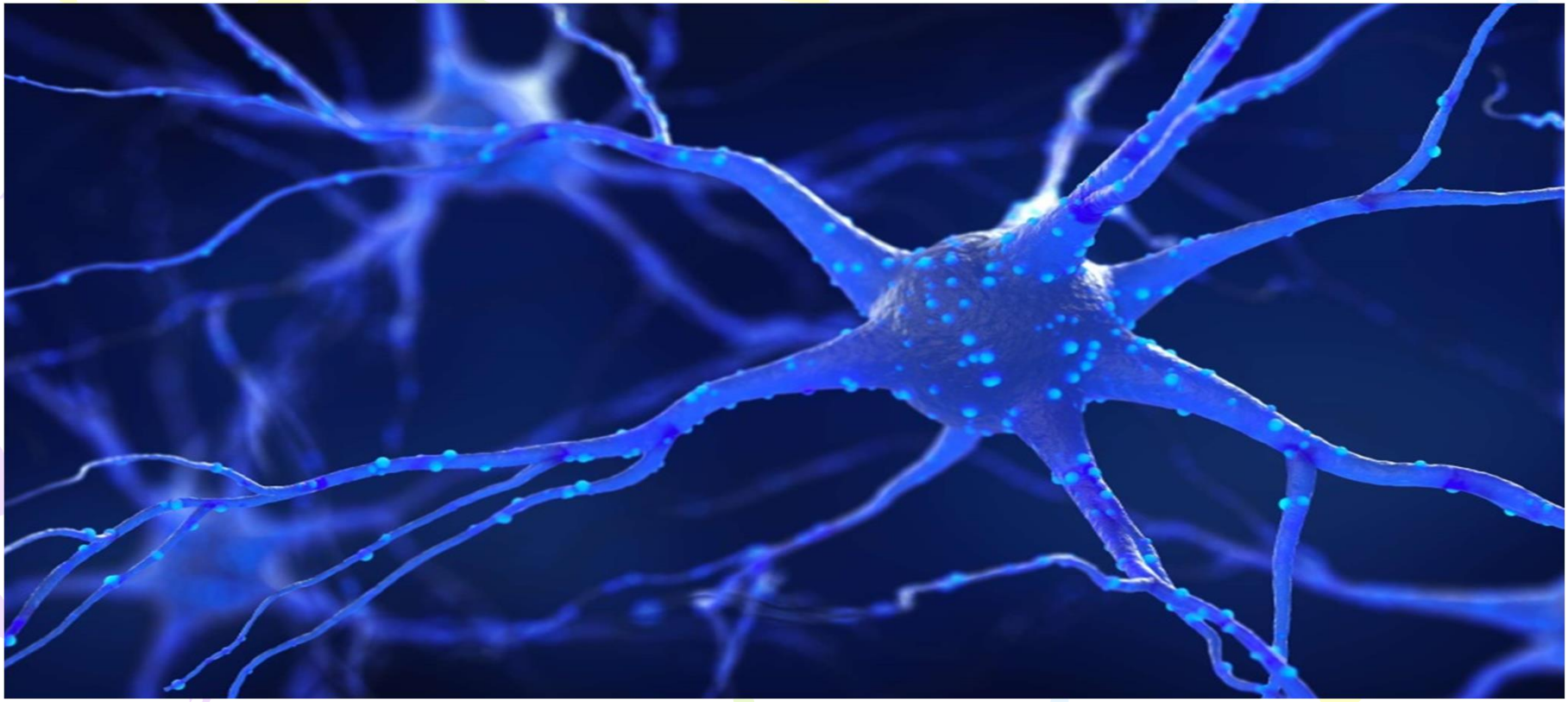
Introduction to Central Nervous System



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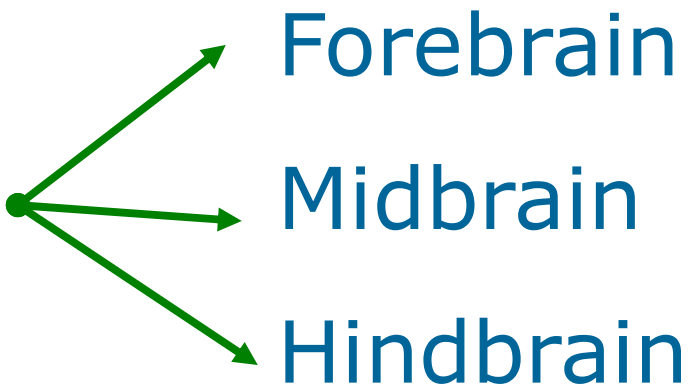
Learning Objectives :

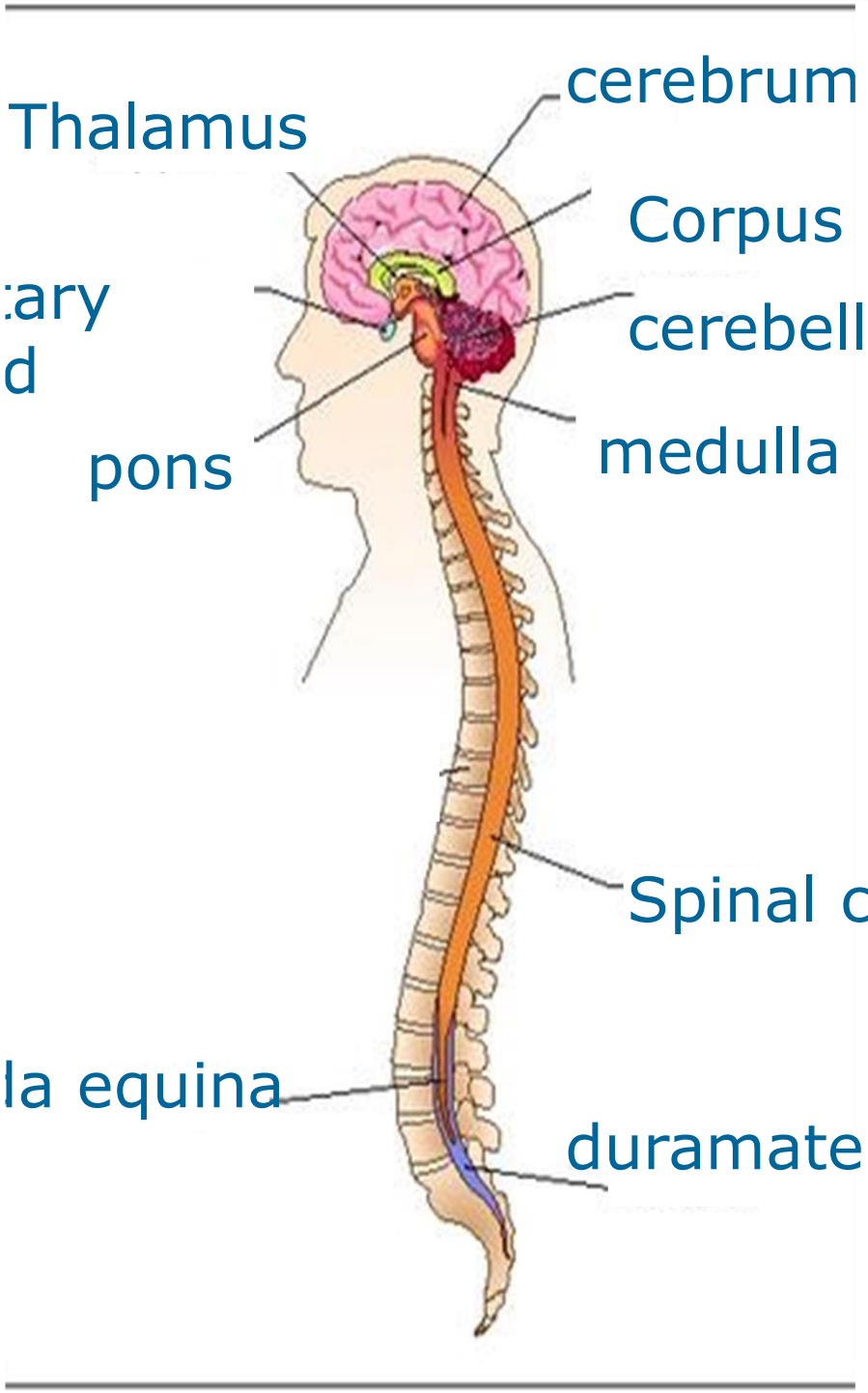
1. Introduction to CNS
2. Physiological Anatomy
3. Spinal cord
4. Cerebrum
5. Cerebellum
6. Pons, medulla and midbrain
7. Basal Ganglia
8. Neuroglia

