



神經解剖學
NEUROANATOMY

TELENCEPHALON

盧家鋒 助理教授

臺北醫學大學醫學系 解剖學暨細胞生物學科

臺北醫學大學醫學院 轉譯影像研究中心

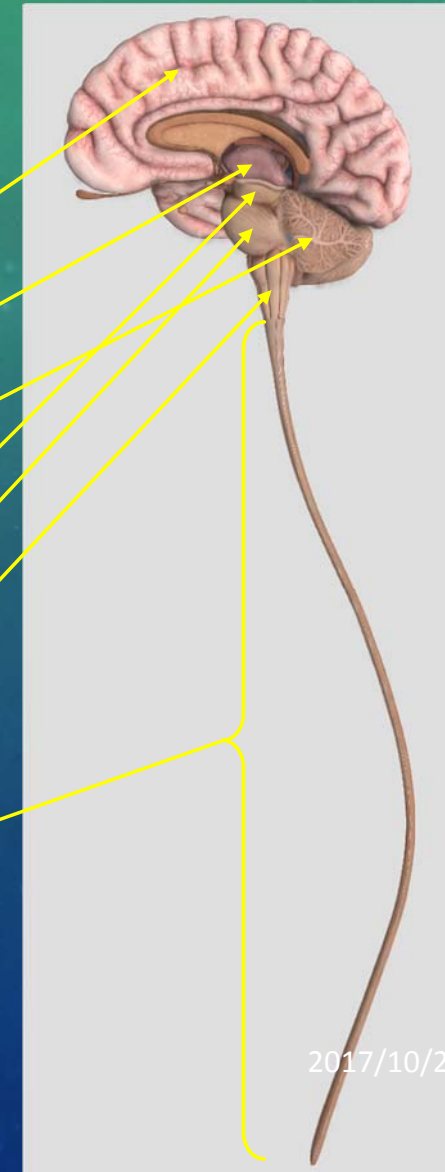
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REGIONAL NEUROBIOLOGY

- **Telencephalon (Cerebrum)**
- Diencephalon (Thalamus)
- Cerebellum
- Brain stem
 - Midbrain
 - Pons
 - Medulla oblongata
- Spinal cord

Week 2 to 8

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Central Nervous System



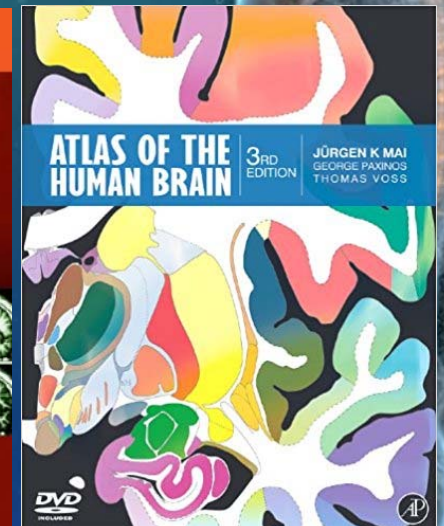
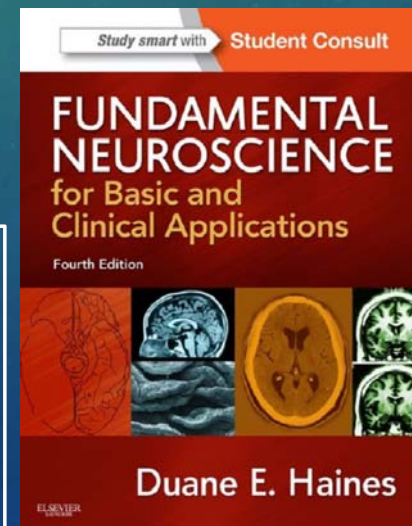
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2

OUTLINE

- Overview: Gross Anatomy
- Lobes of the Cerebral Cortex
- White Matter of the Cerebral Hemisphere
- Basal Nuclei

- Fundamental Neuroscience (4th edition)
 - Chapter 16: The Telencephalon
- Atlas of the Human Brain (3rd edition)



OVERVIEW: GROSS ANATOMY

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4

TELENCEPHALON 端腦

The largest part of human brain (~ 85% of total brain weight)

- Cerebral Cortex
 - Gyri
 - Sulci
 - Lobes
- Subcortical White Matter (Myelinated fibers)
 - Association fibers
 - Commissural fibers
 - Projection fibers (Internal capsule)
 - Corticofugal fibers
 - Corticopetal fibers
- Basal nuclei
- Hippocampus & Amygdala



TELENCEPHALON (CEREBRUM)

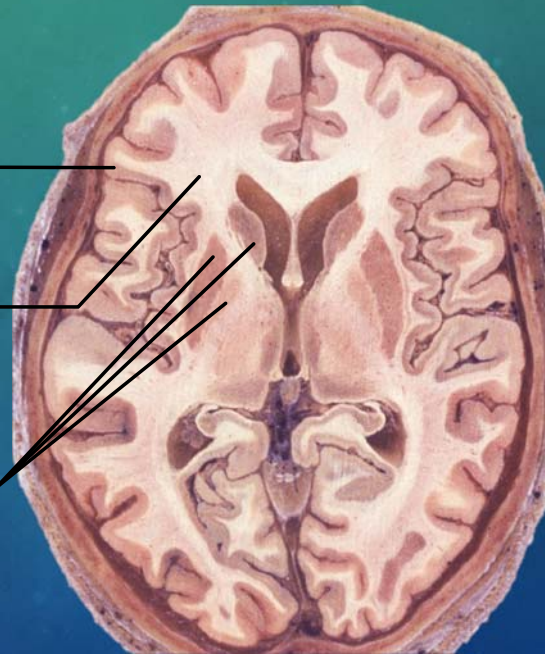
Superficial

- Cerebral Cortex

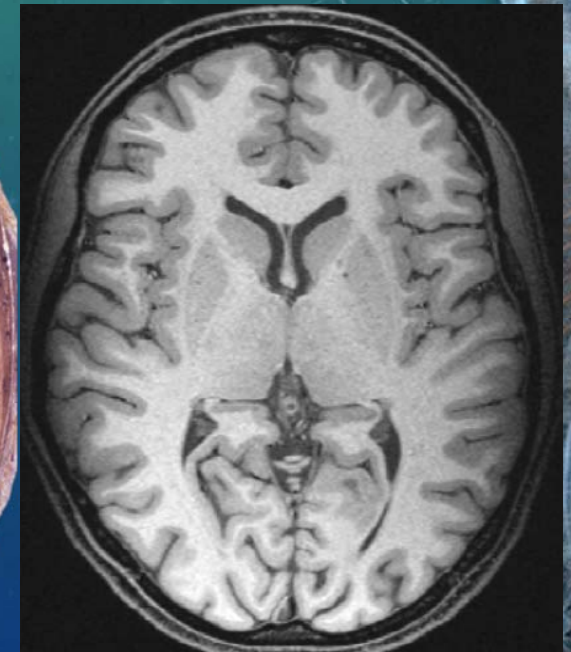
- Subcortical White Matter
(Myelinated fibers)

Deep

- Basal nuclei



MRI T1-weighted image

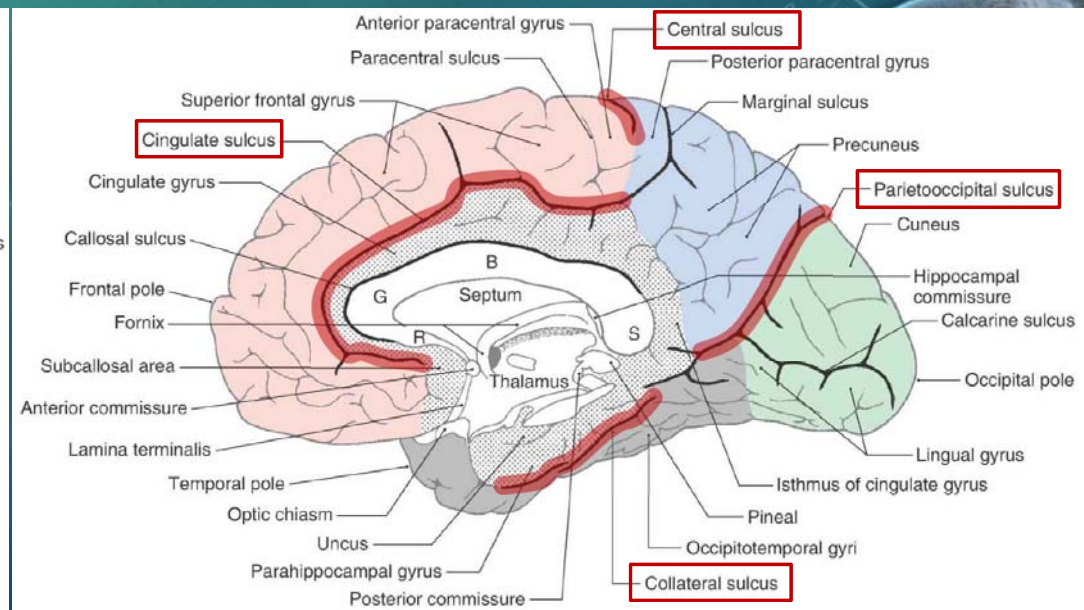
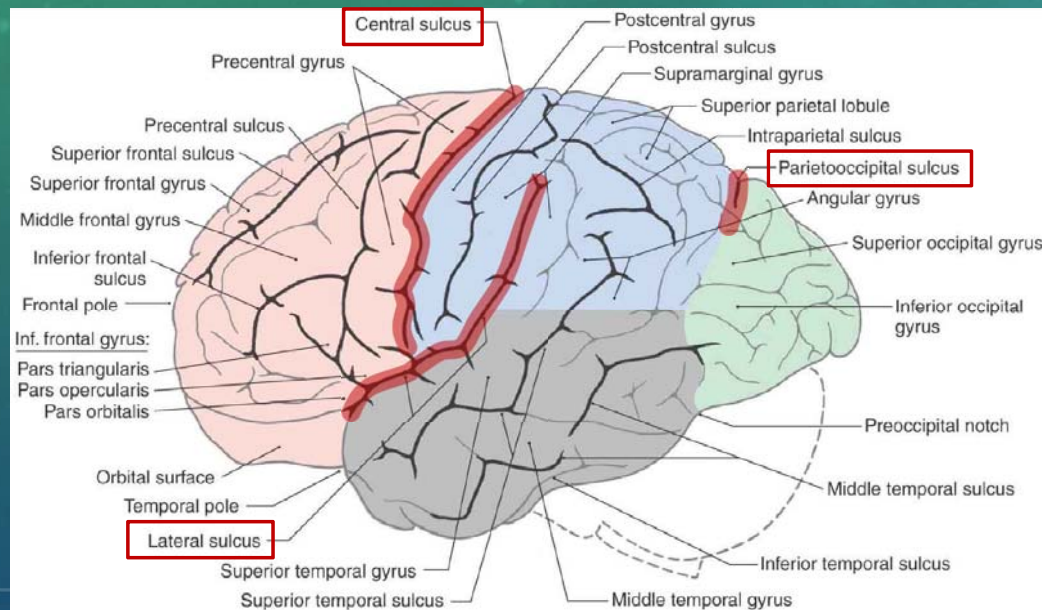


SULCI & LOBES OF CEREBRUM

- Cerebral Cortex
 - Gyrus
 - Sulcus
- Lobes

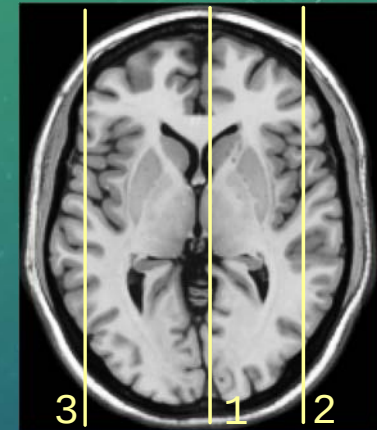
Frontal lobe	
Parietal lobe	
Occipital lobe	
Temporal lobe	
Limbic lobe	

(Limbic system will be introduced in next lesson.)

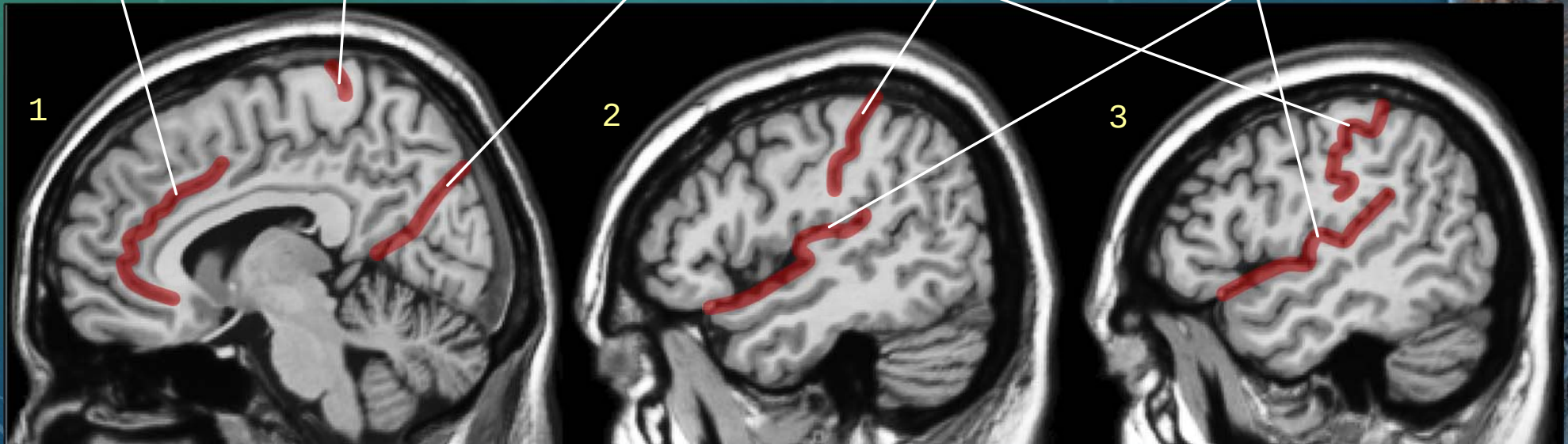


SULCI & LOBES OF CEREBRUM

- Cerebral Cortex
 - Gyrus
 - Sulcus
- Lobes



Cingulate sulcus Central sulcus Parietooccipital sulcus Central sulcus Lateral (sylvian) sulcus



NEURAL DEVELOPMENT: NEURULATION

Chapter 5. Development of the Nervous System

2-MINUTE NEUROSCIENCE

EARLY NEURAL DEVELOPMENT

<https://youtu.be/Tp25wrm-AoA>

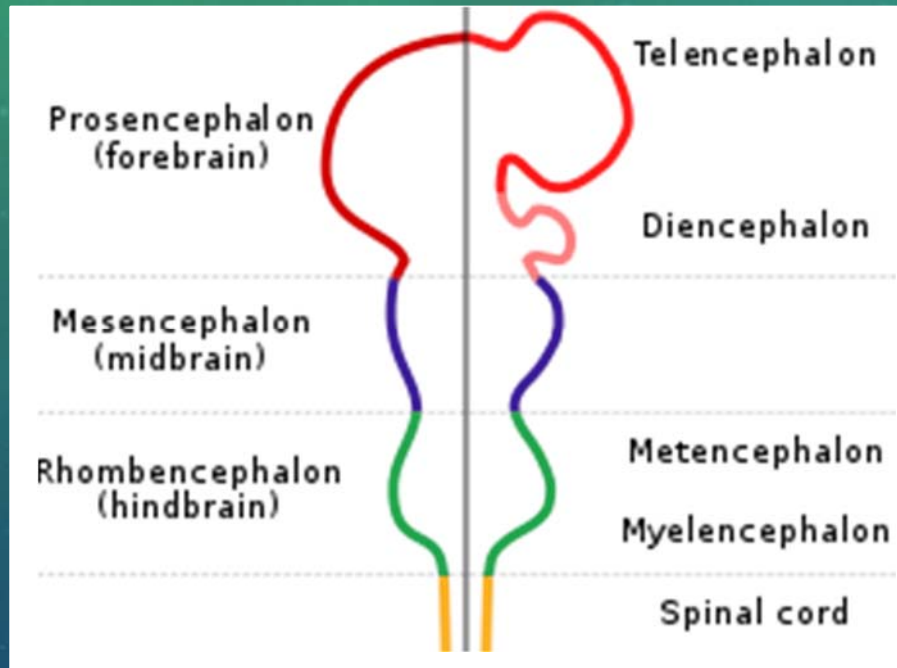


In the first four weeks after conception, neural tissue,

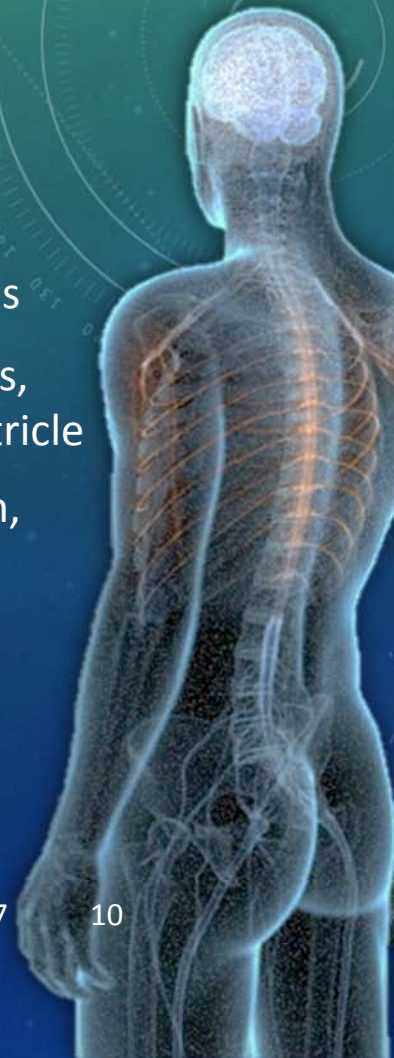
https://youtu.be/wAiecj_uEnI

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NEURAL DEVELOPMENT: NEURULATION

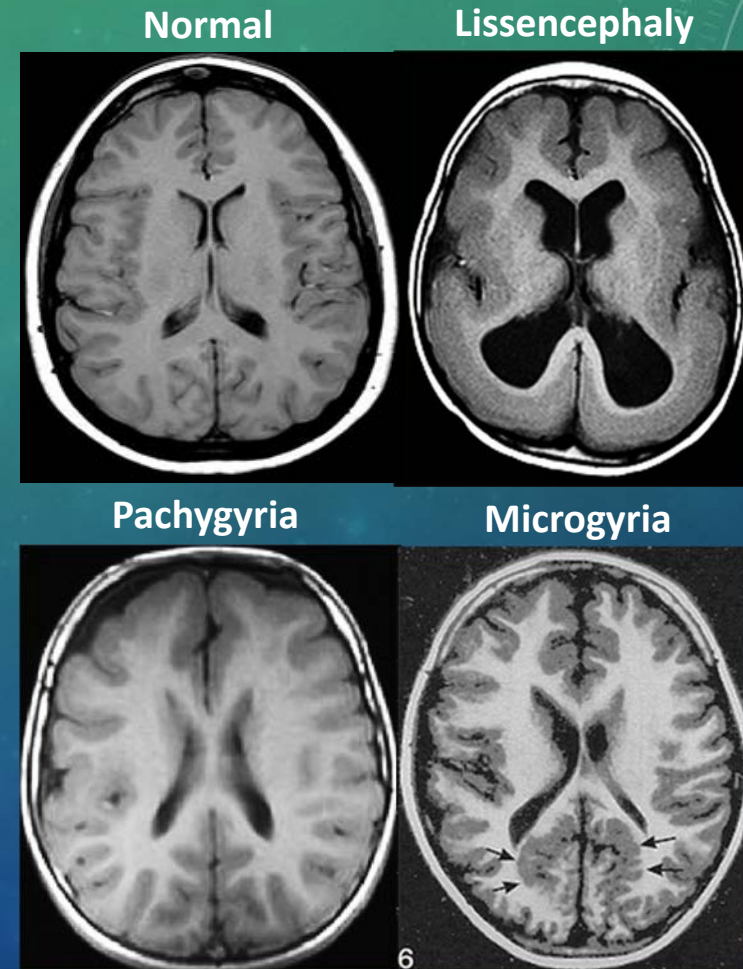


- Cerebral cortex, basal nuclei, hippocampus, amygdala, lateral ventricles
- Epithalamus, Thalamus, Hypothalamus, Subthalamus, Pituitary, Pineal, Third ventricle
- Tectum, Cerebral peduncle, Pretectum, Cerebral aqueduct
- Pons, Cerebellum
- Medulla Oblongata



