



Classroom Teacher Preparation

Anatomy/Physiology 40: Healing the Brain with Electric Current

Please use the following to prepare for the next SfS lesson.

Description:

This module introduces students to neuromodulation (change in the excitability of neurons in a particular area of the brain) and how it can be used in simple electric devices to help patients recover from injury or disease. Students act as doctors to design a treatment plan for different case studies.

Lesson Objectives – SWBAT (“Students Will Be Able To…”):

7th-8th:

- Define neuromodulation, describe how it affects the functioning of the nervous system and how we can use it to help people
- Identify what tDCS (transcranial Direct Current Stimulation) is and how and why it is used

Disciplinary Core Idea (DCI)

LS1 From Molecules to Organisms: Structures and Processes – LS1.D Information Processing

- Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories.

Science & Engineering Practice (SEP)

Obtaining, Evaluating, and Communicating information

- Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations

Developing and Using Models

- Develop and/or use a model to predict and/or describe phenomena

Crosscutting Concept (CCC)

Systems and System Models

- Students can understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. They can use models to represent systems and their interactions—such as inputs, processes, and outputs—and energy, matter, and information flows within systems. They also learn that models are limited in that they only represent certain aspects of the system under study.

NGS Standard:

- **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.



Preparation:

This lesson will be students' first exposure to the concept of neuromodulation. However, it is an **advanced** module.

Students should know the basic structure of a neuron (cell body, axon, dendrite), and the following additional terms: synapse, action potential (spike), neurotransmitter

As a prerequisite, students will need to have completed (or have the equivalent background of) *AP01: Cells & Organelles* and *AP18: The Mammalian Brain*. Students would also benefit from having done *AP19: What's in My Head* and *AP20: Experimenting with Our Brains*.

Room Set Up for Activities:

Students will work in pairs to solve 1-3 case studies and write up a medical report for each case study. They can work at their normal tables or desks. The room lights may need to be dimmed in order to see clearly the lights on the circuit boards.

Safety:

There are no safety precautions necessary for this lesson.

Related Modules:

This lesson may be taught as part of a sequence or group of related modules on **Neuroscience**. Modules include:

Anatomy/Physiology 1: Cells & Organelles – Students make a cell model to learn about the functions and interactions of a cell's organelles.

Anatomy/Physiology 18: The Mammalian Brain – Students examine preserved sheep brains to learn about the different structures of the brain, including cerebrum, cerebellum, and brainstem.

Anatomy/Physiology 19: What's in My Head – This lesson is an introduction to the human nervous system, focusing on the human brain and its functional units, the neurons. Students explore the structure and function of the brain and neurons through the construction of models.

Anatomy/Physiology 20: Experimenting with Our Brains – This activity demonstrates how the brain learns to adapt to an altered situation by doing an experiment with prism goggles and beanbags.

For other module sequences and groups, look here: www.sciencefromscientists.org/sequences

After Our Visit:

Extend this lesson with **The Domino Effect**. Construct and explore a simple device that models several important aspects of the way a nerve impulse is propagated from dendrite to axon:

<https://www.exploratorium.edu/sites/default/files/dominoeffect.pdf>

To help Evaluate, check out our Open Response questions online at sciencefromscientists.org/open-response-questions. They are freely available for all of our lessons for current teachers. Use the password supplied by your instructor to log in.

Additional Resources:

- Science Trek, The Brain. A brief overview of the brain's structure and function (2:39): <https://www.youtube.com/watch?v=wiVft5eIL-E>
- Modeling the Action Potential Using Dominoes: <https://www.youtube.com/watch?v=xzvZ11EutBY>
- How tDCS (transcranial Direct Current Stimulation) works (8:29). PBS Science correspondent Miles O'Brien gets hooked up to a tDCS device to explore its potential uses: <https://www.youtube.com/watch?v=yoEu2mEdLjw>

