Section 1
Neuroanatomy

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COGS 17 A05

04/07/25

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Education:
first-year PhD Student in Cognitive Science
MA Psychology
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Research:
- Biomarkers of Neurodevelopmental disorders

Contact Info:
- Email: 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

Use this section to boost your learning

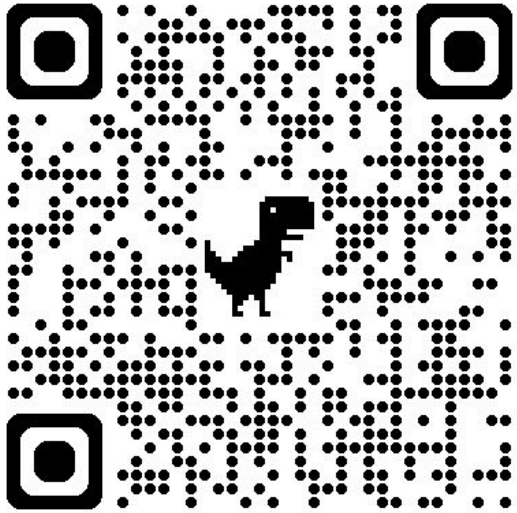
- The aim of this section is to review contents covered in class
- Attending section and actively engaging will improve your learning!
- It's okay to be wrong

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

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)

