

# 511-2018-09-05-anatomy-II

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# Prelude



# Today's Topics

- Web resources
- Wrap up on the forebrain
- White matter tracts
- The peripheral nervous system

# Web resources

- Harvard Whole Brain Atlas
  - Whole Brain Atlas Top 100 Brain Structures List
- Normal Anatomy
  - Linked list of structures

# Organization of the brain

Major division	Ventricular Landmark	Embryonic Division	Structure
Forebrain	Lateral	Telencephalon	Cerebral cortex
	Third	Diencephalon	Thalamus
	Cerebral Aqueduct	Mesencephalon	Hypothalamus
Midbrain			Tectum, tegmentum

# Organization of the brain

Major division	Ventricular Landmark	Embryonic Division	Structure
Hindbrain	4th	Metencephalon	Cerebellum, pons
	-	Myelencephalon	Medulla oblongata

# Cerebral Cortex

Cerebral hemispheres

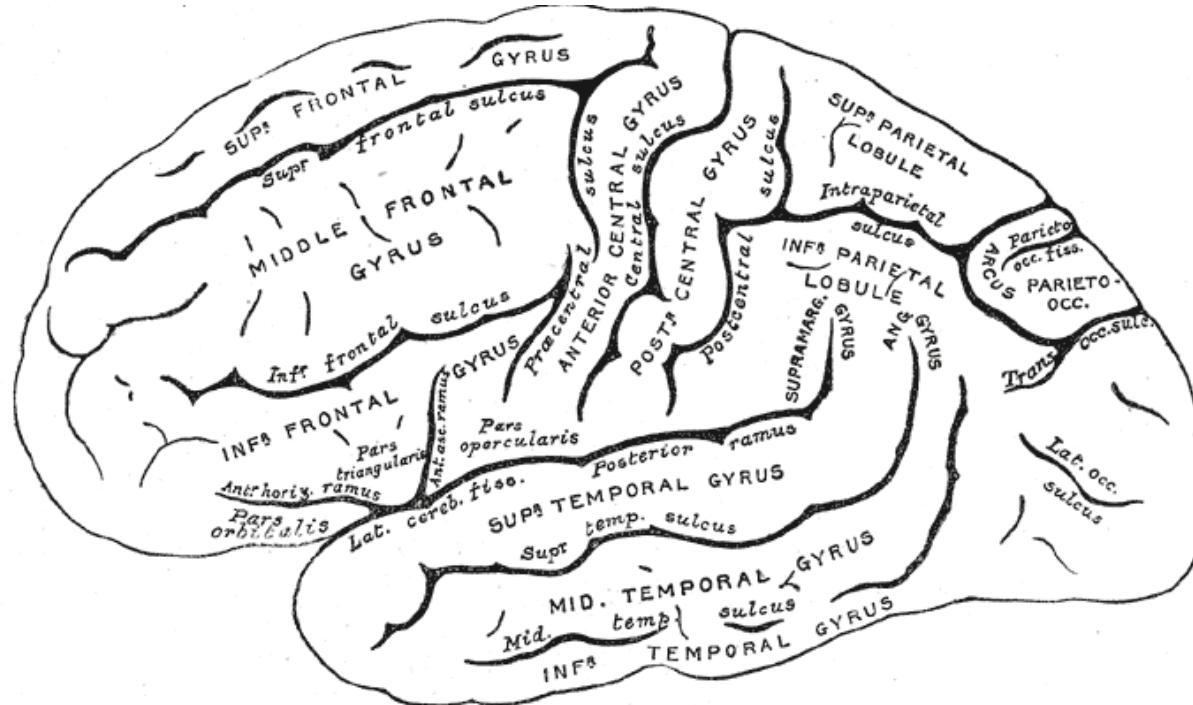
Groove (sulcus or sulci)

Bumps (gyrus or gyri)

Grey vs.white matter

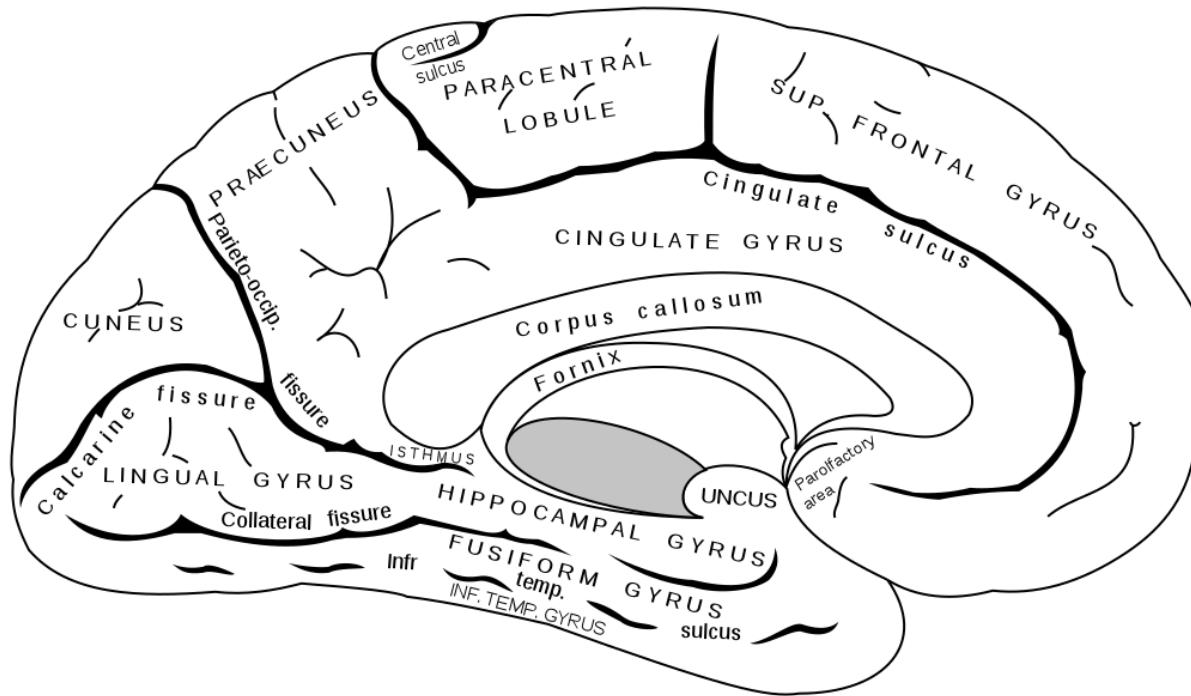
Lobes

# Cortical Gyri – Lateral



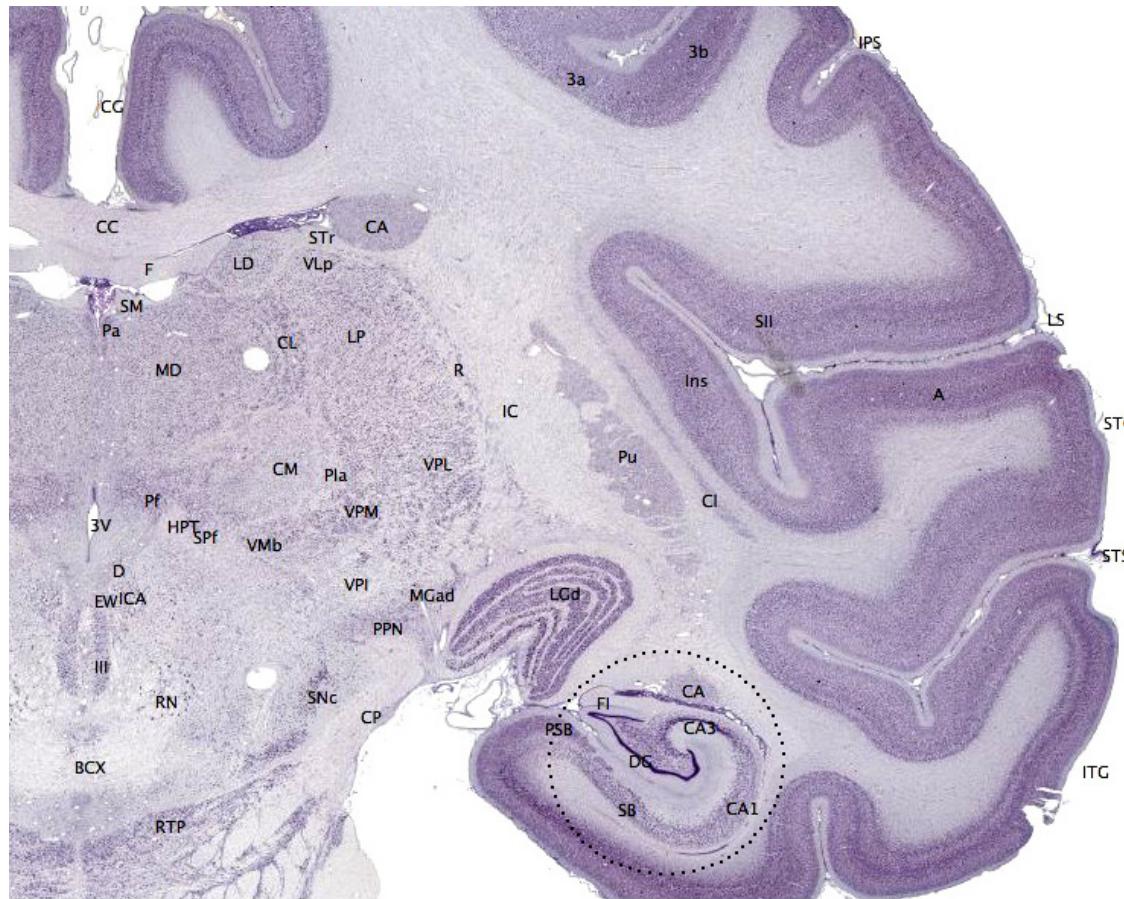
<https://upload.wikimedia.org/wikipedia/commons/3/35/Gray726.png>

# Cortical Gyri – Medial



<https://upload.wikimedia.org/wikipedia/commons/thumb/f/fe/Gray727.svg/1025px-Gray727.svg.png>

# Gray vs. White Matter



<https://upload.wikimedia.org/wikipedia/commons/9/9a/Brainmaps-macaque-hippocampus.jpg>

