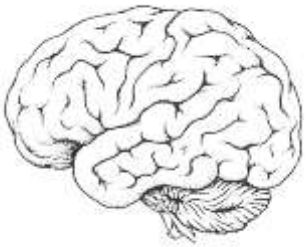


BAU-Medicine

Sheet no. 4
Lecture Date: 25.2.2021
Lecture Title: Cerebral Cotex
Written by: RAHAF YAGHII
Edited by: JOUD HADIDII

دعاء لزميلنا رشيد

اللهمّ افسح له في قبره مدّ بصره، وافرش قبره من فراش الجنّة ,اللهمّ أعذه من عذاب القبر، وجفاف الأرض عن جنبيها.

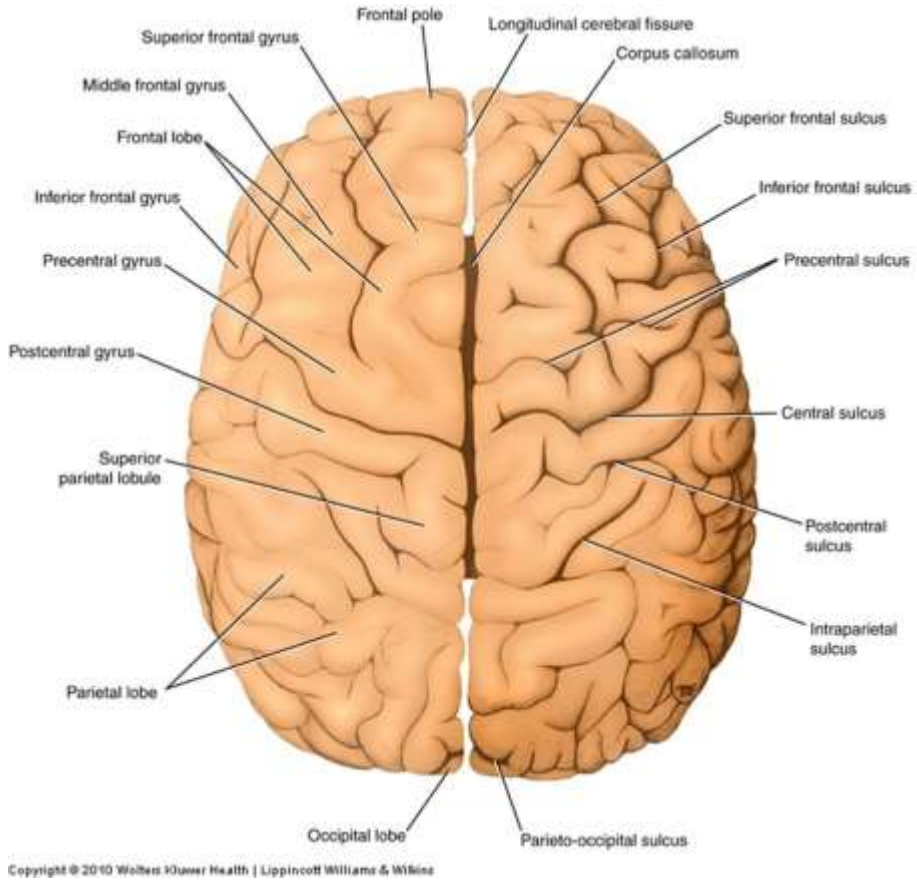
If you come by any mistake (whether it be spelling, grammatical or scientific) while browsing this sheet, kindly report it to the Academic team Facebook account.

Lecture Objectives

- Describe the organization of the cerebral cortex.
- Locate the motor, sensory and other cortical areas.
- Describe the cortical areas related to the written and spoken language.
- Identify the components of the medial temporal lobe and the hippocampal formation.
- Identify the structures in coronal, sagittal and horizontal sections of brain.

Cerebral Hemispheres

- Longitudinal fissure separates left &right cerebral hemispheres
- Cerebral cortex is gray matter overlying white matter
  - 2-4 mm thick containing billions of cells
  - grew so quickly formed folds (gyri) and grooves (sulci or fissures)
- Corpus callosum is band of white matter connecting left and right cerebral hemispheres
- Each hemisphere is subdivided into 4 lobes (and the insula)



#Sheet Page

-Cerebral cortex located mainly behind corpus callosum , behind the wall of 3rd ventricle .

-Central fissure

-is the only continuous fissure and it extends from the longitudinal fissure almost up to the lateral fissure

-Anterior to it is the frontal lobe

-Posterior to it is the parietal lobe

-Lateral fissure

-Inferior to it is the temporal lobe

-insula located deep within the lateral fissure

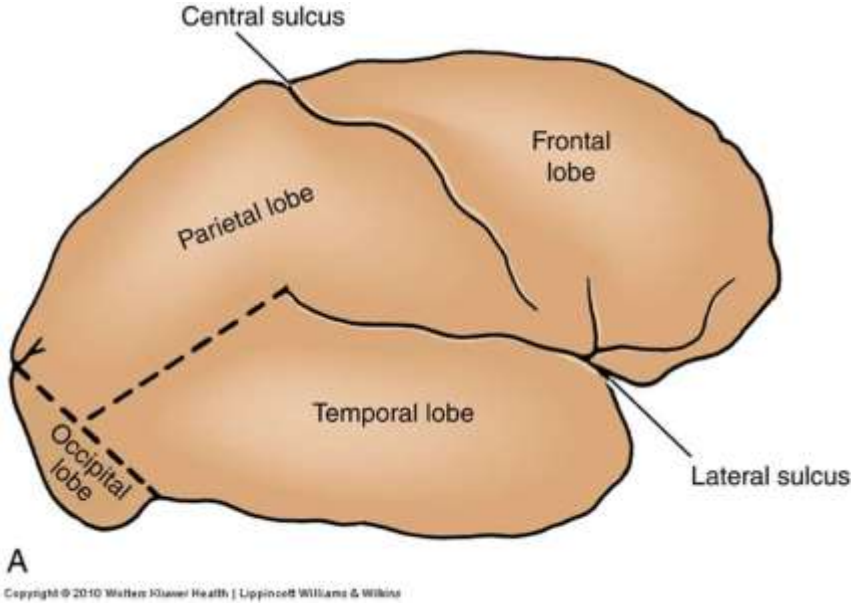
-Parieto-occipital sulcus

-Appears short when looking from the lateral view but it's actually long if you look from the medial view (by midsagittal section)

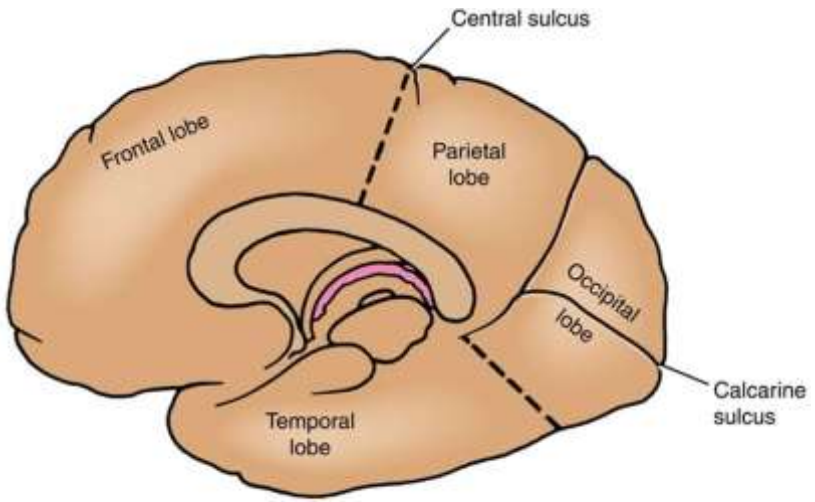
-As the name suggests it separates the occipital and parietal lobes

Cerebral Lobes

- Longitudinal fissure
- Lateral sulcus (of Sylvius)
- Frontal lobe
- Central sulcus (of Rolando)
- Parietal lobe
- Parieto-occipital sulcus
- Occipital lobe
- Preoccipital notch
- Calcarine sulcus
- Temporal lobe
- Insula



#Sheet note : the dotted lines mean that this is an imaginary line



#Sheet Page

-Pre-occipital notch

-an indentation located just anterior to the occipital lobe

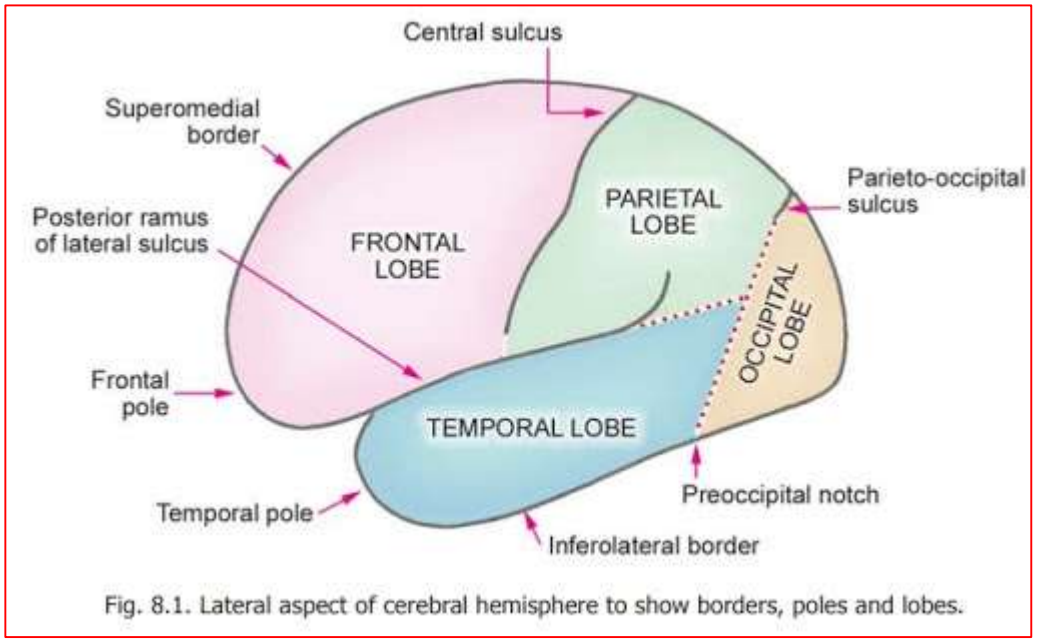
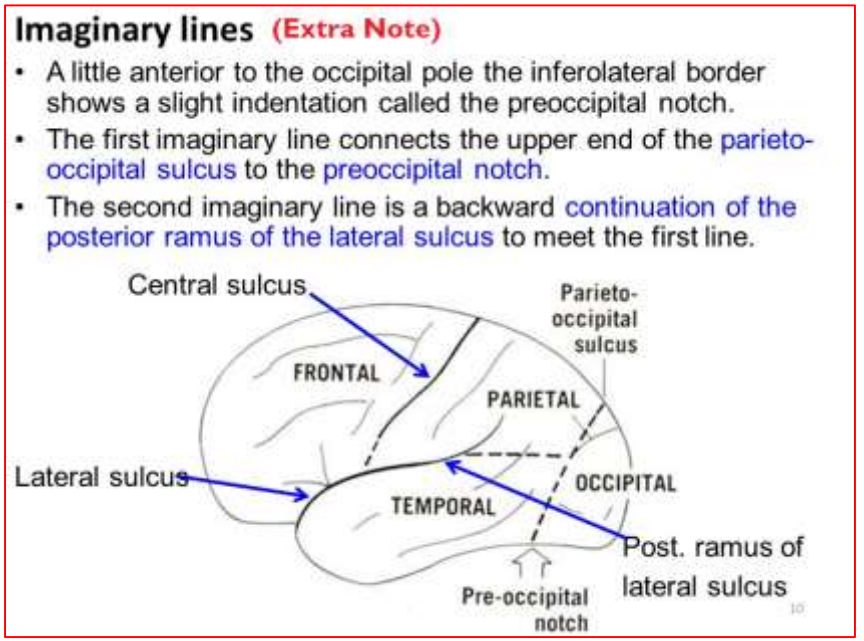


