

Cerebrum and Functional Areas

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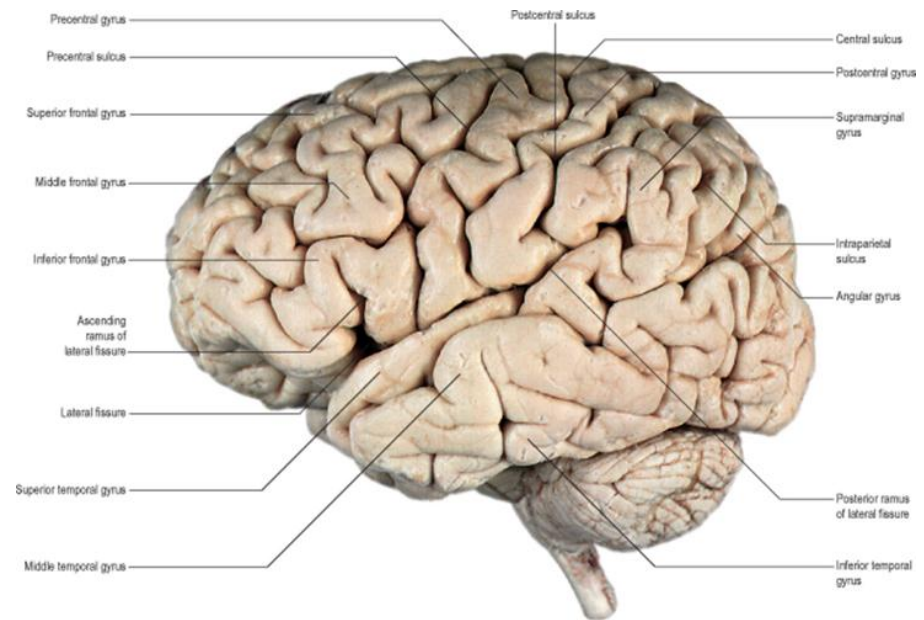
School of Anatomical Sciences

Lecture Outline

- Review sulci and gyri of cerebral hemisphere
- Functional Areas

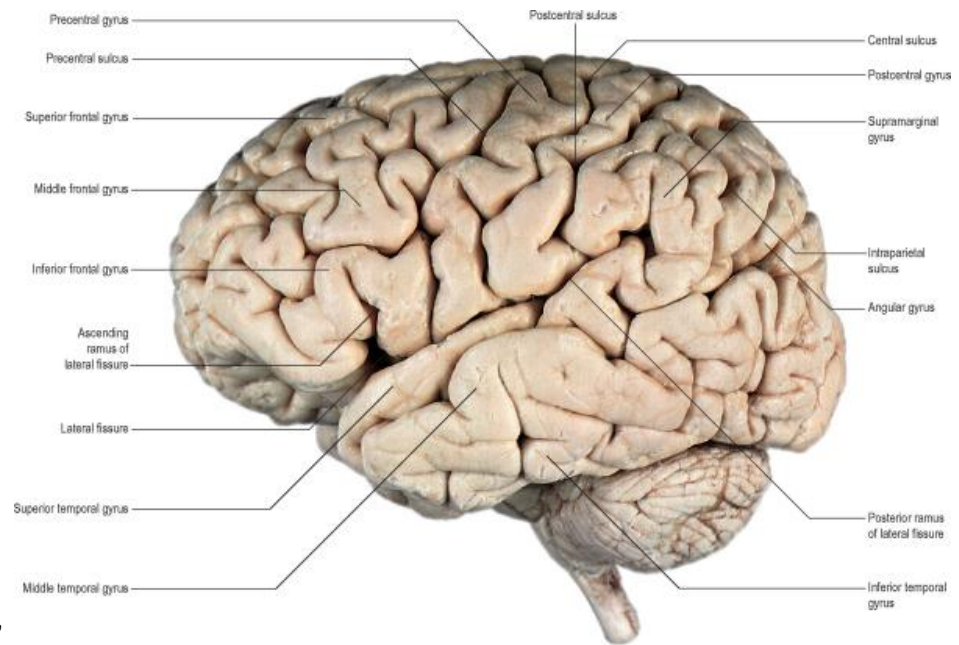
Cerebral Hemispheres

- Largest part of the brain
- Greatest degree of development is in humans
- Occupy the anterior and middle cranial fossae
- Consist of an outer cerebral cortex and an inner white matter
- A median longitudinal fissure incompletely separates the cerebrum into 2 halves; right and left



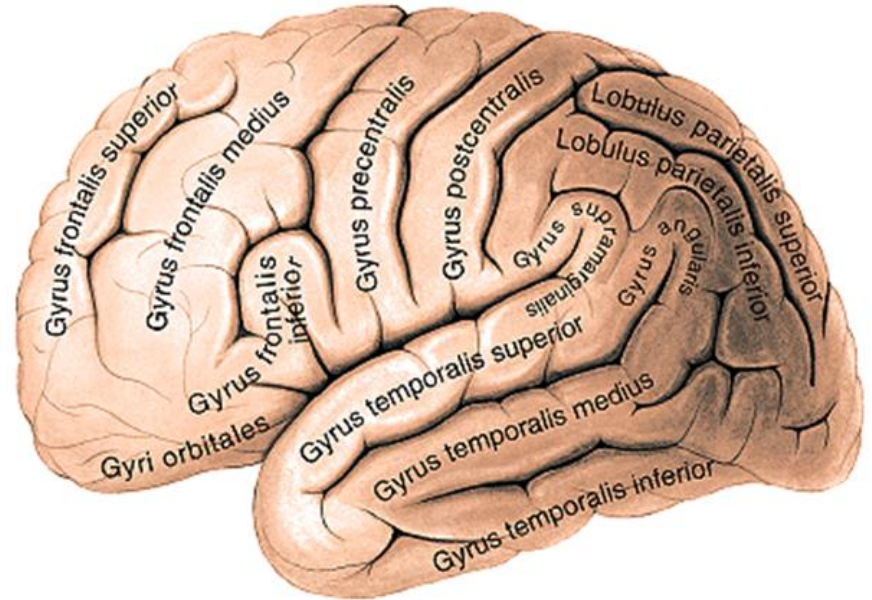
Gyri and Sulci

- **Gyri** – Complicated irregular foldings (convolutions) of surface of cerebral hemispheres
- **Sulci** – Intervening grooves between gyri.
 - May be shallow or deep.
 - Sometimes deep sulci are called fissures.
- Gyri & sulci maximise surface of cerebrum;
 - 70% of cerebrum is hidden in sulci.
 - Fairly constant, at the same time, vary within certain limits, not only from one brain to another, but within the same brain.



