Section 1: Anatomy of the Nervous System

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OH: Tuesday 9-10am in CSB 114

COGS 17: Summer I 2019

Section **7/3**, Week 1

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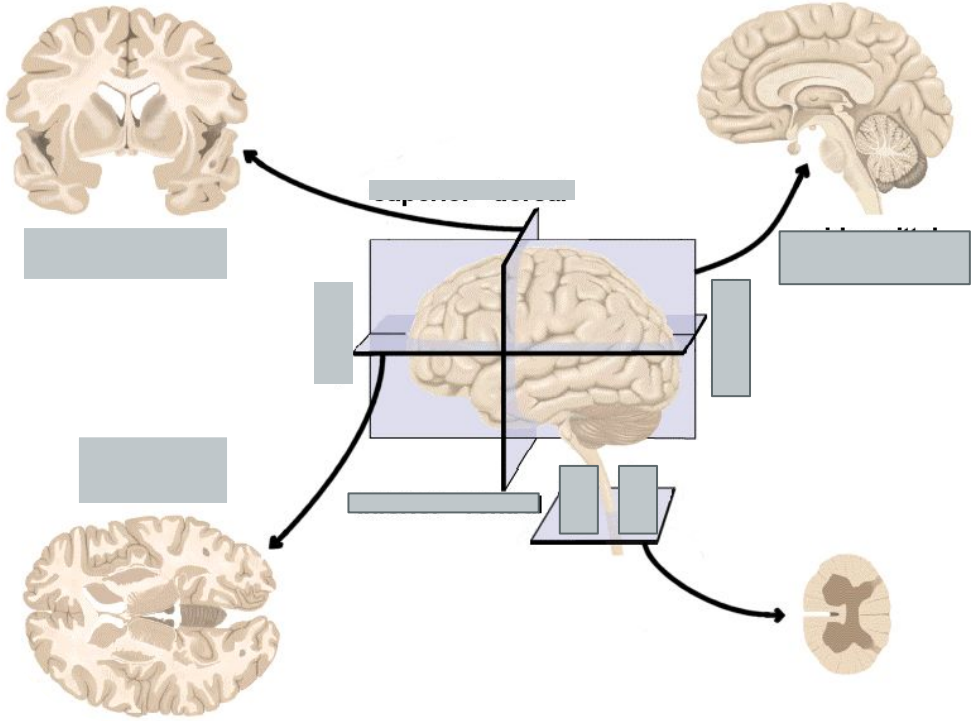
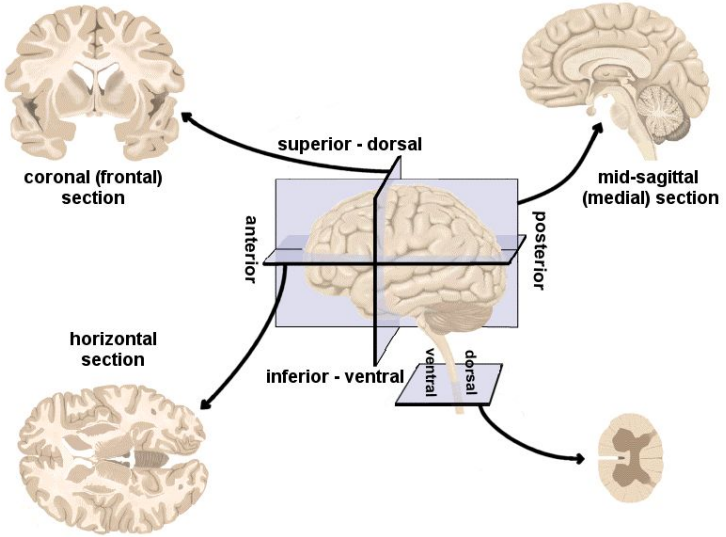
Lexi	*adfrankl@ucsd.edu*	Tuesday, 9-10 am	CSB 114

