



AL-Mustaqbal University College Department of Pharmacy physiology lec2/ 2nd stage

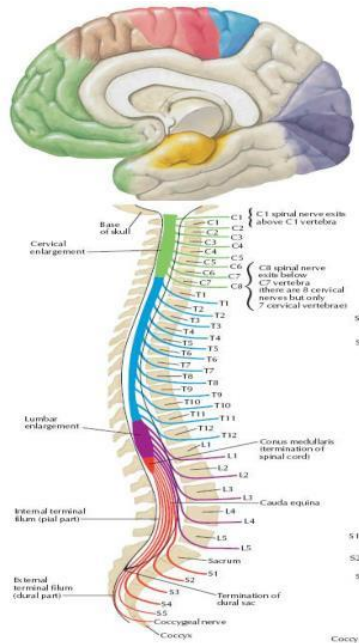


Brain and Spinal Cord

By: Dr. Weaam J. Abass

- Brain
- Spinal cord

CNS



CNS FUNCTIONS

The **CNS** comprises the brain and spinal cord, both of which play an important role .

- The brain plays a major role in controlling the various body functions, which include movement, sensation, thinking, memory, speech, etc.
- On the other hand, the spinal cord is connected to the brain at a particular section of the brain referred to as **the brainstem**.
- Our brain is protected by the skull, whereas the spinal cord is protected by the vertebrae or the spinal column.

HUMAN BRAIN

- ▶ The **brain** is one of the most important organs in the human body system. It is the **center of all commands**. It monitors all the **conscious and unconscious processes** of the body.
- ▶ The brain is divided into two halves, the right hemisphere and the left hemisphere.
- ▶ The human brain can be divided into three parts:

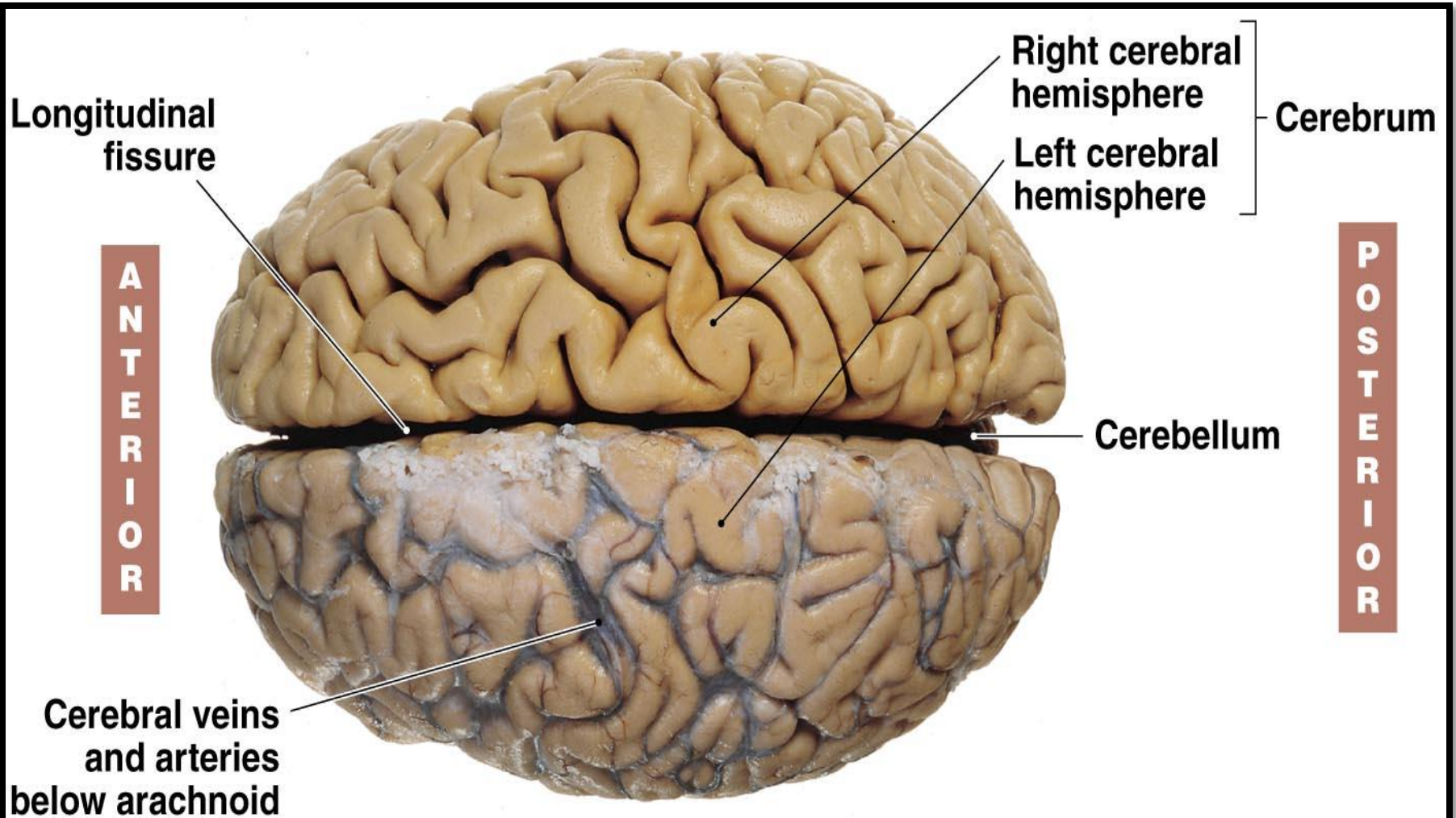
1-Forebrain

2-Midbrain

3-Hindbrain

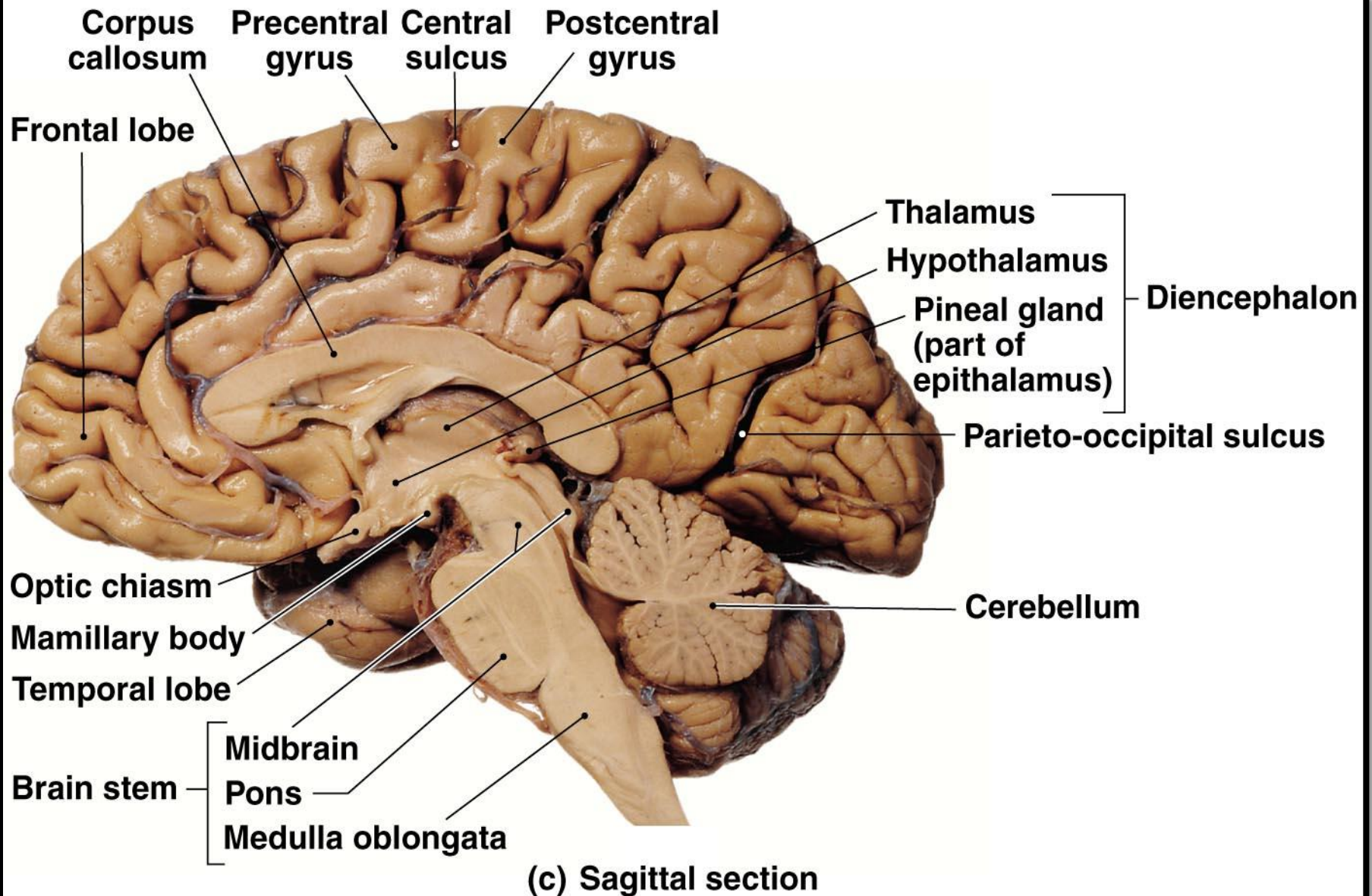
These, regulate some specific functions of the body.

THE BRAIN



(a) Superior view

THE BRAIN



HUMAN BRAIN

- ▶ **A/ The Forebrain** : Consists of the **cerebrum**, which is the largest part of the brain and is the center of intelligence, memory, emotion, personality, speech and the ability to feel.
- ▶ **B/ The Midbrain** : Is located underneath the middle of the forebrain and is the coordinator of the messages or impulses coming in and out of the brain.
- ▶ **C/ the Hindbrain** : Is located below the back end of the cerebrum, consists of the **cerebellum, pons and medulla**.

