

# Section 1

# Neuroanatomy

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COGS 17 A05

04/07/25

## Sujin Park

### Education:

first-year PhD Student in Cognitive Science

MA Psychology

BA Political Science and Diplomacy & Psychology

### Research:

- Biomarkers of Neurodevelopmental disorders

### Contact Info:

- Email: [sup031@ucsd.edu](mailto:sup031@ucsd.edu) (Pls include COGS17 in subject line) or Canvas Inbox
- Discussion Section: Monday 1pm @ CSB 004
- Office Hours: Thursday 2pm (zoom link on the announcement on canvas)

Feel free to reach out if you have any questions or problems!



# Ground Rules

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## Use this section to boost your learning

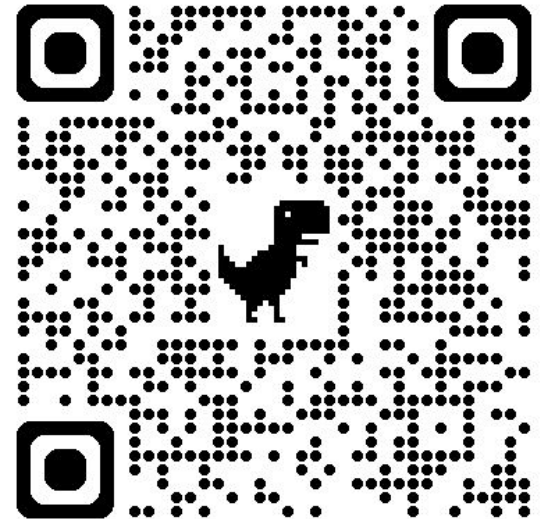
- The aim of this section is to review contents covered in class
- Attending section and actively engaging will improve your learning!
- It's okay to be wrong

## Keep discussions on topic

- Everyone has different opinions about various things
- Let's keep the conversation about class and lecture subjects

Section slides are on [github](#) (scan QR code)

Let's all get As!



# Important Reminders

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## Homework Problem sets

- Homework problems are Required, they guide your learning and will inform us of how you are doing for the lectures
- Due every Wednesday at Midnight (**EXCEPT** April 21st - Monday)
- IMPORTANT: NO LATE HOMEWORKS WILL BE ACCEPTED

## Exams

- 4 Exams total: Online, Open book, “one shot” for consecutive 80 Minutes
- 3 Midterms are NON-cumulative
- 1 Final is Comprehensive (on the SAME DAY after 3rd Midterm)

## Extra Credit

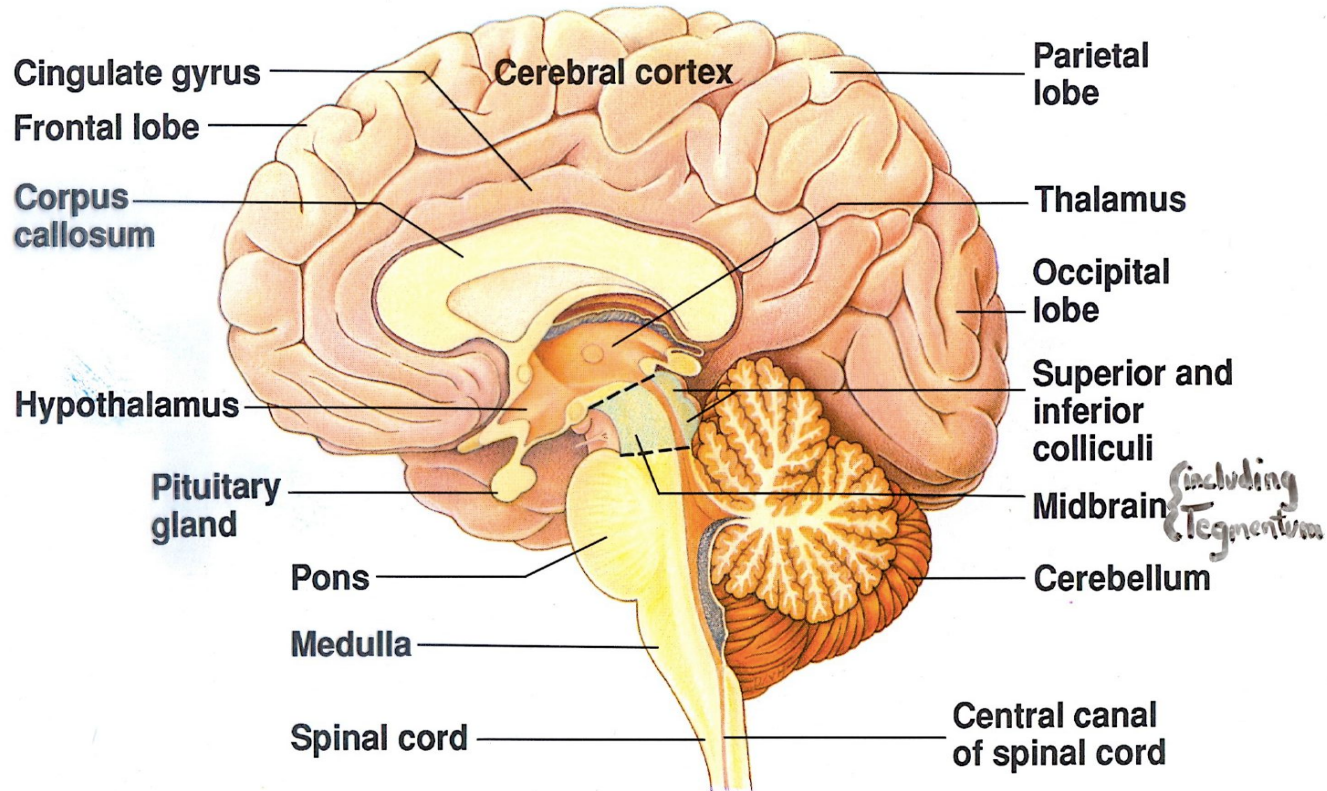
- SONA
- Mnemonics
- Homeworks

# Lecture 1

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## Anatomy of the Nervous System

# Mid-Sagittal Section



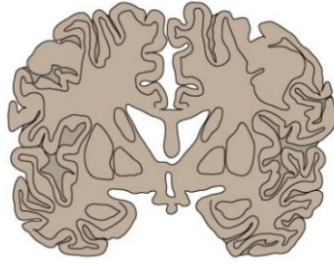
***Sagittal section of human brain***

After Nieuwenhuys et al., 1988

© 1992 Wadsworth, Inc.

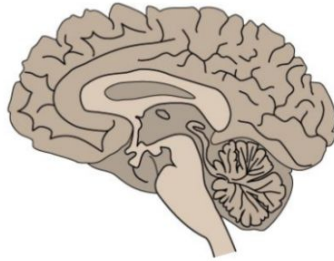
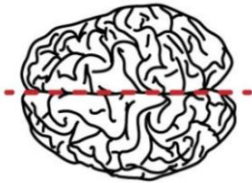
# Planar Views of the Brain

