

# Cerebral Function

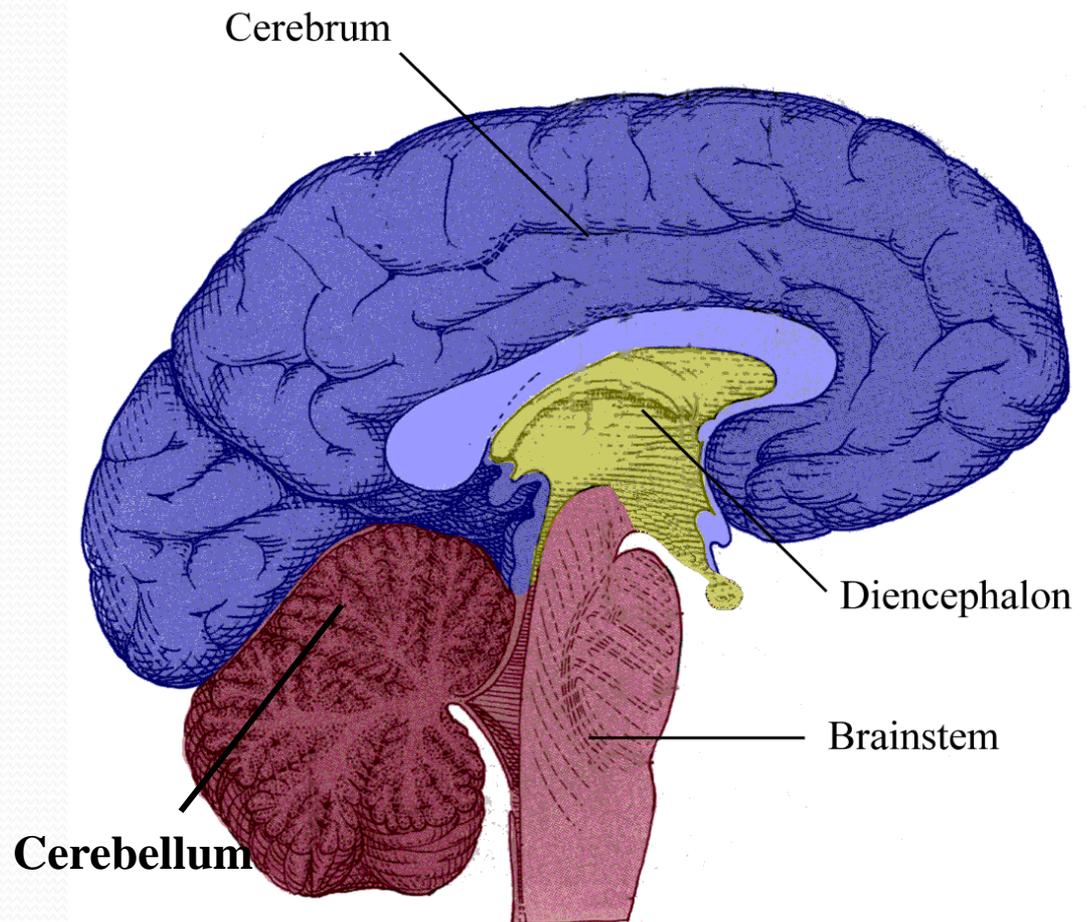
Done By:

**Asma Bedaiwi**  
**Nujud Al-Hejin**



# Brain Regions

1. Cerebrum
2. Diencephalon
3. Brainstem
4. Cerebellum



# MENINGES

## 1. DURA MATER

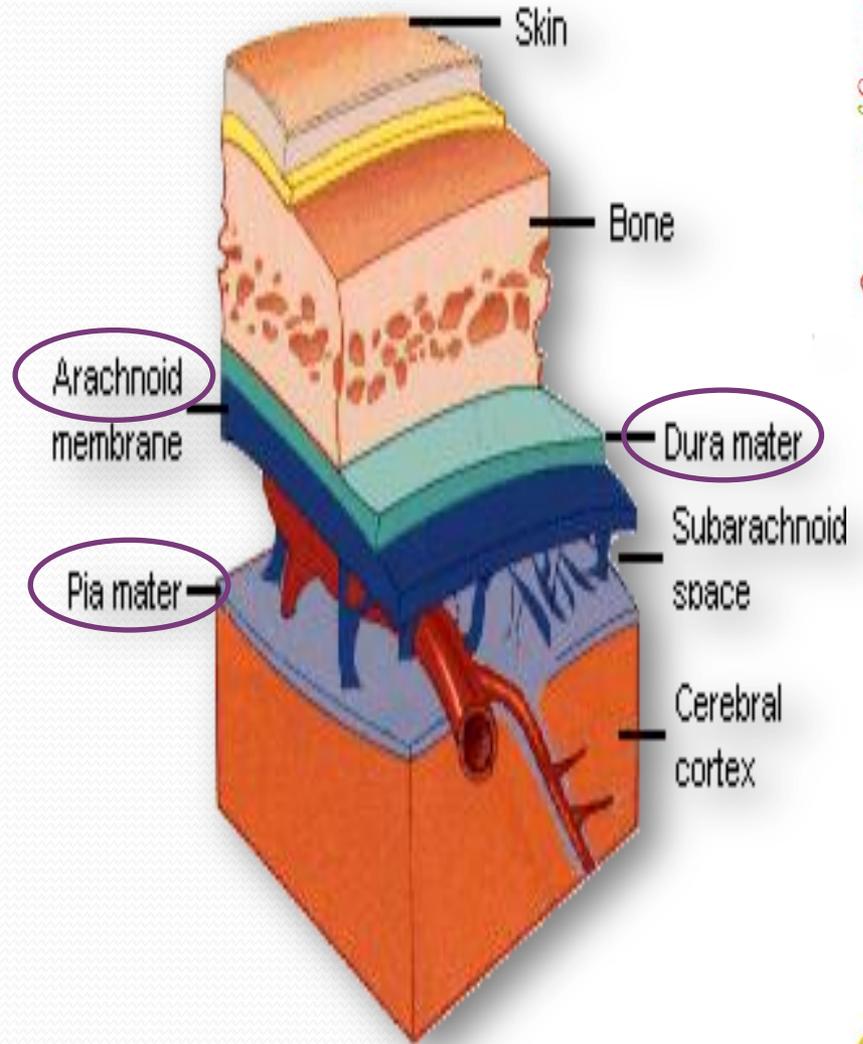
Outer covering

## 1. ARACHNOID MATER

Middle covering

## 1. PIA MATER

Inner most covering



# Cerebrum (cerebral cortex)

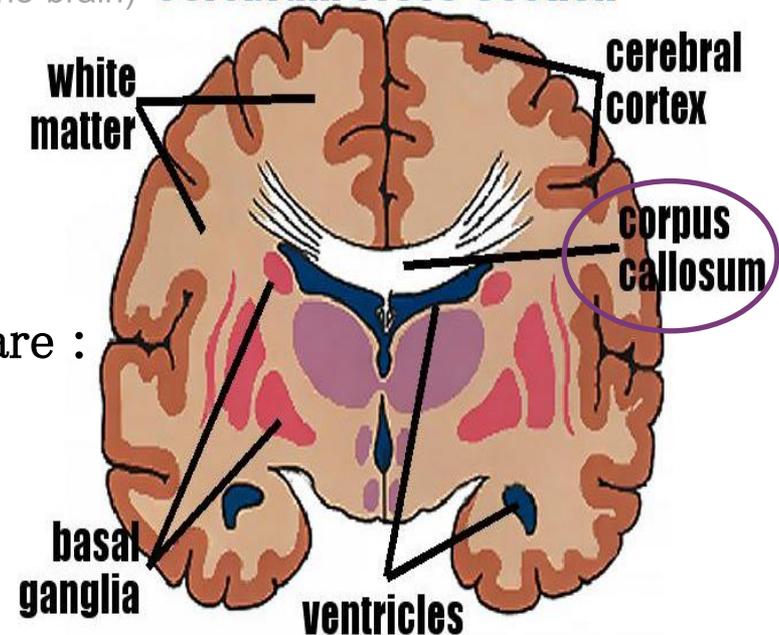
The largest, portion of the brain.

