

Cerebral Function

Done By:

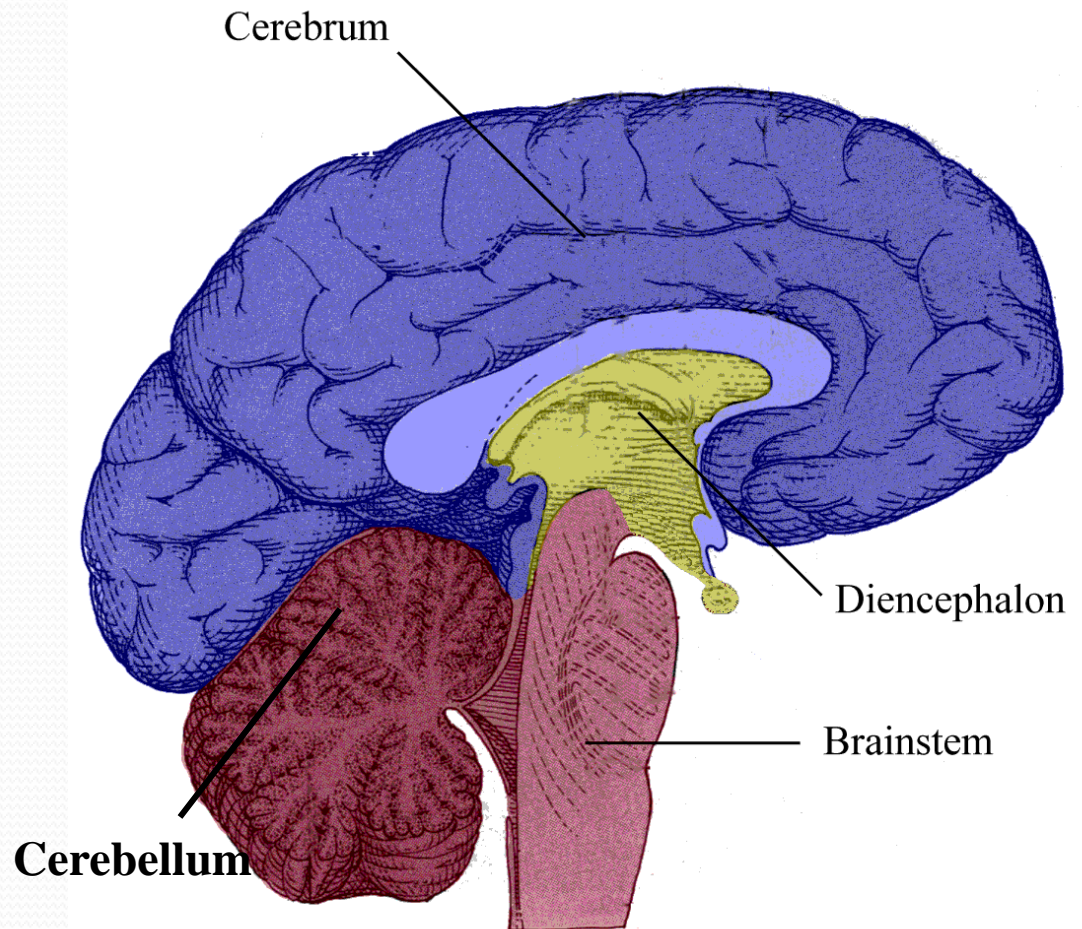
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Brain Regions

1. Cerebrum

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



MENINGES

1. DURA MATER

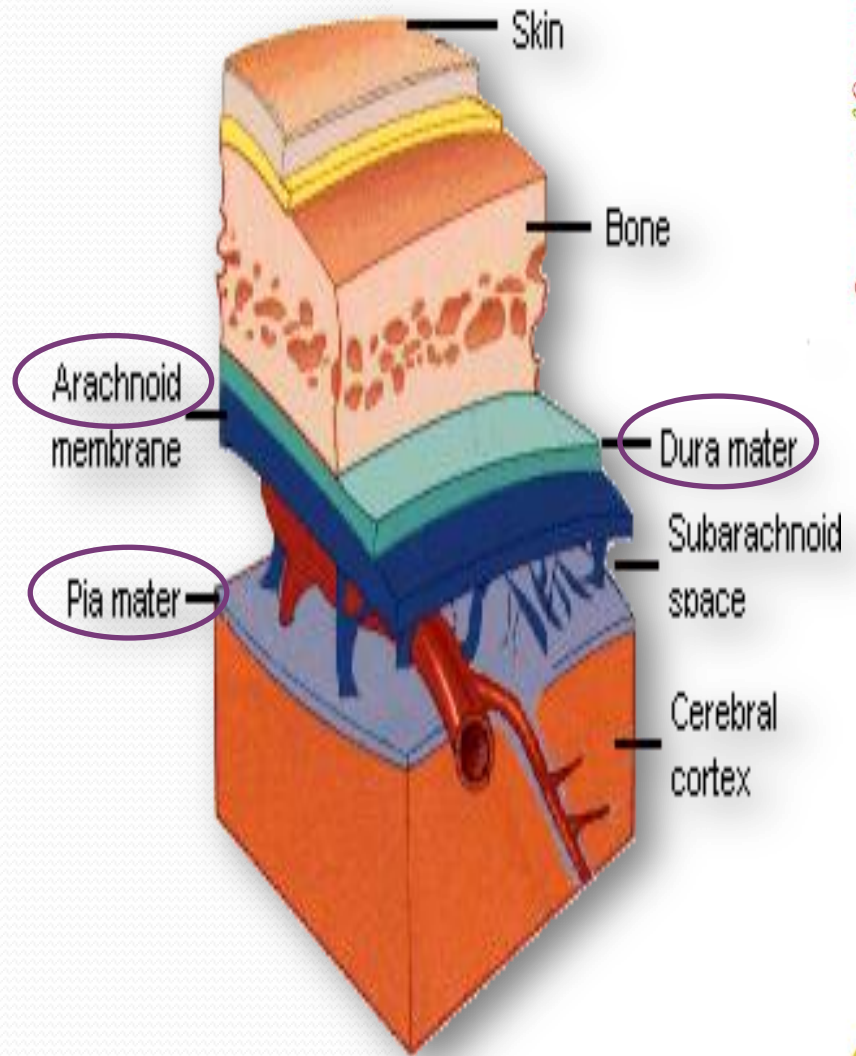
Outer covering

1. ARACHNOID MATER

Middle covering

1. PIA MATER

Inner most covering

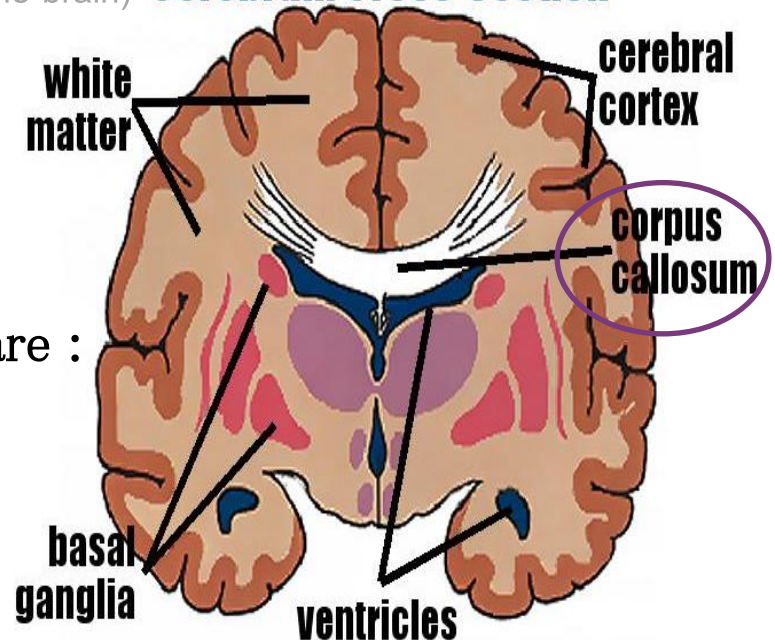


Cerebrum(cerebral cortex)

The largest, portion of the brain.