Fig. 8.1. Lateral aspect of cerebral hemisphere to show borders, poles and lobes.



-there is an imaginary line drawn from the tip of the Preoccipital notch up to the lateral of the Parieto-occipital sulcus (1st imaginary line)

-this line allows us to separate the occipital lobe from the temporal and parietal lobes.

-we can draw another imaginary line from the end of the lateral fissure to the middle of the 1st imaginary line to separate the posterior part of the parietal lobe from the temporal lobe (2nd imaginary line)

This help us to define boundaries of temporal ,parietal and occipital lobes .

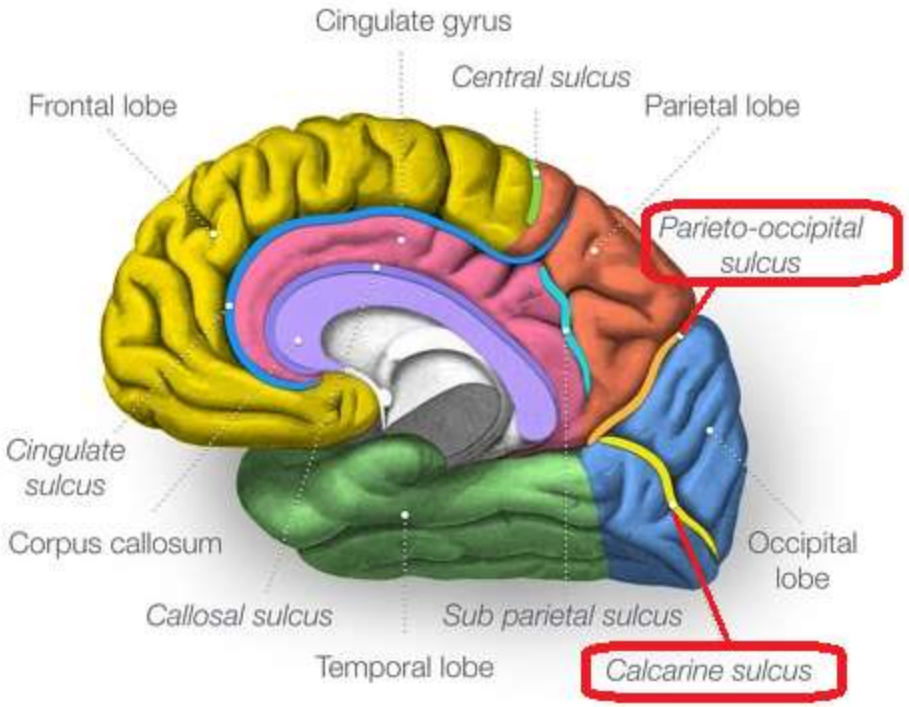
#Sheet Page

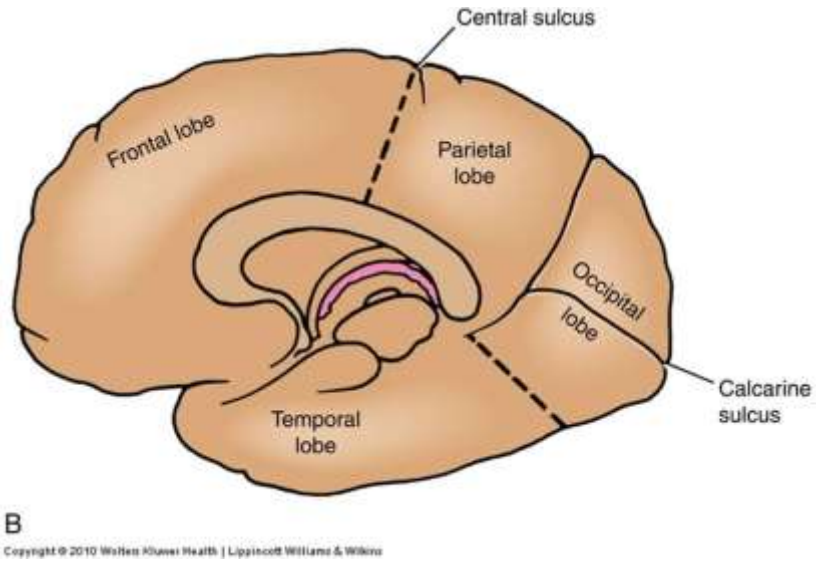
-Calcarine Sulcus [medially]

Found in the center od occipital lobe

- Extends from the middle of the occipital lobe medially and joins the parieto-occipital sulcus

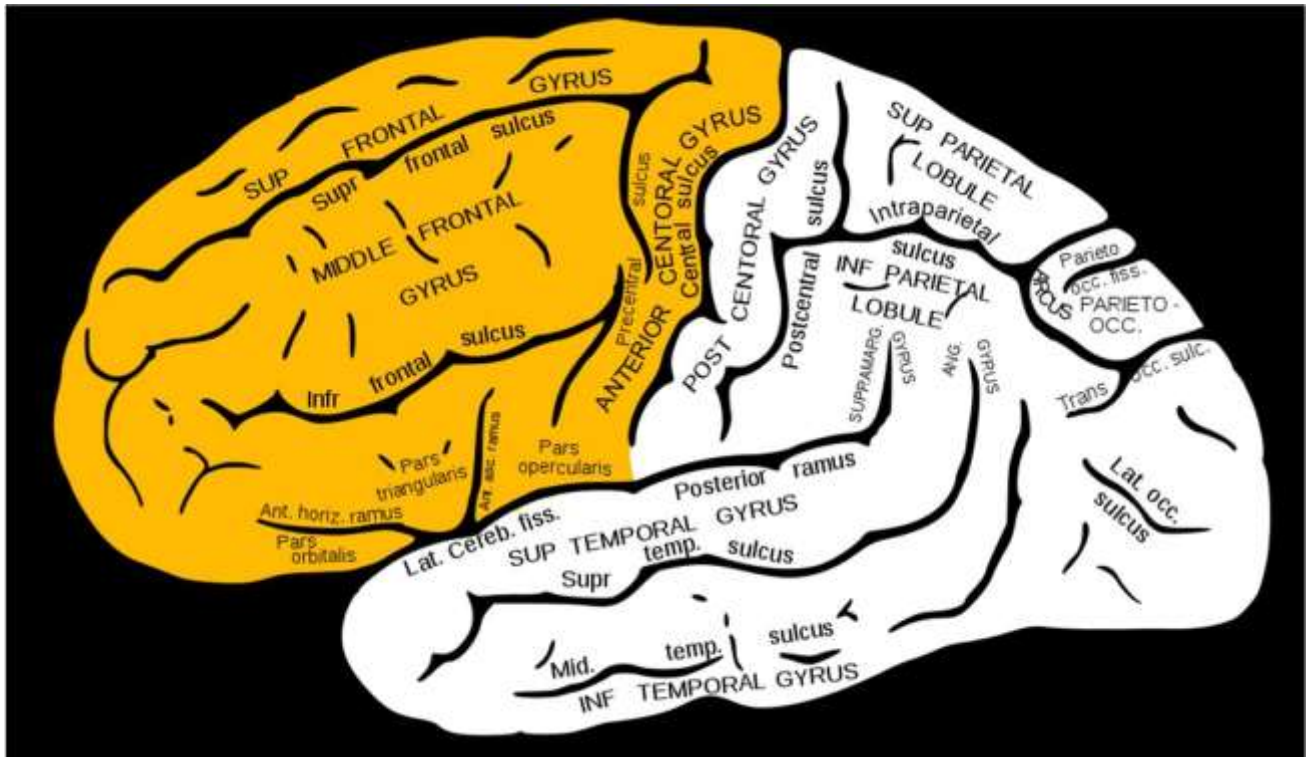
- **Central sulcus** : separate between the frontal and parietal lobe





Frontal Lobe: Laterally (left side)

- Central Sulcus
- Precentral gyrus
- Precentral sulcus
- Superior frontal gyrus
- Superior frontal sulcus
- Middle frontal gyrus
- Inferior frontal sulcus
- Inferior frontal gyrus



#Sheet Notes:

-This lobe is Anterior to the central sulcus (immediately anterior to the central sulcus we have a gyrus called the Pre-Central Gyrus (Primary Motor Area)

-Anterior to the Pre-Central Gyrus is the Pre-Central Sulcus

-Anterior to the Pre-Central Sulcus we have 3 major gyri separated by the superior and inferior frontal sulci

