CEREBRUM

Dr. Jamila Elmedany Dr. Essam Eldin Salama

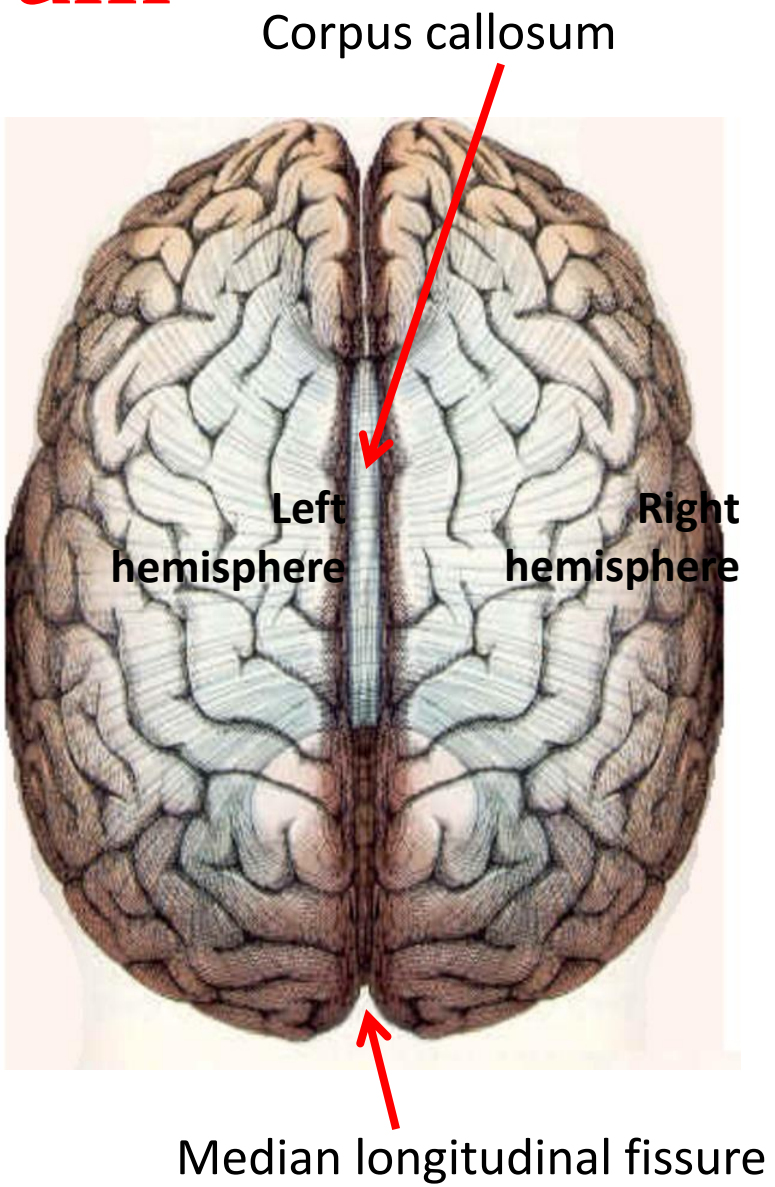
Objectives

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

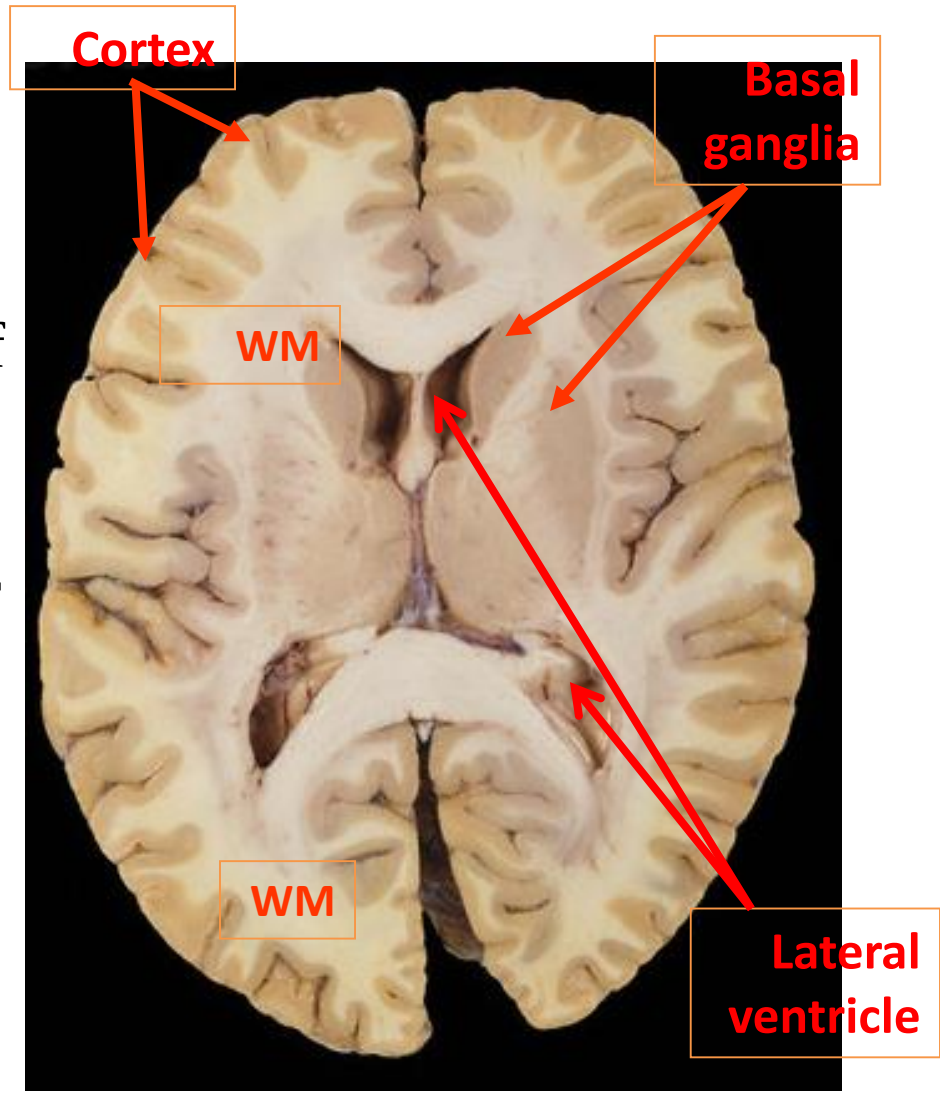
- List the parts of the cerebral hemisphere (cortex, medulla, basal nuclei, lateral ventricle).
- Describe the subdivision of a cerebral hemisphere into lobes.
- List the important sulci and gyri of each lobe.
- Describe different types of fibers in cerebral medulla (association, projection and commissural)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

Cerebrum

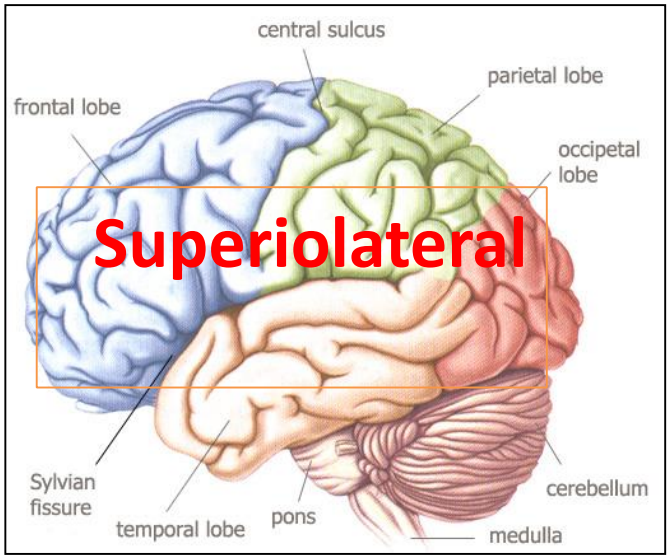
- Largest part of the forebrain
- Divided into two halves, the cerebral hemipheres, which are separated by a deep median longitudinal fissure which lodges the falx cerebri.
- In the depth of the fissure, the hemispheres are connected by a bundle of fibers called the corpus callosum.

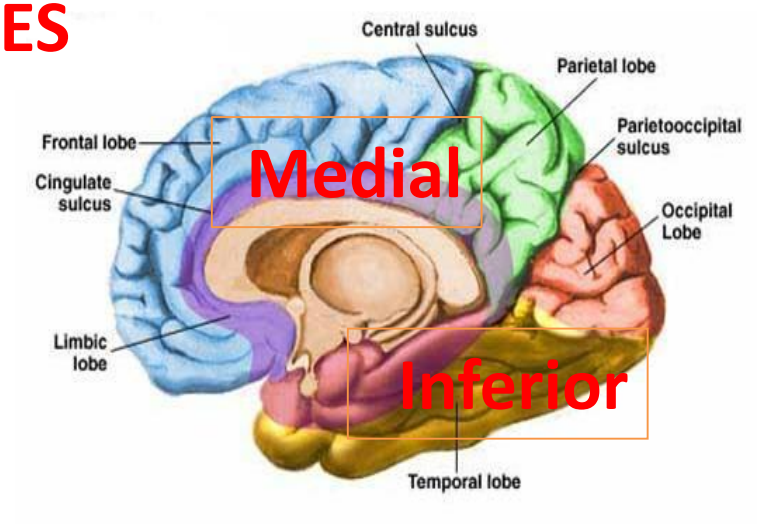


- The **structure of cerebral hemipheres** includes:
  - Superficial layer of grey matter, the **cerebral cortex.**
  - Deeper to the cortex, axons running to and from the cells of the cortex form an extensive mass of **white matter (WM).**
  - Burried within the white matter lie a number of nuclear masses (caudate, putamen, globus pallidus) collectively known as the **basal ganglia.**
  - The cavity of hemisphere is called the **lateral ventricle.**

