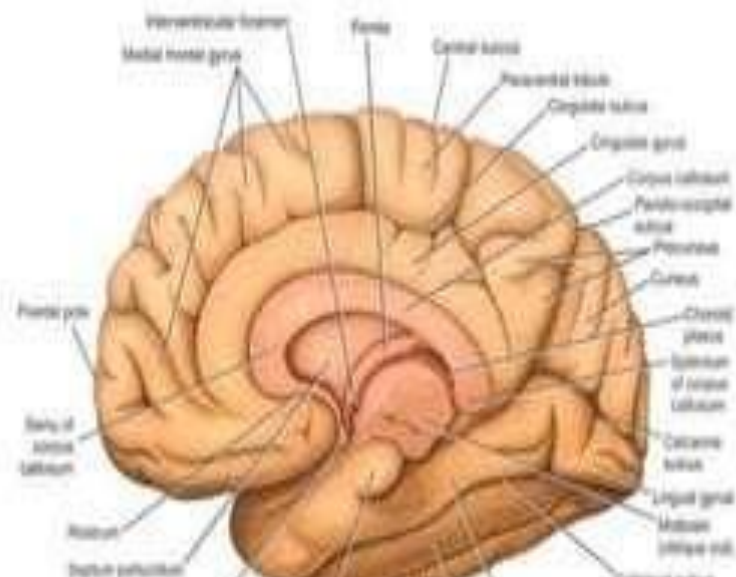
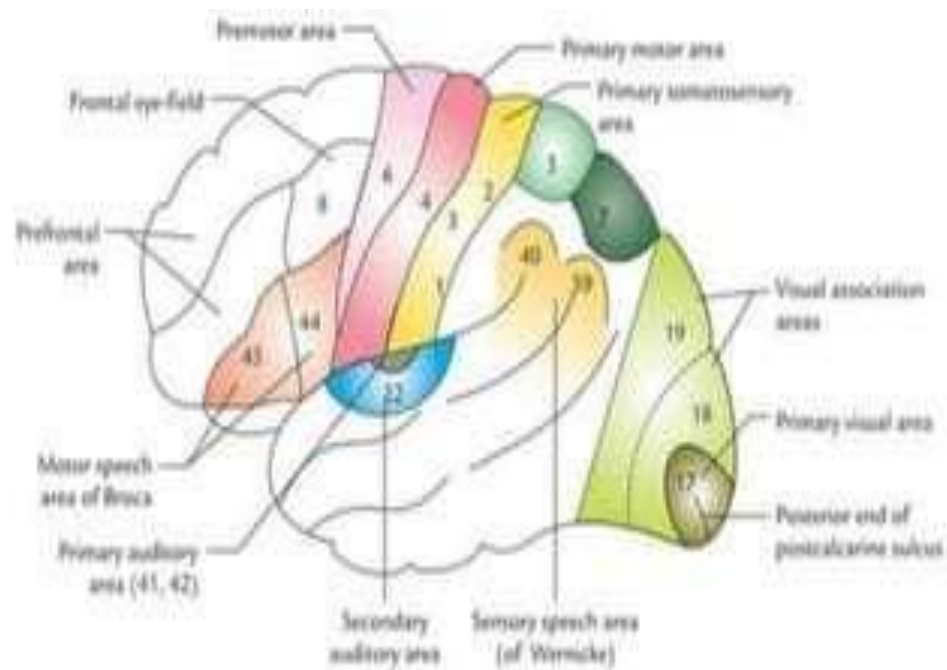
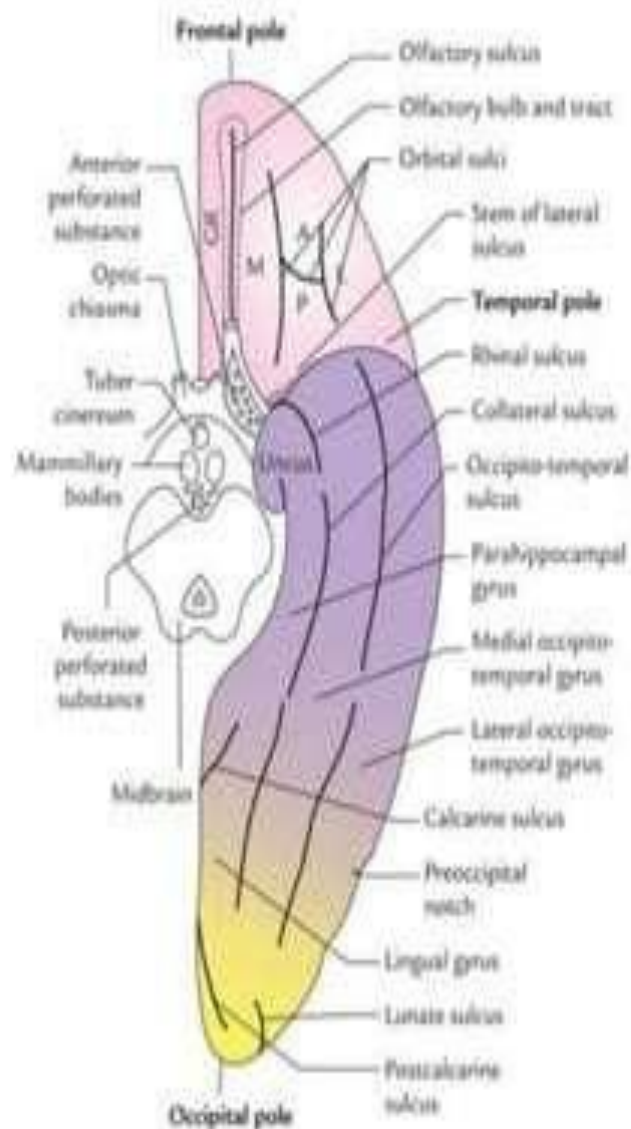


# Functional Cortical Area & White Matter of cerebrum

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(M.D.S., M.C.)



**White matter of the cerebrum:** consists of myelinated fibres which connect various parts of cortex to one another and to the other parts of the CNS.

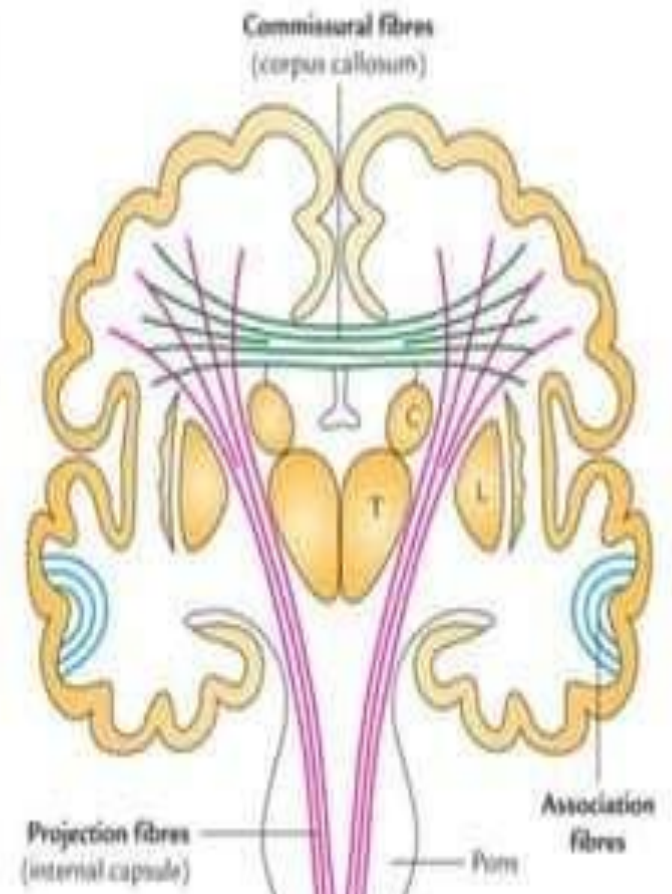
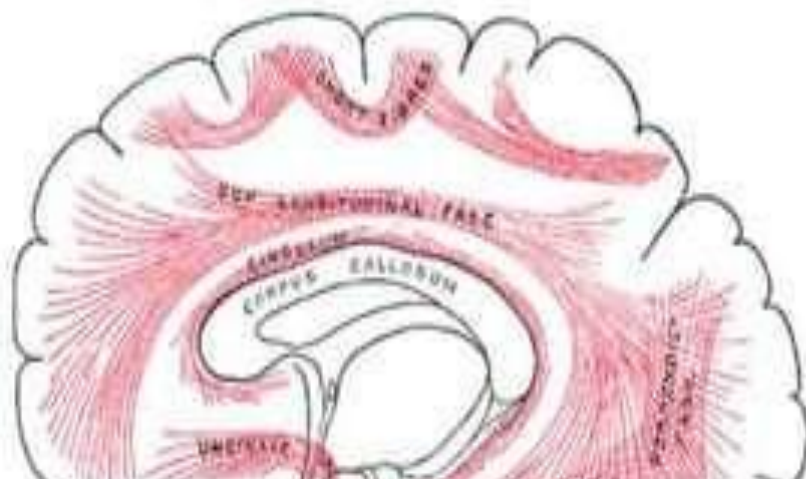
Fibres are classified as : 1. association fibres, 2. projection fibres, & 3. commissural fibres

### Association (Arcuate) Fibres

- Connect different cortical areas of the same hemisphere to one another.

#### A. Short association fibres:

connect adjacent gyri to one another



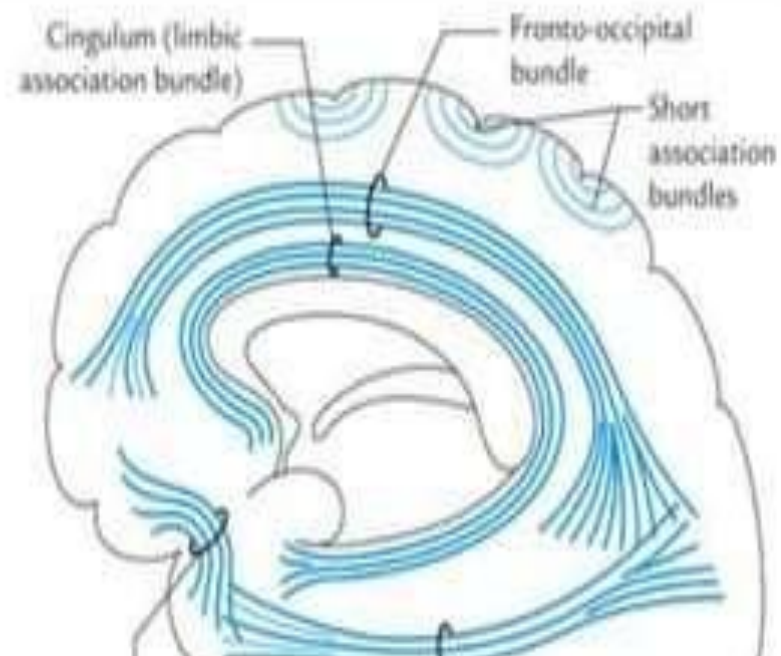
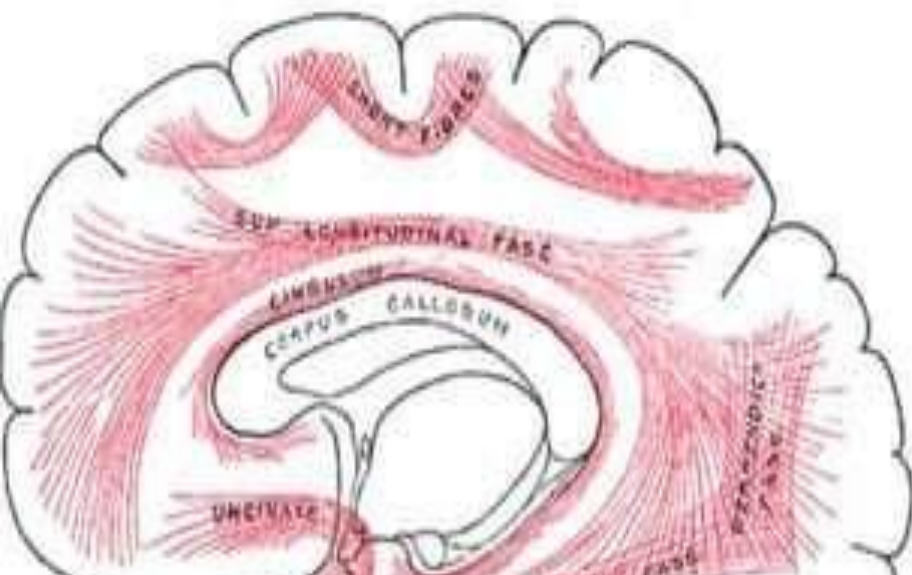
B. *Long association fibres*: Connect more widely separated gyri to one another.

(1) *Uncinate fasciculus*: connect temporal pole to motor speech area and to the orbital cortex.

(2) *Cingulum*: connect cingulate gyrus to parahippocampal gyrus

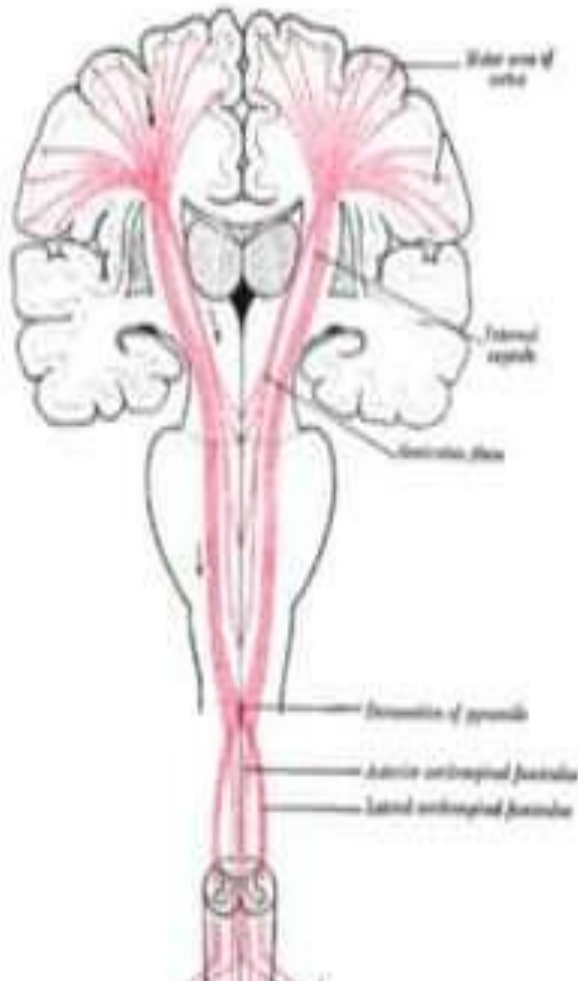
(3) *Superior longitudinal fasciculus*: connect frontal lobe to the occipital and temporal lobes

(4) *Inferior longitudinal fasciculus*: connect occipital & temporal lobes.



**Projection Fibres:**

connect cerebral cortex to other parts of CNS.e.g. corticospinal and corticopontine tract



## Structural and Functional Type of the Cortex:

- **Archicortex:** - Represented by hippocampus & parts of rhinencephalic regions.  
-Structurally it is simple and made up of three layers.
  
- **Paleocortex:** Rrepresented by the cingulate gyrus.

Archicortex and Paleocortex together constitute the **allocortex**

- **Neocortex:** Phylogenetically it is most recent in development and in man it comprises about **90% of the total area of the cerebral cortex.**  
  
-Structurally it is thick and consists of six layers.

