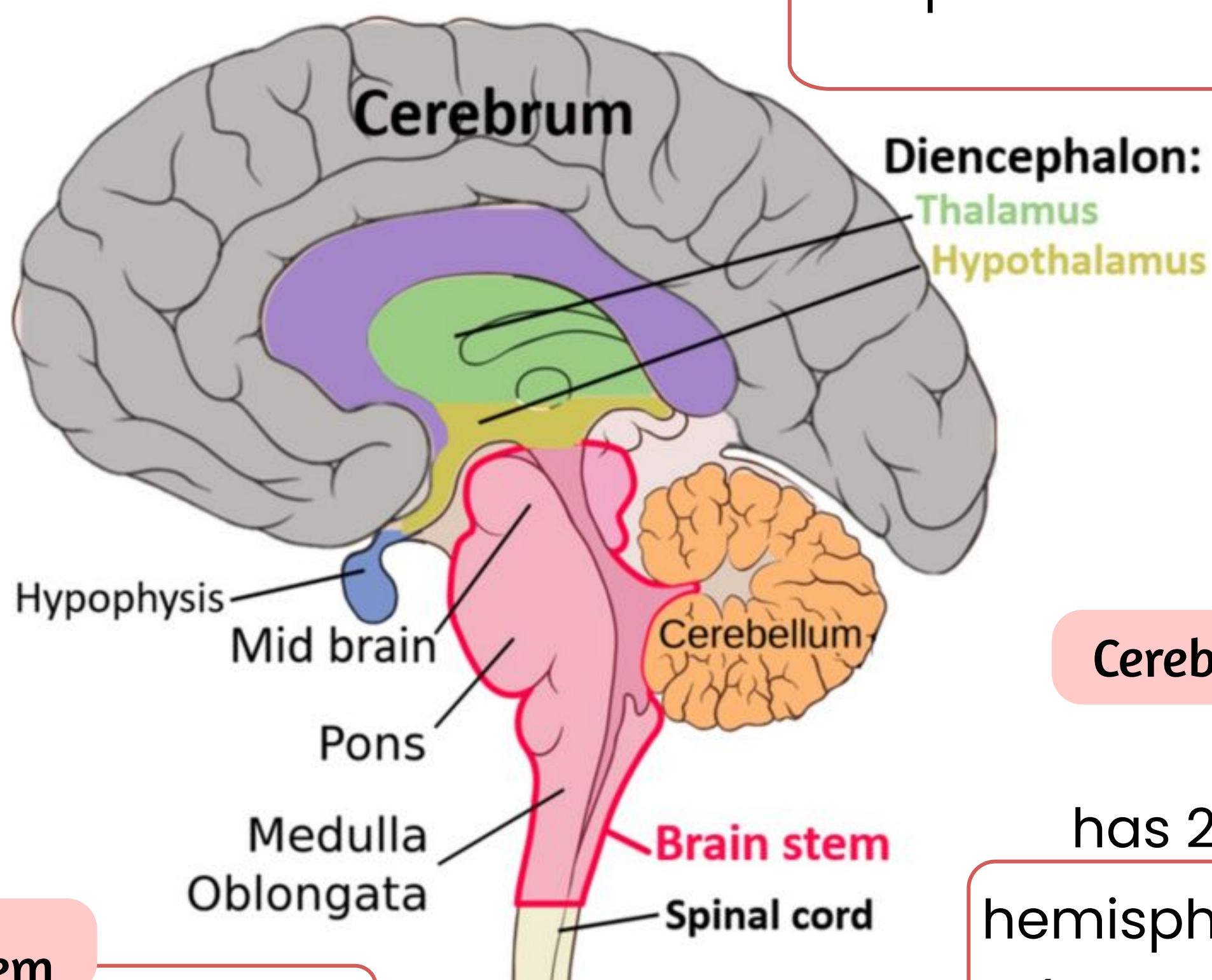
Diencephalon

Thalamus

Hypothalamus

Subthalamus

Epithalamus



Diencephalon:

Thalamus

Hypothalamus

Cerebellum

has 2

hemisphere
s (similar to
the
cerebrum)

Brain Stem

Pons

Medulla

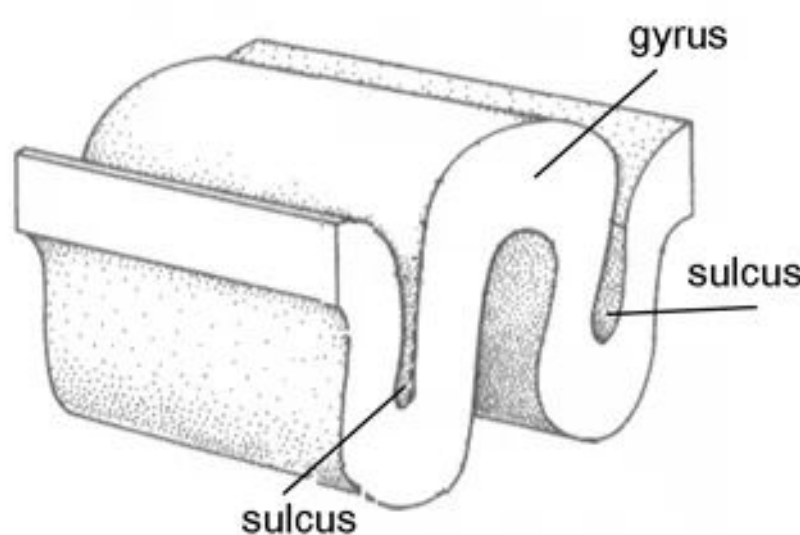
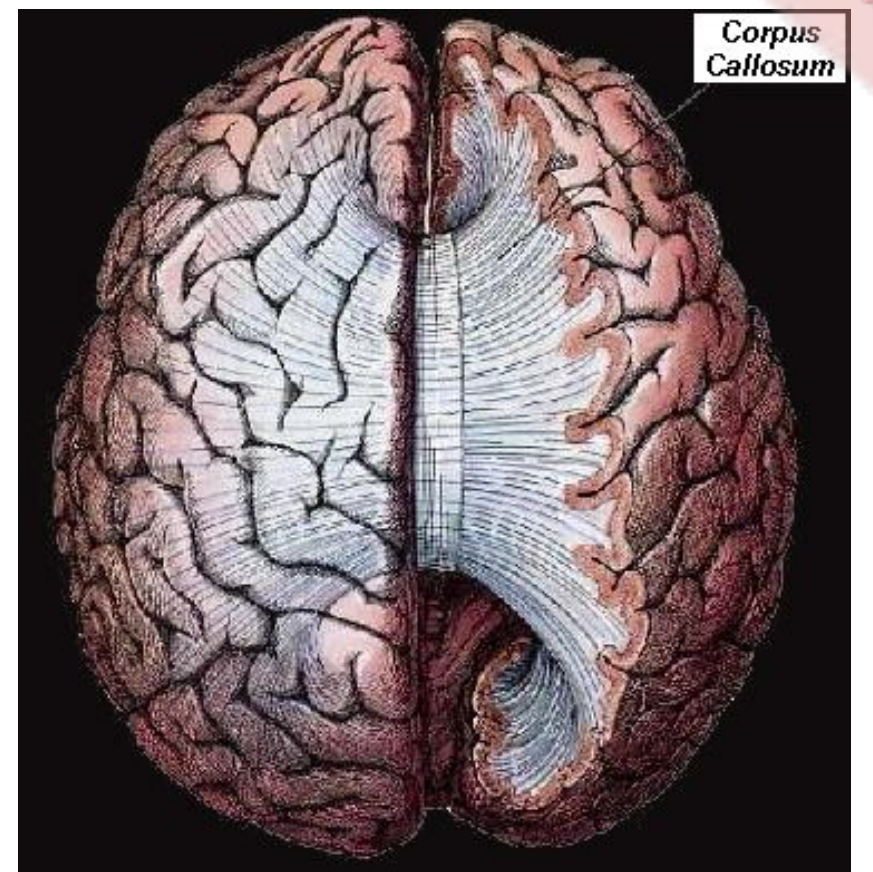
Oblongata

Cerebrum

The largest part of the brain.
cerebrum has **two hemispheres**

The two hemispheres are connected by a
thick bundle of nerve fibers called **corpus**

