

Neuromatrix Lesson

NeuroDefender: Make That Pass!

Introduction:

The brain has one hundred billion neurons, more or less. They connect in a huge network exchanging billions of signals per second with one another and with your body. Neurons relay signals via the synapse, the tiny space between nerve cells. When a synapse occurs, neurotransmitters flow from one neuron to the next. A neurotransmitter is a chemical that relays the signal. Neurons firing, synapses connecting, that's what the brain's all about. Nanobots are intercepting the neurotransmitters that make the synapse work. (Note: Show students synapse diagram on Lesson Handout.)

Dr. Eric Chudler from the University of Washington explains the neurotransmission process this way: "Communication of information between neurons is accomplished by movement of chemicals across a small gap called the synapse. Chemicals, called neurotransmitters, are released from one neuron at the presynaptic nerve terminal. Neurotransmitters then cross the synapse where they may be accepted by the next neuron at a specialized site called a receptor. The action that follows activation of a receptor site may be either depolarization (an excitatory postsynaptic potential) or hyperpolarization (an inhibitory postsynaptic potential). A depolarization makes it MORE likely that an action potential will fire; a hyperpolarization makes it LESS likely that an action potential will fire." (<http://faculty.washington.edu/chudler/chnt1.html>, Chudler)

Web Sites for Further Study:

http://science.education.nih.gov/supplements/nih2/addiction/activities/lesson2_neurotransmission.htm (National Institutes of Health and National Institute on Drug Abuse)
<http://psych.hanover.edu/Krantz/neurotut.html> (Tutorials on brain functions by Hanover College, Psychology Department, Hanover Indiana)
<http://faculty.washington.edu/chudler/synapse.html> (Dr. Eric Chudler's site on the synapse)
<http://faculty.washington.edu/chudler/chnt1.html> (Dr. Eric Chudler's site on neurotransmitters)

<http://faculty.washington.edu/chudler/neurok.html> (Dr. Eric Chudler)

Objectives:

Students will learn:

Neurons are the key cells in the nervous system; neurons pass signals from one cell to another, which makes the brain work and sends messages to the body.

Neurons are the building blocks of the brain. They communicate with each other thousands of times a second.

The space or gap between nerve cells is called a synapse.

The synapse contains a presynaptic neuron, the synaptic space and a postsynaptic neuron.

The brain works with the rest of the body.

The projections that collect messages and transmit them to the cell body are called dendrites.

Each neuron has a projection, called the axon, which carries messages away from the cell body.

Neurotransmitters are like messengers that travel between one brain cell and another. They are chemical signals that neurons use to talk to each other, which is what makes the brain work. Neurotransmitters help determine how a person feels, thinks and acts.

Major Concept:

Neurons convey information using electrical and chemical signals.

Standards:

1. National Science Education Life Science Standards Levels 5-8: Structures and functions in living systems
2. NSE Standards: Science as Inquiry: Abilities necessary to do scientific inquiry and understandings about scientific inquiry.

California State Language Arts Standards: Grade 6

Writing

1.0 Writing Strategies

Students write clear, coherent, and focused essays. The writing exhibits students' awareness of the audience and purpose. Essays contain formal introductions, supporting evidence, and conclusions. Students progress through the stages of the writing process as needed.

Organization and Focus

1.1 Choose the form of writing (e.g., personal letter, letter to the editor, review, poem, report, narrative) that best suits the intended purpose.

1.2 Create multiple-paragraph expository compositions:

- a. Engage the interest of the reader and state a clear purpose.
- b. Develop the topic with supporting details and precise verbs, nouns, and adjectives to paint a visual image in the mind of the reader.
- c. Conclude with a detailed summary linked to the purpose of the composition.

1.3 Use a variety of effective and coherent organizational patterns, including comparison and contrast; organization by categories; and arrangement by spatial order, order of importance, or climactic order.

Research and Technology

1.4 Use organizational features of electronic text (e.g., bulletin boards, databases, keyword searches, e-mail addresses) to locate information.