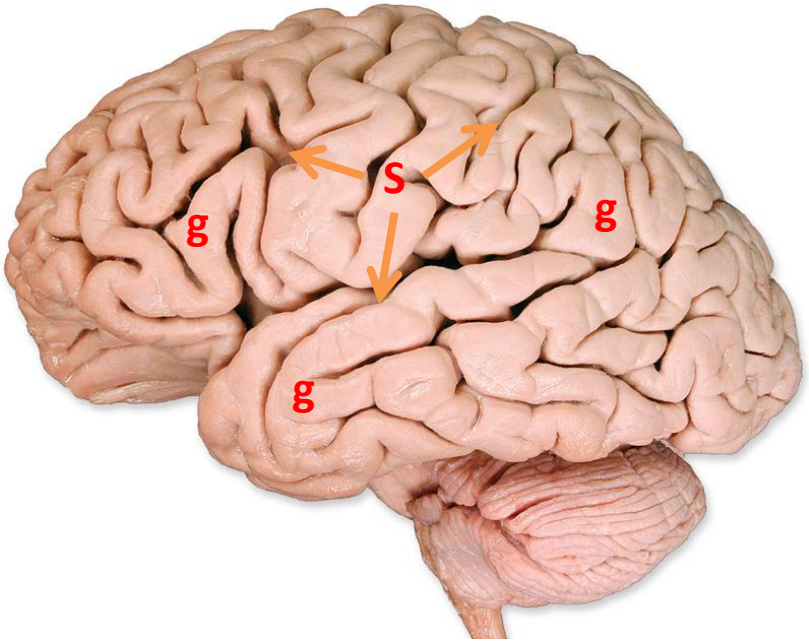


SURFACES





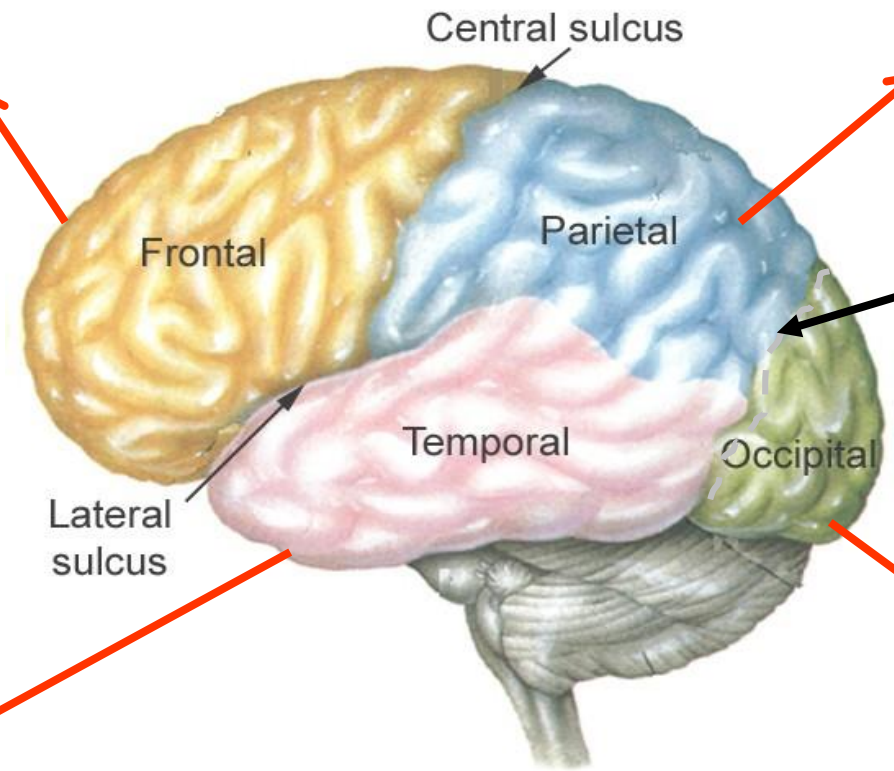
- The superficial layer of grey matter is highly convoluted to form a complex pattern of ridges **(gyri)** and grooves **(sulci).**
- This arrangement maximize the surface area of the cerebral cortex (about 70% is hidden within the depths of sulci).



- Three sulci, consistent in their position (central, lateral & parieto-occipital) are used to divide each hemisphere into lobes.
- Each hemisphere is divide into FOUR lobes (named after overlying bones).

motor function, motivation, aggression, smell and mood

reception and evaluation of sensory information

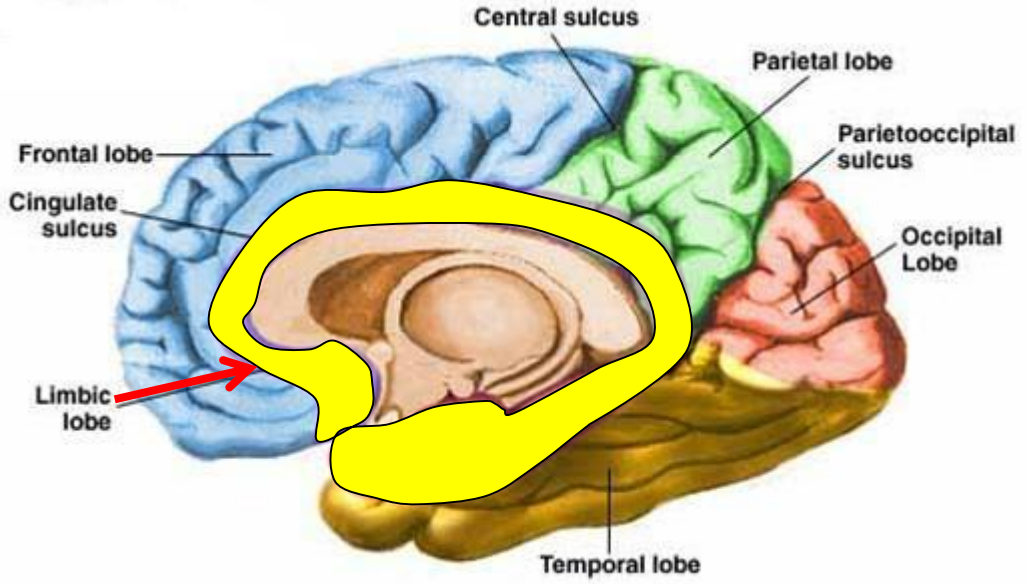


Parieto-occipital sulcus

visual processing

smell, hearing, memory and abstract thought

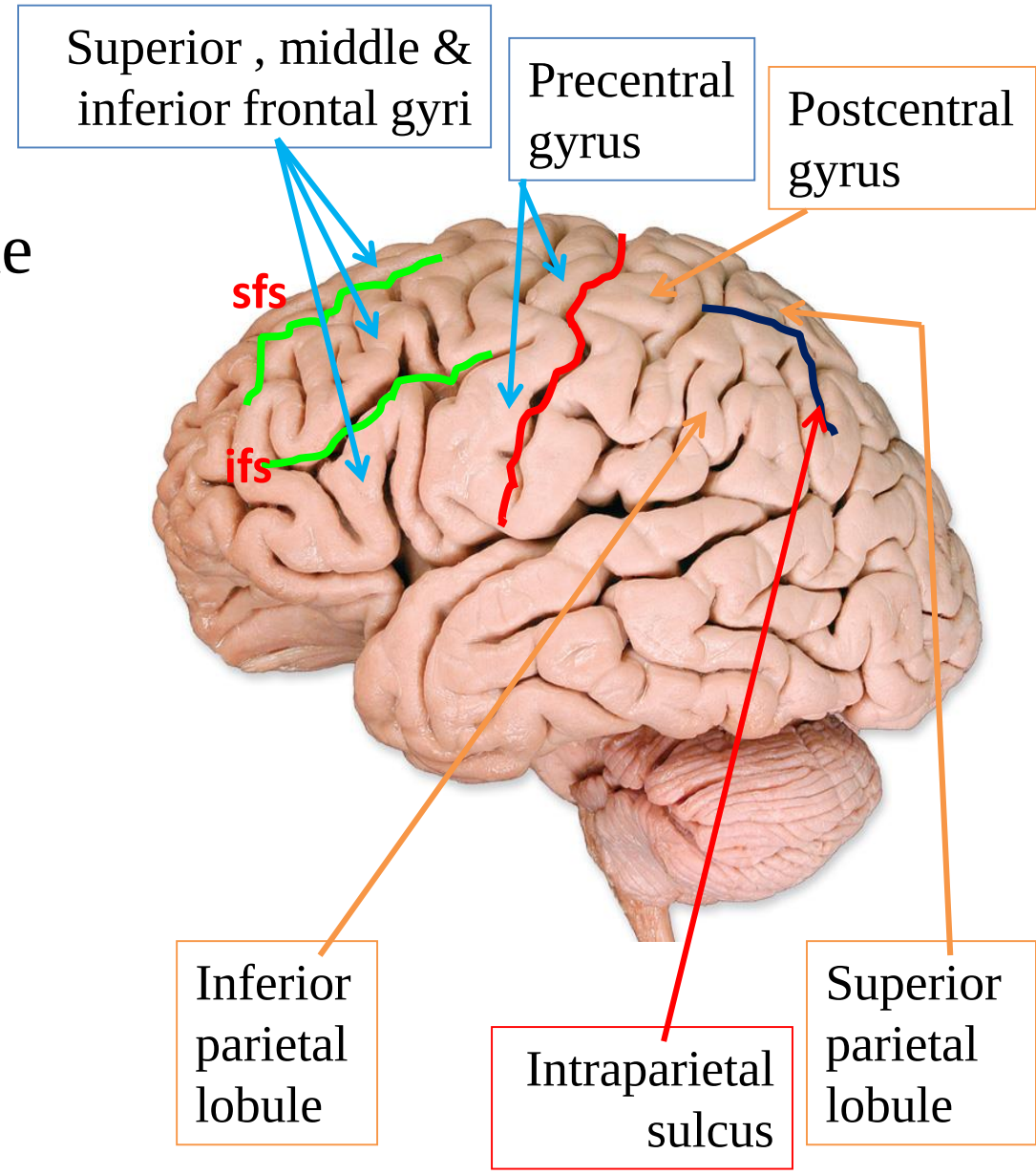
❑ Functionally each hemisphere contains a ‘limbic lobe’ on the medial surface.



