

# Section 1

Sujin Park  
COGS 17 A04

01/17/25

## 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
- Office Hours: Thu 2-3 pm in-person @ SSRB Room 239 - better reach out before since the door is locked!

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

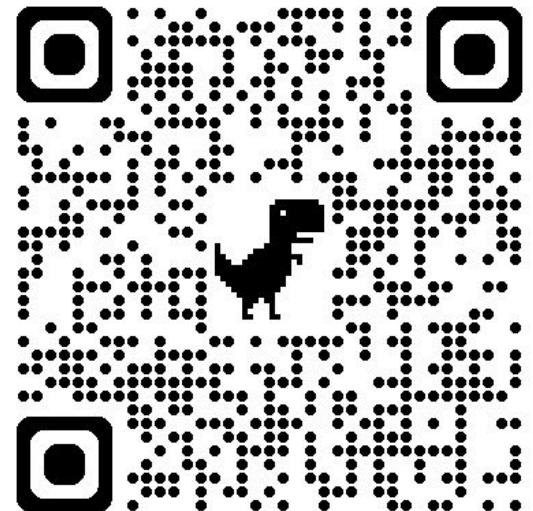
- Discussion section is optional!
- The aim of this section is to review contents covered in class
- Attending section and actively engaging will improve your learning!
- Feel free to give feedback or comments on how to run this section
- It's okay to be wrong

## 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!

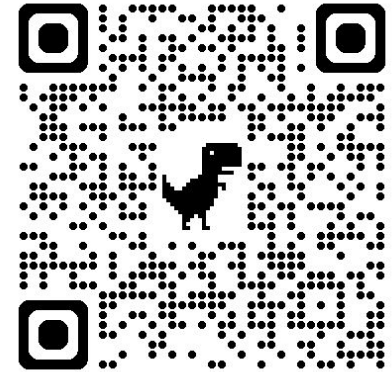


# Opportunities that you might be interested

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[PNI Summer Internship Program](#) (scan QR code): Hands-on summer research internship at the Princeton Neuroscience Institute

- for *non-Princeton undergraduates* who are interested in pursuing a graduate degree in neuroscience or a related field
- nine weeks across early June to early August. *For 2025*, SIP will take place June 2 - August 1
- application for Non-Princeton Student Deadline (SIP) this year: February 3, 2025



[Innovators in Cognitive Neuroscience seminar videos](#)

- Dartmouth Center for Cognitive Neuroscience
- ~1h talk
- might use for extra credit essays?

# 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** Homework 3, Jan 27 - 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

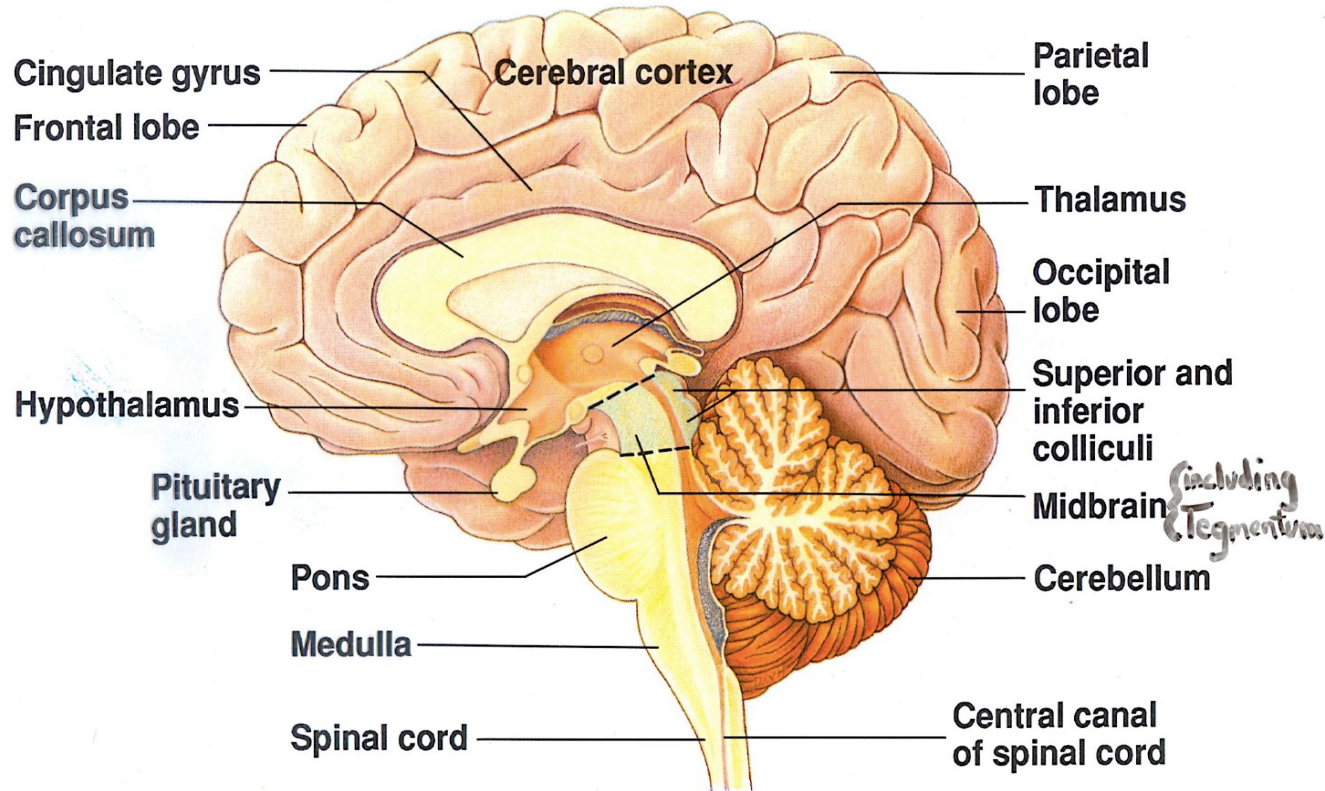
- SONA
- Essay
- Mnemonics
- Homeworks

# 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.

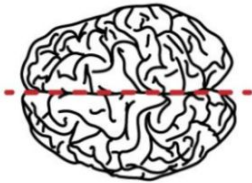
# Planar Views of the Brain

Frontal or  
coronal plane



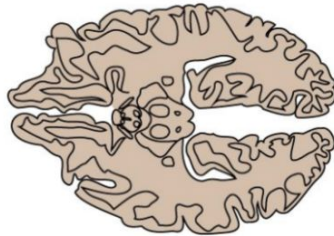
Coronal Plane -- From the **FRONT**

Sagittal plane



Sagittal Plane -- From the **SIDE**

Horizontal plane

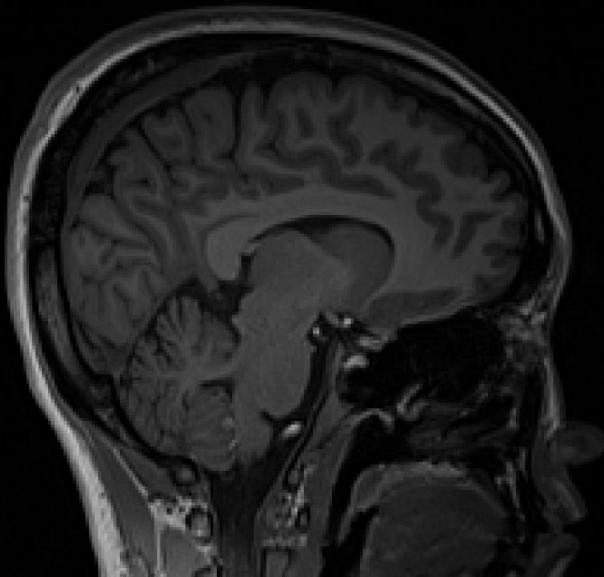


Horizontal Plane -- From the **ABOVE**

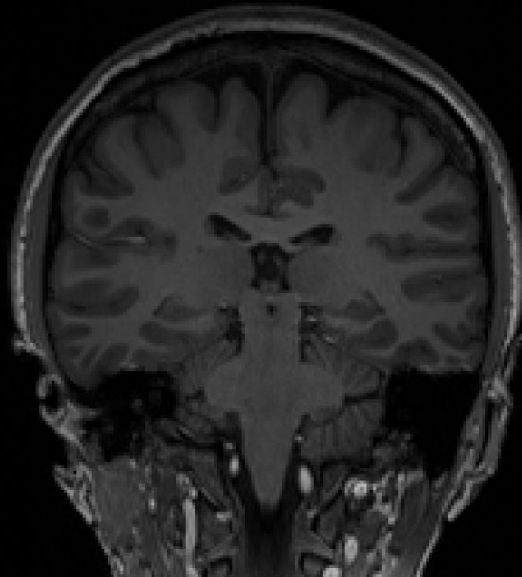


# Planar Views of the Brain - Surprise Quiz

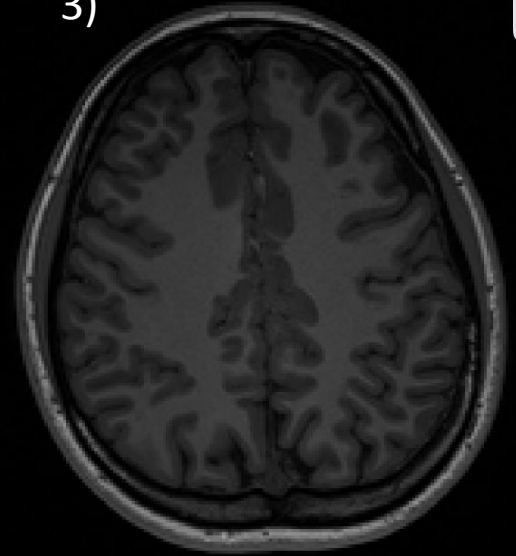
1)