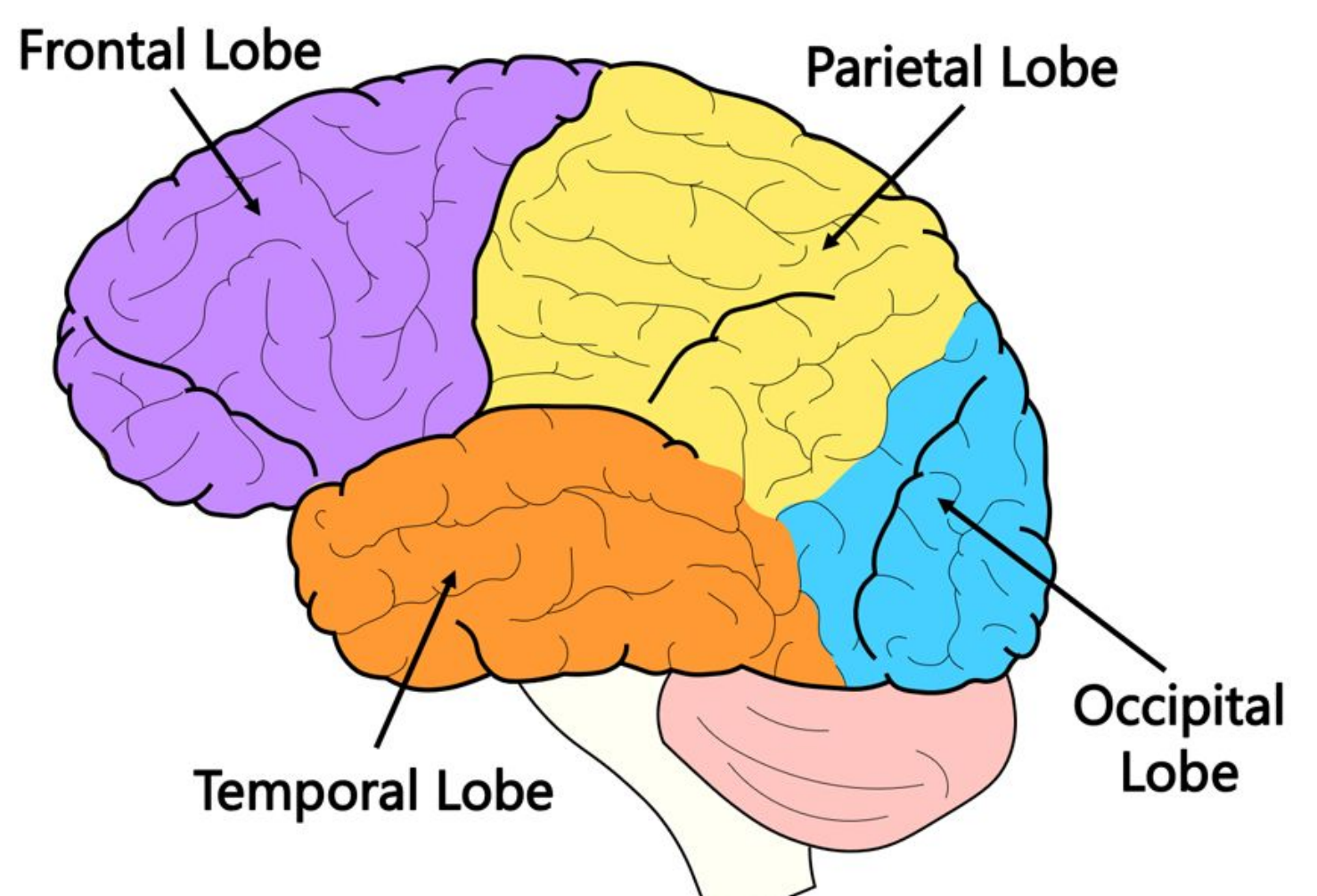
callosum
The surface shows **ridges of tissue** called **gyri**
separated by grooves called **sulci**



- gyri: plural
- gyrus: singular
- sulci: plural
- sulcus: singular

Each hemisphere of the cerebrum is further
divided into 4 lobes:

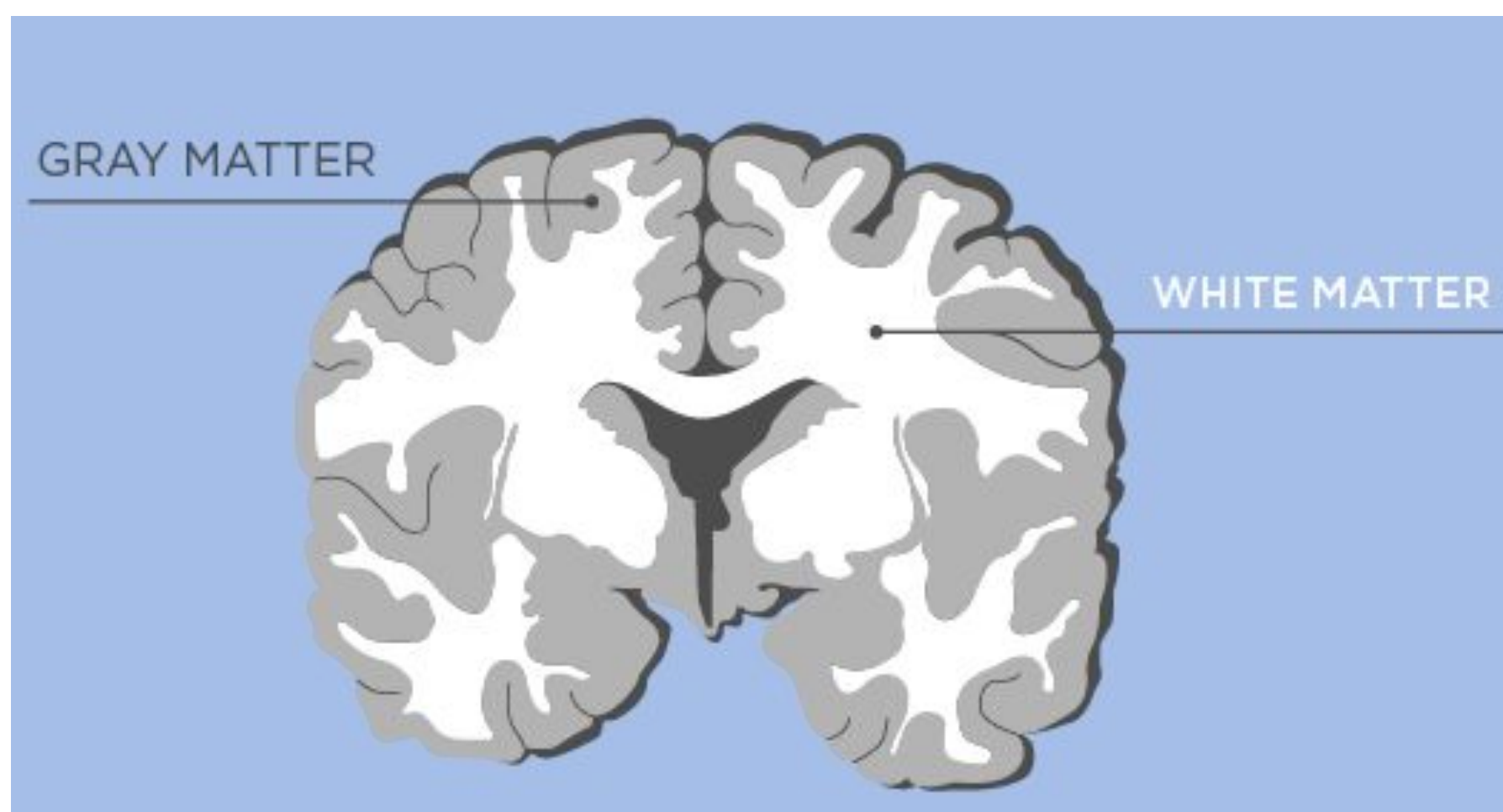
- **Frontal Lobe**
- **Parietal Lobe**
- **Occipital Lobe**
- **Temporal Lobe**



Tissue of the Cerebral Hemisphere

Outermost layer is called **grey matter** or **cortex**

Deeper within the grey matter is the **white matter**; composed of **fiber tracts** (bundles of nerve fibers), carrying impulse to and from the cortex (grey matter)



