Nervous System

Nervous System Functions
- Maintains homeostasis
- Provides for sensation, higher mental functioning, and emotional response
- Activates muscles and glands

Organization of the Nervous System
- **Structural**
  - Central Nervous System (CNS)
  - Brain and spinal cord
  - Peripheral Nervous System (PNS)
  - Nerves and ganglia
- **Functional**
  - Stimulates skeletal muscles (somatic division)
  - Stimulates smooth/cardiac muscles & glands (autonomic division)
Supportive Connective Tissue Cells

- Neuroglia
  - Support and protects neurons in CNS
  - Myelinate neuron processes in CNS
- Schwann cells
  - Myelinate neuron processes in PNS
Anatomy of a Neuron

- **Dendrites** (one to many per cell)
  - Conducts impulses toward the cell body
- **Cell body**
  - Contains the nucleus
- **Axon** (one per cell)
  - Conducts impulses away from the cell body
  - Releases a neurotransmitter

Myelin sheath from multiple wrappings of Schwann cells
Classification - Based on Function

- Direction of impulse transmission
- Sensory (afferent) neurons
- Association (interneurons) neurons
- Motor (efferent) neurons
Classification - Based on Structure

Number of processes extending from body
- Unipolar (one process)
  - Most sensory neurons
- Bipolar (two processes)
  - Sensory neurons in eyes and ears
- Multipolar (many processes)
  - Motor and association neurons

Neuron Physiology

- A nerve impulse is an electrochemical event.
- Various stimuli causes a change in the plasma membrane permeability.
Resting state and propagation of an action potential along an axon

Graph of Depolarization and Repolarization
Nerve Impulse/Action Potential

- **Depolarization**
  - Sodium ions enter the cell
- **Repolarization**
  - Potassium ions leave the cell
- **Resting state restored**
  - Sodium-Potassium pump

Synapse Location and Anatomy

- Axon branches of neuron
- Mitochondrion
- Synaptic vesicles
- Axon bulb
dendrite

Synaptic Transmission

- Neurotransmitter
- Synaptic vesicle
- Presynaptic membrane
- Receptor
- Postsynaptic membrane
Reflex

A rapid, predictable response to a stimulus.

Components of a Reflex Arc

1. Receptor
2. Sensory neuron
3. Motor neuron
4. Effector
Central Nervous System

- Brain
- Spinal cord

Human Brain - Lateral View

Cerebral sulcus
Parietal lobe
Occipital lobe
Cerebellum

Frontal lobe
Lateral sulcus
Temporal lobe
Pons
Medulla oblongata
Human Brain - Sagittal View

- Corpus callosum
- Thalamus
- Hypothalamus
- Midbrain
- Pons
- Medulla oblongata
- Cerebellum
- Pituitary gland
- Choroid plexus
- Cerebral hemispheres

Overview and functions of the brain

- Cerebrum
  - Sensory areas for skin sensations, vision, hearing, affection
  - Motor areas for voluntary control of movement
  - Association areas for interpreting sensations, language, thinking, decision making, self-awareness, creativity, and storage of memories

- Coronal view of the brain
The Brain

1. Cerebral hemispheres
   - Surface (cortex) convoluted - gray matter
   - Interior - white matter
   - Logical reasoning, moral conduct, emotional responses, sensory interpretation, and initiation of voluntary muscle activity

The Brain

2. Diencephalon
   - Superior to brain stem
   - Enclosed by cerebral hemispheres
   - Thalamus
     - Encloses third ventricle
     - Relay station for sensory impulses
   - Hypothalamus
     - Floor of third ventricle
     - Most important regulatory center for ANS
   - Epithalamus
     - Includes pineal gland
The Brain

3. Brain stem
- Midbrain
  - Most superior
  - Primarily fiber tracts
- Pons
  - Inferior to midbrain
  - Involved in respiration
- Medulla oblongata
  - Most inferior
  - Regulates breathing, heart rate, blood pressure, etc
The Brain

4. Cerebellum

- Large, cauliflower-like part
- Posterior to fourth ventricle
- Coordinates muscle activity and balance
**Spinal Cord**

- Reflex center and conduction pathway.
- Found within vertebral canal.
- Has central bat-shaped area of gray matter surrounded by white matter.
- Carries sensory and motor tracts to and from the brain.

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**Spinal Nerve Anatomy**

- White matter
- Central canal
- Gray matter
- Dorsal root ganglion
- Spinal nerve
- Dorsal root
- Ventral root
- Meninges
Protection of the CNS

- Bones of the skull
- Meninges
- Cerebrospinal fluid (CSF)
- Blood-brain barrier
**Meninges**

- Connective tissue membranes.
- Dura mater - tough outermost
- Arachnoid mater - middle weblike
- Pia mater - innermost delicate

**Cerebrospinal fluid (CSF)**

- Provides watery cushion around brain and spinal cord.
- Formed by choroid plexuses of brain.
- Found subarachnoid space, ventricles, and central canal.
- Continuously formed and drained.

**Blood-Brain Barrier**

- Composed of relatively impermeable capillaries.
Brain Dysfunctions

- Head trauma
  - Concussion - reversible damage
  - Contusion - nonreversible damage
- Cerebrovascular accidents (CVA/stroke)
  - Blood circulation to brain neurons blocked > brain tissue dies
- Alzheimer’s disease
  - Degenerative brain disease - abnormal protein deposits appear

Parkinson’s disease

Pathway that degenerates in Parkinson’s disease

Alzheimer Disease Neuron

neurofibrillary tangles

amyloid plaques
Diagnostic Techniques

- EEG
- Simple reflex tests
- Angiography
- CT scans
- PET scans
- MRI scans