2)



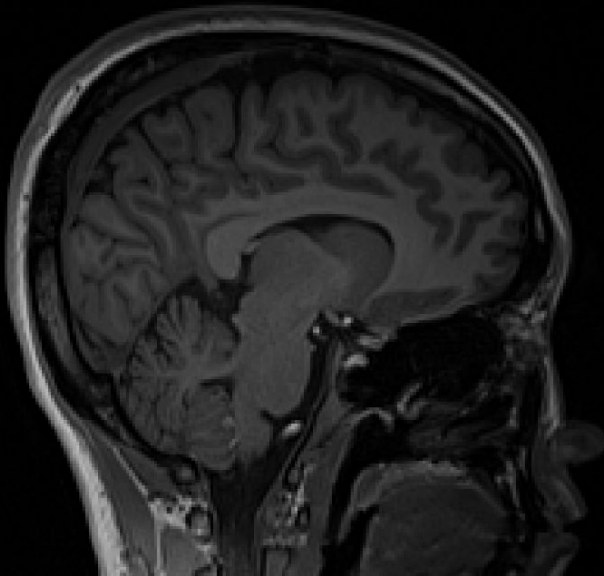
3)



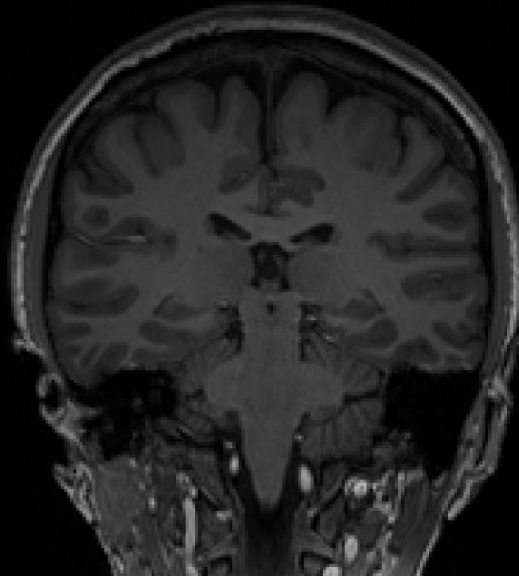
Guess whose brain this is 🤔

# Planar Views of the Brain - Surprise Quiz

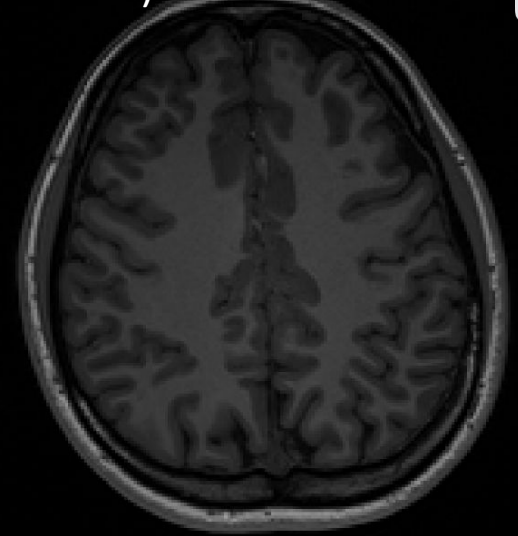
1) Sagittal



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

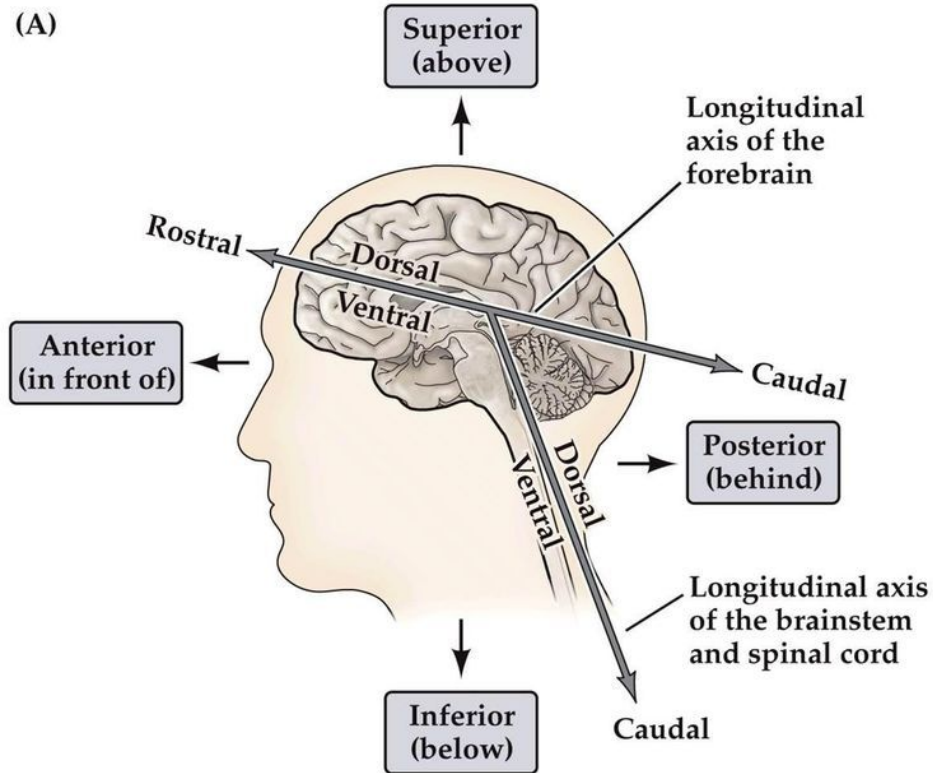
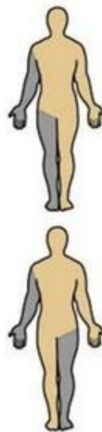
- Dorsal: The “top” of the brain
- Ventral: The “underside” of the brain

## Anterior & Posterior

- Anterior: Front
- Posterior: Back

## Bilateral Structure

- Ipsilateral: Same side
- Contralateral: Opposite side

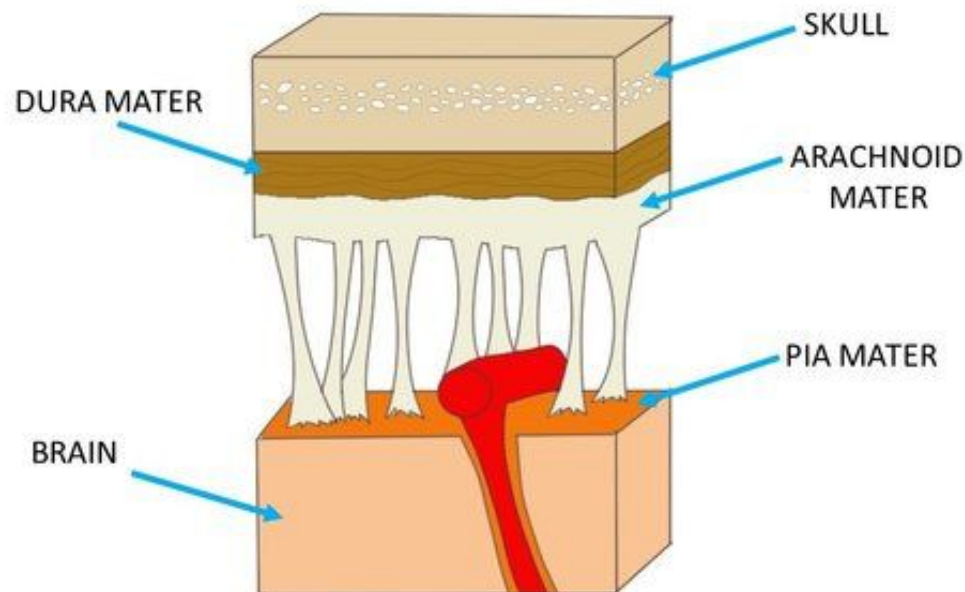


NEUROSCIENCE 5e, Figure A1 (Part 1)  
© 2012 Sinauer Associates, Inc.

