



**Physiology Team**



# LECTURE 25

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## Functions Of The Cerebral Hemisphere

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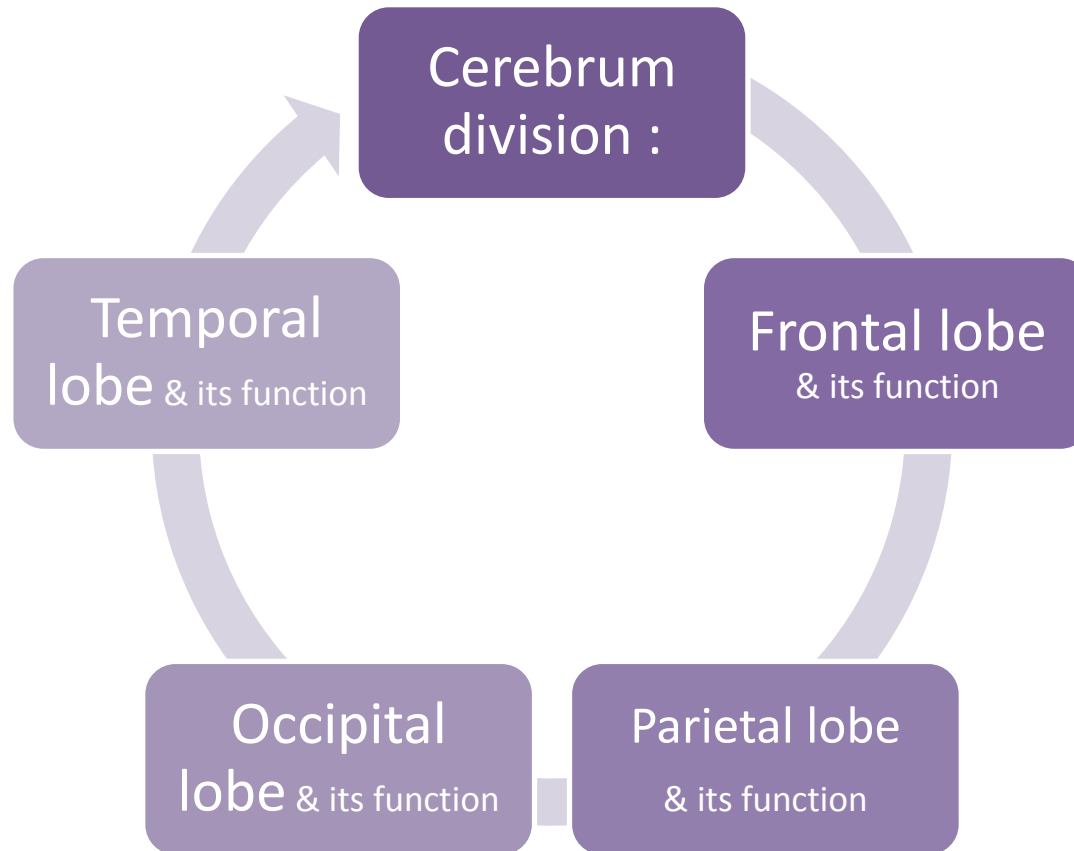
**Reviewed By: Abdulrahman Al-Akeel & Leena Al-Yahya**

# OBJECTIVES

At the end of this lecture, student should be able to describe:

- Students will be able to describe the general structure of the Cerebrum and Cerebral Cortex.
- Students will be able to identify the Cerebrum, the Lobes of the Brain, the Cerebral Cortex, and its major regions/divisions.
- Students will be able to describe the primary functions of the Lobes and the Cortical Regions of the Brain.

# MIND MAP



# Components of The Brain

Telencephalon	Diencephalon	Brainstem	Cerebellum
Contains 1) Cerebrum. 2) Basal Ganglia ( collection of grey matter situated inside the cerebral hemispheres )	Contains 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	_____

# The Brainstem

- The term “ **brainstem** ” is actually an **anatomic rather than physiologic term** , because it is easier , in terms of anatomy , to group “ all CNS structures that hang between the cerebrum and spinal cord ” together .
- However , in terms of Physiology , the situation is more complicated , because brainstem structures are involved in many diverse & different bodily functions .

