

Anatomy

Nervous system

Assistant Lecturer • Purnima Hase

Introduction

Nervous System

The human **Nervous system** is the most complex system in the human body , is formed by a network of more than **100 million** nerve cells (**neurons**) assisted by many more **glial cells** .

Anatomically the nervous system is divided into the **Central Nervous System** consisting of the brain and the spinal cord and the **Peripheral Nervous System**, composed of the nerve fibers and small aggregates of nerve cells called nerve ganglia.

Central Nervous System

Brain

Spinal cord

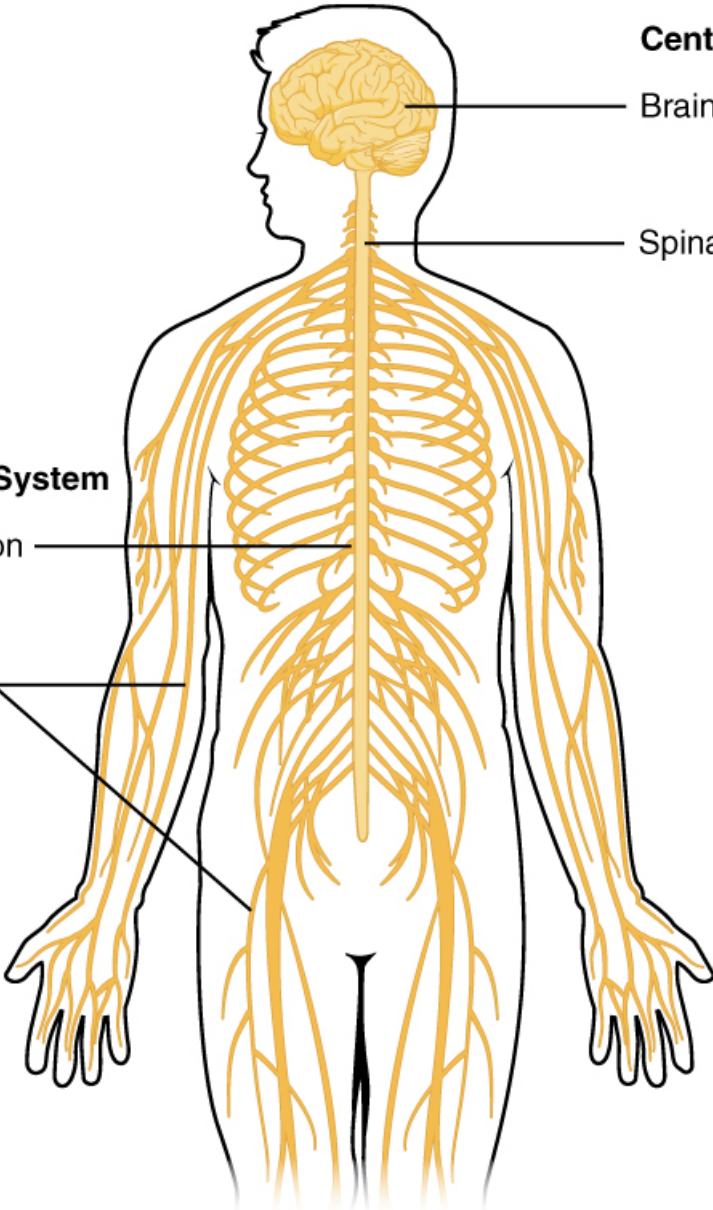
PNS

Peripheral Nervous System

Ganglion

Nerve

CNS



Structurally ,nerve tissue consist of two cell types : **nerve cells** or neurons ,which show numerous long processes and several types of **glial cells**, which have short processes, support and protect neurons and participate in neural activity , nutrition and the defense processing in the **Central Nervous System**.

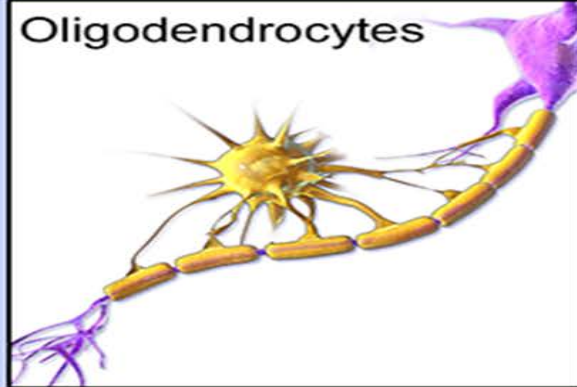
Types of Neuroglia

Central Nervous System

Ependymal cells



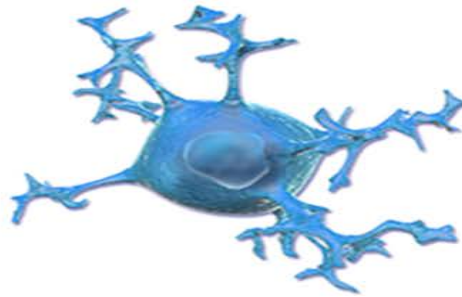
Oligodendrocytes



Astrocytes

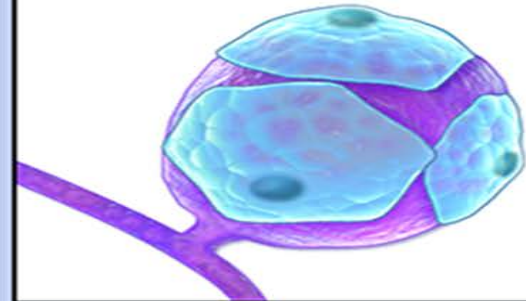


Microglia

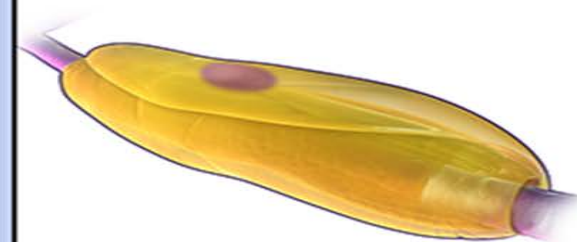


Peripheral Nervous System

Satellite cells



Schwann cells



Neuron structure

basic structural features

- a typical neuron has a **cell body** .
- Projecting from the cell body are processes called *Dendrites and Axons* .
- The cell body serves as neuron's control center and is responsible for receiving , integrating and sending nerve impulse .
- The cell body enclosed by plasma membrane contains cytoplasm , surrounding a nucleus , a nucleus contain a nucleolus .

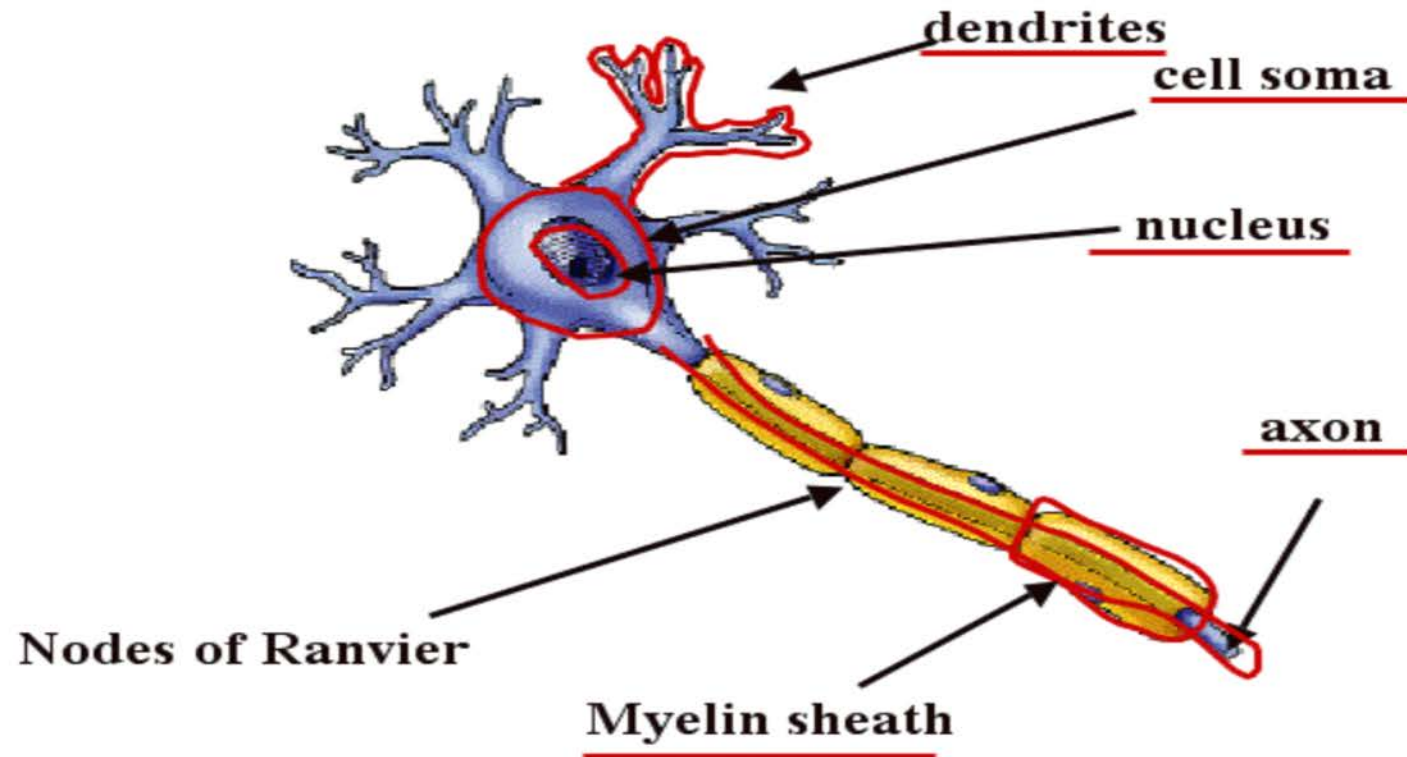
Dendrites :