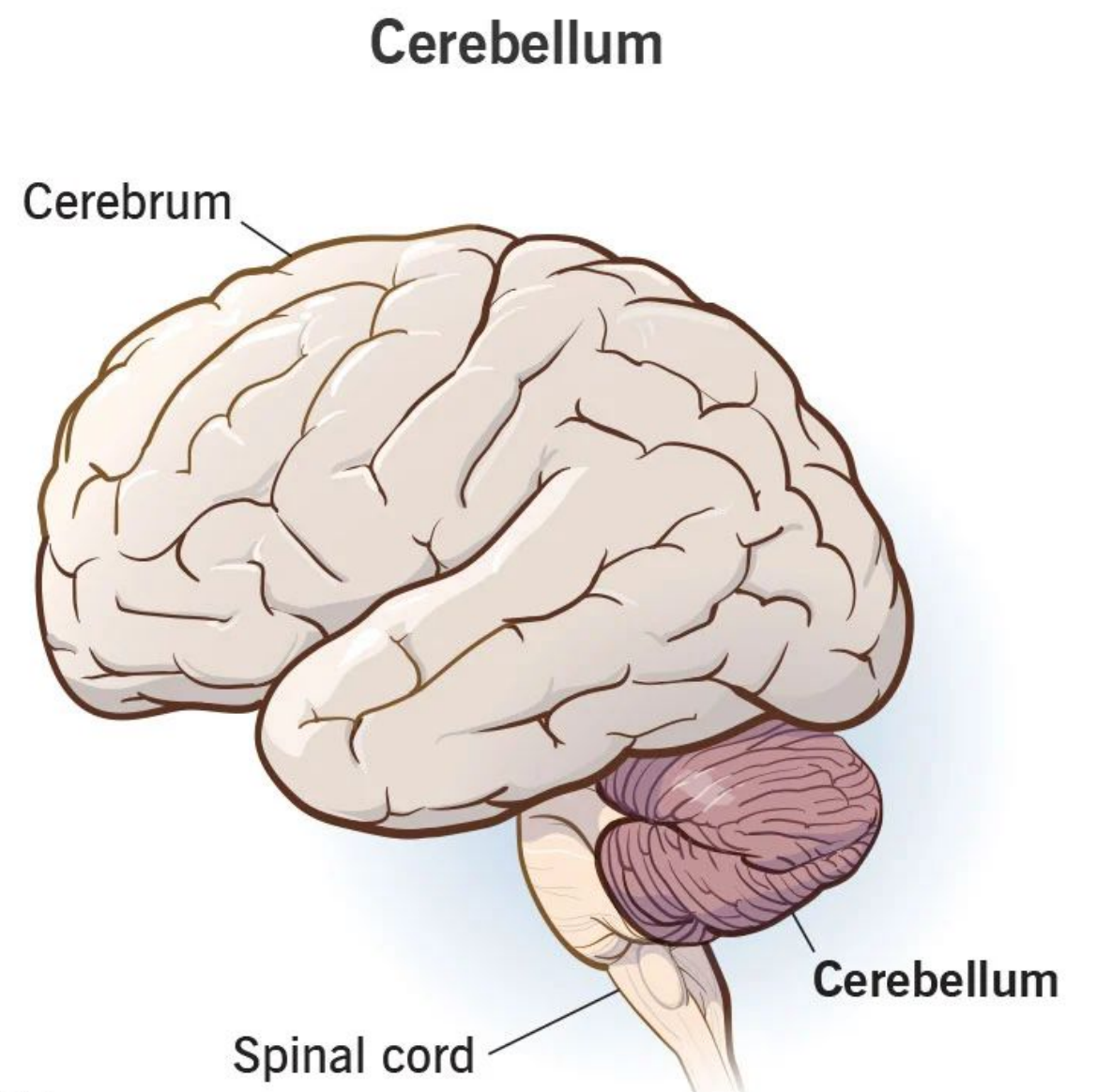
Deeper within the white matter is the **basal nuclei**. They help the motor cortex in regulating voluntary motor activities. (motor control).

The basal nuclei has Grey matter in it

Cerebellum

The part of the brain that gives **precise coordination** and helps **maintain equilibrium**

Similar to the cerebrum:

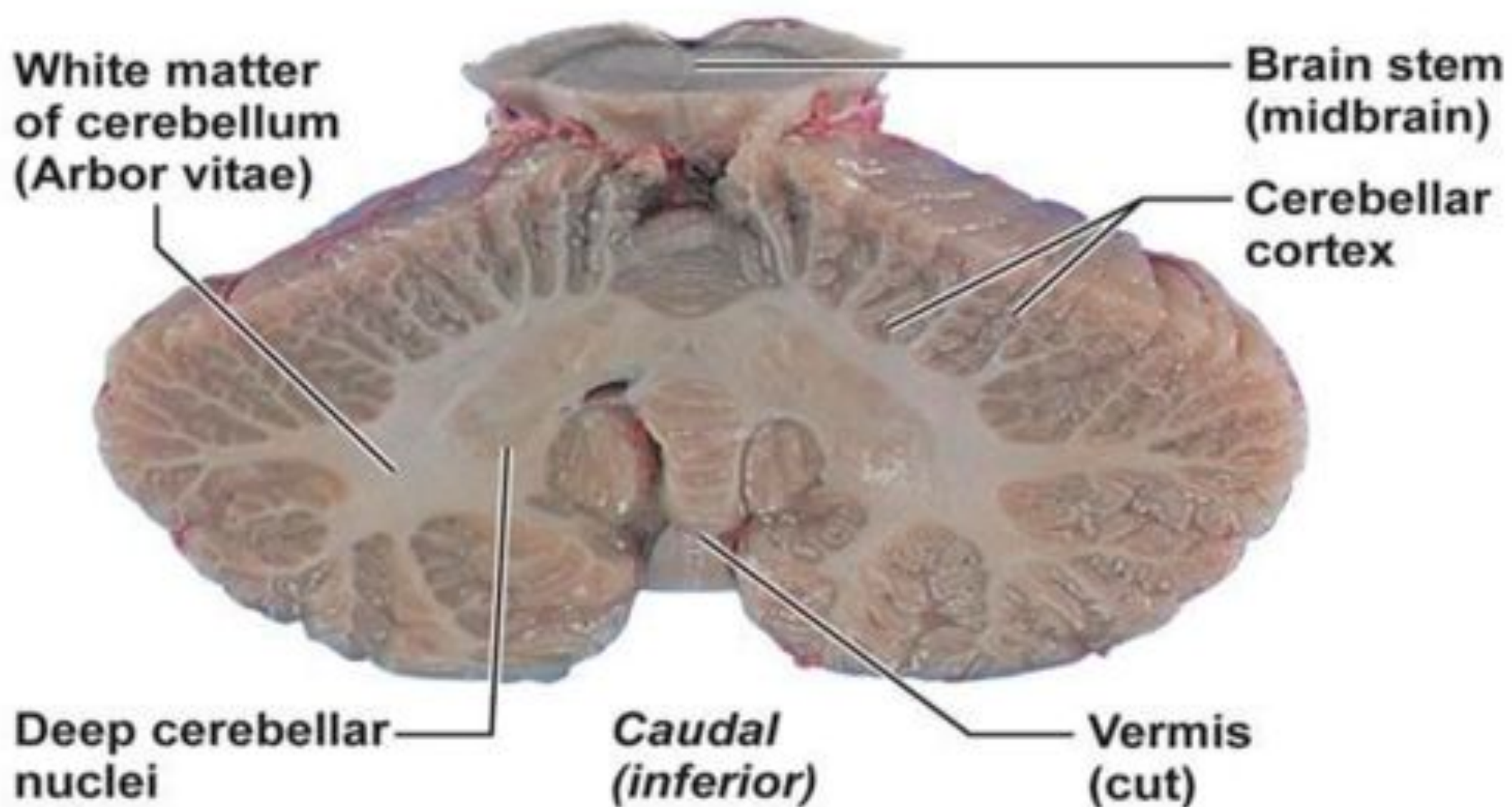


It has **2 hemispheres** and a convoluted surface

(سطح معقد)

The outer layer is made up of **grey matter** and on the inside, it is made up of **white matter**

The Cerebellum – White and Gray Matter



(d) Coronal section, posterior view

The Spinal Cord

It's a two-way conduction pathway to the brain, and it is a major reflex center

42-45 cm long, cylindrical in shape, and can be found in the vertebral canal

From foramen magnum to L2 vertebra

Caudal Tapering End called **Conus Medullaris**

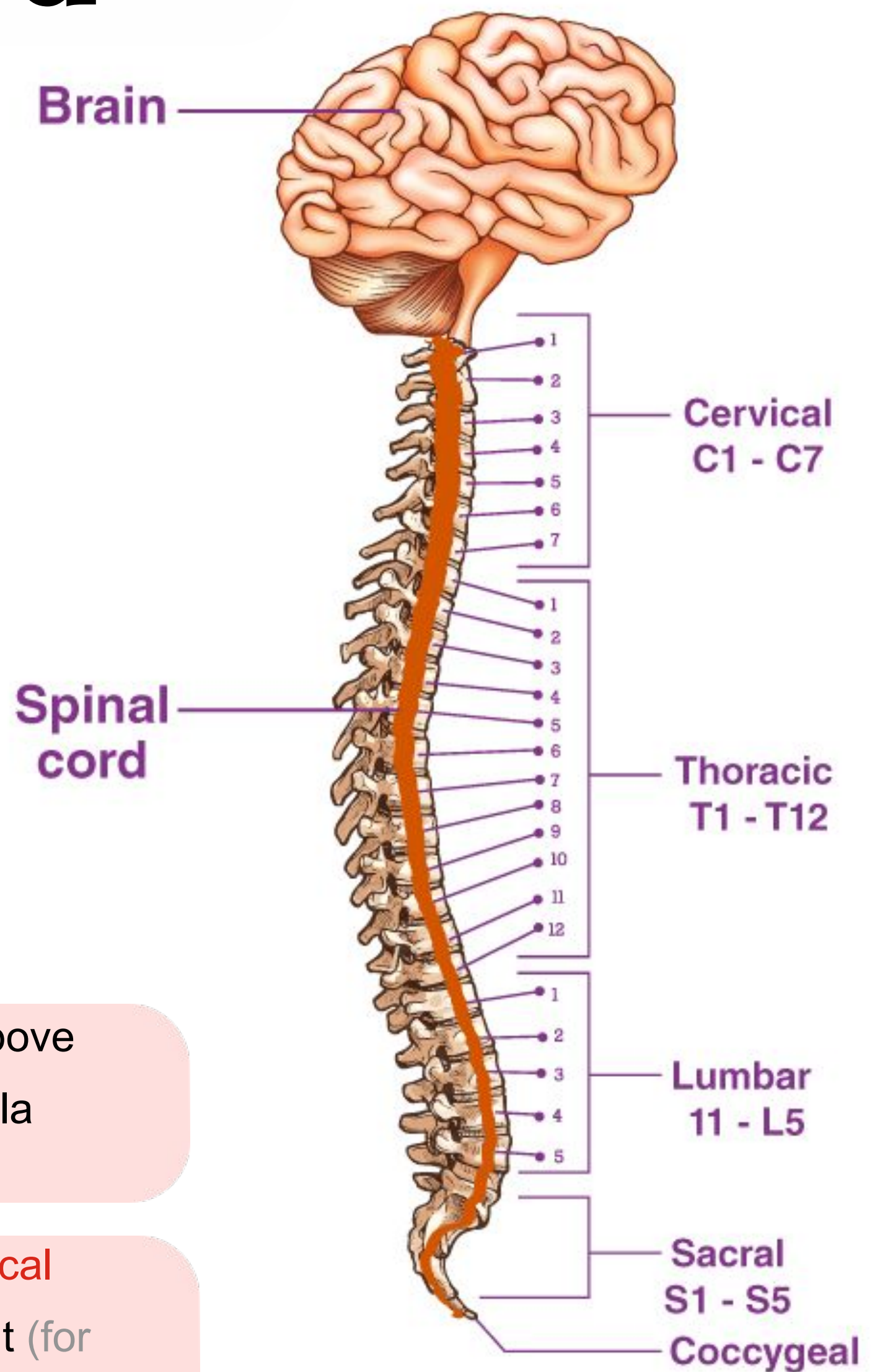
Has **Lumbosacral Enlargement** (for lower limb muscles)