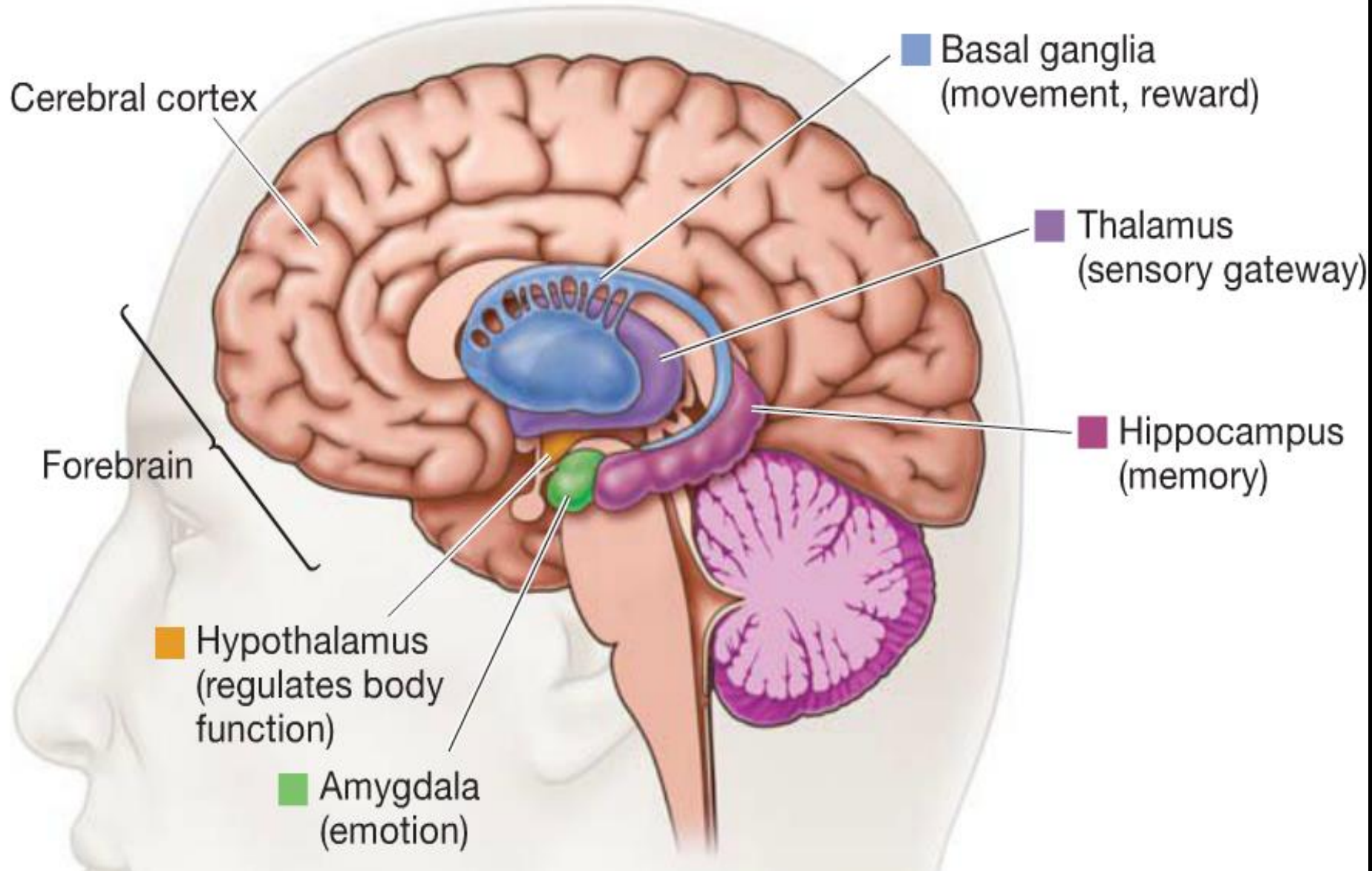
FOREBRAIN

- ▶ **Forebrain** is considered as the **highest region of the brain** it essentially differentiates us humans from the rest in the animal kingdom .This region is also involved in **processing complex information**
- ▶ The forebrain is composed of :
 1. **The limbic system,**
 2. **The thalamus, the hypothalamus,**
 3. **The cerebral cortex.**
 4. **The basal ganglia**

FOREBRAIN

1- The limbic system, "emotional brain" is made up of the amygdala and the hippocampus. Overall, the limbic system is involved in **memories and emotions**

- **Amygdala** : From a Latin word meaning "**almond**", owing to its shape, the Amygdala is responsible for processing **emotions** - how humans become aware of them and how we express them.
- **The hippocampus**, on the other hand, is presumably involved in **memory storage** because damage to the part actually results to inability to store **new information**. Patients with **damaged** hippocampus therefore live the day without remembering yesterday (**Alzheimer disease**) .



NOTE : The hypothalamus is the center of homeostasis control , while thalamus is the sensory gateway to the higher region : the brain cortex

FOREBRAIN

The cerebral cortex

- ▶ It is the **largest part of the human brain, making up to 80% of the brain's volume.**
- ▶ **High-level processing** also takes place in this part of the brain. Because of the complexity and the influence of the cerebral cortex

The basal ganglia

- ▶ Is a cluster of neurons sandwiched **between the thalamus and the cerebral cortex.** It works with the cerebral cortex and the cerebellum for **coordinating voluntary movements**, such as bicycle riding and typing.
- ▶ The basal ganglia gets **damaged** with **Parkinson's Disease..**

Cerebrum

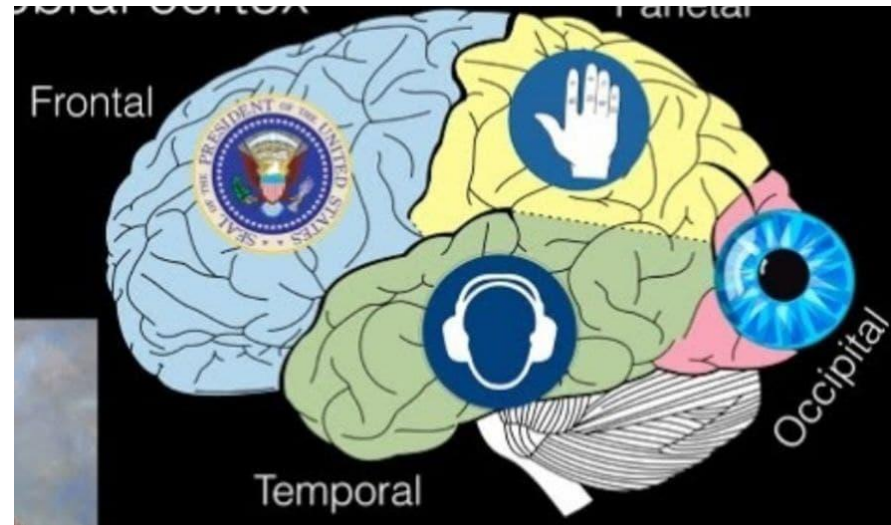
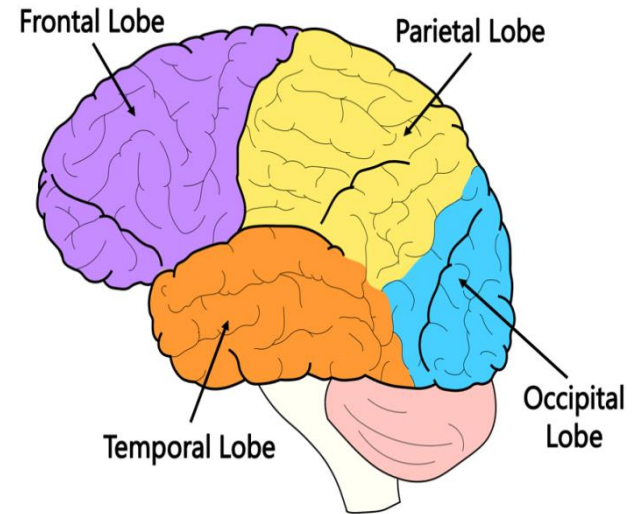
- **Frontal lobe**
(cerebral cortex)

Influence the personality
,creativity

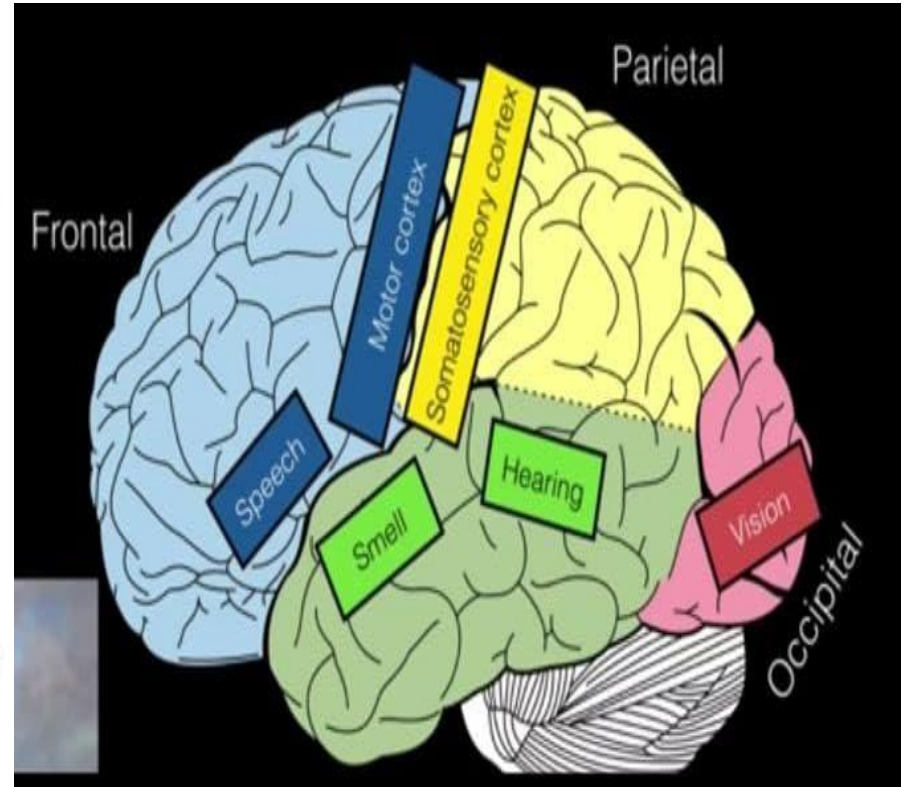
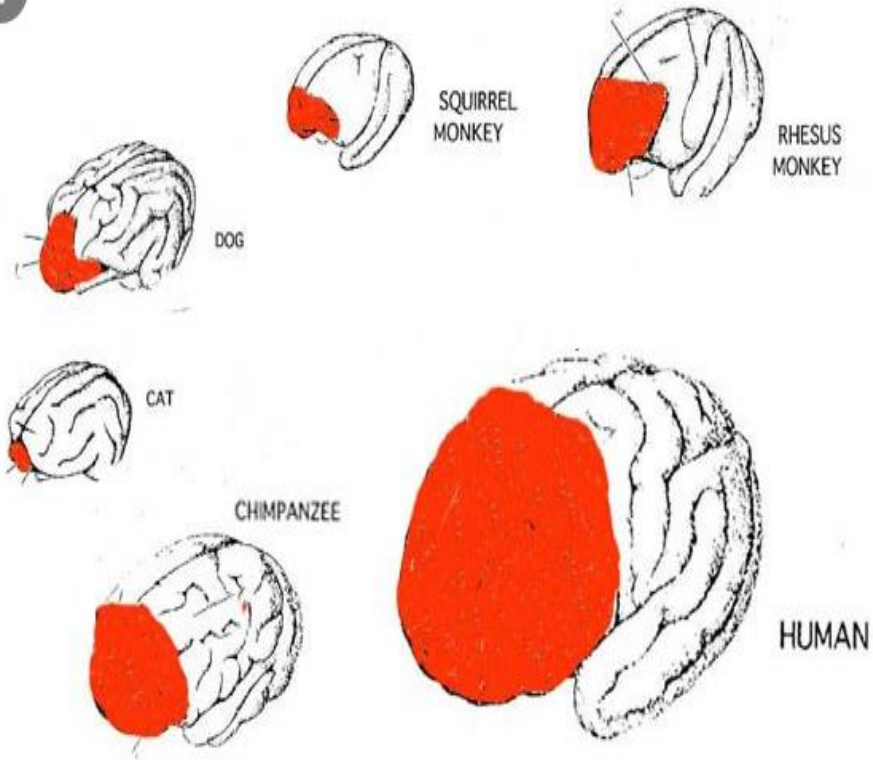
,emotions and problem
solving

