

# CEREBRUM



BY  
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**Neuroanatomy** – Study of the nervous system.

Nervous system is the chief controlling and coordinating system of the body.

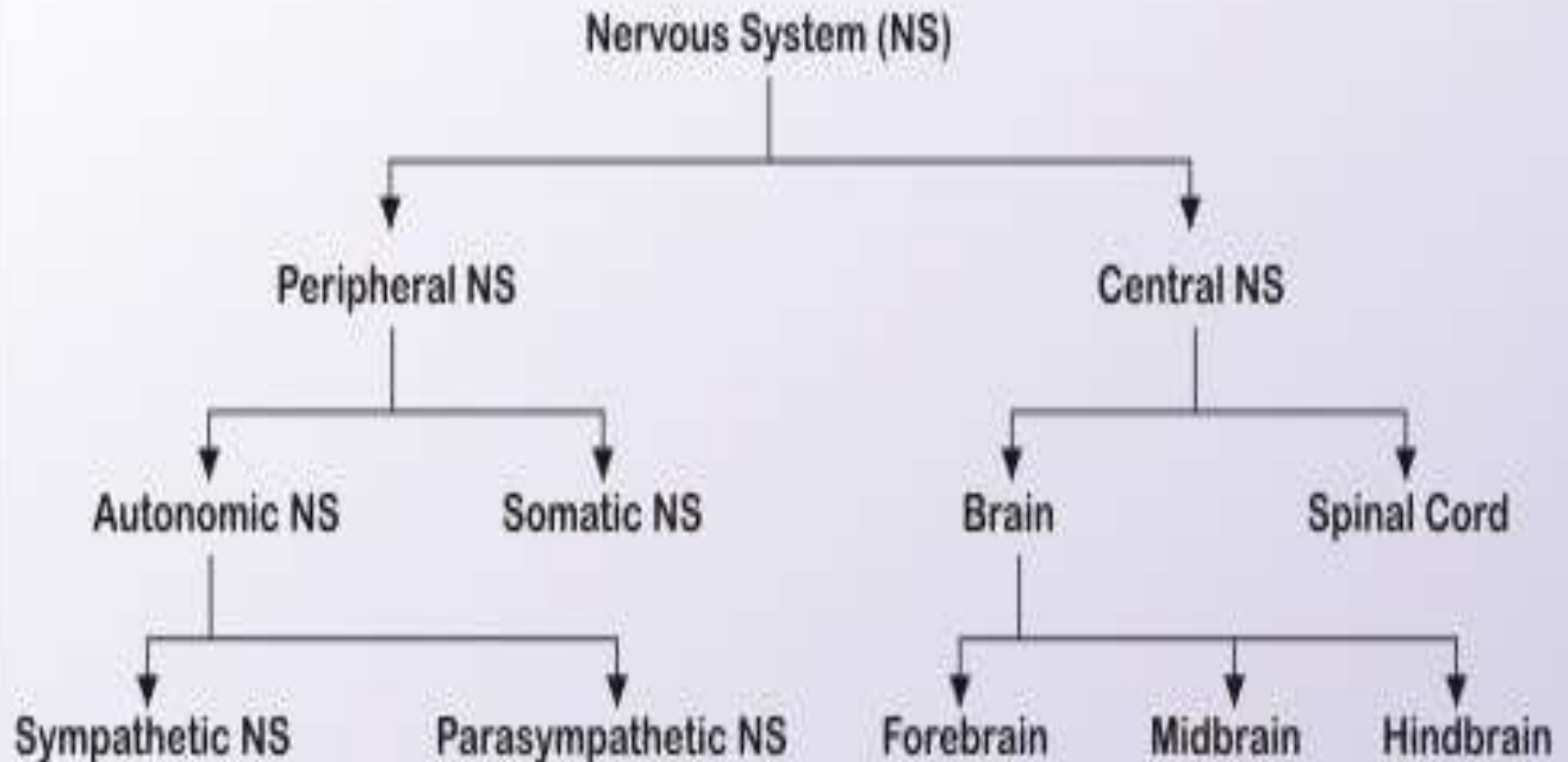
It controls all the activities of the body whether voluntary or involuntary and adjust the individual to the surrounding.

### **Functions:**

1. Reception of sensory stimuli from internal and external environments.
2. Integration of sensory information.
3. Coordination & control of voluntary & involuntary activities of the body.
4. Assimilation of memory, learning and intelligence.
5. Storage of experiences.

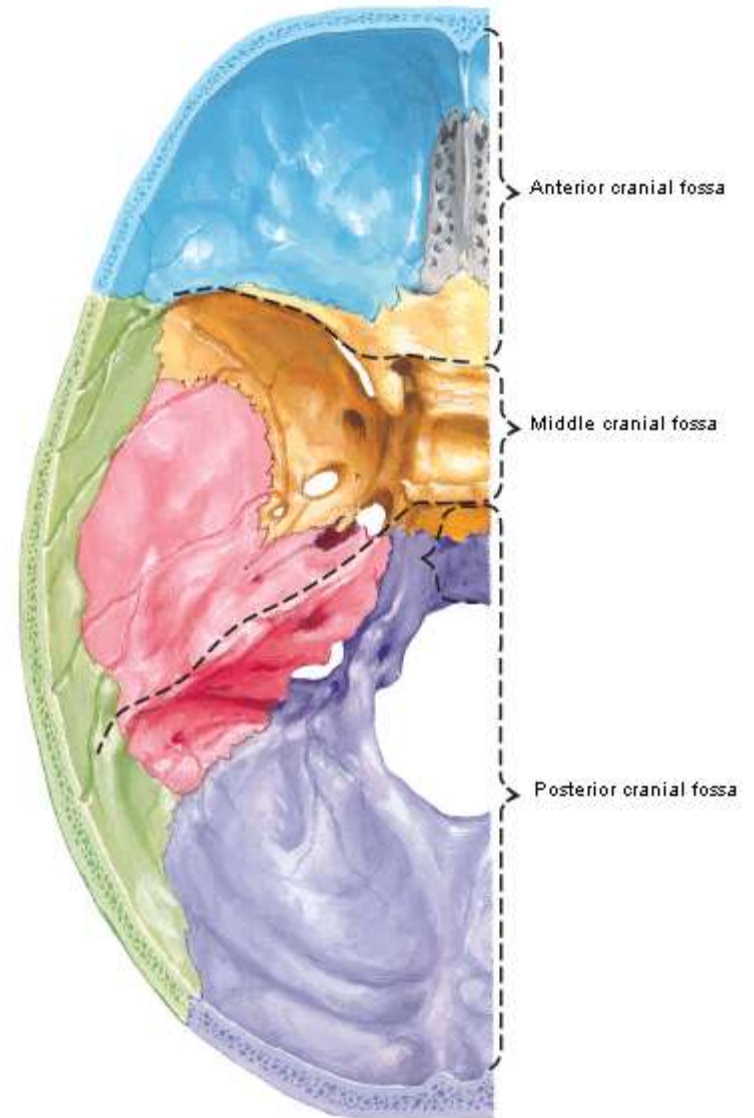
# Classification of Nervous System

## Anatomical

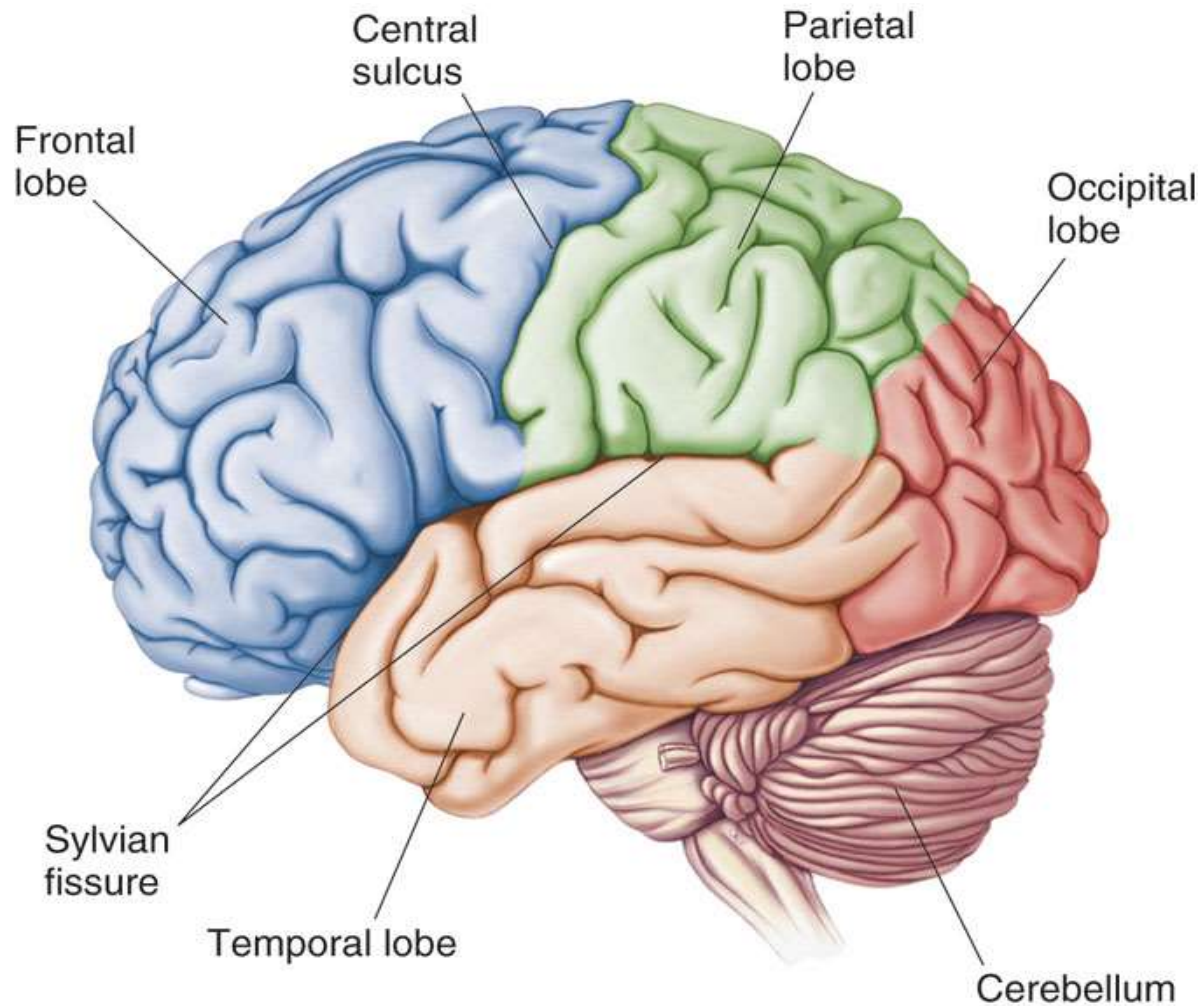


# Divided into three cranial fossa:

- a. Anterior cranial fossa
- b. Middle cranial fossa
- c. Posterior cranial fossa



# BRAIN-CEREBRUM

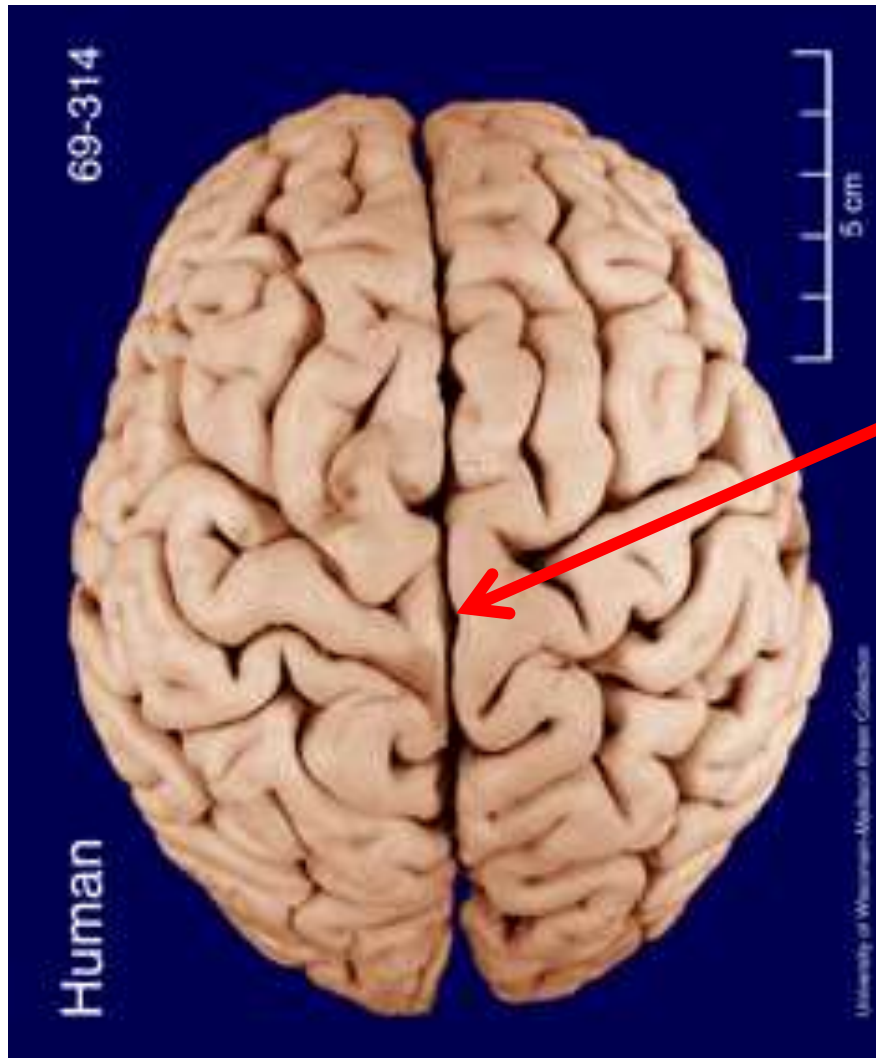


# INTRODUCTION

- ❑ The cerebrum is the largest part of the brain with two hemisphere.
- ❑ It is located in the anterior and middle cranial fossa.
- ❑ The two hemispheres are incompletely separated from each other by the median longitudinal fissure.
- ❑ The two cerebral hemisphere are linked across the median plane 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 contains motor and sensory areas.
- ❑ Each cerebral hemisphere contains lateral ventricle continuous with the third ventricle through interventricular foramen.
- ❑ Each cerebral cortex is often divided phylogenetically into old allocortex, consisting of archicortex and paleocortex and a newer neocortex.

