



# CNS PHYSIOLOGY

- Text
- Important
- Formulas
- Numbers
- Doctor notes
- Notes and explanation

Lecture  
No.19

"The One Who Falls And Gets Up Is So  
Much Stronger Than The One Who Never  
Fell"



# Function of Cerebral hemisphere

## Objectives:

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

# Introduction

## ONLY IN MALES' SLIDES

- The cerebrum is the largest part of the brain with two hemispheres, linked by commissural fibres of corpus callosum.
- Each cerebral hemisphere contains externally highly convoluted cortex of grey matter and internal mass of white matter or medulla.
- The cerebral hemispheres contain motor and sensory areas and the limbic system.

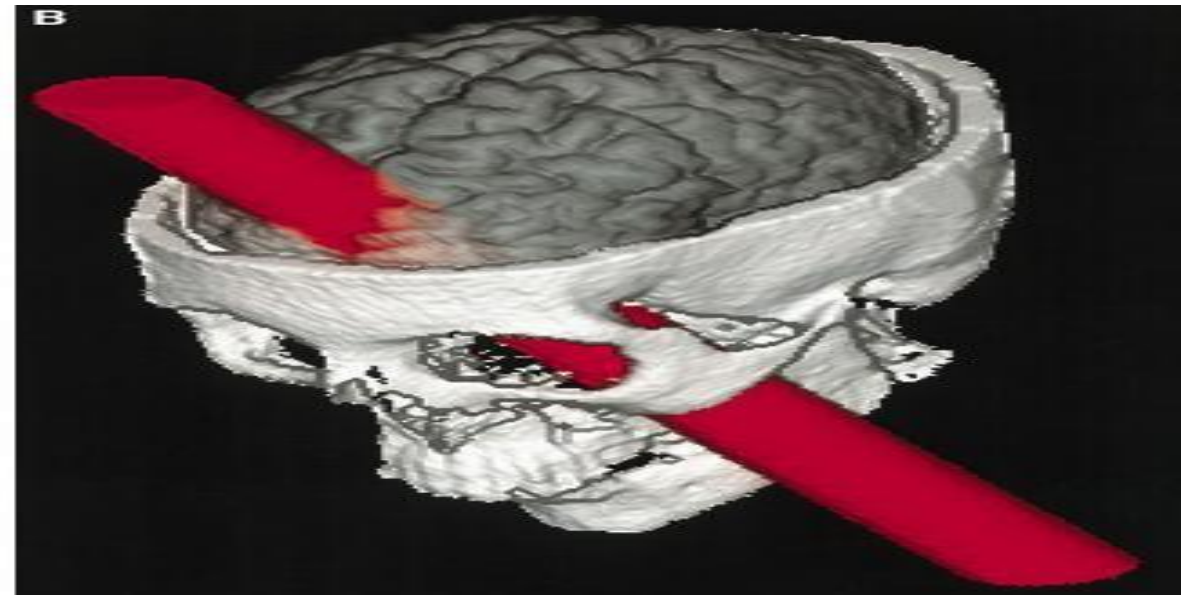
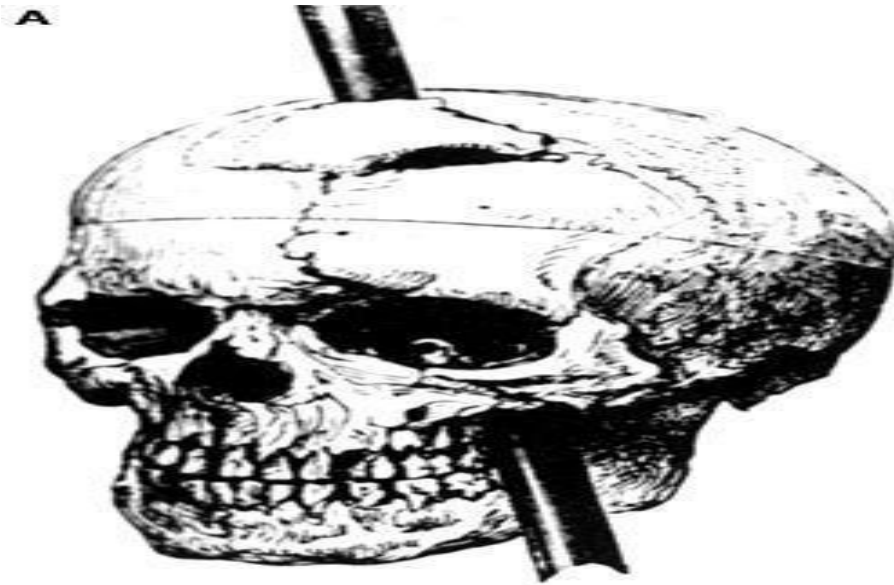
Cerebrum is the largest division of the brain. It is divided into two hemispheres, each of which is divided into four lobes.



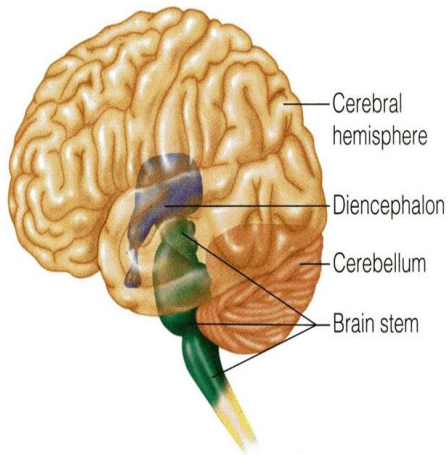
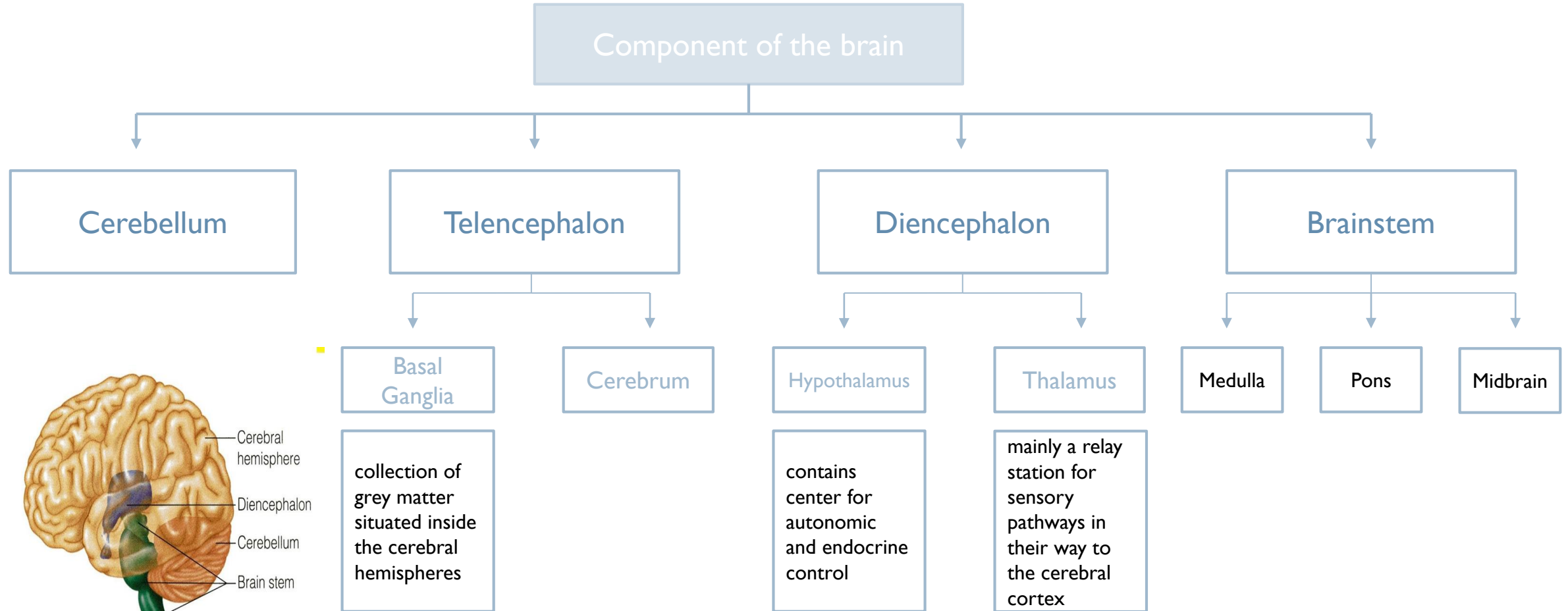
# Phineas Gage

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.



