



# Medical Biology

1<sup>st</sup> Grade

Lab 9

# Nervous System

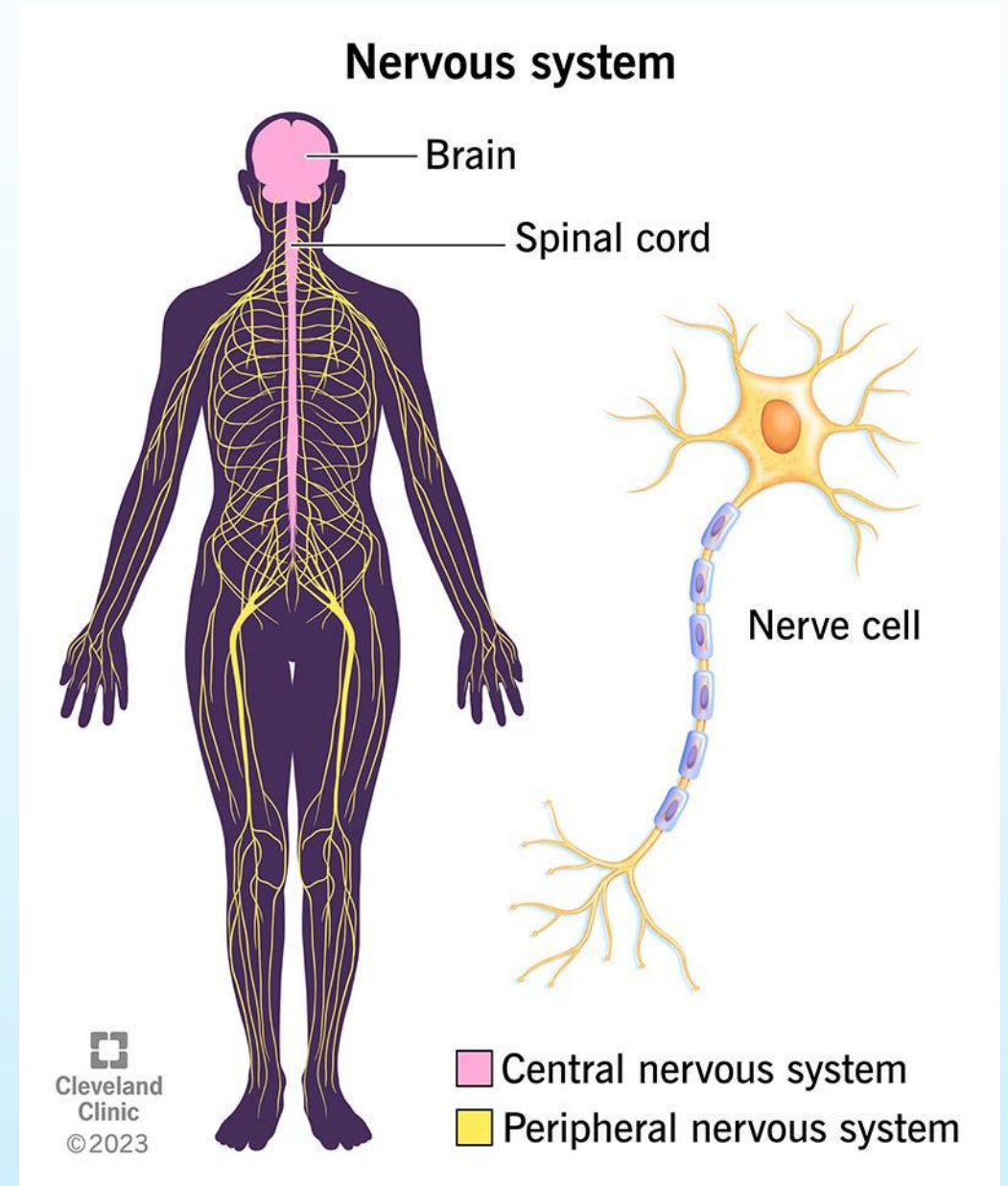
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# Organization of the Nervous System

- With a mass of only 2 kg about 3% of the total body weight, the nervous system is one of the smallest and yet the most complex of the 11 body systems
- It is organized into two main subdivisions: the central nervous system and the peripheral nervous system.



## **The Central Nervous System (CNS)**

A division of the nervous system which is named central due to two reasons; anatomical as it sits in the center of the body and functional as it's the site of integration of information of the whole body.