- **The occipital lobe**

This function interpret
visual stimuli



Cerebrum- frontal lobe



Cerebrum

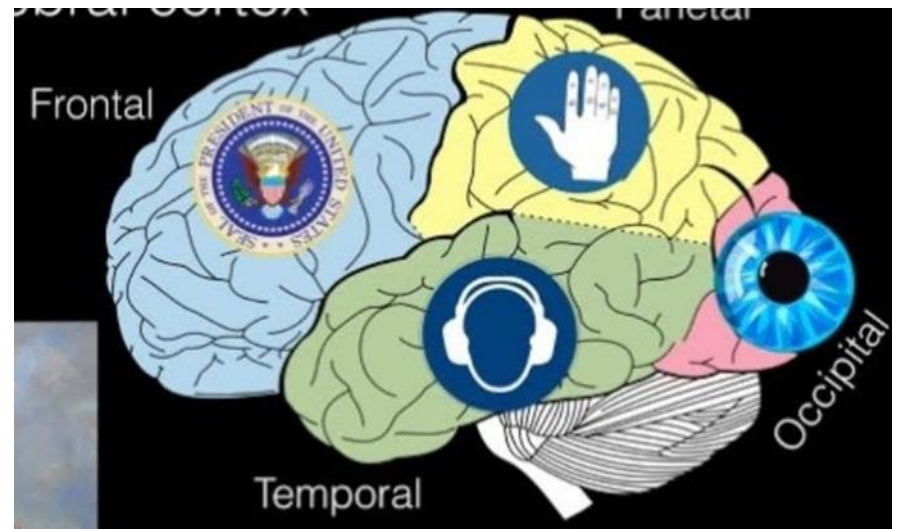
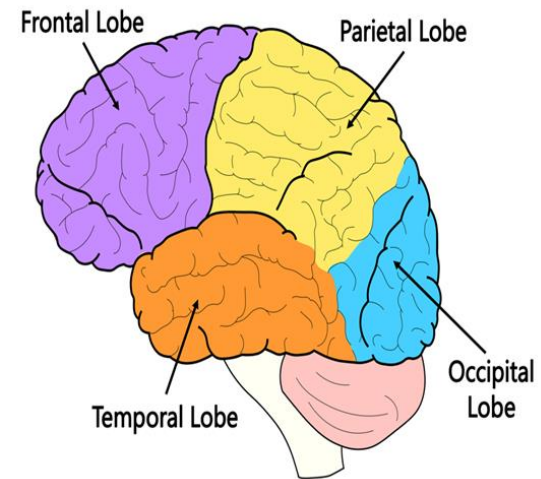
- **The Temporal lobe**

Control the hearing ,language comprehensions ,storage and recall memories

- **The Parietal lobe**

- This is the principle center for the reception and interpretation of **sensation**

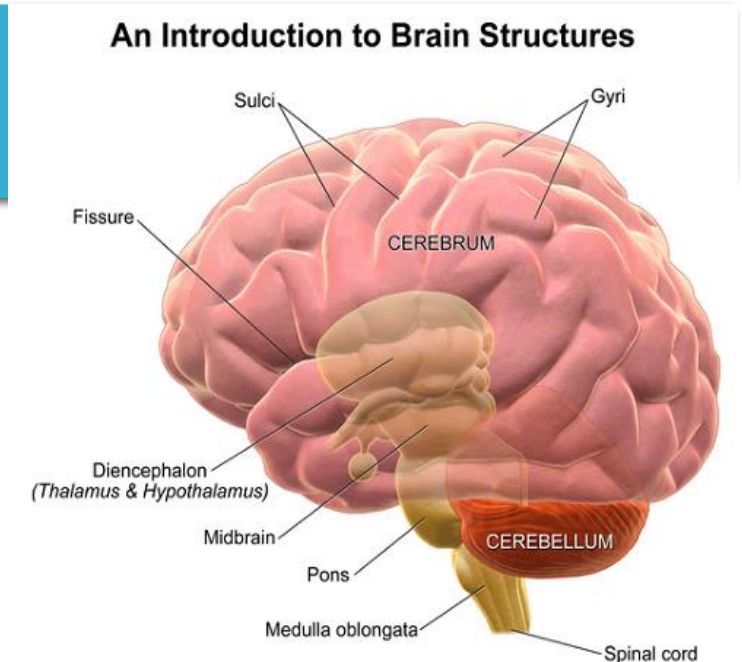
- Interpret and integrate the sensory inputs like **touch** ,**temperature**



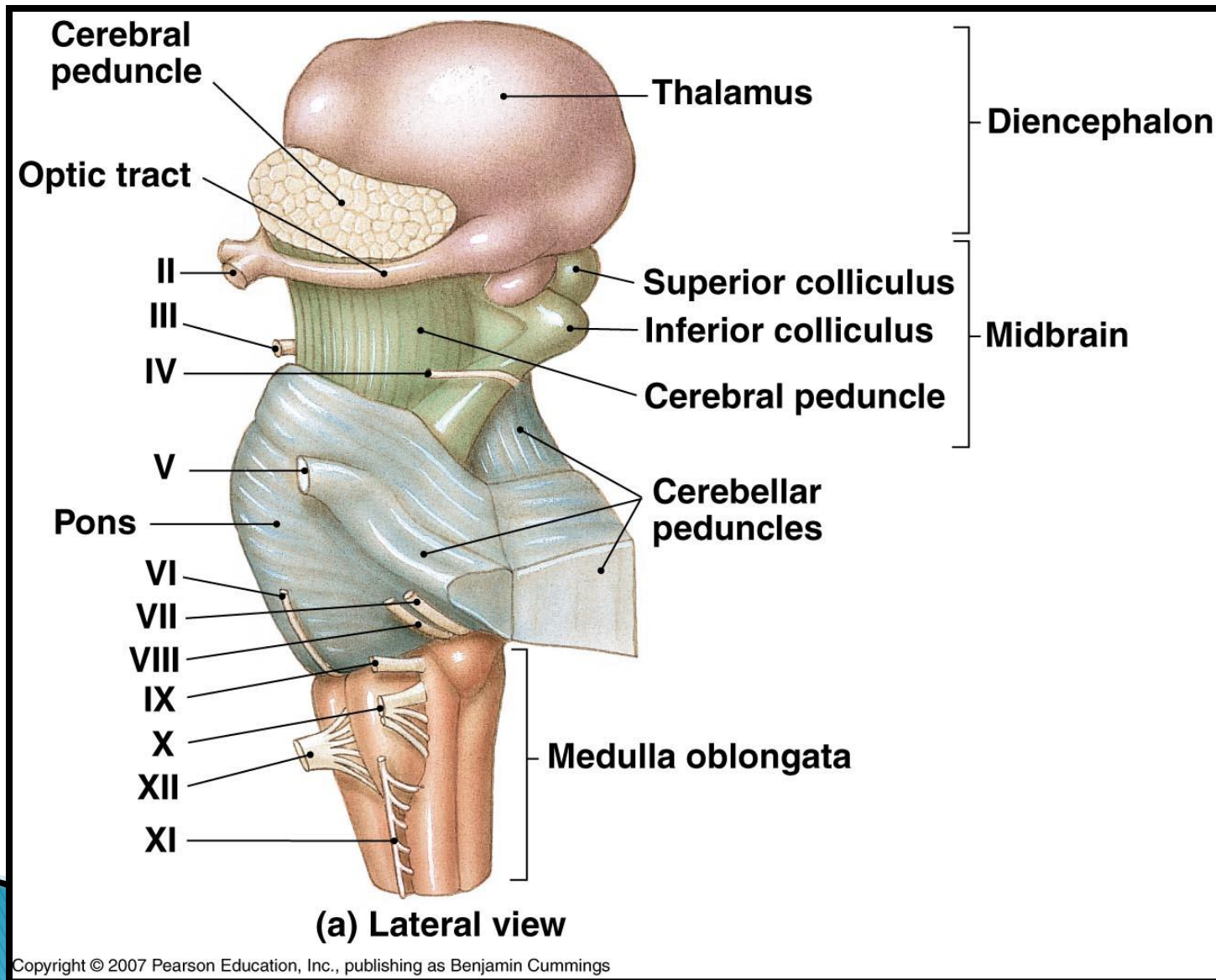
Cerebellum

Function :

1. Control **posture and balance**.
2. Controlled the **muscle tone** and coordinate muscle movement (skilled movement)
3. If cerebellum damaged ,muscle tone decreases and fine motor movements become **very clumsy**.
4. **By training specify the mistake in movement and correct it and storage in cerebrum .**



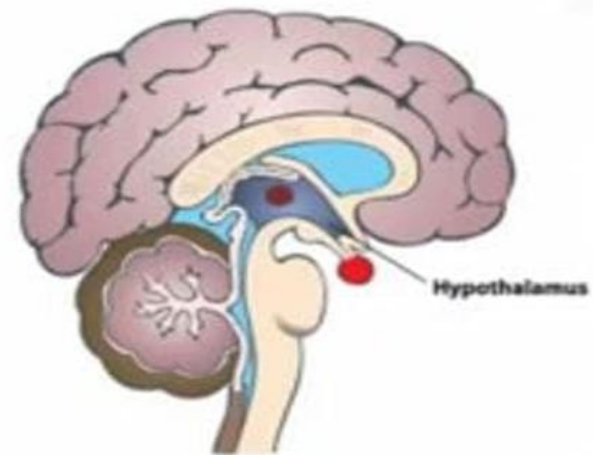
The Diencephalon and Brain Stem



Diencephalon (Thalamus and hypothalamus)

The Diencephalon

- The thalamus and the hypothalamus
- The **thalamus** is the relay station of all sensory stimuli towards the brain .
- The **hypothalamus** controls body temperature, appetite, water balance, pituitary secretions and sleep-wake cycle .

