

21 Function of the cerebral hemispheres

CNS



Sources:

- Female slides
- Linda

OBJECTIVES :

- Describe the general structure of the Cerebrum and Cerebral Cortex.
- Identify the Cerebrum, the Lobes of the Brain, the Cerebral Cortex, and its major regions/divisions.
- Describe the primary functions of the Lobes and the Cortical Regions of the Brain.



Overview of the brain :

COMPONENT OF THE BRAIN :

Telencephalon	Diencephalon	Brain stem	Cerebellum
1- cerebrum 2- basal ganglia (collection of grey matter situated inside the cerebral hemispheres)	Mainly : 1- thalamus (mainly a relay station for sensory pathways in their way to the cerebral cortex) 2- hypothalamus (contains center for autonomic and endocrine control)	1- midbrain 2- pons 3- medulla oblongata	---

The brain stem :

- Brain stem : anatomical term that groups all CNS structures that hang between the cerebrum And spinal cord together .
- Physiologically, very complicated because the brain stem structures involved in many different body functions as following :
 1. regulation of Consciousness , Wakefulness & Sleep
 2. Respiratory , Cardiovascular and Gastrintestinal control
 3. Balance (Vestibular nuclei)
 4. it contain several Cranial Nerve nuclei

Cerebrum : The largest division of the brain. It is divided into 2 hemispheres by longitudinal fissure, each of 2 hemispheres is divided into **4 lobes**: frontal, parietal, occipital & temporal.

Cerebral cortex : The outermost layer of gray matter making up the superficial aspect of the cerebrum.

Cerebral features :

1- gyri: Elevated ridges “winding” around the brain.

2- sulci: Small grooves dividing the gyri.

- **Central Sulcus**: Divides the Frontal Lobe from the Parietal Lobe.

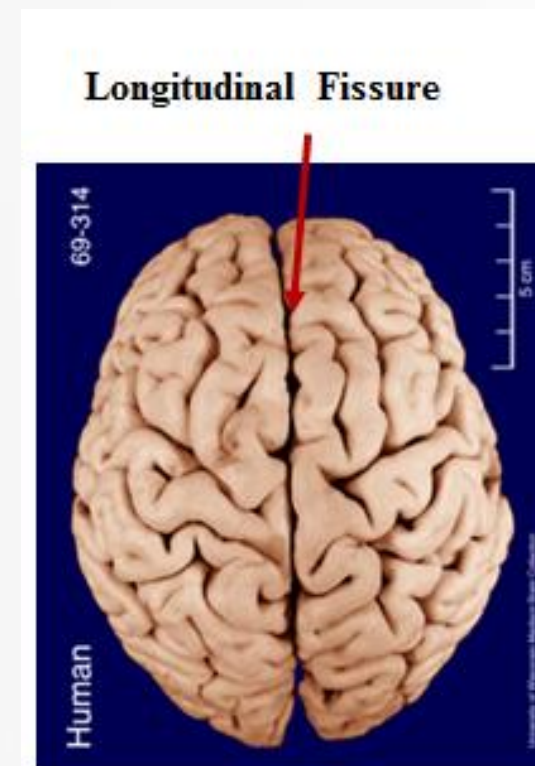
3- fissures: Deep grooves, generally dividing large regions/lobes of the brain.

