Al-Mustaqbal University
College of Pharmacy
Second stage /2024
Physiology Lec2 Nervous system

Brain and Spinal Cord

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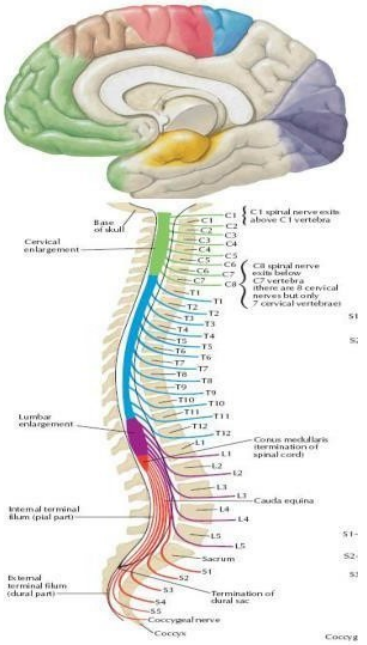
CNS

- Brain
- Spinal cord



CNS FUNCTIONS

The **CNS** comprises the brain and spinal cord, both of which play an important role .The **brain** is consist of 100 billion neurons located inside the skull, It is the **center of all commands**. It monitors all the **conscious and unconscious processes** of the body.

- 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 aparticular 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**.

Divisions of brain

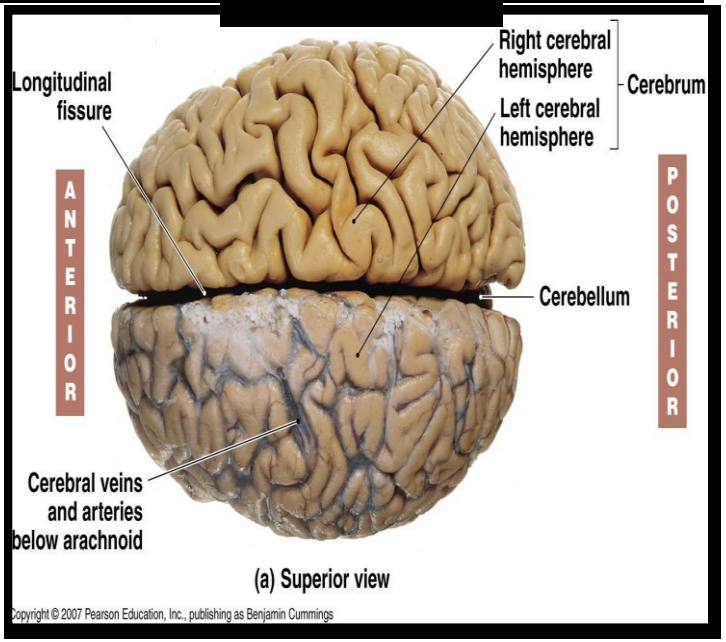
- The **brain** is consist of 100 billion neurons located inside the skull, It is the **center of all commands**. It monitors all the **conscious and unconscious processes** of the body.

- The brain is divided into **two halves**, the right hemisphere and theleft hemisphere Or to **four different regions**: the cerebrum, diencephalon, brainstem, and cerebellum

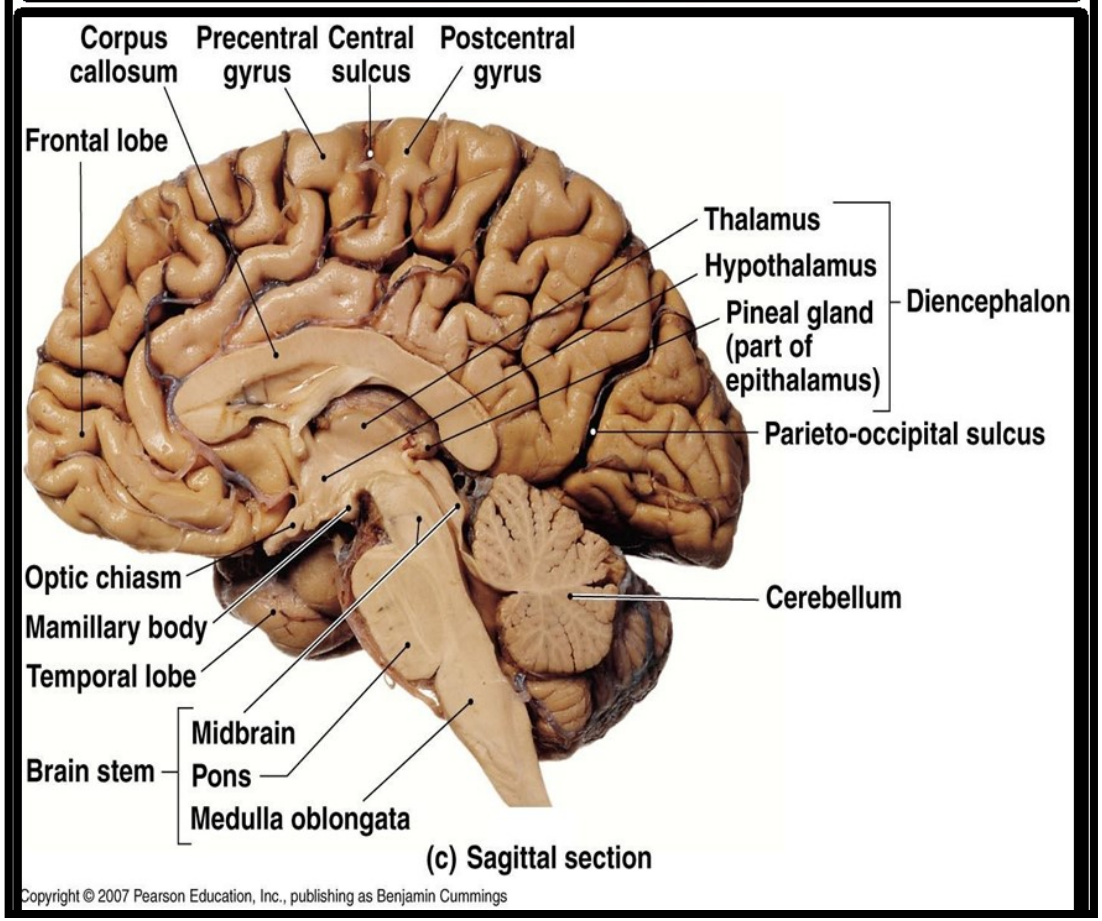
- Also can be divided into **three parts:1-Forebrain -2Midbrain -3 Hindbrain**

These, regulate some specific functions of the body.

THE BRAIN



THE BRAIN



HUMAN BRAIN

A/ The Forel 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 c **on of the brain** it essentially **differentiates** us numans from the rest in the animal kingdom .This region is also involved in **processing complex information**

- The forebrain is composed of:

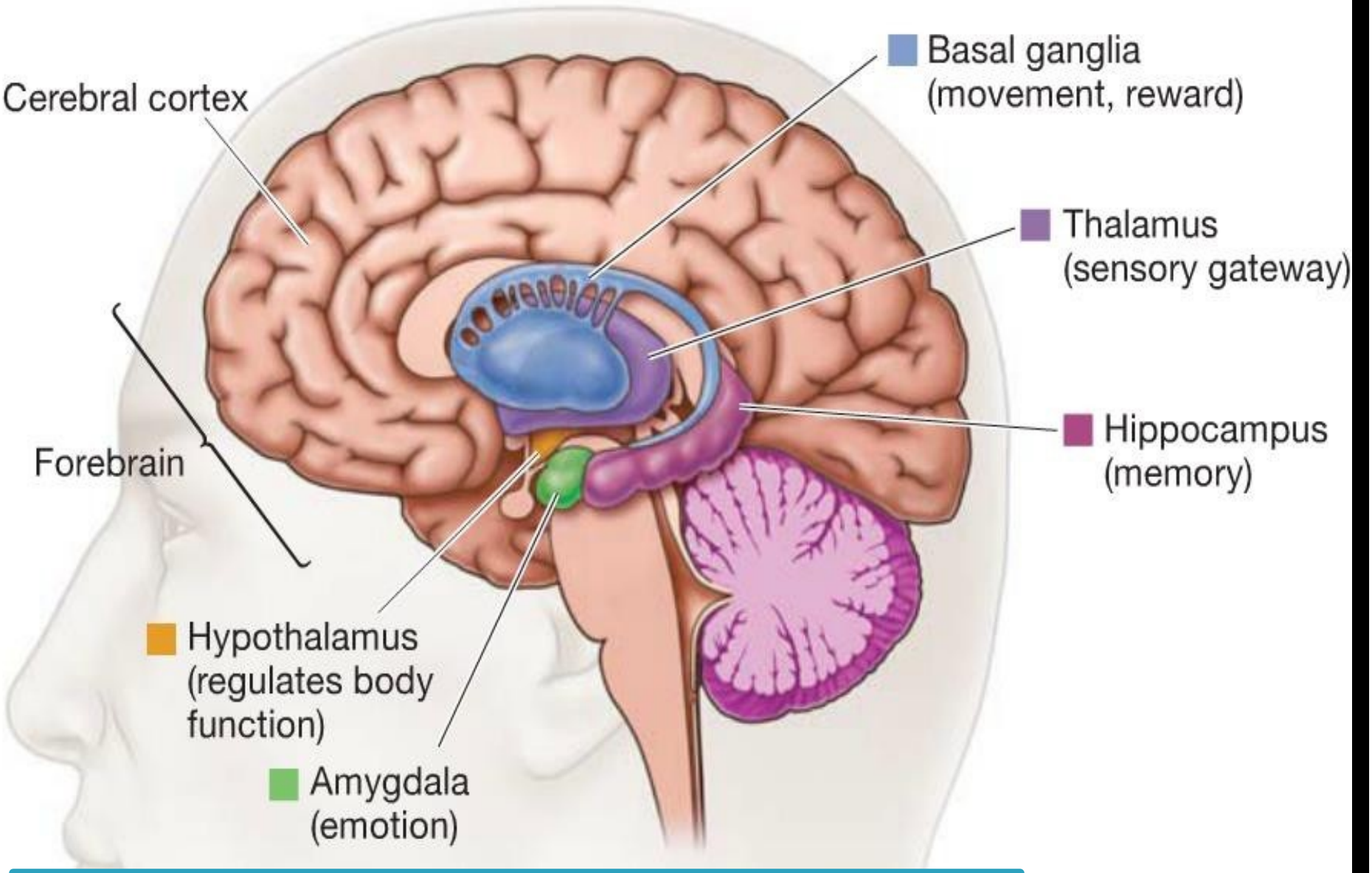
1. **The limbic system،**
2. **The thalamus, the hypothalamus،**
3. **The cerebral cortex.**
4. **The basal ganglia**

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**..

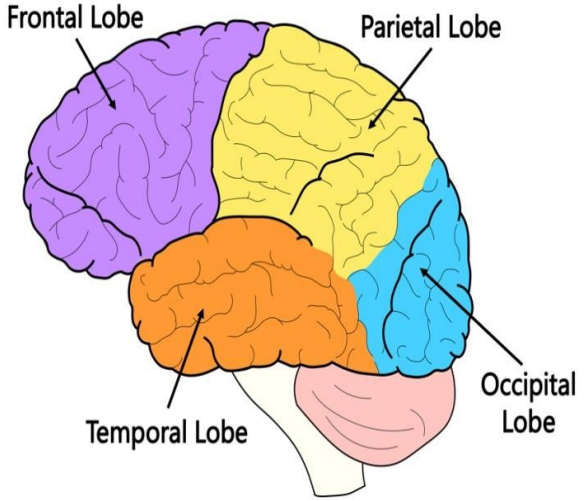
Cerebrum

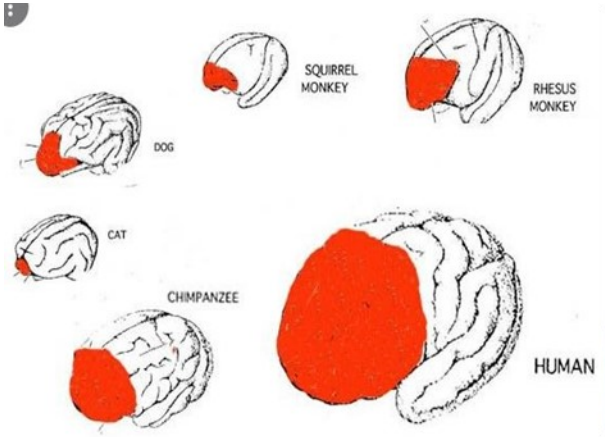
- **Frontal lobe (cerebral cortex)** Influence the
- **personality**

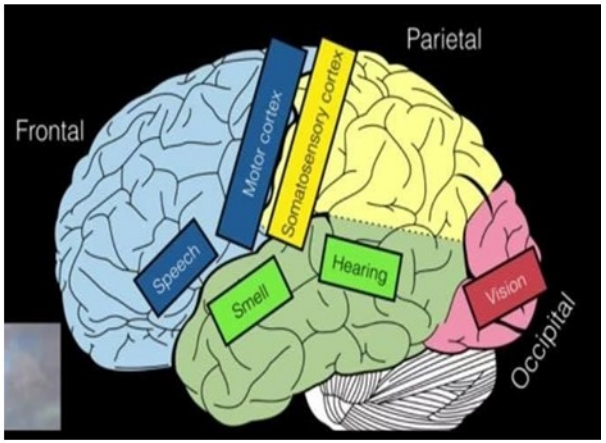
Creativity

emotions

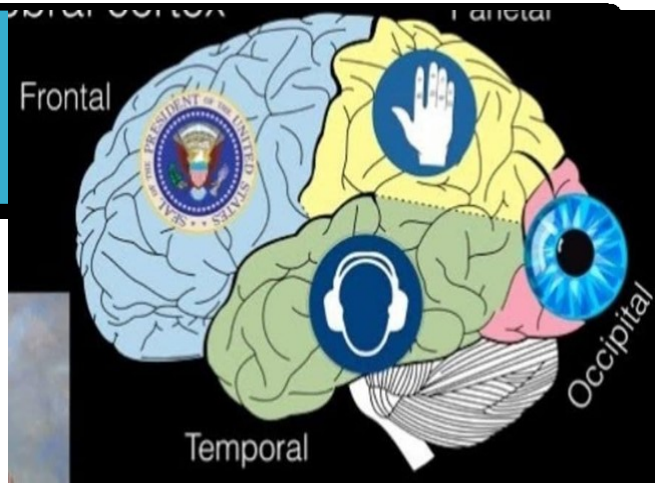
problem solving







Cerebrum



- **The occipital lobe**

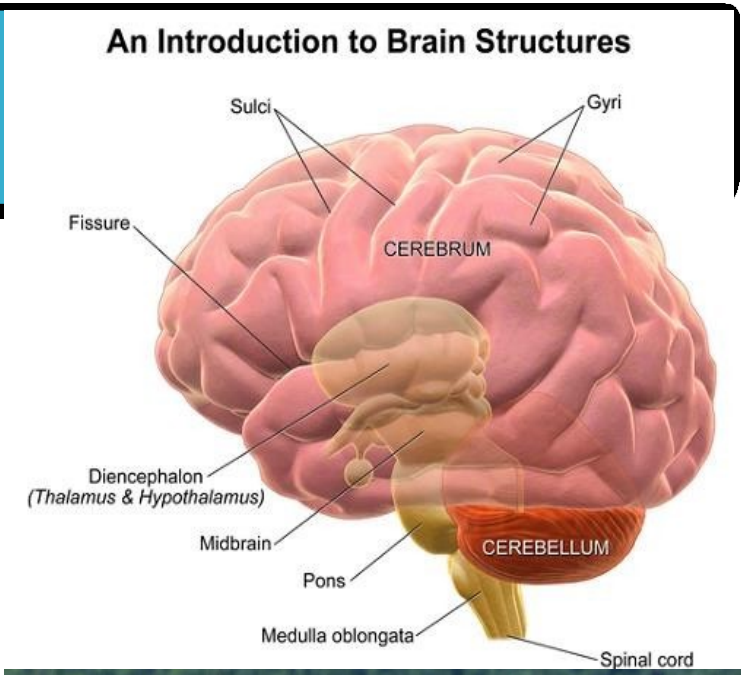
This function interpret **visual stimuli**