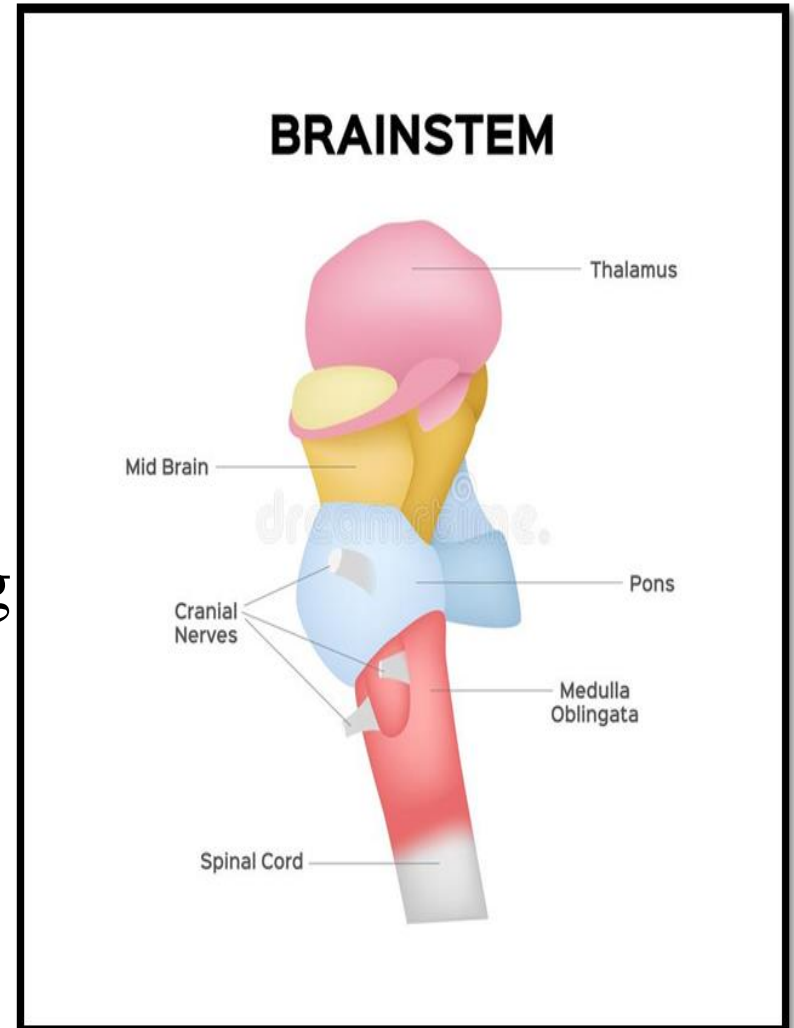


Brain stem

- **Mid Brain**

Contain reflex for certain visual activities

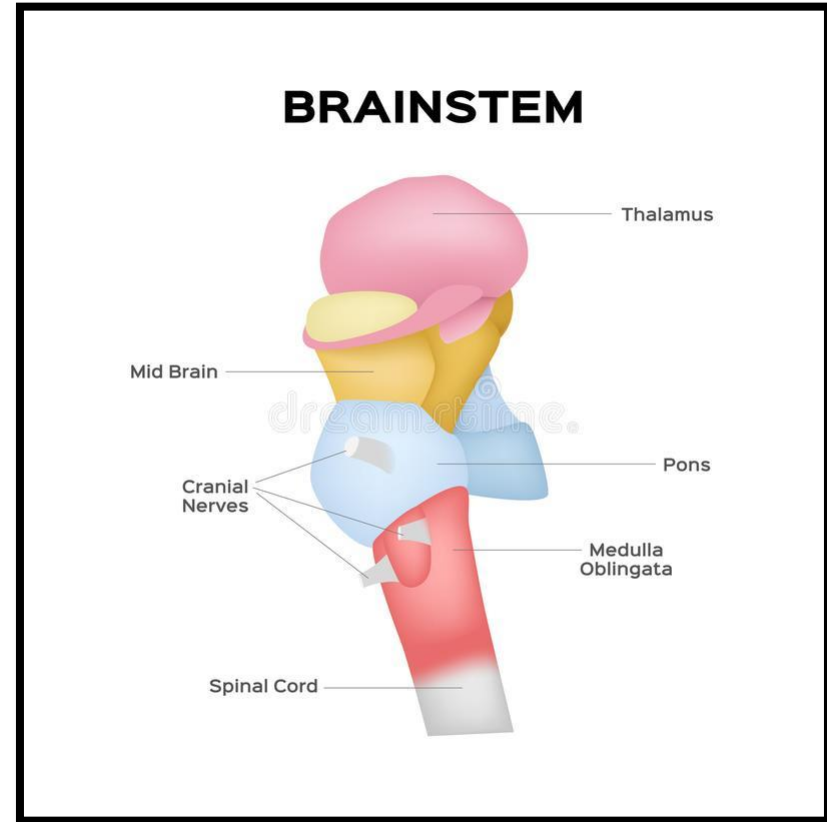
It controls the extrinsic eye muscles , to adjust eye movements for tracking (moving images) e.g. moving car and scanning stationary images (as you are doing to read this sentence).



Brain stem

- **Pons**

1. Connects (as **bridge**) the cerebellum with cerebrum
2. Coordinate with the medullary respiratory and cardiovascular center
3. Exit points for cranial nerve 5,6 and 7

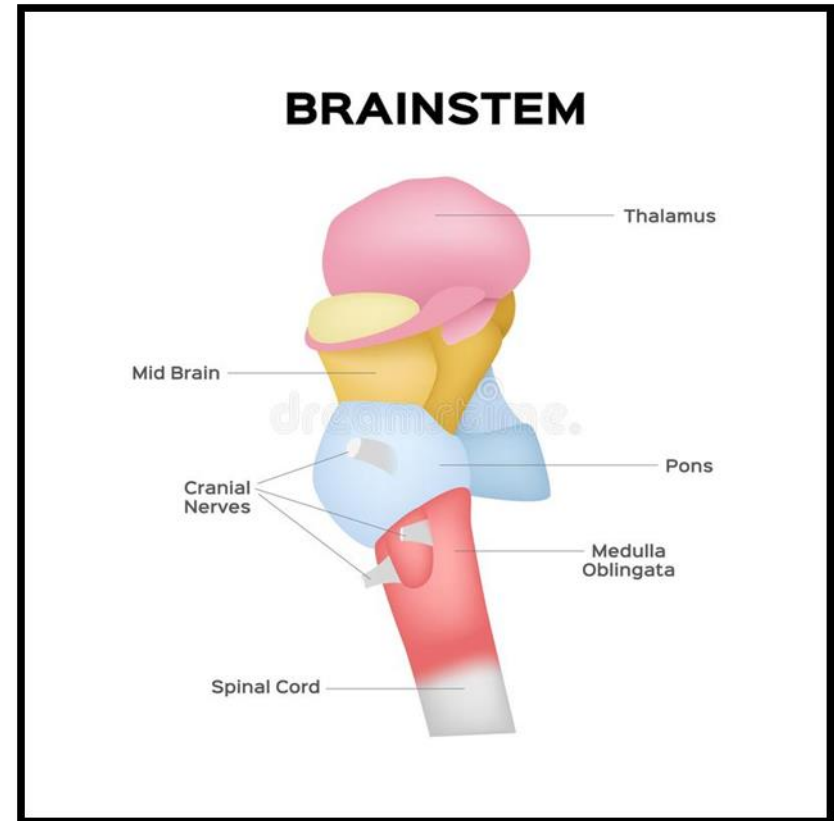


Brain stem

- **Medulla oblongata**

Nuclei in the medulla include cardiovascular center and medullary rhythmicity area .

- ❖ The cardio-vascular regulate the rate and force of the heart beat and the diameter of blood vessels.
- ❖ The medullary rhythmicity area of the respiratory center adjusts the basic rhythm of breathing .