Structure and Function of CNS

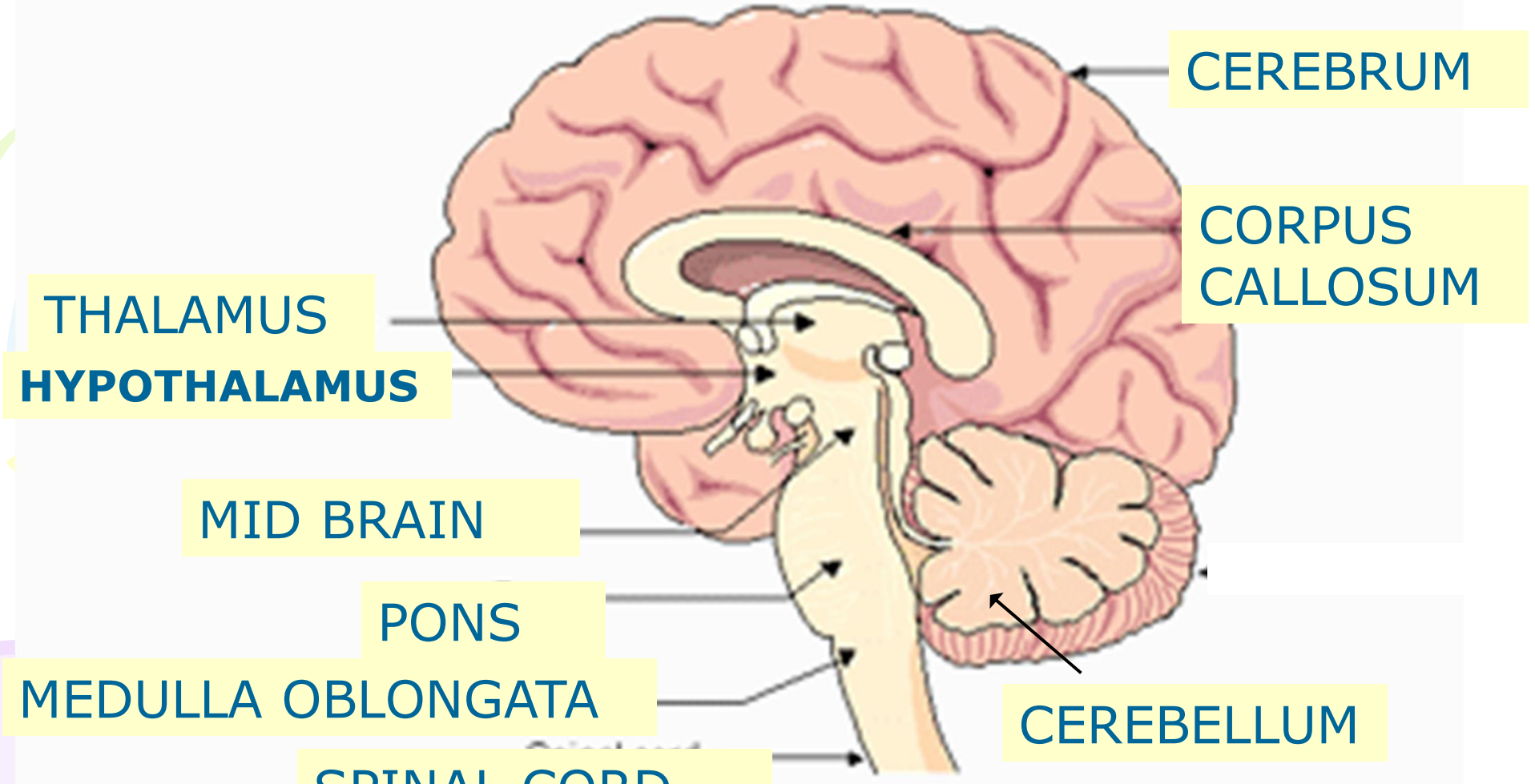
Structural divisions :

- Spinal Cord – in the vertebral column
- Brain – intracranial




Thalamus
cerebrum
Corpus callosum
Pitu :ary
glar d
cerebellum
pons
medulla
Spinal cord
Qua(la equina
duramater

Brain -

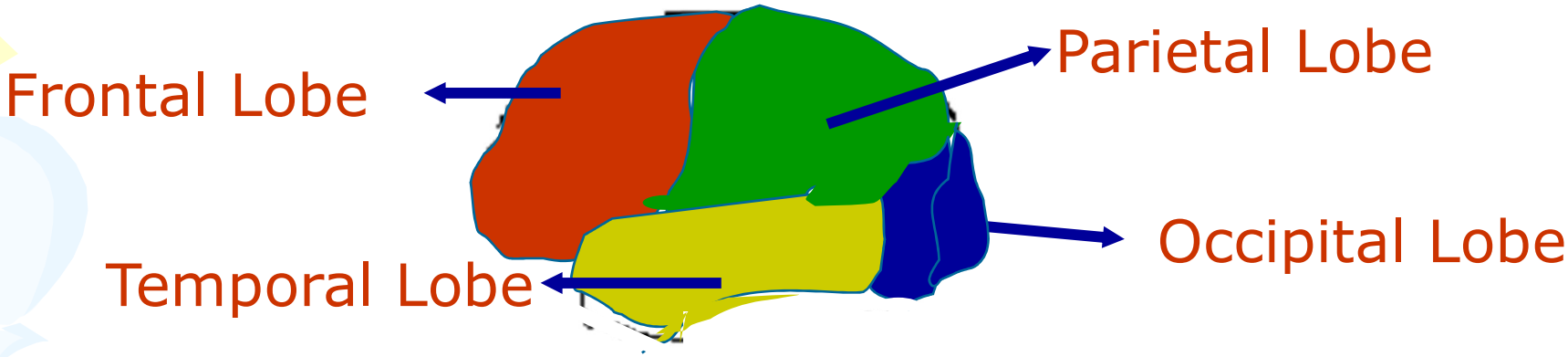

CEREBRUM
CORPUS CALLOSUM
THALAMUS
HYPOTHALAMUS
MID BRAIN
PONS
MEDULLA OBLONGATA
SPINAL CORD
CEREBELLUM

Forebrain – telencephalon & diencephalon

1)Telencephalon –

cerebral hemisphere

cerebral Cortex



Subcortical Structures

Basal Ganglia

Hippocampus and Amygdala

(parts of the Limbic System)

corpus callosum

The **telencephalon**, commonly called the cerebral hemispheres, is the largest portion of the central nervous system (CNS) and consists of the cerebral cortex, subcortical white matter (commissural, association, and projection fibers), and basal nuclei.

2) Diencephalon

Thalamus

Hypothalamus

The **diencephalon** is made up of four main components: the thalamus, the subthalamus, the hypothalamus, and the epithalamus. ... The thalamus is critically involved in a number of functions including relaying sensory and motor signals to the cerebral cortex and regulating consciousness, sleep, and alertness.

The neocortex, also called, isocortex, or the six-layered cortex

- set of layers of the mammalian cerebral cortex involved in higher-order brain functions such as sensory perception, cognition, generation of motor commands, spatial reasoning and language.

The **neocortex** comprises the largest part of the cerebral cortex and makes up approximately half the volume of the human brain.