DEVELOPMENTAL DEFECTS

- Improper migration of maturing neurons on radial glia (as a scaffolding)
 - **Lissencephaly**: a lack of gyri and sulci, a smooth brain
 - **Pachygyria**: abnormally large gyri that are few in number
 - **Microgyria**: abnormally small gyri that are greater in number

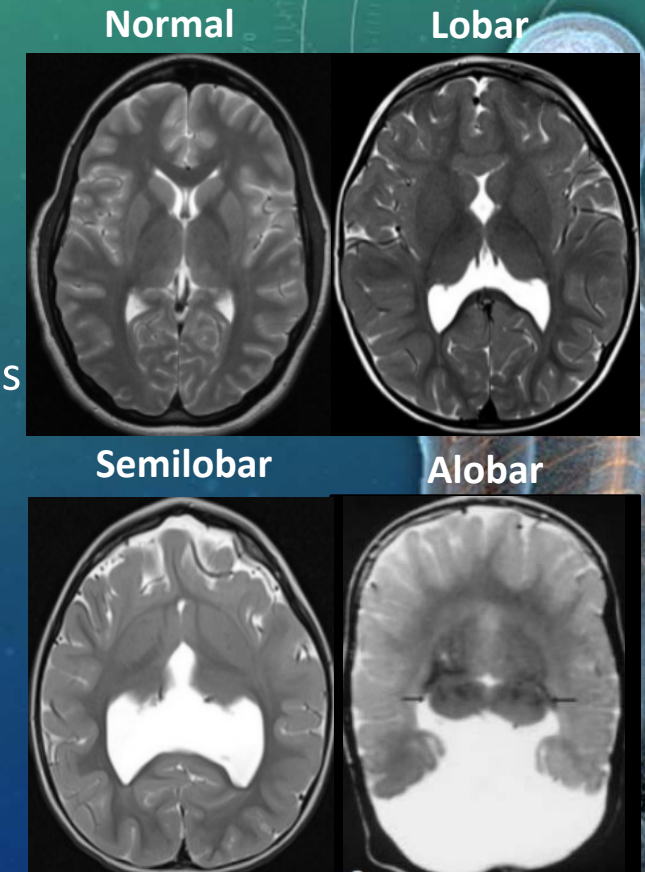
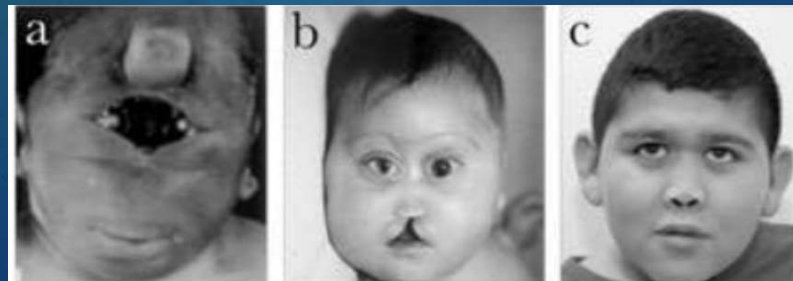


DEVELOPMENTAL DEFECTS

- **Holoprosencephaly**, a preneurulation defect

- Degree of severity ↑
- **Alobar holoprosencephaly**: consists of a midline ventricle, no hemispheres or corpus callosum, and severe retardation.
 - **Semilobar holoprosencephaly**: a partial formation of lobes with the ventricles formed; the frontal lobes may be fused.
 - **Lobar holoprosencephaly**: largely completed longitudinal fissure and hemispheres; a fusion of the hemispheres at frontal pole or at the orbital surface of frontal lobe.

Formation of the eyes is linked to structural brain defects.

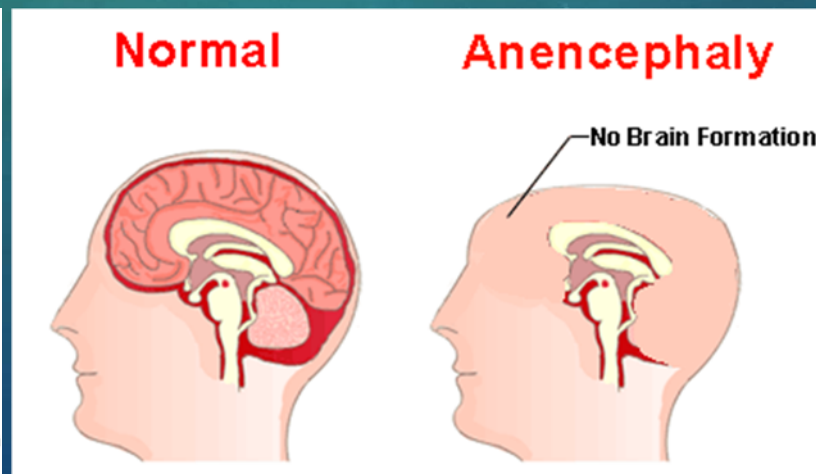
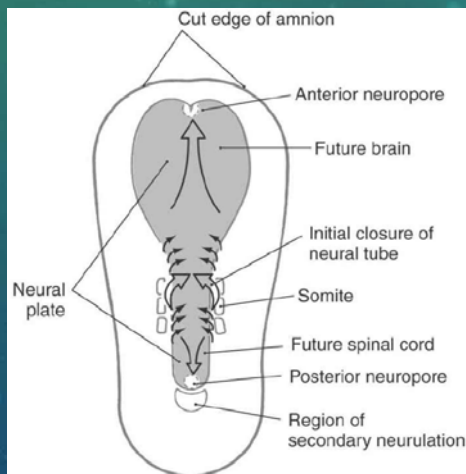


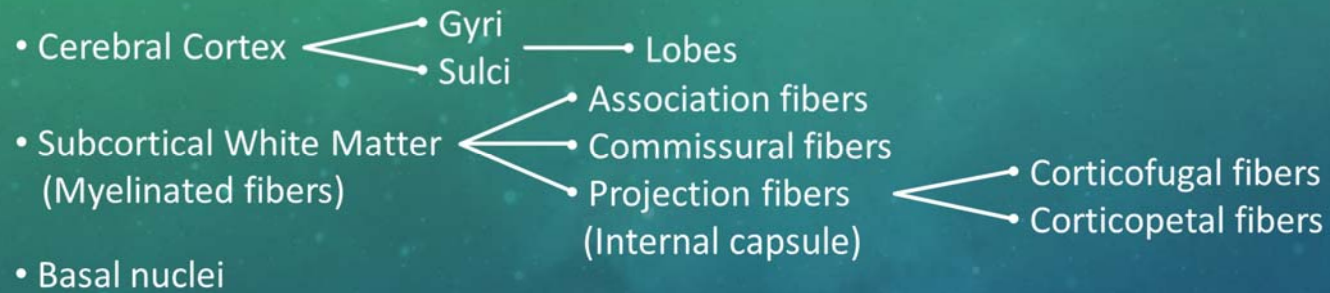
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12

DEVELOPMENTAL DEFECTS

- **Anencephaly**, a severe developmental failure in which the telencephalon and the surrounding skull/scalp are largely absent.
 - A failure of the anterior neuropore to close.

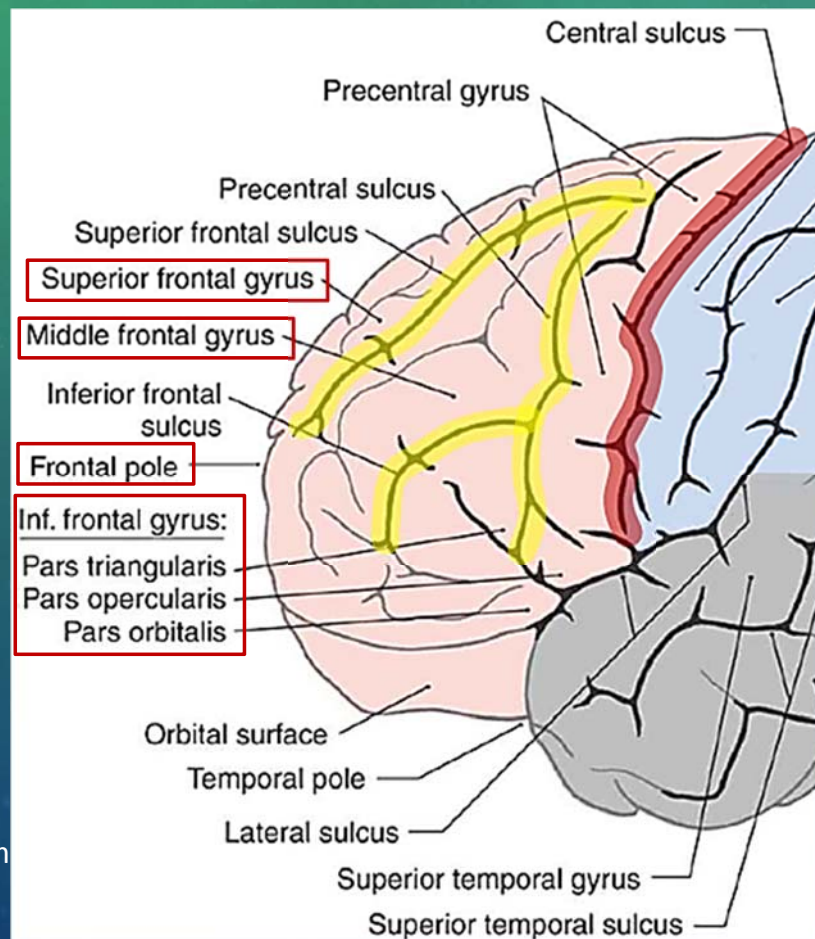




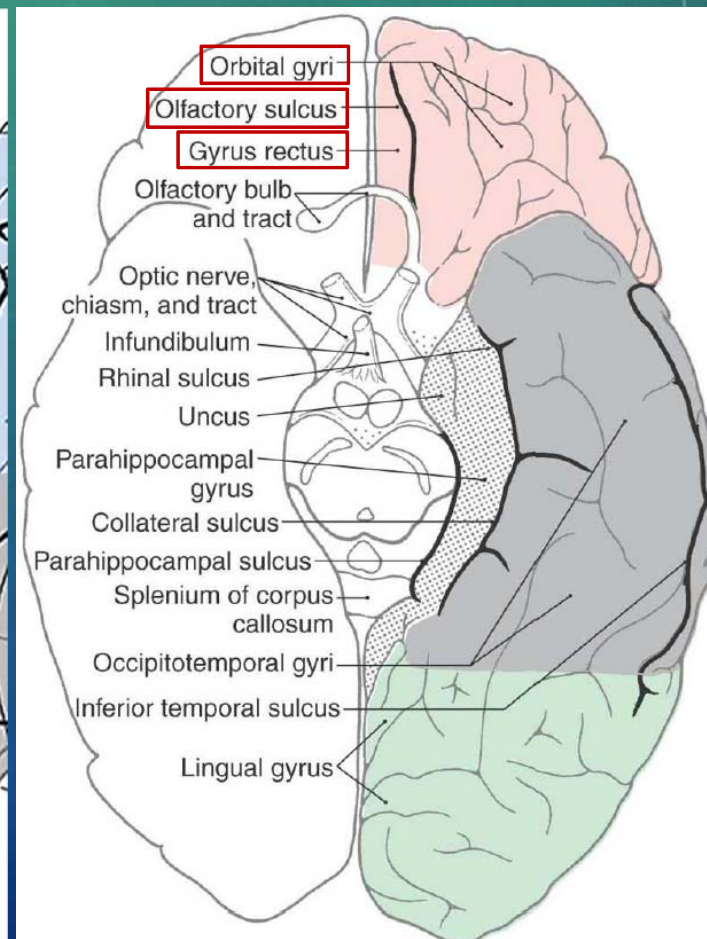
LOBES OF THE CEREBRAL CORTEX

FRONTAL, PARIETAL, TEMPORAL, OCCIPITAL, INSULAR, AND LIMBIC LOBES

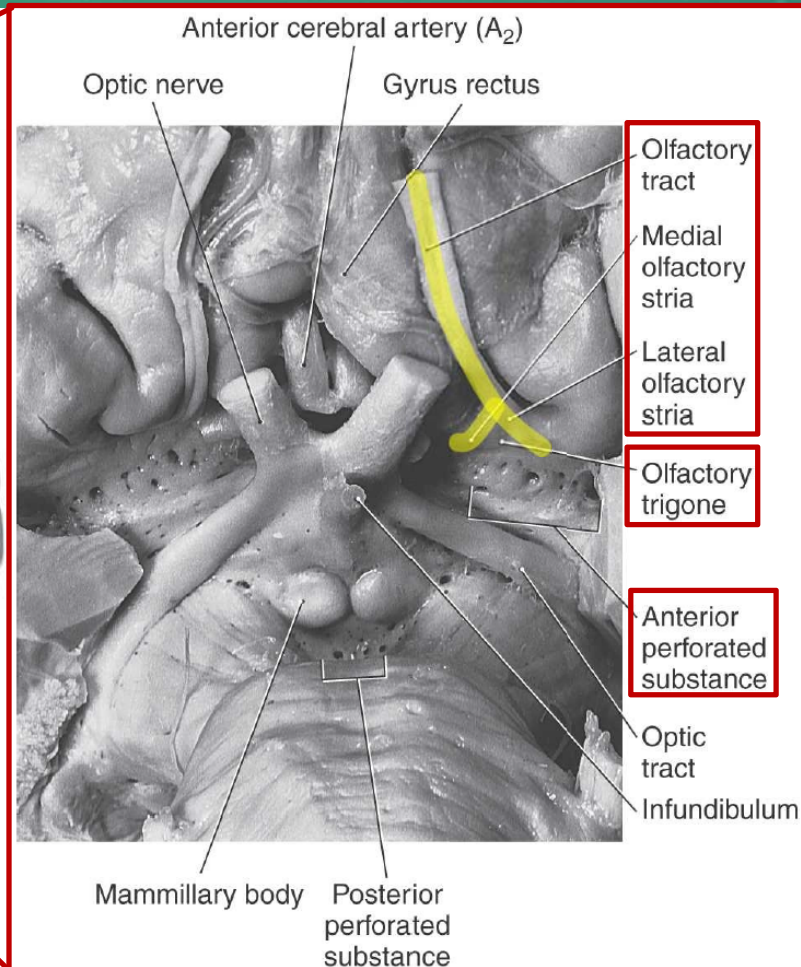
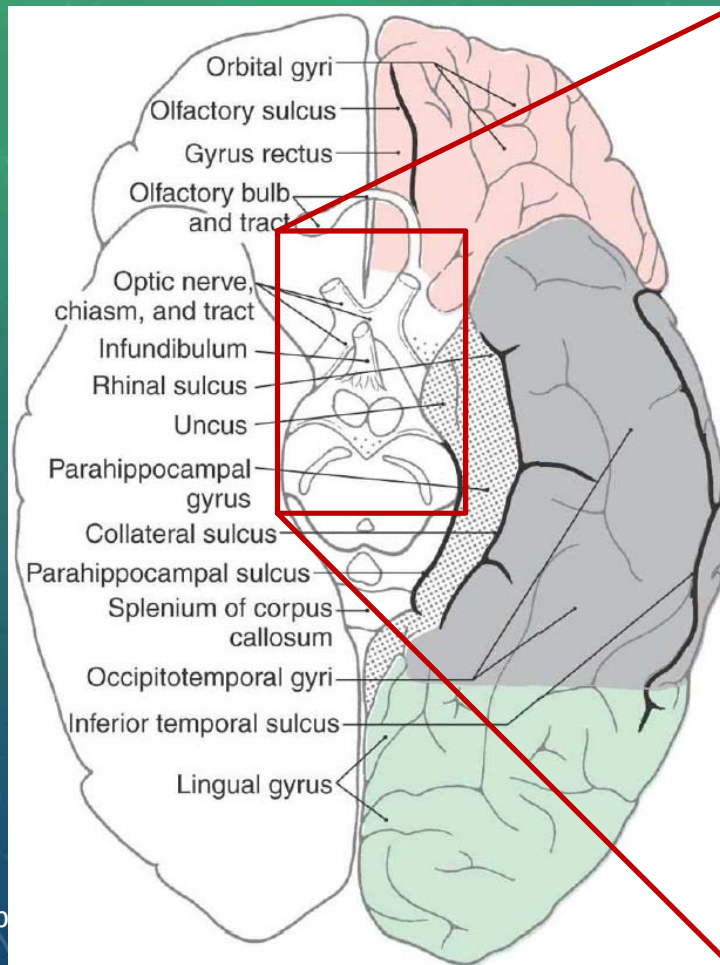
FRONTAL LOBE



Frontal pole



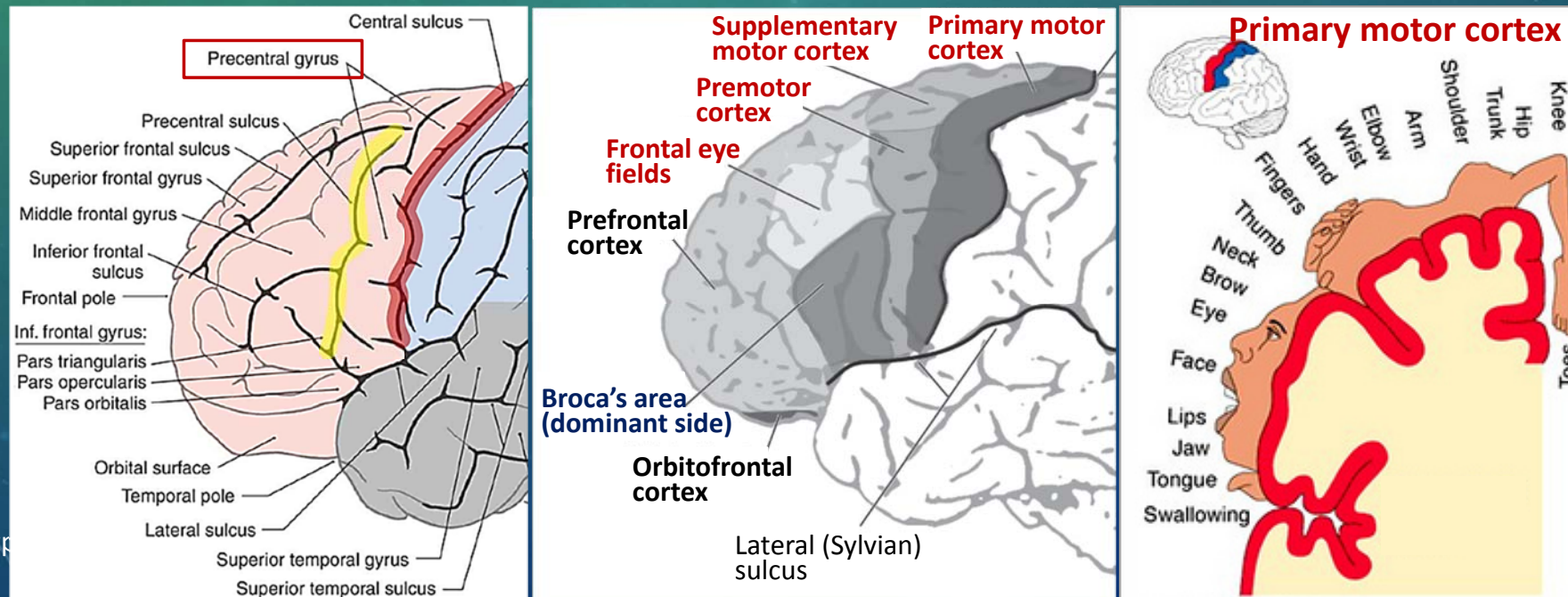
FRONTAL LOBE



The surface of the hemisphere is characterized by numerous small holes formed by vessels (lenticulostriate arteries) as they enter the brain