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

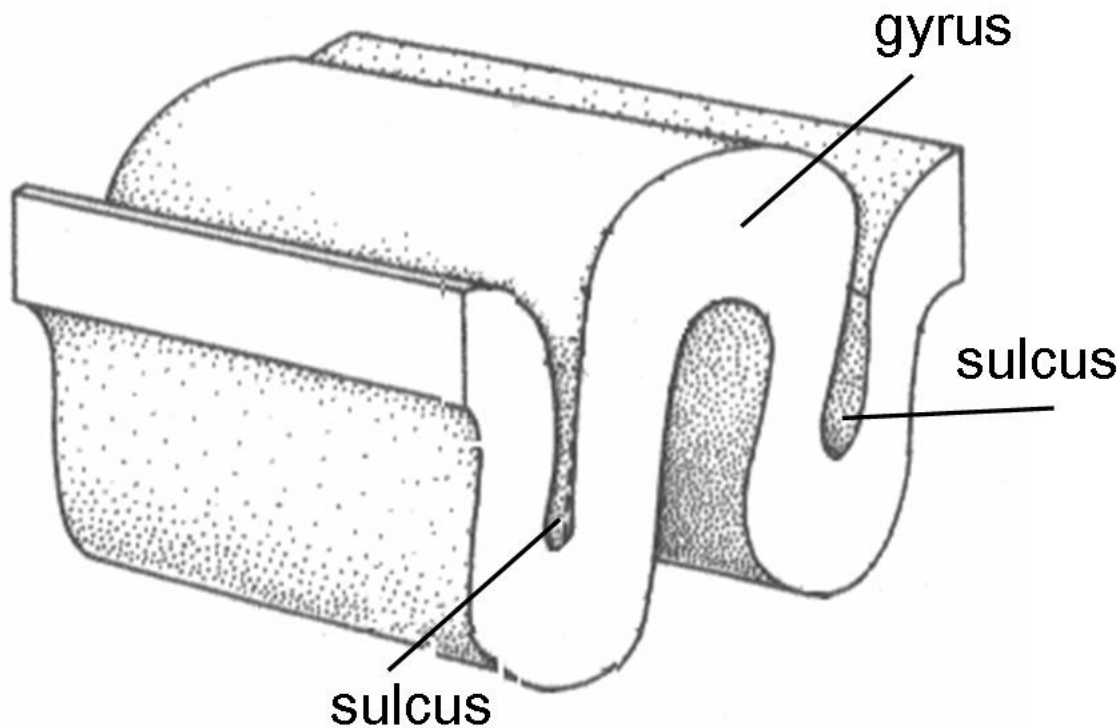
Cerebrum Cross-Section



- 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 found within the white matter

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



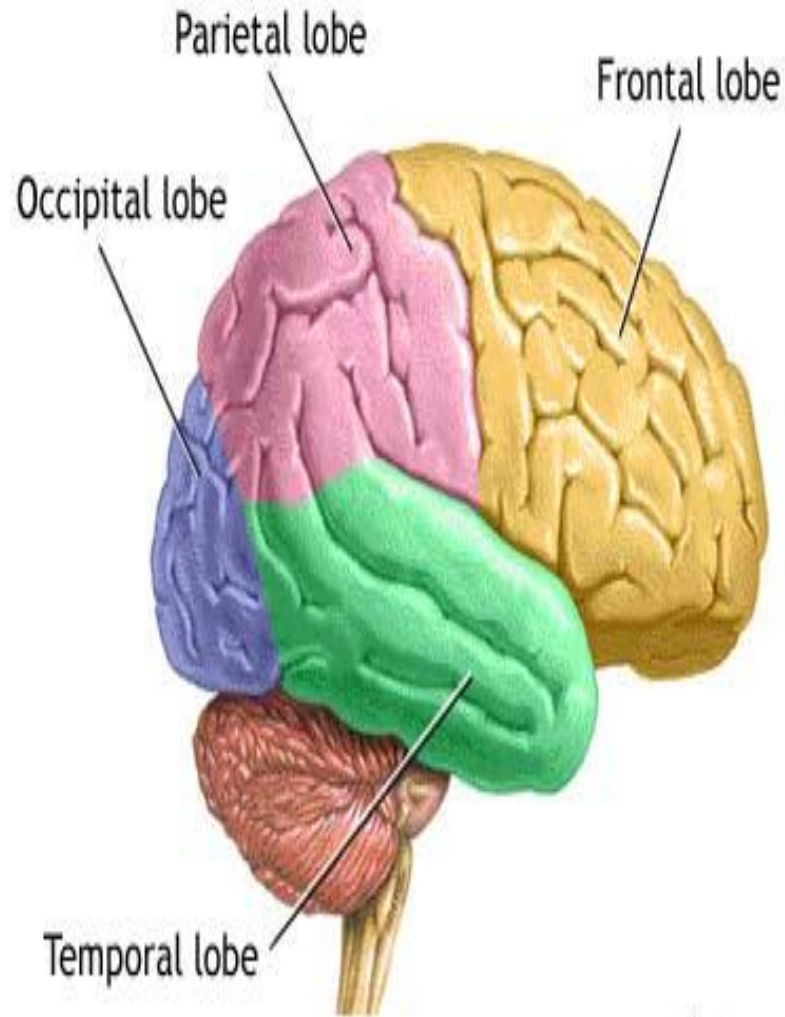
Cerebrum lobes

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:

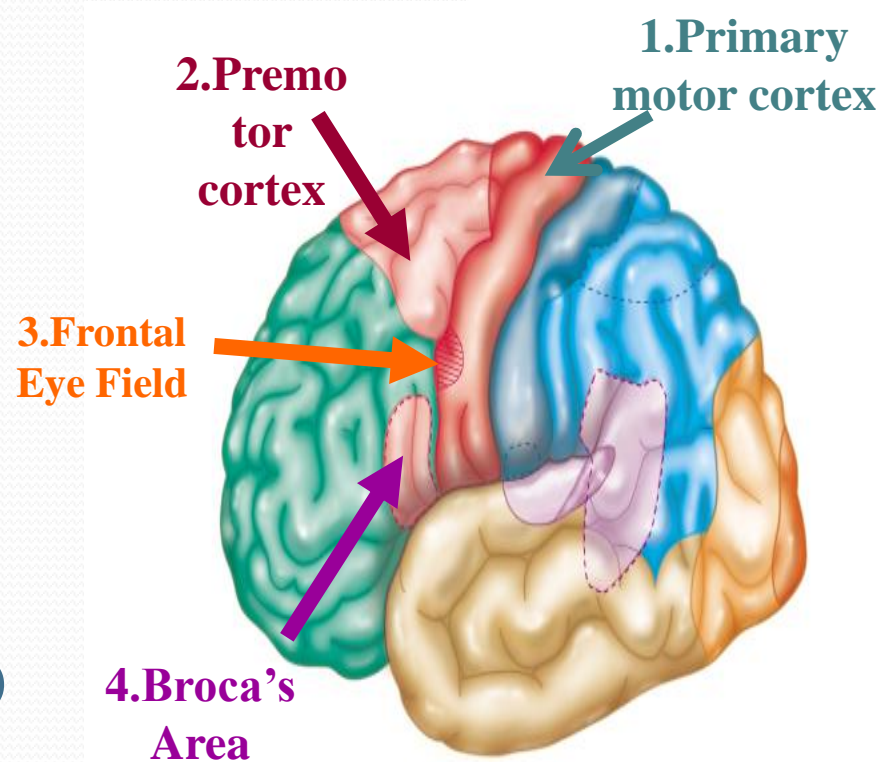
A- Primary motor cortex (m1)