It is thought to be **responsible for the neuronal computations of attention, thought, perception and episodic memory**.

In humans, 90% of the cerebral cortex is the neocortex.

Distinctive in higher mammals for its wrinkly appearance.

Lesions that develop in **neurodegenerative disorders**, such as Alzheimer's disease, interrupt the transfer of information from the sensory neocortex to the prefrontal neocortex.

This disruption of sensory information contributes to the progressive symptoms seen in neurodegenerative disorders such as changes in personality, decline in cognitive abilities, and dementia

The neocortex ratio of a species is the ratio of the size of the neocortex to the rest of the brain.

Diencephalon Functions :

- Sense impulses throughout the body.
- Autonomic **function**.
- Endocrine **function**.
- Motor **function**.
- Homeostasis.
- Hearing, vision, smell, and taste.
- Touch perception.

- Mid brain (mesencephalon)
  - Tegmentum – cerebral peduncles, Substantia nigra
  - Tectum – sup. & inf. Colliculi

- Hind brain
  - Medulla
  - Pons
  - Cerebellum

The midbrain connects the forebrain and the hindbrain.

It acts as a bridge and transmits signals from hindbrain and forebrain.

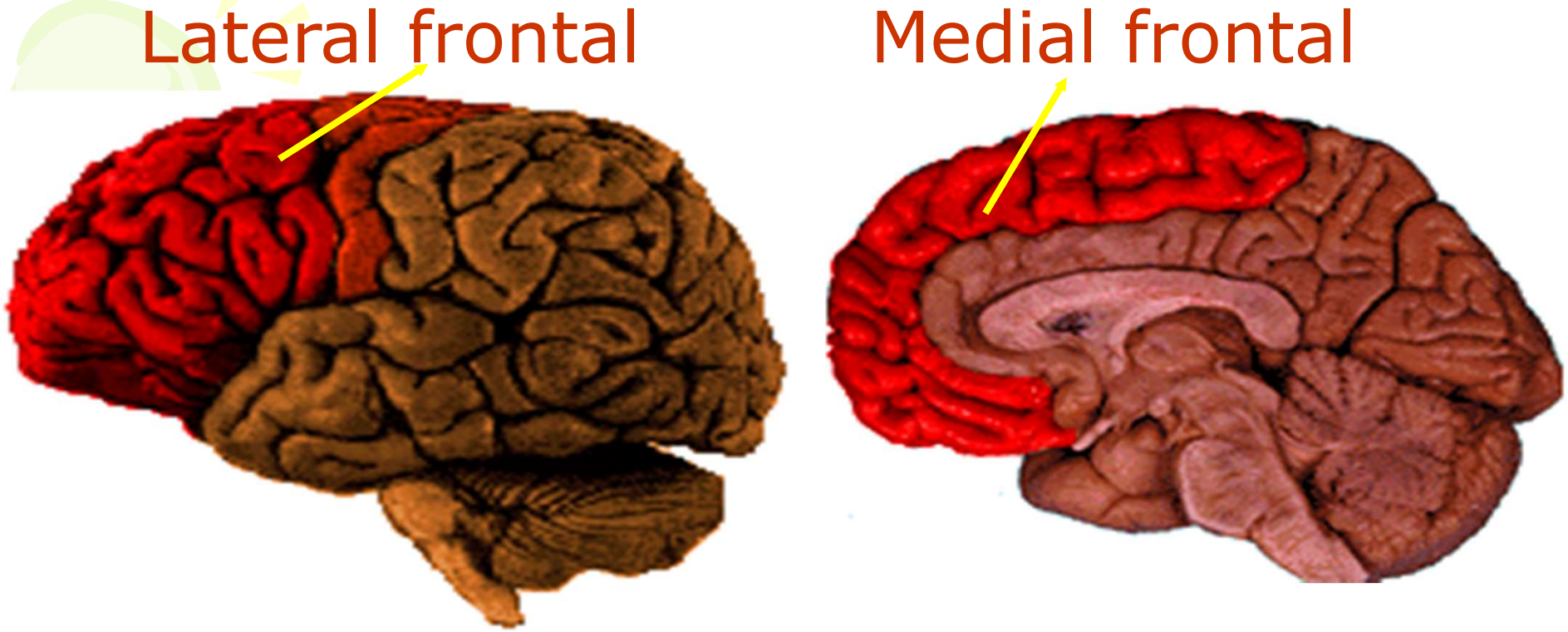
Mid brain functions :

- Regulates vital cardiac and respiratory **functions**
- Acts as a vehicle for sensory information
- Associated with vision, hearing, motor control, sleep, and wake up cycles, alertness, and temperature regulations.
- Contains tracks that carry signals from the cerebrum to the medulla and to the **cerebellum**.

The **hindbrain** is the well-protected central core of the brain.

It includes the cerebellum, reticular formation, and brain stem, which are responsible for some of the most basic autonomic functions of life, such as breathing and movement.

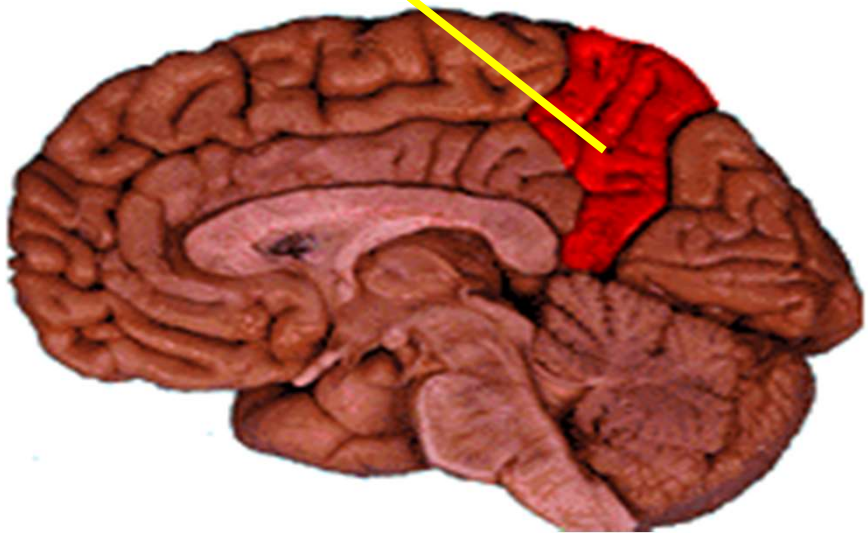
The brain stem contains the pons and medulla oblongata.



Most developed in humans
Largest of the four lobes
Motor cortex–planning, execution, attention
Olfactory cortex
Language production
Memory and higher cognitive function