- **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**

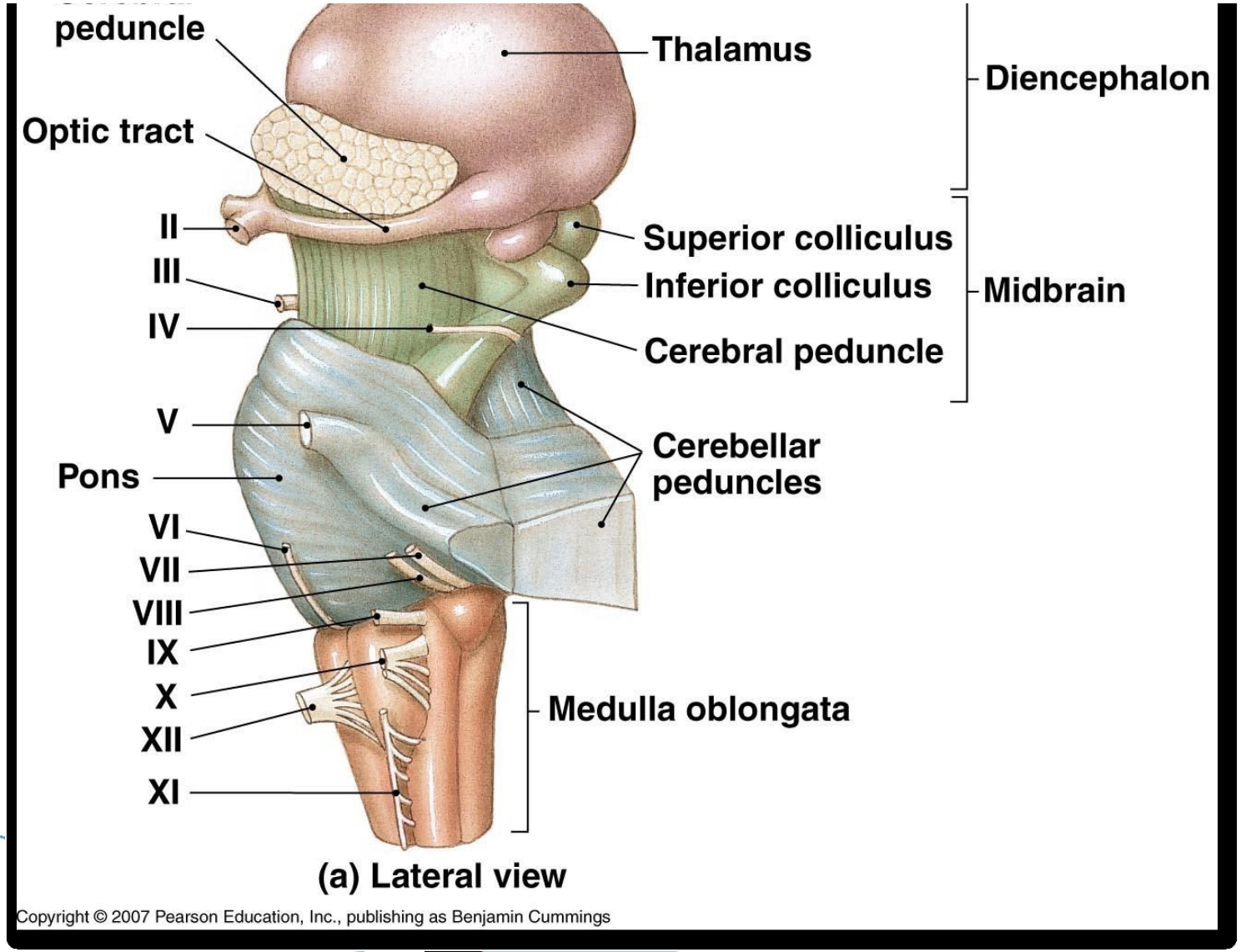
Cerebellum



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 <u>cerebrum</u>.**

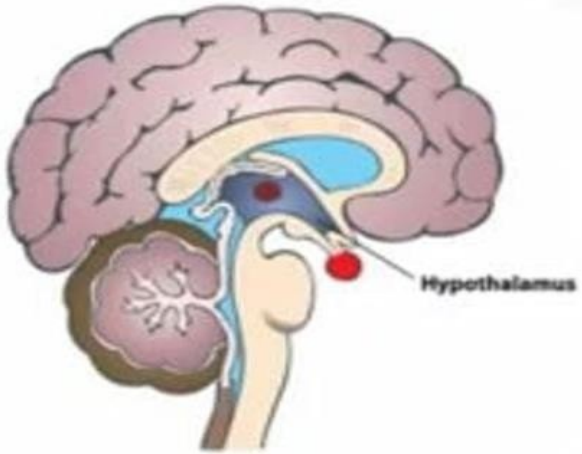
The Diencephalon and Brain Stem



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 .



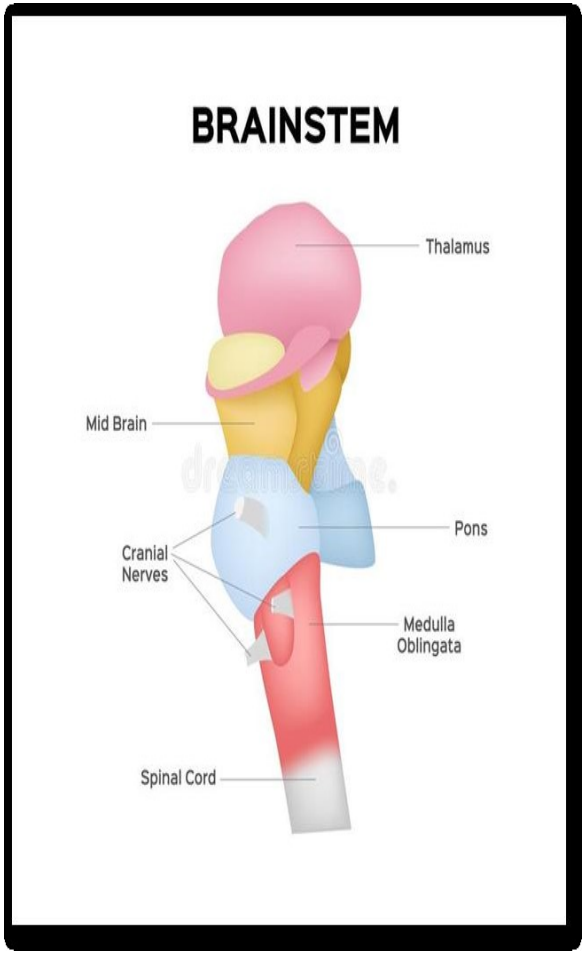
Brain stem

- **Mid Brain**

Contain reflex for certain visual activities

It controls the extrinsic eye muscles , to adjust eye movements for tracking (moving images