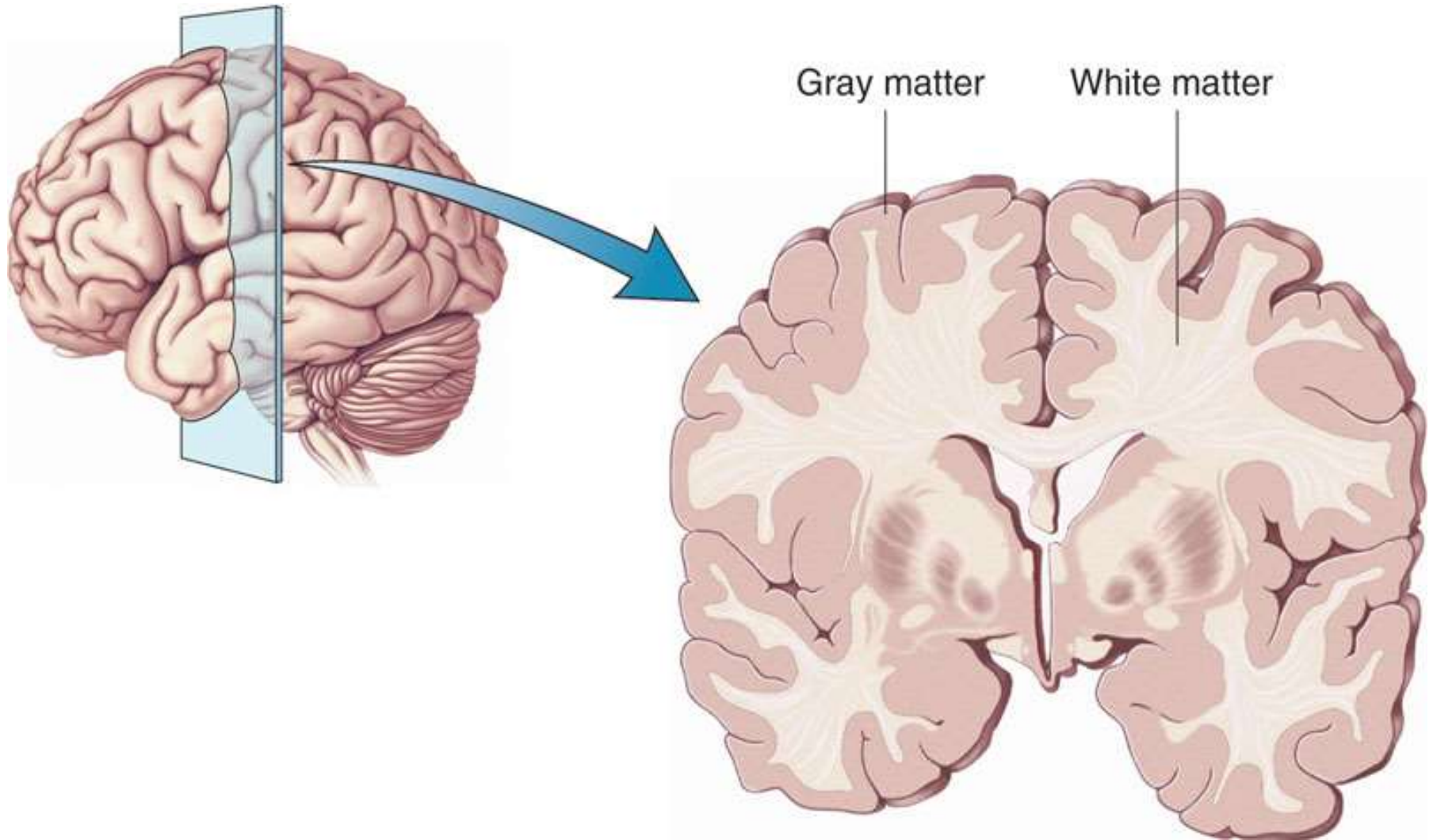


# Cerebral hemisphere



**Median Longitudinal  
Fissure**

# Cortex and medulla





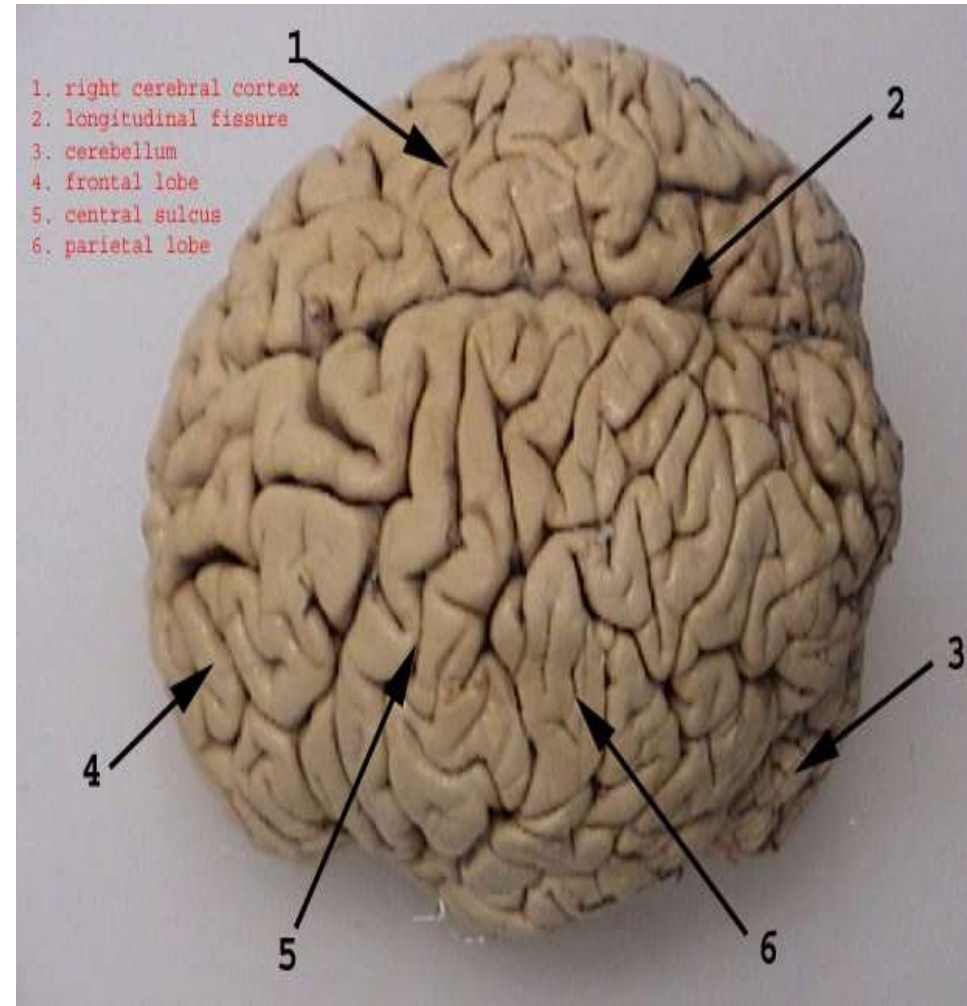
# EXTERNAL FEATURES: Surfaces of cerebral hemisphere

➤ Each cerebral hemisphere has **three surfaces**

- I. Superolateral surface
- II. Medial surface
- III. Inferior surface.

➤ *Inferior surface* further divided into two

- i. Orbital surface
- ii. Tentorial surface



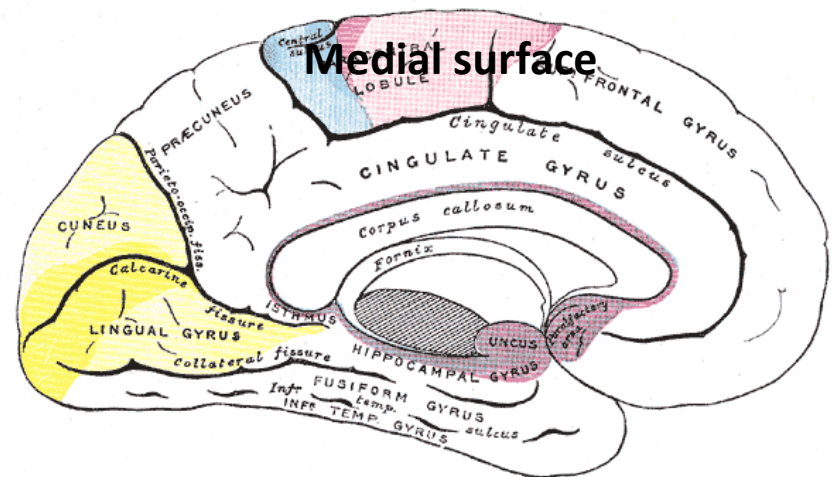
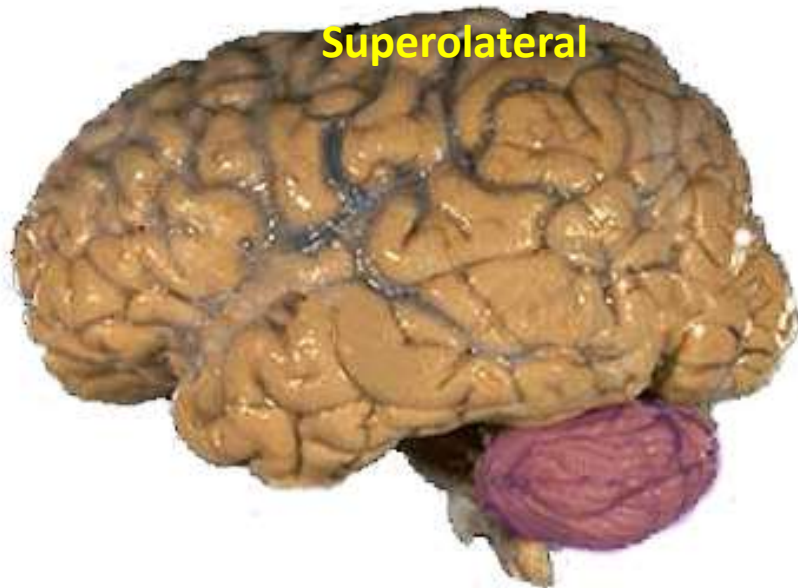
# Surfaces of the brain

## ❖ Superolateral surface

It is convex and follows the concavity of the cranial vault.

## ❖ Medial surface

It is flat and vertical and separated from its fellow by the median longitudinal fissure and falx cerebri.

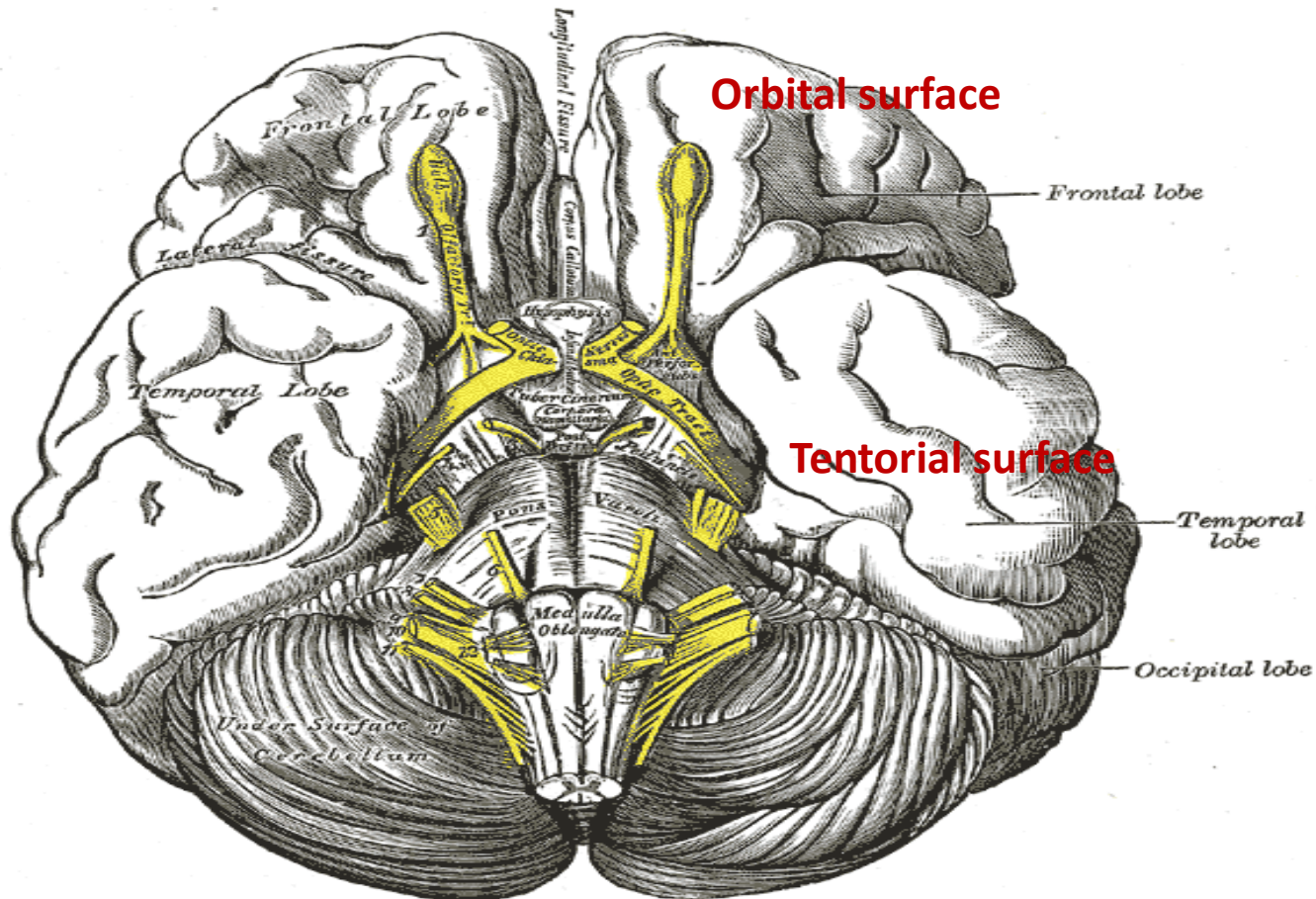


# Inferior surface

## ❖ Inferior surface

Inferior surface or the basal surface is irregular and divided into anterior orbital surface and posterior tentorial surface.

The two parts are separated by a deep cleft called the stem of the lateral sulcus.