-Superior Frontal Gyrus

-Middle Frontal Gyrus

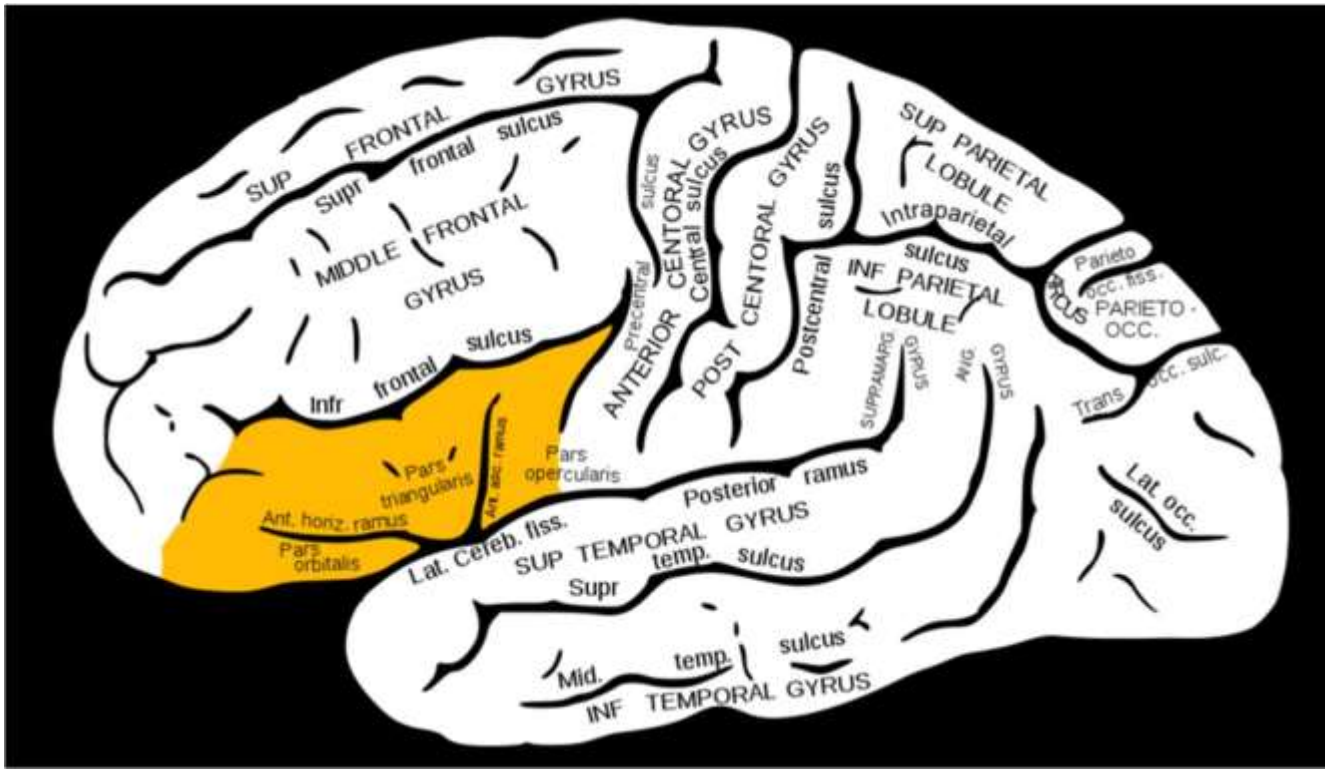
-Inferior Frontal Gyrus (most important one, check the next slide)

-pre and postcentral gyrus and central sulcus have a clear continuation .

Frontal Lobe: Laterally

- Inferior frontal gyrus
  - Orbital gyri
  - Anterior horizontal ramus
  - Triangular gyrus*
  - Anterior ascending ramus
  - Opercular gyrus*

*form speak (Broca's) area



#Sheet Notes:

-Two sulci extend from the lateral fissure (Ant. Horiz. Ramus & Ant. Asc. Ramus) they split the inf. Frontal ramus into 3 gyri

-Orbital gyri
-Triangular gyrus (between the two rami)
-Opercular gyrus

} They form Broca's area (Speech) ..its part of primary motor area

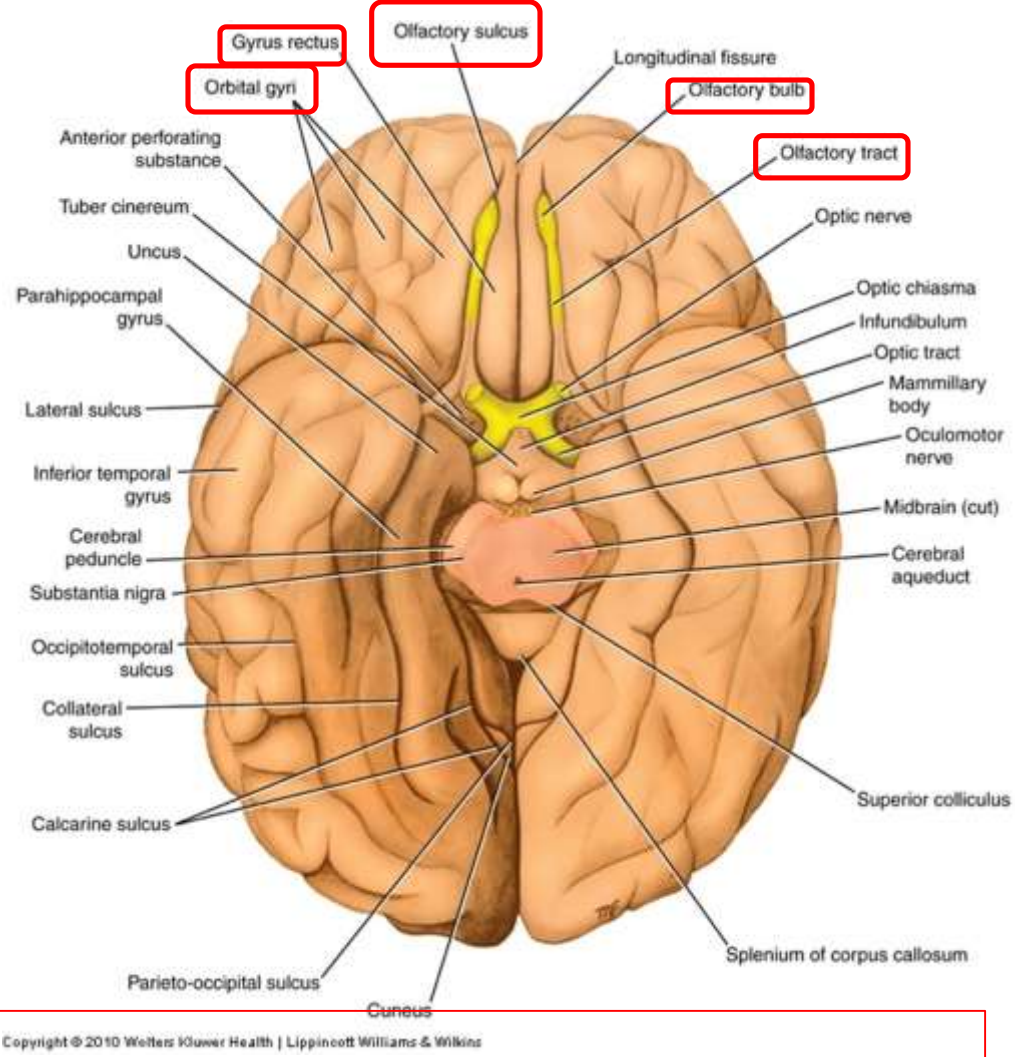
Opercular gyrus (between precentral gyrus and ascending ramus)

Speech area give order to skeletal muscle (laryngeal ,pharynx ,tongue , palate) to contract

If this area is damaged these muscles will paralyze and the patient won't be able to speak .

Frontal Lobe: Inferiorly

- Rectus (straight) gyrus
  - Most medial
- Olfactory sulcus
  - Olfactory bulb
  - Olfactory tract
- Medial & lateral olfactory striae
- Anterior perforating substance
- Orbital gyri



#Sheet Notes:

-From lateral to medial

orbital gyri -> gyrus rectus

-Lat. To the gyrus rectus there is a sulcus called the straight or olfactory sulcus

-this sulcus contains the olfactory bulb & olfactory tract

-The olfactory tract divides into two parts

medial stria (mostly connects with the medial stria from the other side)

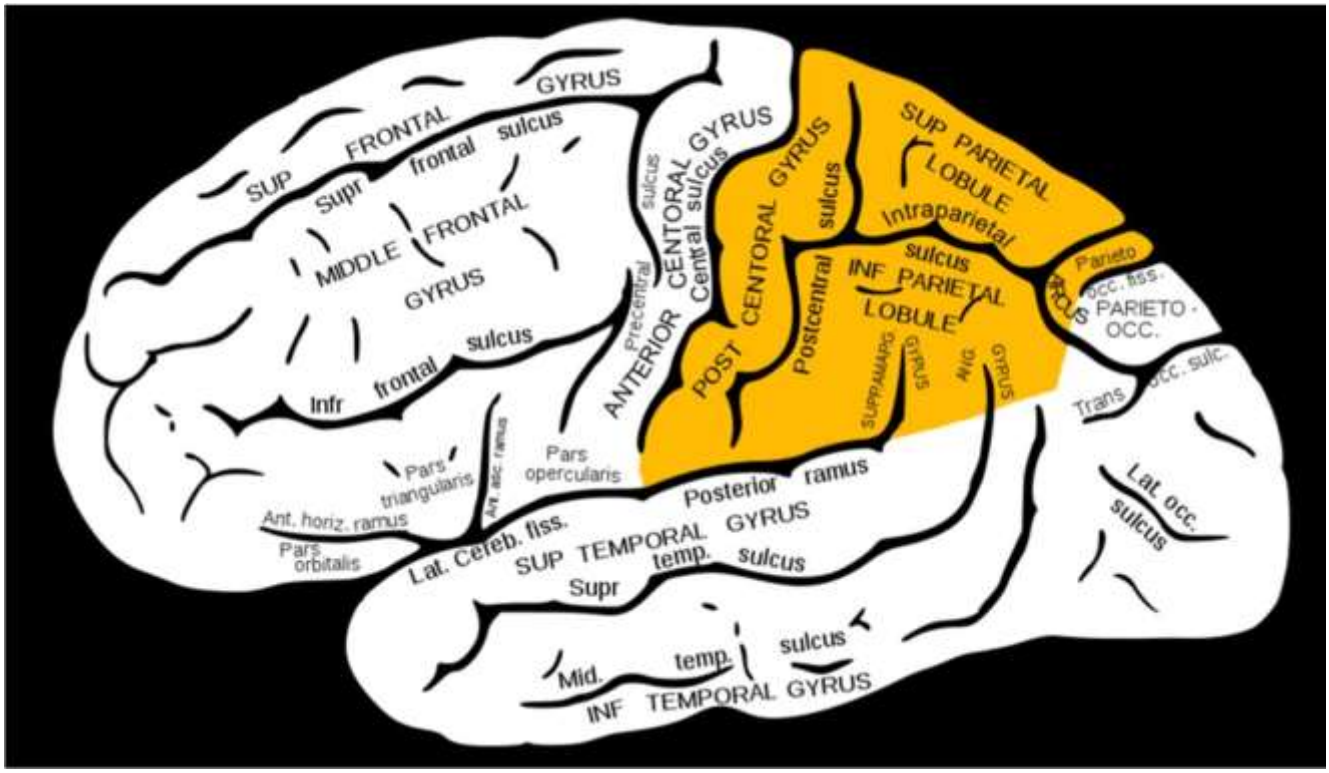
lateral stria (goes to other parts of the brain responsible for olfaction mainly in temporal lobe)