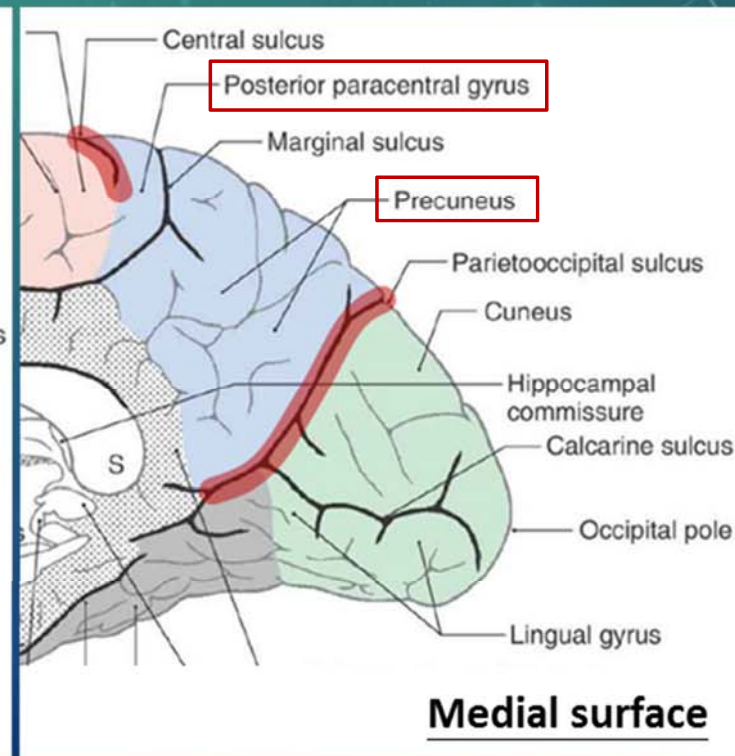
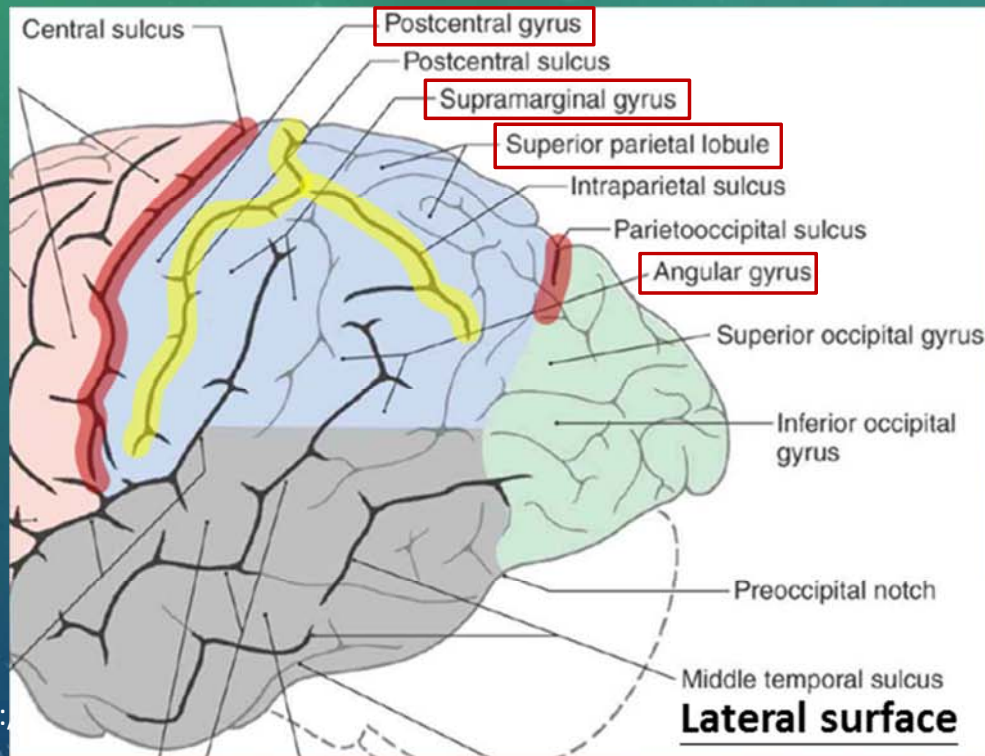
FRONTAL LOBE - MOTOR CORTEX (LABELED IN RED)

- Involvement of the **planning, control (preparation), and execution** of voluntary movements.
- Lesions of these areas: **weakness or paralysis** of the corresponding part of the body **on the contralateral side**.



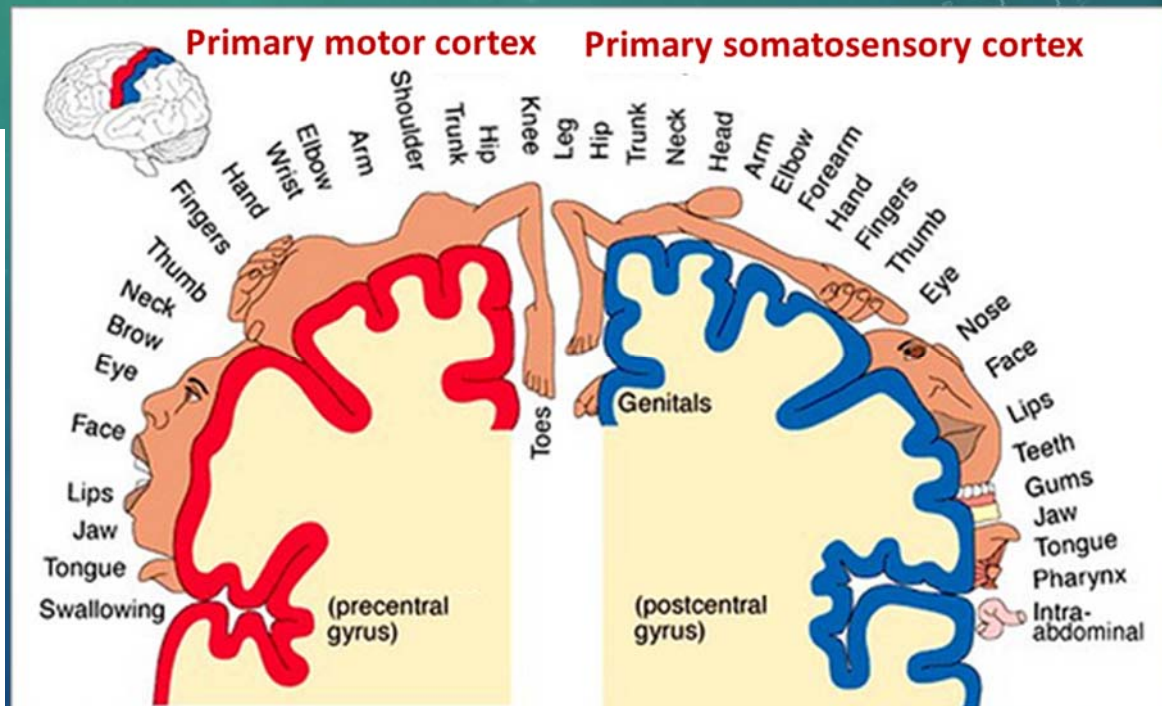
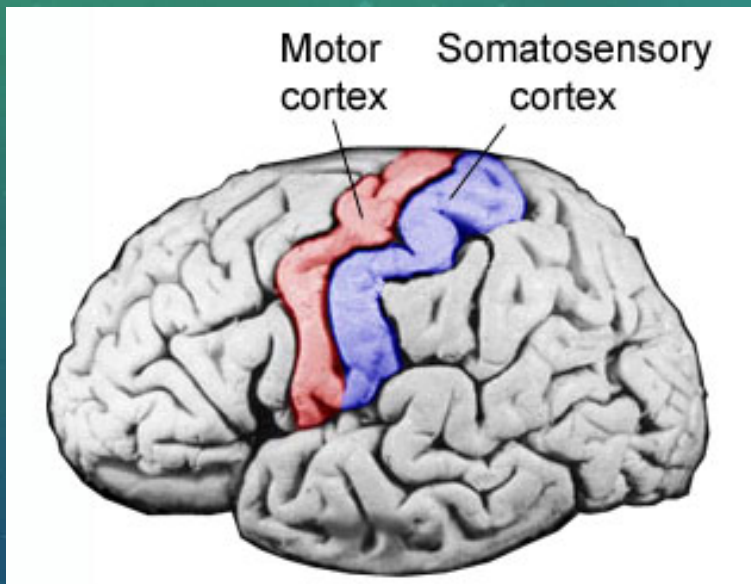
PARIETAL LOBE

- Postcentral gyrus & Posterior paracentral gyrus
- Superior parietal lobule & Precuneus
- Inferior parietal lobule
 - Supramarginal gyrus
 - Angular gyrus



PARIETAL LOBE – PRIMARY SOMATOSENSORY CORTEX

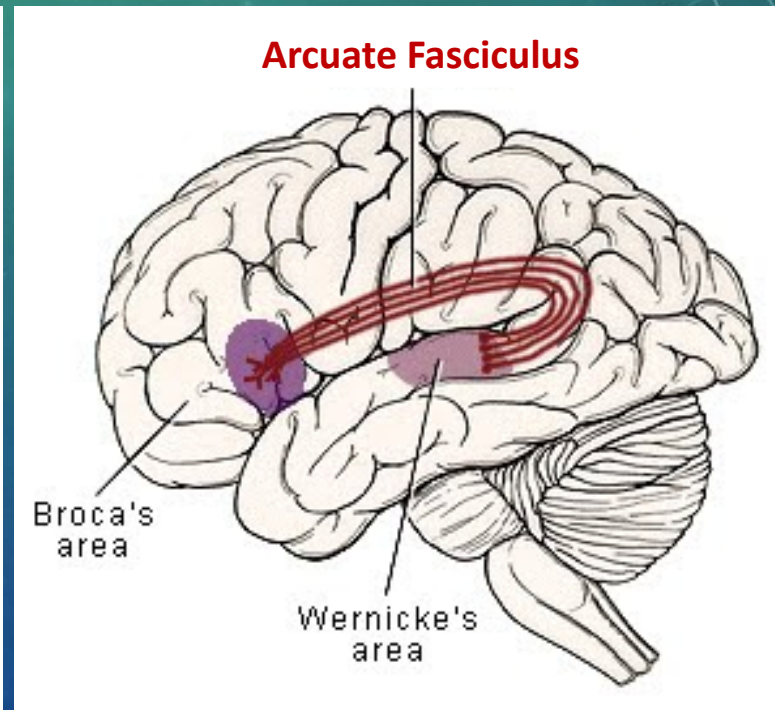
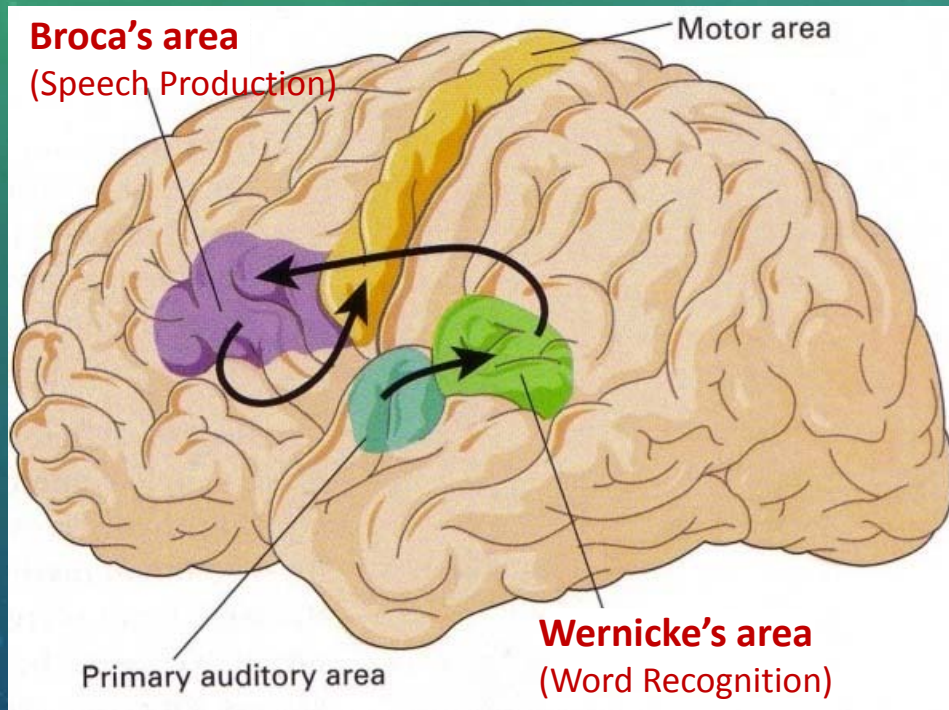
Postcentral gyrus + posterior paracentral gyrus



PARIETAL LOBE – WERNICKE'S AREA

Circuits of language communication

- Supramarginal gyrus
- Angular gyrus



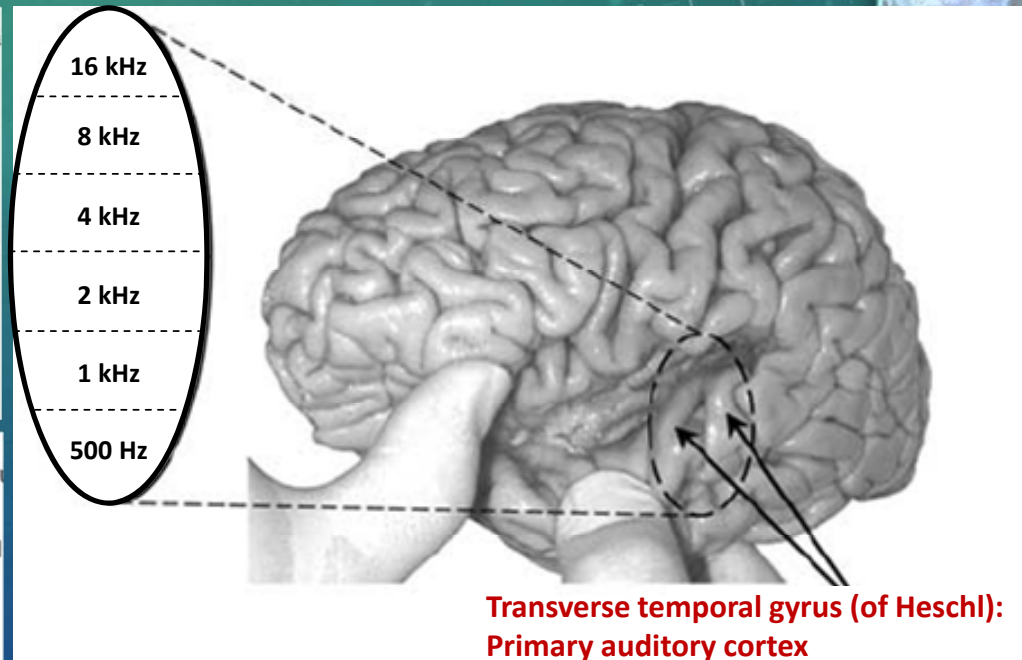
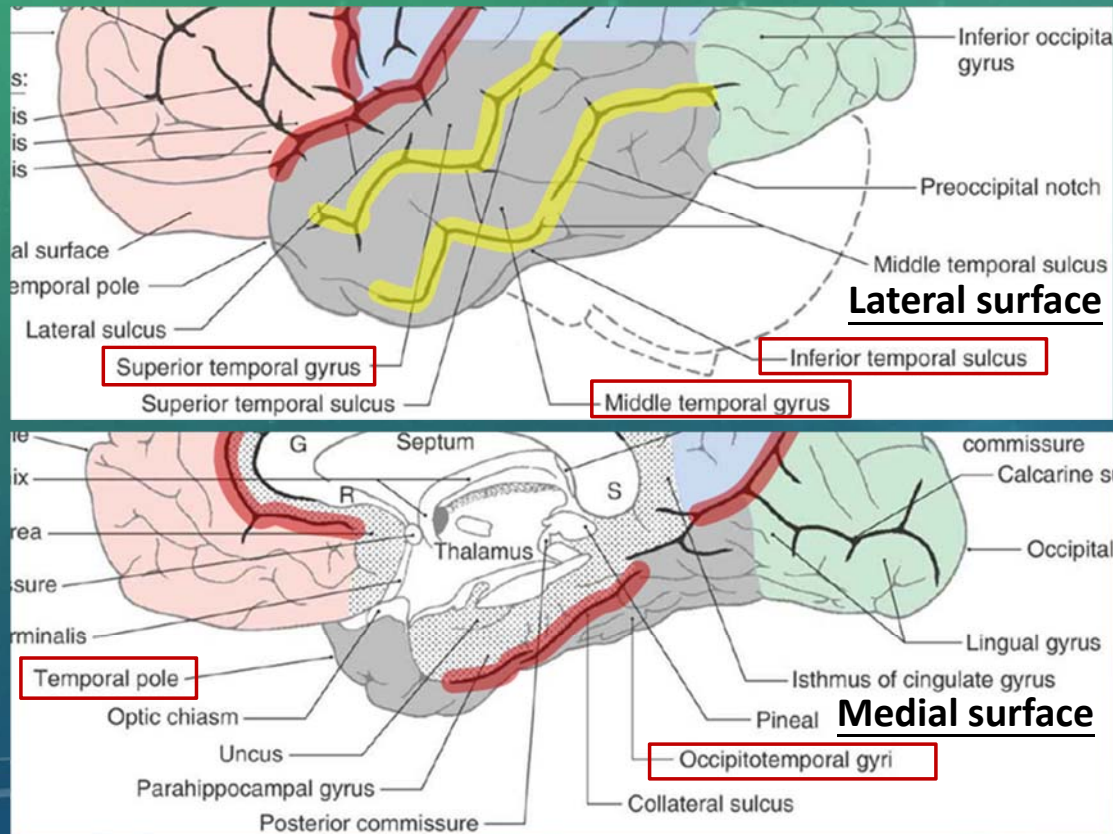
APHASIA

- **Broca aphasia (expressive aphasia):** These patients do not have paralysis of the speech apparatus but have great difficulty translating thoughts and concepts into coherent sentences.
- **Wernicke aphasia (receptive aphasia):** These patients cannot understand what they hear, cannot read or write, and speak in a jumble of words that makes no sense. Information is received but it cannot be understood or used to express coherent thought.