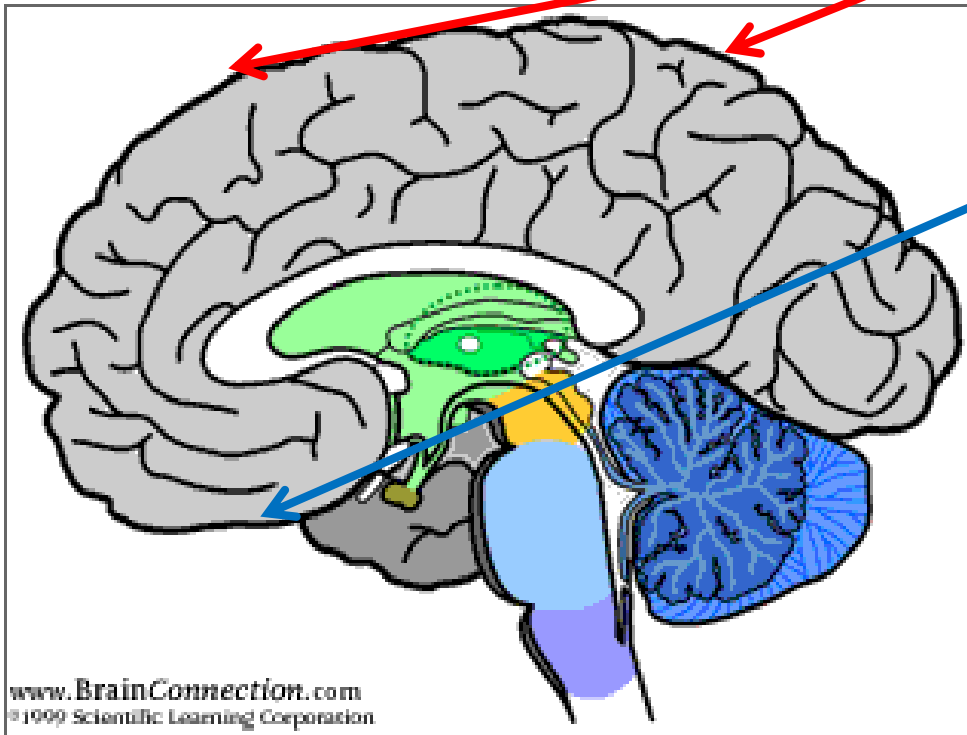


# Borders of cerebral hemisphere – Four Borders

1. Superomedial border
2. Inferolateral border
3. Medial orbital border
4. Medial occipital border

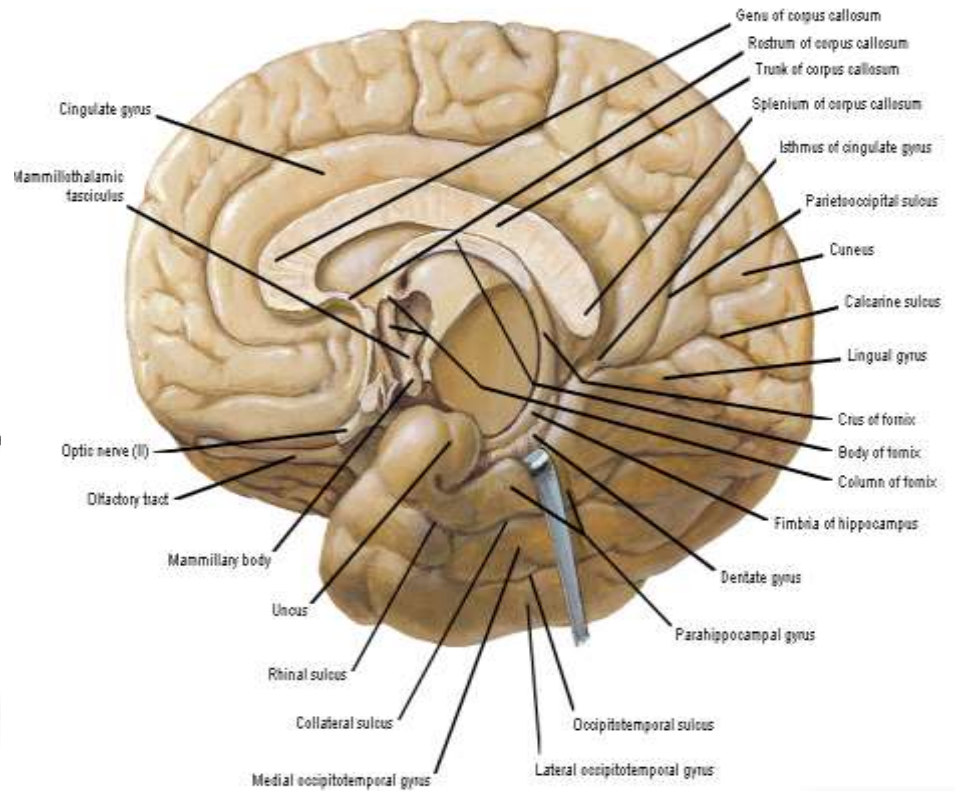
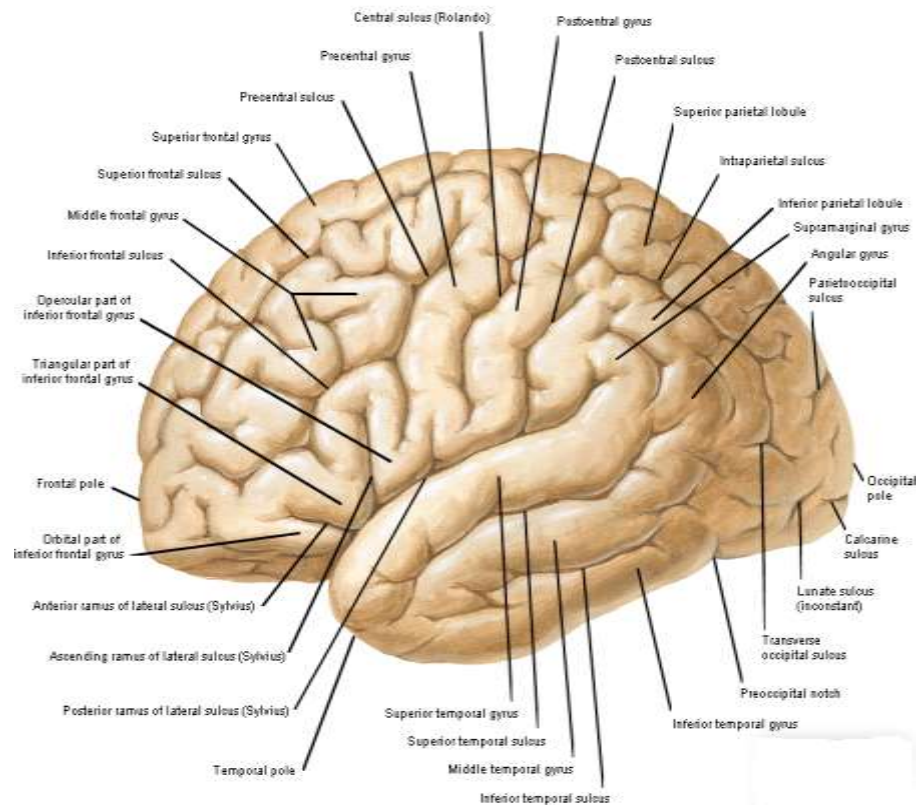
**Superomedial border**

**Inferolateral border**





# Four Borders



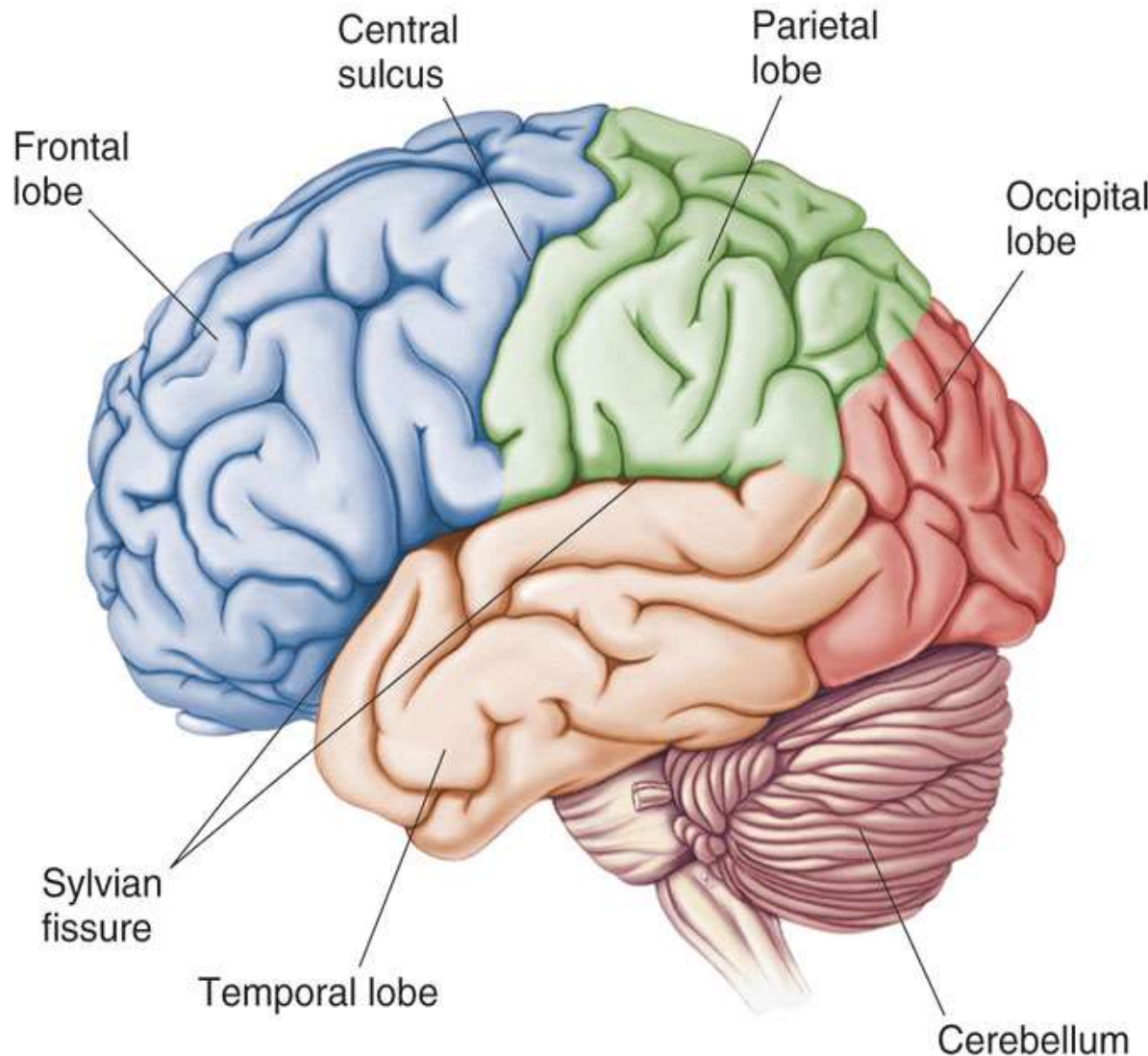


# Lobes of the brain

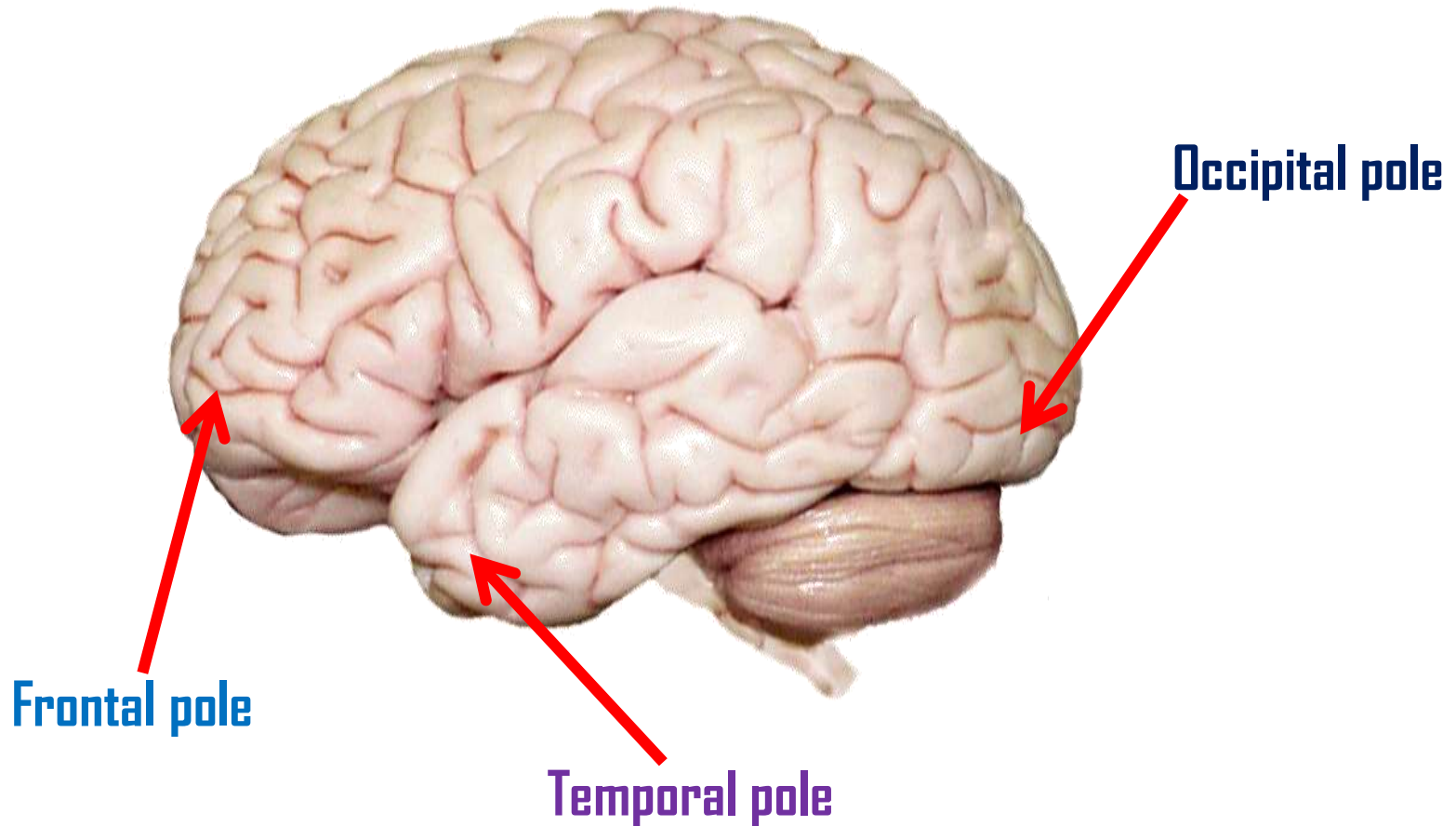
## Four lobes are present

- Frontal
- Parietal
- Occipital
- Temporal

❖ Occasionally **insula** is considered as the fifth lobe

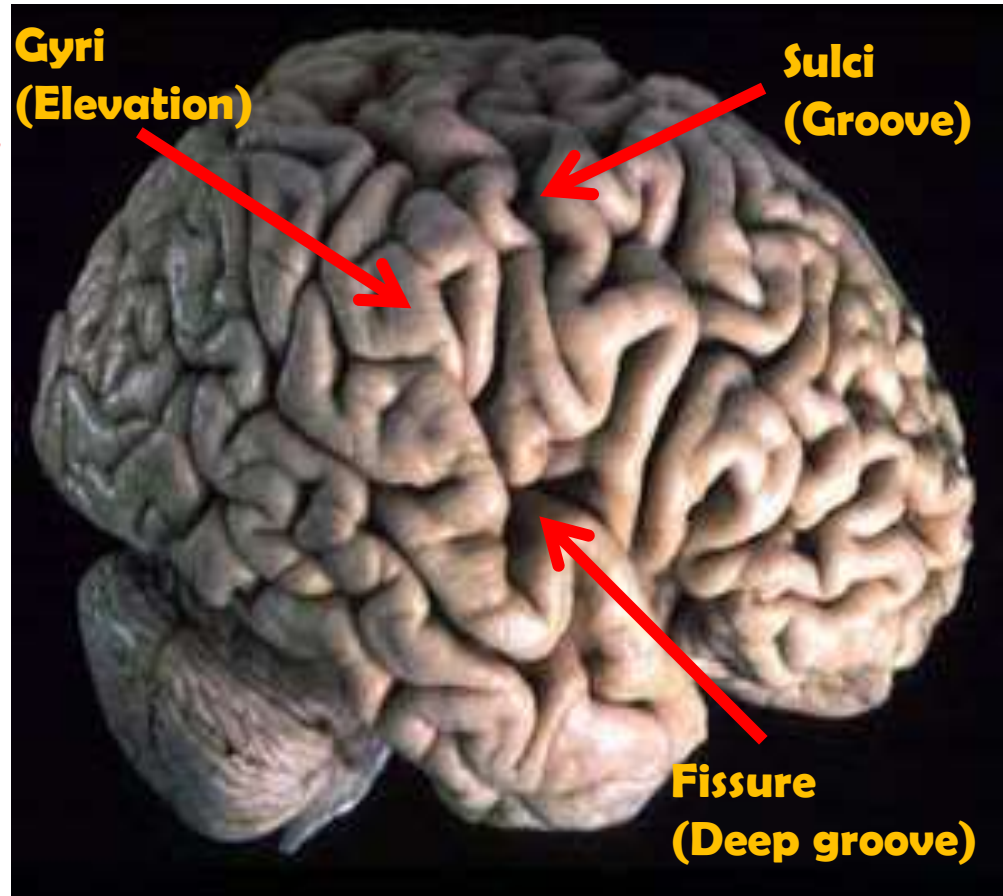


# Poles of the brain – Three poles



# Gyrus and sulcuses

- ❑ Each cerebral hemisphere shows a complex pattern of convulation/fold called **Gyri**.
- ❑ The gyruses are separated by furrows/groves of varying length called **Sulci**.
- ❑ The appearance of sulci and gyri increases the surface area for the neurons many times, without increasing the size of the brain.
- ❑ The area of the cerebral cortex is **2000cm<sup>2</sup>**

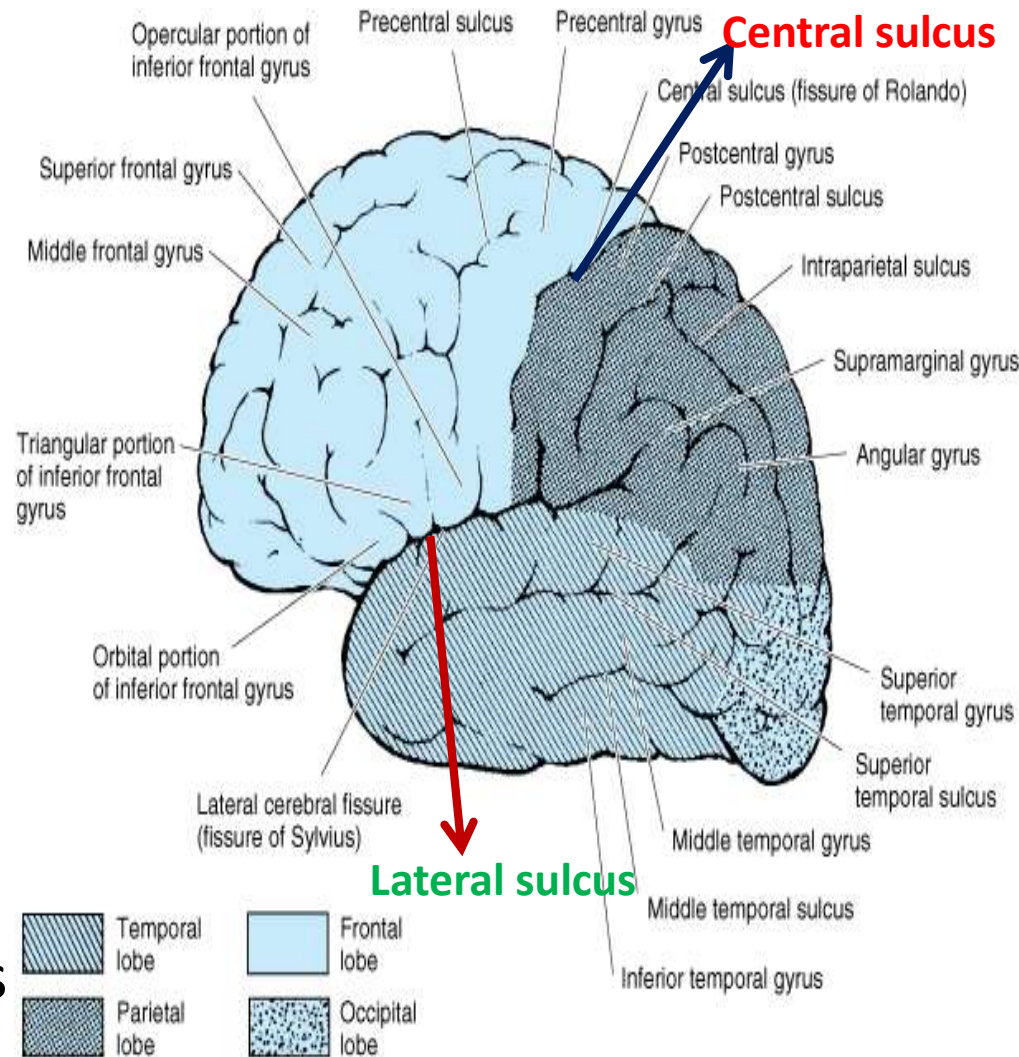


# Important sulci and gyri

➤ In the suprolateral surface:

## i. Lateral sulcus

- Deep cleft on the lateral and inferior surface
- It separates the orbital and tentorial parts of the inferior surface.
- It has a stem which divides into three rami: anterior, ascending & posterior
- The floor of the posterior ramus is the insula which is hidden cortex.