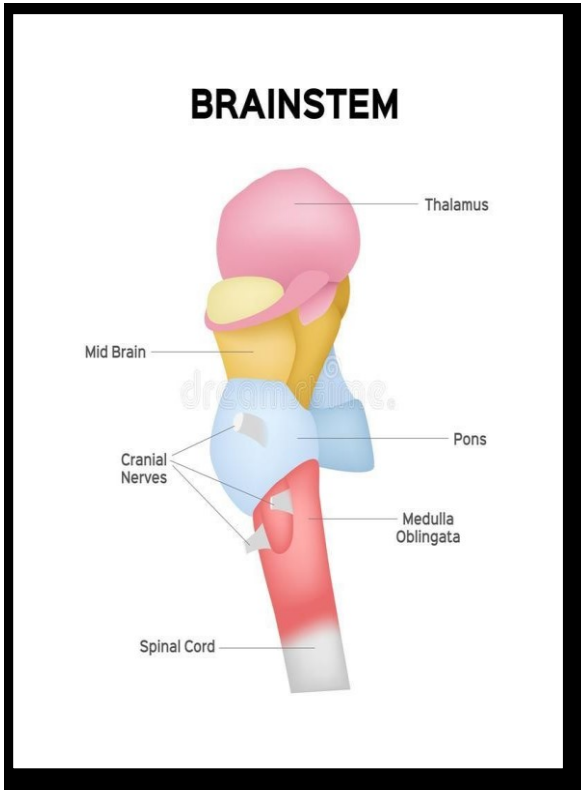
(e.g. moving car and scanning stationary images (as you are doing to read this sentence.



Brain stem

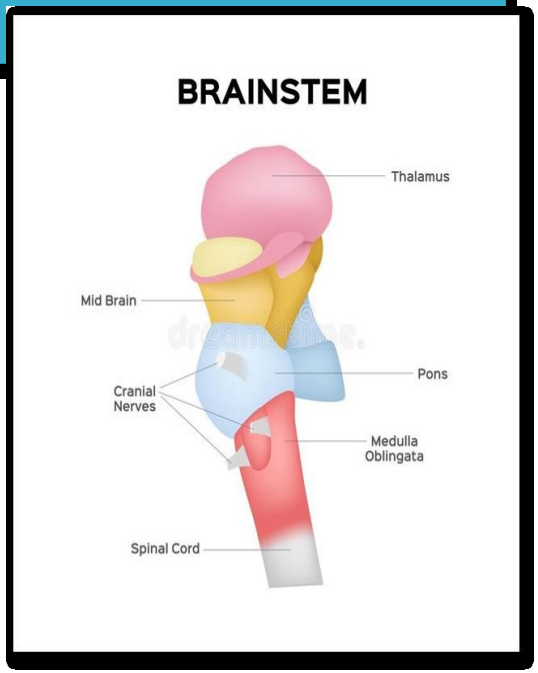
- **Pons**

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

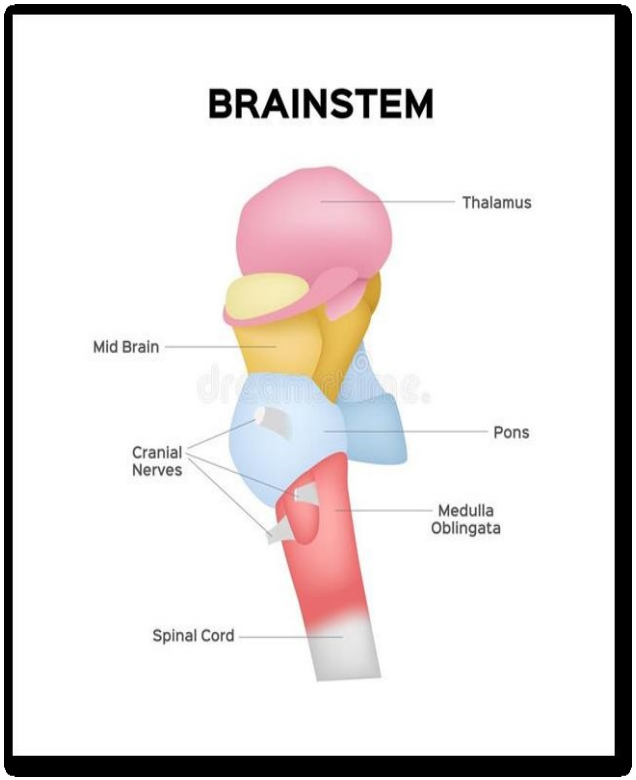
vomiting,

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

12pairs

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(CSF)
- Spinal cord made of **a core** of **gray matter** surrounded by white matter.

- **31pairs** of spinal nerves branch off spinal cord through inter vertebral foramen.