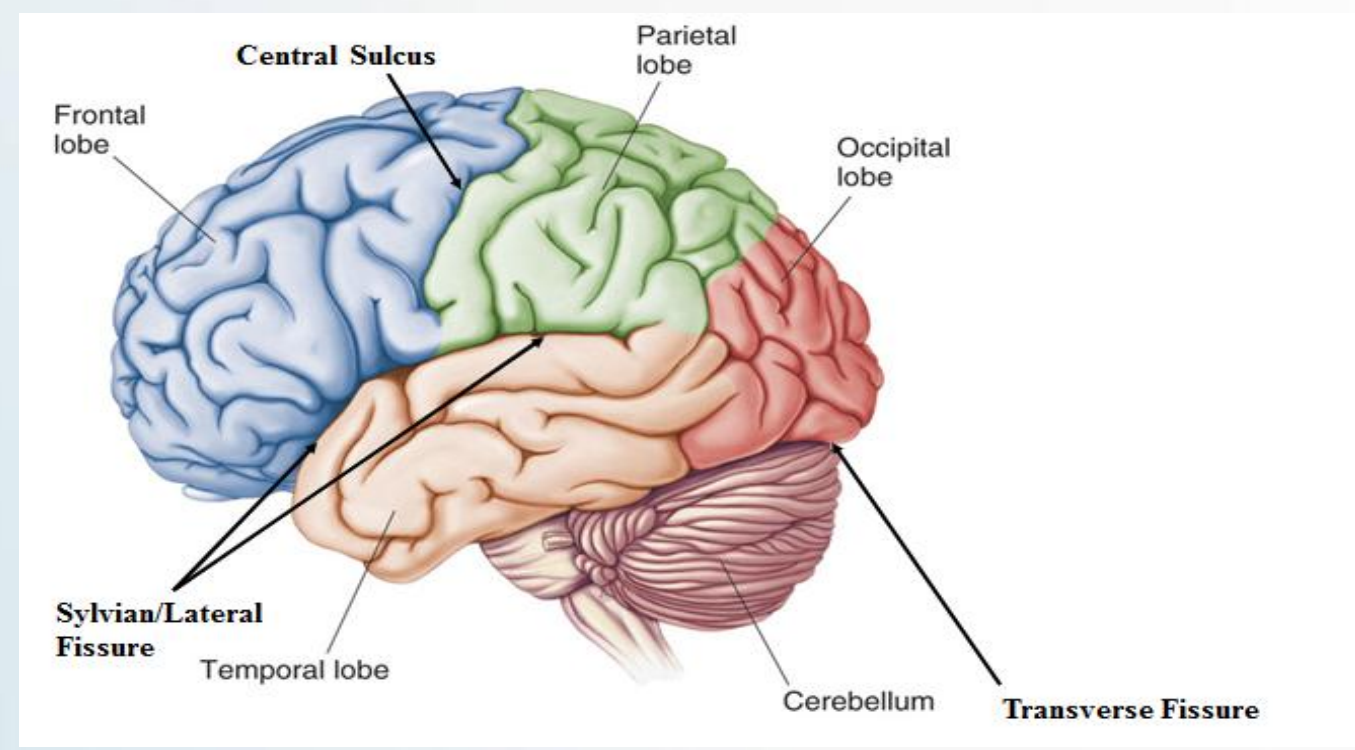
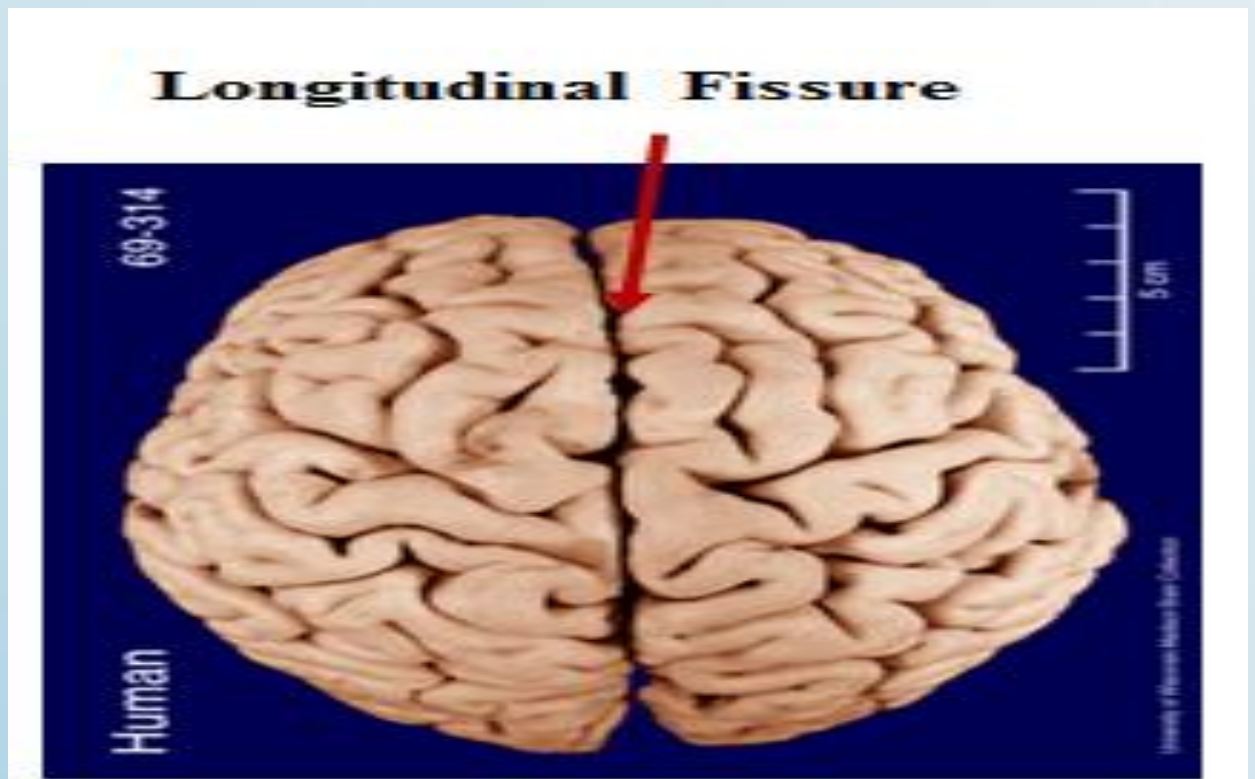
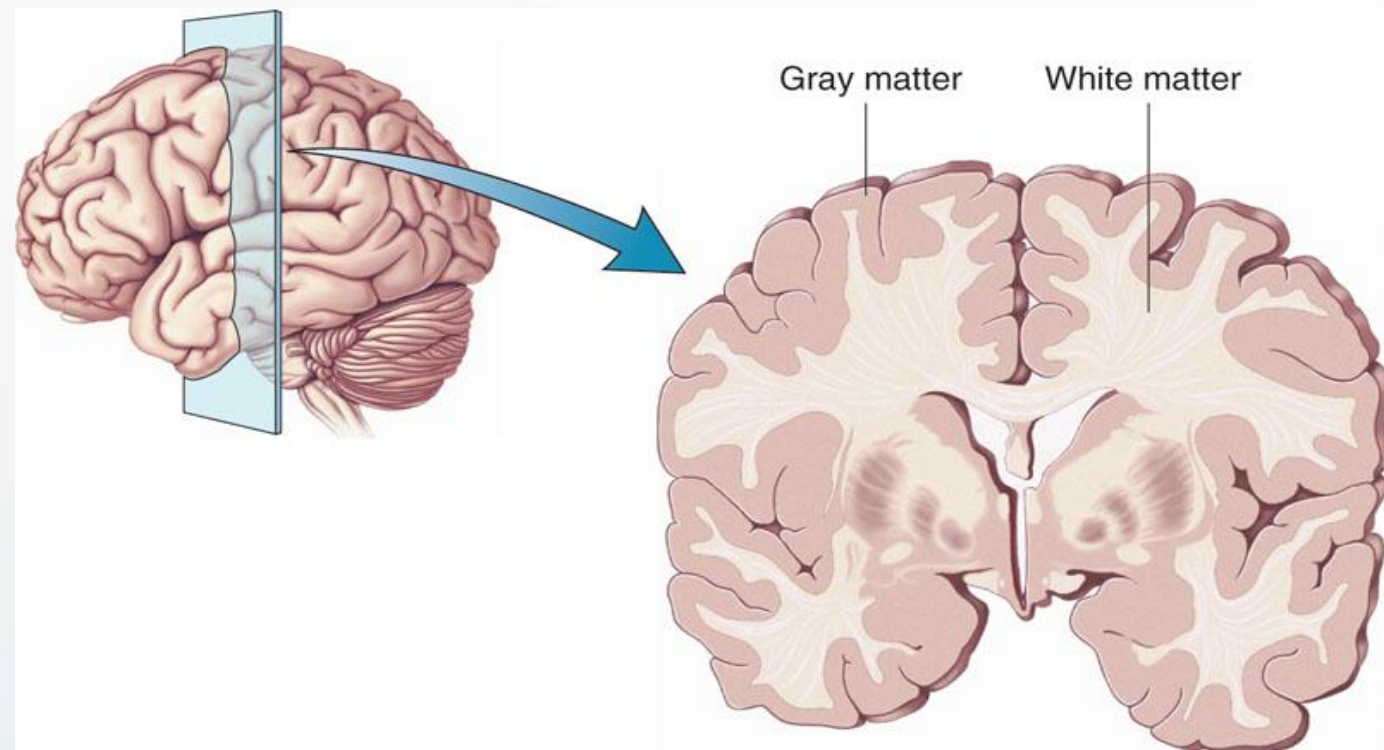