❑ It is responsible for:

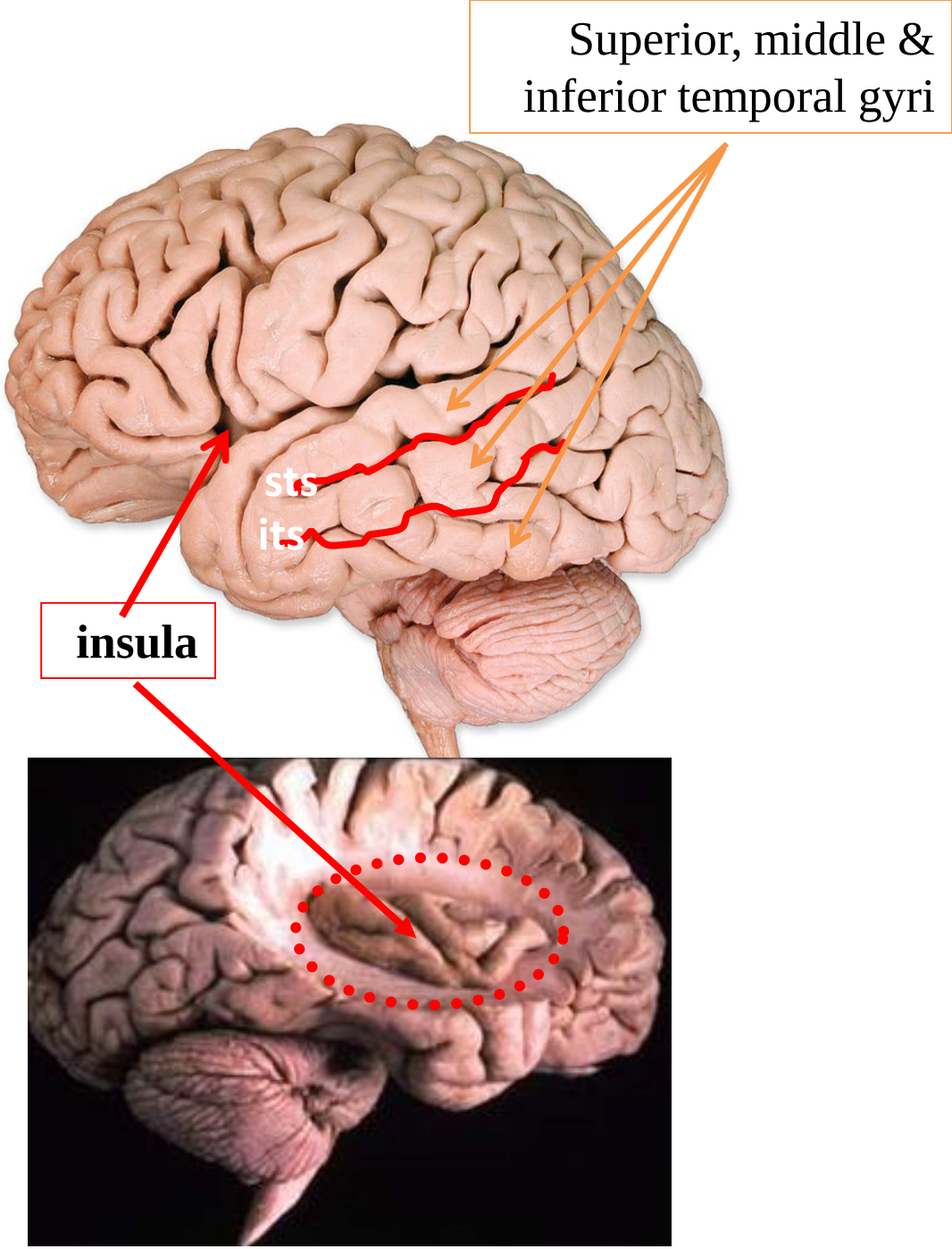
- Establishing **emotional** states
- **Linking** conscious **intellectual** functions with the unconscious **autonomic** functions
- Facilitating **memory** storage.

- **Frontal lobe:**
  - Precentral gyrus.
  - Superior & inferior frontal sulci divide the lobe into superior, middle & inferior frontal gyri.
- **Parietal lobe:**
  - Postcentral gyrus.
  - Intraparietal sulcus dividing the lobe into superior & inferior parietal lobules.



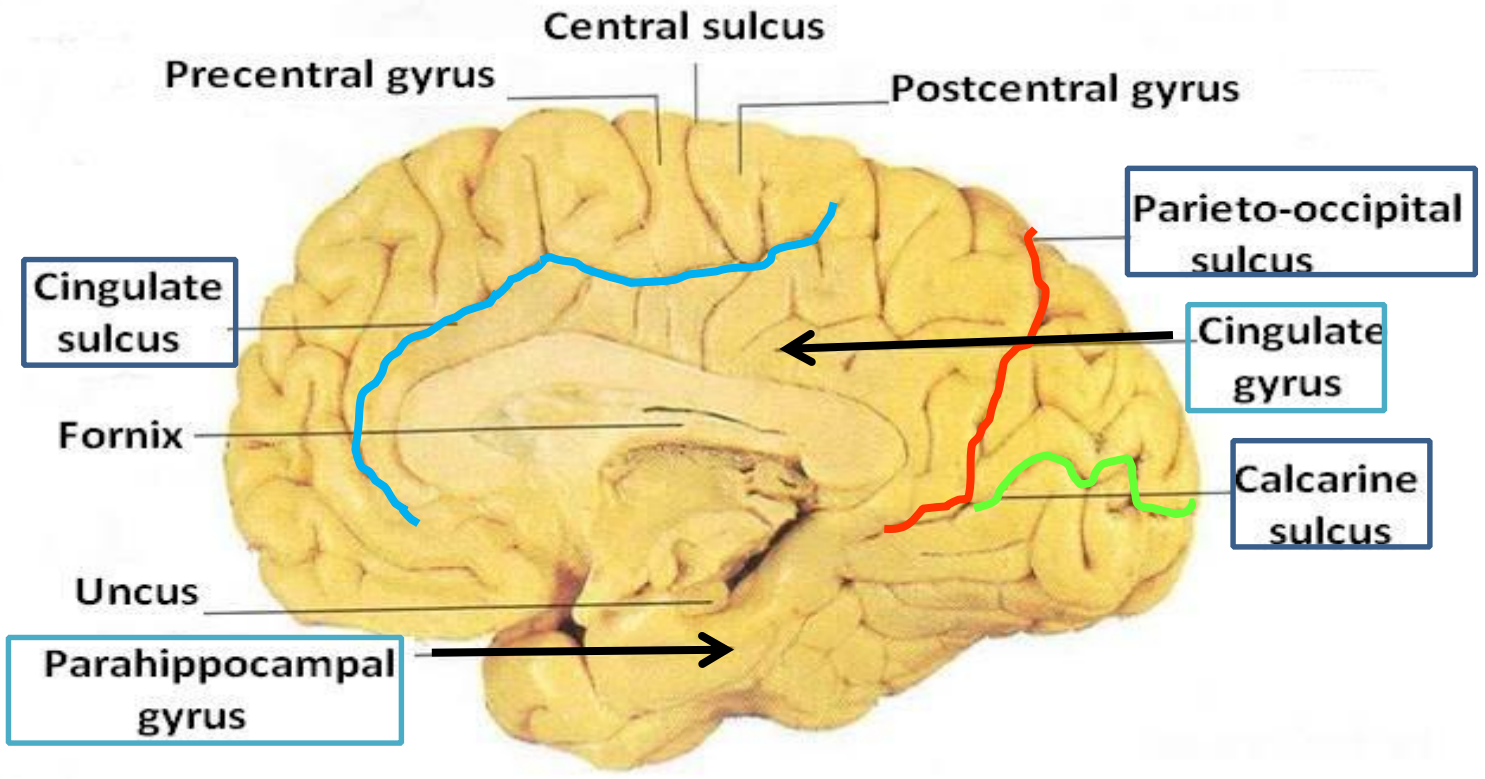
❑ Temporal lobe:

- Superior & inferior temporal sulci giving rise to superior, middle & inferior temporal gyri.
- Insula: the gyri in the depth of lateral fissure, covered by parts of frontal, parietal & temporal lobes called the opercula (removed in lower pic.).



Medial Surface

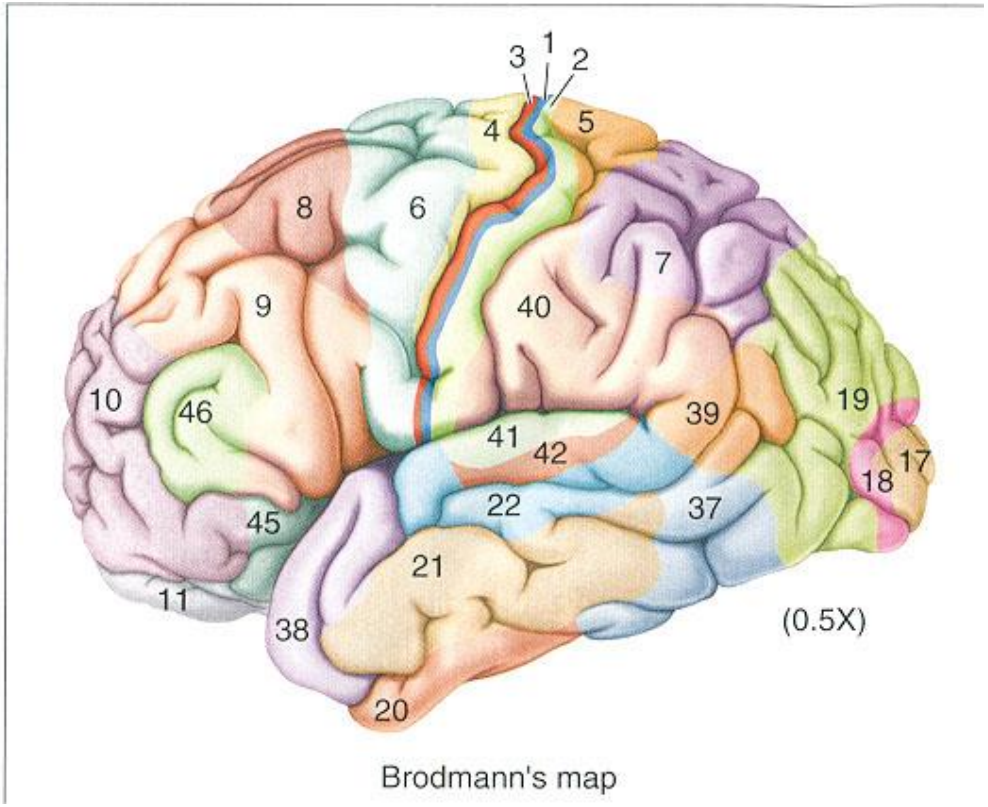
- Sulci: Parietooccipital, Calcarine, Cingulate
- Gyri: Cingulate, Parahippocampal



Brodmann produced a numbered, cytological map of cerebral cortex based upon its regional histological characteristics.

