Functions of the Nervous System

1. **Sensory**
   - Monitoring changes in internal and external environment- stimuli
   - Receive information- sensory input

2. **Integration**
   - Process and interpret the information

3. **Motor**
   - Response to processed information
   - Activates muscle contraction, glandular secretion, etc.
Organization of the Nervous System

- Organized by structure and function

- Two **STRUCTURAL** divisions:
  1. **Central Nervous System (CNS)** - brain & spinal cord
  2. **Peripheral Nervous System (PNS)** - spinal and cranial nerves, all neural tissue outside the CNS

Central Nervous System:
- brain
- spinal cord

Peripheral Nervous System:
- autonomic
- parasympathetic
- sympathetic
- somatic (sensory and motor nerves)
Organization of the Nervous System

Two **FUNCTIONAL** divisions (only for PNS):

1. **Afferent (sensory) Division** - send impulses from sensory receptors throughout the body to CNS
2. **Efferent (motor) Division** - carries impulses from CNS to effector organs, muscles, & glands to cause a motor response (activates muscles or glands)

- **Somatic Nervous System** - voluntary control of skeletal muscles
- **Autonomic Nervous System** - involuntary control of smooth & cardiac muscles and glands
  - **Sympathetic** - emergency responses; fight or flight
  - **Parasympathetic** - non-emergency responses
### Affect
- Something is experienced; **sensory**
- Afferent nerves = sensory nerves; bring information **TOWARD** the CNS bases on sense

### Effect
- Something is done or not done; **motor**
- Efferent nerves = motor nerves; carry information **AWAY** from the CNS to cause an action
Nervous System
Nervous Tissue

- **Neurons**
  - Nerve cells
  - Excitable
  - Transmit messages (nerve impulses) from one part of the body to another

- **Neuroglia (glia)**
  - Supporting cells
  - Support, insulate, protect, and nourish neurons
  - Includes many types
Structure of Neurons

- **Dendrites** - fibers that receive impulses and send signals toward the cell body.
- **Cell body** - central unit of neuron. Contains nucleus, cytoplasm, etc.
- **Axon** - process that takes impulses away from the cell body. Neurons have at least 1 axon.
Structure of Neurons

- **Myelin Sheath**: Fatty material that surrounds the axon and allows nerve impulses to travel faster.
- **Node of Ranvier**: Portion of axon that is not wrapped by myelin sheath. Gaps in myelin.
**Structure of Neurons**

- **Axon terminals** - Branching ends of a neuron. Contain neurotransmitters, which send signals to other cells when there is an impulse.

- **Synaptic Cleft (Synapse)** - Gap between one neuron and another
Structure of Neurons

- Dendrites
- Cell body
- Neuroglia
- Axon
Try This!

1. Which way does an impulse travel through a neuron?

2. What cells help to support and provide nourishment to the neural tissue?
Types of Neurons

1. **Sensory (Afferent) Neurons** - Receive and carry info from sensory receptors (sense organs, skin, muscles) to the CNS.

2. **Motor (Efferent) Neurons** - Carry impulses from CNS to organs, muscles, and glands.

3. **Interneurons** - Connect sensory and motor neurons. Only in the CNS.
Types of Neurons

- Dendrites
- Receptors
- Peripheral process (axon)
- Sensory neuron
- Central process (axon)
- Ganglion
- Cell body
- Spinal cord (central nervous system)
- Peripheral nervous system
- Afferent transmission
- Association neuron (interneuron)
- Motor neuron
- Efferent transmission
- To effectors (muscles and glands)
Action Potential Video

https://www.youtube.com/watch?v=8-T8HTzt7D8
Neuron Function: Resting Potential

- When a neuron is resting, the plasma membrane is **polarized**
  - There are more positive (+) ions outside of the cell membrane and more negative (-) ions inside the cell membrane.
  - Potassium (K+)
  - Sodium (Na+)
Neuron Function: Resting Potential
Neuron Function: Action Potential

- When neurons are excited by a stimulus, the sodium pumps in the membrane open and sodium (Na+) flows inside the membrane.
- As Na+ rushes into the neuron, the membrane becomes **depolarized** - the number of + ions inside/outside has changed.
Neuron Function: Action Potential
Neuron Function: Action Potential

- Once this happens at one location on the axon, it affects the next section, and the next section...
- This sends the electrical impulse (action potential) along the entire axon.
- As the signal travels along the axon, Na+ rushes into the cell as K+ rushes out of the cell to try to repolarize the membrane.
- This action requires ATP and the impulse travels faster when axon is covered by myelin sheath.
Neuron Function: Action Potential
Action Potential Summary

1. **Resting**- positive outside, negative inside
2. **Stimulus**- local depolarization (one spot of axon)
3. **Depolarization**- Na+ rushes in, creates action potential
4. **Propagation**- action potential moves along axon
5. **Repolarization**- K+ rushes out to restore original conditions
6. **Initial conditions**- back to resting state until another stimulus
Action Potential Summary

**Action Potential**

- **Stimulus**
- **Trigger Zone**

**Interstitial Fluid**

**Cytoplasm**

**Na+ Na+ Na+**

**K+ K+ K+**

**Na+ Na+ Na+**

**K+ K+ K+**

**Na+ Na+ Na+**

**K+ K+ K+**

**Na+ Na+ Na+**

**K+ K+ K+**
Action Potential Summary

#1. Resting Potential
#2. Stimulus
#3. Depolarization & Propagation
#4. Repolarization
Research
“Multiple Sclerosis”
Communication

- Neurons interact to form longer nerves
- Neurons interact/communication at **synapses** - space in between neurons
Communication

- Impulses are able to cross the synapse to another neuron via **neurotransmitters**
- Neurotransmitters = chemical messenger
- Gets released from axon terminal of one neuron
- Dendrites of the next neuron has **receptors** that are stimulated by the neurotransmitter
- Action potential is started in the dendrite and will continue down the neuron
Reflexes

- **Reflex** - rapid, predictable, and involuntary response to stimuli. 2 Types:
  - **Somatic** reflexes
    - Stimulate the skeletal muscles
    - Example: when you touch a hot stove and you pull your hand away
  - **Autonomic** reflexes
    - Smooth muscle regulation
    - Heart and blood pressure regulation
    - Regulation of glands
    - Digestive system regulation
The Reflex Arc

- **Reflex arc** - direct route from a sensory neuron, to an interneuron in the CNS, to an motor neuron.
The Reflex Arc

5 Elements:
1. Sensory receptor- detects a stimulus
2. Sensory neurons- sends message to the CNS
3. Integration center- processing site in the CNS
4. Motor neurons- carry message from CNS
5. Effector organ- muscle or gland that is activated
The Reflex Arc

Step 1: Arrival of stimulus and activation of receptor

Step 2: Activation of a sensory neuron

Step 3: Information processing in CNS

Step 4: Activation of a motor neuron

Step 5: Response by effector

Sensation relayed to the brain by collateral