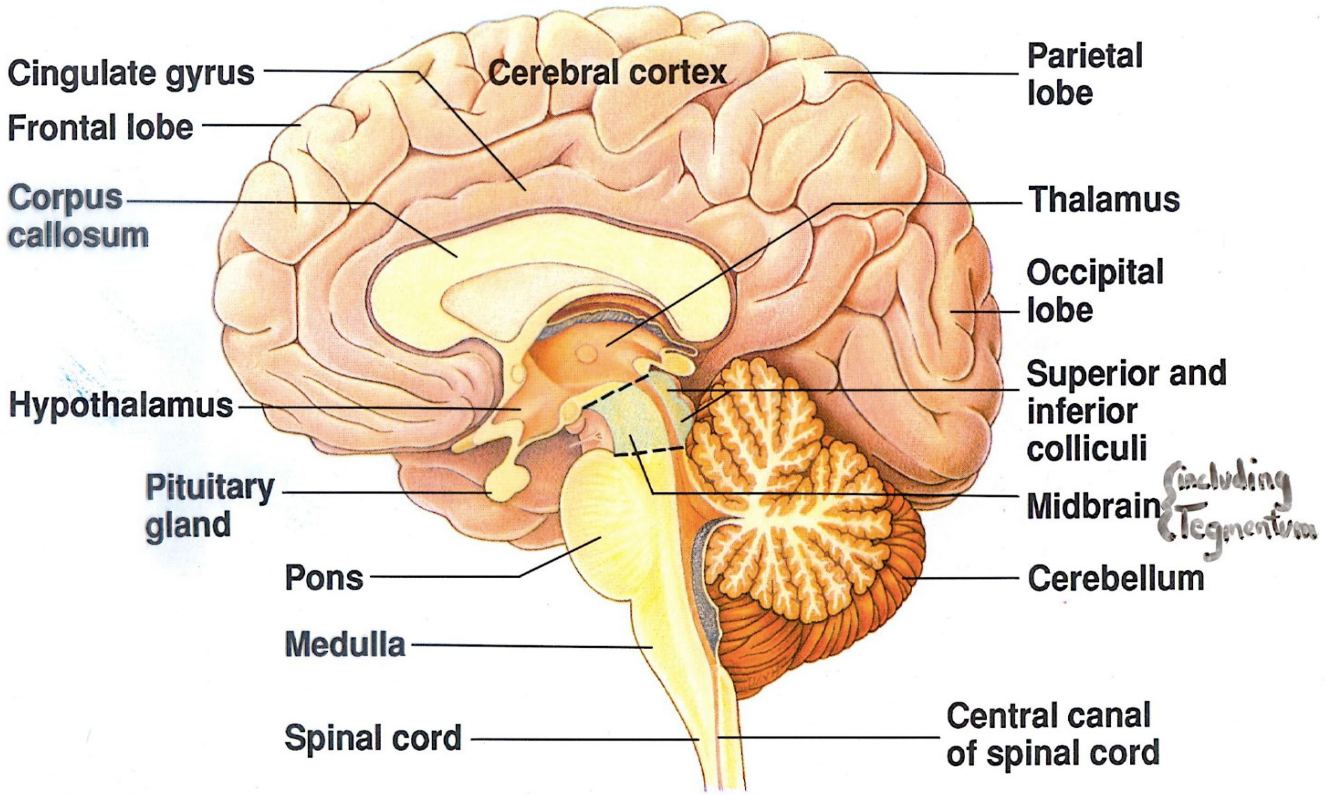
Extra Credit

- SONA
- Mnemonics
- Homeworks

Lecture 1

Anatomy of the Nervous System

Mid-Saggital Section



Sagittal section of human brain

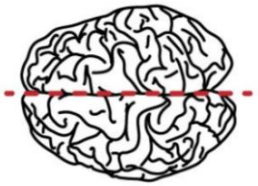
After Nieuwenhuys et al., 1988

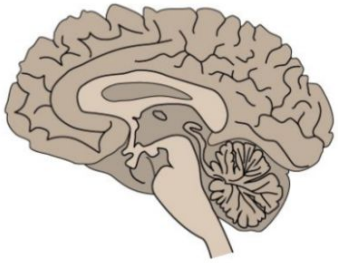
Planar Views of the Brain

Frontal or coronal plane

Coronal Plane -- From the **FRONT**

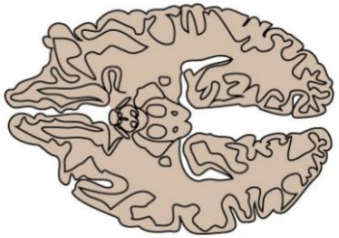
Sagittal plane





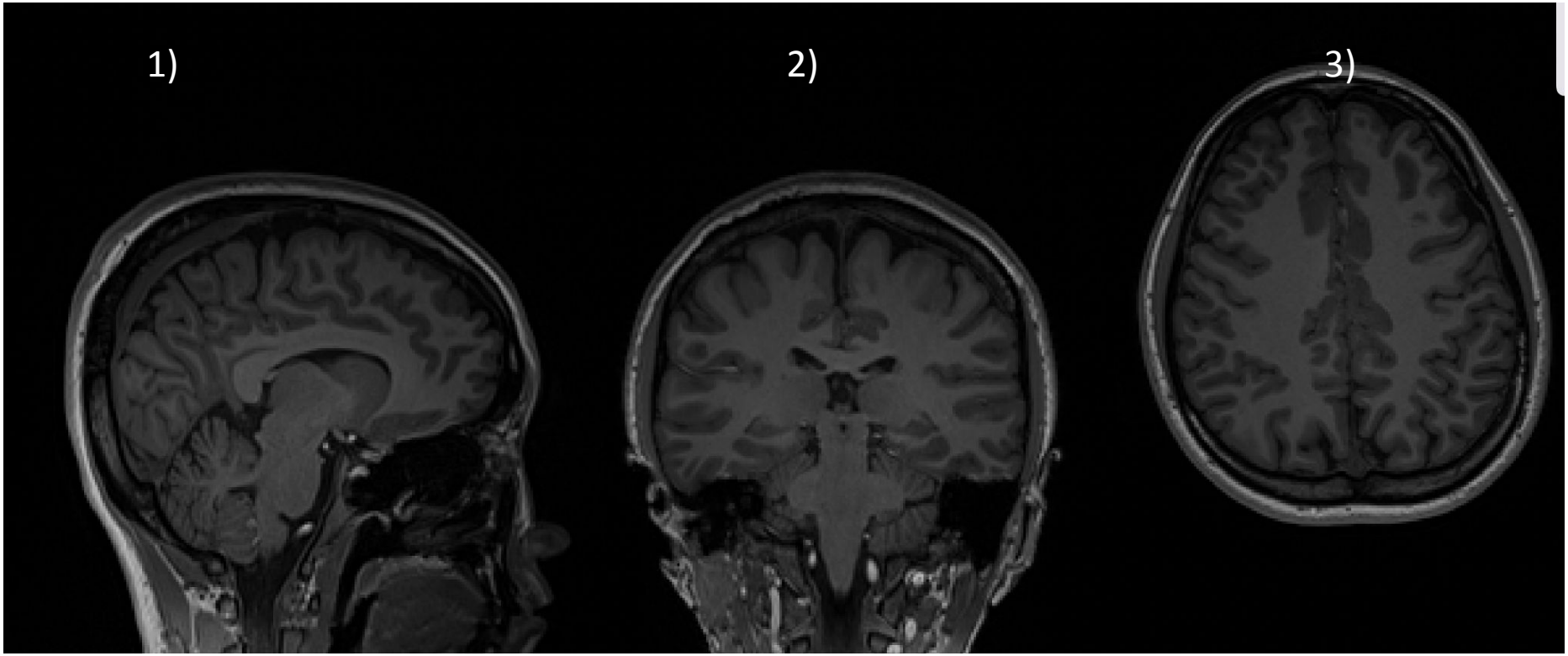
Sagittal Plane -- From the **SIDE**

Horizontal plane



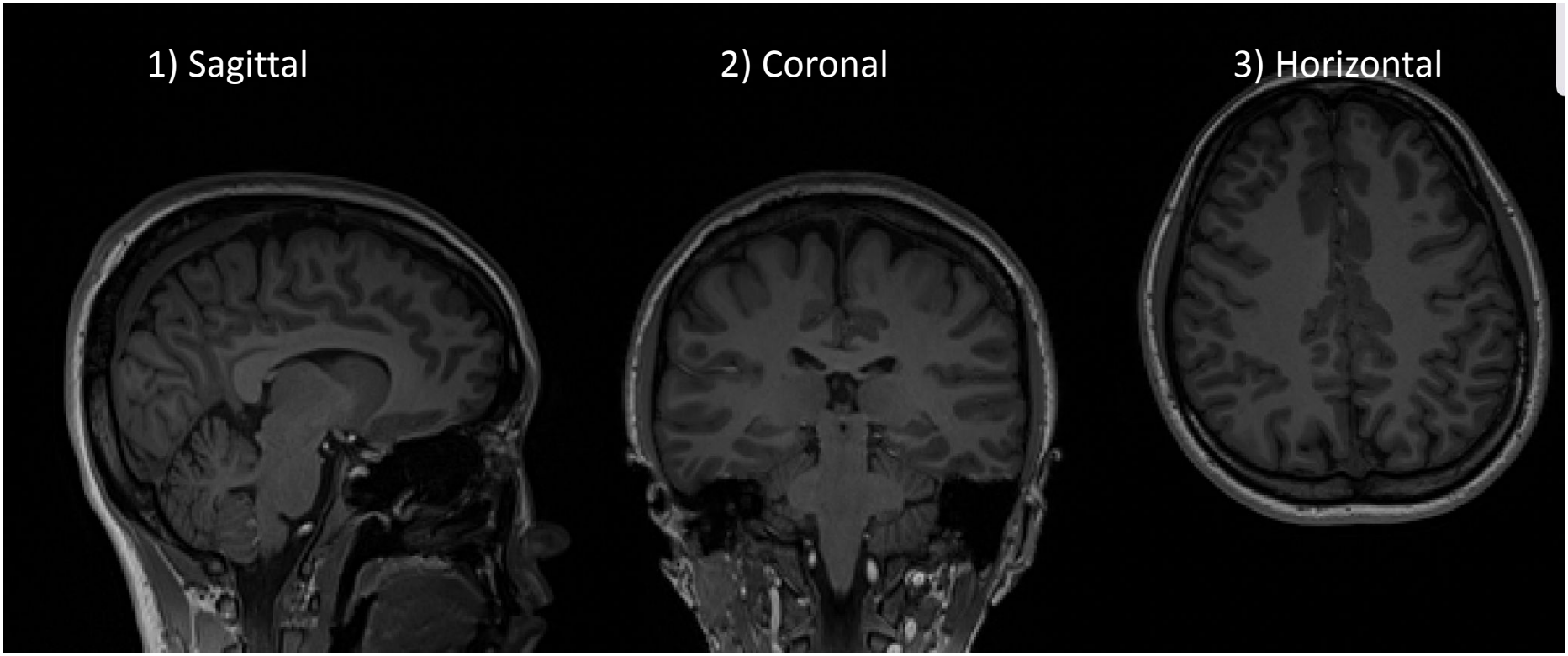
Horizontal Plane -- From the **ABOVE**

Planar Views of the Brain - Surprise Quiz



Guess whose brain this is 😏

Planar Views of the Brain - Surprise Quiz



Guess whose brain this is 😏

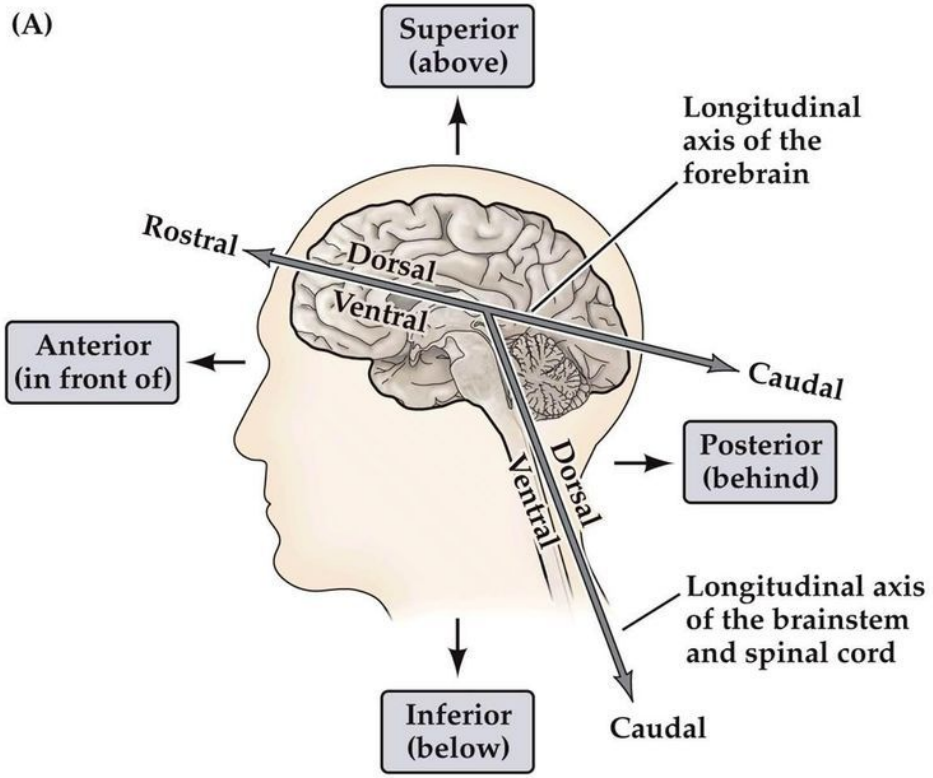
Orientation and Views

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

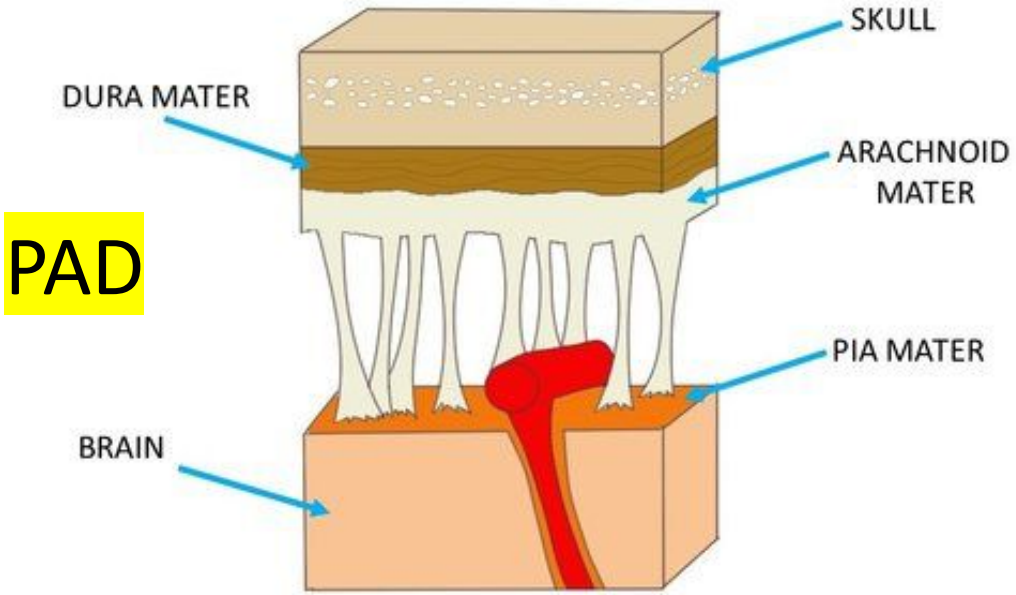


NEUROSCIENCE 5e, Figure A1 (Part 1)

Support Structure

Meninges: surrounds CNS under bone