These **functions** include

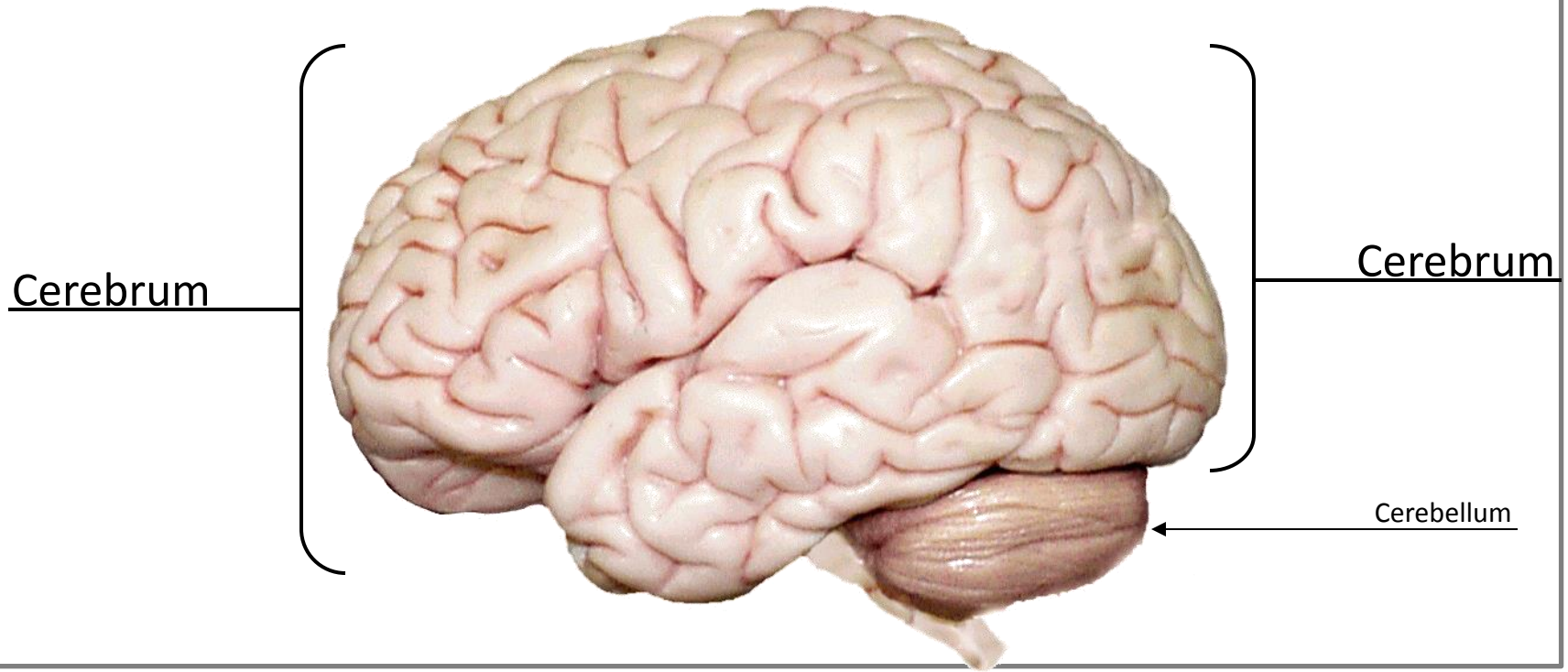
- (1) regulation of Consciousness , Wakefulness & Sleep ,
- (2) Respiratory , Cardiovascular and Gastrointestinal control ,
- (3) Balance ( Vestibular nuclei ) .
- (4) Moreover , it contain several Cranial Nerve nuclei .