- It is composed of 2 hemispheres connected by the corpus callosum (the largest commissure of the brain)

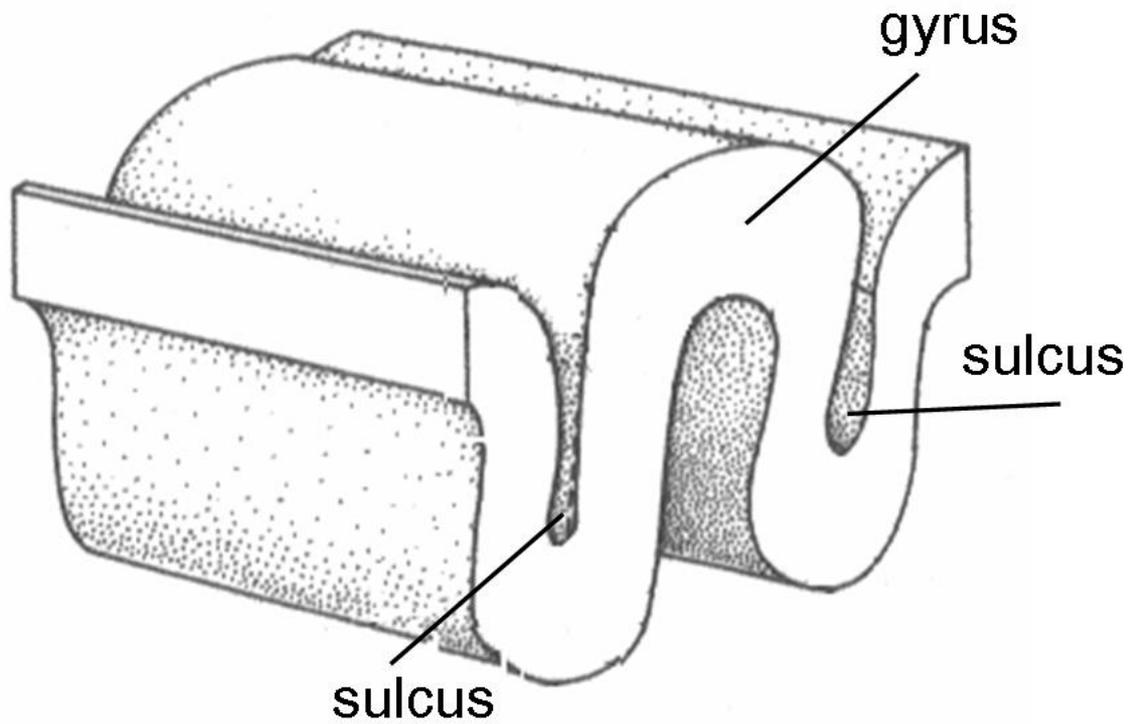
- The outer cortex is gray matter
- The interior cortex is **white matter**, except for a few small portions, which are :

- ❖ The basal nuclei islands of gray matter foun within the white matter

## Cerebrum Cross-Section



The surface is marked by ridges called **gyri** separated by grooves called **sulci**.



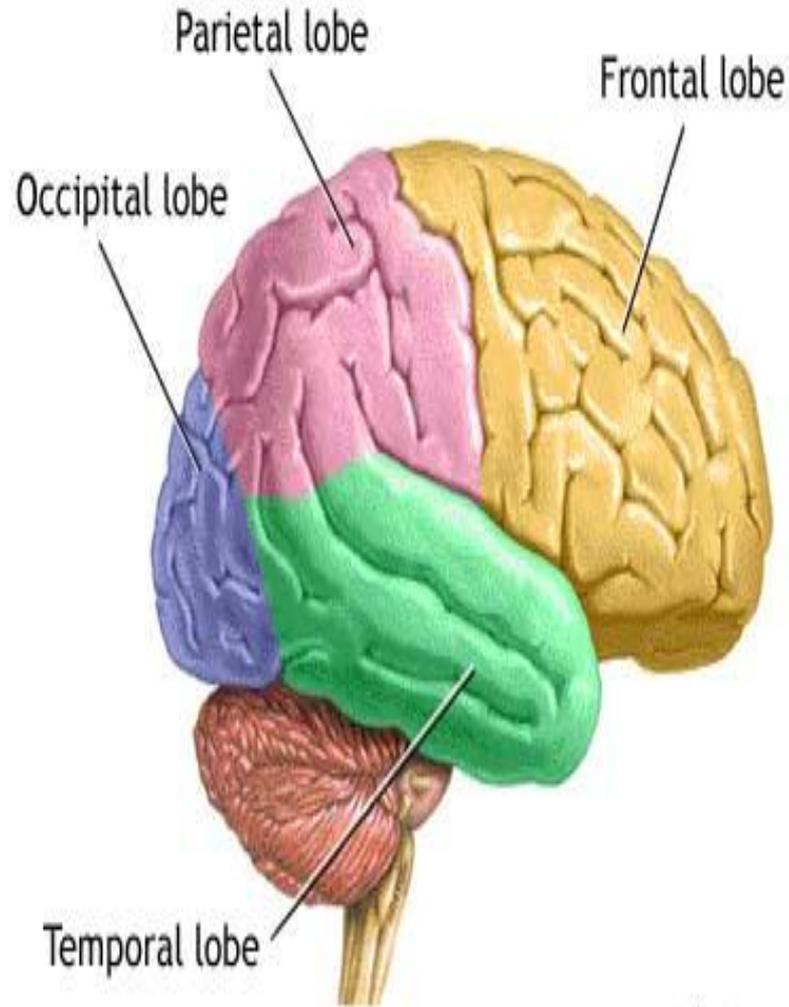
# Cerebrum lobes

1-frontal lobe

2- Parietal lobe

3- Temporal lobe

4- Occipital lobe



# Brain lobes

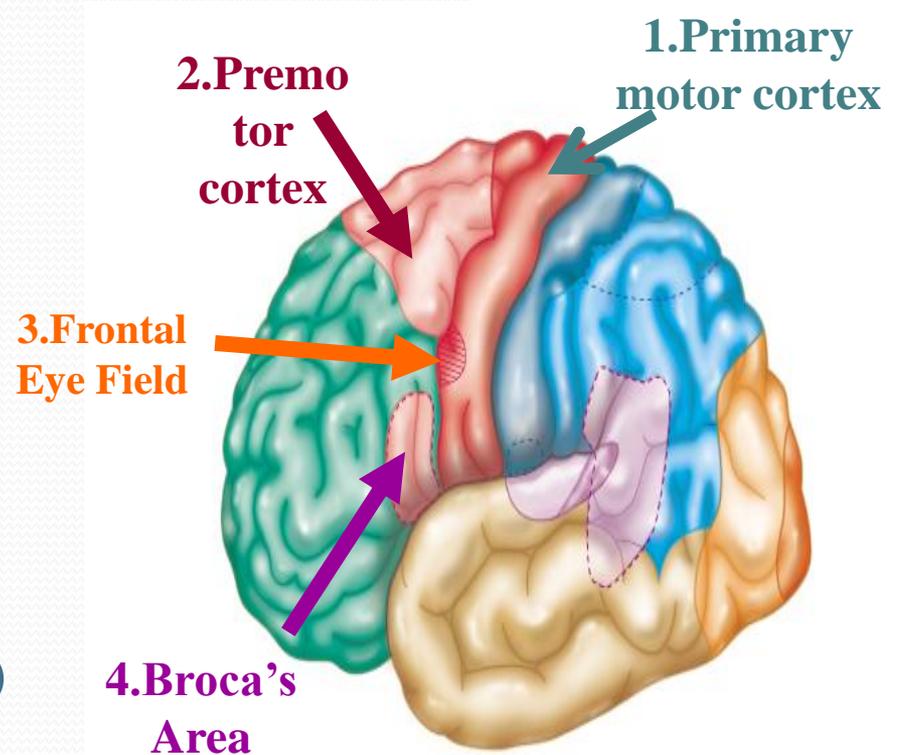
## 1-Frontal lobe :

*Centre of cortical motor areas :*

1. Motor cortex which includes:
  - A- Primary motor cortex (m1)
  - B- Supplementary motor area
  - C- Premotor area

### 2. Frontal Eye Field Area

### 3. Broca's Area for speech



- **NOTE :**

Regarding the motor area:

\* All the three (Primary motor cortex (m1) + Supplementary motor area + Premotor area) projects *directly* to the spinal cord via **corticospinal** tract.

\* Premotor and supplementary motor cortex also project to *primary motor cortex* and is involved in **coordinating & planning complex sequences of movement** (motor learning).