# Support Structure

## Meninges

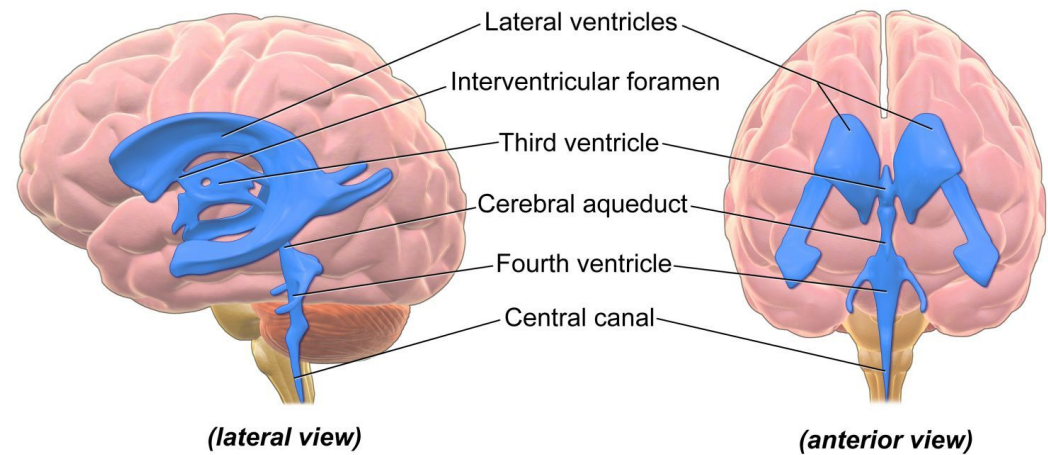
- Dura Mater: Thick outer layer
- Arachnoid Mater: Spider-web like, spongy layer filled with Cerebrospinal fluid (CSF), shock absorber
- Pia Mater: flexible inner layer that conforms to the brain and spine surfaces, include blood vessels



# Support Structure

## Ventricles

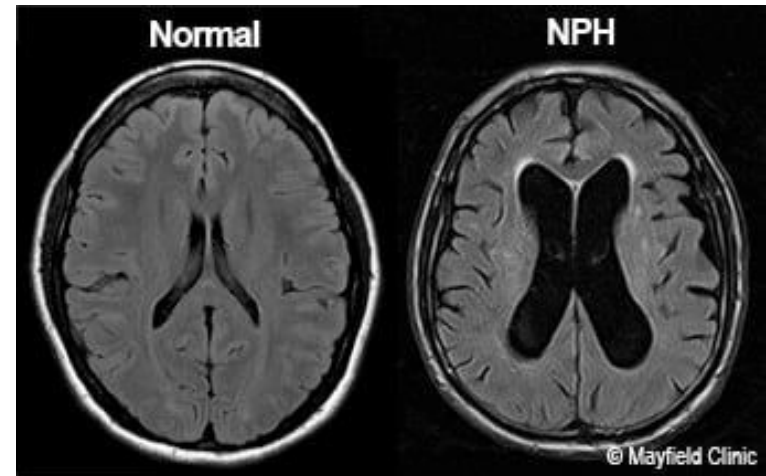
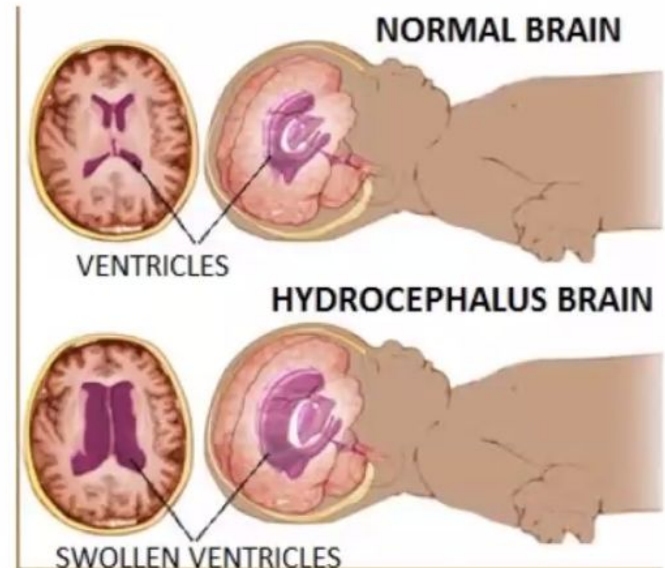
- Hollow, interconnected cavities
- produce and circulate CSF
- Structure:
  - 2 Lateral Ventricles
  - Central Third Ventricle
  - Cerebral Aqueduct
  - Central Fourth Ventricle



# Hydrocephalus

## Swollen ventricles

- When CSF is not properly drained out through the cerebral aqueduct, the ventricles tend to swell up
- 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

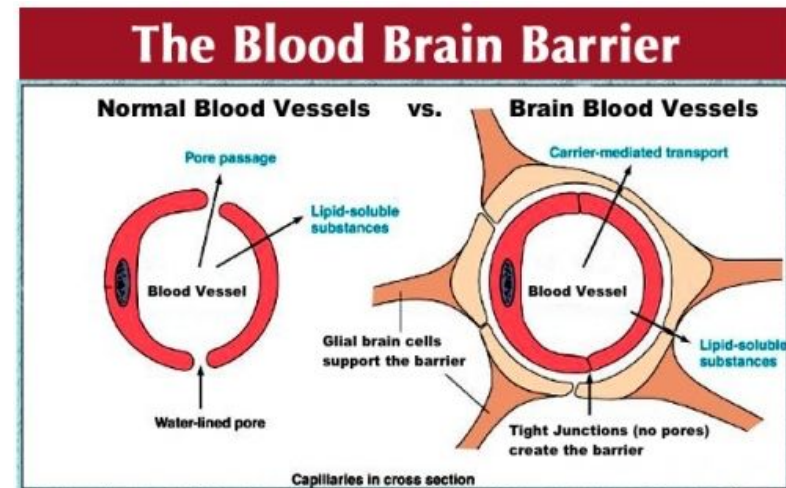
## Blood Vessels

- 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 chemicals in the brain
- 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



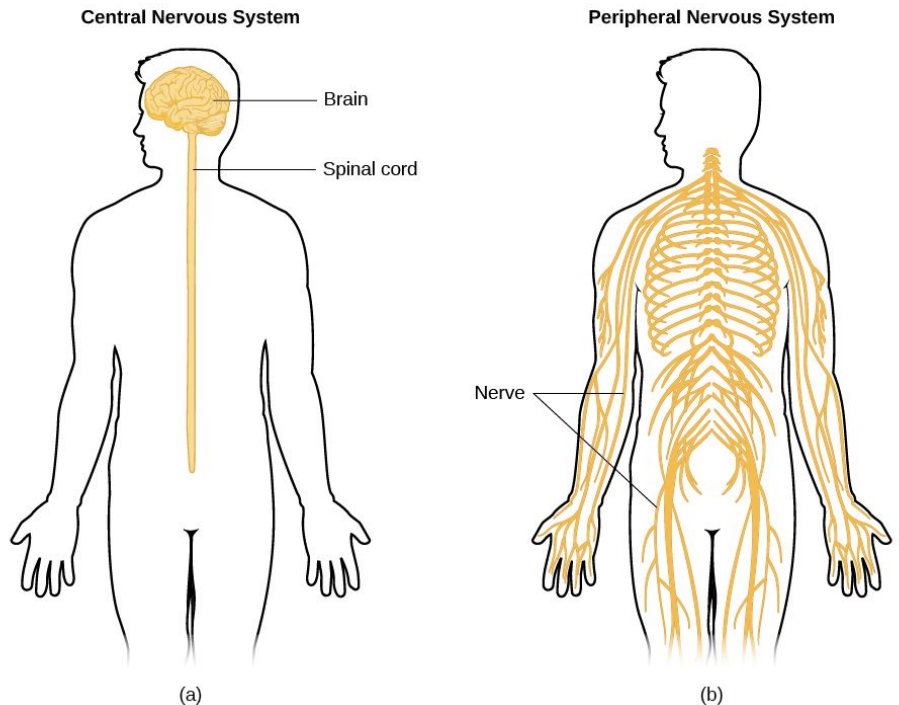
# CNS vs PNS

## 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

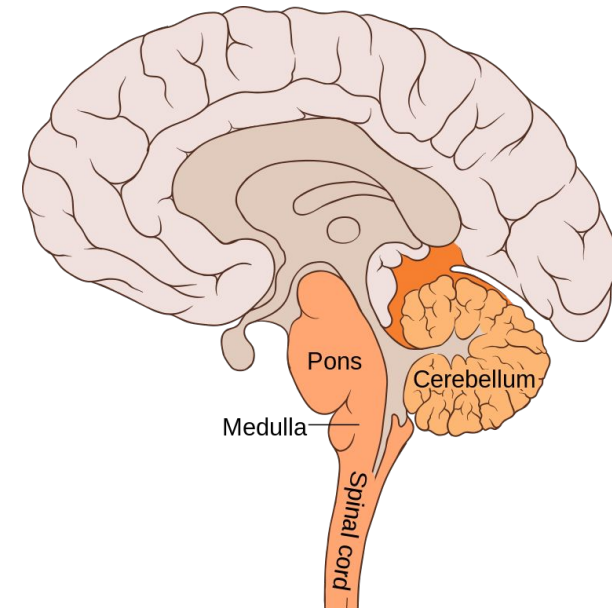
- Control vital reflexes (e.g., breathing, heart rate)