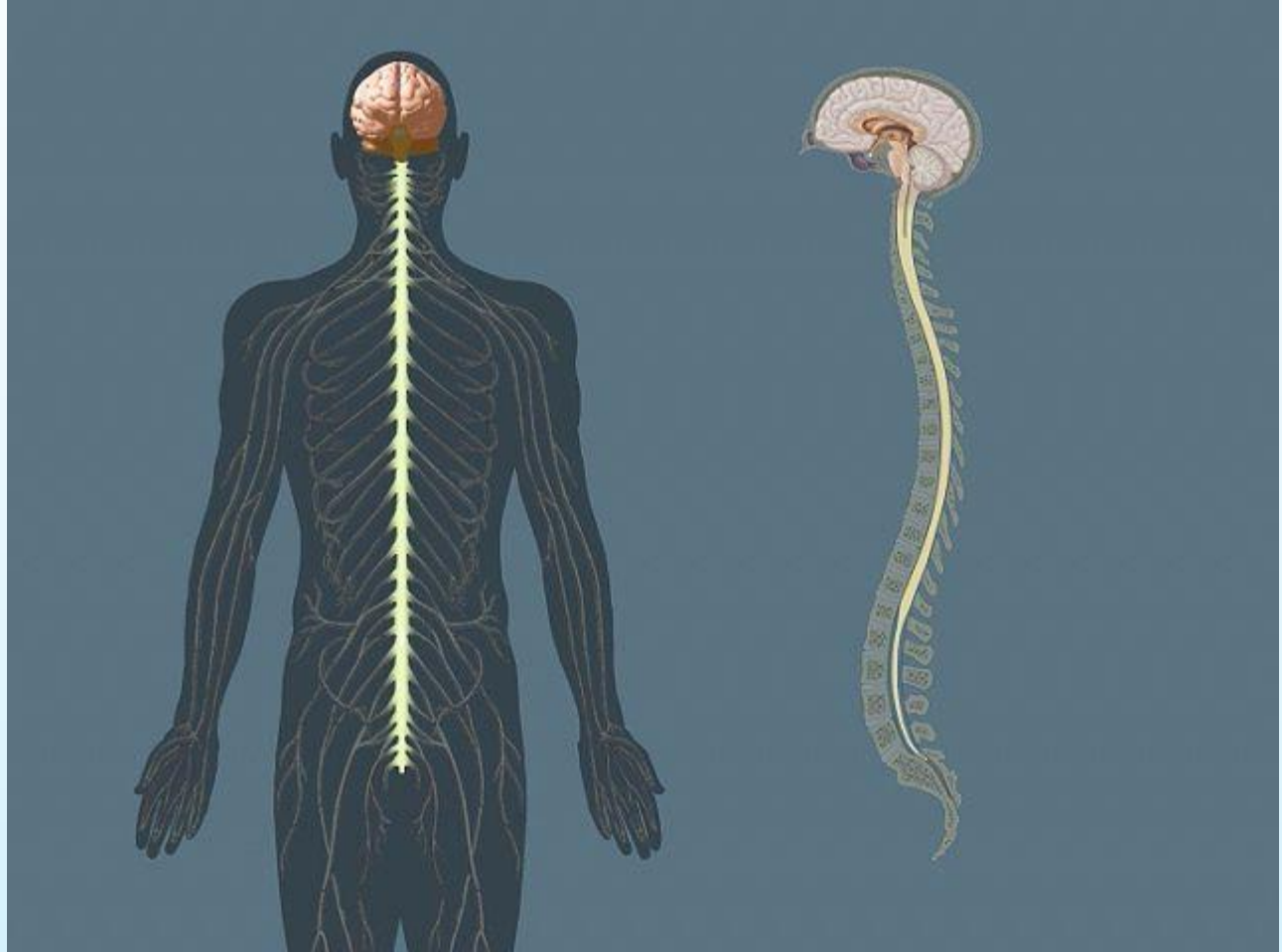
CNS is composed of two parts: **the brain and the spinal cord.**

The brain, also known as **encephalon**, is made up of two types of cells: neurons and glial cells and the spinal cord extends from the base of the brain along the backbone.

# Functions of the CNS

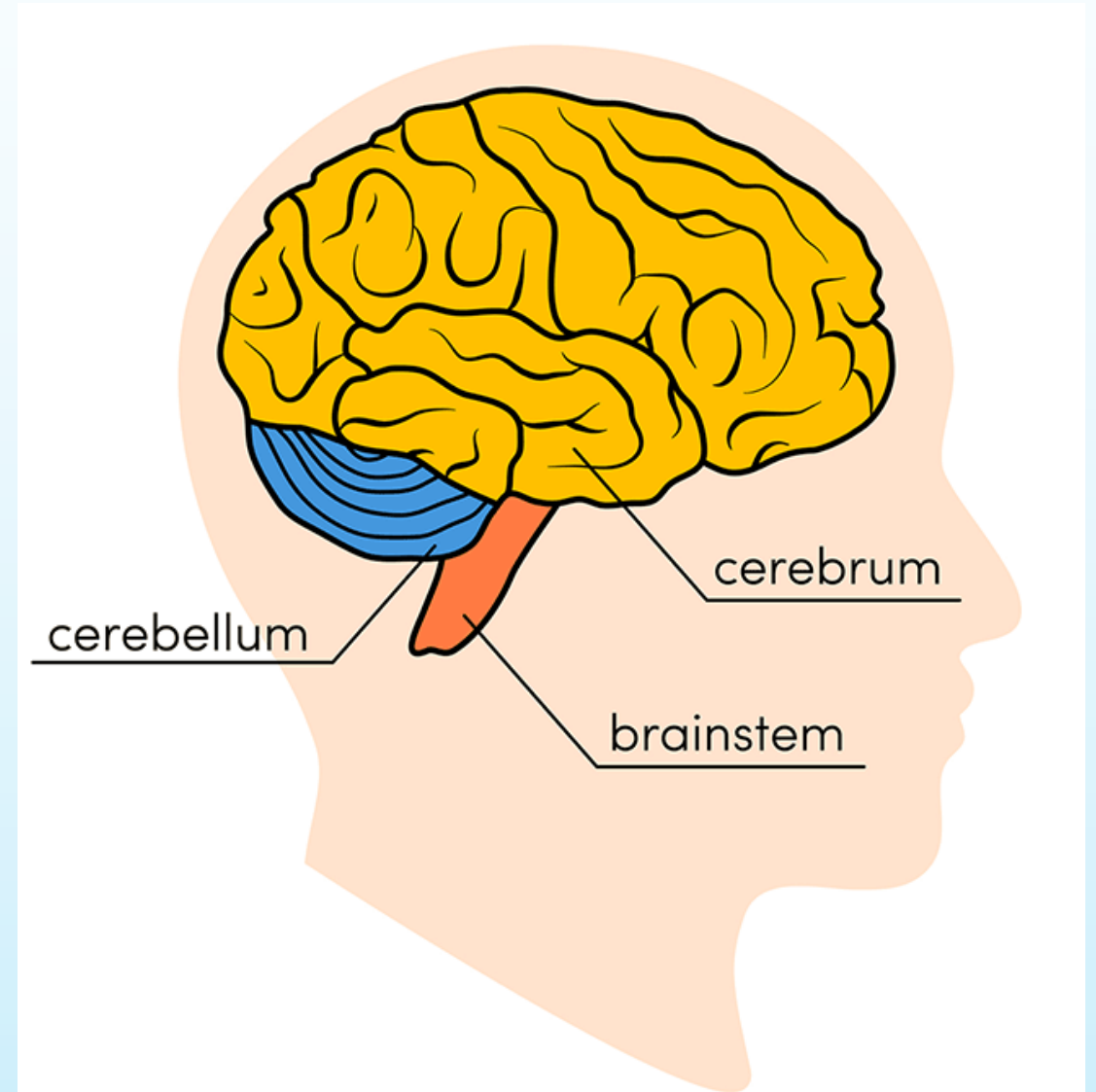
1. Processing and integration of information