Brain stem

- **Medulla oblongata**

- ❖ The medulla also **control** reflexes for

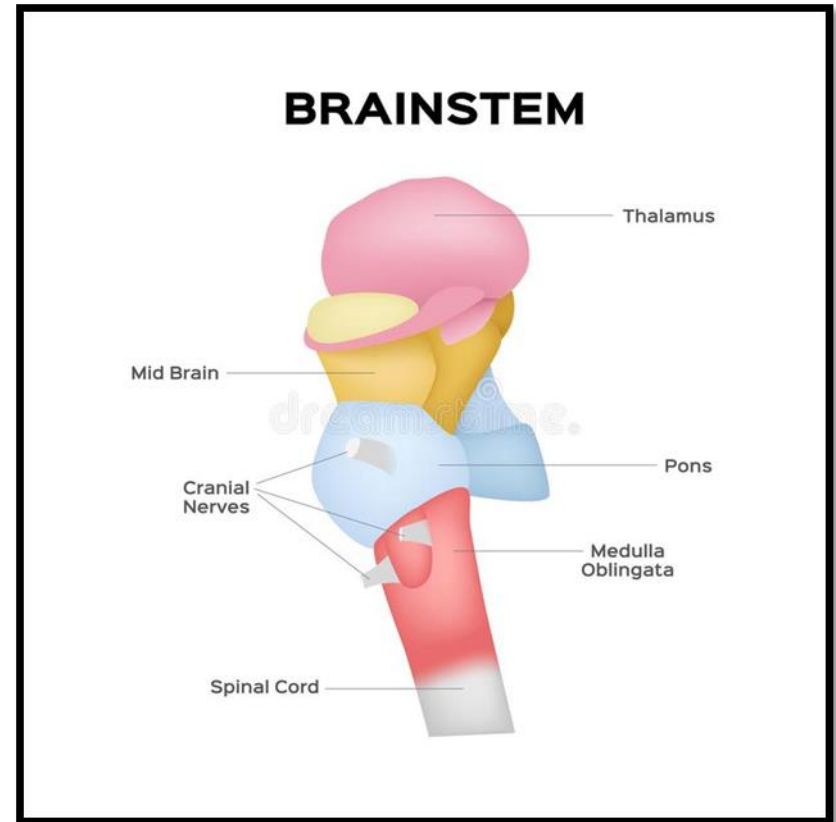
vomiting ,

swallowing,

sneezing

,coughing

and **hiccupping**



Cranial nerves

Cranial Nerves

- I Olfactory
- II Optic
- III Oculomotor
- IV Trochlear
- V Trigeminal
- VI Abducens
- VII Facial
- VIII Vestibulocochlear
- IX Glossopharyngeal
- X Vagus
- XI Accessory
- XII Hypoglossal

12 pairs

Cranial nerves

- **I Olfactory Nerve** for smell
- **II Optic Nerve** for vision
- **III Oculomotor** for looking around
- **IV Trochlear** for moving eye
- **V Trigeminal** for feeling touch on face
- **VI Abducens** to move eye muscles



Cranial nerves

- **VII Facial** to smile, wink, and help us taste
- **VIII Vestibulocochlear** to help with balance, equilibrium, and hearing
- **IX Glossopharyngeal** for swallowing and gagging
- **X Vagus** for swallowing, talking, and parasympathetic actions of digestion
- **XI Spinal** accessory for shrugging shoulders
- **XII Hypoglossal** for tongue more divided into different regions as muscles



SPINAL CORD

- ▶ The spinal cord is a bundle of nerves that run down the back from the brain in the spinal column. The spinal cord is about 40 cm in length and as wide as the thumb.
- ▶ The function of the spinal cord is to relay all the impulses, information from all around the body, internally and externally, to the brain.
- ▶ If the spinal cord gets affected due to an injury, leading to **paralysis** in different parts of the body like the upper and lower limbs.

SPINAL CORD

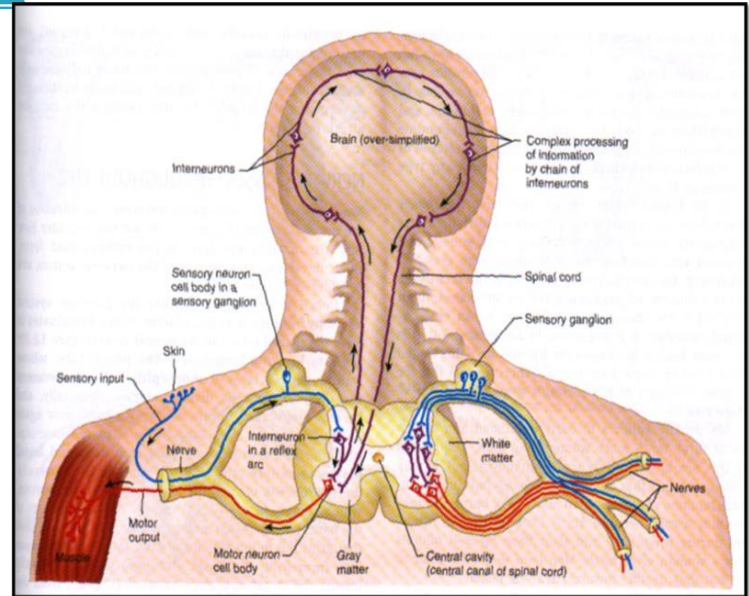
- ▶ Runs through vertebral canal of the vertebral column
- ▶ Protected by bone, meninges, and cerebrospinal fluid
- ▶ Spinal cord made of a core of **gray matter** surrounded by white matter.
- ▶ **31 pairs** of spinal nerves branch off spinal cord through inter vertebral foramen.

SPINAL CORD – FUNCTION

1. Nerve impulse propagation

The white matter tract in spinal cord are highways for nerve impulse propagation sensory input nerve travel along the tract toward the brain and motor output travel from the brain

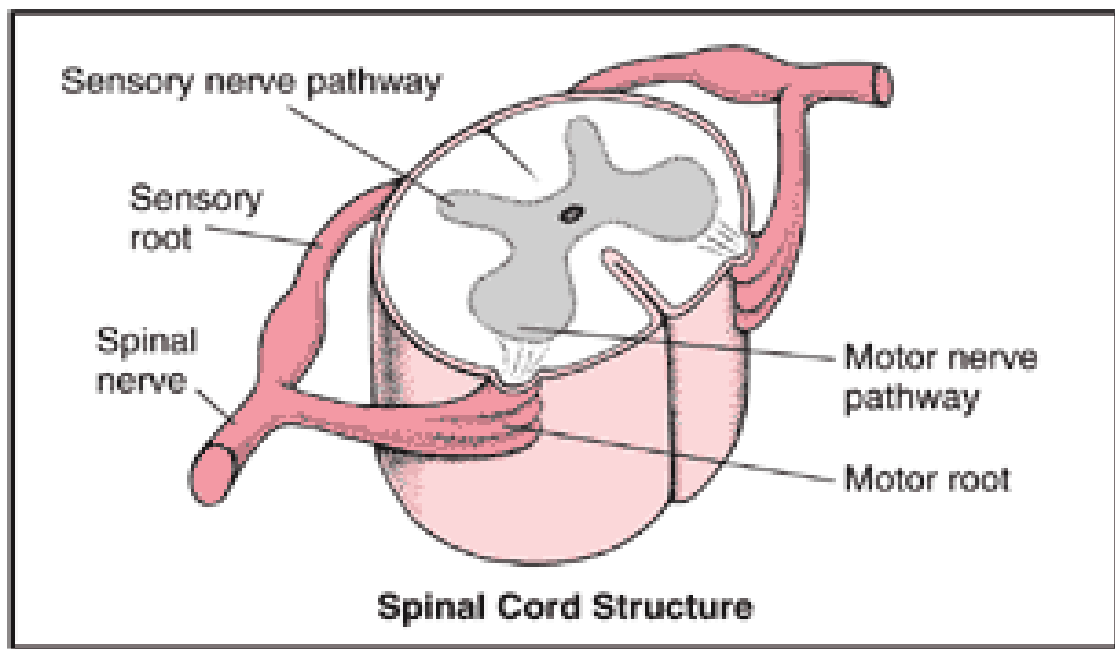
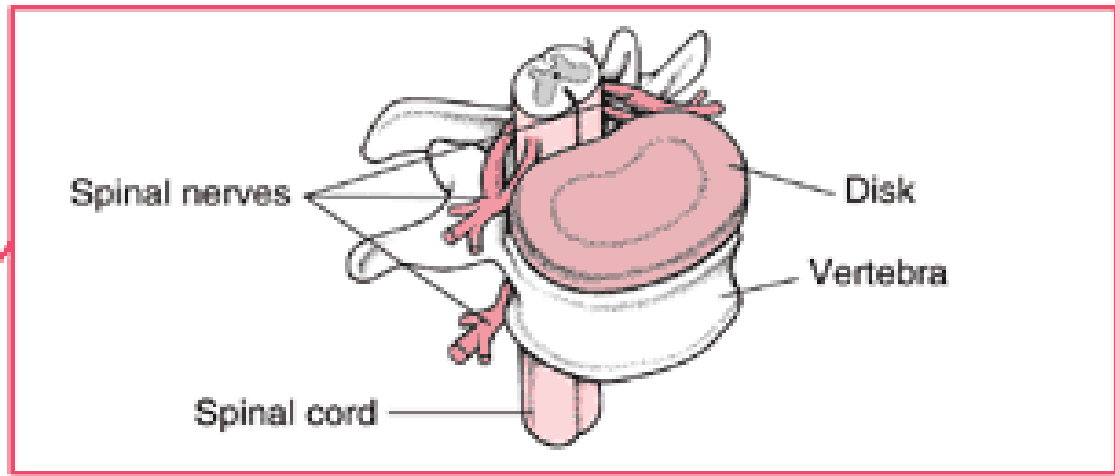
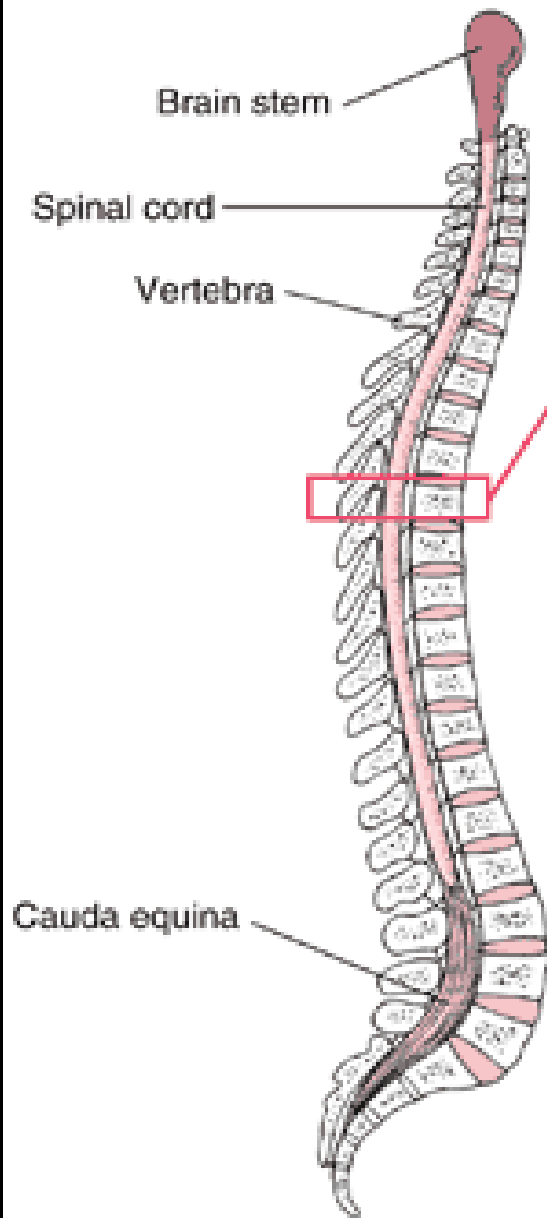
1. Integration of information and reflexes