### It is subdivided into

- a. Granular cortex: Is basically a sensory cortex.
- b. Agranular cortex. Is the motor cortex.

## Commissural Fibres

Connect corresponding parts of two hemispheres.

### (1) *corpus callosum*:

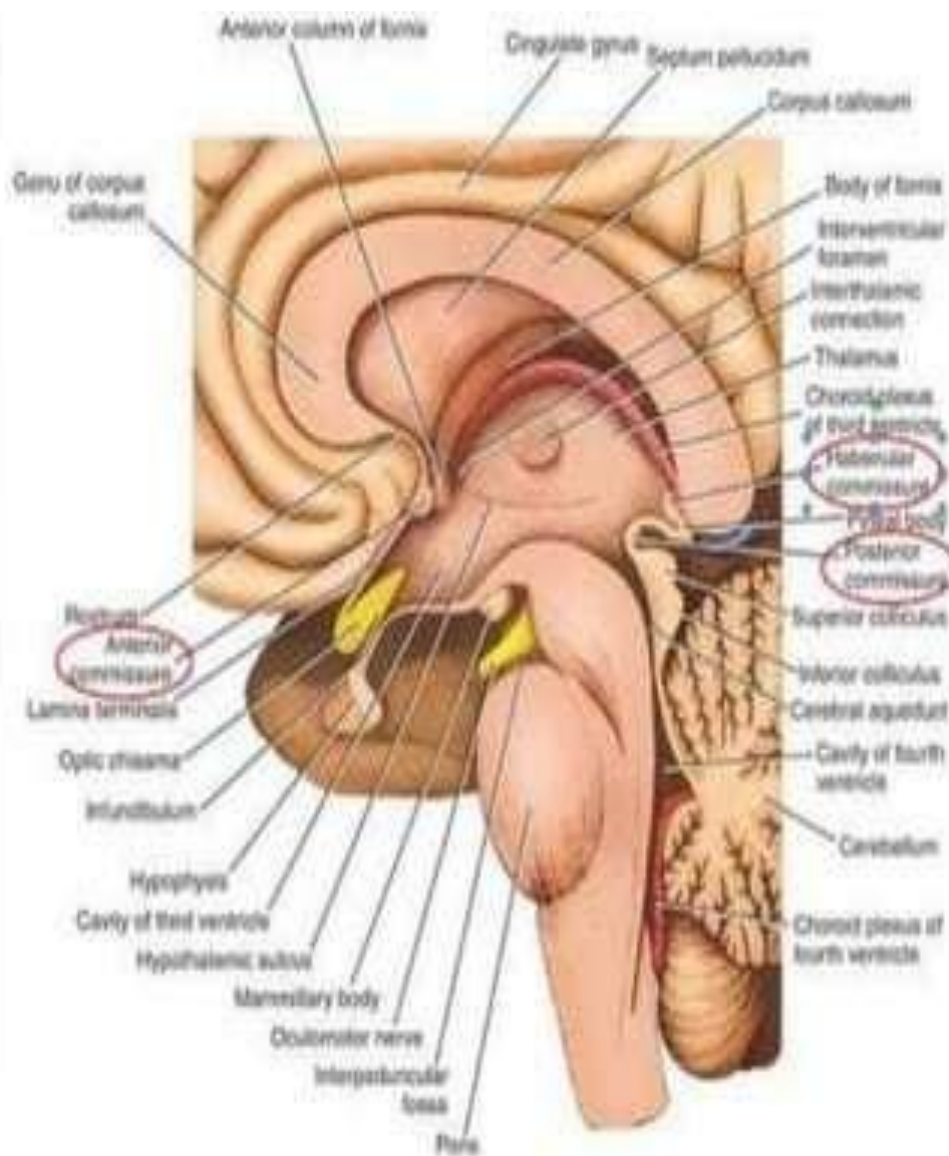
Connect cerebral cortex of two sides.

### (2) *Anterior commissure*:

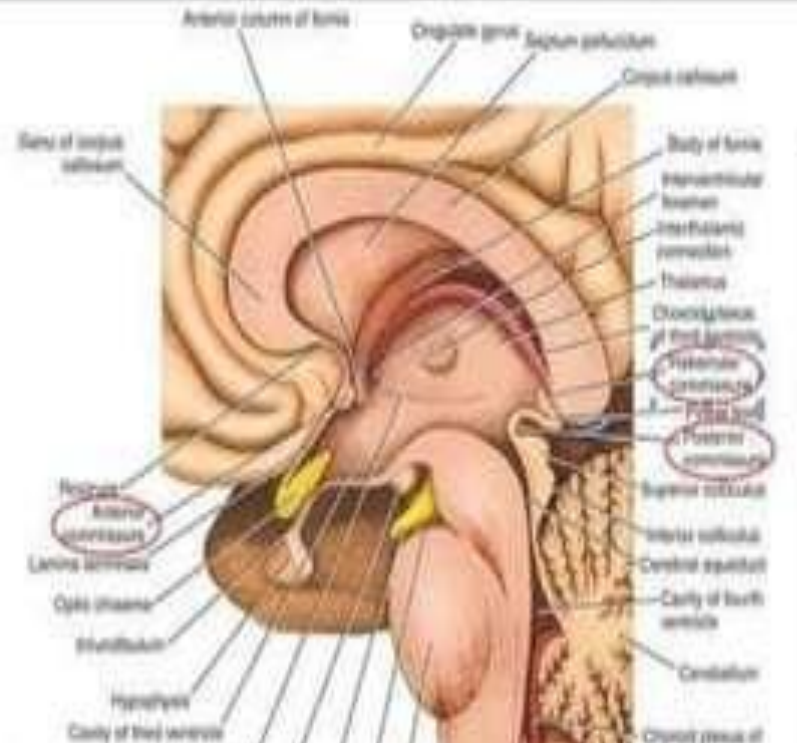
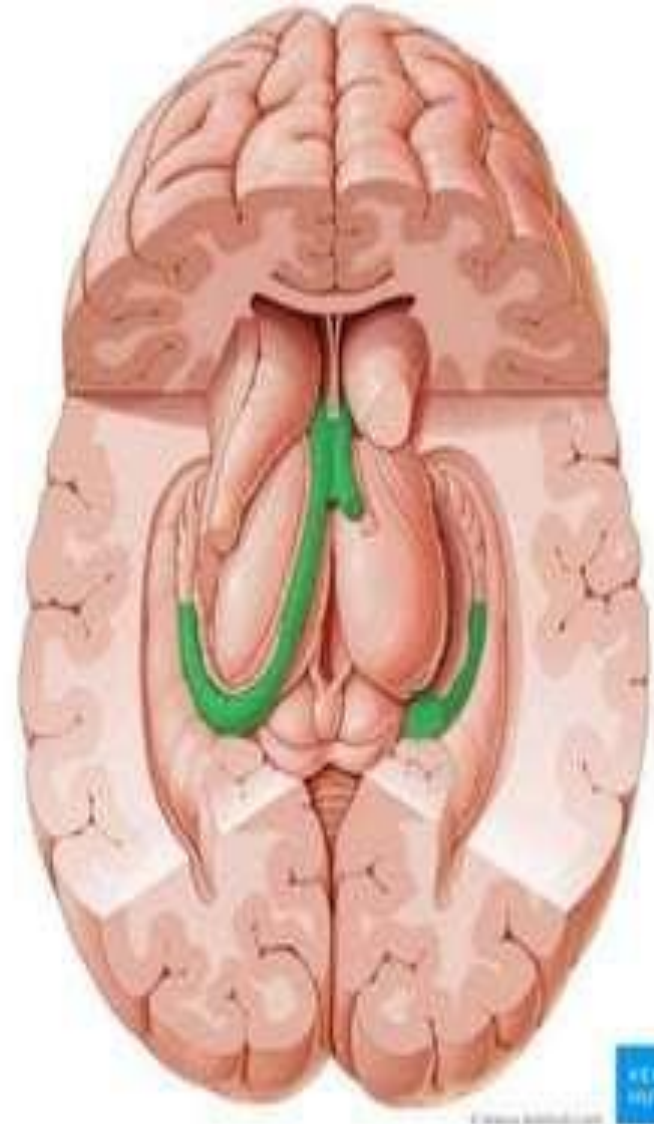
Connect the archipallia (olfactory bulbs, piriform area and anterior parts of temporal lobes) of the two sides.

### (3) *Posterior commissure*:

- Connect superior colliculi,
- Transmit corticotectal fibres & fibres from pretectal nucleus to Edinger- Westphal nucleus of the opposite side.



- (4) *commissure of the fornix (hippocampal commissure):*  
Connect crura of the fornix and thus the hippocampal formations of the two sides.
- (5) *habenular commissure:* connect habenular nuclei
- (6) *Hypothalamic commissures:*





## Corpus Callosum

- Largest commissure
- Connects all parts of two cerebral cortex .

- except

Lower & anterior parts of temporal lobes which are connected by anterior commissure.

Parts:

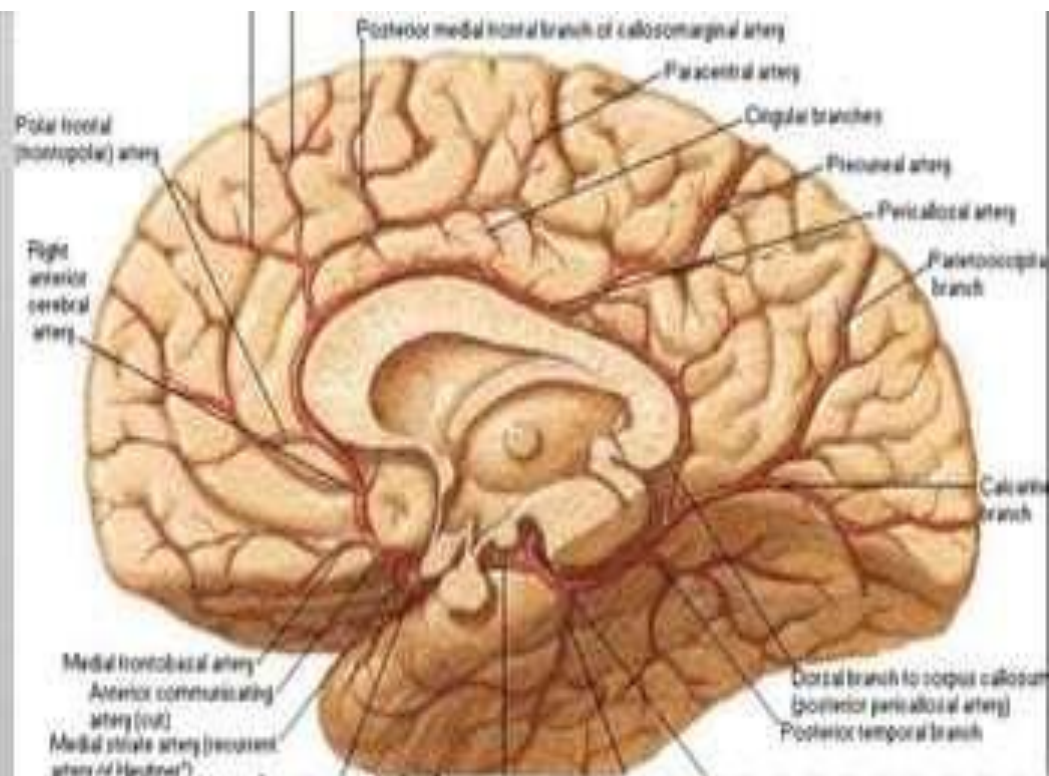
*Genu:*

-is the anterior end

-lies 4 cm behind the frontal pole.

-related anteriorly to **anterior cerebral arteries**

-posteriorly to **anterior horn of lateral ventricle**



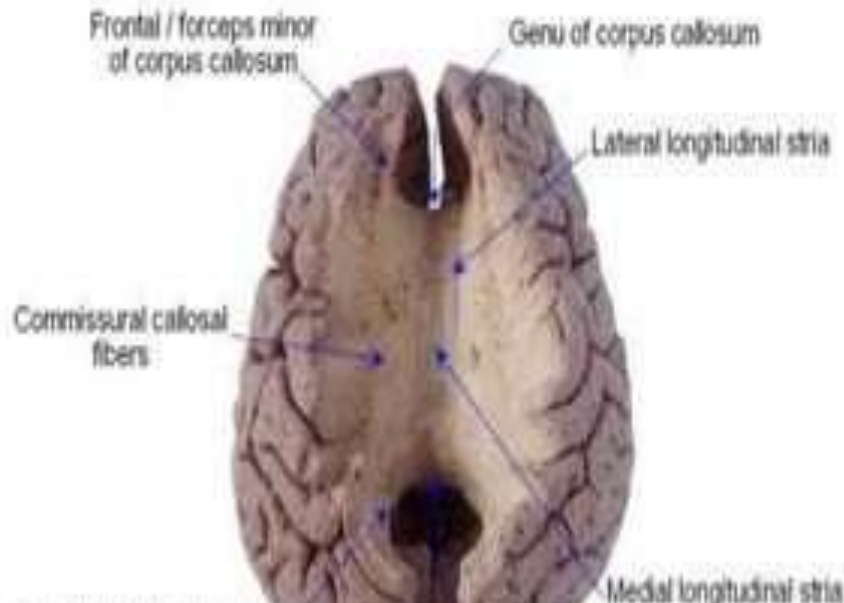
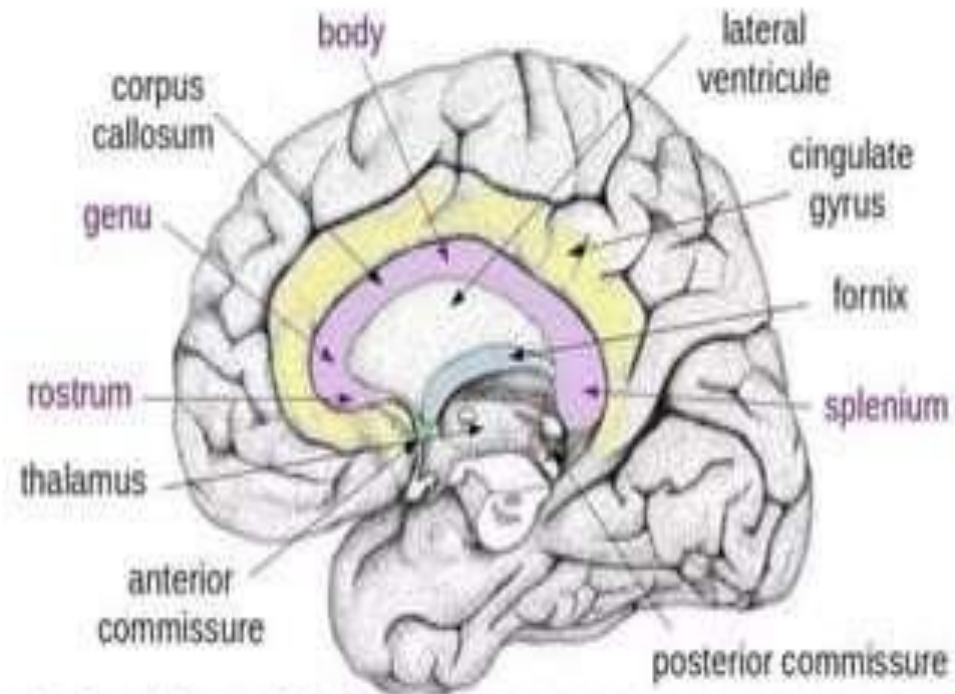
**Lateral ventricle**



**Cerebral hemisphere**

## Rostrum:

- is directed downwards & backwards from genu.
- ends by joining the lamina terminalis, in front of the anterior commissure.
- related superiorly to **anterior horn of the lateral ventricle**
- inferiorly to the **indusium griseum** and the **longitudinal striae**.



