Chapter 3: Biology and Behavior

3.1 How does the Nervous System Operate?

Neurons: the basic of the nervous system; cells that receive, integrate, and transmit information in the nervous system. They operate through electrical impulses, communicate with other neurons through chemical signals, and form neural networks.

Central Nervous System (CNS): the brain and the spinal cord.

Peripheral Nervous System (PNS): All nerve cells in the body that are not part of the central nervous system. The peripheral nervous system includes the somatic and autonomic nervous systems.

Sensory Neurons: One of the three types of neurons; these neurons detect information from the physical world and pass that information to the brain.

Motor Neurons: These neurons direct muscles to contract or relax, thereby producing muscle movement.

Interneurons: These neurons communicate within local or short-distance circuits.

Dendrites: Branchlike extensions of the neuron that detect information from other neurons.

Cell Body (soma): The site in the neuron where information from thousands of other neurons is collected and integrated.

Axon: A long narrow outgrowth of a neuron by which information is transmitted to other neurons.

- Vary in length
- A nerve is a bundle of axons that carry specific information from the brain to specific parts of the body

Terminal Buttons: At the end of axons, small nodules that release chemical signals from the neuron into the synapse.

Synapse: The gap between the axon of a "sending" neuron and the dendrites of a "receiving" neuron; the site at which chemical communication occurs between neurons.

Resting Membrane Potential: The electrical charge of a neuron when it is not active.

Action Potential: The electrical signal that passes along the axon and subsequently causes the release of chemicals from the terminal buttons.

Myelin Sheath: A fatty material, made up of glial cells, which insulates some axons to allow for faster movement of electrical impulses along the axon.

Nodes of Ranvier: Small gaps of exposed axon, between the segments of myelin sheath, where action potential takes place.

All-or-none Principle: The principle that when a neuron fires, it fires with the same potency each time; a neuron either fires or not- it cannot partially fire, although the frequency of firing can vary.

Neurotransmitters: Chemical substances that transmit signals from one neuron to another.

- Convey signals across the synapse to the postsynaptic cells

Receptors: In, neurons, specialized protein molecules on the postsynaptic membrane; neurotransmitters bind to these molecules after passing across the synapse.

Reuptake: The process whereby a neurotransmitter is taken back into the presynaptic terminal buttons, thereby stopping its activity.

Acetylcholine (ACh): The neurotransmitter responsible for motor control at the junction between nerves and muscles; it is also involved in mental processes such as learning, memory, sleeping, and dreaming.

Epinephrine: A monoamine neurotransmitter responsible for bursts of energy after an event that is exciting or threatening.

- Adrenaline
- Fight or flight response

Norepinephrine: A monoamine neurotransmitter involved in states or arousal and attention.

- Fine tuning the clarity of attention

Serotonin: A monoamine neurotransmitter important for a wide range of psychological activity, including emotional states, impulse control, and dreaming.

Dopamine: A monoamine neurotransmitter involved in motivation, reward, and motor control over voluntary movement.

GABA: Gamma-aminobutyric acid; the primary inhibitory transmitter in the nervous system.

Glutamate: The primary excitatory transmitter in the nervous system.

Endorphins: Neurotransmitters involved in natural pain reduction and rewards.

3.2 What are the Basis Brain Structures and Their Functions?

Broca's Area: A small portion of the left frontal region of the brain, crucial for the production of language.

Electroencephalograph (EEG): A device that measures electrical activity in the brain.

Positron Emission Tomography (PET): A method of brain imaging that assesses metabolic activity by using a radioactive substance injected into the bloodstream.

Magnetic Resonance Imaging (MRI): A method of brain imaging the uses a powerful magnetic field to produce magnetic field to produce high-quality images of the brain.

Functional Magnetic Resonance Imaging (fMRI): An imaging technique used to examine changes in the activity of the working human brain by measuring changes in the blood's oxygen levels.

Transcranial Magnetic Stimulation (TMS): The use of strong magnets to briefly interrupt normal brain activity as a way to study brain regions.

Brain Stem: An extension of the spinal cord; it houses structures that control functions associated with survival, such as heart rate, breathing, swallowing, vomiting, urination, and orgasm.

- Consists of medulla oblongata, the pons, and the midbrain
- Contains a network of neurons called the reticular formation. The reticular formation projects up into the cerebral cortex (outer portion of the brain, thought and planning)

Cerebellum: A large, convoluted protuberance at the back of the brain stem; it is essential for coordinated movement and balance.

- Motor learning and motor memory

Thalamus: The gateway to the brain; it receives almost all incoming sensory information before that information reaches the cortex.

Hypothalamus: A brain structure that is involved in the regulation of bodily functions, including body temperature, body rhythms, blood pressure, and blood glucose levels; it also influenced our basic motivated behaviors.

Hippocampus: A brain structure that is associated with the formation of new memories.

Amygdala: A brain structure that serves a vital role in learning to associate things with emotional responses and in processing emotional information.

- Intensifies the function of memory during times of emotional arousal

Basal Ganglia: A system of subcortical structures that are important for the plan and production of movement.

- Receive input from the entire cerebral cortex
- Nucleus accumbens, important for experiencing reward and motivating behavior.