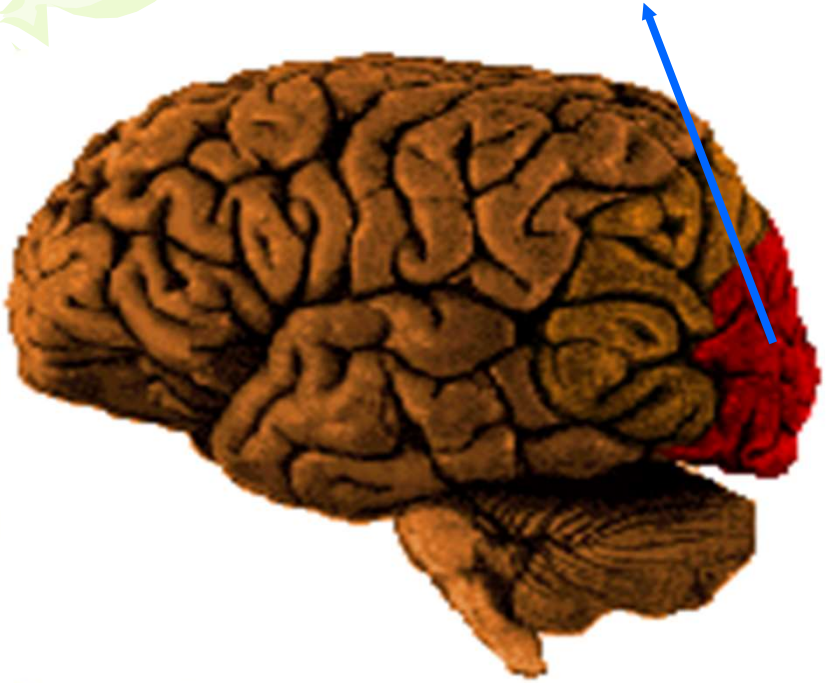
Lateral parietal

Medial parietal

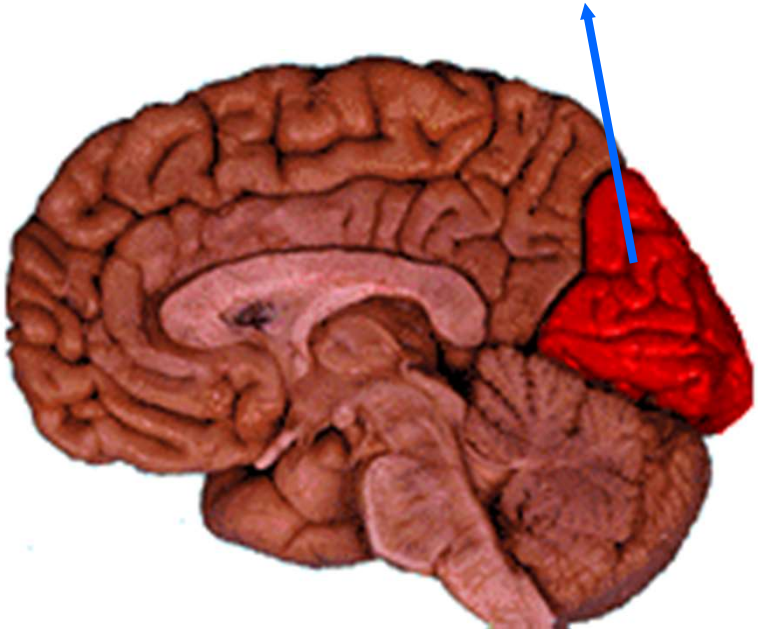


Somatosensory
Spatial processing
Attention

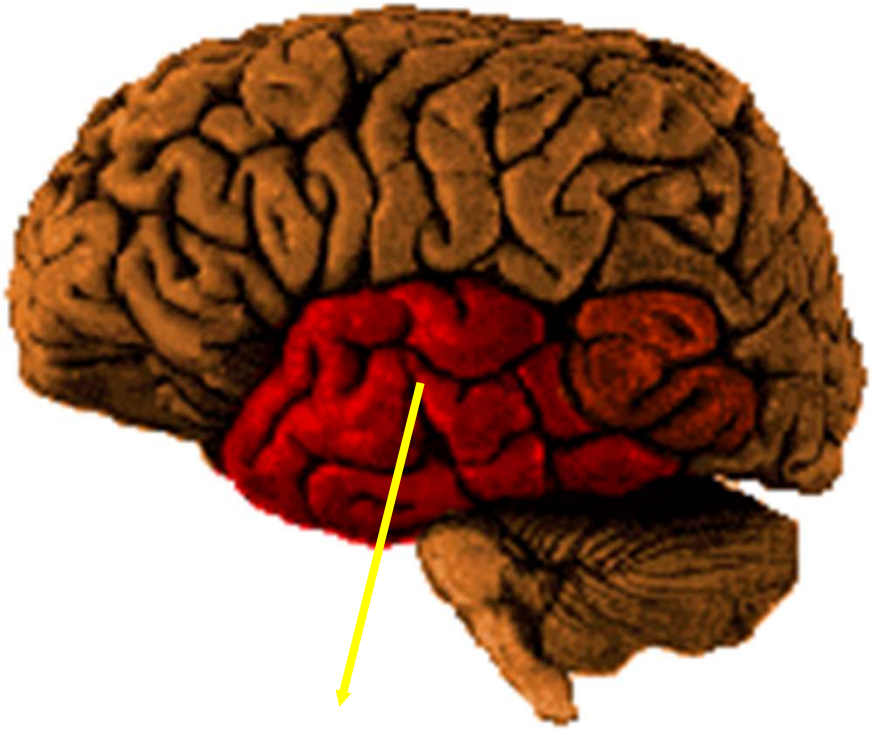
Lateral occipital



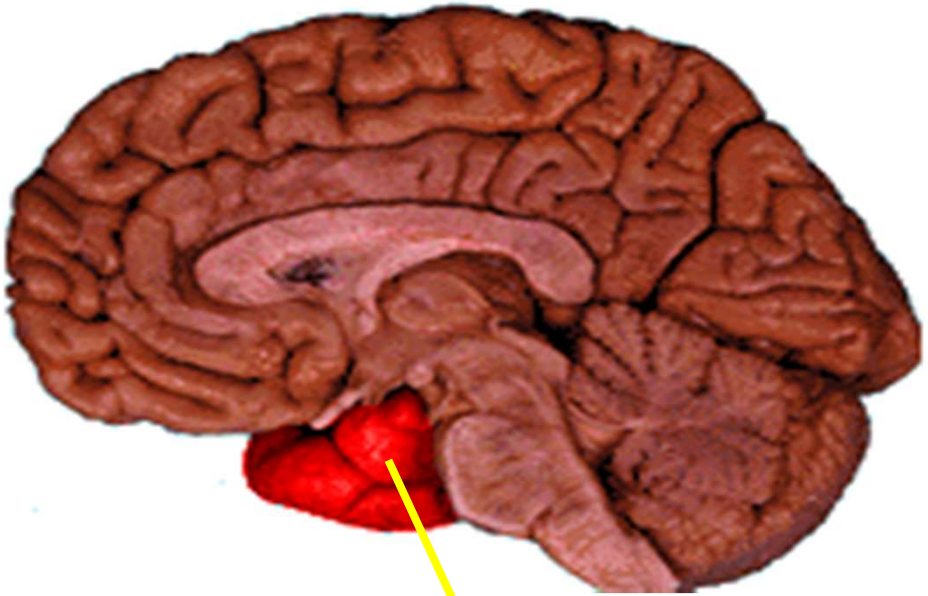
Occipital



- Visual processing

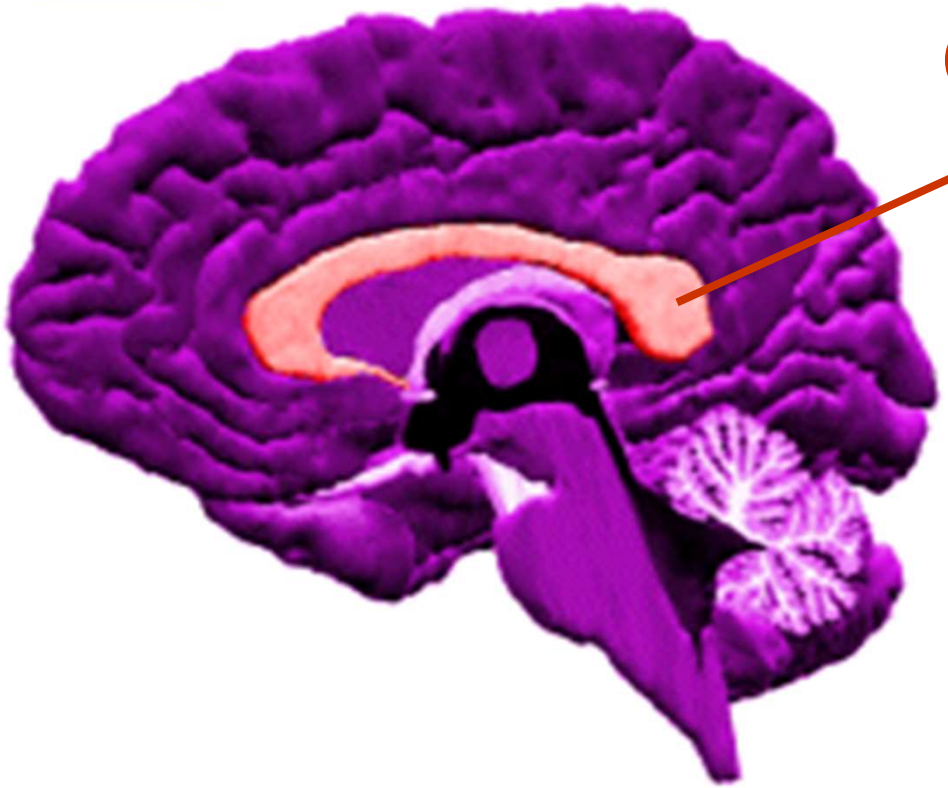


Lateral temporal