## Lateral ventricle



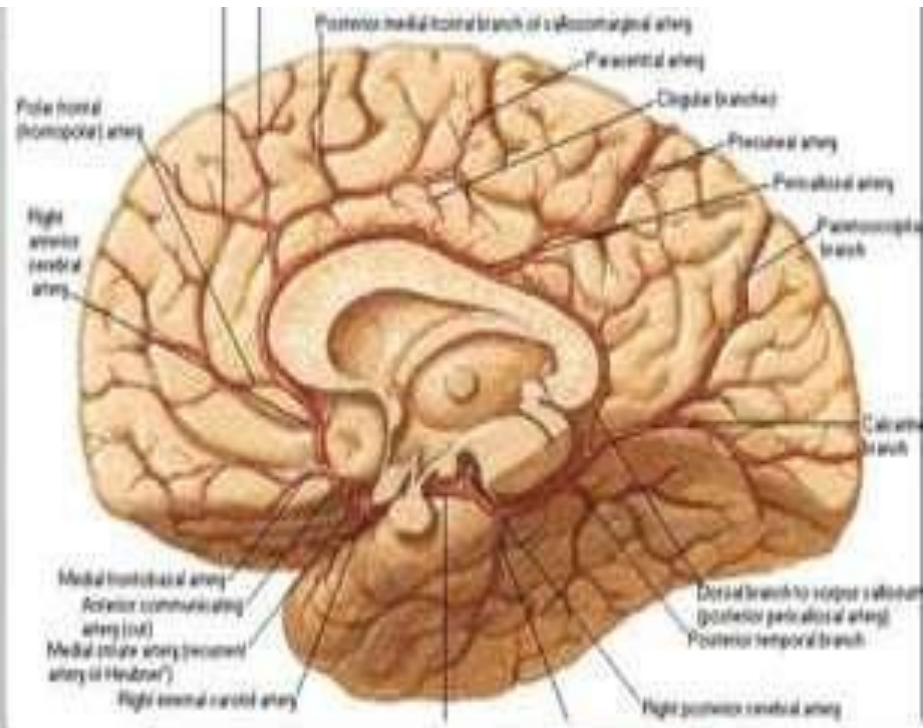
### Trunk or body:

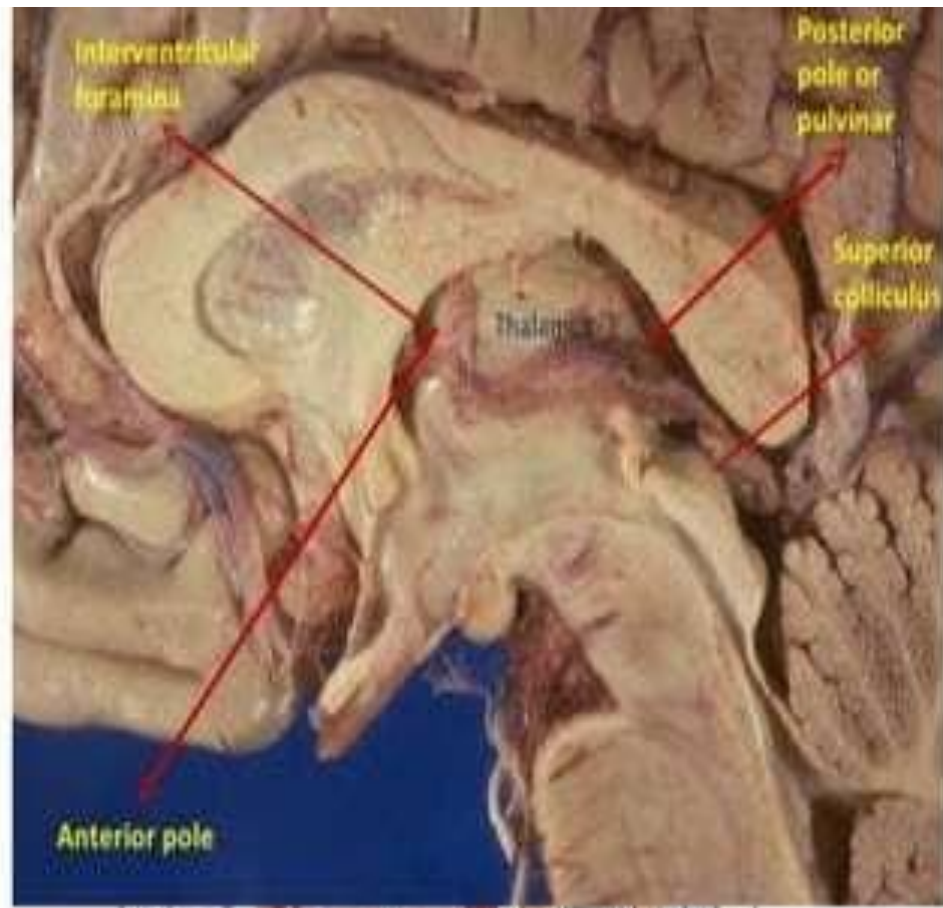
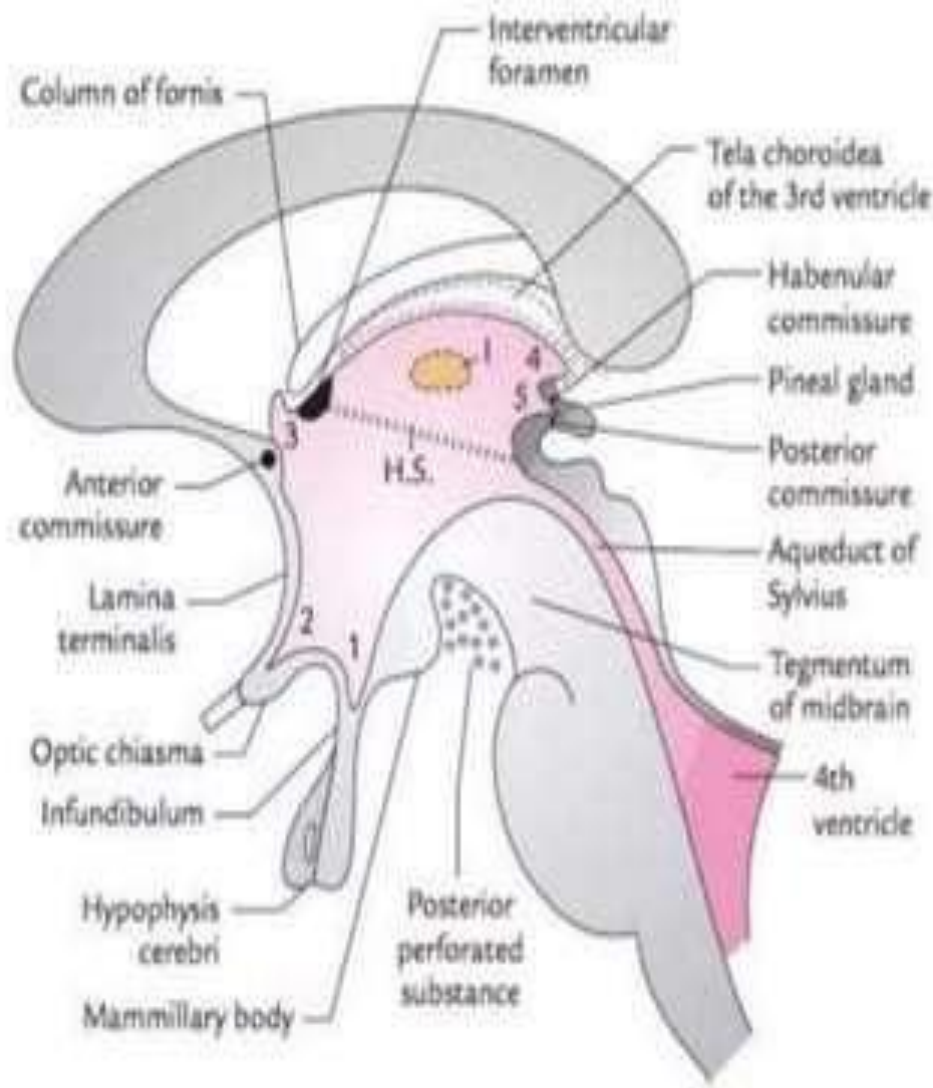
#### Superior surface

- Is related to **anterior cerebral arteries**, lower border of the **falx cerebri**.
- overlapped by the **gyrus cinguli** and is covered by **indusium griseum** & **longitudinal striae**.

#### Inferior surface

- provides attachment to **septum pellucidum** & **fornix**,
- forms **roof of central part of lateral ventricle**





\*Inferior surface is related to tela choroidea of third ventricle, pulvinar, pineal body & tegmentum of

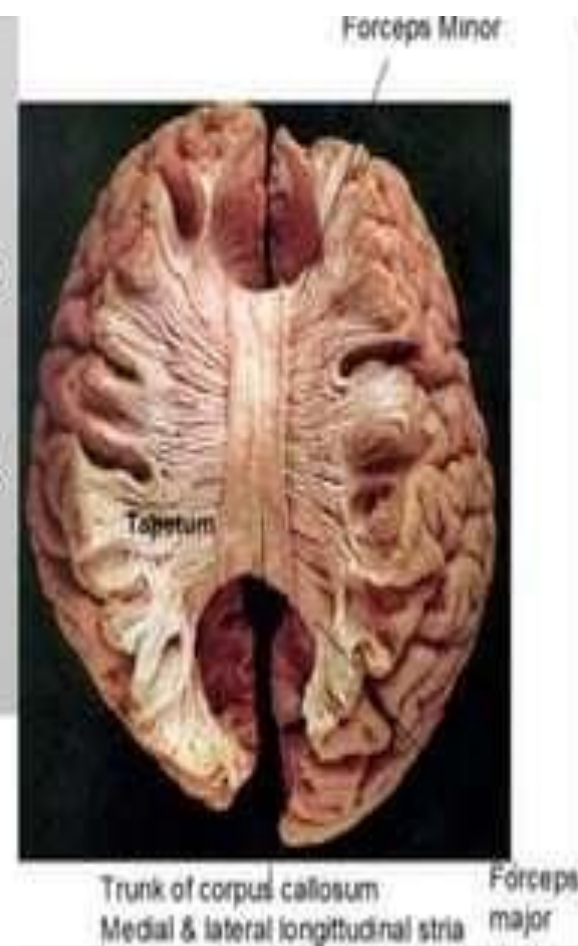
## Fibres of Corpus Callosum

1. **Rostrum**: connects orbital surfaces of two frontal lobes.
2. **Forceps minor**: made up of fibres of genu connecting two frontal lobes
3. **Forceps major**: made up of fibres of splenium connecting two occipital lobes
4. **Tapetum**: made up of fibres from trunk & splenium.

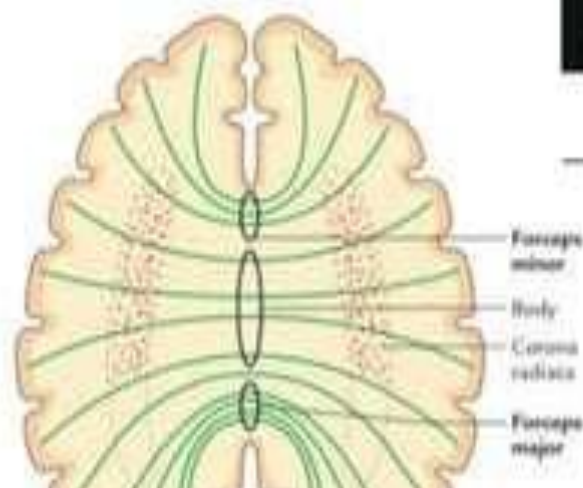
Tapetum forms- roof & lateral wall of the posterior horn,  
- lateral wall of inferior horn of the lateral ventricle.

## Functional Significance

Corpus callosum helps in coordinating activities of the two hemispheres.



are referred to as the Tapetum.



## Frontal Lobe:

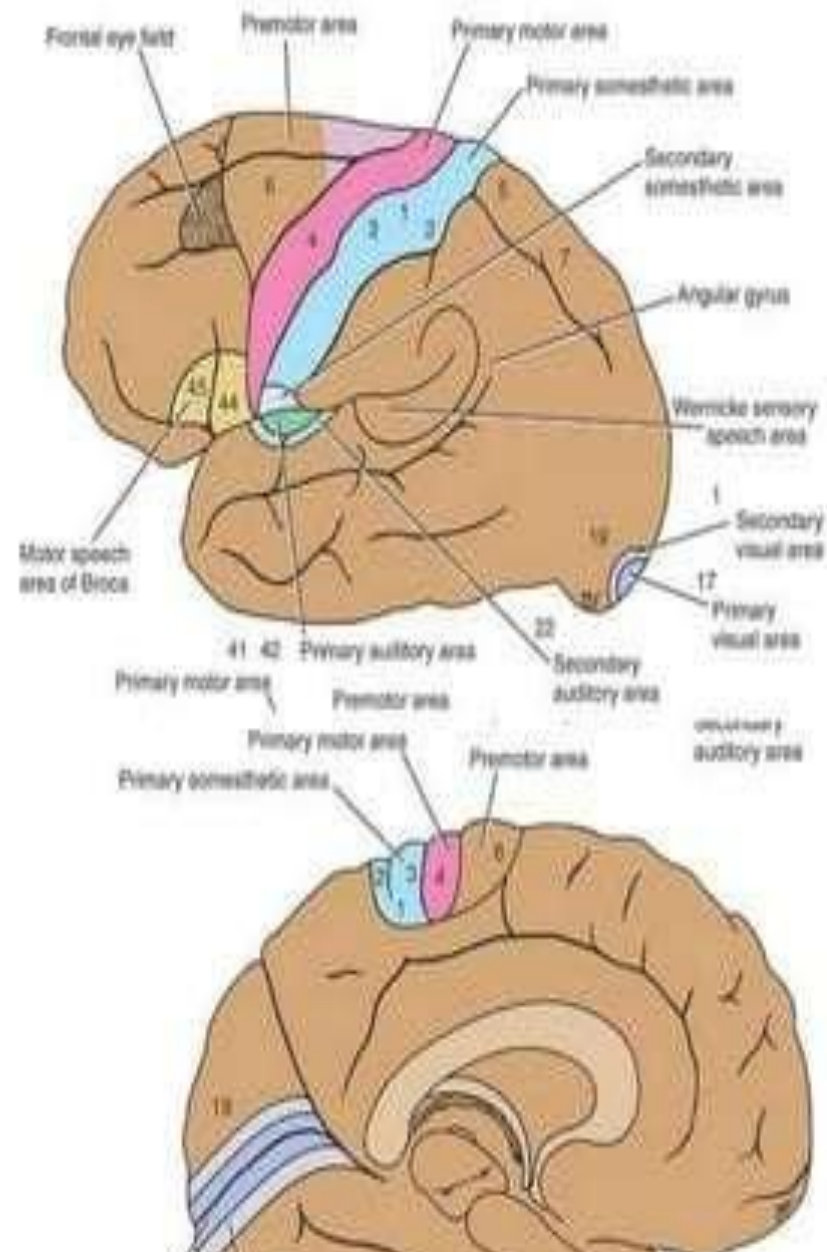
**Precentral area:** -Situated in the precentral gyrus;  
-Includes anterior wall of central sulcus & posterior parts of superior, middle & inferior frontal gyri  
-Extends over superomedial border of hemisphere into the paracentral lobule

**precentral area: divided into posterior & anterior regions.**

**Posterior region- primary motor area (Brodmann area 4):**  
occupies precentral gyrus extending over the superior border into the paracentral lobule.