SPINAL CORD – FUNCTION

Reflexes

Is a fast automatic unplanned sequences of action occurs to a particular stimulus



Meninges of Brain and Spinal Cord

1. Dura mater(superficial)

Spinal dural sheath

- Does not attach to bone
- ▶ Epidural space
 - Fat and veins
 - Between dura mater and vertebra
- ▶ Subdural space
 - Between dura mater and arachnoid

2. Arachnoid mater(middle)

Impermeable layer (Barrier)

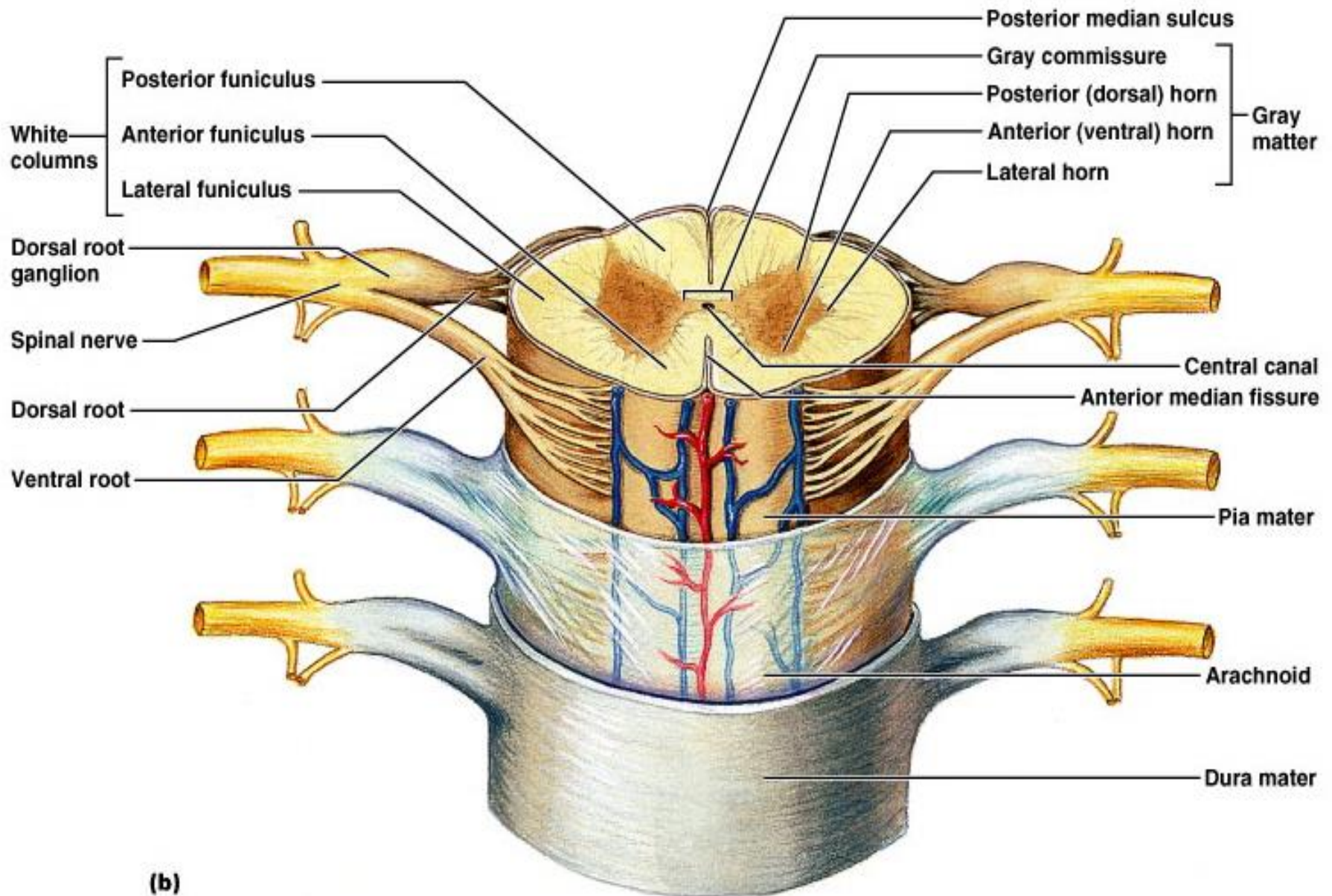
- ▶ Subarachnoid space
 - Between arachnoid and pia mater
 - Contains CSF

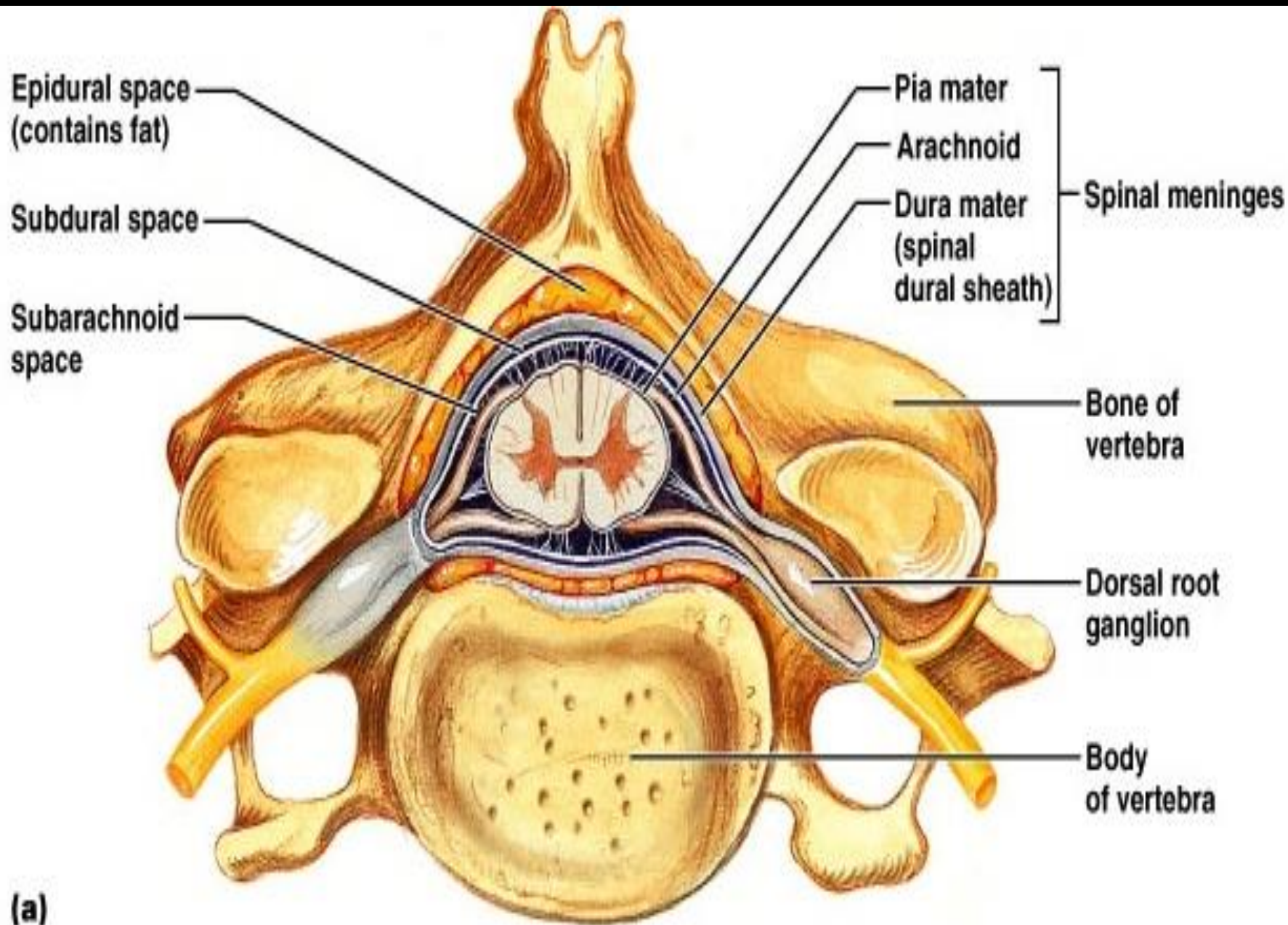
3. Pia mater (deep)