# Lobes of the cerebral cortex

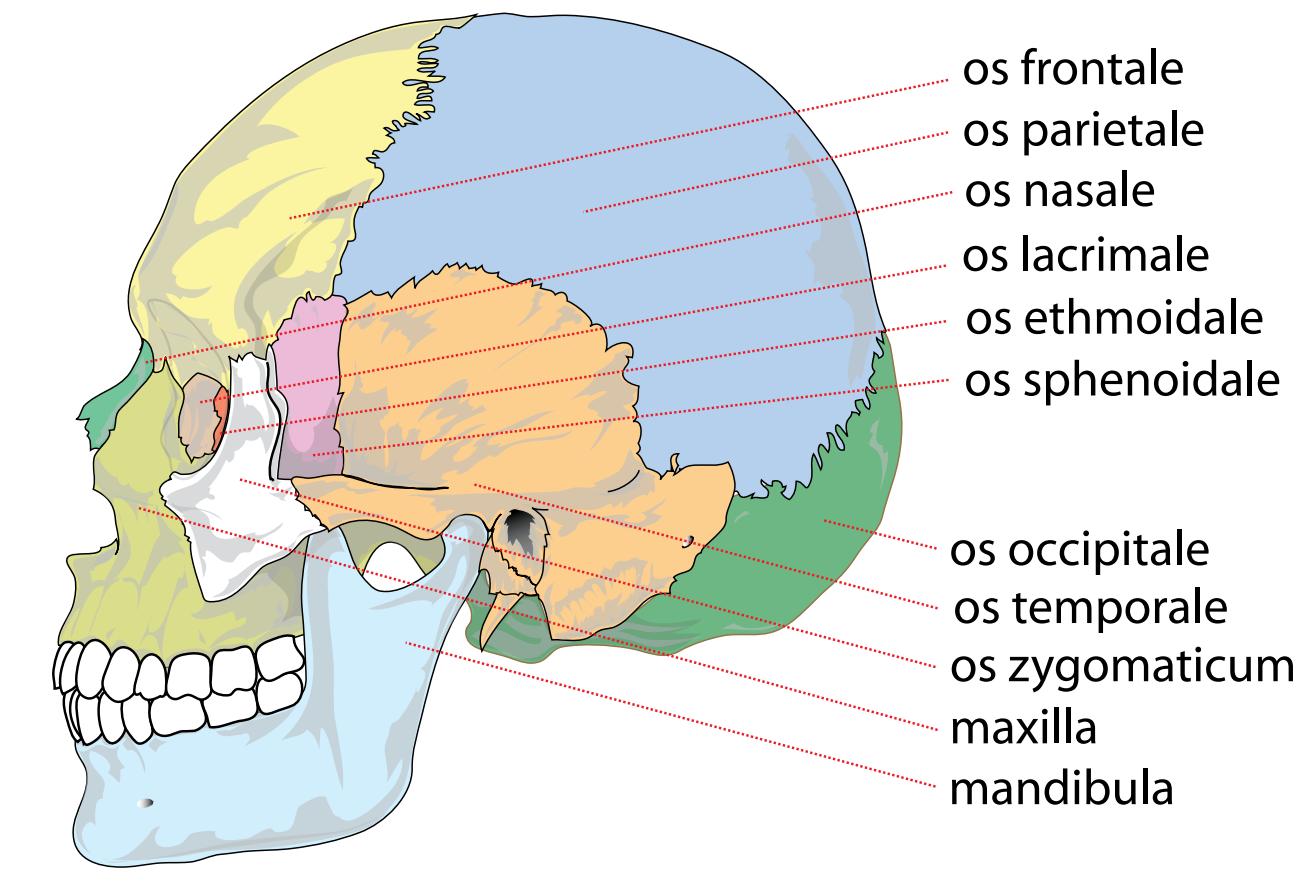
Frontal

Temporal

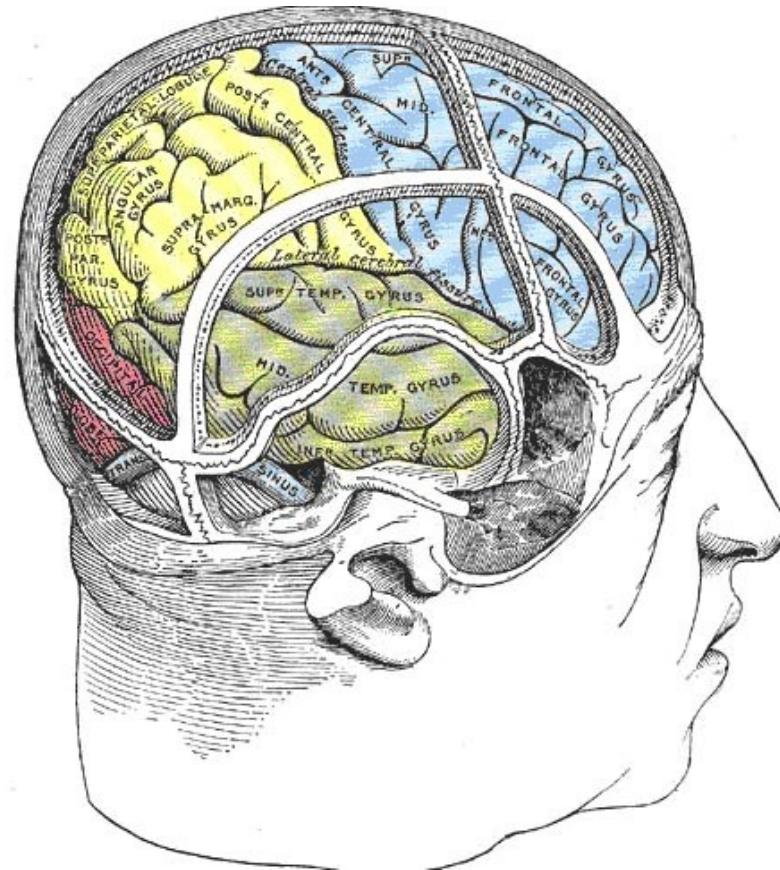
Parietal

Occipital

# Bones of the skull



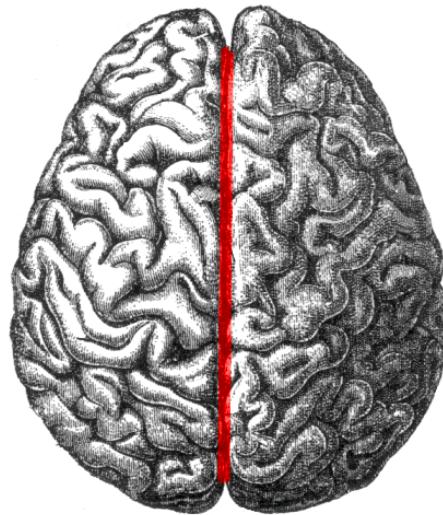
# Lobes



[http://40.media.tumblr.com/tumblr\\_m1kpkr7Wsq1rn6pqko1\\_500.jpg](http://40.media.tumblr.com/tumblr_m1kpkr7Wsq1rn6pqko1_500.jpg)

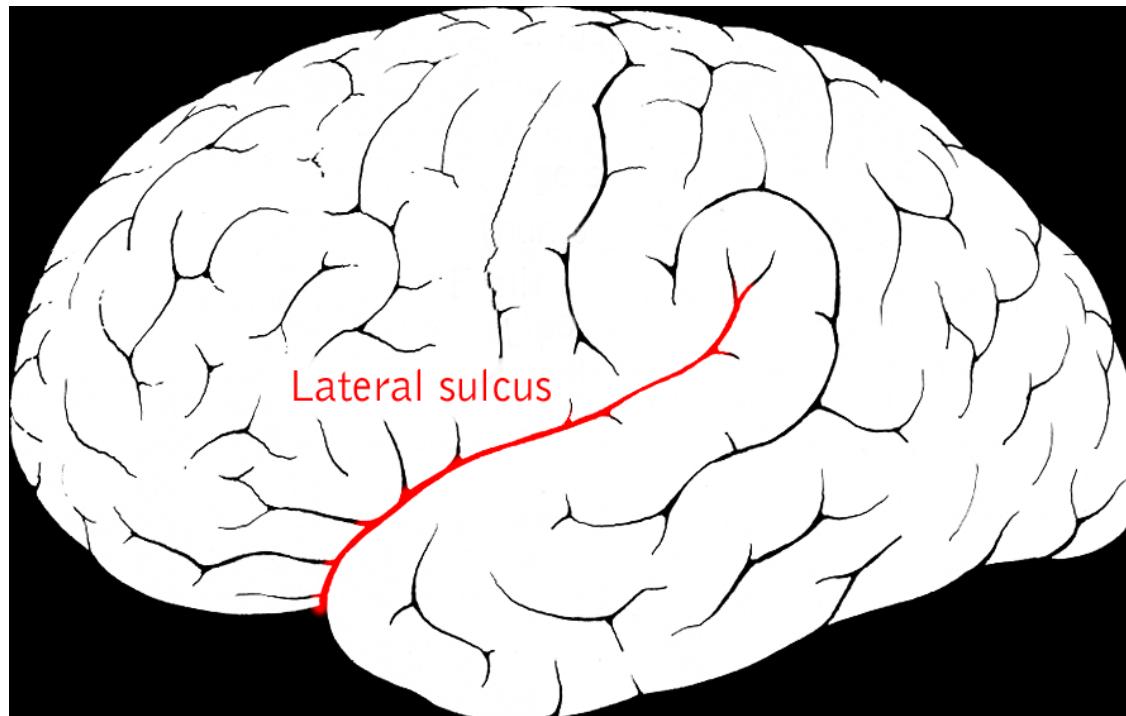
# Landmarks of the cortex

Longitudinal fissure



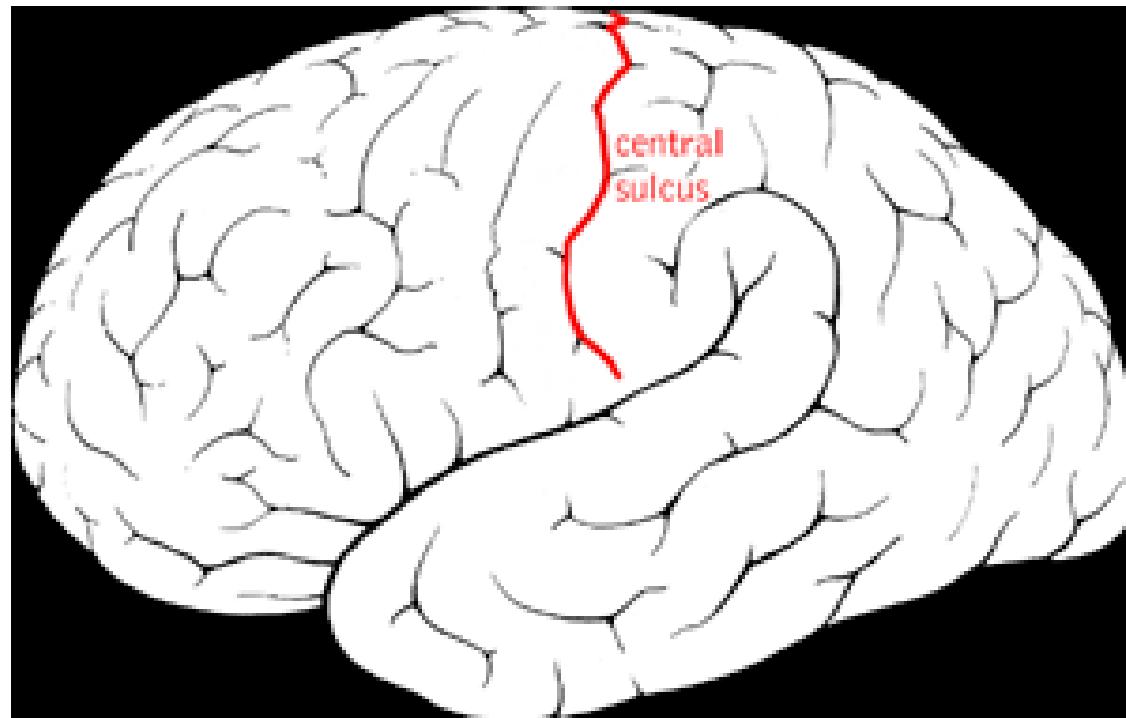
[https://upload.wikimedia.org/wikipedia/commons/0/04/Human\\_brain\\_long.png](https://upload.wikimedia.org/wikipedia/commons/0/04/Human_brain_long.png)