## Pons

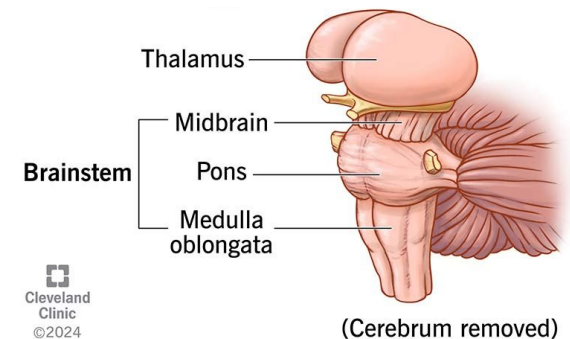
- Latin for “Bridge”
- Relay between cortex & cerebellum and brain & spinal cord
- Includes reticular formation (arousal) and raphe system (sleep)

## Cerebellum

- Motor programs with real-time sensory coordination
- Guide movements
- Critical in timing actions and also important for shifting attention
- NOT the brain stem



## + Hypothalamus



# Midbrain

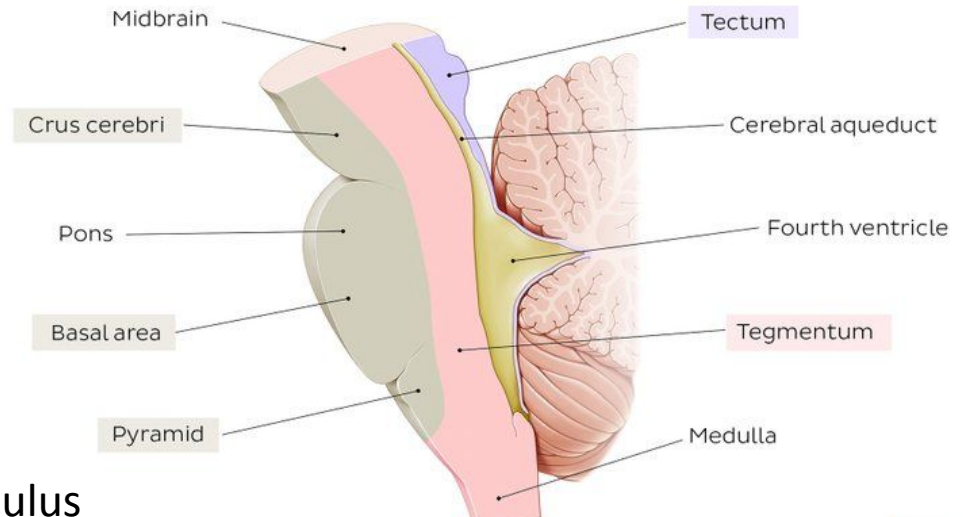
## Entirely contained in the brain stem

### Tectum

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

### Tegmentum

- Latin for “Covering” or “Rug”
- 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)

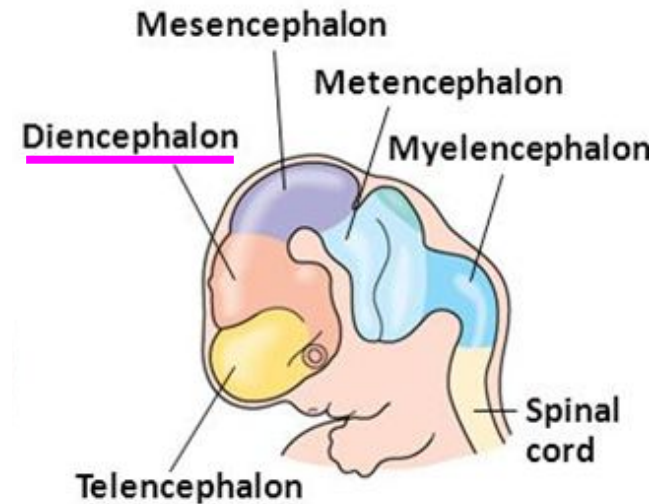
Diencephalon consists of the thalamus and hypothalamus

## Thalamus

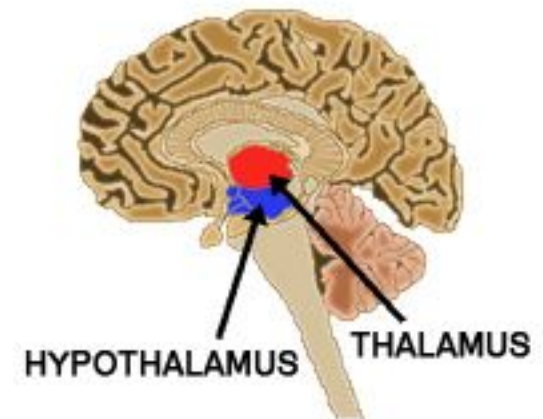
- Primary source of input to cerebral cortex
- Nuclei of many sensory and motor systems
- Involved in cortical arousal

## Hypothalamus

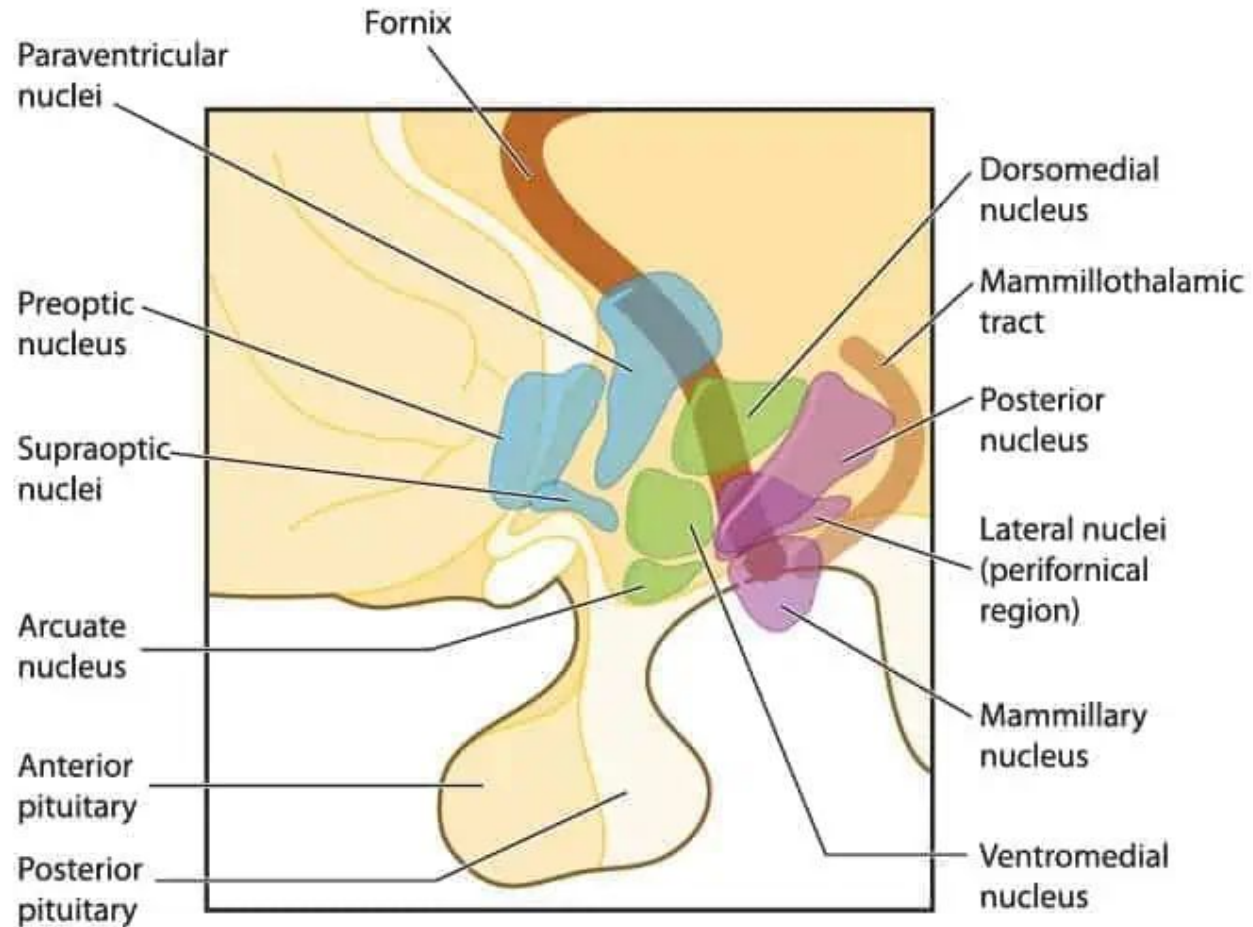
- Hypo = “below”
- Oversees “4Fs”: Fighting, Fleeing, Feeding, F...
- Also regulates temperature and internal clock
- Controls the endocrine system via the Pituitary Gland