Directions and Views

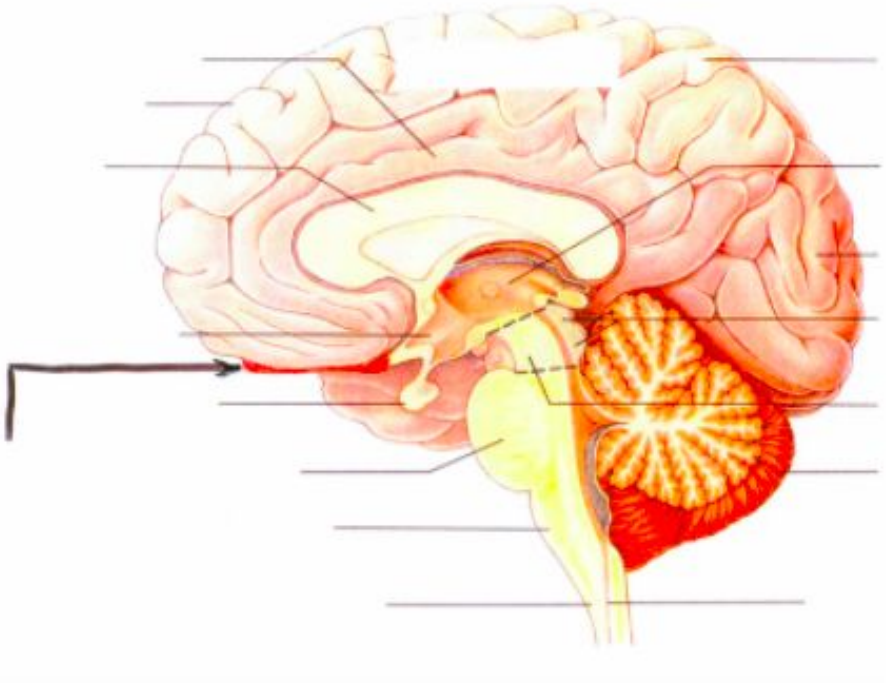


Directions and Views

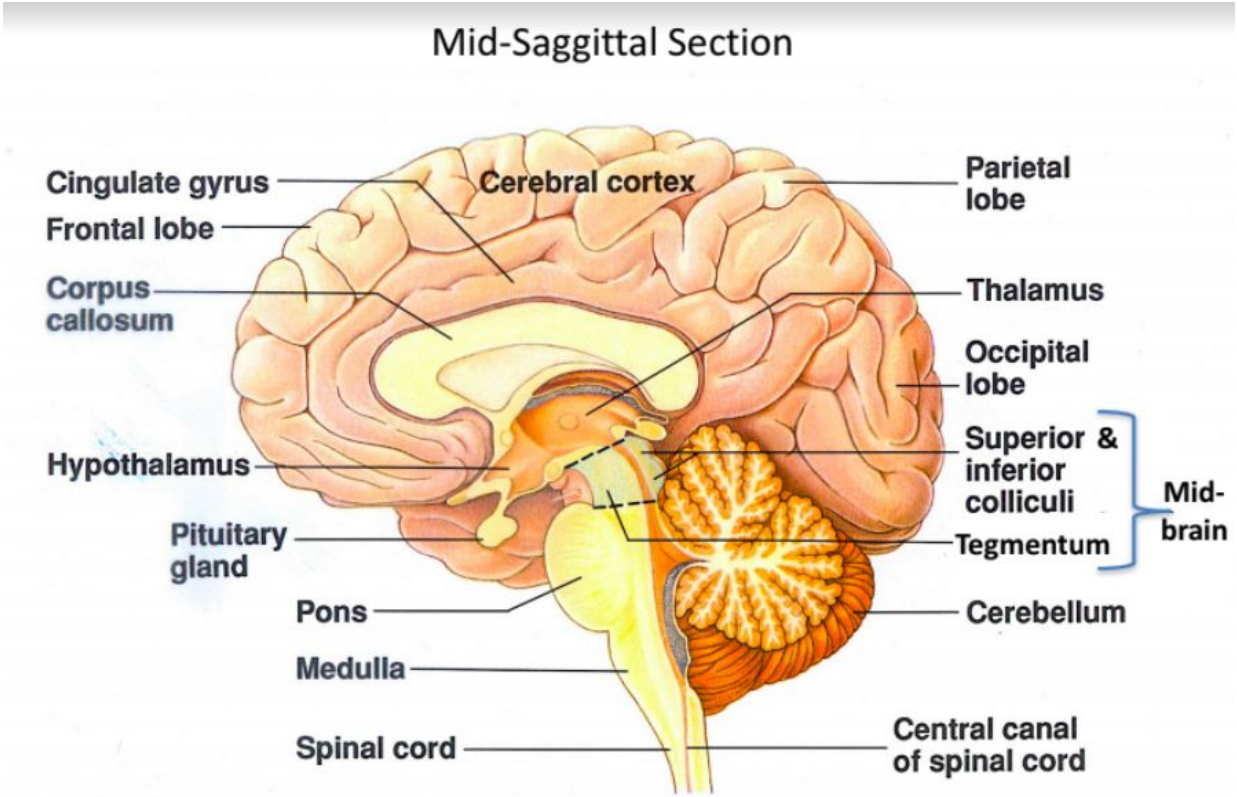
- Directions
  - Dorsal and Ventral: top/bottom
  - Rostral and Caudal: front/back
  - Anterior and Posterior: front/back
  - Lateral and Medial: side/middle
- Sections
  - Coronal
  - Horizontal
  - Sagittal
- Connections
  - Ipsilateral: same side
  - Contralateral: opposite side