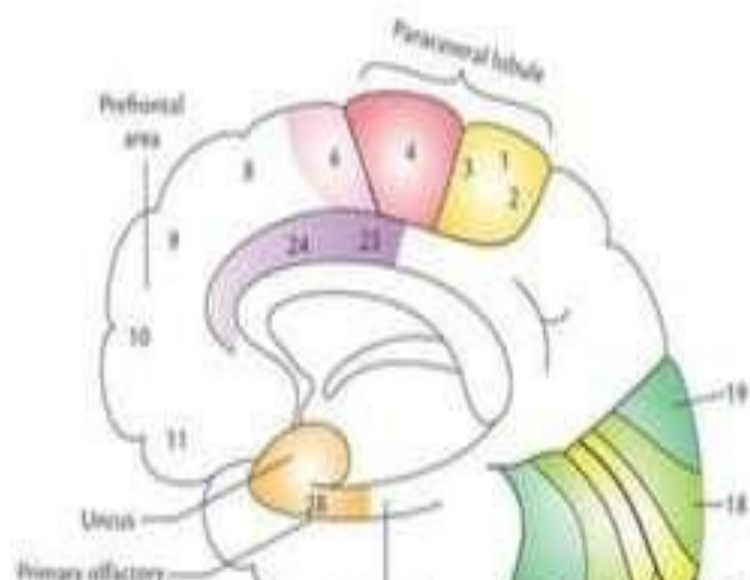
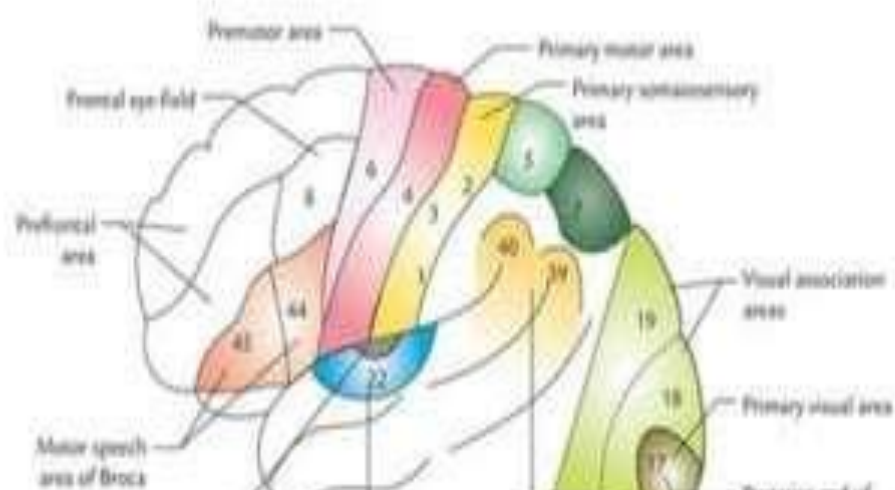
-Receives numerous afferent fibers from the premotor area, sensory cortex, thalamus, cerebellum & basal ganglia.

-is the final station for conversion of the design of movement into execution of the movement.



Although the primary motor area control contralateral musculature of body, the muscles of the upper part of the face, tongue (genioglossus), mandible, larynx, pharynx and axial musculatur has significant bilateral control

Lesions of primary motor area in one hemisphere produce **flaccid paralysis** of the extremities of the opposite half of the body (**hemiplegia**). The upper facial, extraocular, masticatory, laryngeal & pharyngeal muscles are spared for being represented bilaterally.



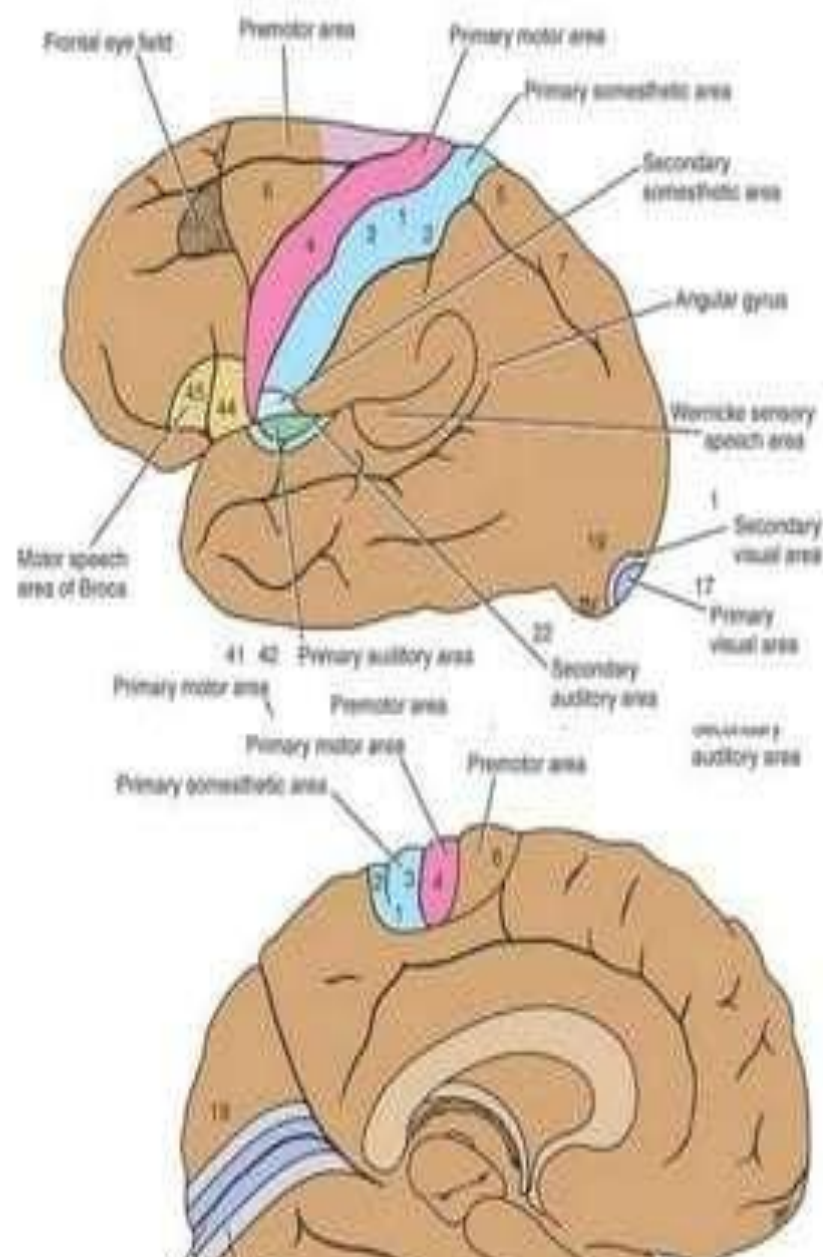
Anterior region-  
secondary motor area (premotor area) ( **Brodmann area 6** )

-Occupies the anterior part of the precentral gyrus and the posterior parts of the superior, middle, and inferior frontal gyri.

-premotor area receives numerous inputs from the sensory cortex, the thalamus & basal ganglia.

-Function is to store programs of motor activity assembled as the result of past experience. Thus, premotor area programs the activity of primary motor area

Lesions of premotor (secondary motor) area produce difficulty in performance of skilled movements.



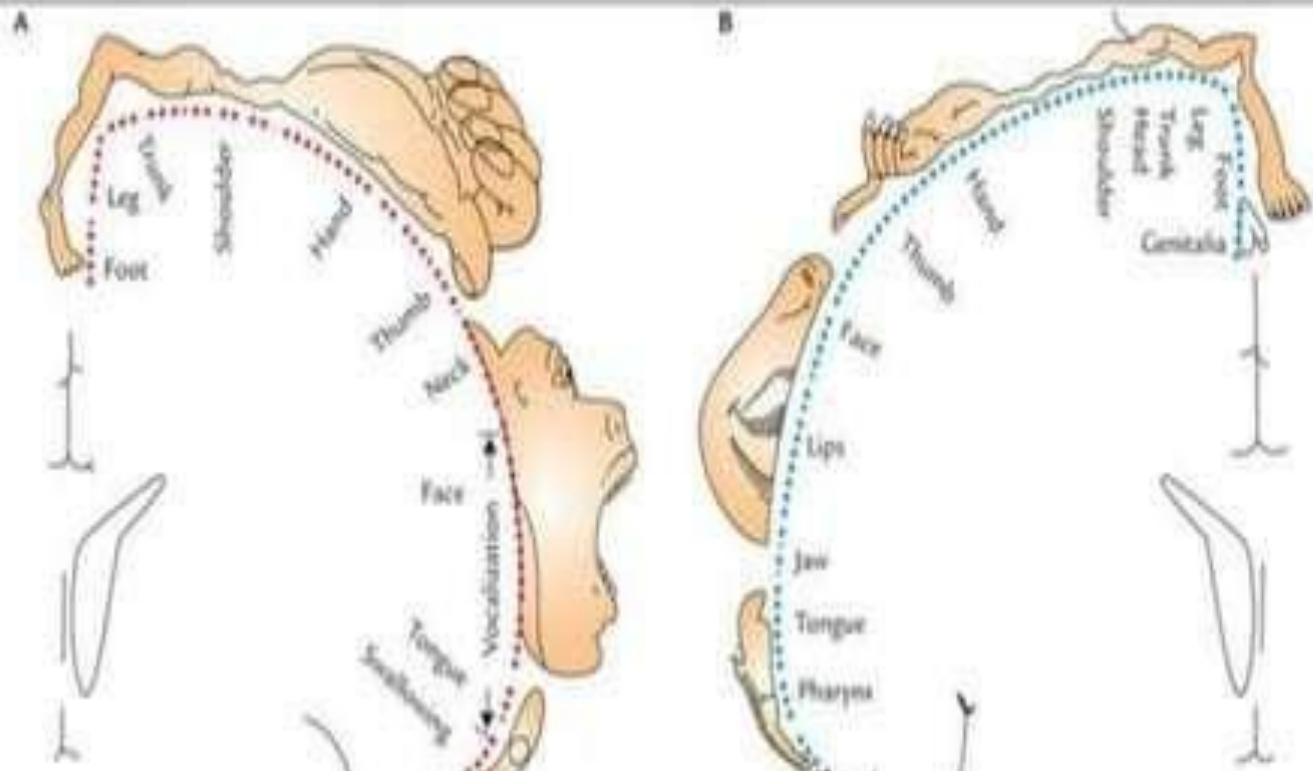


### Motor homunculus:

Area of cortex controlling a particular movement is proportional to the skill involved in performing the movement and is unrelated to muscle mass participating in the movement.

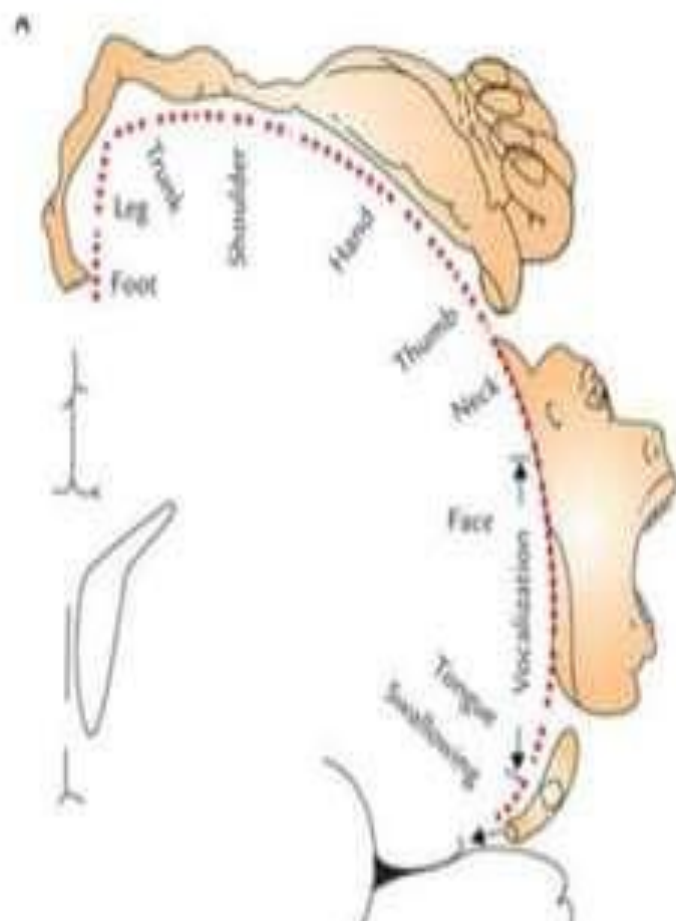
### Sensory homunculus:

Area of cortex allocated to each part of the body is directly proportional to the number of sensory receptors present in that part of the body.



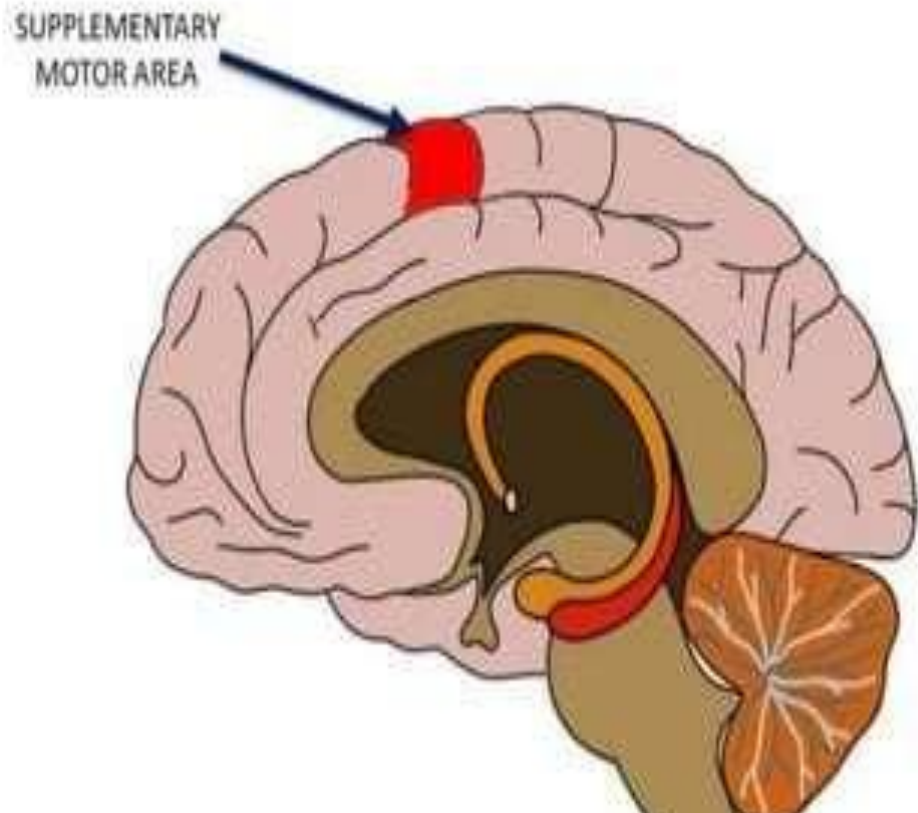
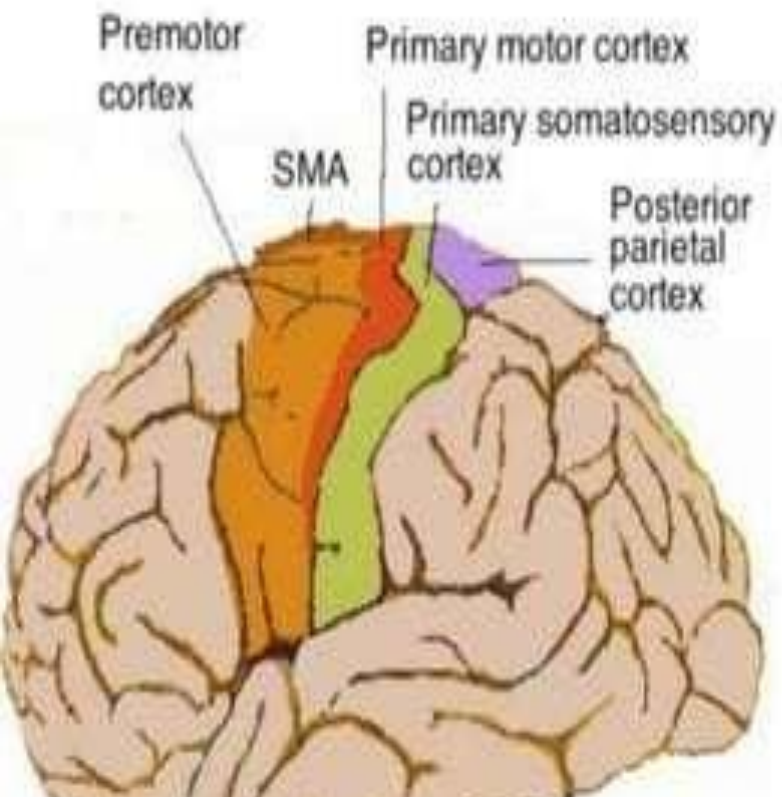
**Jacksonian epileptic seizure:** is due to an irritative lesion of the primary motor area (area 4).