The basis of Brodmann's cortical localization is its subdivision into **'areas'** with similar cellular and laminar structure.

Brodmann's numbering of these cortical locations has become one of the standard ways in which clinicians identify brain areas.



Brodmann's map

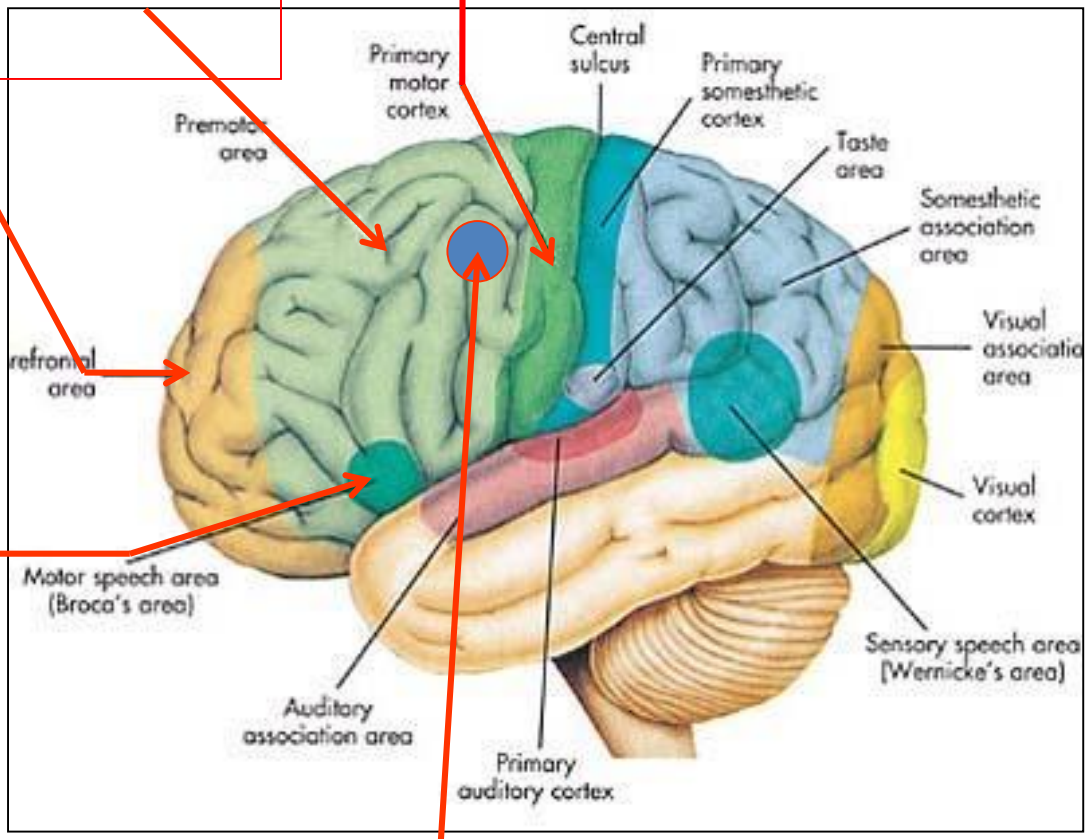
Functional Areas of the Cerebral Cortex

Frontal Lobe

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

Primary motor cortex: Located in precentral gyrus (Brodmann area 4) Allows conscious control of skilled, voluntary movements
i.e., controls skeletal muscle.

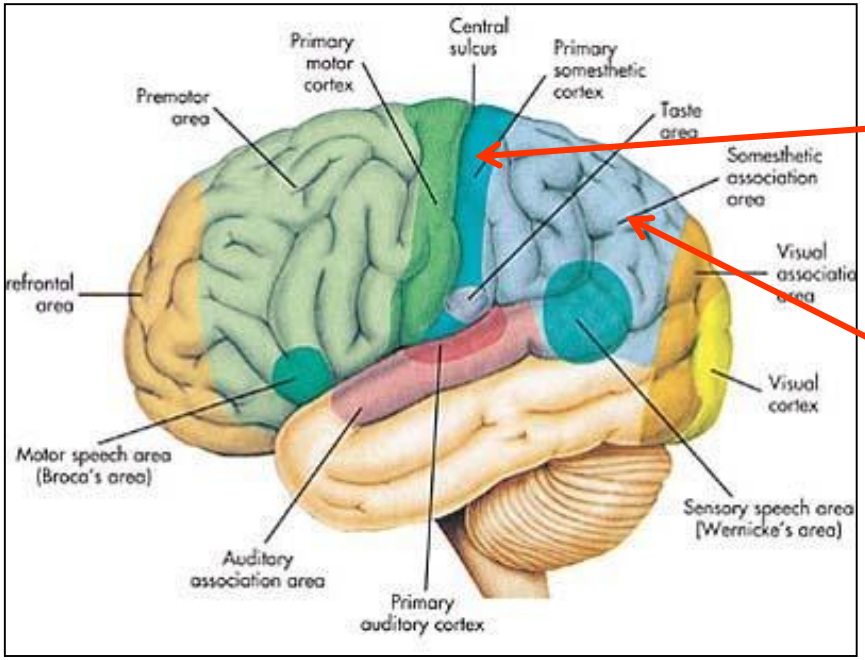
Prefrontal cortex: Extensive region of the frontal lobe anterior to premotor area. Performs cognitive functions
Involved with intellect, cognition, recall, and personality
Necessary for judgment, reasoning, persistence, and conscience
Also related to mood
Closely linked to the limbic system (emotional part of the brain)



Broca's (motor speech) 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

Frontal eye field: Located in the middle frontal gyrus immediately in front of premotor cortex (Brodmann's area 8).
Control of visual attention and eye movements

Parietal lobe



Primary somatosensory cortex:

located in postcentral gyrus (Brodmann's area 1, 2, 3).

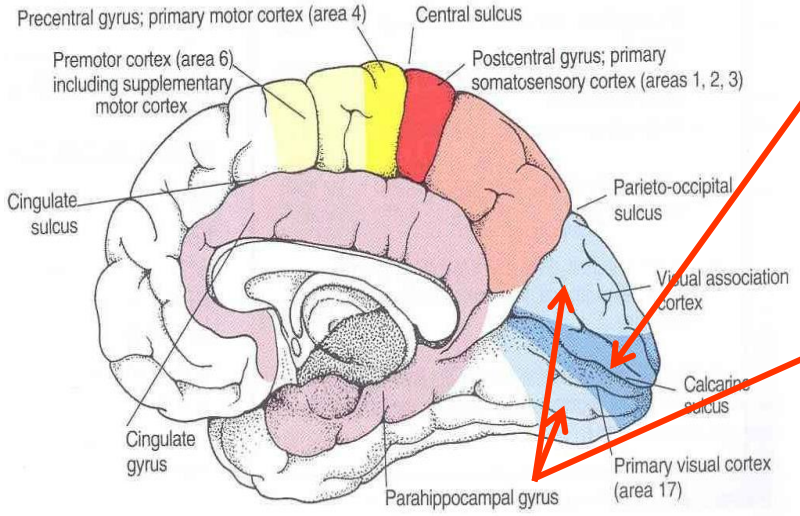
- Involved with conscious awareness of general somatic senses
- Receives information from the skin and skeletal muscles
- Exhibits spatial discrimination
- Precisely locates a stimulus

Parietal association cortex:

located posterior to primary somatosensory cortex.

- Integrates sensory information
- Forms comprehensive understanding of the stimulus
- Determines size, texture, and relationship of parts.

Occipital lobe



Primary visual cortex:

located on the medial surface of the hemisphere, in the gyri surrounding the calcarine sulcus (Brodmann's area17).

Receives visual information from the retinas

Visual association cortex:

located around the primary visual cortex.

Interprets visual stimuli (e.g., color, form, and movement)

Temporal Lobe

<u>Primary auditory cortex</u>:

located in the superior surface of the superior temporal gyrus (Brodmann's area 41, 42)

- Receives information related to pitch, rhythm, and loudness

<u>Auditory association cortex:</u>

located immediately around the primary auditory cortex (also includes Wernick's area)

Located posterior to the primary auditory cortex

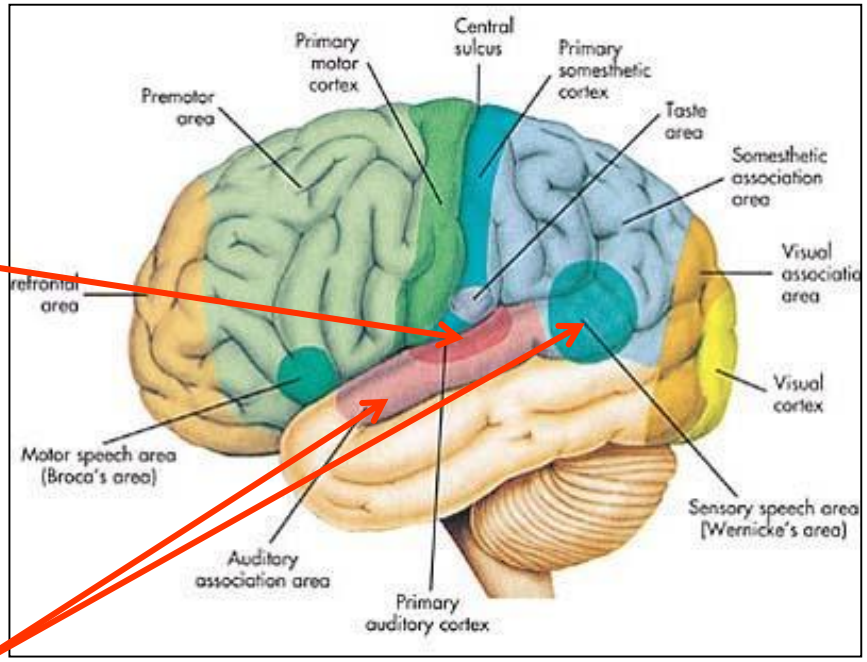
Stores memories of sounds and permits perception of sounds

