MED437
KING SAUD UNIVERSITY

ANATOMY
Team 437

Anatomy of Cerebral Hemispheres

Lecture (15)

- Important
- Doctors Notes
- Notes/Extra explanation

Please check our Editing File

هذا العمل مبني بشكل أساسي على عمل دفعة ٤٣٦ مع المراجعة والتدقيق وإضافة الملاحظات ولا يغني عن المصدر الأساسي للمذاكرة

{وَمَنْ يَتَوَكَّلْ عَلَى اللَّهِ فَهُوَ حَسْبُهُ}

Objectives

At the end of the lecture, students should be able to:

- ✓ List the parts of the cerebral hemisphere (cortex, medulla, basal nuclei, lateral ventricle).
- ✓ Describe the subdivision of a cerebral hemisphere into lobes.
- ✓ List the important sulci and gyri of each lobe.
- ✓ Describe different types of fibers in cerebral medulla (association, projection and commissural) and give example of each type.

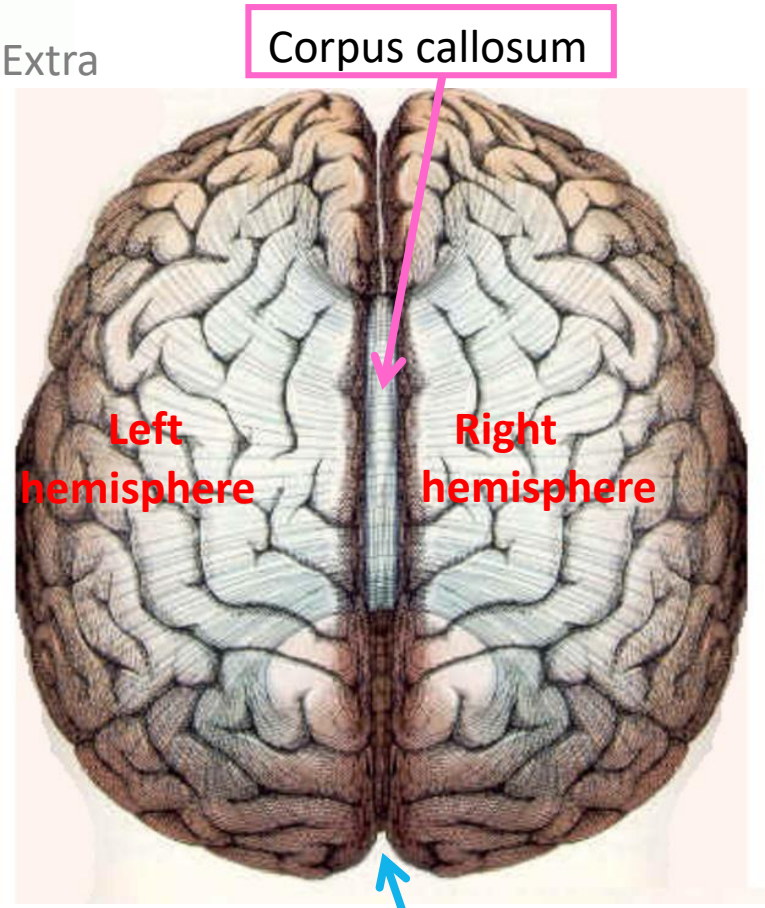
Cerebrum

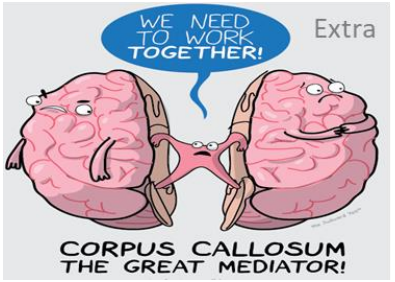
Extra

- Largest part of the forebrain. (makes up 2/3rd weight off all brain)

(recall: the forebrain gives the cerebral hemispheres and the diencephalon)

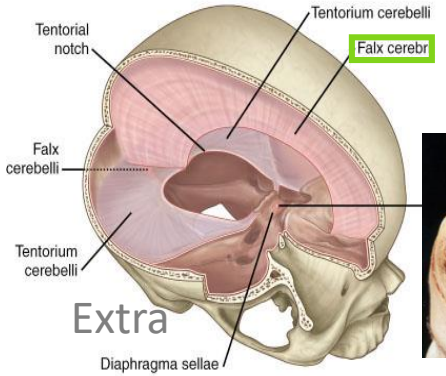
- Divided into two halves, the **cerebral hemispheres** (right and left), which are separated by a deep **median longitudinal fissure** which lodges the falx cerebri*(fold of dura matter)
- In the **depth** of the fissure, the hemispheres (left & right) are connected by a bundle of fibers (of white matter) called the **corpus callosum** (it's example of commissural fibers).





Extra

*It is a large, crescent-shaped fold of meningeal layer of dura mater that descends vertically in the longitudinal fissure between the cerebral hemispheres



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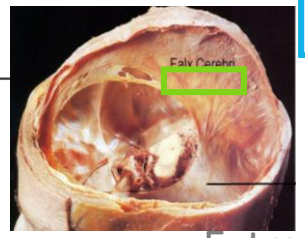
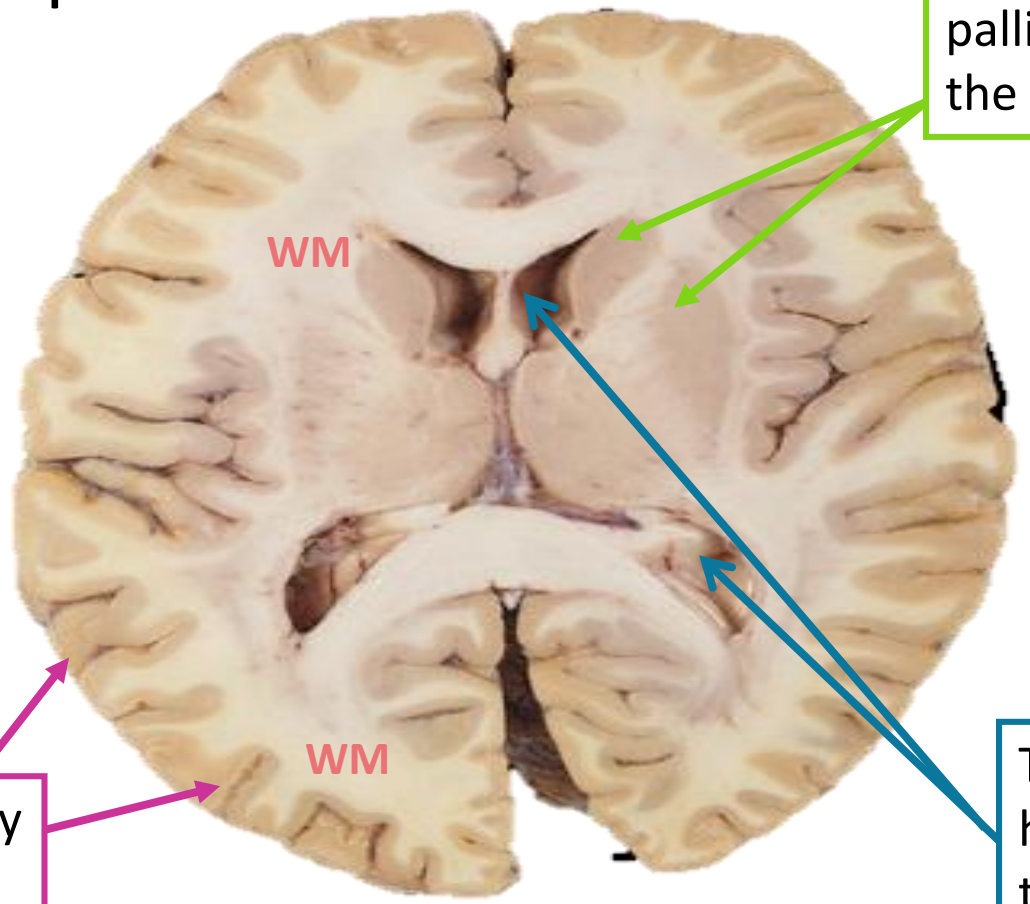


Extra

Cerebrum
Cerebral Hemispheres

The structure of cerebral hemipheres includes:

Buried within the white matter lie a number of nuclear masses (caudate, putamen, globus pallidus) collectively known as the **basal ganglia.** (nerve cells)



Cerebral medulla:
Deeper to the cortex, axons running to and from the cells of the cortex form an extensive mass of **white matter** (WM).

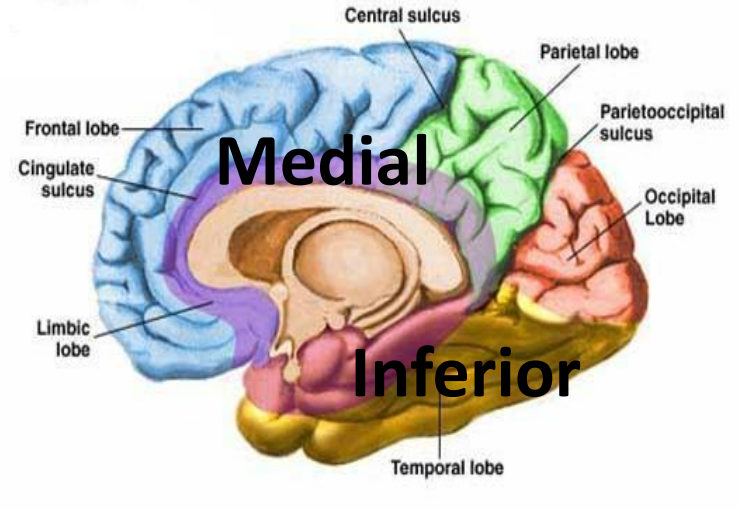
Contains synapses (50 trillion)

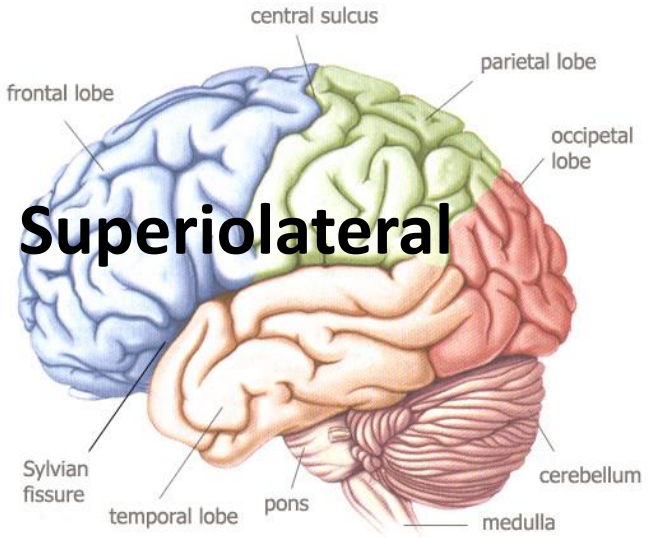
Superficial (outer) layer of grey matter, the **cerebral cortex**.