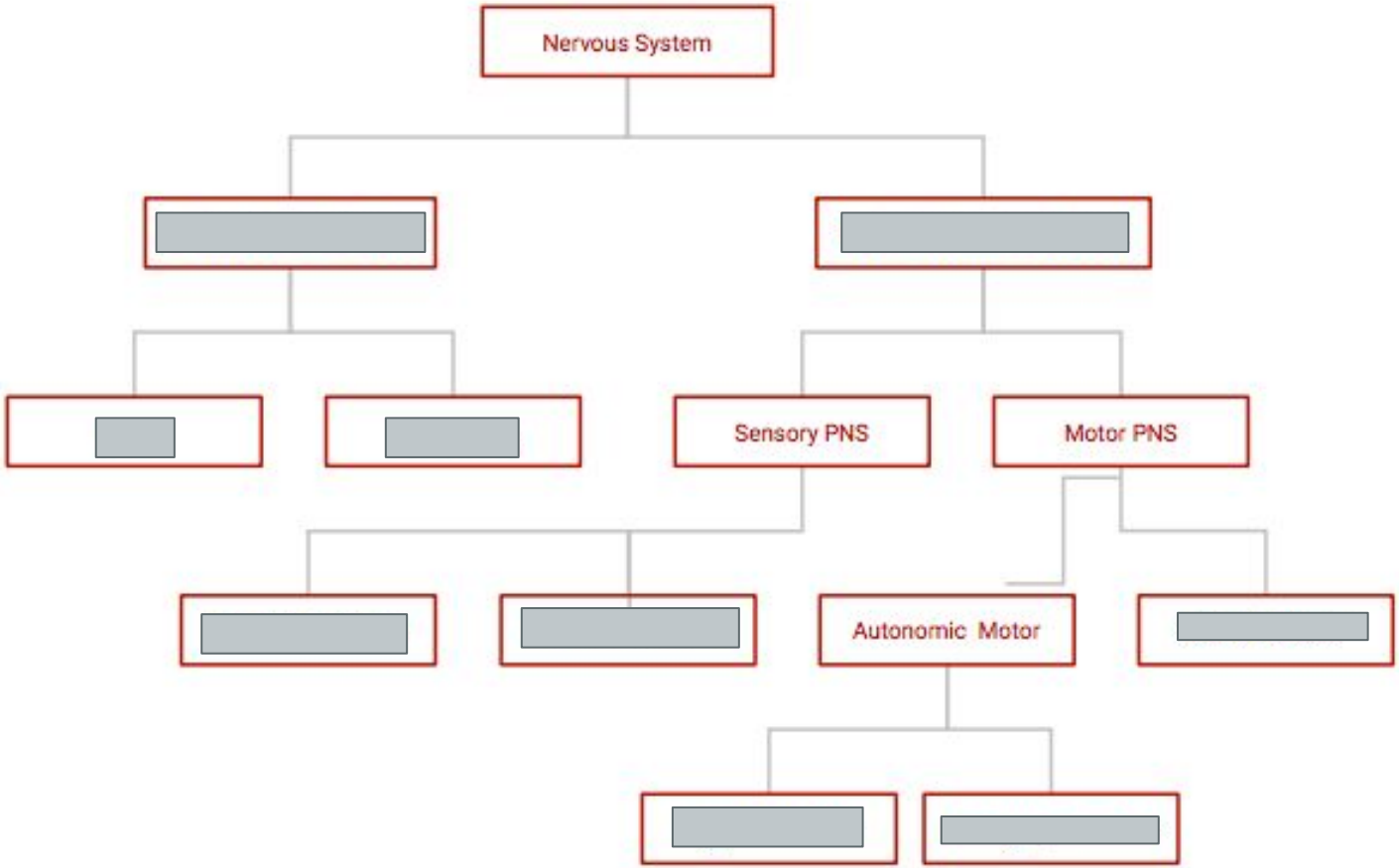


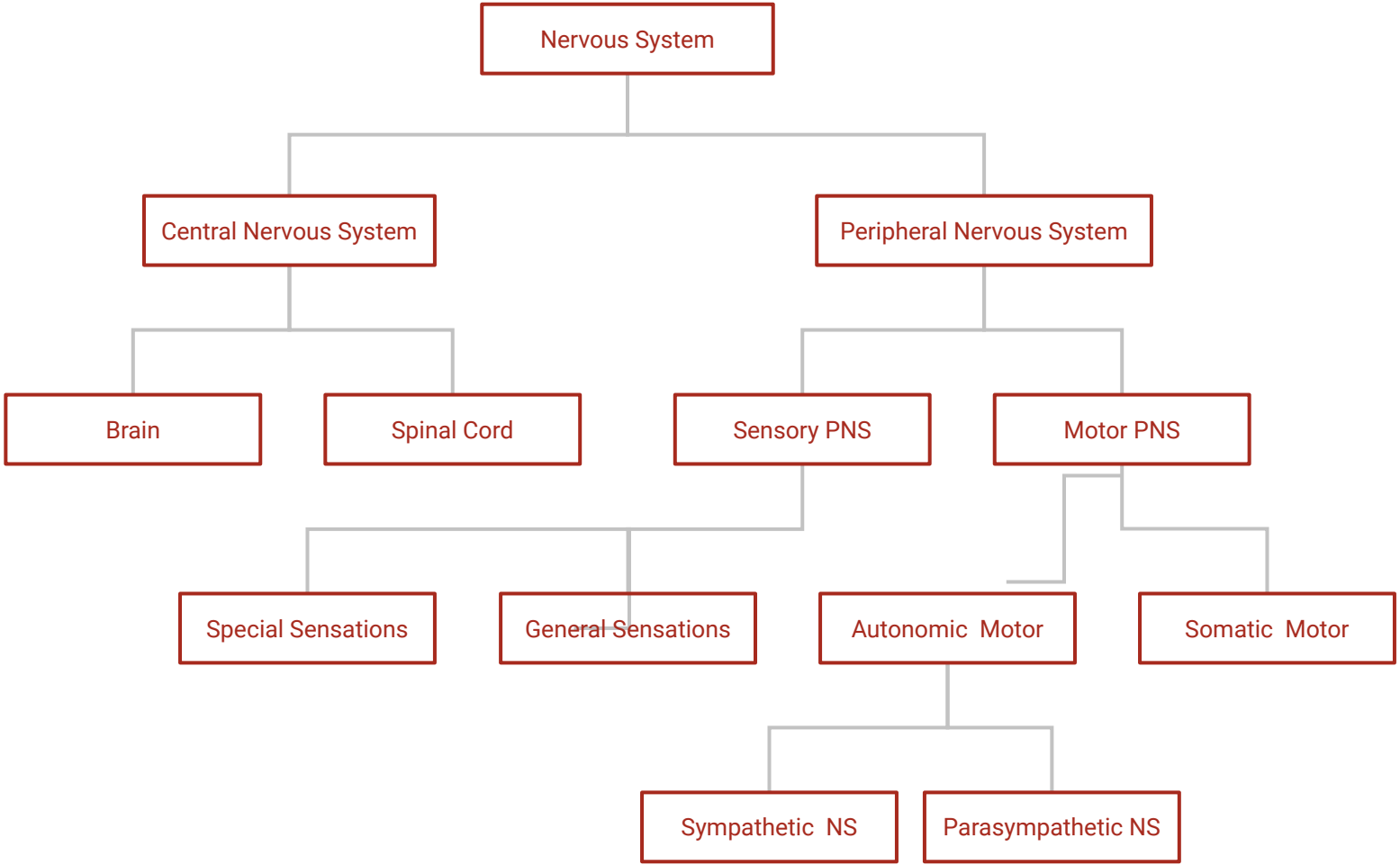
Overview of Important Structures



Overview of Important Structures



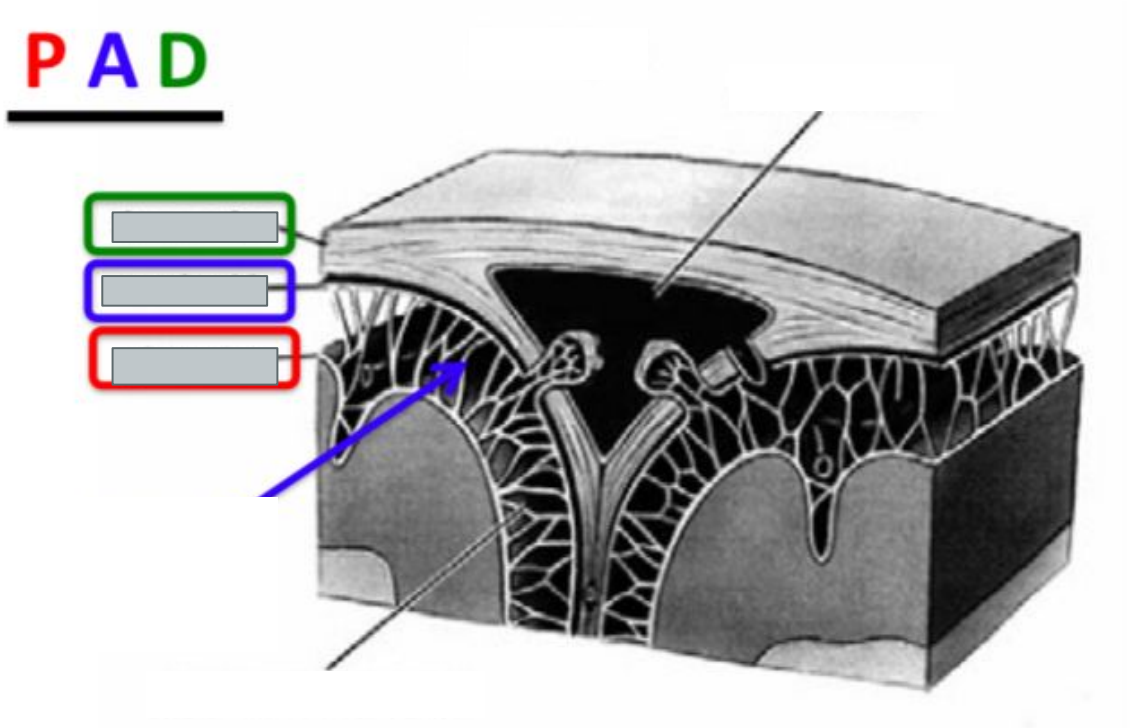

Nervous System
Sensory PNS
Motor PNS
Autonomic Motor


Nervous System
Central Nervous System
Peripheral Nervous System
Brain
Spinal Cord
Sensory PNS
Motor PNS
Special Sensations
General Sensations
Autonomic Motor
Somatic Motor
Sympathetic NS
Parasympathetic NS