2. Coordination of voluntary and involuntary activities



# Brain Regions and Their Functions

1. **Cerebrum** (two cerebral hemispheres) → movement, cognition and sensation.
2. **Cerebellum** → balance and voluntary movements.
3. **Brainstem** → basic life functions (breathing, heart rate).

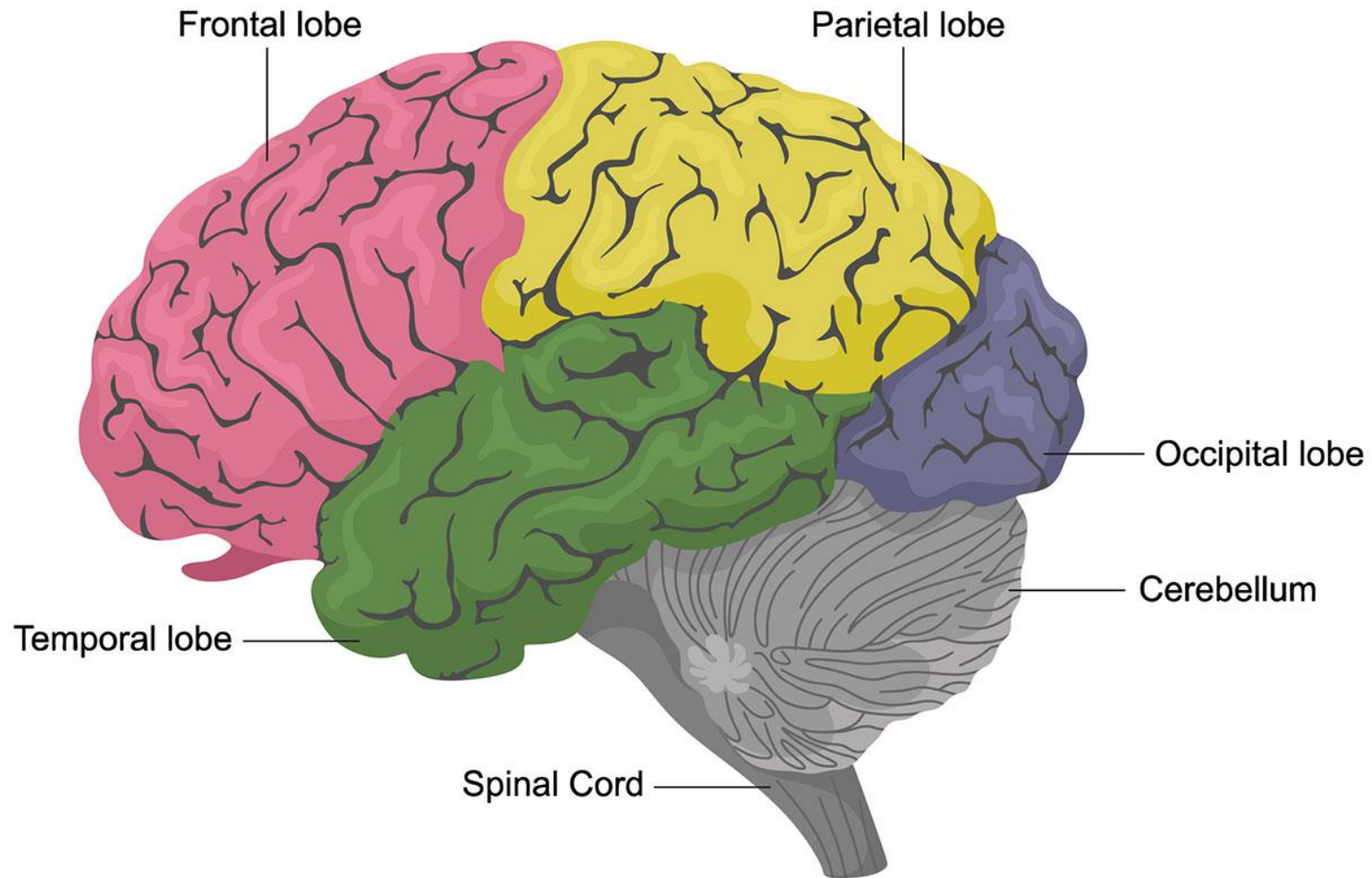


# Lobes of the Brain and What They Control

Each brain hemisphere (parts of the cerebrum) has four sections, called lobes, these are:

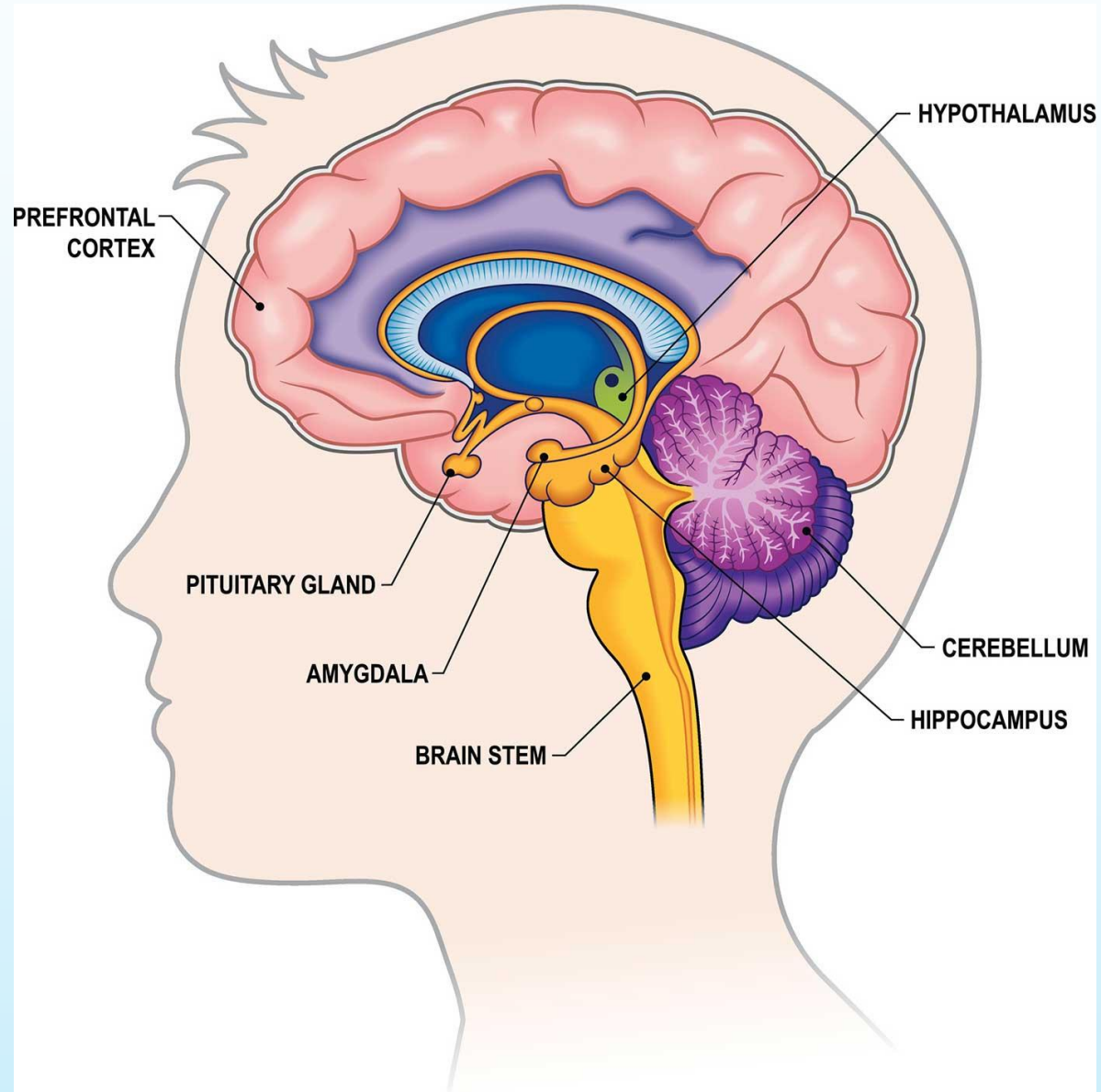
1. **Frontal lobe:** personality characteristics, decision-making and movement.
2. **Parietal lobe:** involved in interpreting pain and touch in the body.
3. **Occipital lobe:** involved with vision.
4. **Temporal lobe:** involved in short-term memory, speech, musical rhythm and some degree of smell recognition.