## ii. The central sulcus

- It is the boundary between frontal and parietal lobes.
- It starts at the superomedial border of the hemisphere, a little behind the midpoint between frontal and occipital poles. It runs downwards and forwards for about 8-10cm to end little above the posterior ramus of lateral sulcus.
- It demarcates the motor and sensory area of the cerebral cortex.

## iii. The other known sulcuses are

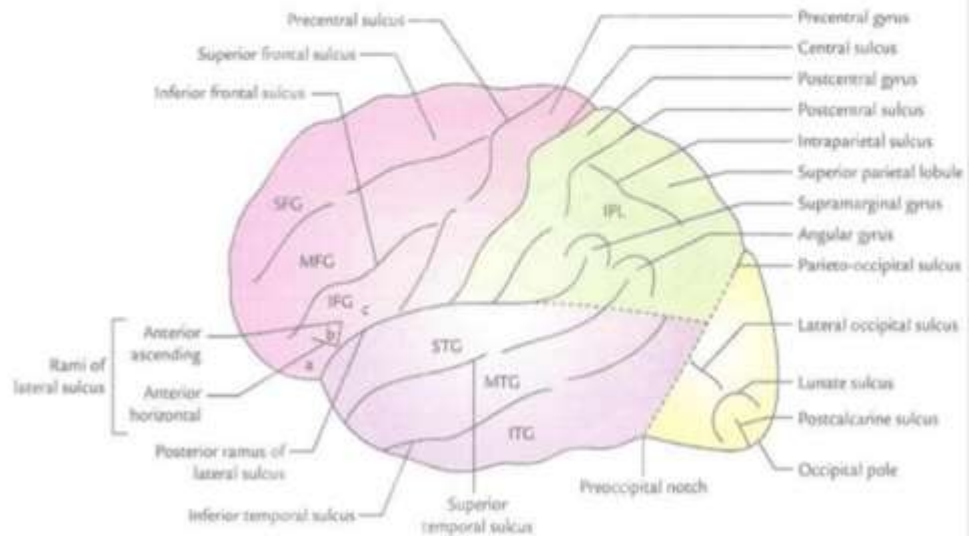
- superior frontal sulcus
- Inferior frontal sulcus
- Precentral sulcus
- Postcentral sulcus



# Sulci & Gyri on superolateral surface

## Frontal lobe:

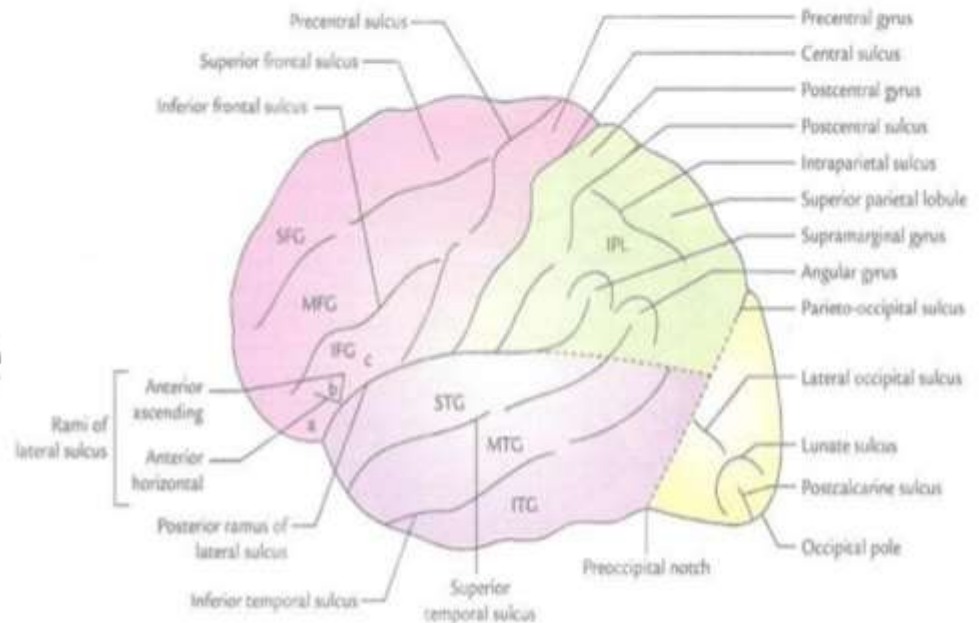
- Precentral sulcus
- Precentral gyrus
- Superior frontal sulci &
- Inferior frontal sulci
- Superior frontal gyrus
- Middle frontal gyrus
- Inferior frontal gyrus



# Sulci & Gyri on superolateral surface cont...

## Parietal lobe:

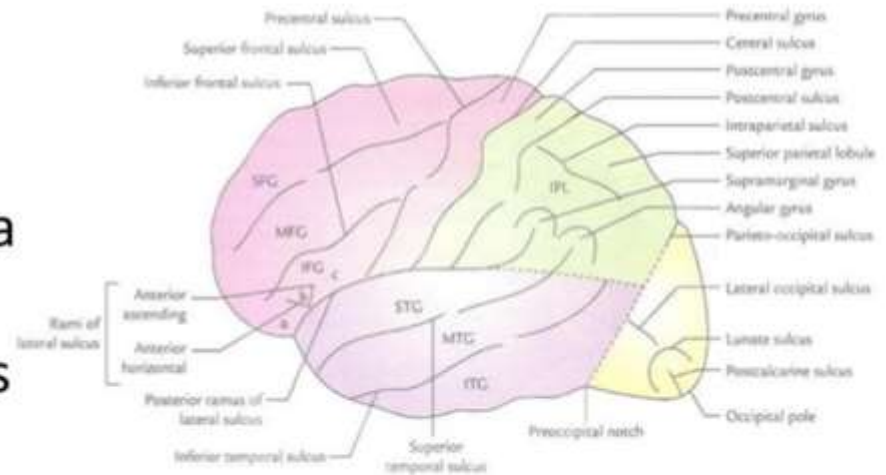
- Postcentral sulcus
- Postcentral gyrus
- Intraparietal sulcus
- Superior parietal lobule
- Inferior parietal lobule



# Sulci & Gyri on superolateral surface cont...

## Temporal lobe:

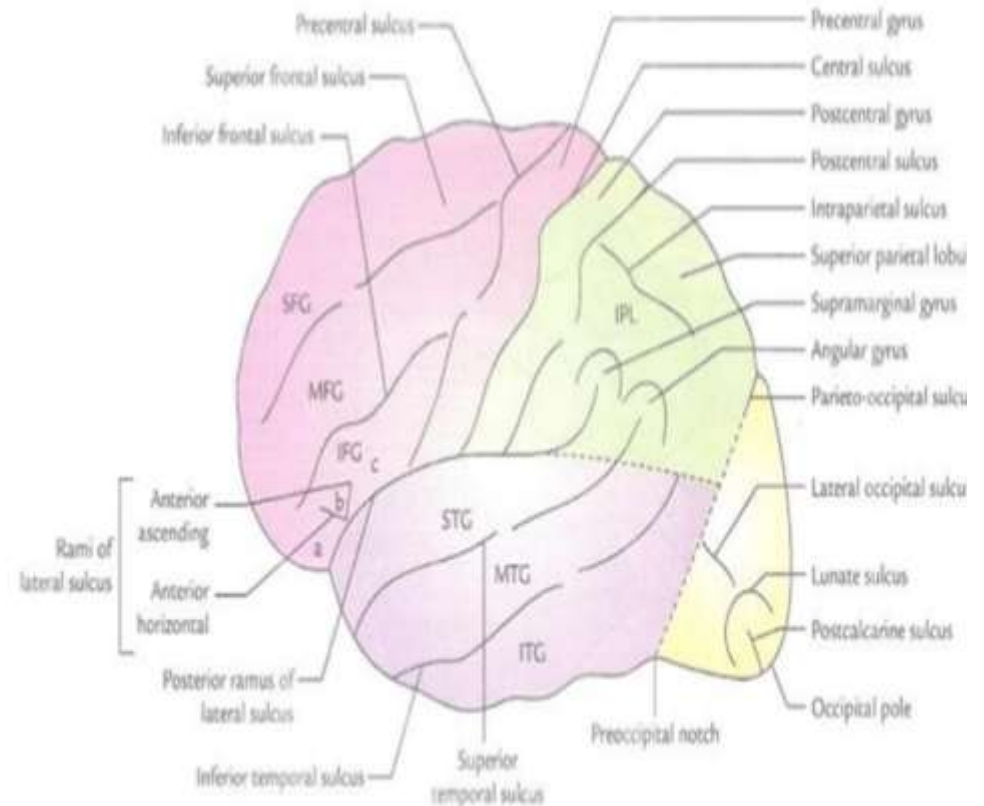
- Superior temporal sulci &
- Inferior temporal sulci
- Superior temporal gyrus
- Middle temporal gyrus
- Inferior temporal gyrus
- Sup. surface of sup.temporal gyrus has
- 2 transverse temporal gyrus (ant. & post.)
- Ant.transverse temporal gyrus (Heschl's gyrus – primary auditory area)



# Sulci & Gyri on superolateral surface cont...

## Occipital lobe:

- Lateral occipital sulcus
- Superior & inferior occipital gyrus
- Lunate sulcus
- Calcarine sulcus





# Medial surface

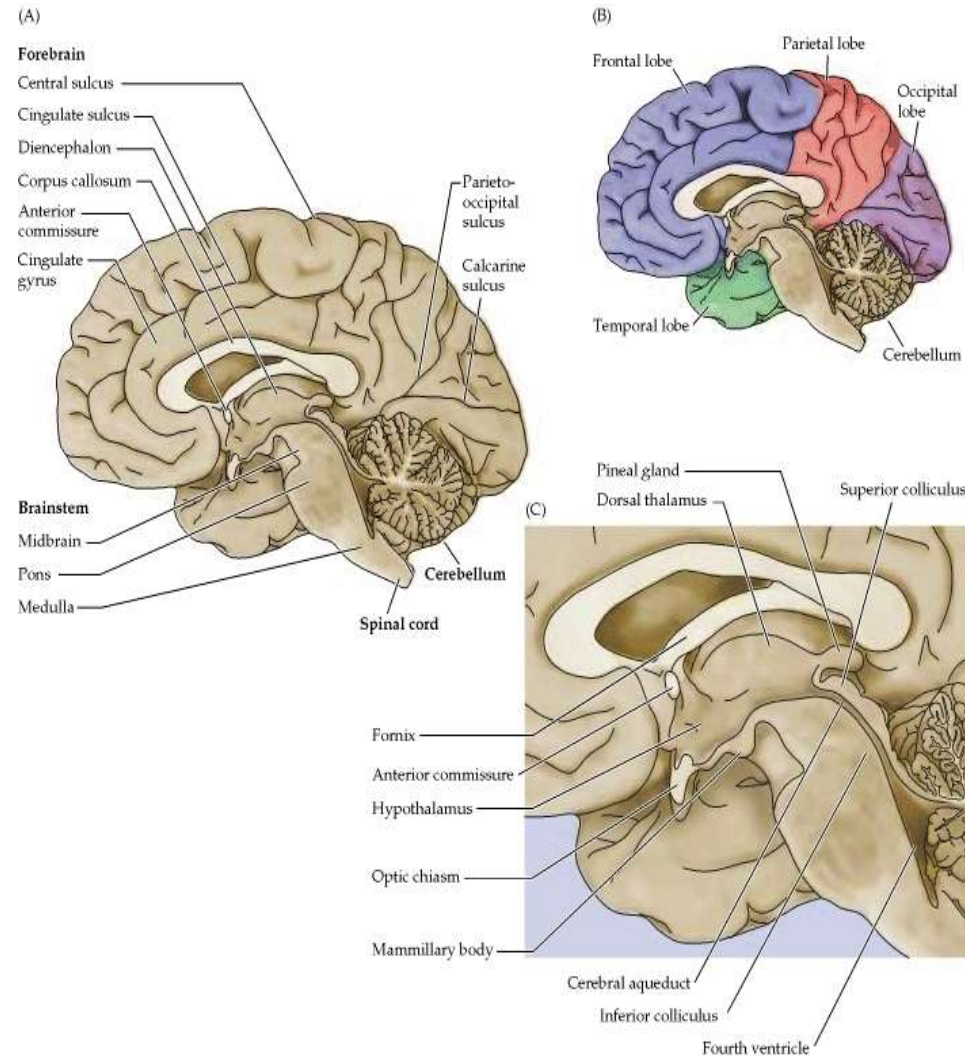
## ➤ In the medial surface

❖ The commissural fibres of the corpus callosum lies in the depth of longitudinal fissure

## ❖ Parts of corpus callosum

- Rostrum
- Genu
- Trunk or body
- Splenium

❖ The anterior part divided into outer and inner zone by cingulate sulcus





(A)

**Forebrain**

Central sulcus

Cingulate sulcus

Diencephalon

Corpus callosum

Anterior commissure

Cingulate gyrus

**Brainstem**

Midbrain

Pons

Medulla

**Medial surface with corpus callosum**

**Body or trunk**

**splenium**

**Genu**

**Rostrum**

Pre-occipital sulcus

Calcarine sulcus

Cerebellum

Spinal cord

(B)

Frontal lobe

Parietal lobe

Occipital lobe

Temporal lobe

Cerebellum

(C)