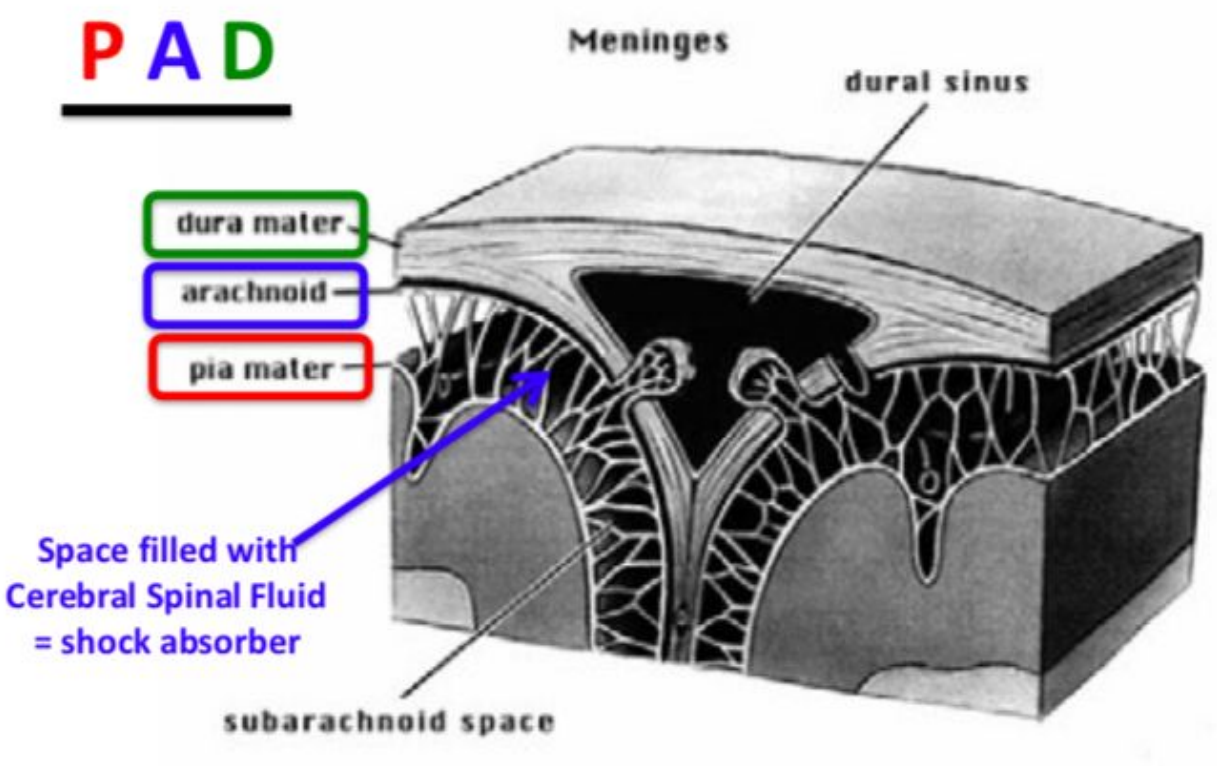
Divisions of the Nervous System

- Central Nervous System
  - Spinal cord and the Brain
  - Encased in bone and meninges
- Peripheral Nervous System
  - Nerves outside of the CNS
  - Sensory PNS:
    - Special Sensations: taste, olfaction, auditory, vision, equilibrium balance
    - General Sensations:
      - Somatic: skin, touch, pain, temperature, locomotor system, and proprioception
      - Visceral: dull pain, distention
  - Motor PNS:
    - Somatic Motor: voluntary control
    - Autonomic Motor: involuntary control
      - Sympathetic NS: “Fight or Flight”
      - Parasympathetic NS: “Rest and Digest”

Support Structures



Support Structures

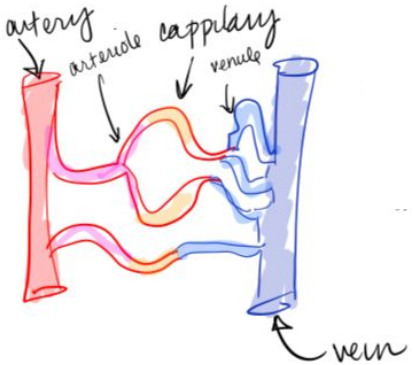


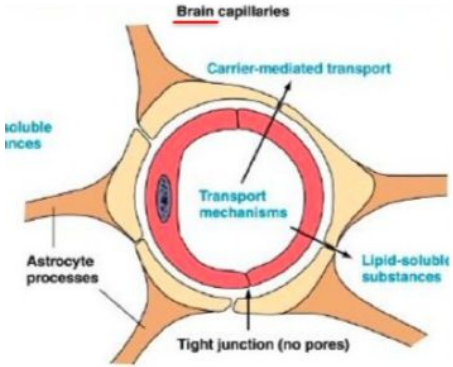
Support Structures

- Meninges
  - Pia Mater: flexible inner layer that conforms to the brain and spinal surfaces
  - Arachnoid Space: spongy layer filled with CSF
  - Dura Mater: thick outer layer
- Ventricles
  - Hollow inter-connected cavities
  - Produces CSF
  - 2 lateral ventricles, third ventricle, cerebral aqueduct, and fourth ventricle
  - Cushions and supports the brain
  - Hydrocephalus
- Blood Vessels
  - Web of incoming arteries and outgoing veins
  - Cleanses brain
  - Uses A LOT of blood relative to its weight
- Blood-Brain Barrier
  - Strict control over chemicals in the brain
  - Protects the brain from infection
  - What it protects: brain, spinal cord, and peripheral nerves
  - What is allowed in: water, O_2, CO_2, lipids, glucose, amino acids
  - What is <u>not</u> allowed in: large and highly polarized molecules

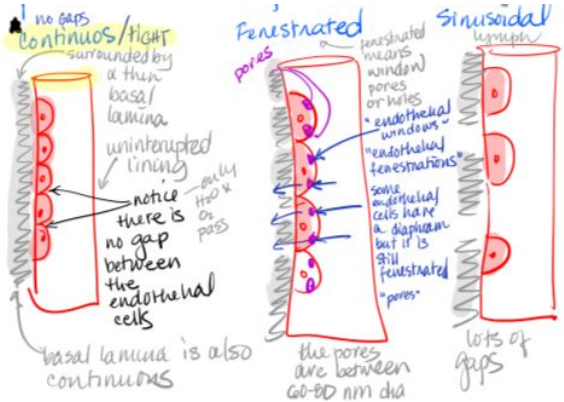
Side Note: Capillaries

- Blood Vessels in the Body:
  - artery -> arteriole -> capillary -> venule -> vein



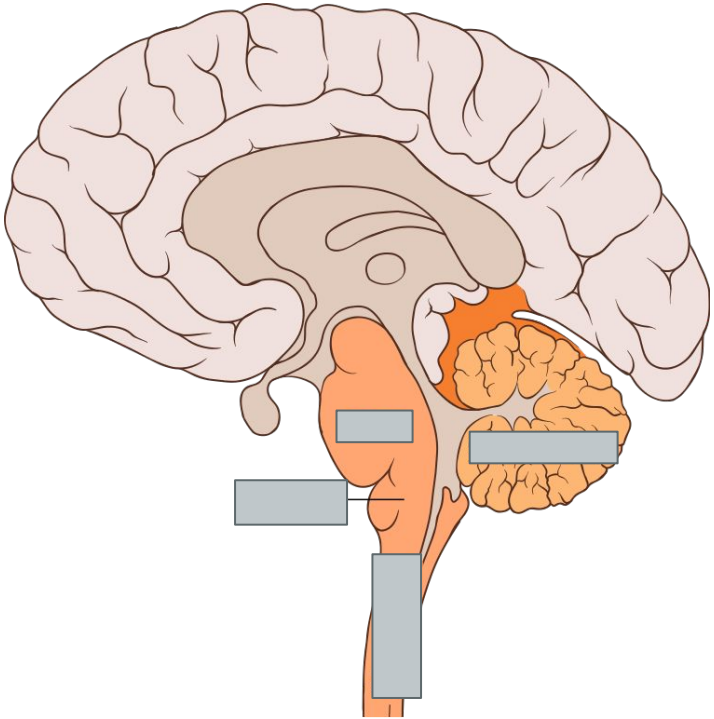


- Types of Capillaries in the Body
  - Continuous/ Tight: no gap between endothelial cells
  - Fenestrated: pores in the endothelial cells
  - Sinusoidal: bigger gaps between the cells