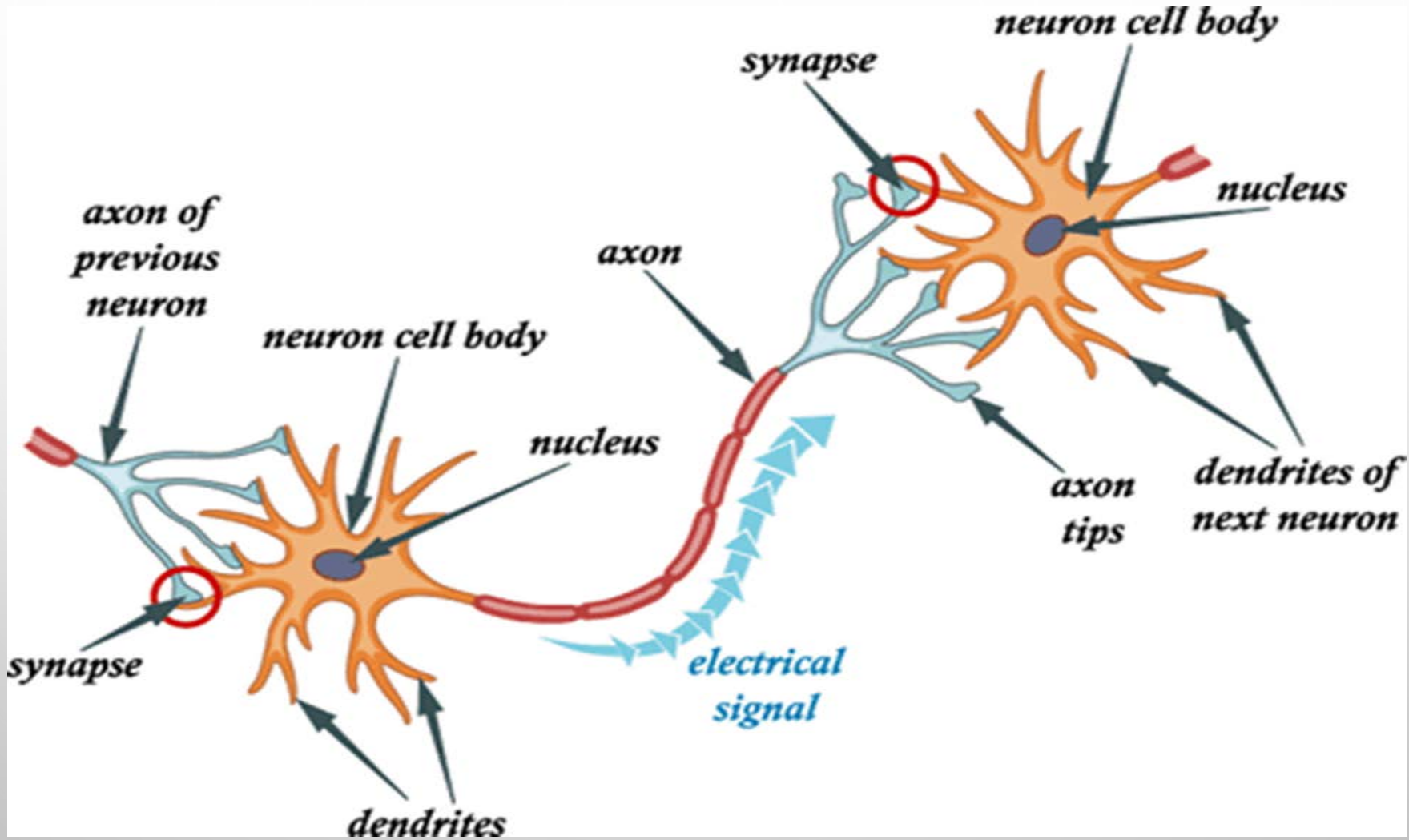
- Processes that branch off the cell body
- Conduct nerve impulses toward the cell body
- The more dendrites a neuron has , the more nerve impulses that neuron can receive from other cells.

Axons :

- Larger , longer nerve cell process projecting from the cell body , sometimes called **nerve fiber**.
- All neurons have only one axon .
- it transmits a nerve impulse away from the cell body toward another cell (transmits output information to other cells)

Neuron general structure





The nervous system has three specific functions:

Sensory input :- Sensory receptors present in skin and organs respond to external and internal stimuli by generating nerve impulses that travel to the brain and spinal cord.

Integration :- The brain and spinal cord sum up the data received from all over the body and send out nerve impulses. These functions include memory, thinking, learning, language, speech, emotions and general behavior.

Motor output :- The nerve impulses from the brain and spinal cord go to the effectors, which are muscles and glands. Muscle contractions and gland secretions are responses to stimuli received by sensory receptors.

Nervous system division

A- Structural division :

- **Central nervous system (CNS)** : Consists of brain and spinal cord .
- **Peripheral nervous system (PNS)** : Consists of nerves , cranial nerves and spinal nerves .

B- Functional division :

- **Sensory (afferent division) : (Input)**

(transmits information from periphery to CNS , contain receptors)

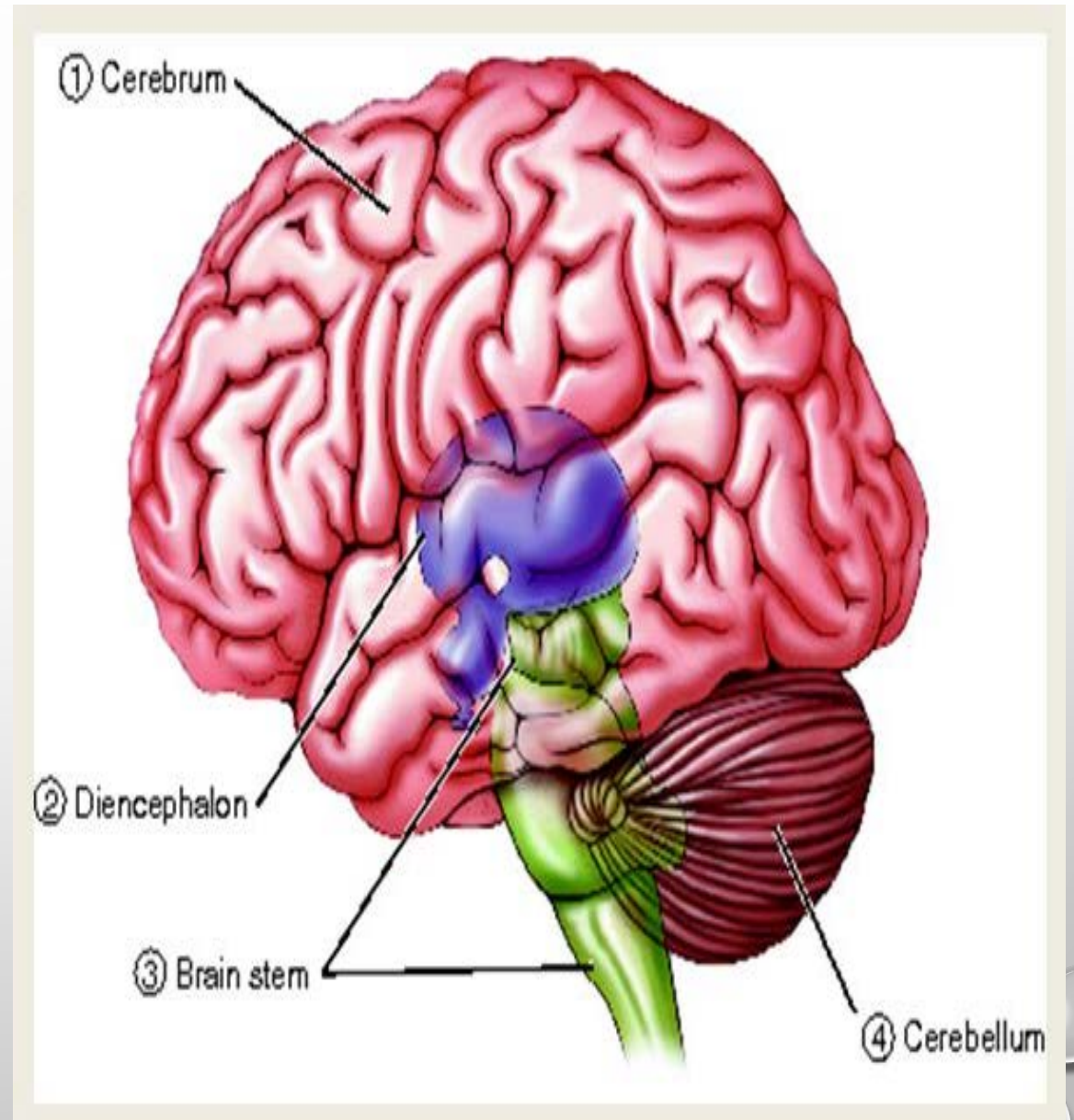
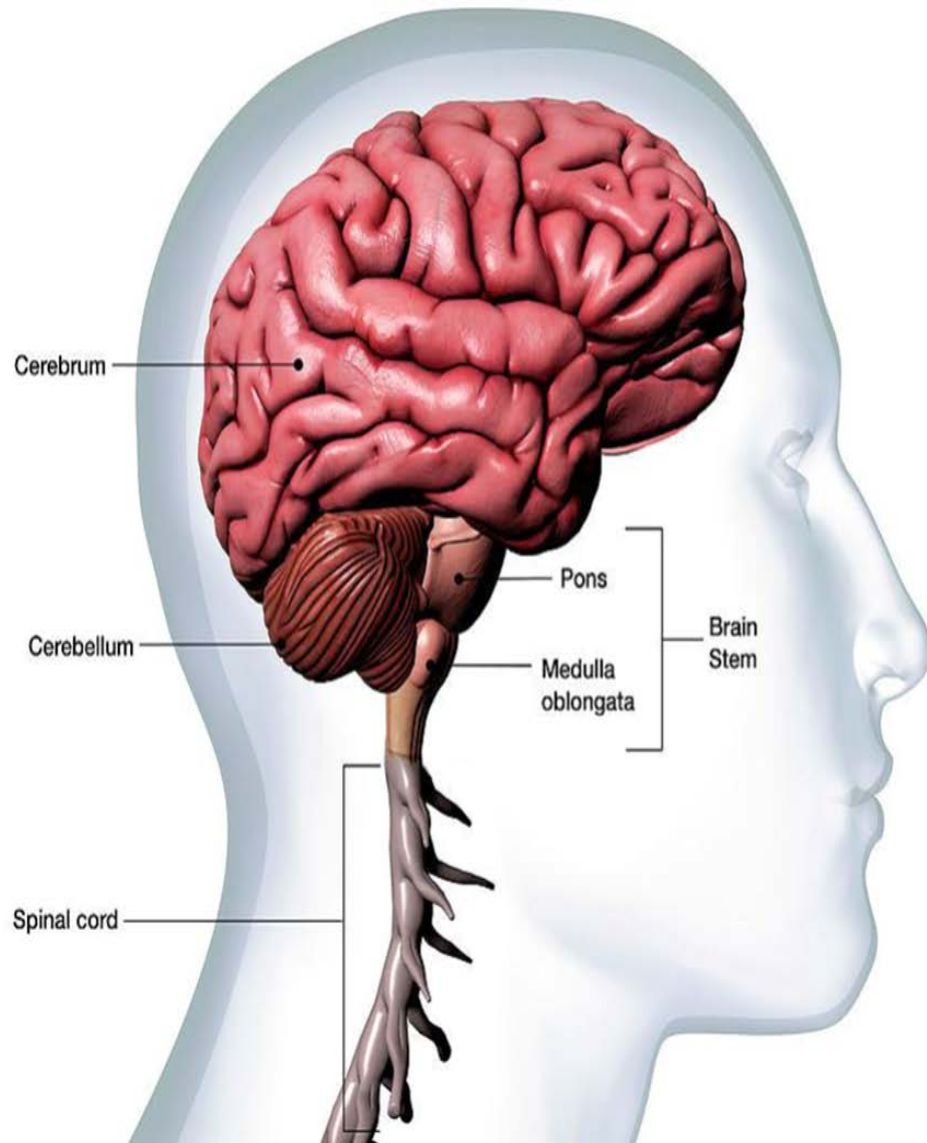
- **Motor (efferent) division : (output)**