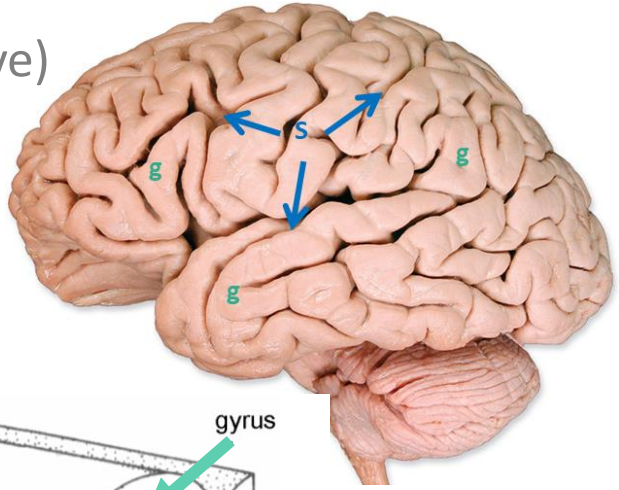
The cavity of hemisphere is called the **lateral ventricle.**

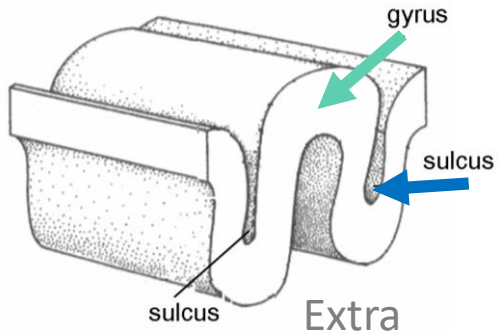
Cerebrum
Surfaces

- The superficial layer of grey matter is highly convoluted* to form a complex pattern of ridges (**gyri**) and grooves (**sulci**). Gyri (plural) gyrus (singular) | Sucli (plural) sulcus (singular)
- This arrangement maximize the surface area of the cerebral cortex (about 70% is hidden within the depths of sulci).
- Each hemisphere has **3 surfaces**: Superiolateral, Medial, and Inferior.
- The inferior has two parts: tentorial** and orbital
- *highly convoluted : increase surface area = increase nerve cells = more active)
- **It's cover by tentorium (fold of dura matter forming a portion between cerebrum & cerebellum)









Extra

Cerebrum Lobes

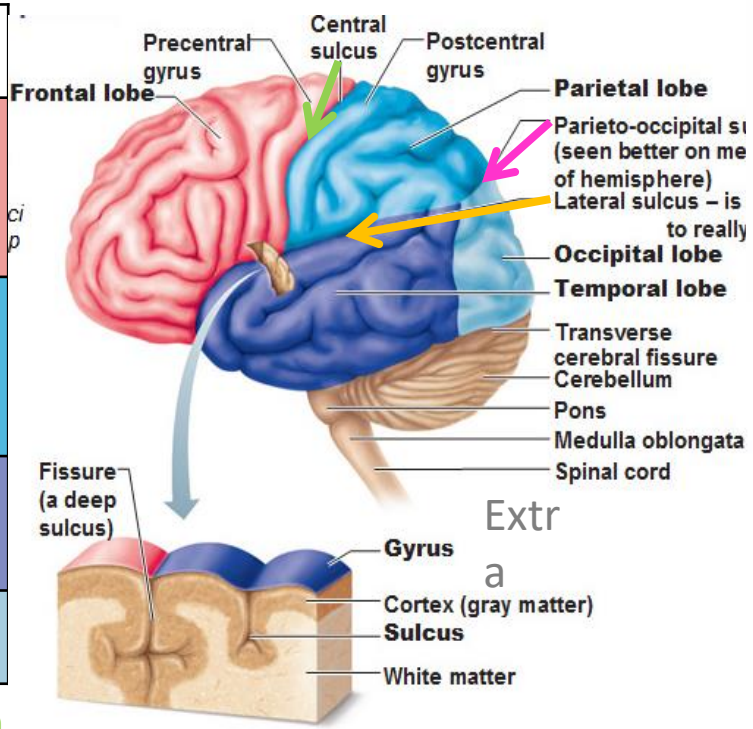
*not everyone has the same gyri and sulci in their brain. If we view different brains we might not find the same sulci/gyri present in both. But the these 3 sulci (central, lateral, & parieto-ociptal) are found in almost everyone

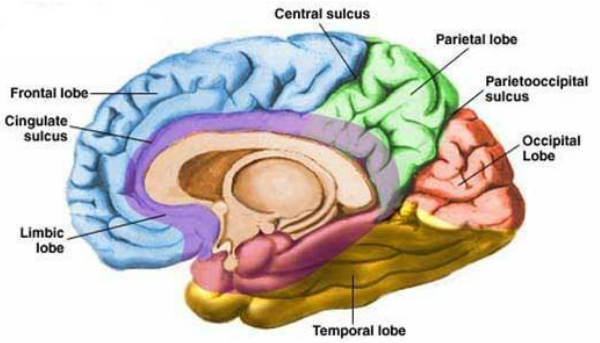
central	Separates frontal+parietal
lateral	Seperates frontal+parietal+temporal
parieto-occipital	Seperates parietal+occipital

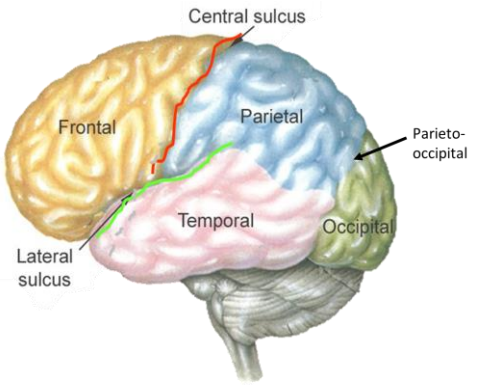
- Three sulci, consistent in their position* (**central**, **lateral** (sylvian) & **parieto-occipital**) are used to divide each hemisphere into the four lobes.
  - Anatomically (positions) we have **4 lobes**
  - Physiologically (Functionally) we have **5 lobes**
- Each hemisphere is divide into **FOUR** lobes (named after overlying bones): Frontal, Parietal, Temporal, and Occipital. **(pool : is the tip of lobe, Parietal lobe don't have pool)**

Lobes	Function
Frontal	motivation, motor function, smell, mood and aggression (personality and emotion)
Parietal	reception and evaluation of sensory information via thalamus protection from dangerous
Temporal	smell, hearing, memory and abstract thought
Occipital**	visual processing

**Occulus means eye in latin so occipital = vision

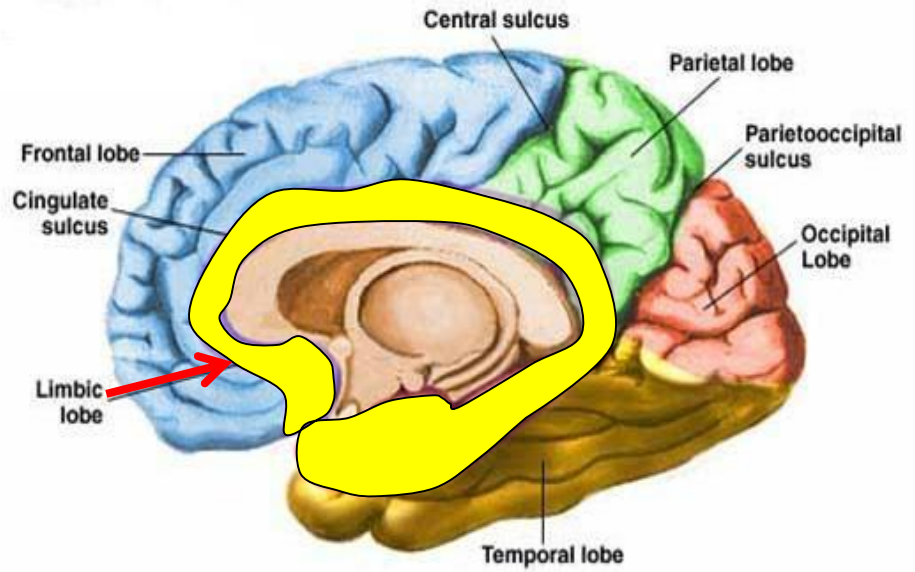




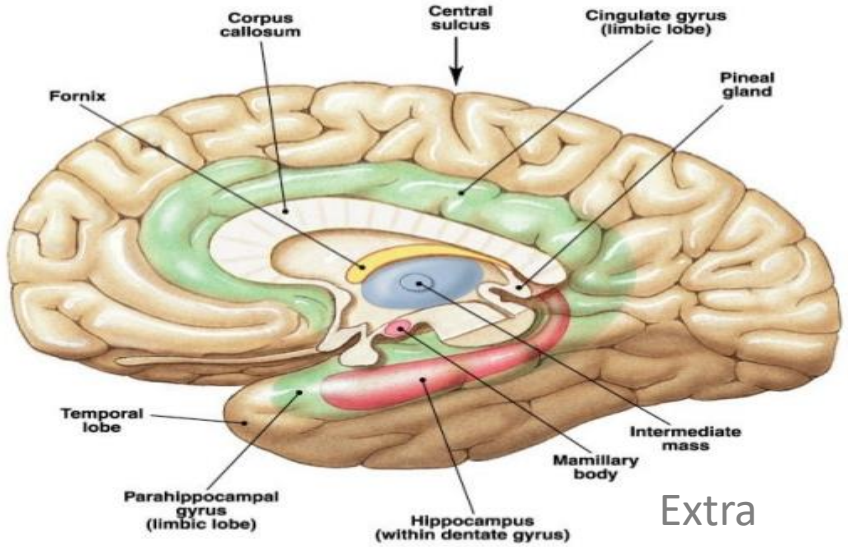


Cerebrum
Lobes

- Functionally each hemisphere contains a **‘limbic lobe’** on the medial surface.
- It responsible for:
  - Establishing emotional states
  - Linking conscious intellectual functions with the unconscious autonomic functions
  - Facilitating memory storage.



- Anatomically (positions) we have **4 lobes:**
Frontal, Parietal, Temporal & Occipital
- Physiologically (Functionally) we have **5 lobes:**
Frontal, Parietal, Temporal, Occipital & limbic



Extra

Cerebrum Lobes

IMPORTANT (OSPE & mcqs)
- Name of lobs
- Gyrus of each lobe
- Functional area

Main gyri in **superolateral** surface:

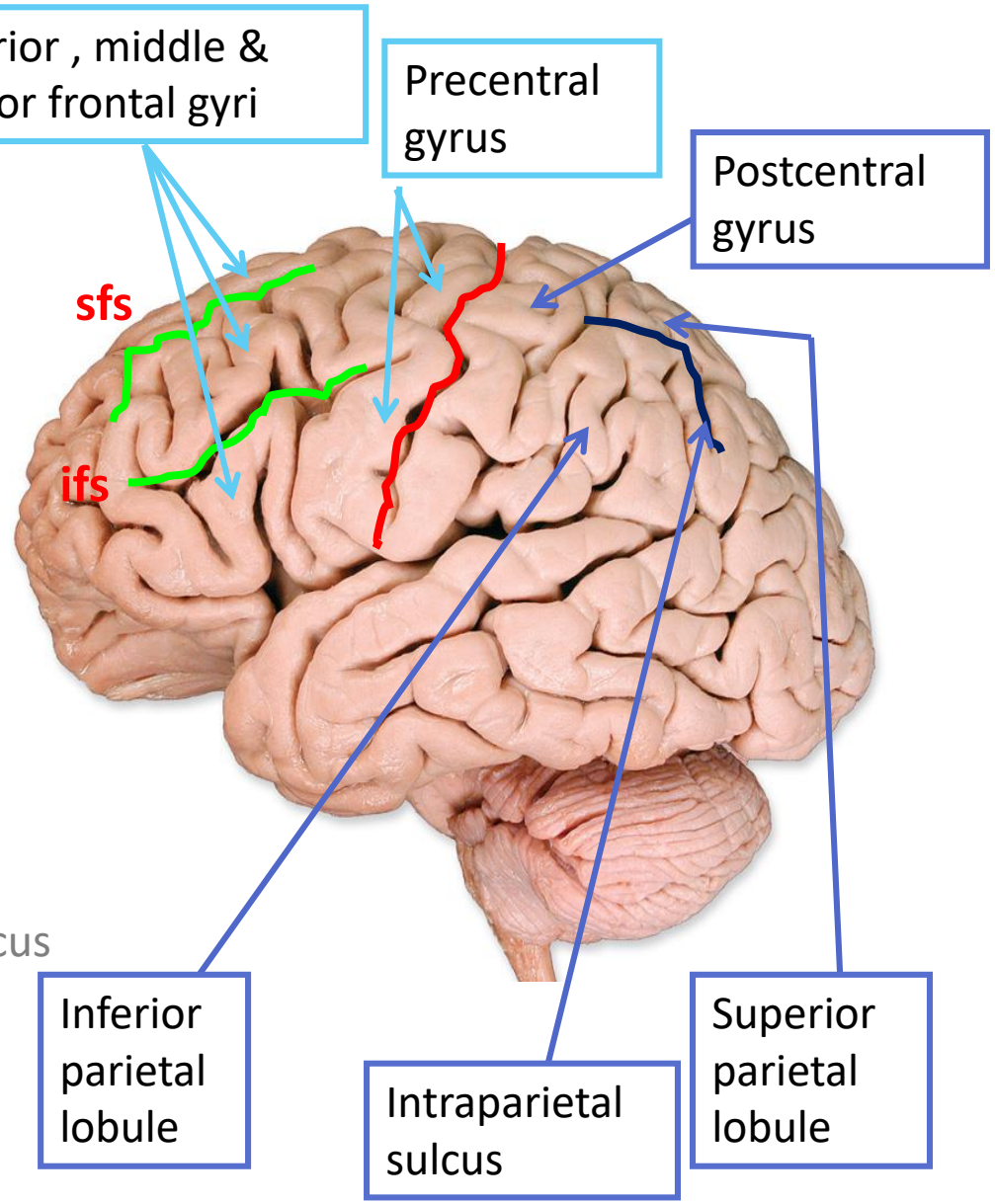
Frontal Lobe*	
Gyri	**Precentral** gyrus (motor area)
Sulci	Superior **frontal** sulci Inferior **frontal** sulci
	(divide lobe into) superior, (middle & inferior)** **frontal** gyri

*In front of central sulcus & above the lateral sulcus

Parietal Lobe***	
Gyri	**Postcentral** gyrus (sensory area)
Sulci	**Intraparietal** sulcus
	dividing the lobe into superior & inferior **parietal** lobules.