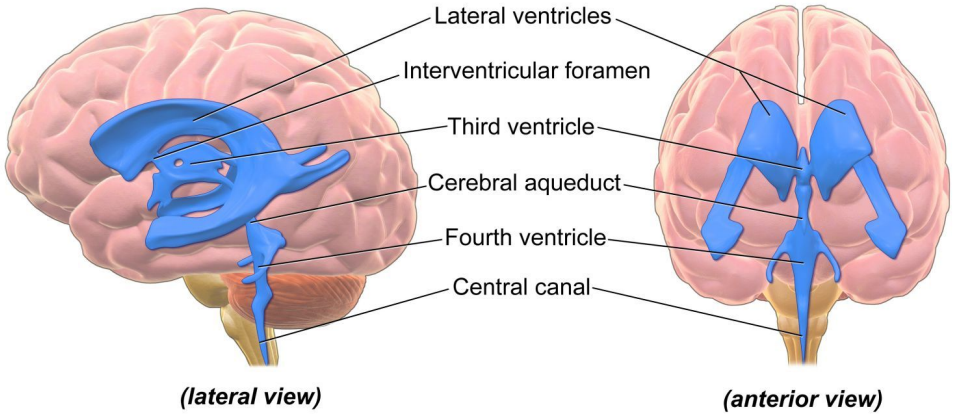
- Dura Mater (=Tough mother): Thick outer layer
- Arachnoid Mater: Spider-web like, spongy layer filled with Cerebrospinal fluid (CSF), shock absorber
- Pia Mater: flexible inner layer that conforms to the brain and spine surfaces, include blood vessels



PAD

Ventricles

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



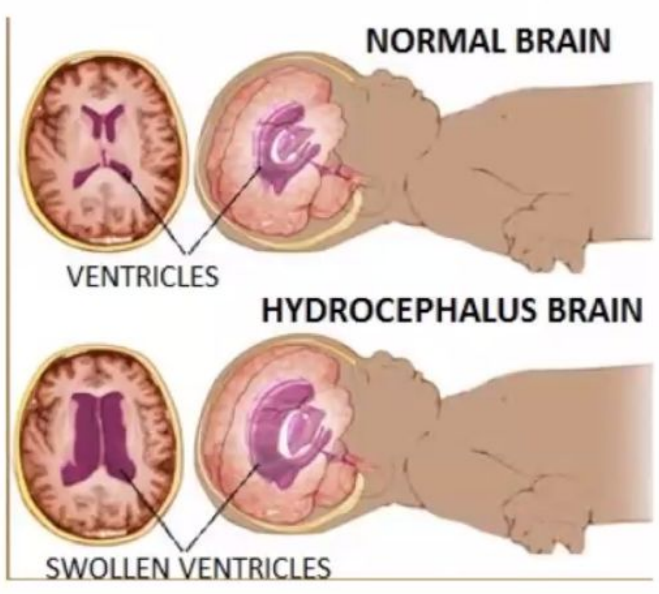
Hydrocephalus

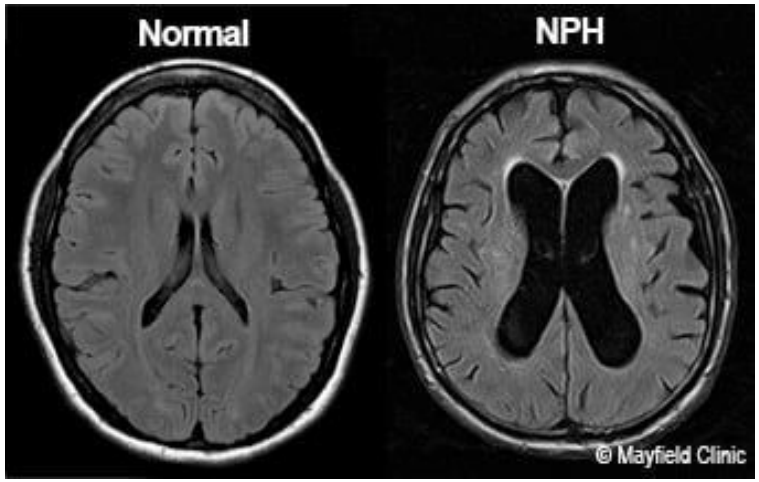
Swollen ventricles

- 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





Hydrocephalus

Feeding the brain

Blood Vessels

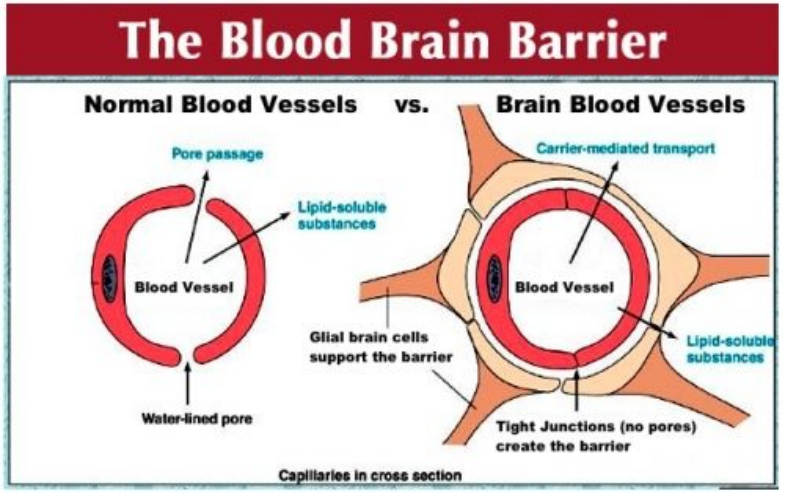
- Web of incoming **arteries** and outgoing **veins**
- Helps clear out the brain of waste
- Carries out “used” CSF
- 2% of body weight but uses 20% of blood supply

Blood-Brain Barrier (BBB)

- Strict control over what enters brain from bloodstream
- Protects the brain from infections

- Only small uncharged particles (O2, CO2) and some fat-soluble molecules can passively cross BBB