transmit information from CNS to the rest of the body , sends motor information to effectors .

Brain and Cranial Nerves

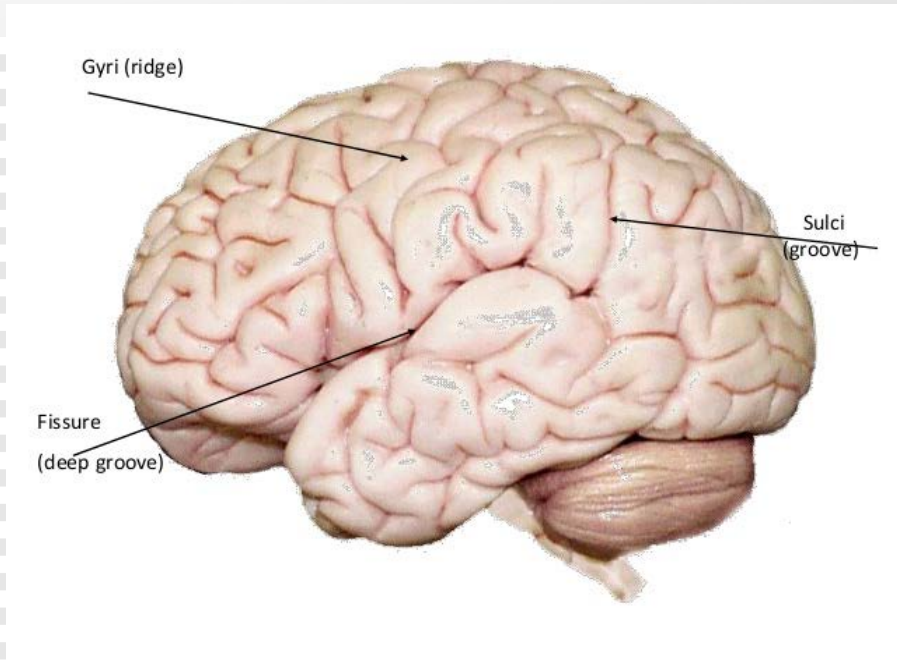
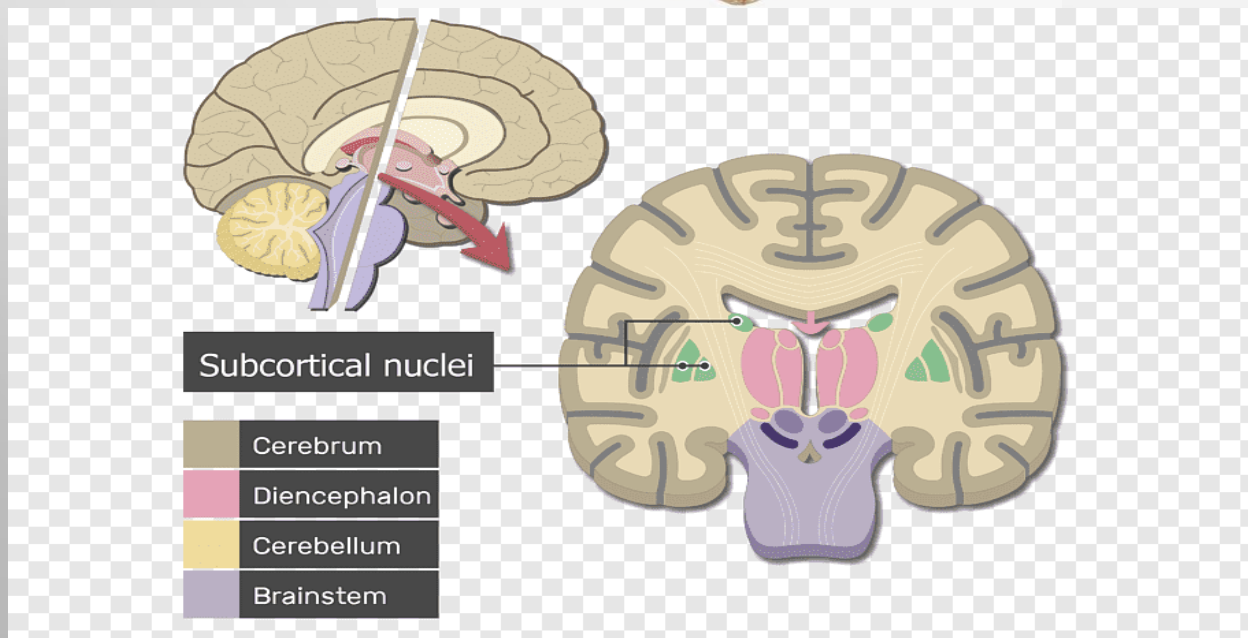
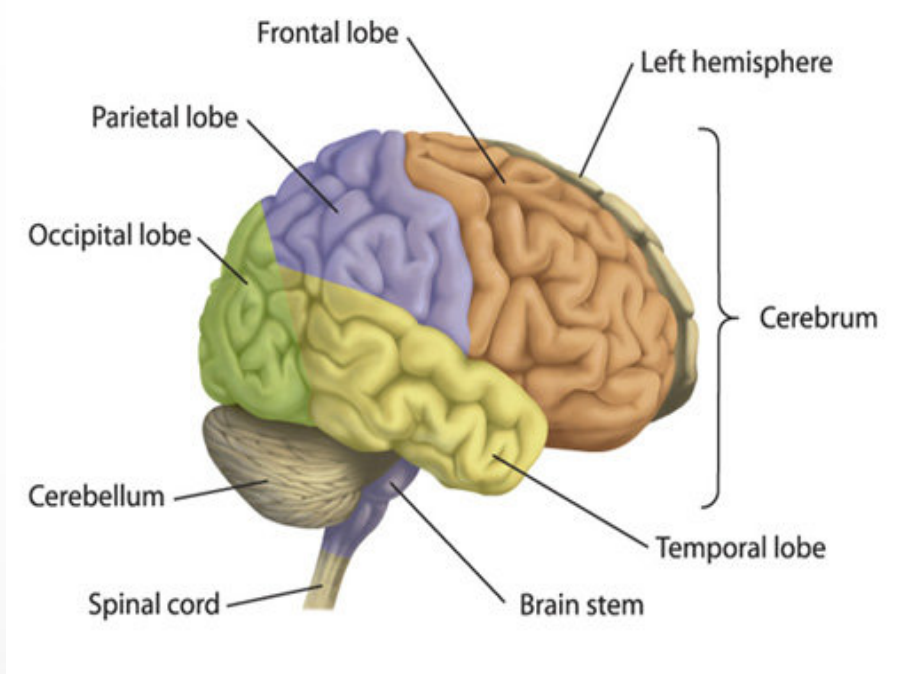
The brain is divided into four major regions :

- The Cerebrum
- The Diencephalon
- The Brain stem
- The Cerebellum



When viewed superiorly , the cerebrum is divided into **two halves** called the left and right **cerebral hemispheres** .