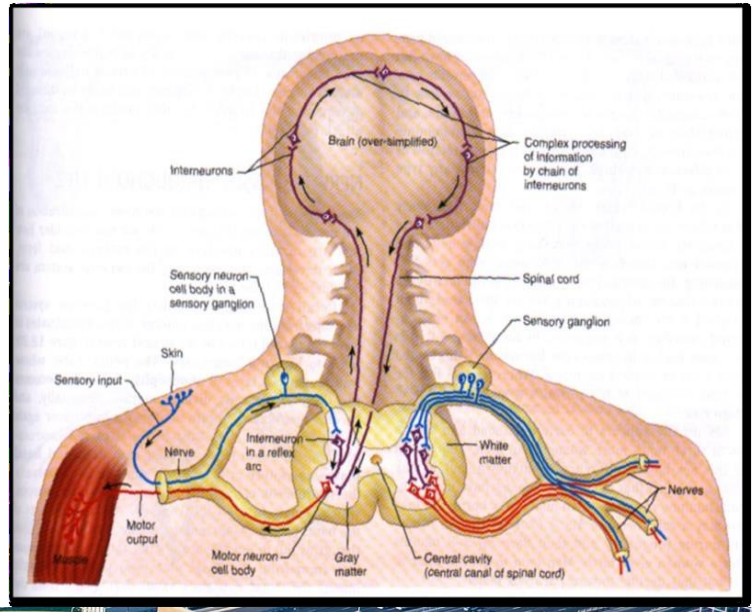
SPINAL CORD – FUNCTION

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

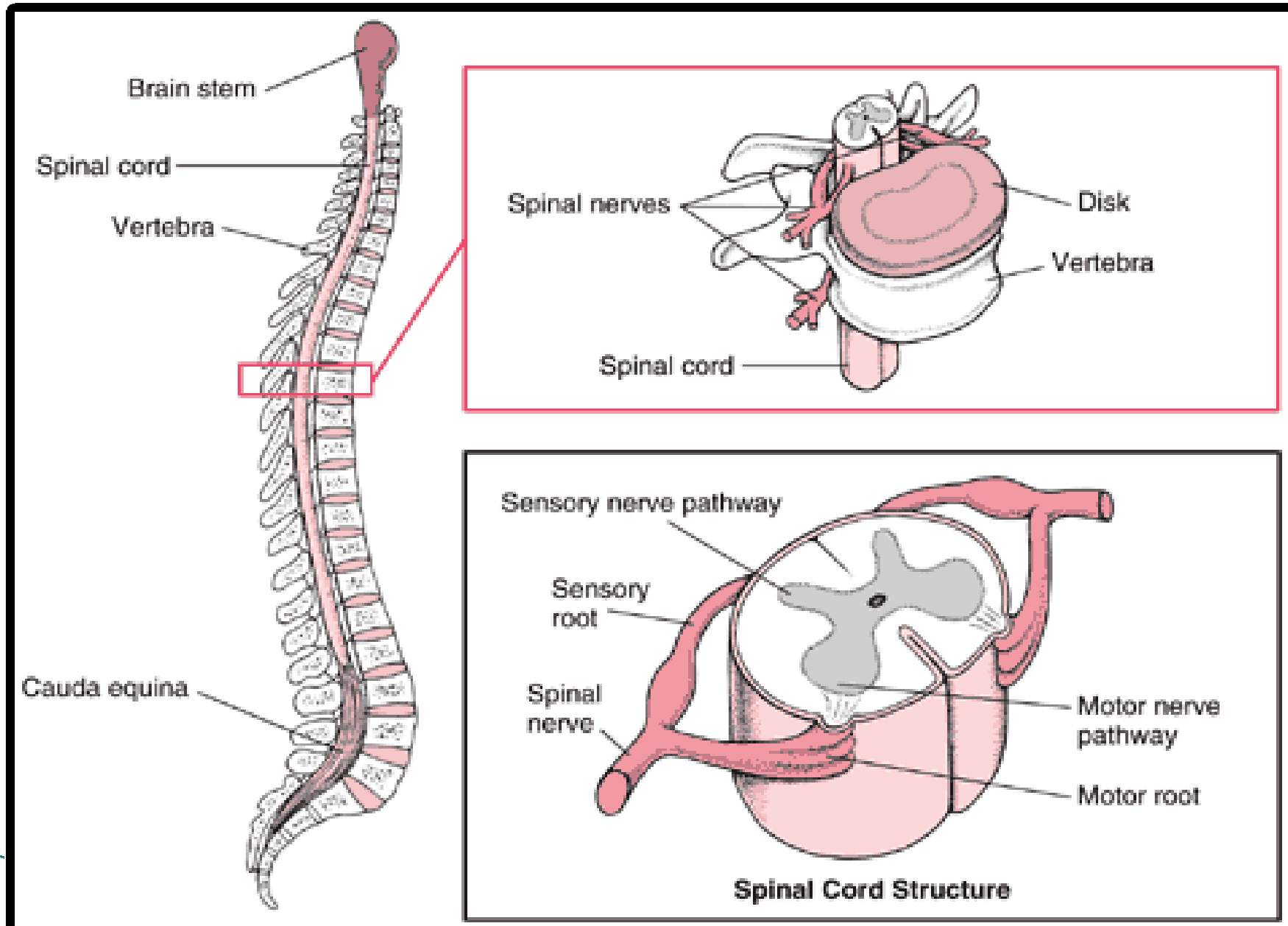


1. **Integration of information and reflexes**

SPINAL CORD = FUNCTION

Reflexes

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


Brain stem
Spinal cord
Vertebra
Cauda equina
Spinal nerves
Disk
Vertebra
Spinal cord
Sensory nerve pathway
Sensory root
Spinal nerve
Motor nerve pathway
Motor root
Spinal Cord Structure