***Between the central & lateral & parietooccipital sulcus

**more important than superior frontal gyri



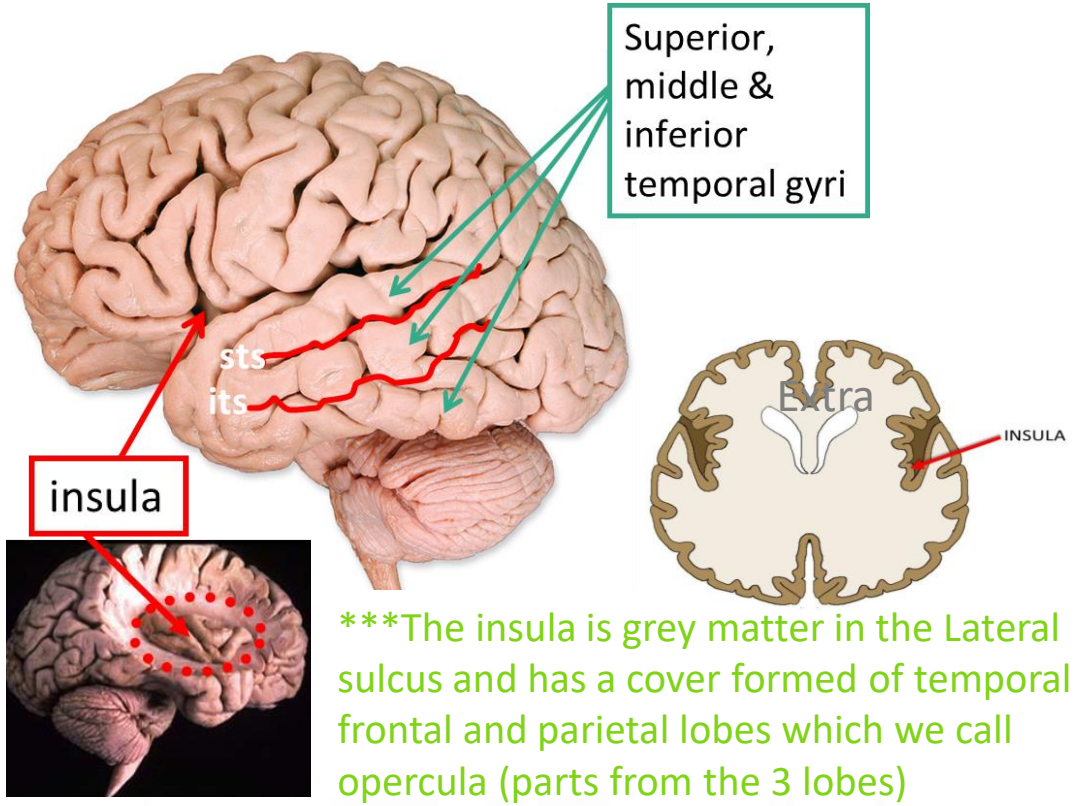
Cerebrum Lobes

*Under the lateral sulcus & between it & the parietooccipital lobe

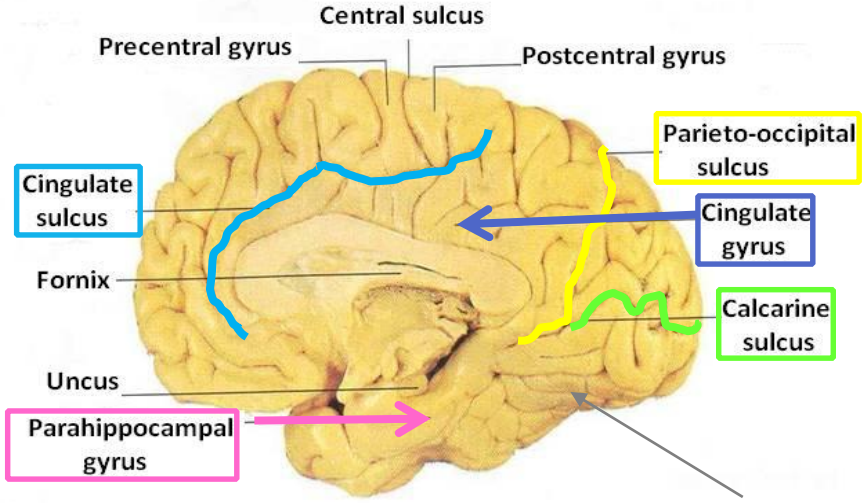
Temporal lobe*	
Gyri	Superior, middle & inferior **temporal** gyri
Sulci	Superior & inferior **temporal** sulci giving rise to superior, middle & inferior **temporal** gyri.
Insula** *(normal cerebral cortex but inside)	the gyri in the depth of lateral fissure/sulcus**, covered by parts of frontal, parietal & temporal lobes called the **opercula** (removed in lower pic so we can see the insula)

Medial Surface	
Gyri	1. Cingulate 2. Parahippocampal
Sulci	1. Parietooccipital 2. Calcarine divide into: **Pre**calcarine & **Post**calcarine 3. Cingulate

**Fissure and sulcus both mean groove. But fissure is deeper



***The insula is grey matter in the Lateral sulcus and has a cover formed of temporal frontal and parietal lobes which we call opercula (parts from the 3 lobes)

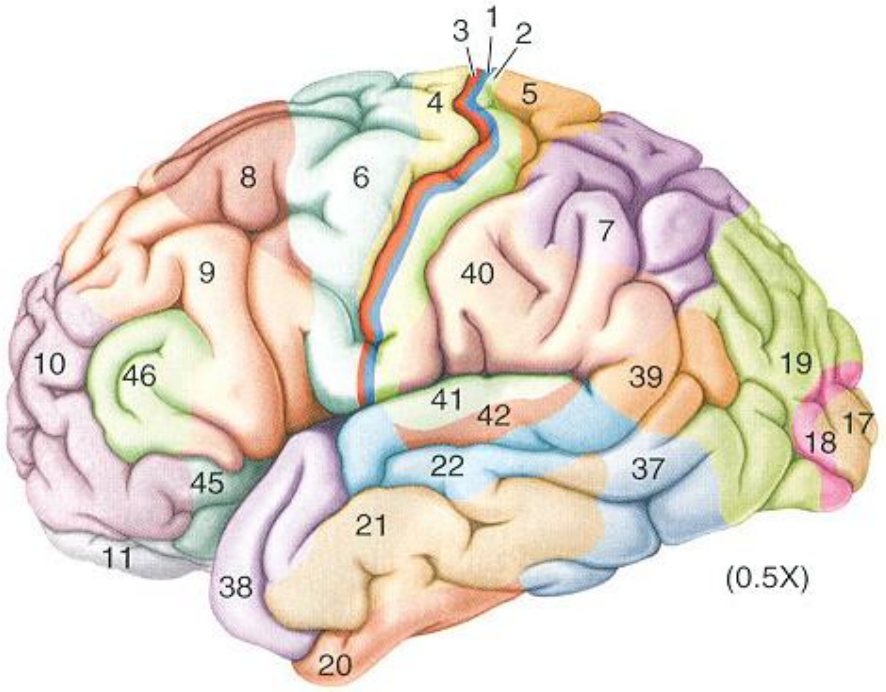


Note: Form y shape

Broadmann’s Map

05:25

- **Brodmann** produced a **numbered**, **cytological map** of cerebral cortex based upon its <u>regional histological characteristics.</u>
- The basis of Brodmann's cortical localization is its subdivision into **'areas'** with <u>similar cellular and laminar structure.</u>
- Brodmann's numbering of these cortical locations has become one of the **standard ways** in which **clinicians identify brain areas**.