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)

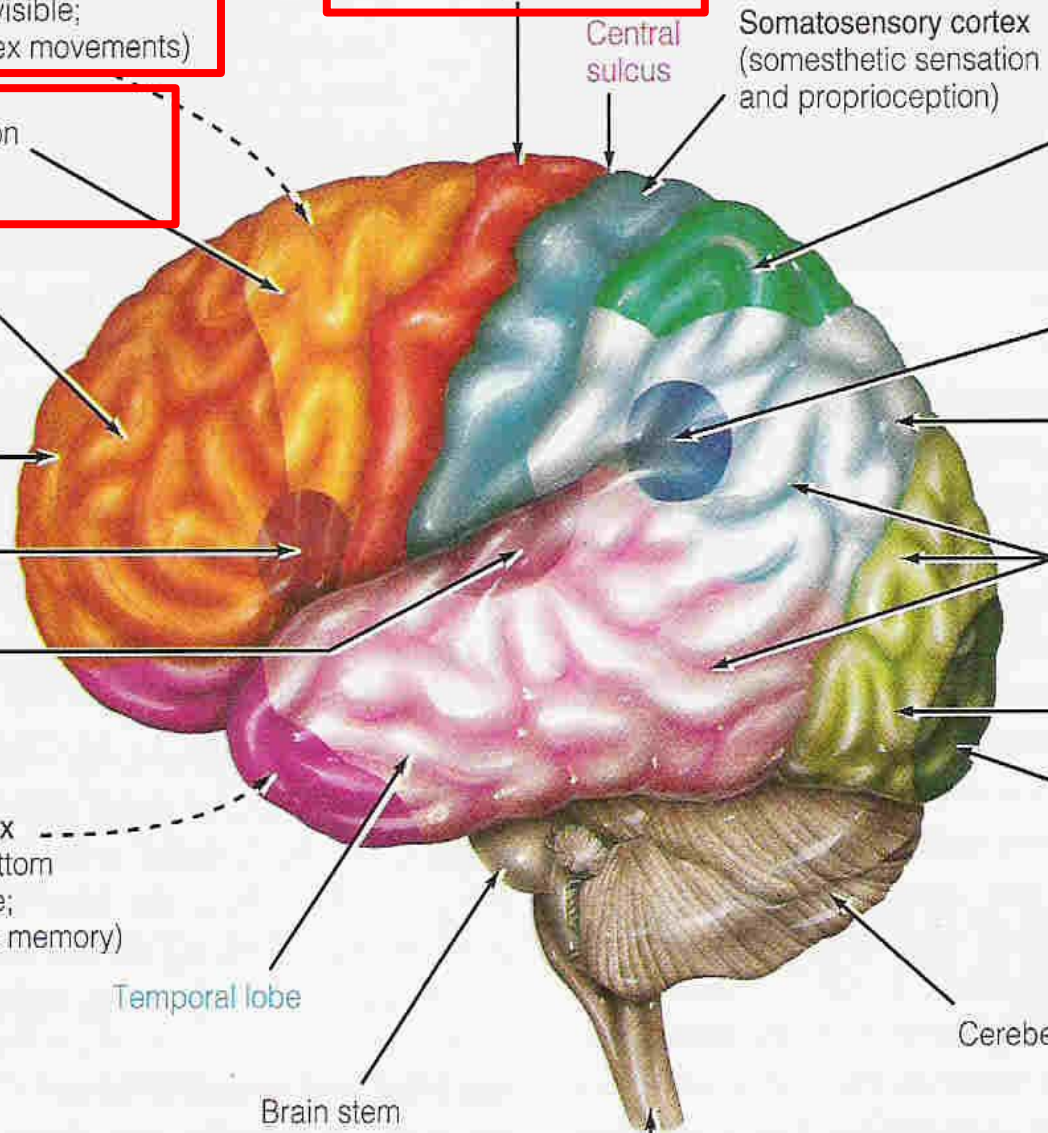
Primary visual cortex
surrounded by higher-
order visual cortex (sight)

Temporal lobe

Cerebellum

Brain stem

Spinal cord



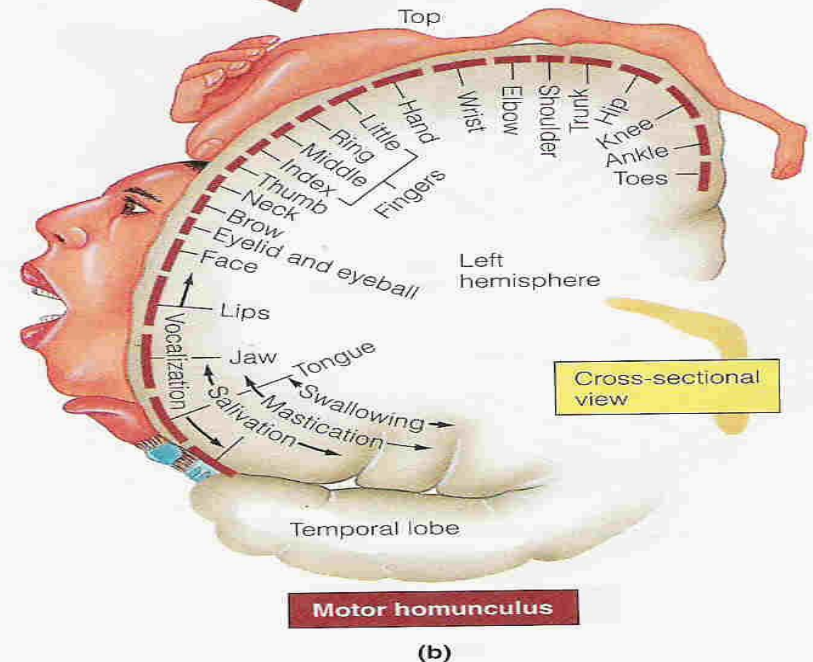
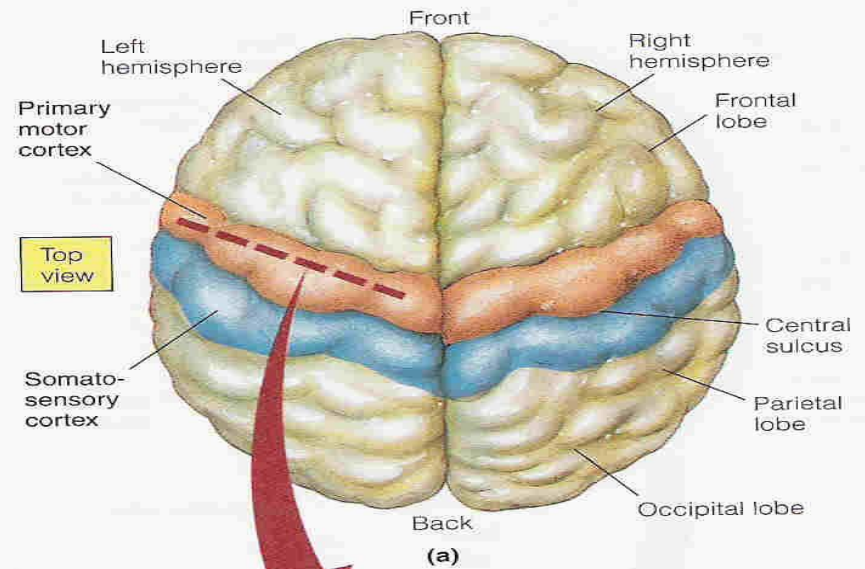
• A-Primary Motor Cortex:

