Neurons & Control of Movement

Lesson Overview: In this lesson students will examine the role of the brain in voluntary movement while also learning about the primary cell type of the brain (neurons) and how they send signals to one another.

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Age or Grade Level: Middle School

Delivery Format: In-class

Instructional Time (min): 50-60 minutes

Number of Instructors Preferred (required): 2+ (2)
Suggested Student:Instructor Ratio: 10:1

Next Generation Science Standard Addressed:

Performance Expectation		
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.		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Obtaining, Evaluating, and Communicating Information	LS1.D: Information Processing	Cause and Effect

Learning Objectives:
1. Recognize that neurons use electrical signaling to communicate

Phenomenon/Driving Question *(An observable event that can drive student inquiry):*

How can signals from one person's brain control movement of someone else?

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Teacher Preparation:

Anticipated Student Misconceptions	Scientific Vocabulary
Often students have not thought about how their brain can make their body move at all. Introducing the idea of electrical signals can be difficult.	*Parietal lobe* *Frontal lobe* *Temporal lobe* *Occipital lobe* *Brainstem* *Cerebellum* *Neuron* *Axon* *Soma* *Dendrite* *Myelin*

Preparation Resources **for Instructors**
https://www.youtube.com/watch?v=Ma4i6nH3qMQ - Short description of the motor pathway *https://www.youtube.com/watch?v=LQ4DlE1Xyd4 – Description of the lobes of the brain* *https://www.youtube.com/watch?v=zKA8iaxfEww - Long description of the motor pathway, more detail than necessary for students*

Materials: *List ALL materials needed for this event including consumables, hardware and worksheets.*

Group/Class Needs	Individual Student Needs
Human to Human Interface (https://backyardbrains.com/products/HHI) Claw Interface (https://backyardbrains.com/products/clawBundle) Electrodes (2+ per student) Basket and balls that can be held by the claw Spare 9V batteries	Lesson Worksheet (https://drive.google.com/drive/folders/1HwSnlrRfR0I3k0p3WuY9skILVRlSAimG?usp=sharing)

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Timeline:

Intro (10 minutes max)

- Who we are (Brain Explorers from WMed, our names, etc.)
- Demo: human-to-human interface
    - Woah! What is going on?!? How does this work?
    - Driving question: How can signals from one person's brain control movement of someone else?

- Discussion: What does the brain do?
    - Different parts of the brain have different functions (briefly introduce lobes of the brain)
    - What is the smallest part of the brain? Neurons – the primary cells of the brain
        - Draw a neuron on the board and contrast with a "typical" cell
        - Neurons are cool – they talk to each other and to other cells; they do this by receiving info at dendrites and sending info down axon

- Where are the neurons that send a signal to your muscles? (spinal cord)

- If the neurons that control muscles are in the spinal cord, how do they get the signal to move? (From your brain)
    - draw a simplified descending motor pathway [1 neuron from brain down to spinal cord including the decussation (cross) and then a neuron from spinal cord to muscle].

Split into 2 groups: (15 minutes/station)
This equipment is expensive. Please be very careful and listen to your instructors.

1. Human-to-human interface
    a. Generally only have students controlling an instructor rather than being controlled to avoid any student discomfort.
2. Claw
    a. Have a task for students to complete such as stacking cups or grabbing something and placing it into a container of some sort. Have several objects of varying difficulty to keep things interesting.

Reflection & Wrap Up: (<10 minutes)
Discussion: How could this information be used to benefit others?