# Overview of the brain



# Cont.

- ▶ 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:

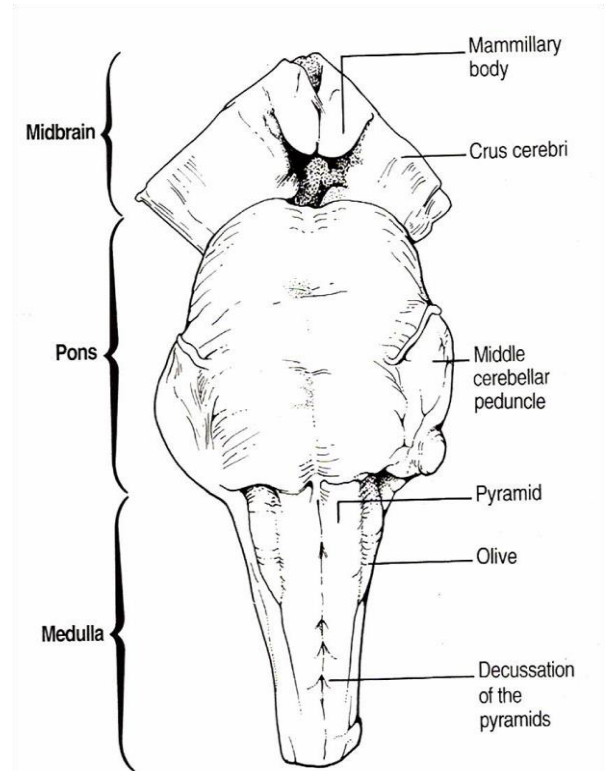
Regulation of consciousness wakefulness and sleep

it contain several Cranial Nerve nuclei

Balance ( Vestibular nuclei )

Respiratory , Cardiovascular and Gastrointestinal control

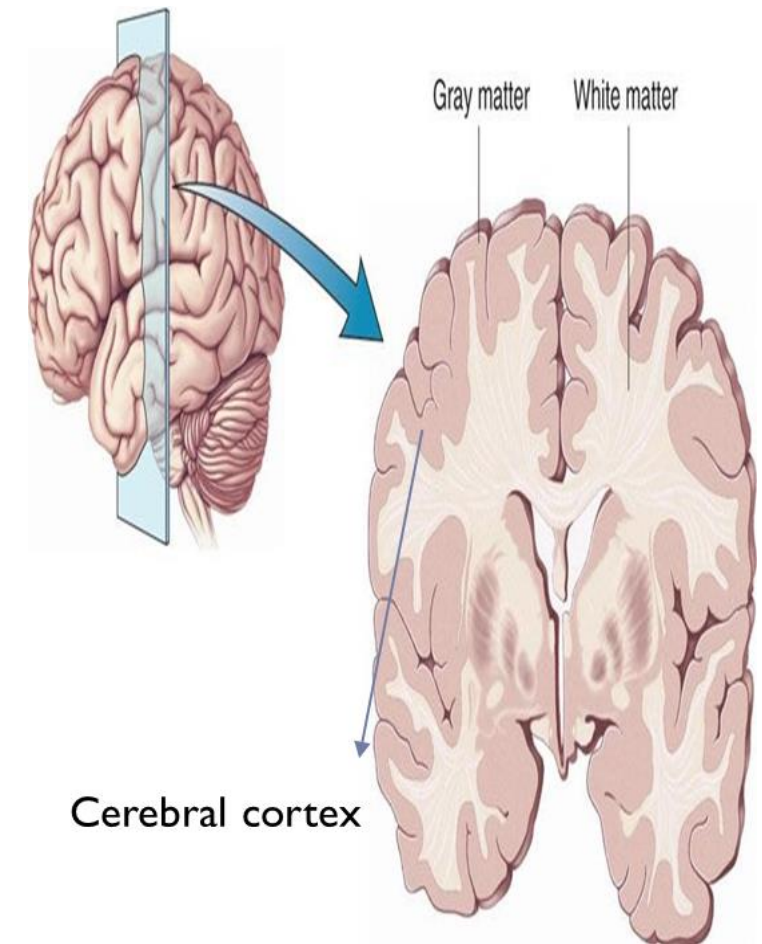
- ▶ Most people ( about 90 % ) have the left cerebral hemisphere dominant , and are therefore right-handed.
- ▶ The remaining ( around 10 % ) of the population usually have their right hemisphere dominant, and are therefore left-handed.
- ▶ The frontal lobe of the dominant hemisphere contains Broca’s area ( the area for production of speech ).
- ▶ Therefore, if a right-handed person gets a stroke involving his left cerebral hemisphere , he is hemiplegia ( paralysis ) and aphasia ( loss of the power of speech ).