Cauda Equina are the group of spinal nerves near the end

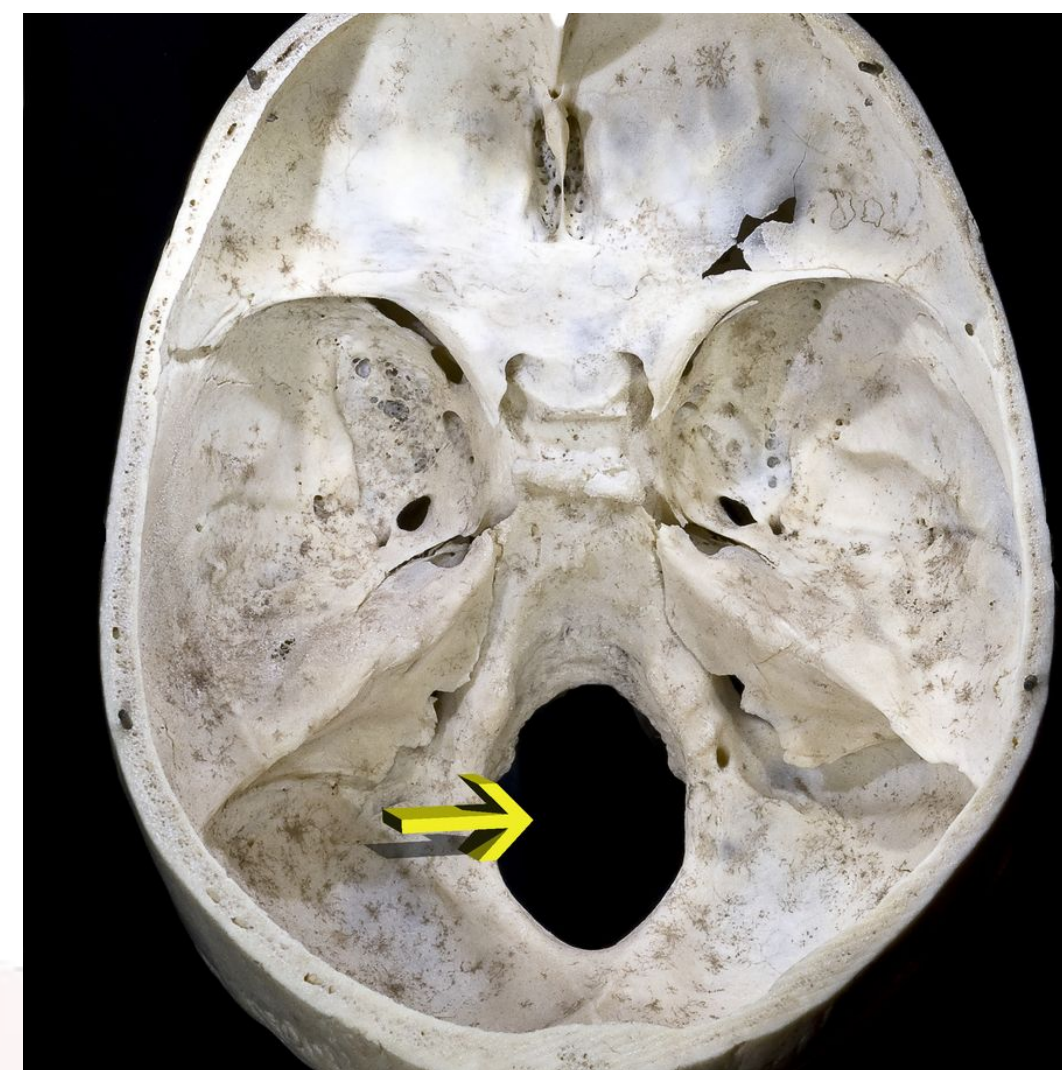
Continuous above with the Medulla Oblongata

Has **Cervical Enlargement** (for upper limb muscles)

Gives rise to **31 pairs** of spinal nerves



Foramen Magnum



Cross Section of the Spinal Cord

Incompletely divided into 2 parts:

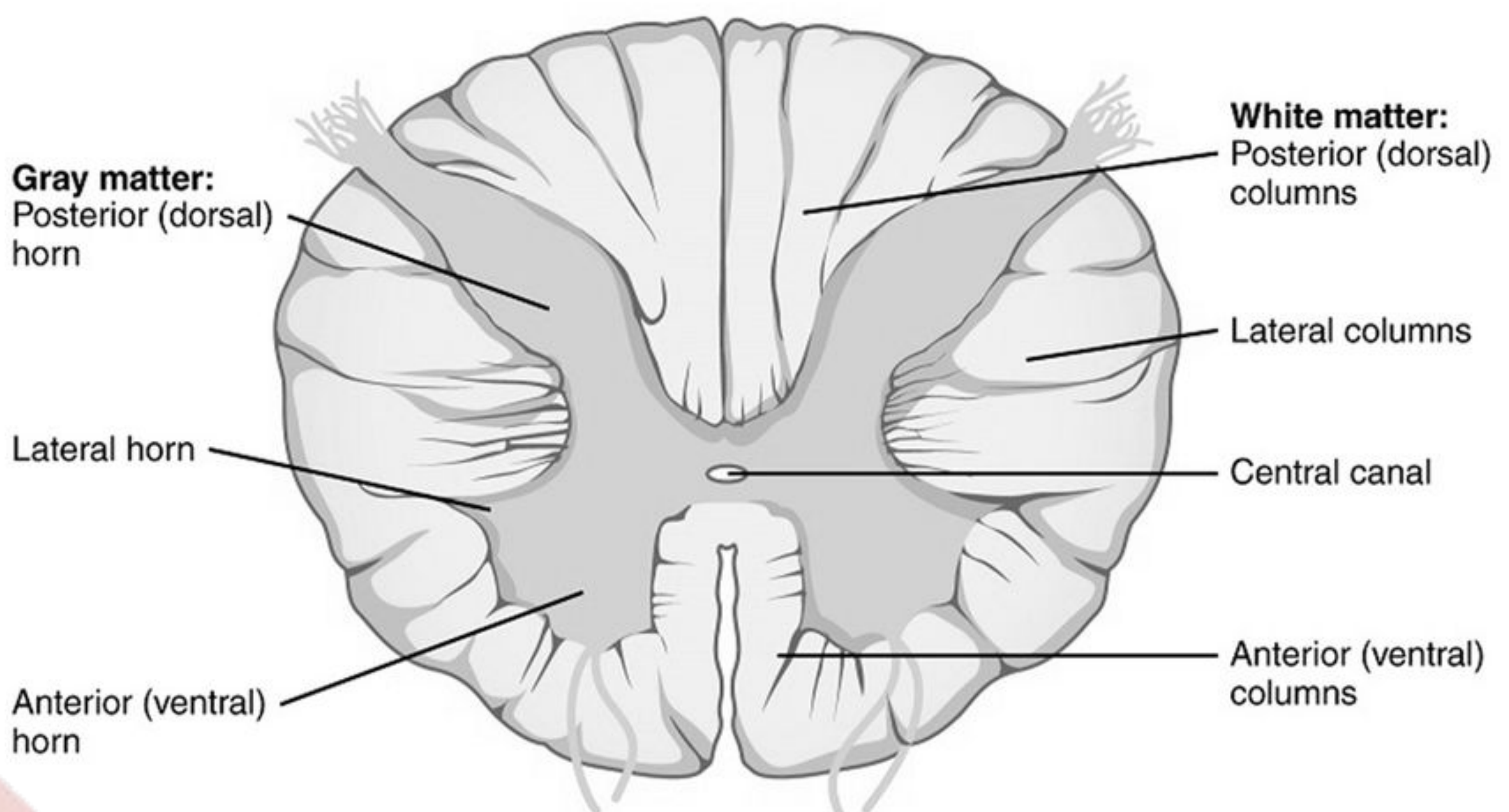
- Anteriorly: by a short, shallow median fissure
- Posteriorly: by a deep, narrow median septum composed of **grey matter** in the center surrounded by **white matter**