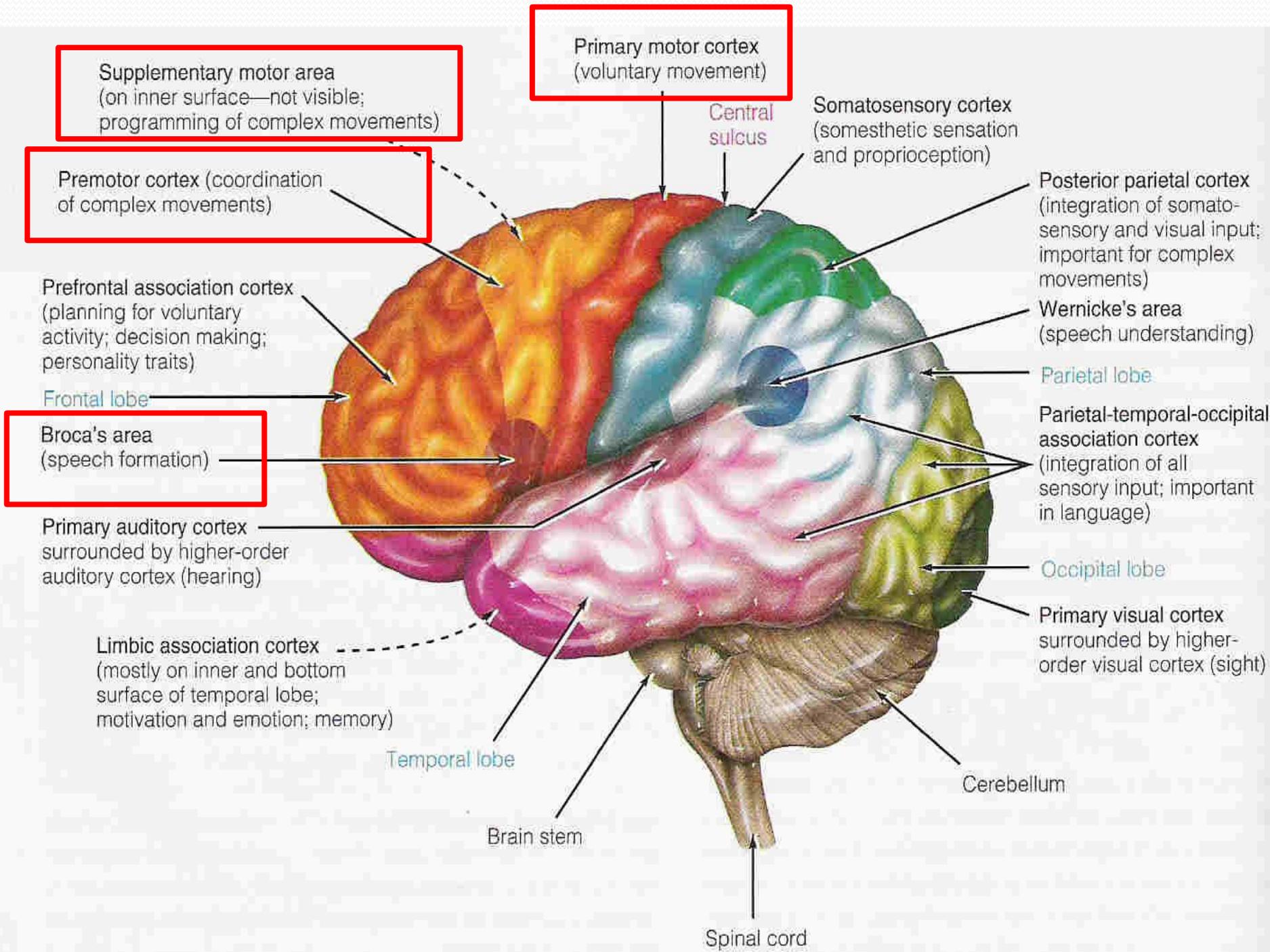


# Frontal lobe (cont):

## ❖ Functions:

- High intellectual functions [*center of thinking*]
- problem solving
- Intelligence
- decision
- Making verbal communication
- Speaking ability.
- Elaboration of thoughts.





Supplementary motor area  
(on inner surface—not visible;  
programming of complex movements)

Primary motor cortex  
(voluntary movement)

Central sulcus

Somatosensory cortex  
(somesthetic sensation  
and proprioception)

Premotor cortex (coordination  
of complex movements)

Posterior parietal cortex  
(integration of somato-  
sensory and visual input;  
important for complex  
movements)

Prefrontal association cortex  
(planning for voluntary  
activity; decision making;  
personality traits)

Wernicke's area  
(speech understanding)

Frontal lobe

Parietal lobe

Broca's area  
(speech formation)

Parietal-temporal-occipital  
association cortex  
(integration of all  
sensory input; important  
in language)

Primary auditory cortex  
surrounded by higher-order  
auditory cortex (hearing)

Occipital lobe

Limbic association cortex  
(mostly on inner and bottom  
surface of temporal lobe;  
motivation and emotion; memory)

Primary visual cortex  
surrounded by higher-  
order visual cortex (sight)

Temporal lobe

Cerebellum

Brain stem

Spinal cord

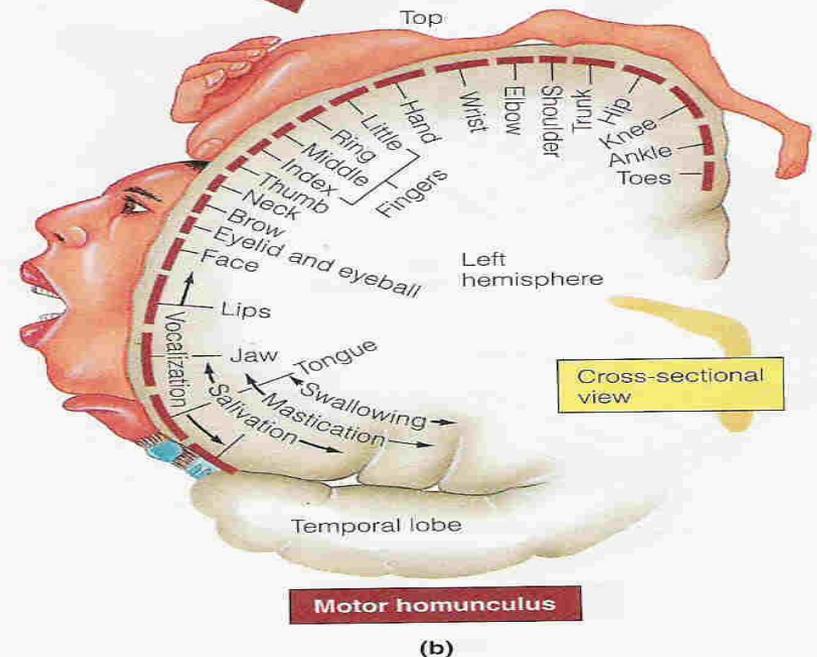
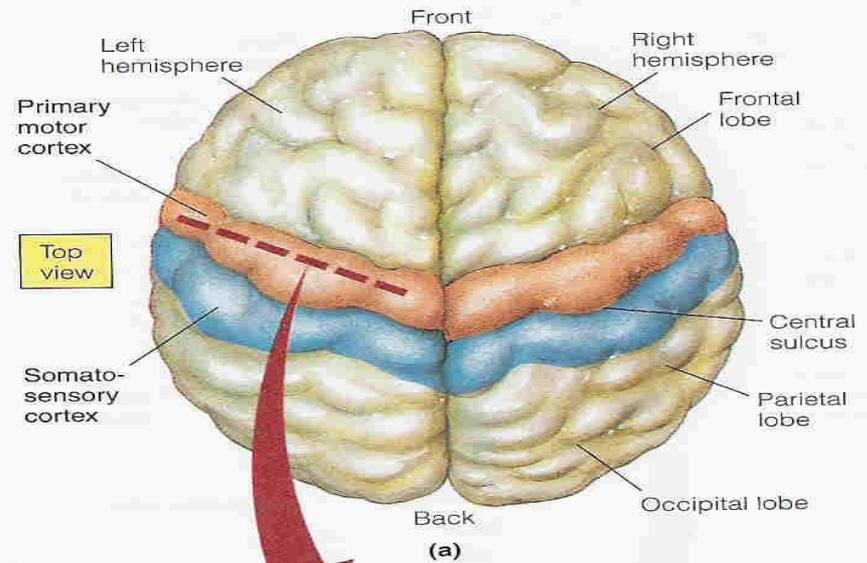
## • A-Primary Motor Cortex:

### \* Site & location:

Contains large neurons:  
pyramidal cells called **Betz cells**

Immediately anterior to the central sulcus (**precentral gyrus**)

Extends to the medial surface of hemisphere also known as **Broadmann's area 4** [is a motor homunculus]



## Primary Motor Cortex (cont):

### **Body presentation** ( on the surface of the primary motor cortex )

- 1- inverted ( upside down) & stretched in the medial surface (pelvic+ leg muscles presenting area)
- 2-face represented bilaterally , but rest of body unilateral
- 3- crossed ( control the musculature of the opposite side of the body)
- 4-area of presentation is proportionate to skill of this part  
(lips , tongue, thumb , hands have large area because of frequently use (skill))
- 5- axial & proximal parts of limbs at anterior edge of precentral gyrus & distal parts at posterior edge