Frontal or  
coronal plane



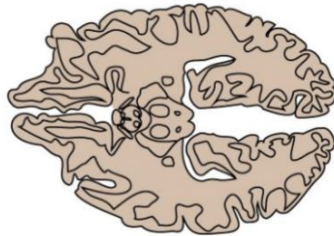
Coronal Plane -- From the **FRONT**

Sagittal plane



Sagittal Plane -- From the **SIDE**

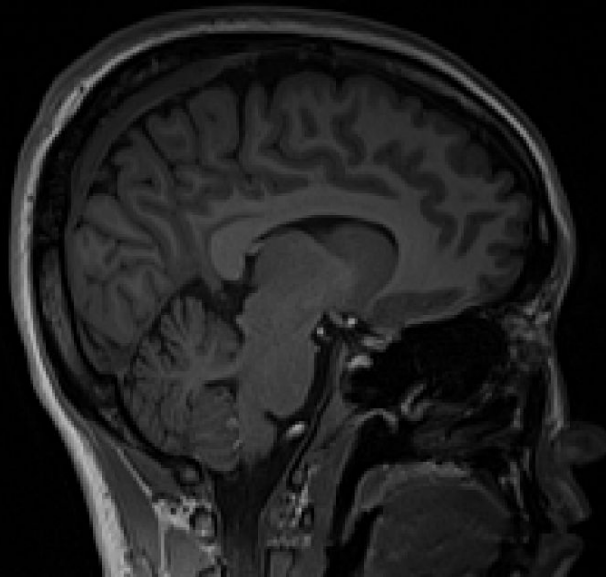
Horizontal plane



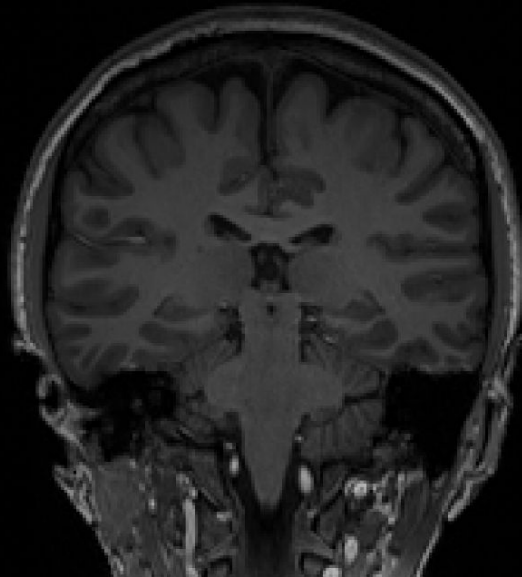
Horizontal Plane -- From the **ABOVE**

# Planar Views of the Brain - Surprise Quiz

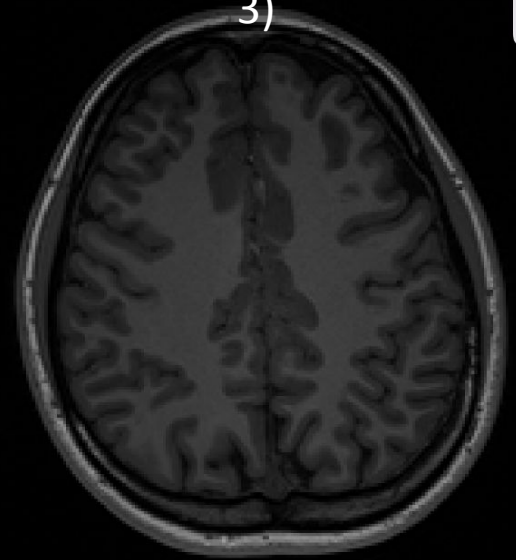
1)



2)



3)

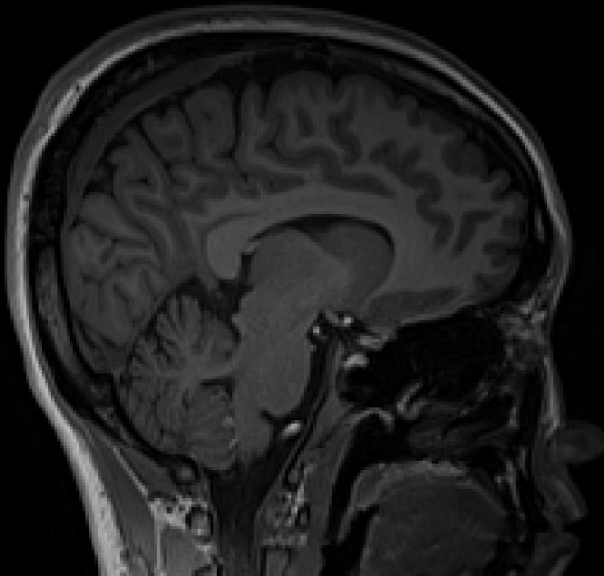


Guess whose brain this is 🤔

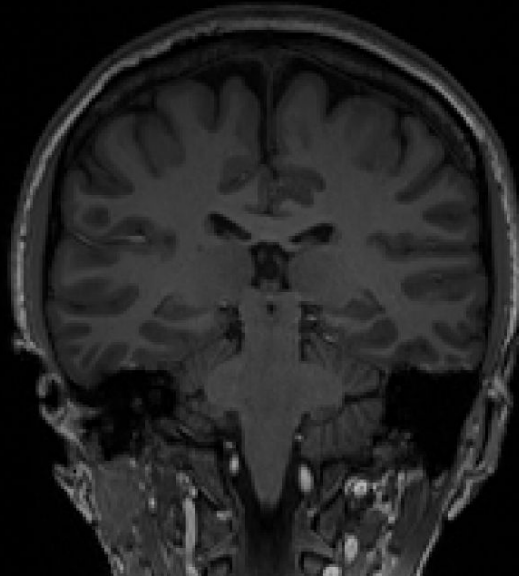


# Planar Views of the Brain - Surprise Quiz

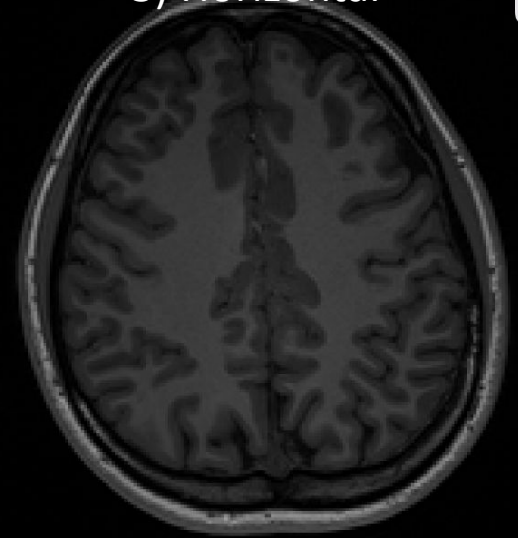
1) Sagittal



2) Coronal



3) Horizontal



Guess whose brain this is 🤔

# Orientation and Views

## Lateral & Medial

- Lateral: Towards the sides (Outside)
- Medial: Towards the middle (Center)

## Dorsal & Ventral

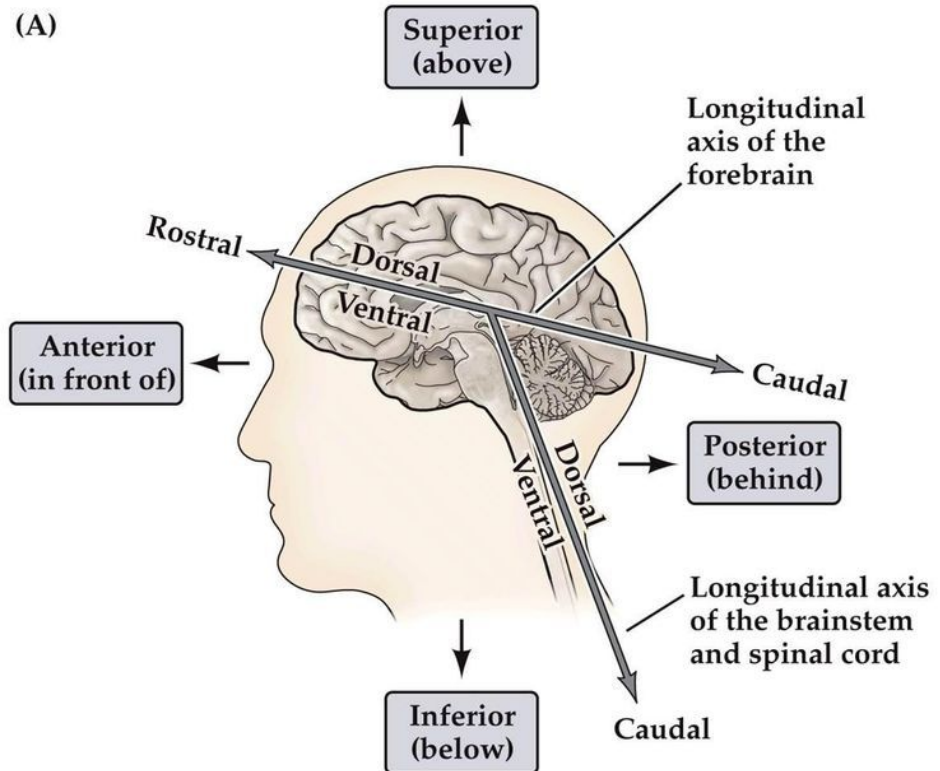
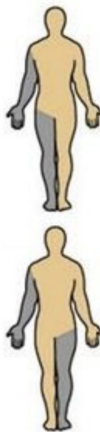
- Dorsal: The “top” of the brain
- Ventral: The “underside” of the brain