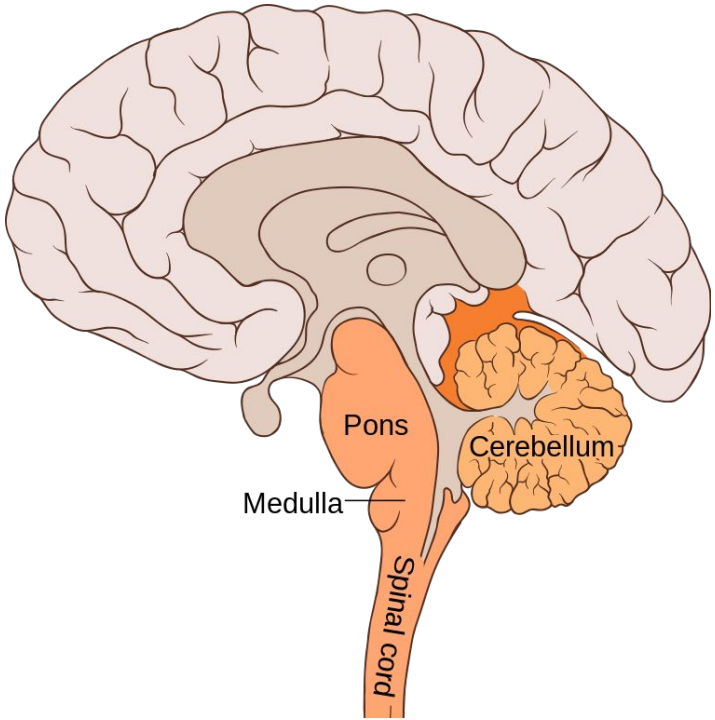


- Capillaries in the Brain
  - Continuous endothelial cells
  - Tight junctions
    - Location chosen by astrocytes

Hindbrain



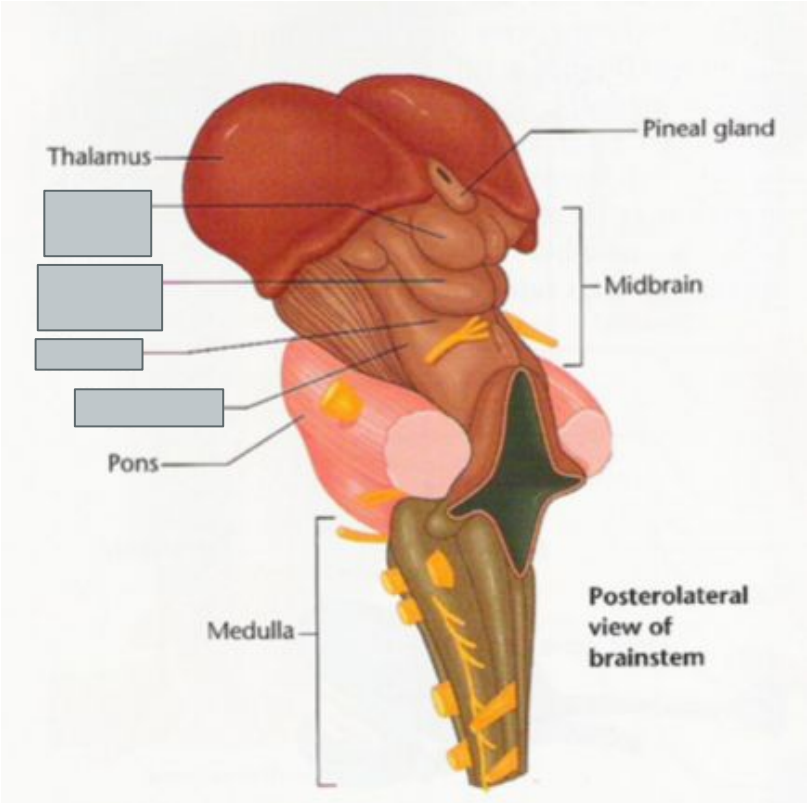
Hindbrain



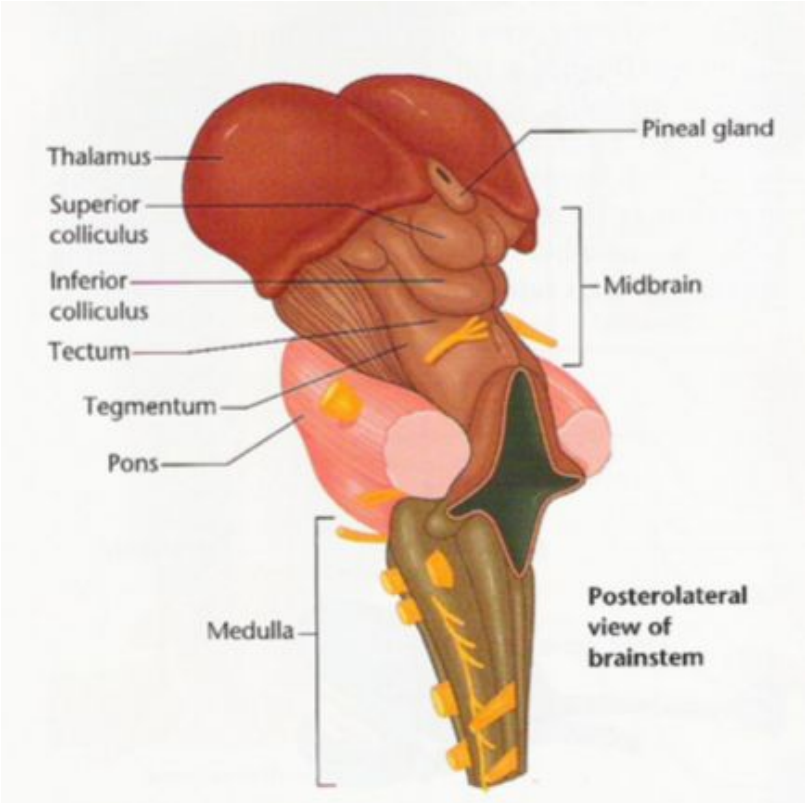
Hindbrain

- Medulla
  - Vital reflexes
- Pons
  - Relay between cortex & cerebellum and brain & spinal cord
  - Includes reticular formation (arousal) and raphe system (sleep)
- Cerebellum
  - “Little Brain”
  - Motor programs with real-time sensory coordination
  - Critical for timing actions
  - Guides movement
- Cranial Nerves
  - Most enter/exit through the Medulla and Pons