convulsive movement may be restricted to one part of the body or may involve many regions, depending on the irritation of the primary motor area



## Supplementary motor area:

- situated on the medial surface of the hemisphere, anterior to the paracentral lobule.
- Stimulation results in movements of the contralateral limbs, but a stronger stimulus is necessary.
- Removal of the supplementary motor area produces no permanent loss of movement.



## Frontal eye field (parts of Brodmann areas 6, 8 & 9):

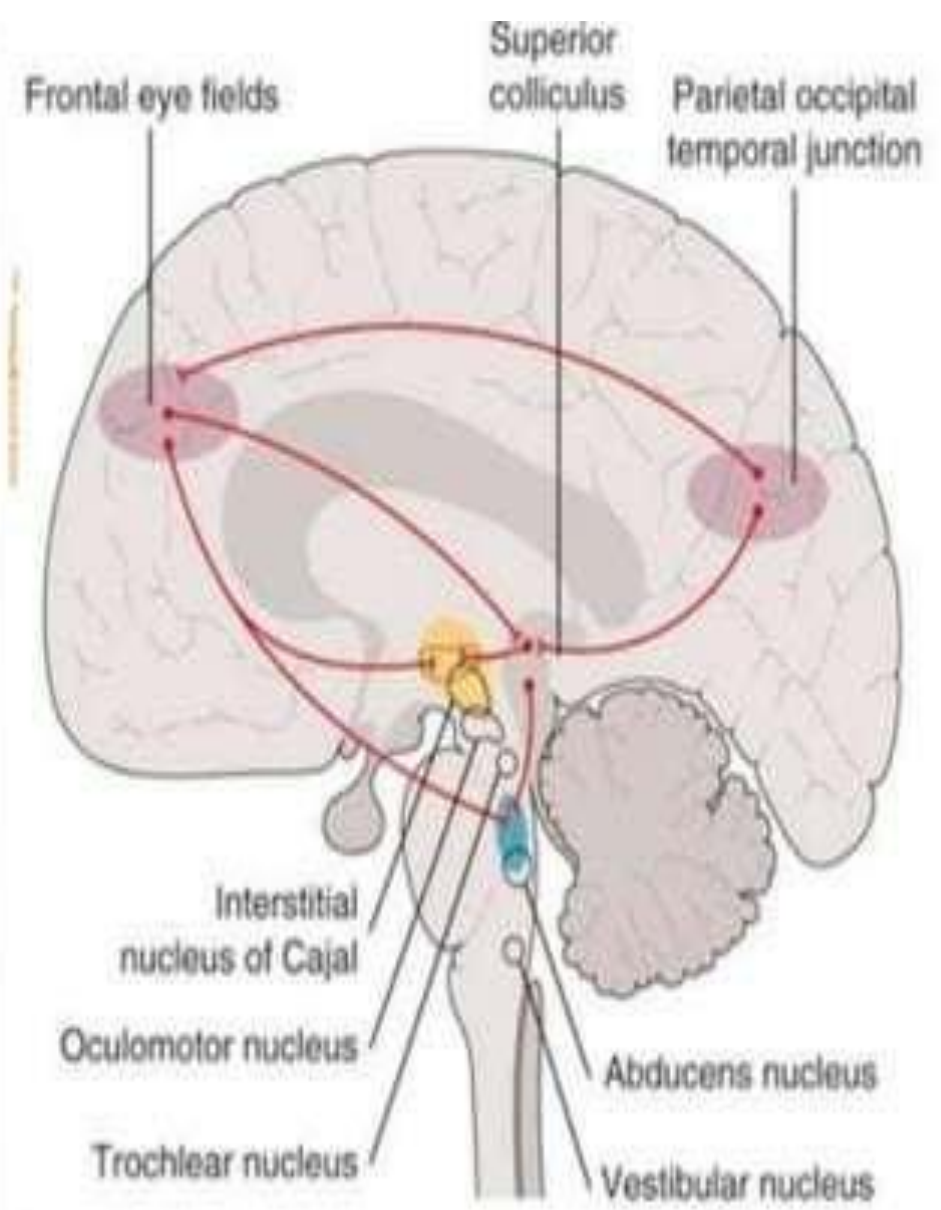
--Extends forward from precentral gyrus into the middle frontal gyrus

-Stimulation causes conjugate movements of eyes.

- Nerve fibers from this area pass to the **superior colliculus** which is connected to **the nuclei of the extraocular muscles** by **paramedian pontine reticular formation** reticular formation.

-Frontal eye field, **control voluntary scanning movements of eye and is independent of visual stimuli.**

-Involuntary following of moving objects by the eyes involves the visual area of the occipital cortex. (to which the frontal eye field is connected by association fibers.)



Rostral interstitial nucleus of the medial longitudinal fasciculus

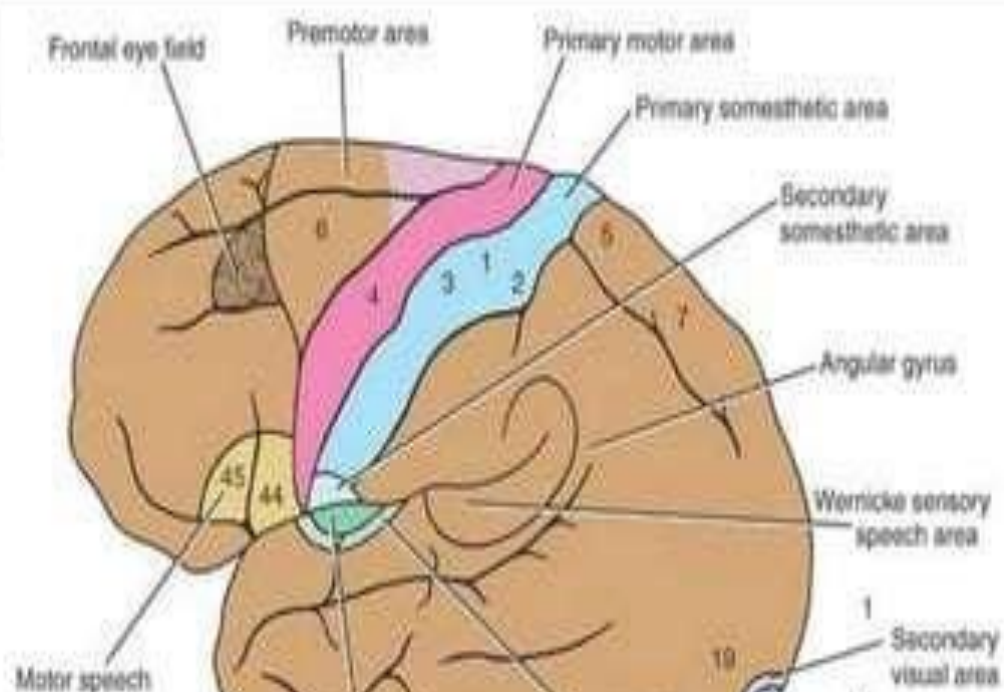
Motor speech area(Broca Area)(Brodmann areas 44& 45)

-Located in inferior frontal gyrus between anterior & ascending rami and ascending and posterior rami of the lateral sulcus.

-Broca area brings about the formation of words by its connections with the adjacent primary motor areas that stimulate the muscles of the larynx, mouth, tongue, soft palate, and the respiratory muscles

-Ablation of Broca area on the dominant hemisphere will result in paralysis of speech.

**Expressive aphasia (motor aphasia).**

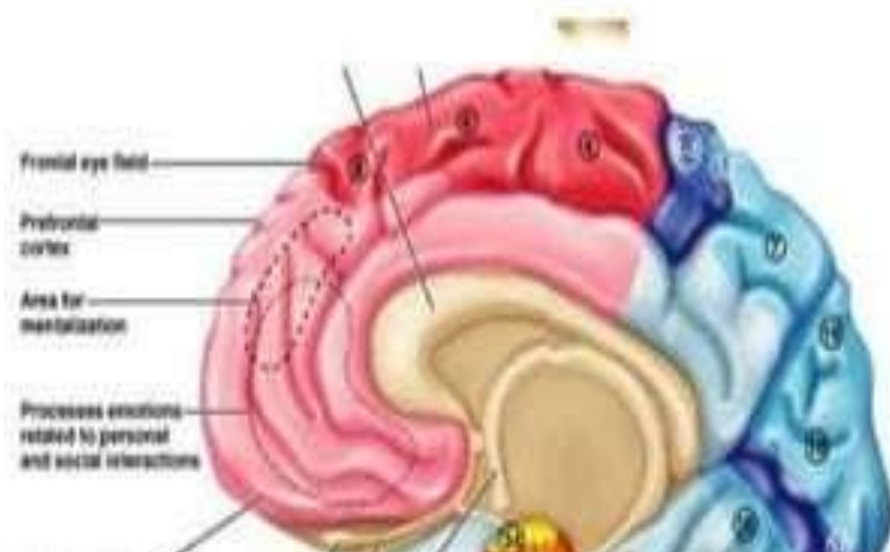
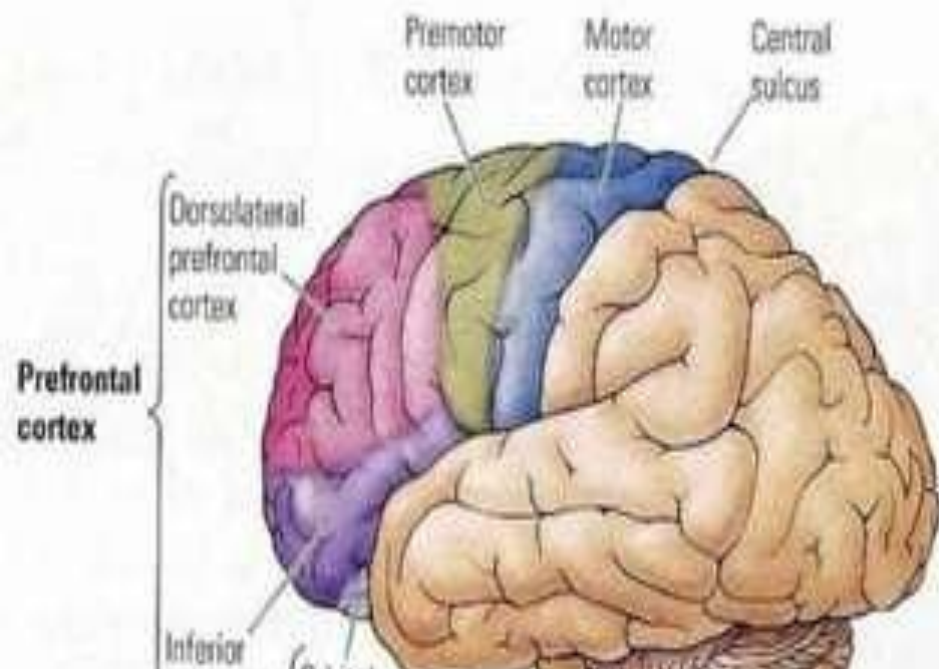


## Prefrontal cortex (Brodmann areas 9, 10, 11, and 12):

-lies anterior to the precentral area.

-Includes

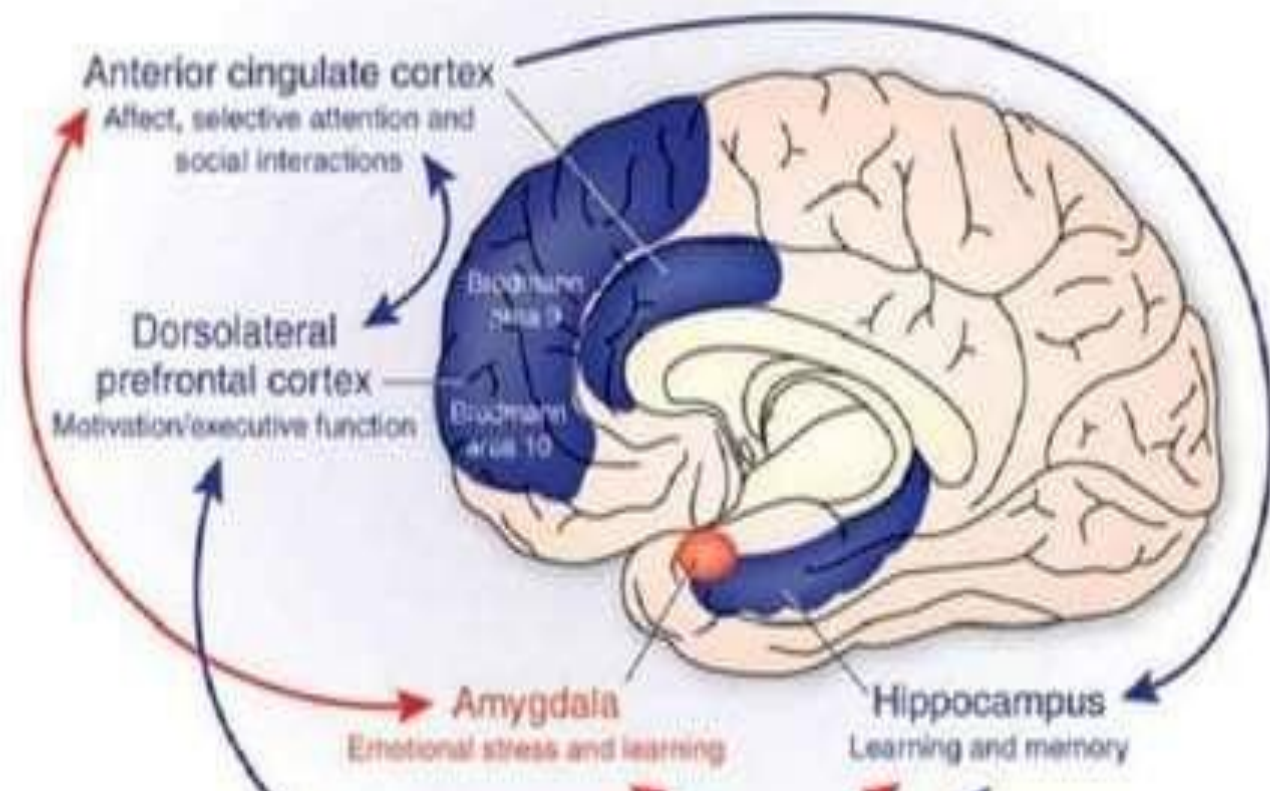
Greater parts of superior, middle & inferior frontal gyri; orbital gyri; most of the medial frontal gyrus & anterior half of cingulate gyrus



**Prefrontal area is concerned with makeup of individual's personality**

Large numbers of afferent and efferent pathways connect the prefrontal area with other areas of the cerebral cortex, the thalamus, the hypothalamus, and the corpus striatum.