# Human Brain Anatomy



# Deeper Structures Within the Brain

1. Pituitary Gland
2. Hypothalamus
3. Amygdala
4. Hippocampus
5. Pineal Gland
6. Ventricles and Cerebrospinal Fluid

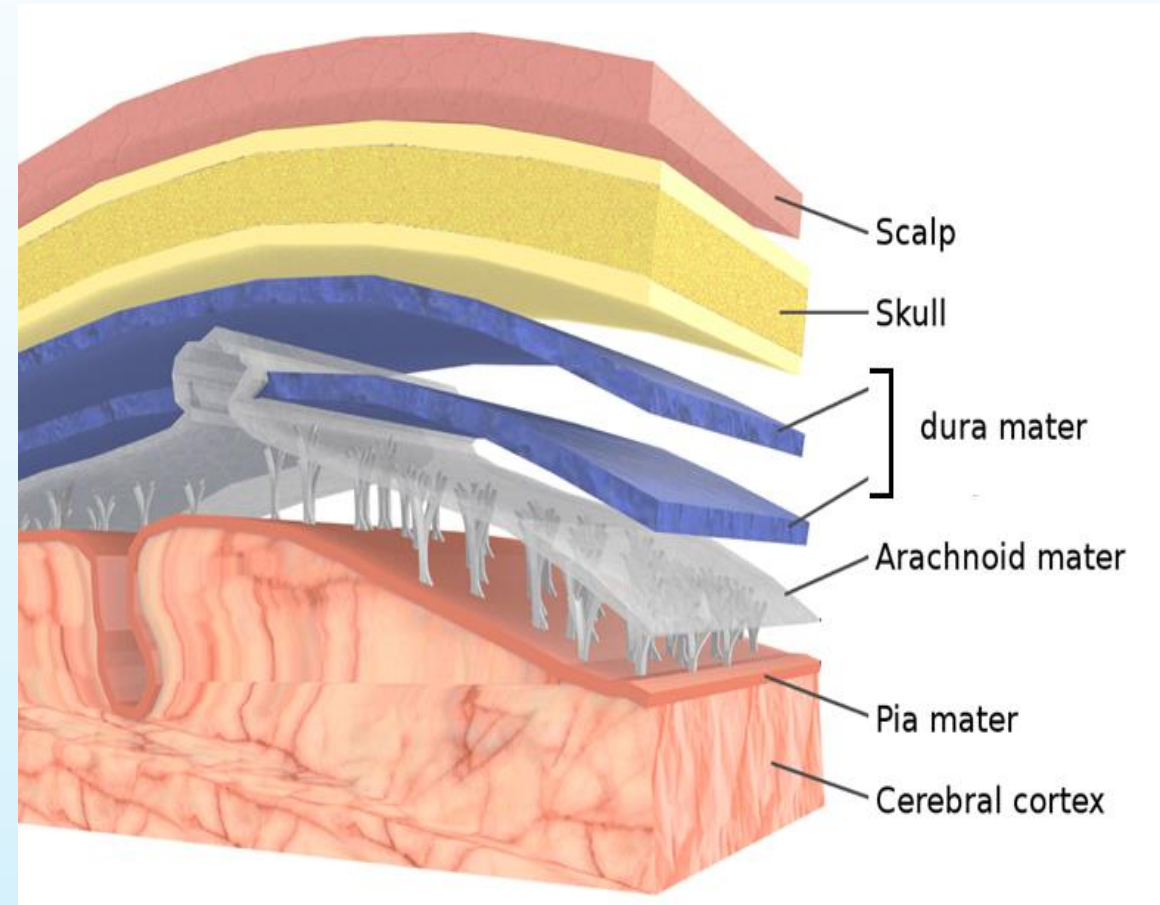


**Three layers of protective covering called meninges surround the brain and the spinal cord. They are listed below from outer to inner order:**

**1. Dura Mater:** protection and support

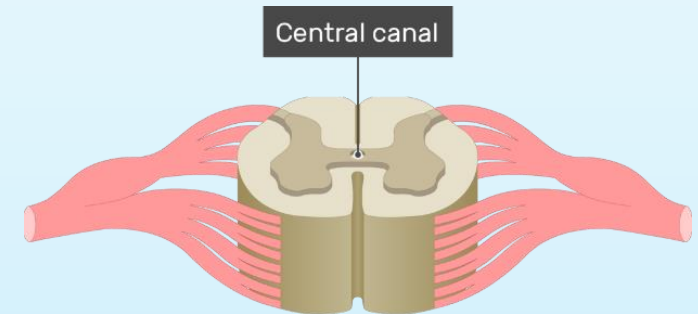
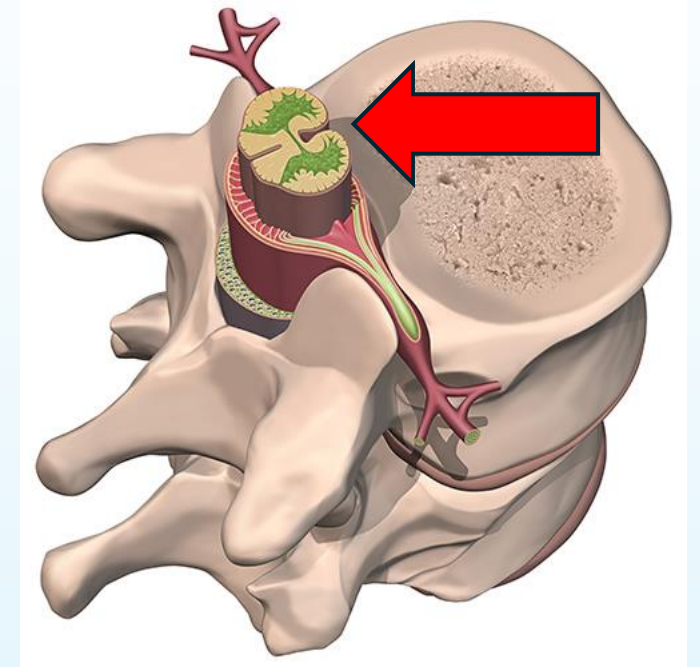
**2. Arachnoid Mater:** cushioning and shock absorption

**3. Pia Mater:** nourishment and protection



# The Spinal Cord

- A column of nerve tissue that extends from the base of the brain to the lower back and it is covered by the meninges and surrounded by the vertebrae (back bones).
- It runs along five regions: Cervical (neck), thoracic (chest), lumbar (abdominal), sacral (pelvic) and coccygeal (tailbone)
- Length: ~ 45 centimeters.
- Diameter: ranges from 13 mm to 6.4 mm depending on the region.
- Central canal: filled with cerebrospinal fluid (CSF)