# Lateral sulcus/fissure



[https://upload.wikimedia.org/wikipedia/commons/4/41/Lateral\\_sulcus2.png](https://upload.wikimedia.org/wikipedia/commons/4/41/Lateral_sulcus2.png)

# Central sulcus



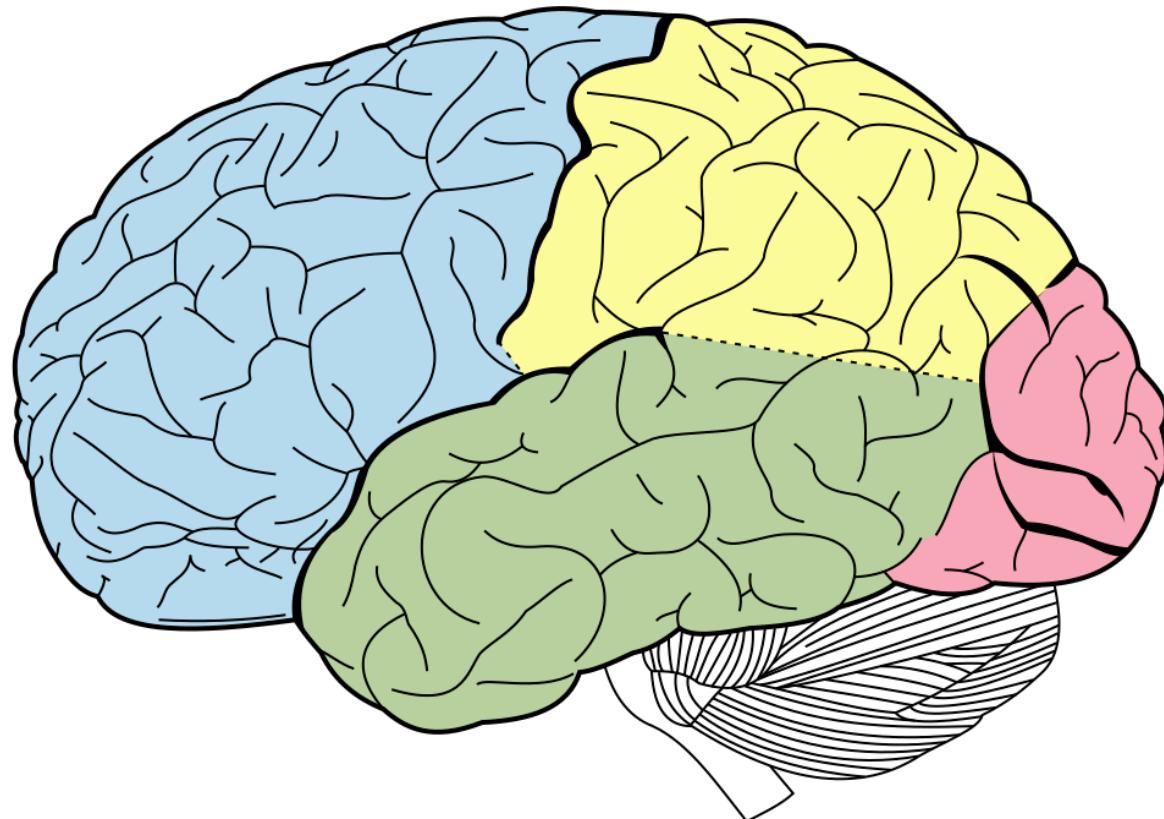
[https://upload.wikimedia.org/wikipedia/commons/8/88/Central\\_sulcus\\_diagram.png](https://upload.wikimedia.org/wikipedia/commons/8/88/Central_sulcus_diagram.png)

# Frontal lobe

Where is it?

- Anterior to central sulcus
- Superior to lateral fissure
- Dorsal to temporal lobe

# Lobes of the Cerebral Cortex



[https://upload.wikimedia.org/wikipedia/commons/thumb/0/0e/Lobes\\_of\\_the\\_brain\\_NL.svg/1024px-Lobes\\_of\\_the\\_brain\\_NL.svg.png](https://upload.wikimedia.org/wikipedia/commons/thumb/0/0e/Lobes_of_the_brain_NL.svg/1024px-Lobes_of_the_brain_NL.svg.png)

# Frontal lobe

## What does it do?

- Primary motor cortex (M1)
  - Supplementary motor cortex
  - Frontal eye fields (FEF)
- Prefrontal cortex
  - Planning, problem solving, working memory...?

# Frontal lobe

## What does it do?

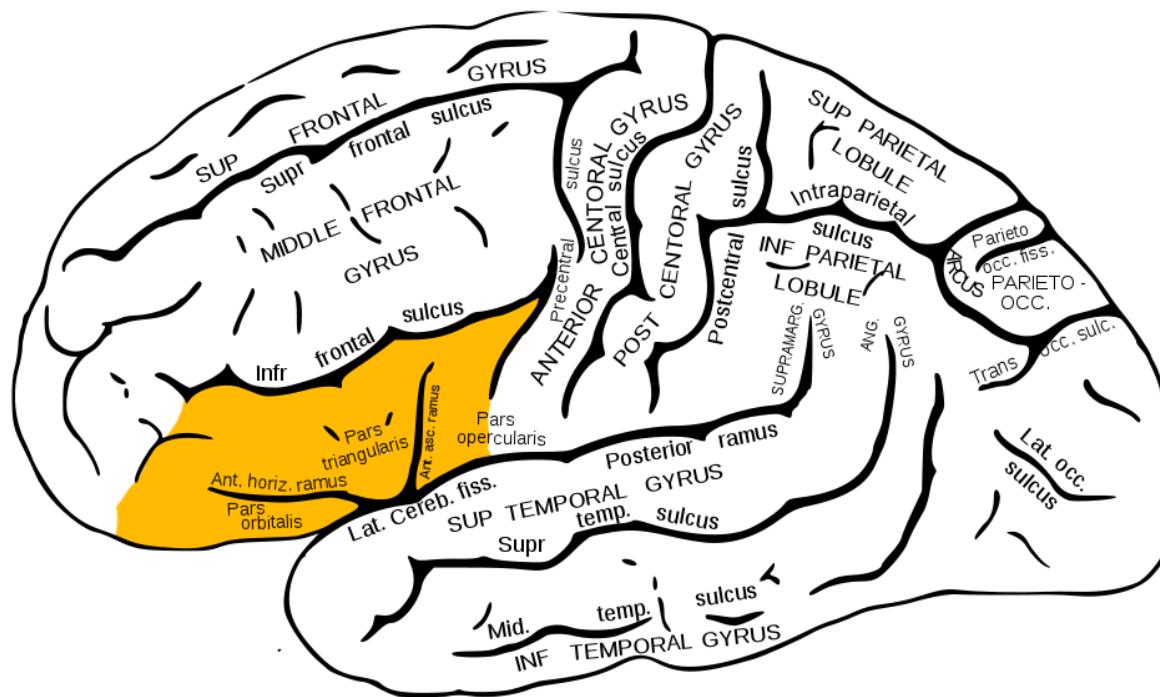
- Basal forebrain
  - Nucleus accumbens (NAcc), part of ventral striatum
- Anterior cingulate cortex (ACC)
- Primary olfactory cortex

# Cingulate Gyrus



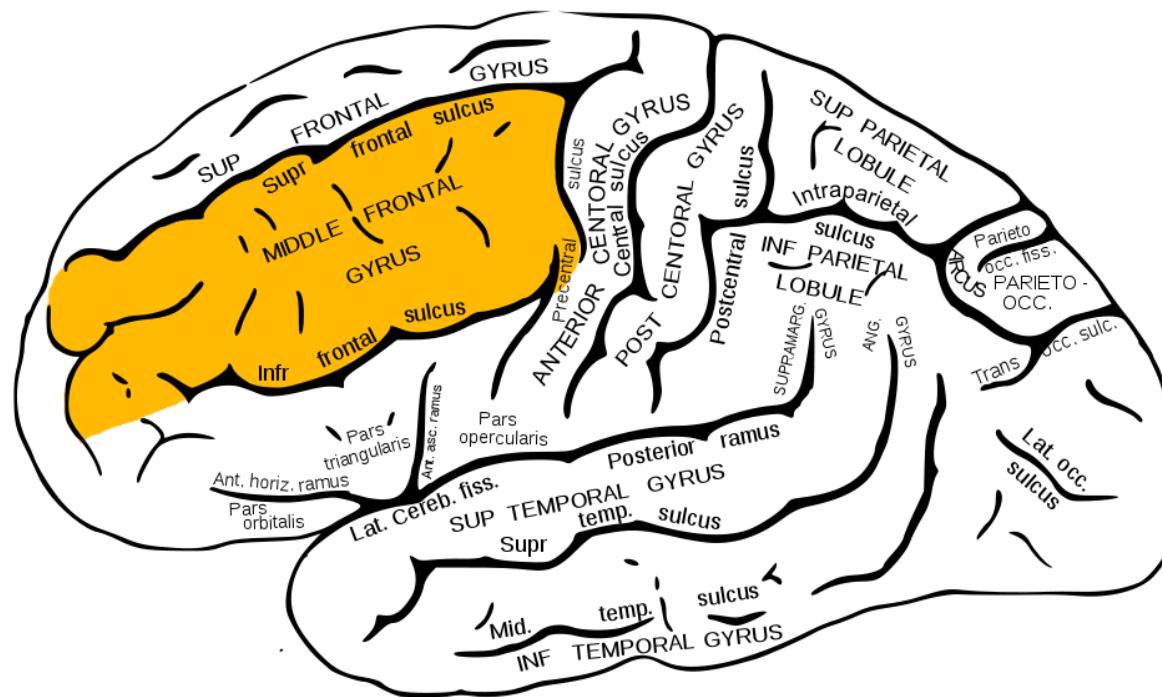
[http://cis.jhu.edu/data.sets/cortical\\_segmentation\\_validation/photos/cinggyrus75.jpg](http://cis.jhu.edu/data.sets/cortical_segmentation_validation/photos/cinggyrus75.jpg)

# Inferior Frontal Gyrus (IFG)



[https://upload.wikimedia.org/wikipedia/commons/b/b2/Gray726\\_inferior\\_frontal\\_gyrus.png](https://upload.wikimedia.org/wikipedia/commons/b/b2/Gray726_inferior_frontal_gyrus.png)

# Middle Frontal Gyrus (MFG)



[https://upload.wikimedia.org/wikipedia/commons/7/7f/Gray726\\_middle\\_frontal\\_gyrus.png](https://upload.wikimedia.org/wikipedia/commons/7/7f/Gray726_middle_frontal_gyrus.png)

# Temporal lobe

Where is it?