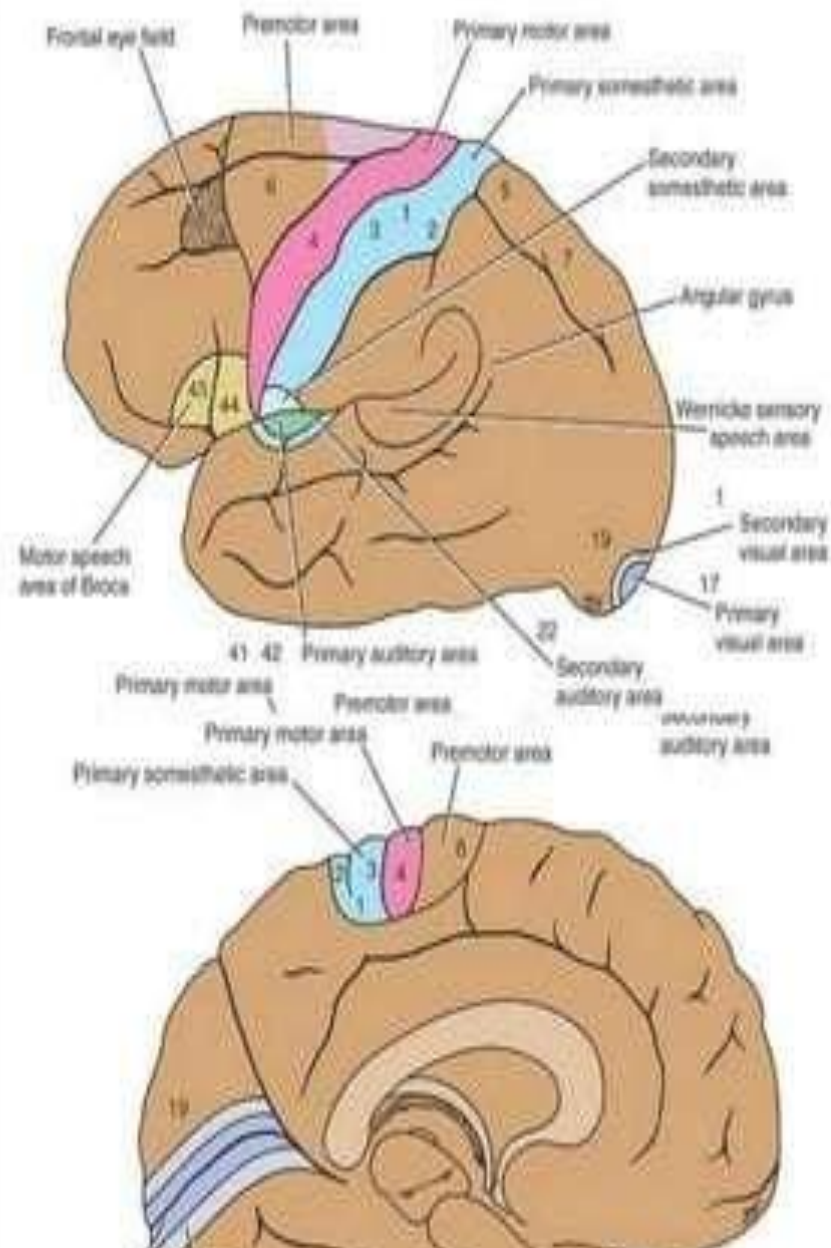
### The corticolimbic system



## Parietal Lobe

Primary somesthetic area (primary somatic sensory cortex)  
(Brodmann areas 3, 1, and 2):

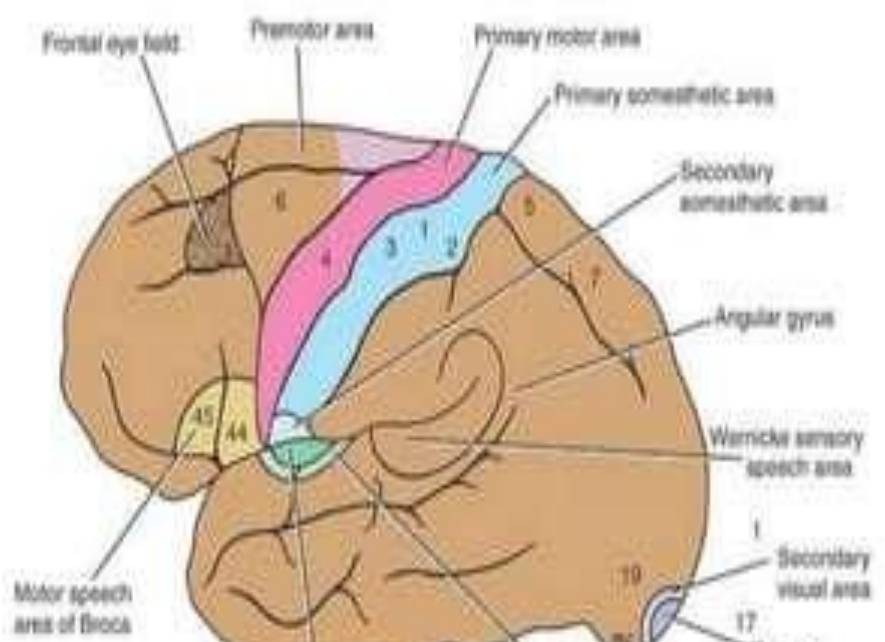
- Located in the postcentral gyrus and extends into posterior part of the paracentral lobule.
- primary sensory area receives projection fibres from nuclei of the thalamus
- *Is concerned with the perception of extero-ceptive (pain, touch and temperature) and proprioceptive (vibration, muscle and joint sense) sensations from the opposite half of the body.* However, sensations from pharynx, larynx and perineum go to both sides.
- Lesions of primary sensory area lead to the loss of appreciation of exteroceptive and proprioceptive sensations from the opposite half of the body.





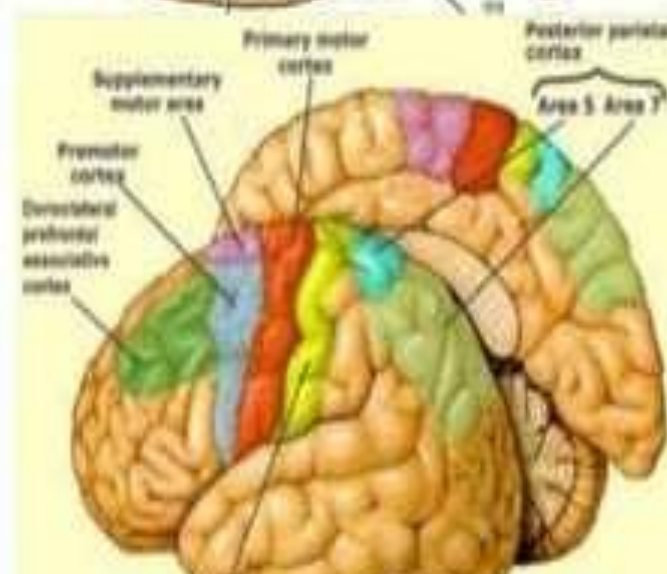
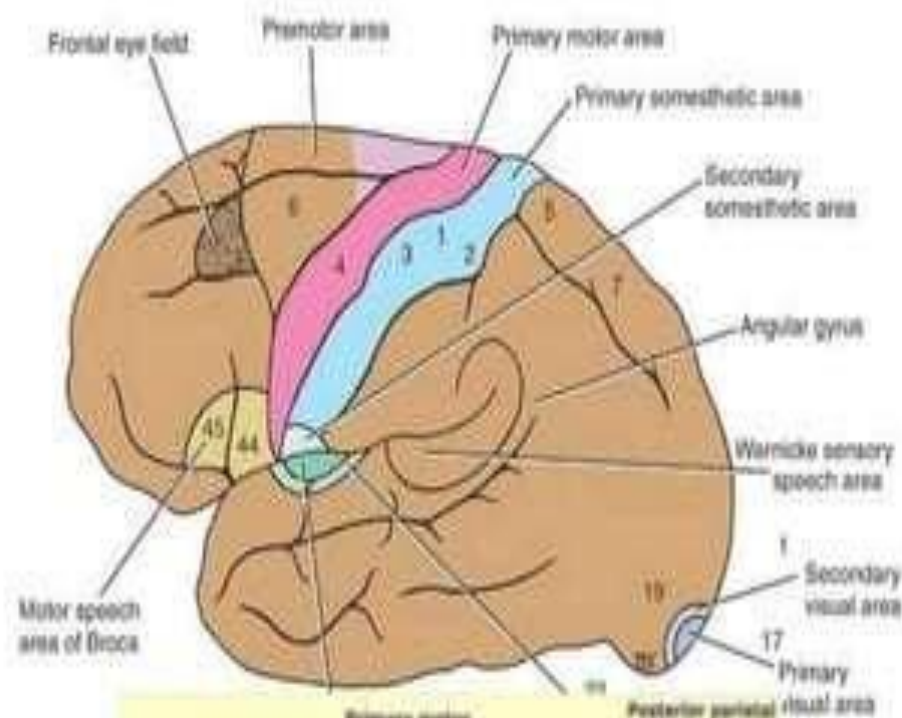
## Secondary somesthetic area (secondary somatic sensory cortex)

- Lie in the superior lip of the posterior limb of lateral sulcus
- Functional significance is not understood.



### somesthetic association area (Brodmann areas 5 & 7):

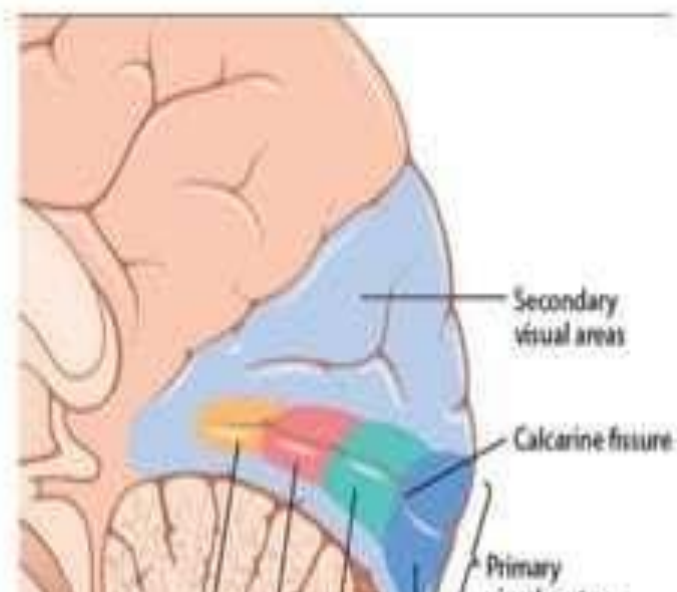
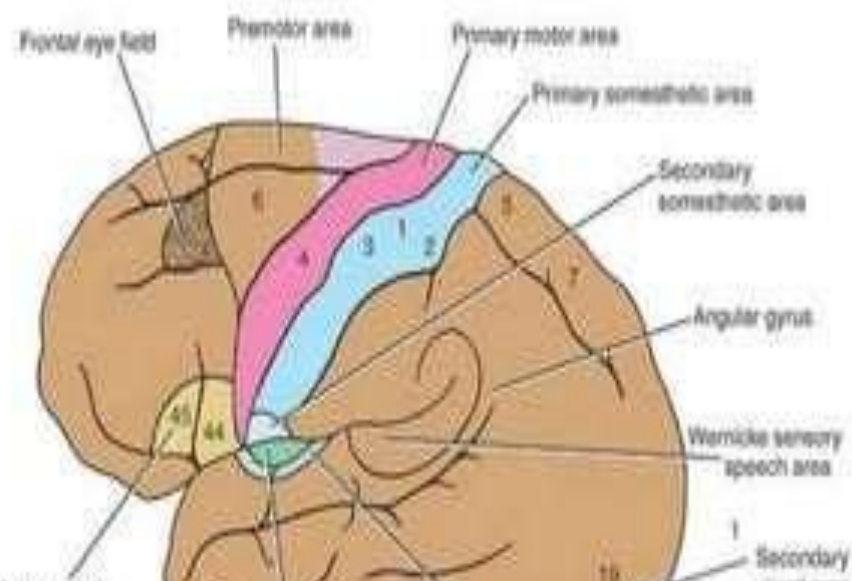
- occupies superior parietal lobule extending onto the medial surface of the hemisphere.
- This area has many connections with other sensory areas of the cortex.
- its main function is to receive and integrate different sensory modalities (*stereognosis*)
- Lesions of this area result in inability to recognize or identify an object by its feel- **Tactile agnosia** or **astereognosis**.



## Occipital Lobe

Primary visual area (Brodmann area 17):

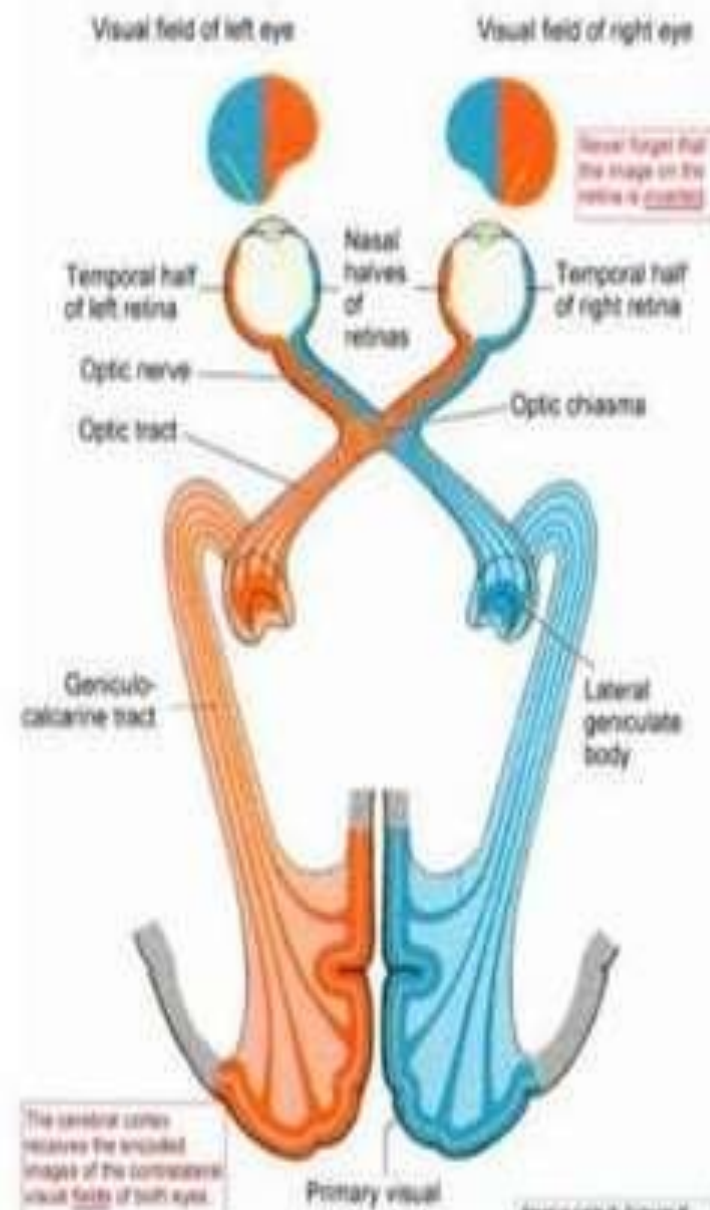
- Situated in walls of posterior part of calcarine sulcus & extends around occipital pole.