Pineal gland

Dorsal thalamus

Superior colliculus

Fornix

Anterior commissure

Hypothalamus

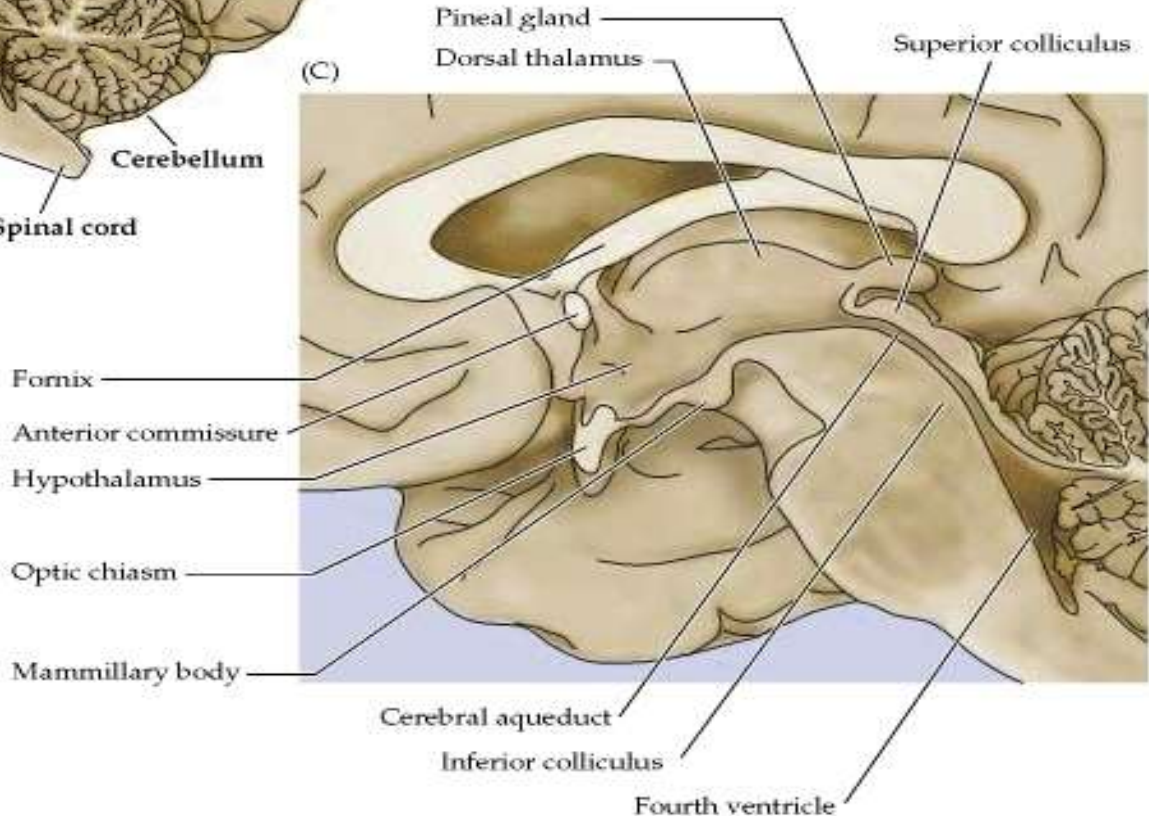
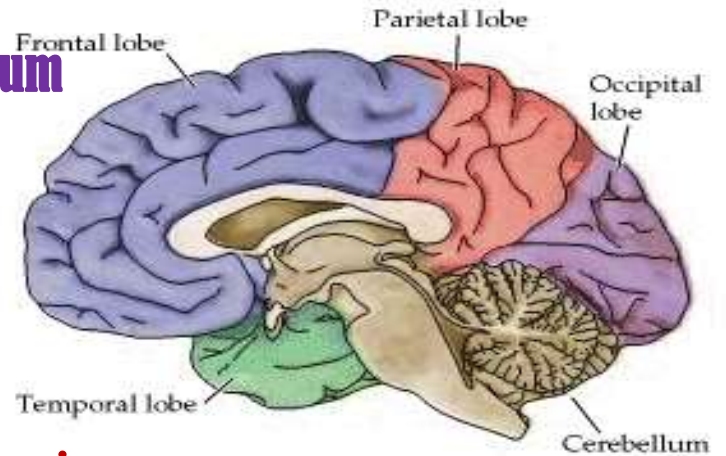
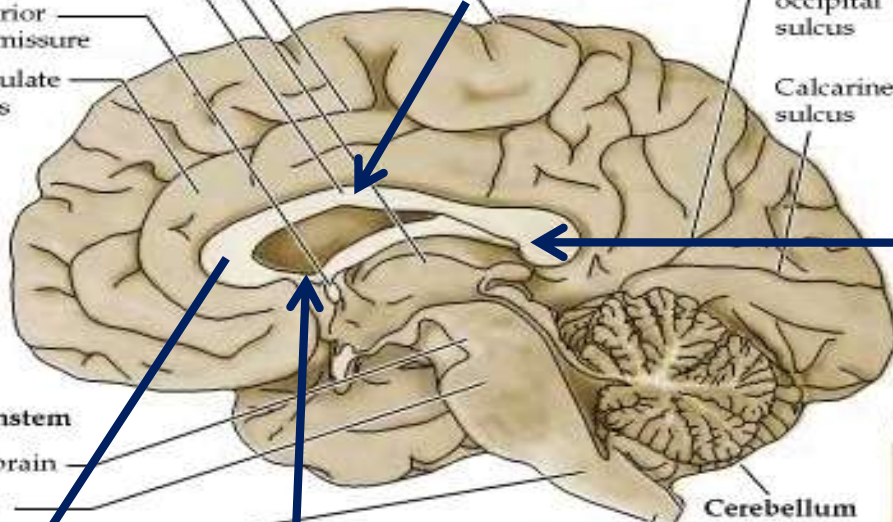
Optic chiasm

Mammillary body

Cerebral aqueduct

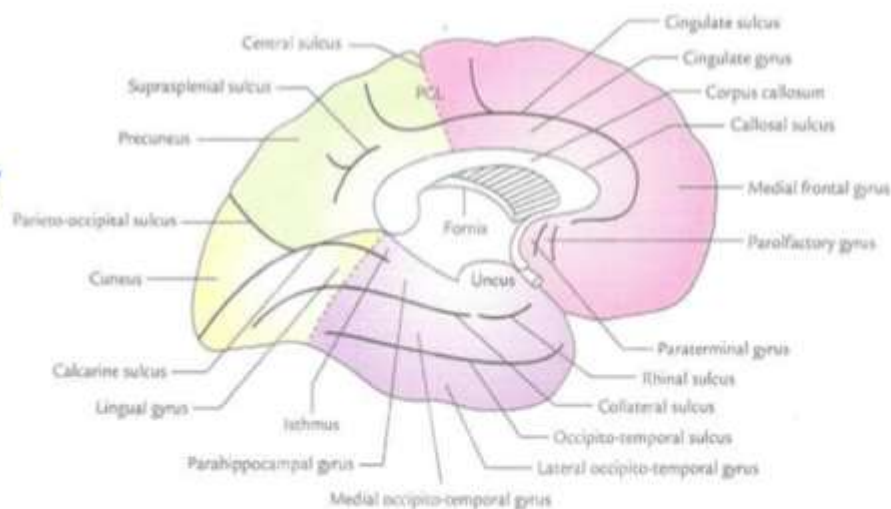
Inferior colliculus

Fourth ventricle



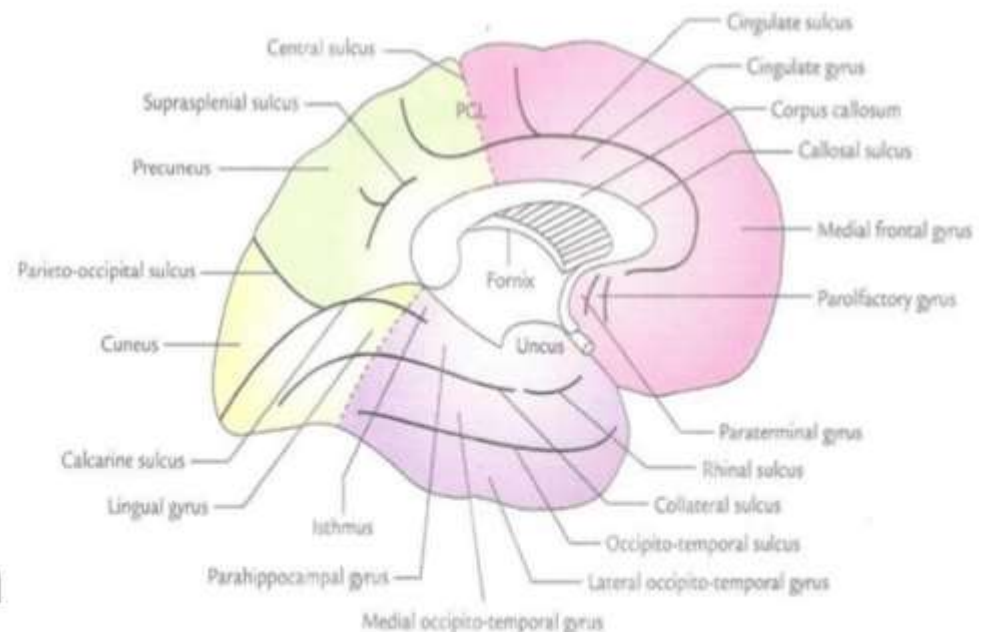
# Sulci & Gyri on the medial surface

- Callosal sulcus
- Cingulate sulcus
- Cingulate gyrus
- Medial frontal gyrus
- Paracentral lobule (higher centre for micturition & defecation)
- Ant. & post. parolfactory sulcus
- Paraterminal gyrus
- Parolfactory gyrus

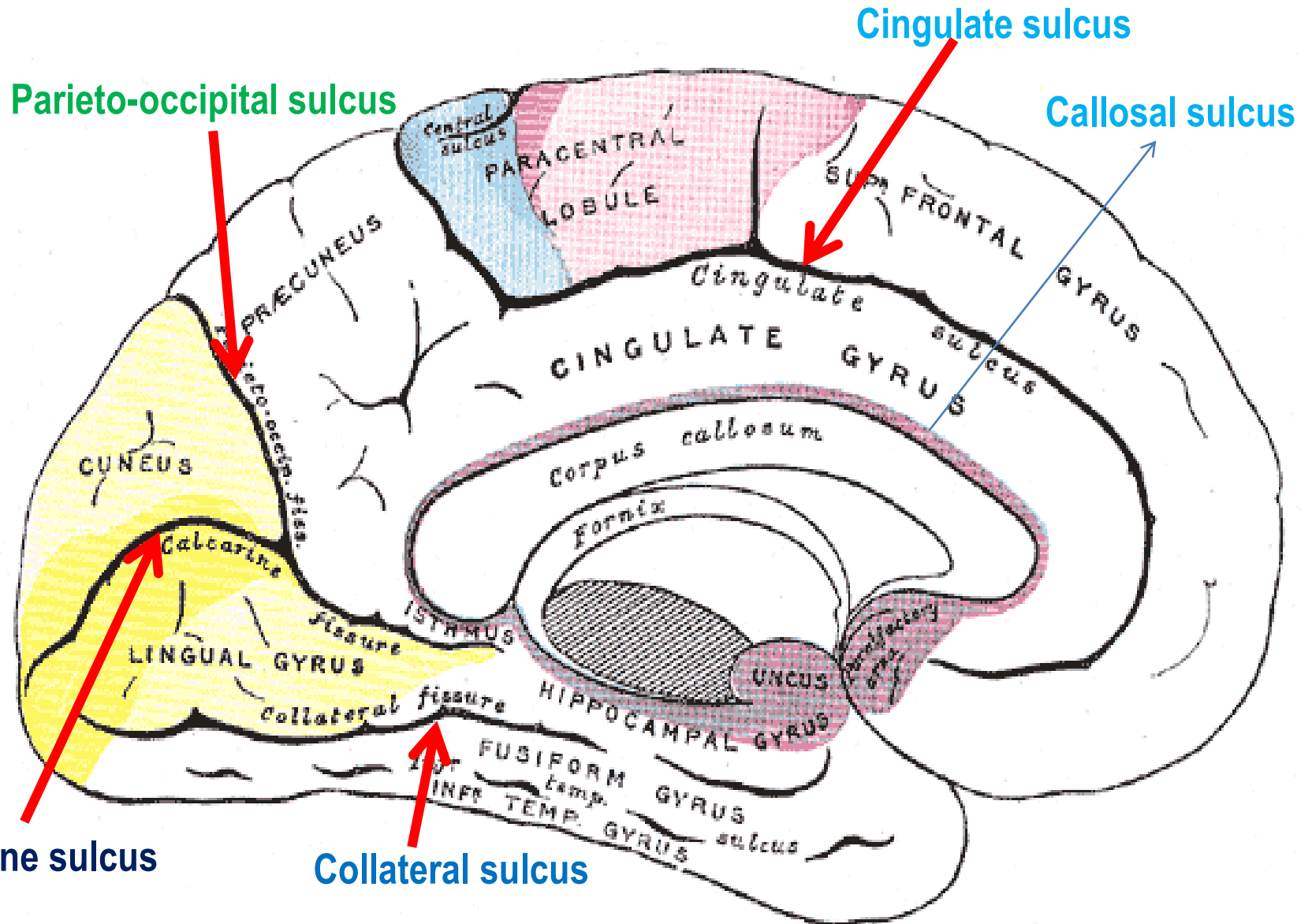


# Sulci & Gyri on the medial surface cont...

- Suprasplenial sulcus
- Parieto-occipital sulcus
- Calcarine sulcus
- Cuneus
- Precuneus
- ❖ **Isthmus** –narrow region between splenium & calcarine sulcus



# Sulcus in the medial surface



## Sulcus and gyrus.....contd.

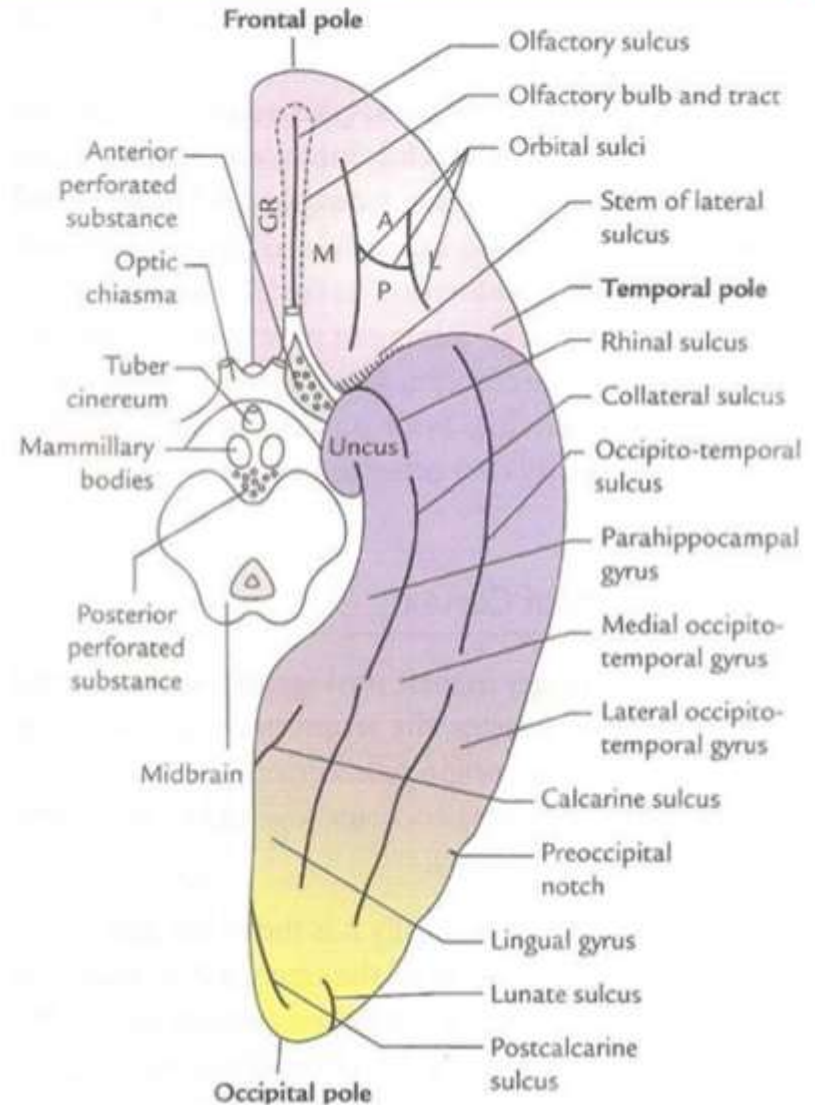
- ❖ The posterior region of the medial surface is traversed by **parieto-occipital** and **calcarine sulcus**. The parieto-occipital sulcus marks the boundary between parietal and occipital lobes.
- ❖ The visual cortex lies above and below the calcarine sulcus.