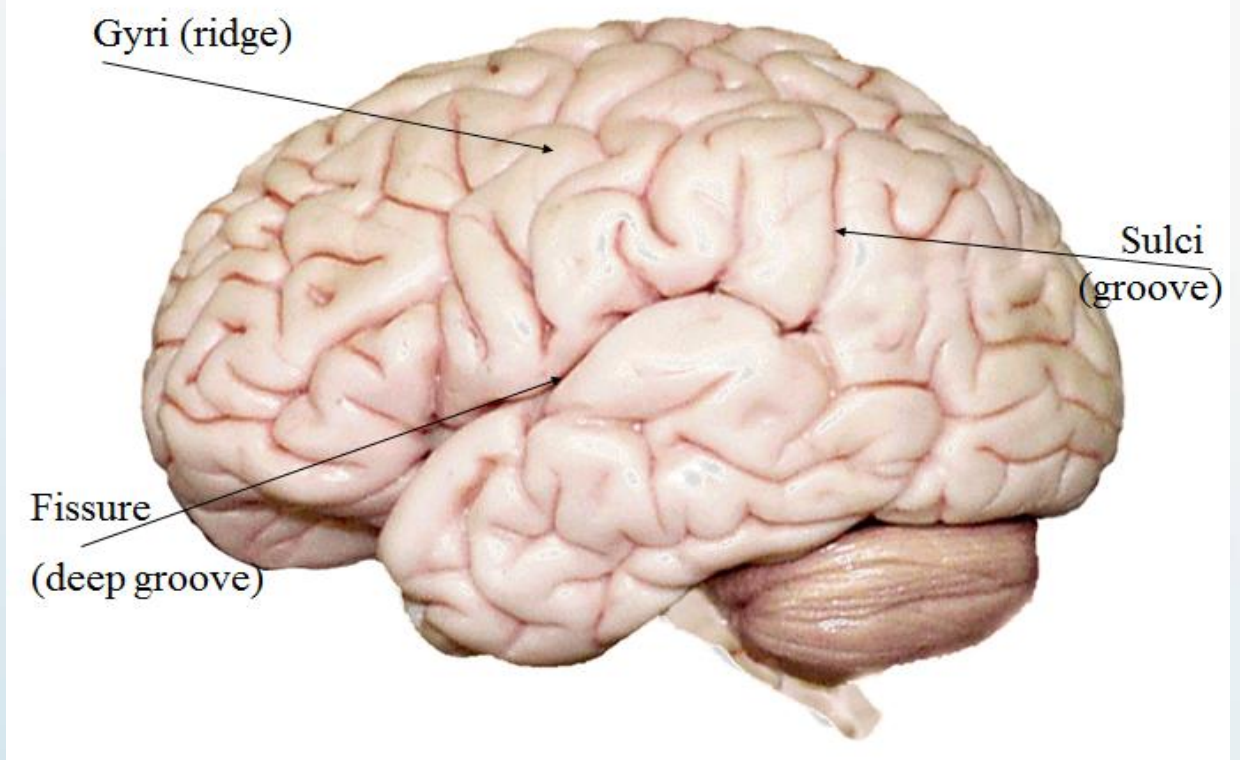
- **Longitudinal Fissure**: Divides the two Cerebral Hemispheres.