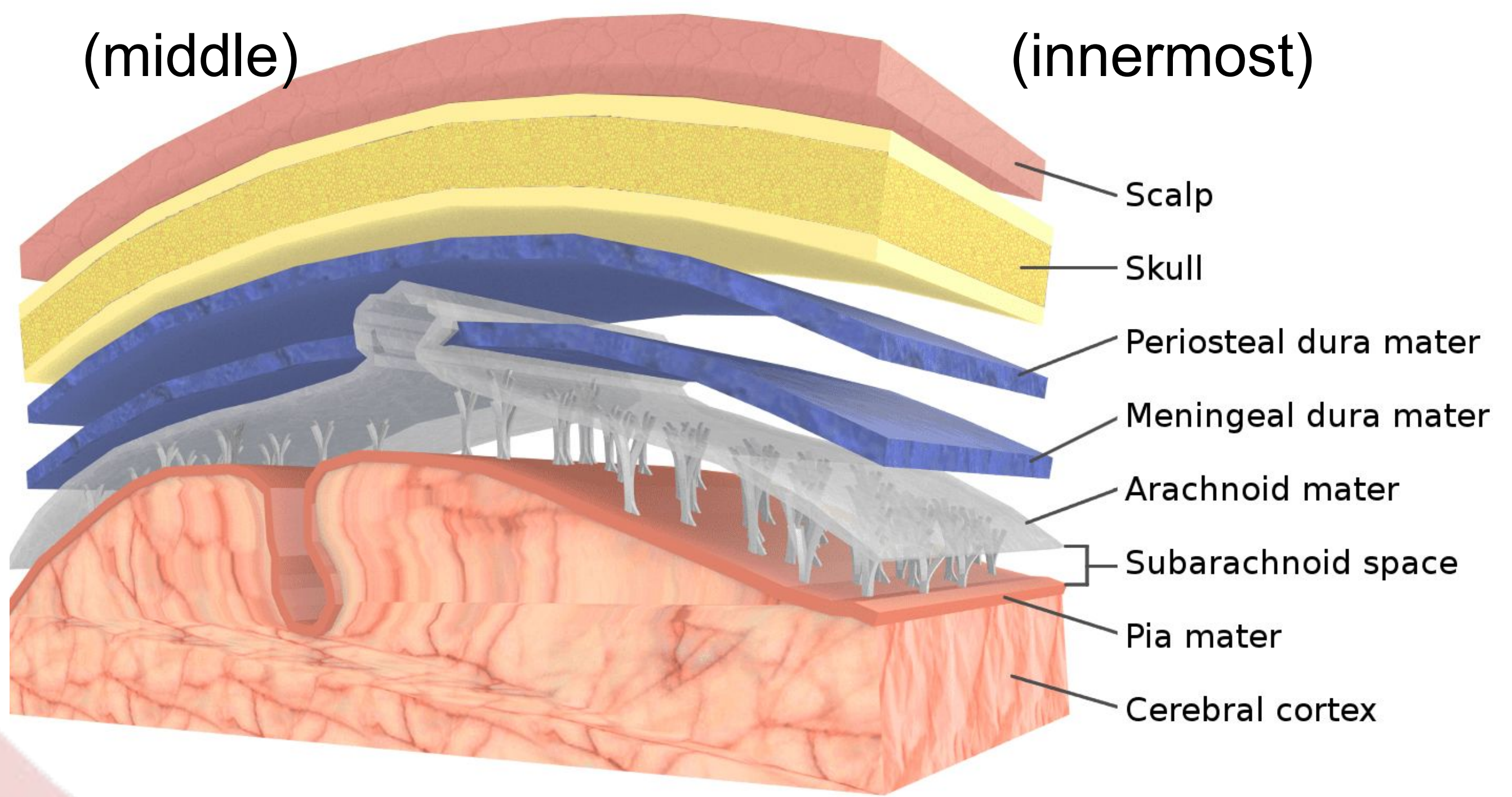
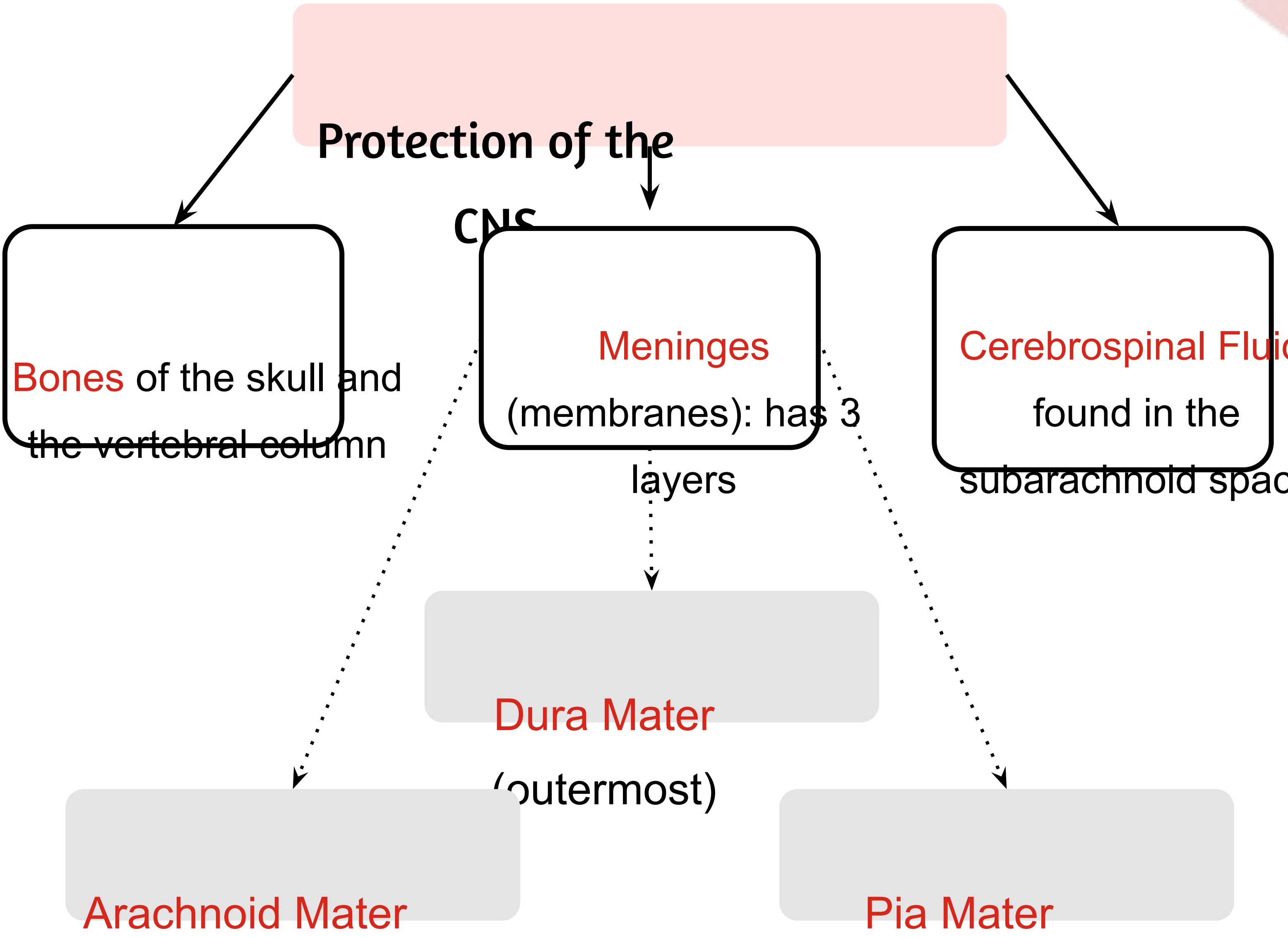
(contrary to cerebellum and cerebrum)

The grey matter is arranged in a way that makes the letter **H** that contains: **two anterior, two posterior, and two lateral horns**



The lateral horns are not present in all of the spinal cord (they're only present in the thoracolumbar region)