- Astrocyte helps to create barrier



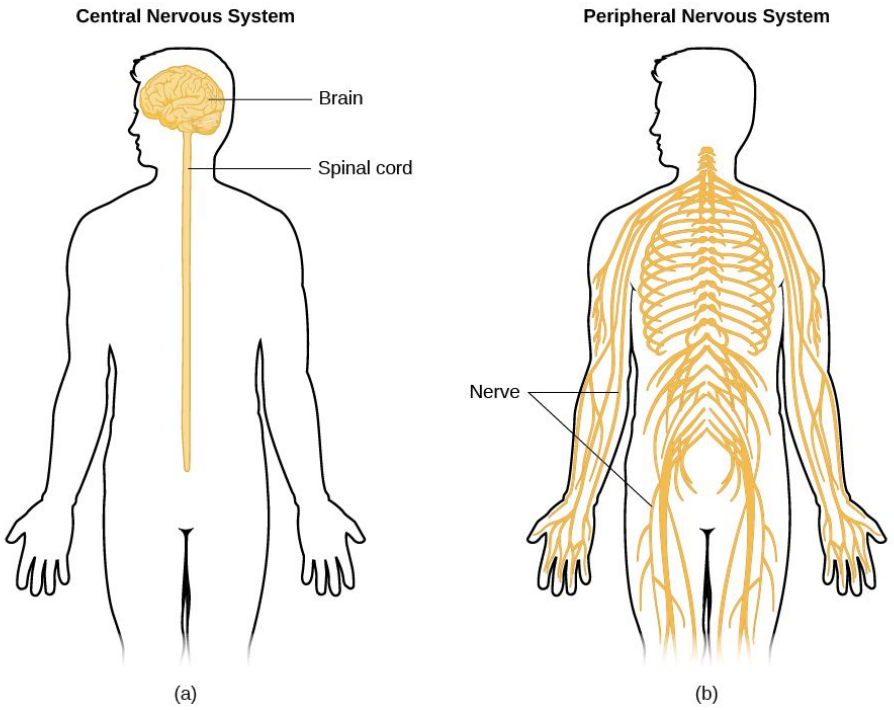
CNS vs PNS

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

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

_____ Brain and spinal cord

_____ Surrounded by bone and meninges

_____ Autonomic nervous system

Review Questions

Match definition to concept:

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

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

PNS	Somatic nervous system	CNS	Surrounded by bone and meninges
CNS	Brain and spinal cord	PNS	Autonomic nervous system

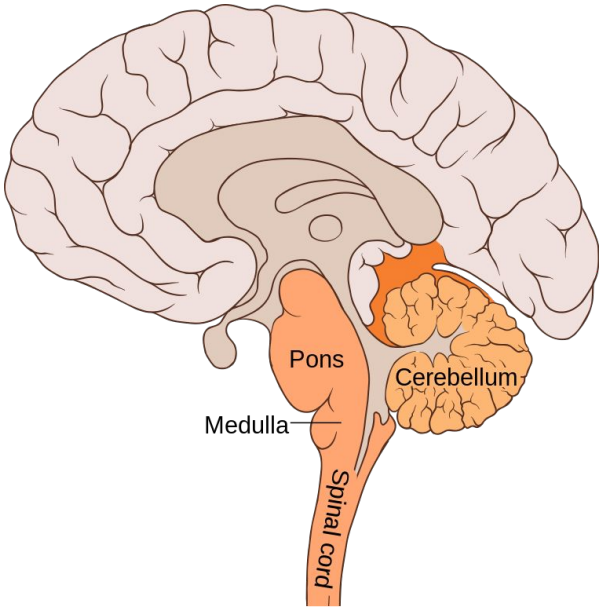
HindBrain

Medulla Oblongata

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

Pons

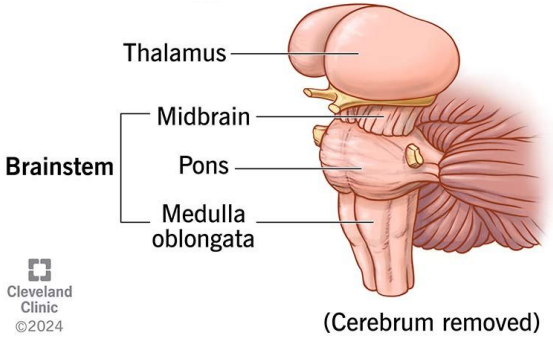
- Latin for “Bridge”: relay b/w cortex & cerebellum and brain & spinal cord
- Lateral: signals to/from cerebellum
- Medial: De-/Arousal system (i.e. reticular formation for arousal, and raphe system for sleep)



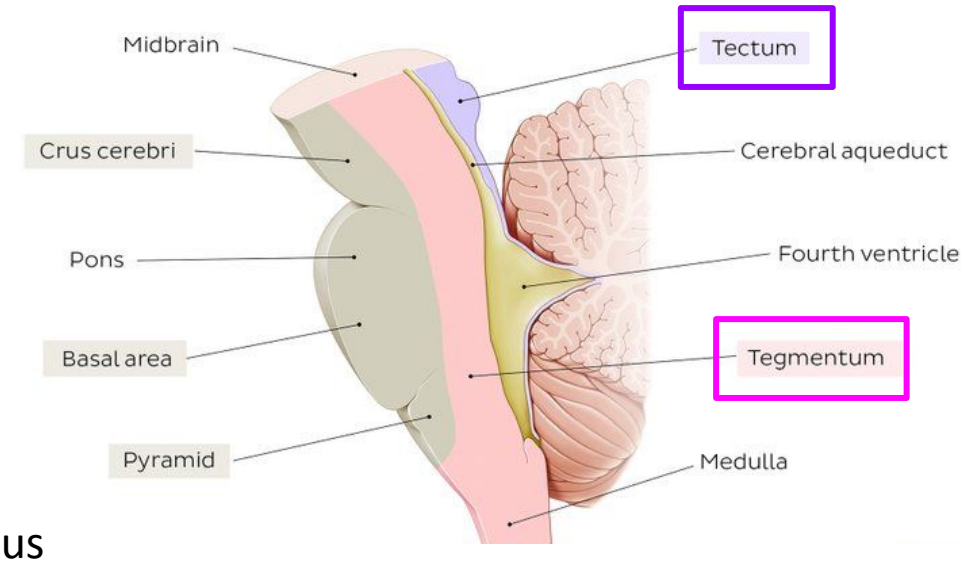
Cerebellum

- 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

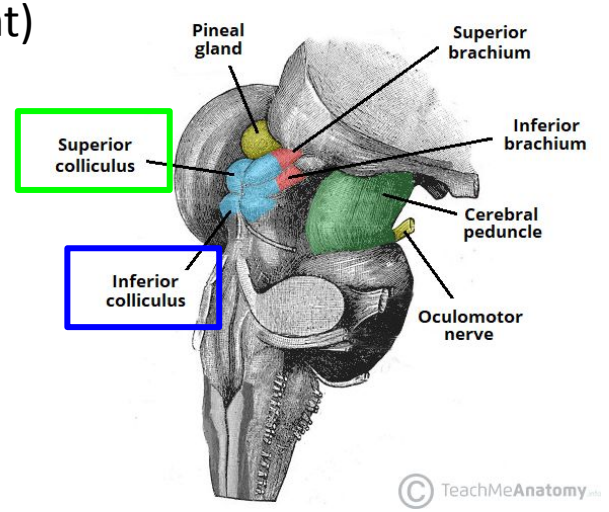


Midbrain



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



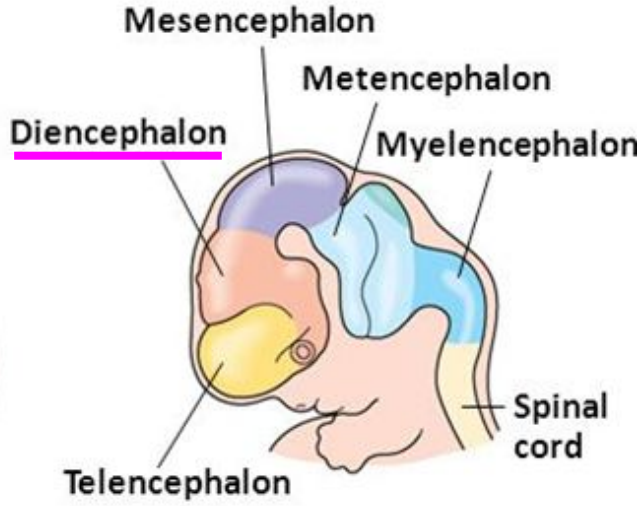
Tegmentum

- 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

Forebrain (Diencephalon)