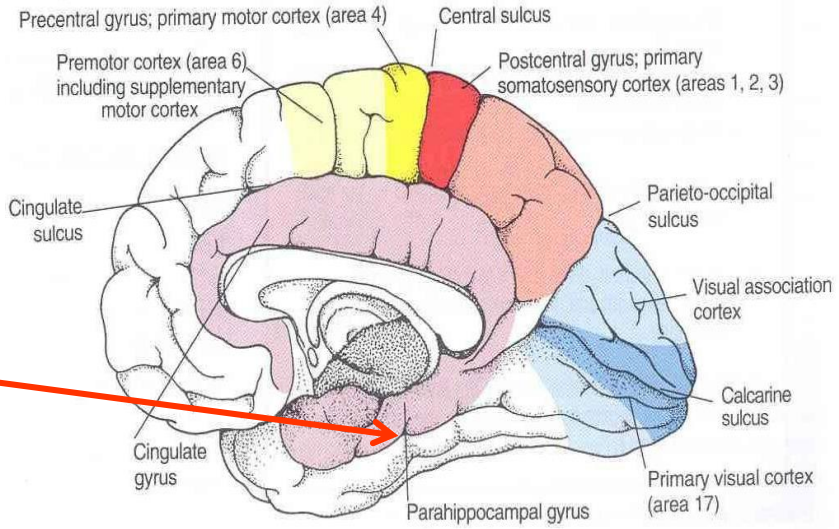
Involved in recognizing and understanding speech

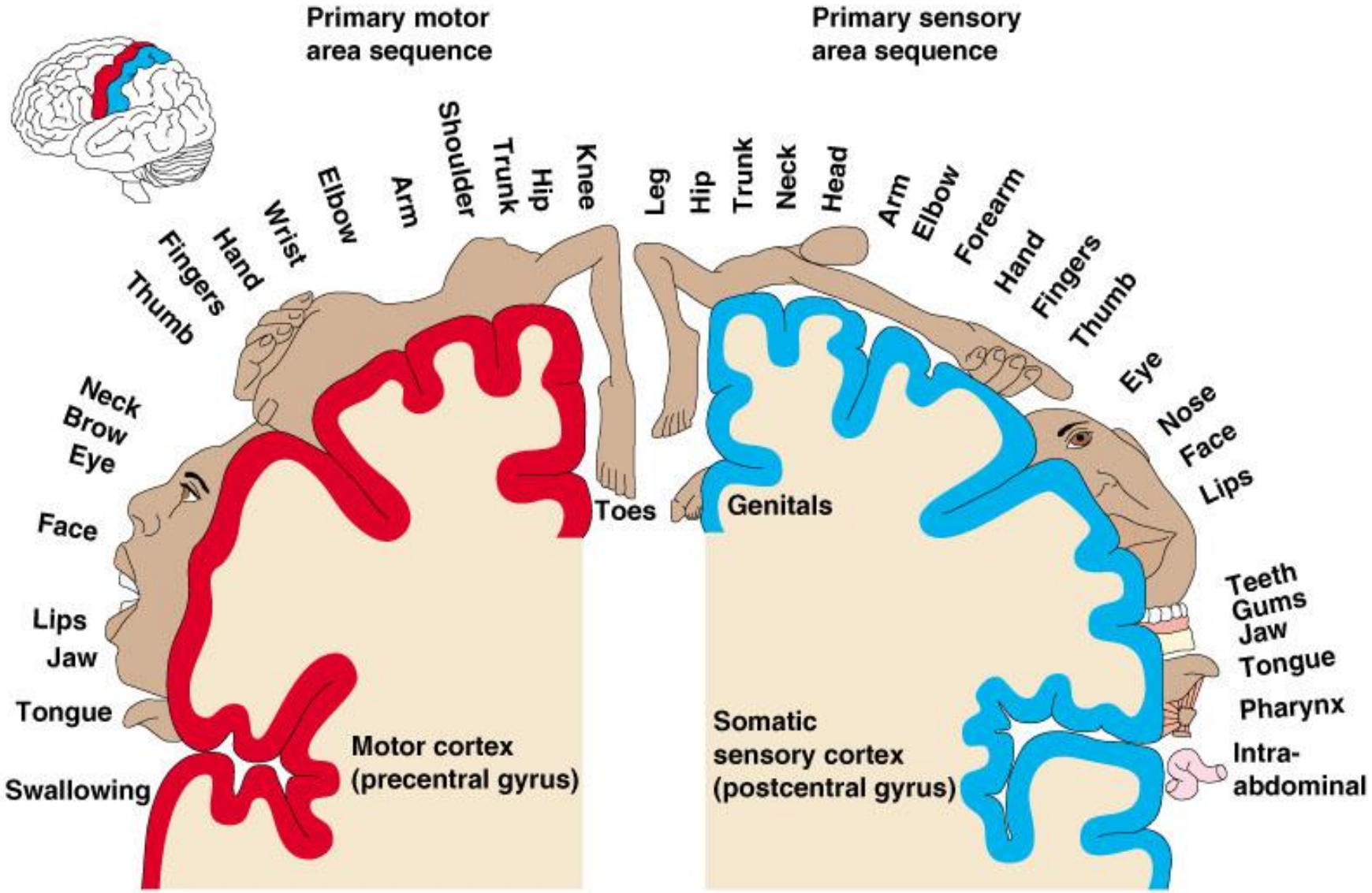
Lies in the center of Wernicke's area

<u>Parahippocampal gyrus:</u>

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

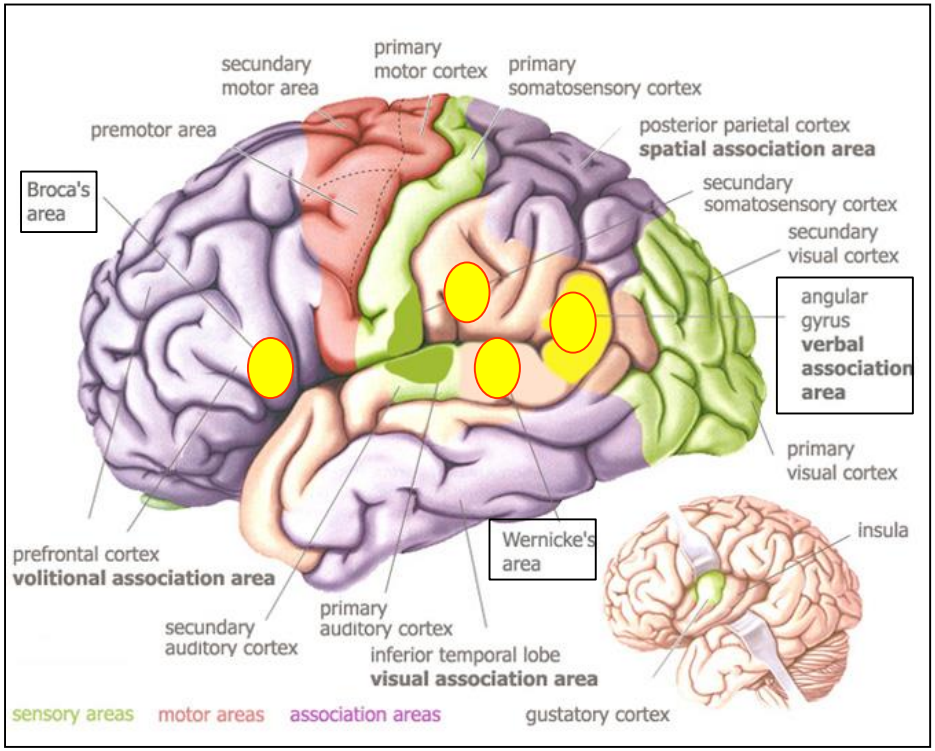






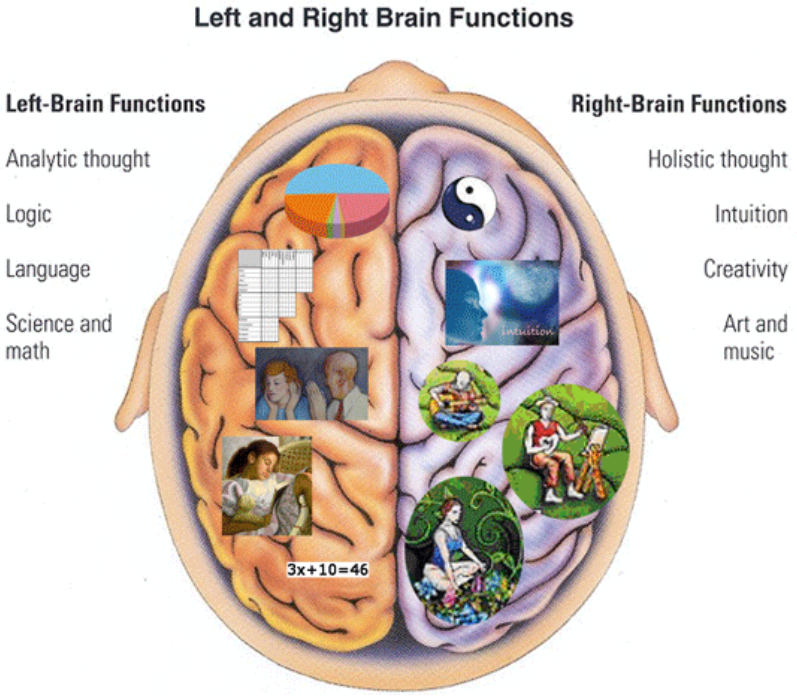
Language Area

- Organized around the lateral fissure.
- Broca's area: concerned with expressive aspects of language.
- Wernick's area: responsible for comprehension of the spoken words.
- Nearby regions of temporal lobe and parietal lobe (angular gyrus & supramarginal gyrus of the inferior parietal lobule) are important in naming, reading, writing, and calculation.