## **Cerebrospinal fluid (CSF)**

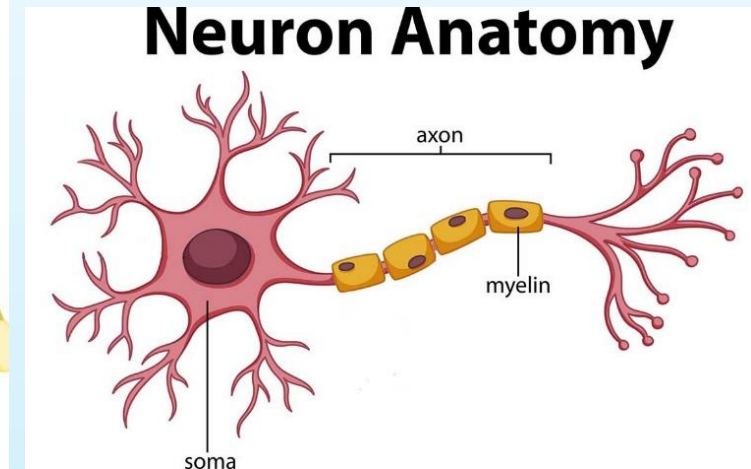
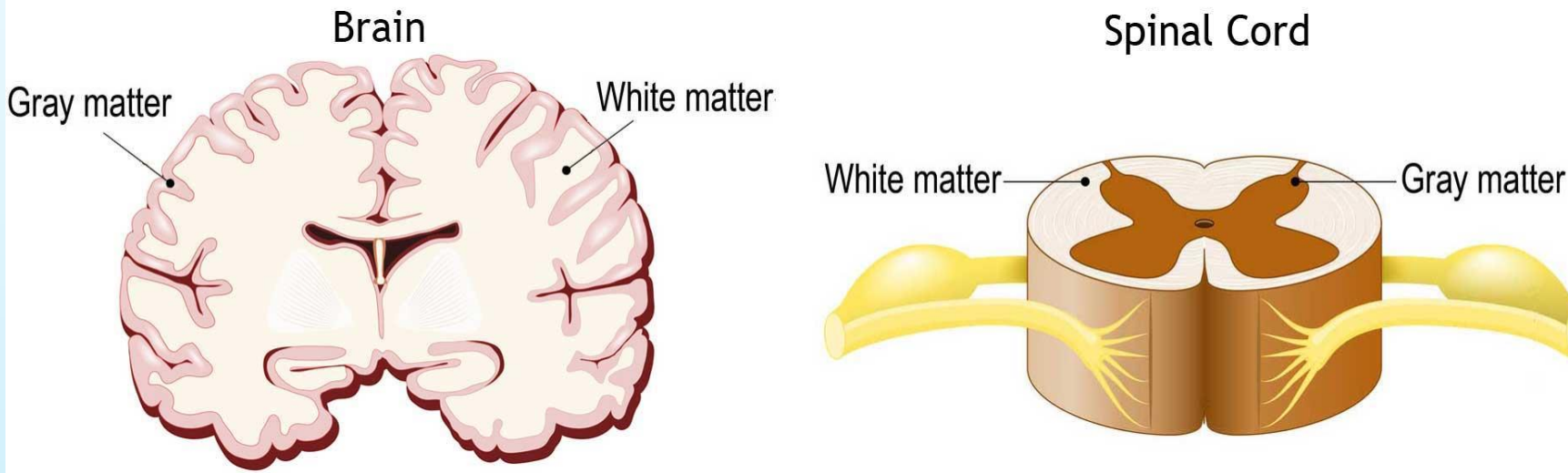
CSF is a watery colorless fluid that circulates in and around the ventricles and the spinal cord, and between the meninges with a total volume of 80 to 150 ml. CSF contains no more than 5 WBCs/mm<sup>3</sup>

### **CSF function:**

- a. serves as a shock-absorbing medium in the spinal cord and brain.
- b. washes out waste and impurities.
- d. delivers nutrients such as oxygen and glucose.

# Nervous Tissue Types in CNS:

1. **Gray matter:** a nervous tissue composed of neuron somas (cell bodies) and unmyelinated axons.
2. **White matter:** a nervous tissue made of bundles of axons wrapped in myelin. The white color derives from the myelin that coats axons providing electrical insulation



# The blood–brain barrier (BBB)

BBB consists mainly of tight junctions that seal together the endothelial cells of brain blood capillaries and a thick basement membrane that surrounds the capillaries.

A few water-soluble substances, such as glucose, cross the BBB by active transport.

Other substances, such as creatinine, urea, and most ions, cross the BBB very slowly.

other substances—proteins and most antibiotic drugs—do not pass at all from the blood into brain tissue