Set:

The students assume the role of sports reporters. They observe the role-playing activity, read the informational writing, complete the game-diagram activity, and play the NeuroDefender game. At the end of the lesson, students write a sports report for the local newspaper.

A metaphor for the process of transmitting information from one cell to another can be found in our athletic games. For example, it is much like the game of football or soccer, where a team tries to score points by passing the ball to one of its members. The neurotransmitter is like the quarterback throwing the pass to the wide receiver or the forward on a soccer team passing the ball to a wing. The pass itself is like the synapse, where an idea or message is taken from one side to the other. In the NeuroDefender game, the Nanobots are the opposing team that tries to intercept the ball and stop the pass from the quarterback to the wide receiver or from the forward to the wing.

Activities:

Read the NeuroDefender Game Description.Group Practice Activity:

Role Play a Football Game Diagram

Copy and give each student the attached activity Diagram #1, The "Pass", to demonstrate the similarities between a football or soccer pass and the neurotransmission process in the brain. Review the diagram with the students.

Divide the class into opposing teams. Assign a quarterback and a wide receiver from one team. Ask the quarterback to throw a football to the wide receiver. The people on the opposing team will try to intercept it.

Copy and give each student the activity Diagram #2, The Neurotransmission Process in the Brain (no labels), to demonstrate the process of neurotransmission. Ask the students to work in small groups of 3 or 4 to label the diagram. Diagram #3, The Neurotransmission Process in the Brain (master with labels) is included for you to use as a guide. This activity will serve as a content vocabulary study and a way to transfer the student's prior knowledge of how a pass is used in a football game, which is similar to how neurotransmission works in the brain.

Play the NeuroDefender Game:

NeuroDefender Game Description

Nerve impulses are releasing neurotransmitters to help send messages to Agent NM7's body so she can regain her balance in order to cross a dangerous chasm. These neurotransmitters are being launched into the synaptic cleft at nerve-ending terminals, where a neuron's axon meets another neuron's dendrite. However, one particular synaptic cleft has become a dangerous place for neurotransmitters. This synaptic cleft is filled with nasty Nanobots, sent to robotize Agent NM7's brain and stop the neurotransmitters from reaching their correct receptors. It's up to you to help guide the neurotransmitters safely to their final destinations.

You have a limited amount of time to find each neurotransmitter's correct receptor before the body takes over and sends in its own big guys, Acetylcholinesterase, to destroy the well-meaning neurotransmitters. Once the player has successfully docked all three neurotransmitters, the synapse fires. Agent NM7 regains her balance and coordination and is able to cross the chasm.

To the Teacher:

This is the movie screen script. Use this to help build the students' background knowledge prior to playing the game.

Movie Script: Intro to NeuroDefender

Yeah, like I was saying, your brain's got a hundred billion neurons more or less. They connect in a huge network exchanging billions of signals per second with one another and with your body. The neuron's a busy little nerve cell. Neurons relay signals via the synapse, the tiny space between to neurons. When a synapse occurs, neurotransmitters flow from one neuron to the next. A neurotransmitter is a chemical that relays the signal. Neurons firing, synapses connecting, that's what the brain's all about. Here's a synapse that's got all it going on. But the other synapse has issues, and guess who's to blame. Nanobots are intercepting the neurotransmitters that make the synapse work. Get in there and stop them!

Movie Script: NeuroDender Finale

You did it! The synapse is working again. Agent NM7 will make it across the chasm!

Follow-up Activities:

Diagram Activity

Write a sports report that describes the process.

Ask students to return to their Diagram #2, The Neurotransmission Process in the Brain and complete the diagram.

Assessment:

Ask students to assume the role of a sports reporter. They should play the Neuromatrix game again and refer to their Diagram #2, The Neurotransmission Process in the Brain. They can write a sports report about the neurotransmission process and include their own drawings to illustrate the process. For example, students can write a "play-by-play" coverage report or a summary of the game. Ask students to share their sports reports with the class or post them online on a class web site.