* 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]

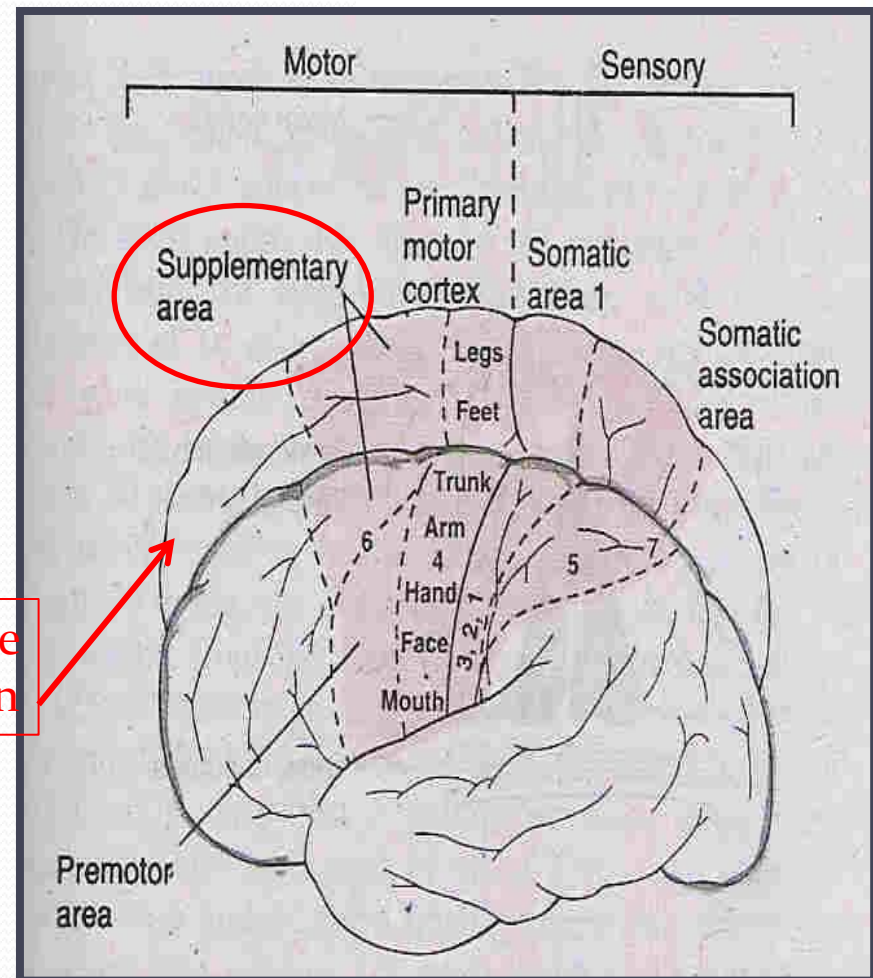
• B- Supplementary motor area (M-II):

* 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 .



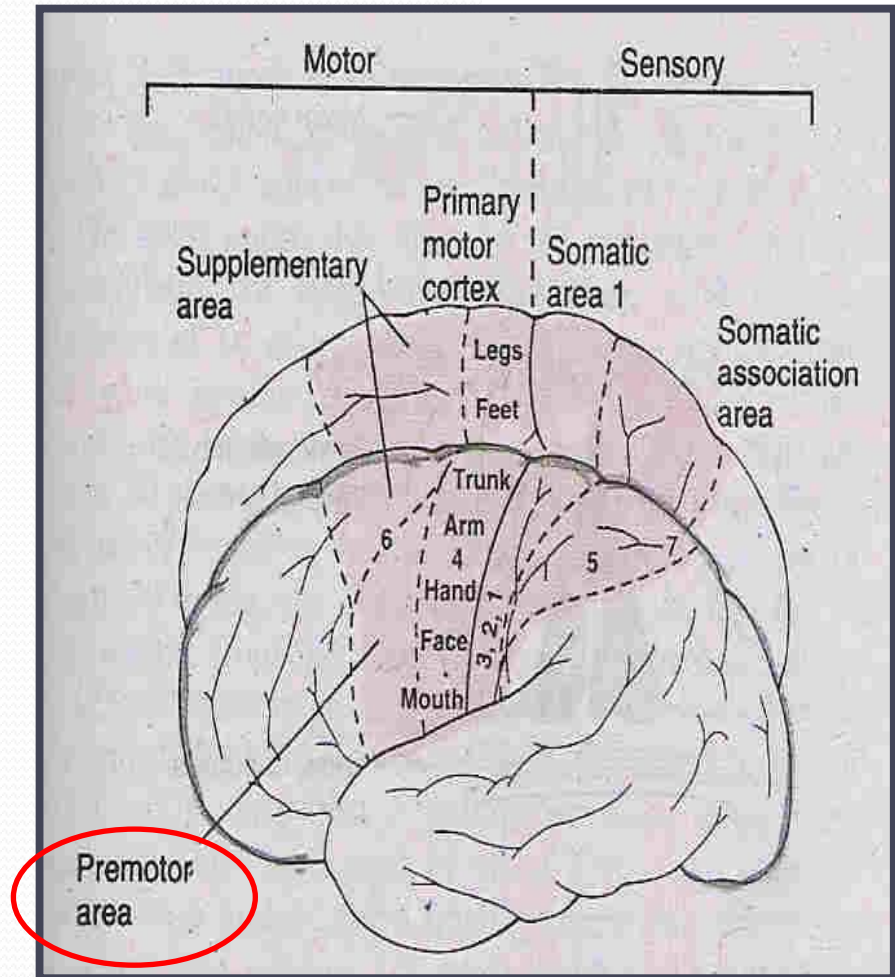
•C-Premotor cortex [motor association area]

*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)



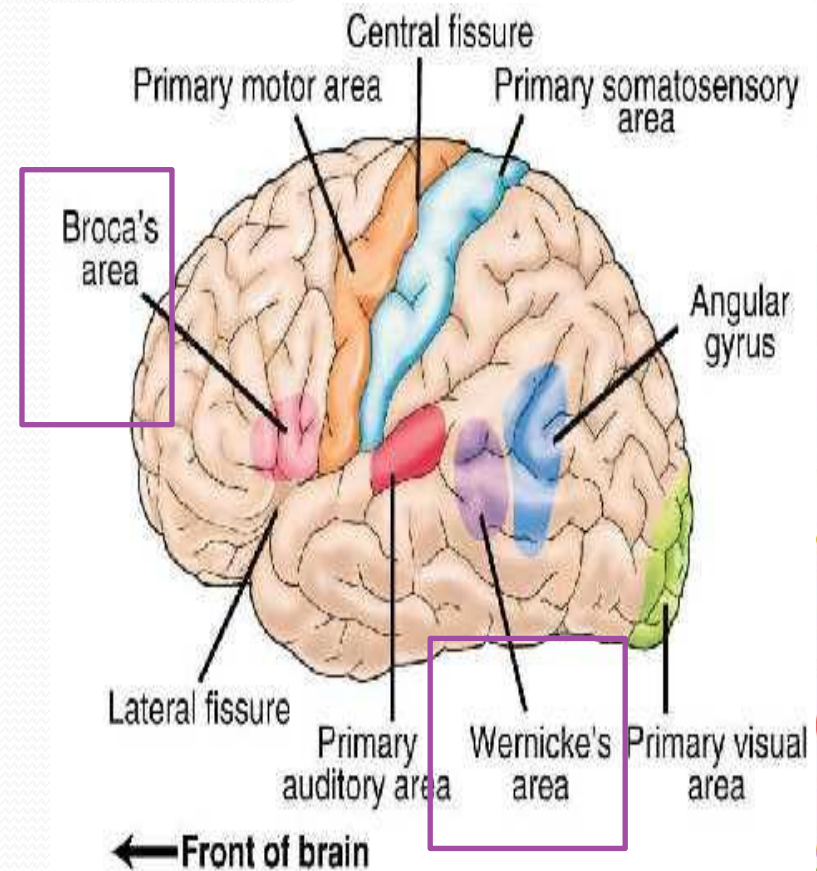
Broca's Area [Motor area of speech]