Superolateral surface of cerebrum

- **Lateral sulcus (Sylvius):** between frontal, Parietal & temporal lobes.
- **Central sulcus (Rolando):** 1 cm post to midpoint between frontal & occipital pole; Runs downwards & ends just before lateral sulcus; Landmark separating frontal from parietal lobes
- **Frontal lobe:** Largest: **3 sulci:** Precentral sulcus, Superior & inferior frontal sulci
- **4 gyri:** Precentral gyrus, Superior, middle & inferior gyri



Parietal Lobe

Sulcus: Postcentral & Intraparietal
Gyri: Postcentral, superior parietal lobule, inferior parietal lobule with supramarginal & angular gyri

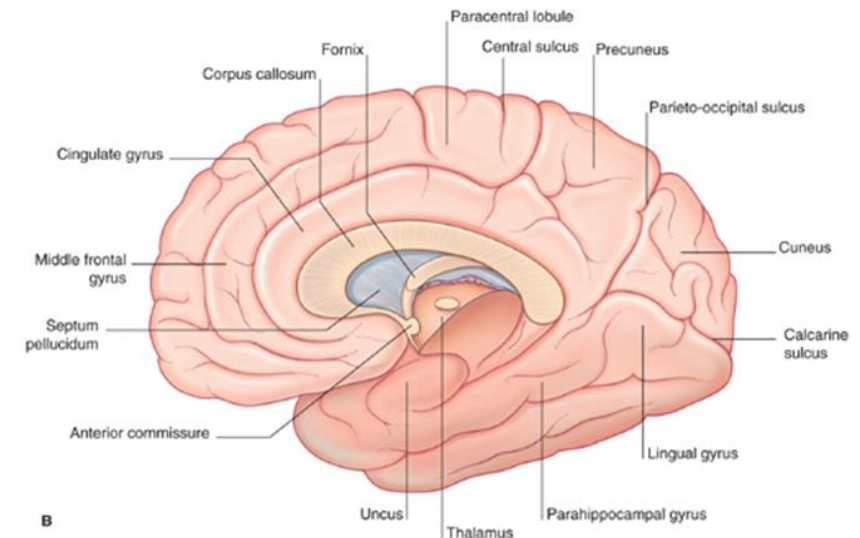
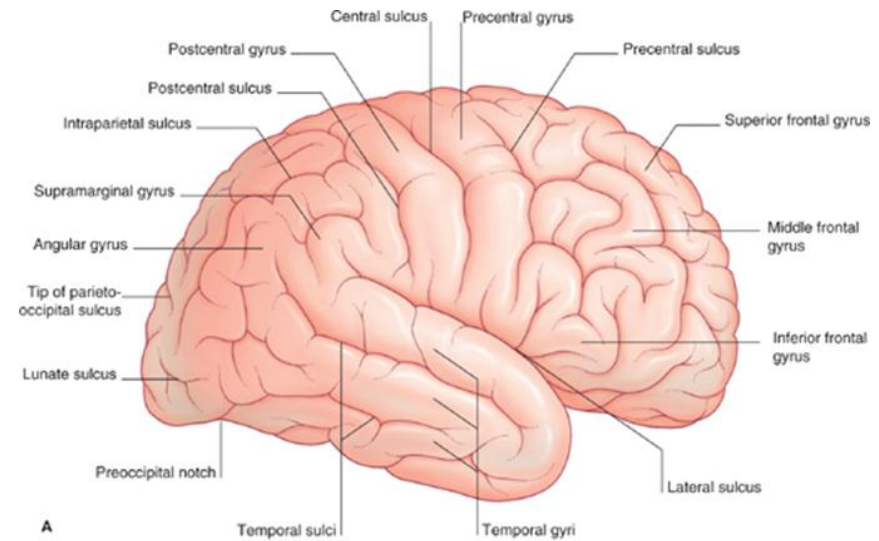
Temporal & Occipital lobes

- **Temporal lobe**

- Lies inferior to lateral sulcus.
- Sulci: superior & inferior
- Gyri: superior, middle & inferior.

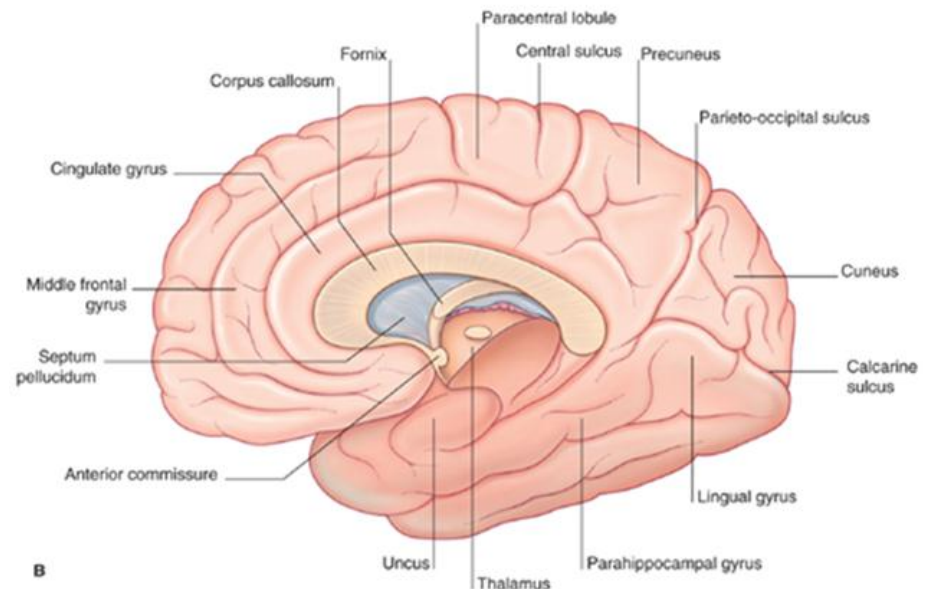
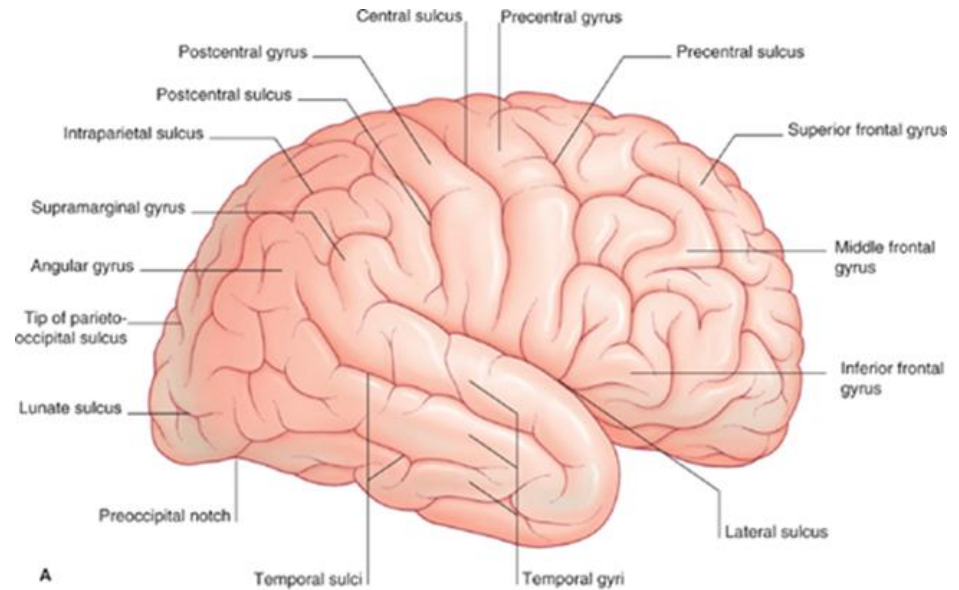
- **Occipital lobe**