## Anterior & Posterior

- Anterior: Front
- Posterior: Back

## Bilateral Structure

- Ipsilateral: Same side
- Contralateral: Opposite side

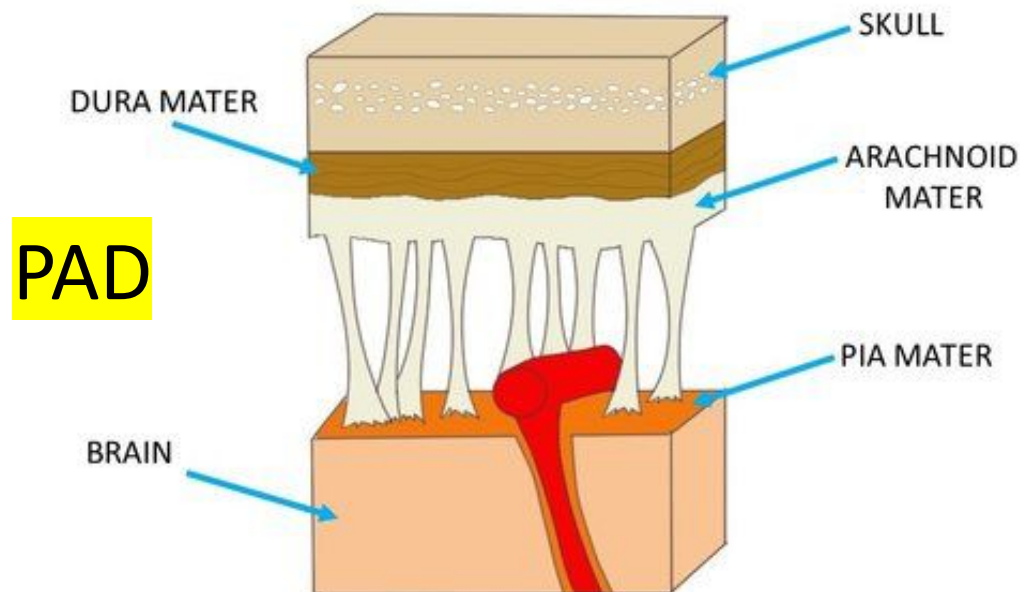


NEUROSCIENCE 5e, Figure A1 (Part 1)  
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# Support Structure

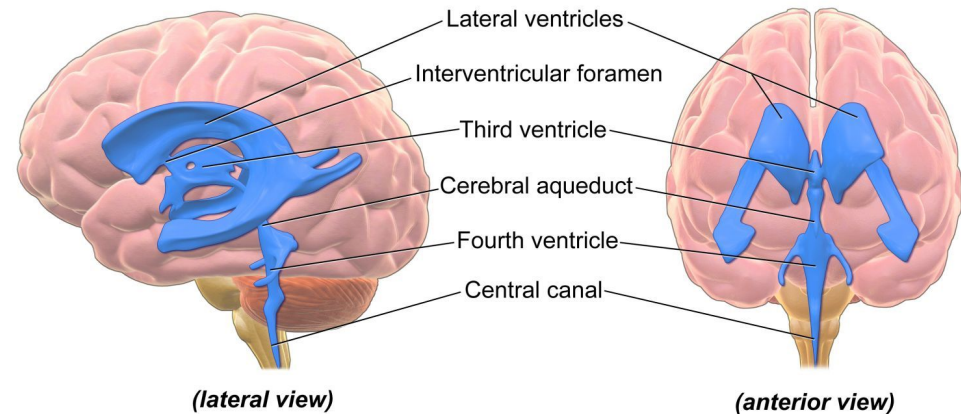
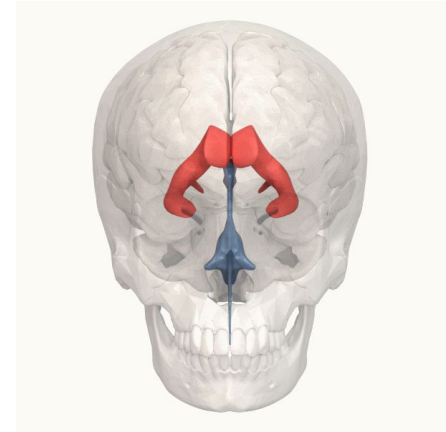
## **Meninges:** surrounds CNS under bone

- Dura Mater (=Tough mother): Thick outer layer
- Arachnoid Mater: Spider-web like, spongy layer filled with Cerebrospinal fluid (CSF), shock absorber
- Pia Mater: flexible inner layer that conforms to the brain and spine surfaces, include blood vessels



## Ventricles

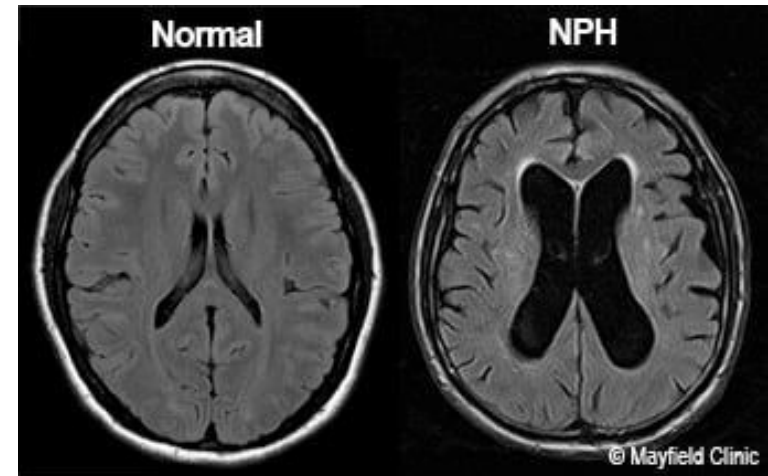
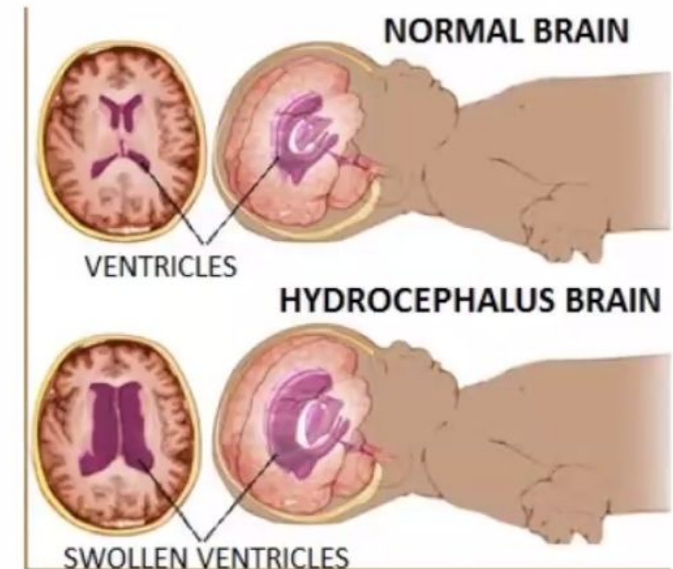
- Hollow, interconnected cavities
- produce and circulate CSF
- Structure:
  - 2 Lateral Ventricles
  - Central Third Ventricle
  - Cerebral Aqueduct
  - Central Fourth Ventricle



# Hydrocephalus

## Swollen ventricles

- When does this happen: CSF is not properly drained out through the cerebral aqueduct, the ventricles tend to swell up
- Then... CSF swelling pushes the brain matter against the PAD, replacing cortical matter with CSF
- Typically Fatal
  - Interventions can redirect excess CSF into the abdominal cavity to reduce the swelling







# Feeding the brain

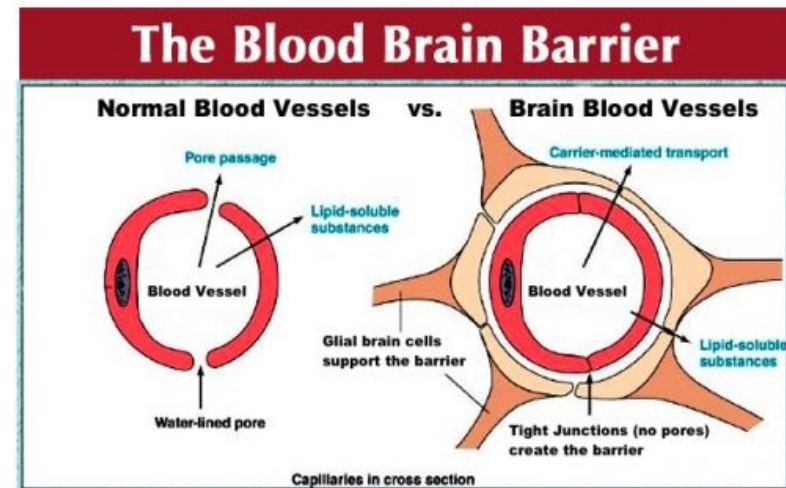
## Blood Vessels

- Web of incoming **arteries** and outgoing **veins**
- Helps clear out the brain of waste
- Carries out “used” CSF
- 2% of body weight but uses 20% of blood supply



## Blood-Brain Barrier (BBB)

- Strict control over what enters brain from bloodstream
- Protects the brain from infections
- Only small uncharged particles (O<sub>2</sub>, CO<sub>2</sub>) and some fat-soluble molecules can passively cross BBB
- Astrocyte helps to create barrier