## Primary Motor Cortex (cont):

### Functions:-

- 1- fine skilled movements
- 2- direction, force and velocity of movements
- 3- muscle tone

### Lesions: [ pure m1 lesions are rare ]

- contralateral weakness in fingers (paresis)
- loss of ability to control fine movements
- hypotonia ( Lesion of m1 alone cause **hypotonia** not spasticity)

**30% of corticospinal tract is from the primary motor area.**

[project pathways are known as the corticospinal tracts or pyramidal tracts to AHC s of SC]

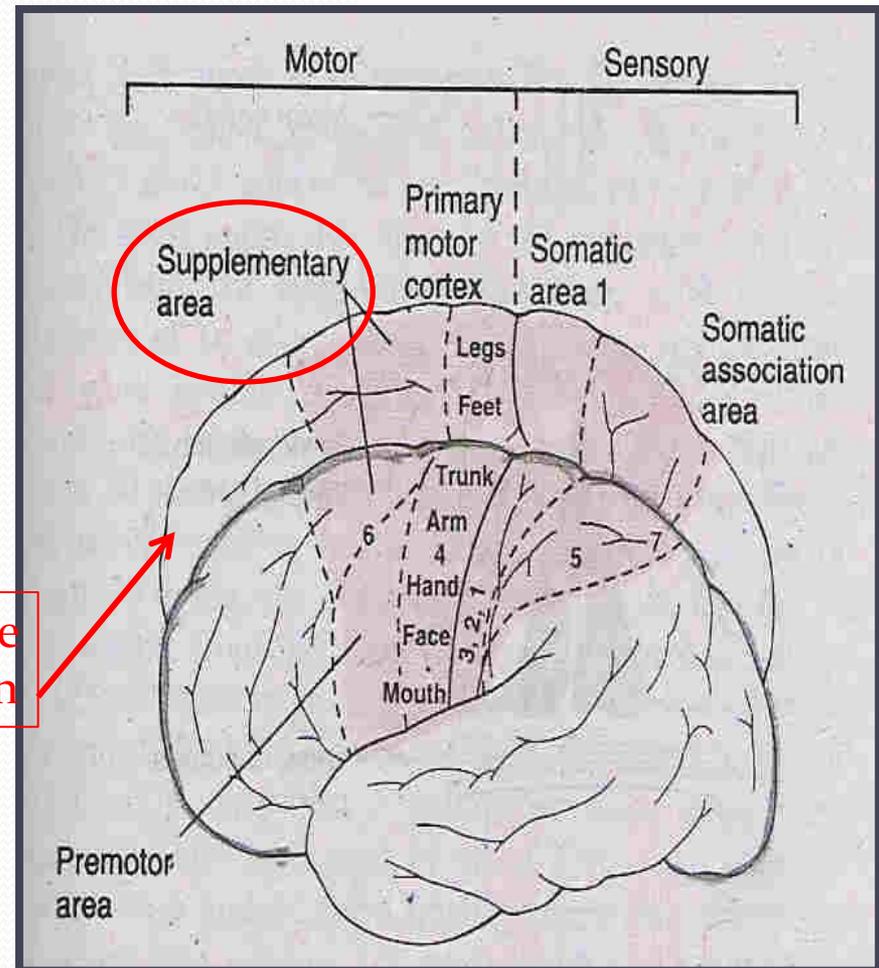
## • B- Supplementary motor area (M-II):

\* Site & Location:

Found on both lateral and medial aspect of the frontal lobe.

It extends from **cingulate sulcus** on the medial side to reach premotor cortex on the lateral surface of the brain.

Medial side of the brain



## Supplementary motor area (cont):

- **Functions:** [It works together with premotor cortex ]

1-programming & planning of motor sequences

2-Bilateral coordination for movements that requires both hands.

3-mental rehearsal of movements before performing a complex motor functions.

- \***With premotor cortex area 6 :**

- 1-it translates the desire to perform a motor task into a series of motor command that will do the task (MENTAL LEARNING).

- 2-give 30% origin to corticospinal & corticobulbar tracts

- **Lesions:**

Produces weakness in performing complex activity like bilateral coordinated activity .



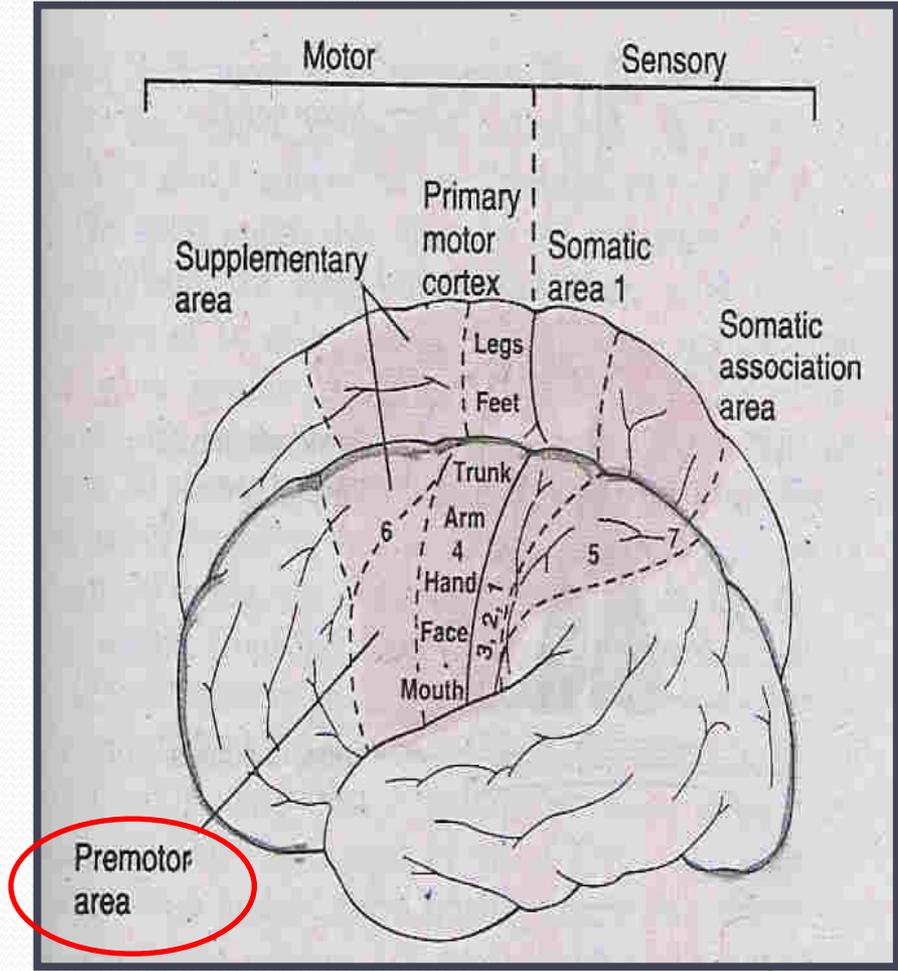
• C-Premotor cortex [motor association area]

\*site & Location:

Broadmann's area 6.

It lies immediately anterior to primary motor cortex (area 4) on the lateral surface of frontal lobe .

It is more extensive than primary motor cortex (about 6 times)



## Premotor Cortex (cont):

### • Functions:

[It works with the help of basal ganglia, thalamus, primary motor cortex, posterior parietal cortex ]

- 1- set posture at start of planned movements
- 2- getting ready to perform movements
- 3- motor learning
- 5- control gross subconscious movements

**\*Together with supplementary motor area :**  
give 30% origin to corticospinal & corticobulbar tracts

### • Lesion:

When damaged with supplementary cortex it may result in APRAXIA ( no paralysis but only **slowing** of movement )