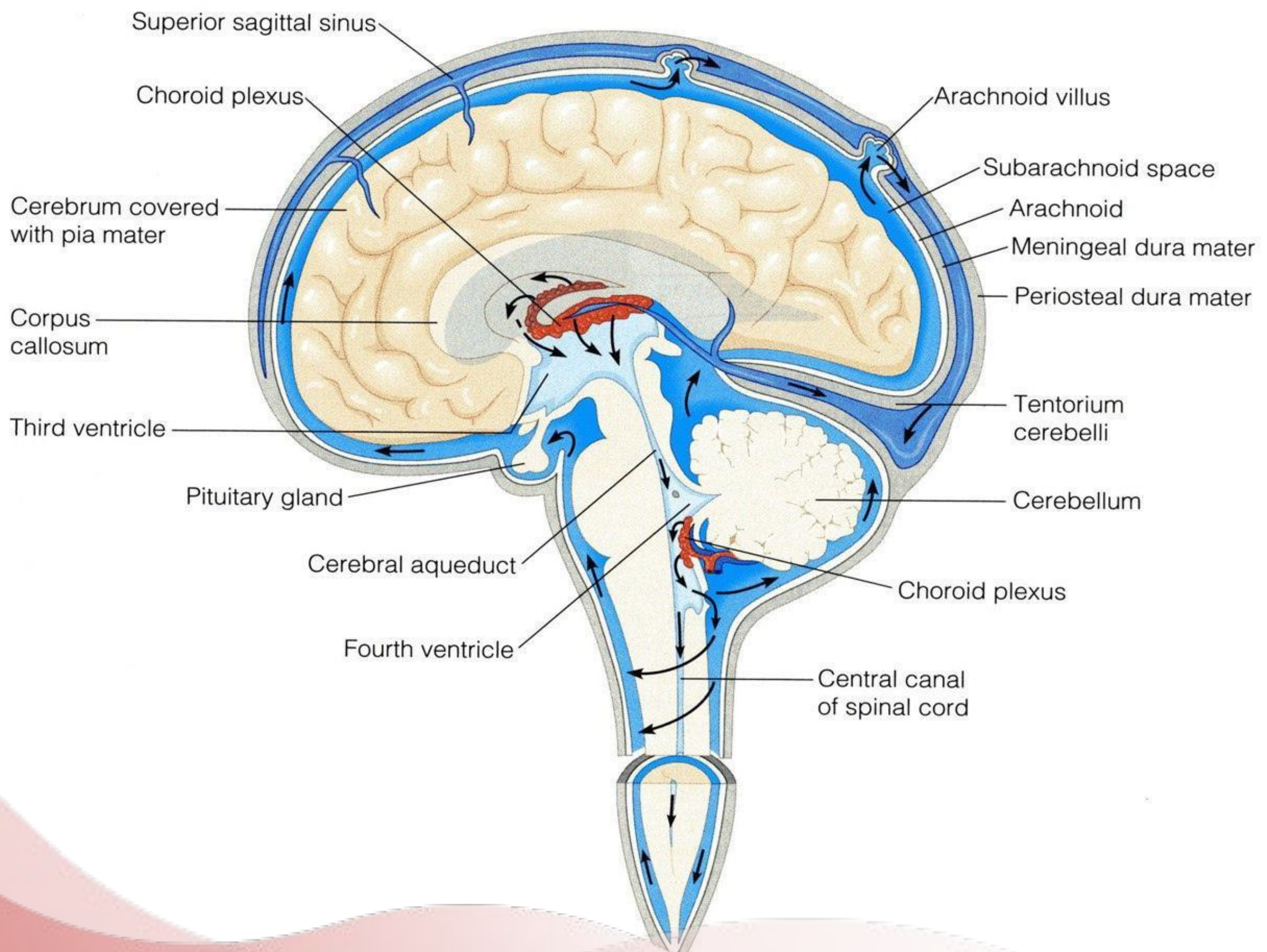


Cerebrospinal fluid (CSF)

1 CSF is Constantly **Produced** by the **Choroid plexuses** inside the ventricles of the brain.

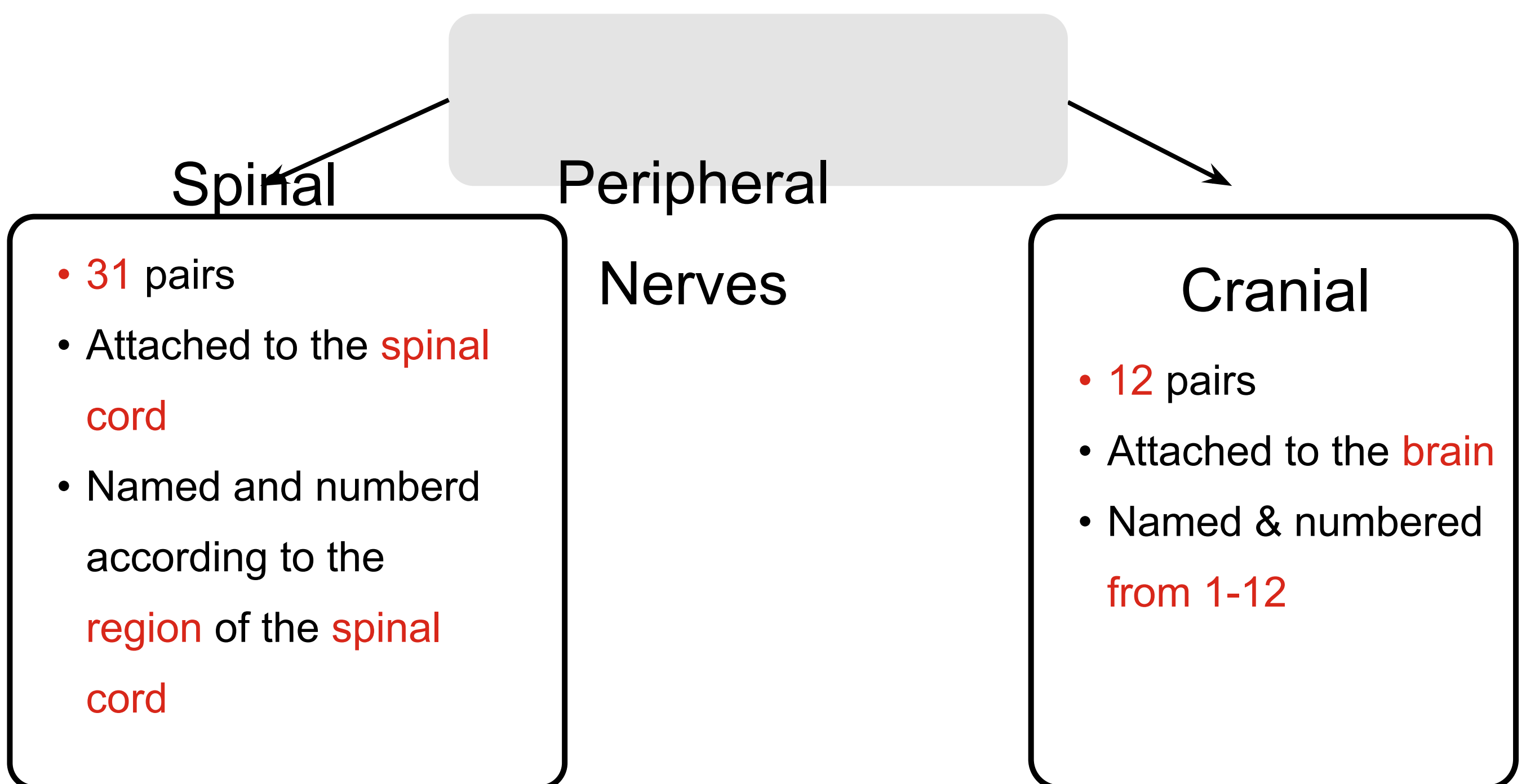
2 Most of the CSF drains from the ventricles into the **subarachnoid space** around the brain and spinal cord. A little amount flows down in the **central canal** of the spinal cord.

3 CSF is constantly **drained** into the **dural venous sinuses** (superior sagittal sinus) through the **arachnoid villi**.