,

- ✓ Most people ( **about 90 %** ) have the **left cerebral hemisphere dominant** , and are therefore **right-handed** .
- ✓ The remaining ( **around 10 %** ) of the population usually have their **right hemisphere dominant** , and are therefore **left-handed** .
- ✓ The **frontal lobe** of the **dominant hemisphere** contains **Broca's area** (the area for production of speech ) .
- ✓ Therefore, 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).

# The Cerebrum

- The **largest division** of the brain.
- It is divided into **two hemispheres**, each of which is divided into **four lobes**.



**Cerebral Cortex** - The outermost layer of gray matter making up the superficial aspect of the cerebrum.

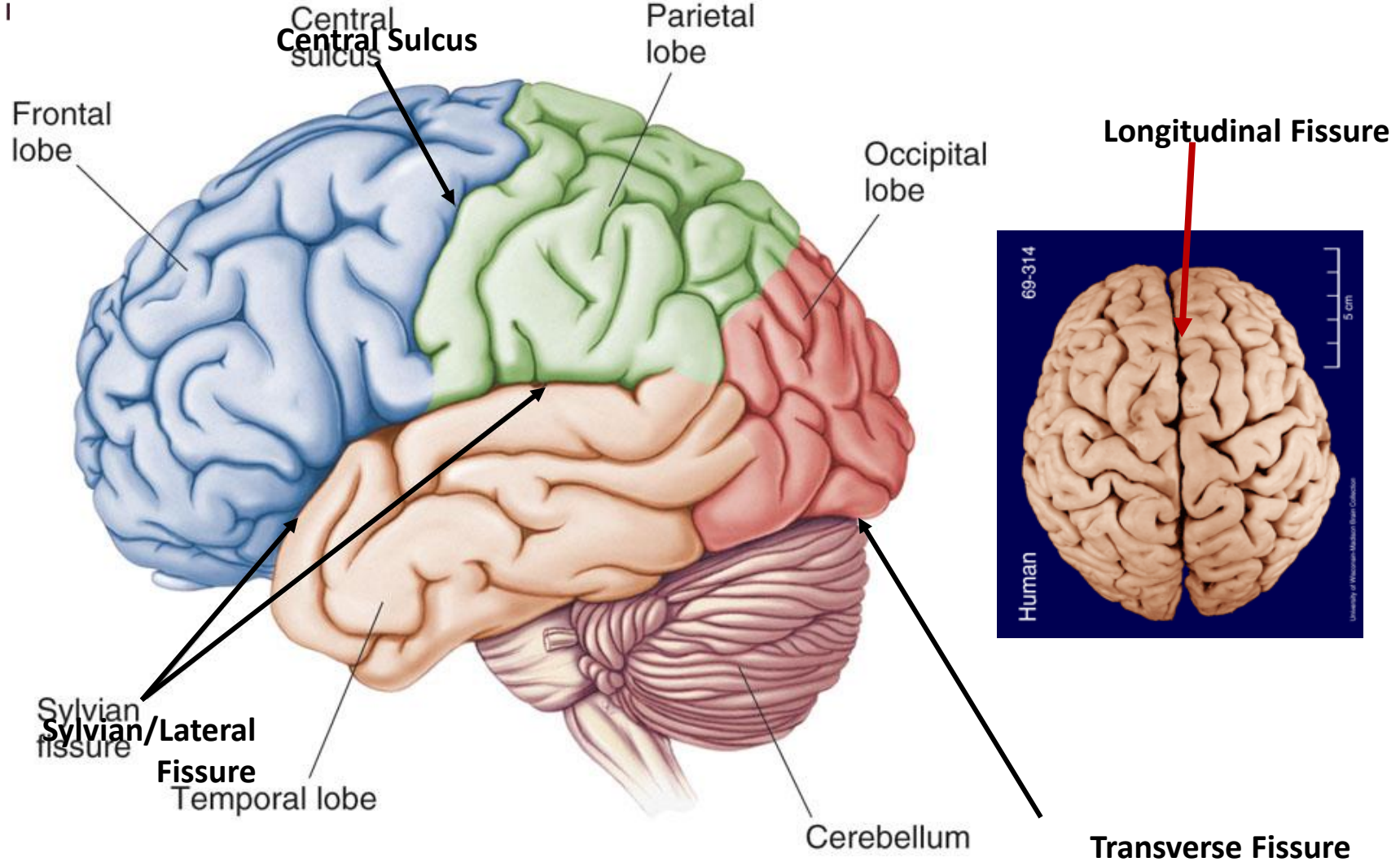
## ***CEREBRAL FEATURES:***

- **Gyri** – Elevated ridges “winding” around the brain.
- **Sulci** – Small grooves dividing the gyri
  - Central Sulcus** – Divides the Frontal Lobe from the Parietal Lobe
- **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





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**Slides**

**Important**

**Doctor's Notes**

**Explanation**

**Boy's Slides**

# Lobes of the Brain (4 lobes)

Frontal lobe	Parietal Lobe	Occipital lobe	Temporal lobe
<ul style="list-style-type: none"> <li>is located deep to the Frontal Bone of the skull</li> <li>It plays an integral role in the following functions/action:               <ul style="list-style-type: none"> <li>-Memory Formation</li> <li>- Emotions</li> <li>- Decision</li> <li>- Making/Reasoning</li> <li>- Personality</li> </ul> </li> </ul>	<p>is located deep to the Parietal Bone of the skull.