- Each hemisphere may be further subdivided into five functional areas called “ **lobes** “ .
- The outer surface of an adult brain exhibits folds called **Gyri** (gyrus) , and shallow depressions between those folds called **sulci** (sulcus) .
- The brain is associated with 12 pairs of **cranial nerves** !

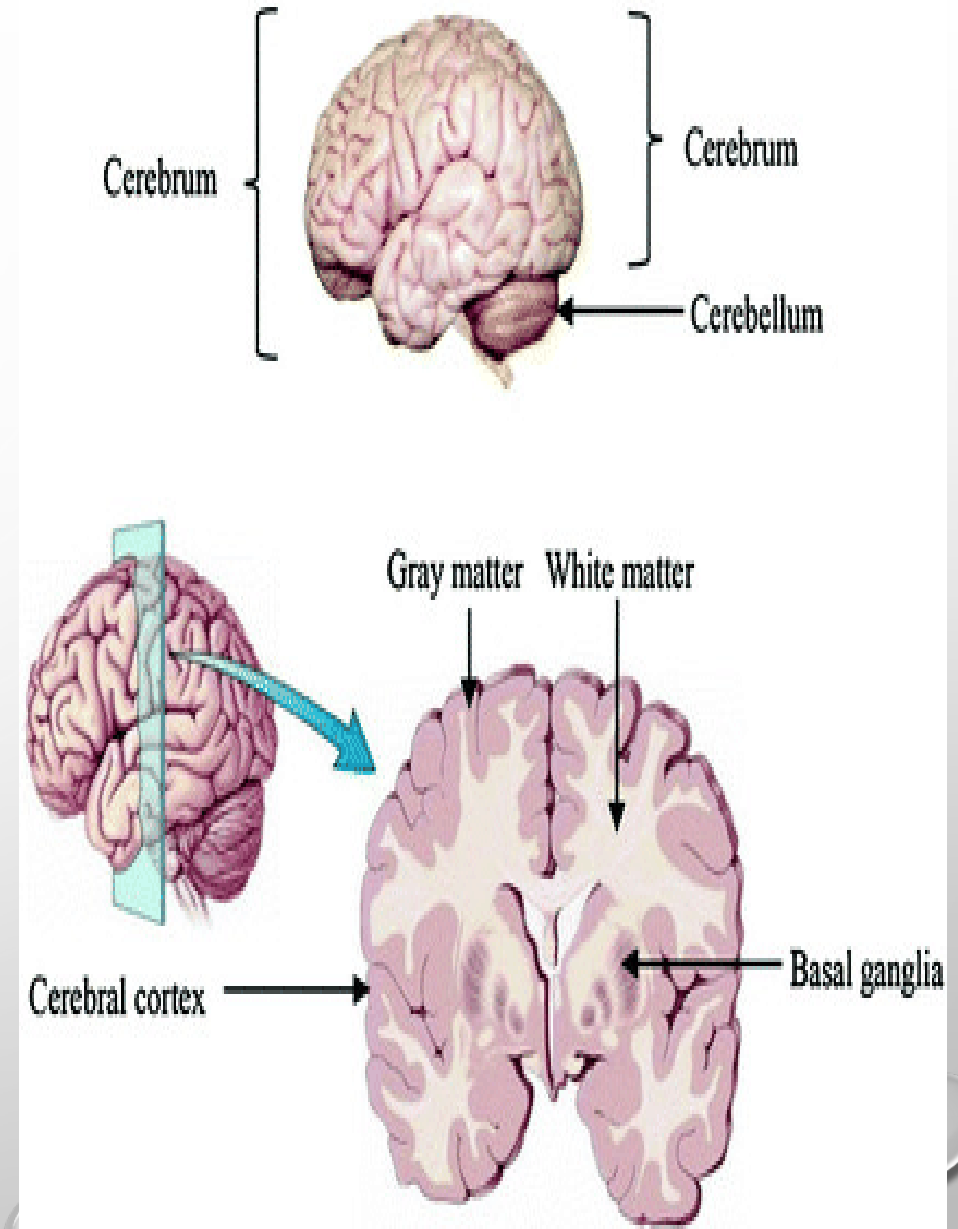


Organization of the brain tissue :

Two distinct tissue areas are recognized within the brain and spinal cord (gray matter and white matter) .

- **Gray matter houses** : motor neurons , dendrites and unmyelinated axons.
- **White matter** : derives its color from the myelin in the myelinated axons.

The external sheets of gray matter , called **cortex** , cover the surface of most of the adult brain.



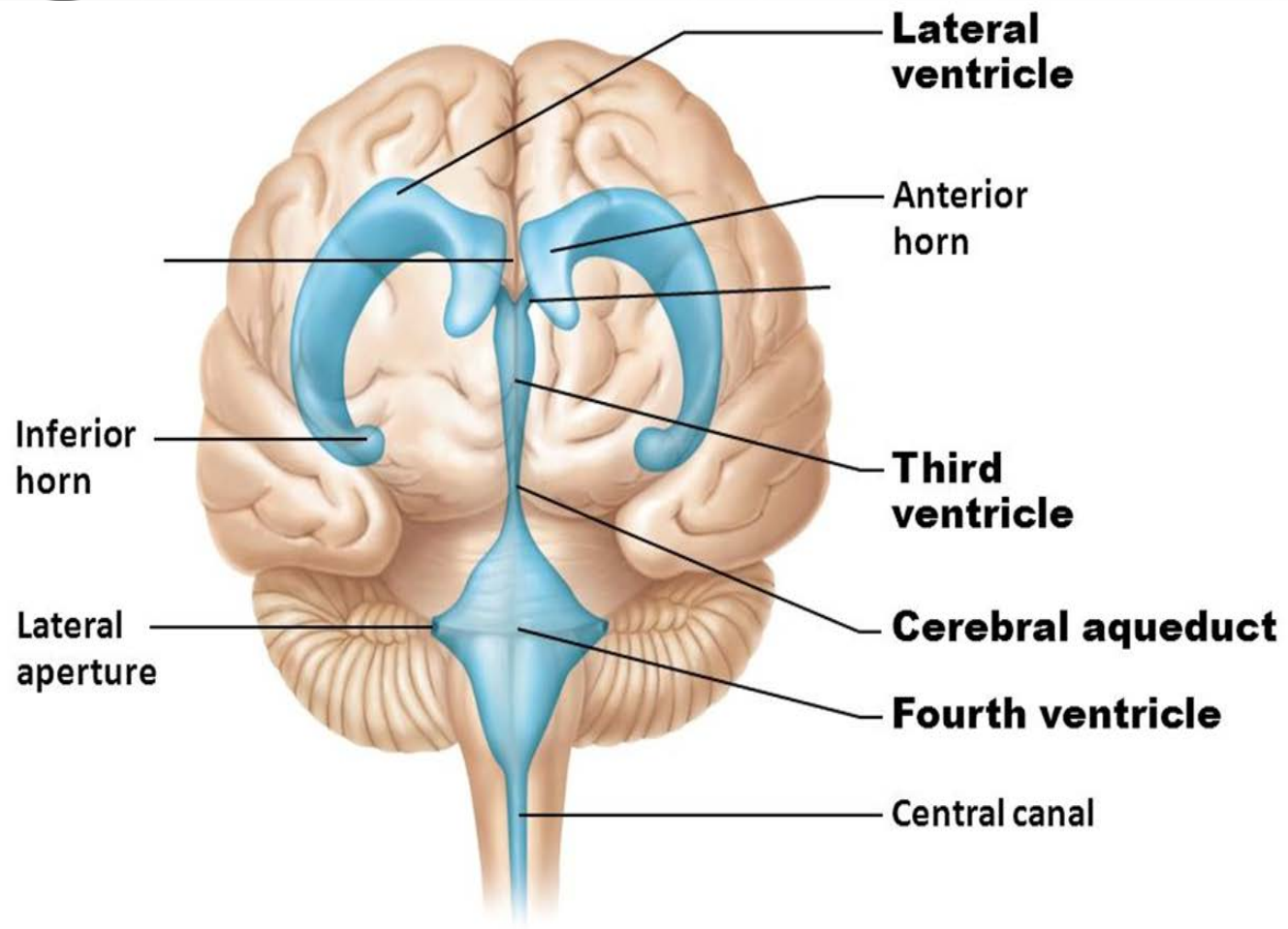
Brain ventricles

Ventricles are cavities or expansions within the brain . the ventricles are continuous with one another as well as with the central canal of the spinal cord .