-In between these two striae is the Anterior perforating substance

The first two cranial nerves are pure sensory nerve .. Their cell bodies outside cns and their axons will associate with 2nd order neuron which found in olfactory bulb (if we talk about olfactory nerve).
Olfactory tract (group of axons of olfactory nerve)
olfactory bulb (contains cell bodies of olfactory nerve)

Parietal Lobe: Laterally

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



#Sheet Notes:

-This lobe is Posterior to the central sulcus (immediately posterior to the central sulcus we have a known gyrus called the Post-Central Gyrus (Primary Somatosensory Area) vertically oriented

-Posterior to the Post-Central Gyrus is the Post-Central Sulcus

-Posterior to the Post-Central Sulcus we have 2 gyri separated by the intraparietal sulcus

-Superior Parietal Lobule

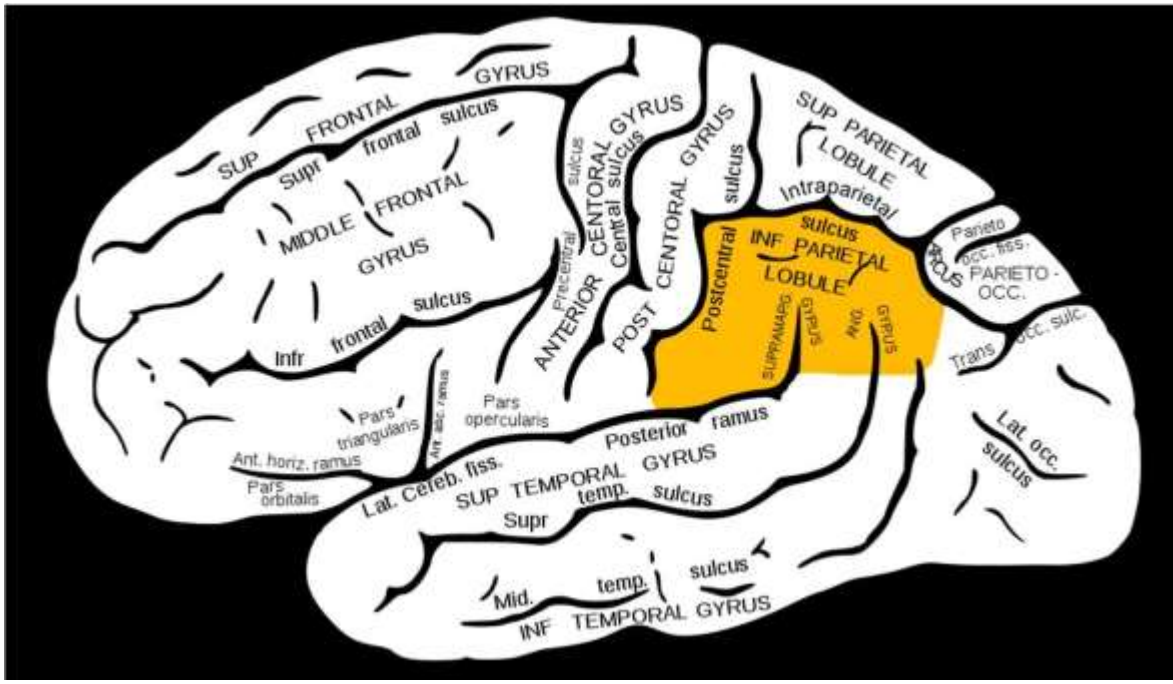
-Inferior Parietal Lobule (important, check the next slide)

***** lobule : agroup of gyrus , and they're different functionally**

Parietal Lobe: Laterally

- Inferior parietal lobule
  - Supramarginal gyrus*
    - Lateral sulcus
  - Angular gyrus*
    - Superior temporal sulcus

*form language (Wernicke's) area



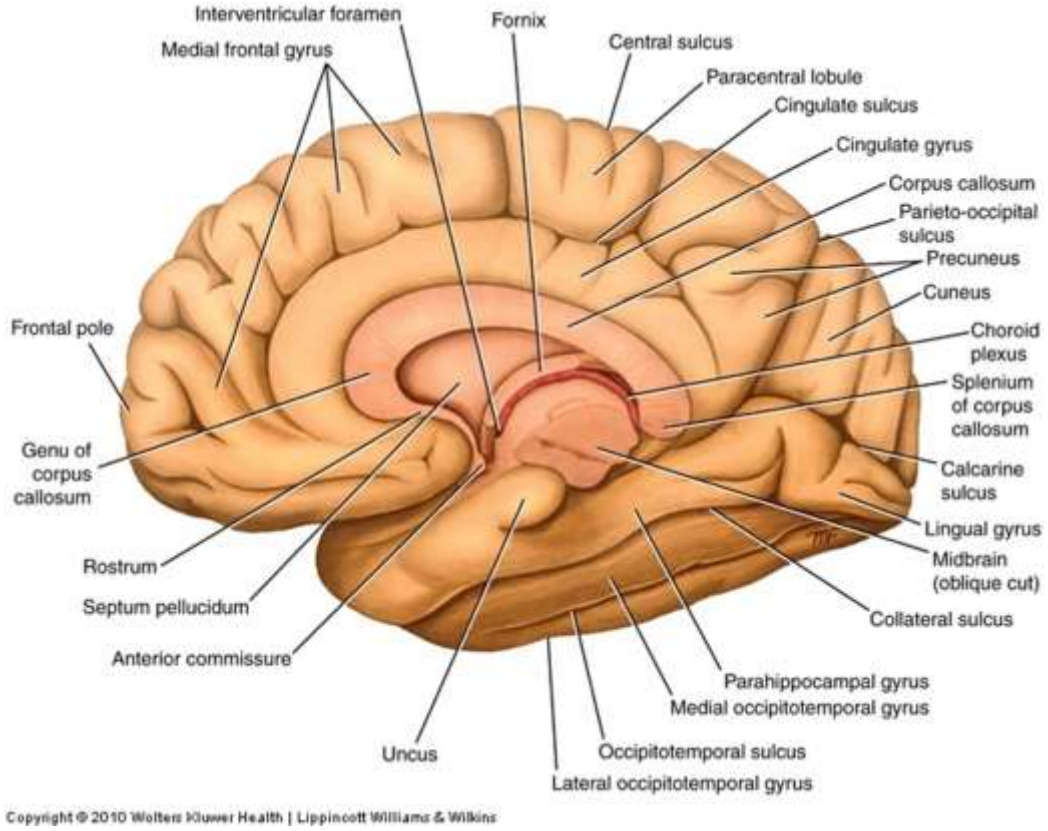
#Sheet Notes:
-The Supramarginal gyrus surrounds the tip of the lateral sulcus
-The Angular gyrus surrounds the end of the superior temporal sulcus

-Both of these gyri combine to form Wernicke's area (Language)

-Broca's area and Wernicke's area are connected by a bundle of nerve fibers called the arcuate fasciculus.
Broca's area sends orders to muscle and wernicke's area sequences the words (arranging words)

Occipital Lobe: Medially

- Lingual gyrus
  - Calcarine sulcus
- Cuneus
  - Parieto-occipital sulcus
- Precuneus (parietal lobe)



#Sheet Notes:

-Lingual gyrus -> inferior to the calcarine sulcus

-The area between the calcarine and parieto-occipital sulci is called the Cuneus

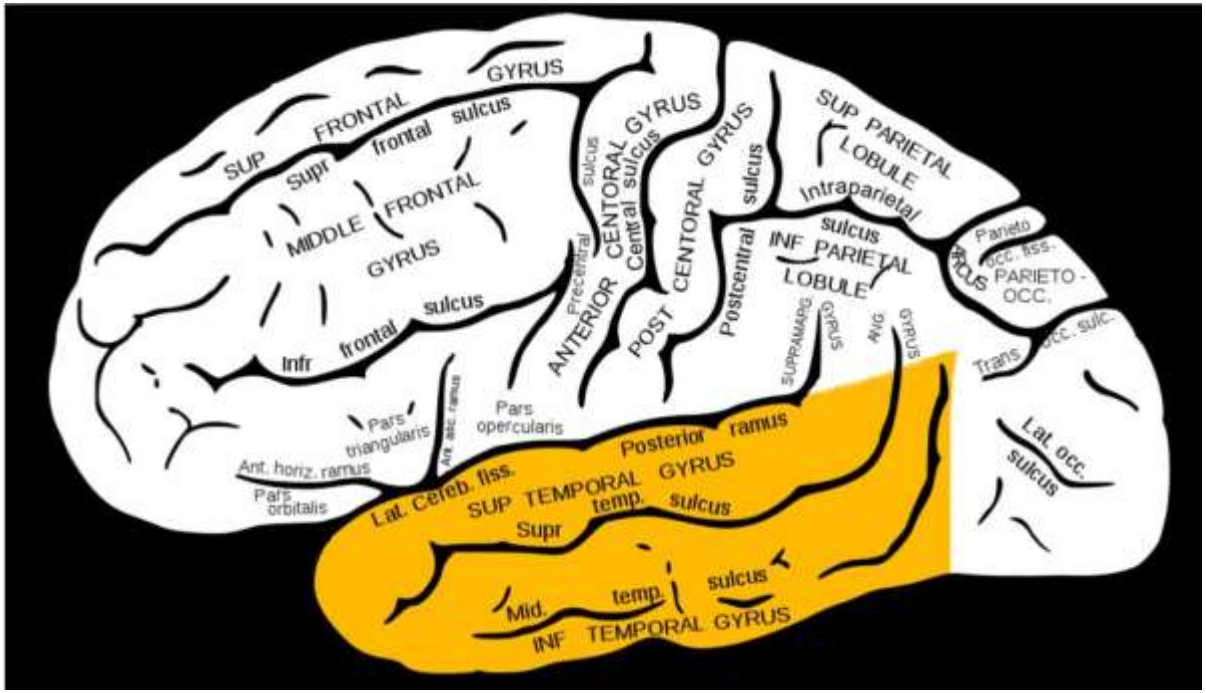
-The lingual gyrus and the cuneus are connected by a bundle of nerve fibers called the calcarine fasciculus.