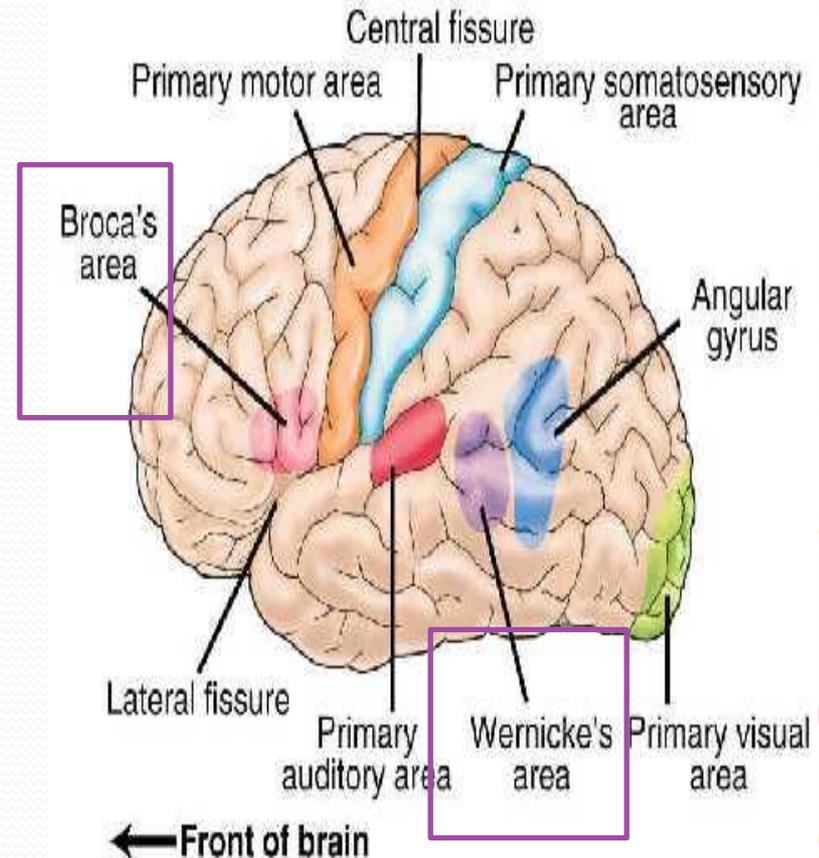
# Broca's Area [Motor area of speech ]

Found in only one hemisphere  
(often the left)

Present in **frontal lobe**  
(inferior frontal gyrus in its posterior part)

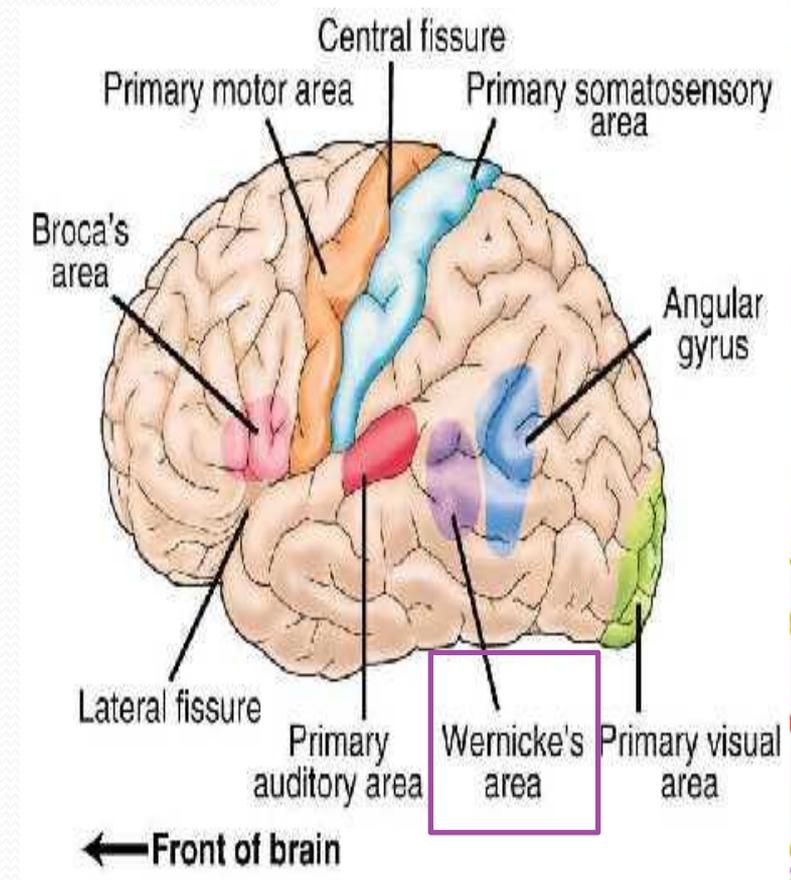
## • **Function :**

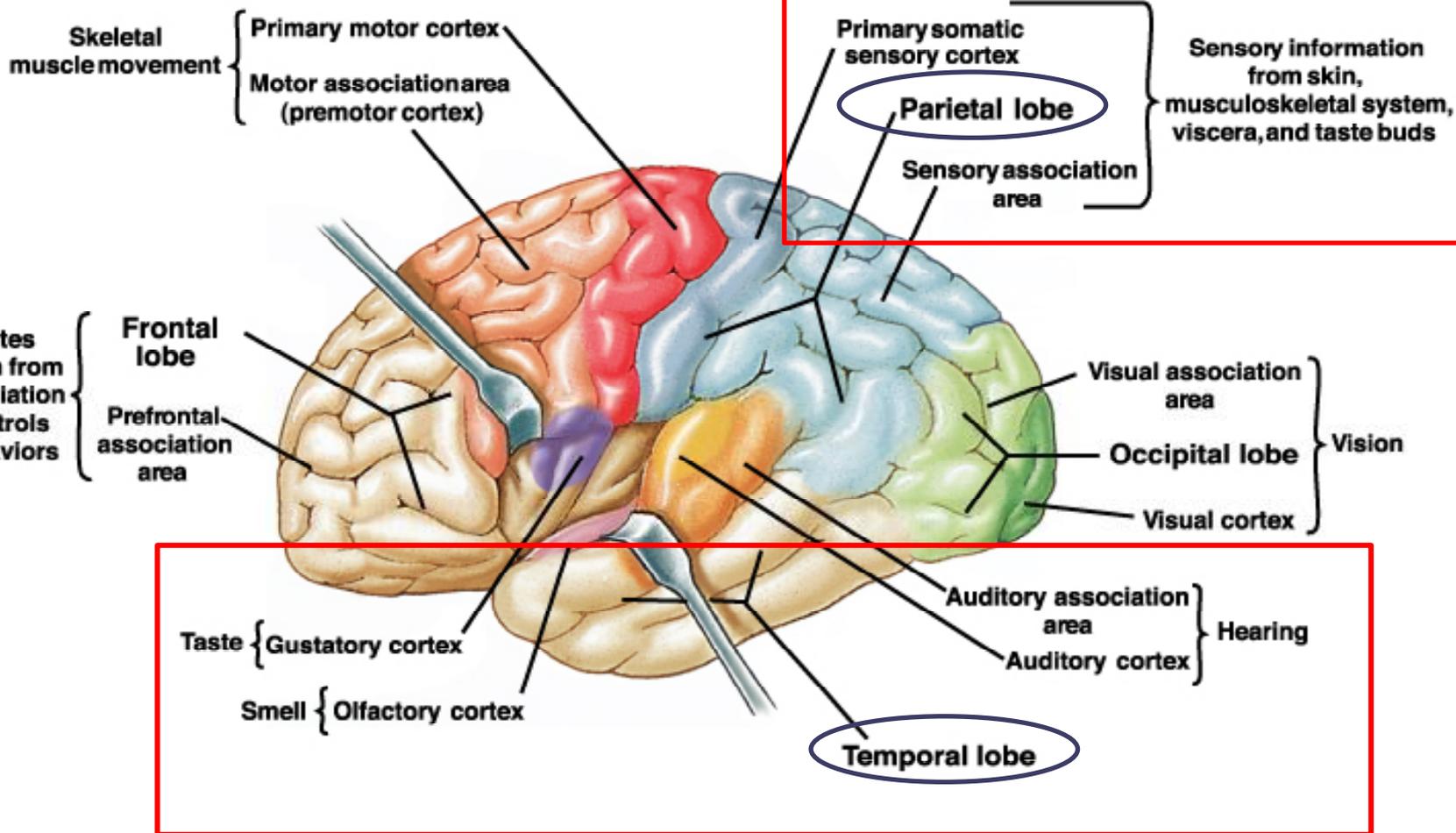
- Directs muscles of tongue, lips and throat that are used in speech production.



# Wernicke's Area [ Sensory area of speech ]

- Sensory component of speech essential for **comprehension**.
- Present in the superior temporal gyrus.





## 2- Parietal lobe:

1- Somatosensory area for cutaneous and muscular sensations : [receiving sensory input such as touch, pressure, heat, cold, and pain from the surface of the body ]

2- Interpreting texture and shapes

3- perceives awareness of the body position [a process called proprioception ]

4-It contains Areas of speech for formulation of words and understanding of speech



## 3- The temporal lobe:

- \*Contains auditory centers that receive information from the cochlea of each ear.
- \*Involved in interpretation of auditory stimuli .
- \*storage of auditory & visual experiences

It contains The insula.



The insula: [deep inside temporal lobe ]

The insula is known to be activated by **unpleasant tastes**, so perhaps this response evolved into activation of the area by faces showing disgust.

\* Function?