TEMPORAL LOBE

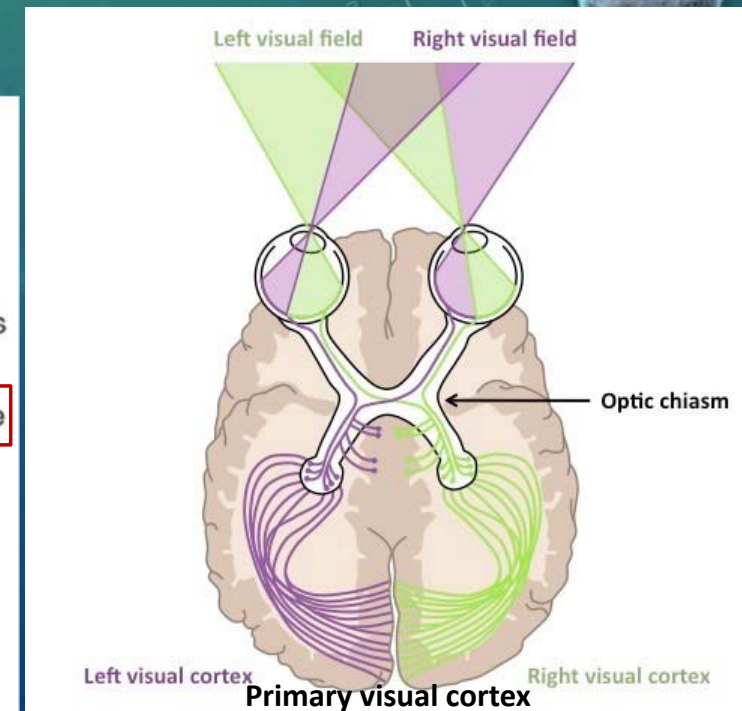
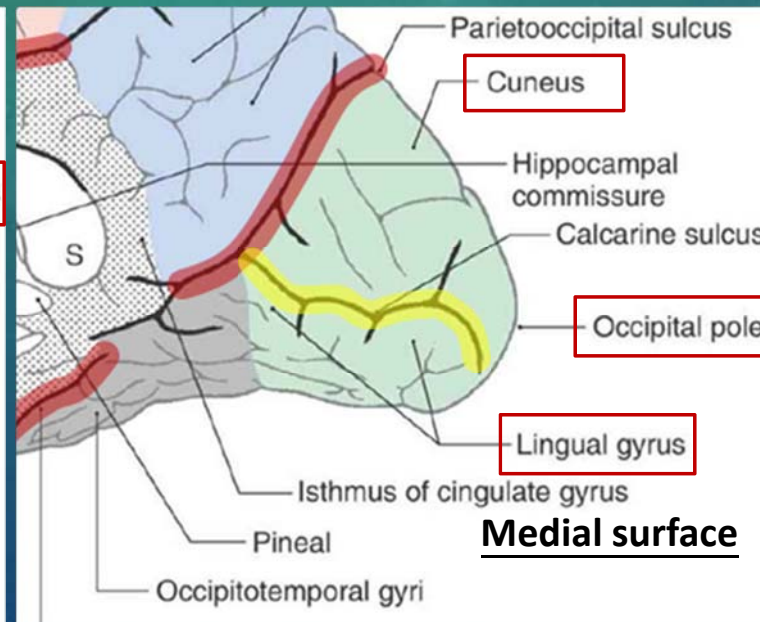
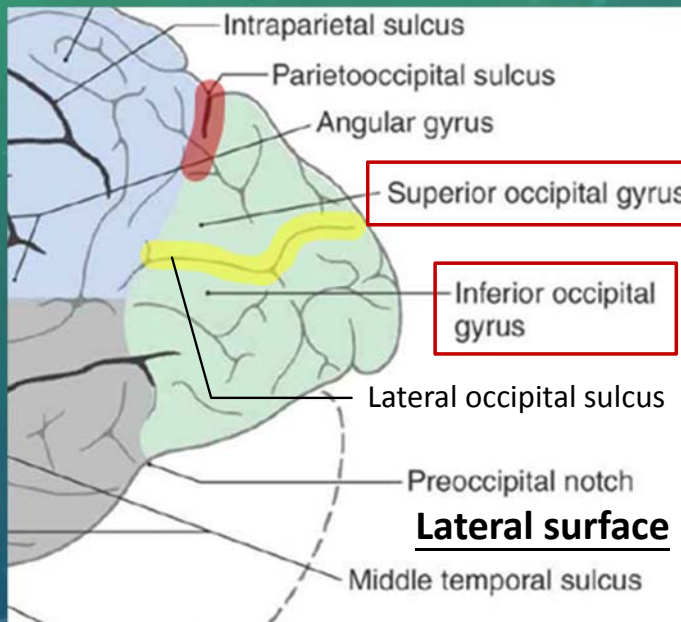
Between the lateral sulcus and the collateral sulcus



Lesions of the auditory cortex may result in difficulty in interpreting a sound or localizing a sound in space, but they do not lead to deafness in one ear.

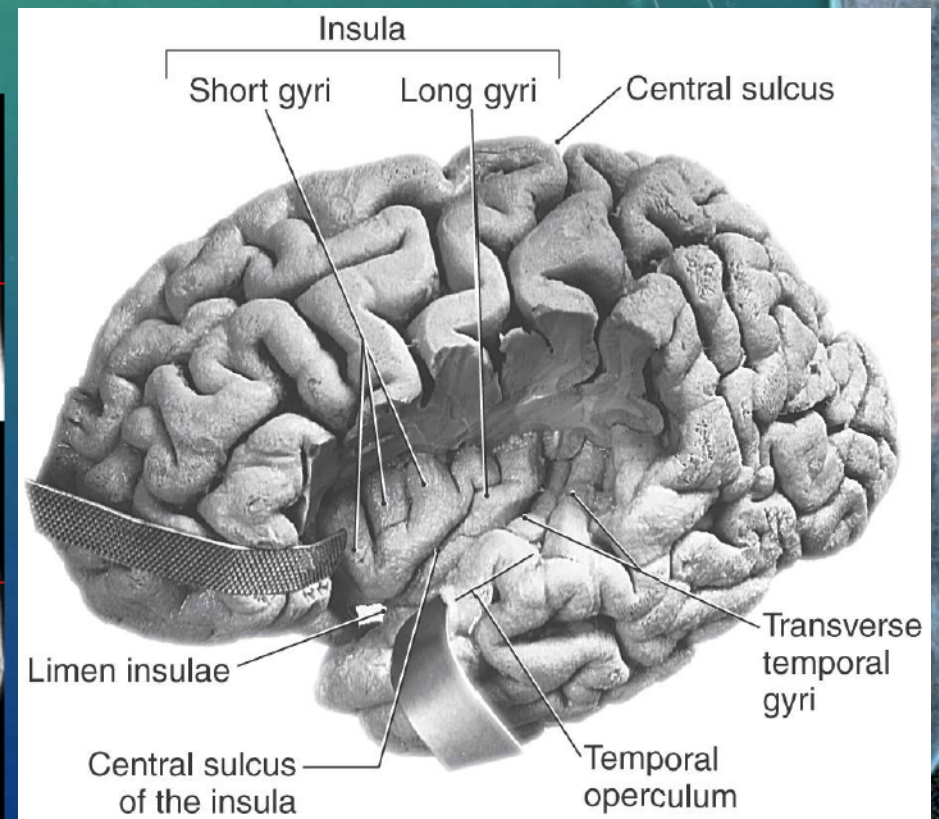
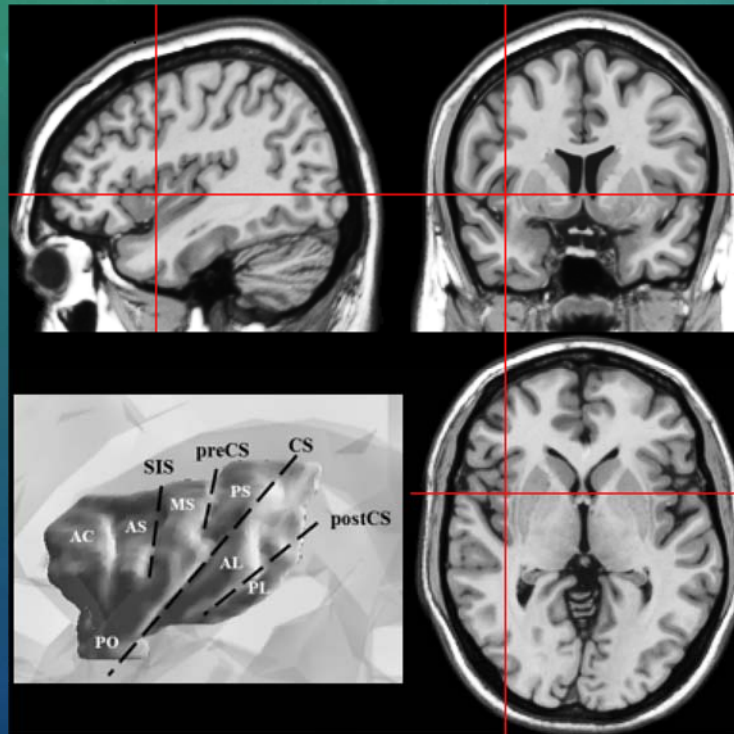
OCCIPITAL LOBE

- **Homonymous hemianopia**: A lesion of the primary visual cortex of one occipital lobe results in a loss of visual input from the contralateral half of the visual field of each eye.

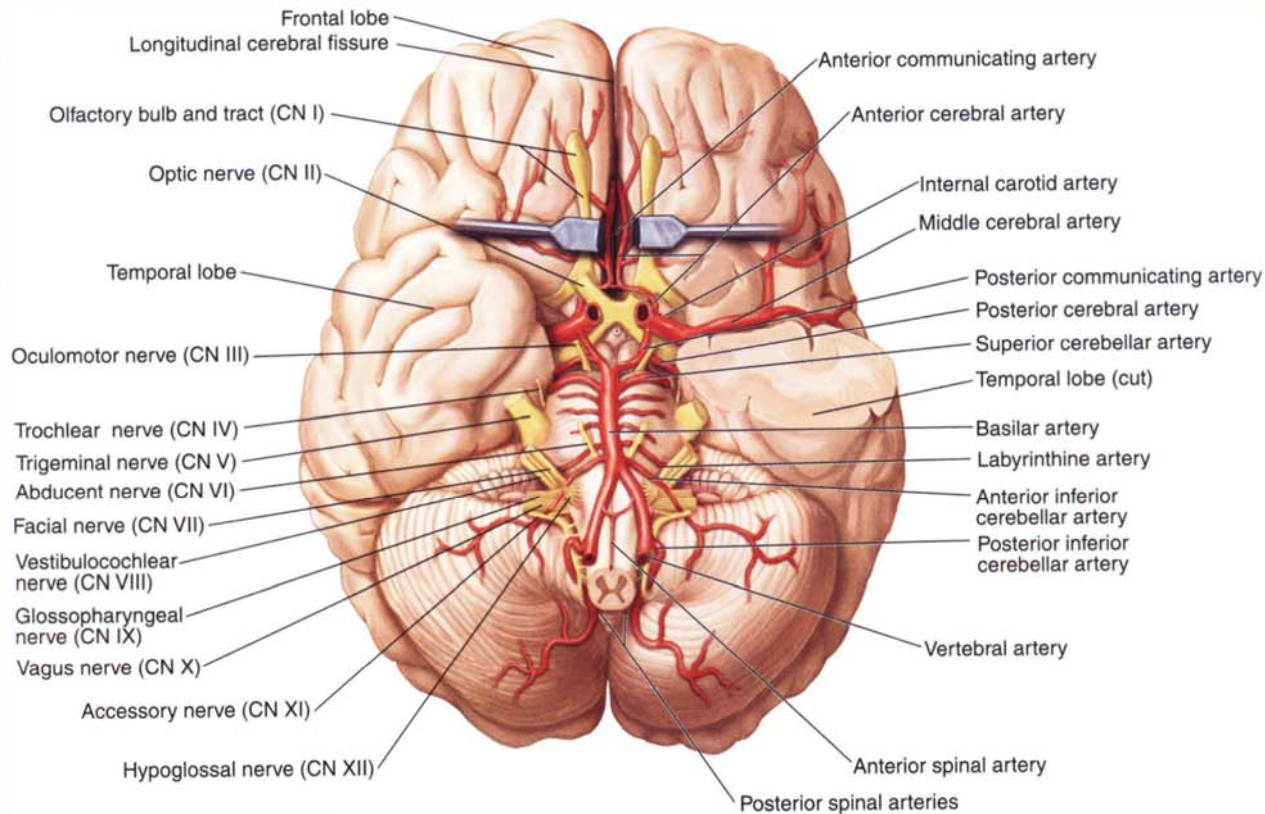


INSULAR LOBE RECEIVES **NOCICEPTIVE** AND **VISCEROSENSORY** INPUT

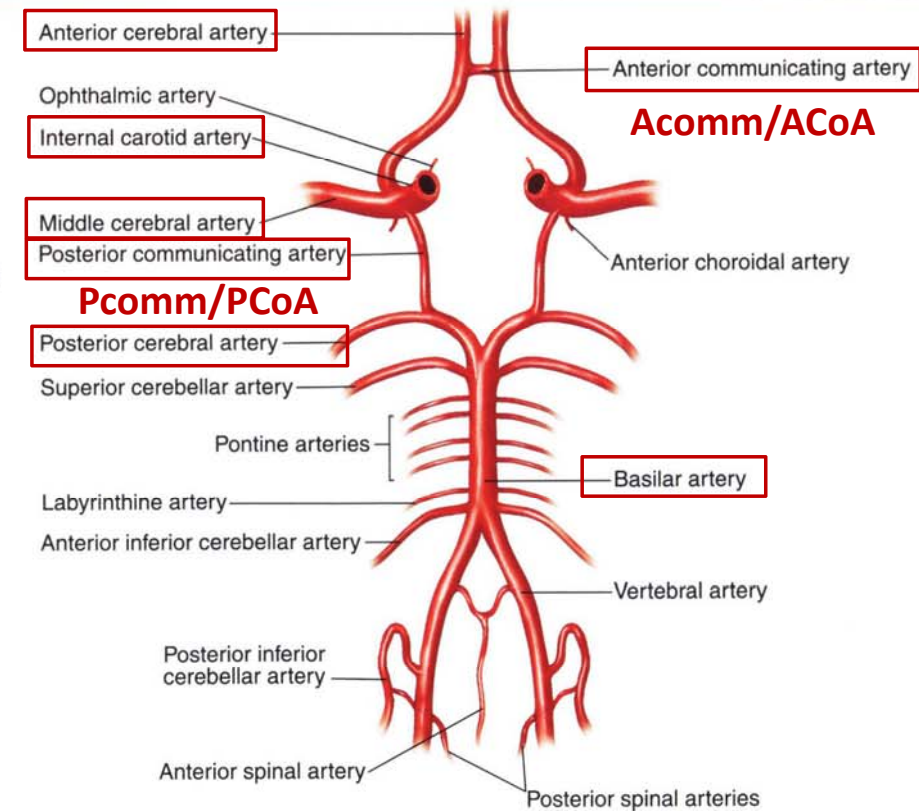
- Cerebral Cortex
 - Gyrus
 - Sulcus
- Lobes



VASCULATURE OF CEREBRUM



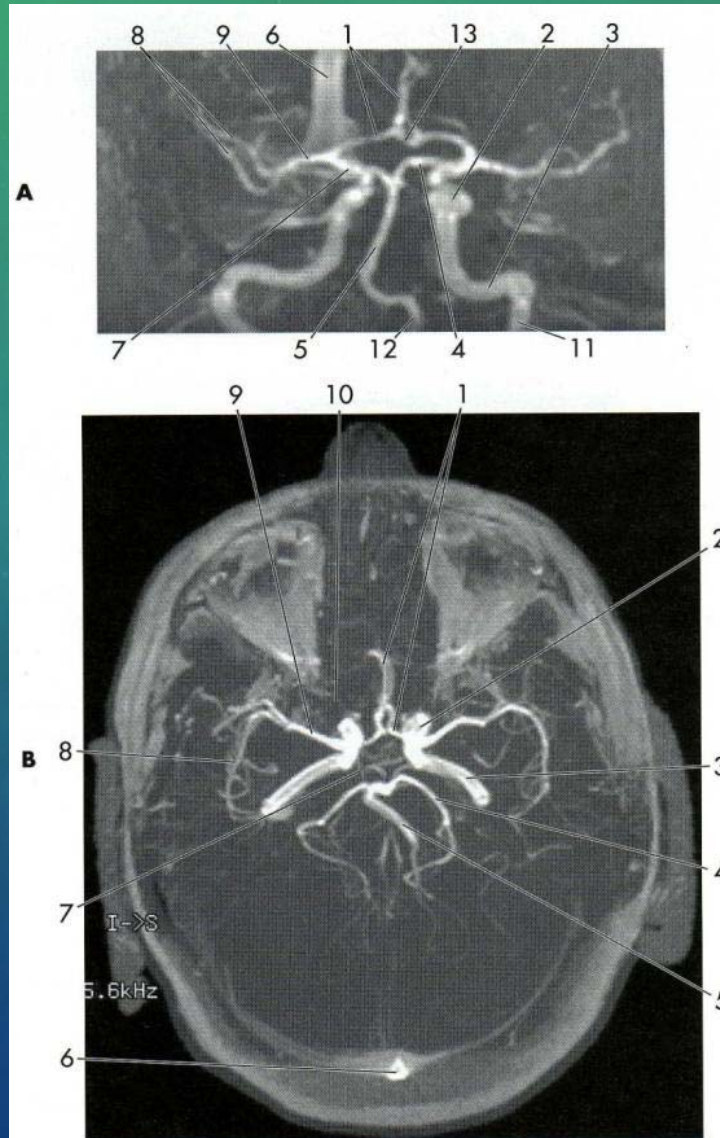
Circle of Willis



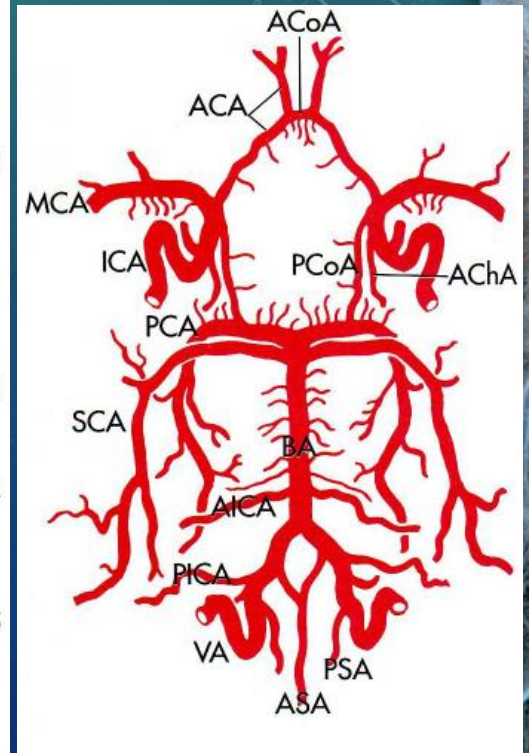
MR ANGIOGRAPHY

1. Anterior cerebral a. (ACA)
2. Cavernous sinus part
3. Temporal bone part
4. Posterior cerebral a. (PCA)
5. Basilar a. (BA)
6. Superior sagittal sinus
7. Posterior communicating a. (PCoA)
8. Branch on the surface of the insula
9. Middle cerebral a. (MCA)
10. ophthalmic a.
11. Internal carotid a. (ICA)
12. Vertebral a. (VA)
13. Anterior communicating a. (ACoA)

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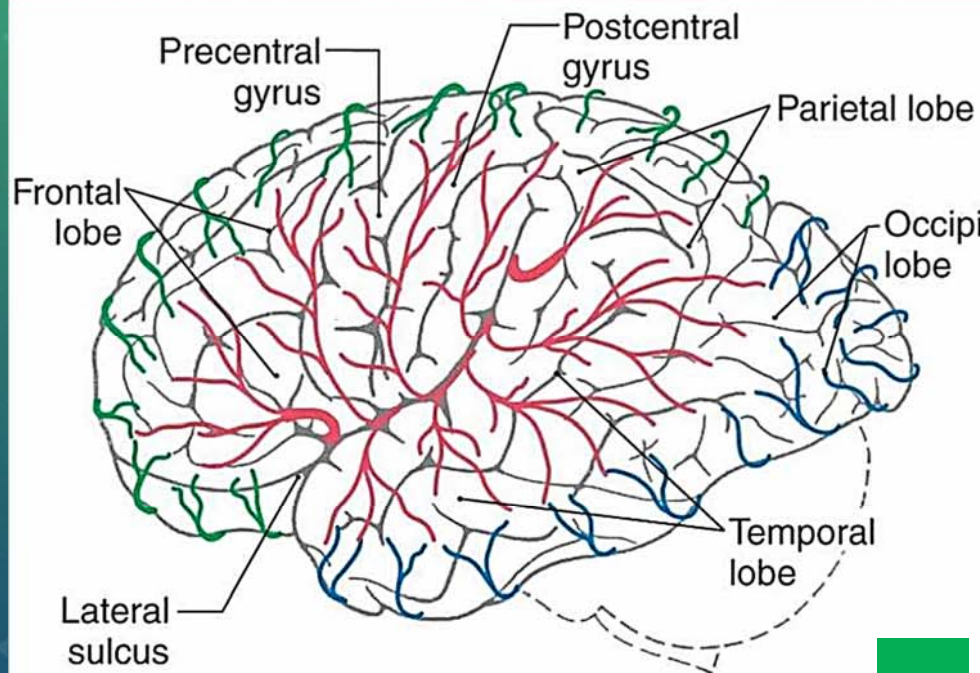