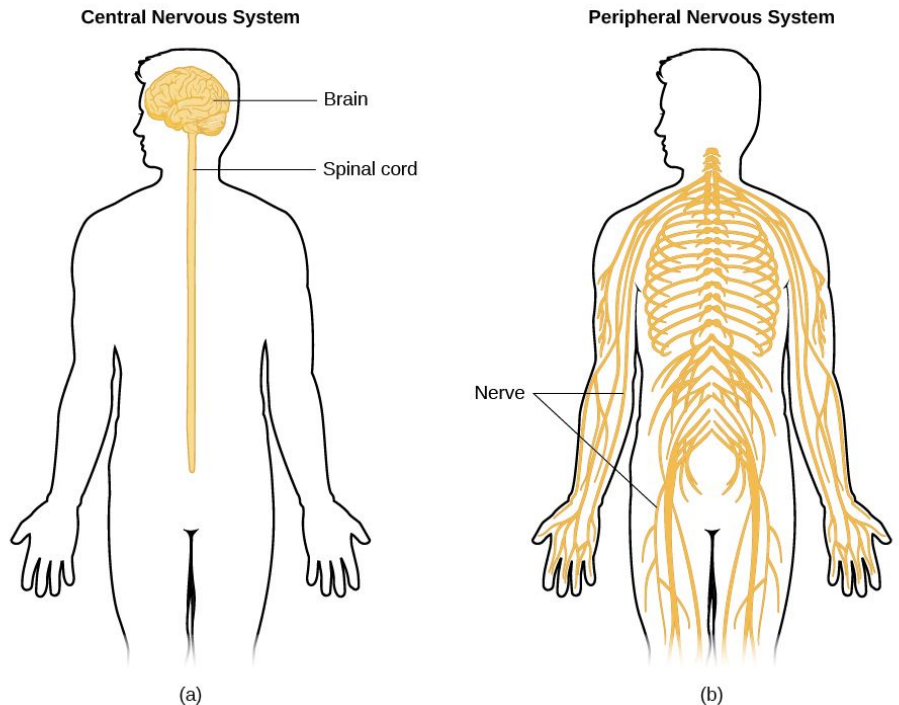
# CNS vs PNS

## Central Nervous System (CNS)

- Spinal cord and brain
- Encased in bone and meninges

## Peripheral Nervous System (PNS)

- Nerves outside the CNS
- Somatic Nervous System:  
interaction with the external  
environment (Sensory/Motor)
- Autonomic Nervous System:  
interaction with the internal  
environment (internal organs)





# Review Questions

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*Match definition to concept:*

- |  |                  |
|--|------------------|
| _____ Towards the center of the brain  | A. Lateral       |
| _____ Bottom of the brain              | B. Medial        |
| _____ Top of the brain                 | C. Dorsal        |
| _____ On both sides of the brain       | D. Ventral       |
| _____ Same-side connections            | E. Bilateral     |
| _____ Towards the outside of the brain | F. Ipsilateral   |
| _____ Opposite side connections        | G. Contralateral |

*Label as either pertaining to the central nervous system (CNS) or peripheral nervous system (PNS):*

- |                              |                                       |
|------------------------------|---------------------------------------|
| _____ Somatic nervous system | _____ Surrounded by bone and meninges |
| _____ Brain and spinal cord  | _____ Autonomic nervous system        |

# Review Questions

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*Match definition to concept:*

<u>B</u>	Towards the center of the brain	A. Lateral
<u>D</u>	Bottom of the brain	B. Medial
<u>C</u>	Top of the brain	C. Dorsal
<u>E</u>	On both sides of the brain	D. Ventral
<u>F</u>	Same-side connections	E. Bilateral
<u>A</u>	Towards the outside of the brain	F. Ipsilateral
<u>G</u>	Opposite side connections	G. Contralateral

*Label as either pertaining to the central nervous system (CNS) or peripheral nervous system (PNS):*

<u>PNS</u>	Somatic nervous system	<u>CNS</u>	Surrounded by bone and meninges
<u>CNS</u>	Brain and spinal cord	<u>PNS</u>	Autonomic nervous system

# HindBrain

## Medulla Oblongata

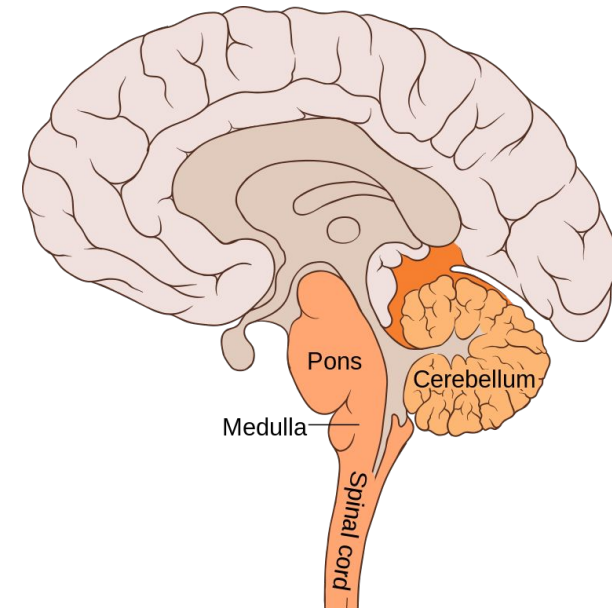
- Control primal reflexes (e.g., breathing, heart rate, coughing, vomiting)
- functions that basically keep us alive

## Pons

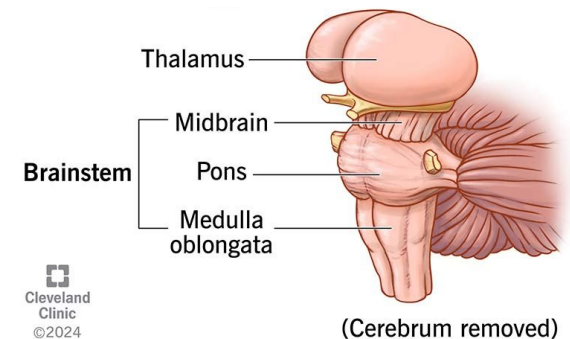
- Latin for “Bridge”: relay b/w cortex & cerebellum and brain & spinal cord
- Lateral: signals to/from cerebellum
- Medial: De-/Arousal system (i.e. reticular formation for arousal, and raphe system for sleep)

## Cerebellum

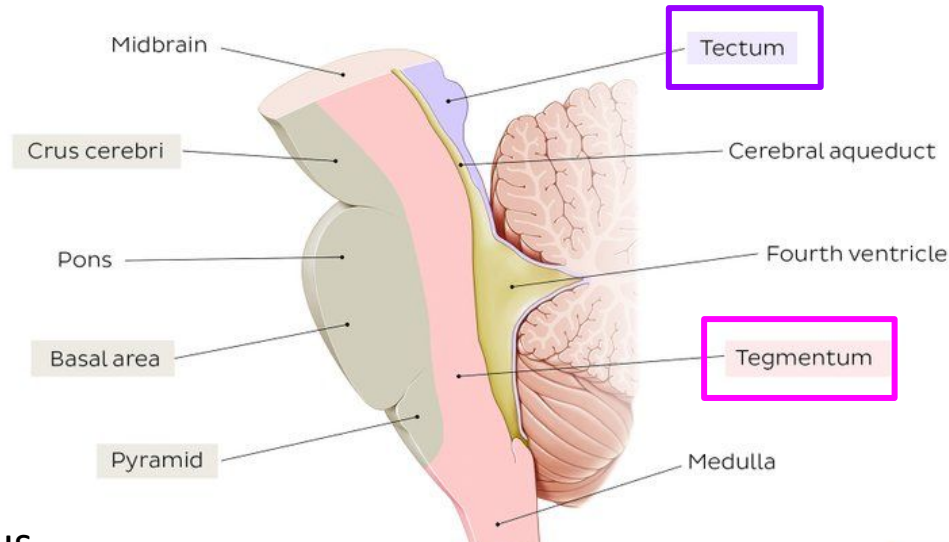
- Store motor programs w/ real-time sensory coordination
- Critical in timing/well-coordinated actions and also important for shifting attention
- Propose motor sequences and guide movements
- NOT the brain stem



## + Hypothalamus



# Midbrain

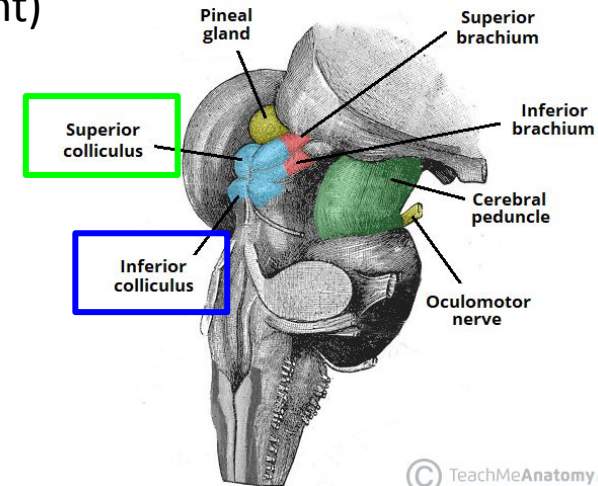


## Tectum

- Latin for “Roof”
- Part of **sensory** pathways to the brain
- Consists of superior and inferior colliculus
  - 1) **Superior colliculus**: visual motion (including Blindsight)
  - 2) **Inferior colliculus**: auditory motion

