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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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

Mid-Saggittal Section

- Cingulate gyrus
- Frontal lobe
- Corpus callosum
- Cerebral cortex
- Parietal lobe
- Thalamus
- Occipital lobe
- Superior & inferior colliculi
- Tegmentum
- Hypothalamus
- Pituitary gland
- Pons
- Medulla
- Spinal cord
- Central canal of spinal cord
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

- **PAD**
- **Dural Sinus**
- **Meninges**
  - **Dura Mater**
  - **Arachnoid**
  - **Pia Mater**

- Space filled with Cerebral Spinal Fluid = shock absorber
- **Subarachnoid Space**
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, O2, CO2, lipids, glucose, amino acids
  ○ What is not 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
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 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

Central Sulcus

Lateral Sulcus
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
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!