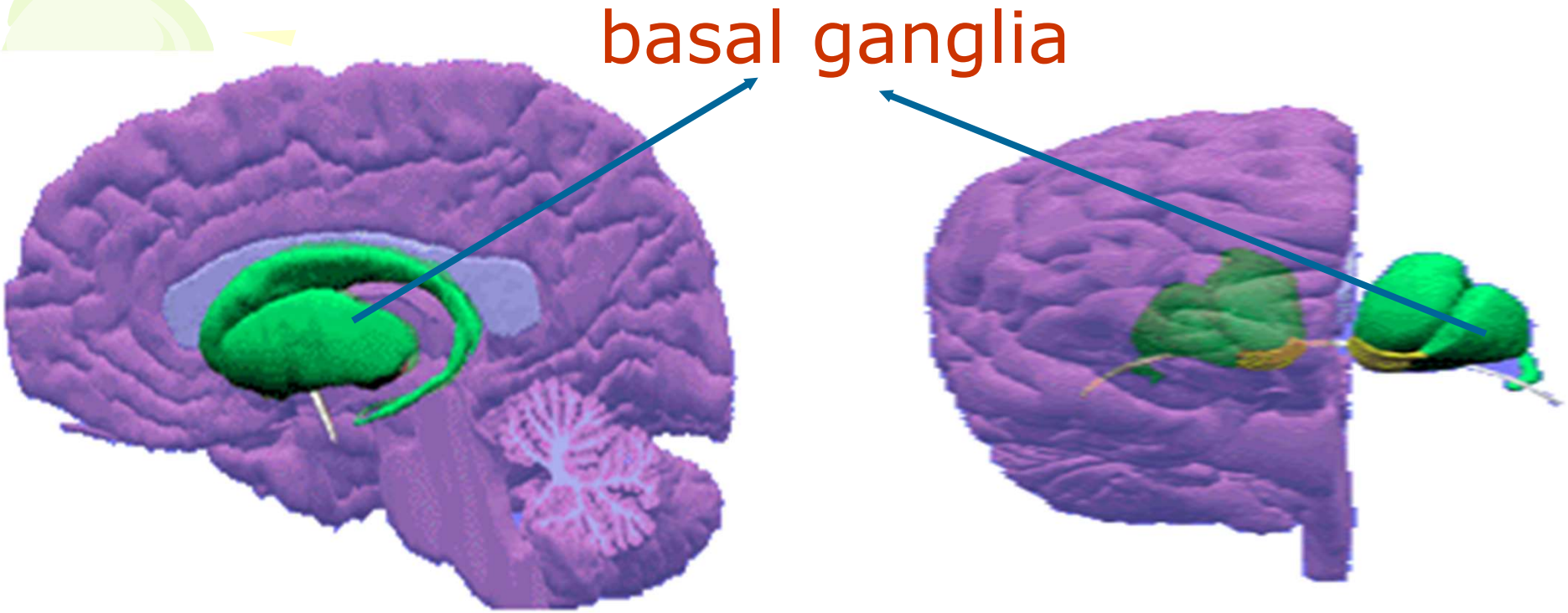


Medial temporal

Auditory processing
Memory
Understanding
language
Olfaction



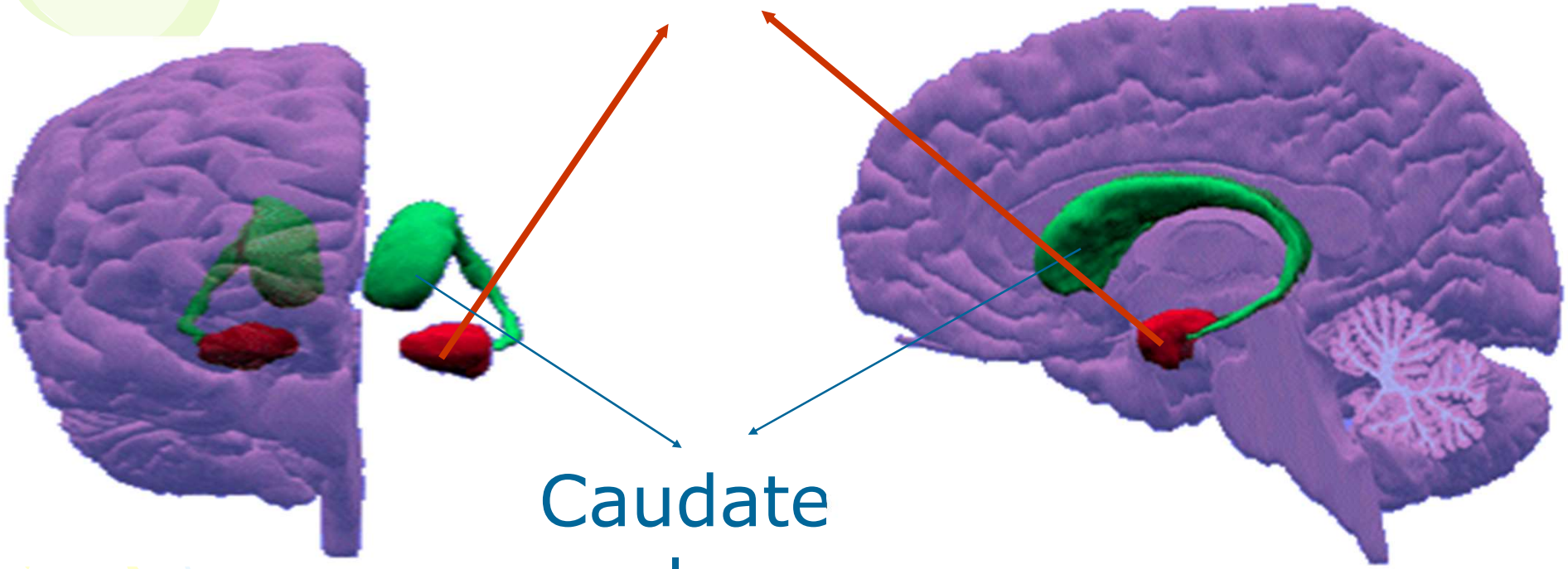
- The major link between the left and right hemispheres
- Bundle of axons which allow communication of neurons across both hemispheres



Caudate nucleus, putamen, globus pallidus, (S. nigra, subthalamic nucleus)