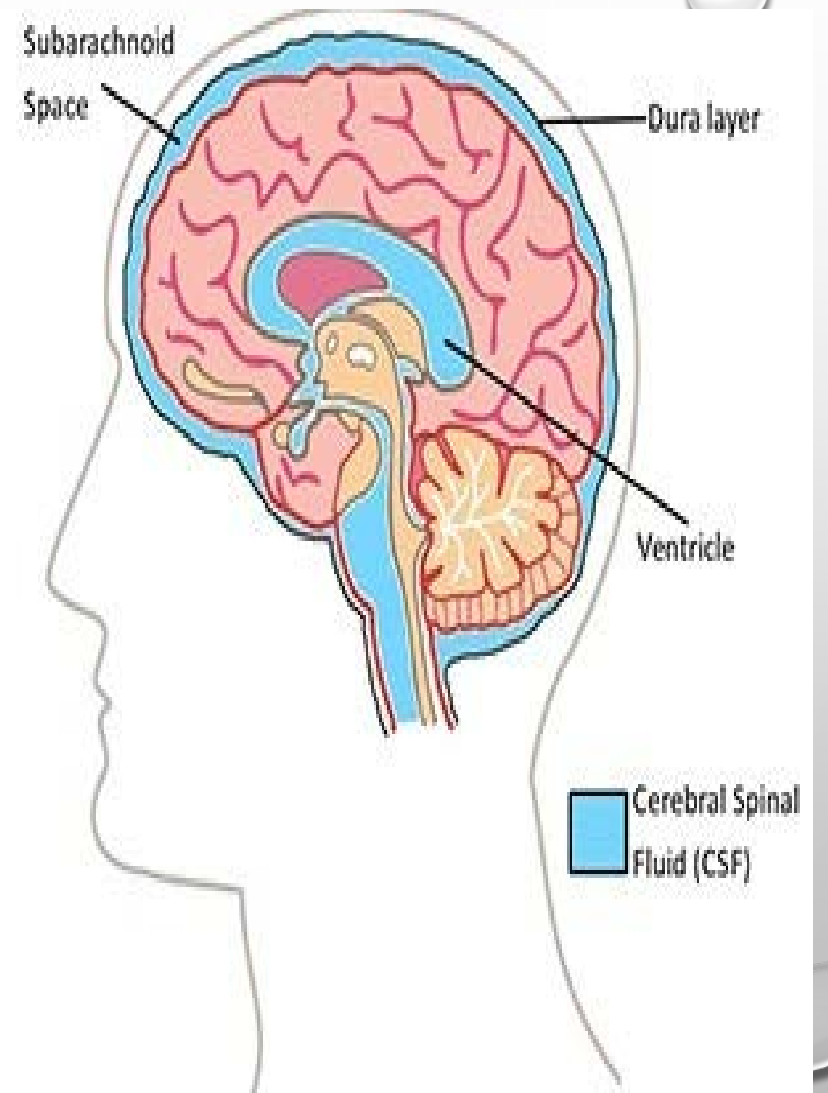
There are four ventricles in the brain :

- **Two lateral ventricles (in cerebrum)**
- **The third ventricle**
- **The fourth ventricle**

All of the ventricles contain cerebrospinal fluid (CSF).



(a) Anterior view



Cerebrum :

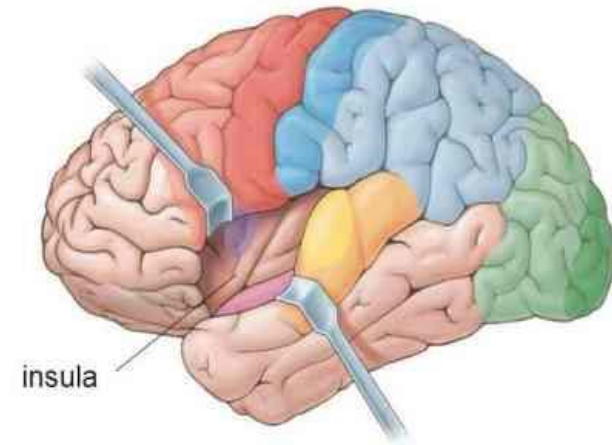
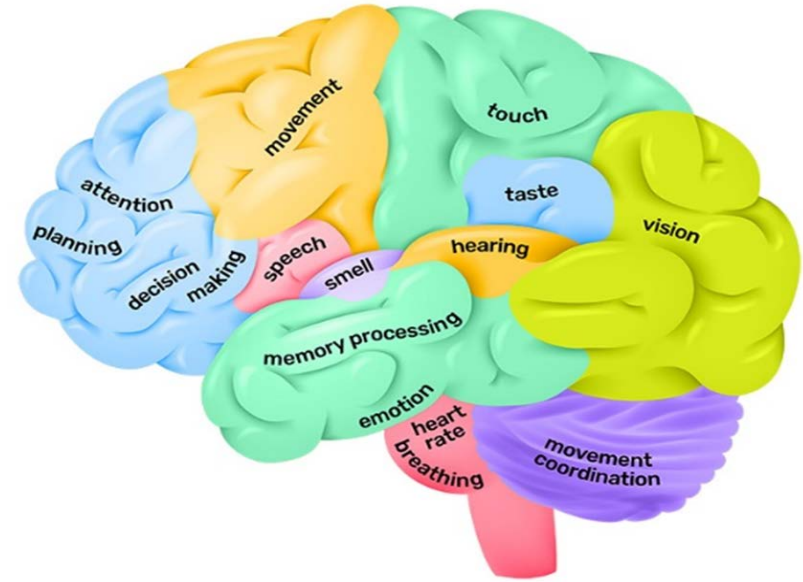
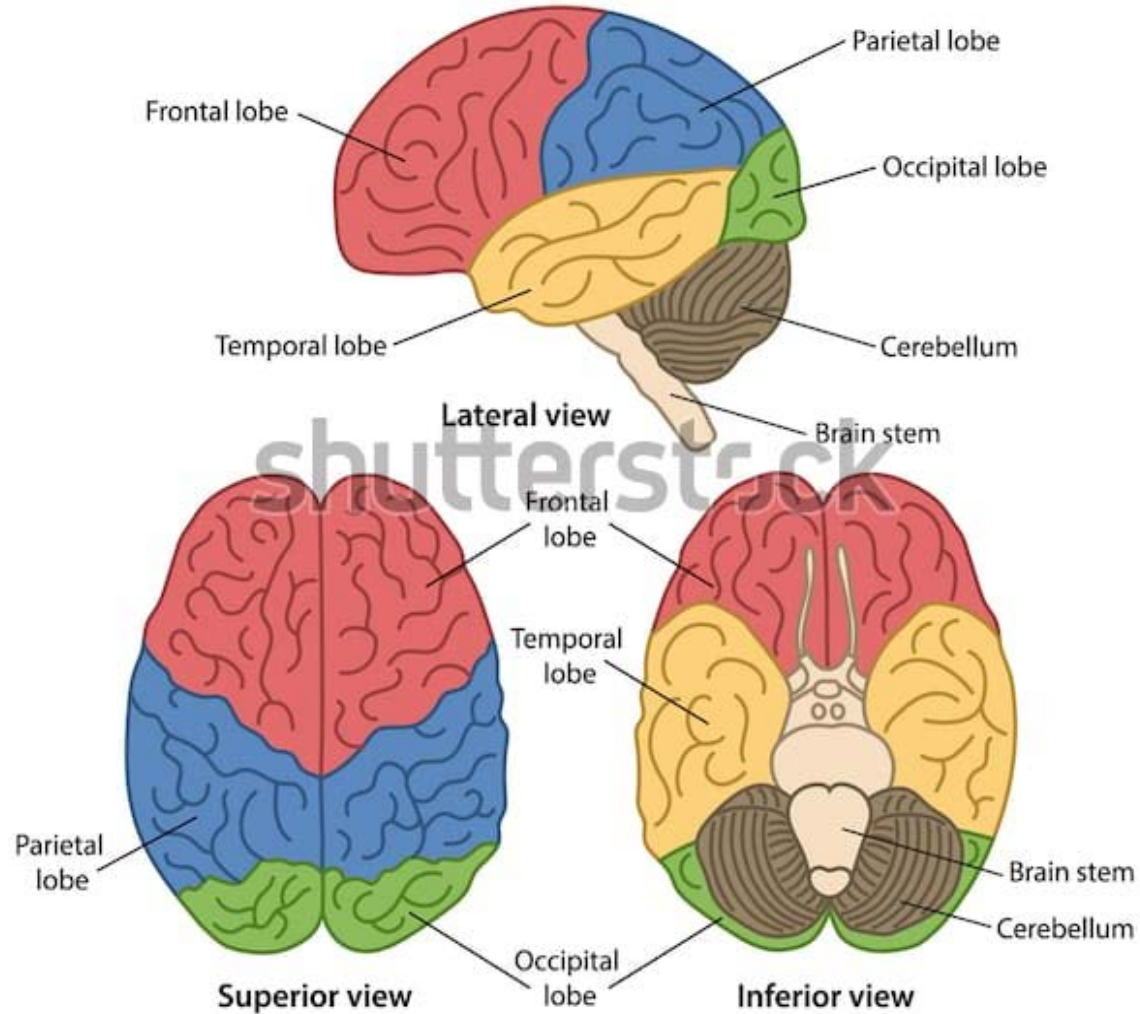
Composed of two halves : left and right **cerebral hemispheres**.

The Right cerebral hemisphere controls the left side of the body , and vice versa.