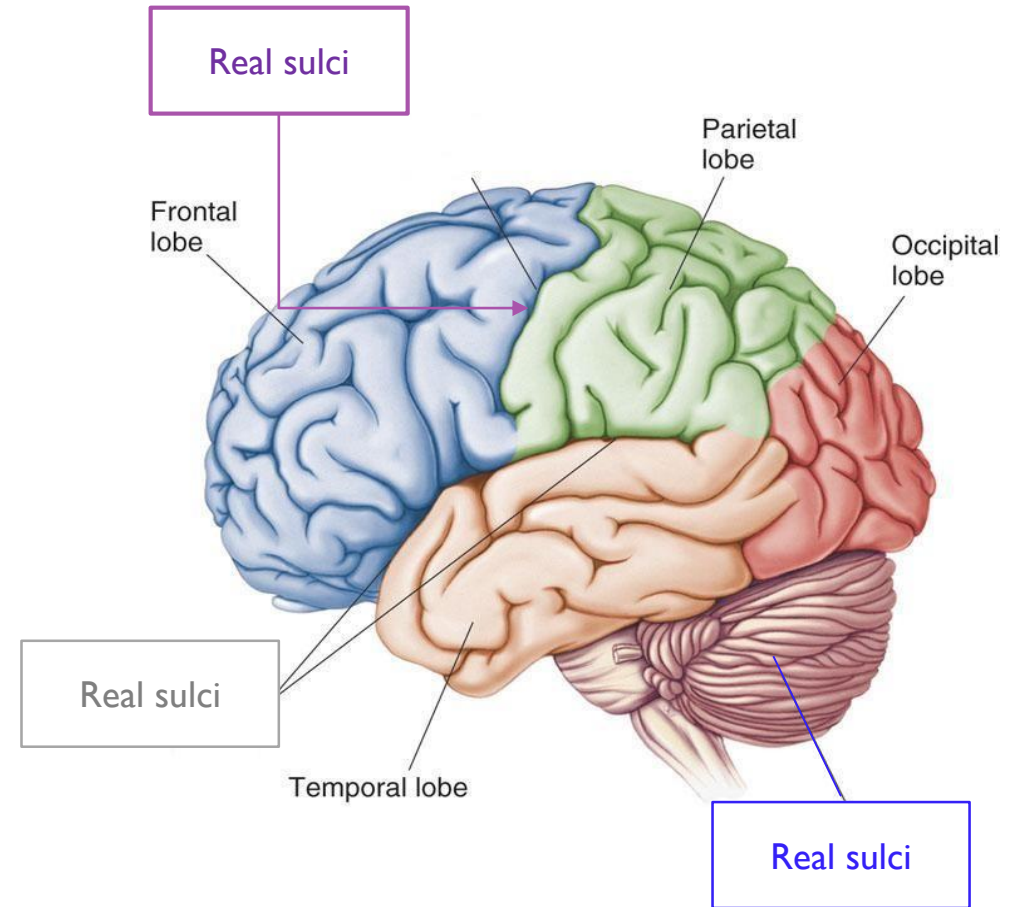
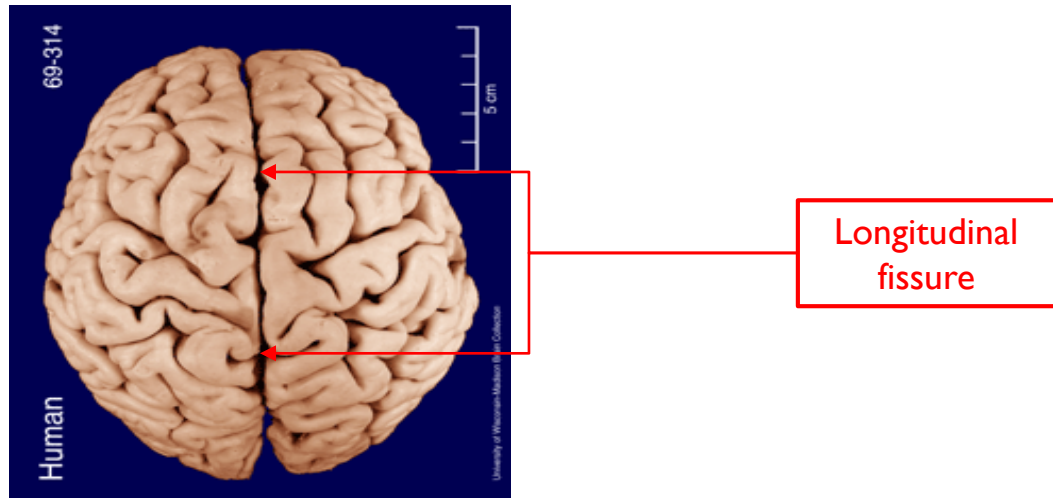
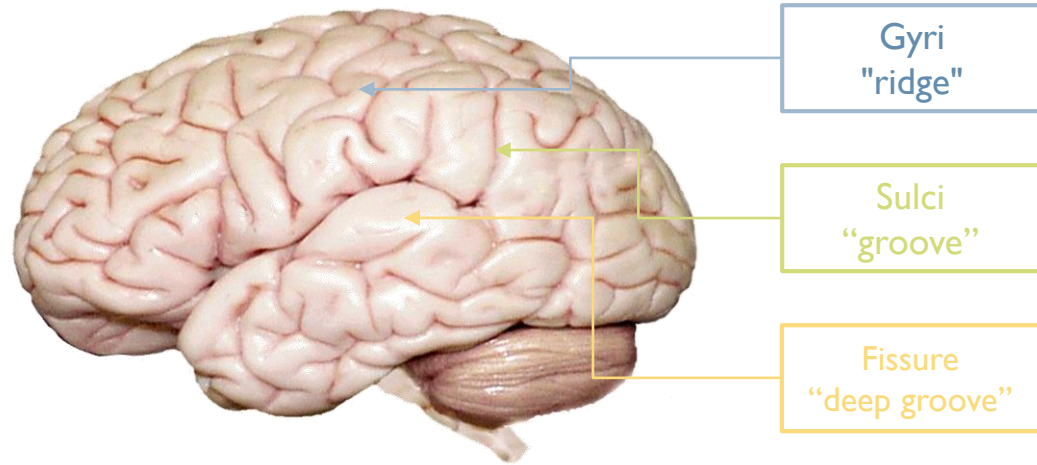
# Cerebral cortex

- ▶ Cerebral cortex is the outermost layer of gray matter making up the superficial aspect of the cerebrum.

| Cerebral features       |   |
|-------------------------|---|
| Gyri                    | Elevated ridges “winding” around the Brain.                         |
| Sulca                   | Small grooves dividing the gyri                                     |
| Central sulcus          | Divides the frontal lobe<br>From the parietal lobe                  |
| Fissures                | Deep grooves, generally dividing large regions / lobes of the brain |
| Longitudinal fissures   | 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       |



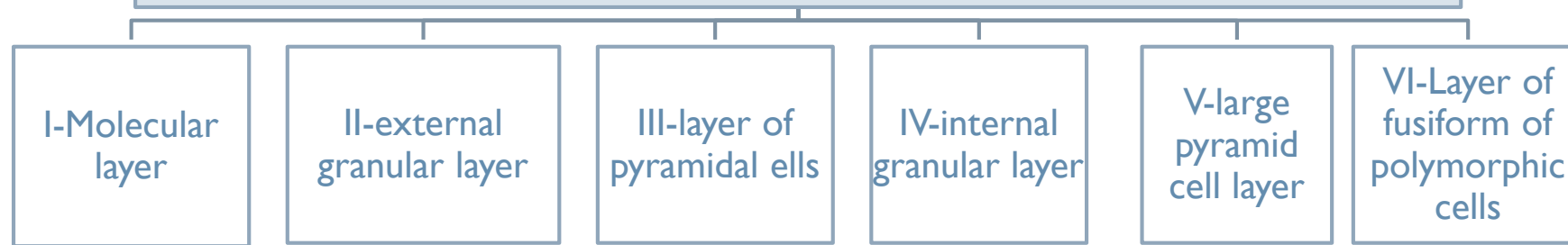
# Cont.



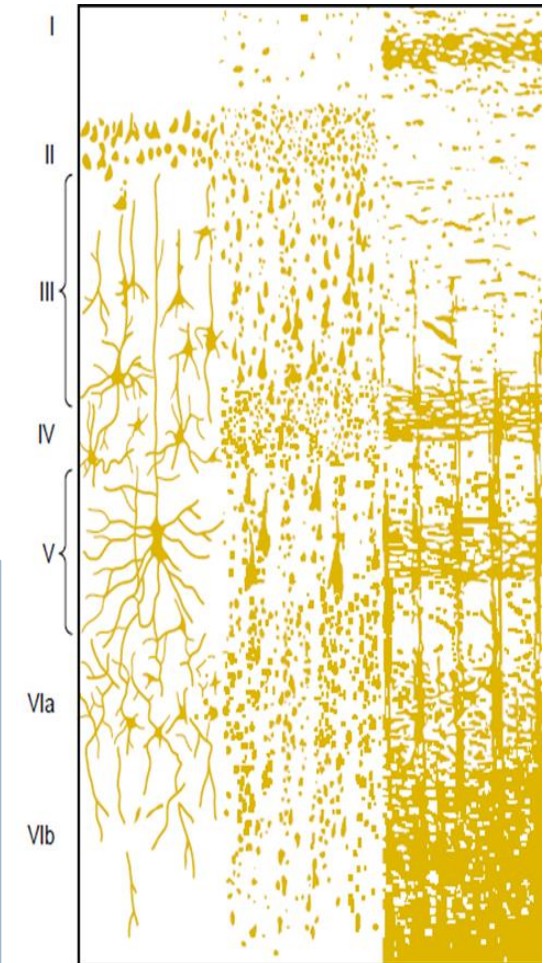


# Cerebral cortex layers

Microscopically the cortex consist of six layers or lamina parallel to the surface  
From outside to inside the layers are:



- The incoming sensory signal excites neuronal layer **IV** first; then the signal spreads toward the surface of the cortex and also toward deeper layers.
- Layers **I** and **II** & **III** perform most of intracortical association function.
- The neurons in layers **II** and **III** making short horizontal connections with adjacent cortical areas.
- The neurons in layers **V** and **VI** send output signals to brain stem ,spinal cord (**V**) & thalamus (**VI**)



# There are three type of functional area of cerebral cortex

## primary motor& sensory areas

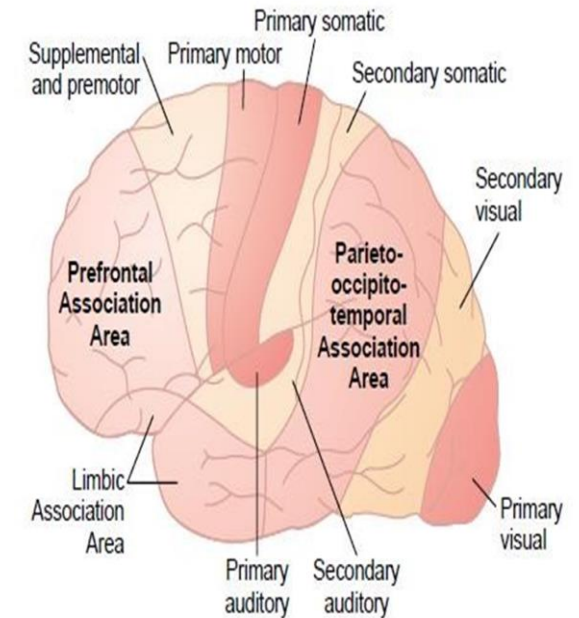
- **primary motor areas** have **direct connections with specific muscles** for causing discrete muscle movements.
- **primary sensory areas** detect specific sensation(visual, auditory,somatic) transmitted directly to the brain from peripheral sensory organs.