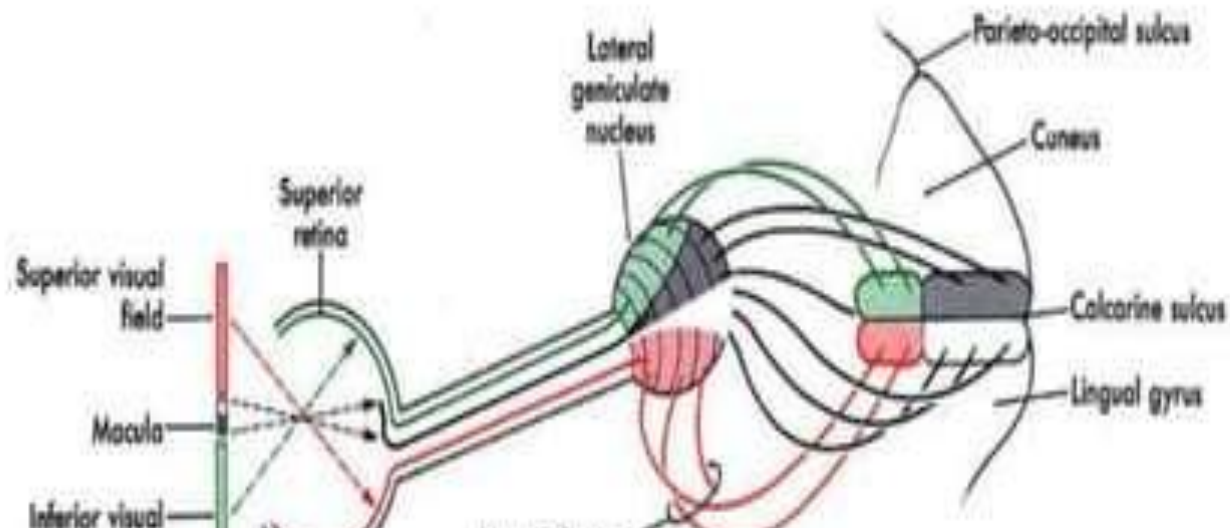
Visual cortex receives afferent fibers from temporal half of ipsilateral retina and the nasal half of the contralateral retina.

The right half of the field of vision is represented in visual cortex of the left cerebral hemisphere and vice versa.

Lesions of the primary visual area result in the loss of vision in the opposite visual field



- Superior retinal quadrants (inferior field of vision) pass to superior wall of calcarine sulcus.
- Inferior retinal quadrants (superior field of vision) pass to inferior wall of calcarine sulcus.
- Macula lutea- central area of the retina and the area for most perfect vision, is represented on occipital cortex in the posterior part of area 17



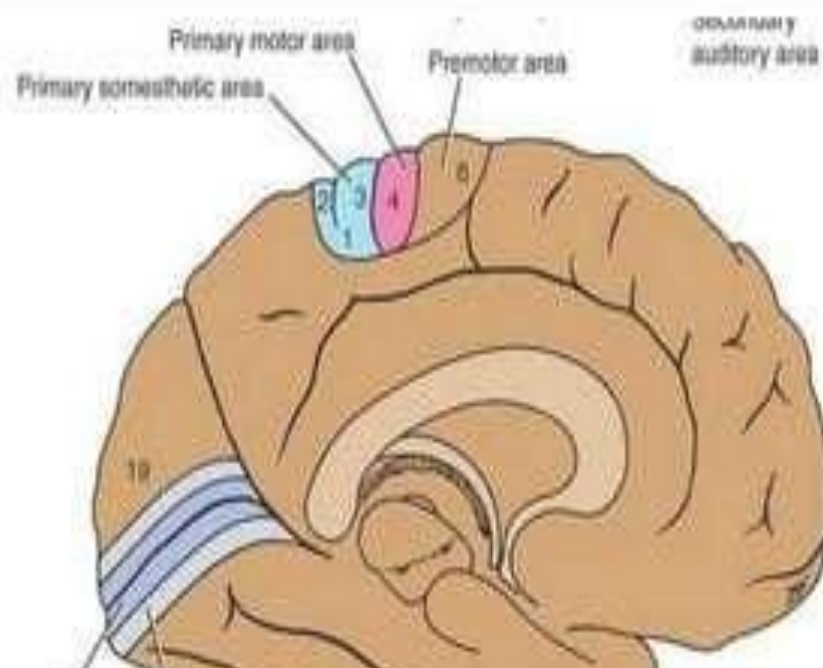
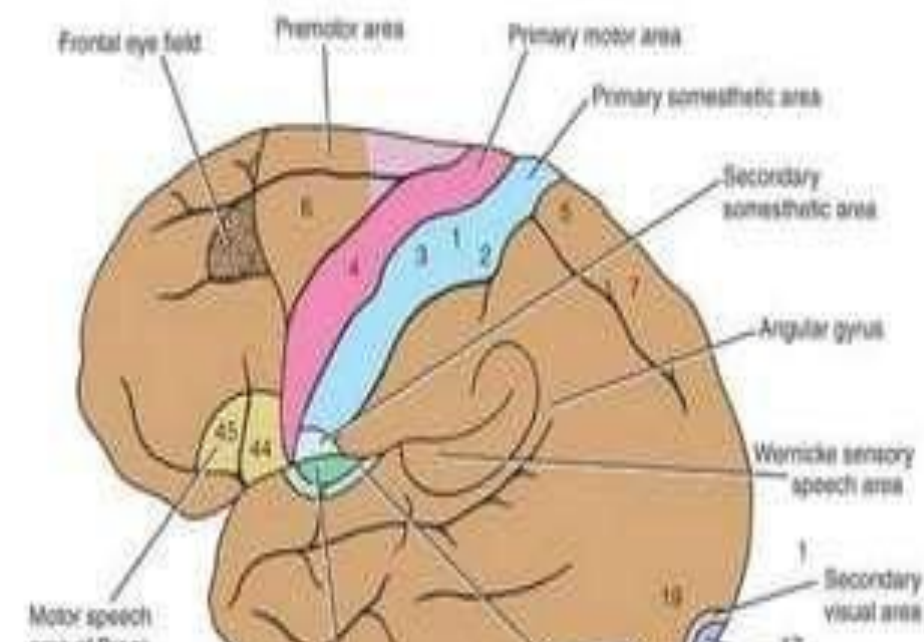
## Secondary visual area (Brodmann areas 18 & 19) :

-Surrounds primary visual area on medial & lateral surfaces

-Receives afferent fibers from area 17 & other cortical areas as well as from the thalamus.

-Function : relate the visual information received by primary visual area to past visual experiences

-Lesions of the secondary visual area result in a loss of ability to recognize objects (**visual agnosia**)



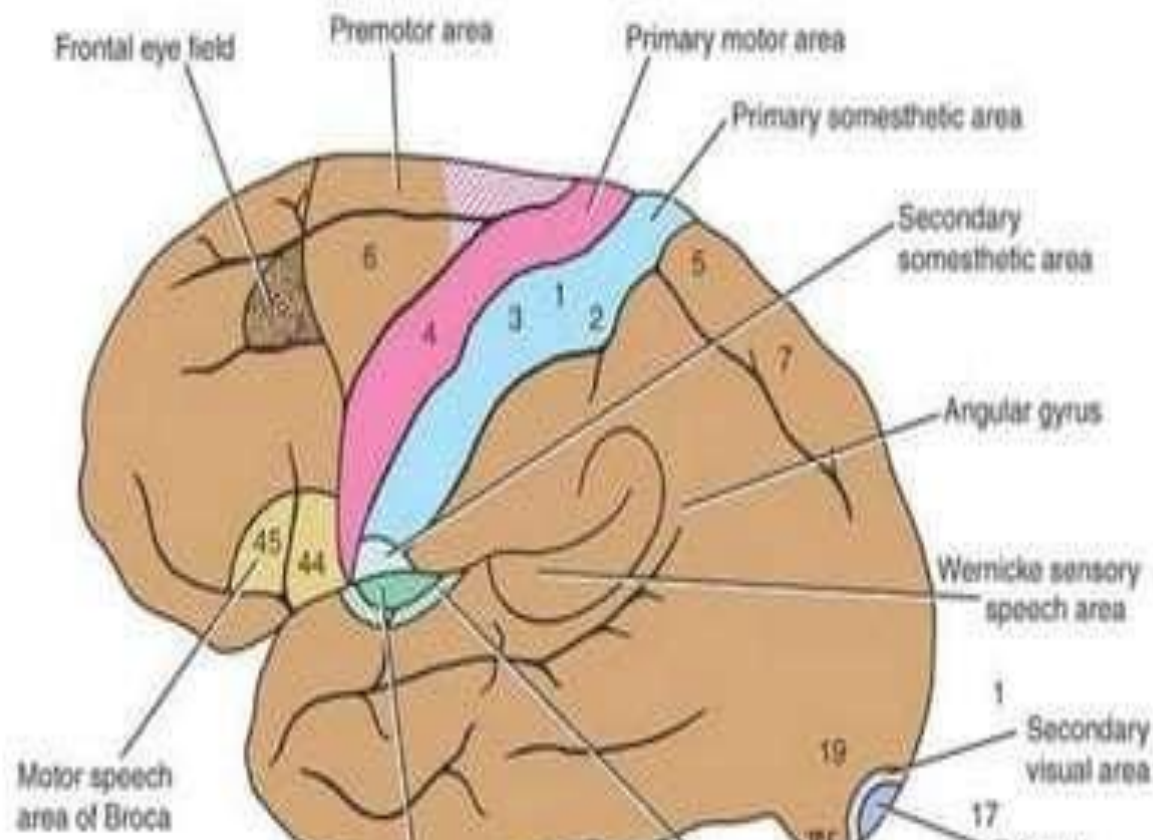
## Temporal Lobe

Primary auditory area (Brodmann areas 41 and 42):

-Includes gyrus of Heschl and is situated in the inferior wall of the lateral sulcus.

-Area 41 is a granular type of cortex

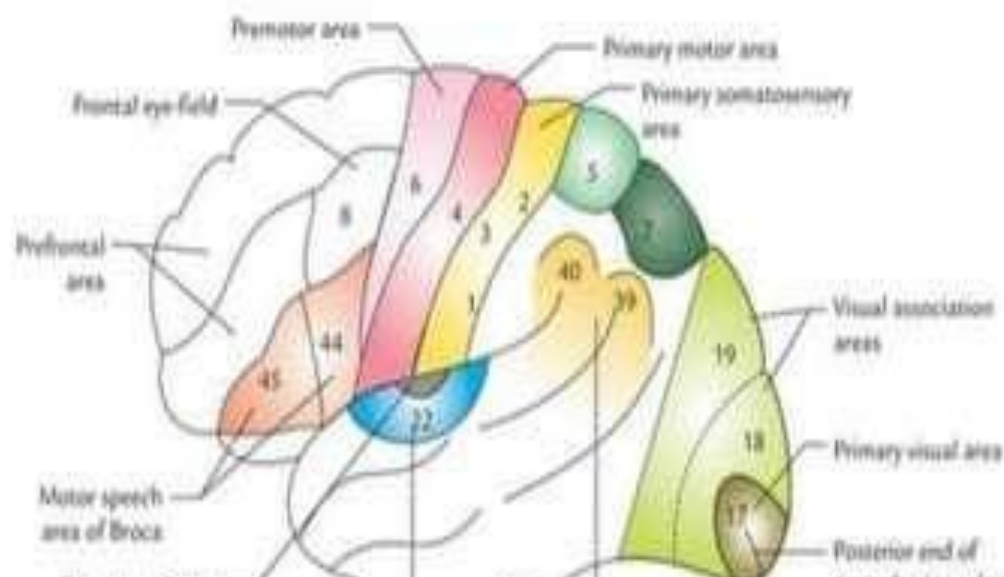
-Area 42 is homotypical and is mainly an auditory association area



## Secondary auditory area/auditory association area (Brodmann's area 22)

- Located on the lateral surface of the superior temporal gyrus
- It receives auditory impulses from primary auditory area and correlates them with the past auditory experiences.

Lesions of secondary auditory area result in an inability to interpret the meaning of the sounds heard, and the patient may experience **word deafness (auditory verbal agnosia)**.

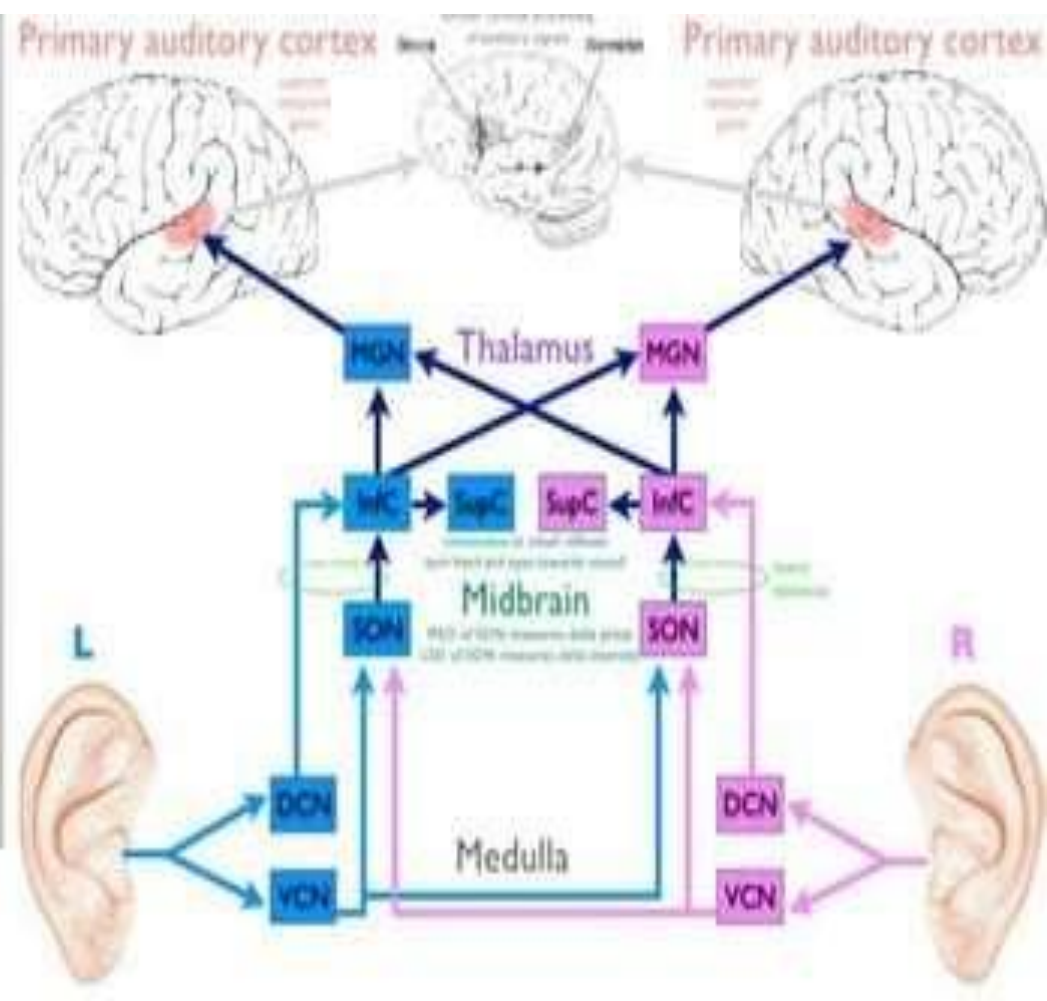




Anterior part of the primary auditory area is concerned with the reception of sounds of low frequency & posterior part is concerned with the sounds of high frequency.