Lobes of the cerebrum :

- **Frontal lobe** : (high intellectual functions) Concentration, decision making ,planning, personality, verbal communication, voluntary motor, control of skeletal muscles .
- **Parietal lobe** : understanding speech and formulating words
- **Temporal lobe** : auditory and olfactory sensation
- **Occipital lobe** : visual
- **Insula** : taste and memory

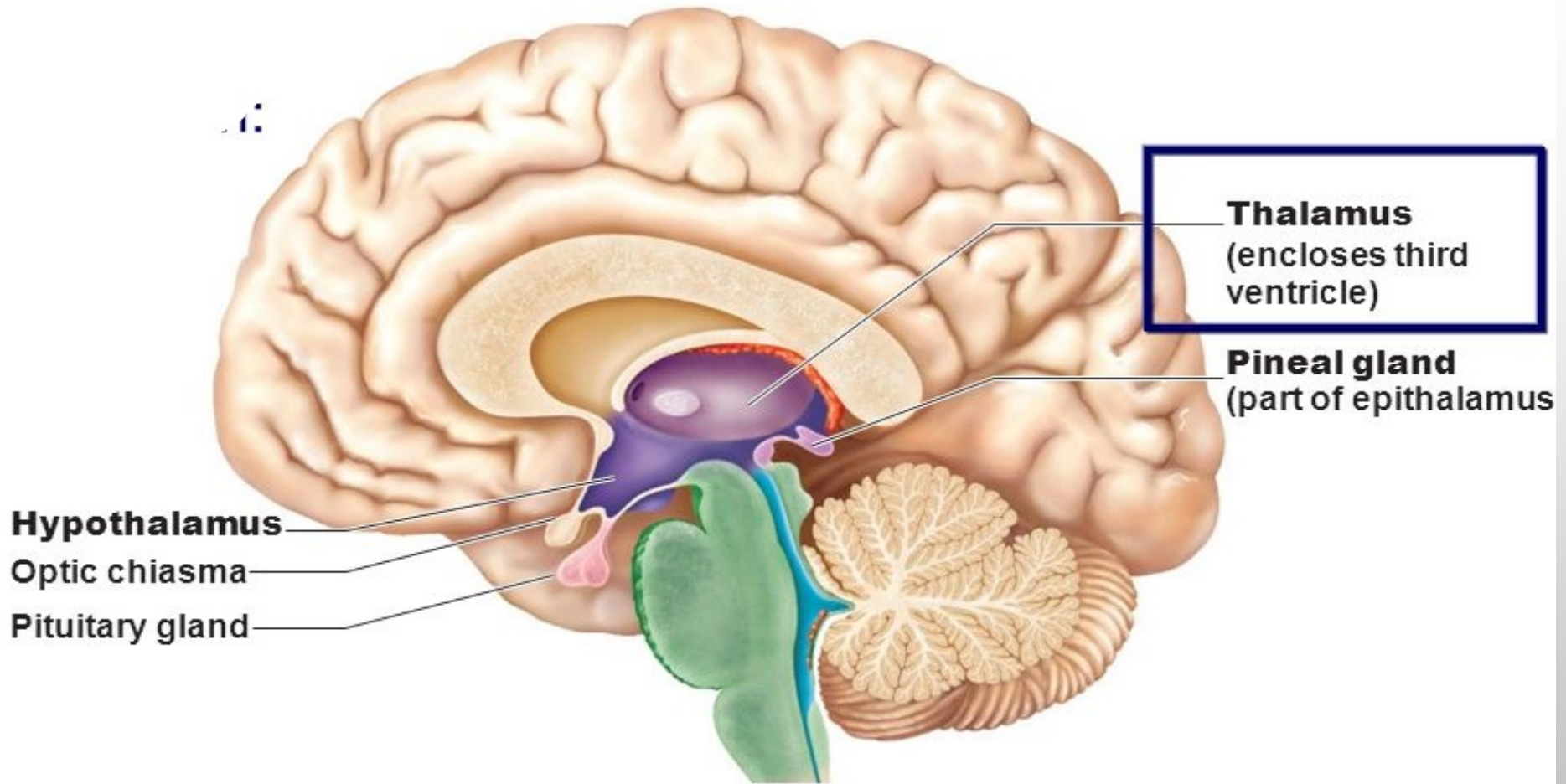
Parts of the Human Brain



Diencephalon :

Diencephalon Consist of :

- 1- **Epithalamus** : (houses pineal gland)(endocrine gland) which secrete the hormone melatonin which regulate the day-night cycles (circadian rhythm).
- 2- **Thalamus** :Is the principal and final relay point for sensory information that will be processed and projected to the primary somatosensory cortex .
- 3- **Hypothalamus** Functions :
 - Master control of endocrine system
 - Regulation of body temperature (shivering – sweating)
 - Control of emotional behavior
 - Control of food intake
 - Control of water intake
 - Regulation of sleep – wake rhythm (acting as the body's biological clock).



Brain stem :

It is a bidirectional passageway for all tracts extending between the cerebrum and the spinal cord .

Three regions form the brainstem :

- Midbrain
- Pons (respiratory center)
- Medulla oblongata :

Cardiac center

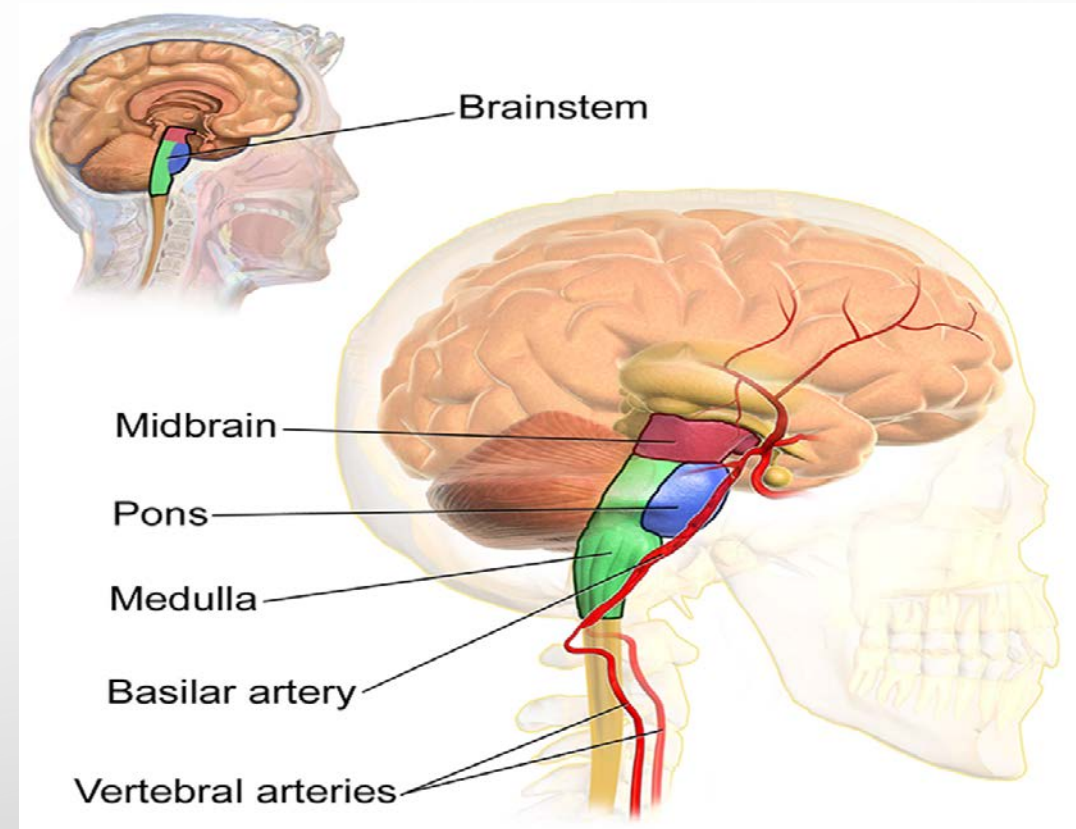
Vasomotor center (blood pressure control)

Respiratory center

Others : coughing , sneezing ,
salivation , swallowing , gagging , vomiting .

Cerebellum :

Maintain equilibrium and posture (regulates the body position) .



Cranial nerves :

Are part of the peripheral nervous system and originate on the inferior surface of the brain .

There are 12 pairs of cranial nerves :

1 : Olfactory (smell)

2 : Optic (vision)

3 : Oculomotor (eye movement)

4 : Trochlear (eye movement)

5 : Trigeminal (sensation in face and motor function such as biting and chewing)

6 : Abducent (eye movement)

7 : Facial (facial expression)

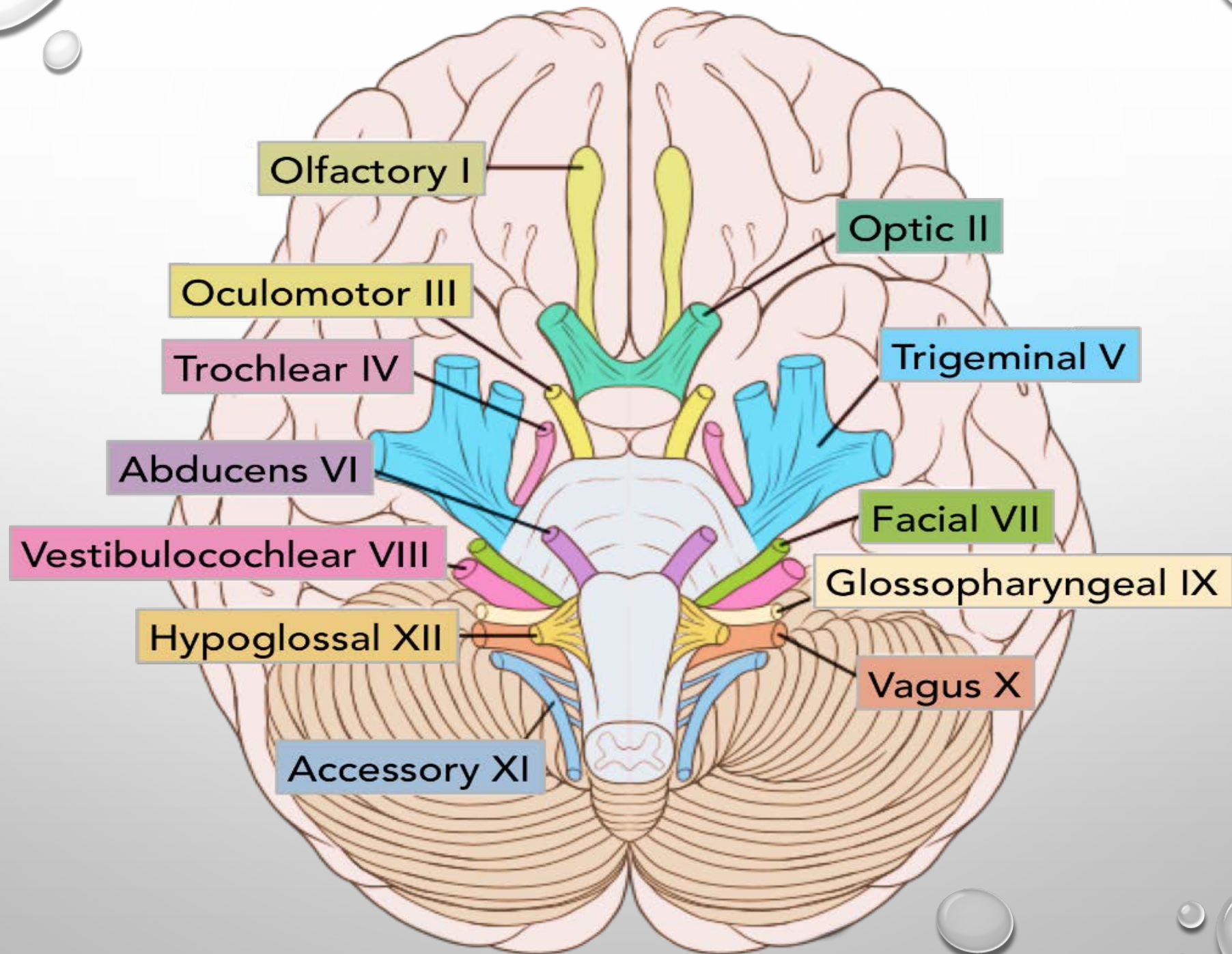
8 : Vestibulocochlear (hearing and equilibrium)