# The Peripheral Nervous System (PNS)

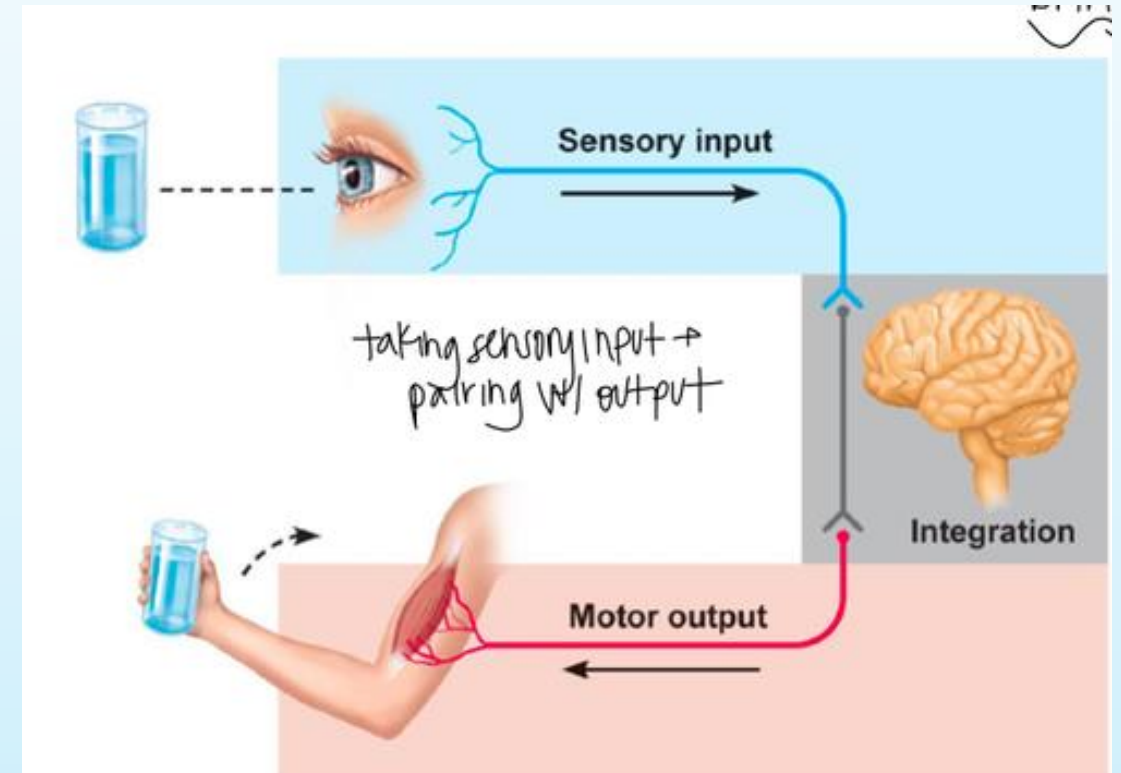
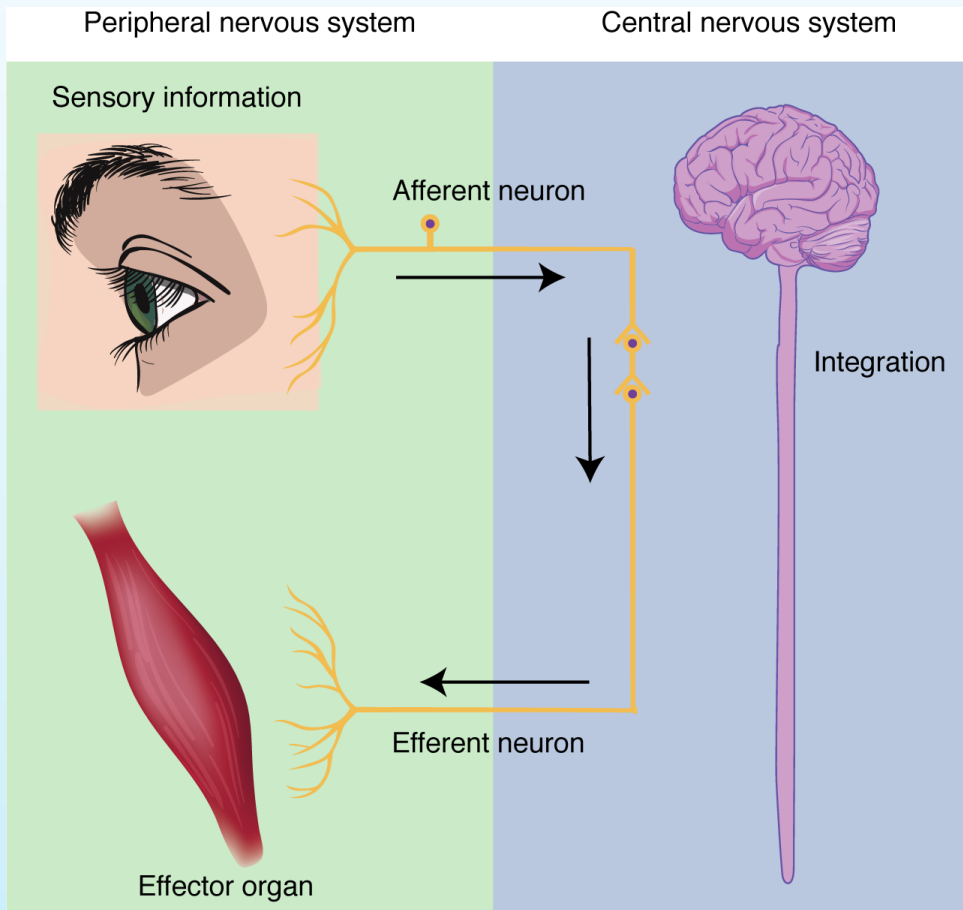
- The peripheral nervous system (PNS) consists of all nervous tissue outside the CNS. Components of the PNS include nerves, ganglia, enteric plexuses, and sensory receptors
- **Divisions of the PNS**
  1. Somatic nervous system: voluntary control of skeletal muscles
  2. Autonomic nervous system: involuntary control (sympathetic and parasympathetic divisions)

# Functions of the PNS

1. Transmission of sensory information to the CNS.
2. Execution of motor commands from the CNS.
3. Regulation of body functions (heart rate, digestion).