## Secondary areas

- **The secondary areas make sense out of the signals**
  - **in the primary areas.**

## Association area

- They receive and analyze signals simultaneously from multiple regions of both the motor and sensory cortices as well as from subcortical structures.
- The most important association areas are:
  - (1) Parieto-occipitotemporal association area.
  - (2) prefrontal association area.
  - (3) limbic association area.

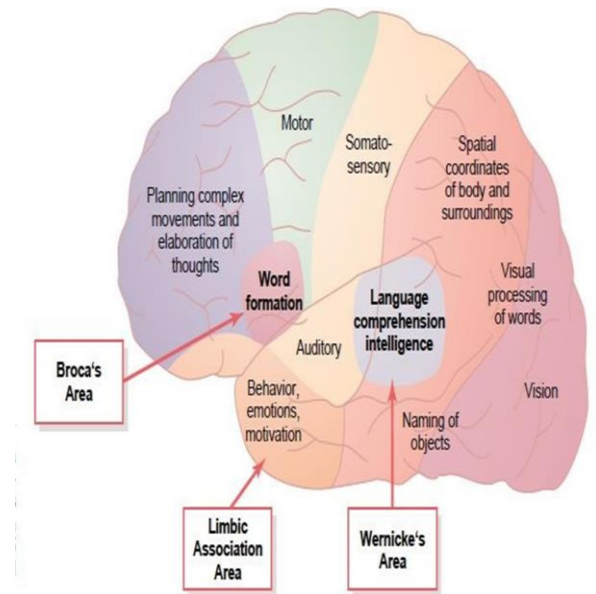


# (1) Parieto-occipitotemporal association area

► Functions:

- Analysis of the Spatial Coordinates of the Body.
- Language Comprehension.
- Initial Processing of Visual Language (Reading).
- Area for Naming Objects.

| Area  | Site  | Function  |
|---|---|---|
| Analysis of the spatial coordinates of the body.          | Beginning in the posterior parietal cortex and extending into the superior occipital cortex                               | Computes the coordinates of the visual, auditory, and body surroundings.                    |
| Area for language comprehension                           | Wernicke's area, lies behind the primary auditory cortex in the posterior part of the superior gyrus of the temporal lobe | Higher intellectual function  |
| Area for initial processing of visual language (reading). | Angular gyrus area  | Make meaning out of the visually perceived words (lesion causes dyslexia or word blindness) |
| Area for naming objects.                                  | Lateral portion of anterior occipital lobe & posterior temporal lobe  | Naming objects.   |



## Prefrontal area

▶ Is the anterior pole of frontal lobe. It contributes in the following functions:

1. Planning of complex pattern of movements.
2. Production of deep, more abstract and logically sequenced thoughts which enable attainment of goals.
3. Working memory (ability to tie thoughts together in a logical sequence by comparing many bits of information with appropriate stored knowledge and be able to instantly recall this information for future planning).

المنطقة هذي مسؤولة عن التفكير المعقد وإنشاء خطط وتنبؤات في المخ وإذا ما كانت سليمة قد يفقد المريض الوظيفة هذه

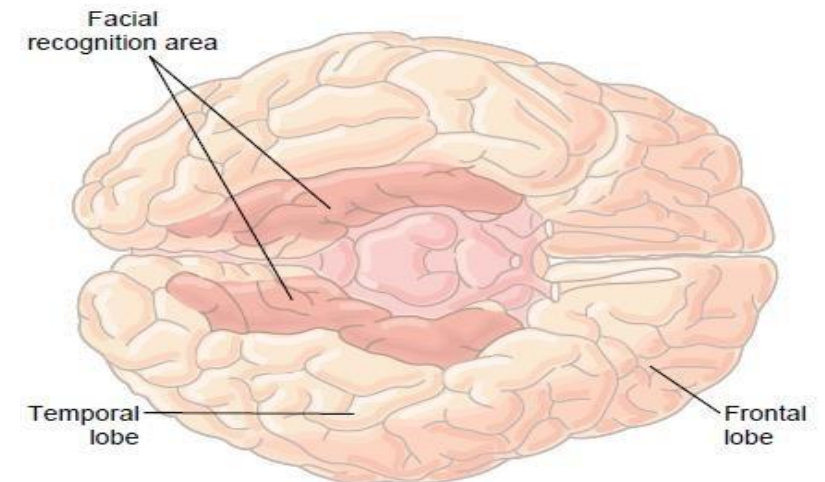
- ▶ Lesions in this area lead to change in personality and behaviour

## limbic area

1. Consists of anterior and inner portion of temporal lobe.
2. It is primarily concerned with emotion, behavior and motivational drive for different tasks most importantly learning.
3. Lesion of this area may lead to decreased aggression , lack of emotion , hyper sexuality & hyperphagia

## Area of faces recognition

1. Located on the underside of the brain on the medial occipital and temporal lobes.
2. The occipital portion is contiguous with visual cortex , while the temporal one is closely associated with limbic system.
3. inability to recognize faces is called “prosopagnosia”.