Found in only one hemisphere
(often the left)

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

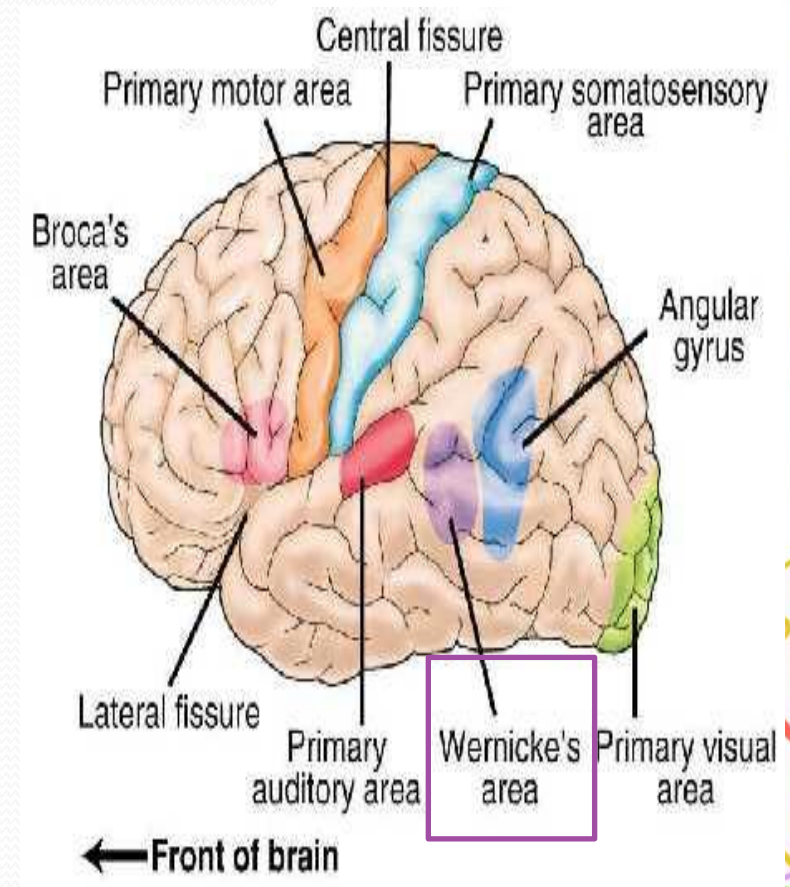
• **Function :**

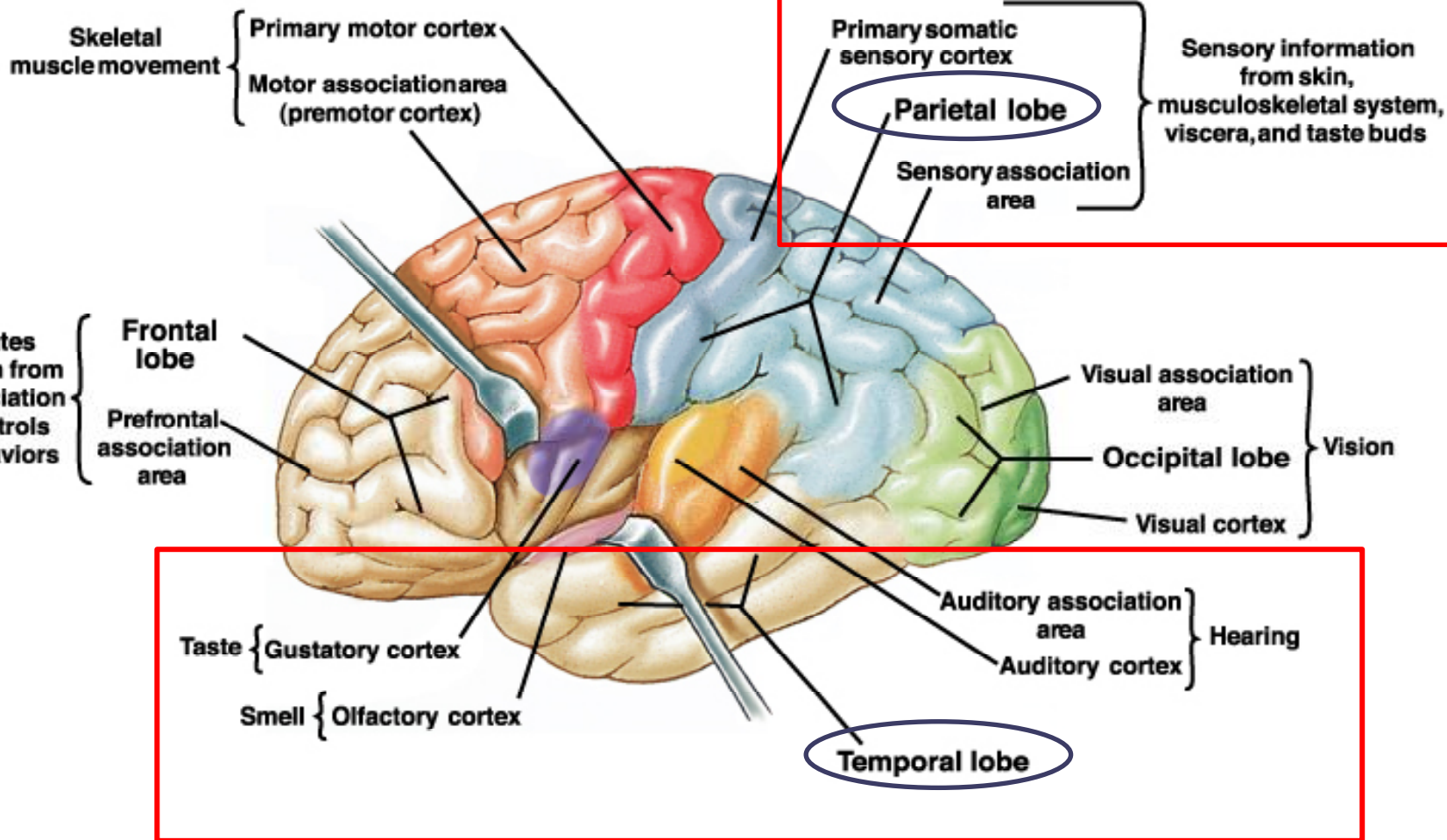
- Directs muscles of tongue, lips and throat that are used in speech production.