Meninges of Brain and Spinal Cord

.1 Dura mater(superficial(

Spinal dural sheath
- Does not attach to bone

- Epi**dural** space
  - Fat and veins
  - Between dura mater and vertebra

- Sub**dural** space
  - Between dura mater and arachnoid

.2 Arachnoid mater(middle(

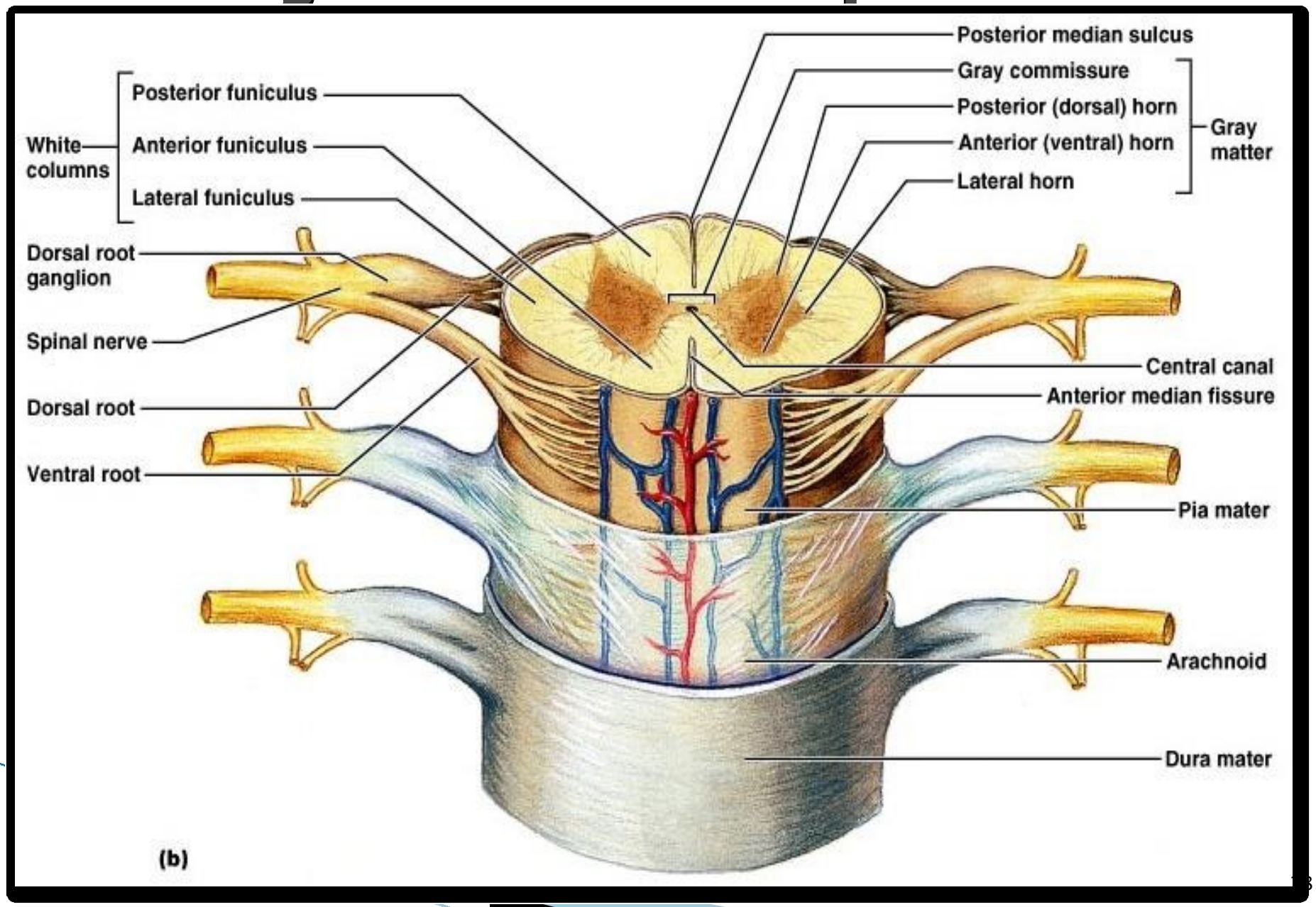
Impermeable layer (Barrier(

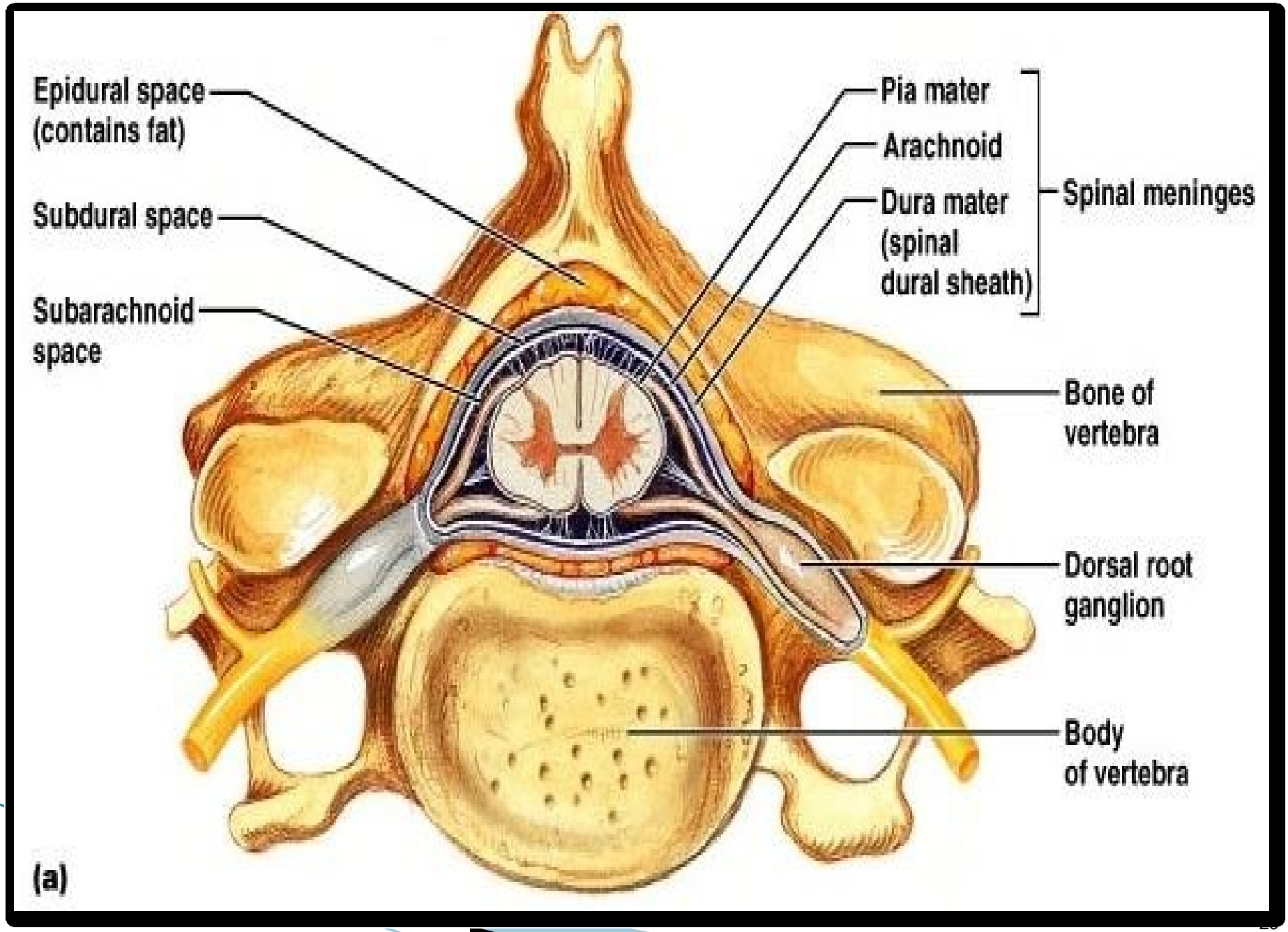
- Sub**arachnoid** space
  - Between arachnoid and pia mater
  - Contains CSF

3. Pia mater (deep(

Highly vascular
- Adheres to brain/spinal cord tissue

Meninges of Brain and Spinal Cord




Epidural space
(contains fat)
Subdural space
Subarachnoid
space
Pia mater
Arachnoid
Dura mater
(spinal
dural sheath)
Spinal meninges
Bone of
vertebra
Dorsal root
ganglion
Body
of vertebra
(a)