Movement regulation
Skill learning

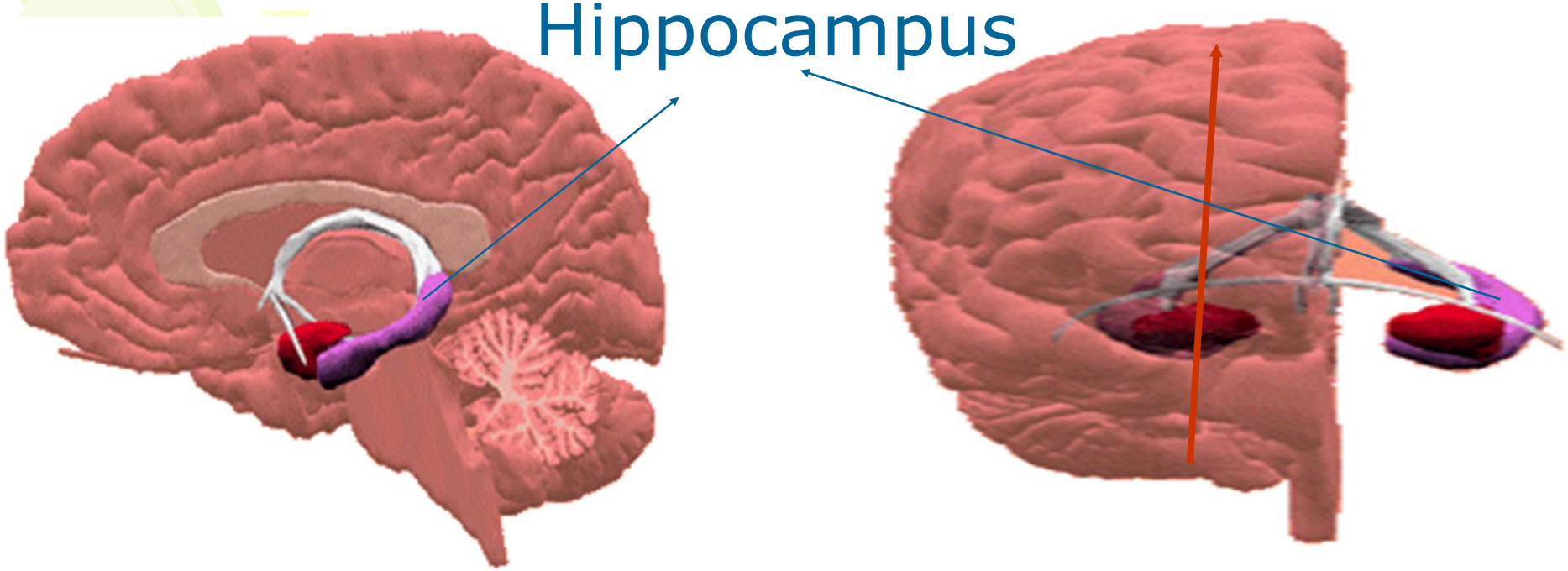
Amygdala



Caudate nucleus

Emotion processing

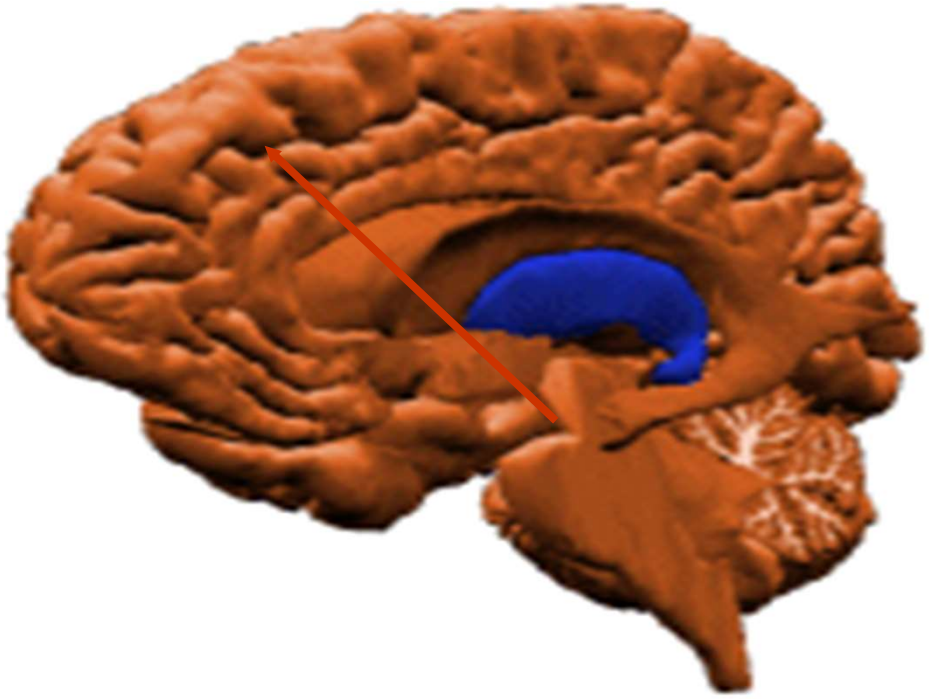
Hippocampus



Responsible for the formation of long-term memories

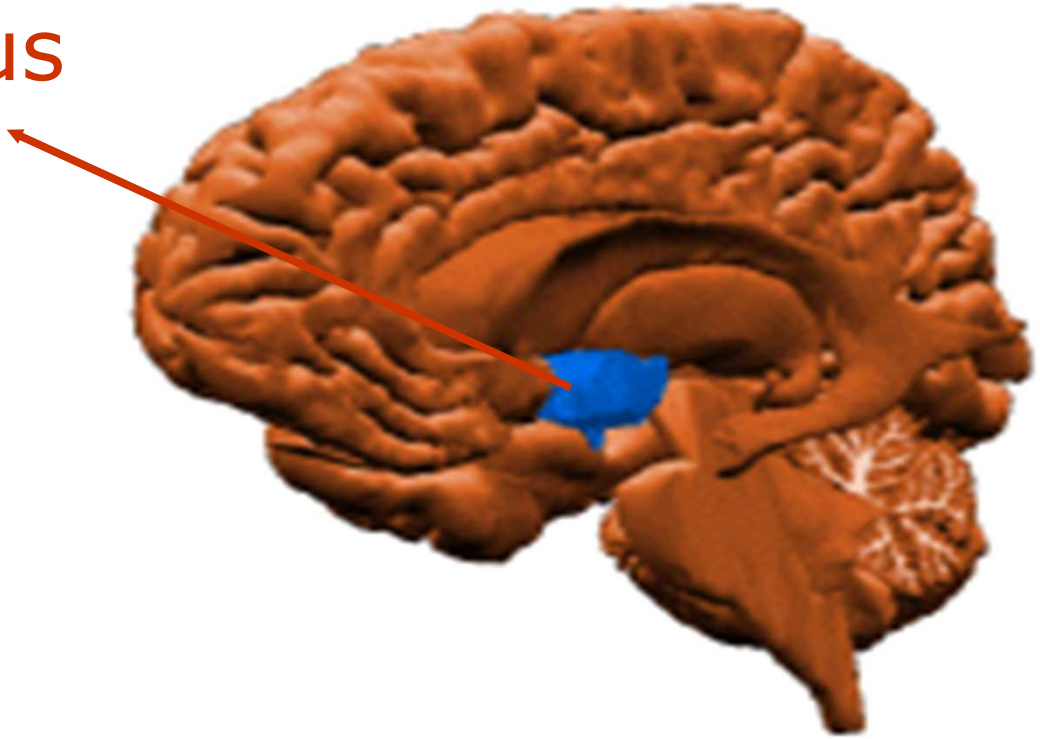
Damage to this area does not destroy old memories; rather, new memories can no longer be formed