Highly vascular

- Adheres to brain/spinal cord tissue

Meninges of Brain and Spinal Cord

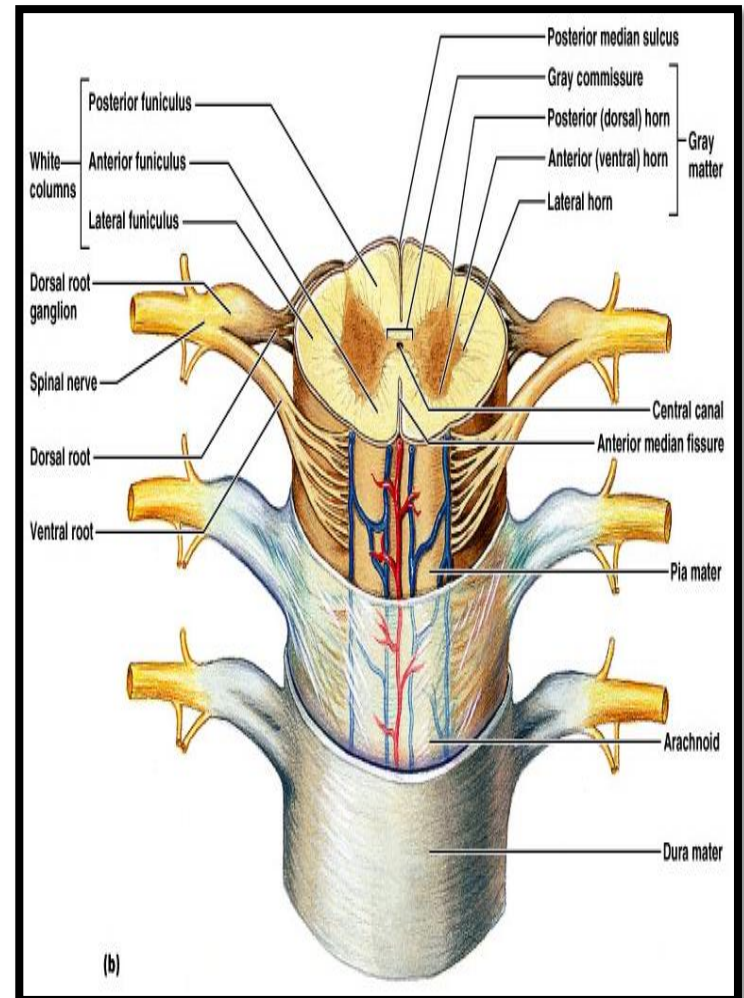




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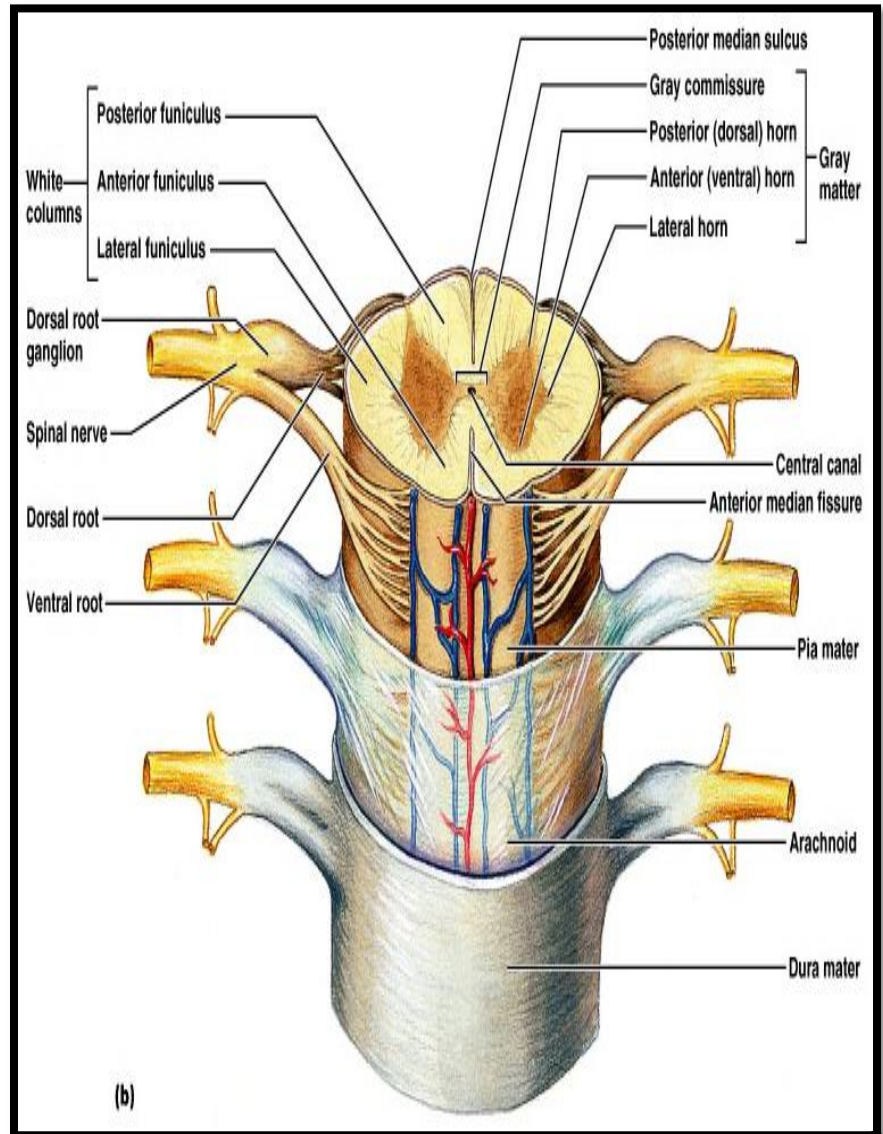
Gray Mater

- ▶ Consists of neuron cell bodies, unmyelinated axons, dendrites, and neuroglia
- ▶ Shaped like an “H”
 - Gray commissure (crossbar)
 - Central canal
- ▶ Posterior horns
- ▶ Anterior horns



White Mater

- ▶ Surrounds **gray matter**
- ▶ Composed of myelinated and unmyelinated axons
- ▶ Divided into white columns (funiculi)
- ▶ Allow for communication between
 - Parts of the spinal cord
 - Spinal cord and brain



White Mater

- ▶ There are 3 types of nerve fibers:
 - **Ascending**
 - Carry sensory informations from sensory neurons of body to brain
 - touch, pressure, pain, temperature
 - **Descending**
 - Carry motor instructions from brain to spinal cord
 - Contraction of muscles and secretion of glands
 - control precise, skilled movement = writing, maintain balance, create movement
 - **Commissural**
 - Cross from one side of cord to the other