Unilateral lesion of the auditory area produces partial deafness in both ears, the greater loss being in the contralateral ear.

\*Medial geniculate body receives fibers mainly from the organ of Corti of the opposite side as well as some fibers from the same side.



## Sensory speech area of Wernicke (Area 39 & 40 of Brodmann)

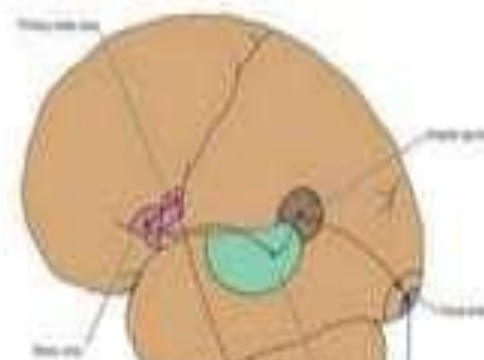
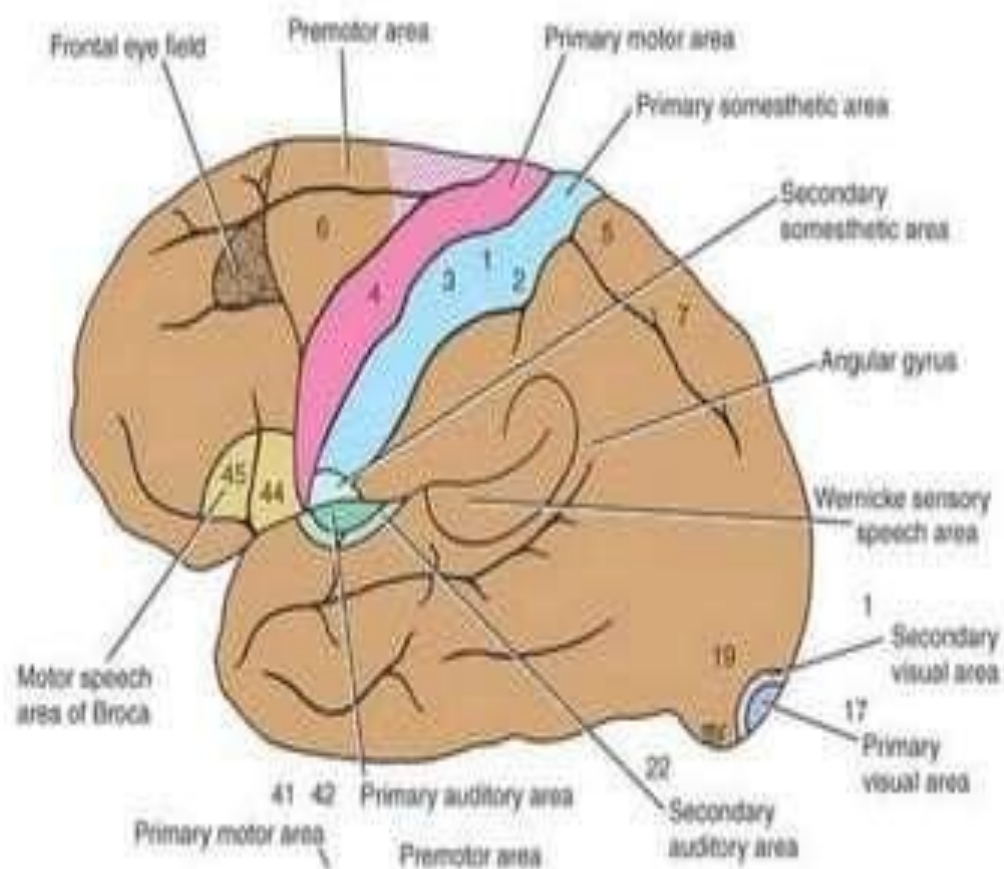
- Located in posterior part of the superior temporal gyrus of temporal lobe and angular (area 39) & supramarginal (area 40) gyri of inferior parietal lobule of dominant hemisphere

- *Is concerned with the interpretation of language through visual and auditory input.*

- *Wernicke's area is connected to Broca's area by a bundle of nerve fibres – **arcuate fasciculus**.*

- Lesions of Wernicke's area produce loss of ability to understand the spoken and written speech - **Receptive sensory aphasia**

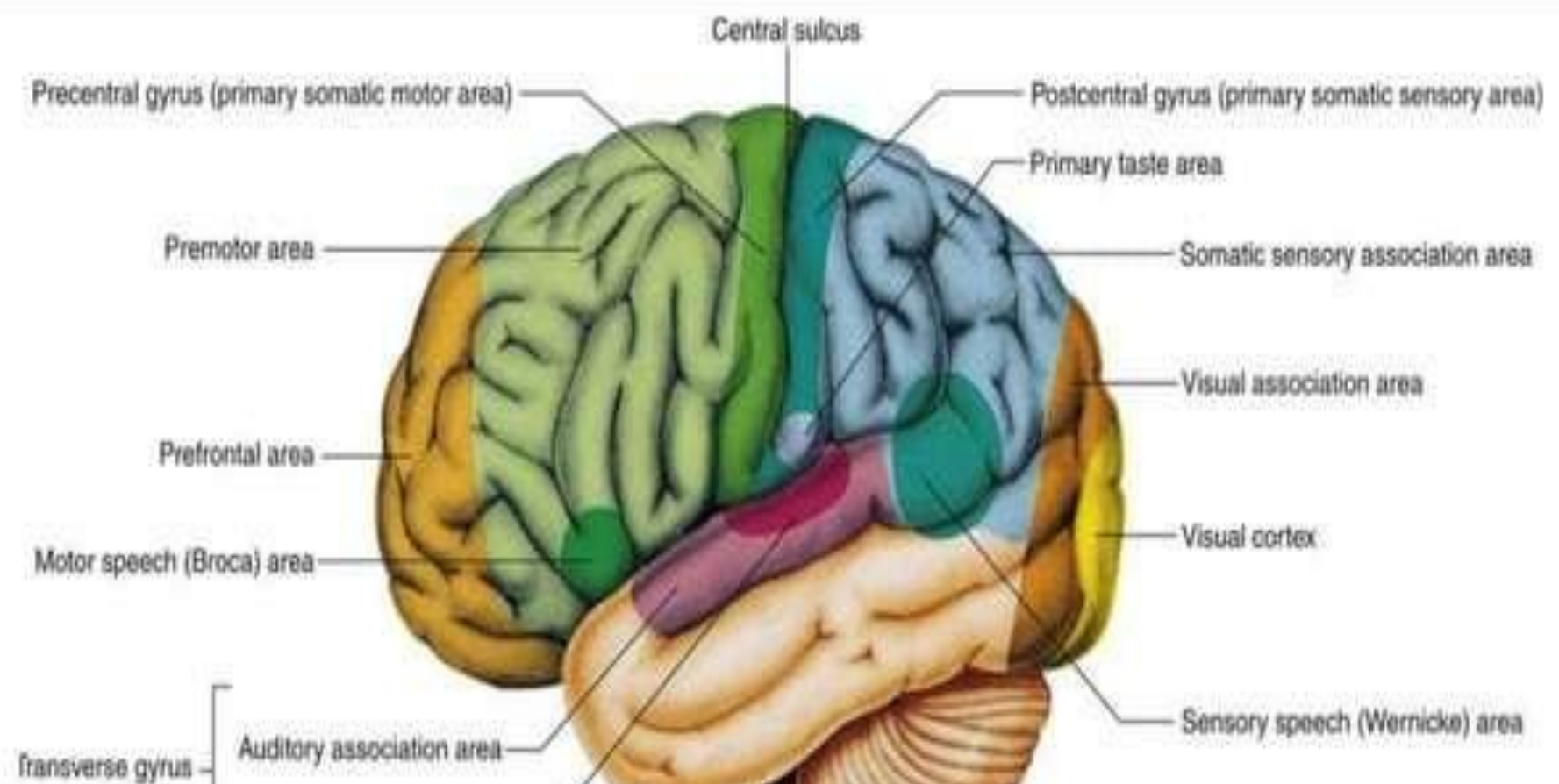
- Lesions involving both Broca's & Wernicke's speech areas result in loss of production of



## Taste area (Brodmann area 43). :

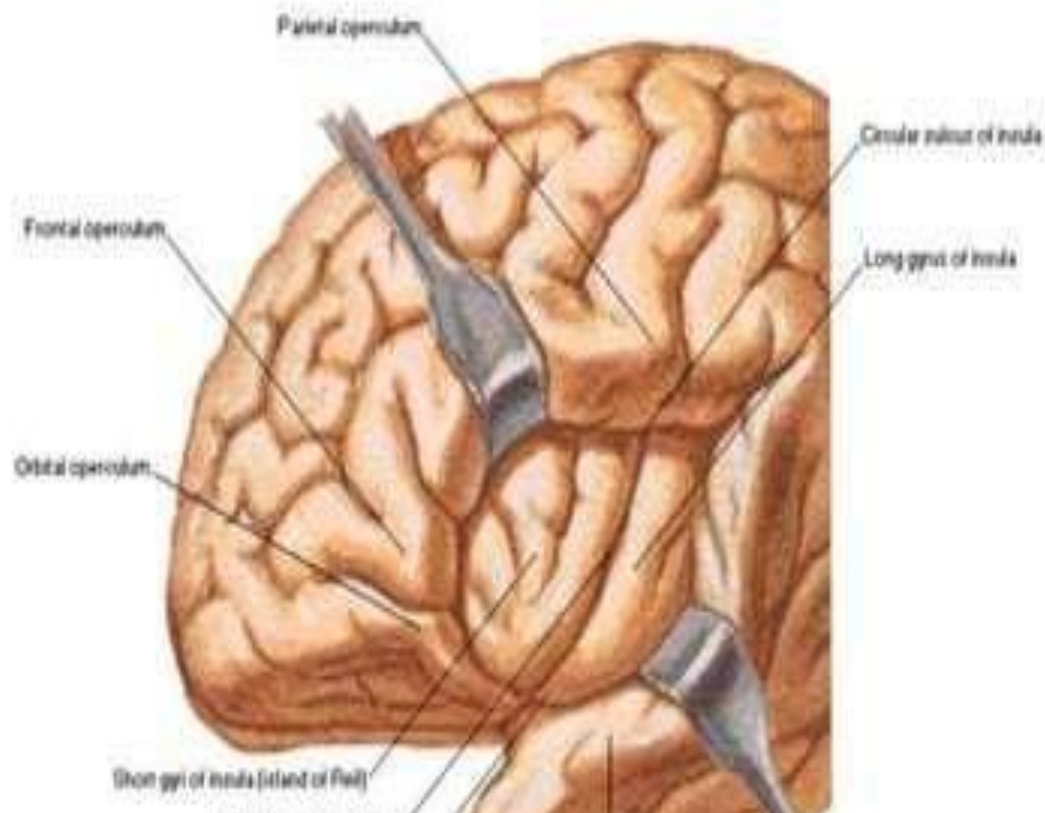
--lie at the lower end of the postcentral gyrus in the superior wall of the lateral sulcus and in the adjoining area of the insula.

--Fibers from the nucleus solitarius ascend to the ventral posteromedial nucleus of the thalamus, where they synapse on neurons that send fibers to the cortex.



**Insula:** is an area of the cortex that is buried within the lateral sulcus and forms its floor

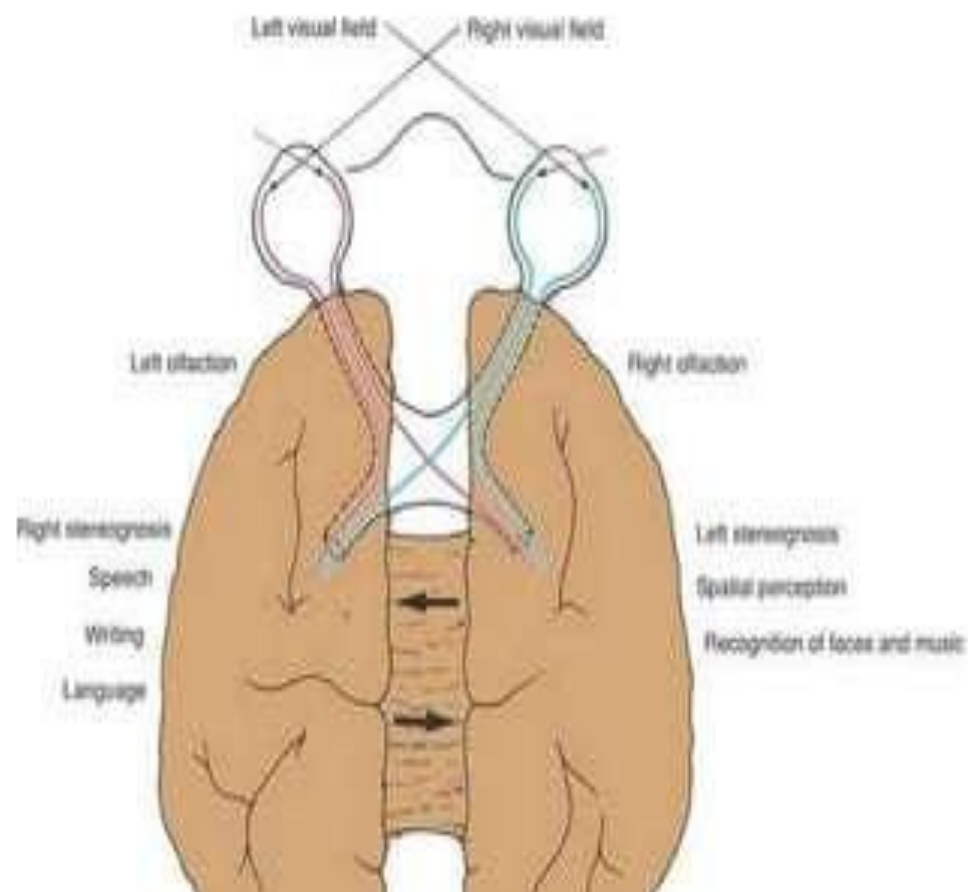
- important for planning or coordinating the articulatory movements necessary for speech.



## Cerebral Dominance

90% of the adult population is right-handed and, therefore, is left hemisphere dominant. About 96% of the adult population is left hemisphere dominant for speech.

It is only after the first decade that the dominance becomes fixed



**Thank you**