</p> <ul style="list-style-type: none"> <li>It plays a major role in the following functions/actions:               <ul style="list-style-type: none"> <li>-Senses and integrates sensation(s)</li> <li>-Spatial awareness and perception</li> <li>(Proprioception - Awareness of body/body parts in space and in relation to each other)</li> </ul> </li> </ul>	<p>is located deep to the Occipital Bone of the Skull.</p> <p>Its primary function is the processing, integration, interpretation, etc. of VISION and visual stimuli.</p>	<p>is located on the sides of the brain, deep to the Temporal Bones of the skull.</p> <ul style="list-style-type: none"> <li>plays an integral role in the following functions               <ul style="list-style-type: none"> <li>•-Hearing</li> <li>•organization\Comprehension of language</li> <li>•Information Retrieval (Memory and Memory Formation)</li> </ul> </li> </ul>



# Frontal lobe - Cortical Regions

initiation and execution of voluntary movement contains Broca's area of speech in the dominant hemisphere ( i.e., in the left hemisphere in most people ).

Lesion can cause →

- (1) paralysis on opposite side of the body ,
- (2) aphasia ( loss of ability to speak ) if lesion involves Broca's area in the dominant hemisphere ).

## ❖ Primary Motor Cortex (Precentral Gyrus) –

Cortical site involved with controlling movements of the body.

## ❖ Broca's Area – Controls facial neurons, speech, and language comprehension. Located on Left Frontal Lobe.

– **Broca's Aphasia** – Results in the ability to comprehend speech, but the decreased motor ability (or inability) to speak and form words.

## ❖ Orbitofrontal Cortex – Site of Frontal Lobotomies

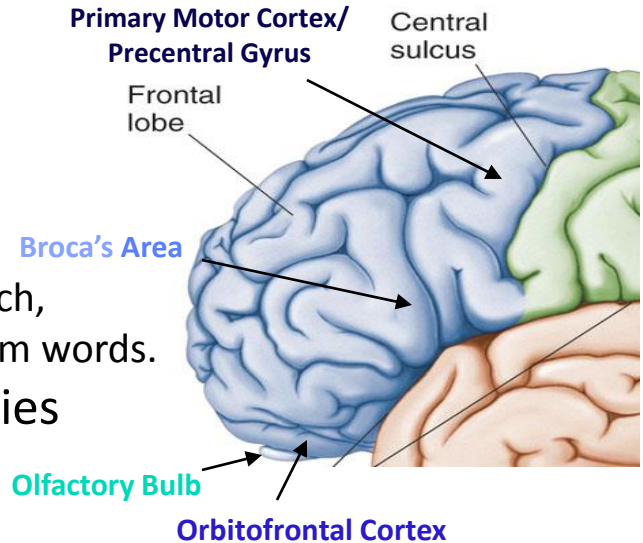
### \* Desired Effects

- Diminished Rage
- Decreased Aggression
- Poor Emotional Responses

### \* Possible Side Effects: Olfactory Bulb

- Epilepsy
- Poor Emotional Responses
- Perseveration (Uncontrolled, repetitive actions, gestures, or words)