Peripheral Nerves

May be **sensory**, **motor**, or **mixed**, and there are two types:



Cranial Nerves



12 pairs

4 pairs are mixed

- trigeminal n. (5th)
- facial n. (7th)
- glossopharyngeal n. (9th)
- vagus n. (10th)

5 pairs are motor

- oculomotor n. (3rd)
- trochlear n. (4th)
- abducens n. (6th)
- accessory n. (11th)
- hypoglossal n. (12th)

3 pairs are sensory

- olfactory n. (1st)
- optic n. (2nd)
- vestibulocochlear n. (8th)

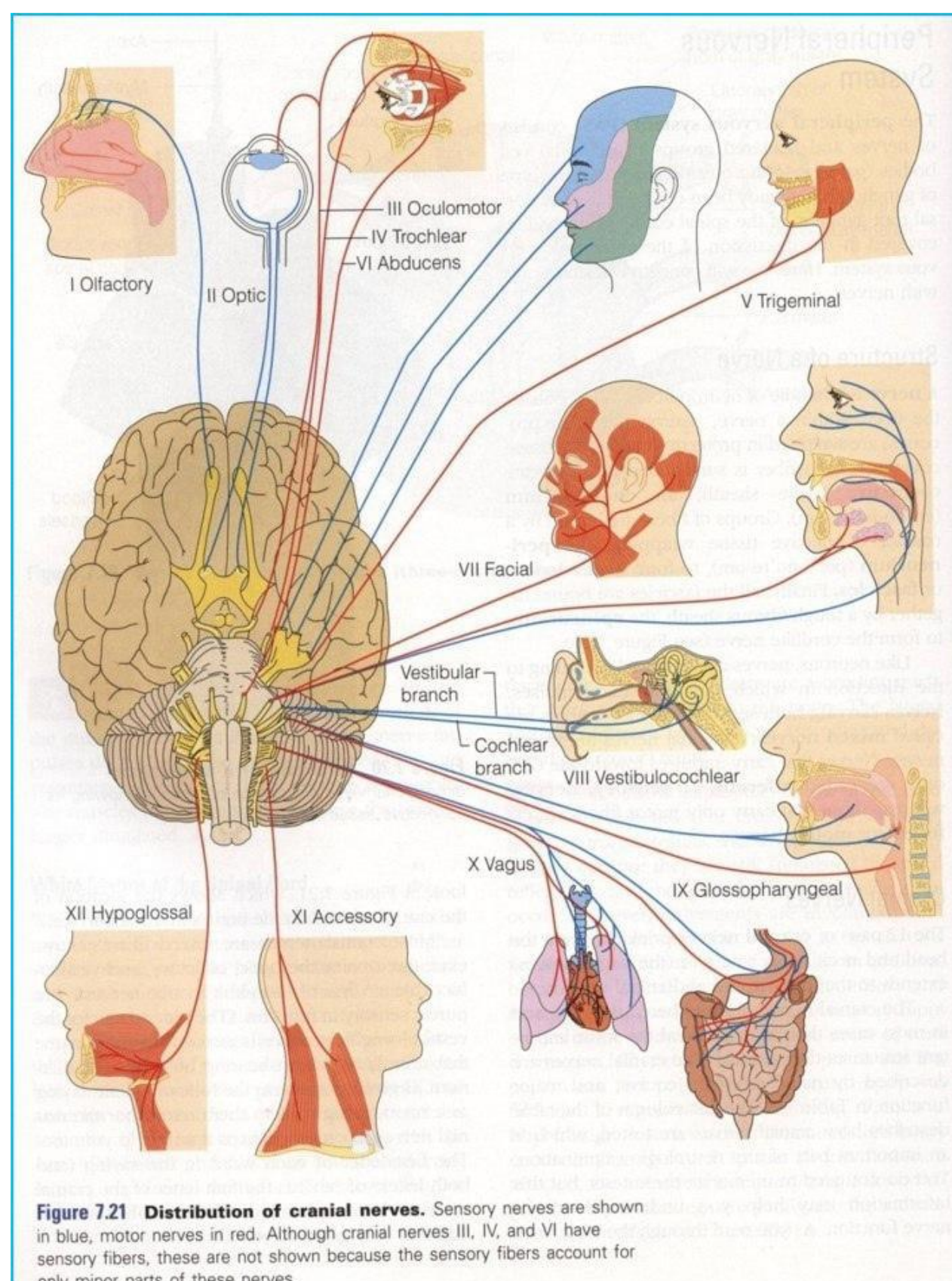


Figure 7.21 Distribution of cranial nerves. Sensory nerves are shown in blue, motor nerves in red. Although cranial nerves III, IV, and VI have sensory fibers, these are not shown because the sensory fibers account for only minor parts of these nerves.

Spinal Nerves and Nerve Plexuses

31 pairs, each spinal nerve is attached by two dorsal (sensory) & ventral (motor) roots.

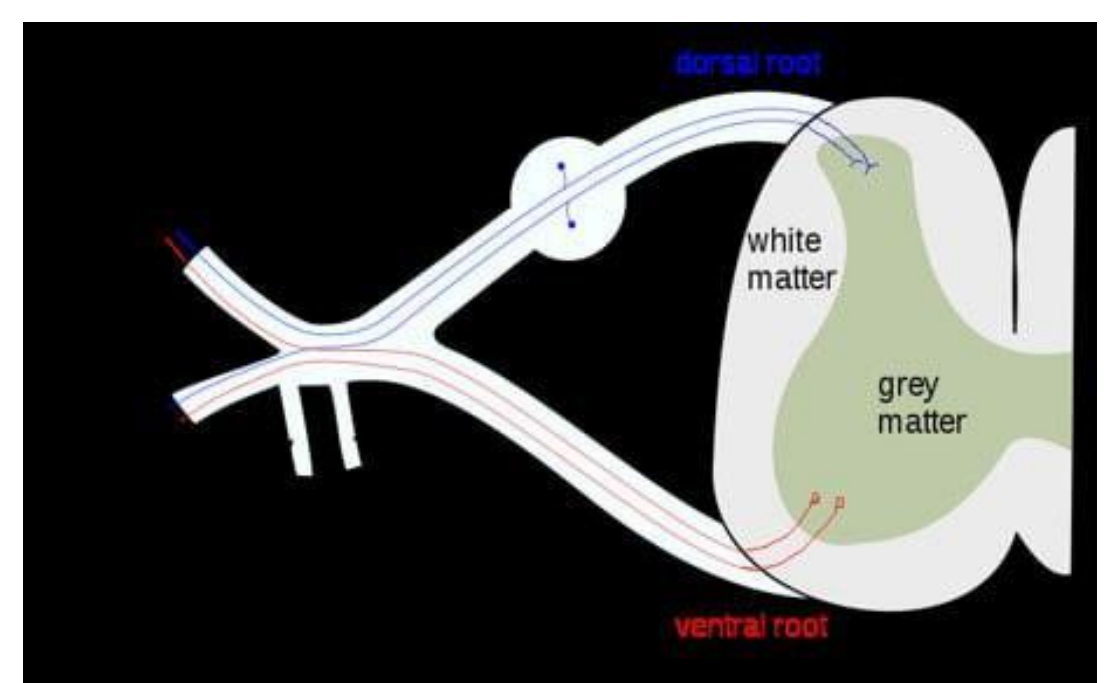
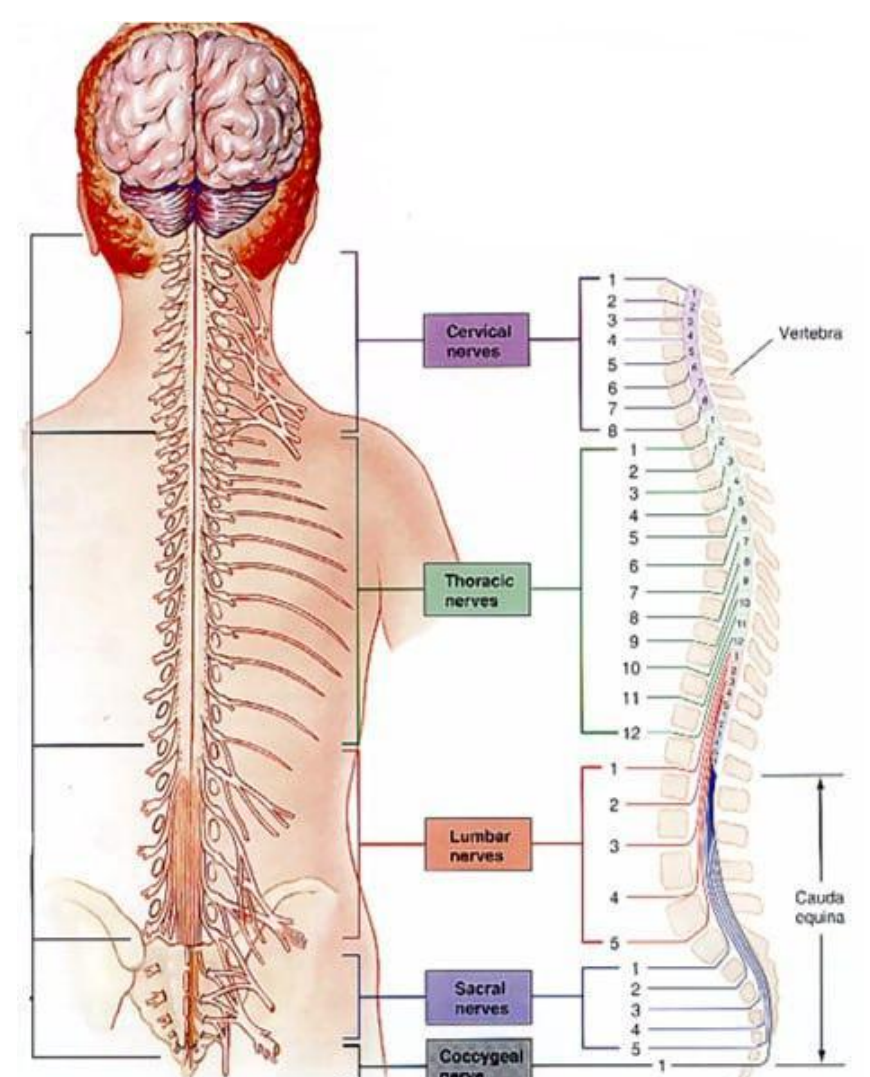
Dorsal root bears a sensory ganglion (DRG)

Each spinal nerve exits from the intervertebral foramen and divides into a dorsal and ventral ramus.