9 : Glossopharyngeal

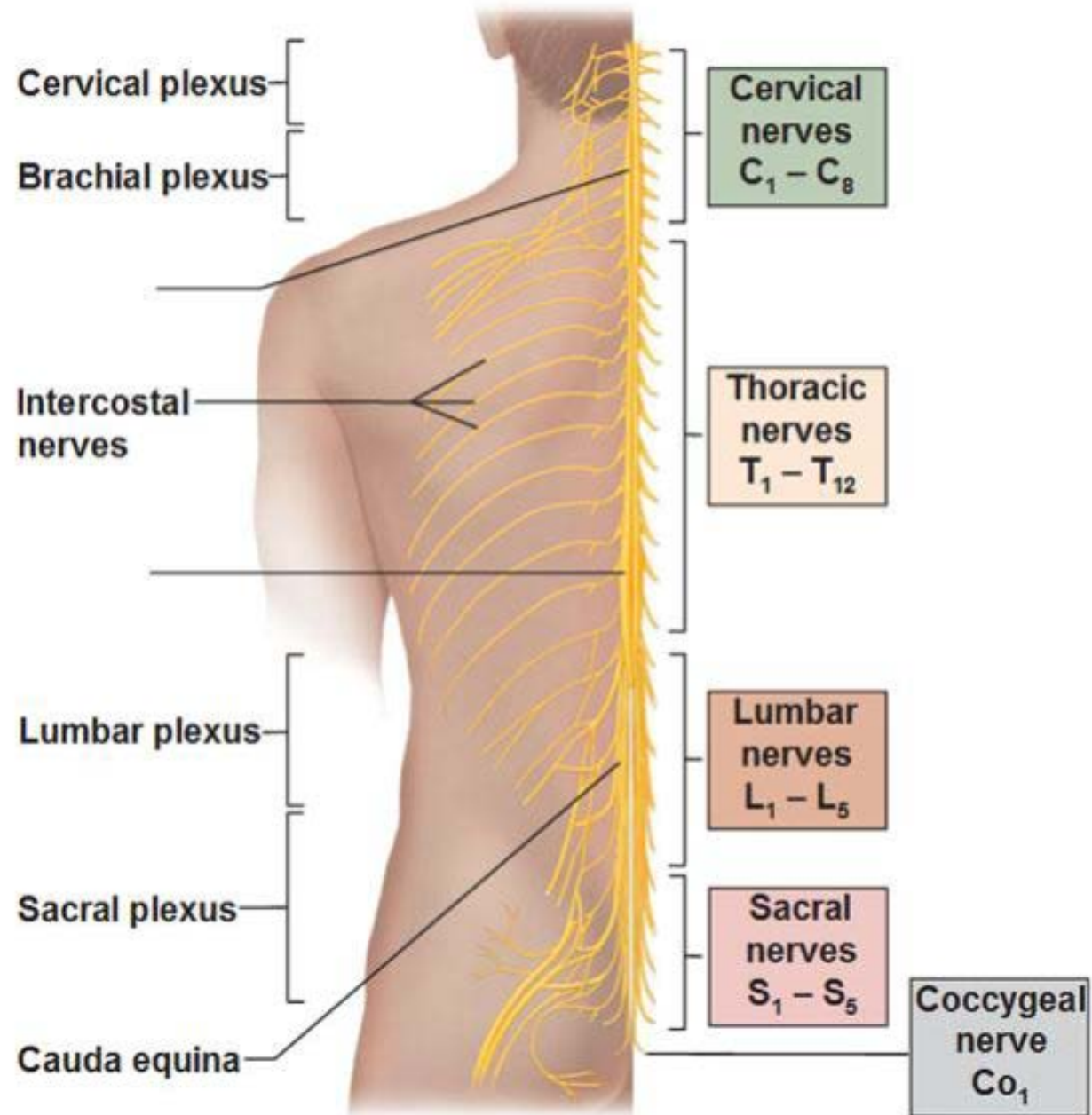
10 : vagus (parasympathetic control of heart , lungs , digestive tract).

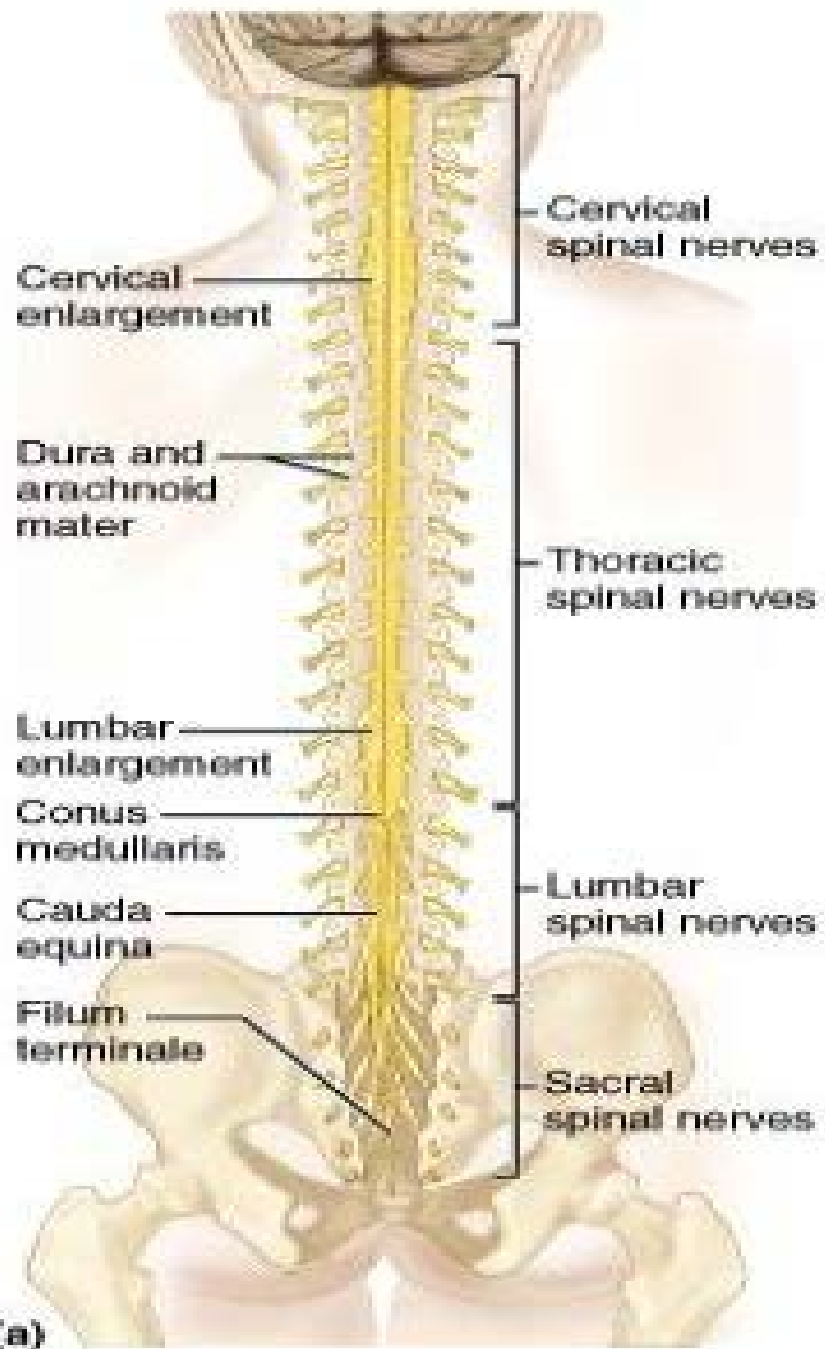
11 : accessory (some neck muscles)

12 : Hypoglossal (tongue)