- **Transverse Fissure**: Separates the Cerebrum from the Cerebellum.

- **Sylvian/Lateral Fissure**: Divides the Temporal Lobe from

- the Frontal and Parietal Lobes .





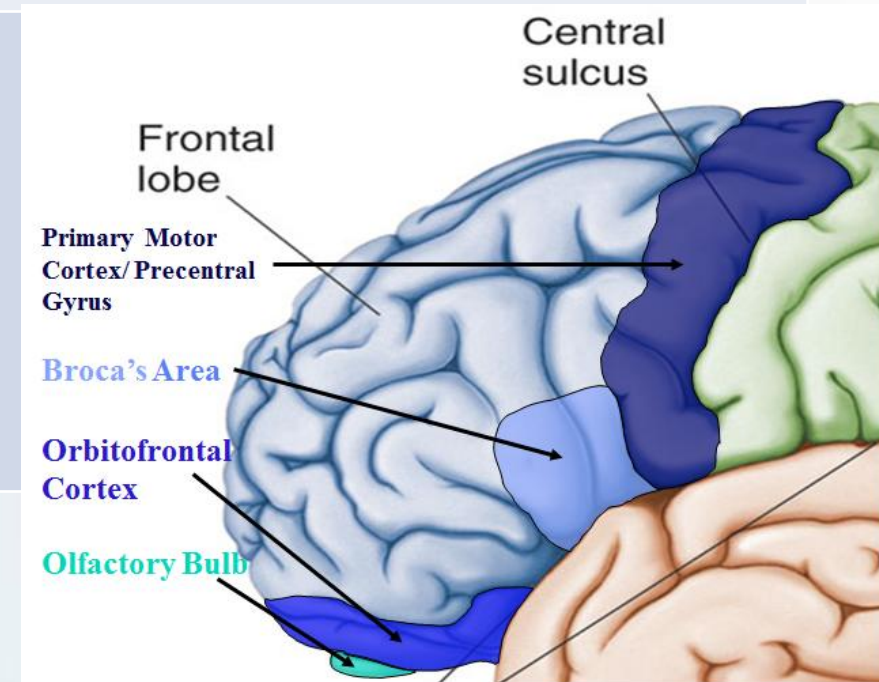
Lobes of the brain

1- frontal lobe :

location	function	lesions
Deep to the frontal lobe	<p>1- plays an integral role in :</p> <ul style="list-style-type: none">• memory formation• emotions• decision making/reasoning• personality <p>2- Responsible for initiation and execution of voluntary movement</p> <p>3- contains Broca's area of speech in the dominant hemisphere (i.e., in the left hemisphere in most people)</p>	<p>1- paralysis on opposite side of the body ,</p> <p>2- Broca's Aphasia: Results in the ability to comprehend speech, but the decreased motor ability (or inability) to speak and form words if lesion involves Broca's area in the dominant hemisphere.</p>