Embryo at 5 weeks



# Forebrain (Diencephalon)



nuclei of Hypothalamus

## Review Questions

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*In regards to the Brainstem, indicate whether the following are TRUE or FALSE.*

A) The brainstem includes hindbrain, midbrain, and forebrain structures. [ ]

B) The Raphe System, which runs along the medial face of the brainstem, plays a role in feeding behavior. [ ]

C) The Reticular Activating System, that runs up the brainstem, arouses the brain. [ ]

D) The brainstem includes the Cerebellum. [ ]

E) The brainstem includes the Thalamus and Hypothalamus. [ ]

## Review Questions

---

*In regards to the Brainstem, indicate whether the following are TRUE or FALSE.*

A) The brainstem includes hindbrain, midbrain, and forebrain structures. **[ T ]**

B) The Raphe System, which runs along the medial face of the brainstem, plays a role in feeding behavior. **[ F ]**

C) The Reticular Activating System, that runs up the brainstem, arouses the brain. **[ T ]**

D) The brainstem includes the Cerebellum. **[ F ]**

E) The brainstem includes the Thalamus and Hypothalamus. **[ T ]**



# Forebrain (Telencephalon)

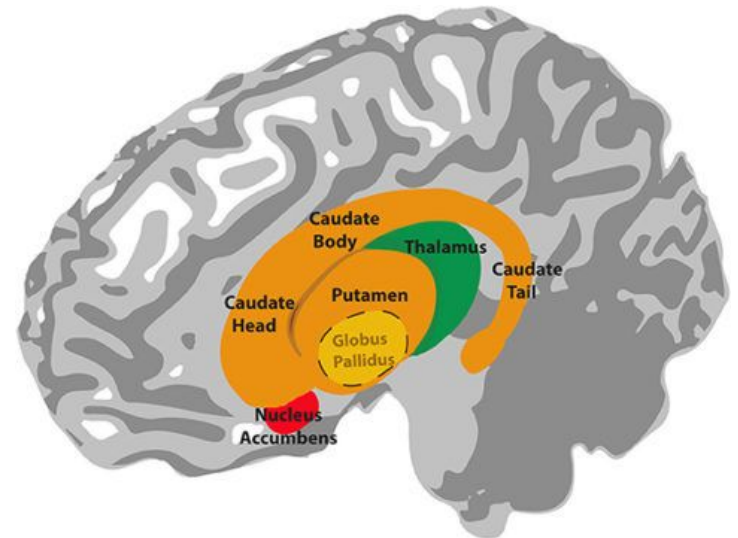
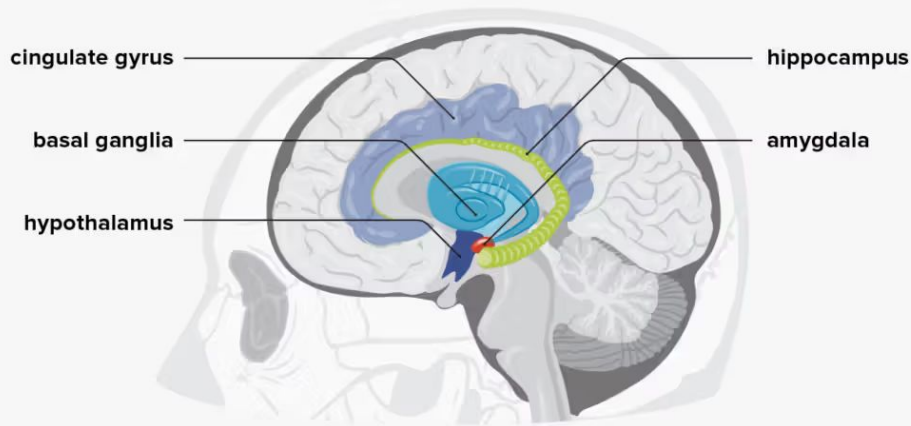
## Limbic System

- Motivational and emotional behavior
- Hippocampus: formation of new memories and spatial mapping
- Amygdala: emotional expression and interpreting others' emotions
- Cingulate Gyrus: assess valence +/-
- Olfactory Bulb: exchanges olfactory information with the rest of the limbic system

## Basal Ganglion

- Includes caudate, putamen, and globus pallidus
- Control of movement, especially **planned sequential behaviors** (task setting)

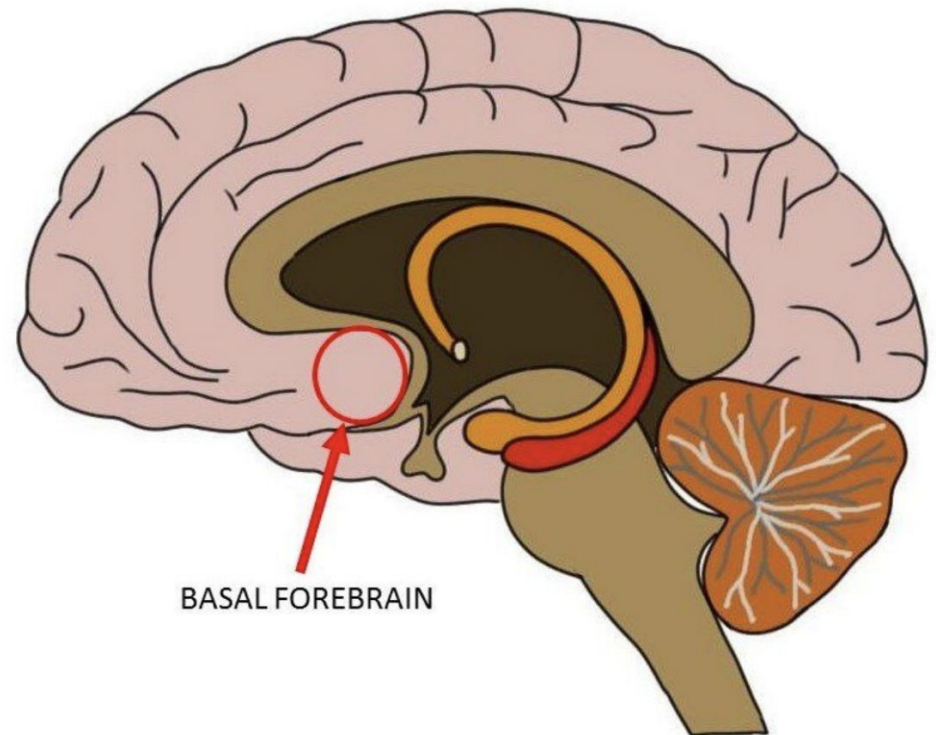
The limbic system



# Forebrain (Telencephalon)

## Basal Forebrain

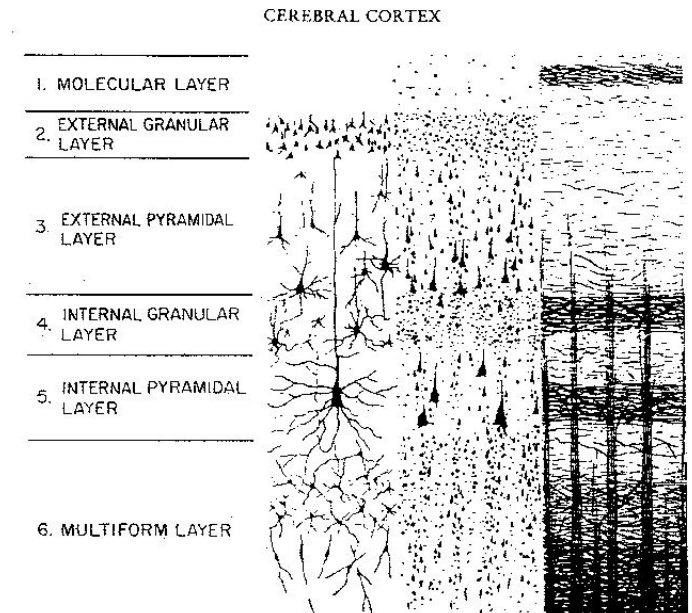
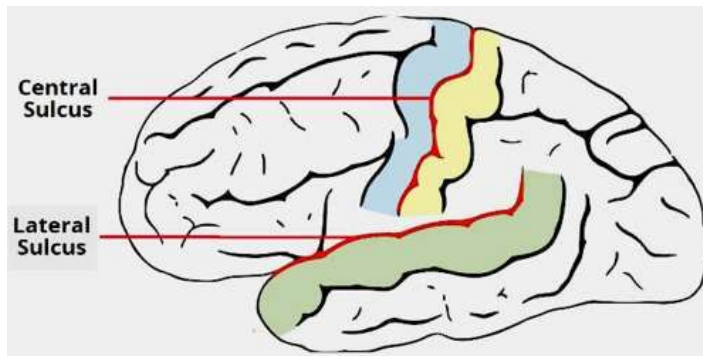
- attention and cortical arousal
- Main source of ACh (Acetylcholine, excitatory neural transmitter) and GABA (Gamma-Aminobutyric Acid, inhibitory neural transmitter)
- sleep/arousal cycles