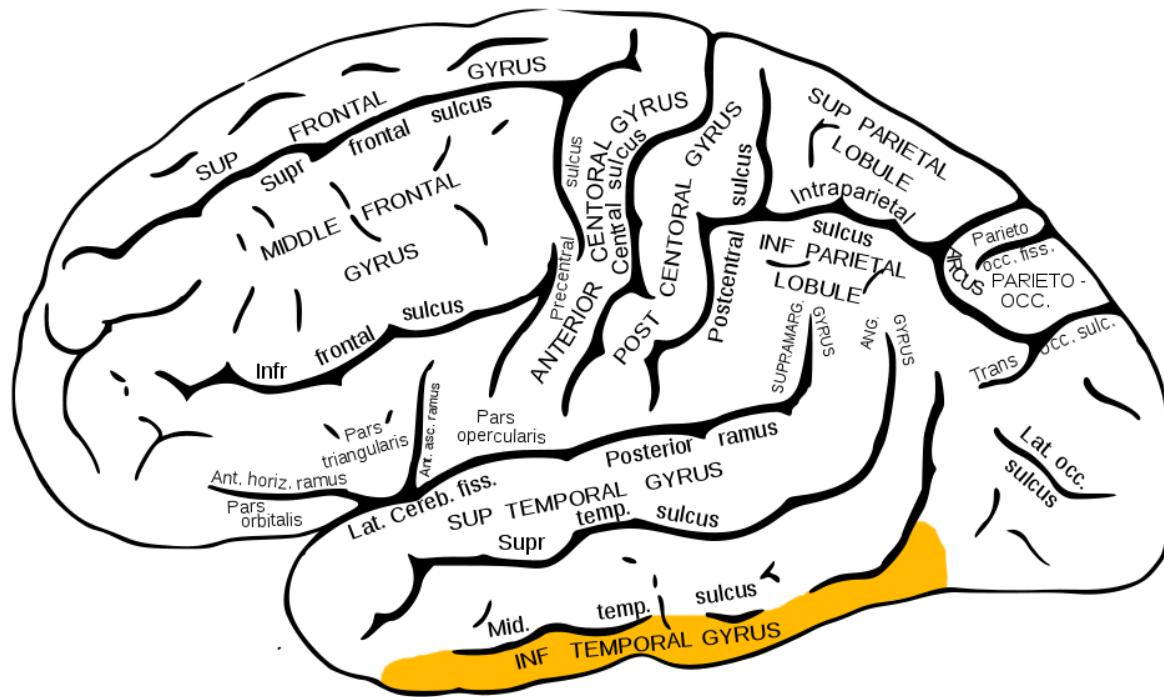
- Ventral to frontal, parietal lobes
- Inferior to lateral fissure

# Temporal lobe

## What does it do?

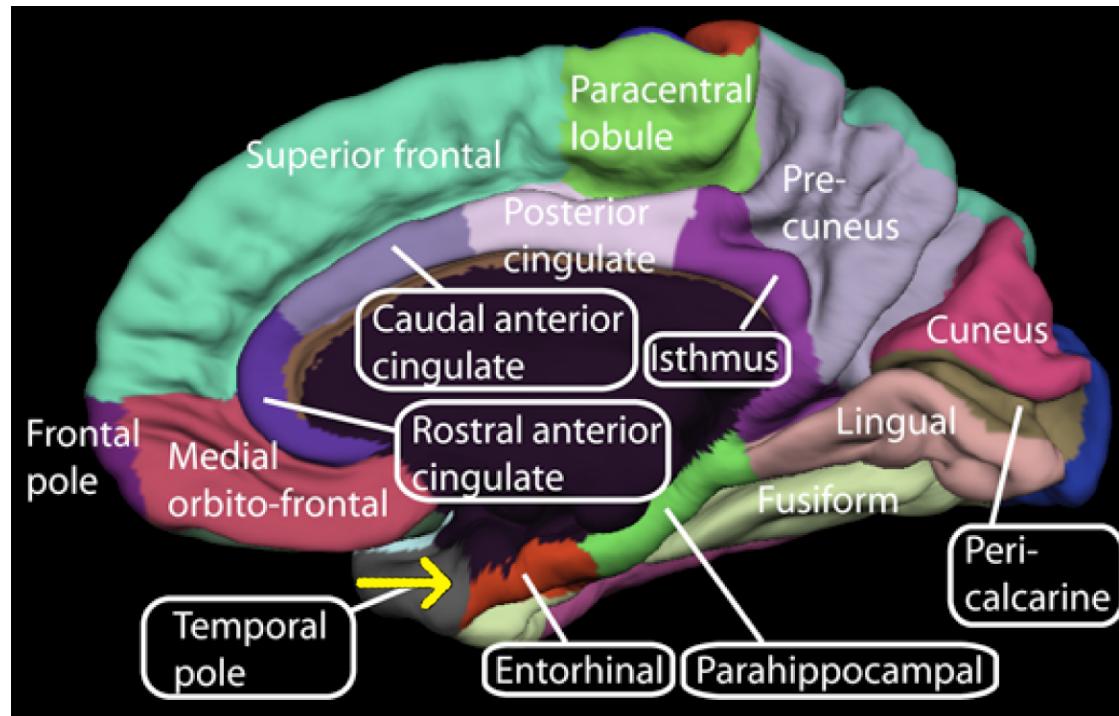
- Primary auditory cortex
- Object, face recognition
- Storage of memories about events, objects
- Amygdala, hippocampus

# Inferior Temporal Gyrus (ITG)



[https://upload.wikimedia.org/wikipedia/commons/1/18/Gray726\\_inferior\\_temporal\\_gyrus.png](https://upload.wikimedia.org/wikipedia/commons/1/18/Gray726_inferior_temporal_gyrus.png)

# Entorhinal Cortex (ER)



[https://upload.wikimedia.org/wikipedia/commons/1/15/Medial\\_surface\\_of\\_cerebral\\_cortex\\_-\\_entorhinal\\_cortex.png](https://upload.wikimedia.org/wikipedia/commons/1/15/Medial_surface_of_cerebral_cortex_-_entorhinal_cortex.png)

# Parietal lobe

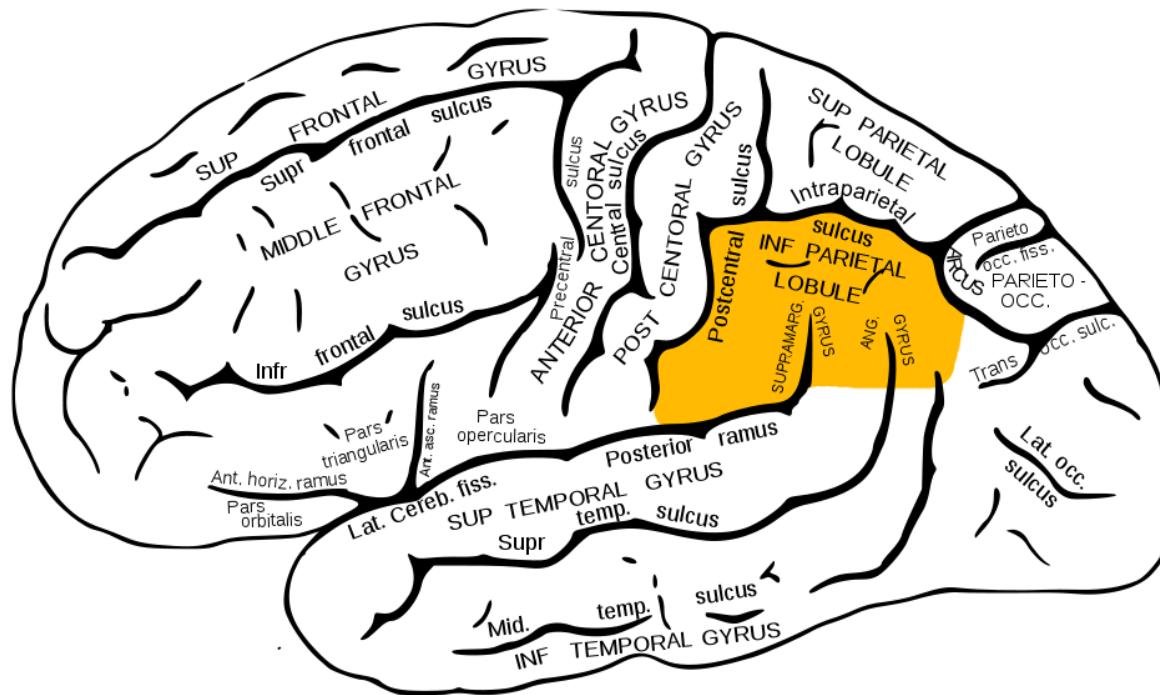
## Where is it?