The rami contain both sensory and motor fibers

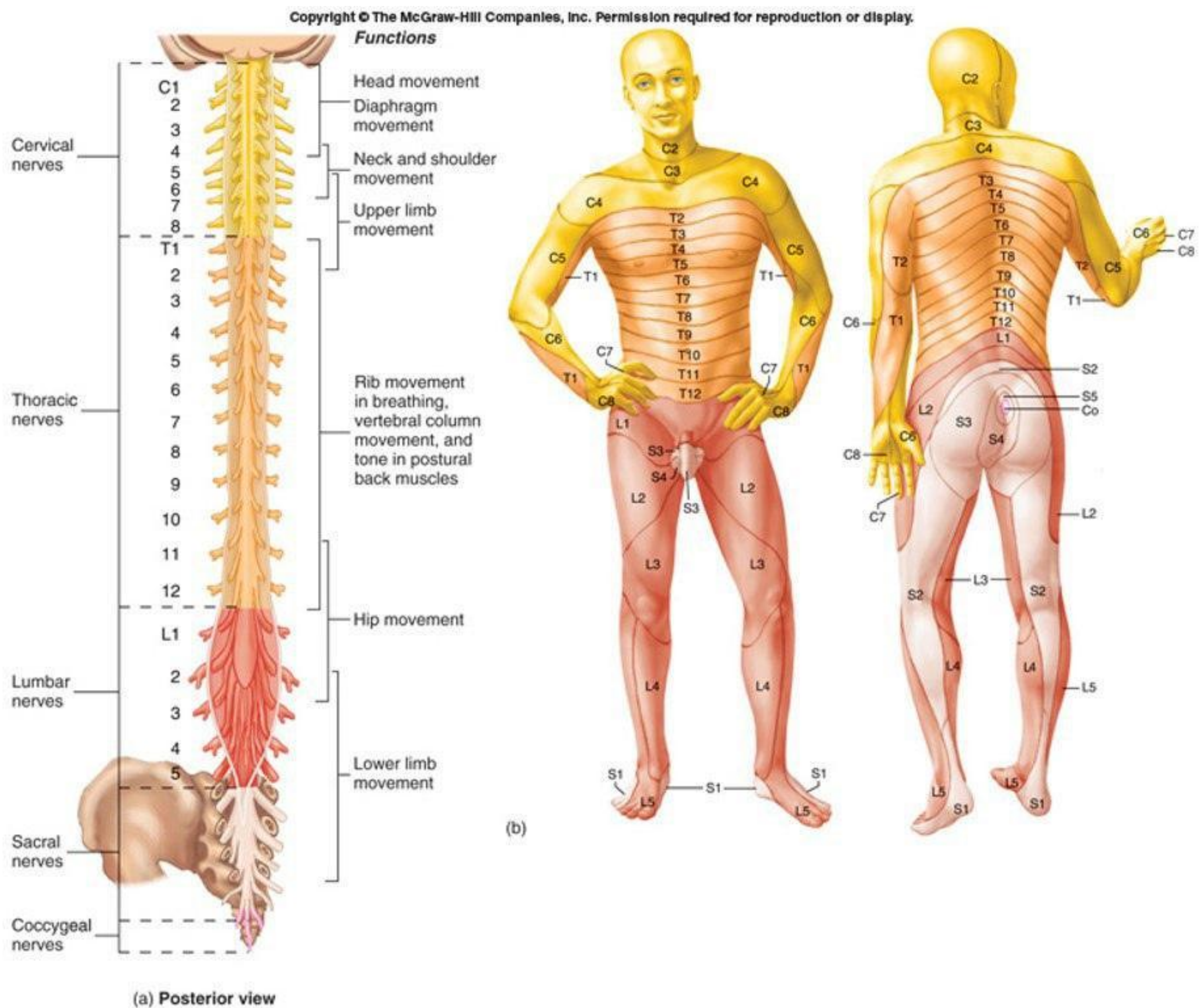
The dorsal rami are distributed individually, supply the skin and muscles of the back.

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'**

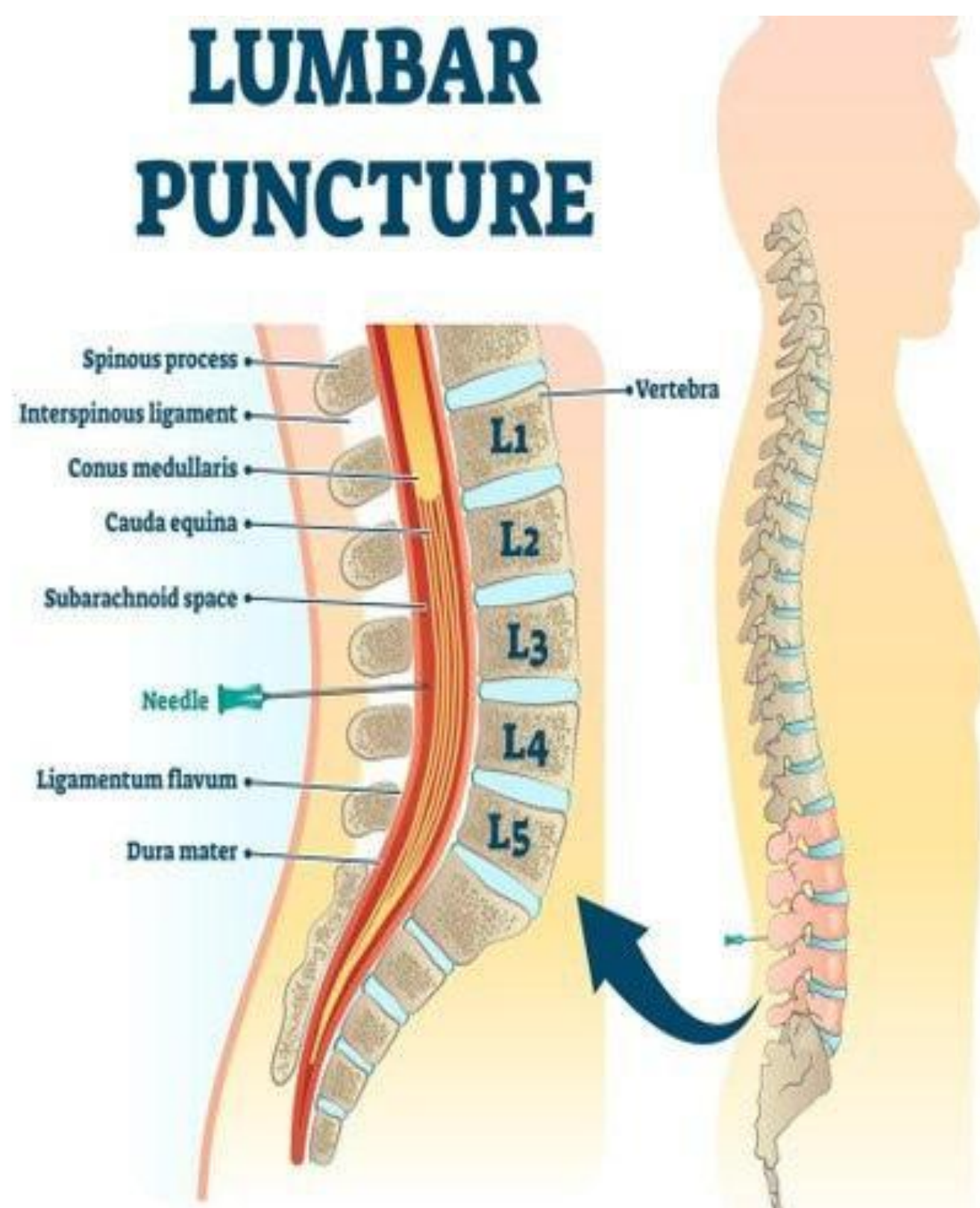


Diagnostic Lumbar Puncture

Girls' Slides

IMPORTANT!

- ◆ It is one of the **most commonly** performed invasive tests in clinical medicine.
- ◆ Lumbar puncture (LP) occurs between **L3 - L4** vertebrae for CSF collection.
- ◆ It is **essential** for the diagnosis of inflammatory and infectious disease of the nervous system (as meningitis) and in cases of subarachnoid hemorrhage.



MCQs

1

Which one of the following belongs to the ganglia?

A- Groups of neurons outside the CNS

B- Groups of neurons inside the CNS

C- Groups of fibers inside the CNS

D- Groups of fibers outside the CNS

2

The CSF is formed by which one of the following?

A- Dura mater

B- Arachnoid mater

C- Choroid plexuses

D- Dural sinuses

3

A patient is diagnosed with lumbar puncture as meningitis. At which level can we do this puncture?

A- Between L2-L3 vertebrae

B- Between L4-L5 vertebrae

C- Between L3-L4 vertebrae

D- Between S1-S2 vertebrae

4

At which one of the following sites is CSF finally drained?

A- Subdural space

B- Subarachnoid space

C- Arachnoid villi

D- Dural venous sinus



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