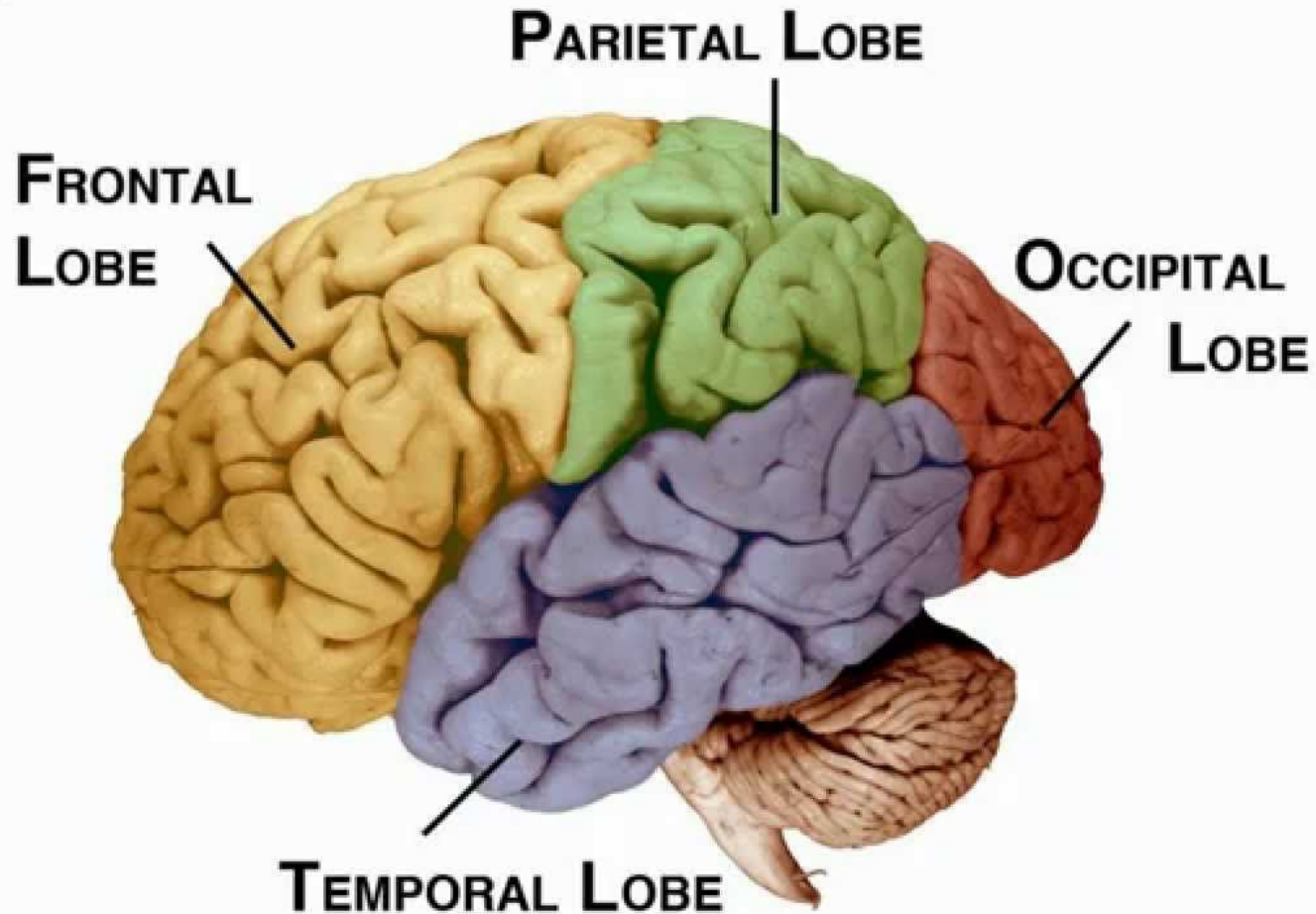
# Cerebral Cortex

## Organized into 6 layers

- Information projected in at layer 4
- Bulges = gyri
- Folds = sulci
- Central Sulcus divides parietal from frontal lobe
- Lateral Sulcus divides temporal from frontal lobe



# Lobes of the Brain



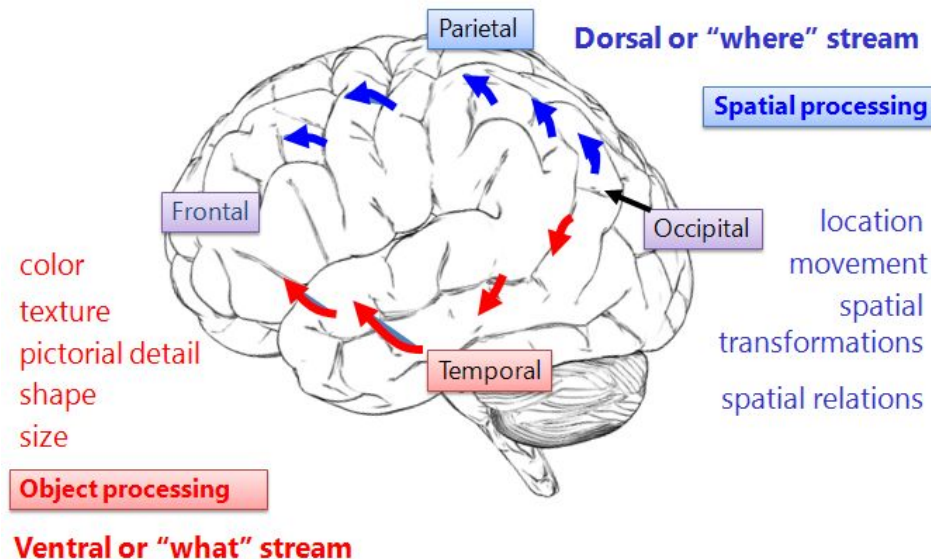
# Breaking down the Lobes

## Occipital Lobe

- Visual processing
- Contains V1 and receives projections from the thalamus & higher visual areas
- Separate pathways for details (e.g., color, depth) that project to other lobes

## Temporal Lobe

- Contains auditory areas (including Wernicke's Area)
- Inferior Temporal: ventral "who/what" pathway, specializes for face detection
- Anterior Temporal: emotional expression and interpretation





# Breaking down the Lobes

## Parietal Lobe

- integrating visual and somatosensory info
- Spatial mapping
- Medial Temporal (MT): dorsal “where/how” pathway

### Canonical cells

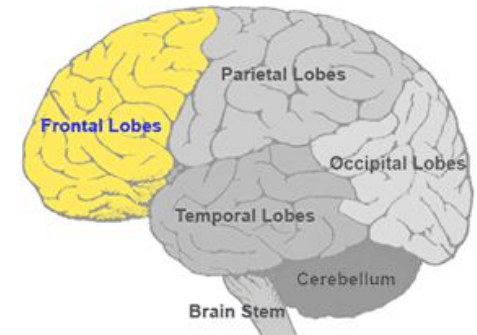
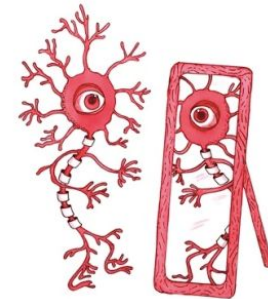
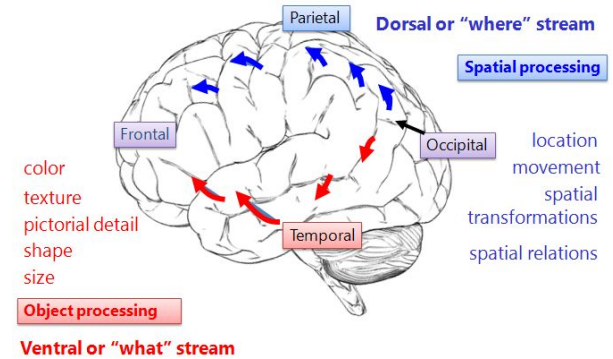
- Responds to “affordances” of objects
- Motor cortex also contains canonical cells