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]

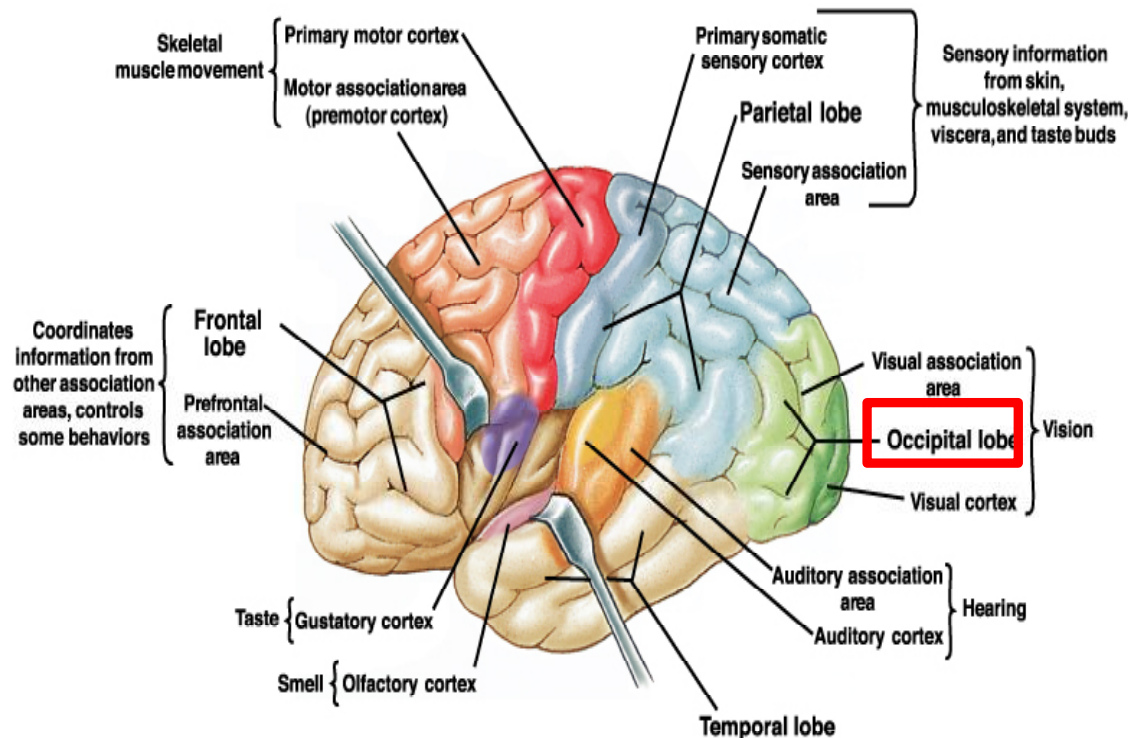
It's difficult to recognize disgust on the faces or the voices of people the patient met but other emotions are recognized easily.

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.





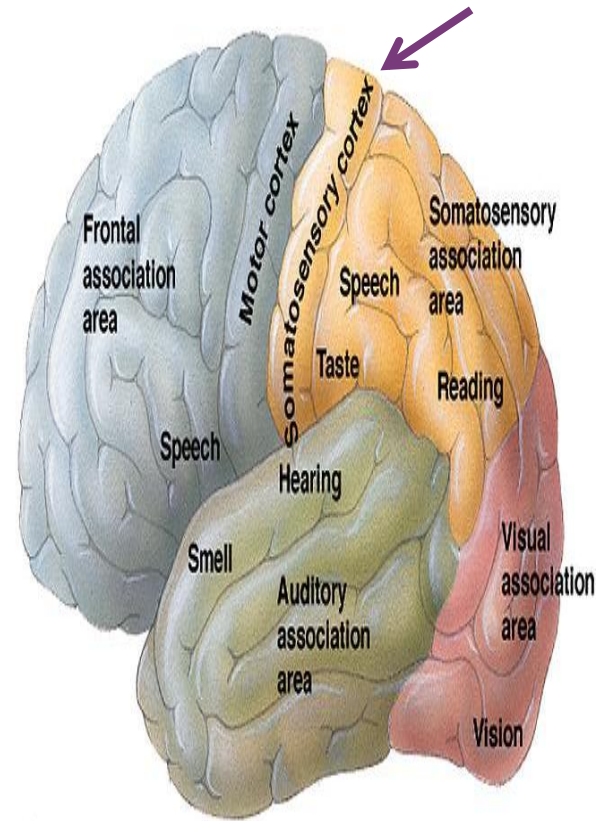
Sensory Areas

- 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.

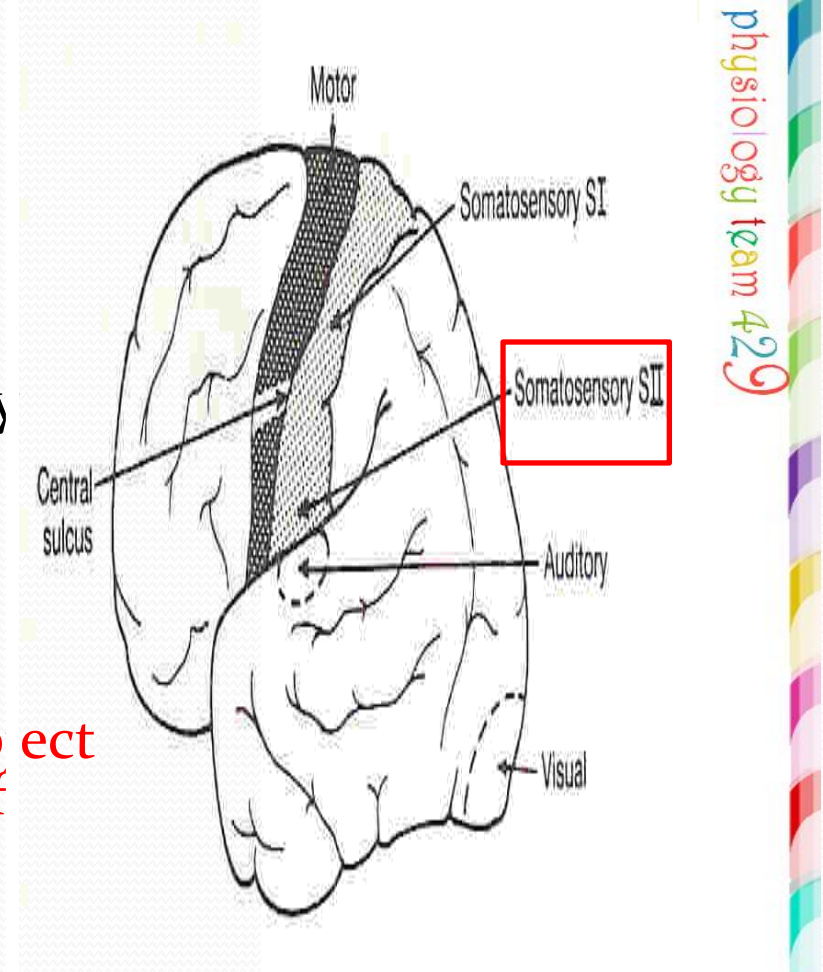
5- Receives sensory information exclusively from the opposite side of the body.



❖ 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)

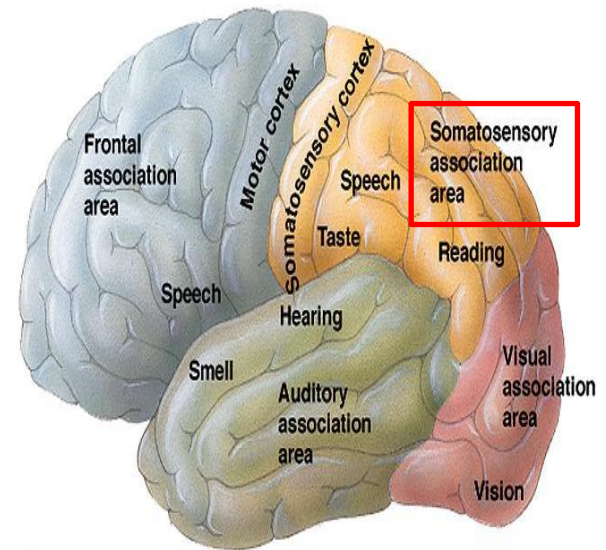
- The localization is **poor** as compared to SI [Primary Somatosensory Cortex]
- Ablation(lesion) of **SI** results in deficits in sensory processing in **SII**
- where as ablation of **SII** has no gross effect on the processing in **SI**.