Diencephalon consists of the thalamus and hypothalamus

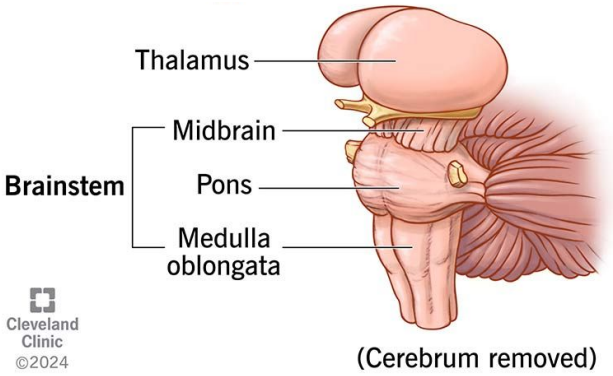


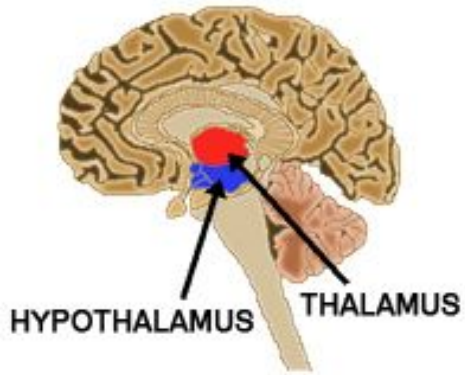
Thalamus

- 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

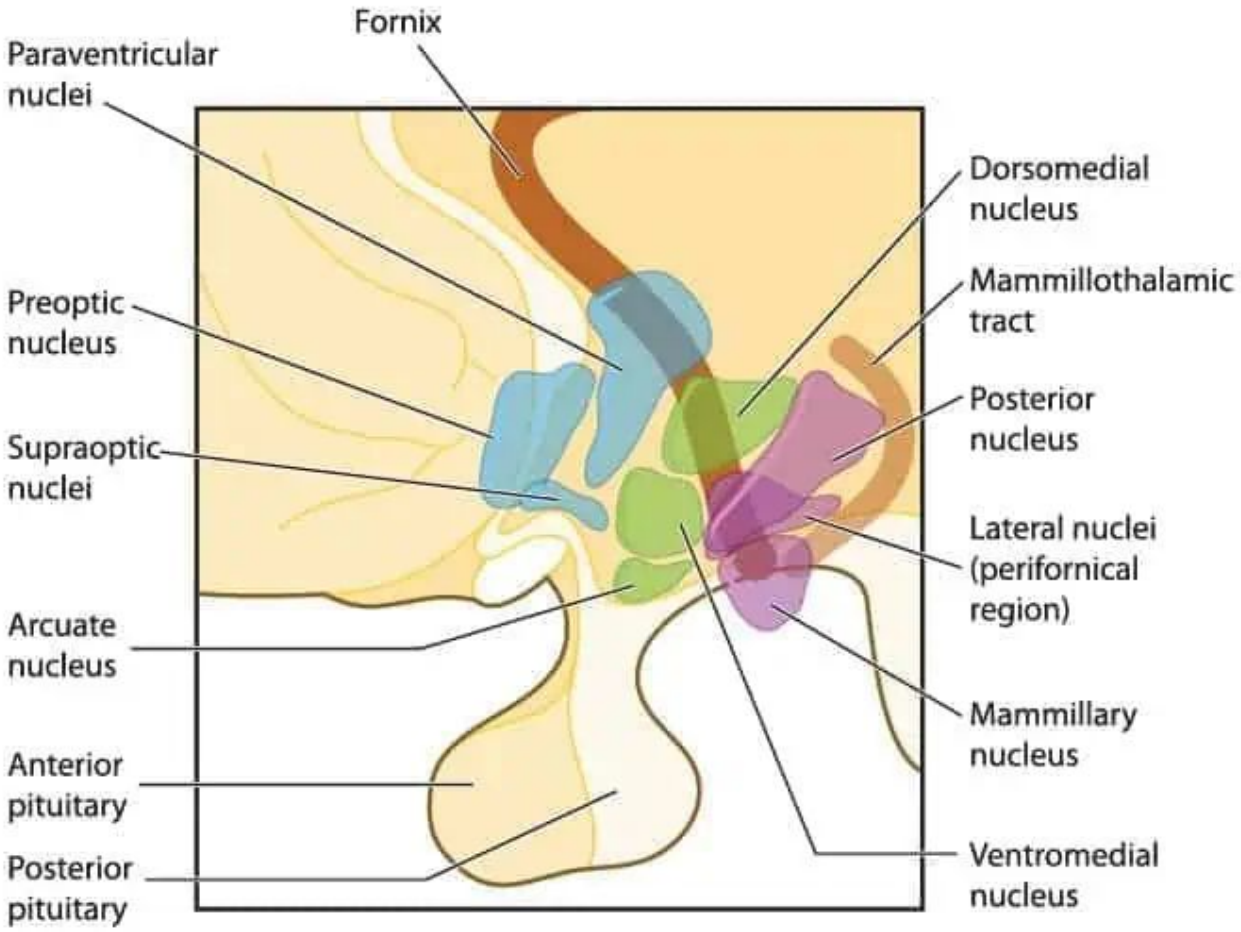
Hypothalamus

- 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





Forebrain (Diencephalon)



nuclei of Hypothalamus

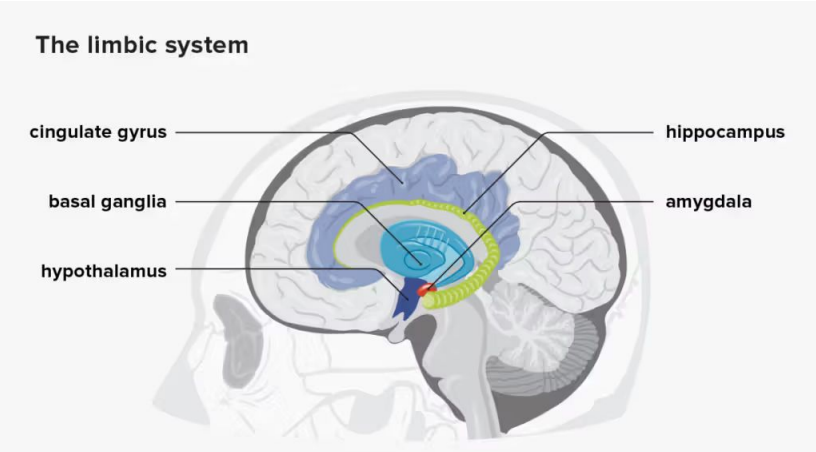
Forebrain (Telencephalon)