# Four lobes of the brain

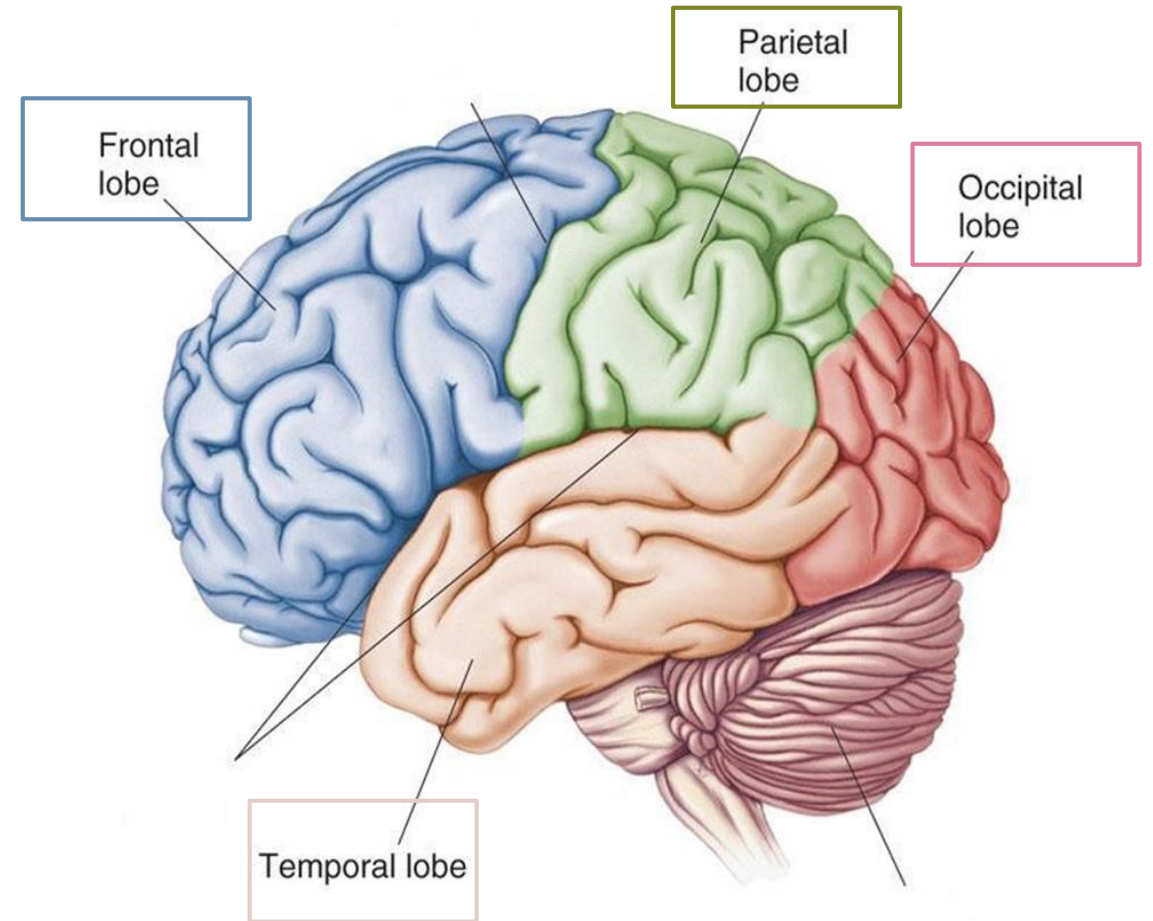
---

Frontal

Parietal

Temporal

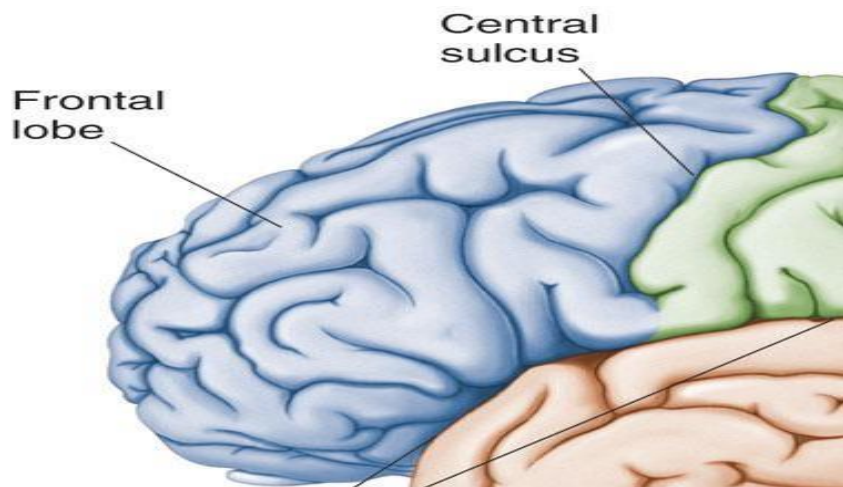
Occipital



\* Note: Occasionally, the Insula is considered the fifth lobe. It is located deep to the Temporal Lobe.

# Frontal lobe

- ▶ The Frontal Lobe of the brain is located deep to the Frontal Bone of the skull.
- ▶ It plays an integral role in the following functions:
  1. Memory Formation
  2. Emotions
  3. Decision Making
  4. Reasoning
  5. Personality



The frontal lobe is Responsible for initiation and execution of voluntary movement .

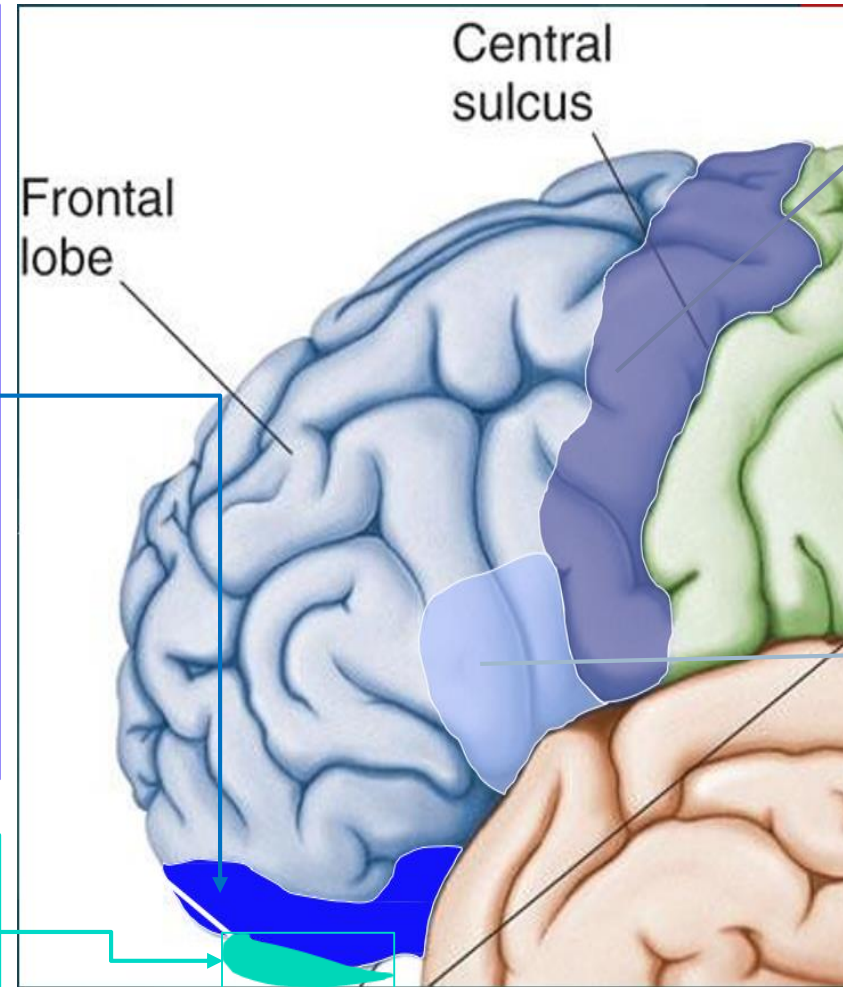
- Also contains Broca's area of speech in the dominant hemisphere ( i.e., in the left hemisphere in most people ) .
- Lesion can cause:
  1. paralysis on opposite side of the body.
  2. **Aphasia:** ( loss of ability to speak ) if lesion involves Broca's area in the dominant hemisphere.

# Frontal lobe (cortical region)

- 3-Orbitofrontal cortex :
- ✓ Site of frontal lobotomies.
- ✓ is a neurosurgical operation that involves severing connections in the brain's prefrontal lobe.
- ✓ Possible Side Effects:
  - A. Epilepsy
  - B. Poor Emotional Responses
  - C. Perseveration (Uncontrolled, repetitive actions, gestures, or words)
- ✓ Desired Effects:
  - A. Diminished Rage
  - B. Decreased Aggression
  - C. Poor Emotional responses

## 4-Olfactory Bulb :

- ✓ Cranial Nerve I, Responsible for sensation of Smell



## I. Primary motor cortex (precentral gyrus) :

- ✓ Cortical site involved with controlling body movement

## 2-Broca's area :

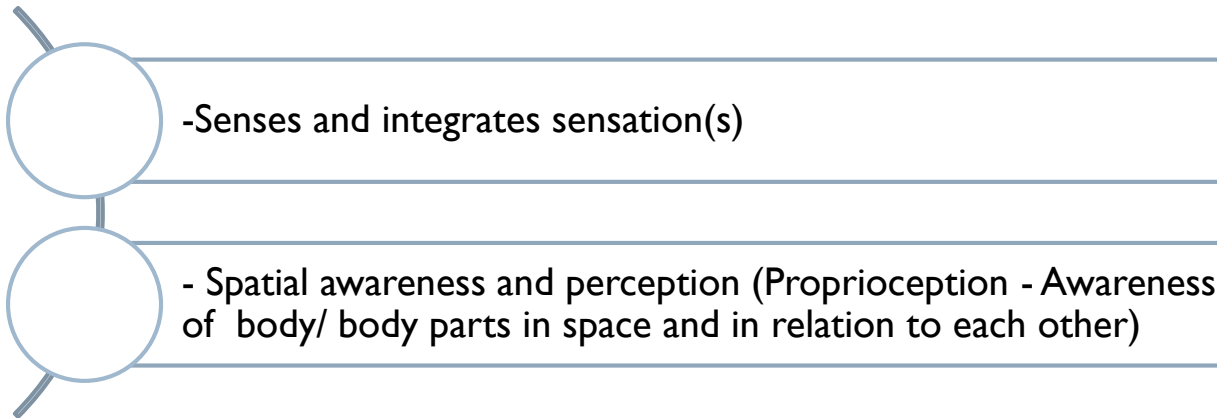
- ✓ plan of motor pattern for expressing of individual words, located on left frontal lobe (males)
- ✓ Controls facial neurons, speech, and language comprehension. (female)
- ✓ Located on Left Frontal Lobe.
- ✓ "Broca's Aphasia " : Results in the ability to comprehend speech, but the decreased motor ability (or inability) to speak and form words.