Circle of Willis

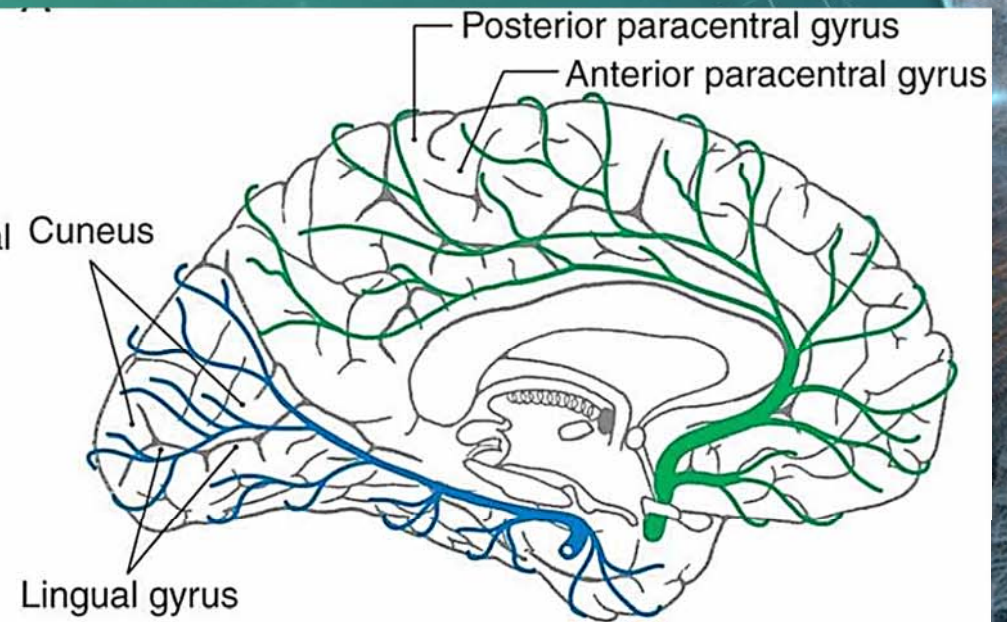


VASCULATURE OF CEREBRUM

Lateral View



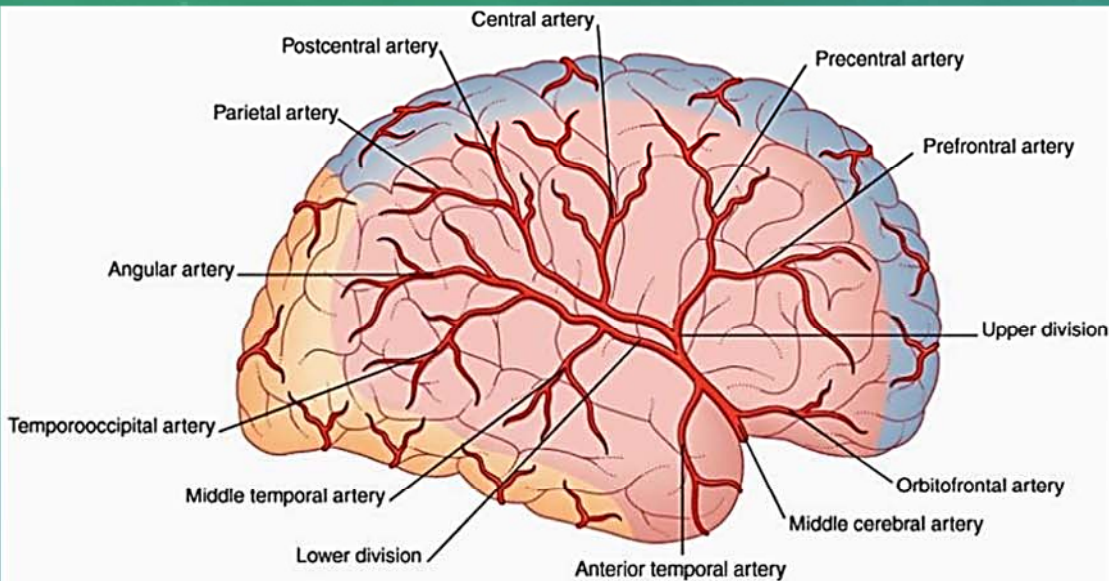
Medial View



Anterior Middle Posterior Cerebral Arteries

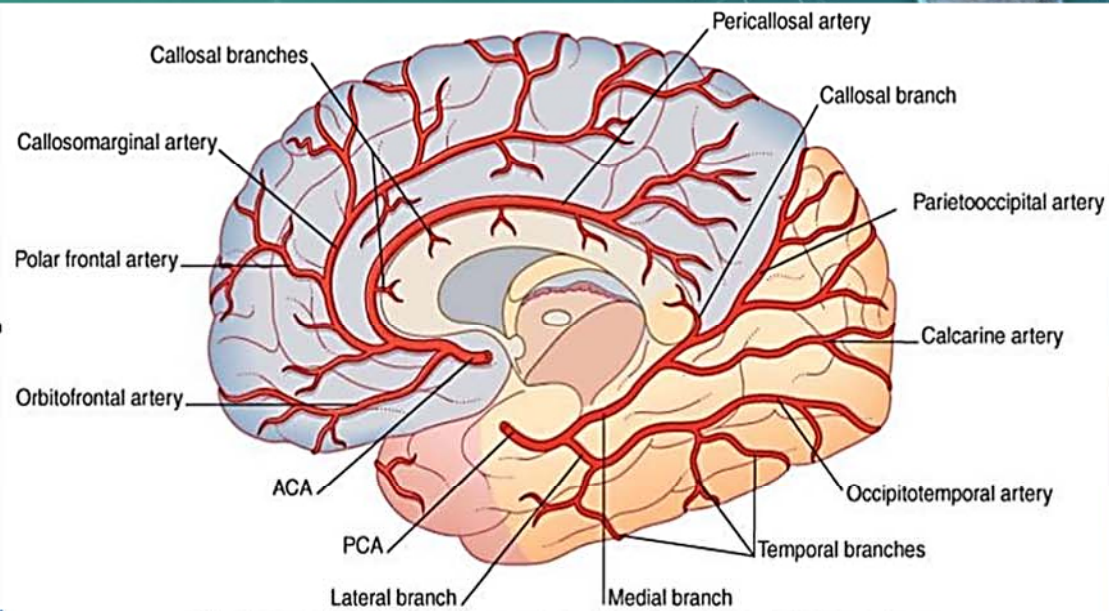
VASCULATURE OF CEREBRUM

Lateral View



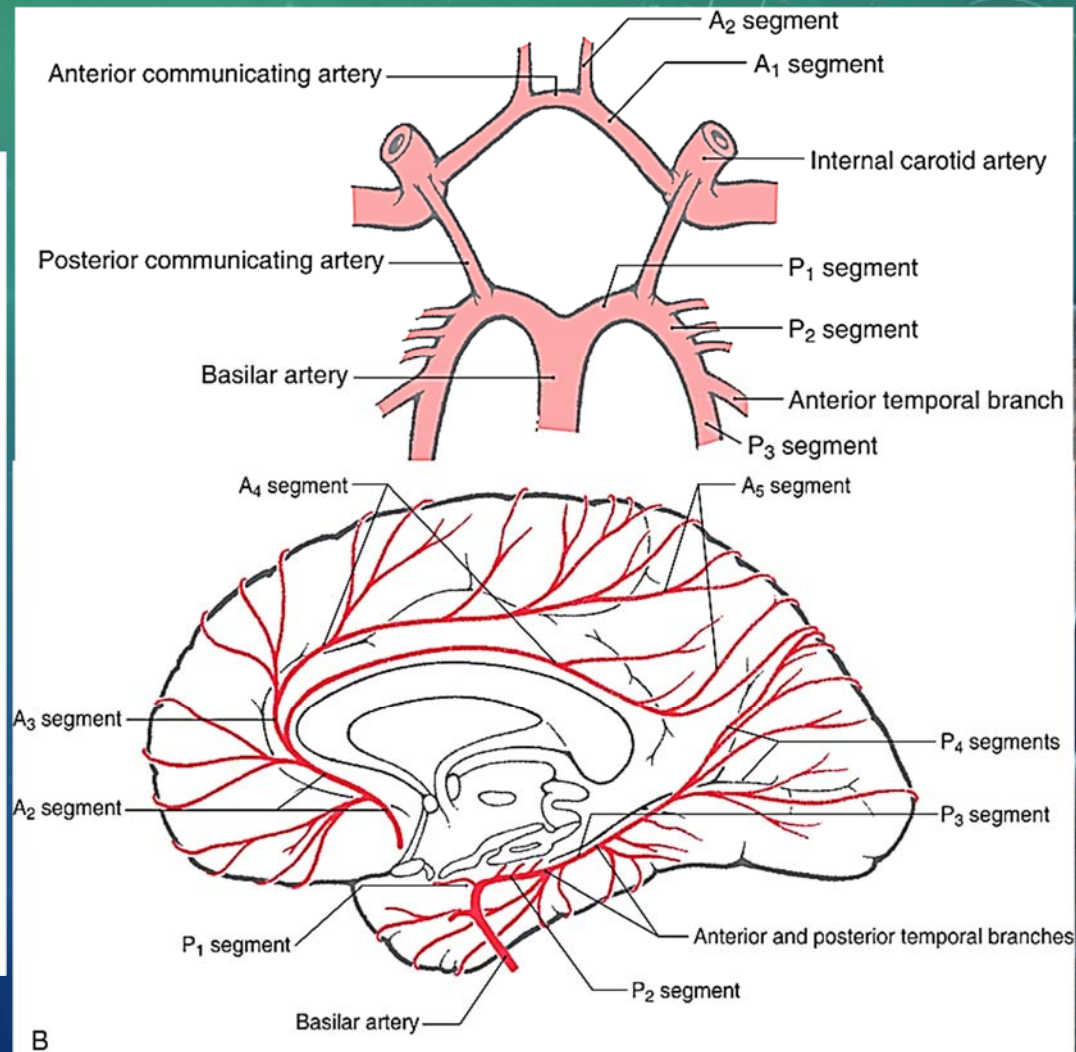
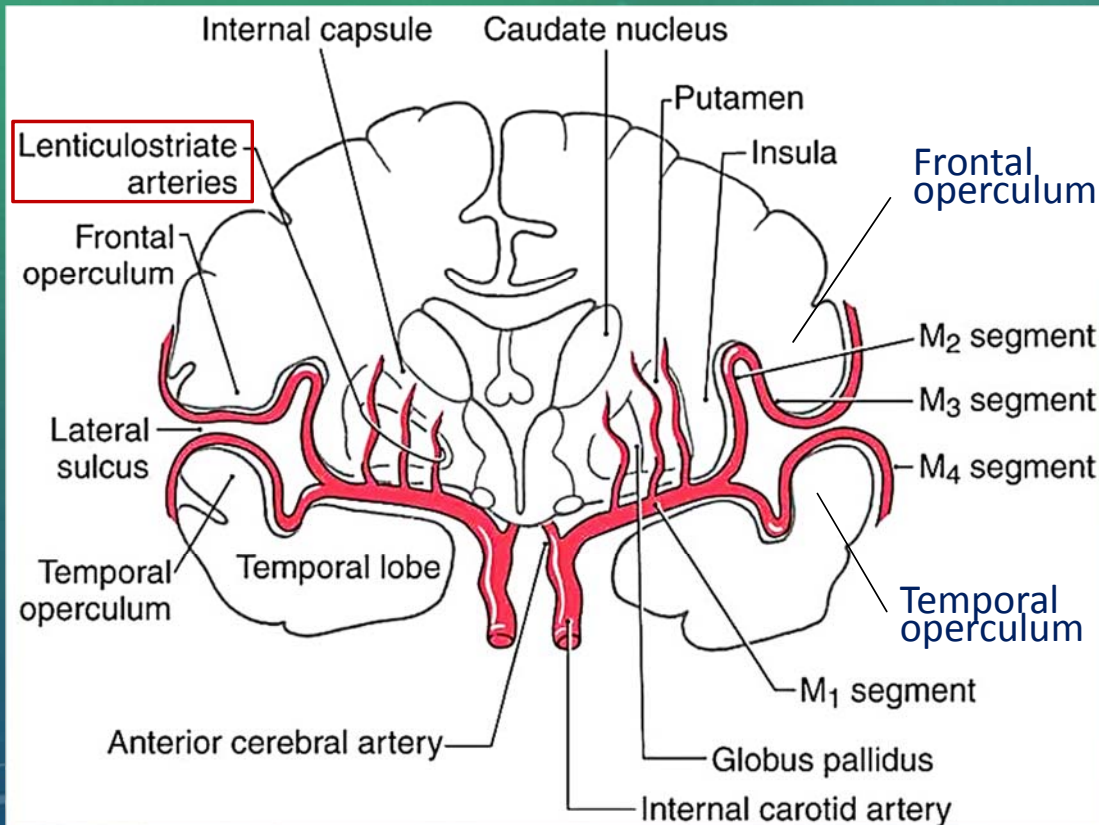
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Medial View



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VASCULATURE OF CEREBRUM



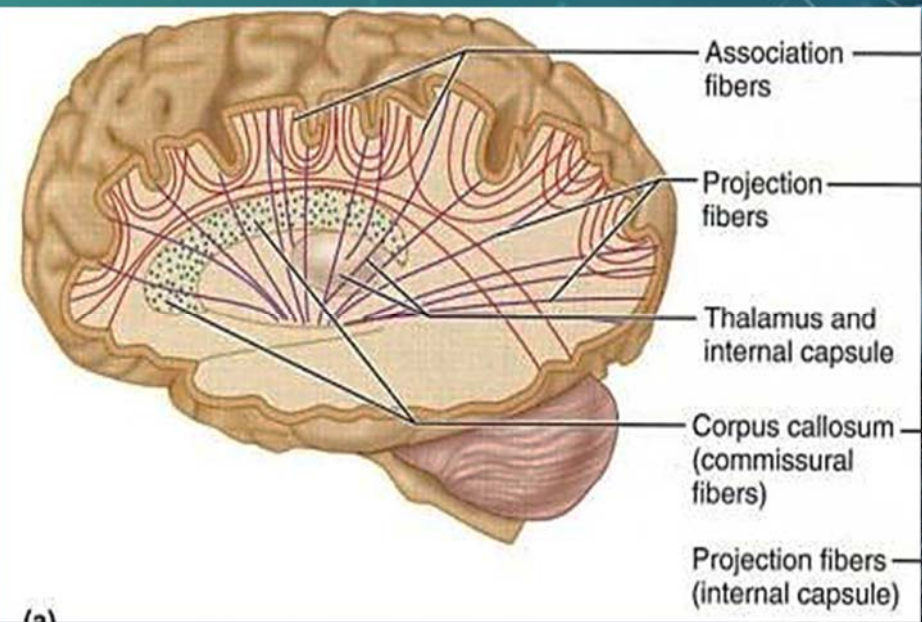
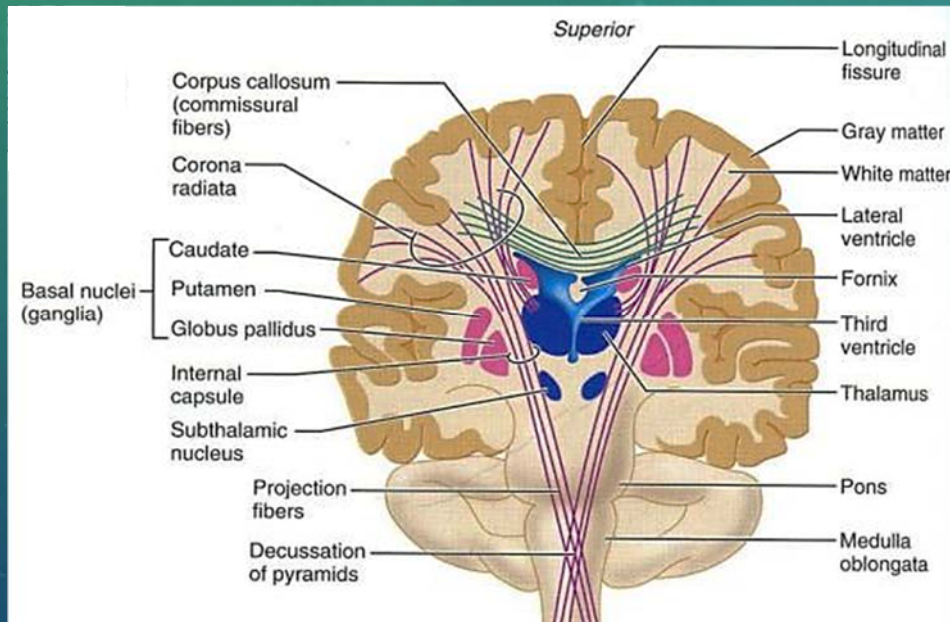
- Cerebral Cortex
 - Gyri
 - Sulci
 - Lobes
- Subcortical White Matter (Myelinated fibers)
 - Association fibers
 - Commissural fibers
 - Projection fibers (Internal capsule)
 - Corticofugal fibers
 - Corticopetal fibers
- Basal nuclei

WHITE MATTER OF THE CEREBRAL HEMISPHERE

WHITE MATTER

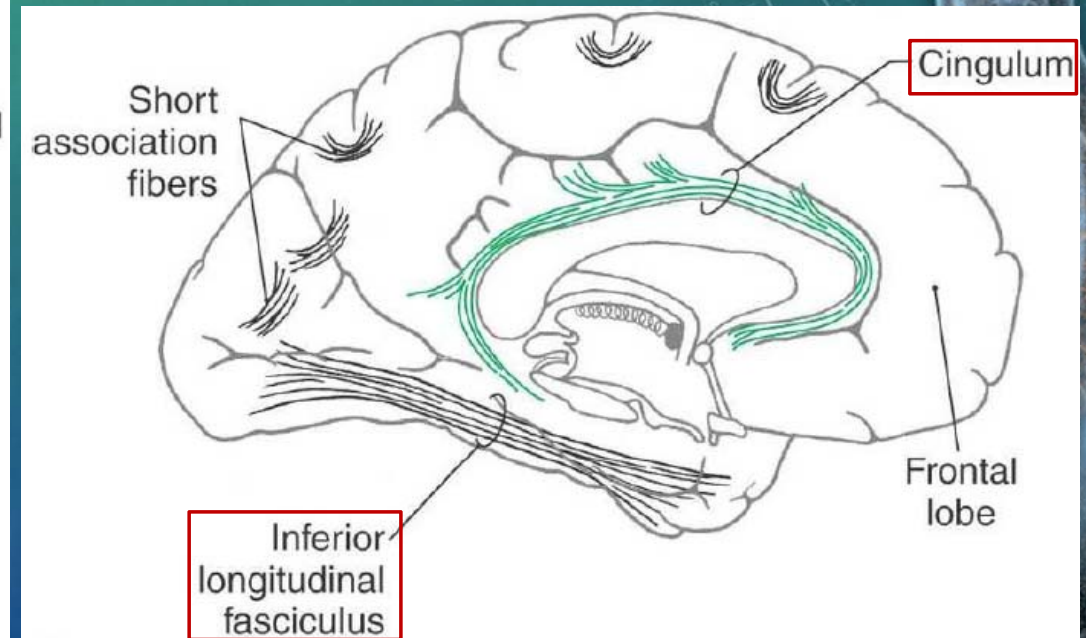
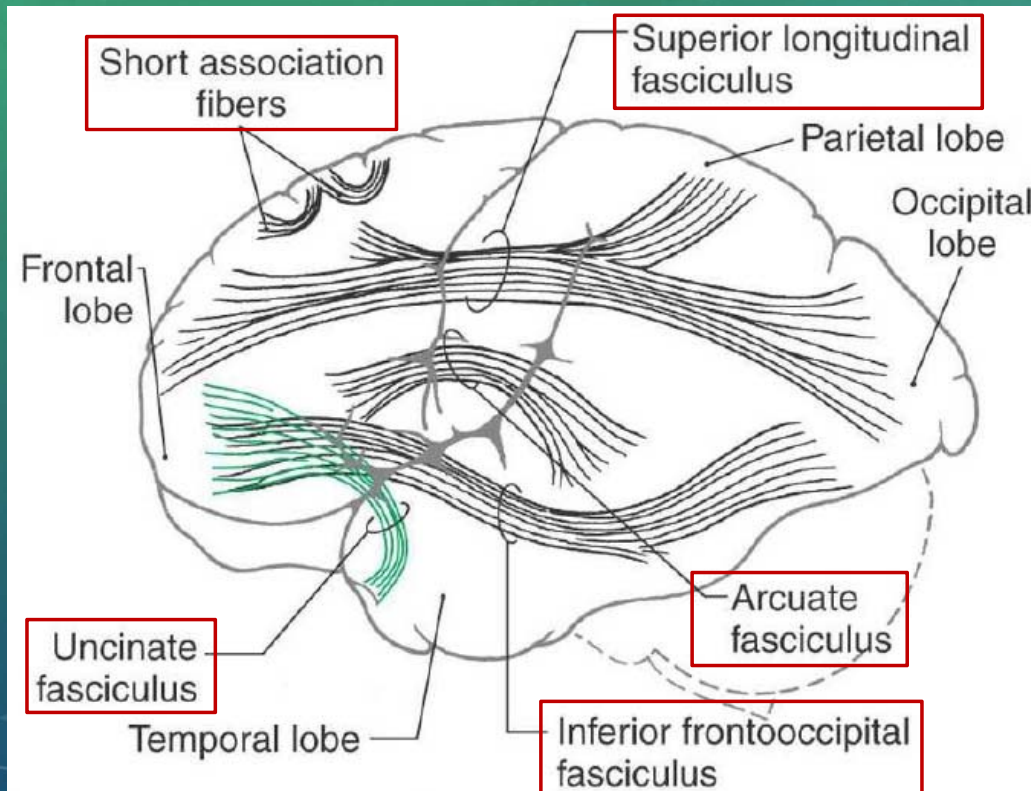
Myelinated fibers

- Association fibers
- Commissural fibers
- Projection fibers



ASSOCIATION FIBERS

interconnect various cortical areas within the same hemisphere.