Cortical region

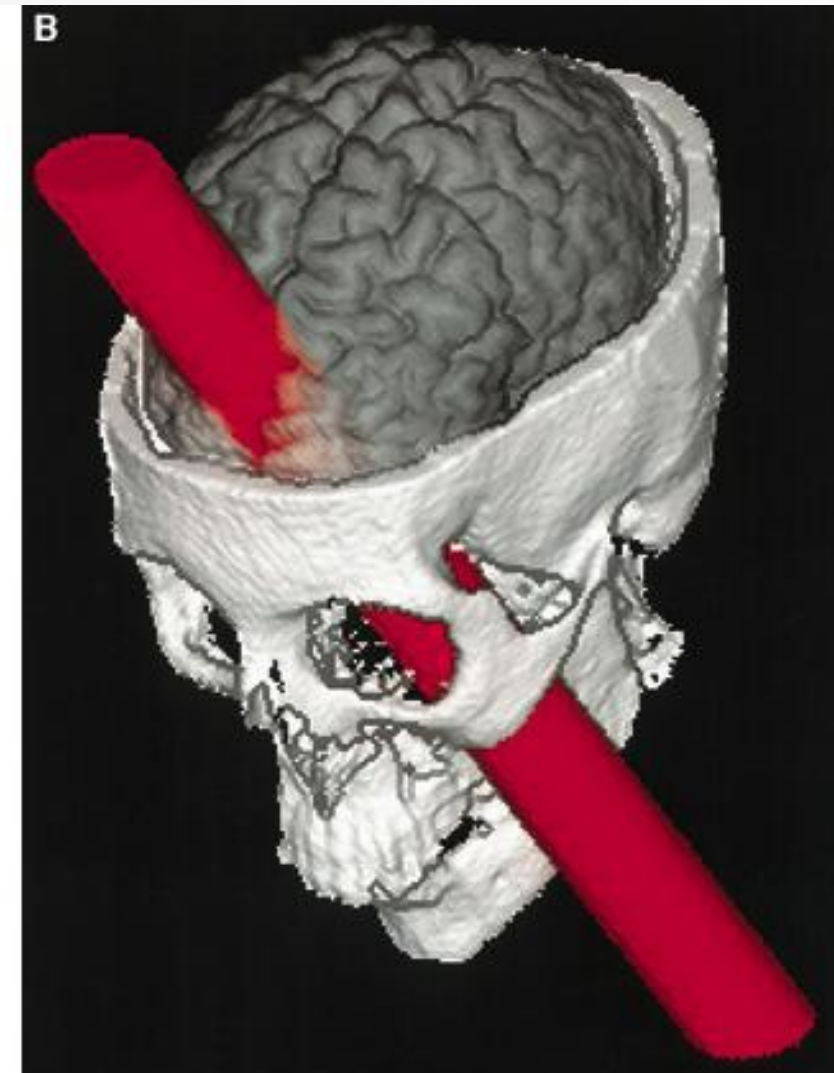
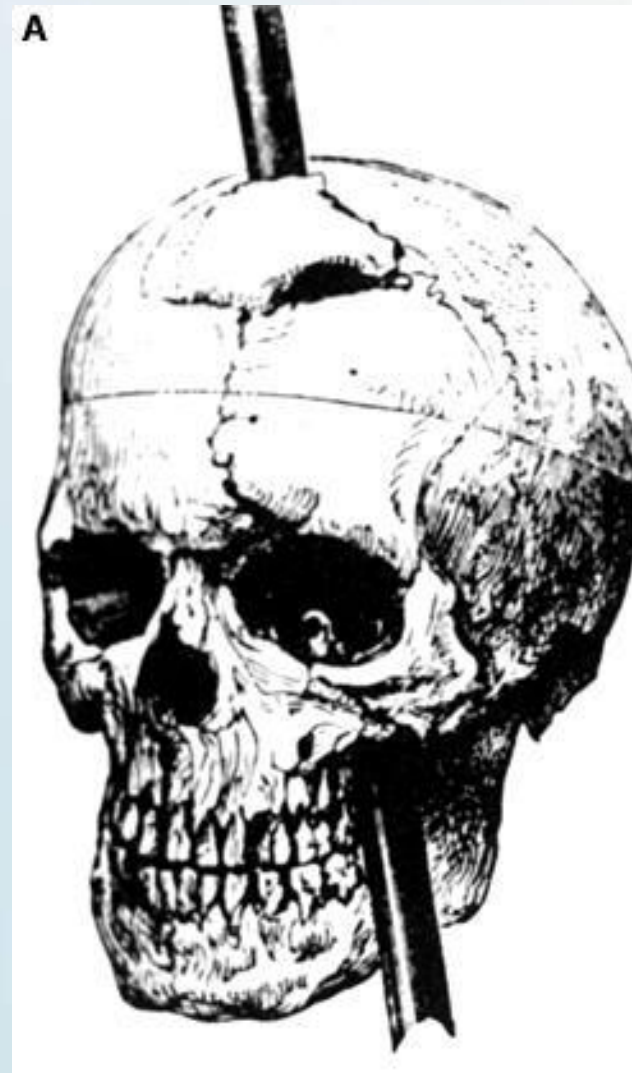
- 1- **Primary Motor Cortex (Precentral Gyrus):** Cortical site involved with controlling movements of the body.
- 2- **Broca's Area:** Controls facial neurons and speech "motor speech"
- 3- **Orbitofrontal Cortex** – Site of Frontal Lobotomies
- 4 - **Olfactory Bulb** - Cranial Nerve I, Responsible for sensation of Smell



Phineas Gage

- In 1848 in Vermont, had a 3.5-foot-long, 13 lb. metal rod blown into his skull, through his brain, and out of the top of his head. Gage survived. In fact, he never even lost consciousness.
- Friends reported a complete change in his personality after the incident. He lost all impulse control.