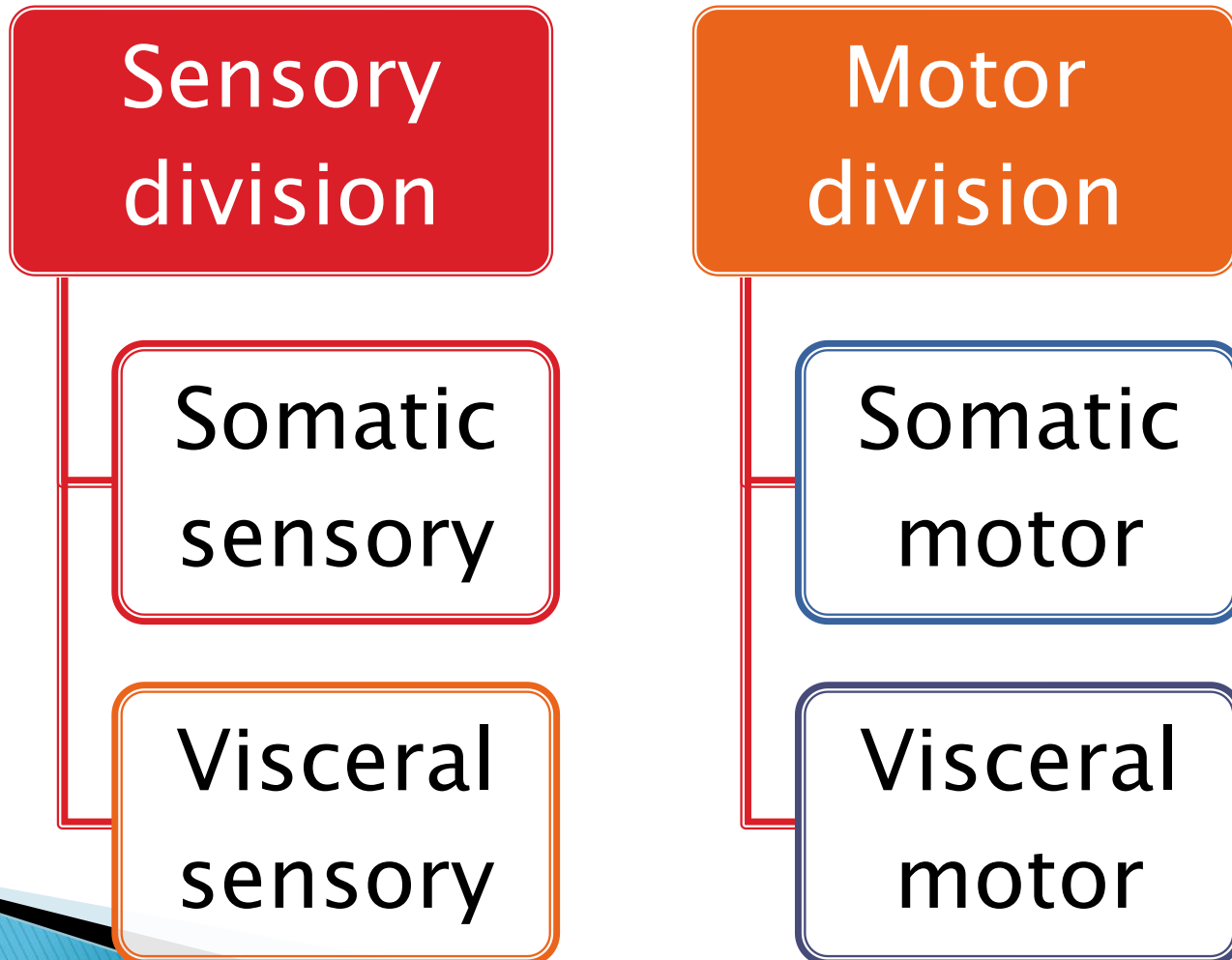
Spinal nerves

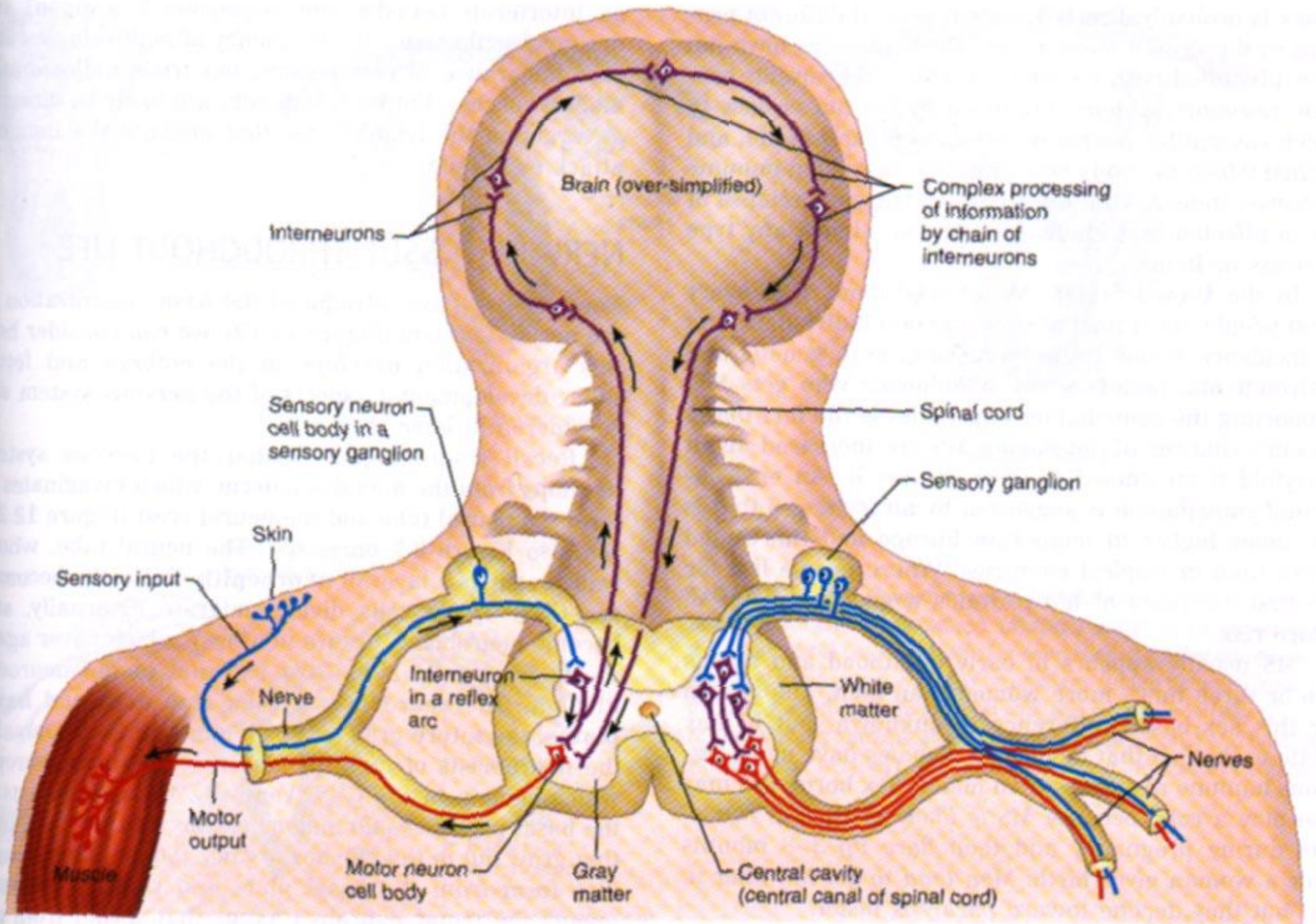
- ▶ **functions:-**
- ▶ **1-Spinal nerve are mixed nerves, which carry **sensory, motor, autonomic information** .**
- ▶ **2-The cervical spinal nerve** innervate the muscle and provide sensation for the head ,neck ,diaphragm as well as limbs and back
- ▶ **3-The lumbar, sacral and coccygeal nerves** combine to form the lumba-sacral plexus.

Peripheral Nervous System PNS

- ▶ Nervous system structures outside the brain and spinal cord
- ▶ Either somatic or visceral
 - Visceral motor portion is the ANS
- ▶ Structural components:
 - Sensory receptors
 - Motor endings
 - Nerves and ganglia

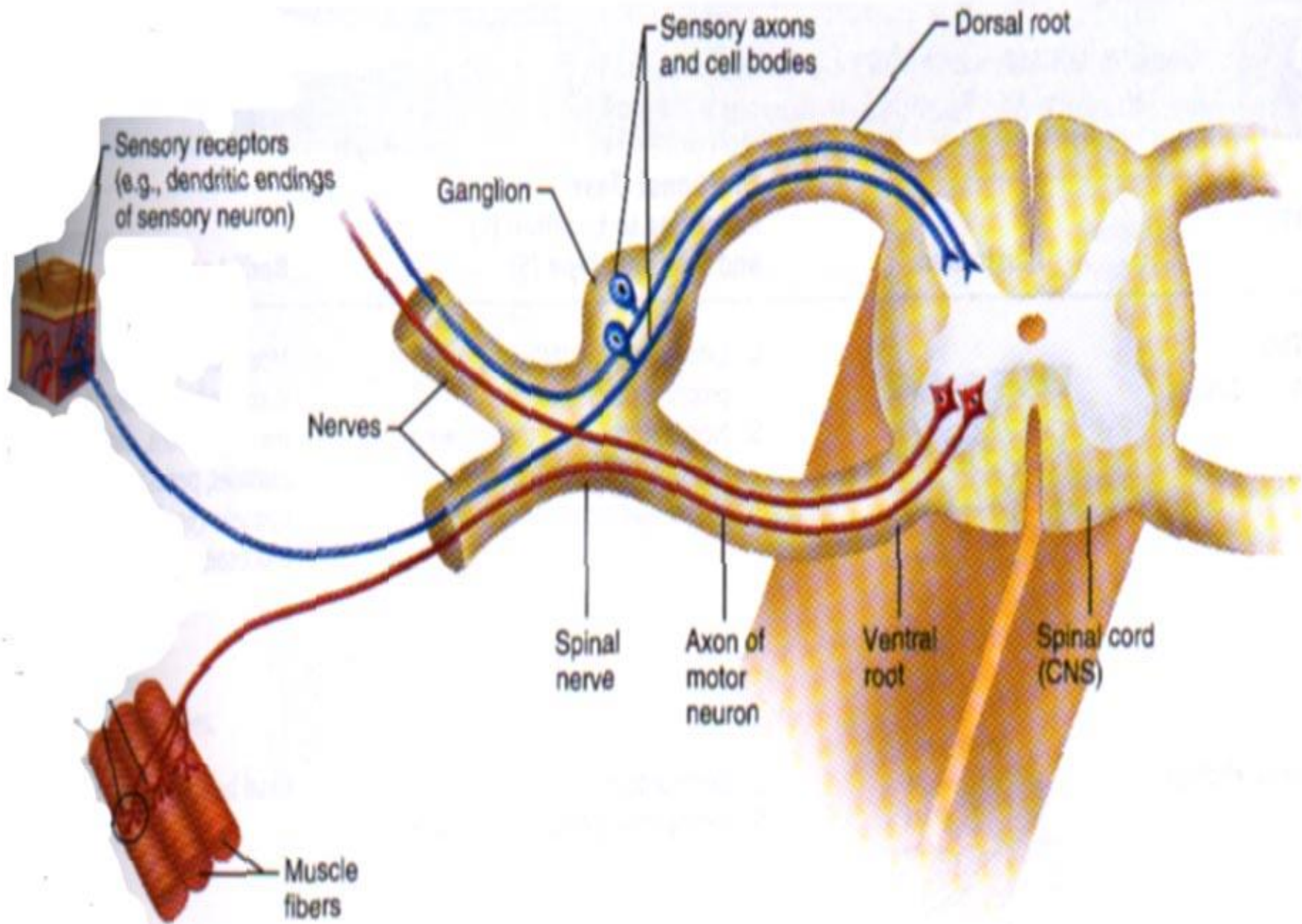
PNS - Sensory and Motor Signals



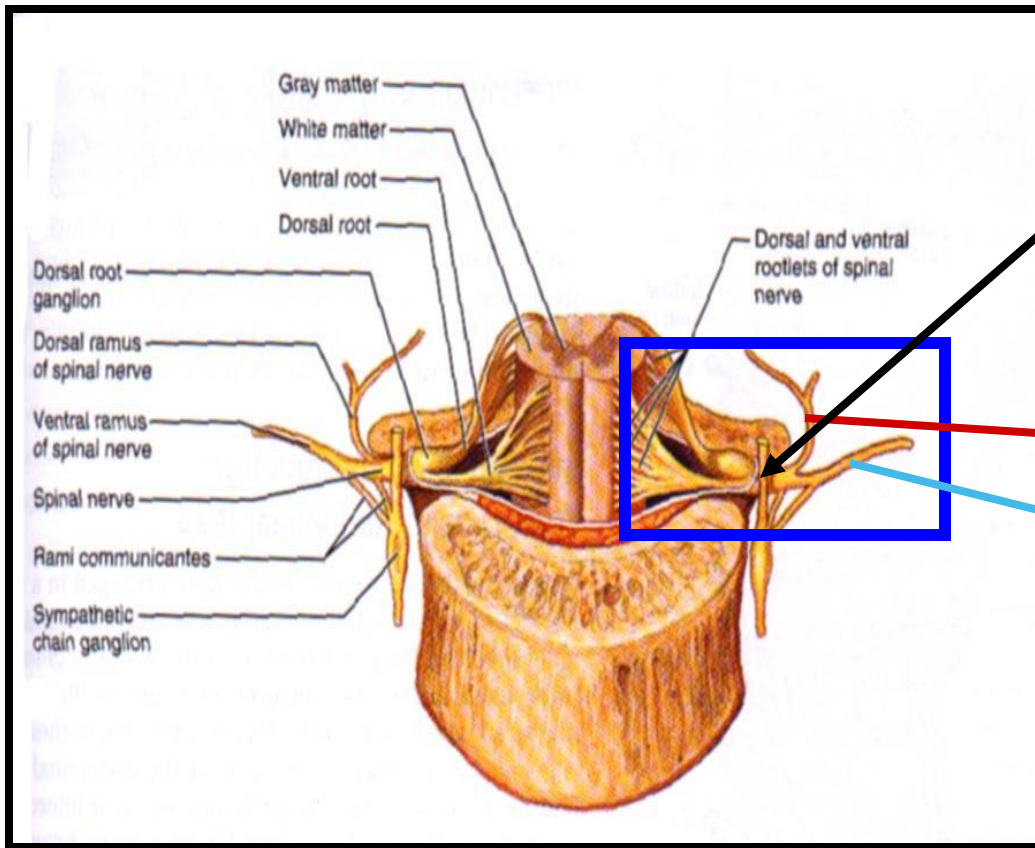


Spinal Nerves

- ▶ Each spinal nerve connected to spinal cord via dorsal (sensory) and ventral (motor) root
- ▶ Spinal nerves branch into dorsal ramus and ventral ramus
 - Ventral ramus
 - Connects to rami communicantes, which then lead to sympathetic chain ganglia
 - Supply anterior and lateral regions of the neck, trunk, and limbs
 - Dorsal ramus
 - Supply the dorsum of the neck and trunk (back)



The Big Picture



- ▶ Just lateral to intervertebral foramen, each spinal nerve then splits in 2
 - **Dorsal Rami**
 - **Ventral Rami**
- ▶ Contain BOTH Sensory and Motor fibers

Somatic Nervous System

- ▶ Innervates skeletal muscle
- ▶ Neurons runs from CNS directly to muscle
- ▶ Consists of single neuron plus skeletal muscle cells
- ▶ Voluntary control
 - Running, moving limbs, typing on a computer!