- Posterior to line joining pre-occipital notch to parieto-occipital sulcus (medial surface)
- Lateral occipital sulcus (lunate)
 - The only fairly constant sulcus on superolateral surface
 - Calcarine sulcus (medial surface)



Medial Surface

- **Corpus callosum**
 - most conspicuous structure; white matter
- **Cingulate sulcus**
 - intervenes between cingulate gyrus & extension of superior frontal gyrus.
- **Paracentral lobule**
- **Middle frontal gyrus**
- **Precuneus, Cuneus & Lingual gyri**
- **Parieto-occipital sulcus**
- **Calcarine sulcus – Occipital lobe**



Inferior Surface

- Divided into 2 parts

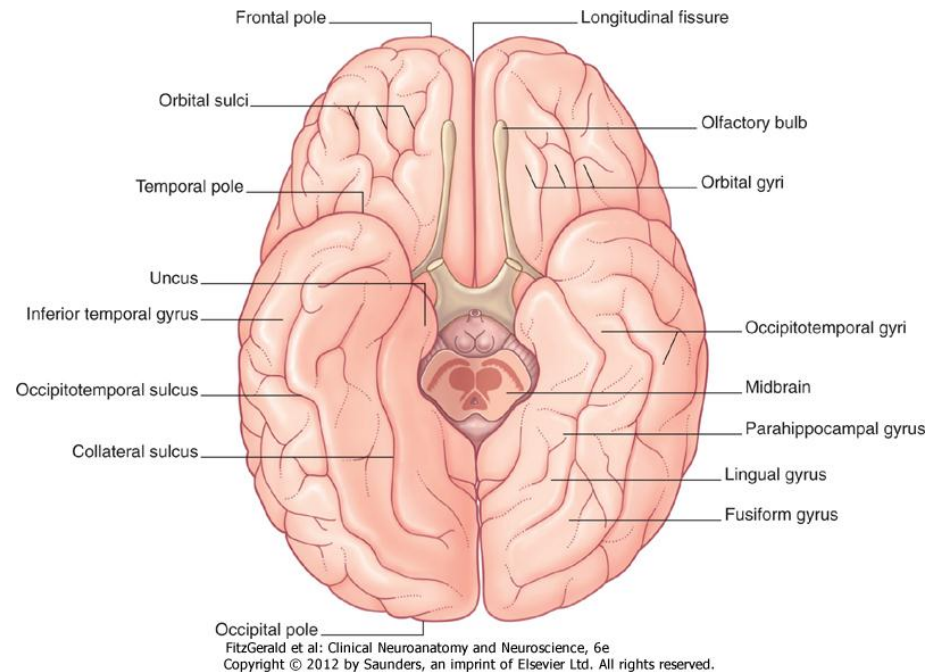
Small Ant. (orbital part):

- olfactory sulcus, gyrus rectus;
- H-shaped sulcus with anterior, posterior, lateral & medial orbital gyri

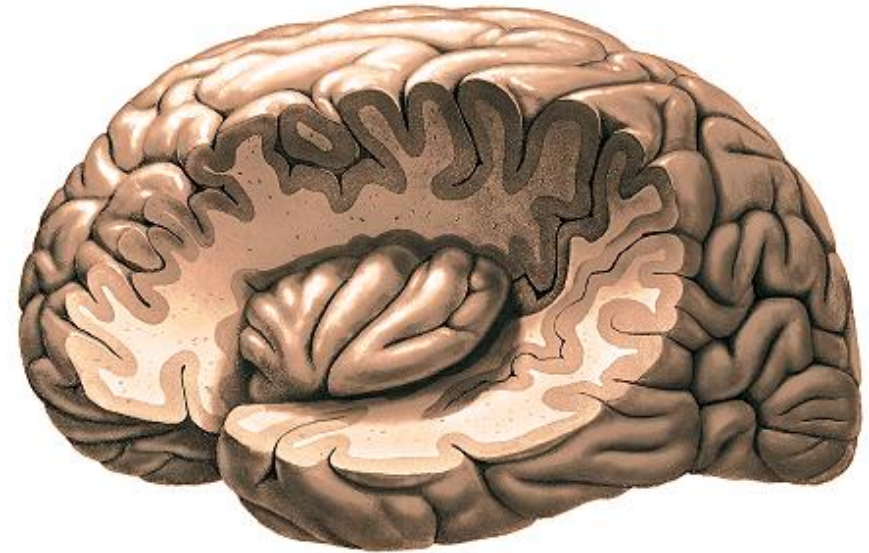
Large post. part:

- Collateral sulcus,
- occipito-temporal sulcus, medial and lateral occipito-temporal gyri,
- parahippocampal gyrus

Uncus: hook-like projection at anterior end of parahippocampal gyrus



INSULAR LOBE



- Location:
 - floor of lateral sulcus; seen only when temporal & frontal lobes are separated
- Opercular: parts of frontal, parietal & temporal lobes that overlie insula.
- Outlined by a *circular sulcus* divided into 2 regions by a *central sulcus*
- 3-4 short anterior gyri
- 1-2 long posterior gyri
- **Function:** Poorly understood but associated with taste, vestibular, visceral sensation, secondary somatic and auditory.