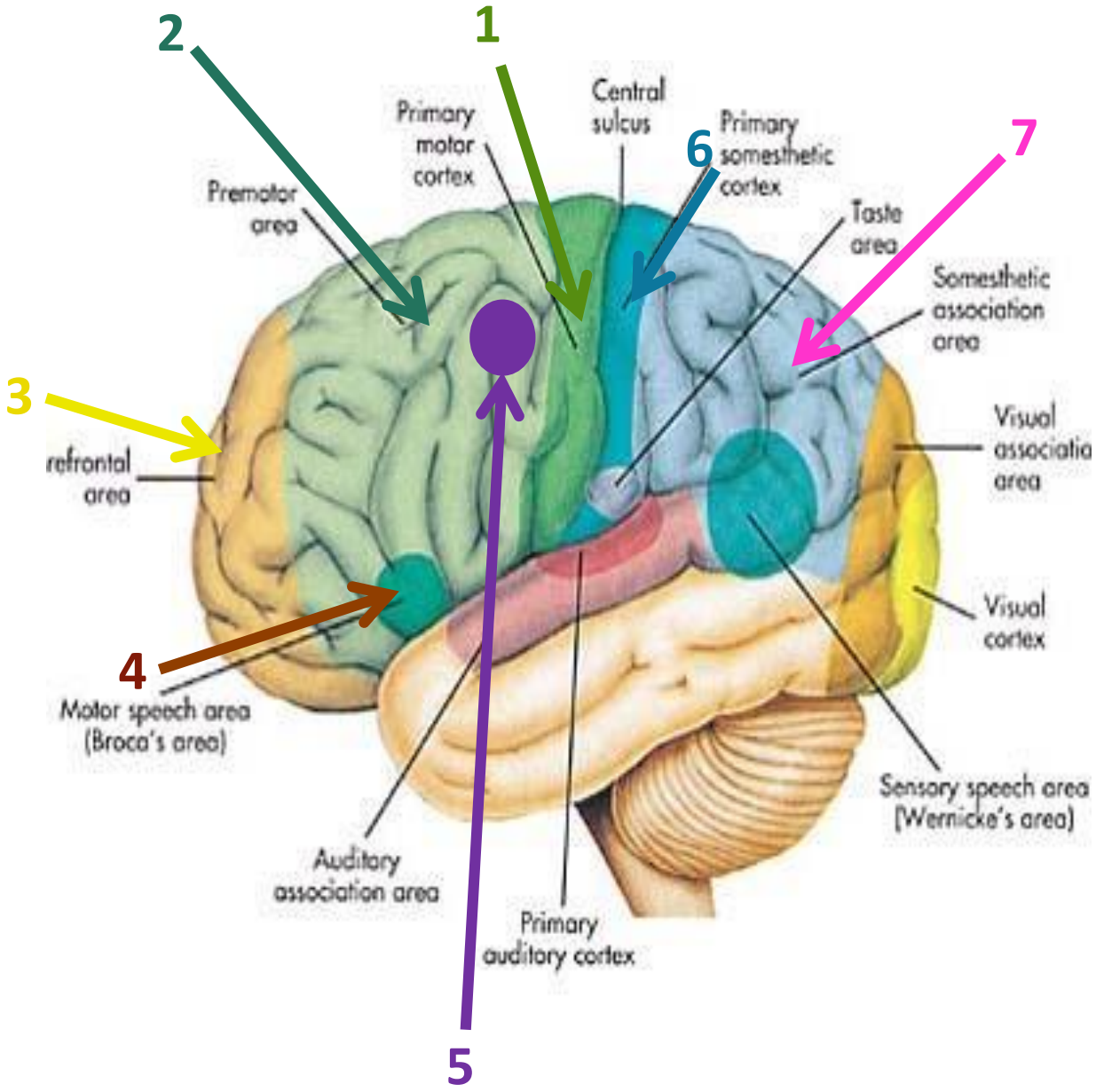
Brodmann's map

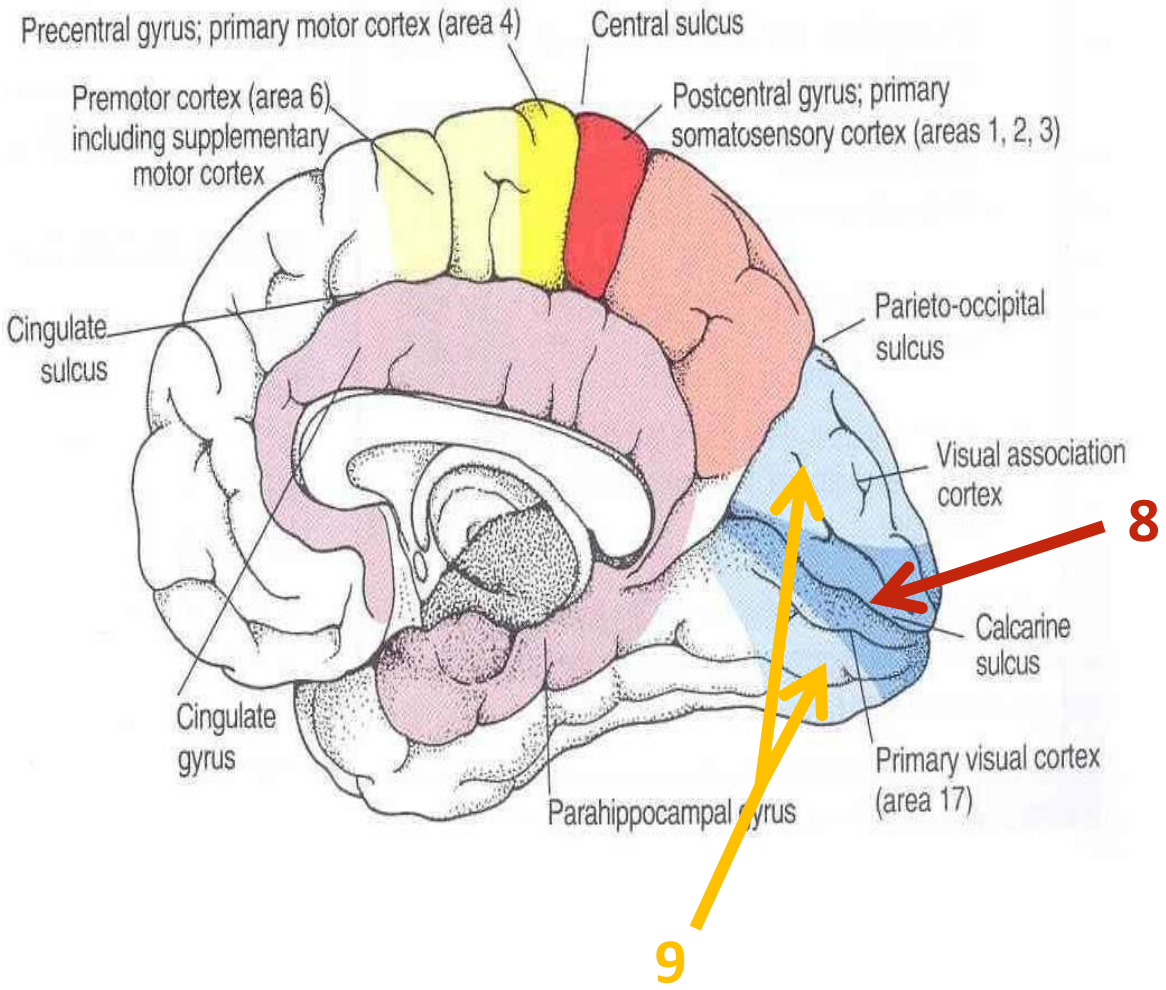
*In the spinal cord the grey matter was divided into rexed laminae. Here broadmanns map is similar but in the cerebral hemispheres

Functional Areas of the Cerebral Cortex

"Each primary cortex has association cortex"

Frontal Lobe			Only on the boy's slides
1-Primary motor cortex	Located in **precentral gyrus**	Brodman's area **4**	allows conscious control of **skilled voluntary (gross) movement** (controls skeletal muscles)
2-Premotor cortex:	Located in the region **immediately anterior to the precentral gyrus**	Brodmann's area **6**	Controls learned, repetitious, or patterned motor skills, typing, playing a musical instrument. Coordinates simultaneous or sequential actions. Involved in the **planning of movements.**
3-Prefrontal cortex:	**Extensive** region of the **frontal lobe** anterior to premotor area.		Involved with intellect, cognition, recall, and personality. **Necessary for judgement**, reasoning, persistence, and conscience. Also related to mood. Closely linked to limbic system (emotional part of brain)
4-Broca's (motor speech) area: (in the premotor area)	Located in the **inferior frontal gyrus** of the dominant hemisphere, usually left	Brodmann's area **44 & 45**	A **motor speech area** that directs muscles of the tongue. Is active as one prepares to speak.
5-Frontal eye field:	Located in the **middle** frontal gyrus immediately in front of premotor cortex	Brodmann's area **8**	


2
1
Primary motor cortex
Central sulcus
6
Primary somesthetic cortex
7
Premotor area
Taste area
Somesthetic association area
3
refrontal area
Visual associatio area
Visual cortex
4
Motor speech area (Broca's area)
Sensory speech area (Wernicke's area)
Auditory association area
Primary auditory cortex
5


Precentral gyrus; primary motor cortex (area 4)
Central sulcus
Premotor cortex (area 6) including supplementary motor cortex
Postcentral gyrus; primary somatosensory cortex (areas 1, 2, 3)
Cingulate sulcus
Parieto-occipital sulcus
Visual association cortex
8
Calcarine sulcus
Cingulate gyrus
Primary visual cortex (area 17)
Parahippocampal gyrus
9

Functional Areas of the Cerebral Cortex

"Each primary cortex has association cortex"

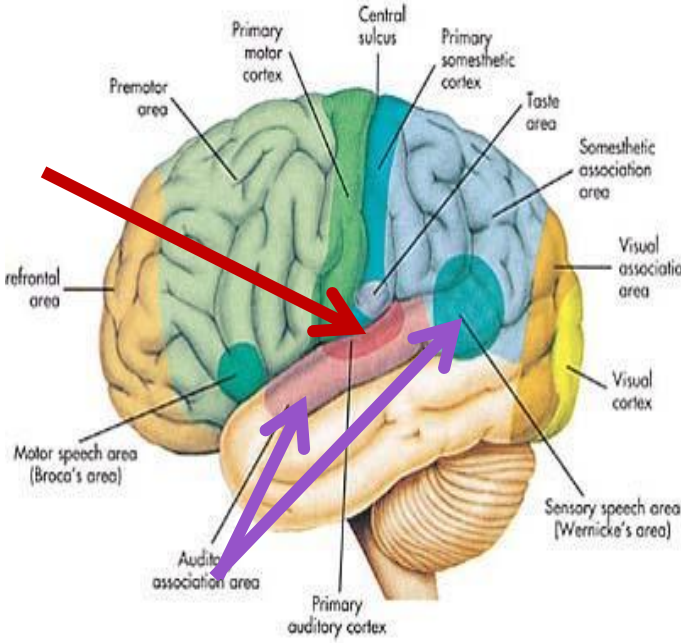
Only on the boy's slides

Parietal lobe			
6-Primary somatosensory cortex	located in **postcentral gyrus**	Brodmann's area **1, 2, 3**	Involved with conscious awareness of general somatic senses Receives information from the skin and skeletal muscles Exhibits spatial discrimination Precisely locates a stimulus
7-Parietal association cortex	located posterior to primary somatosensory		Integrates sensory information زي المترجم Forms comprehensive understanding of the stimulus Determines size, texture, and relationship of parts.
Occipital lobe			
8-Primary visual cortex	located on the medial surface of the hemisphere, in the gyri surrounding the calcarine* sulcus	Brodmann's area **17**	Receives visual information from the retinas - If we have injury in this area we cannot see any thing *Especially postcalcarine
9-Visual association cortex	located around the primary visual cortex	Brodmann's area **19**	Interprets visual stimuli (color, form, & movement) - If we have injury in this area we can see, but we don't know what we say

Functional Areas of the Cerebral Cortex

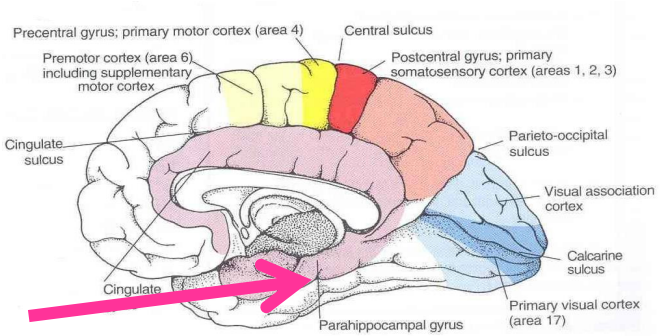
"Each primary cortex has association cortex"

Temporal Lobe			Only on the boy's slides
Primary auditory cortex	located in the superior surface of the superior temporal gyrus	Brodmann's area **41, 42**	Receives information related to pitch, rhythm, and loudness
Auditory association cortex	located immediately around the primary auditory cortex (also includes **Wernick's area**) Located posterior to the primary auditory cortex		Stores memories of sounds and permits perception of sounds Involved in recognizing and understanding speech Lies in the center of Wernicke's area Auditory is always associated with speech (I need to hear so I can speak)

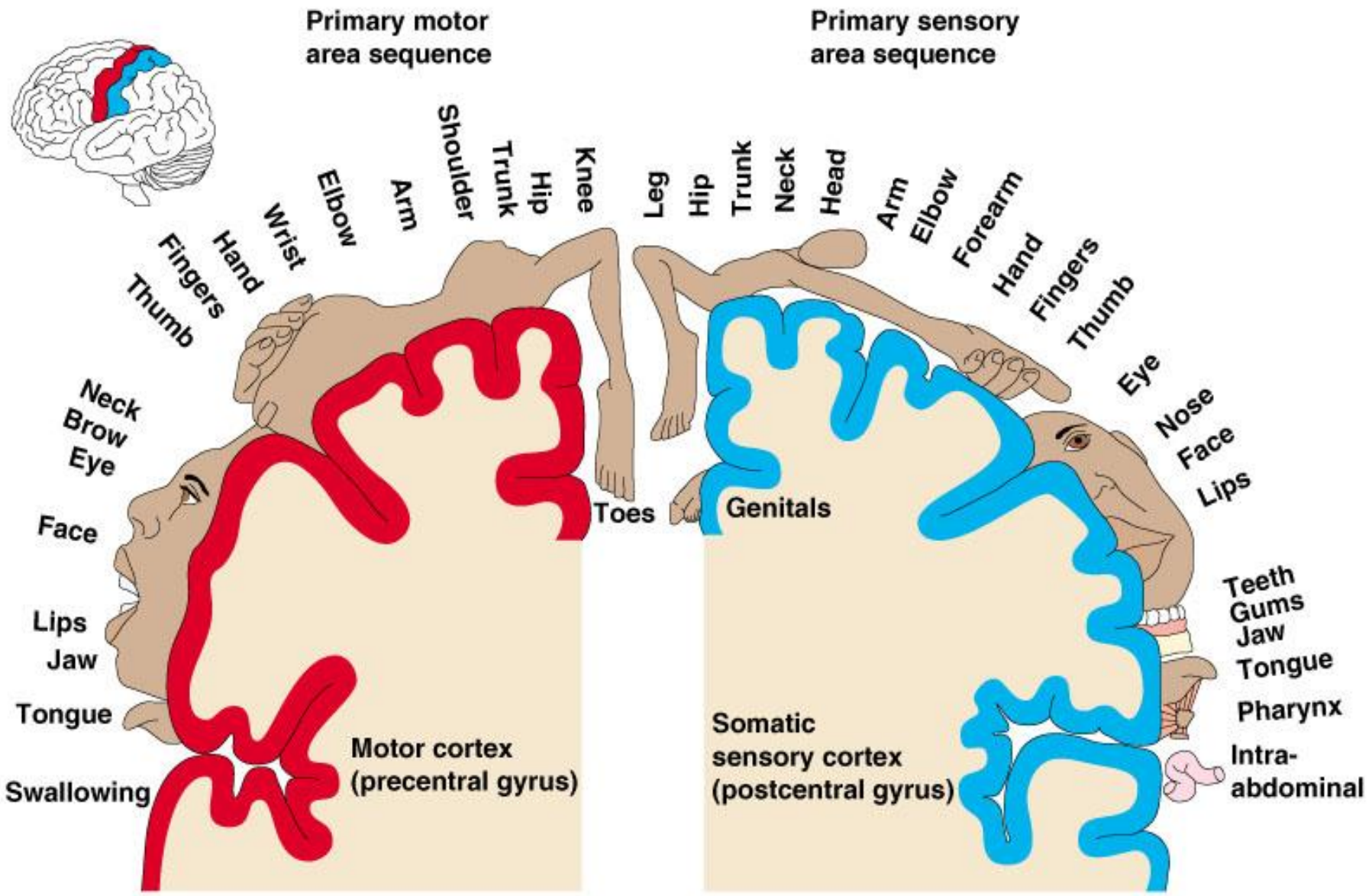


Parahippocampal gyrus:

- located in the inferomedial part of temporal lobe.
- Deep to this gyrus lies the **hippocampus** and the **amygdala**, which are parts of **limbic system**



Hippocampus = seahorse/حصان البحر

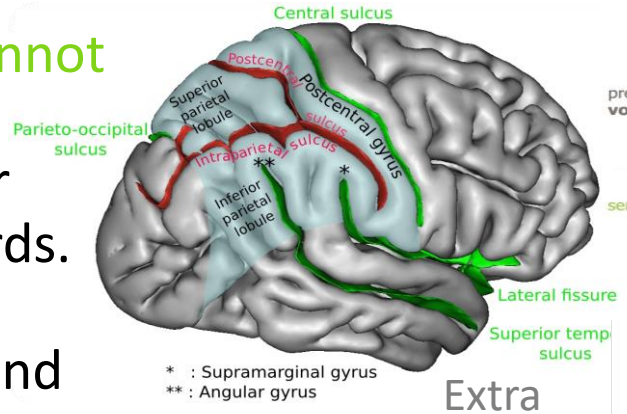


- **The body is represented upside down**
- Upper part is toes and leg and as we go down the brain we reach the body and hands and face and finally the larynx.
- **Representation of the body is according to precise function not size** so a lot of space (largest area) is for fingers tongue, hand, face and larynx, while the trunk has a small area.

Language Area

- Organized around the lateral fissure.
- **(1) Broca's area:** concerned with expressive aspects of language.
- Motor: so if there is a lesion he cannot speak
- **(2) Wernick's area:** responsible for comprehension of the spoken words.
- Wernick = supramarginal
- Nearby regions of temporal lobe and parietal lobe **"(3) angular gyrus & (4) supramarginal gyrus"** of the inferior parietal lobule) are important in naming, reading, writing, and calculation.

*Injury to (angular gyrus & supramarginal gyrus) doesn't cause the loss of ability to talk, it only affect reading, writing, naming and calculation.



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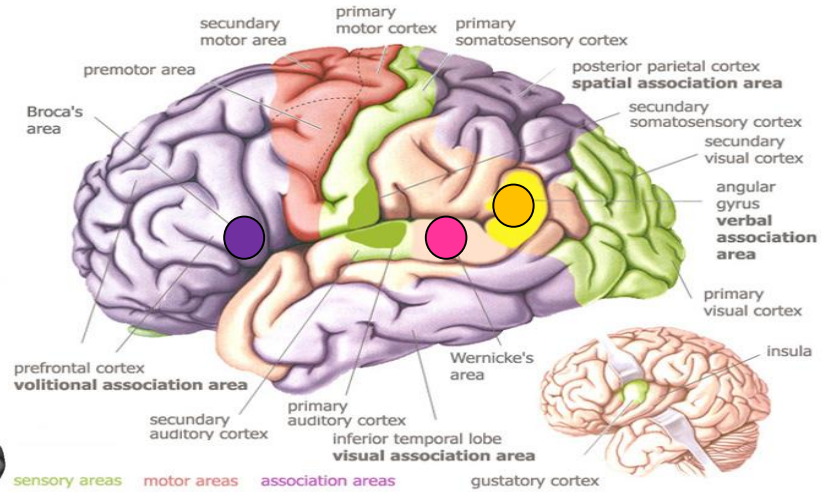
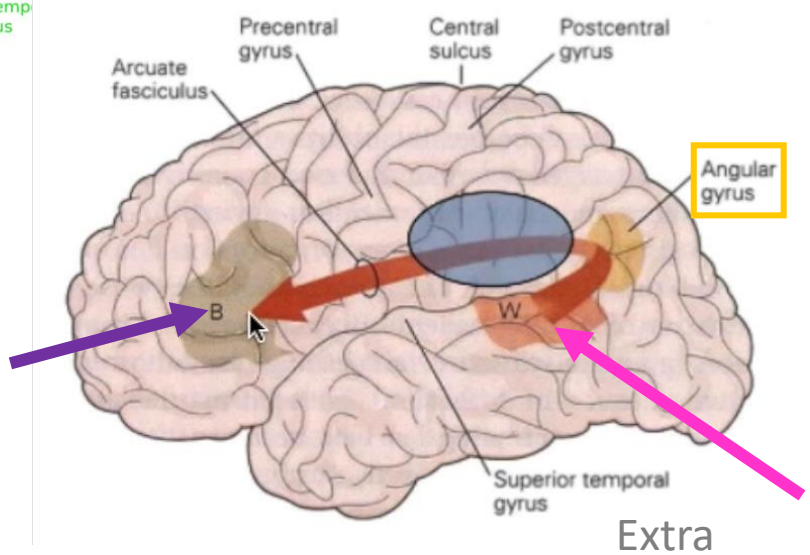
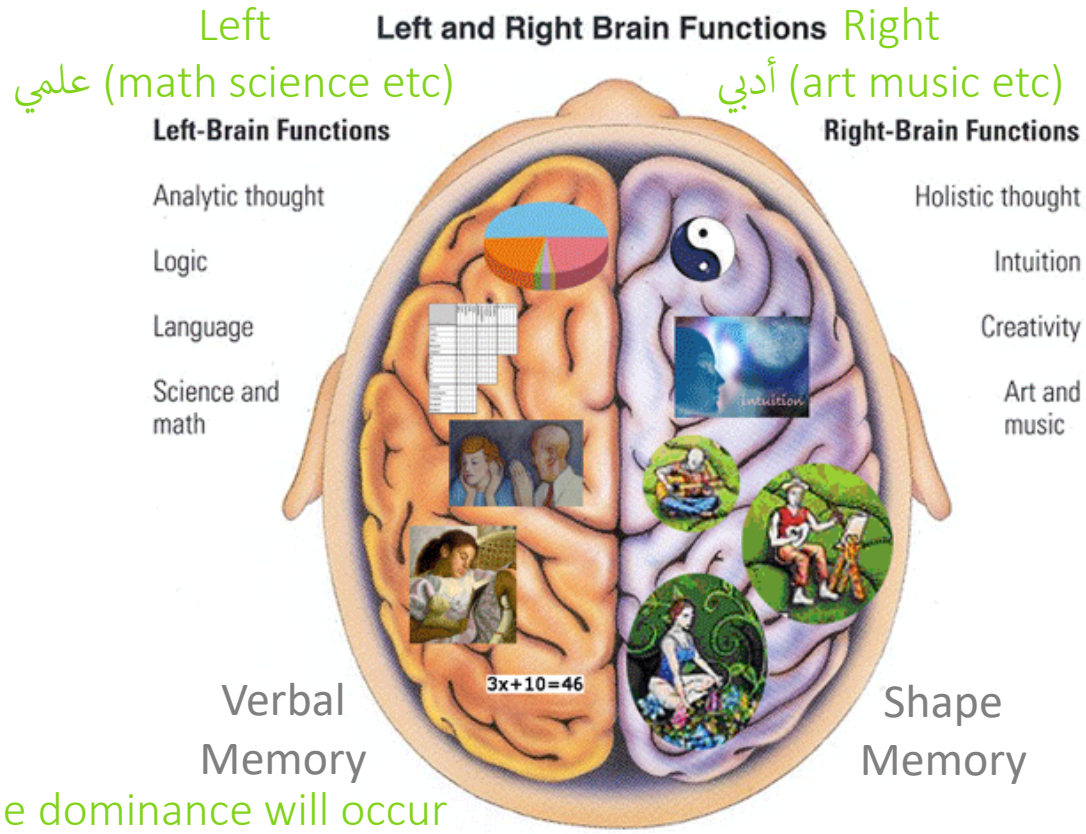




Extra

Hemispheric Dominance

- The localization of **speech centers & mathematical ability** (Calculation and language) is the criterion for defining the dominant cerebral hemisphere.*
- In 96% of normal **right-handed** individuals and 70% of normal **left-handed** individuals, the left hemisphere contains the language centers. These are **left hemisphere dominant.**
- Cerebral dominance becomes established during the **first few years after birth.**



Hemispheres communicate via the **corpus callosum**

*When child starts talking and language centres are formed then the dominance will occur
*these centres are present in both sides but more active in one side.
Example: in left dominance the broca's area that is active is in left
(we have it in the right but inactive)
The right will become active if there is injury to left but will take time. So after the injury the person cannot talk but after time the right side becomes active and he can talk again.

White Matter

*Similar areas in the same lobe (short) but from different lobes (long)

- Underlies the cortex
- Contains: 1. Nerve fibers 2. Neuroglia cells 3.Blood vessels.
- The nerve fibers originate, terminate or sometimes both, within the cortex.
- Depending on their origin & termination, these nerve fibers are classified into three types:

1. **Association fibers:** *

Unite different parts of the same hemisphere (within it self)

2. **Commissural fibers**: **

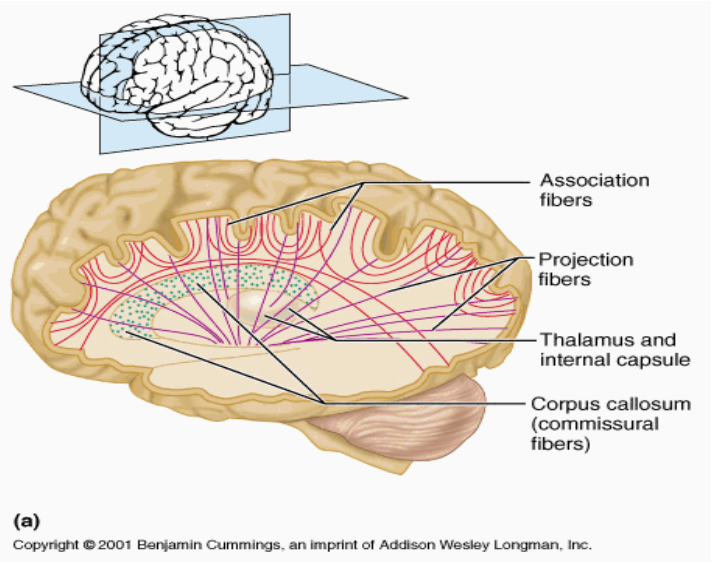
Connect the corresponding regions of the two hemispheres

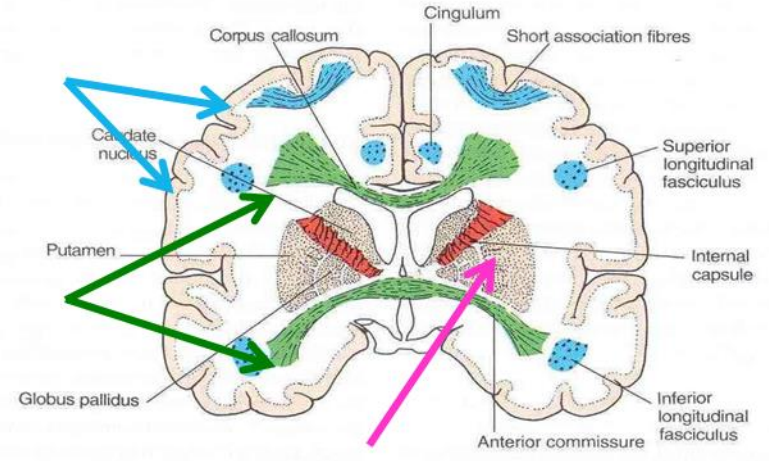
3. **Projection fibers**: Consisting of:

(connect cerebral cotrex with spinal cord)

a. Afferent fibers conveying impulses to the cerebral cortex.

b. Efferent fibers conveying impulses away from the cortex.