Midbrain


Thalamus
Pineal gland
Midbrain
Pons
Medulla
Posterolateral view of brainstem

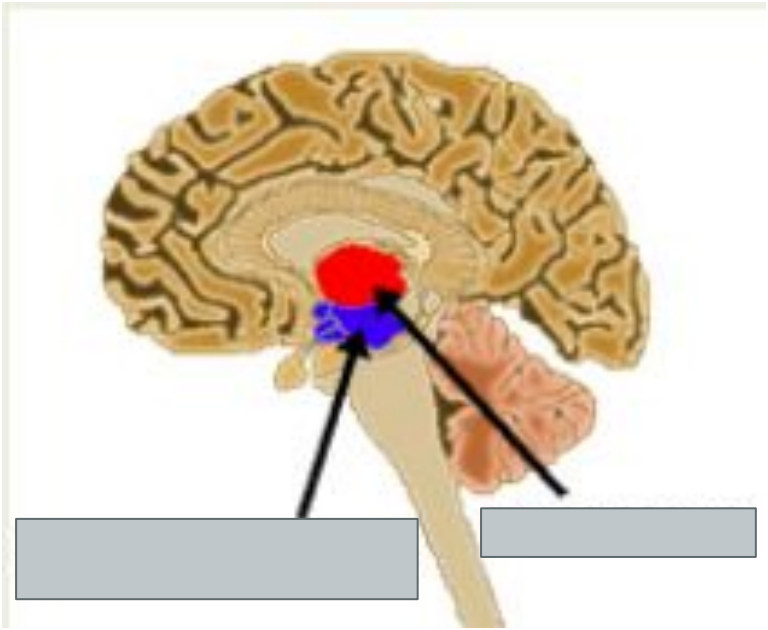
Midbrain


Thalamus
Superior colliculus
Inferior colliculus
Tectum
Tegmentum
Pons
Medulla
Pineal gland
Midbrain
Posterolateral view of brainstem

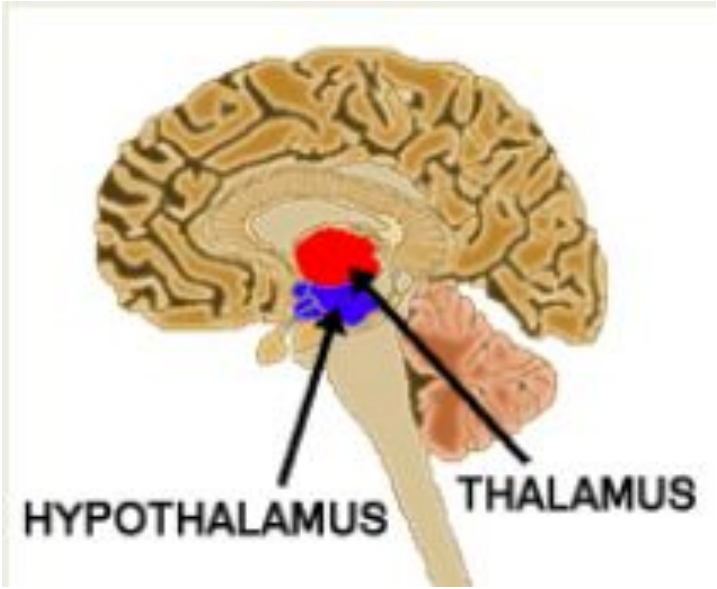
Midbrain

- Tectum
  - Part of sensory pathways
  - Superior Colliculus: detects visual motion
  - Inferior Colliculus: detects auditory motion
- Tegmentum
  - Contains major motor pathways and some cranial nerves
  - Includes Red Nucleus and Substantia Nigra
    - Contains dopaminergic neurons that degenerate in Parkinson's disease
  - Contains cranial nerves to control eye movements
  - Part of the the reticular formation for arousal
- "Tectum to detect 'em, Tegmentum for momentum"

Forebrain - Diencephalon



Forebrain - Diencephalon

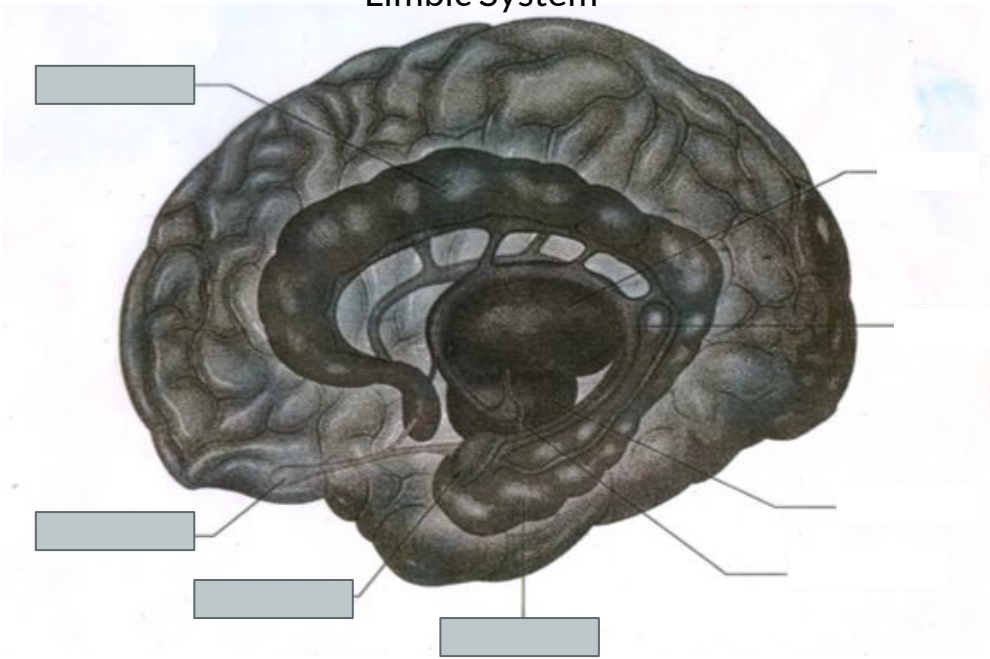


Forebrain - Diencephalon

- Forebrain is divided into 2 parts
  - Diencephalon: brain stem
  - Telencephalon: the rest
- Thalamus
  - Primary source of input to cortex
  - Nuclei of many sensory and motor systems
  - Involved in cortical arousal
- Hypothalamus
  - Controls the “4 F’s”
  - Regulates temperature and internal clock
  - Controls the endocrine system via the Pituitary Gland
    - Anterior pituitary: receives “releasing hormones” via veins
    - Posterior pituitary: receives other hormones (ex: NTs) via axons and then releases into bloodstream