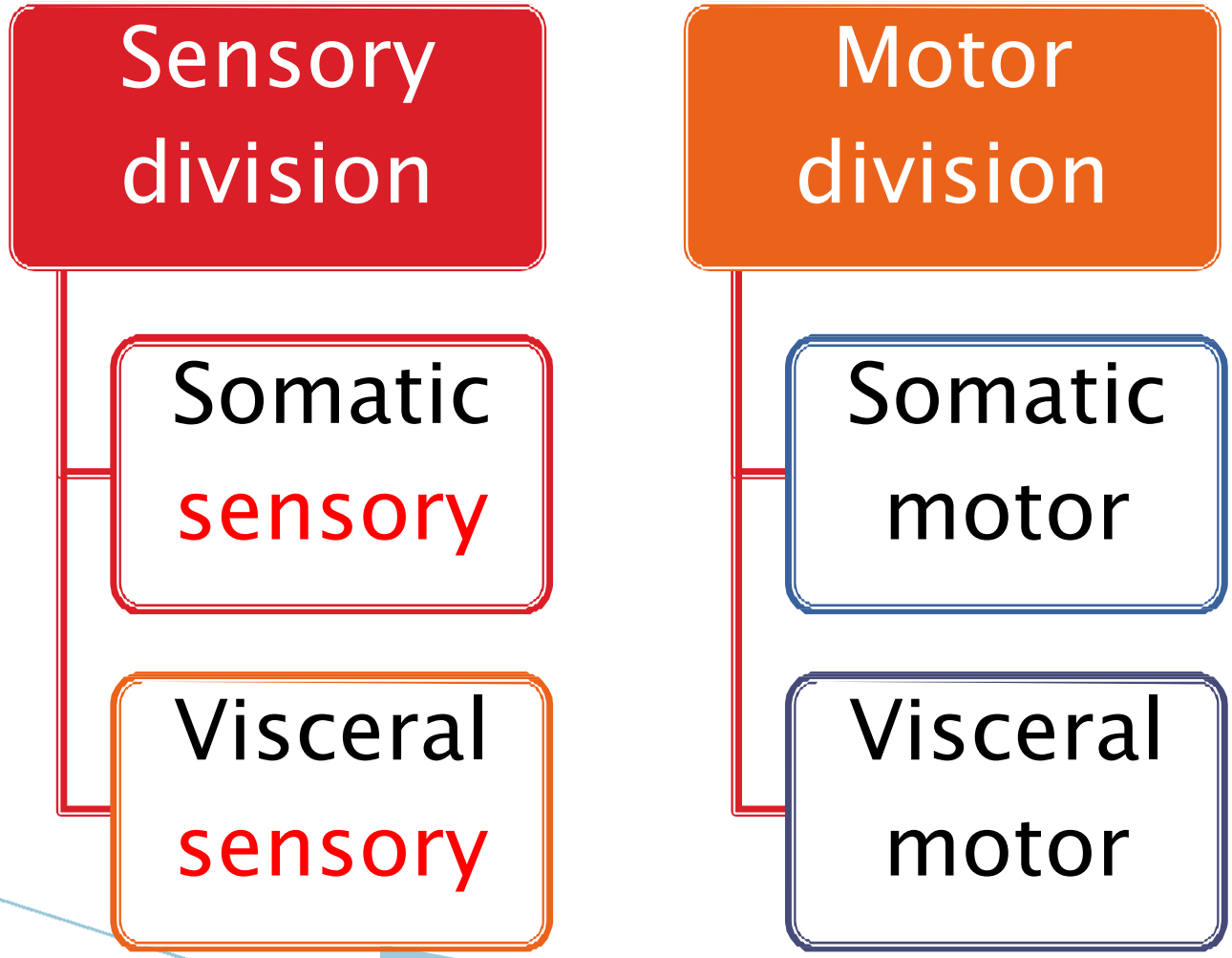
Spinal nerves

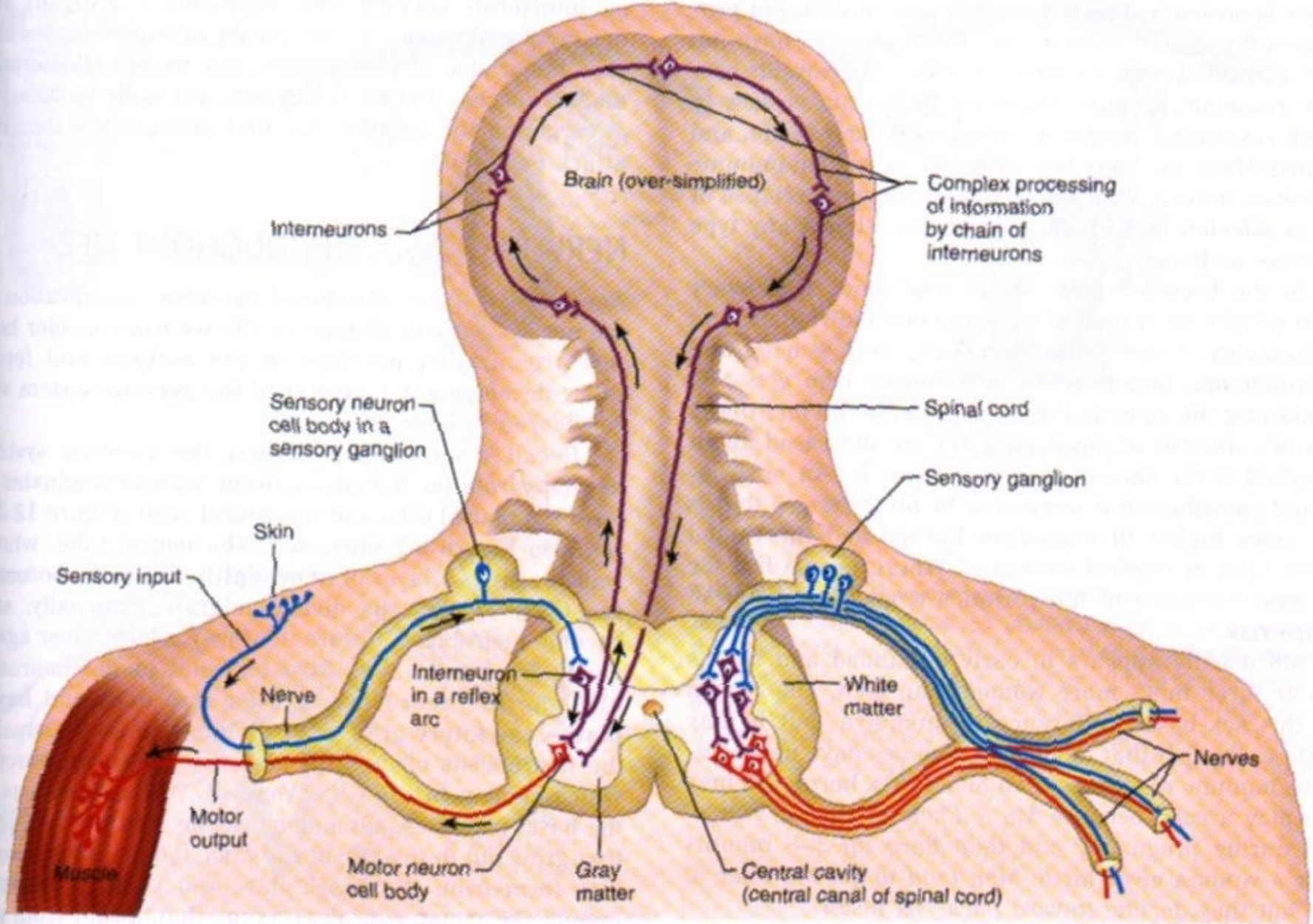
- **functions-:**
- **-1Spinal nerve are mixed nerves , which carry sensory, motor, autonomic information.**
- **-2The cervical spinal nerve** innervate the muscle and provide sensation for the **head ,neck ,diaphragm** as well as **limbs and back**
- **-3The lumbar, sacral and coccygeal nerves** combine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

Peripherall 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**

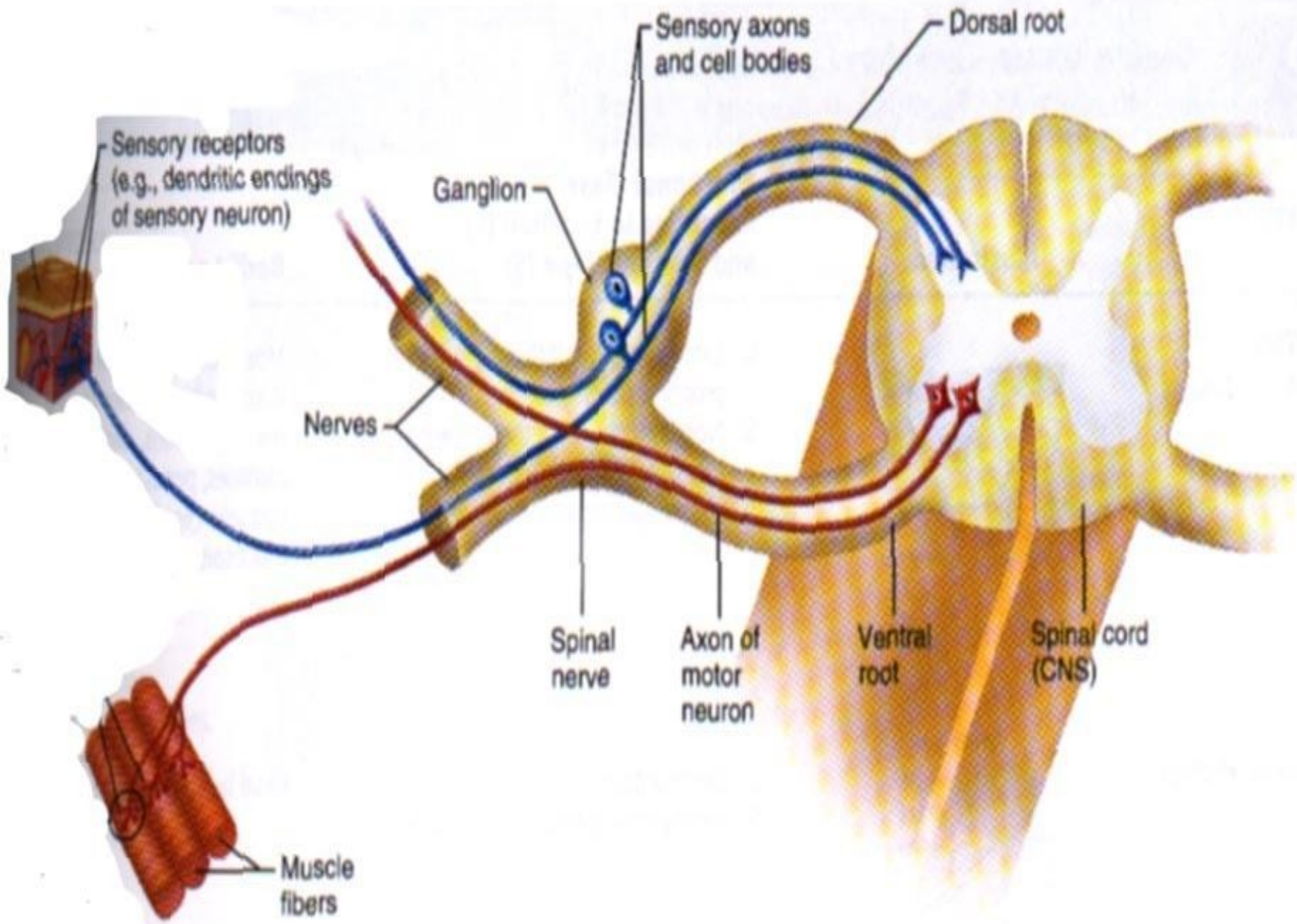
PNS - Sensory and Motor Signals




Brain (over-simplified)
Interneurons
Complex processing of information by chain of interneurons
Sensory neuron cell body in a sensory ganglion
Spinal cord
Sensory ganglion
Skin
Sensory input
Interneuron in a reflex arc
Nerve
White matter
Nerves
Motor output
Muscle
Motor neuron cell body
Gray matter
Central cavity (central canal of spinal cord)