\***Olfactory Bulb** - Cranial Nerve I, Responsible for sensation of Smell



# Parietal lobe

**Primary Somatosensory Cortex (Postcentral Gyrus)** – Site involved with processing of tactile and proprioceptive information.

- **Somatosensory Association Cortex** - Assists with the integration and interpretation of sensations relative to body position and orientation in space. May assist with visuo-motor coordination.
- **Primary Gustatory Cortex** – Primary site involved with the interpretation of the sensation of Taste.

❖ **Contains** →

1) Primary Somatosensory in the post-central gyrus →

to receive general sensations from opposite ( contralateral ) half of the body

2) Sensory Association Cortex ( for integration & association of sensory information )

- ✓ **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 (palpation = examination of objects by touch ) & develops Sensory Inattention on opposite side

# Occipital lobe

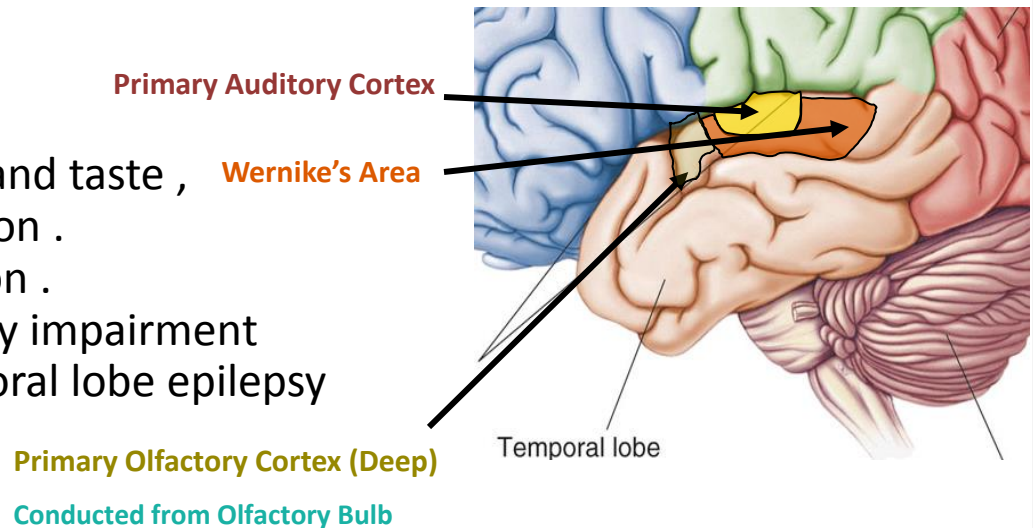
- **Primary Visual Cortex** – This is the primary area of the brain responsible for sight -recognition of size, color, light, motion, dimensions, etc.
- **Visual Association Area** – Interprets information acquired through the primary visual cortex.

