project NEURON

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Novel Education for Understanding Research On Neuroscience

Project NEURON brings cutting-edge science to middle and high school students through inquiry-driven activities based on research conducted at the University of Illinois.

For materials and information visit
http://neuron.illinois.edu/

What changes our minds?
Foods, drugs, and the brain

Lesson 1: What changes our minds?

The purpose of this lesson is to introduce the driving question: What changes our minds? Students generate answers to this question through discussions about a series of videos in which people with different backgrounds address the question. Using class discussions and others' responses, students begin to answer the driving question from both brain and mind perspectives. Students begin to learn an important concept in psychology that people's understandings and conceptions can and do change over time and based on experiences.

Lesson 2: How do we define what changes our minds?

This lesson introduces students to commonly held definitions and categorizations of "drugs" and "toxicants." Students investigate their own ideas about these words through a categories game where they group terms into the drug, toxin, toxicant, and poison categories based on initial reactions and then a series of questions. After whole class definitions are generated, a video presents University of Illinois scientists explaining their definitions of "drugs" and "toxicants" and why they define these words as such. Based on the video and subsequent homework reading, students develop a better understanding of the differences between drugs and toxicants.

Lesson 3: How do drugs affect planarians?

Students are tasked with investigating a popular energy drink and its components: caffeine, B vitamins, sugar, and ginseng. Using hypothesis development, data collection, and analysis, students draw conclusions regarding the effects of these drugs on planarians and how they might relate to humans. As an assessment, students look at the nutrition facts of different popular beverages in order to compare the amounts of drugs in these drinks to that of the energy drink.

Lesson 4: How does an estrogen affect a rat's mind?

In this lesson, students are asked to read background information on estrogens' effects on the reproductive and nervous system and then read a transcript of a lab meeting featuring a fictional high school student visiting the lab of a behavioral neuroendocrinologist. Students develop a hypothesis relating how ovariectomized rats will learn, with and without estrogen treatment. After collecting data from video trials of treated and untreated rats, students graph their results and revisit their hypothesis to evaluate the accuracy of their hypothesis based on the evidence.

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Lesson 5: What are the effects of drugs on the nervous system?

Students continue learning about organisms' potential responses to drugs through observing what happens to humans undergoing a "sweat test," which introduces students to the sympathetic nervous system and how drugs might influence the test. Students continue learning about the nervous system through a series of readings on the different parts and functions of the nervous system. Using a jigsaw strategy, students discuss how certain drugs (specifically caffeine, alcohol, and sugar) can affect the nervous system.

Lesson 6: How do neurons communicate?

Students first design a "newron" of a fictional organism to begin developing an understanding of the functions of an actual neuron. Next, the students investigate how neurons communicate via the generation of an action potential and how drugs can affect the action potential. Finally, students revisit their models of the nervous system they illustrated in Lesson 5 to add more details as to how the nervous system operates within the context of how drugs affect the cells of the nervous system.

Lesson 7: How do drugs affect neuron communication?

Students begin by creating a clay model of a resting neuron and demonstrate what happens when a neurotransmitter sends a message to the cell. Then they explore how drugs affect this messaging system using an excitatory drug, nicotine, and an inhibitory drug, hexamethonium, by adding these compounds to the clay models. Finally, the students relate what they have learned to the planarian experiment in Lesson 3 as well as apply their knowledge to describe the mechanism of action of two other drugs, curare and yerba mate tea.

Lesson 8: How can animal models reflect the effects of drugs?

Students explore multiple levels of drug action on the nervous system by looking at different measures: behavioral effects, system-level brain activation, and neuron activity and morphological changes. In addition to learning about the multiple levels of the effects of drugs on the brain, students examine how these effects are similar and different in humans, rats, and planarians. Discussions address why scientists use animal models in the study of drugs, including the benefits and the limitations.

Lesson 9: When should the FDA regulate a drug?

In this lesson, students revisit the definition of a drug and consider when and why use of different drugs is regulated in different ways. Students use information about the types of biological responses to drugs discussed in previous lessons (cellular, physiological, behavioral) to debate the relative benefits and risks of several familiar substances. They use the outcomes of these debates to better understand how the US government classifies existing and newly developed drugs.

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