# Sulci & Gyri on the inferior surface

## Orbital part:

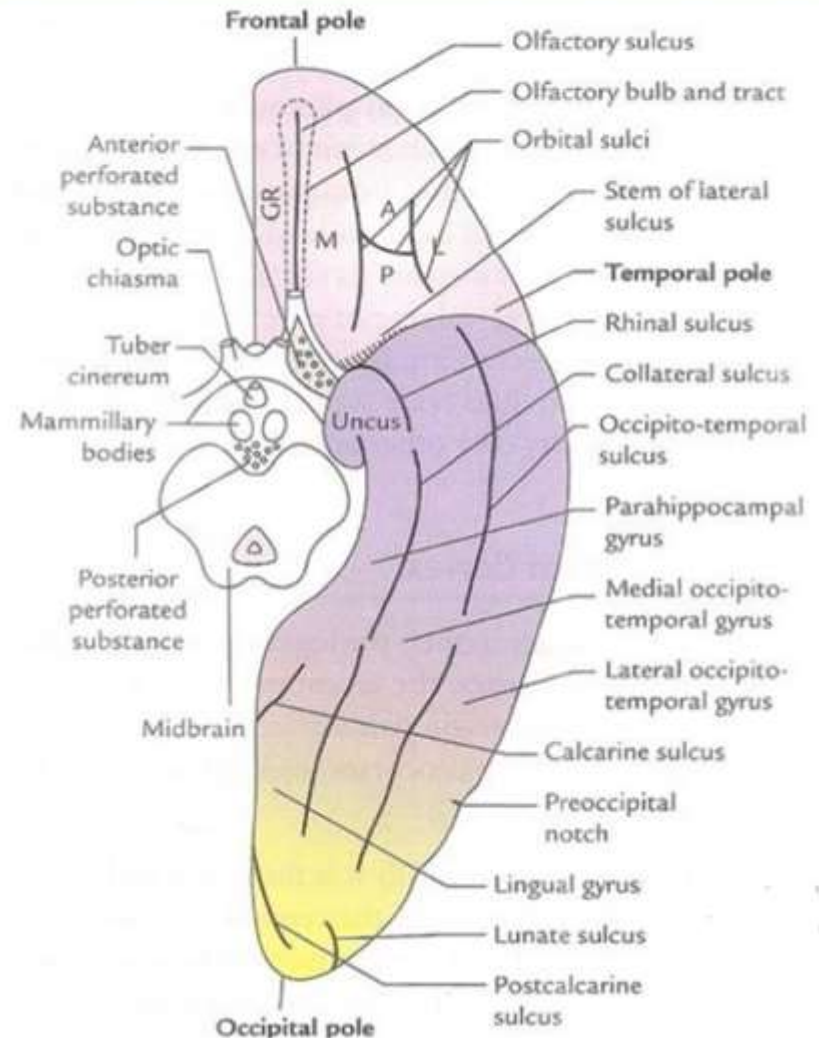
- Olfactory sulcus
- Gyrus rectus
- Orbital sulcus (H-shaped)
- Medial orbital gyrus
- Lateral orbital gyrus
- Anterior orbital gyrus
- Posterior orbital gyrus



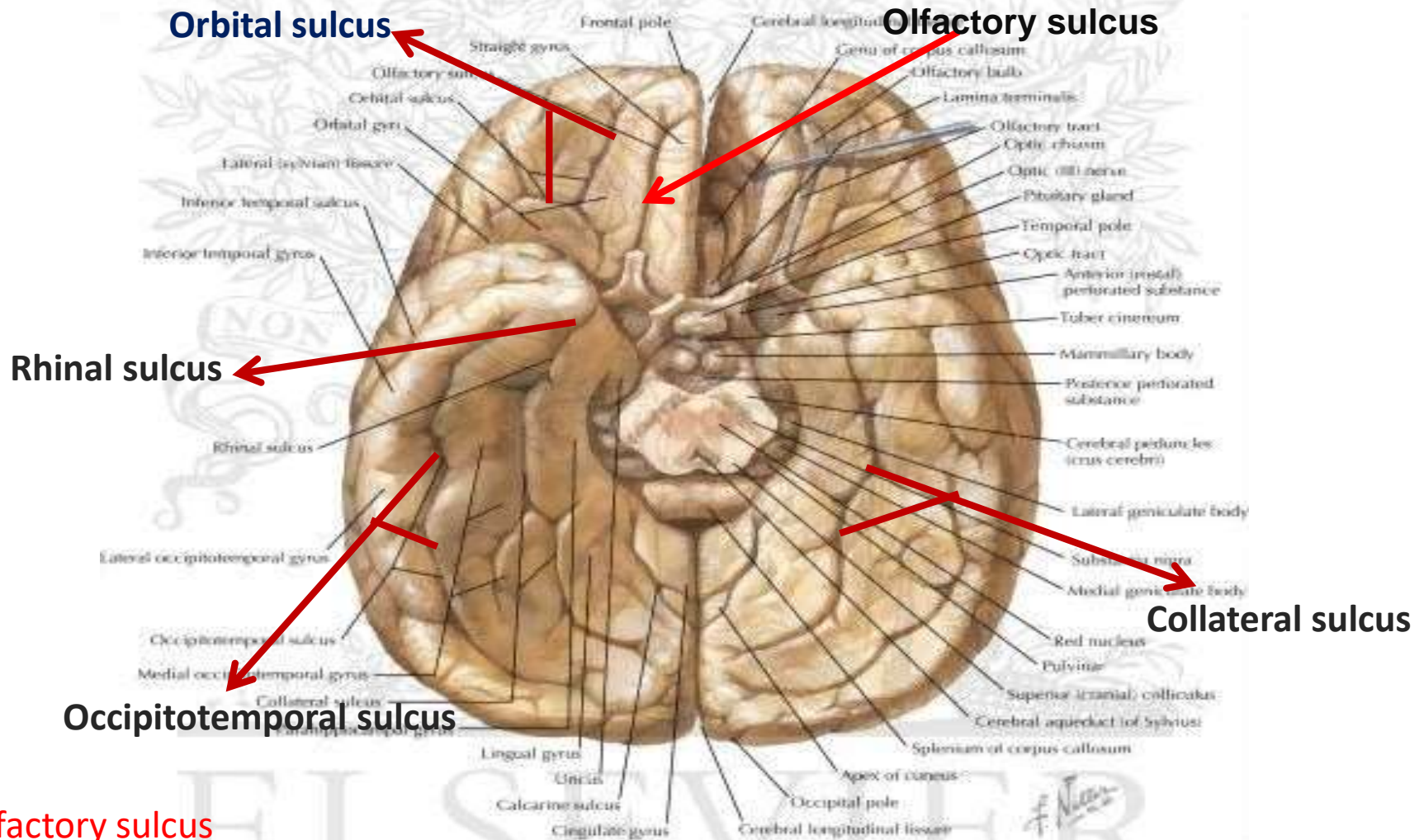
# Sulci & Gyri on the inferior surface cont...

## Tentorial part:

- Collateral sulcus (medial)
- Occipito-temporal sulcus (lateral)
- Medial occipito-temporal gyrus
- Lateral occipito-temporal gyrus
- Rhinal sulcus
- Uncus
- Parahippocampal gyrus
- Lingual gyrus



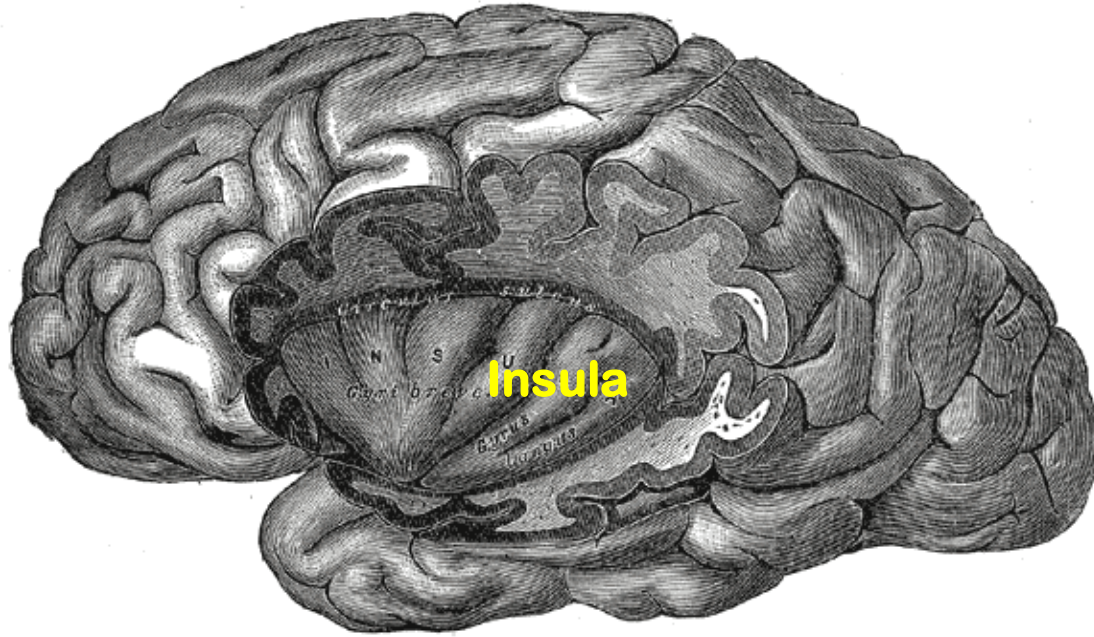
# Sulcus on inferior surface of cerebral hemisphere



- Olfactory sulcus
- Rhinal sulcus
- Occipitotemporal sulcus
- Collateral sulcus



# Insula



-Present within the floor of lateral sulcus.

Between temporal, parietal and frontal Lobe.

-The overlying cortical areas are called opercula formed from the parts of frontal, temporal and parietal lobe.

Insula comprises

1. Frontal operculum
2. Frontoparietal operculum
3. Temporal operculum.

-**Functions** linked to emotion and body's homeostasis

Role of anterior insular cortex is in olfaction and taste.

Role of posterior insular cortex is in language function.



# **FUNCTIONAL AREAS**

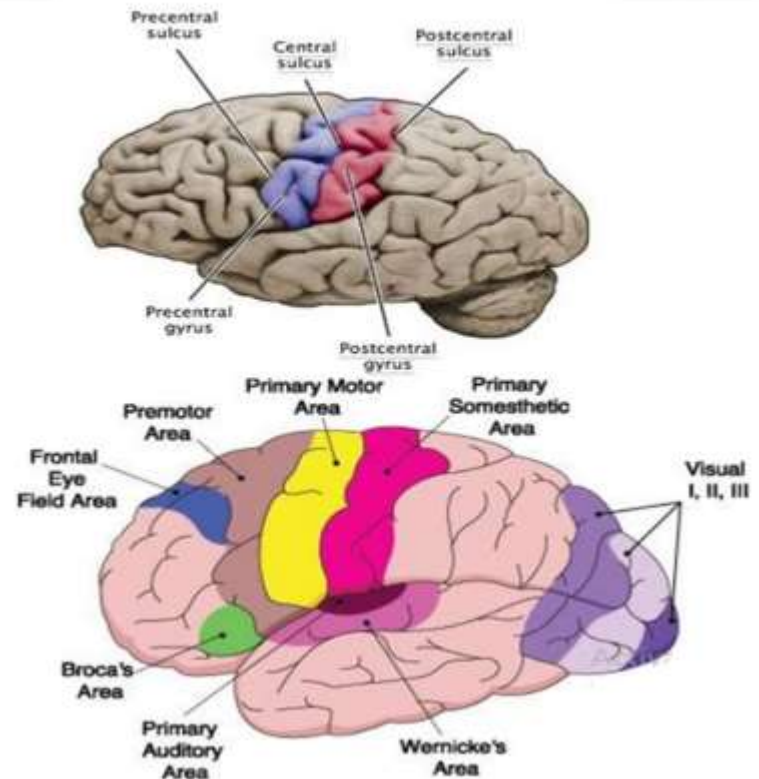
# Functional Areas of the Cerebral Cortex

- Brodmann (1909) had divided the cerebral cortex into 47 such areas and indicated each of them by a number.
- Types of cortical areas:
  - **Motor areas:**
    - These are primarily concerned with the motor functions and give origin to the projection fibers which form corticospinal and corticonuclear tracts.
  - **Sensory areas:**
    - These areas are primarily concerned with the sensory functions and receive afferent fibers from the thalamic nuclei in which major sensory pathways terminate.
  - **Association areas:**
    - These areas are not concerned with motor or sensory functions but have more important associative, integrative and cognitive functions.

# Types of cortical functional areas

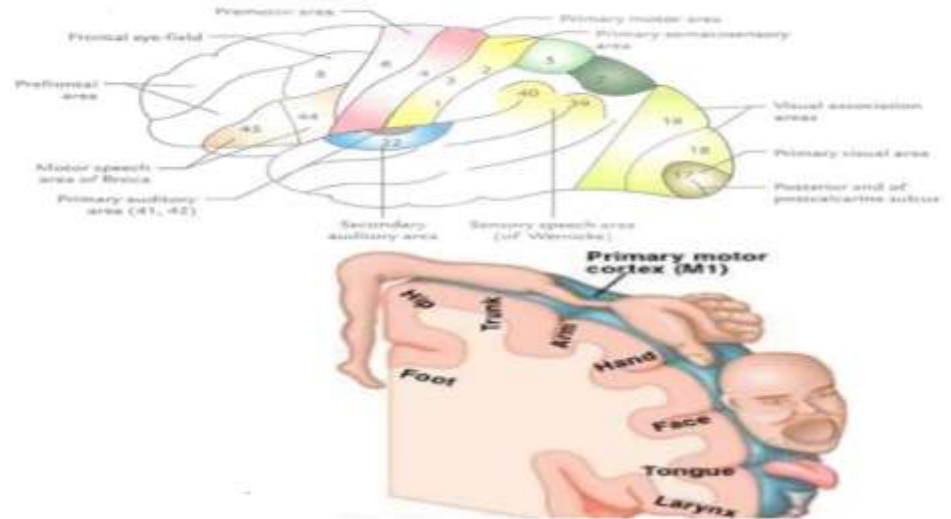
## ❖ 3 Types of functional areas

1. Motor areas
2. Sensory areas
3. Association areas



# Primary motor area (area 4)

- ✓ **Precentral gyrus (superolateral surface)**
- ✓ **Motor homunculus**
- ✓ **Control voluntary movements of contralateral side**



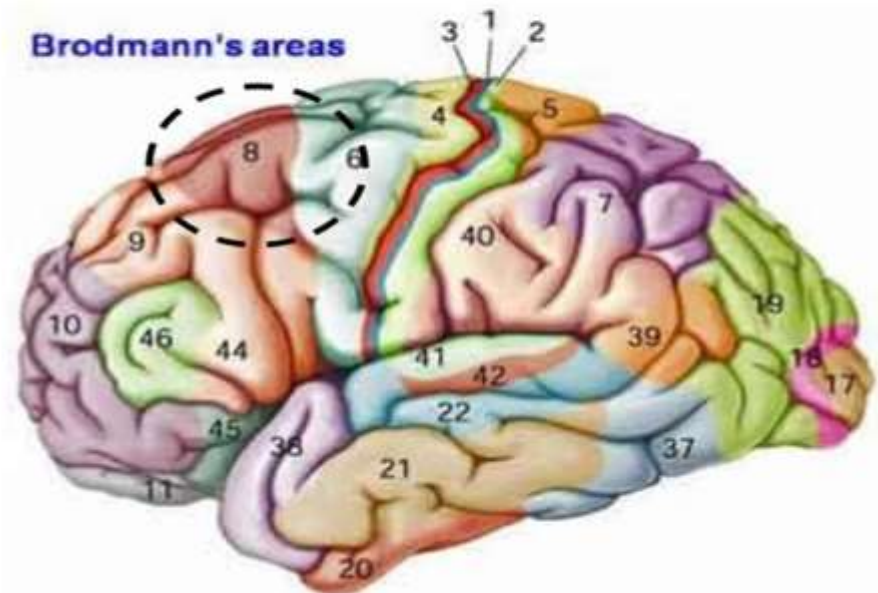
## Primary Motor Area (Area 4 of Brodmann)

- Primary motor area is located in the precentral gyrus on the superolateral surface and extends to the anterior part of paracentral lobule on the medial surface of the cerebral hemisphere.
- *About 40% pyramidal (corticospinal and corticonuclear) fibres arise from this area.*
- **Lesions of primary motor area** in one hemisphere produce spastic paralysis of the extremities of the opposite half of the body (*hemiplegia*).