## Tegmentum

- Latin for “Covering” or “Rug”, below Tectum
- Contains major motor pathways and some cranial nerves
- Includes Red Nucleus and Substantia Nigra
- Contains cranial nerves to control eye movements



tectum to detect 'em, tegmentum for momentum

© TeachMeAnatomy.com

# Forebrain (Diencephalon)

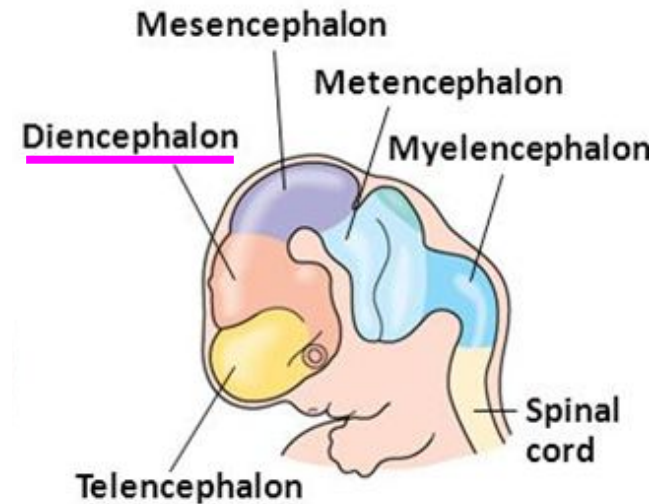
Diencephalon consists of the thalamus and hypothalamus

## Thalamus

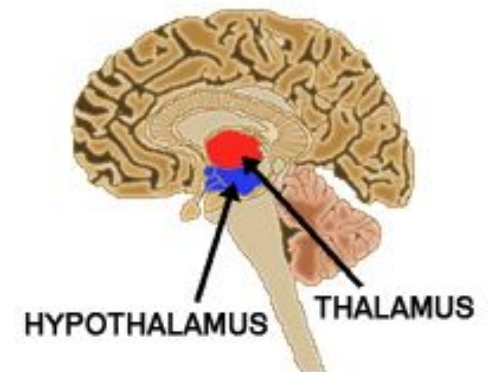
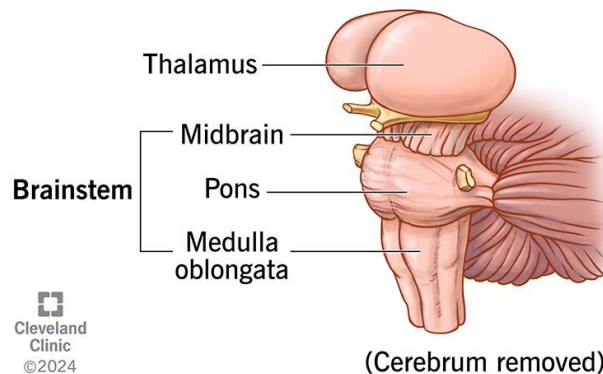
- Primary source of input to cerebral cortex
- Projects to/Receives from Sensory, Motor & Arousal sys
- Nuclei of many sensory and motor systems
- Involved in cortical arousal

## Hypothalamus

- Hypo = “below” → tucked in below Thalamus
- Oversees “4Fs”: Fighting, Fleeing, Feeding, F...
- Also regulates temperature and internal clock
- Neuro-Endocrine Sys: control brain + hormone sys by communicating to Pituitary Gland

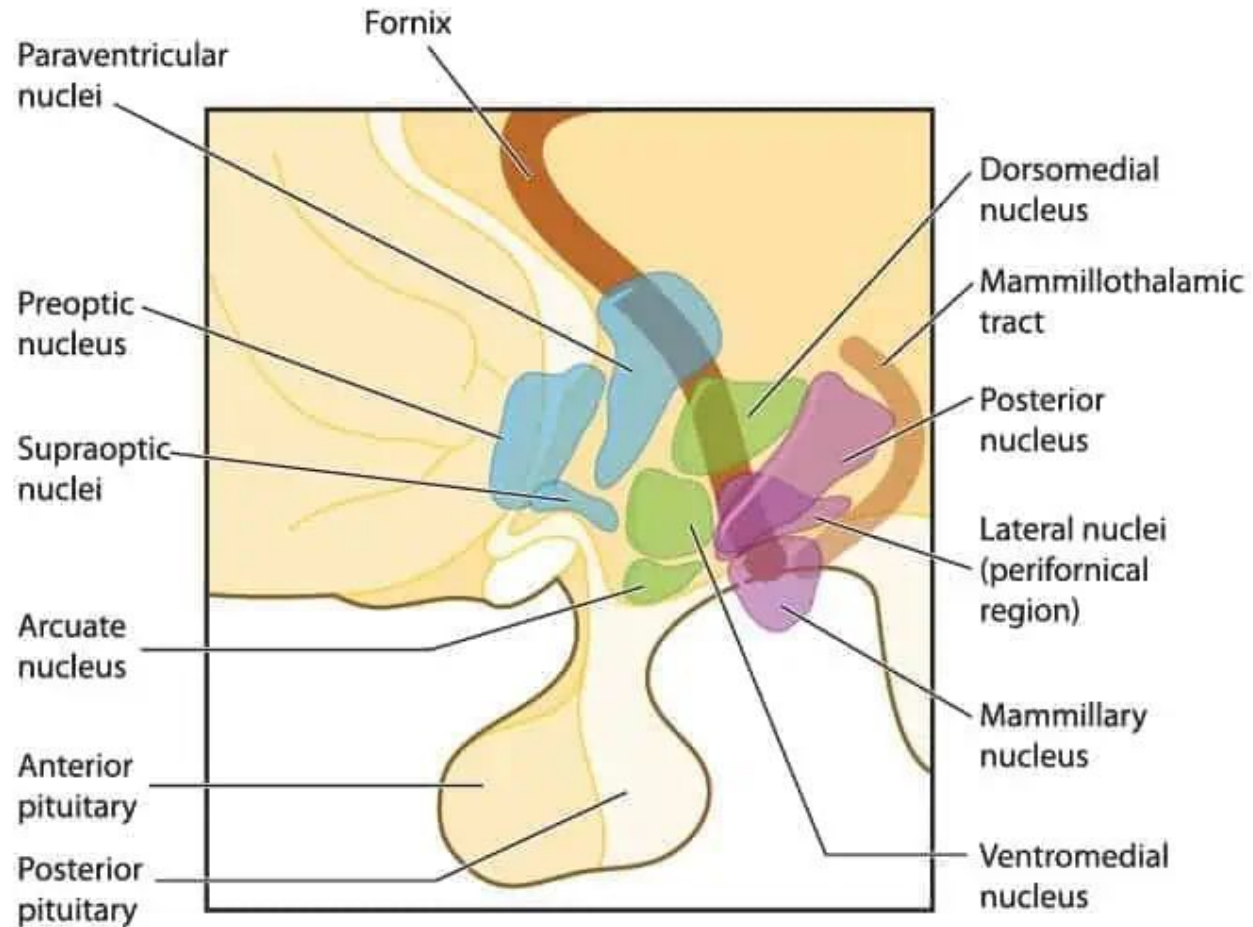


Embryo at 5 weeks





# Forebrain (Diencephalon)



nuclei of Hypothalamus

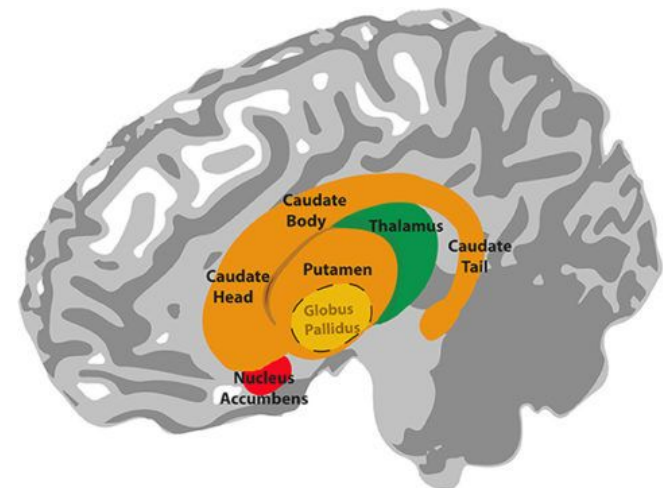
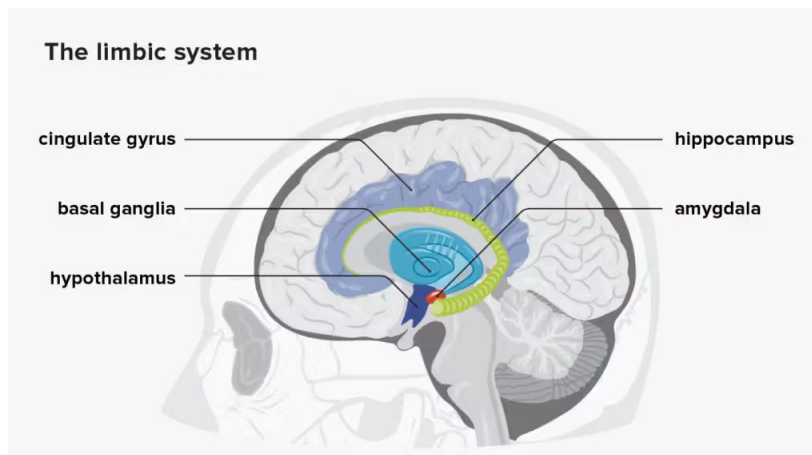
# Forebrain (Telencephalon)