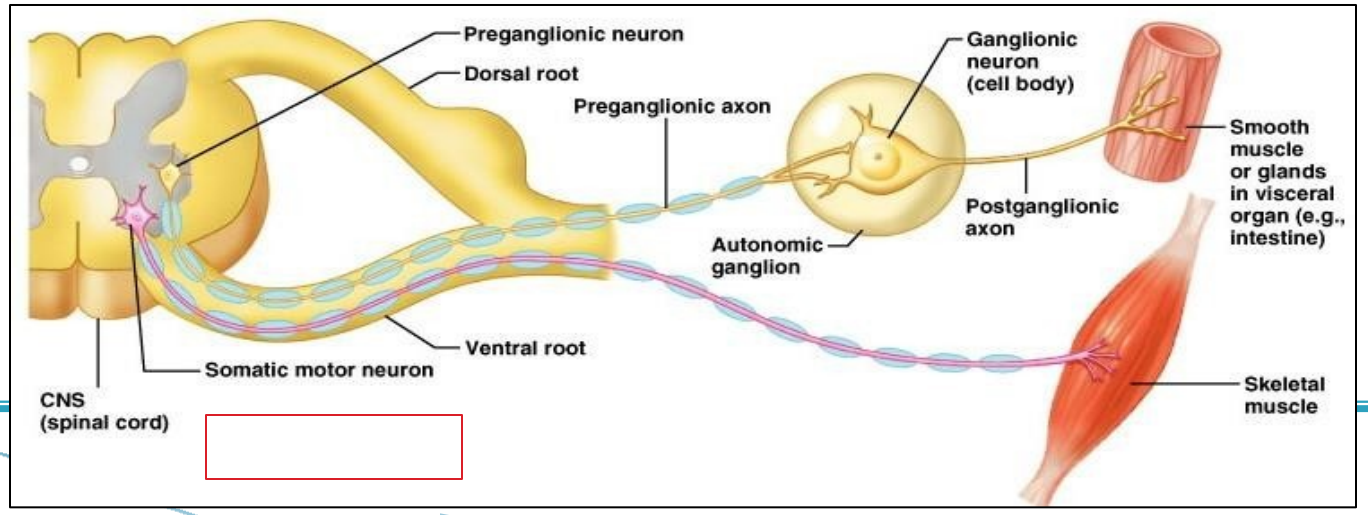
Spinal Nerves

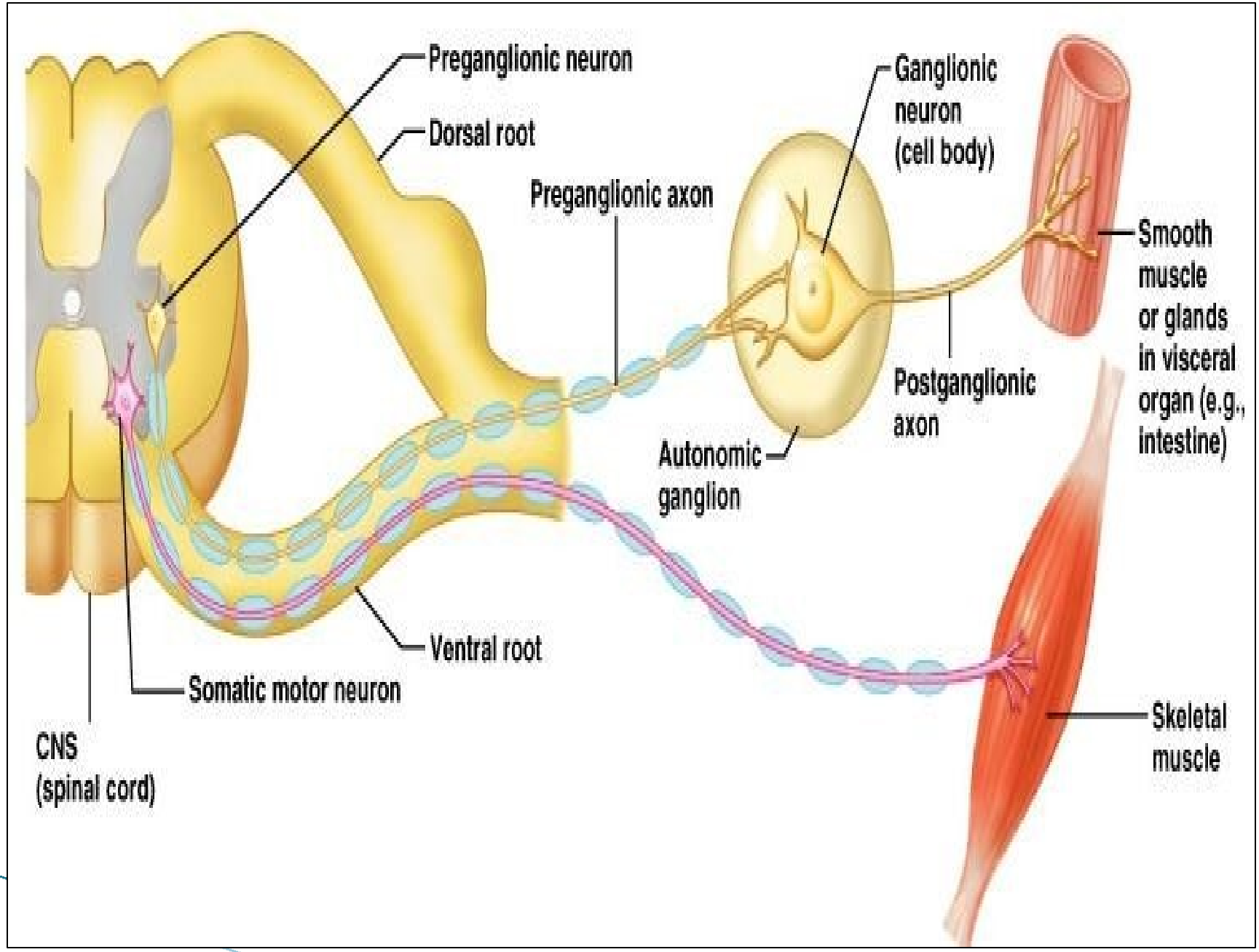
- Each spinal nerve connected to spinal cord via dorsal (sensory) and ventral (motor) root
- Spinal nerves branch into dorsal ramus and ventral ramus
  - Ventral ramus
    - Connects to rami communicates, which then lead to sympathetic chain ganglia
    - Supply anterior and lateral regions of the neck,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


Sensory axons and cell bodies
Dorsal root
Sensory receptors (e.g., dendritic endings of sensory neuron)
Ganglion
Nerves
Spinal nerve
Axon of motor neuron
Ventral root
Spinal cord (CNS)
Muscle 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!




Preganglionic neuron
Dorsal root
Ganglionic neuron (cell body)
Preganglionic axon
Smooth muscle or glands in visceral organ (e.g., intestine)
Postganglionic axon
Autonomic ganglion
Ventral root
Somatic motor neuron
CNS (spinal cord)
Skeletal muscle


(بالعقل صلاح لكل امر)الامام علي (عليه السلام)