# Partial lobe

---

- ▶ The Parietal Lobe of the brain is located deep to the Parietal Bone of the skull.
- ▶ 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.

It plays a major role in the following functions/actions:



## ONLY IN FEMALES' SLIDES

Partial lobe Contains :

- (1) Primary Somatosensory cortex in the post-central gyrus: involve with processing of tactile and proprioceptive information
- (2) Sensory Association Cortex, for integration & association of sensory information



# Parietal lobe “cortical regions”

## Primary somatosensory cortex (postcentral gyrus)

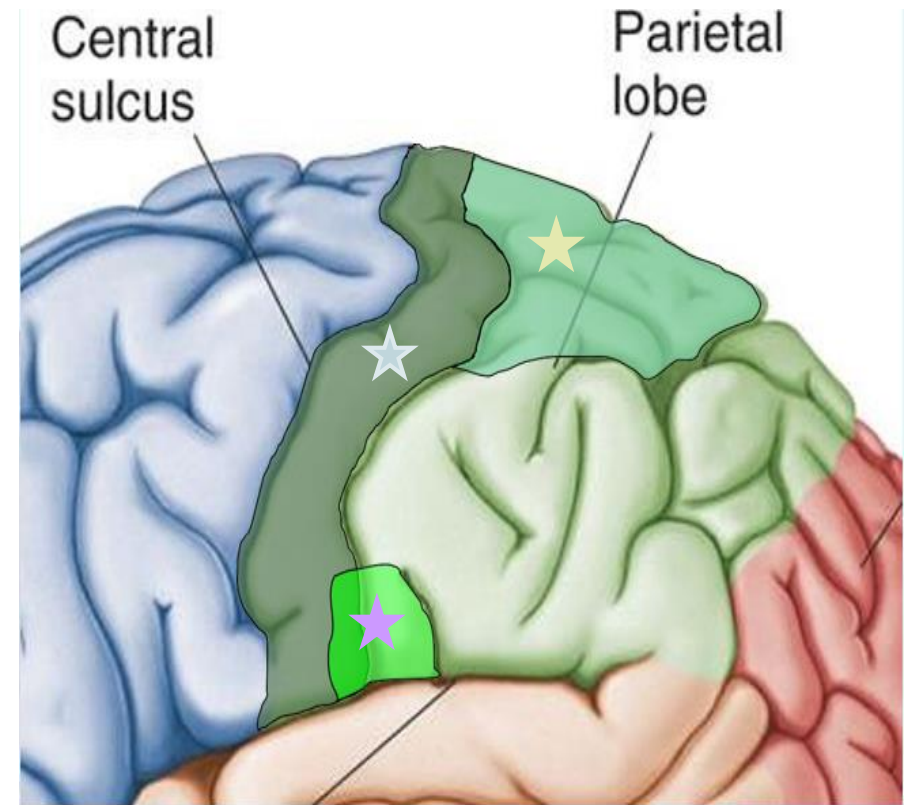
- Site involved with processing of tactile and proprioceptive information.

## 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.

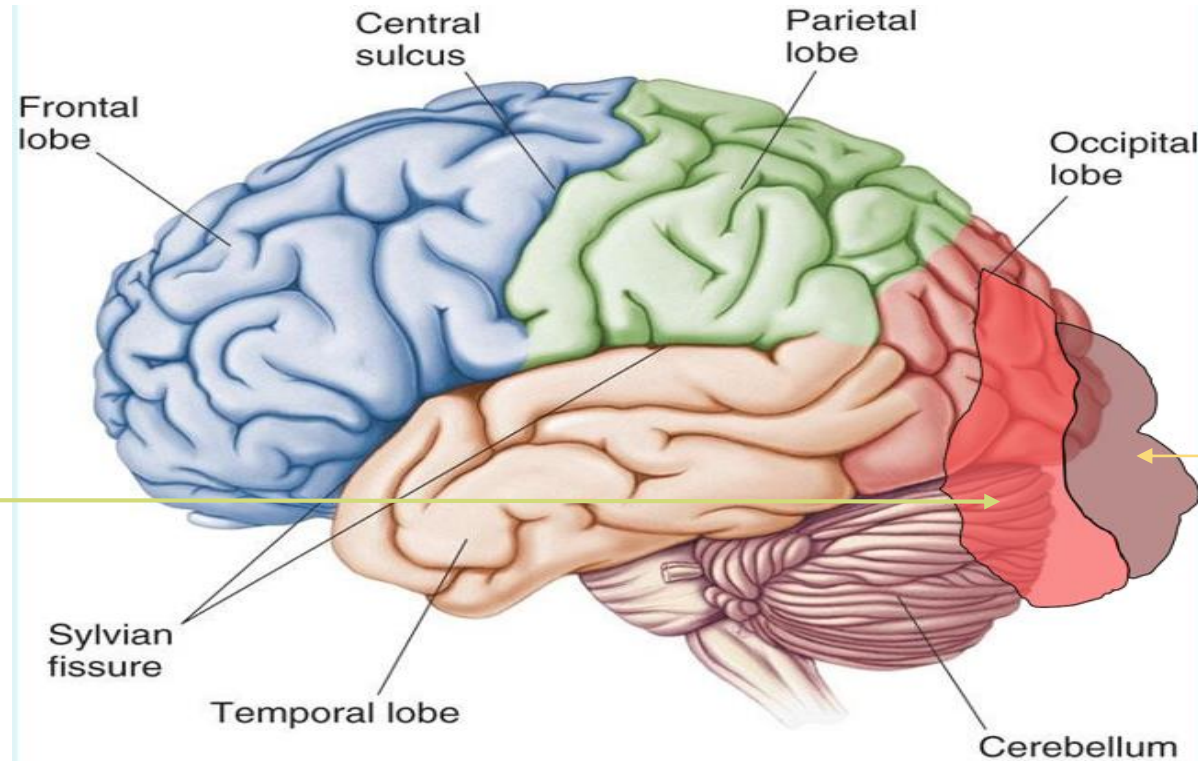
## Primary gustatory cortex

- Primary site involved with the interpretation of the sensation of Taste.



# Occipital lobe

- ▶ The Occipital Lobe of the Brain is located deep to the Occipital Bone of the Skull.
- ▶ Its primary function is the processing, integration, interpretation, etc. of VISION and visual stimuli.