Thalamus

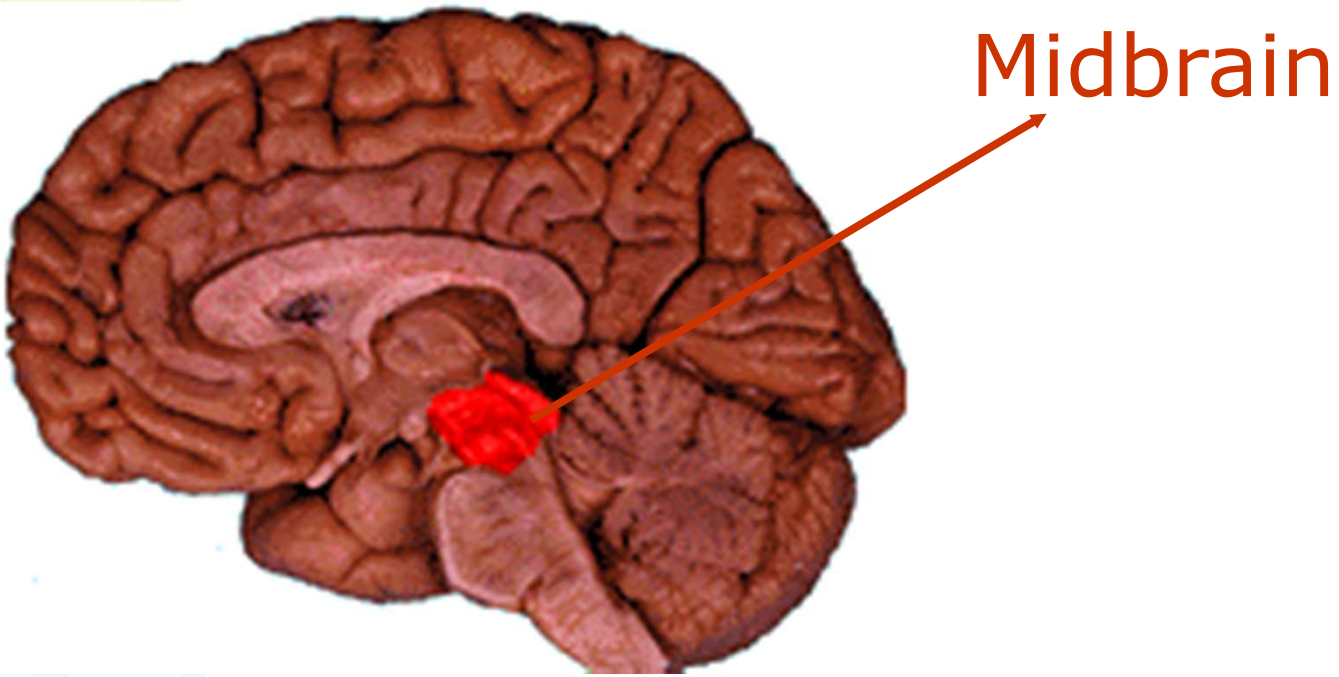


Primary "gate" between sensory or motor neurons in the PNS and the cerebral hemispheres in the CNS

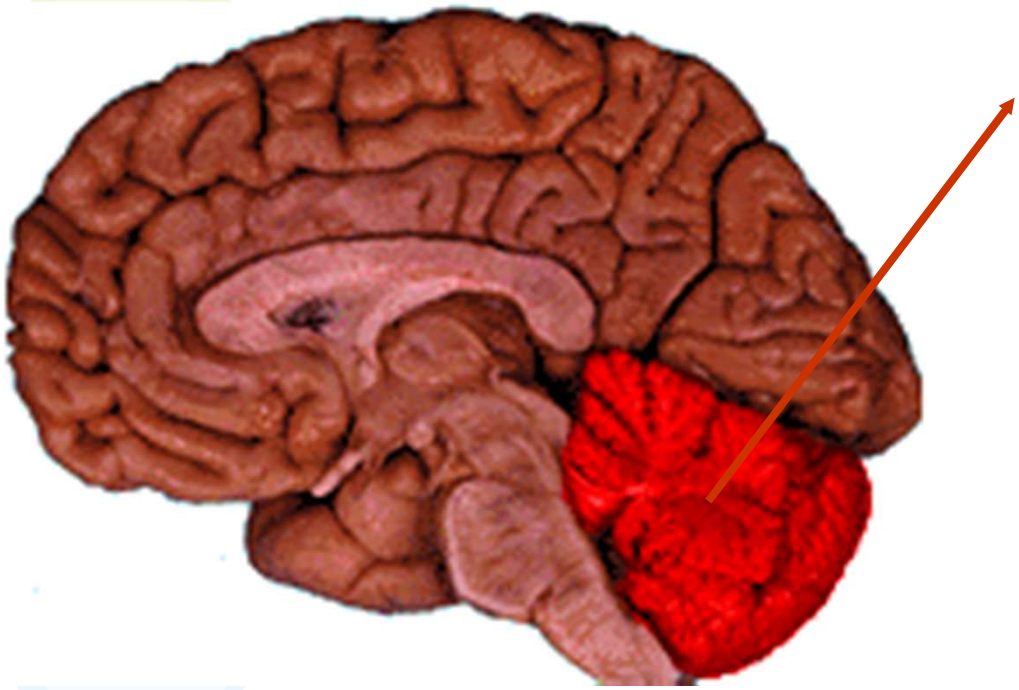
Hypothalamus



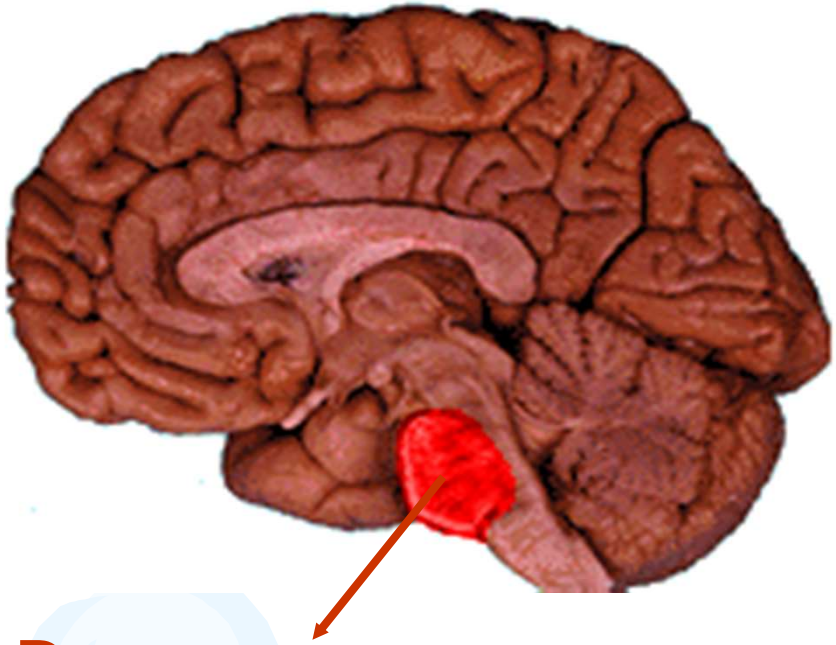
Maintains homeostasis: like a thermostat, it increases or decreases metabolism in order to regulate body activity



Visuomotor functions, visual reflexes, auditory relays, motor coordination



Located directly behind the brainstem
Use for coordination and balance
Handles walking and posture

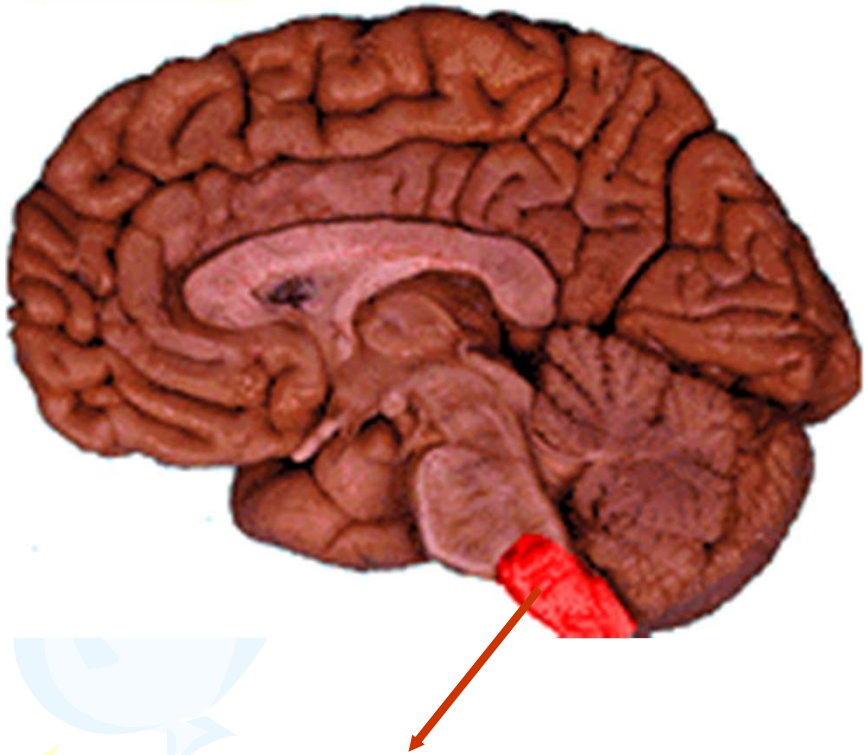


Pons

Originally means 'bridge'