-Anterior to the parieto-occipital sulcus there is an area called the Precuneus but it's apart from the parietal lobe

(functionally related to gyri in occipital , but structurally it's apart from parietal lobe)

Temporal Lobe: Laterally

- Lateral sulcus
- Superior temporal gyrus
  - Transverse temporal gyri (of Heschl)
    - Buried in the lateral fissure
    - Primary auditory cortex
- Superior temporal sulcus
- Middle temporal gyrus
- Middle temporal sulcus
- Inferior temporal gyrus



#Sheet Notes:

-Begins inferior to the lateral fissure

-We have 3 gyri separated by the superior & middle temporal sulci

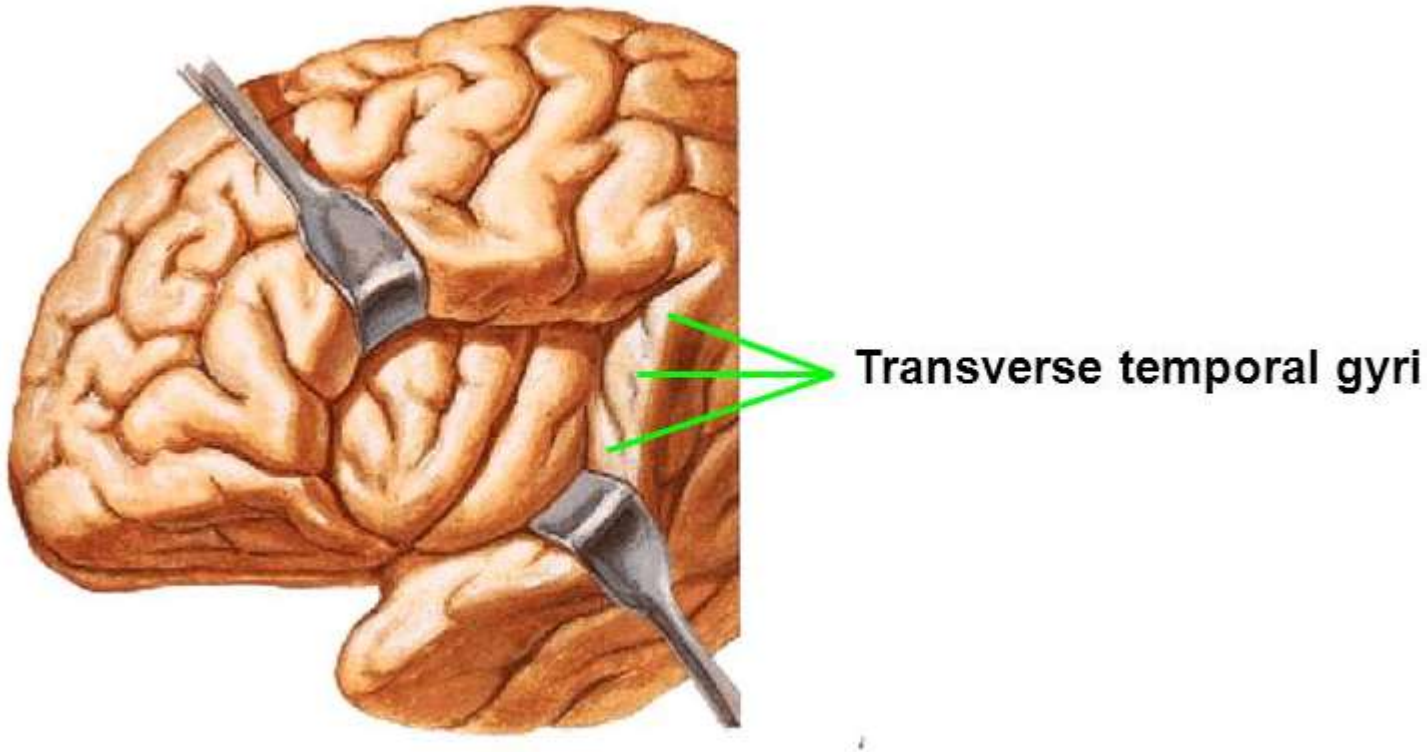
-from sup. To inf. (superior temporal gyrus -> middle temporal gyrus -> inferior temporal gyrus)

-The inferior wall of the lateral fissure is part of the superior temporal gyrus called the Transverse temporal gyri (Heschl) -> Primary auditory cortex

Its function to hear the sound only (not explain it)

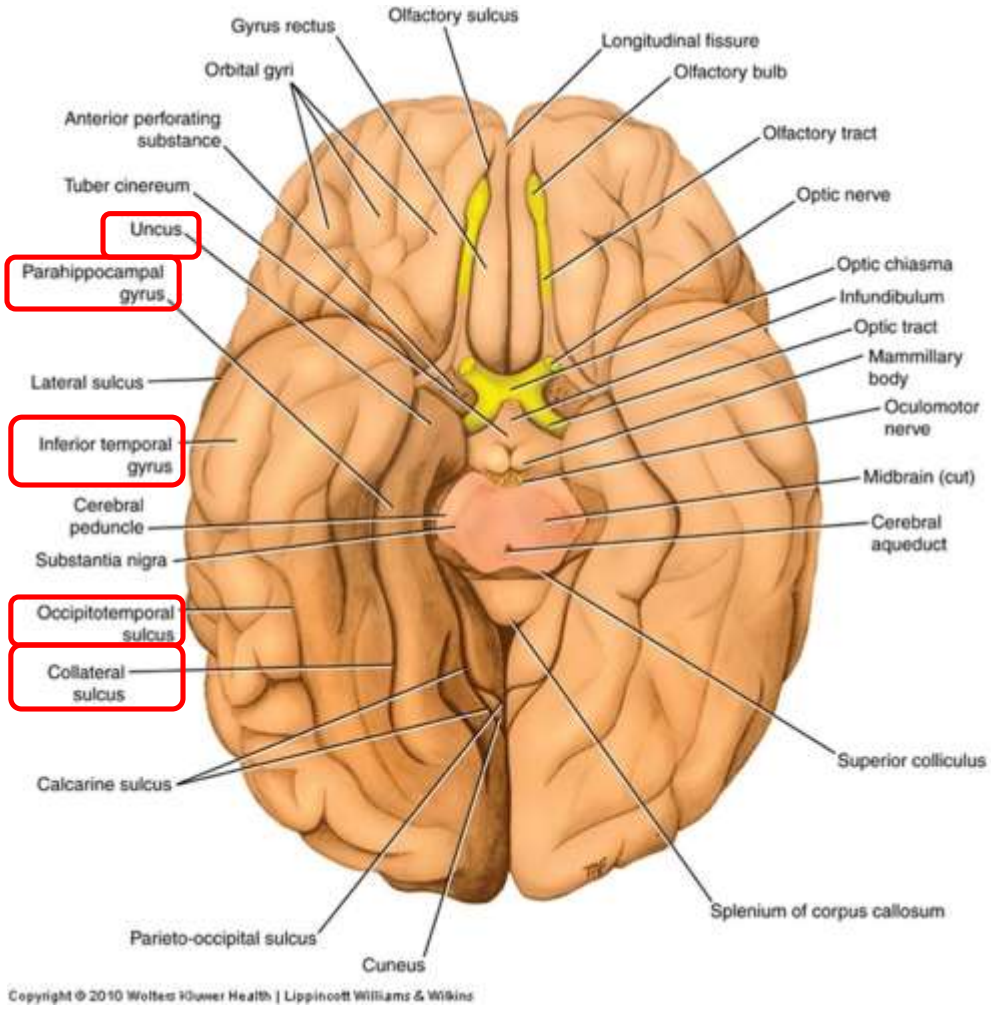
If this area damaged patient will not be able to hear the sound.

Extra Sheet Note : an image of the transverse temporal gyri



Temporal Lobe: Inferiorly

- Inferior temporal gyrus
  - Most lateral
- Occipitotemporal sulcus
- Occipitotemporal gyrus (fusiform gyrus)
  - Extend to the occipital lobe
- Collateral sulcus
- Parahippocampal gyrus (medial temporal lobe ; for it's importance)
  - Most medial
  - Uncus
    - Small medial extension



#Sheet Notes:

-from lateral to medial

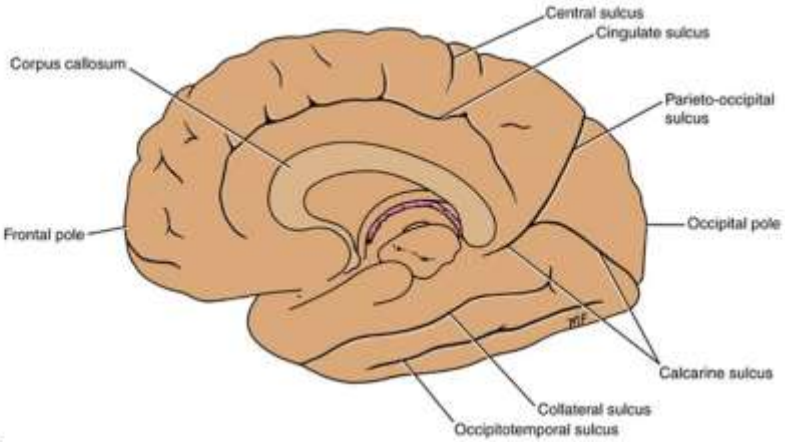
-inferior temporal gyrus -> occipitotemporal sulcus -> occipitotemporal (fusiform) gyrus collateral sulcus -> parahippocampal (medial temporal) gyrus or lobe