- Caudal to frontal lobe
- Dorsal to temporal lobe
- Posterior to central sulcus

## What does it do?

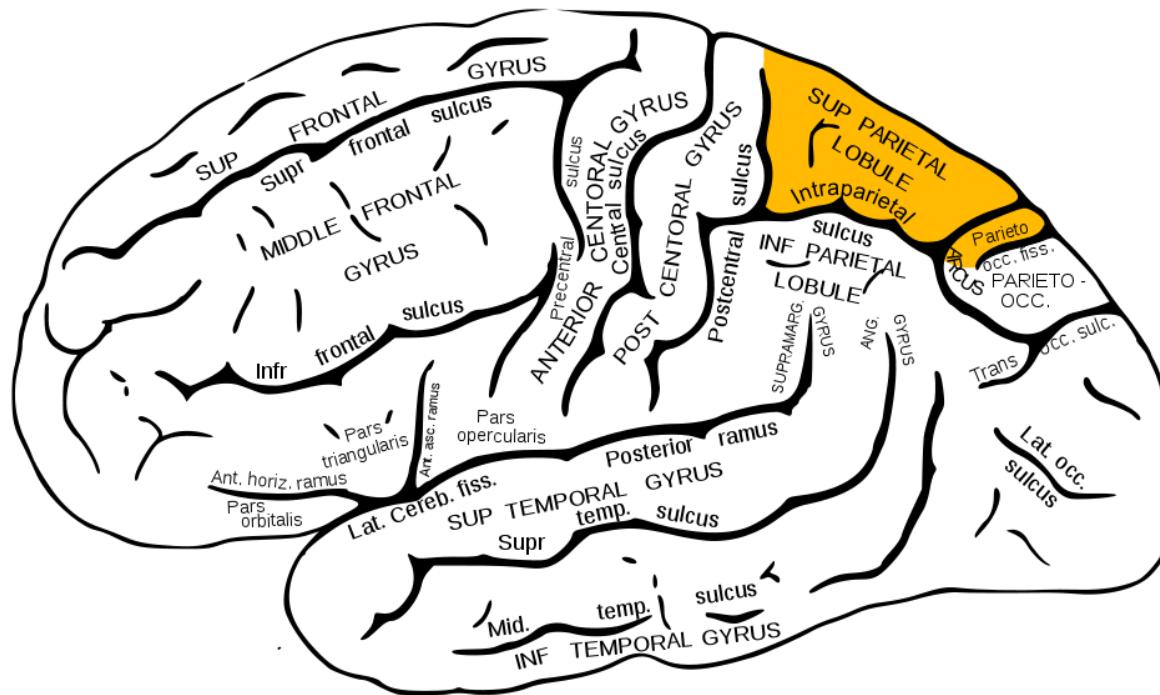
- Primary somatosensory cortex
- Perception of spatial relations, action planning

# Inferior Parietal Lobule



[https://upload.wikimedia.org/wikipedia/commons/e/e3/Gray726\\_inferior\\_parietal\\_lobule.png](https://upload.wikimedia.org/wikipedia/commons/e/e3/Gray726_inferior_parietal_lobule.png)

# Superior Parietal Lobule



[https://upload.wikimedia.org/wikipedia/commons/9/9d/Gray726\\_superior\\_parietal\\_lobule.png](https://upload.wikimedia.org/wikipedia/commons/9/9d/Gray726_superior_parietal_lobule.png)

# Occipital lobe

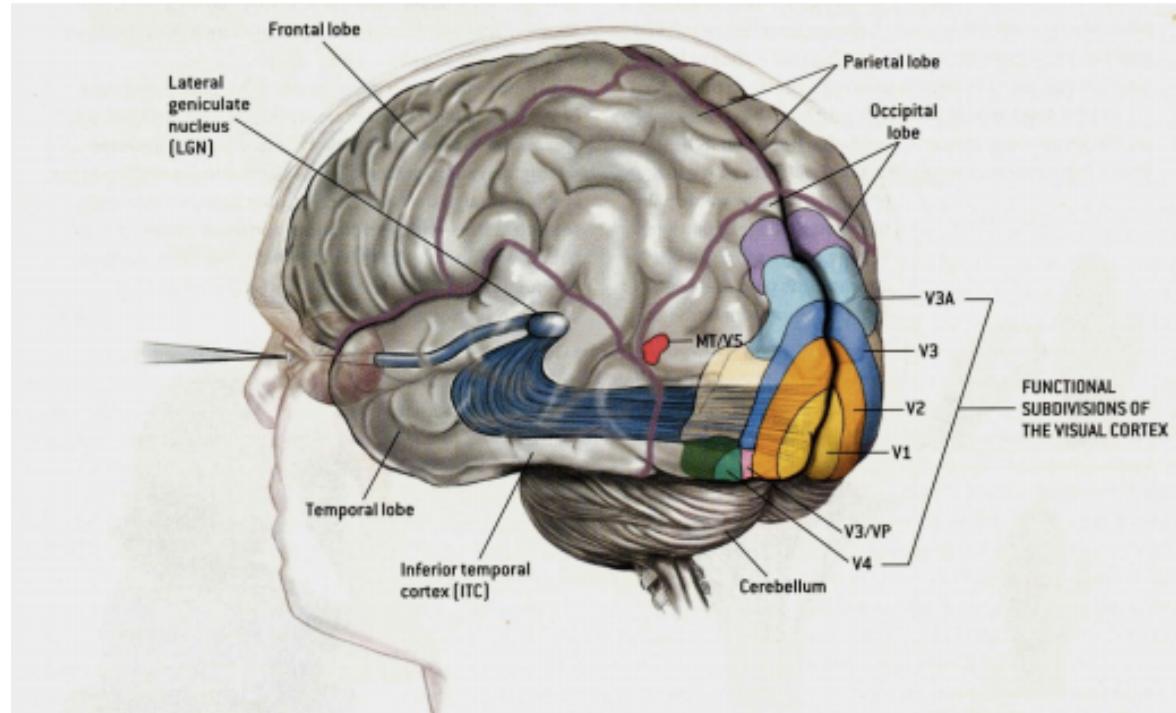
Where is it?

- Caudal to parietal & temporal lobes

What does it do?

- Primary visual cortex (V1)

# Visual Cortex



<http://bethycotter.wdfiles.com/local-files/introducingtheeye/Screen%20Shot%202012-08-24%20at%2011.36.20%20PM.png>

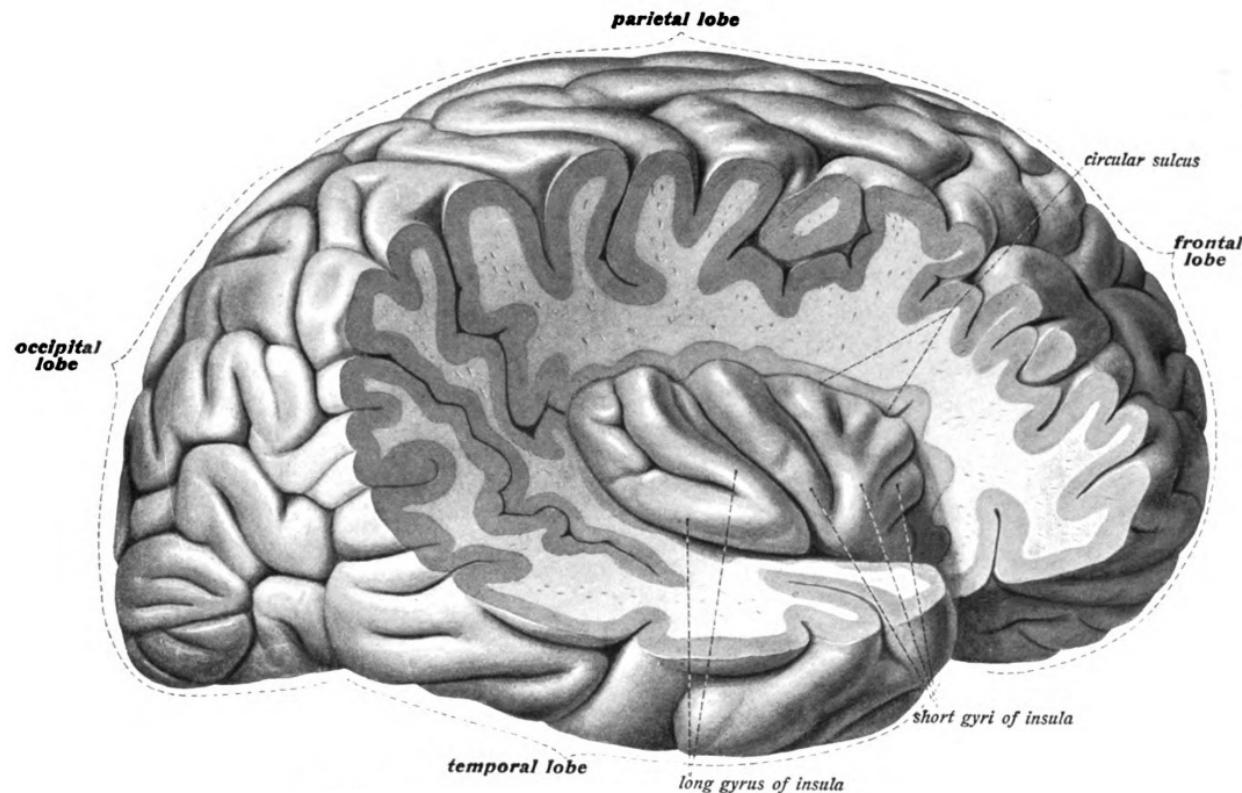
# Insular cortex (insula)

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Where is it?

- medial to temporal lobe
- deep inside lateral fissure

# Insula



[https://upload.wikimedia.org/wikipedia/commons/b/b4/Sobo\\_1909\\_633.png](https://upload.wikimedia.org/wikipedia/commons/b/b4/Sobo_1909_633.png)

# Insula

## What does it do?

- Primary gustatory cortex
- self-awareness, interpersonal experiences, motor control