### Mirror cells

- Respond to seeing self or other perform an action
- Promotes imitation

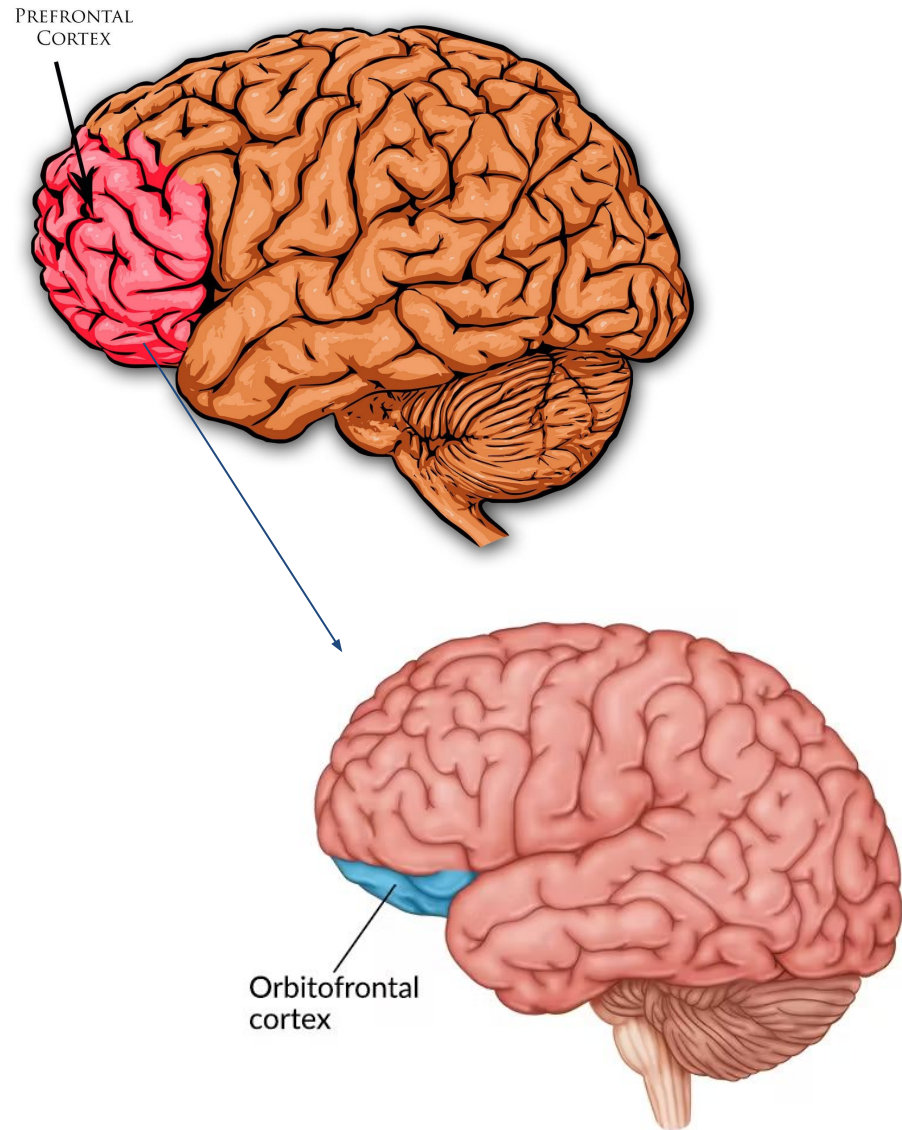
## Frontal Lobe

- Important for motor movements, language production, and strategy
- Precentral gyrus: motor cortex
- Premotor areas contain mirror cells
- Contains Broca’s Area (prepare to speak)
- Prefrontal cortex



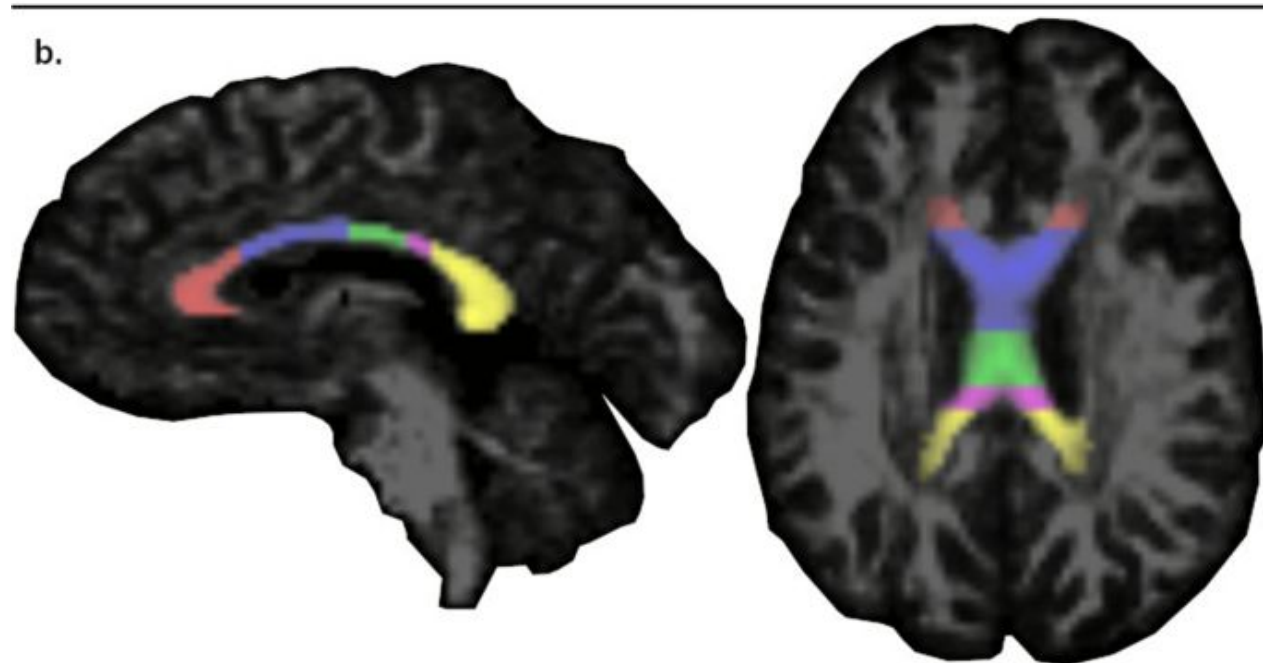
# Prefrontal Cortex

- Self-control
- Delayed gratification
- Culturally/socially appropriate behavior
- Cost/benefit analysis
- Orbital-Frontal Cortex
  - Plays an important role in social strategy



# Corpus Callosum

- Large axonal fibers connecting the two hemispheres
- Part of the “white matter” of the brain
  - Consists of mainly myelinated axons





## Review Questions

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- The cerebral cortex is composed of \_\_\_\_ layers.
- Information is projected into the cortex at layer \_\_\_\_.
- The bulges in the cortex are called \_\_\_\_\_ while the folds are called \_\_\_\_\_.
- choose the right option
  - The **inferior temporal (IT)/medial temporal (MT)** contains face cells and is part of the **dorsal/ventral** pathway for information on “who” and “what,” while the **inferior temporal (IT)/medial temporal (MT)** is part of the **dorsal/ventral** pathway and includes motion sensitive cells.
  - In the frontal lobe, there are **canonical/mirror** cells that respond to “affordances” of objects while the **canonical/mirror** system is said to react when you see yourself or others perform an action.

## Review Questions

---

- The cerebral cortex is composed of   6   layers.
- Information is projected into the cortex at layer   4  .
- The bulges in the cortex are called   gyri   while the folds are called   sulci  .
- The **inferior temporal (IT)/medial temporal (MT)** contains face cells and is part of the **dorsal/ventral** pathway for information on “who” and “what,” while the **inferior temporal (IT)/medial temporal (MT)** is part of the **dorsal/ventral** pathway and includes motion sensitive cells.
- In the frontal lobe, there are **canonical/mirror** cells that respond to “affordances” of objects while the **canonical/mirror** system is said to react when you see yourself or others perform an action.