## Limbic System

- Emotion, Motivation
- Hippocampus: formation of new memories and spatial mapping
- Amygdala: emotional expression and interpreting others' emotions
- Cingulate Gyrus: Valence +/- Evaluator, "RE-entrant System"
- Olfactory Bulb: exchanges olfactory information with the rest of the limbic system

## Basal Ganglion

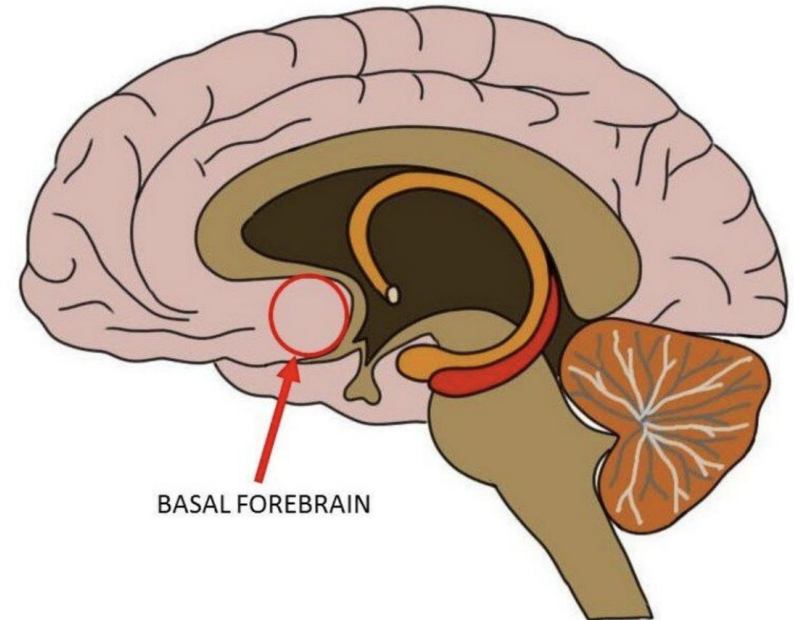
- Includes caudate, putamen, and globus pallidus
- "Motor Area", but diff. from cerebellum (which muscle to use): organizing activity into TASKS, especially **planned sequential behaviors** (task setting, check goals...)
- Another "RE-entrant system": bottom-up input + hierarchical cortical analysis



# Forebrain (Telencephalon)

## Basal Forebrain

- Cortical area just anterior to Hypothalamus
- Major role in attention and cortical arousal
- Main source of ACh (Acetylcholine, excitatory neural transmitter; wakes you up in the morning...) and GABA (Gamma-Aminobutyric Acid, de-arousal/inhibitory neural transmitter; shut you down, put you to sleep...)
- Receives input from Raphe/Reticular Arousal System in Brainstem





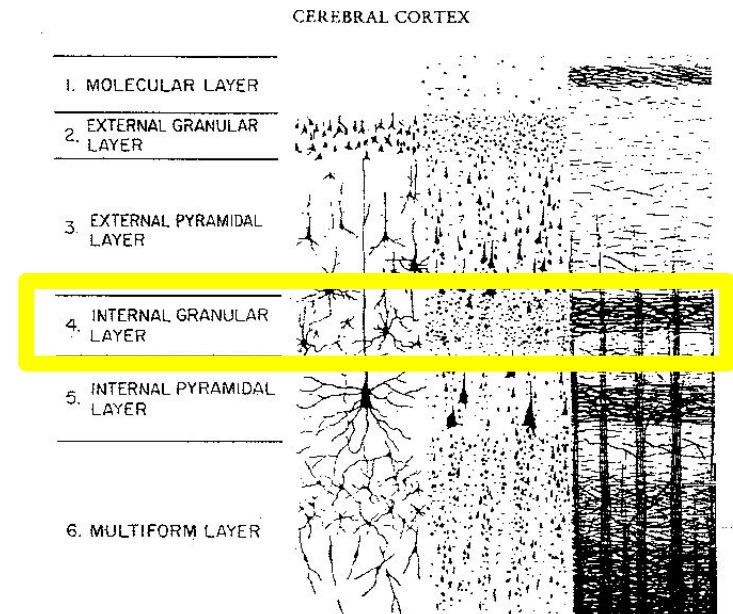
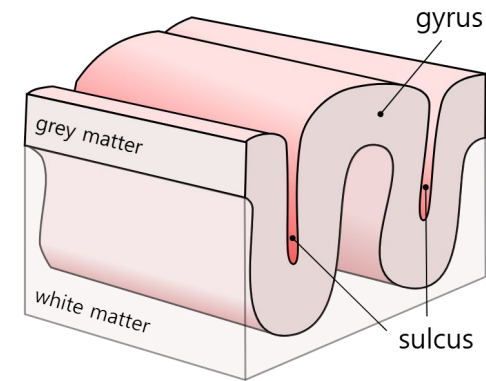
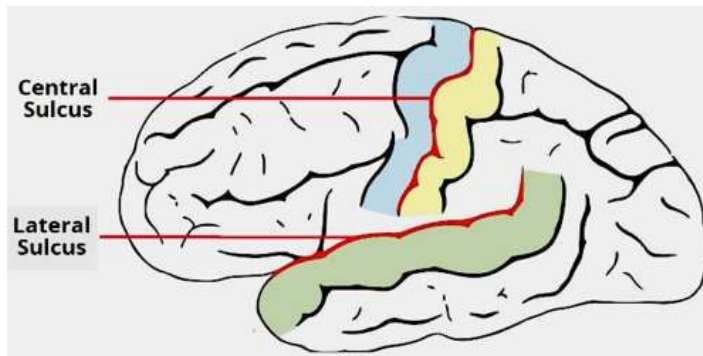
# Cerebral Cortex

**Organized into 6 layers** (highly convoluted)

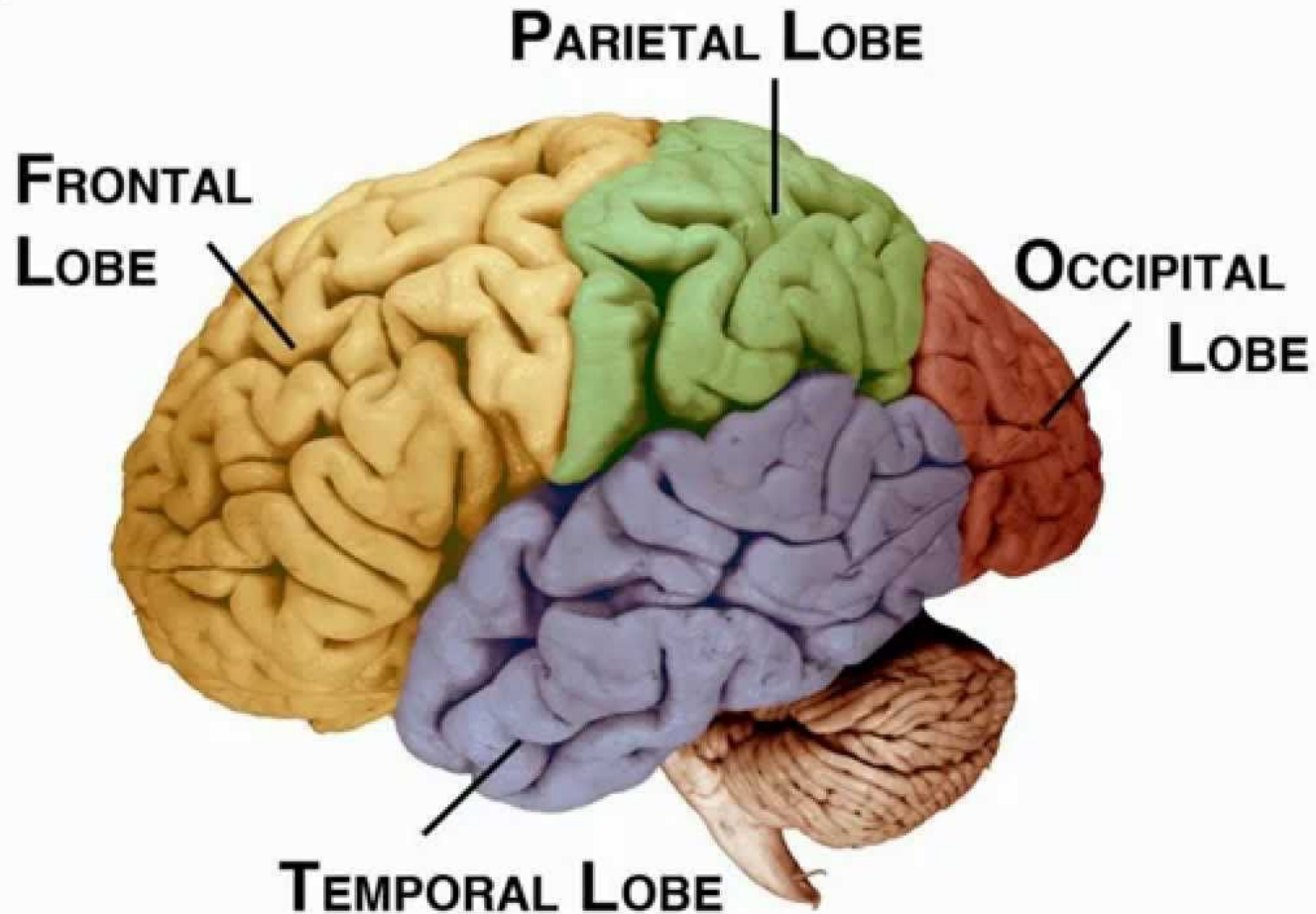
- Information projected to cortex enters at layer 4
- Bulges = gyri (sing. gyrus)
- Folds = sulci (sing. sulcus)