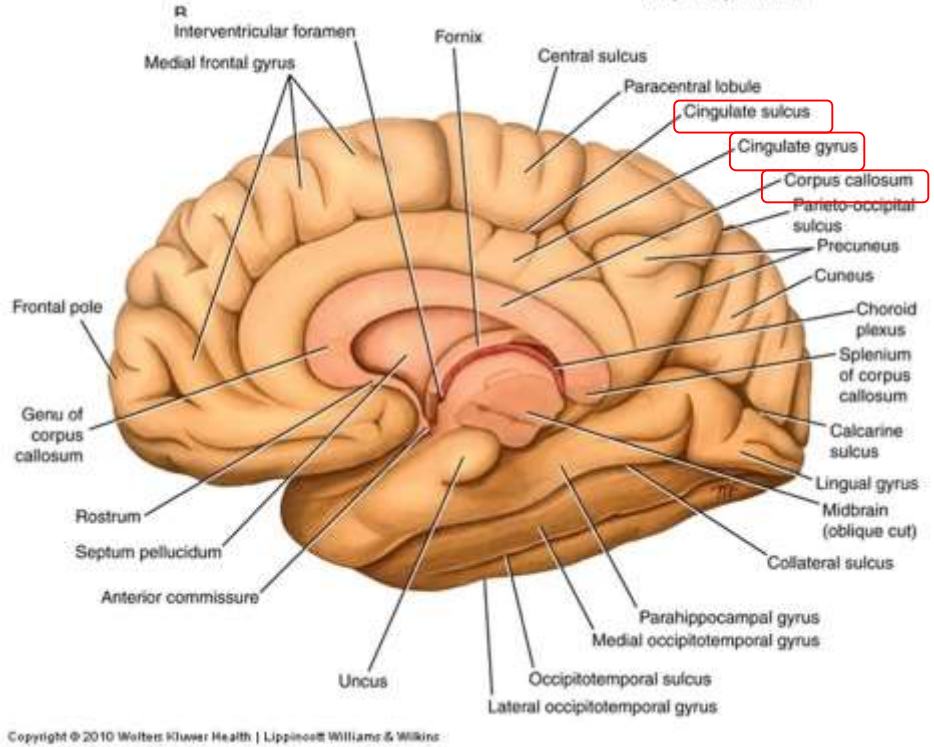
-a lot of centers (olfaction ,limbic system , memory " hippocampus") found within temporal lobe

-the most anterior media part of parahipocampal gyrus that extends to the midline is called the Uncus

Main Medial Structures

- Corpus callosum
  - parts
- Callosal sulcus
- Cingulate gyrus
  - Continue with the parahippocampal gyrus
- Cingulate sulcus
- Paracentral lobule
- Medial frontal gyrus





#Sheet Notes:

-the first gyrus above the corpus callosum is called the Cingulate gyrus (crosses the frontal, parietal , occipital lobes & continues with the hippocampal gyrus in the temporal lobe) , there is a sulcus between them called the Callosal sulcus

-superior to the cingulate gyrus we find the cingulate sulcus

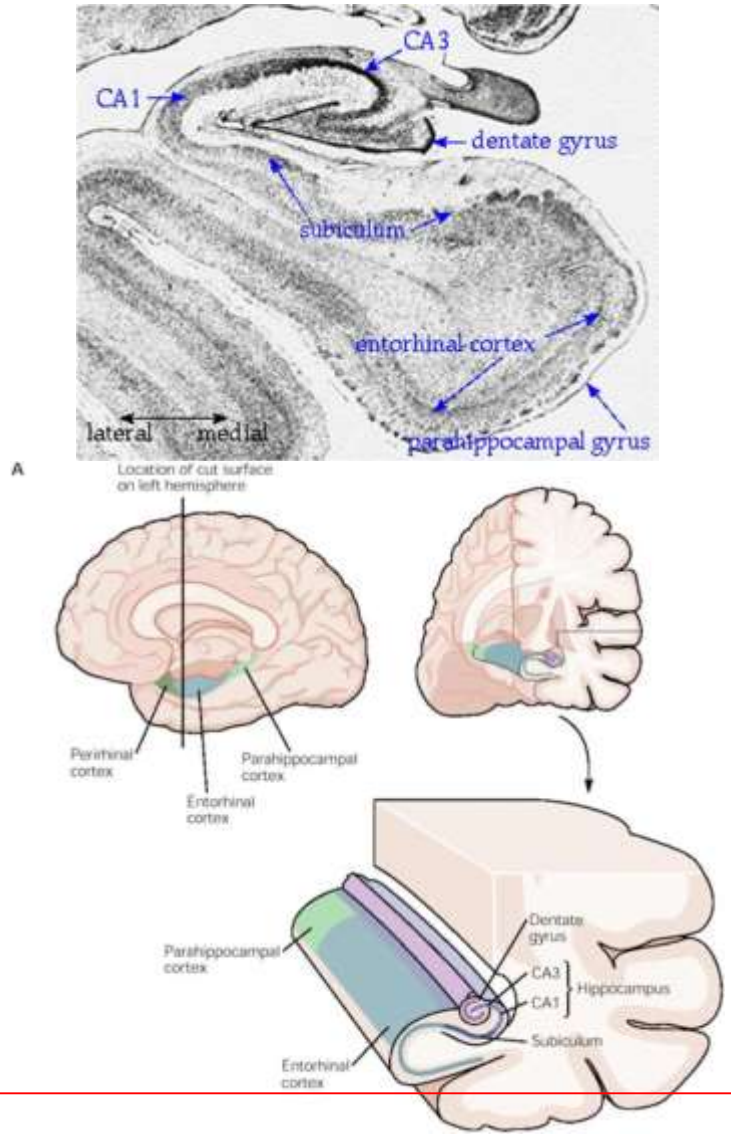
-cingulate gyrus is part of limbic lobe .

- Paracentral lobule surrounds the central sulcus .. Half in frontal and the other half in parietal .

Medial Temporal Lobe
Hippocampal Formation

time stamp:40:00

- Collateral sulcus
- Parahippocampal gyrus
  - Perirhinal cortex
  - Entorhinal cortex
  - Parahippocampal cortex
- Subiculum
- Hippocampal sulcus
- Hippocampus (cornu ammonis)
  - CA1, CA2, CA3
- Dentate gyrus



#Sheet Notes:

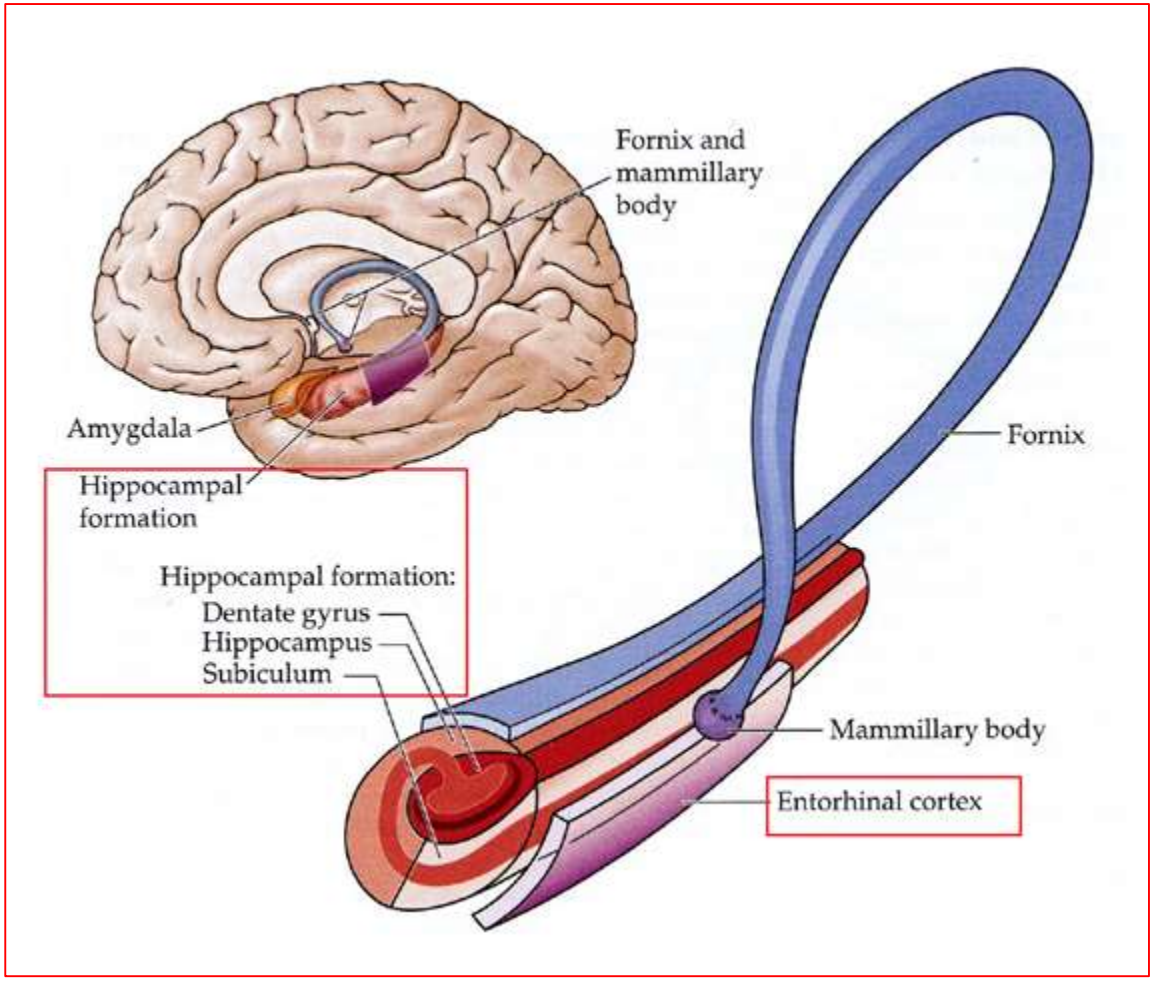
-The cortex of the parahippocampal gyrus is divided into 3 parts (ant. -> post.) :