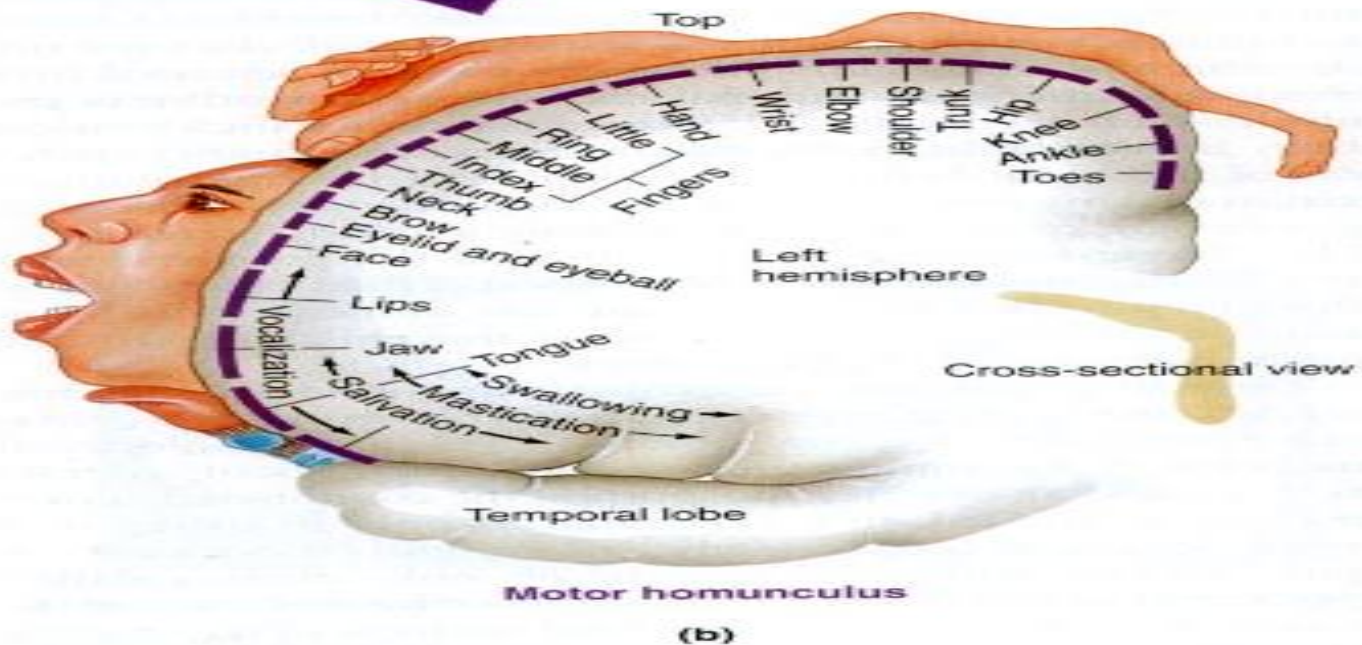
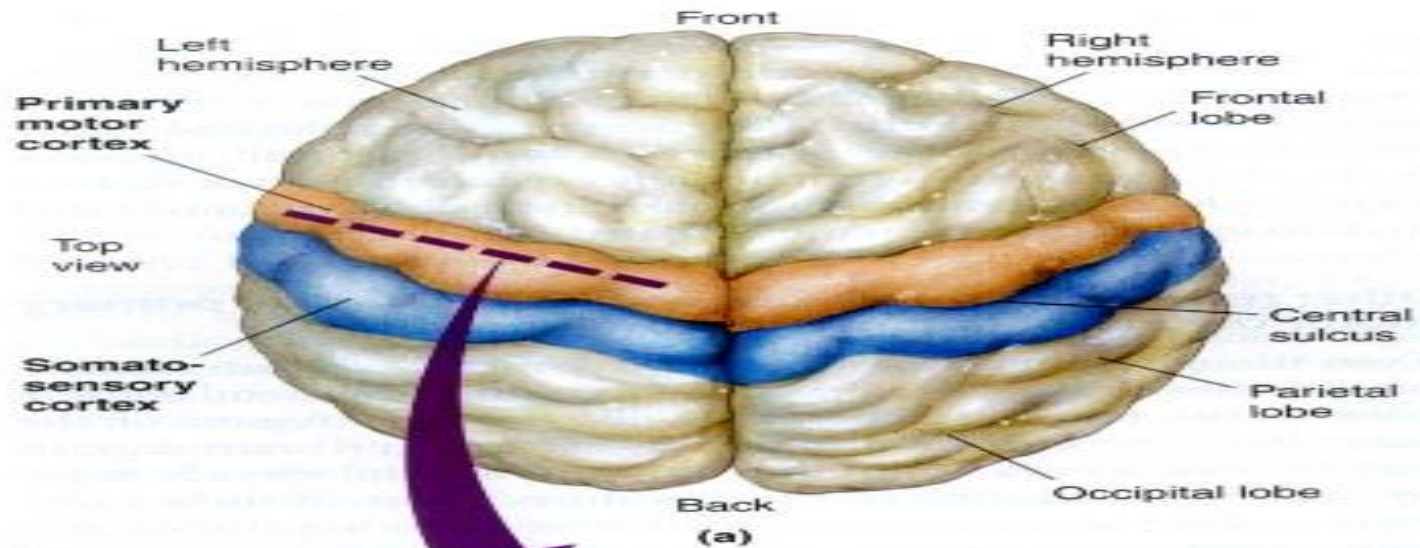