Landmarks

- Central Sulcus divides parietal from frontal lobe
- Lateral Sulcus/Fissure divides temporal from frontal lobe



# Lobes of the Brain



# Breaking down the Lobes

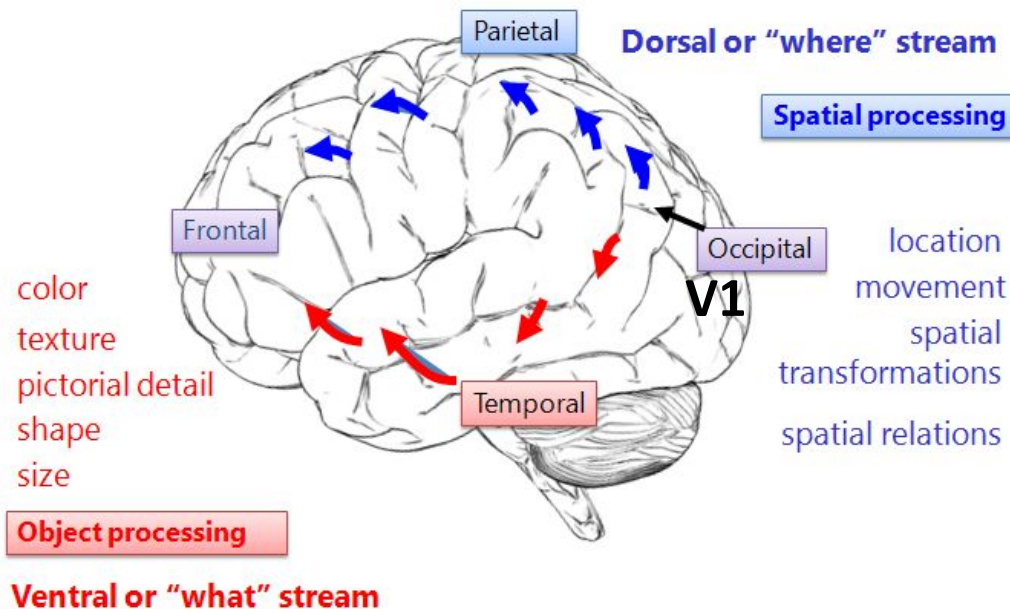
## Occipital Lobe

- Devoted to Visual processing
- Contains V1 (primary visual cortex) and receives projections from thalamus
- major visual pathways: Ventral/Dorsal stream

## Temporal Lobe

- Contains Medial Temporal (MT) - includes Direction-sensitive motion detectors, Medial Superior Temporal (MST) - includes Optic flow detectors, Ventral Visual Pathway - include Face cells,, Auditory areas - includes Wernicke's Area, and Anterior Temporal - emotional expression and interpretation (esp. right hem)

Ventral  
= Who/What  
: color & detail



Dorsal  
Where/How  
: Motion & Depth

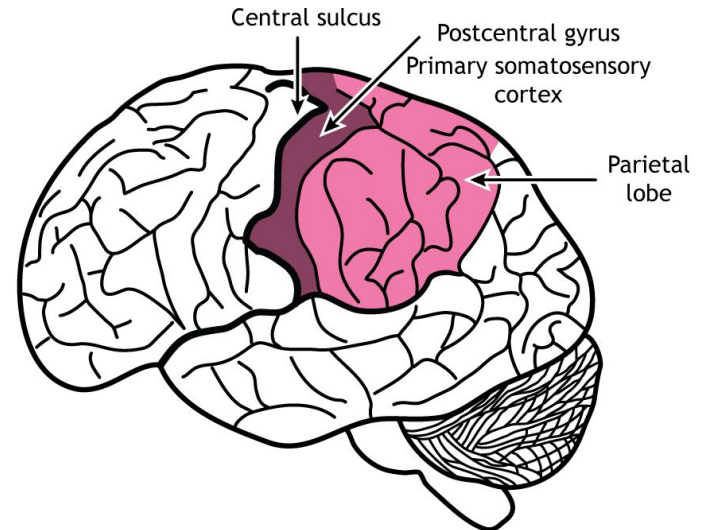
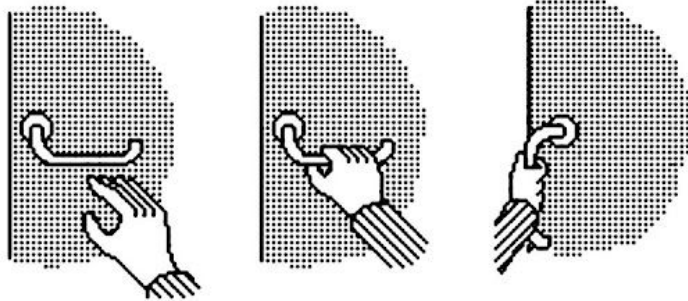
# Breaking down the Lobes

## Parietal Lobe

- integrating visual and somatosensory info (touch, pain, temperature, proprioception such as body position and movement, etc)
- Post-central gyrus (S1): primary somatosensory cortex
- also includes higher visual areas of “where/how” pathway, and the examples are...

## Canonical cells

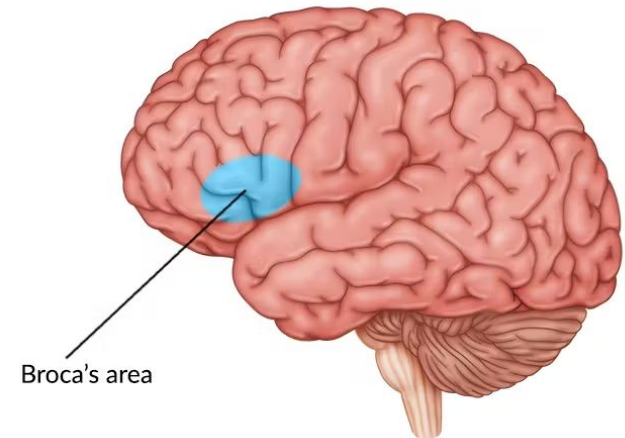
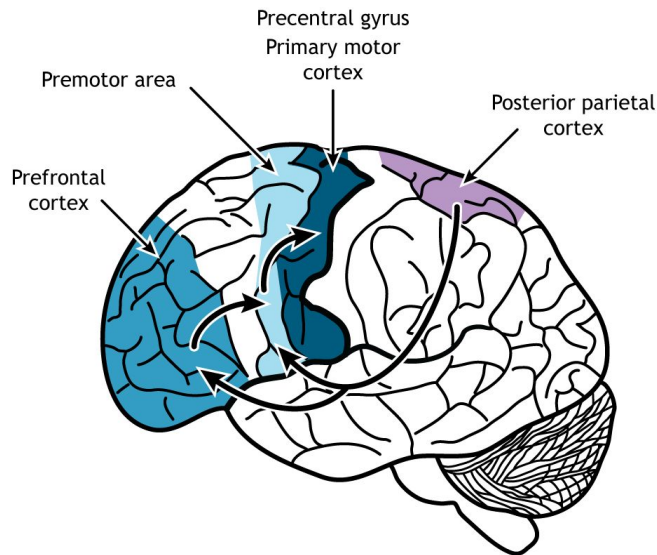
- Responds to “affordances” of objects (“Can I grab this object? How?”)
- Activity reverberates w/ premotor cortex, to shape how hand approaches