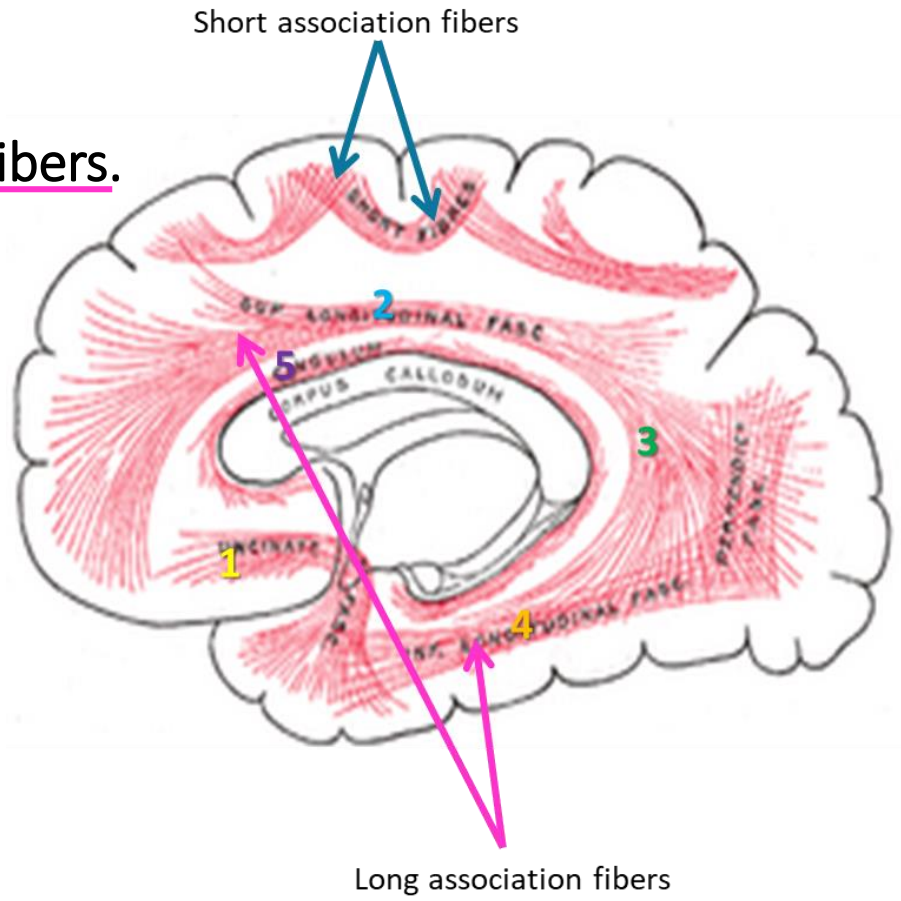
**Same area but in two hemispheres. Example corpus callosum which will help the two hemispheres act in harmony

Only on the boy's slides

White Matter
1. Association Fibers

- Unite different parts of the same hemisphere.
- Are of two kinds:
  - Those connecting adjacent gyri, short association fibers
  - Those connecting more distant parts, long association fibers.

Long Association Fibers	
1. Uncinate fasciculus	connects frontal to temporal lobe.
2. Superior longitudinal fasciculus	connects the frontal, occipital, parietal, and temporal lobes
3. Arcuate fasciculus	connect gyri in frontal to temporal lobes
4. Inferior longitudinal fasciculus	connects occipital to temporal pole
5. Cingulum	connects frontal & parietal lobes to the para-hippocampal gyrus and adjacent temporal gyri



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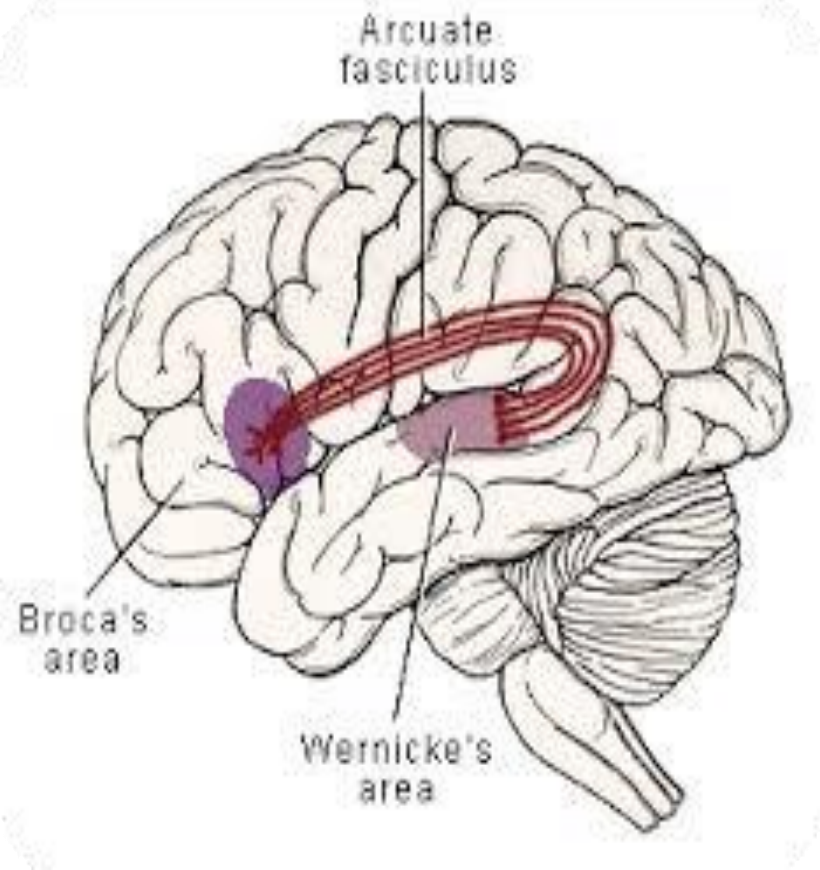
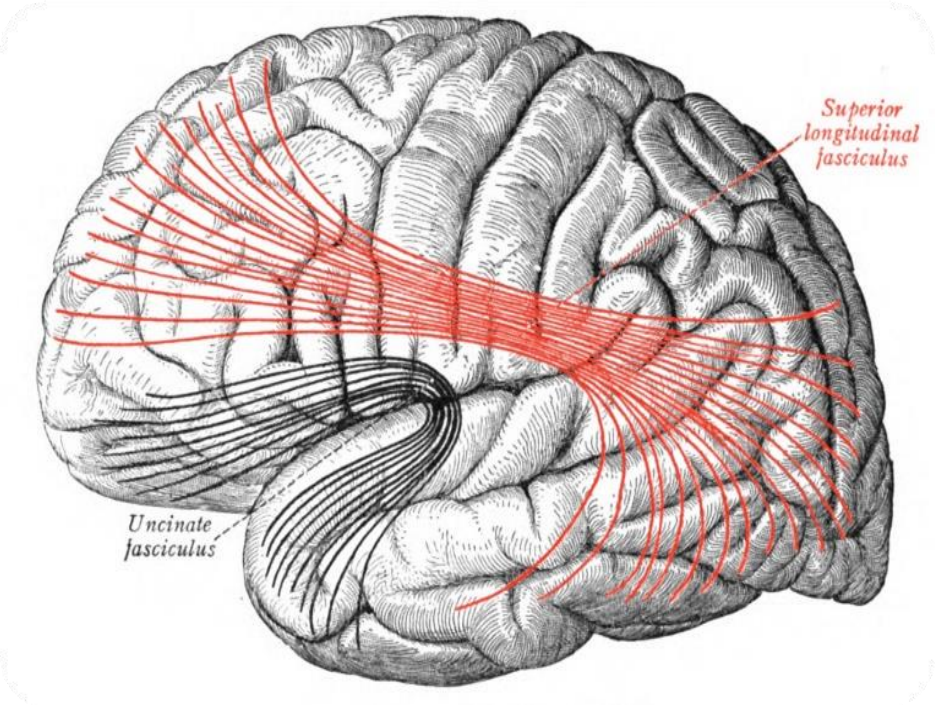
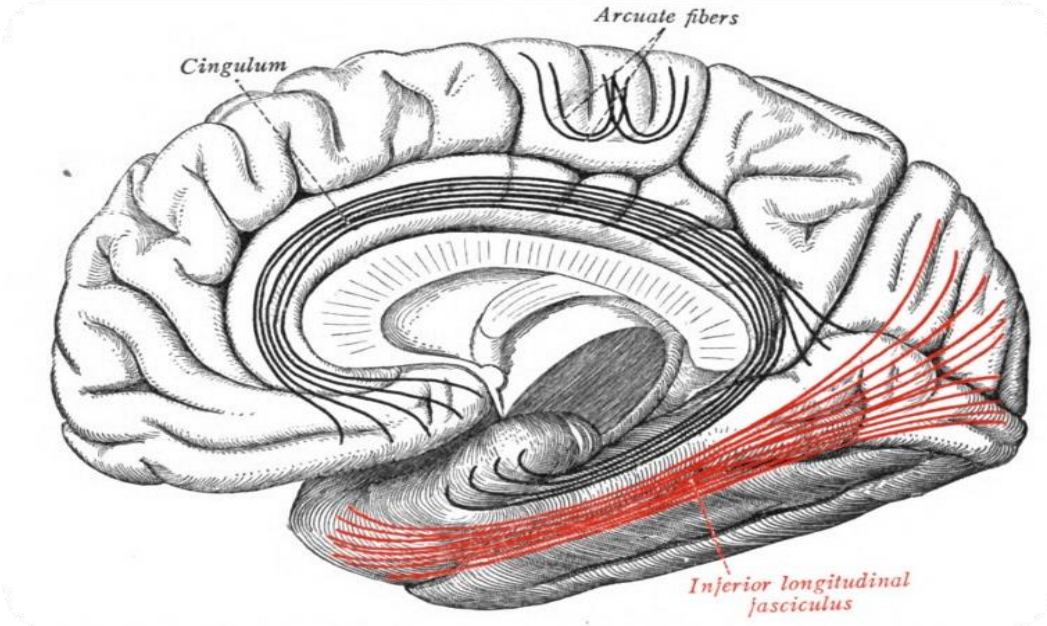


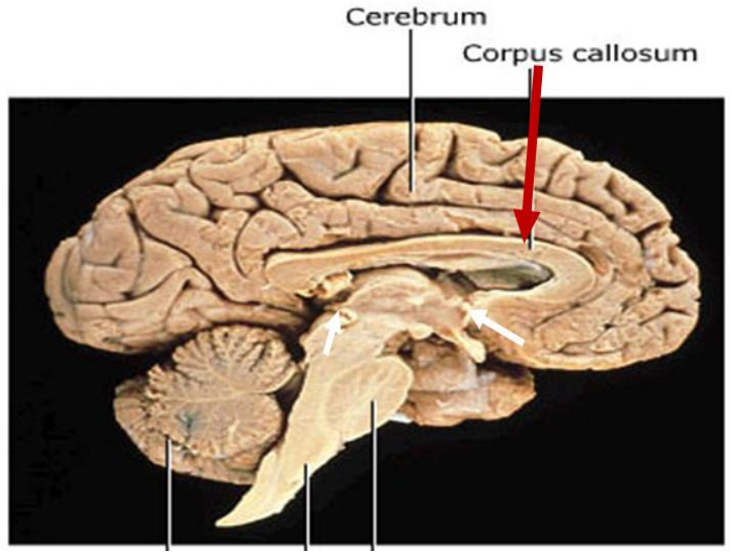


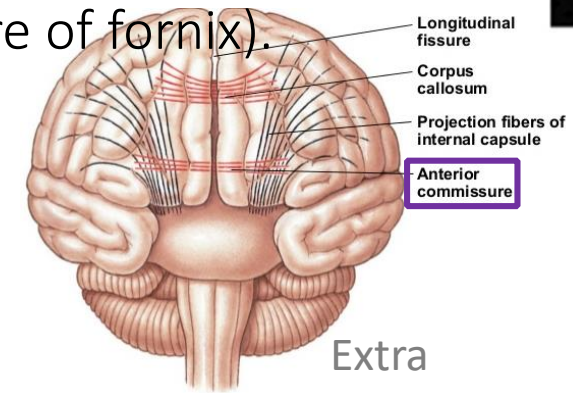


Only on the boy's slides

White Matter
2. Commissural Fibers

- Connect the corresponding regions of the two hemispheres.
- Include:
  - Corpus callosum.
  - Anterior commissure.
  - Hippocampal commissure (commissure of fornix).
  - Posterior commissure.





