

## The Nervous System

### Neurons

- A. Definition
  - 1. Basic cells of the nervous system
- B. Functions of Neurons
  - 1. Responding to chemical and physical stimuli
  - 2. Conducting impulses
  - 3. Releasing chemical regulators
- C. Neuron Structure
  - 1. Cell body
    - a. Contains the nucleus and other organelles
  - 2. Dendrites
    - a. Receive stimuli
    - b. Conduct impulses toward the cell body
  - 3. Axon
    - a. Carries impulses away from the cell body
- D. Axon structure
  - 1. Myelin sheath
    - a. Insulating coat of plasma membranes
    - b. Sections of sheath are called "Schwann Cells"
  - 2. Nodes of Ranvier
    - a. Bare axonal membrane between Schwann cells
  - 3. Unmyelinated axons carry impulses much slower than myelinated axons
- E. Types of Neurons
  - 1. Motor Neurons
    - a. Transmit signals from the brain and spinal cord
    - b. Signals go to muscles or glands
  - 2. Sensory Neurons
    - a. Transmit information from the sensory organs to the brain and spinal cord
  - 3. Interneurons
    - a. Transmit signals from one neuron to another

### Response to Stimuli

- A. Stimulus
  - 1. A change in the environment that may cause an organism to respond
- B. Sensory Receptors
  - 1. Collect and transmit information about the outside world
    - a. Five senses

## Transmission of Impulses

### A. Electrical Impulse

1. Nerve membranes are normally **polarized**
  - a. Uneven distribution of ions inside and out
2. Stimulation causes **depolarization**
  - a. Sodium ions diffuse into the neuron
3. Membrane quickly **repolarizes**
  - a. Potassium ions diffuse out of the neuron

### B. Nerve Impulses

1. Wave of depolarization that travels along a neuron
2. Membrane must repolarize before another impulse can travel down the neuron

### C. Stimulus Threshold

1. "All or nothing" rule
  - a. Threshold must be reached for neuron to "fire"
  - b. Greater stimulus fires more neurons
    - (1) Individual neurons don't fire "harder" with greater stimulus

## Synapses

### A. Definition

1. Junction (or gap) between a neuron and a second cell

### B. Neurotransmitters

1. Chemical messengers that carry nerve signal across the synapse
  - a. Quickly broken down or reabsorbed after signal is transmitted
2. Examples
  - a. Some amino acids
  - b. Endorphins and Enkephalins
    - (1) Stimulate natural opioid receptors in the brain
  - c. Acetylcholine

## Evolution of Nervous Systems

### A. Invertebrates

1. Wide variety of nervous systems
  - a. Ganglia
    - (1) Specialized bundles of nerve cell bodies
  - b. Nerve net
    - (1) Even distribution of nerve cells in the body

### B. Three Trends in Vertebrate Brain Evolution

1. Increase in the relative size of the brain
2. Increased specialization of function
  - a. Cerebellum, cerebrum, hypothalamus etc.
3. Increasing sophistication and complexity of the forebrain

## The Central Nervous System

### A. Protection of the CNS

#### 1. Meninges

a. Membranes that cover the brain

(1) dura mater and pia mater

#### 2. Cerebrospinal fluid

a. Cushions brain from shock

#### 3. Cranium

#### 4. Spinal column

### B. Structures of the CNS

#### 1. Brain

#### 2. Spinal cord

## The Peripheral Nervous System

### A. Sensory Division

#### 1. Bring information to the CNS

### B. Motor Division

#### 1. Carries signals away from the CNS

a. Somatic (voluntary) nervous system

(1) Skeletal muscle action

b. Autonomic nervous system

(1) Controls organ systems

### C. Divisions of the Autonomic Nervous System

#### 1. Sympathetic

a. Stress responses

(1) Pupils dilate

(2) Mouth dries up (saliva decreases)

(3) Heart rate increases

(4) Blood flow to skeletal muscle increases

#### 2. Parasympathetic

a. Relaxation response

(1) Heart rate slows

(2) Pupils constrict

(3) Stimulates salivation

(4) Digestive processes stimulated