Hemispheric Dominance

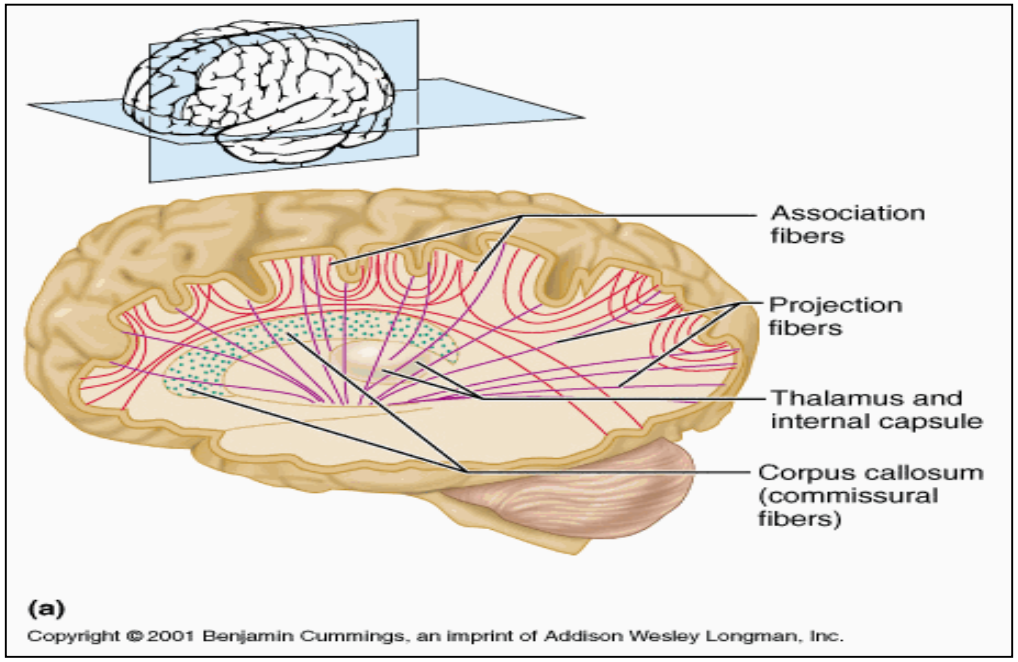
- The localization of **speech centers & mathematical ability** is the criterion for defining the dominant cerebral hemisphere.
- In 96% of normal **right-handed** individuals and 70% of normal **left-handed** individuals, the left hemisphere contains the language centers. These are left hemisphere dominant.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



Hemispheres communicate via the corpus callosum

White Matter

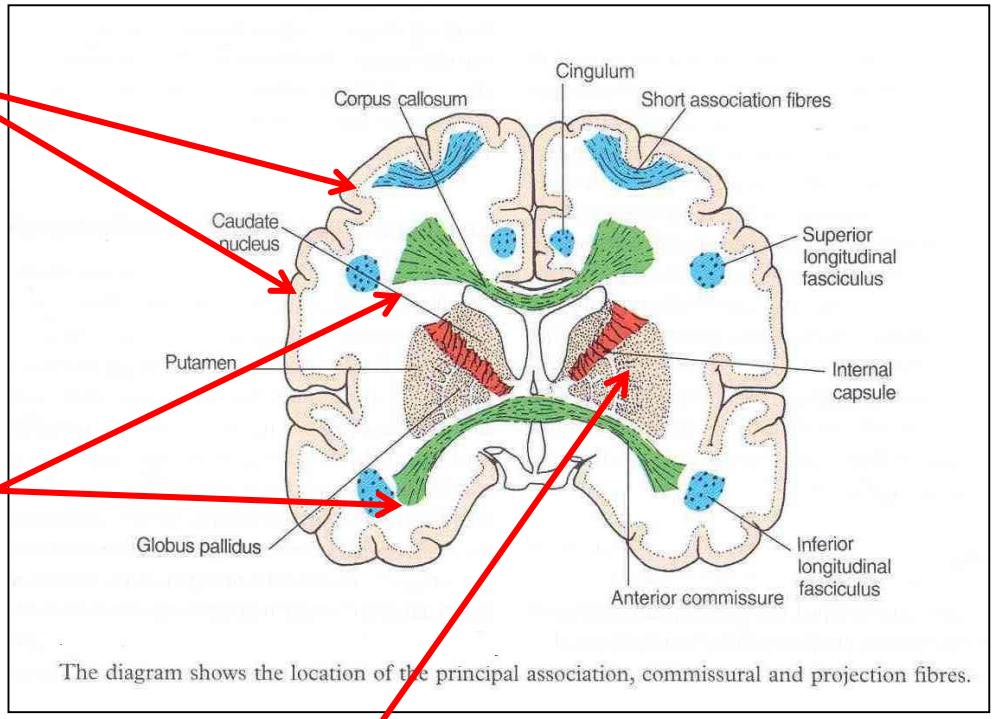
- Underlies the cortex
- Contains:
  - Nerve fibers.
  - Neuroglia cells.
  - Blood vessels.
- The nerve fibers originate, terminate or sometimes both, within the cortex.



Depending on their origin & termination, these nerve fibers are classified into three types:

Association fibers: Unite different parts of the same hemisphere

Commissural fibers: Connect the corresponding regions of the two hemispheres

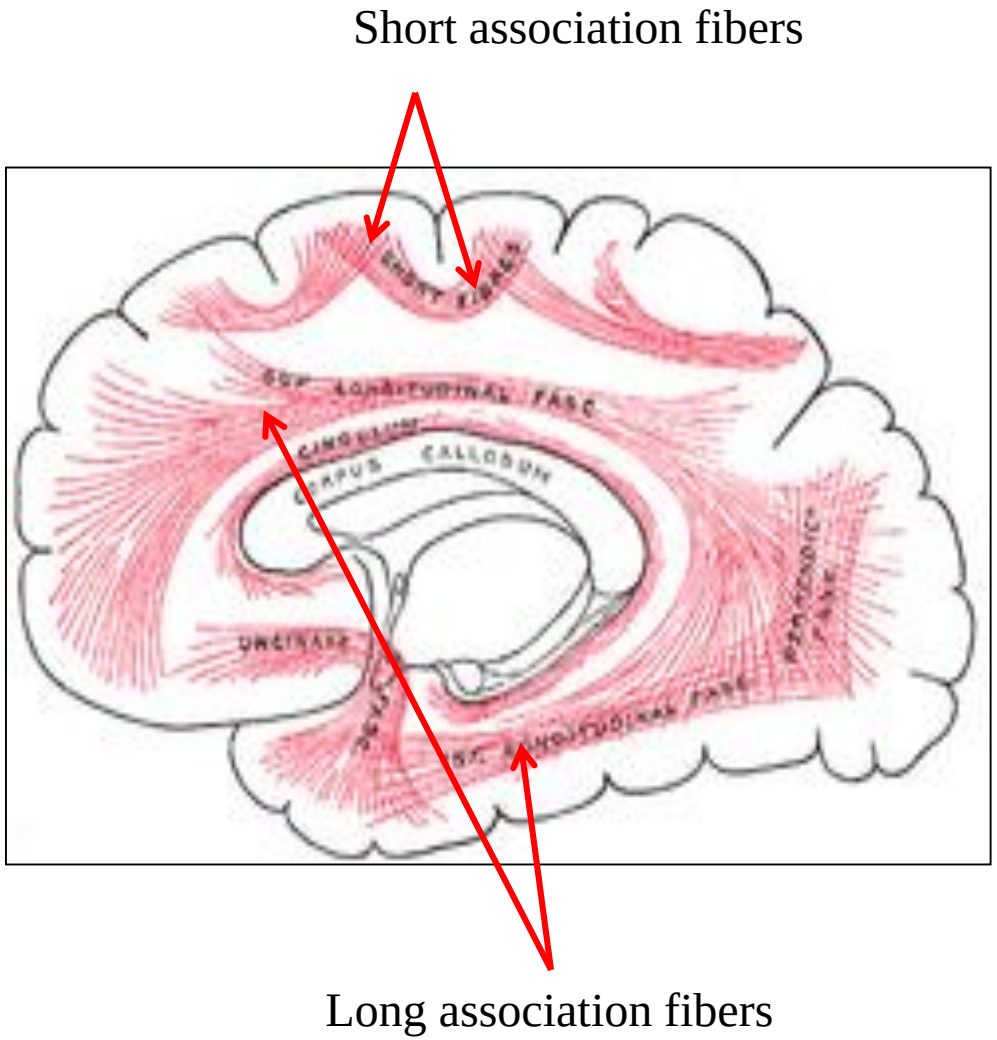


The diagram shows the location of the principal association, commissural and projection fibres.

Projection fibers: Consisting of
- Afferent fibers conveying impulses to the cerebral cortex.
- Efferent fibers conveying impulses away from the cortex.

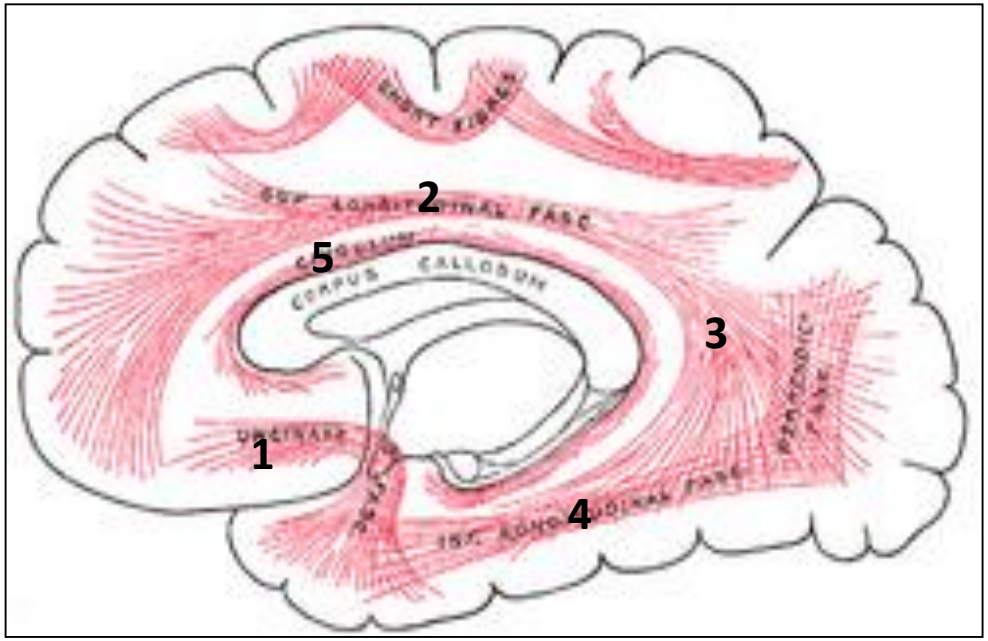
Association Fibers

- 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.