# Temporal lobe

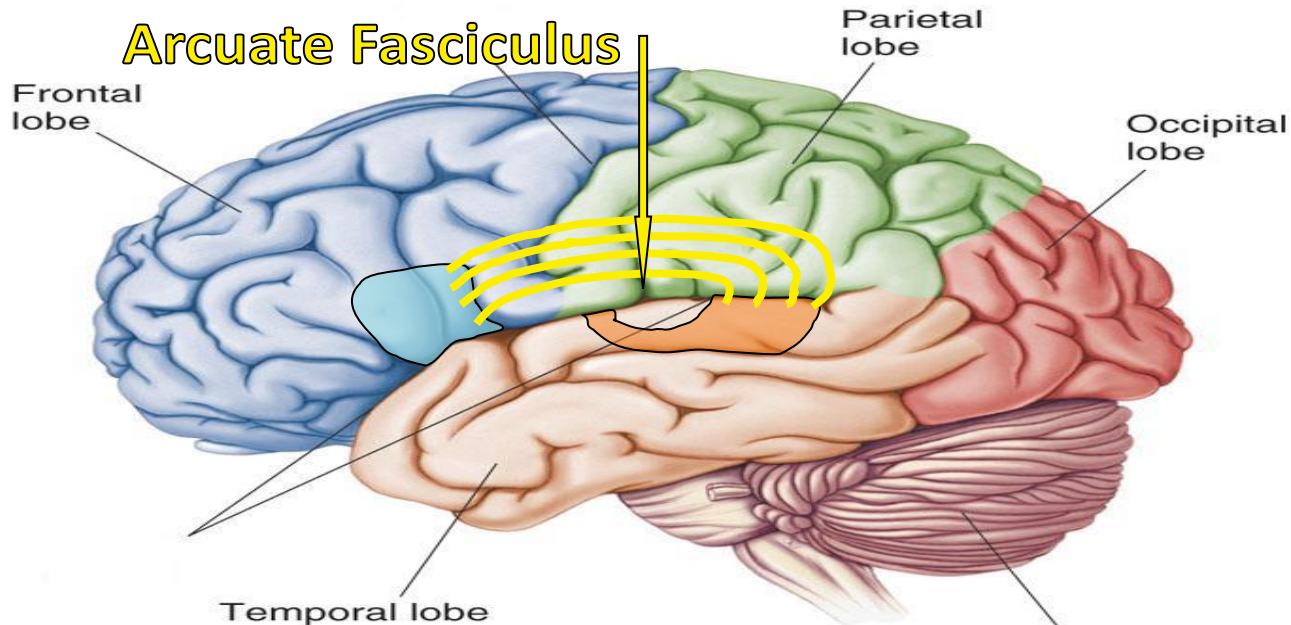
- ❖ **Primary Auditory Cortex** – Responsible for hearing
- ❖ **Primary Olfactory Cortex** – Interprets the sense of smell once it reaches the cortex via the olfactory bulbs. (Not visible on the superficial cortex)
- ❖ **Wernicke's Area** – Language comprehension. Located on the **Left** Temporal Lobe.
  - **Wernicke's Aphasia** – Language comprehension is inhibited. Words and sentences are not clearly understood, and sentence formation may be inhibited or non-sensical.

## Contains :

- 1) contains centers for hearing and taste ,
- 2) contributes to smell perception .
- 3) essential for memory function .
- 4) lesion → may lead to memory impairment & can be associated with temporal lobe epilepsy



- **Arcuate Fasciculus** - A white matter tract that connects Broca's Area and Wernicke's Area through the Temporal, Parietal and Frontal Lobes. Allows for coordinated, comprehensible speech. Damage may result in:
  - **Conduction Aphasia** - Where auditory comprehension and speech articulation are preserved, but people find it difficult to repeat heard speech.



## Sensory and Motor Areas of the Cerebral Cortex

Boy's slide

Cortical "Motor" Areas Includes :	Primary motor cortex (M-I)	Supplementary motor area (M-II)	Premotor cortex (PMC)	Frontal Eye field	Broca's area
<b>Location</b>	Immediately anterior to the central sulcus and extends to the medial surface of hemisphere also known as Broadmann's area 4 is a motor homunculus.	Found on both in lateral and medial aspect of <b>the frontal lobe.</b>	Broadmann's area 6. It lies immediately anterior to primary motor cortex. It is more extensive than primary motor cortex (about 6 times)	-	Present in frontal lobe (inferior frontal gyrus in its posterior part)
<b>Function</b>	<ul style="list-style-type: none"> <li>❖ It controls the musculature of the opposite side of the body.</li> <li>❖ Face area is bilaterally represented.</li> <li>❖ Is used in execution of skilled movements also in codes the direction, force and velocity of movements.</li> </ul>	It works together with premotor cortex . Involved programming of motor sequences	It works with the help of basal ganglia, thalamus, primary motor cortex, posterior parietal cortex. It plays role in planning and anticipation of a specific motor act.	-	Motor area of speech.
<b>Lesion</b>	Pure M-I lesions are rare. May have <b>contralateral weakness in distal muscle (fingers).</b> Ability to control <b>fine movements</b> is gone. Ablation of M-I alone cause hypotonia not Spasticity.	Produces awkwardness in performing complex activity like bimanual coordinated activity.	-	-	-