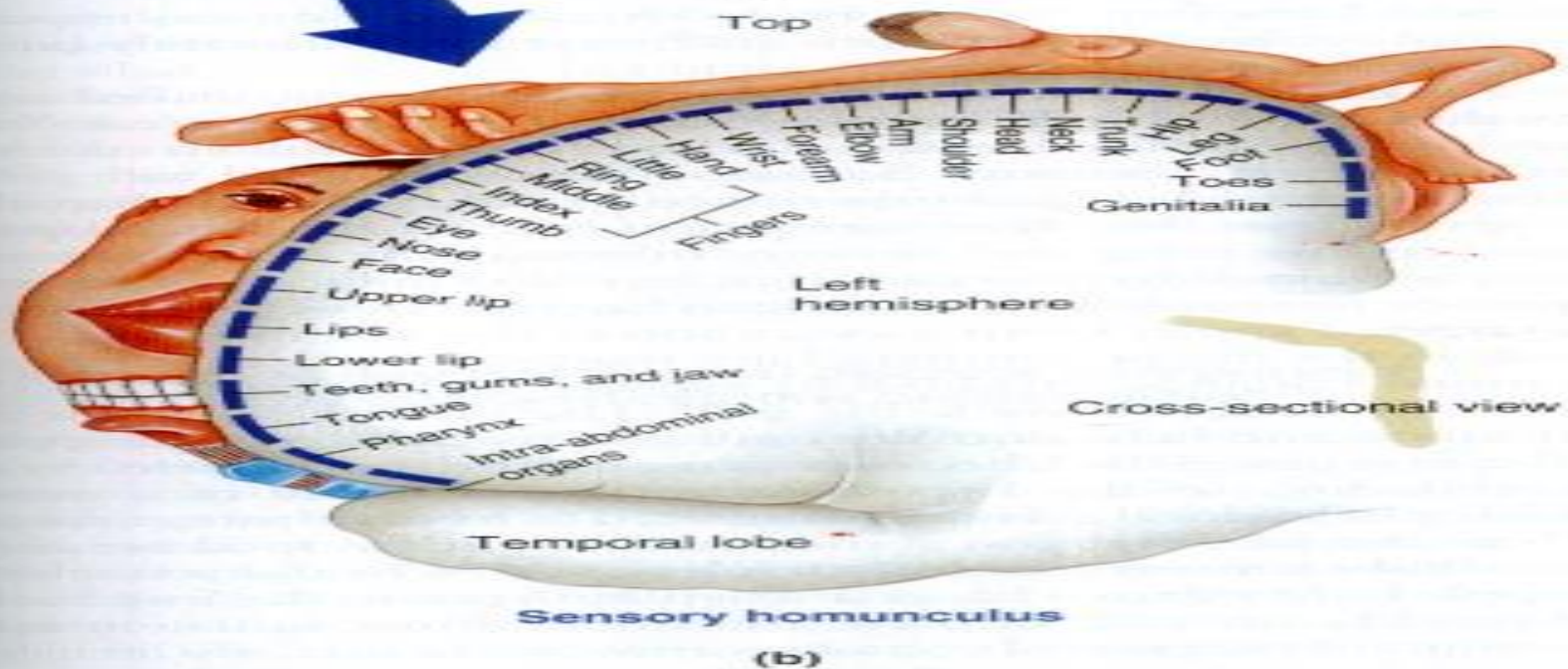
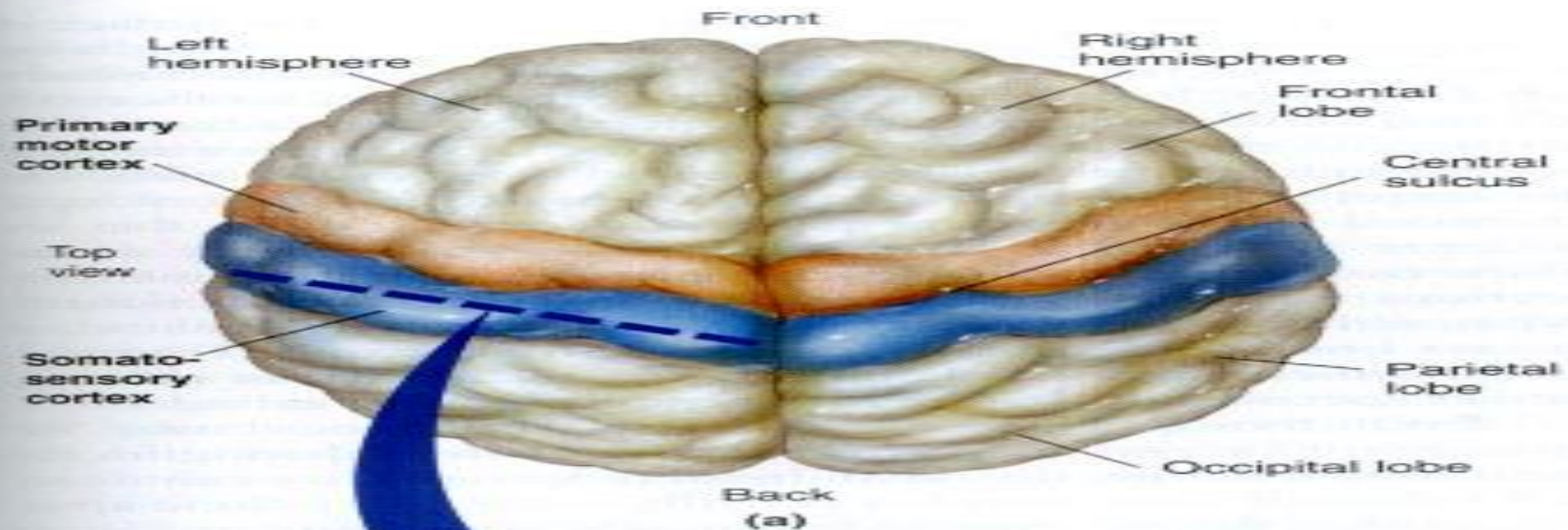
❖ Somatosensory association areas:

- 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.**



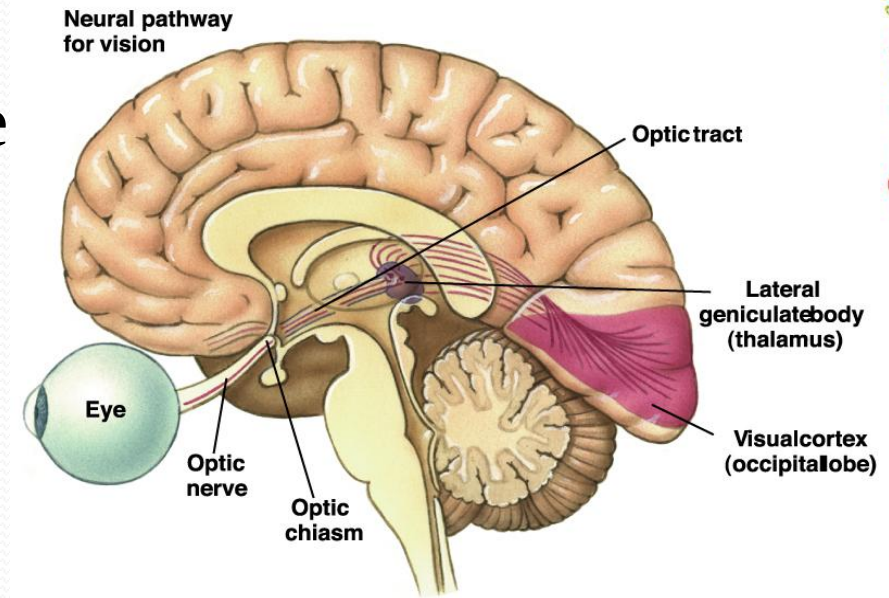




❖ Primary Visual Cortex

(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



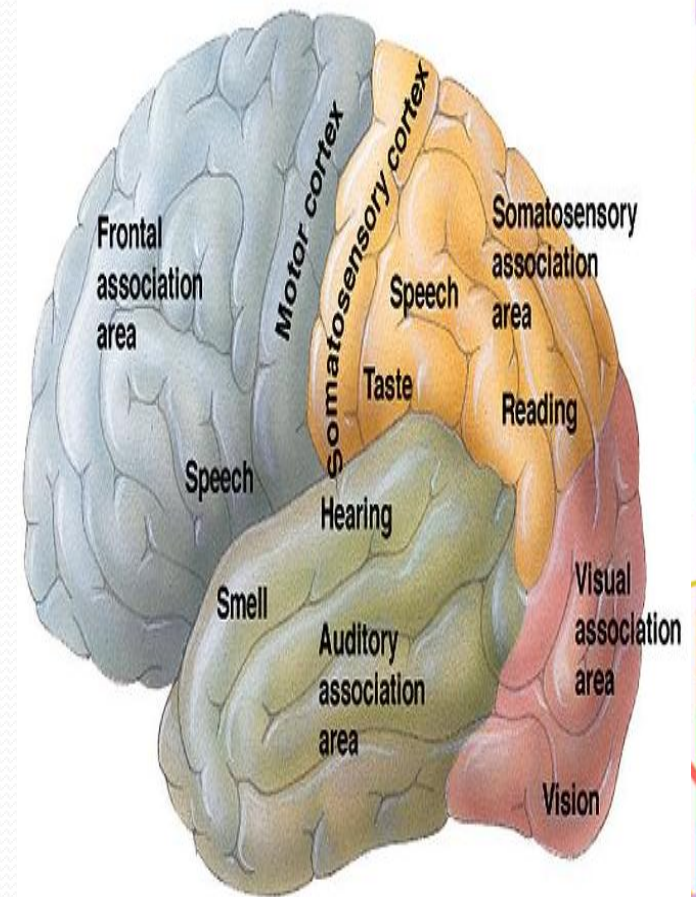
❖ Auditory Cortex

- 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