# Breaking down the Lobes

## Frontal Lobe

- Important for motor movements, language production, and strategy
- Precentral gyrus: primary motor cortex (initiating and controlling voluntary movements, “Ok, execute!”)
- Premotor areas: anterior to motor cortex (action planning)
  - includes mirror cells (w/ Parietal) which responds to seeing self or other perform familiar manual tasks
  - includes Broca’s Area (speech production and articulation)
- Prefrontal cortex



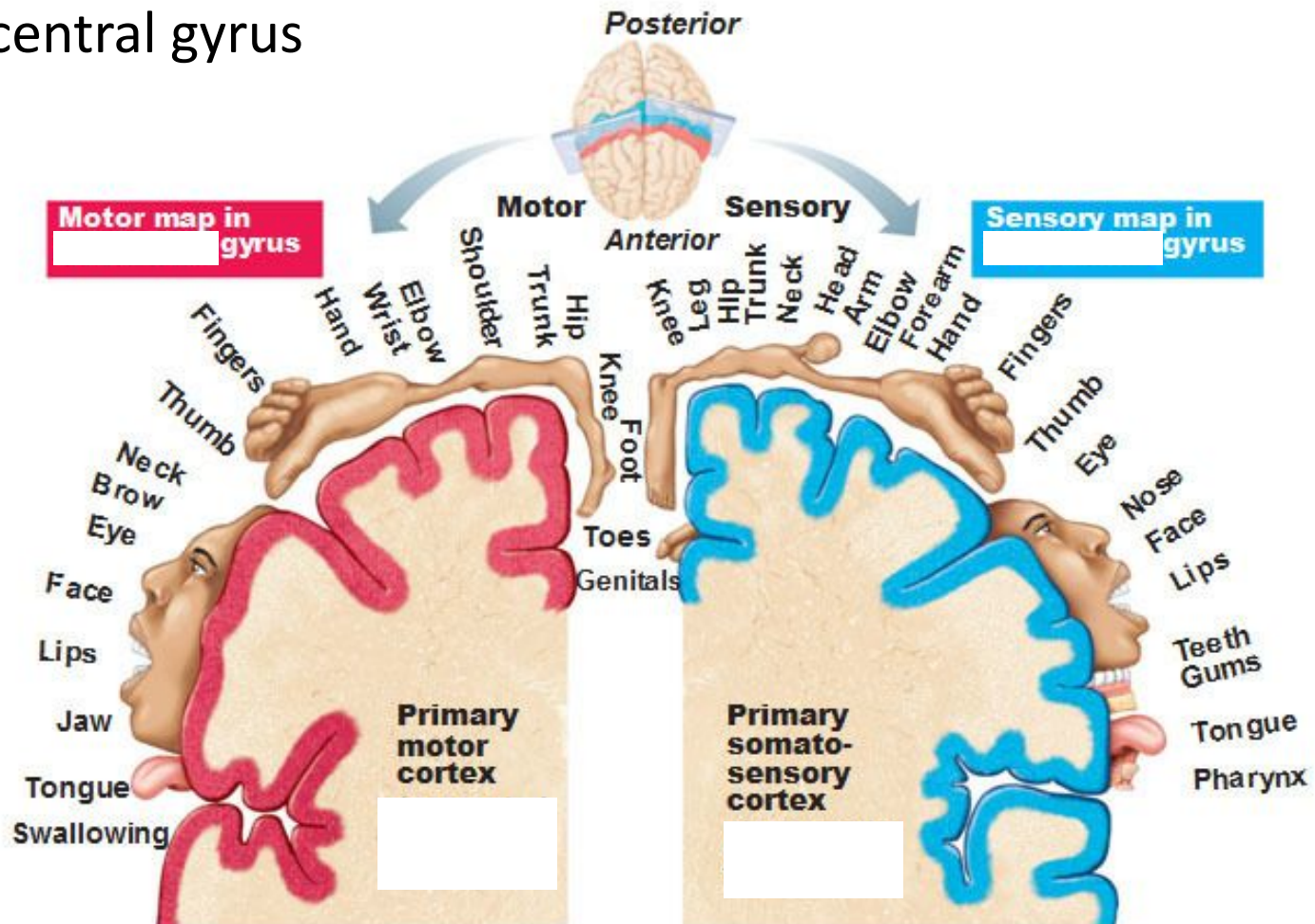


# Breaking down the Lobes

*Do you remember...?*

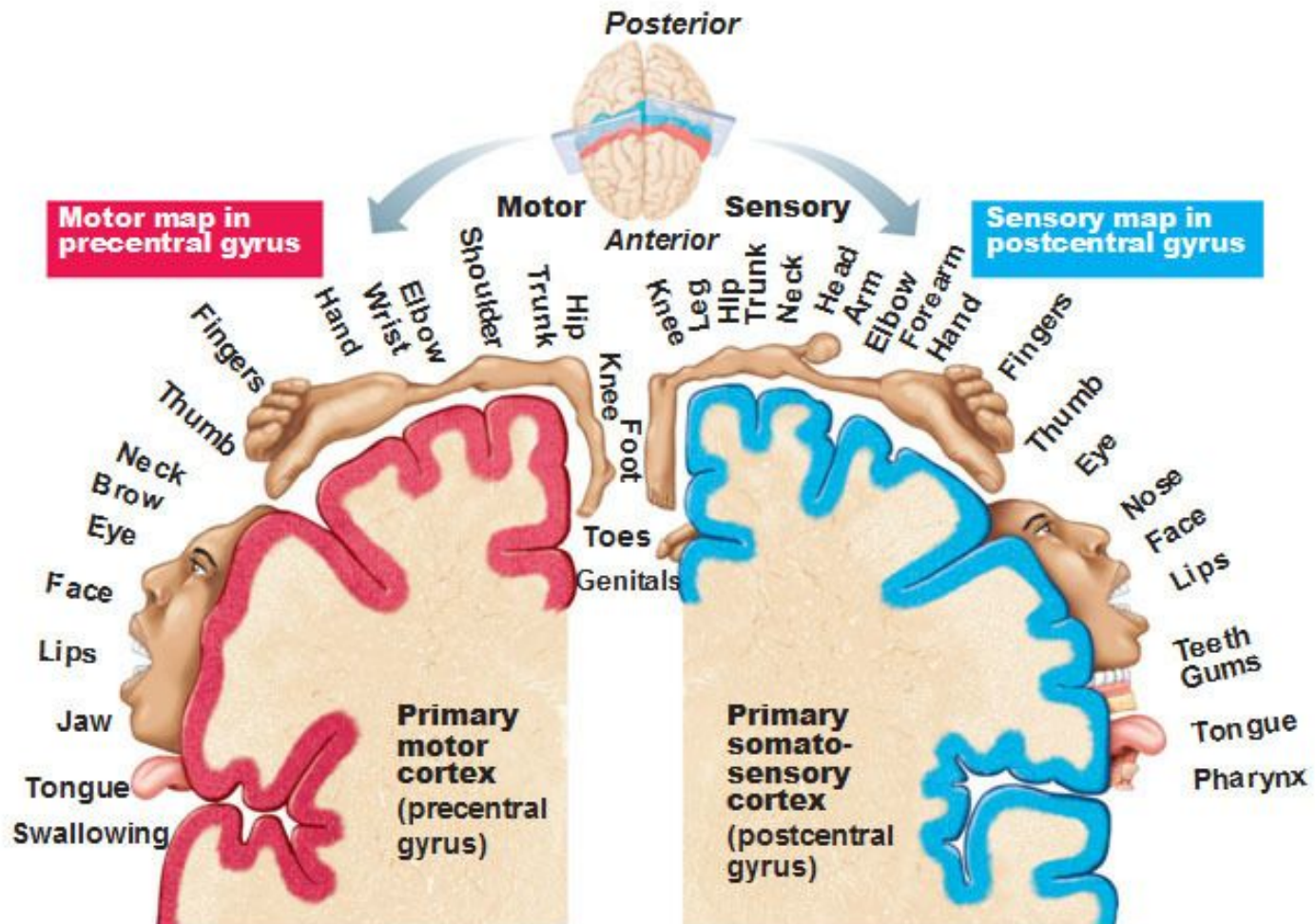
- postcentral gyrus
- postcentral gyrus

*Note that each hemisphere receives info from the opposite side of the body*



# Breaking down the Lobes

*Note that each hemisphere receives info from the opposite side of the body*



## LEFT BRAIN VS. RIGHT BRAIN





# See you next week!

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