# Brodmann Areas

## Korbinian Brodmann

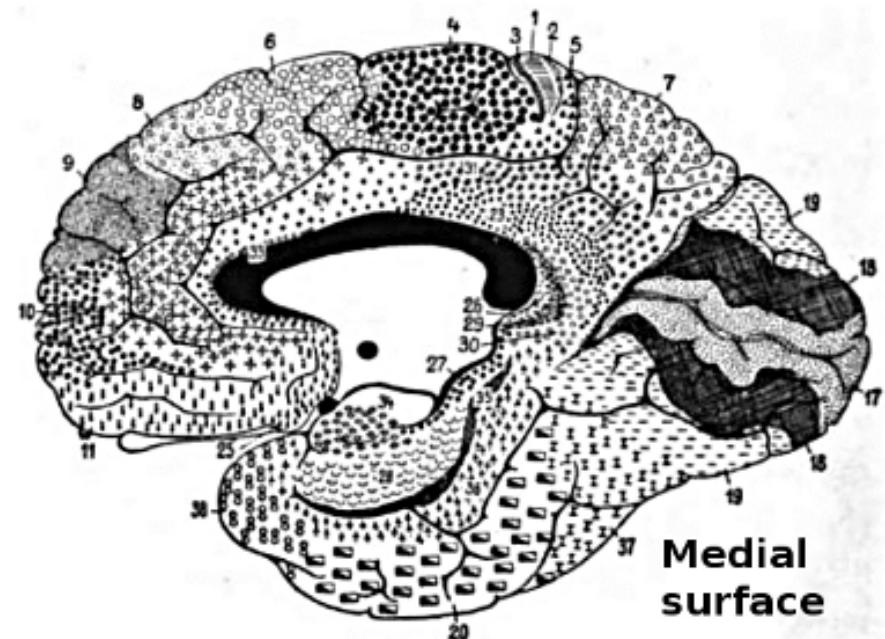
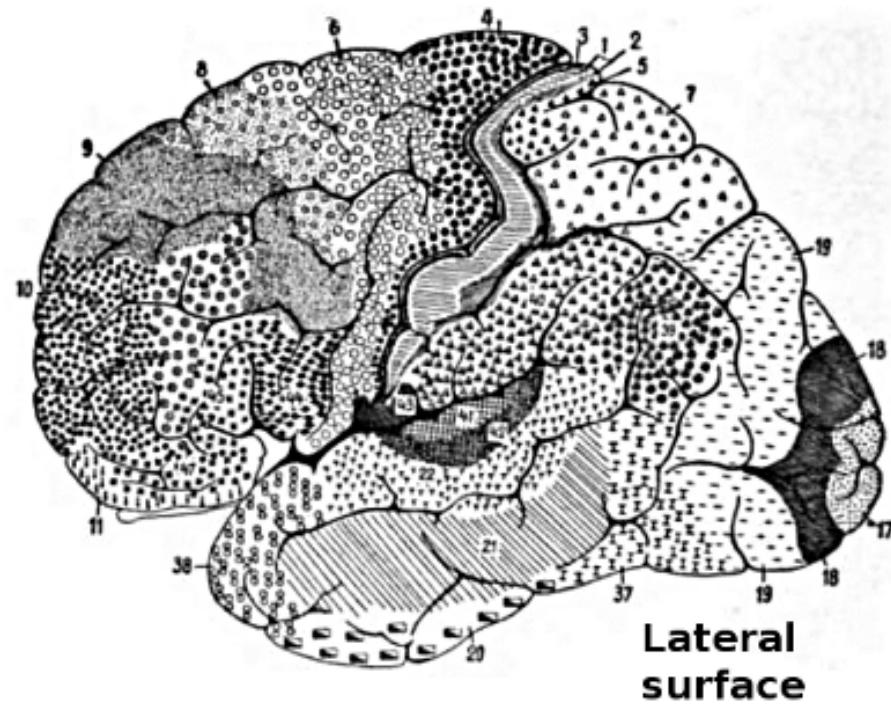
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- Cytoarchitectonic differences in cerebral cortex



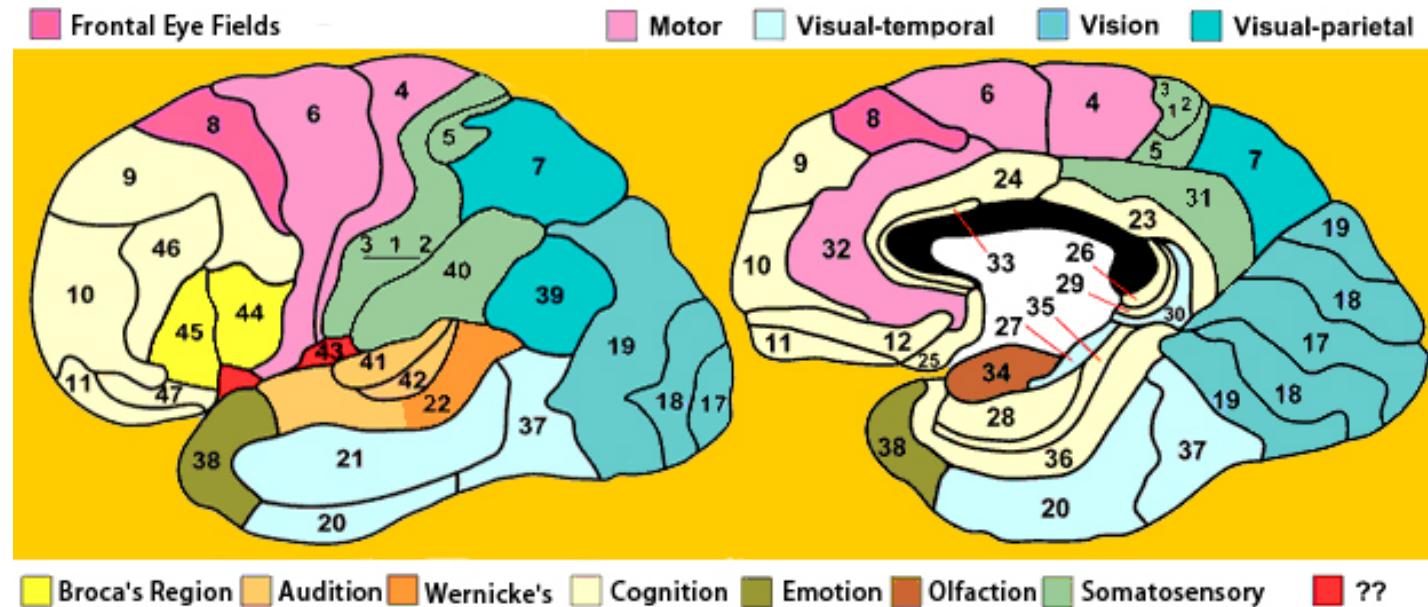
[http://www.spektrum.de/lexika/images/bio/fff1209\\_w.jpg](http://www.spektrum.de/lexika/images/bio/fff1209_w.jpg)

# Brodmann Areas



<https://upload.wikimedia.org/wikipedia/commons/0/09/Brodmann-areas.png>

# Brodmann Areas

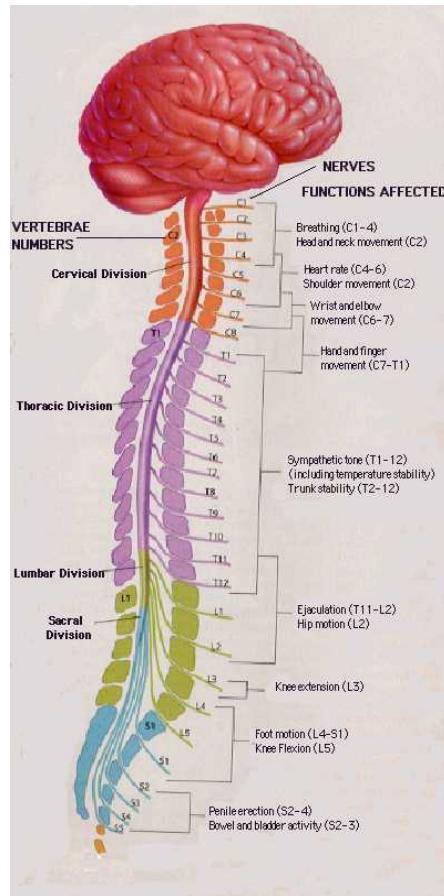


# Spinal cord

## Rostral/Caudal axis

- Spinal column w/ vertebrae
- Cervical (8), thoracic (12), lumbar (5), sacral (5), coccygeal (1)
- Spinal segments & 31 nerve pairs
- Cauda equina

# Spinal cord



<http://www.fauxpress.com/kimball/med/sensory/spinaldivisions.jpg>

# Spinal cord

## Organization of the spinal cord

- Dorsal/Ventral
  - Dorsal root (sensory)
  - Ventral root (mostly motor)
- Grey (interior) vs. white matter (exterior)

Cross section of the spinal cord.

# Organization of the PNS

Somatic division

Autonomic

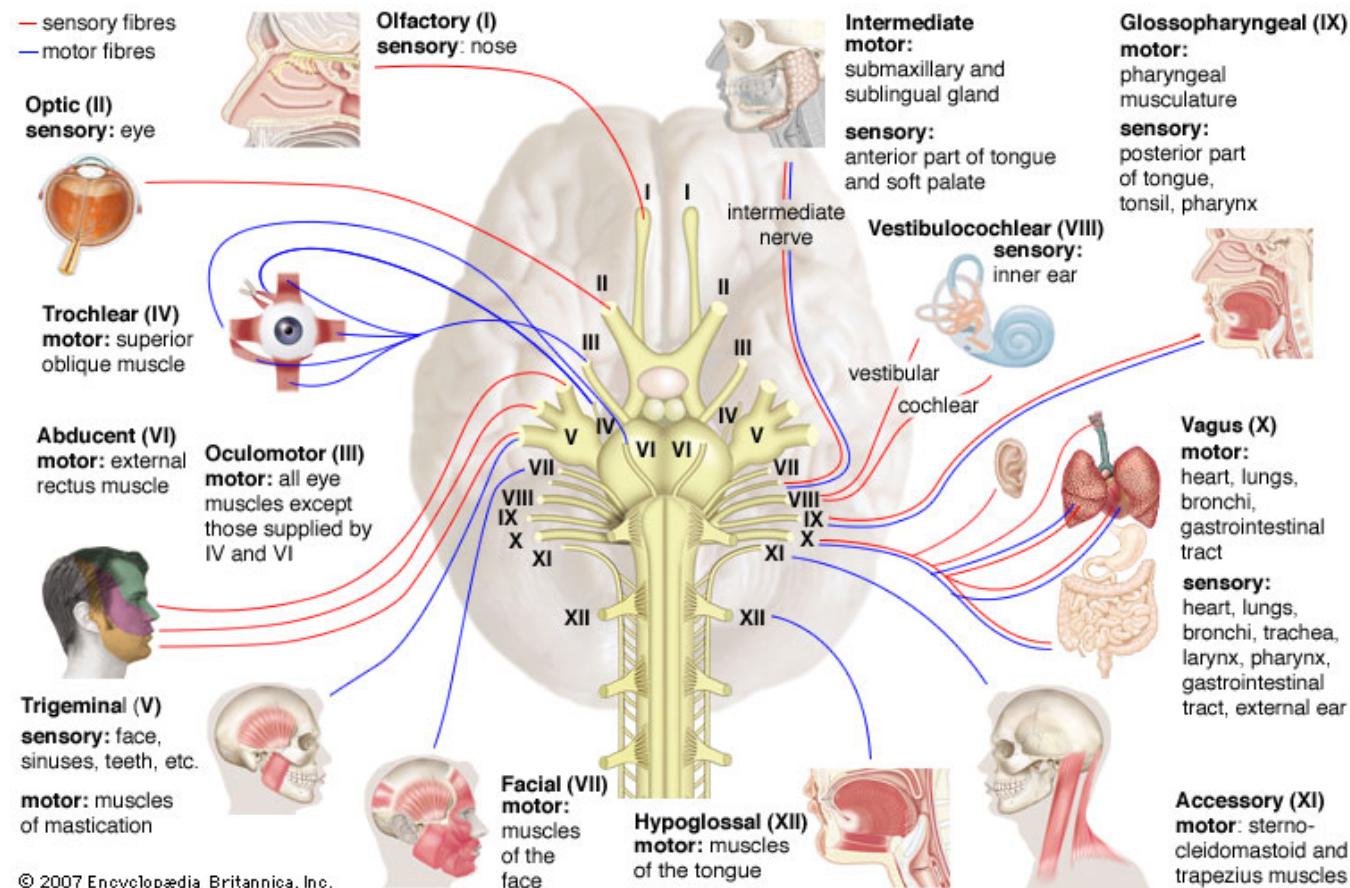
Cranial nerves

Spinal nerves

# Cranial nerves

- Afferents (input), efferents (output), or mixed
- Innervate head and neck
- Olfactory (I), optic (II), (VIII) auditory, vagus (X), etc.
- Spinal nerves

