SN EDUCATOR GUIDE

September 16, 2017

Flex Time

Activity Guide for Students: How Do Neurons Form Connections?

Purpose: To have a better understanding of what neurons look like, how they are interconnected and how learning changes those connections.

Procedural overview: Create your own data table to study prepared microscope slides of neurons from different types of nervous system tissue and create model neurons to demonstrate how connections between these neurons are altered during learning.

Neuron modeling activity: Use the following set of instructions to create pipe cleaner models of neurons and take photos of the neurons interacting while they "learn" something. Write down your answers to the questions along the way, and be prepared to present your models and photos to the teacher or the rest of the class.

Procedure:

1. Use pipe cleaners to make several model neurons. You could make each neuron a different solid color, or you could choose a more elaborate color scheme if you would like. Look up several diagrams to prepare your neurons. Feel free to make neurotransmitters out of additional pipe cleaners or other materials provided by your teacher. Just remember, a neurotransmitter will chemically fit — meaning it will physically fit *and* be attracted to — a receptor on another neuron, so you'll need to make receptors too. Make at least three complete neurons, or more if you have enough pipe cleaners and time.

2. What are the roles of the cell body, the dendrites and the axon in a real neuron?

3. *Please note that this next step is an extreme oversimplification of neural connections made while learning to complete a task. The focus of this exercise is to determine how individual neurons communicate, and relate this concept to the larger networks of neural connections made during learning.*

Decide what role each neuron will play in a task to be learned, and label each neuron with a sticky note. For example, in a simple model of Pavlov's dog, the "food" neuron fires when the dog sees food, the "bell" neuron fires when the dog hears a bell, and the "slobber" neuron fires to make the dog drool in anticipation of eating. Dogs come pre-wired with the axon of the food neuron connected to the dendrites of the slobber neuron. If the dog always hears a bell when food is presented, the dog's brain learns to connect the axon of the bell neuron to the dendrites of the slobber neuron. Through a process called long-term potentiation, the slobber neuron realizes that it always fires at the same time the bell neuron fires, so it should strengthen its connection to the bell neuron.

4. What roles do your model neurons play? What makes each one fire?

5. What will your model neurons learn, and how?

6. Connect the neurons as they would be before learning. If one neuron is communicating with a second, the end of the first neuron's axon should be nearly connected to one of the dendrites of the second neuron. If you're using neurotransmitter models, show the chemicals leaving one neuron and being accepted by another. If a neuron is not communicating with the others, it can be near the other neurons but not touching them, or neurotransmitters may not be accepted by that cell. Take a photo or video of your network of neurons, making sure the labels on each neuron are visible.

7. In this state before learning has occurred, what does your network of neurons do? What has it not yet learned to do?

8. Now make the appropriate adjustments to your neurons and take a photo or video of the neurons during the learning process.

9. Make a final adjustment to your neurons, and take a photo or video of the neurons after the learning process.

10. In this state after learning has occurred, what does your network of neurons do? What has it learned to do that it did not do before?

11. What have you learned about the structure of a neuron from this activity?

12. What have you discovered about learning from this activity?

13. If you had more time and more pipe cleaners, how could you make your model neuron network more elaborate or more scientifically accurate?

Neuron observation activity: Use the following set of instructions to observe prepared slides of various types of neurons under a microscope. Start at the lowest power, focus on the colored layer of the slide and make observations. Move to the next higher power, refocus and make more observations. Make sure you observe different areas of each slide. Write down your observations.

Before you begin, read through the additional instructions below and create a clearly labeled data table for all of your observations.

Procedure:

1. Observe a slide of cerebral cortex. What overall shapes or structures do you see for the cerebral tissue? Which way(s) do neurons point in the sample? What shapes are the individual neurons? Can you identify cell bodies, dendrites and axons? Can you see connections between neurons? What does the cerebral cortex do? Draw a simple sketch to show where cerebral tissue is located in a human brain.

2. Observe a slide of cerebellum. What overall shapes or structures do you see for the cerebellar tissue? Which way(s) do neurons point in the sample? What shapes are the individual neurons? Can you identify cell bodies, dendrites and axons? Can you see connections between neurons? How does the cerebellar tissue appear similar to or different from the cerebral cortex? What does the cerebellum do? Draw a simple sketch to show where cerebellar tissue is located in a human brain.

3. Observe a slide of spinal tissue. What overall shapes or structures do you see for the spinal tissue? Which way(s) do neurons point in the sample? What shapes are the individual neurons? Can you identify cell bodies, dendrites and axons? Can you see connections between neurons? What does spinal nervous tissue do? Draw a simple sketch to show where spinal tissue is located in a human body.

4. Observe a slide of motor neurons. What overall shapes or structures do you see? Which way(s) do neurons point in the sample? What shapes are the individual neurons? Can you identify cell bodies, dendrites and axons? Can you see connections between neurons? What do motor neurons do? Draw a simple sketch to show where motor neurons could be located in a human body.

5. Observe a slide of a peripheral nerve. What overall shapes or structures do you see? Which way(s) do neurons point in the sample? What shapes are the individual neurons? Can you identify cell bodies, dendrites and axons? Can you see connections between neurons? What do nerves do? Draw a simple sketch to show where nerves could be located in a human body.

6. How are the nervous tissue samples similar to or different from your pipe cleaner model?

7. Based on your microscope observations, how could you make the pipe cleaner model more scientifically accurate?