# Communication Pathways between CNS and PNS (Interaction)

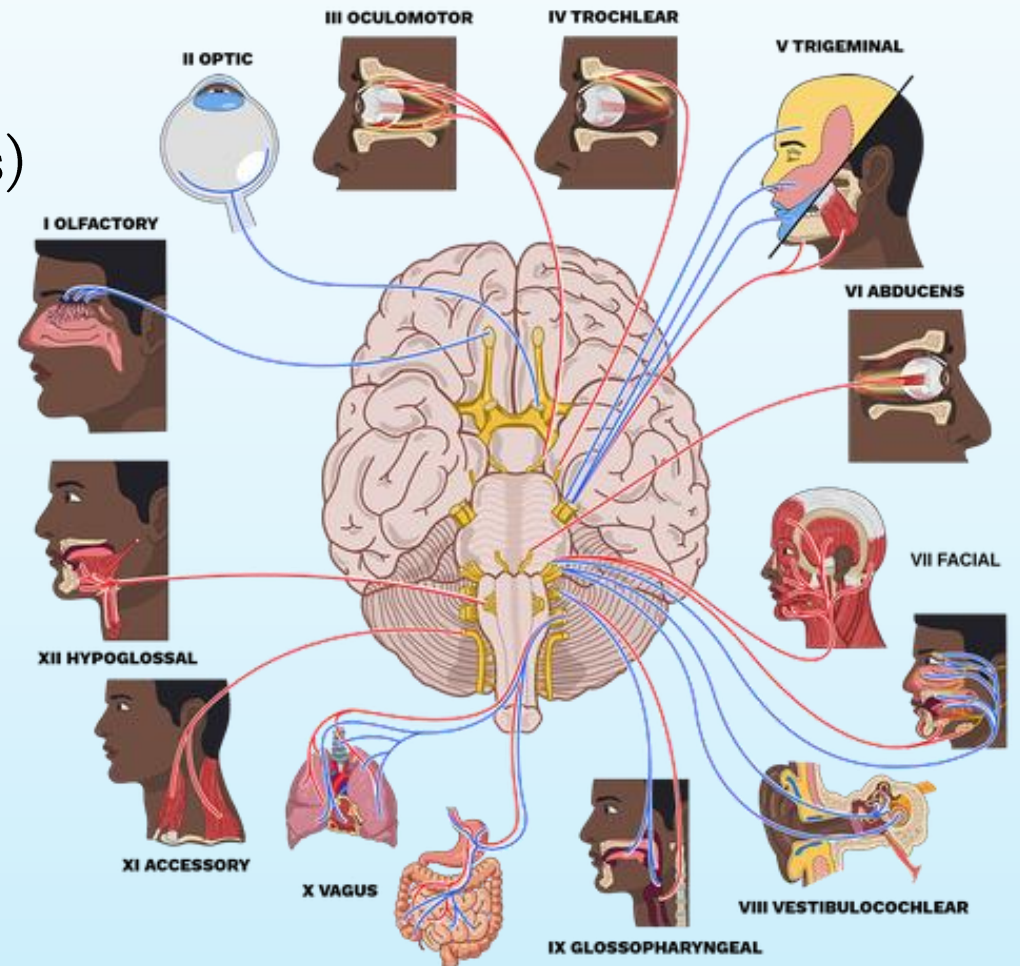
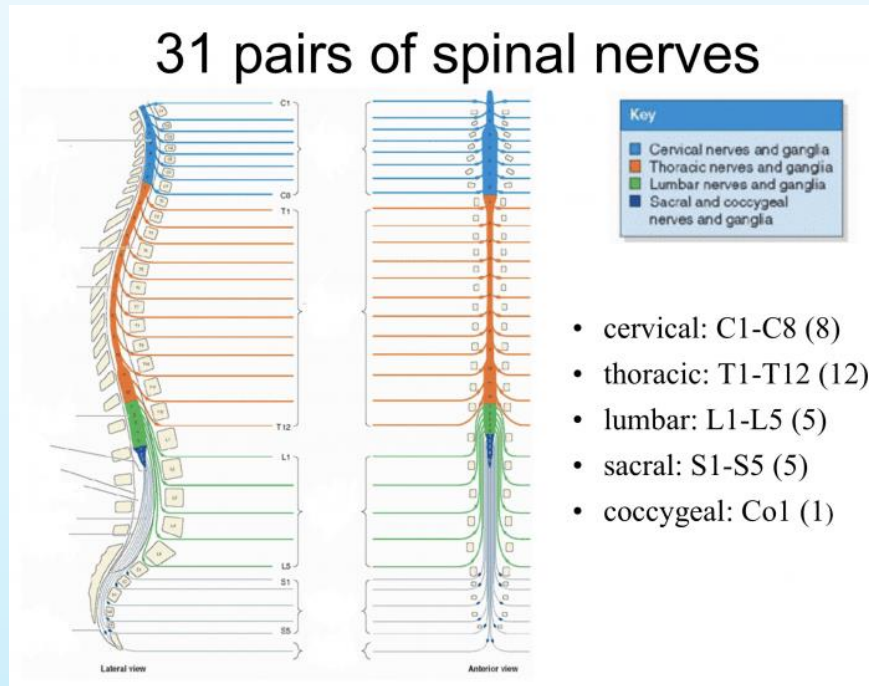
1. Afferent pathways: sensory input from the PNS to the CNS
2. Efferent pathways: motor output from the CNS to the PNS



# Nerves

A nerve is a bundle of hundreds to thousands of axons plus associated connective tissue and blood vessels that lies outside the brain and spinal cord. The main nerves in PNS include:

1. Cranial nerves emerge from the brain (12 pairs)
2. spinal nerves emerge from the spinal cord (31 pairs)



# Reflexes

A reflex is an action that is performed without conscious thought as a response to a stimulus. The simple ones are built into our nervous system, such as pulling the hand away from something hot, knee-jerk reflex, sneezing or coughing . A reflex that is acquired comes from practice, such as playing the piano. A reflex is made up of 5 components:

1. Receptor that responds to an electrical signal.
2. Afferent pathway sends the action onto the integrating center.
3. Integrating center: the CNS
4. Efferent pathway: signals from CNS
5. Effector organ usually a muscle or gland in the body

Thank You