ASSOCIATION FIBERS

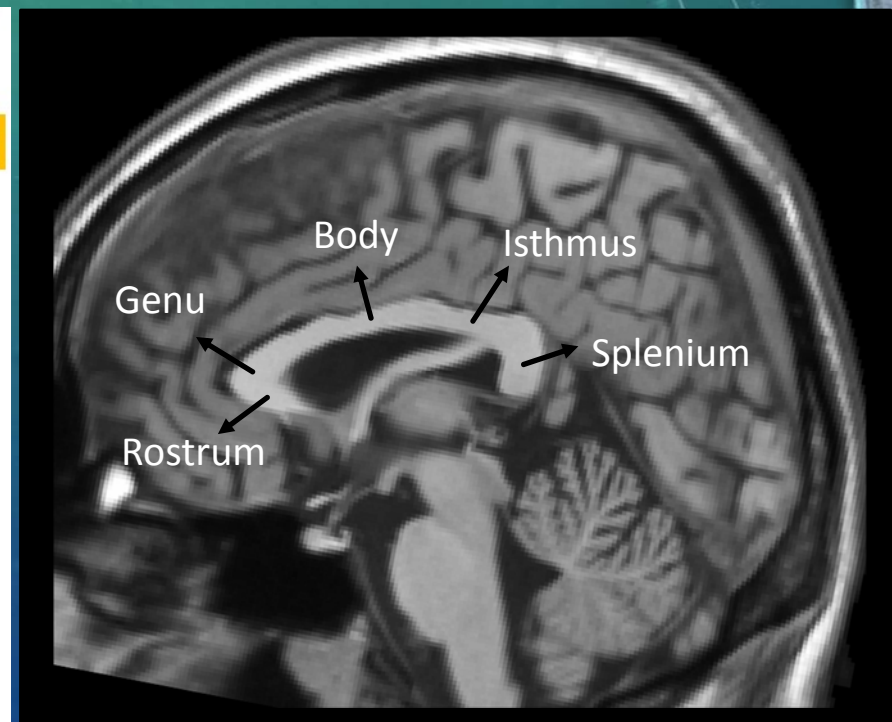
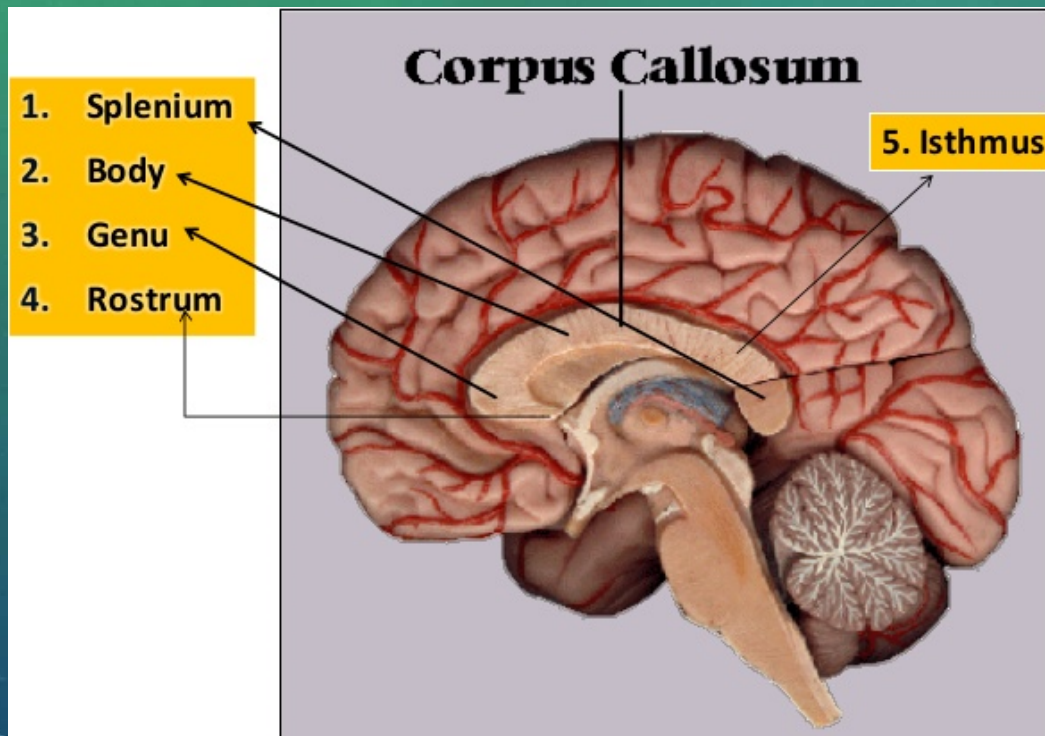
MR-Diffusion Tensor Tractography

- Superior longitudinal fasciculus (yellow)
- Inferior longitudinal fasciculus (brown)
- Uncinate fasciculus (red)
- Superior fronto-occipital fasciculus (light yellow)
- Inferior fronto-occipital fasciculus (orange)

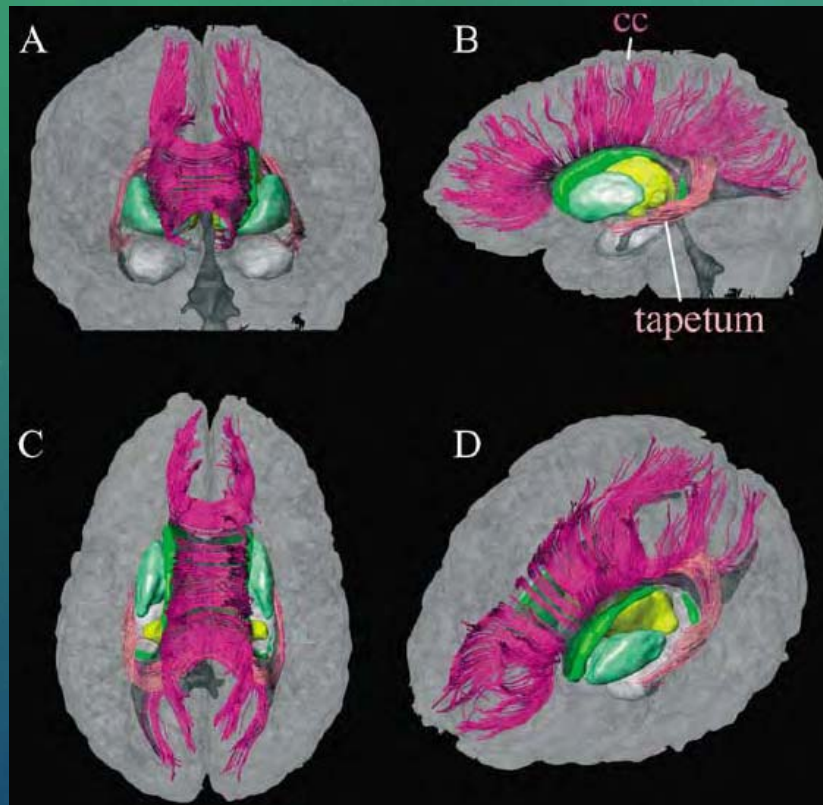


COMMISSURAL FIBERS

The Corpus Callosum: interconnects corresponding structures on either hemisphere.



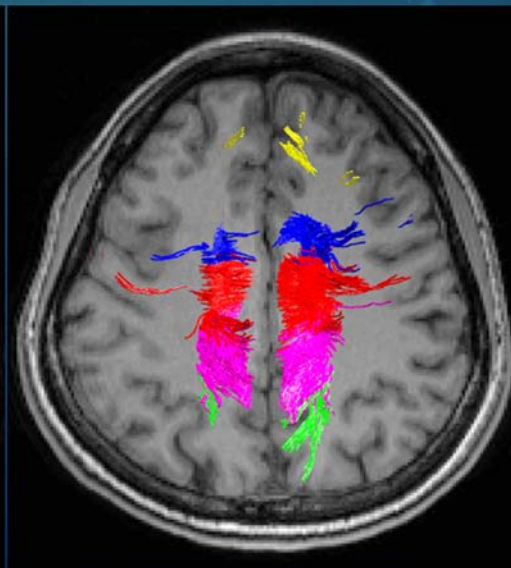
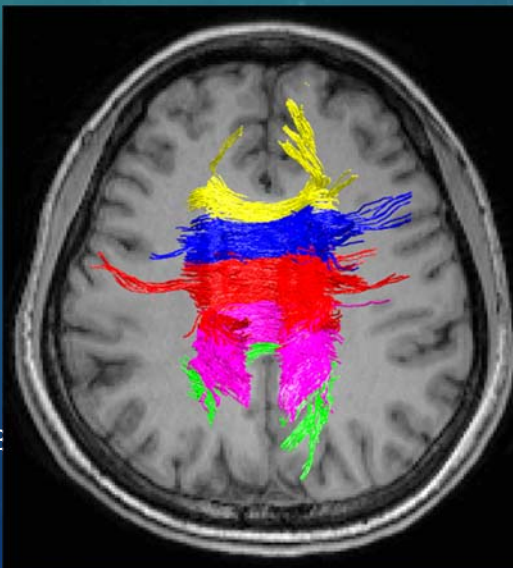
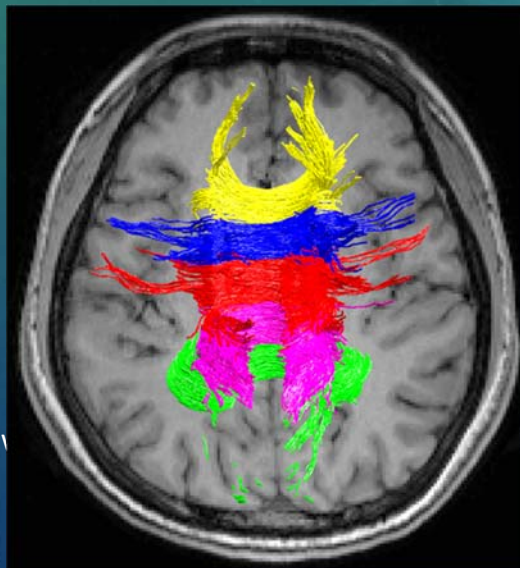
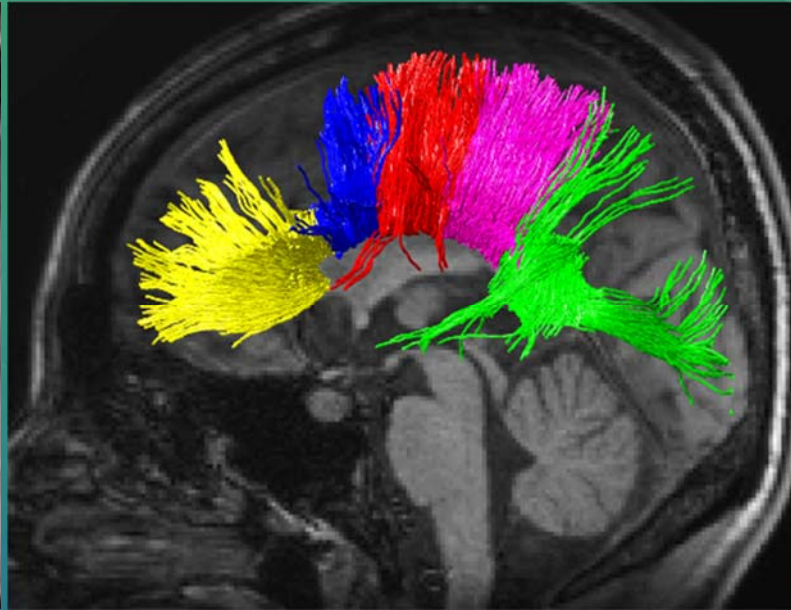
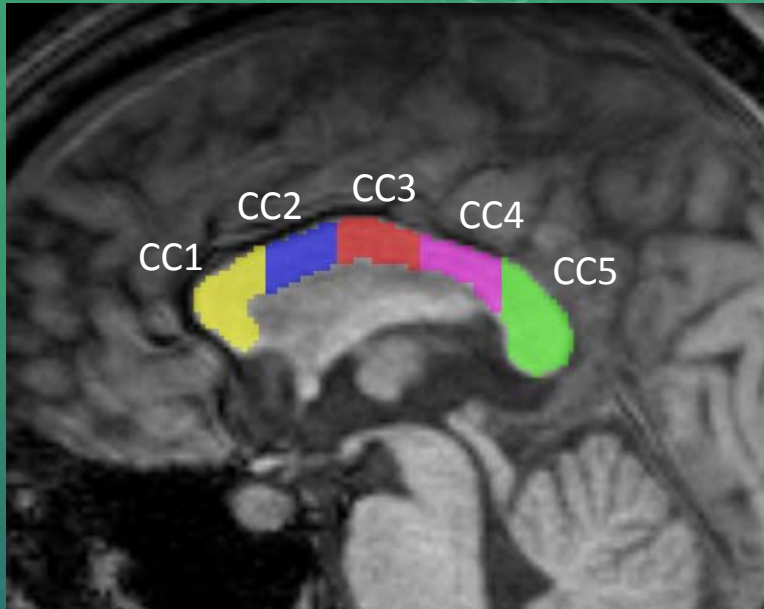
COMMISSURAL FIBERS



- **Corpus callosum (cc)**
 - Contains more than 300 million axons
 - The largest fiber bundle in the human brain
 - Interconnect homologous cortical area between hemispheres
- MR-DTI tractography often fails to reveal commissural connections to the lateral areas of the hemispheres.

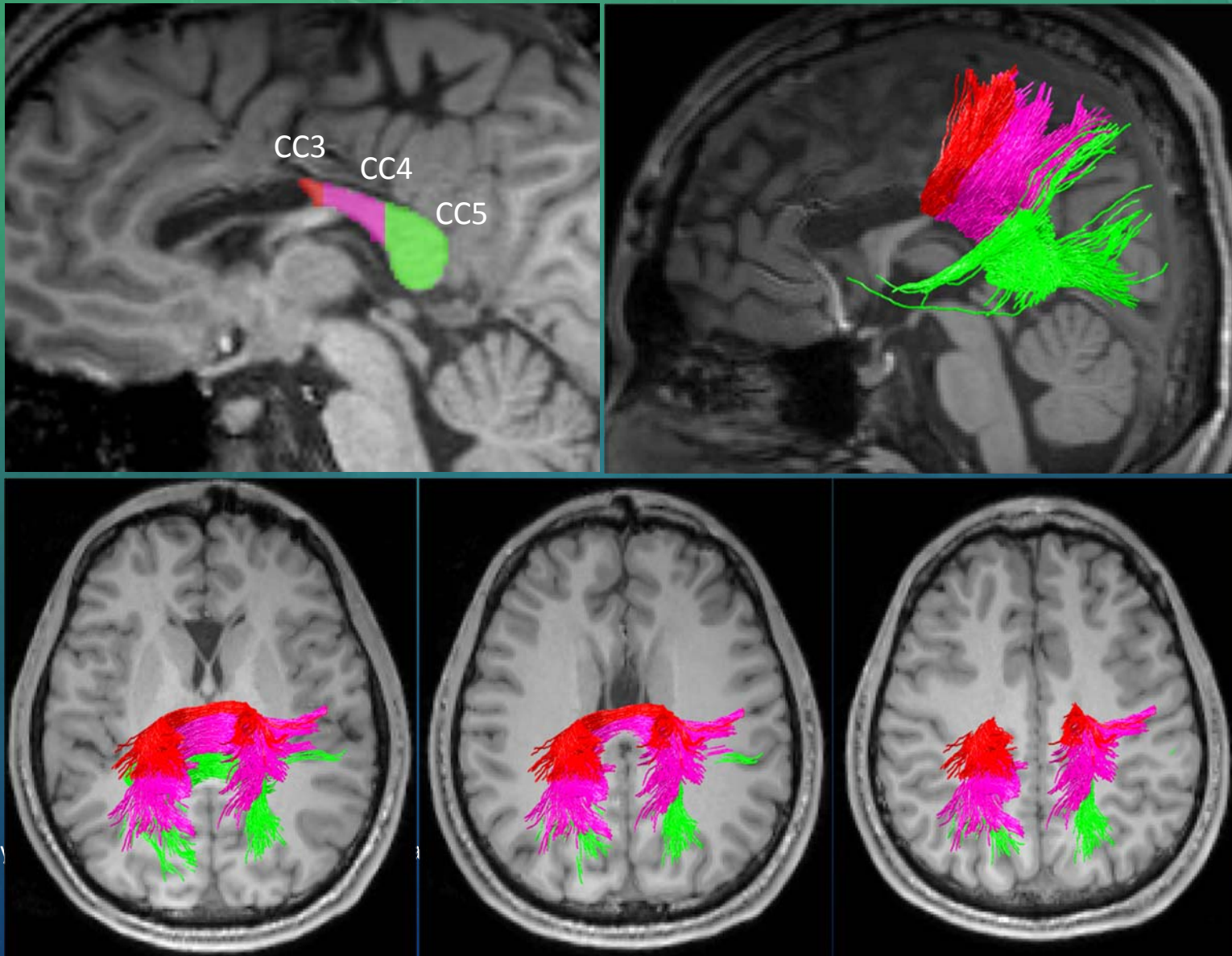


23/F, healthy volunteer



3T Prisma, 64 channel, 64 dir

21/M, with anterior corpus callosotomy



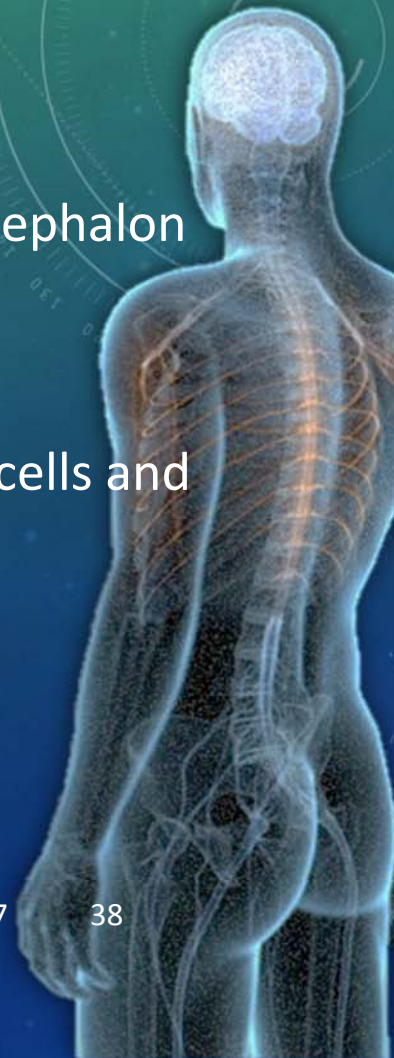
3T Prisma, 64 channel, 64 dir

PROJECTION FIBERS

The Internal Capsule

- **Corticopetal fibers (afferent)**: the axons that originate outside the telencephalon and project to the cerebral cortex.
 - Thalamocortical fibers
- **Corticofugal fibers (efferent)**: the axons that arise from cerebral cortical cells and project to downstream targets.
 - Corticospinal, corticopontine, and corticothalamic fibers