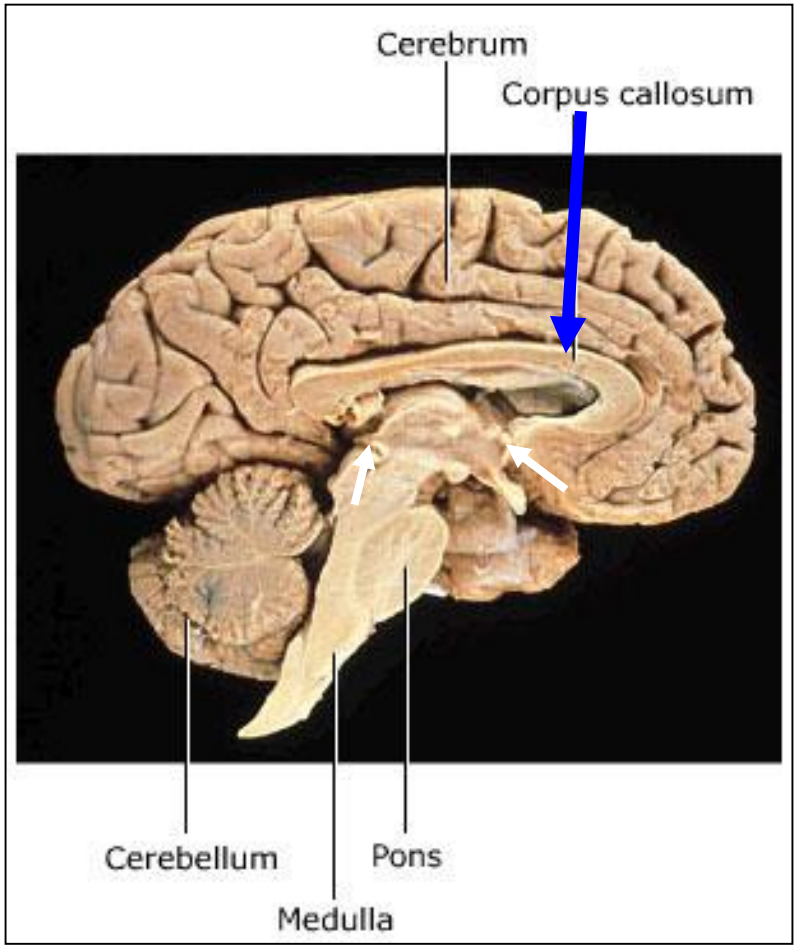
Long Association Fibers

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



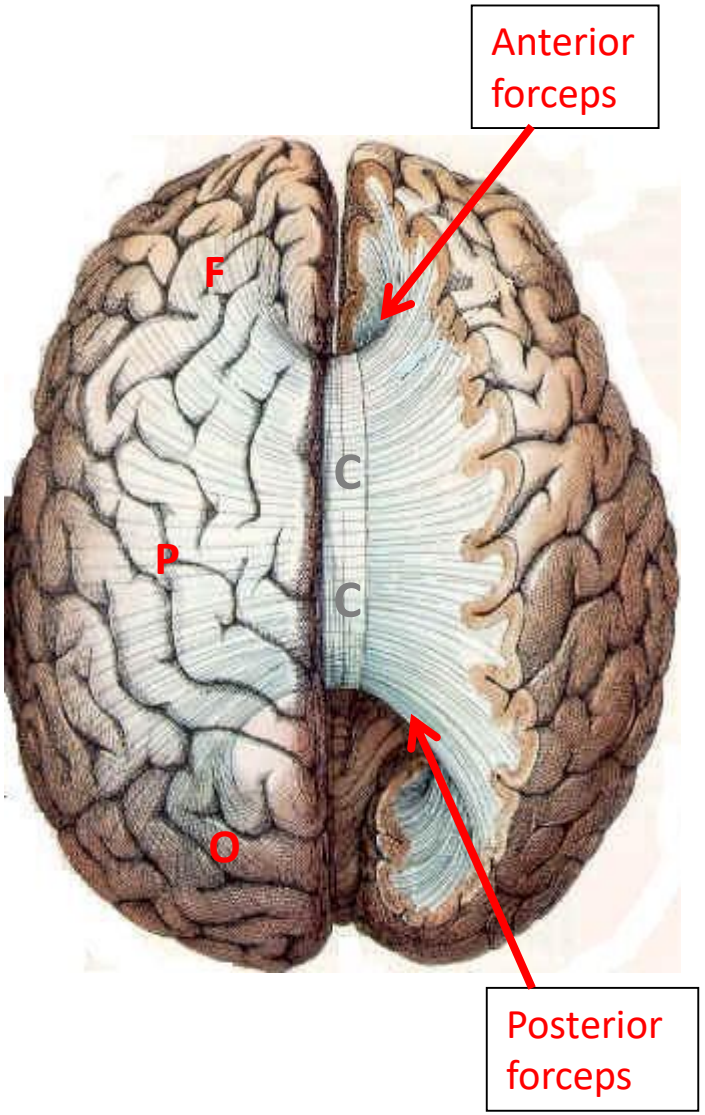
Commissural Fibers

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

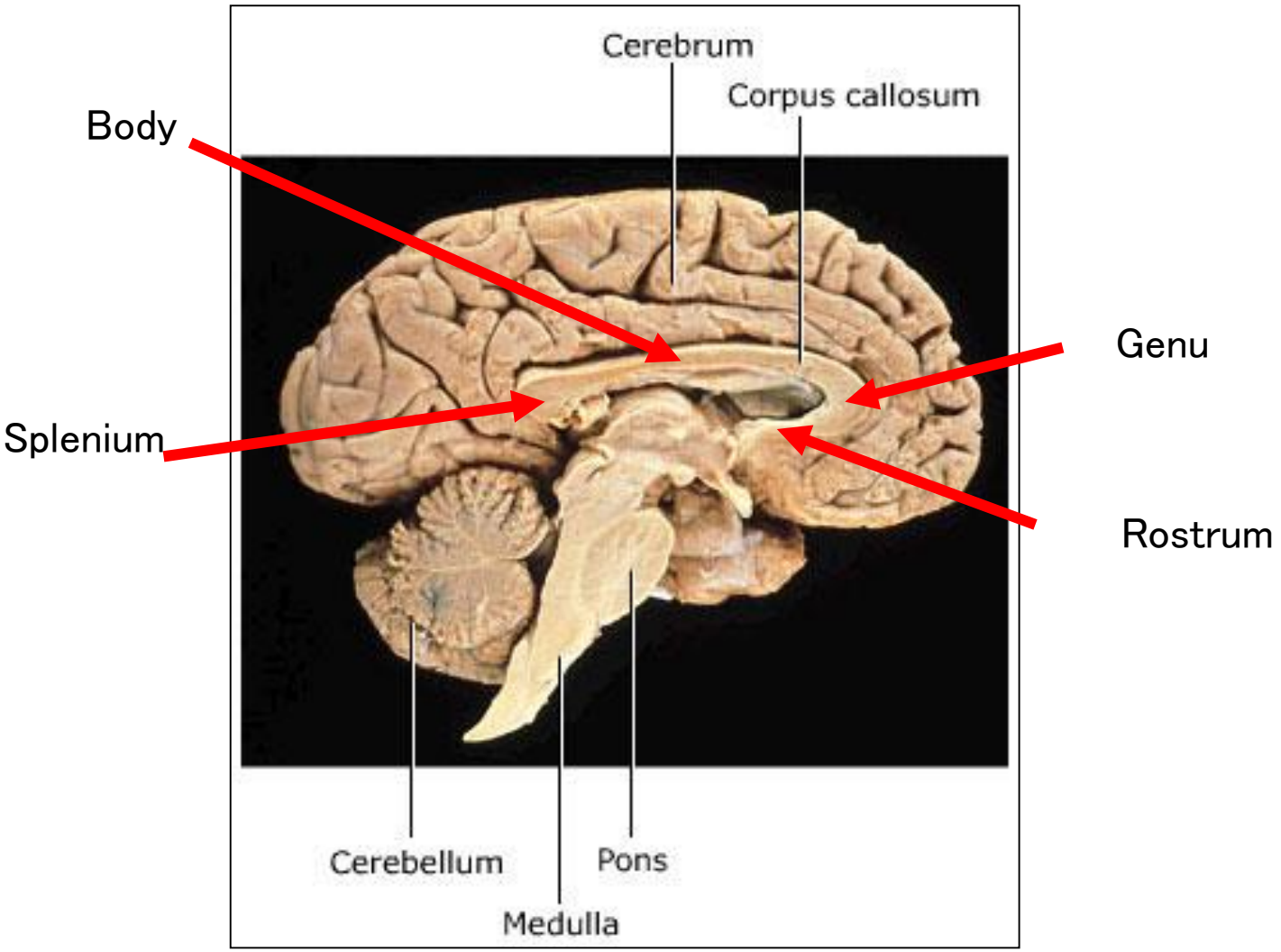


Corpus Callosum

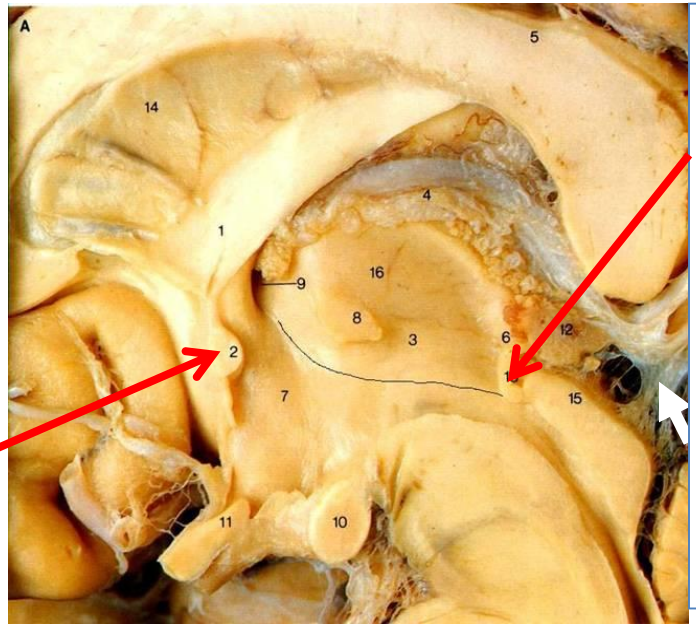
- Connects the corresponding regions of the two hemispheres except the temporal lobes, that are connected by anterior commissure.
- It is shorter craniocaudally than is the hemisphere.
- The callosal fibers linking the frontal poles, curve forward forming anterior forceps (forceps minor).
- The callosal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