Forebrain - Telencephalon

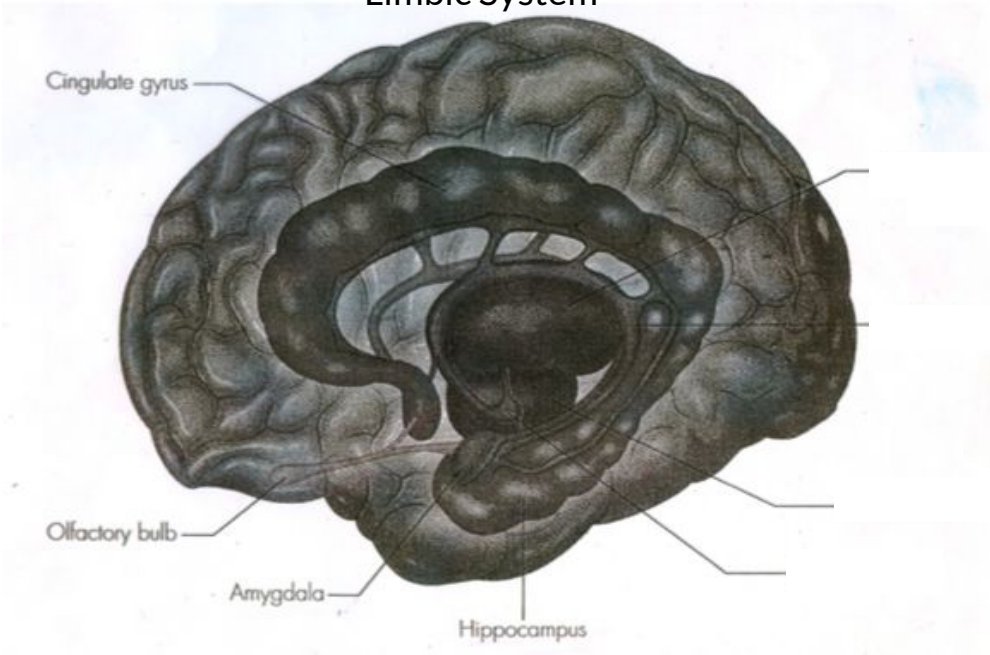
Limbic System



What are the two other structures in the Telencephalon?

Forebrain - Telencephalon

Limbic System



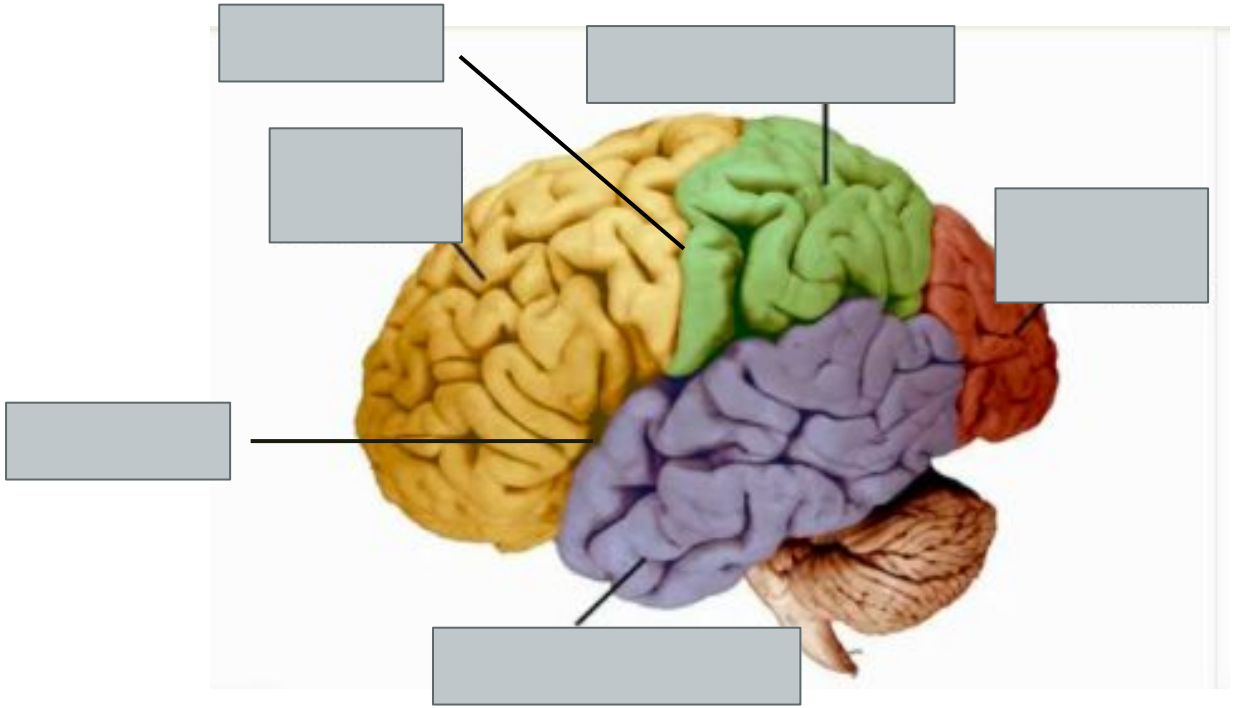
What are the two other structures in the Telencephalon?