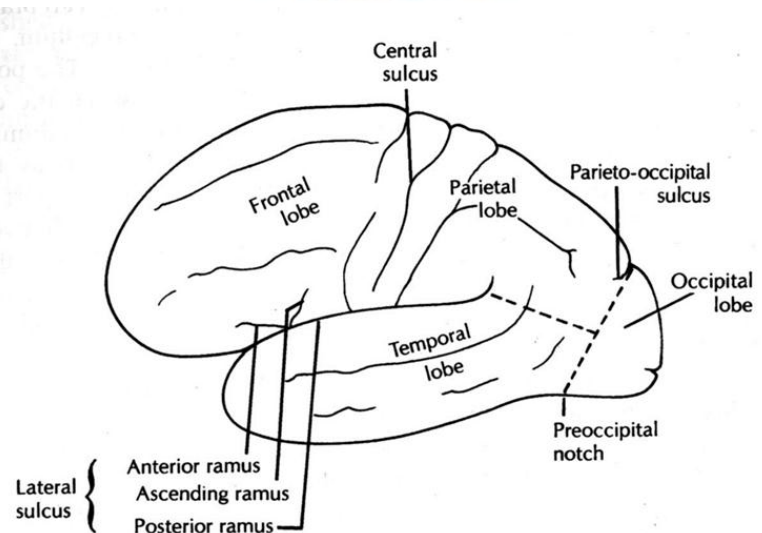
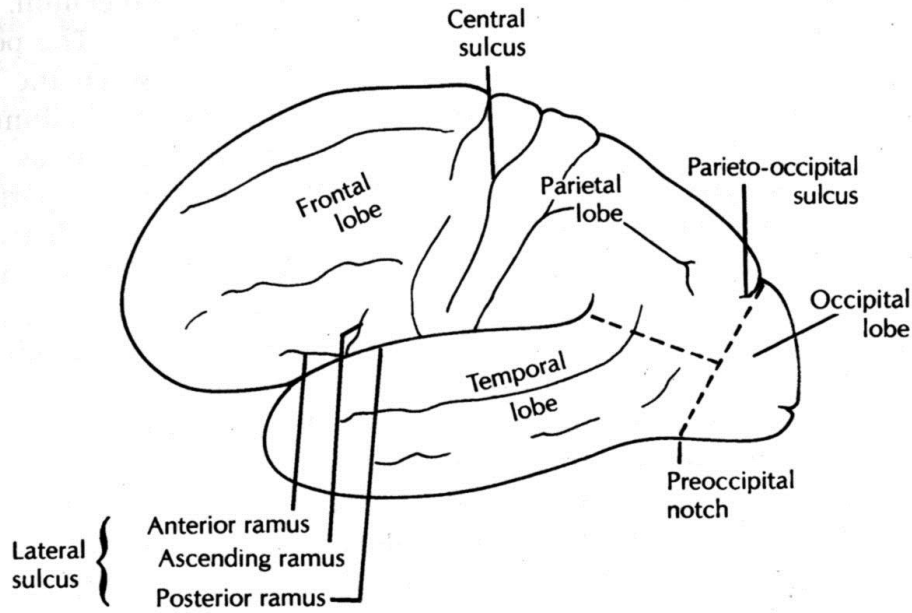
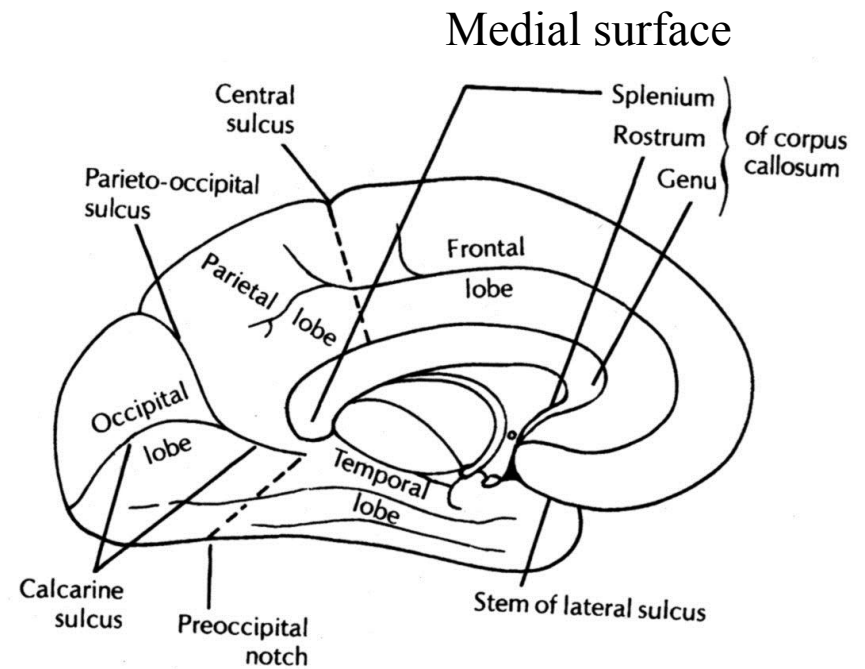


Diagram of Lobes & sulci of the Cerebrum

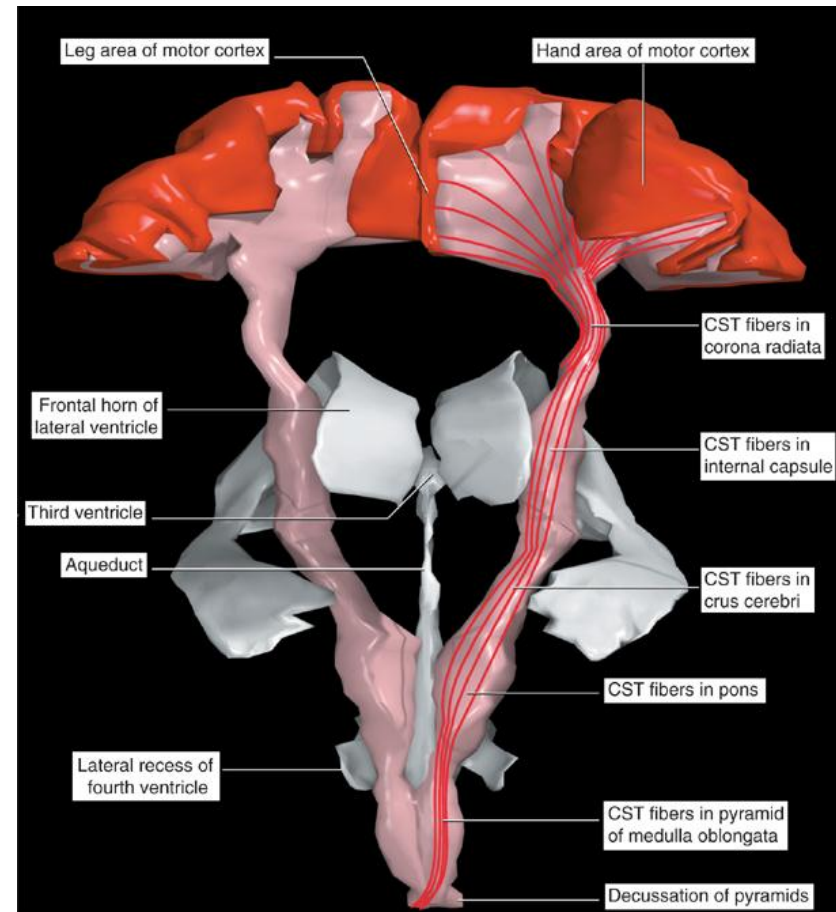


Superolateral surface



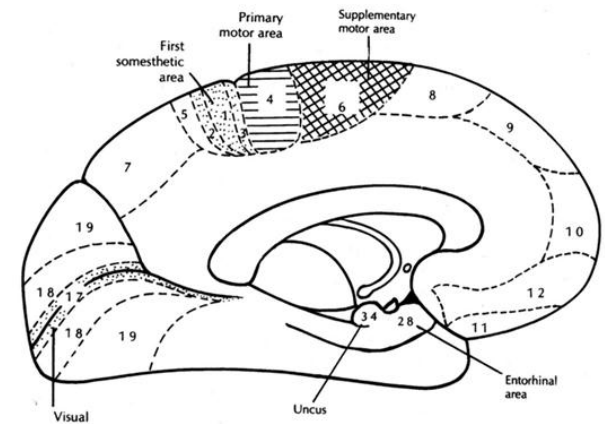
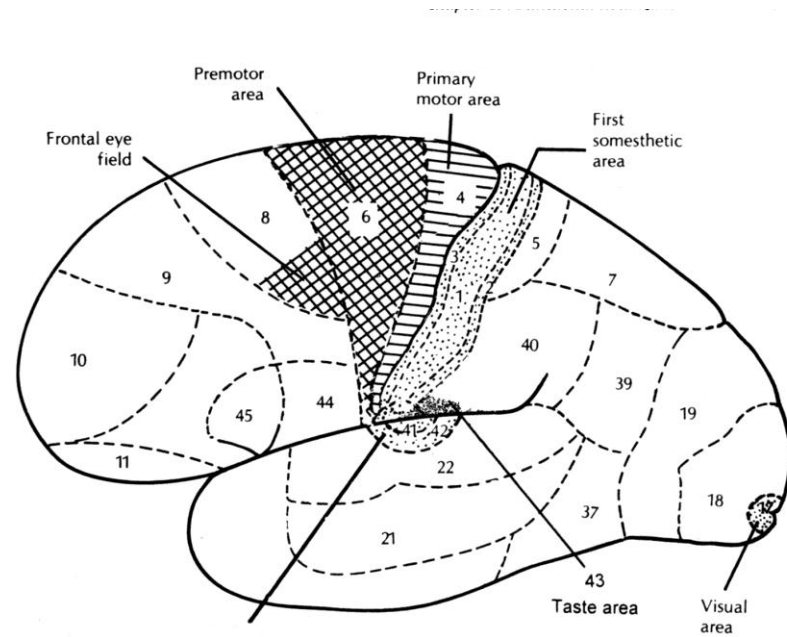
Functional Localization

