



Lesson Summary: This lesson allows students to apply engineering principles in the science classroom. Students learn how neurons convey information through designing and building a physical model of neurotransmission.

Grade Level 9-12

**Lesson Length
1-2 class periods**

Standards Alignment

Next Generation Science Standards

- MS-LS1-2. Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.
- MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.
- MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.
- HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
- **Framework for K-12 Science Education:** Science & Engineering Practices 2,3,6,8

Objectives—Students will

- identify the parts of the neuron and describe their function(s).
- understand synaptic transmission.
- design and build a model to explain how neurotransmitters move from presynaptic neuron to postsynaptic neuron.

Assessment Options

- ask students to present their physical models to the class
- evaluate student reports
- evaluate students' concept maps on neurotransmission

Teacher Notes

This activity works best as a follow-up to the **Bead Neuron** and **Connect The Neurons** lessons.

Materials

- Marbles and/or beads of different sizes
- Plastic containers
- Plastic bottles
- Scissors
- Tape
- Rubber bands
- String

Procedure

Engage

1. Ask students draw a neuron. To complete this activity, students need to have a good understanding of the structure of a neuron: axon and dendrite. You may need to remind students about the structure and function of the axon and dendrites.
2. Once the students have completed their drawings, ask one of the students to present his/her drawing to the class. If necessary, draw a neuron on the board.
3. Ask students how a neuron transmits information to another neuron. Hold a discussion and summarize students' ideas.
4. Divide the class in groups of 3-4 students. Ask each group to further discuss neuronal transmission and, as a group, draw a diagram that shows how one neuron communicates with another neuron. Allow 10 minutes for students to complete their diagrams.
5. Ask students to present their ideas and drawings to the class.

Explore

1. Let students continue to work in their groups to build a physical model that represents chemical neurotransmission.
2. Provide materials such as marbles, plastic bottles, scissors, tape, plastic cups, etc.

Explain

1. Allow students to show their models to the class. Open a discussion and summarize how neurotransmission occurs.
2. Show a neurotransmission animation (for example: BrainU's **The Synapse** at brainu.org/movies) on the computer. Let students watch it a couple of times.
3. Explain the following concepts: synapses, presynaptic neuron, postsynaptic neuron, action potential, and neurotransmitter.
4. Give examples of neurotransmitters such as dopamine, GABA, and serotonin and explain their roles.

Elaborate

1. Allow 15-20 minutes for students to rebuild their physical models based on what they have learned.
2. If time is short and you have video access, give students time to record a demonstration of their updated model, revealing their increased conceptual understanding. This can be evaluated later.

Evaluate

1. Once the groups have finalized their models, ask each group to prepare a report about their updated model and how it works. This can be a video report with demonstration, or a written description, depending on your access to technology.
2. Ask each student to make a concept map of neurotransmission. Students should include the following words on their maps: synapses, presynaptic neuron, postsynaptic neuron, neuron, axon, dendrite, neurotransmitter, and action potential.

Expand (Optional)

Option 1: Ask students to do an internet search on neurotransmitters. Have each student collect information about five different types of neurotransmitters and their effects on the activity of a neuron.

Option 2: Ask students to do an internet search on how drugs may affect synaptic neurotransmission. Assign students to research one drug such as cocaine, nicotine, or alcohol.

Take Home Points

- Neurons communicate through sending and receiving messages or signals.
- Neurons use electrical messages and chemical messages called *neurotransmitter* to communicate. While electrical signaling is used within the neuron, chemical signaling is used between neurons.
- A synapse is not a physical connection between two neurons.