NOTE : If a right-handed person gets a stroke involving his left cerebral hemisphere , he is likely to have right-sided hemiplegia (paralysis) and aphasia (loss of the power of speech)

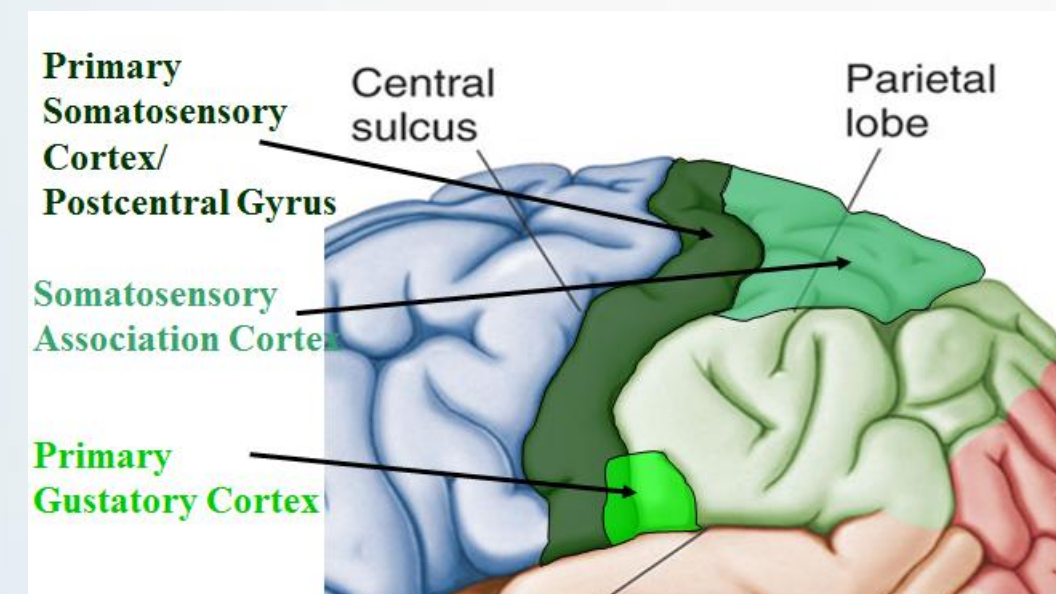


2- Parietal lobe

location	Function	Cortical region
Deep to the parietal bone of the skull	1- Senses and integrates sensation 2- Spatial awareness and perception (Proprioception: Awareness of body or body parts in space and in relation to each other)	1- Primary Somatosensory Cortex (Postcentral Gyrus) : involved with processing of tactile and proprioceptive information contralaterally . 2-Somatosensory Association Cortex : Assists with the integration and interpretation of proprioception. May assist with visuo-motor coordination. 3- Primary Gustatory Cortex : Primary site involved with the interpretation of the sensation of Taste.

lesions

- Parietal lobe is essential for our feeling of touch, warmth/heat , cold, pain , body position and appreciation of shapes of palpated objects .
- When damaged , the person loses the ability to recognize shapes of complex objects by palpation & develops Sensory Inattention on opposite side .