# Cranial nerves



<http://media-1.web.britannica.com/eb-media/44/54244-004-892C5169.jpg>

# Major white matter pathways

Brainstem

Projection fibers

Association fibers

Commissural fibers

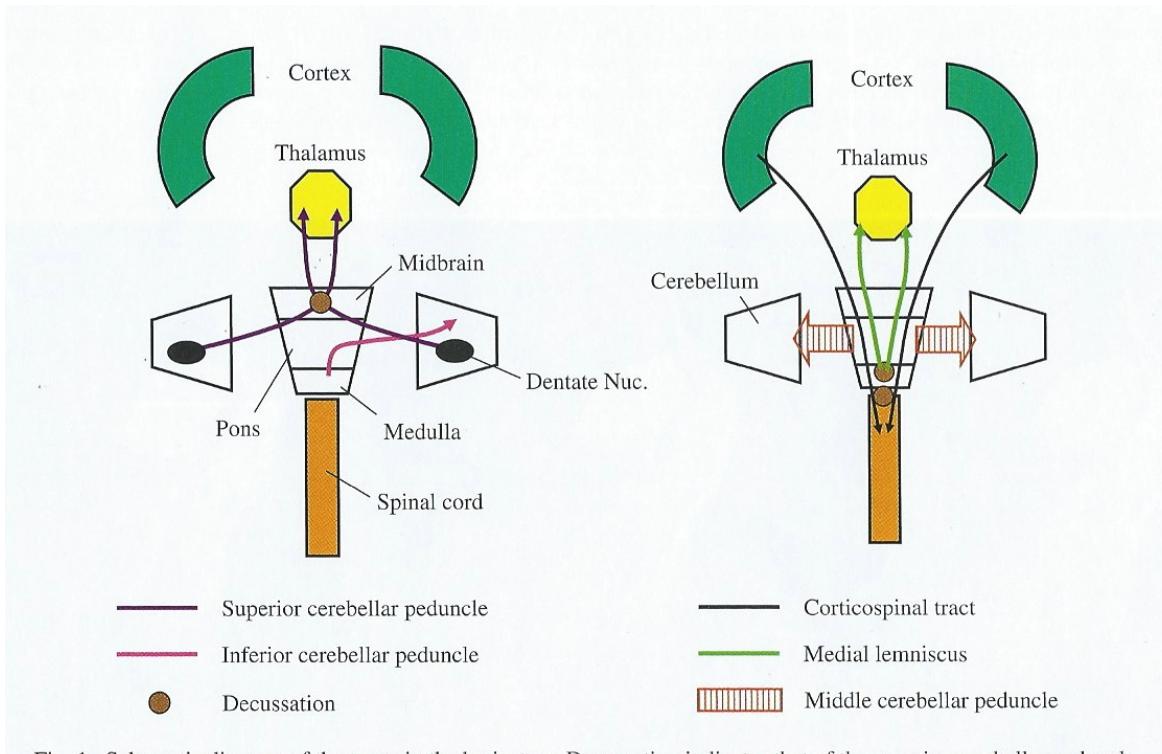


Fig. 1. Schematic diagram of the tracts in the brainstem. Decussation indicates that of the superior cerebellar peduncle.

[\(Oishi, Faria, Zijl, & Mori, 2010\), Chapter 3, Figure 1.](#)

# Brainstem projections

- Corticospinal tract (descending/efferent)
- Dorsal column/medial lemniscus (ascending/afferent)
- Superior/inferior cerebellar peduncles (from/to cerebellum)

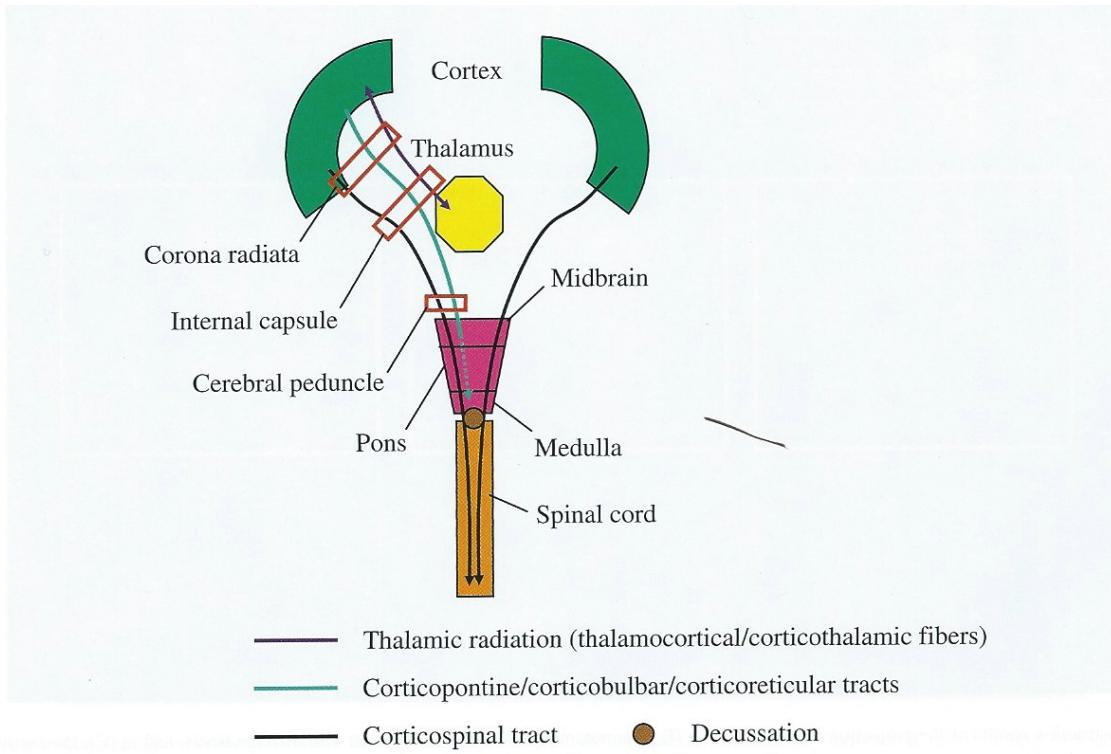


Fig. 8. A schematic diagram of trajectories of projection fibers reconstructed in this atlas. The decussation is that of the corticospinal tract.

(Oishi et al., 2010), Chapter 3, Figure 8.

# Projection fiber tracts

- Internal capsule
  - Thalamic radiation
  - Cortico-{pontine, bulbar, reticular} tracts

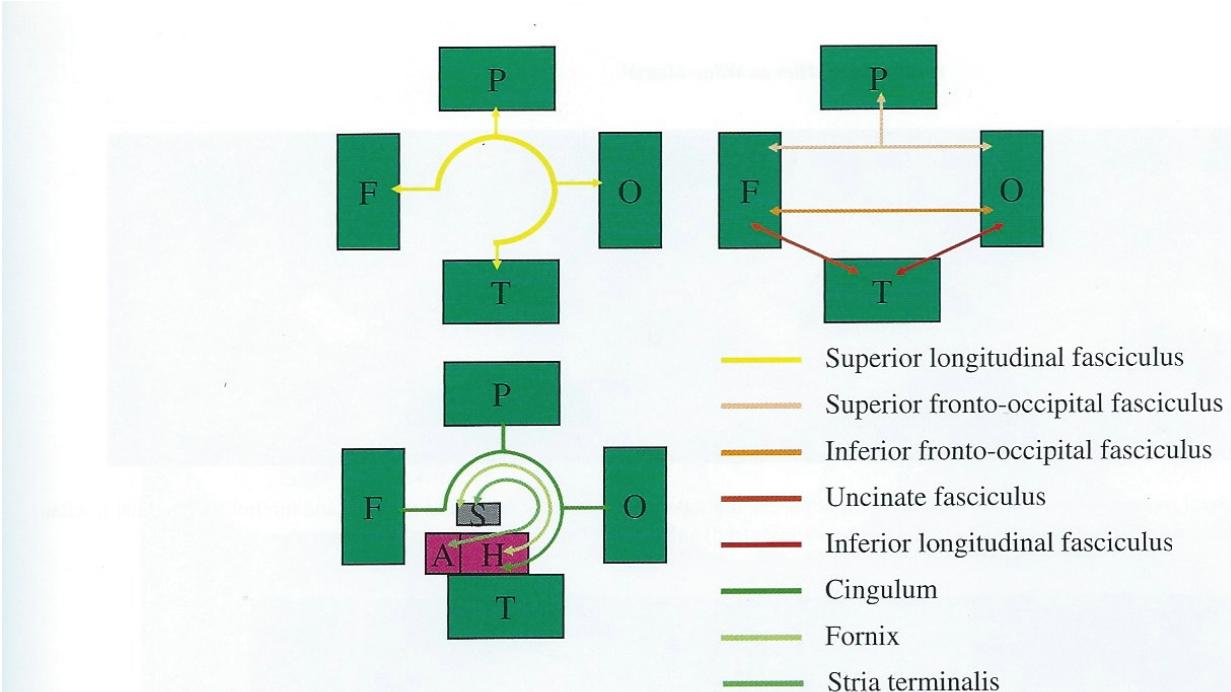


Fig. 11. A schematic diagram of some cortico-cortical connections by association fibers. Abbreviations are F, frontal, P, parietal, O, occipital, and T, temporal cortices, A, amigdala, H, hippocampus, S, septal area.

(Oishi et al., 2010), Chapter 3, Figure 11.