Bridges the cerebrum and the cerebellum through cerebellar peduncles

Auditory and vestibular (balance), sensory and motor



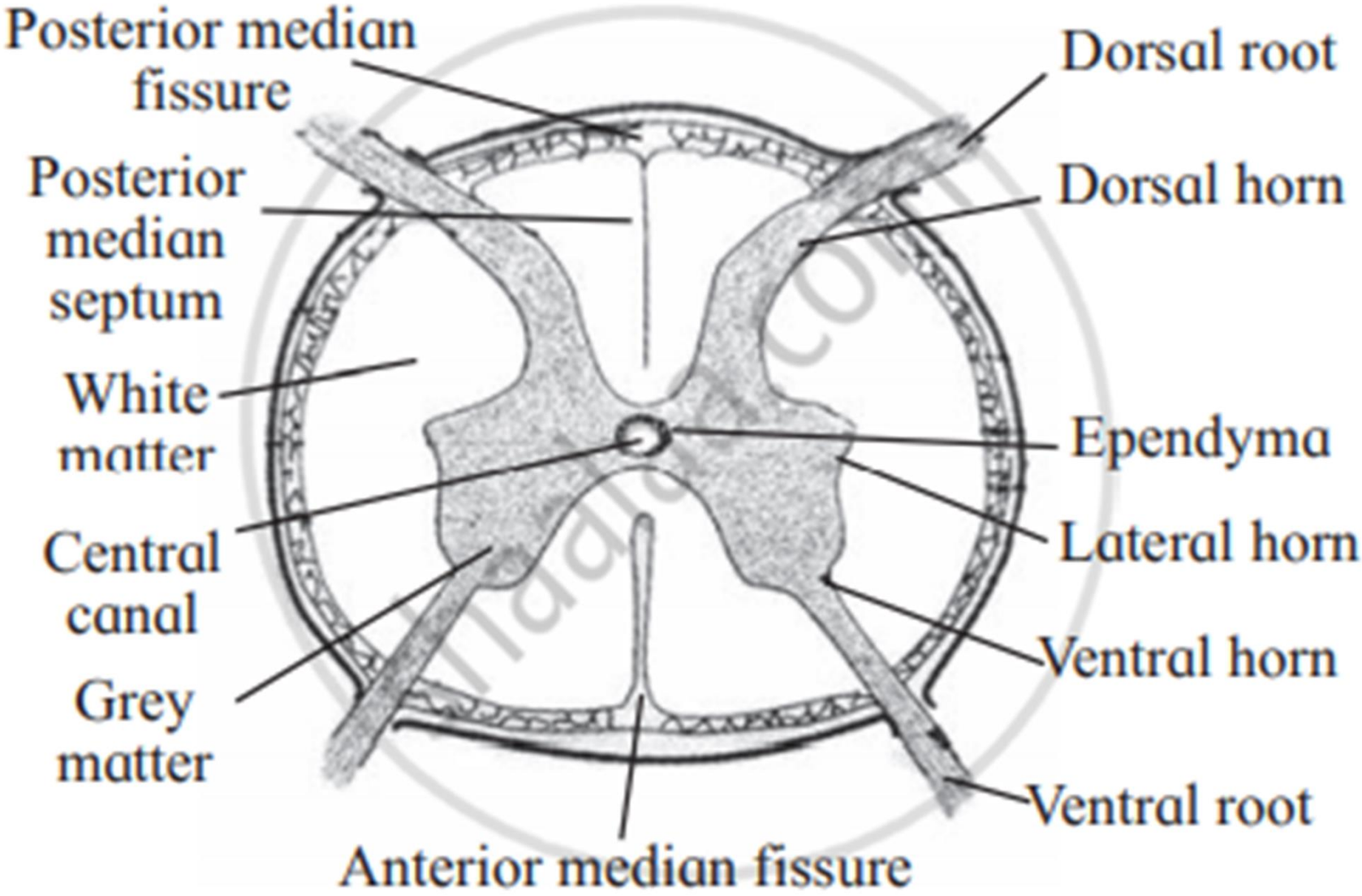
Medulla Oblongata
("oblong marrow")
Connects the
spinal cord to
pons

Autonomic
function
(breathing,
heart rate, etc.)

Cerebral Hemisphere	Primary Function	Secondary Function (Cognitive)
Frontal	Motor	Motor planning and execution, attention, executive functions, perhaps consciousness?
Temporal	Auditory and Olfactory	Memory, language, emotion
Parietal	Somatosensory	Spatial attention
Occipital	Visual	Map of visual world

Structure	Function
Spinal Cord	Input-output of sensory and motor information to and from the CNS-PNS
Medulla	Autonomic function (breathing, heart rate, etc.)
Pons	Auditory and vestibular (balance), sensory and motor
Cerebellum	Motor coordination and motor learning
Midbrain	Visuomotor functions, visual reflexes, auditory relays, motor coordination

Thalamus	Projects information to specific areas of the cerebrum, and controls which information is sent to the cerebral cortex
Hypothalamus	Regulates homeostasis in conjunction with the autonomic nervous system
Basal Ganglia	Centers for motor coordination
Hippocampus	Memory formation
Amygdala	Emotion processing
Corpus Collosum	Bundle of axons which connects the two hemispheres


Posterior median fissure
Posterior median septum
White matter
Central canal
Grey matter
Anterior median fissure
Dorsal root
Dorsal horn
Ependyma
Lateral horn
Ventral horn
Ventral root

Some Facts About Your Brain-

1. Sixty percent of the human brain is made of fat and is one of the fattest organs in the human body.

2. Your brain isn't fully formed until age 25. Brain development begins from the back of the brain and works its way to the front. Therefore, your frontal lobes, which control planning and reasoning, are the last to strengthen and structure connections.

3. Your brain's storage capacity is considered virtually unlimited. Research suggests the human brain consists of about 86 billion neurons. Each neuron forms connections to other neurons, which could add up to 1 quadrillion (1,000 trillion) connections. Over time, these neurons can combine, increasing storage capacity. However, in Alzheimer's disease, for example, many neurons can become damaged and stop working, particularly affecting memory.

4. Brain information travels up to an impressive 268 miles per hour.

5. On average, your spinal cord stops growing at 4 years old.

6. The spinal cord is the main source of communication between the body and the brain.

7. It's a myth that you only use 10 percent of your brain.

8. The human brain weighs 3 pounds. A piece of brain tissue the size of a grain of sand contains 100,000 neurons and 1 billion synapses.

9. The human brain can generate about 23 watts of power (enough to power a lightbulb).

What are the most mind blowing facts about the human brain?

There are more than 100,000 chemical reactions happening in the human brain every second. Your brain uses 20% of the total oxygen in your body and 20% of the blood circulating in your body. The brain can live for 4 to 6 minutes without oxygen, and then it begins to die.

The brain is a complex organ that **controls thought, memory, emotion, touch, motor skills, vision, breathing, temperature, hunger** and every process that regulates our body.

Together, the brain and spinal cord that extends from it make up the central nervous system, or CNS.