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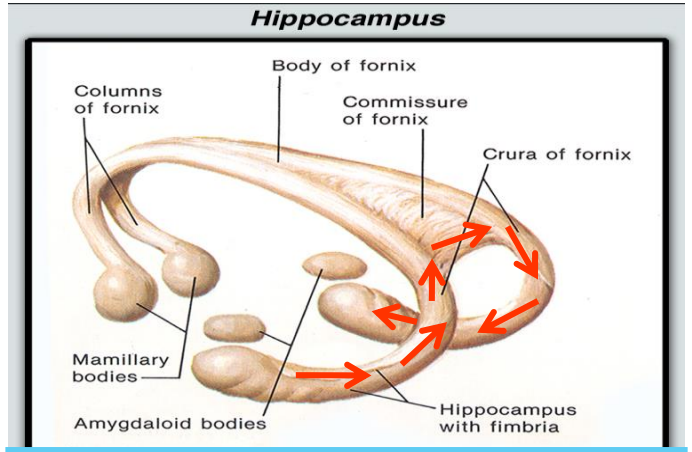
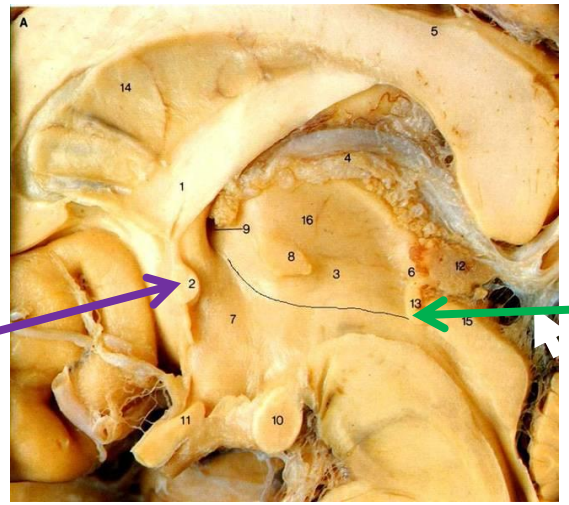




Anterior commissure: connects the **inferior** and **middle temporal gyri** & the **olfactory regions** of the two hemispheres

Posterior Commissure: connects the **left and right midbrain** Important in the bilateral pupillary reflex

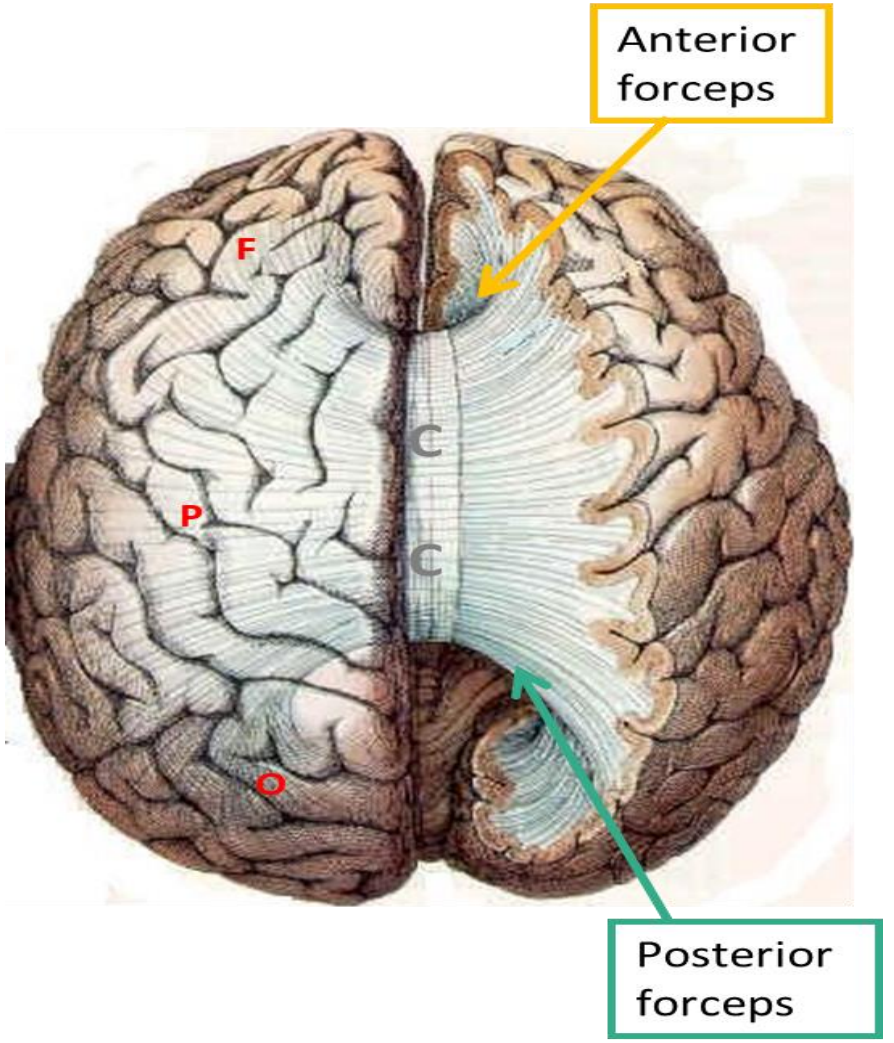
Hippocampal Commissure: connect the two hippocampi with each other

Only on the boy's slides

White Matter
2. Commissural Fibers

Corpus Callosum

- Connects the corresponding regions of the two hemispheres except the temporal lobes, that are connected by anterior commissure.
- It is shorter craniocaudally than is the hemisphere.
- The callosal fibers linking the frontal poles, curve forward forming anterior forceps **(forceps minor).**
- The callosal fibers linking the occipital poles, curve backward forming posterior forceps **(forceps major).**



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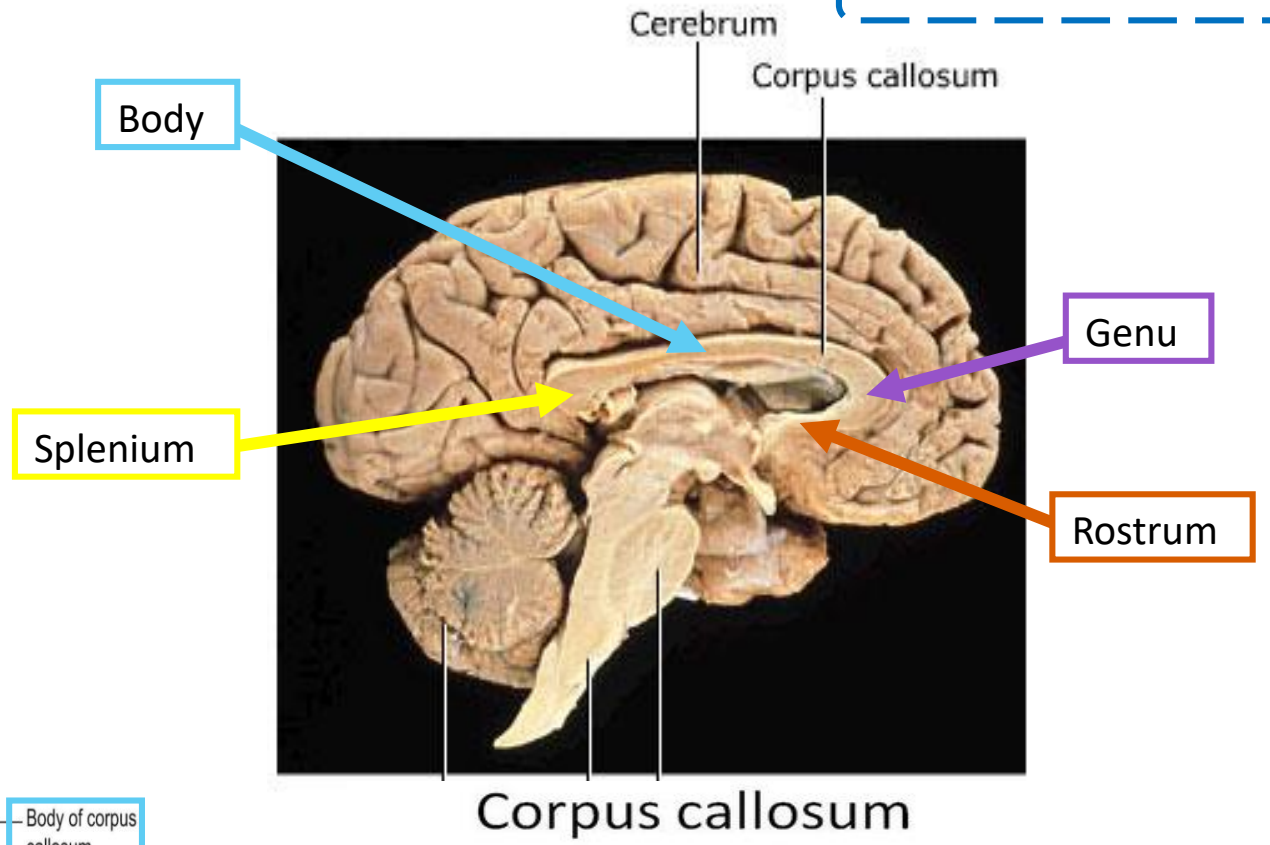
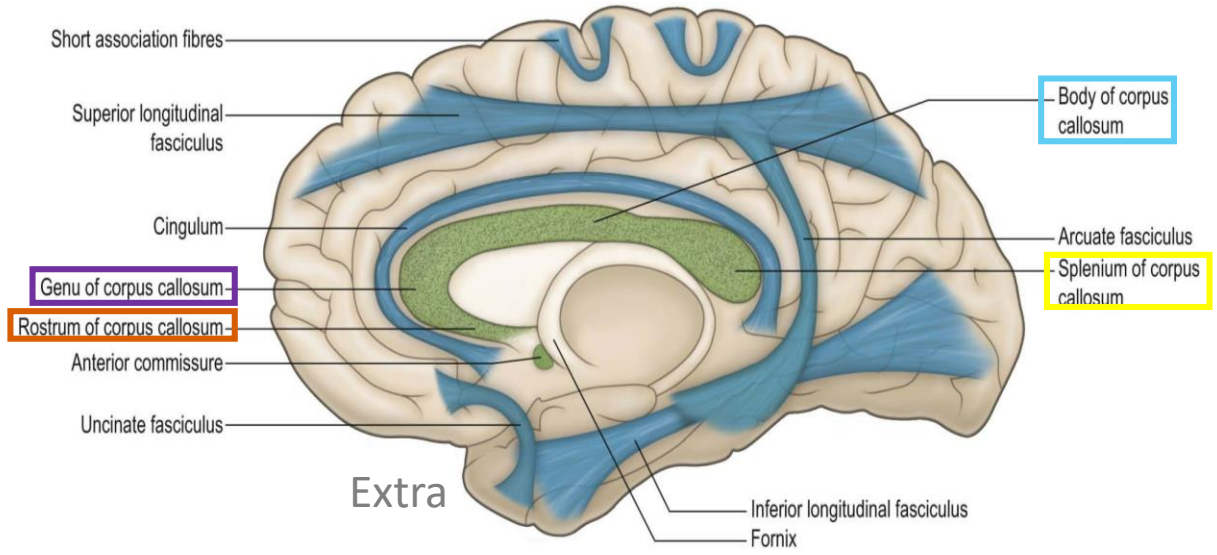
White Matter
2. Commissural Fibers

Parts of **Corpus Callosum**:

1. Body
2. Splenium
3. Genu
4. Rostrum



Corpus callosum



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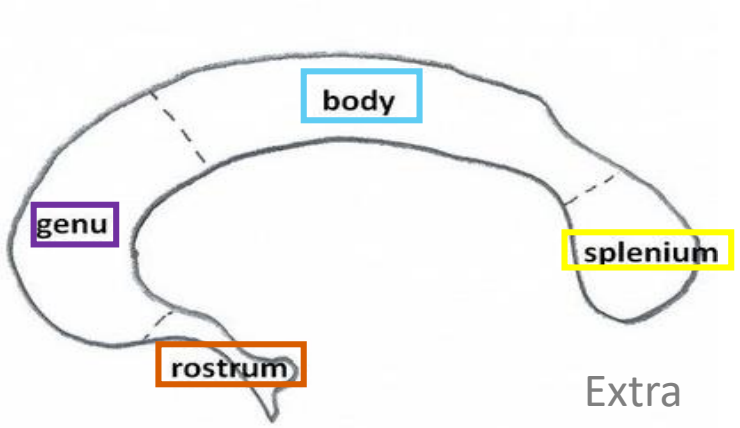

