

## Chapter 7 The Nervous System

### Functions of the Nervous System

- Sensory input – gathering information
  - To monitor changes occurring inside and outside the body
  - Changes = stimuli
- Integration
  - To process and interpret sensory input and decide if action is needed

### Functions of the Nervous System

- Motor output
  - A response to integrated stimuli
  - The response activates muscles or glands

### Structural Classification of the Nervous System

- Central nervous system (CNS)
  - Brain
  - Spinal cord
- Peripheral nervous system (PNS)
  - Nerve outside the brain and spinal cord

### Functional Classification of the Peripheral Nervous System

- Sensory (afferent) division
  - Nerve fibers that carry information to the central nervous system

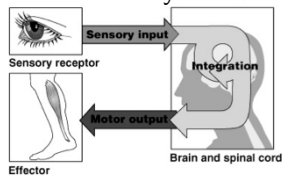


Figure 7.1

### Functional Classification of the Peripheral Nervous System

- Motor (efferent) division
  - Nerve fibers that carry impulses away from the central nervous system

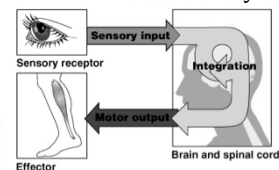


Figure 7.1

## Functional Classification of the Peripheral Nervous System

- Motor (efferent) division
  - Two subdivisions
    - Somatic nervous system = voluntary
    - Autonomic nervous system = involuntary

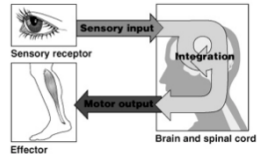


Figure 7.1

## Organization of the Nervous System

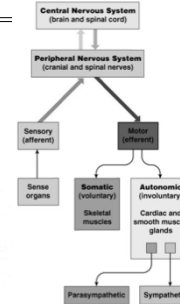


Figure 7.2

## Nervous Tissue: Neurons

- Neurons = nerve cells
  - Cells specialized to transmit messages
  - Major regions of neurons
    - Cell body – nucleus and metabolic center of the cell
    - Processes – fibers that extend from the cell body

## Neuron Anatomy

- Cell body
- Nucleus
- Large nucleolus

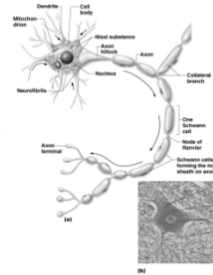


Figure 7.4a-b

## Neuron Anatomy

- Extensions outside the cell body
  - Dendrites – conduct impulses toward the cell body
  - Axons – conduct impulses away from the cell body

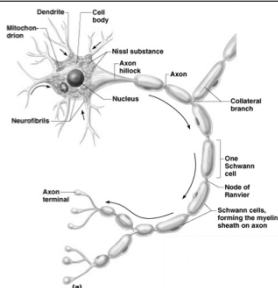


Figure 7.4a

## Axons and Nerve Impulses

- Axons end in axonal terminals
- Axonal terminals contain vesicles with neurotransmitters
- Axonal terminals are separated from the next neuron by a gap
  - Synaptic cleft – gap between adjacent neurons
  - Synapse – junction between nerves

## Nerve Fiber Coverings

- Schwann cells – produce myelin sheaths in jelly-roll like fashion
- Nodes of Ranvier – gaps in myelin sheath along the axon

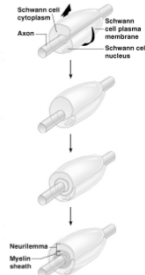


Figure 7.5

## Neuron Cell Body Location

- Most are found in the central nervous system
- Gray matter – cell bodies and unmyelinated fibers
- Nuclei – clusters of cell bodies within the white matter of the central nervous system
- Ganglia – collections of cell bodies outside the central nervous system

## Functional Classification of Neurons

- Sensory (afferent) neurons
  - Carry impulses from the sensory receptors
- Motor (efferent) neurons
  - Carry impulses from the central nervous system

## Functional Classification of Neurons

- Interneurons (association neurons)
  - Found in neural pathways in the central nervous system
  - Connect sensory and motor neurons

## Neuron Classification

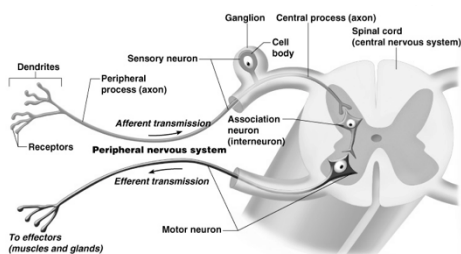
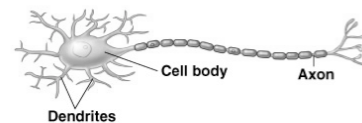


Figure 7.6

## Structural Classification of Neurons

- Multipolar neurons – many extensions from the cell body



(a) Multipolar neuron

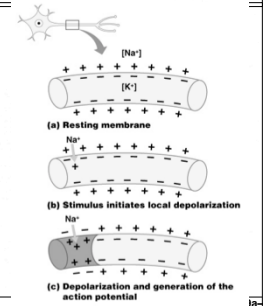
Figure 7.8a

## Functional Properties of Neurons

- Irritability – ability to respond to stimuli
- Conductivity – ability to transmit an impulse
- The plasma membrane at rest is polarized
  - Fewer positive ions are inside the cell than outside the cell

## Starting a Nerve Impulse

- Depolarization – a stimulus depolarizes the neuron's membrane
- A depolarized membrane allows sodium ( $\text{Na}^+$ ) to flow inside the membrane
- The exchange of ions initiates an action potential in the neuron



## The Action Potential

- If the action potential (nerve impulse) starts, it is propagated over the entire axon
- Potassium ions rush out of the neuron after sodium ions rush in, which repolarizes the membrane
- The sodium-potassium pump restores the original configuration
  - This action requires ATP

## Nerve Impulse Propagation

- The impulse continues to move toward the cell body
- Impulses travel faster when fibers have a myelin sheath

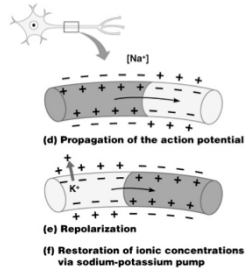


Figure 7.9d-f

## Continuation of the Nerve Impulse between Neurons

- Impulses are able to cross the synapse to another nerve
- Neurotransmitter is released from a nerve's axon terminal
- The dendrite of the next neuron has receptors that are stimulated by the neurotransmitter
- An action potential is started in the dendrite

## How Neurons Communicate at Synapses

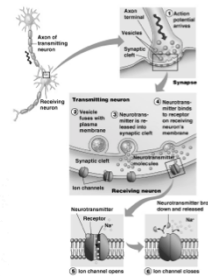


Figure 7.10