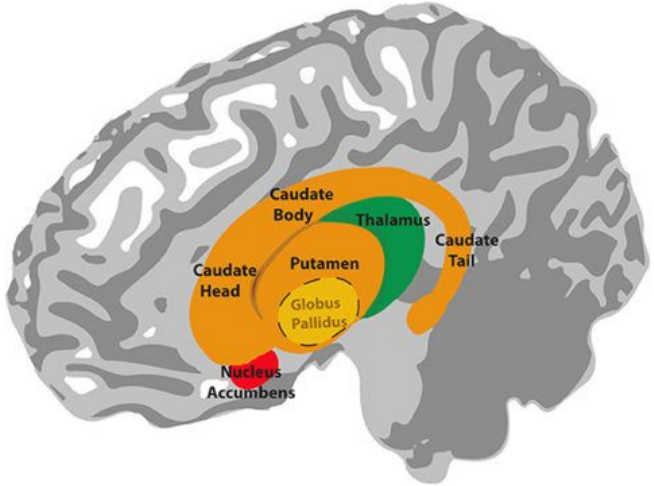
Limbic System

- 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)

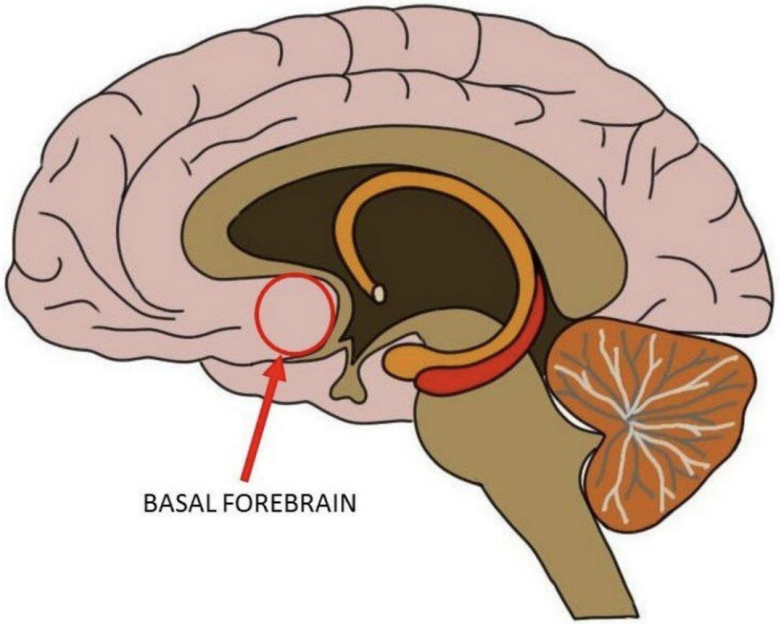
Basal Forebrain

- 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

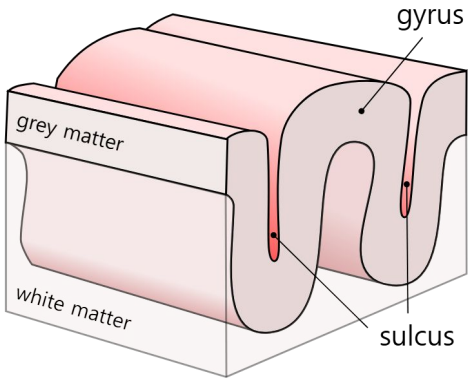


Cerebral Cortex

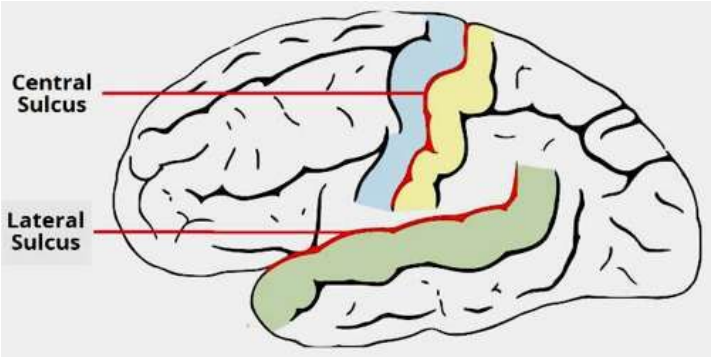
Organized into 6 layers (highly convoluted)

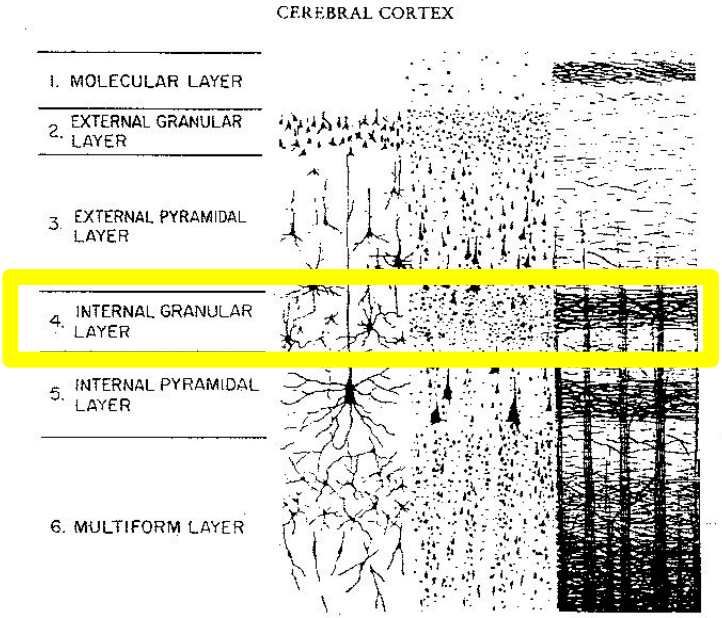
- Information projected to cortex enters at layer 4

- Bulges = gyri (sing. gyrus)
- Folds = sulci (sing. sulcus)