**Recognizing disgust**

\* Lesion : [patient who has a selective lesion of left insula and putamen]

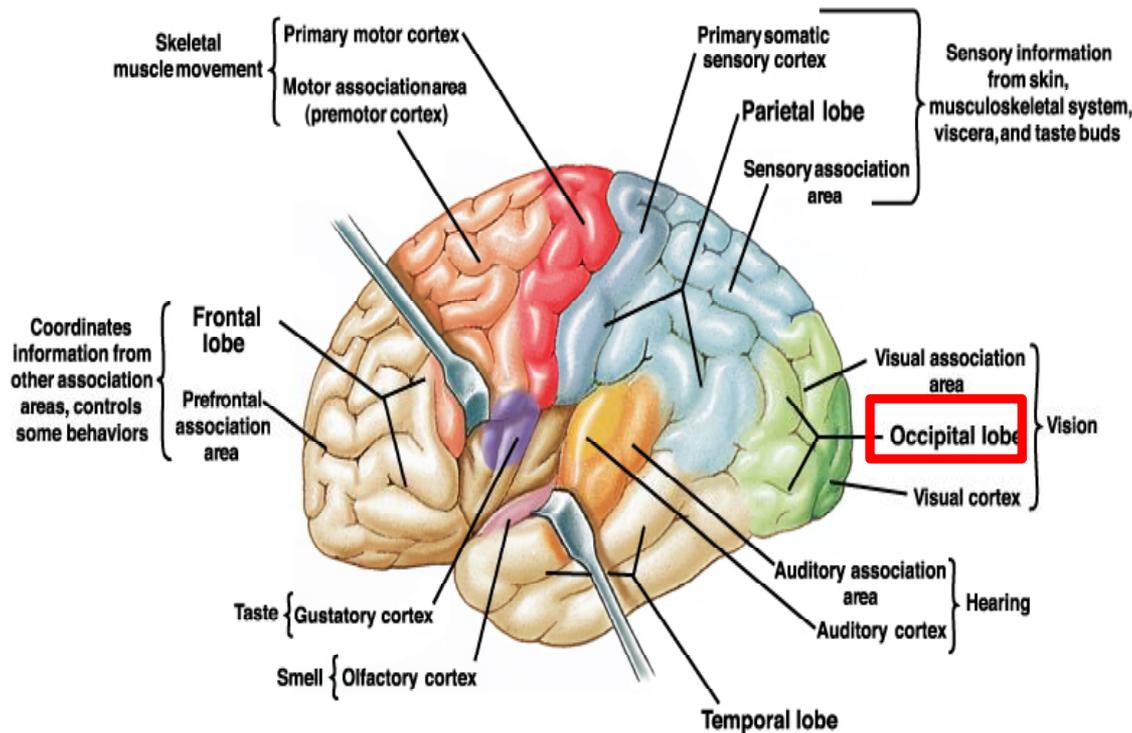
It's difficult to recognize disgust on the faces or the voices of people the patient met but other emotions are recognized easily.

**Huntington's disease** have similar symptoms and damage in the same area.



## 4-The occipital lobe:

Is the primary area responsible for **conscious perception** of vision and for coordination of eye movements.





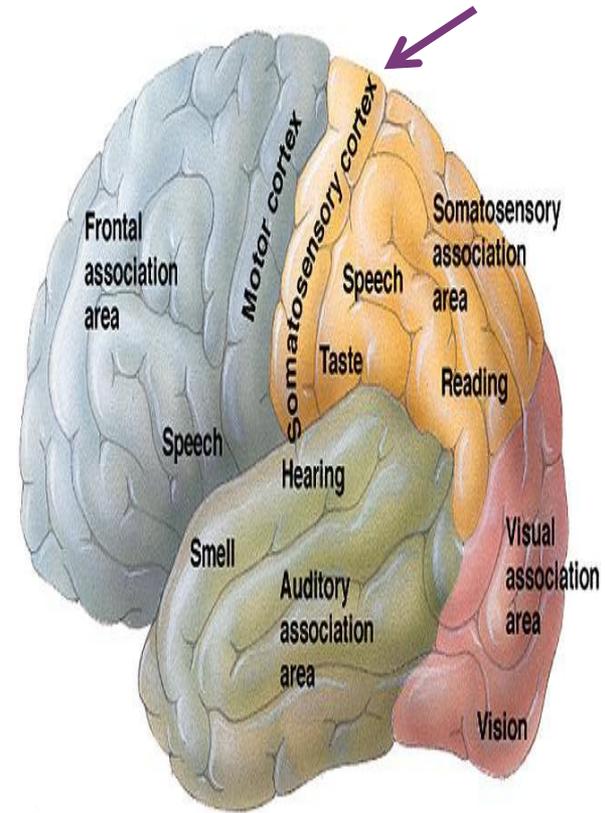
# Sensory Areas

- Found in the **parietal**, **occipital**, and **temporal** lobes.
  1. Primary somatosensory cortex
  2. Somatosensory association cortex
  3. Visual areas
  4. Auditory areas
  5. Olfactory cortex
  6. Gustatory cortex
  7. Vestibular cortex



## ❖ Primary Somatosensory Cortex (AREA I-Primary)

- Found in the **postcentral** gyrus in the **parietal** lobe (bowman's area 1,2,3)
- Receives sensory information from Contralateral side of body except face is bilaterally represented in both sides
- **Body presentation :** represented with legs on top and the head at the lower part of the gyrus.



- Functions :

1- somatosensory area for cutaneous and muscular sensations

[receiving sensory input such as touch, pressure, heat, cold, and pain from the surface of the body ]

2-Interpreting texture and shapes.

3-Perceives awareness of the body position [proprioception ].

4-discrimination of weights, stereognosis.

5-localization of site of stimulation & 2 points discrimination



## Representation of the body in it:

1- The body is represented in an *upside down* (inverted)

2- *The area of representation depend* on the number (density) of *receptors* and on the complexity of the sensation .

lips, face & hands specially thumbs → wide area of representations .

trunk & legs → small area of representations .

3- Cortex is made up of **six** layers. The incoming sensory signal excites neuronal **layer IV** first and then the signal spreads both towards the surface of the cortex and towards the deeper layer.

4- Functionally the neurons of the somatosensory cortex are arranged in vertical columns, Each of these columns serves a single specific sensory modality.

5- Receives sensory information exclusively from the opposite side of the body.



# ❖ Somatosensory Cortex

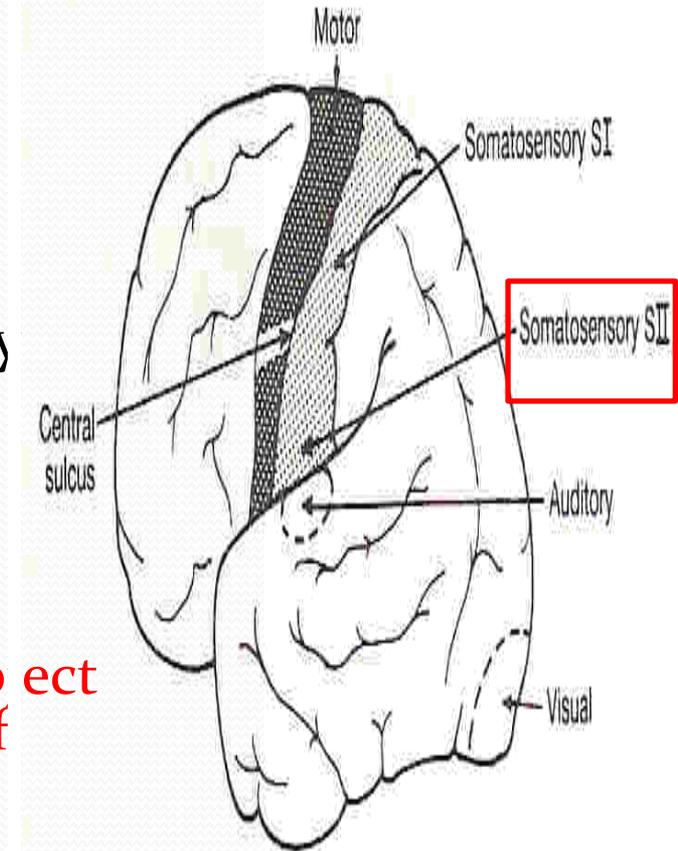
( AREA 2 )

- Found posterior & inferior to the primary somatosensory cortex  
(in the wall of the sylvian fissure).

- **Function :**

create a complete **comprehension of the object being felt & interpretation of meaning of sensation.**

- Face represented anteriorly
- Arms represented centrally
- legs represented posteriorly .