1. Basal Ganglia
2. Basal Forebrain

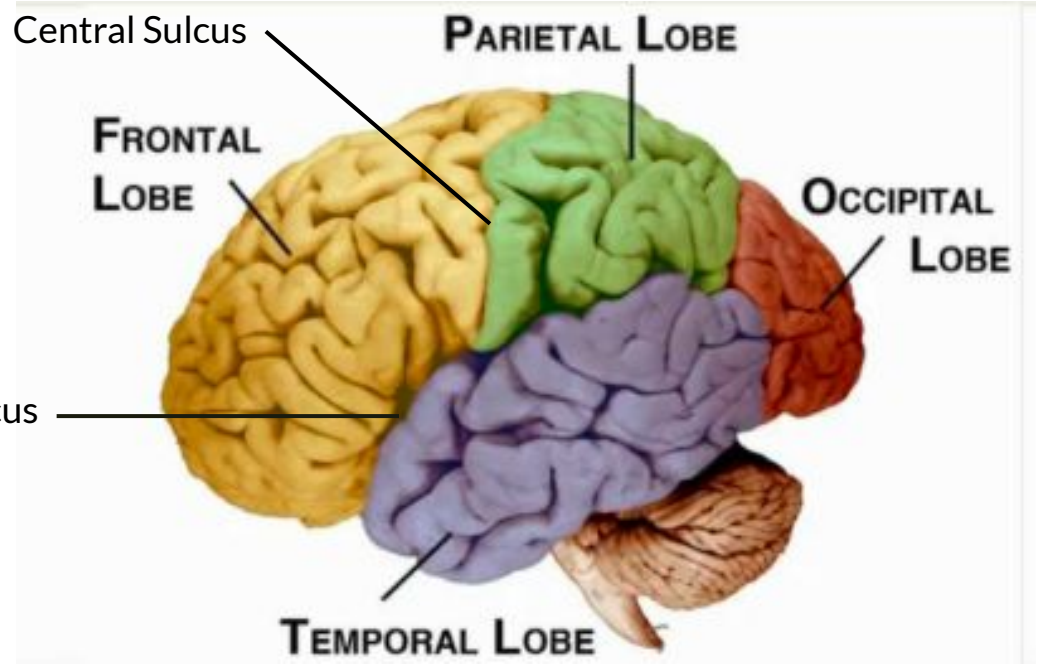
Forebrain - Telencephalon

- Limbic System
  - Motivation and emotions
  - **Hippocampus**: formation of new memories and spatial mapping
  - **Amygdala**: emotional expression
  - **Cingulate Gyrus**: “Re-entrant” system to assess good/bad
  - **Olfactory Bulb**: exchanges olfactory information with the rest of the limbic system
- Basal Ganglia
  - Includes caudate, putamen, and globus pallidus
  - Another “Re-entrant” system
  - Control of movement
- Basal Forebrain
  - Important for attention and cortical arousal
  - Main source of ACh and GABA

Cerebral Cortex - 4 Lobes of the Brain



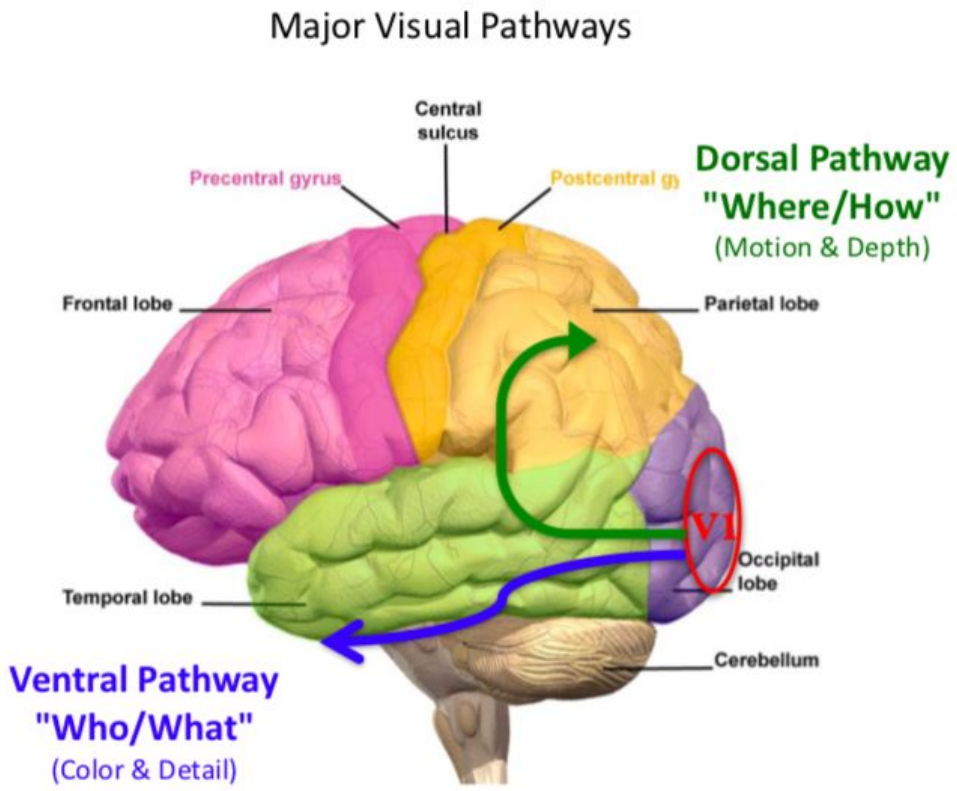
Cerebral Cortex - 4 Lobes of the Brain



Cerebral Cortex - 4 Lobes of the Brain

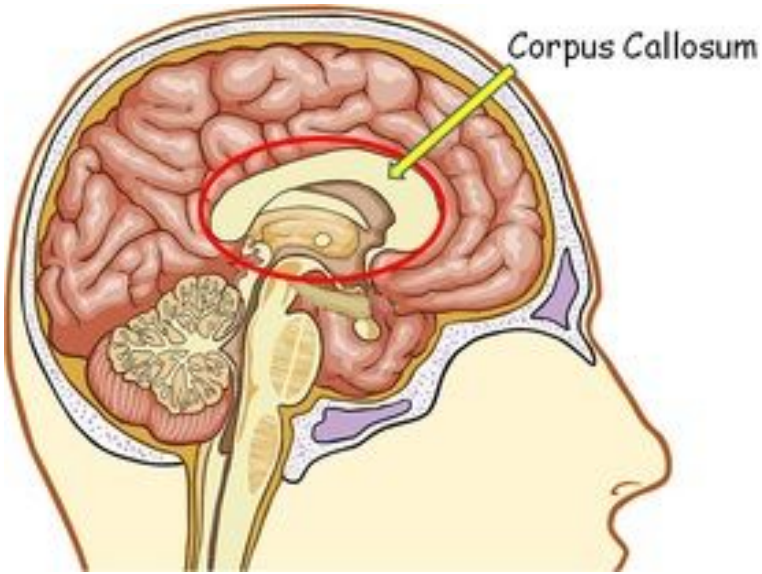
- Parietal Lobe
  - Higher visual and somatosensory processing
  - Spatial mapping
  - Contains the dorsal pathway
- Frontal Lobe
  - Important for motor movements, language production, and strategy
  - Precentral gyrus: motor cortex
  - Premotor areas
    - Prepares for action, planning
    - Include Mirror cells and Broca's Area
  - Prefrontal cortex
    - Planning, self control, impulse control
- Occipital Lobe
  - Visual processing
  - Contains V1
  - Receives projections from the LGN of the thalamus
  - Separate pathways for details projects to other lobes
- Temporal Lobe
  - Contains higher visual, audition, emotion, and language comprehension
  - Contains auditory areas (including Wernicke's Area)
  - Inferior Temporal (IT): ventral, "who/what" pathway
  - Medial Temporal (MT): dorsal "where/how" pathway

Major Visual Pathways



Corpus Callosum

- Made up of axons that connect the two hemispheres of the brain
- Part of the “white matter” of the brain
  - White matter
    - Axons
    - Use a Weigart stain
  - Grey matter:
    - cell bodies
    - Use a Nissl stain
- Brain is 66% white matter by volume



Quiz Time!

- No talking, signaling, or communicating of any kind.
- Put away your books, notes, computers, phones, etc.
- Pen or pencil is okay (just make sure it's a black pen and you press hard with a pencil).
- Write your name in the "Name" box, write and circle in your PID, and sign the academic integrity agreement.
- Bubble in this section
- Please have your student ID out when you turn in your quiz!