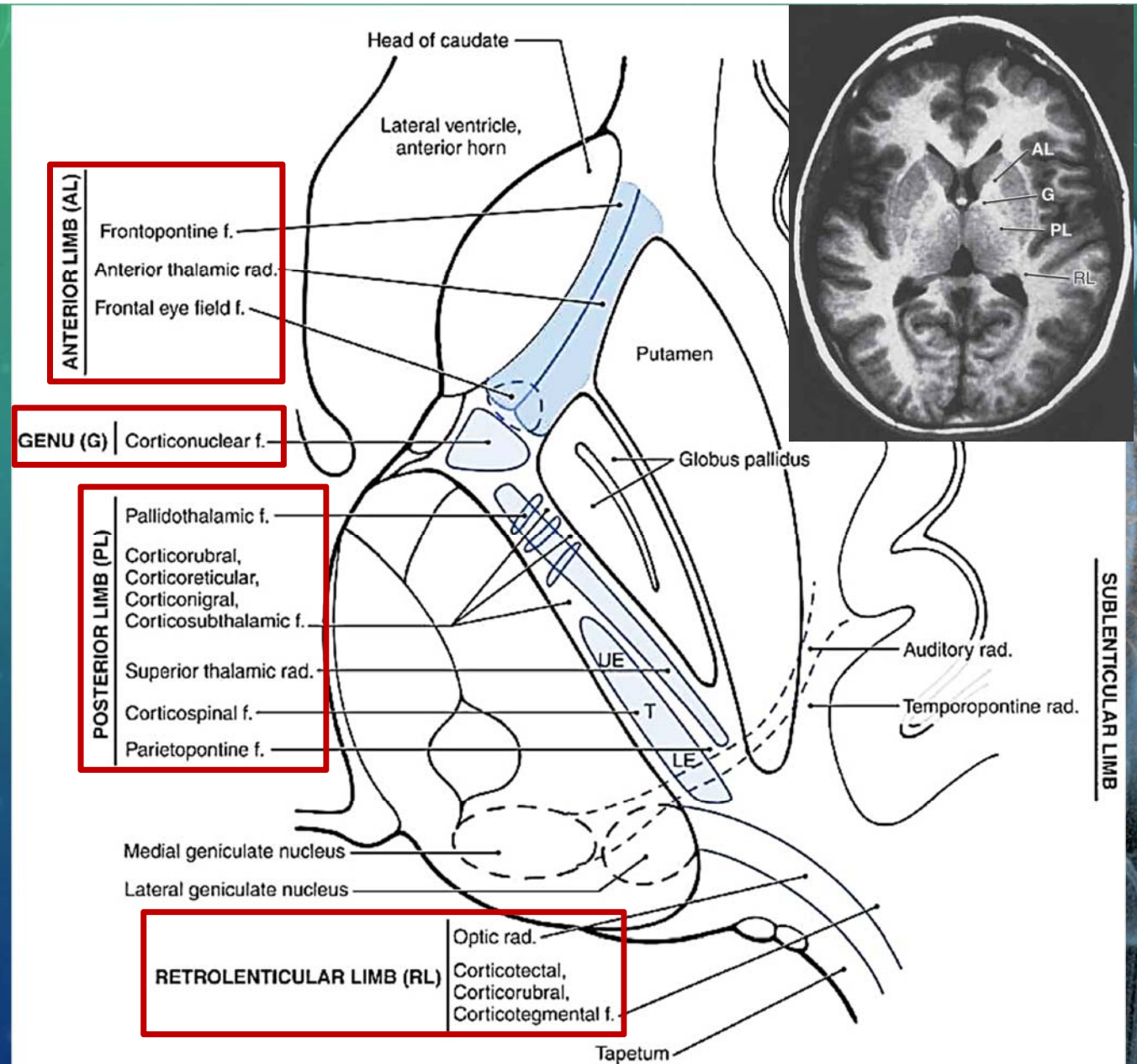
Projection fibers are organized into a large, compact bundle called the internal capsule.



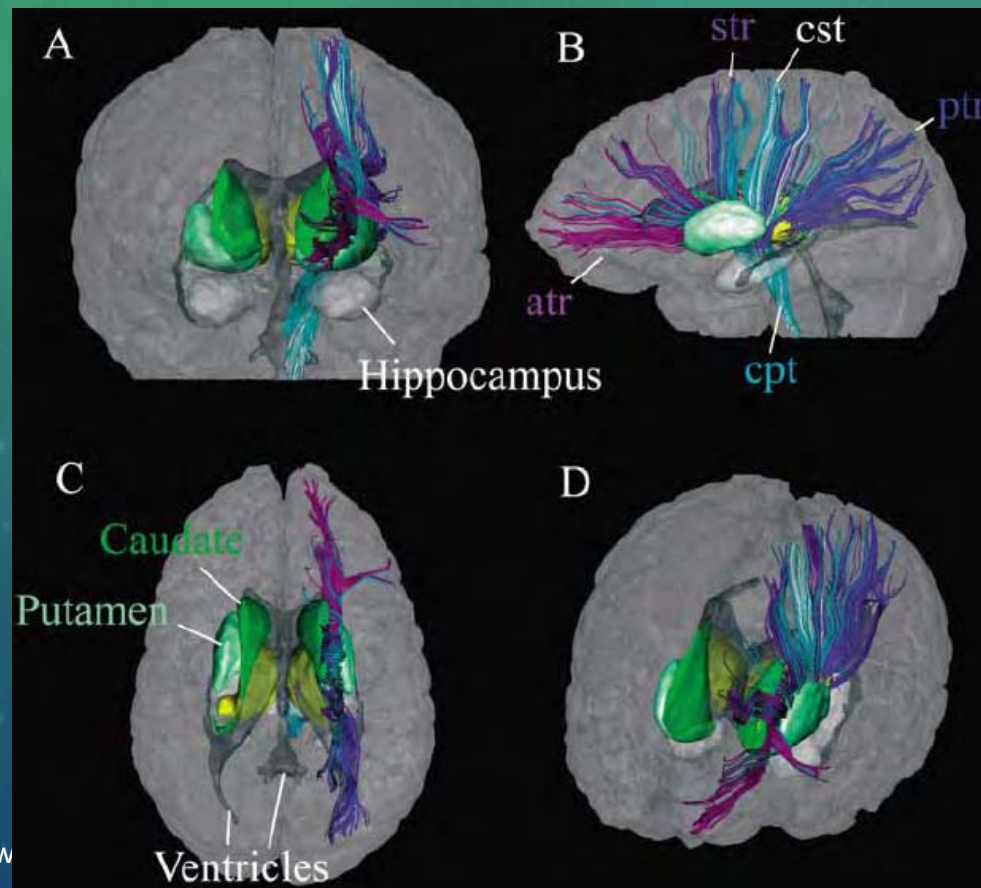
INTERNAL CAPSULE

- Anterior limb
- Genu
- Posterior limb
- Retrolenticular limb

<http://www.ym.edu.tw/~cflu>



PROJECTION FIBERS

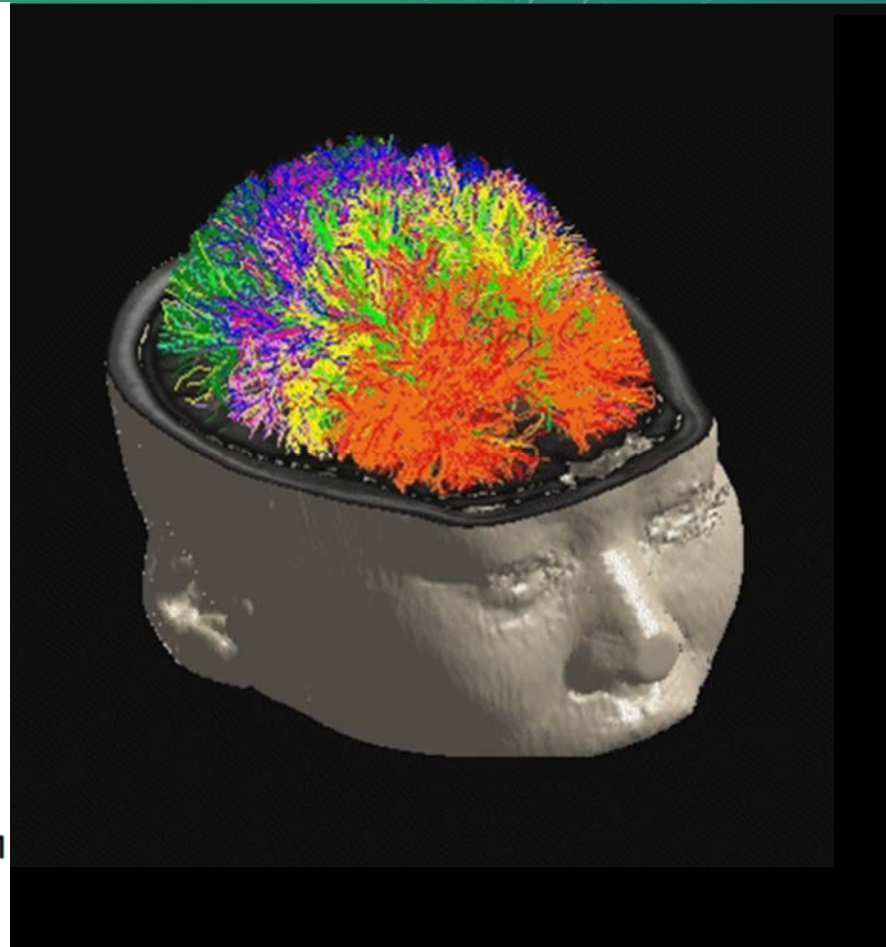
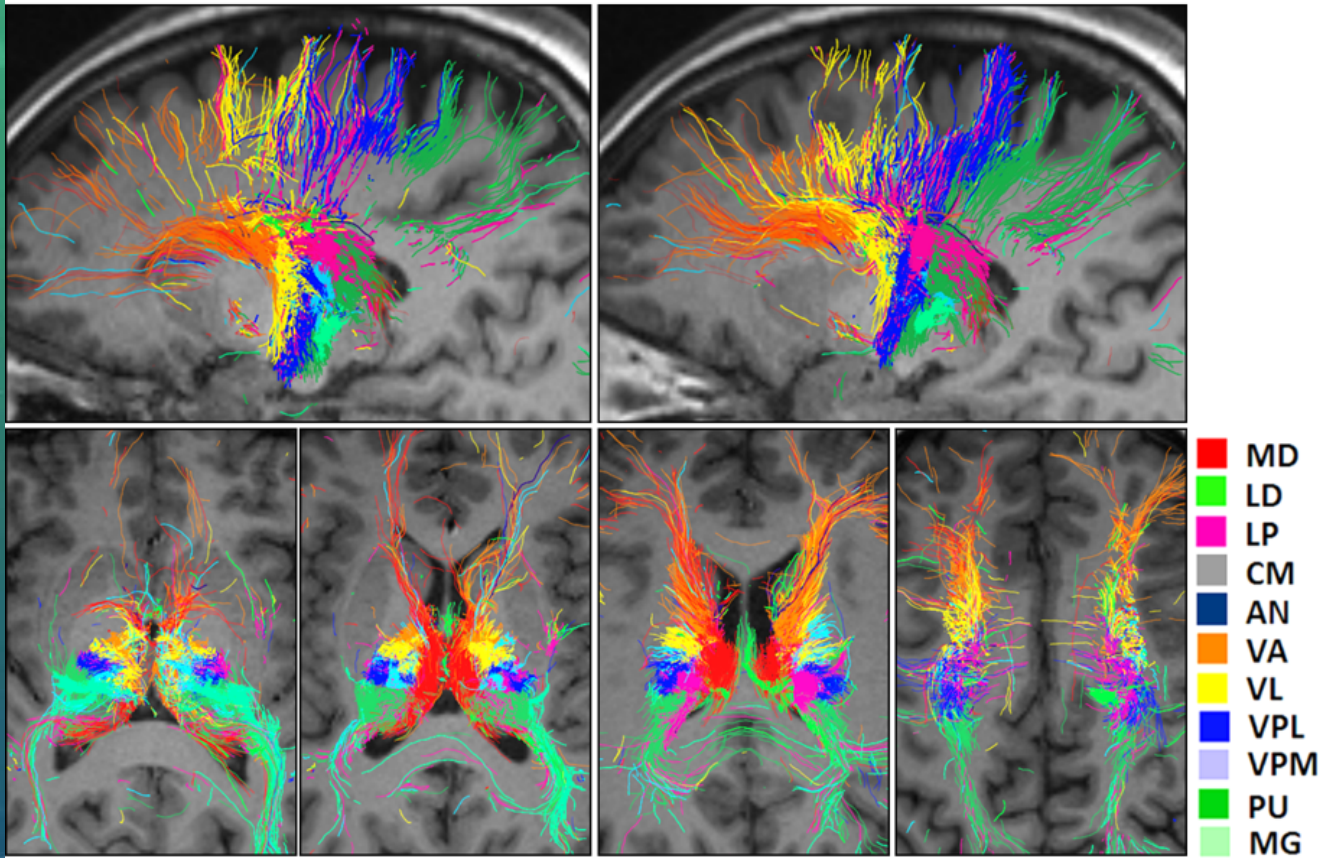


- Anterior thalamic radiation (atr)
- Superior thalamic radiation (str)
- Posterior thalamic radiation (ptr)
- Corticospinal tract (cst)
- Corticopontine tract (cpt)

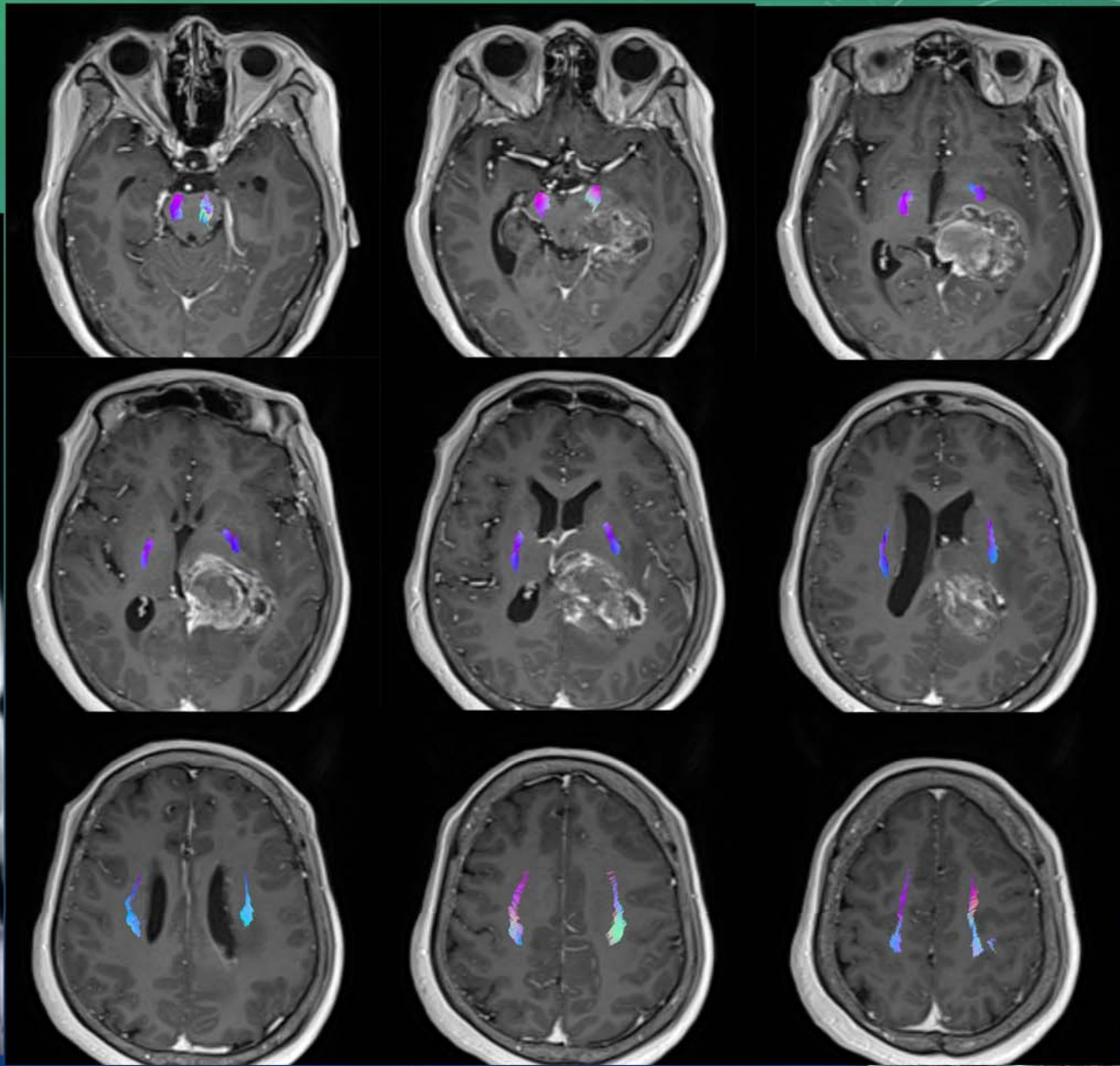
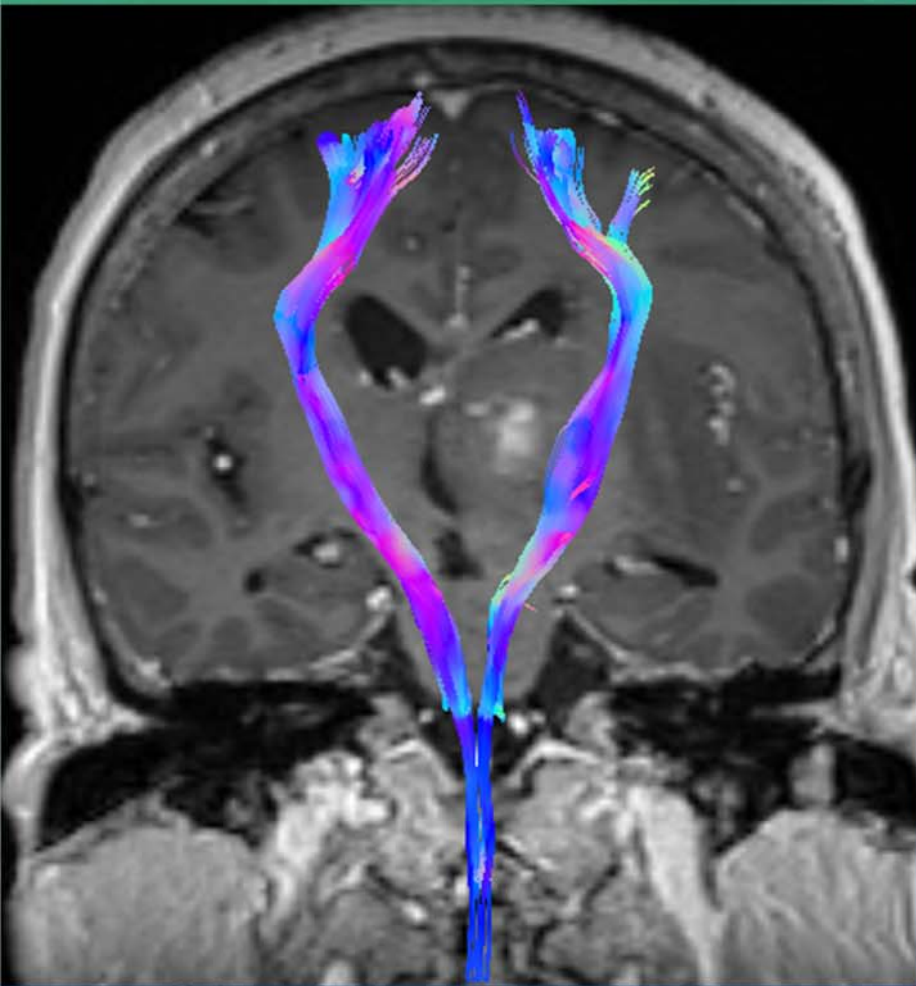
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40