- Cerebral cortex is necessary for conscious awareness and thought, memory and intellect.
- It is the region to which all sensory modalities ascend and are consciously perceived and interpreted based on previous experience.
- Cerebral cortex is the highest level at which motor systems is represented.
 - Actions are conceived and initiated.



Motor – Frontal Lobe

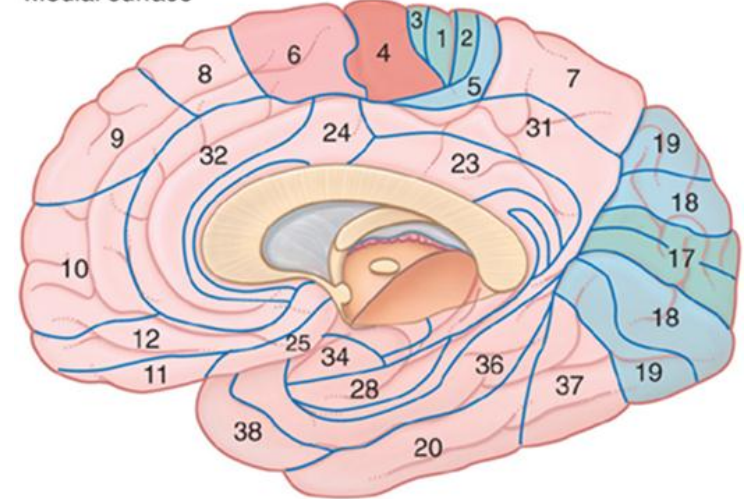
- Primary motor cortex
 - Precentral gyrus + wall of central sulcus.
Voluntary skilled movement
- Premotor (2nd motor) area
 - Anterior to precentral gyrus: for internal urge to carry out a movement.
Programmes skill motor activity
- Frontal eye field
 - Anterior to premotor area (MFG): controls voluntary conjugate movement of eyes
- Prefrontal cortex
 - Remainder of frontal lobe: highest brain functions – abstract thinking, decision making, anticipated effects of specific line of action taken, social behaviour
- Broca's expressive speech (44,45)
 - inferior frontal gyrus (Lt side in Rt handed individuals)



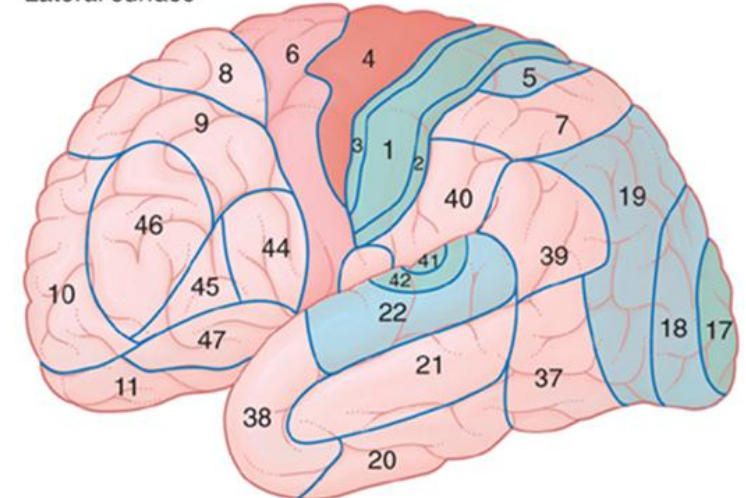
Sensory – Parietal lobe

- Primary somatosensory area
 - Tactile sense, tingling sensation, fine touch, position, movements of parts of the body; post-central gyrus – area 3,1,2
- 2nd somatosensory area
 - Less discriminative sensation is medial surface of postcentral gyrus
- Somatosensory association area
 - Identification of 3-dimensional object held in the hand without looking – superior parietal lobule
 - Inferior lobule – interface with visual and auditory areas
- Gustatory (Taste)
 - Inferior end of postcentral gyrus

Medial surface



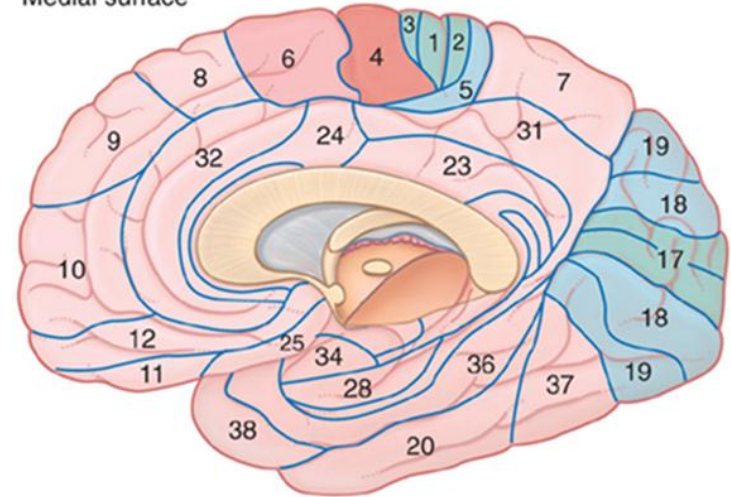
Lateral surface



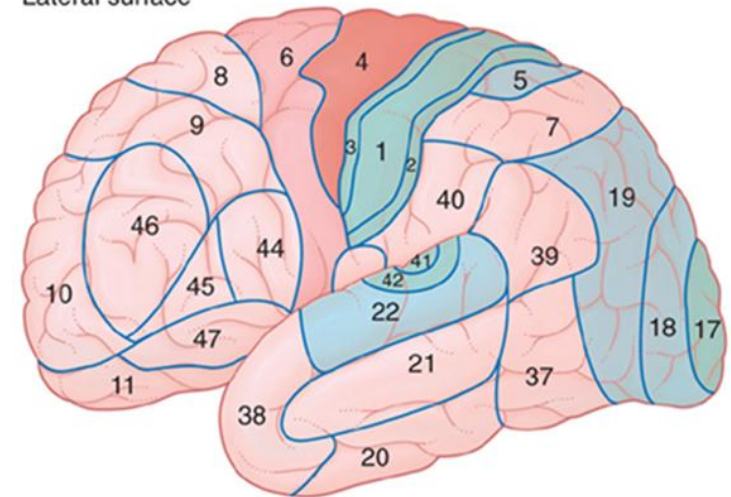
Vision – Occipital lobe

- Primary visual cortex
(Area 17)
 - Calcarine sulcus on medial surface of occipital lobe.
 - Receives optic radiations for vision.
- Association visual cortex
(Areas 18 & 19)
 - Rest of occipital lobe surrounding primary visual cortex.
 - Interprets visual information (shape & accommodation reflex)