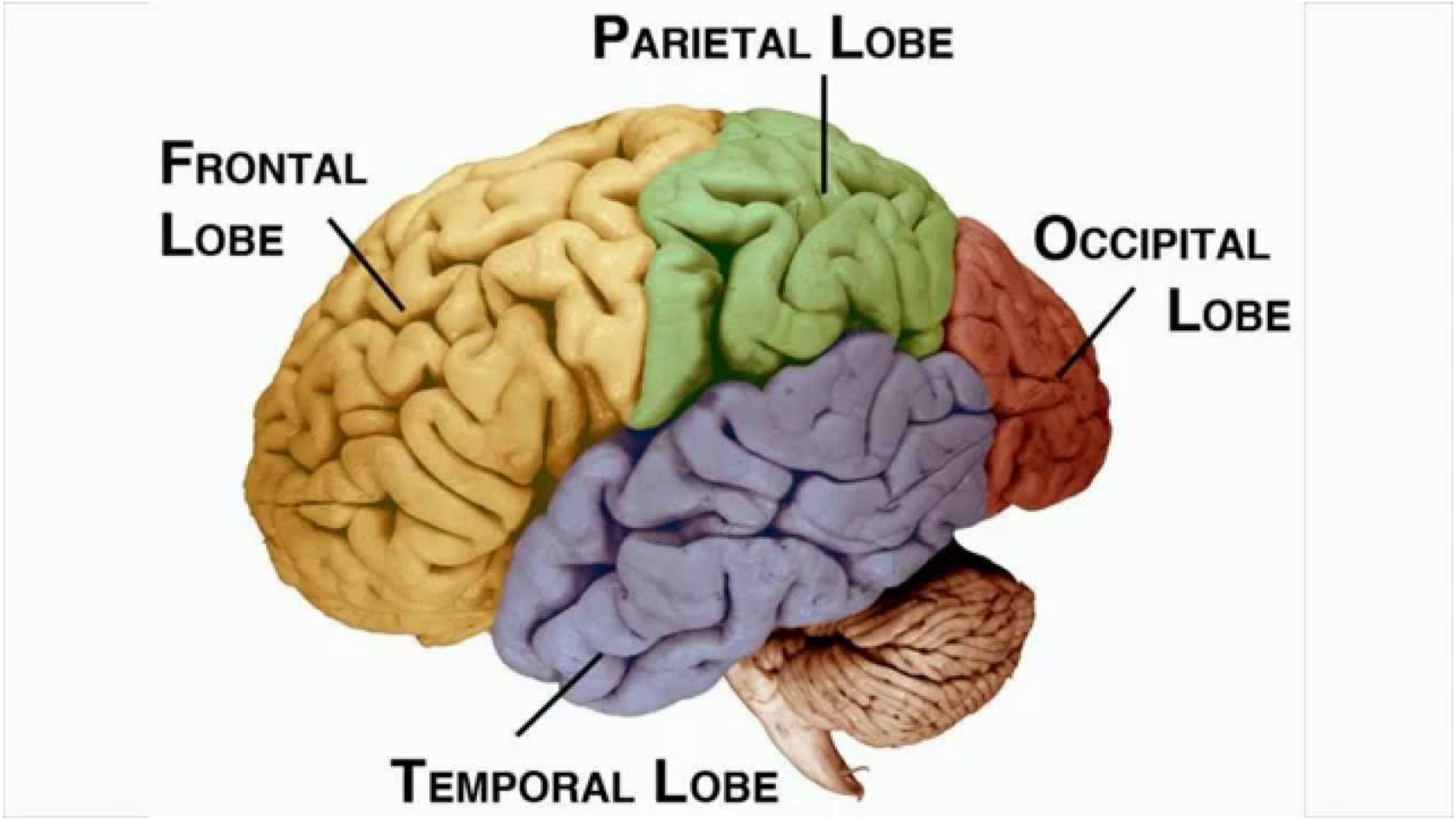


Landmarks
- Central Sulcus divides parietal from frontal lobe
- Lateral Sulcus/Fissure divides temporal from frontal lobe





Lobes of the Brain



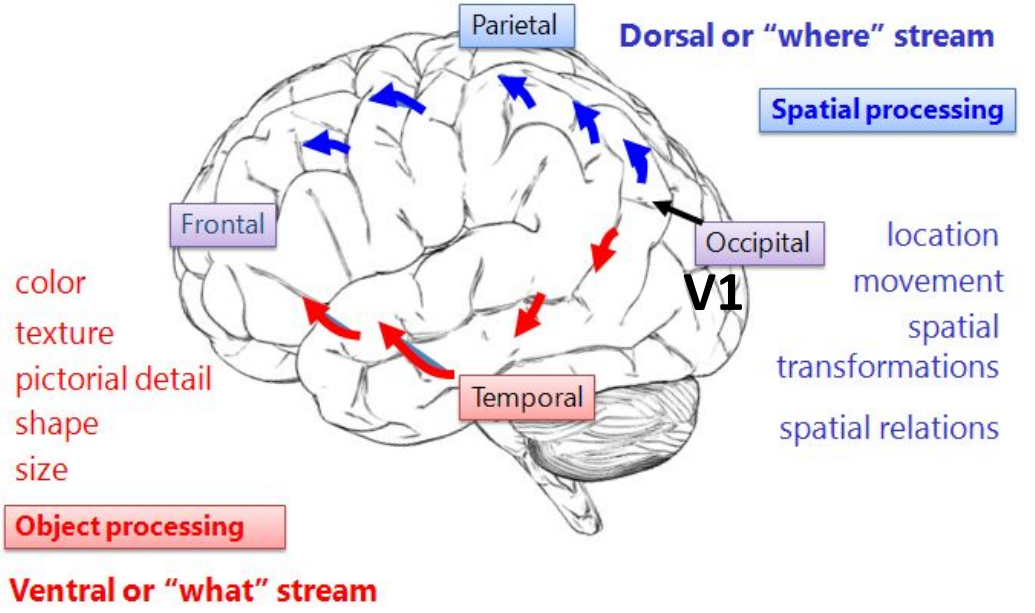
Breaking down the Lobes

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)