## Somatosensory Cortex ( somatosensory association area 2)

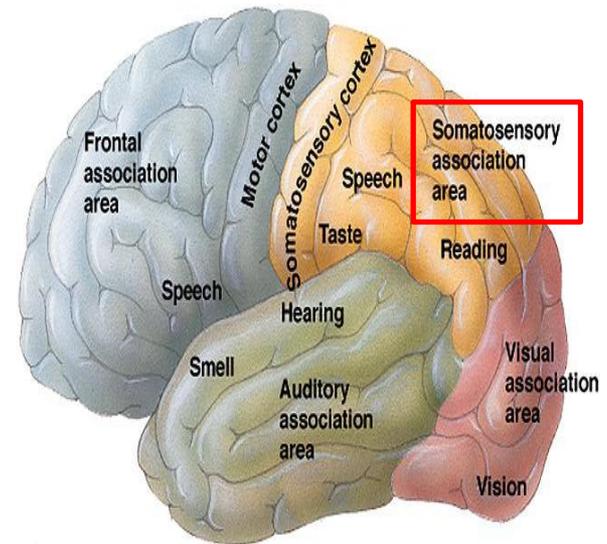
- The localization is **poor** as compared to SI [Primary Somatosensory Cortex]
- Ablation(lesion) of **SI** results in deficits in sensory processing in **SII**  
  
where as ablation of **SII** has no gross effect on the processing in **SI**.

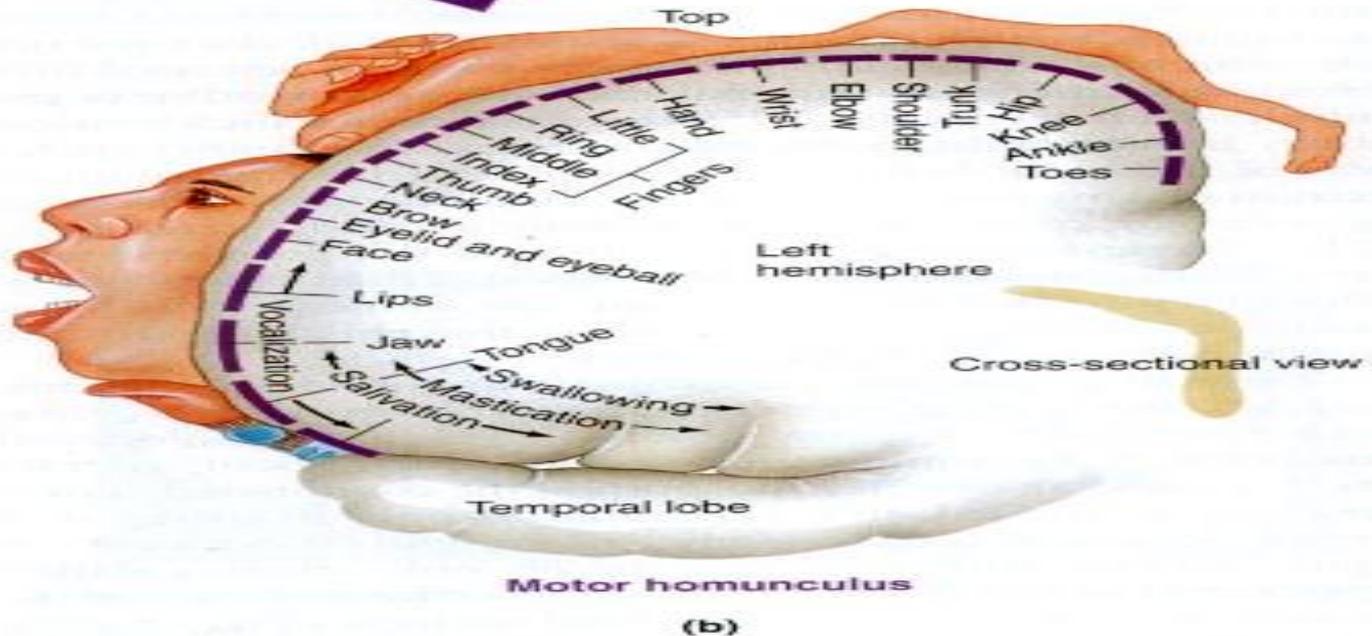
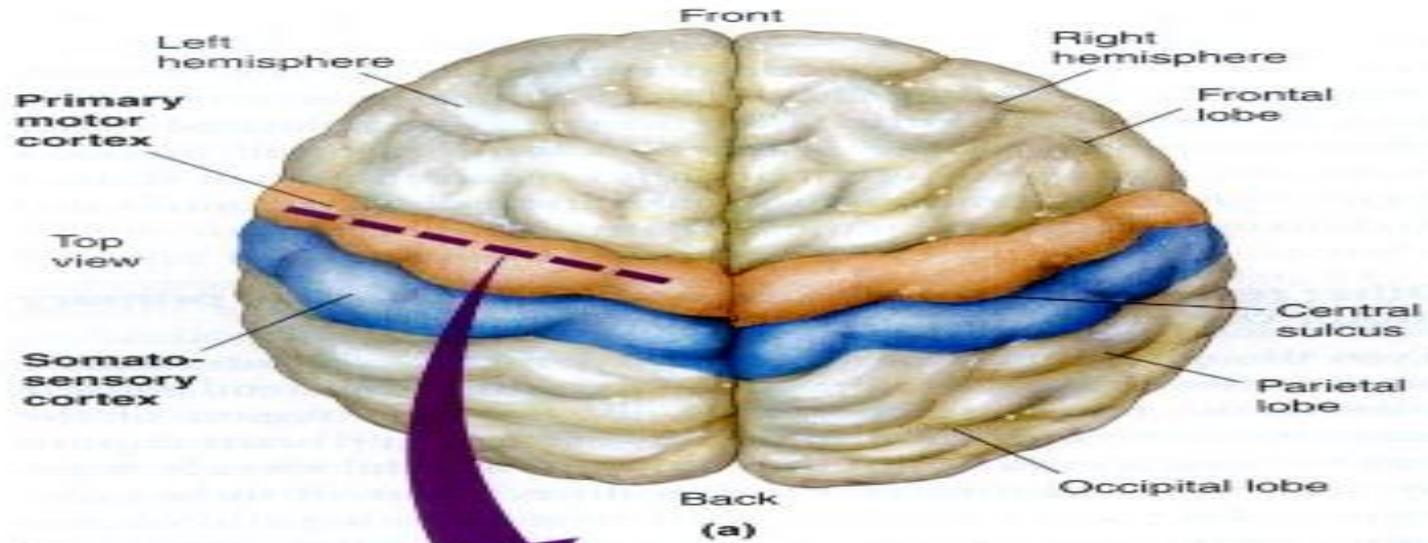