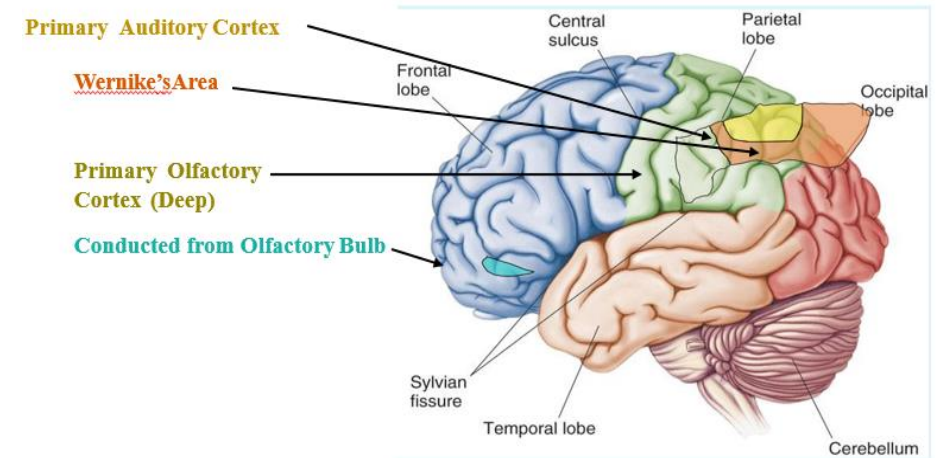


**Visual Association Area**  
Interprets information acquired through the primary visual cortex.

**Primary Visual Cortex**  
This is the primary area of the brain responsible for sight-recognition of size, color, light, motion, dimensions, etc.

# Temporal lobe

- The Temporal Lobes are located on the sides of the brain, deep to the Temporal Bones of the skull.
- They play an integral role in the following functions:
  - A. Hearing.
  - B. Organization/Comprehension of language
  - C. Information Retrieval (Memory and Memory Formation)



## Temporal lobe cortical regions

**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

The temporal lobe contains centres for hearing, taste, contribute to smell perception and essential for memory function.

**ONLY IN FEMALES' SLIDES**

# Cont.

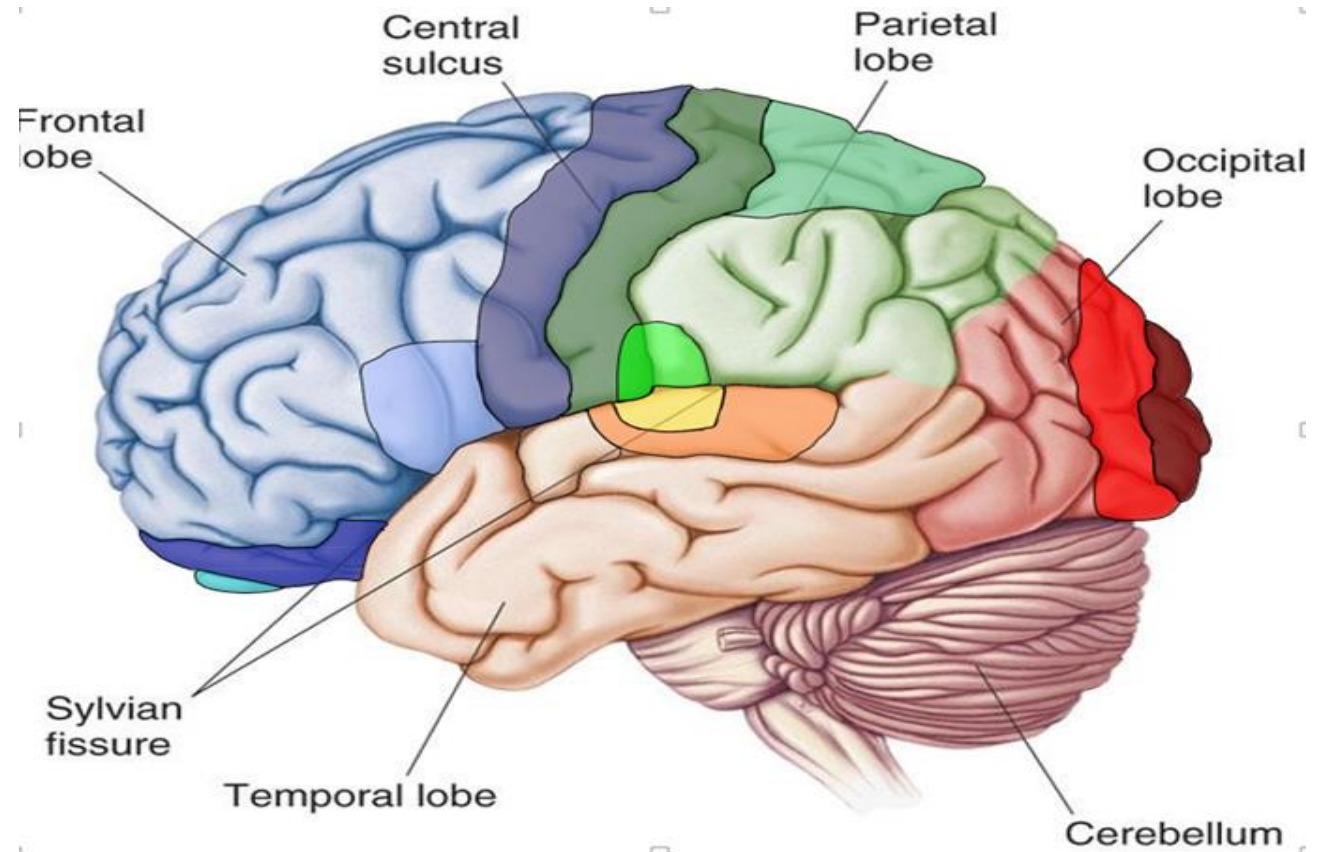
- ▶ Lesion in the temporal lobe cortical regions may lead to:

## 1. Wernicke's Aphasia :

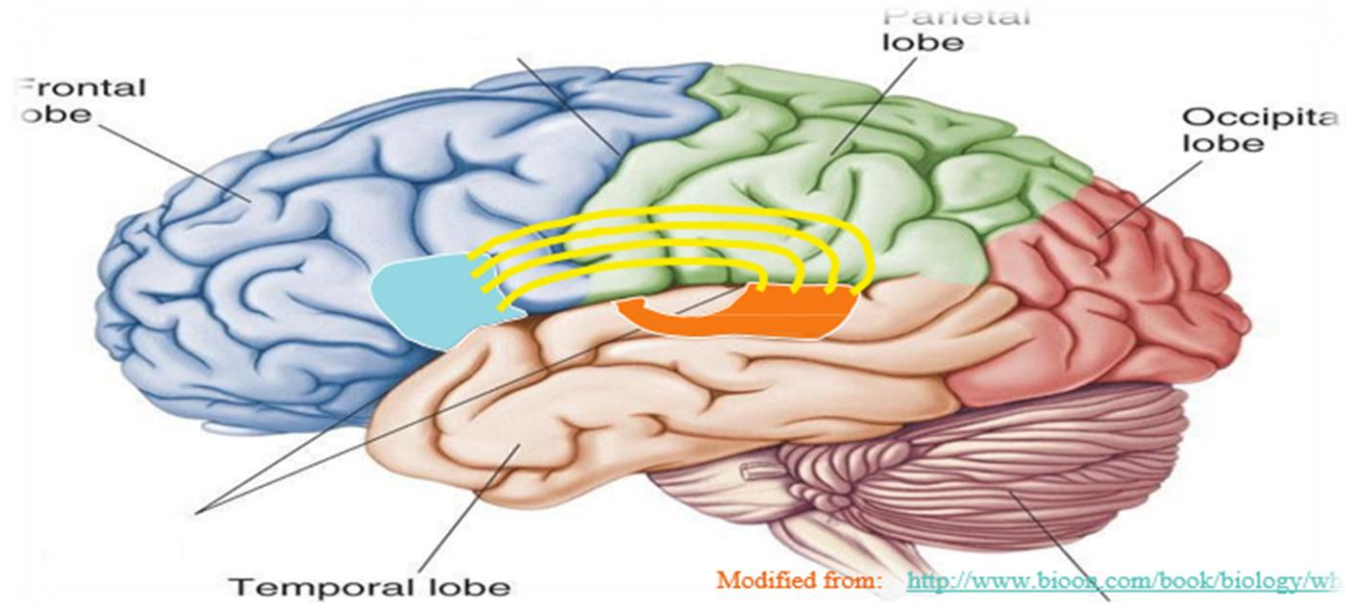
- ▶ Language comprehension is inhibited. Words and sentences are not clearly understood, and sentence formation may be inhibited or non-sensical.