# Spinal Cord

Consists of 31 segments along the spine

## Dorsal Root

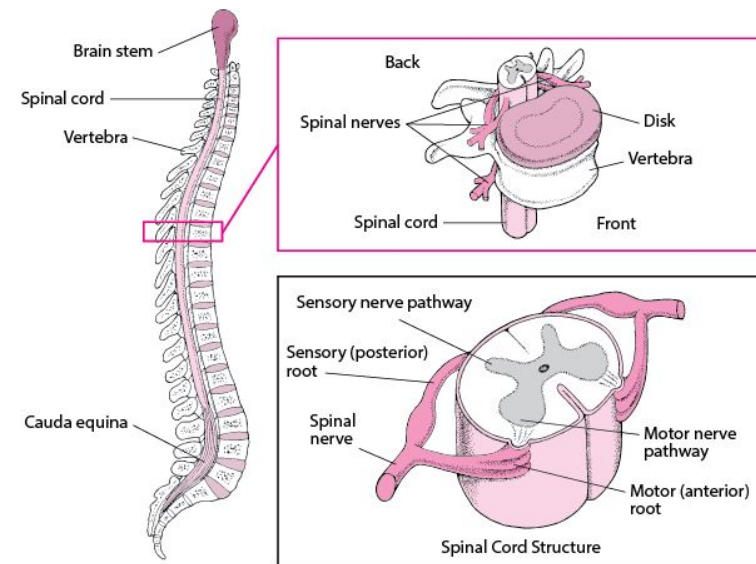
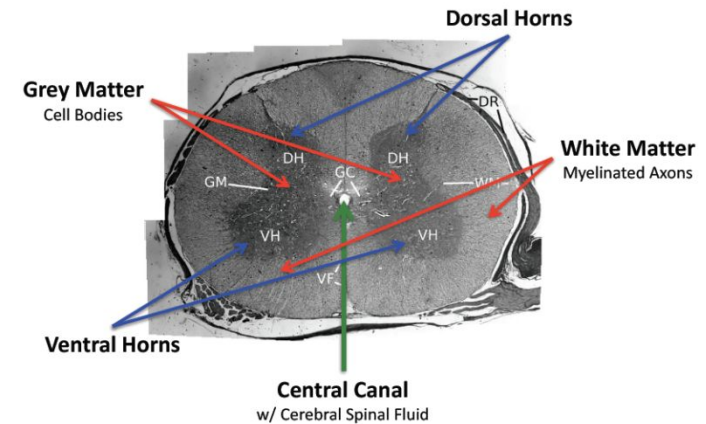
- Afferent nerves
- Information from body to brain

## Ventral Root

- Efferent nerves
- Motor information to muscles and glands

## Bell-Magendie Law

- Sensory information goes in via dorsal roots and exits ventral roots



# Peripheral Nervous System

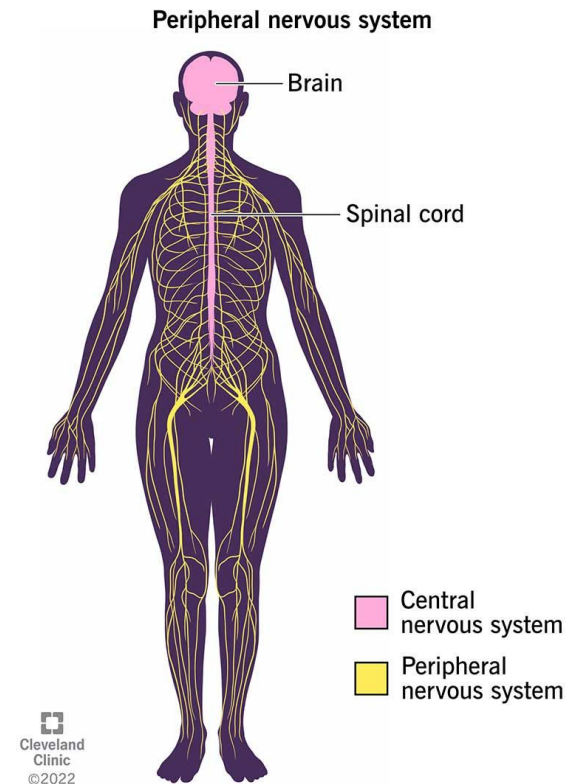
## 2 Subdivisions

### Somatic

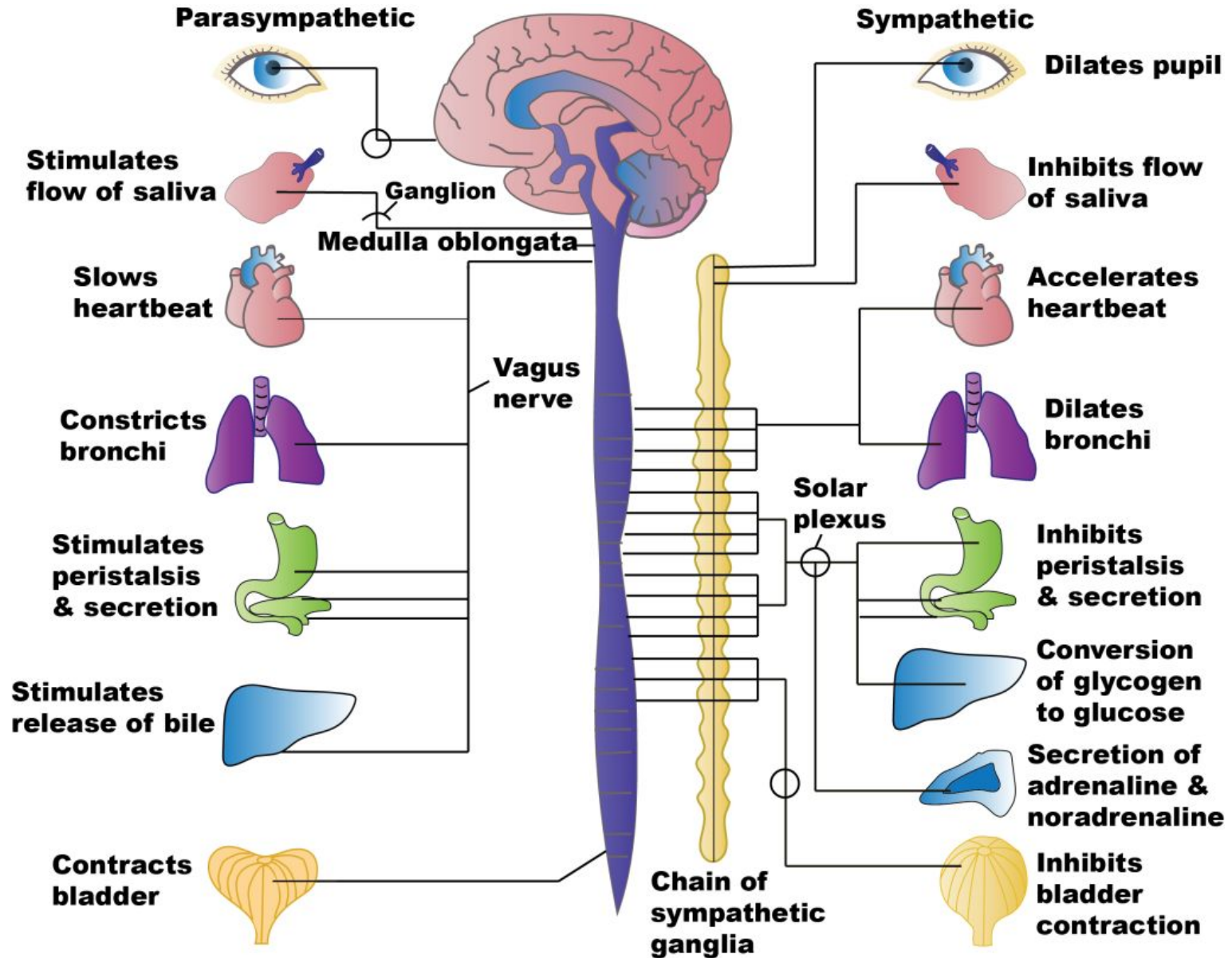
- 31 pairs of spinal nerves: sensory information from body, feedback from skeletal muscles, and motor output to muscles
- 12 cranial nerves: senses, feedback from some organs, motor control of eye movements, and control of facial expressions

### Autonomic

- Regulates internal state
- Sympathetic “Fight or Flight”
- Parasympathetic “Rest & Digest”



# Autonomic Nervous System



# Review Questions

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*Label as either a sympathetic response (S) or a parasympathetic response (P):*

- ☐ Pupils dilate
- ☐ Increased heartrate
- ☐ Saliva production
- ☐ Bronchi constrict
- ☐ Halt digestion
- ☐ Facilitate sexual arousal
- ☐ Hold bladder
- ☐ Blood vessels constrict
- ☐ Pilo-erection

# Review Questions

---

*Label as either a sympathetic response (S) or a parasympathetic response (P):*

- S Pupils dilate
- S Increased heartrate
- P Saliva production
- P Bronchi constrict
- S Halt digestion
- P Facilitate sexual arousal
- S Hold bladder
- S Blood vessels constrict
- S Pilo-erection

# Enjoy the rest of the week!

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