■ Slides

■ Important

■ Doctor's Notes

■ Explanation

■ Boy's Slides



## Sensory and Motor Areas of the Cerebral Cortex

Boy's slide

Somatosensory cortex Includes :	Somatosensory area I (S1)	Somatosensory Cortex (Area SII)	Somatosensory association areas
<b>Location</b>	Postcentral gyrus or Brodmann's area 1,2& 3. The sizes of the areas are directly proportional to the number of specialized sensory receptor in each respective peripheral area of the body.	Present in the wall of the sylvian fissure. The localization is poor as compared to SI.	Situated in Brodmann's area 5 & 7 of the central cortex located in the parietal cortex behind SI area.
<b>Function</b>	Receives sensory information exclusively from the opposite side of the body.	-	It plays an important role in <b>translating</b> the sensory information that enters the somatosensory areas.
<b>Lesion</b>	-	Ablation of SI results in deficits in sensory processing in SII where as ablation of SII has no gross effect on the processing in SI.	When damaged it loses the ability to recognize complex objects on the opposite side of the body.  e.g. Apraxia and sensory inattention.

■ Slides

■ Important

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# SUMMARY

- **BRAIN COMPONENTS:** telencephalon, diencephalon, brain stem & cerebellum.
- **TELENCEPHALON COMPOSED** of: cerebrum & basal ganglia
- **DIENCEPHALON COMPOSED OF:** thalamus & hypothalamus
- **BRAIN STEM COMPOSED** of: mid brain, pons & medulla oblongata
- **Functions of brain stem:**
  1. regulation of consciousness, wakefulness & sleep
  2. Respiratory & cardiovascular system
  3. Balance
  4. Origin of cranial nerves
- **MOST PEOPLE** have the left cerebral hemisphere dominant >> right handed
- **10% OF POPULATIONS** have their right hemisphere dominant >> left handed
- **CEREBRUM** is the largest division of the brain, divided into 2 hemisphere each of which is divided into 4 lobes( frontal, parietal, temporal & occipital)
- **CEREBRAL FEATURES:** gyri, sulci & fissures

# SUMMARY

## Functions of the four lobes

frontal	parietal	temporal	occipital
<ul style="list-style-type: none"><li>• Memory</li><li>• Emotions</li><li>• Decisions</li><li>• Personality</li><li>• Making reasoning</li></ul>	<ul style="list-style-type: none"><li>• Sense &amp; integrates sensations</li><li>• Spatial awareness &amp; perceptions</li></ul>	<ul style="list-style-type: none"><li>• Hearing</li><li>• Organization of language</li></ul>	<ul style="list-style-type: none"><li>• Processing</li><li>• Integration of vision &amp; visual stimuli</li></ul>

# QUESTIONS

**1-Which lobe of the following is playing an integral role in the personality function :**

- a) Frontal .
- b) Occipital .
- c) Temporal .

**2-lesion in the frontal lobe will cause :**

- a) Paralysis on opposite side of the body.
- B) Paralysis of the same side of the body.
- c) loss of smelling sensation.

**3-occipital lobe contains:**

- a) Primary visual cortex .
- b) Primary somatosensory area.
- c) broca's area

Q3:A  
Q2:A  
Q1:A

**THE END**

**If there are any Problems or Suggestions,  
Feel free to contact:**

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**THANK YOU**