## 2. Memory impairment:

- ▶ can be associated with temporal lobe epilepsy.



# Arcuate fasciculus



## 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 results in "conduction aphasia"

## Conduction Aphasia :

Where auditory comprehension and speech articulation are preserved, but people find it difficult to repeat heard speech.

# Functional principle of cerebral hemisphere

---

- ▶ Each cerebral hemisphere receives sensory information from, and sends motor commands to, the opposite side of body.
- ▶ The 2 hemispheres have somewhat different functions although their structures are alike.
- ▶ Correspondence between a specific function and a specific region of cerebral cortex is not precise.
- ▶ No functional area acts alone; conscious behavior involves the entire cortex.

## Higher level :prefrontal cortex

**ONLY IN FEMALES' SLIDES**

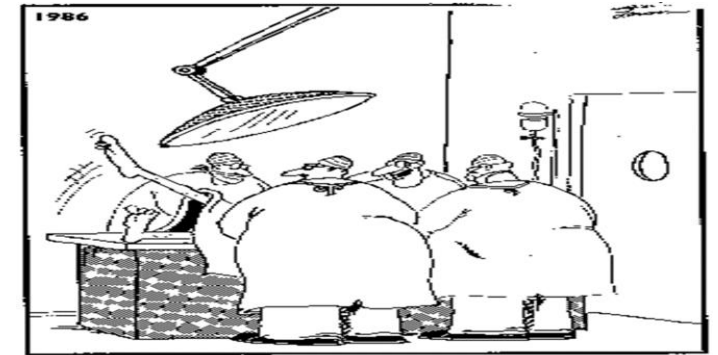
- Most complicated region, coordinates info from all other association areas.
- Important in intellect, planning, reasoning, mood, abstract ideas, judgement, conscience, and accurately predicting consequences.
- Phineas Gage.

# Dominant and non-dominant hemisphere (hemisphere lateralization )

- ▶ Functional differences between left and right hemispheres
- ▶ In most people, left hemisphere (dominant hemisphere) controls:
  - reading, writing, and math, decision-making, logic, speech and language (usually)
- ▶ Right cerebral hemisphere relates to:
  - recognition (faces, voice inflections), affect, visual/spatial reasoning, emotion, artistic skills.

- understanding & interpreting music,
- Non verbal visual Experience
- Spatial relation between the person & their surroundings
- Body language and intonation of peoples voices

ONLY IN  
MALES'  
SLIDES

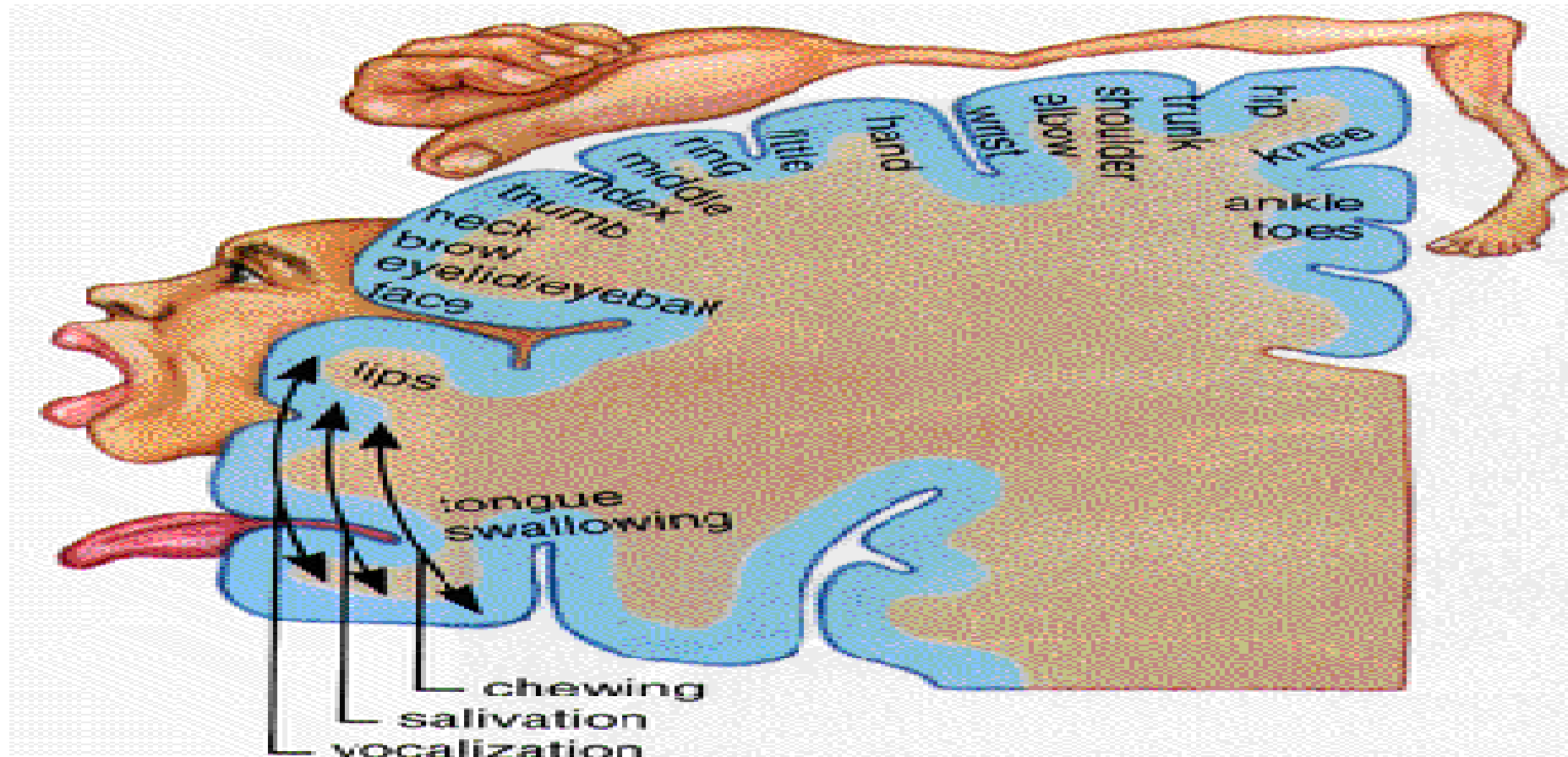


1986  
"Whoa! That was a good one! Try it, Hobbs—just poke his brain right where my finger is."

Q: Assuming this comical situation was factually accurate, what Cortical Region of the brain would these doctors be stimulating?

ONLY IN  
FEMALES'  
SLIDES

# Primary motor cortex



- ▶ This graphic representation of the regions of the primary motor cortex and primary sensory cortex is one example of a Homunculus.



# Doctors' notes

---

- ▶ Function of cerebral:
  - ▶ Frontal lobe: personality emotion memory, motor.
  - ▶ Initiation of voluntary movement, speech.
  - ▶ Lesion on frontal lobe eg. Stroke leads to half of body paralysis cant speak aphasia , personality change emotions.
  - ▶ Parietal lobe lesion loss of sensation somatic sensation vibration pain temperature , awareness of body parts proprioception of the opposite side.
  - ▶ Occipital lobe lesion, vision lost, Temporal lesion, hearing lost olfactory lost.
  - ▶ Difficulty comprehensive of speech.
  - ▶ Each cerebral hemisphere receive information from the opposite side.

# Thank you!

اعمل لترسم بسمة، اعمل لتمسح دمة، اعمل و أنت تعلم أن الله لا يضيع أجر من أحسن عملا.

## The Physiology 436 Team:

Females Members:

Haifa Alwael

Allulu Alsulayhim

Jawaher Alkhayyal

Males Members:

Mohammad almutlaq

Faisal Alfawaz

## Team Leaders:

Lulwah Alshiha

Laila Mathkour

Mohammad Alayed

## Contact us:



QUIZ



اقتراحات وشكاوي

## References:

- Females' and Males' slides.
- Guyton and Hall Textbook of Medical Physiology (Thirteenth Edition.)