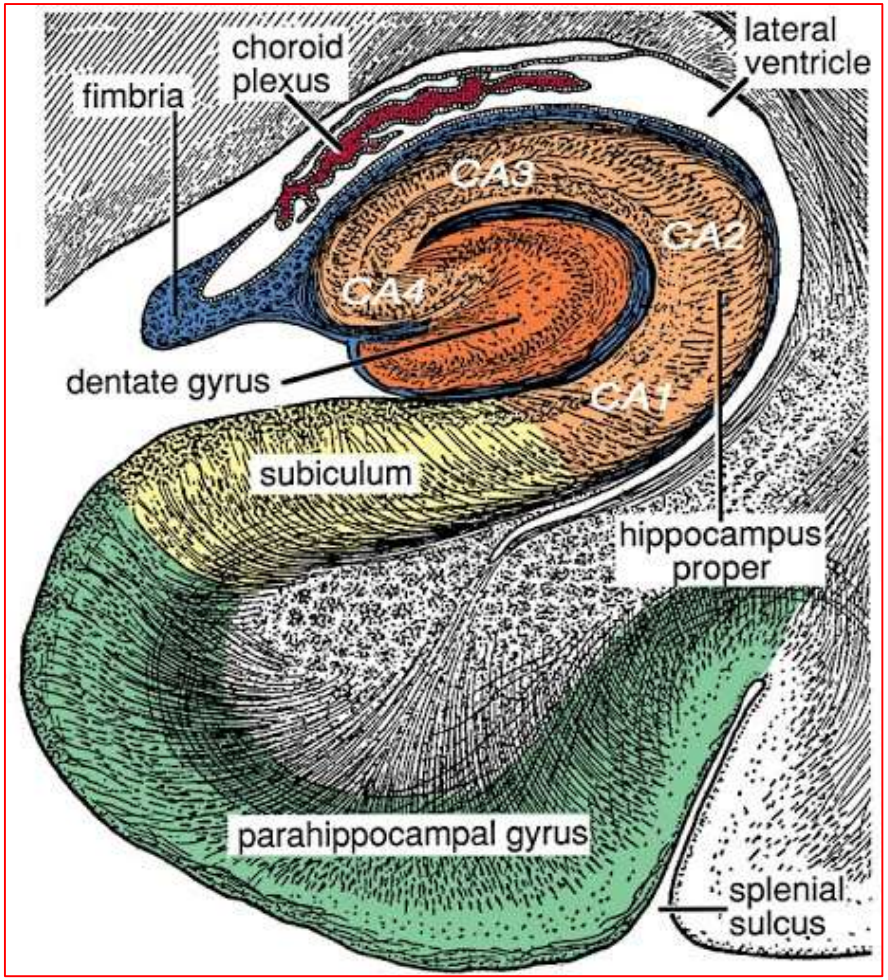
-Perirhinal cortex -Entorhinal cortex -Parahippocampal cortex

-Gyrus = Cortex + White Matter || Cortex = Grey Matter

-Hippocampal formation (memory) = entorhinal cortex + subiculum + hippocampus (divided to ca 1, ca 2 & ca 3) + dentate gyrus (which comes after ca 3)

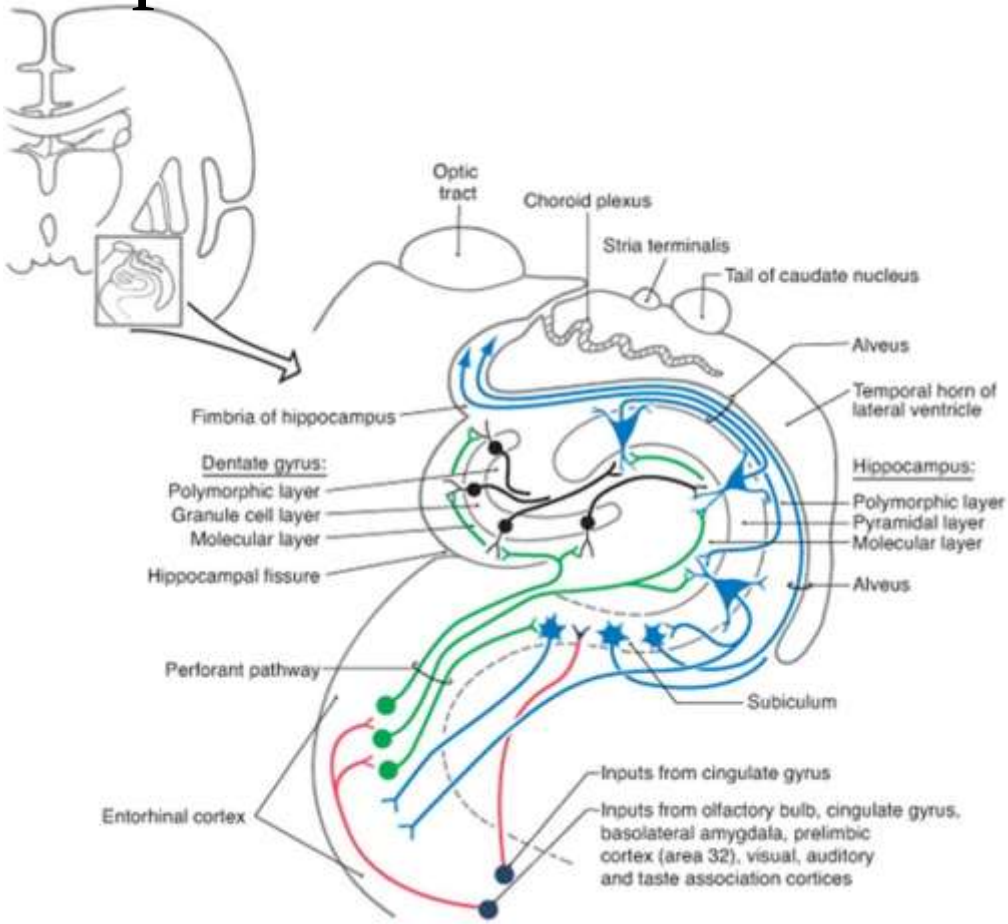
Extra images





Hippocampus

- The hippocampal cortex has 3 layers
  - Molecular layer at the center
    - Consists of interacting axons & dendrites
  - Prominent pyramidal cell layer of large neurons
  - Polymorphic layer containing axons, dendrites &interneurons
- The dentate gyrus has 3 layers like hippocampus but the pyramidal cell layer is replaced by granule cell layer



#Sheet Notes:

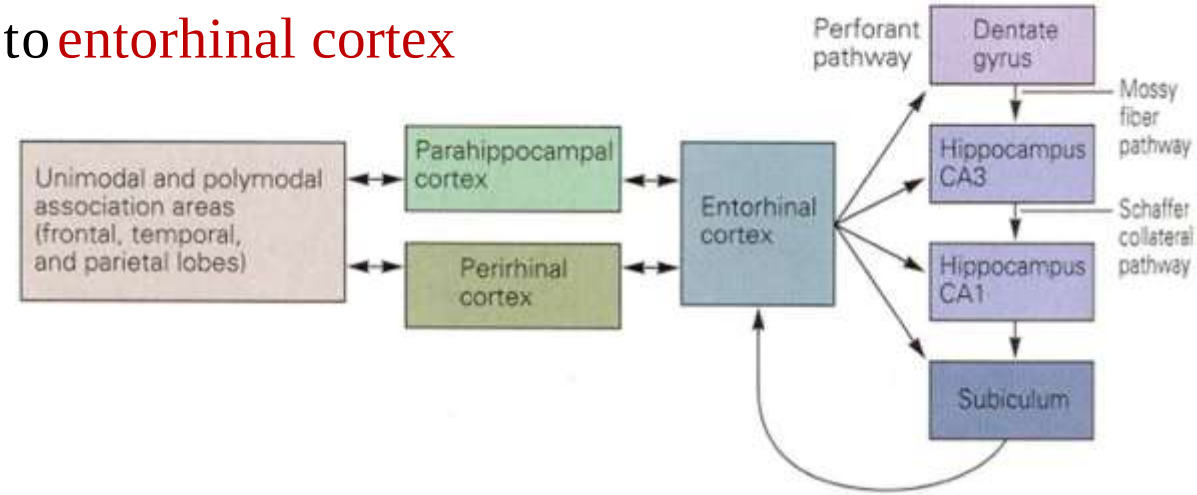
-There Pyramidal cells in the cortex which means that this cortex has projection fibers (long association fibers)

-On the other hand granule cells form internal connections within the layers themselves

-This means that the efferents of the hippocampal formation arise from the hippocampus itself (indicated by the pyramidal cells)

Hippocampal Formation
Intrinsic Circuitry

- Most of the hippocampal afferent come from the entorhinal cortex (perforant pathway)
- Granule cells in the dentate gyrus sends dense fibers (Mossy fibers) to CA3
- CA3 pyramidal neurons send fibers through the fornix (alveus) and collaterals (Schaffer collaterals) to the CA1
- CA1 sends fibers to subiculum
- Subiculum sends fibers to entorhinal cortex



Sheet note

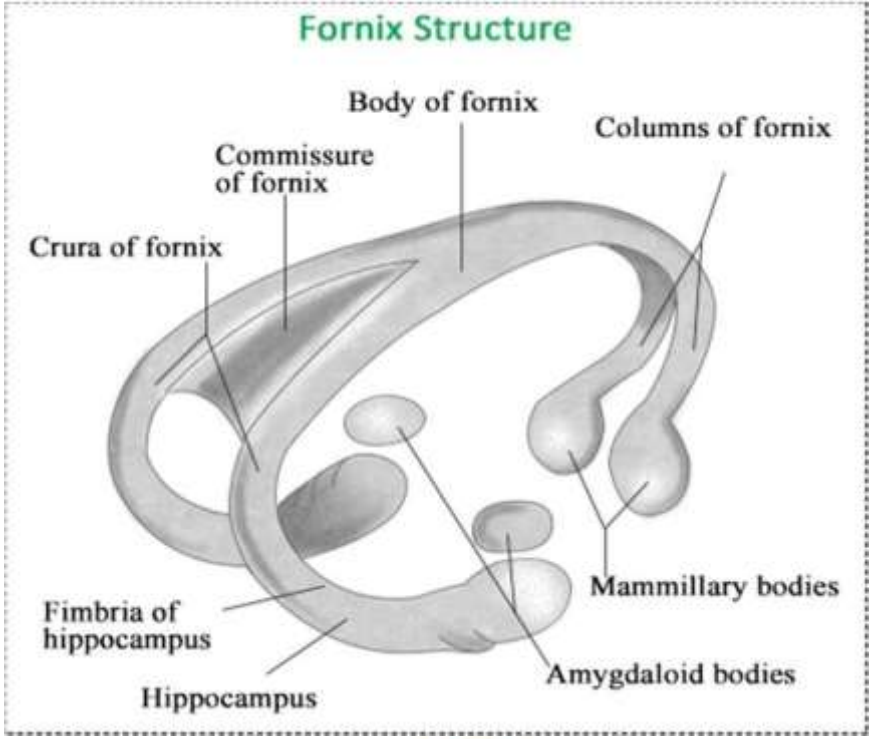
-The entorhinal cortex is connected to the other parts of the formation via performant pathways