Medial surface

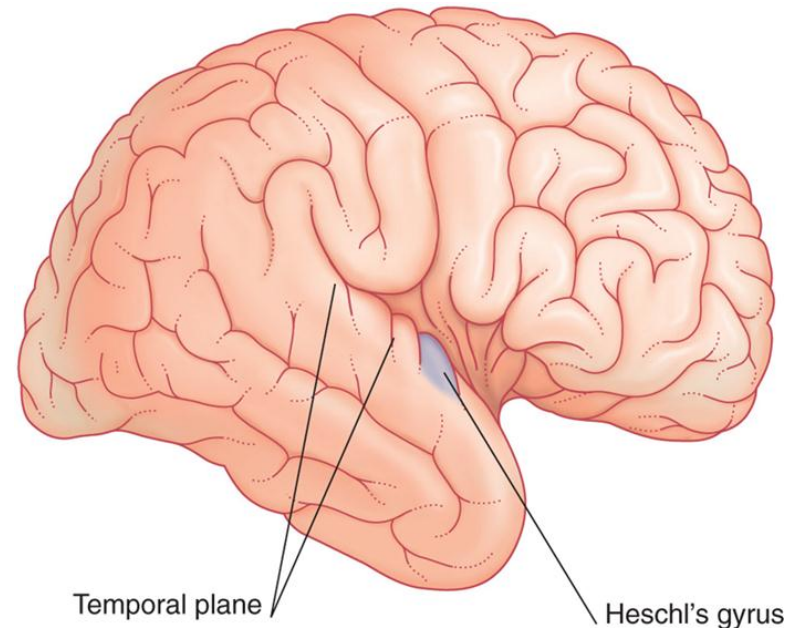


Lateral surface

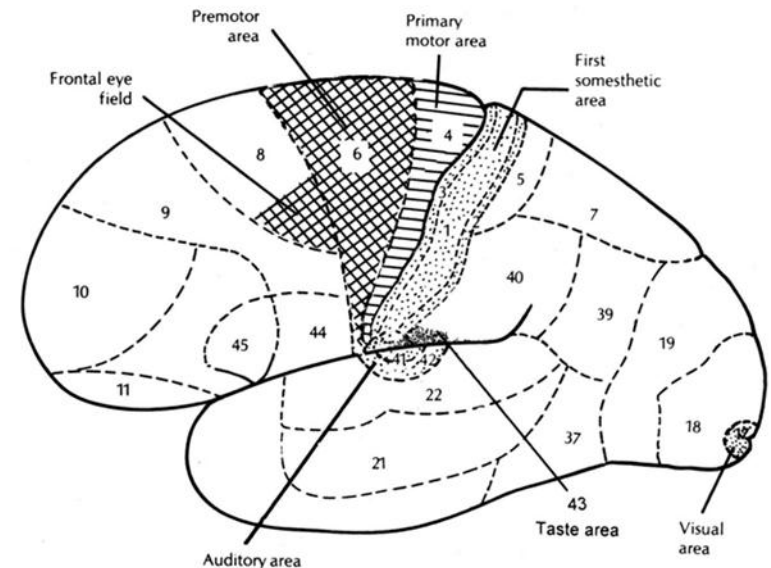


Hearing – Temporal lobe

- Primary auditory cortex
 - superior surface of STGyrus (transverse temporal gyri (Heschl convolutions)). Receives input from MGB of thalamus.
 - Higher frequencies activate lateral stripes
 - Lower frequencies act on medial stripes
- Auditory association cortex (sensory)
 - “Wernicke’s area”; adjacent to primary auditory cortex
 - Interpretation of auditory information (understanding spoken word and reading)



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Hippocampal Formation & Limbic system

Location: Inner portion of temporal lobe.

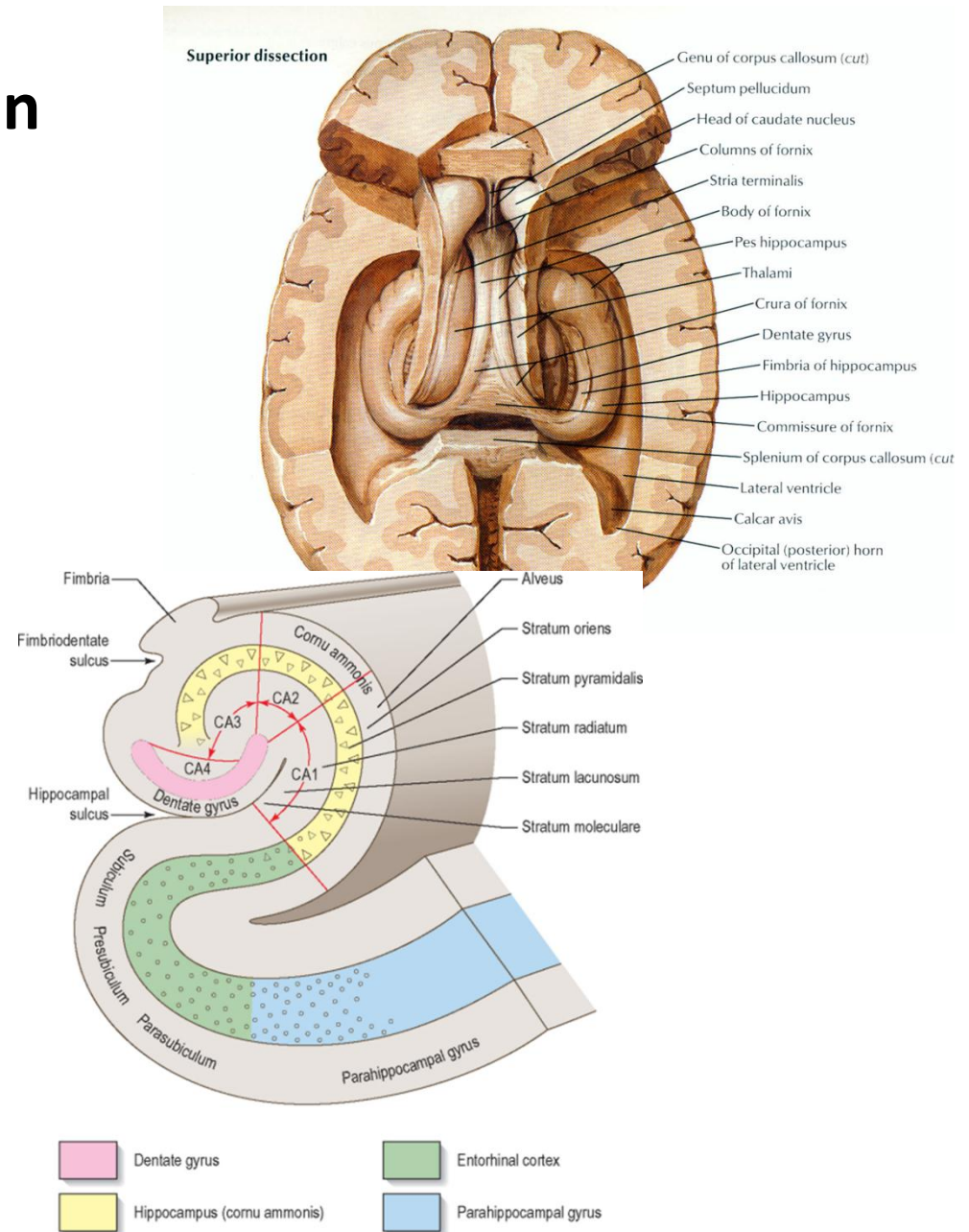
4 sub-regions linked by strong connections uniting them as a **functional entity**