Cross-sectional Thalamocortical Tracts



Presurgical Evaluation of CST in the patient with brain tumors

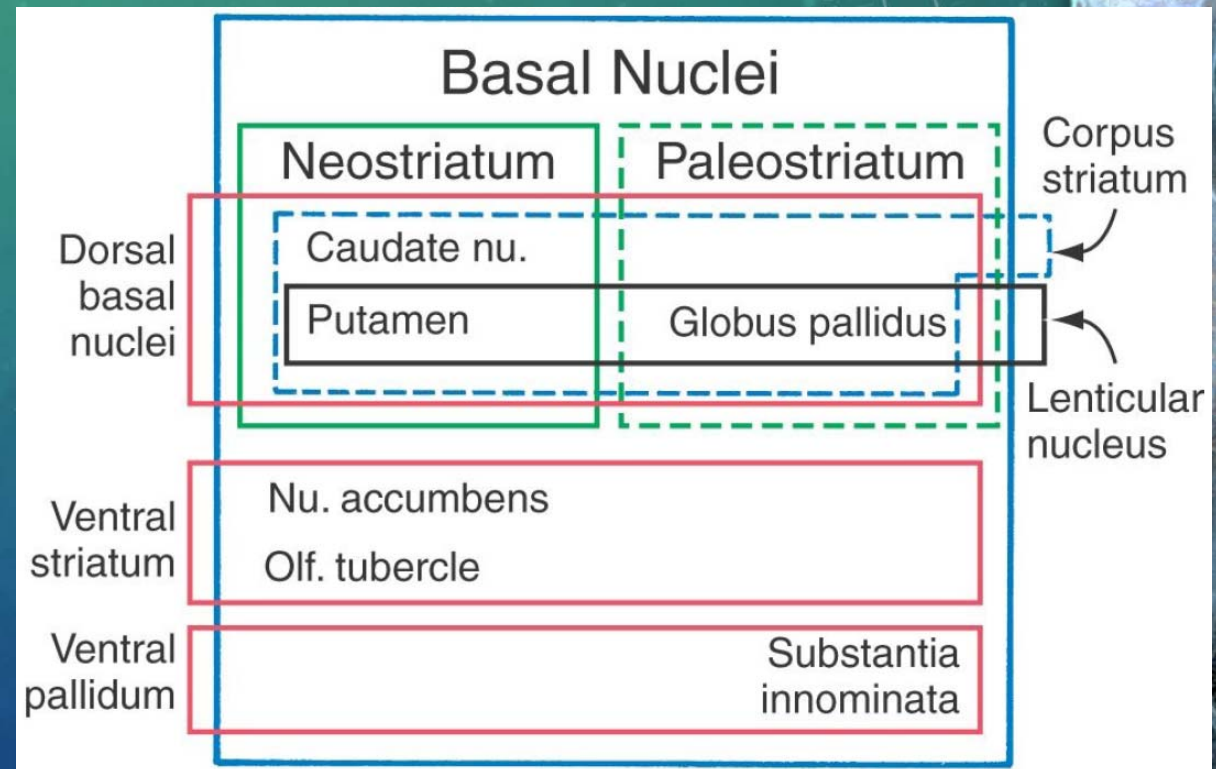


- Cerebral Cortex
 - Gyri
 - Sulci
 - Lobes
- Subcortical White Matter (Myelinated fibers)
 - Association fibers
 - Commissural fibers
 - Projection fibers (Internal capsule)
 - Corticofugal fibers
 - Corticopetal fibers
- Basal nuclei

BASAL NUCLEI

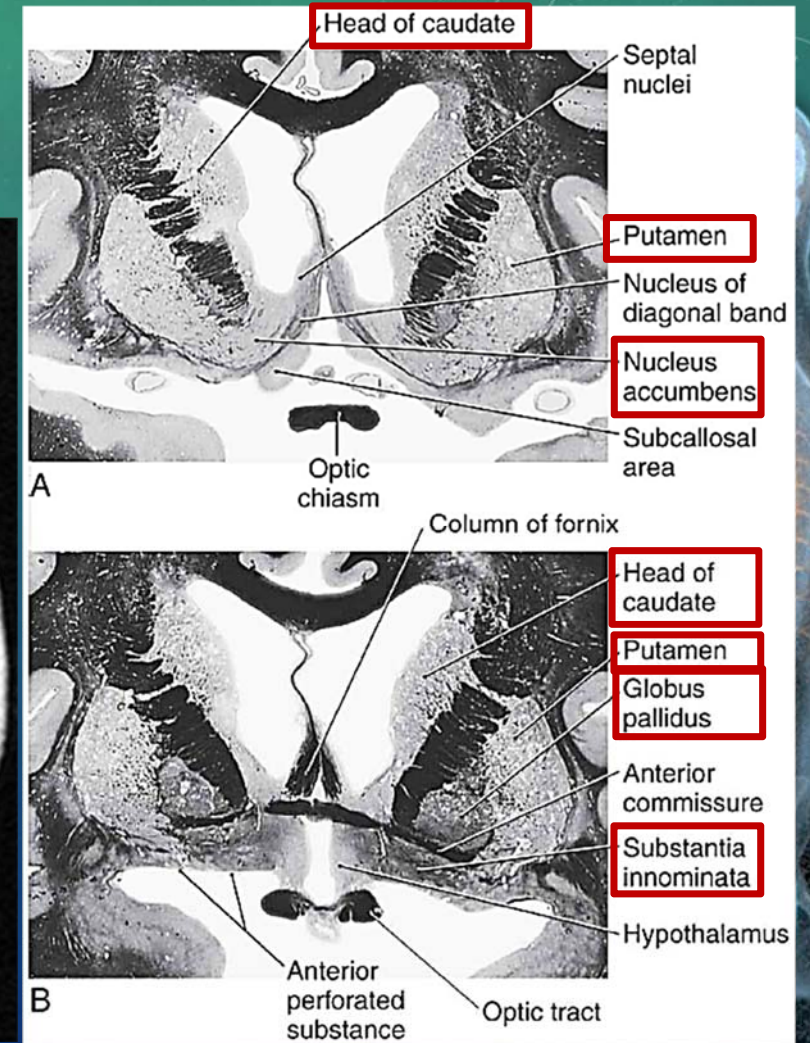
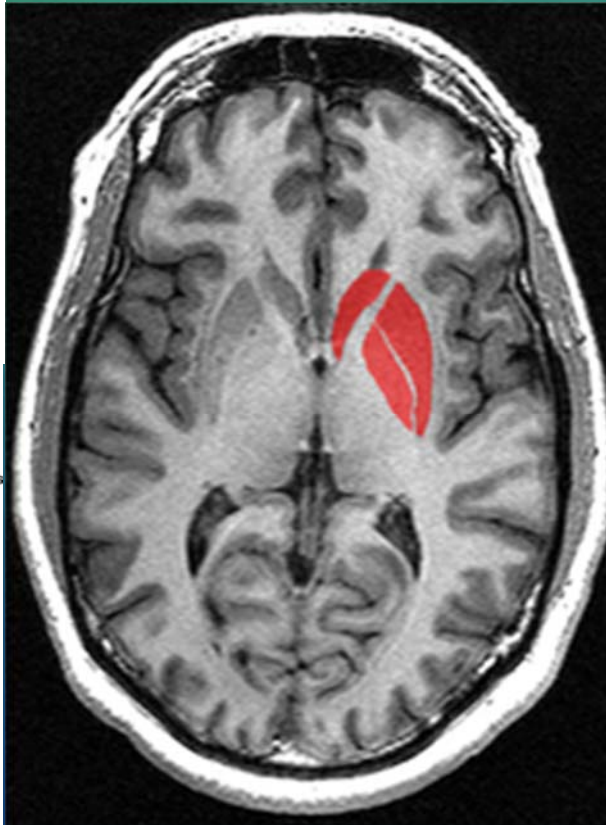
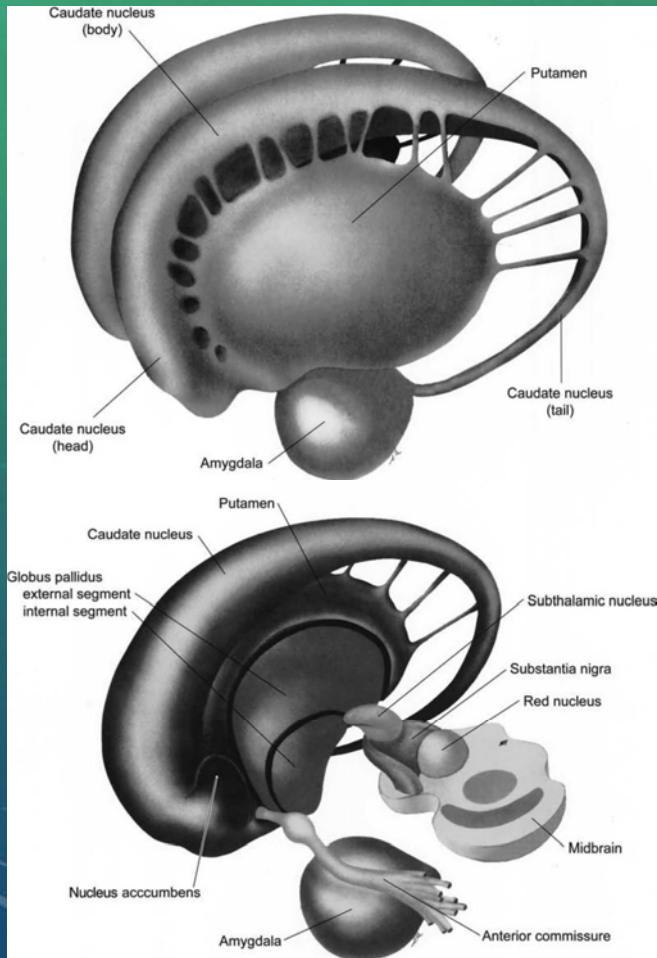
BASAL NUCLEI

- **Dorsal basal nuclei:** the caudate and lenticular nuclei
- **Ventral striatum:** the nucleus accumbens plus parts of the adjacent olfactory tubercle
- **Ventral pallidum:** the substantia innominata



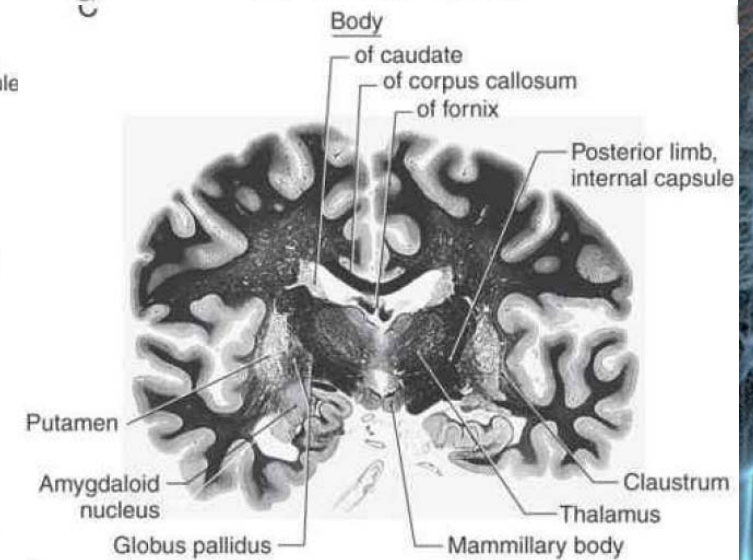
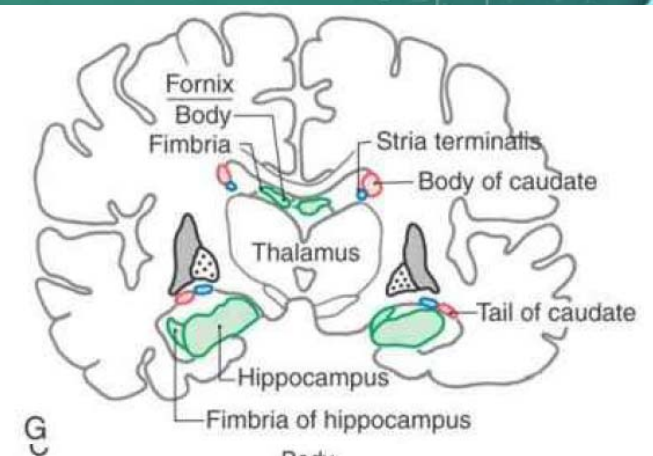
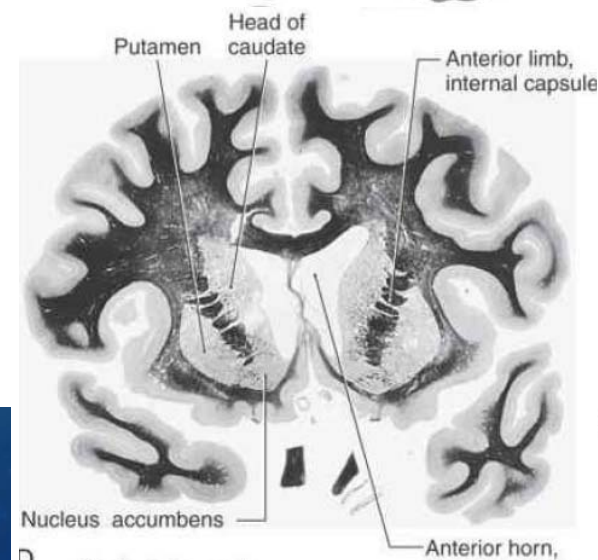
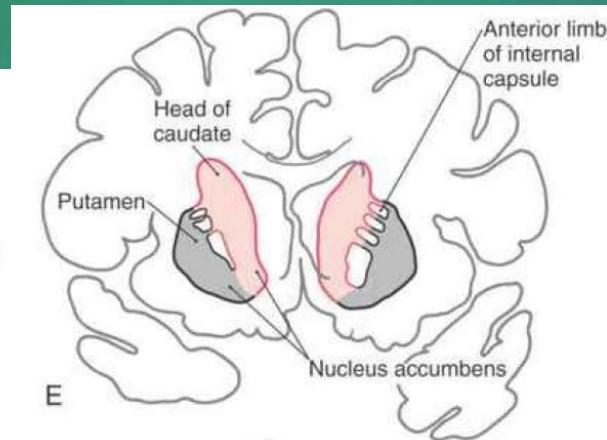
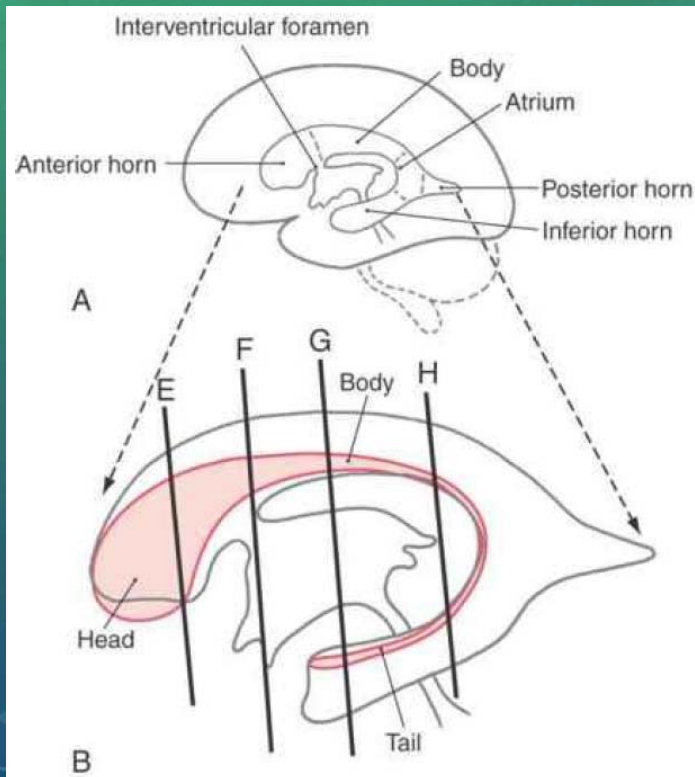
DORSAL BASAL NUCLEI

Caudate Nucleus, Putamen, and Globus Pallidus



DORSAL BASAL NUCLEI

Caudate Nucleus, Putamen, and Globus Pallidus

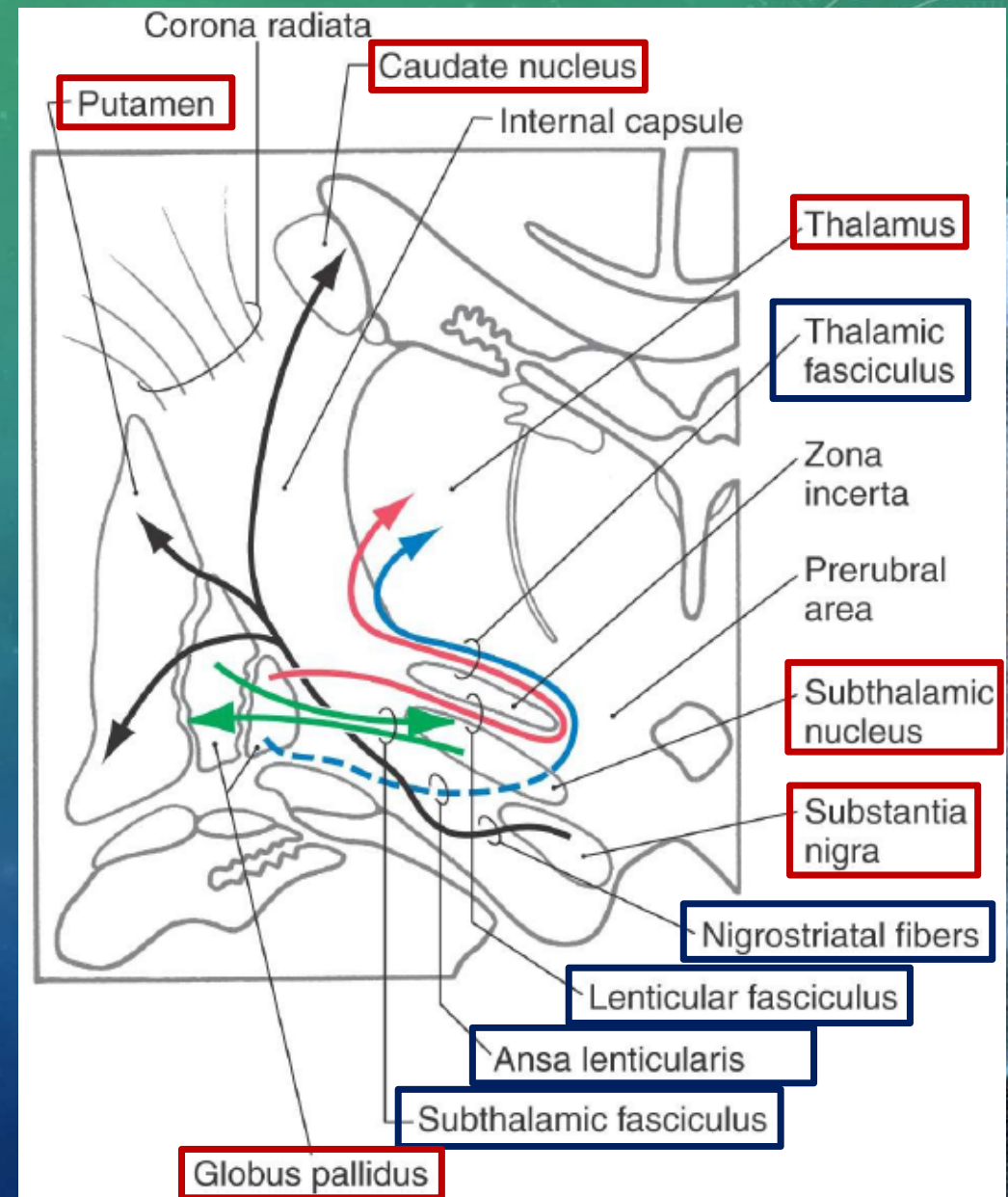


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MAJOR CONNECTIONS OF BASAL NUCLEI

- Efferent fibers:
 - Globus pallidus → Lenticular fasciculus → thalamic fasciculus → thalamus
 - Globus pallidus → Ansa lenticularis → thalamic fasciculus → thalamus
- Bidirectional fibers:
 - Globus pallidus ⇔ subthalamic fasciculus ⇔ subthalamic nucleus
 - Substantia nigra → nigrostriatal fibers → corpus striatum
 - Corpus striatum ⇔ striatonigral fibers ⇔ substantia nigra

<http://www.ym.edu.tw/~cflu>



TELENCEPHALON

- Cerebral Cortex
 - Gyri
 - Sulci
 - Lobes
- Subcortical White Matter (Myelinated fibers)
 - Association fibers
 - Commissural fibers
 - Projection fibers (Internal capsule)
 - Corticofugal fibers
 - Corticopetal fibers
- Basal nuclei



THE END

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