Dorsal
Where/How
: Motion & Depth

Ventral
= Who/What
: color & detail

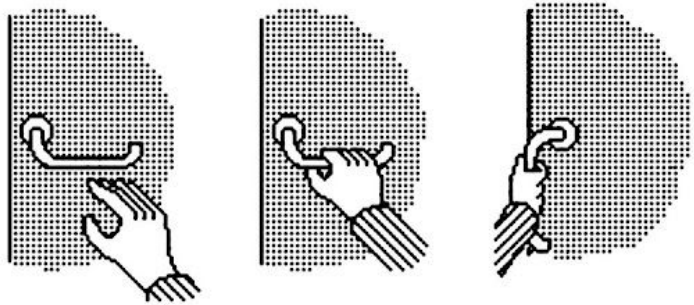
Breaking down the Lobes

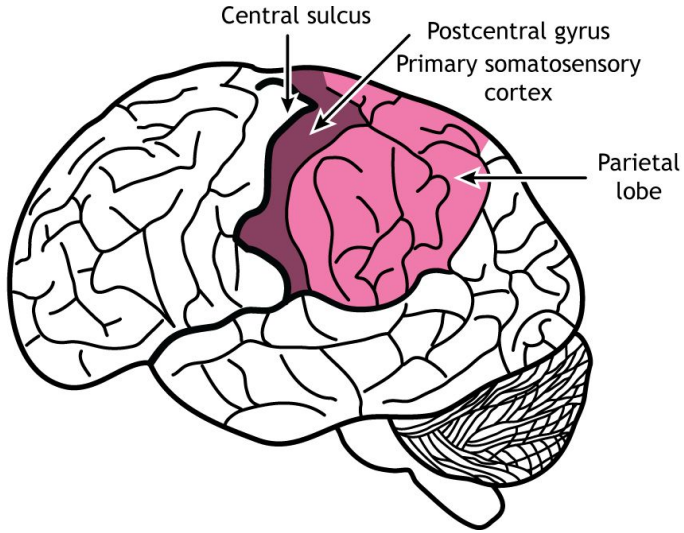
Parietal Lobe

- 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

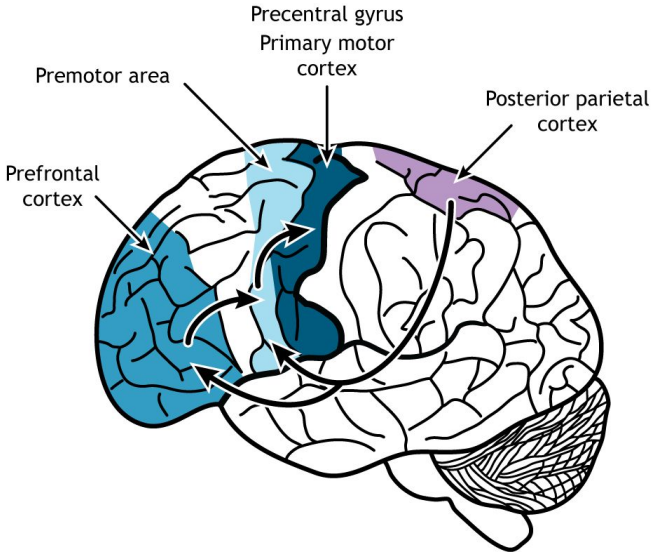


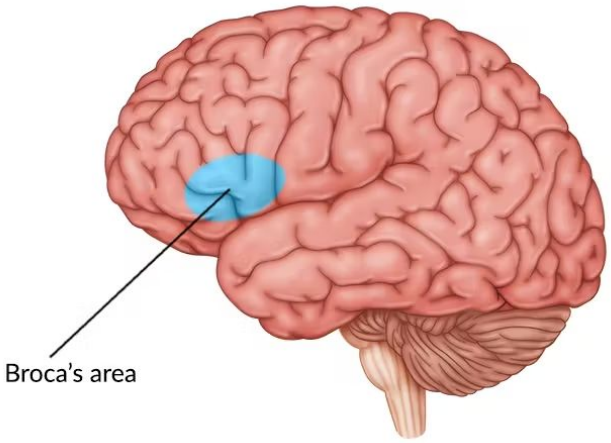


Breaking down the Lobes

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

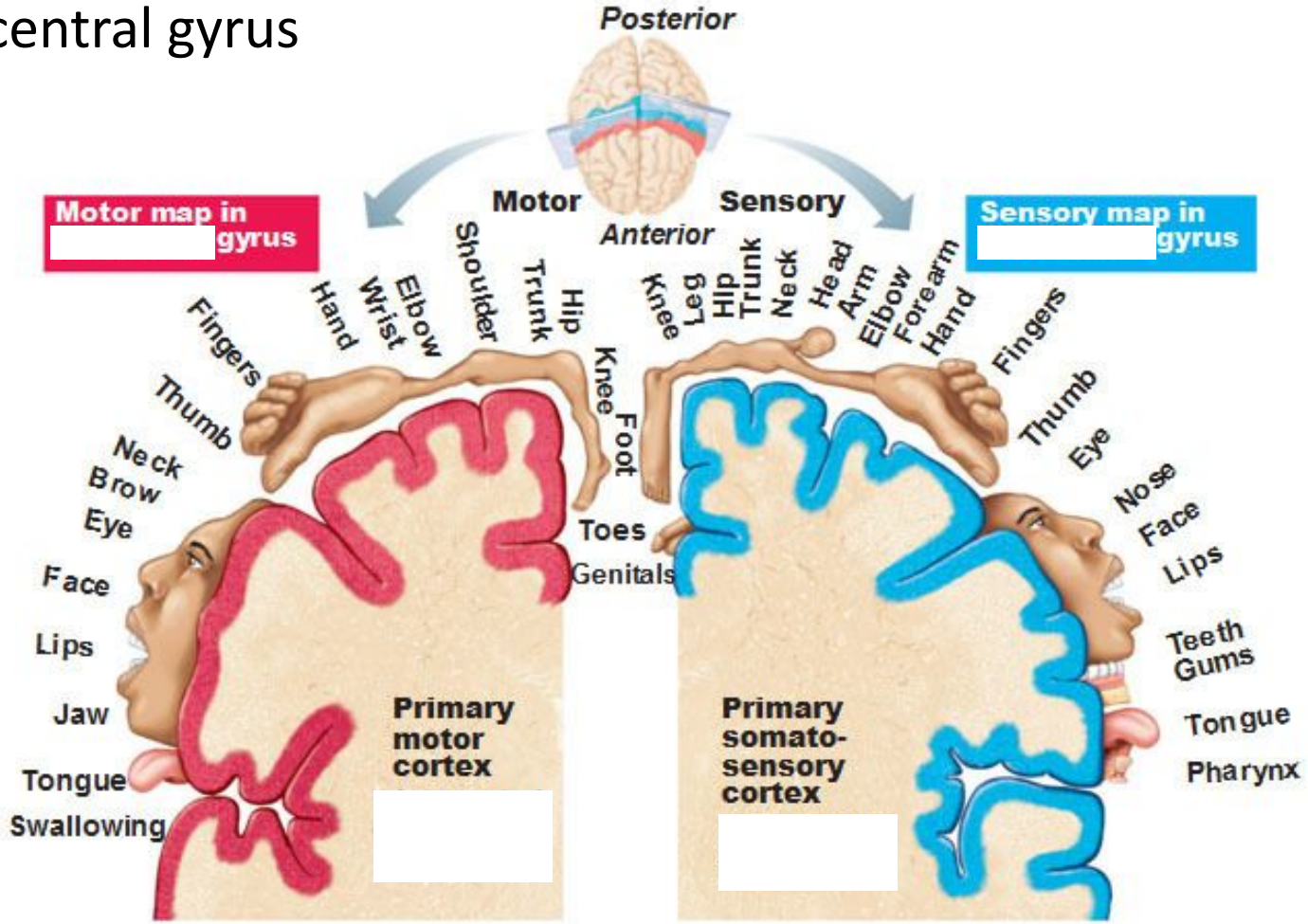




Breaking down the Lobes

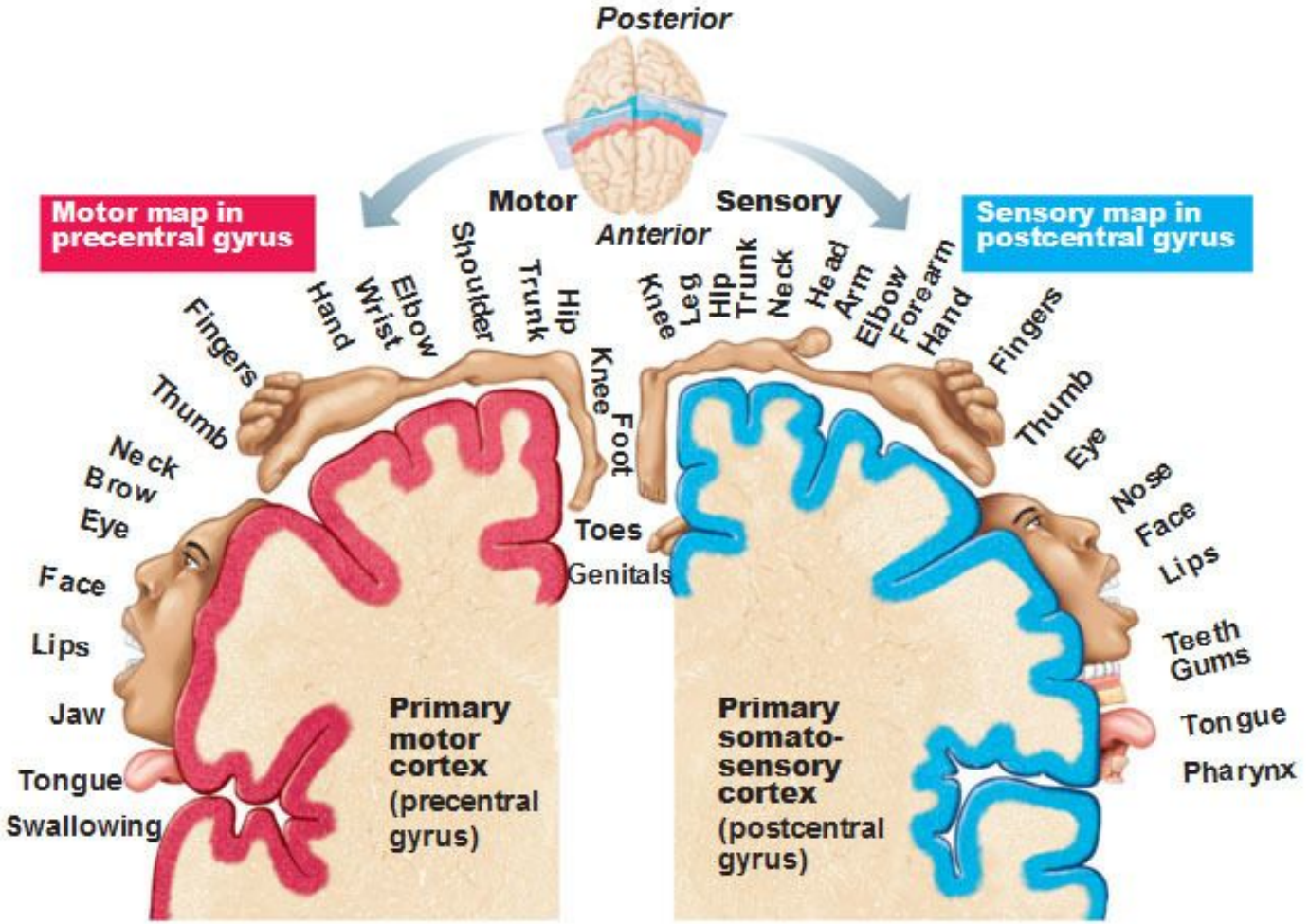
Do you remember…?

- postcentral gyrus
- postcentral gyrus



Breaking down the Lobes

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



Breaking down the Lobes

See you next week!