Chapter 3: Neuroscience and Behavior

- Chronic traumatic encephalopathy (CTE)- progressive brain damage linked to repeated concussions
    - Associated with inability to concentrate, memory loss, irritability, and depression
    - Ray Easterling and Dave Duerson

Neurons: The Origin of Behavior

- Neurons- cells in the nervous system that communicate with one another to perform info-processing tasks
    - Composed of 3 parts:
        1. Cell Body- coordinate info. processing and keeps cell alive
            - Largest component of neuron
            - Protein sythesis, energy production, metabolism
            - Contains nucleus- houses chromosomes with DNA
            - Surrounded by porous cell membrane allowing some molecules to flow in and out of cell
        2. Dendrites- receive info. from other neurons and relay it to cell body
        3. Axon- carries info to other neurons, muscles or glads
            - Covered by myelin sheath- insulating layer of fatty material
                i. Myelin sheath composed of glial cells- support cells found in nervous system
                    - Digests parts of dead neurons, provide physical and nutritional support for neurons, form myelin
                ii. Demyelinating disease- myelin sheath deteriorates, slowing transmission from 1 neuron to next

- 3 Major types of neurons:
    1. Sensory Neurons- receive info. from external world and convey to brain via spinal cord
    2. Motor neurons- carry signals from spinal cord to muscles to produce movement
    3. Interneurons- connect sensory, motor, or other interneurons
- Neurons by location
    - Purkinje cells- type of interneuron that carries info. from cerebellum to rest of brain and spinal cord (dense, bushes)
    - Pyramidal cells- found in cerebral cortex (triangular cell body and single, long dendrite among smaller dendrites)
    - Bipolar cells- sensory neuron in retina of eye (single axon and single dendrite)

The Electrochemical Actions of Neurons: Information Processing

- Conduction- movement of electrical signals within neurons, from dendrites to cell body, the throughout axon
- Transmission- movement of electrical signals from 1 neuron to another over synapse
- Resting potential- difference in electric charge between inside and outside of neuron's cell membrane
- Action potential- electric signal that is conducted along length of neuron's axon to synapse
    - All or none: electric stimulation below threshold fails to produce but at or above threshold always produces action potential at same magnitude and with the same characteristics
    - When electric charge is at threshold, channels that allow K+ to flow out shut down and channels that all flow of Na+ are opened increasing + charge inside axon
    - Membrane channels return to original state and K+ flows out until resting potential
    - Ions unbalanced so no action potential causes refractory period-time following action potential during which a new action potential cannot be initiated
    - Myelin sheath facilitates conduction of action potential
    - Saltatory conduction- charge jumps from node to node
- Terminal buttons- knoblike structure that branch out from axon
    - Filled with tiny vesicles that contain neurotransmitters- chemicals that transmit info. across synapse to a receiving neuron's dendrites
    - Receiving dendrite contains receptors-parts of cell membrane that receive neurotransmitters and either initiate or prevent a new electric signal
- Presynaptic neuron= sending neuron
- Postsynaptic neuron= receiving neuron
- Action potential travels down axon to terminal buttons then stimulates release of neurotransmitters
- Neurotransmitters float across synapse and bind to receptor sites on dendrite
- Synaptic transmission- allows neurons to communicate with one another
    - Lockk and Key- only some neurotransmitters bind to specific receptor sites on dendrite
- Neurotransmitters leave synapse through 3 processes:
    1. Reuptake- neurotransmitters reabsorbed by terminal buttons of presynaptic neuron's axon
    2. Enzyme deactivation- specific enzymes break down specific neurotransmitters
    3. Autoreceptors- detect how much of a neurotransmitter has been released into synapse and signal neuron to stop
- Types and Functions of neurotransmitters

- Acetylcholine (Ach)- neurotransmitter involved in a number of functions including voluntary motor control
  - Found in neurons of brain and synapses where axons connect to muscles and body organs
  - Activates muscles, contributes to regulation of attention, learning, sleeping, dreaming, and memory
  - Alzheimer's associated with deterioration of Ach
- Dopamine- neurotransmitter regulating motor behavior, motivation, pleasure, and emotional arousal
  - Plays role in drug addiction
  - High levels linked to Schizophrenia
  - Low levels linked to Parkinson's
- Glutamate- major excitatory neurotransmitter in brain: enhances transmission of info. between neurons
- GABA (gamma-aminobutry acid)- tends to stop firing of neurons
- Norepinephrine- involved in states of vigilance or heightened awareness of dangers in environment
- Serotonin- involved in regulation of sleep, wakefulness, eating, and agressive behavior
- Endorphins- chemicals that act within pain pathways and emotion centers of brain

- Drugs that mimic neurotransmitters
  - Agonists- drugs that increase action of a neurotransmitter
  - Antagonists- drugs that block function of neurotransmitters

The Organization of the Nervous System

- Nervous system- interacting network of nuerons that conveys electrochemical info. throughout body
  - 2 parts:
    1. Central nervous system- composed of brain and spinal cord
       a. Receives sensory info. from external world, processes and coordinates, sunds commands to skeletal and muscluar systems
    2. Peripheral nervous system- connects central nervous system to body's organs and mucles
       a. 2 parts:
          i. Somatic nervous system- set of nerves that conveys info. between voluntary muscles and central nervous system
             - Concious control
             - Use to perceive, think, and coordinate behaviors
          ii. Autonomic nervous system- set of nerves that carries involuntary and automatic