Extra

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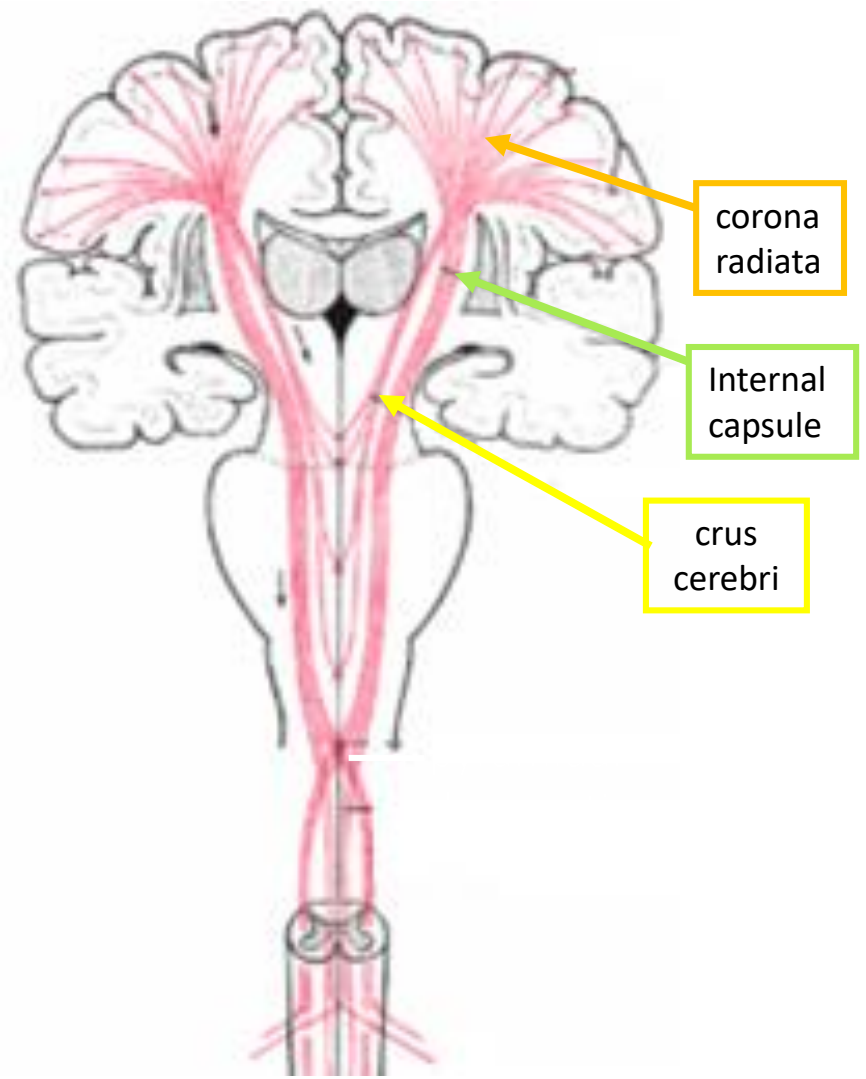
White Matter
3. Projection Fibers

- Consist of:
  - **Afferent fibers** conveying impulses to the cerebral cortex.
  - **Efferent fibers** conveying impulses away from the cortex.
- Deeper to the cortex, these fibers are arranged radially as the **corona radiata**.
- Then the fibers converge downward, form **internal capsule**, between thalamus and basal ganglia.
- Continue in the **crus cerebri** of the midbrain, **basilar** part of pons, & **pyramid** of medulla oblongata.



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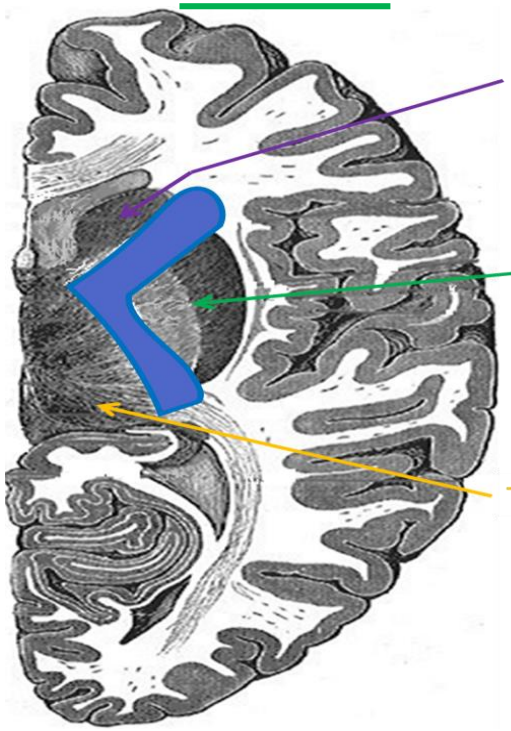
White Matter
3. Projection Fibers

Internal Capsule

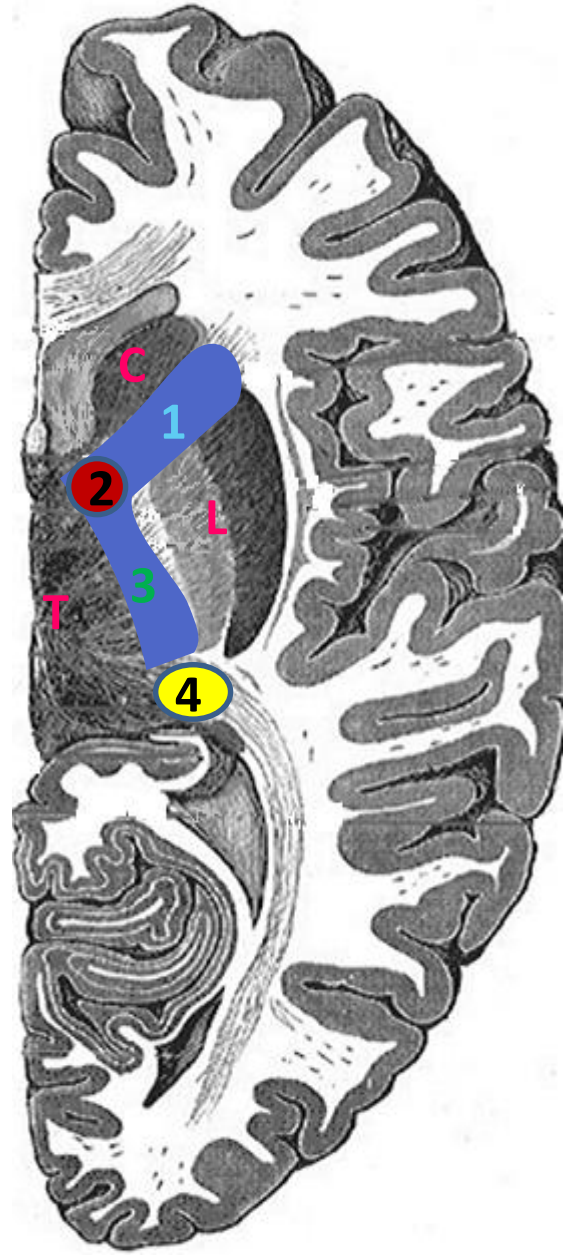
Bundle of projection fibers, passes through the interval between the **thalamus** and the **basal ganglia** (caudate & lentiform* nuclei)



*Putamen and globus pallidus nuclei are collectively known as Lentiform nuclei

Has 5 parts:

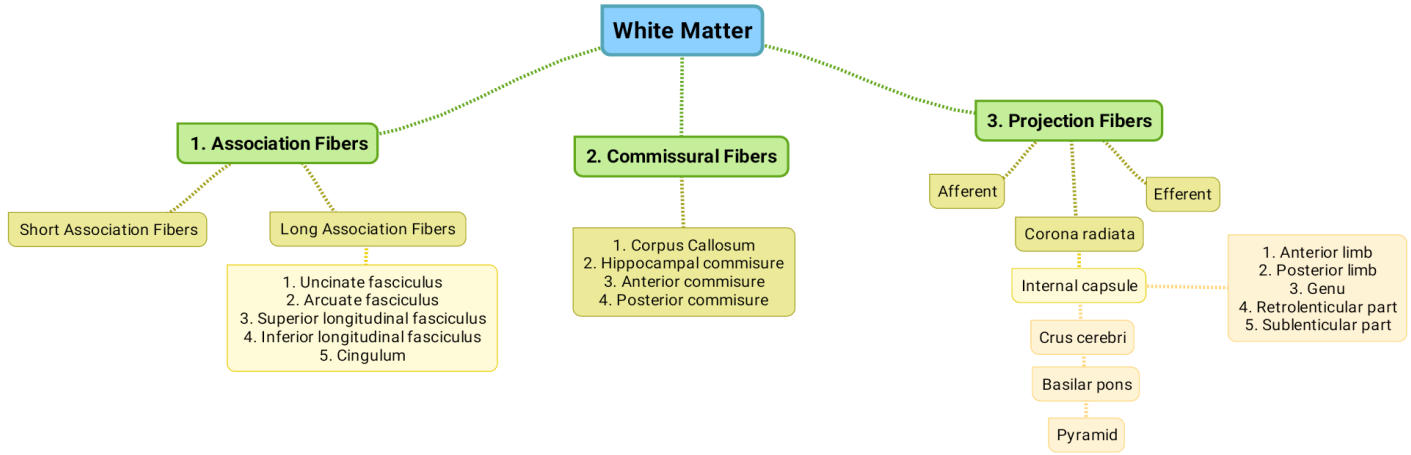
1. **Anterior limb**: Thalamocortical & Frontopontine fibers
2. **Genu:** Corticobulbar fibers
3. **Posterior limb:** Corticospinal, Corticobulbar & Thalamocortical fibers.
4. **Retrolenticular part:** Geniculocalcarine fibers
5. **Sublenticular part:** Geniculo-temporal fibers.



Summary

Broadmann's Areas	
1	Primary somatosensory cortex
2	
3	
4	Primary motor cortex
6	Premotor cortex
8	Frontal eye field
17	Primary visual cortex
19	Visual association cortex
41	Primary auditory cortex
42	
44	Broca's area
45	

Lobe	Gyri	Sulci
Frontal	1. **Precentral gyrus** 2. Superior frontal gyrus 3. Middle frontal gyrus 4. Inferior frontal gyrus	1. Superior frontal sulci 2. Inferior frontal sulci
Parietal	1. **Postcentral gyrus**	1. Intraparietal sulcus
Temporal	1. Insula 2. Superior temporal gyrus 3. Middle temporal gyrus 4. Inferior temporal gyrus	1. Superior temporal sulci 2. Inferior temporal sulci
Medial Surface	1. Cingulate 2. Parahippocampal	1. Parietooccipital 2. Calcarine 3. Cingulate



MCQs

(1) which of the following is not one of the surfaces of the cerebrum?

A) Superiolatral B) Medial
C) Posterior D) Inferior

(2) Which lobe is responsible for smell, hearing and memory?

A) Frontal B) Temporal
C) Occipital D) Parietal

(3) Where is frontal eye field?

C) Occipital D) Parietal
A) Frontal B) Temporal

(4) When is cerebral dominance becomes established?

A) Before birth B) First few years after birth
C) At puberty D) Mid 40s

(5) Which nerve fiber type connect corresponding regions of different hemisphere?

A) Association B) Commissural
C) Projection D) Non of them

(6) Superficial layer of cerebral cortex consist of?

A) Grey matter B) White matter
C) Both A & B D) Non of them

(7) Corpus collosum is example of?

A) Efferent projection fiber B) Commissural fiber
C) Afferent projection fiber D) Association fiber

(8) Brodman's area 4 is related to?

A) Primary motor cortex B) Primary visual cortex
C) Primary motor cortex D) Primary visual cortex

(9) Parahippocampal gyrus located in the inferomedial part of?

A) Frontal lobe B) Parietal lobe
C) Occipital lobe D) Temporal lobe

(10) Which of them regions concerned with expressive aspects of language?

A) Broca’s area B) Wernick’s area
C) Angular gyrus D) Supramarginal gyrus

Answers

(1) C
(2) B
(3) A
(4) B
(5) B
(6) A
(7) B
(8) C
(9) D
(10) A

(1) What is the function of afferent projection fibers?

Afferent fibers convey impulses to the cerebral cortex

(2) Name the 4 Commissural Fibers?

1. Corpus callosum.
2. Anterior commissure.
3. Hippocampal commissure (commissure of fornix).
4. Posterior commissure.

Good luck
Special thank for team436 ❤

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