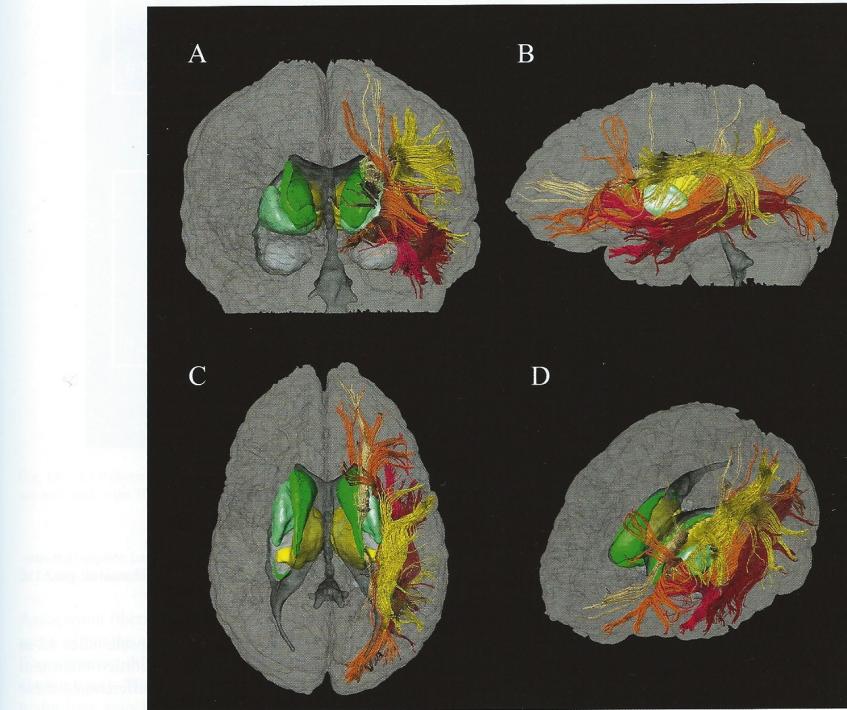


Fig. 12. 3D reconstruction results of some association fibers. Tracts are viewed from the anterior (A), left (B), superior (C), and oblique (left-antero-superior) (D) orientations. Color coding: slf is yellow, ifo is orange, unc is red, and ilf is brown. Cerebral hemispheres are delineated by semi-transparent gray. Thalami are yellow, ventricles are gray, caudate nuclei are green and lentiform nuclei are light green.

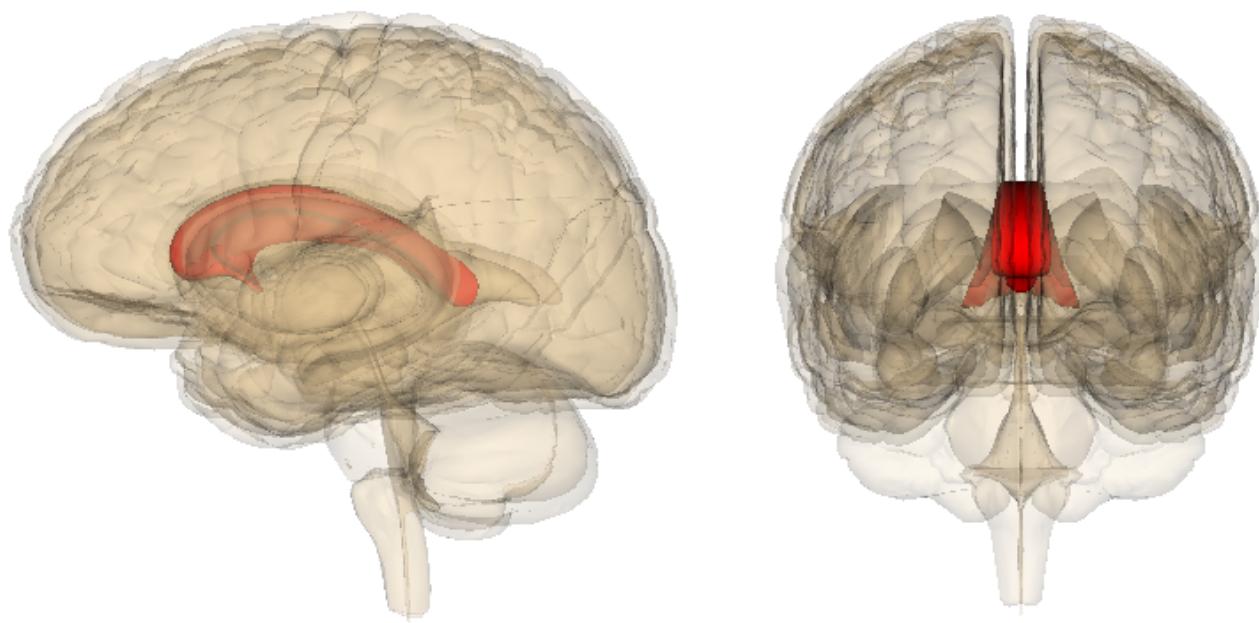
[\(Oishi et al., 2010\), Chapter 3, Figure 11.](#)

# Cortical white matter tracts

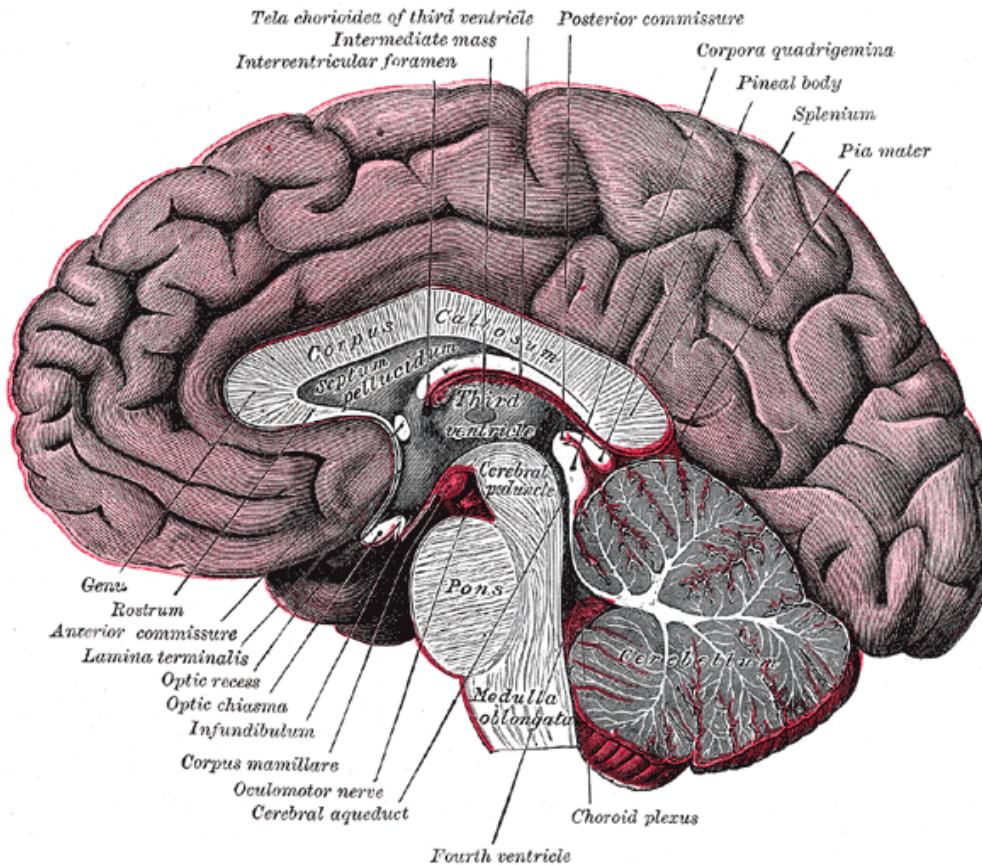
- Superior/inferior longitudinal fasciculus
  - Arcuate fasciculus part of sup. long. f.
- Superior/inferior fronto-occipital fasciculus
- Cingulum, fornix (hyp-hip), stria terminalis (hyp-amyg)

# Commissural fibers

- Corpus callosum
- Anterior commissure (AC)
- Posterior commissure (PC)



# Anterior, Posterior Commissures

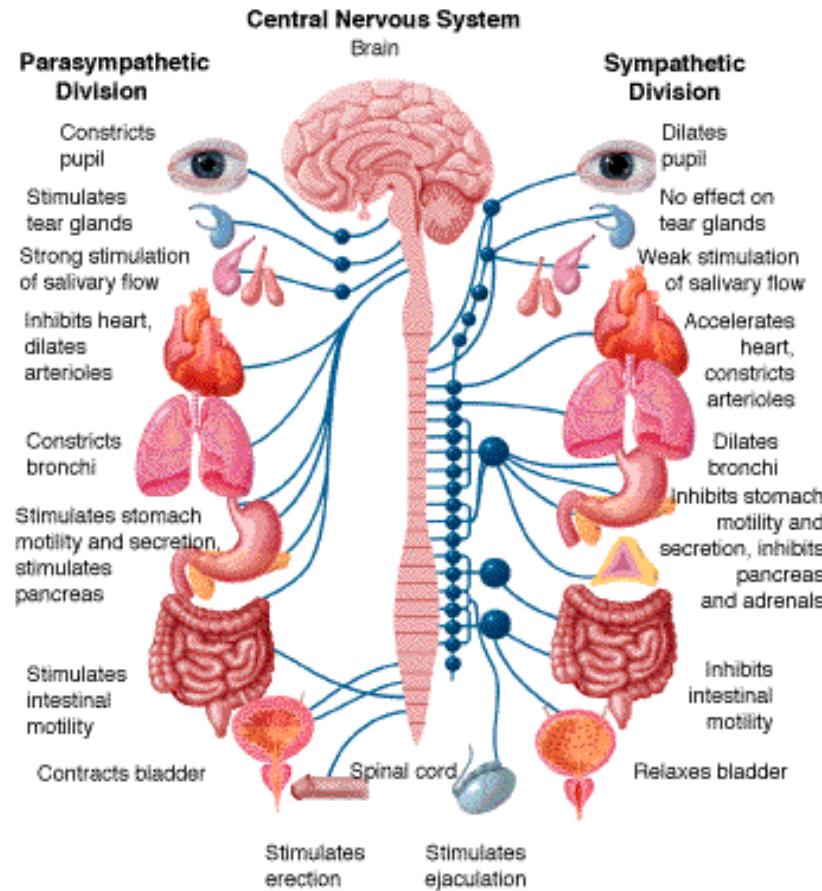


<https://upload.wikimedia.org/wikipedia/commons/2/22/Gray720.png>

# Autonomic nervous system

- CNS & PNS components
- Controls “vegetative functions”
  - Limited voluntary control
- Two divisions
  - Sympathetic
  - Parasympathetic

# ANS



[https://4.bp.blogspot.com/\\_FBNLGBBprSE/TB5b9zkM11I/AAAAAAAHA/LBCT2HkOzvl/s400/PNS.GIF](https://4.bp.blogspot.com/_FBNLGBBprSE/TB5b9zkM11I/AAAAAAAHA/LBCT2HkOzvl/s400/PNS.GIF)

# Sympathetic division

- Prepares body for action
- “Fight or flight”
- Spinal cord
  - ganglion chain along spinal column to End organs
- NTs
  - Preganglionic: ACh
  - Post: NE

# Parasympathetic division

- “Around” sympathetic
- Restorative function
- “Rest & digest”
- Spinal cord (or Vagus n.) -> ganglia near end organs -> end organ
  - NT: ACh

# Next time

- Neuroanatomy lab

# References

Oishi, K., Faria, A. V., Zijl, P. C. van, & Mori, S. (2010). . Academic Press.