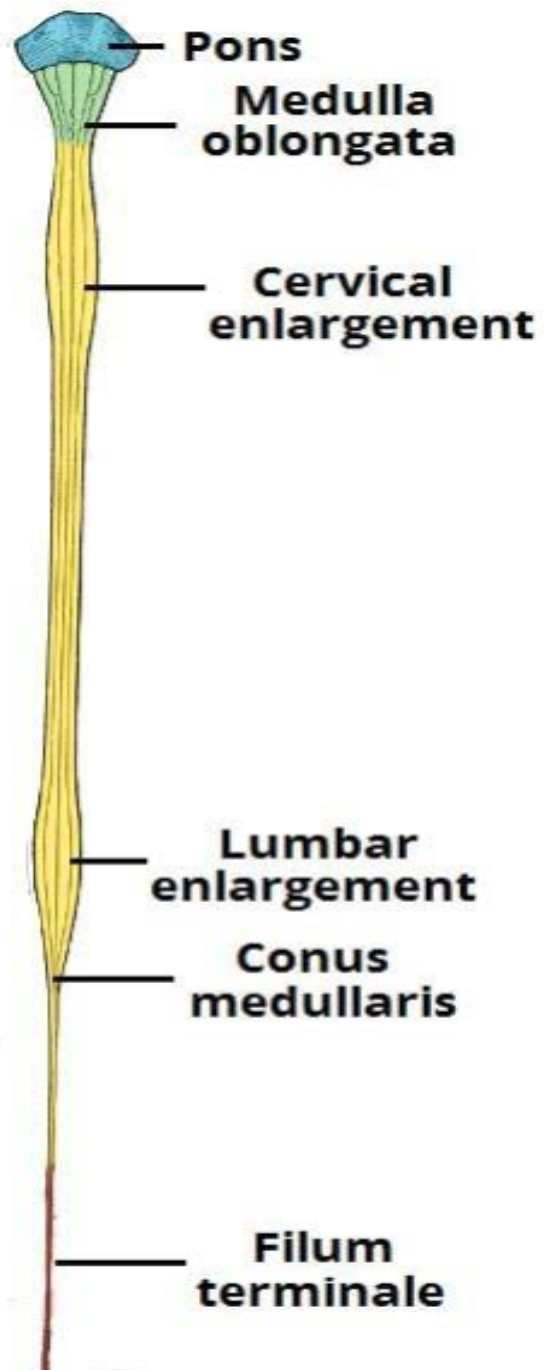


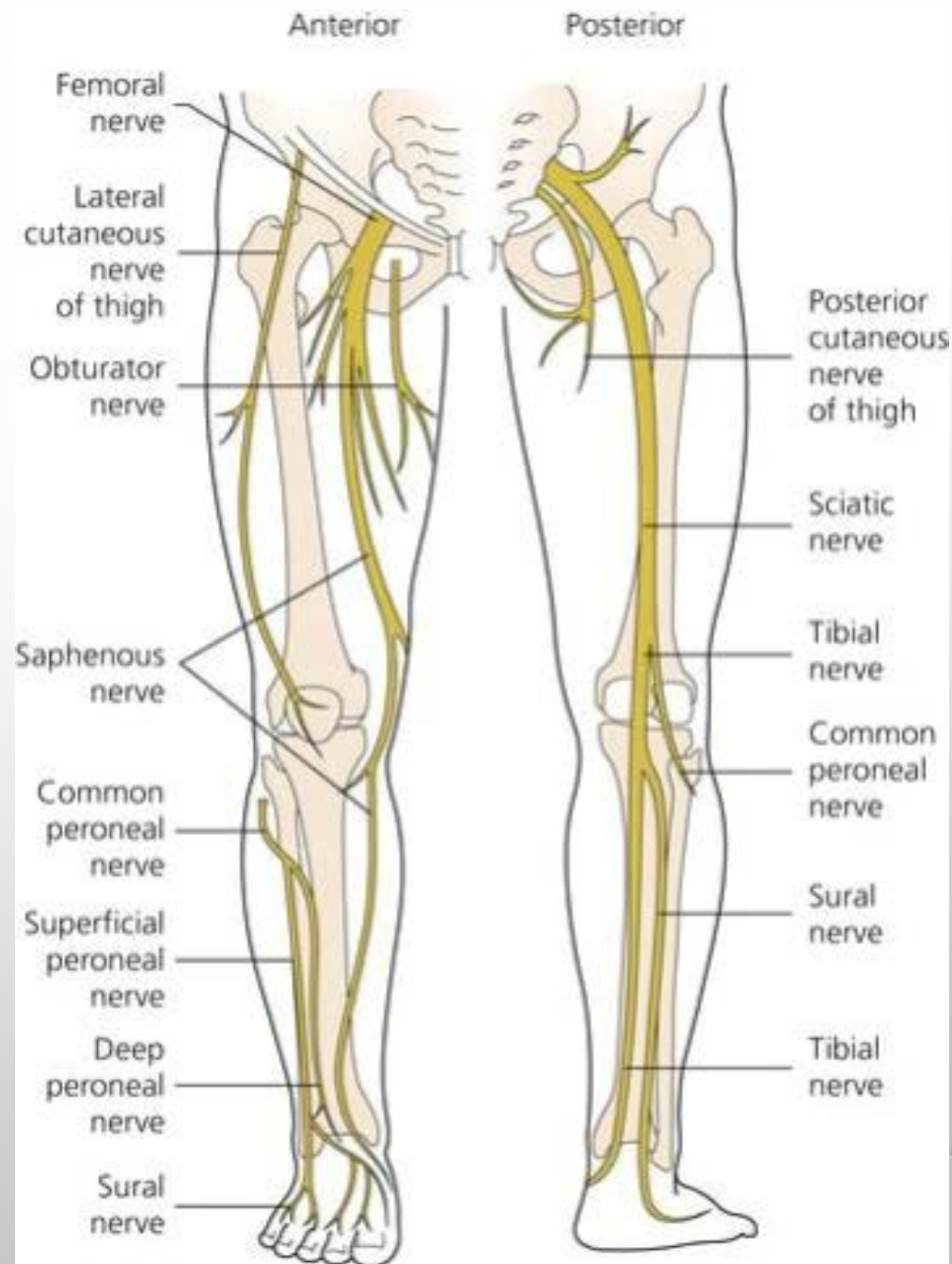
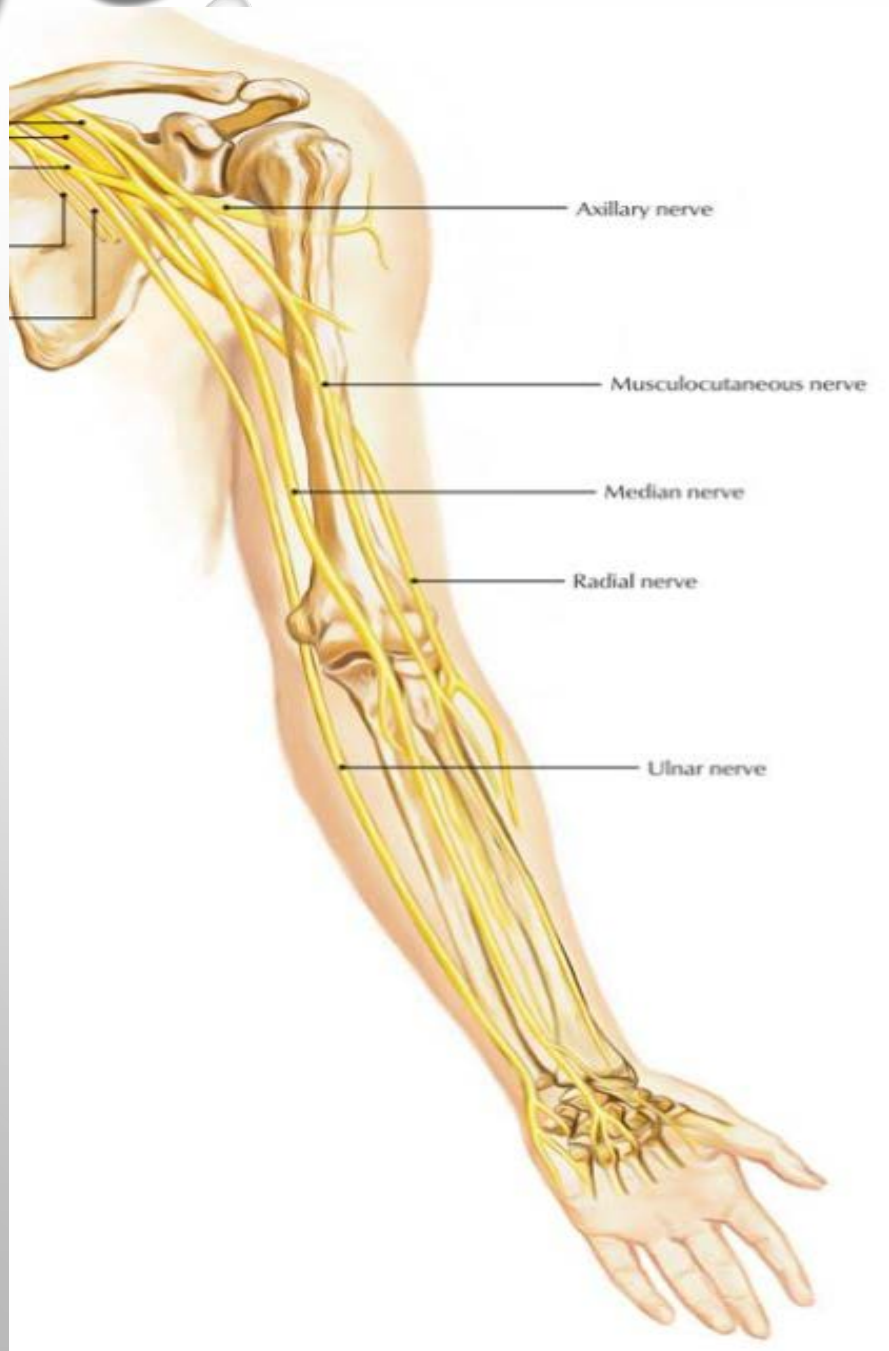
Spinal Nerves Posterior View





(a)





The background features a light gray gradient with several realistic water droplets of various sizes scattered in the corners. The droplets have highlights and shadows, giving them a three-dimensional appearance. The text "Thank you" is centered in a bold, black, sans-serif font.

Thank you