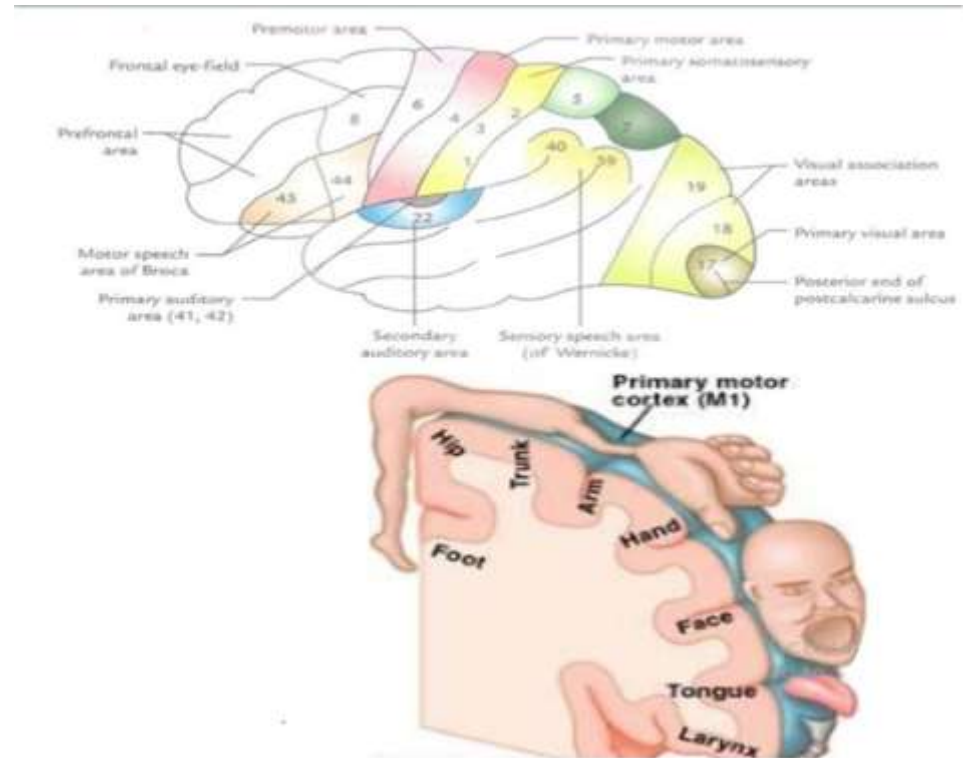
## Pre-motor area (area 6 & 8)

- **Area 6**- skillful acts (programming of movements)
- Upper part of **area 6** – writing centre
- **Area 8** also known as frontal eye field (regulates voluntary conjugate movements)



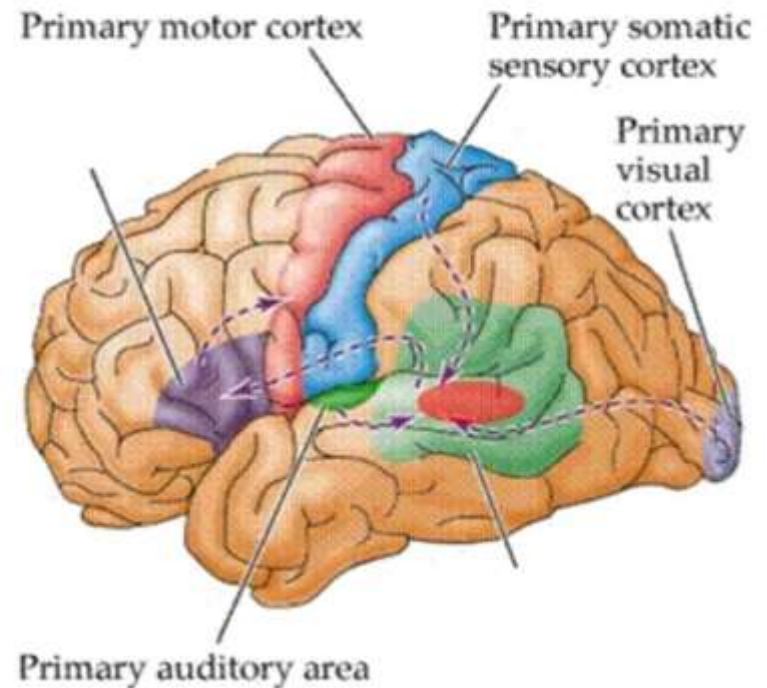
## Motor Speech Area of Broca (Areas 44 and 45 of Brodmann)

- The motor speech area is usually located in the pars triangularis (area 45) and pars opercularis (area 44) of inferior frontal gyrus of frontal lobe of left hemisphere (the *dominant hemisphere* in right handed and most of the left handed individuals).
- **Lesions of motor speech area of Broca** result in loss of ability to produce proper speech, called *expressive aphasia* (also called *motor aphasia*).



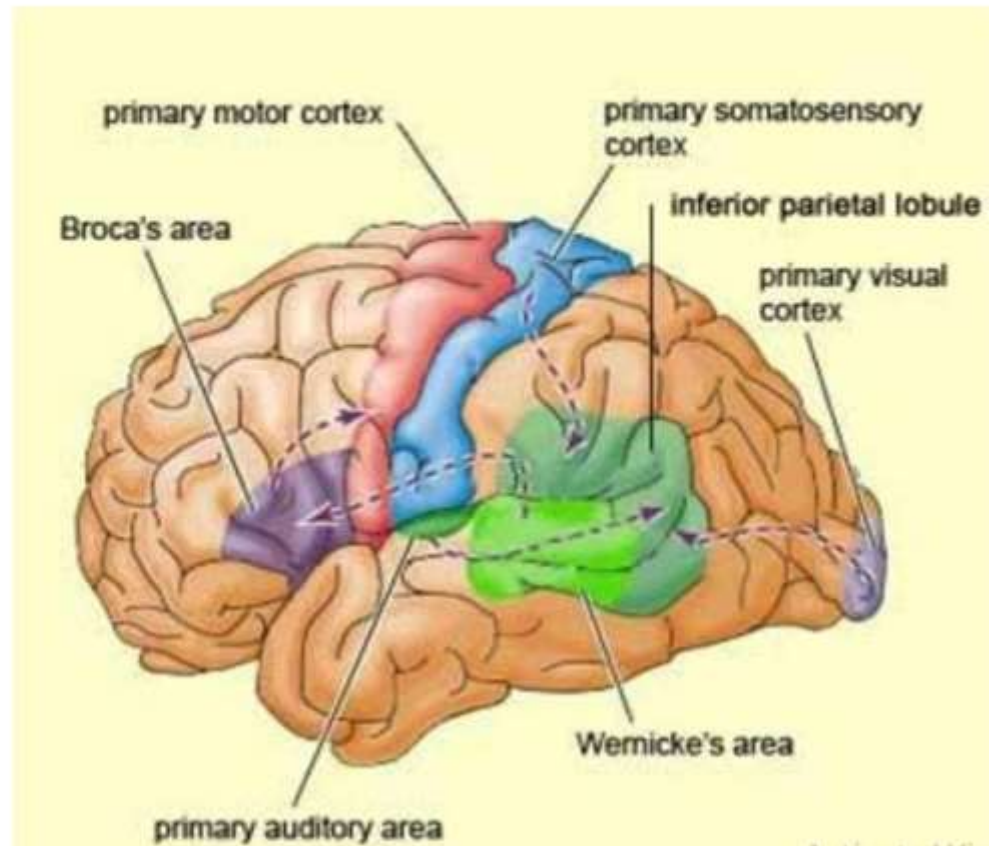
# Sensory areas

1. Primary sensory area
2. Secondary sensory area (only for somesthetic senses)
3. Sensory association area
4. Higher association area



# Primary sensory area

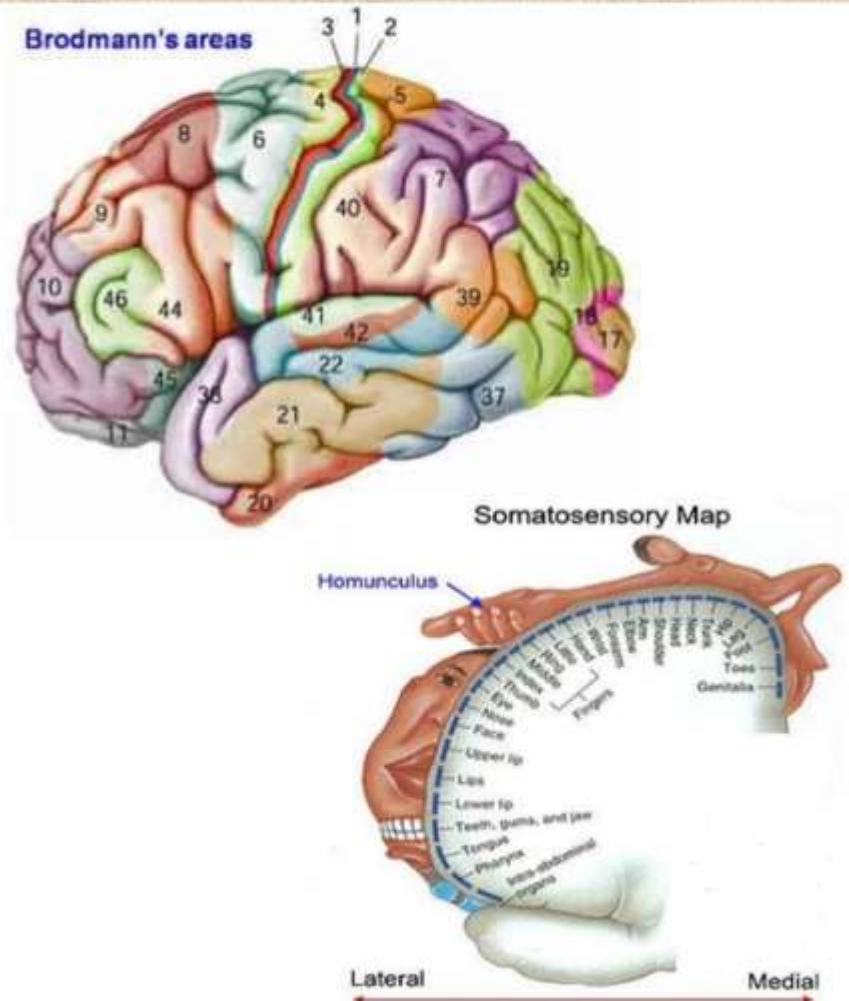
1. Somesthetic area
2. Visual area
3. Auditory area





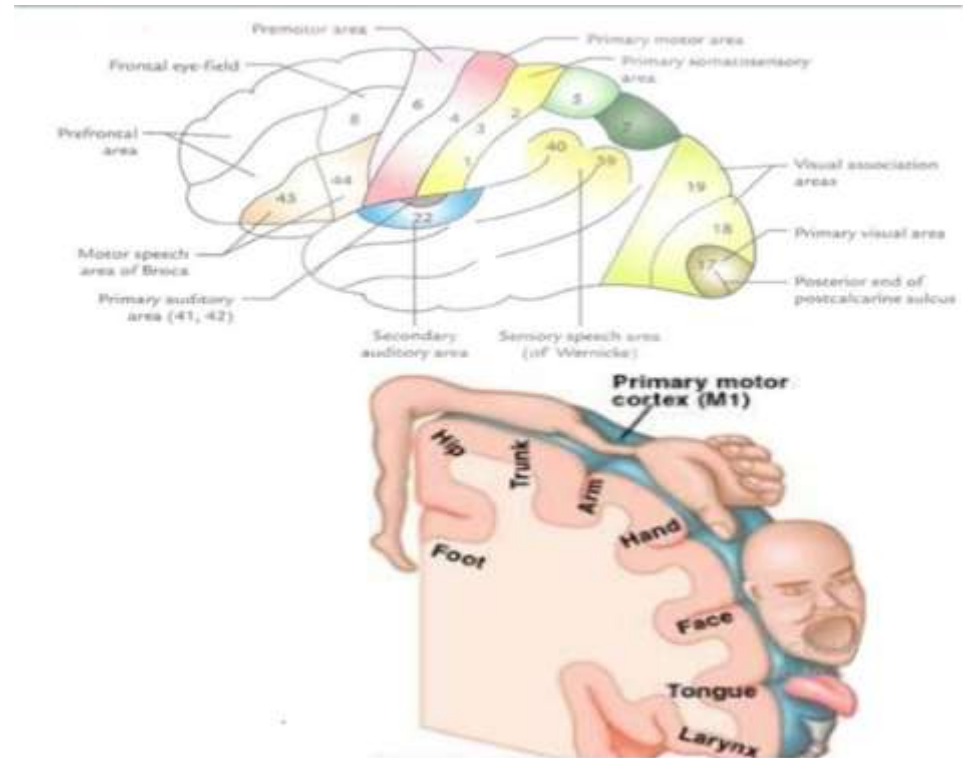
**Primary somesthetic area (area 3,1,2)**

- Located in post central gyrus (superolateral surface)
- **Functions:**
  - Localises, analyses & discriminates different modalities of cutaneous senses (touch, pressure, position & vibration senses)
  - Sensory homunculus (sensations are somatotopically arranged)
  - Lower part of post central gyrus – taste centre (area 43)



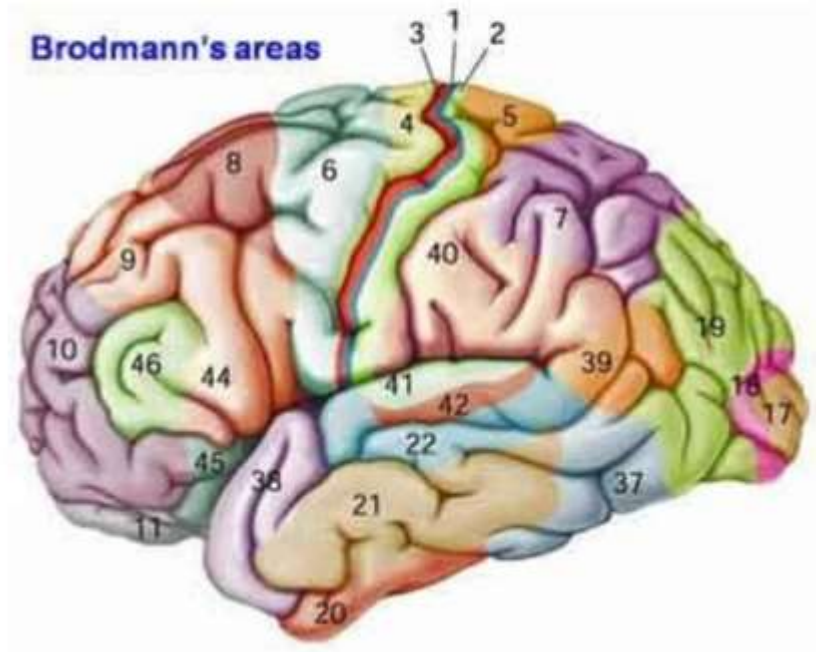
# Primary Sensory Area (Areas 3, 1, and 2 of Brodmann)

- **Lesions of primary sensory area** lead to loss of appreciation of exteroceptive and proprioceptive sensations from the opposite half of the body.



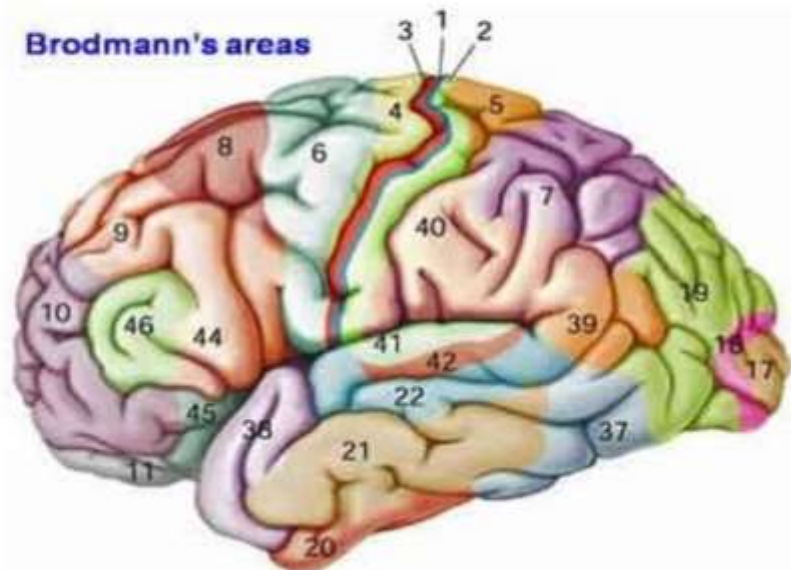
# Visual senses

1. Primary visual area (area 17)
2. Visual association area (area 18 & 19)
3. Higher visual association area (area 39)



# Auditory senses

1. Primary auditory area (area 41)
2. Auditory association area (area 42)
3. Higher auditory association area (area 22)





# Speech function cont...

- ❖ Dominant hemisphere has 4 *speech centres* (3 sensory & 1 motor centre)

Sensory speech area:

1. Area 22

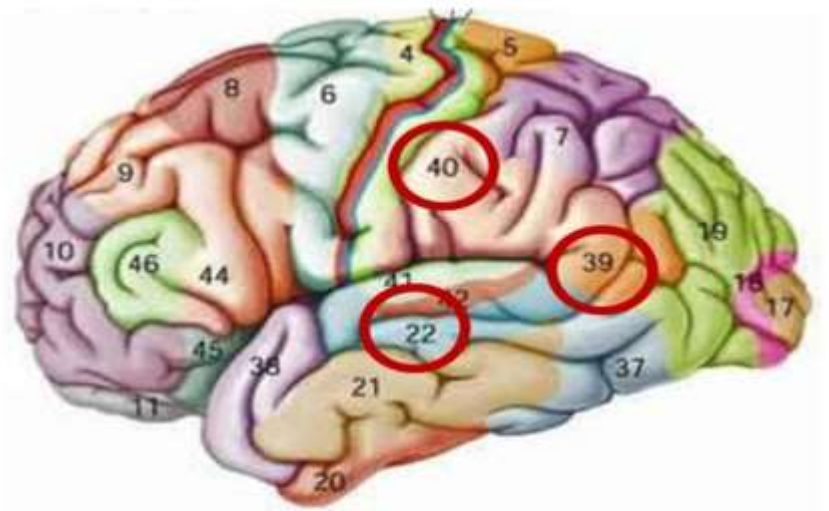
(higher auditory association area/ **Wernicke's area**)

2. Area 39

(higher visual association area)