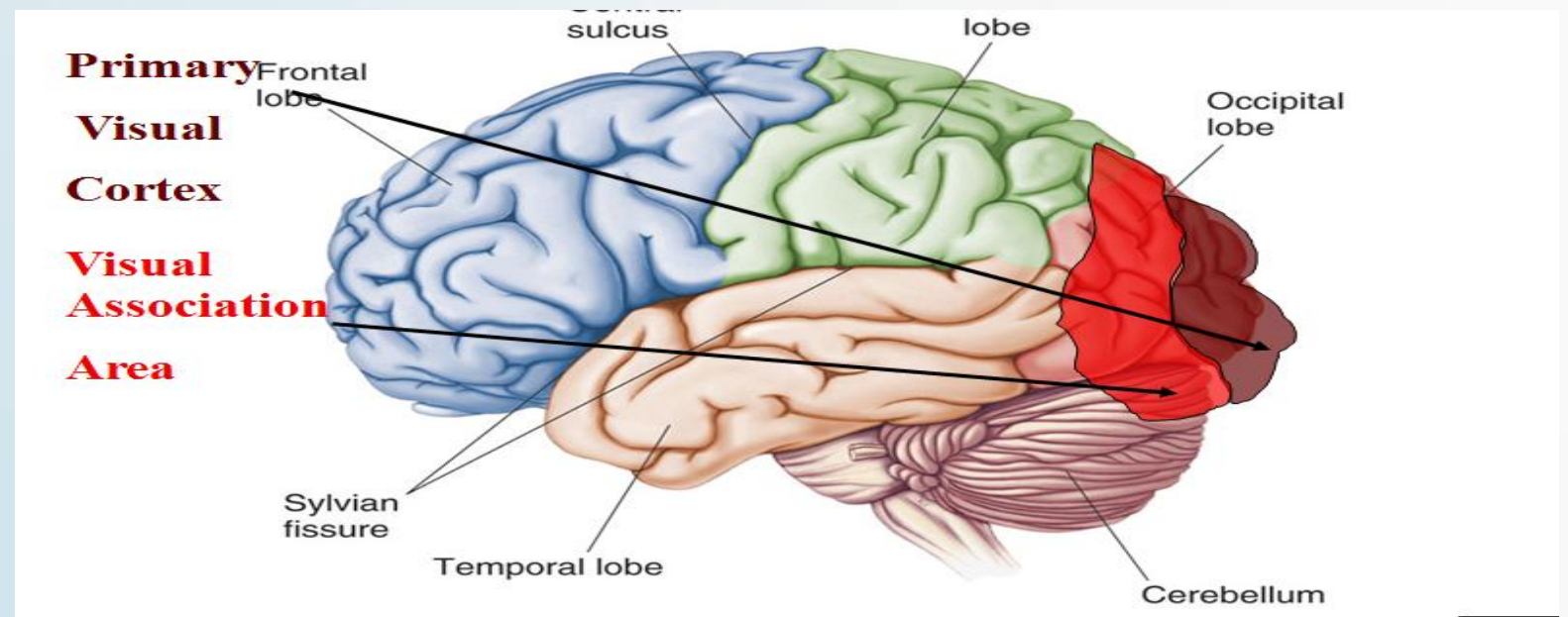
3- Occipital lobe

location	Function	Cortical region
Deep to the occipital bone of the skull	<ul style="list-style-type: none"><input type="checkbox"/> Processing<input type="checkbox"/> Integration<input type="checkbox"/> Interpretation <p>Of :</p> <ul style="list-style-type: none">▪ Vision▪ Visual stimuli	<p>1- primary visual cortex : responsible for sight- recognition of size , color , light , motion dimensions , etc .</p> <p>2- visual association area : interprets information acquired through the primary visual cortex.</p>

lesions

- focal seizures (partial) : visual hallucination (it will be explained in epilepsy lecture)
- sensory / motor deficit : a contralateral visual field loss **but** if it was an bilateral occipital lobe lesion it will lead to cortical blindness .

the information in gray color not important just for extra explanation

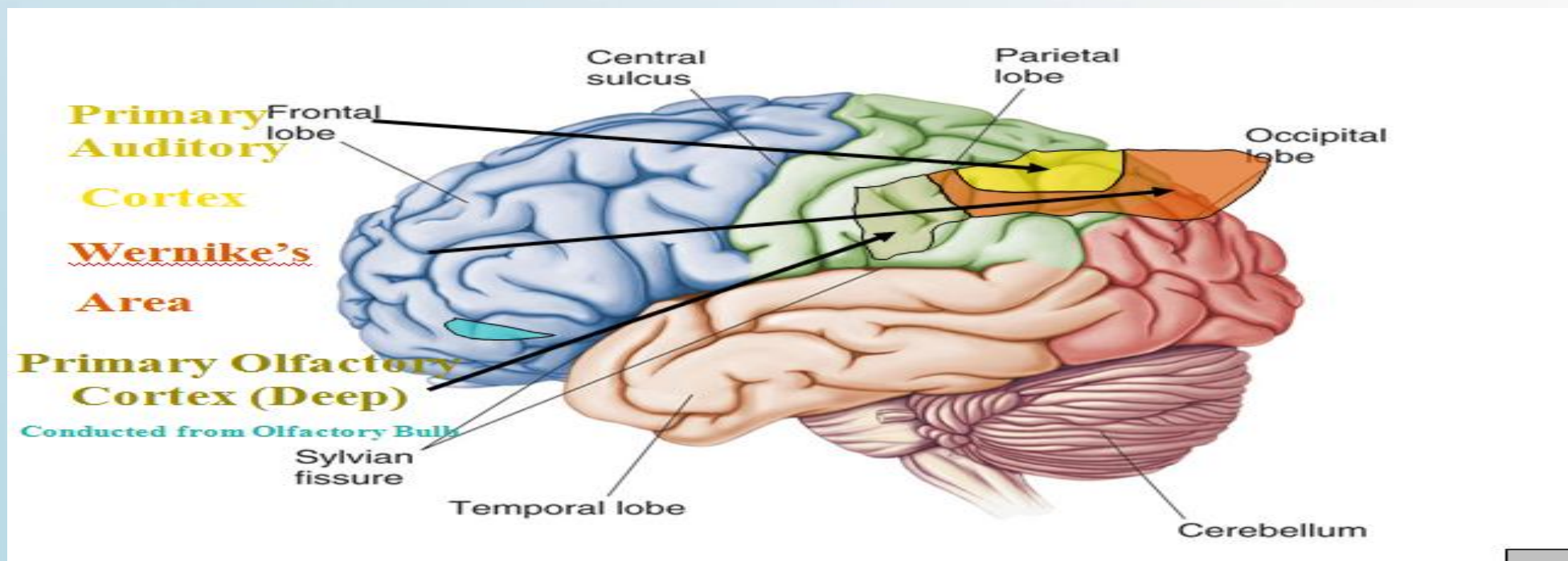


4- Temporal lobe

location	Function	Cortical region
located on the sides of the brain, deep to the Temporal bones of the skull.	<ul style="list-style-type: none"> •Organization/Comprehension of language. Hearing (because it contains Wernicke's Area) •Information Retrieval (Memory and Memory Formation) 	1- Primary Auditory Cortex : Responsible for hearing 2- Primary Olfactory Cortex – Interprets the sense of smell once it reaches the cortex via the olfactory bulbs. (Not visible on the superficial cortex) 3- Wernicke's Area :Language comprehension. Located on the <u>Left</u> Temporal Lobe. ➤ Wernicke's Aphasia :Language comprehension is inhibited. Words and sentences are not clearly understood, and sentence formation may be inhibited or non-sensical