Parts of Corpus Callosum

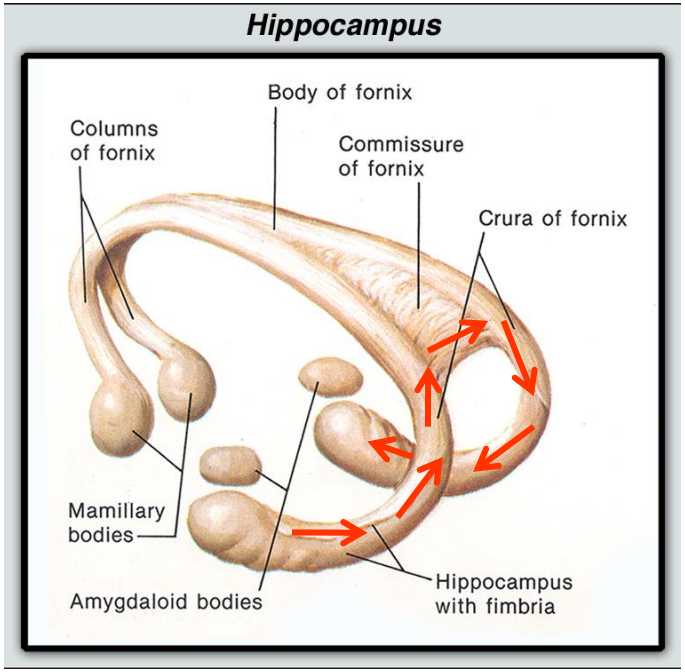


- **Anterior commissure**: connects the inferior and middle <u>temporal gyri & the olfactory regions</u> of the two hemispheres



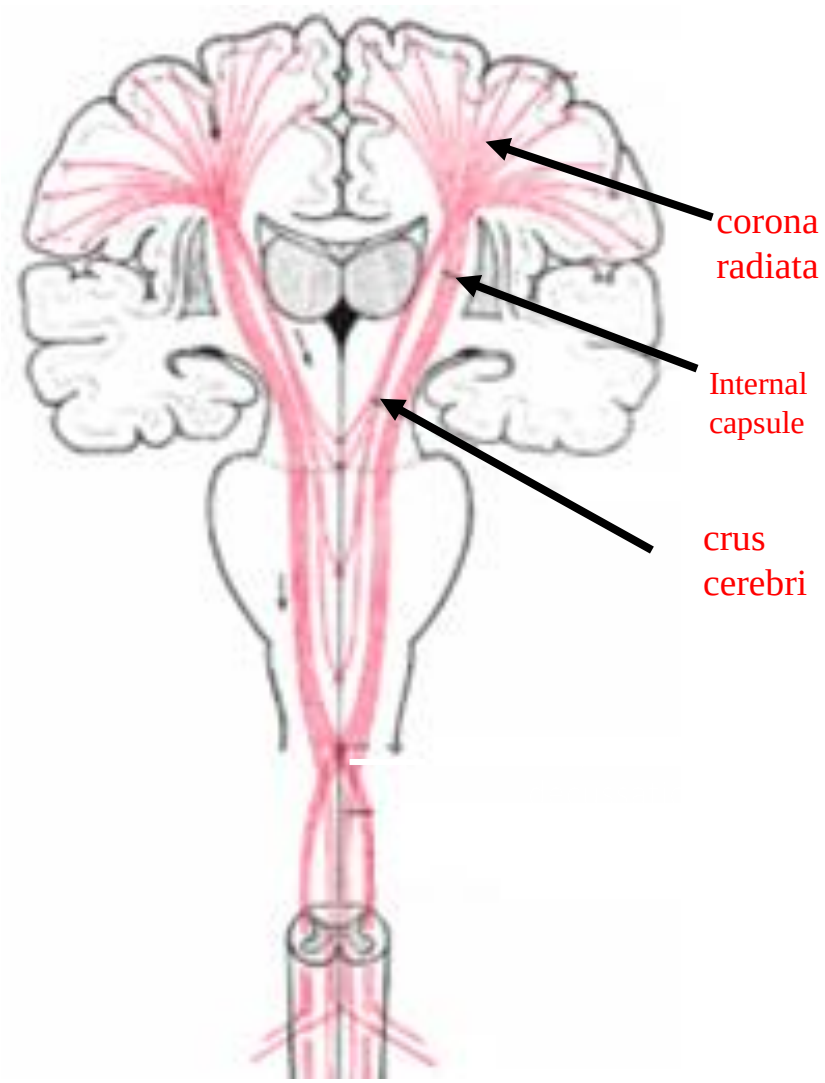
- **Posterior Commissure:** connects the <u>left and right midbrain</u> Important in the bilateral pupillary reflex

- **Hippocampal Commissure:** connect the two hippocampi with each other



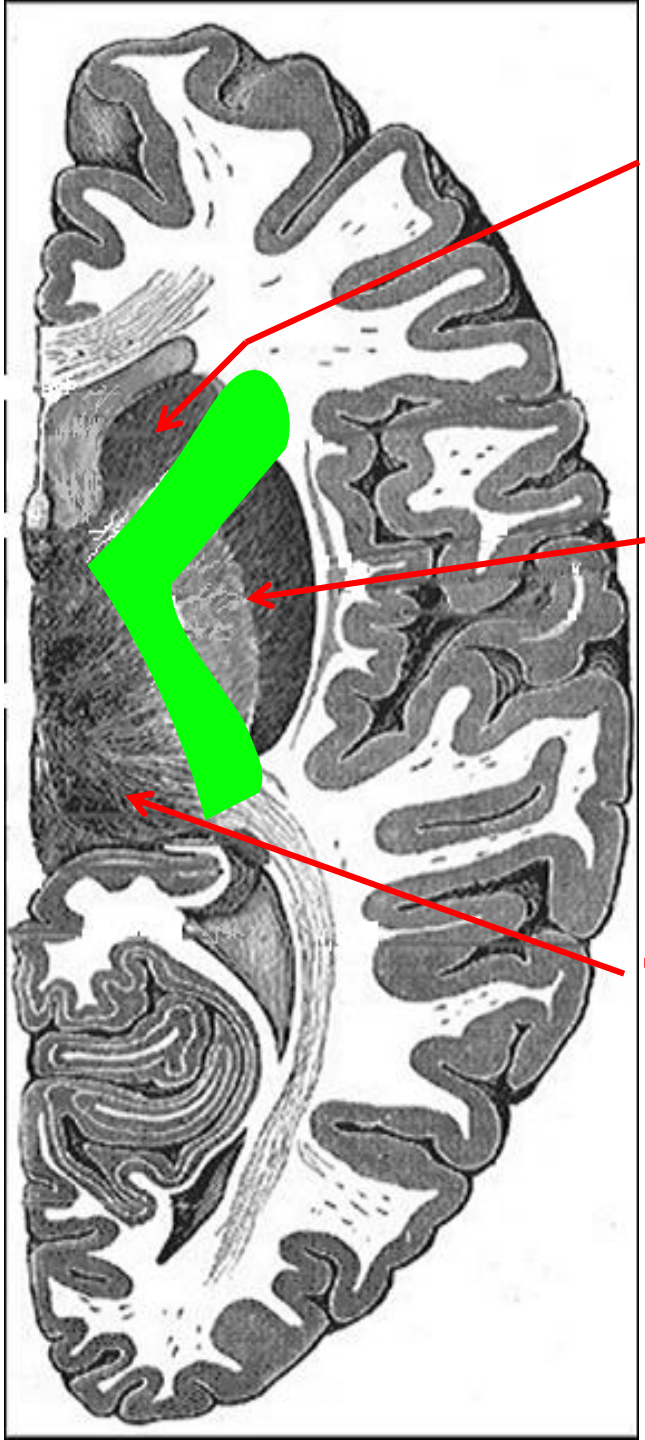
Projection Fibers

- 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.

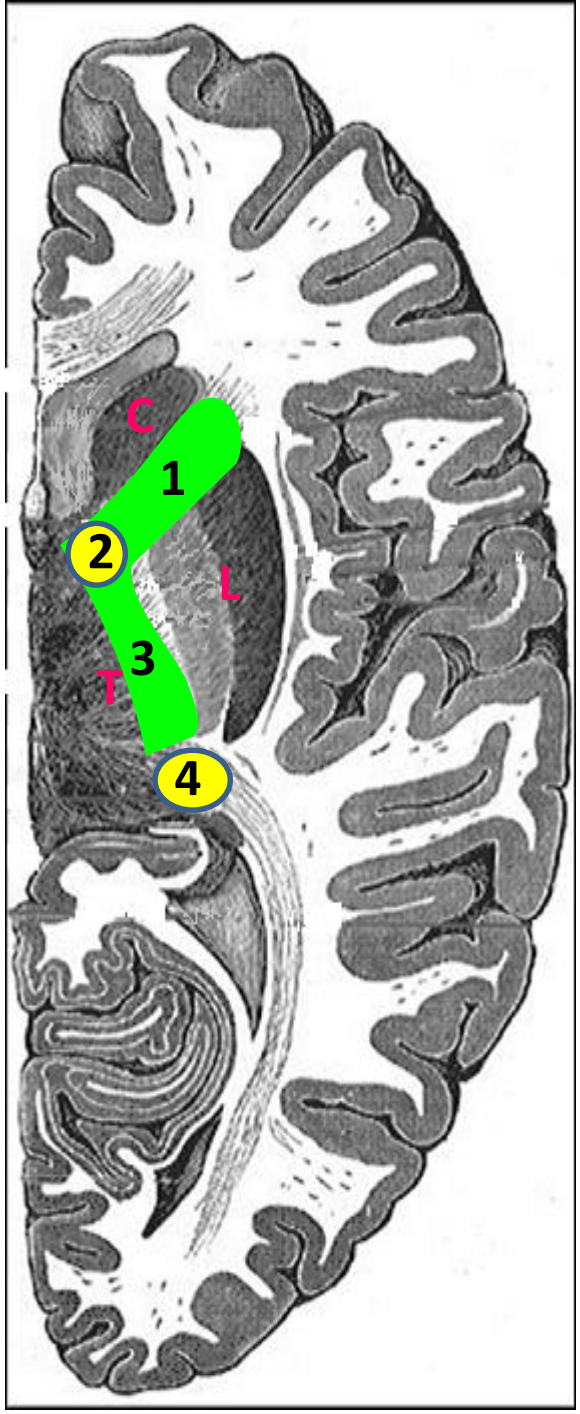


Internal Capsule

- Bundle of projection fibers, passes through the interval between the thalamus and the basal ganglia (caudate & 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.




Thank U & Good Luck