Dentate gyrus

Hippocampus proper

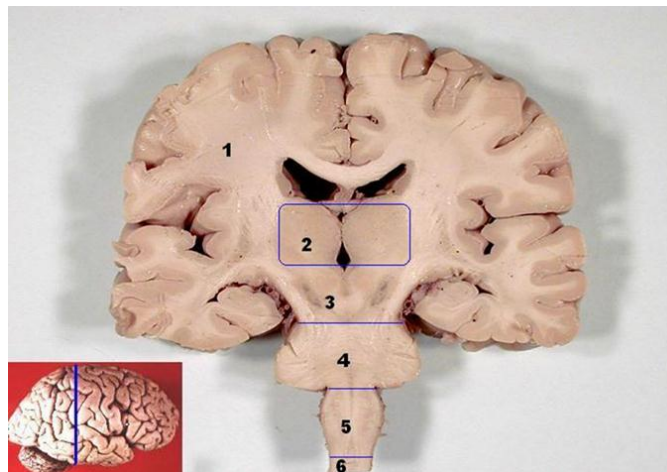
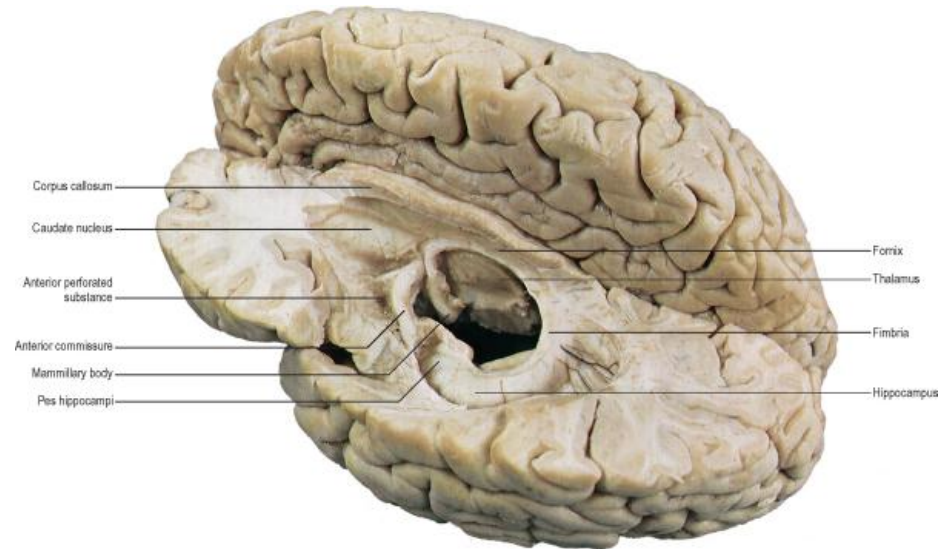
Subicular complex

Entorhinal cortex



Hippocampus (Ammon's horn)

- Ammon's horn & Most prominent
- Curved elevation, ~ 5 cm long, along floor of inferior horn of lateral ventricle.
- 2 or 3 shallow grooves that give a paw-like appearance, the **pes hippocampi**.
- **Function:** Memory & Learning



Limbic System

STRUCTURE



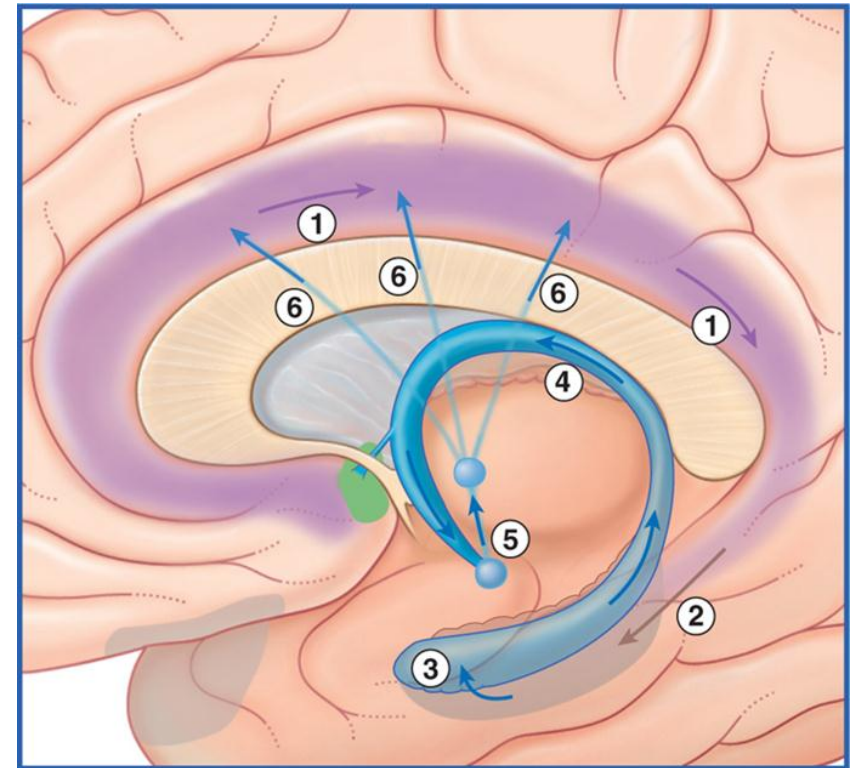
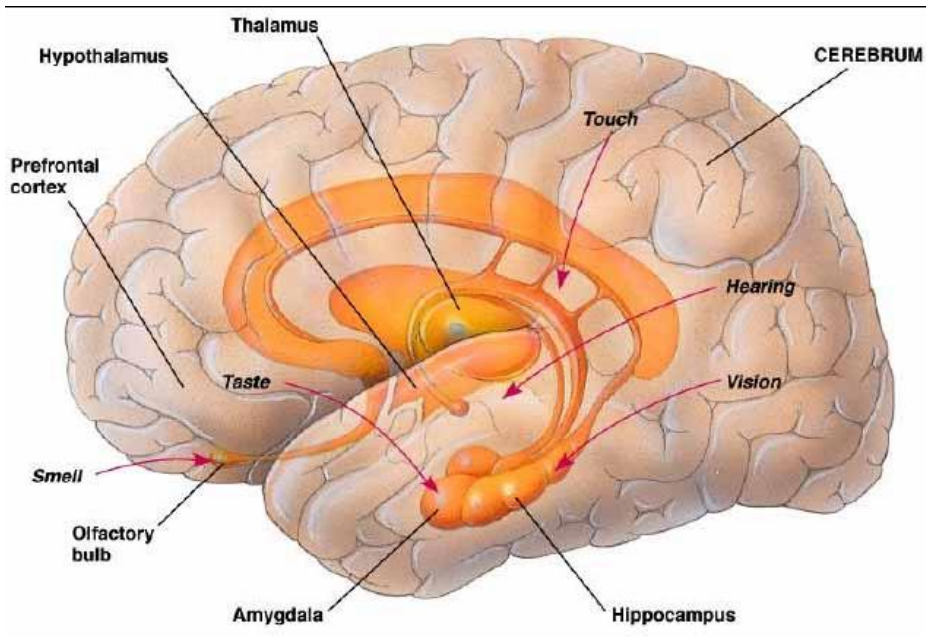
CIRCUITRY