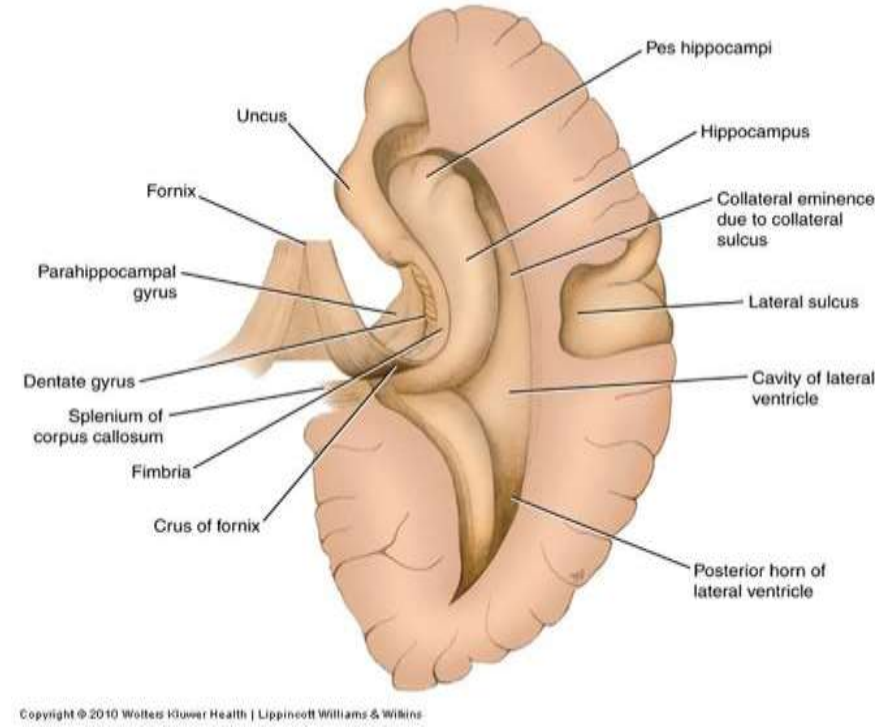
-The dentate is connected to the hippocampus (CA3) via mossy fibers

-CA 3 is connected to Ca 2 is connected to Ca1 is connected to the subiculum which is connected to the entorhinal complex and thus we have a circuit

Fornix (commissural fiber)

- Alveus
  - Efferent fibers of hippocampus to fornix
- Fimbria of hippocampus
- Fornix
  - Parts
    - Crura (posterior columns)
    - Body
    - Columns (anterior columns)
- Mamillary bodies (part of hippocampus)





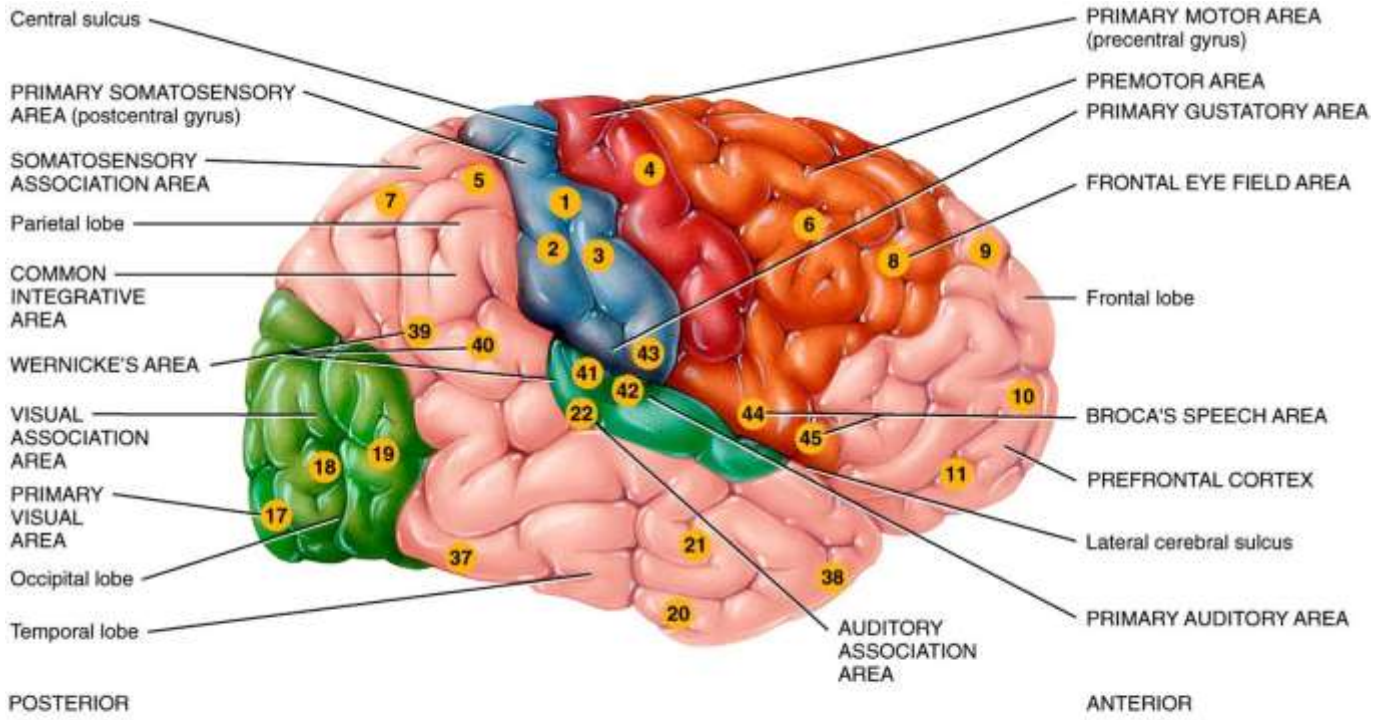
Sheet note :

- Right and left crus unite in the body of fornix
- Body of fornix form apart of the wall of the 3rd ventricle

Functional Organization of the Cerebral Cortex: Sensory Areas

- Primary somatosensory area- postcentral gyrus.
- Primary visual area- occipital lobe.
- Primary auditory area- temporal lobe.
- Primary gustatory area- base of the postcentral gyrus.
- Primary olfactory area- temporal lobe.

Functional Organization of the Cerebral Cortex: Sensory Areas

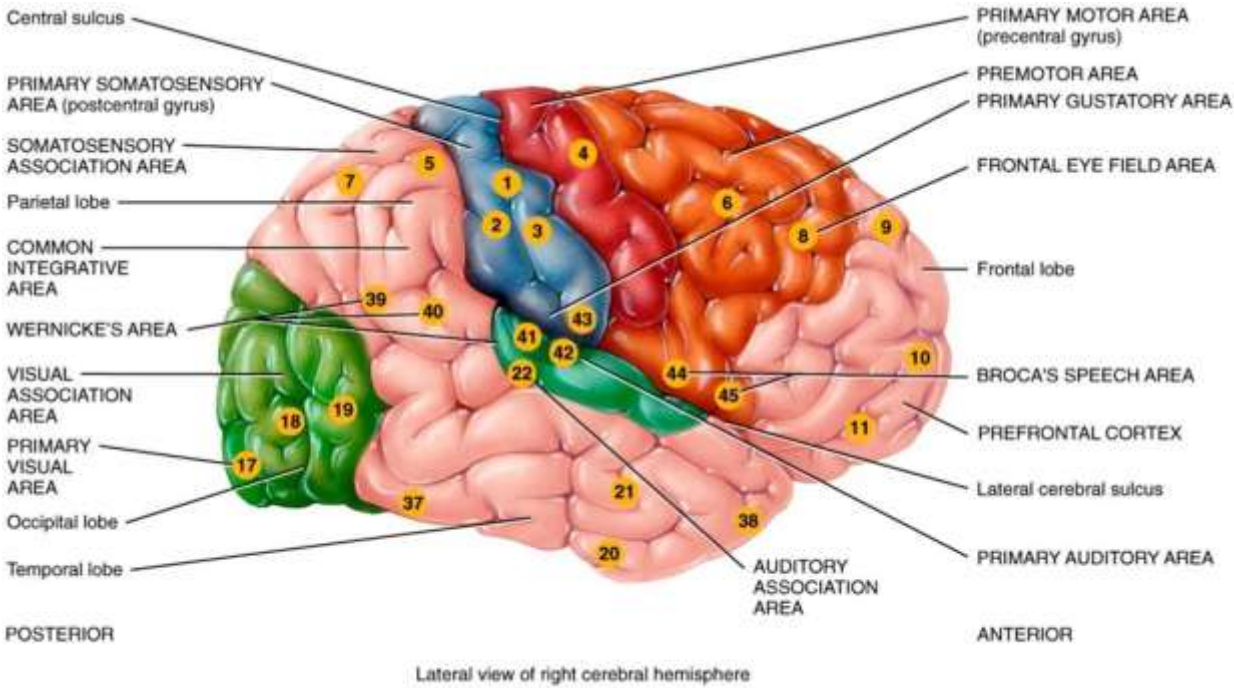


Lateral view of right cerebral hemisphere

Figure 14.15 Tortora - PAP 12/e

Functional Organization of the Cerebral Cortex: Motor Areas

- Primary motor area- precentral gyrus.
- Broca's speech area- left cerebral hemisphere. (inferior frontal gyrus)



Lateral view of right cerebral hemisphere

Functional Organization of the Cerebral Cortex: Association Areas

- Somatosensory association area- posterior to primary somatosensory area.
- Visual association area- occipital lobe.
- Auditory association area- temporal lobe.
- Wernicke's area- left temporal and parietal lobes.
- Prefrontal cortex- anterior portion of the frontal lobe.

#Sheet Notes:

-Most of the analysis of the data occurs in the association areas which are connected to memory, thinking, emotions… etc.

-Example: the primary visual area allows you to see but the visual association area allows you to understand & distinguish what you see

so if the primary area is damaged you won't be able to see but if the association area is damaged you'll be able to see but you won't be able to understand what you see

#Sheet Notes:
-You have to memorize these numbers because this classification is still used

Brodmann Numbers

• Area 17	Primary visual cortex
• Areas 18 &19	Secondary visual cortex
• Area 4	Primary motor cortex
• Area 6	Premotor area
• Area 3, 1, &2	Somatosensory cortex
• Areas 41& 42	Auditory cortex
• Areas 44 &45	Broca's area
• Areas 39 &40	Wernicke's area
• Area 8	Frontal eye field

Somatotopic Organization of Cortex (Homunculus)