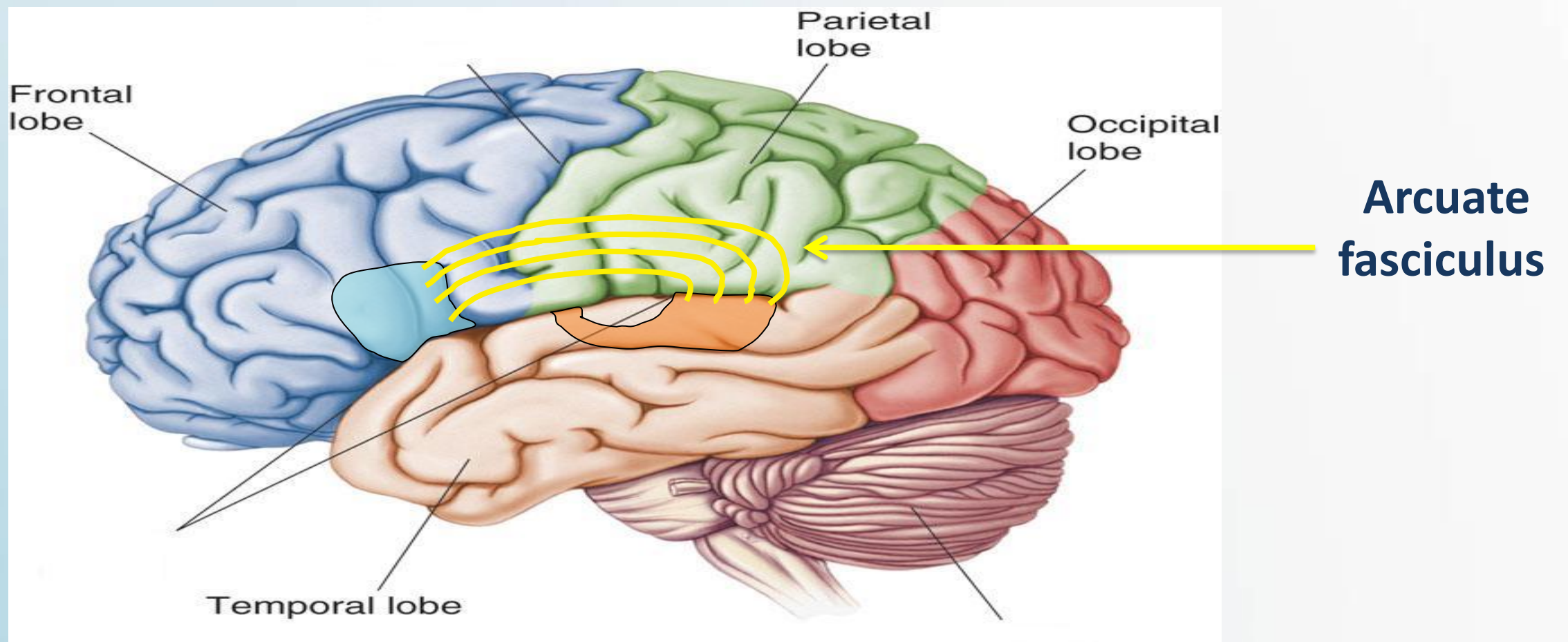
lesions

- lead to memory impairment & can be associated with temporal lobe epilepsy



Arcuate fasciculus :

Components	White matter
Connection :	connects Broca's Area and Wernicke's Area through : <ul style="list-style-type: none">•Temporal lobe•Parietal lobe•Frontal lobe
Function :	•Allowing for coordinated and comprehensible speech .
Lesion :	Conduction Aphasia : Where auditory comprehension and speech articulation are preserved , but people find it difficult to repeat heard speech.



FUNCTIONAL PRINCIPLES OF THE CEREBRAL HEMISPHERES

- 1-Each cerebral hemisphere receives sensory information from, and sends motor commands to, the opposite side of body
- 2- The 2 cerebral hemispheres have :
 - ✓ Different functions
 - ✓ Same structure
- 3-Correspondence between a specific function and a specific region of cerebral cortex is not precise
- 4-No functional area acts alone, conscious behavior involves the entire cortex

PREFRONTAL CORTEX

1. Most complicated region, coordinates info from all other association areas
2. Important in : intellect, planning, reasoning, mood, abstract ideas, judgment, conscience, and accurately predicting Consequences

HEMISPHERIC LATERALIZATION :

- ✓ Functional differences between left and right hemispheres
- ✓ In most people, left hemisphere (dominant hemisphere)

Left cerebral hemisphere controls :

- reading, writing, and math
- decision-making
- Logic
- speech and language

Right cerebral hemisphere controls :

- recognition (faces, voice inflections)
- affect
- visual/spatial reasoning
- Emotion
- artistic skills



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CNS Block