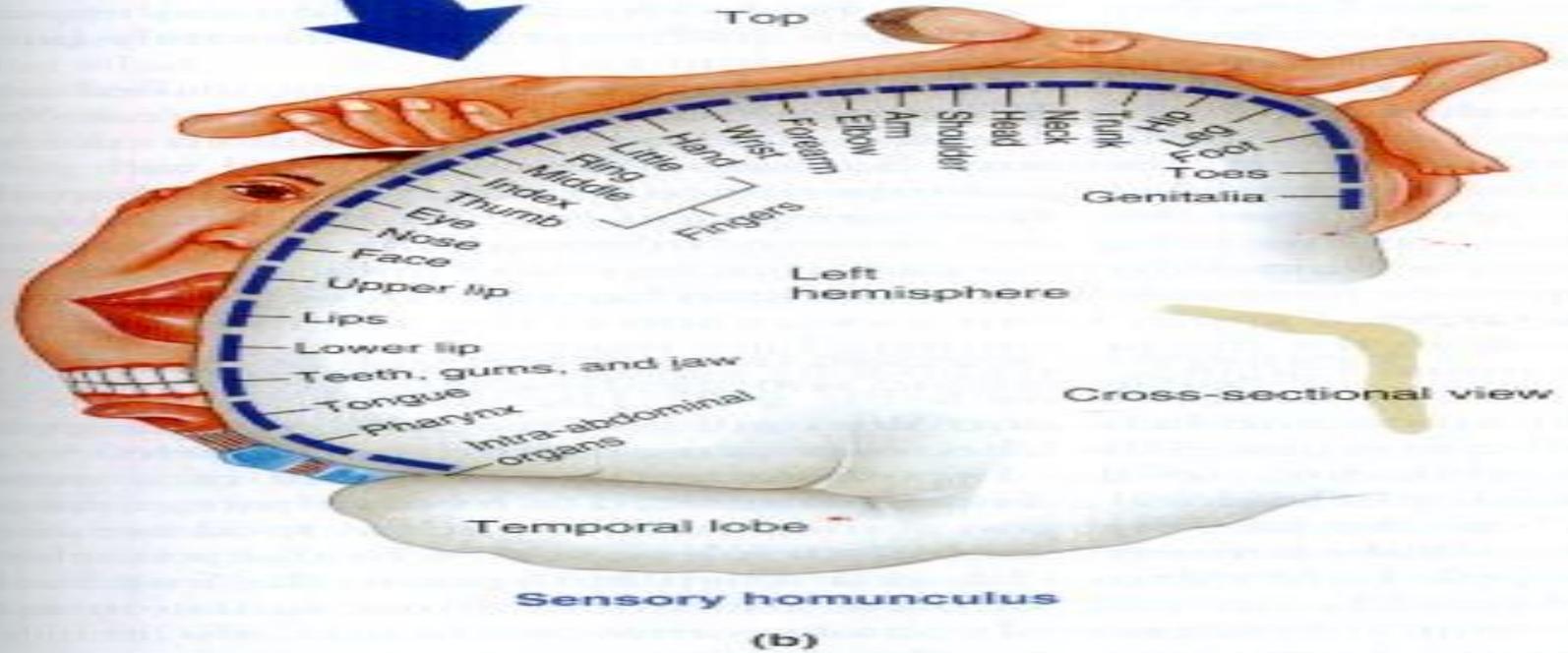
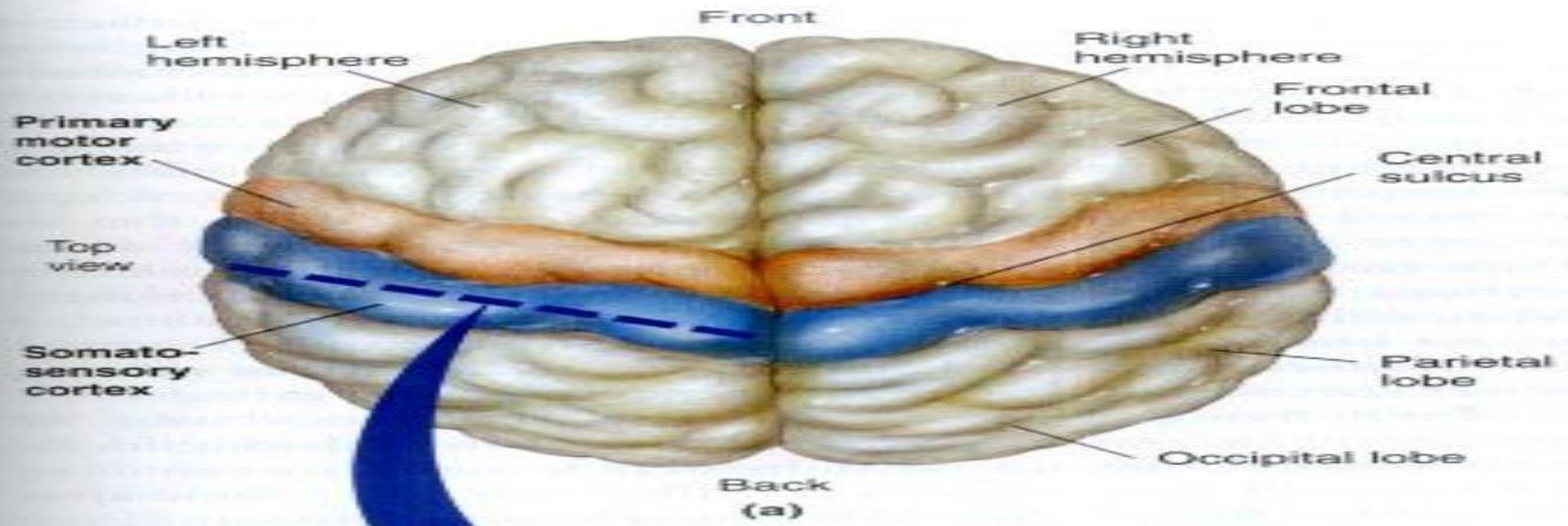
## ❖ Somatosensory association areas:

- Situated in the central cortex located in the **parietal** cortex behind SI area. [Bradman's area 5 & 7 ]
- **Function :**  
translating the sensory information that enters the somatosensory areas.
- **Lesion :**  
it loses the ability to recognize complex objects on the opposite side of the body.

e.g. **Apraxia and sensory inattention.**





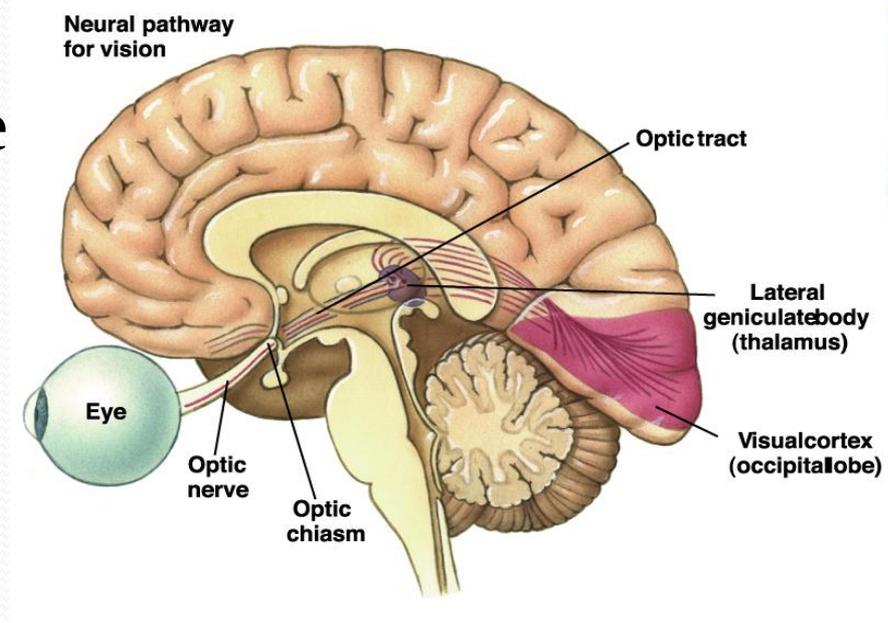


# ❖ Primary Visual Cortex

( area 17 )

- Found in the **occipital** lobe
- **Function:**

Vision without meaning



# ❖ Visual association area

( area 18-19)

- Surrounds the primary visual cortex.
- **Function :**

Vision with meaning



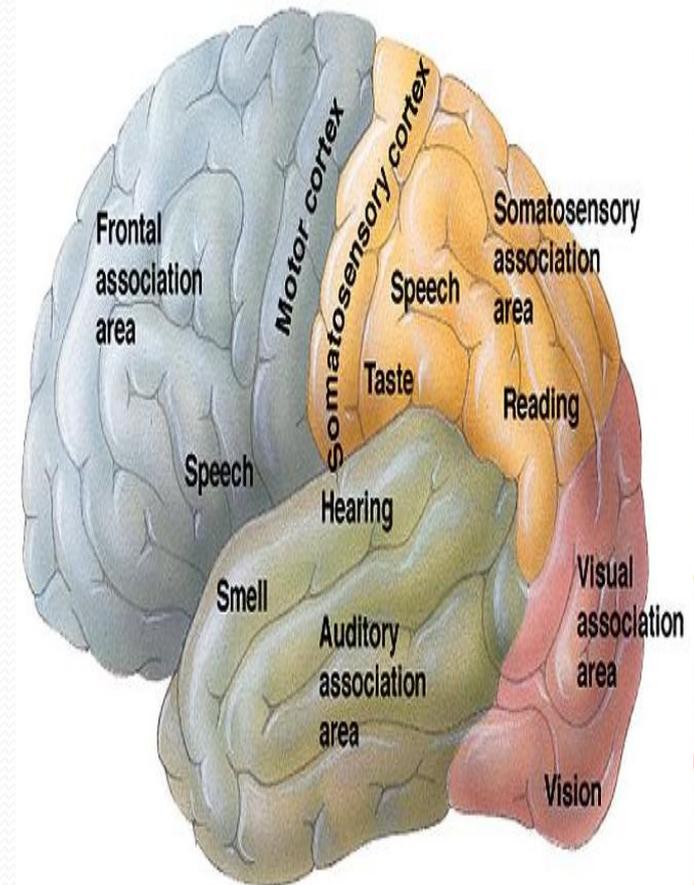
# ❖ Auditory Cortex

- in the superior margin of the **temporal** lobe, next to the lateral sulcus.

## ❖ Auditory association area

- Function:

Let us interpret and remember sounds.



## ❖ Olfactory Cortex:

- Found in the **medial temporal** lobe
- **Function:**  
smelling

## ❖ Gustatory cortex :

- in the **parietal** lobe deep to the temporal lobe.
- **Function:**  
taste

