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.

http://neuron.illinois.edu/

What changes our minds?

Toxicants, exposure, and the environment

Lesson 1: What changes our minds?

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

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 is shown of UIUC 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 difference between drug and toxicant.

Lesson 3: How does the environment magnify our exposure to toxicants?

In this lesson students investigate the role of environment in exposure to toxicants. Playing a board-based Biomagnification Game, students and teacher act as Anchovies, Tuna, and Fishing Boat (humans) to model the biomagnification of a toxicant at each trophic level. Students read articles about how mercury enters food chains and a case study of a community affected by mercury poisoning. Using this information, students analyze data collected from the game to observe trends of biomagnification as toxicant concentration increases with each higher trophic level. Students also evaluate the game as a model for biomagnification by discussing its strengths and limitations. Then, students use recent news articles to gain perspective on how most people are exposed to toxicants today. The lesson concludes with student groups creating public service announcements that communicate the concept of biomagnification and the dangers of consuming high levels of mercury through fish.

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Lesson 4: Where are toxicants and how much are we exposed?

This lesson introduces students to the ways in which they are exposed to toxicants in their daily lives and how their own exposure can be measured. The introduction explores how people are exposed to toxicants through critical evaluation of how different media sources reported the results of a primary research study. Then students determine the quantity of BPA in common products with a common biological assay, ELISA, that uses spectrophotometry. Students will also gain skills in the generation and use of a standard curve that requires basic algebra and graphing.

Lesson 5: How can an environmental toxicant affect *Daphnia*?

In this lesson, students examine the effect(s) that a common aquatic algaecide has on *Daphnia* (also called the water flea), a small zooplankton found in freshwater lakes that is used as a model organism. Using their experimental data, students draw conclusions about the safety of using copper sulfate as a way to control algae overgrowth in aquatic ecosystems and recommend a safe concentration (if there is one) of copper sulfate to use in ponds. As a final assessment students create a scientific argument using the CER framework on the safety of using copper sulfate in aquatic ecosystems.

Lesson 6: Toxicant in action: What changes the cell?

In this lesson students explore a variety of toxicants and chemicals that illustrate potential cellular mechanisms of action. This is a two-day lesson involving both the toxicant information and the integration of these data into a working understanding of the cell and points of influence/regulation. Students start the lesson by developing a visual conceptualization of the neuron (as a picture of a cell, or a schematic of neuron function). Then students are asked to interpret information about the cellular targets of chemicals. Finally, students integrate these ideas into a working model of how a neuron's function can be regulated by external chemicals.

Lesson 7: If it's harmful, why do we use it?

Through this lesson, students learn a historical perspective of why BPA is present in our society and investigate the different positions of those vested in regulating (or not regulating) the use of BPA. Students become familiar with the debate over the use of BPA from the perspective of the mass media. Then, they are placed in "expert groups" where they take on a specific role and conduct research to determine that particular role's position on the use of BPA. Once these groups have developed a position statement, or research statement, students form new groups, similar to a Congressional Panel that reviews different viewpoints before making a decision to regulate a toxicant. The new group will have to decide whether or not BPA should be regulated and explain why based on evidence and reasoning presented in the research reports.

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