3. Area 40

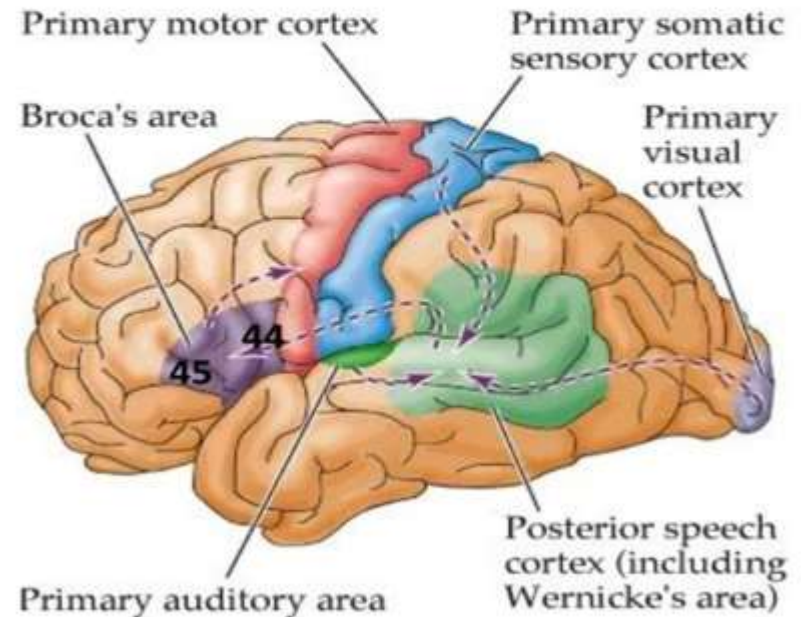
(higher association area for somesthetic senses)



# Speech function cont...

## Motor speech centre:

- ➡ 4. Area 44 & 45 (**Broca's area**)
- ➡ Speech centres (motor & sensory) may be **transferred** to right hemisphere in child up to **6-8 years** (in case of cerebral injury)

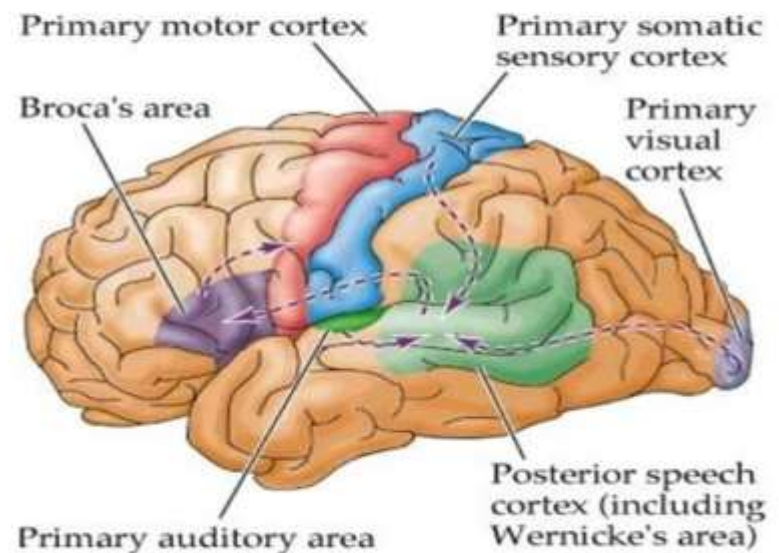


# Lesions of speech centre

- Lesion involving speech centre (dominant hemisphere) – **aphasia**

2 types:

1. Sensory aphasia
  2. Motor aphasia
- ❖ **Conduct aphasia** – lesion of arcuate fasciculus (fluent/comprehension intact /repetition of spoken language is extremely difficult)



# **ARTERIAL SUPPLY TO CEREBRUM**

## ❖ **Arterial Supply of Superolateral Surface**

- The superolateral surface of the cerebral hemisphere is supplied by the following arteries:

### **1. Middle cerebral artery:**

- Most of the superolateral surface (about 2/3rd) is supplied by the middle cerebral artery.
- The region of cerebral cortex supplied by it includes the greater parts of primary motor and sensory areas, and frontal eye field.
- In the left (dominant) hemisphere it includes the Broca and Wernicke's speech areas.

### **2. Anterior cerebral artery:**

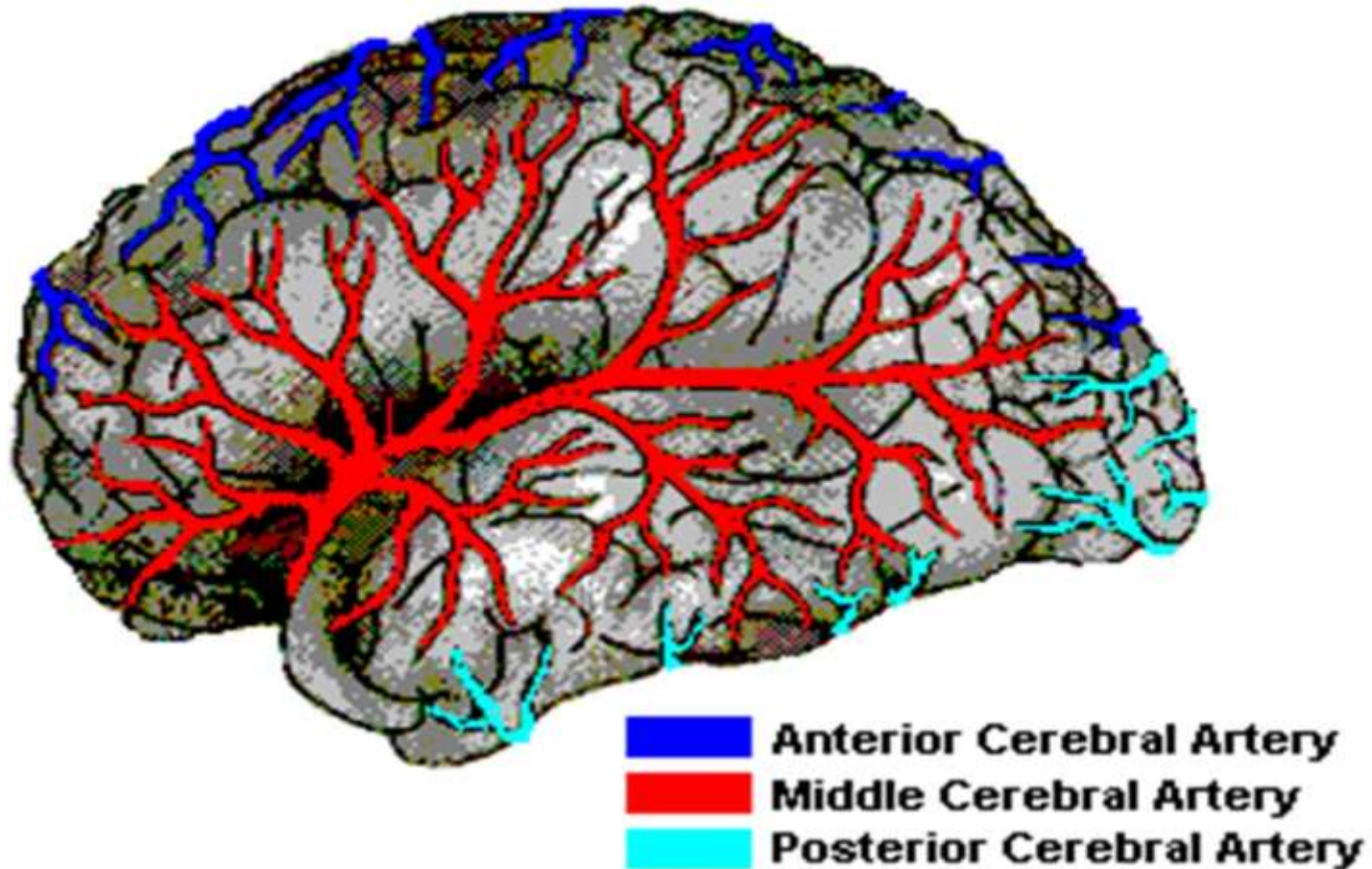
- A narrow strip of the cerebral cortex (about 2.5 cm in width) adjoining superomedial border up to the parieto-occipital sulcus is supplied by anterior cerebral artery.
- The upper parts of primary motor and sensory areas lie in this region.

### **3. Posterior cerebral artery:**

- A narrow strip along the lower border of temporal lobe (excluding temporal pole) and occipital lobe are supplied by **posterior cerebral artery**.
- The posterior parts of visual area fall in this area.



# SUPEROLATERAL SURFACE



## ❖ **Arterial Supply of Medial Surface**

- The medial surface of the cerebral hemisphere is supplied by the following arteries:

### **1. Anterior cerebral artery:**

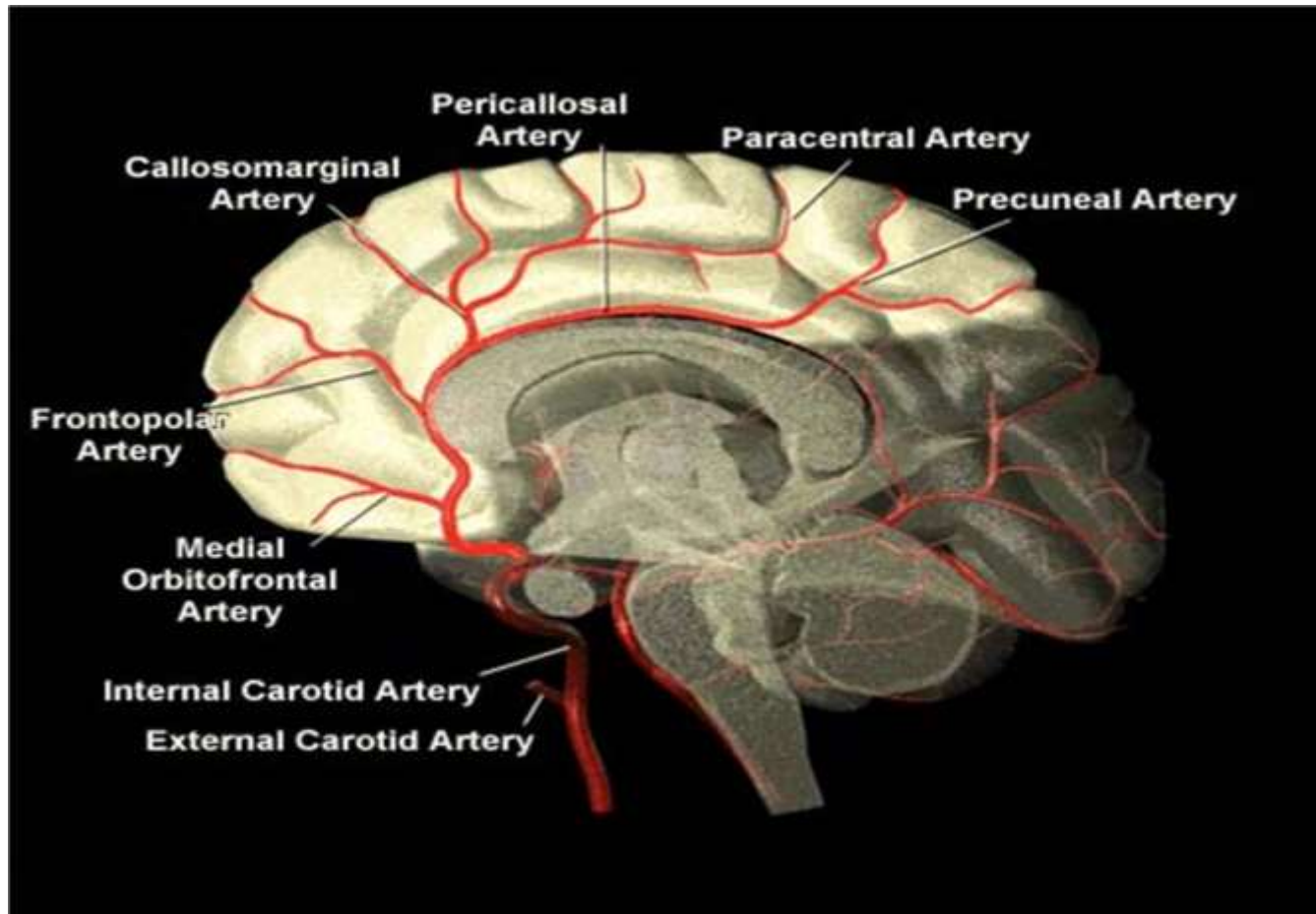
- Most of the medial surface (anterior 2/3rd) is supplied by the anterior cerebral artery.
- The region of cerebral cortex supplied includes the parts of motor and sensory areas (paracentral lobule) concerned with perineum, leg, and foot.

**2. Middle cerebral artery:** Temporal pole of the temporal lobe is supplied by the middle cerebral artery.

### **3. Posterior cerebral artery:**

- Occipital lobe is supplied by the posterior cerebral artery.
- The area supplied includes the visual cortex.

# MEDIAL SURFACE



## ❖ **Arterial Supply of Inferior Surface**

- The inner surface of the cerebral hemisphere is supplied by the following arteries:

### **1. Posterior cerebral artery:**

- Most of the inferior surface except the temporal pole is supplied by the posterior cerebral artery.

### **2. Middle cerebral artery:**

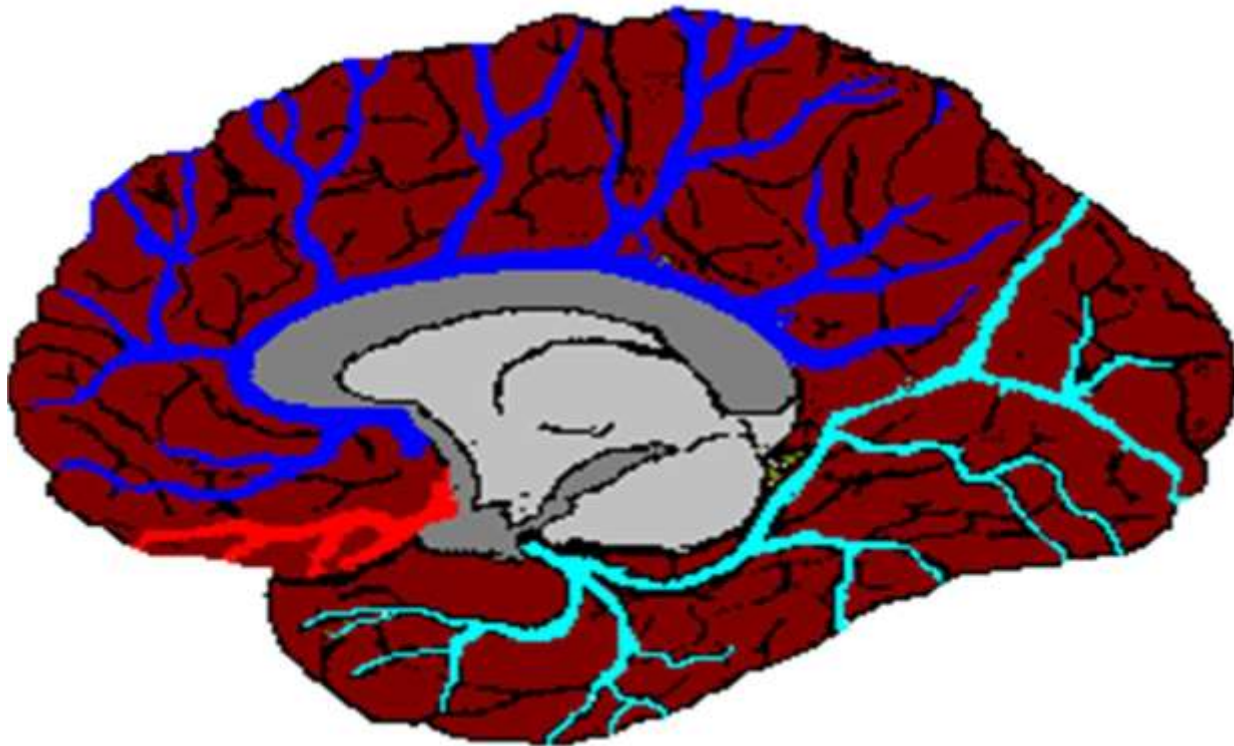
- Lateral part of the orbital surface of the frontal lobe and temporal pole of the temporal lobe are supplied by the middle cerebral artery.

### **3. Anterior cerebral artery:**

- Medial part of the orbital surface of the frontal lobe is supplied by the anterior cerebral artery.



# INFERIOR SURFACE



## **Occlusion of middle cerebral artery:**

The *occlusion of middle cerebral artery* occurs commonly.

It produces the following signs and symptoms:

- *Contralateral hemiplegia and hemianesthesia* involving mainly the face and arm, due to involvement of most of the primary motor and sensory areas.
- *Aphasia*, if left dominant hemisphere is involved—due to involvement of motor and sensory speech areas.
- *Contralateral homonymous hemianopia* due to involvement of optic radiation.

THANK YOU