FUNCTION

Structure	Components
Cortex	Limbic lobe
	➤ Cingulate gyrus
	➤ Subcallosal gyrus
	➤ Parahippocampal gyrus
	➤ Hippocampal formation
	❖ Dentate gyrus
	❖ Hippocampus proper
	❖ Subiculum
Nuclei	Amygdaloid body (nucleus complex)
	Septal nuclei (nuclear complex)
	Some thalamic nuclei
	Some hypothalamic nuclei
	Brainstem (Reticular Formation)
Connections	
	Fornix
	Cingulum
	Mammillothalamic tract
	Stria terminalis
	Stria medullaris thalami

Interconnections of Limbic system: Papez circuit



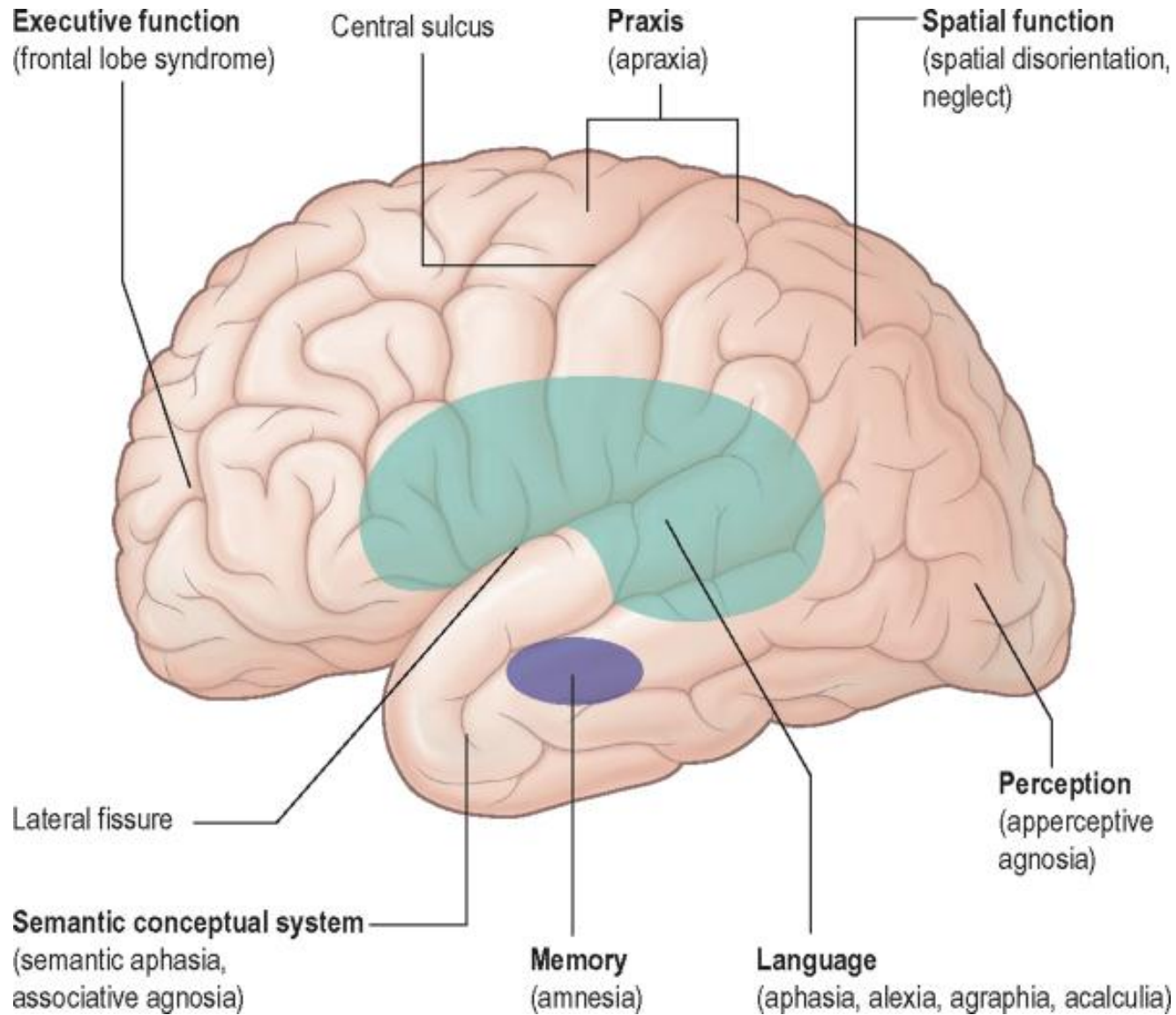
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- 1 Backward-projecting neurons in **cingulate gyrus**.
- 2 Projection into **entorhinal cortex of parahippocampus**.
- 3 Projection into **hippocampus**.
- 4 **Fornix**.
- 5 **Mammillothalamic tract**.
- 6 Projections from **anterior nucleus of thalamus** to cingulate cortex.

Summary of Limbic system

- **Limbic Structures**
- **Limbic Circuitry**
 - ❖ Papez circuit
 - ❖ Hippocampal circuit (Intrinsic & extrinsic)
 - ❖ Fear circuit – amygdala
- **Subcortical sites**
 - Striatum
 - Thalamus
 - Brainstem
- **Functions in health and disease**
 - ❖ Combination and complex
 - ❖ Cognitive processes, fear,
 - ❖ Self preservation (Flight/fight, Eating and Drinking)
 - ❖ Species preservation (Sexual behaviour and Social behaviour)
 - ❖ Emotional behaviour
 - ❖ Motivation
 - ❖ Memory & Learning

Linking function to dysfunction



Questions

- *Draw a well-labelled diagram of the superolateral surface of the cerebral hemisphere indicating the lobes, gyri and sulci.*
- *List the functions associated with each lobe (or a named lobe).*
- *Which cortical areas are involved in the limbic system*
- *List the structures involved in the interconnection of the limbic system called the 'Papez circuit'.*