01 Unit Brain and Neuron Basics

Content Area: **Science**
Course(s): **Neuroscience**
Time Period: **Semester 1**
Length: **4 weeks**
Status: **Published**

Standards

HS-LS1	From Molecules to Organisms: Structures and Processes
HS-LS1-1	Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
	Structure and Function
HS-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
	Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.

Enduring Understandings

- The brain and nervous system underlie all human behavior.
- The brain is the body's control center, managing signals sent to and from the rest of the body.
- The brain is organized into specific parts which are wired to perform specific tasks.
- The brain is composed of neuron cells that are uniquely designed to communicate with each other through neurotransmission.

Essential Questions

- What is the brain and why is it important?
- How does the brain control our bodily functions?
- What are some common misconceptions of the brain?
- How do neurons and communicate with each other?
- How do the various chemical neurotransmitters produce different affects on the brain and body?

Knowledge and Skills

Knowledge:

1. The anatomy of the brain can be characterized in multiple ways that provide orientation to overall structure and functional locations.
2. Individual regions of the brain are typically defined by their primary roles, but many regions work together to carry out complex functions.

3. Many brain functions involve interactions between multiple lobes, but there are key functions that can be roughly geographically assigned to each lobe:
    - The frontal lobe is associated with decision-making, planning, judgment, and motor control.
    - The parietal lobe processes sensory and spatial information and integrates information coming from different senses.
    - The temporal lobe includes regions responsible for sound processing, language comprehension, and memory formation.
    - The occipital lobe is primarily responsible for processing visual information, including color and motion detection.
4. Neurons and glia are cells that make up the nervous system.
5. There are approximately 86 billion neurons in the brain and are likely a similar number of glia, the support cells.
6. Neurons have the unique ability to be electrically excited, so they can transmit signals very quickly throughout the body.
7. Neurons have dendrites, which receive signals, and axons, which send signals.
8. Glia are the support cells of the brain and there are several different types that each play a specific role.
9. Most neurons have a negative charge inside the cell compared to outside the cell which creates an electrical potential across the cell membrane of the axon (the membrane potential).
10. An action potential is activated when an incoming stimulus reaches the threshold for depolarization (a change in charge).
11. An action potential is an all-or-nothing event—the size of the action potential is always the same but a larger stimulus may produce a higher frequency of action potentials.
12. Because of the electrical nature of an action potential, a myelin coating around an axon can provide insulation to help the signal travel faster.
13. Synaptic transmission is the process by which a signal is communicated from one neuron to the next, using chemicals called neurotransmitters.
14. There are many different neurotransmitters that work in different combinations, contributing to the complex signaling in the brain.
15. Neurotransmitters can trigger fast responses (via ions) or slower responses (via second messenger molecules) in the neuron receiving the signal.

Skills:

1. Identify structures of the brain in a simulated dissection.
2. Build a neural network.
3. Use models to simulate an action potential.

Transfer Goals

- Apply knowledge of brain regions to real-world scenarios, such a trauma or explaining behaviors.
- Connect neuronal mechanisms to broader physiological processes such as sensory perception, hormone regulation, or homeostasis.
- Apply understanding of brain anatomy and plasticity to learning of all disciplines.

Assessments

https://docs.google.com/document/d/1wR7bQF-8AQoRrt0g4C3hKja0yjwDjC9_BiAmONWbTcI/edit?usp=sharing

Modifications

https://docs.google.com/document/d/1ODqaPP69YkcFiyG72fIT8XsUIe3K1VSG7nxuc4CpCec/edit?usp=sharing