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LESSON:

Lettuce Explore Perchlorate in Food

Summary: Students explore issues related to the distribution and health risks of the chemical perchlorate in food. The lesson is a "warm-up" and can take 25 minutes or less to implement.

EHP Article: "Perchlorate Exposure: Tip of the Iceberg?"
EHP Student Edition, July 2005, p. A232
http://ehp.niehs.nih.gov/docs/2005/113-4/forum.html#perc

Objectives: By the end of this lesson, students should be able to:

1. Define "ubiquitous" and apply it to the context of perchlorate.
2. Use reasoning and logical explanation to answer questions about the distribution and health risks of perchlorate.

Class Time: 20–25 minutes

Grade Level: 9–12

Subjects Addressed: Biology, Environmental Science

Prepping the Lesson (15–20 minutes)

INSTRUCTIONS:

1. Obtain a class set of *EHP Student Edition*, July 2005, or download the article at http://ehp.niehs.nih.gov/docs/2005/113-4/forum.html#perc.
2. Make copies of the Student Instructions.
3. Review the article, lesson, and Student Instructions.

MATERIALS (per student):

- 1 copy of *EHP Student Edition*, July 2005, or 1 copy of "Perchlorate Exposure: Tip of the Iceberg?"
- 1 copy of student instructions

VOCABULARY:

Anion
Anthropogenic
Biodegrade
Hyperthyroidism
Perchlorate
Ubiquitous

BACKGROUND INFORMATION:

Perchlorate is a primarily man-made anion associated with the salts of ammonium, potassium, and sodium. It is mostly used in explosives and solid rocket propellants. Over the years research has shown that perchlorate contamination may be extensive, and the potential cost of cleaning it up could be huge.

It is known that perchlorate inhibits the transport of iodide into the thyroid. In fact, it has been used in drugs to treat people with hyperthyroidism. What is not known is the effect of long-term chronic exposure to perchlorate, especially to fetuses and infants. The concern, and research indication, is that perchlorate will inhibit the formation of important growth hormones associated with the thyroid gland. This hormone reduction may cause birth defects, including brain development/IQ reduction, and possibly promote thyroid tumors.

RESOURCES:

Environmental Health Perspectives, Environews by Topic pge. Choose: Agriculture/Farming, Chemical Exposures, Food Safety and Regulation, http://ehp.niehs.nih.gov/topic

California Department of Health, "Perchlorate in California Drinking Water: Overview and Links," http://www.dhs.ca.gov/ps/ddwem/chemicals/perchl/perchlindex.htm

Massachusetts.gov, Perchlorate Information, including Health Effects Toxicological Profile and Assessment, http://www.mass.gov/dep/brp/dws/percinfo.htm

Implementing the Lesson

INSTRUCTIONS:

1. Hand out the Student Instructions and a copy of the article "Perchlorate Exposure: Tip of the Iceberg?"
2. Instruct students to read the article and answer the questions on the Student Instructions worksheet.

NOTES & HELPFUL HINTS:

This lesson could be extended by having students investigate the thyroid gland and its function in the human body.

Aligning with Standards

SKILLS USED OR DEVELOPED:

Comprehension (reading)
Critical thinking & response

SPECIFIC CONTENT ADDRESSED:

Health, environmental health, environmental science, perchlorate, risk

NATIONAL SCIENCE EDUCATION CONTENT STANDARDS

Unifying Concepts and Processes Standard

- Systems, order, and organization
- Evidence, models, and explanation
- Change, constancy, and measurement

Science as Inquiry

- Understanding about scientific inquiry

Science in Personal and Social Perspectives Standards

- Personal and community health
- Natural resources
- Environmental quality
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

History and Nature of Science Standards

- Science as a human endeavor
- Nature of scientific knowledge

Assessing the Lesson

Questions and answers below correspond to Steps 2, 3, and 4 of the Student Instructions.

Step 2: Ubiquitous means "being present everywhere at once." Would you say that perchlorate is ubiquitous in the environment? Justify your answer with data from the article.

The article indicates that perchlorate is ubiquitous in the environment because it is being found in foods and water where there is no known source of perchlorate contamination. Students should provide specific examples from the article to support this statement.

Step 3: The article states that "Perchlorate with no anthropogenic [or man-made] source has been found at 20–60 parts per billion (ppb). . . . This suggests that atmospheric reactions may create a low background level of perchlorate." Other than atmospheric reactions, what is another possible reason perchlorate may be found in so many places?

Students will be speculating, so answers may vary. Look for a logical response. Some possible answers include: Perchlorate may be found in so many places because it does not easily biodegrade and could be transported through the air, then deposited on the ground and/or absorbed by food.

Step 4: Risk is the relationship between exposure, dose (how much of a chemical gets inside your body), and how toxic a chemical is.

a) Based on the potential for exposure, do you think perchlorate is a low, medium, or high risk? Explain.

Answers may vary; students need to justify their answers.

b) What other information would you need to determine if perchlorate is a low, medium, or high risk?

Students may mention a variety of ideas including the need to review human and animal research studies themselves or to obtain interpretations of health risks from multiple sources, including any special interest groups, and compare the interpretations.

Authors and Reviewers

Author: Stefani Hines, University of New Mexico Center for Environmental Health Sciences

Reviewers: Susan Booker, Liam O'Fallon, Lisa Pitman, Wendy Stephan, Kimberly Thigpen Tart

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Student Instructions: Lettuce Explore Perchlorate in Food

Step 1: Read "Perchlorate Exposure: Tip of the Iceberg?", *EHP Student Edition*, July 2005, p. A232, http://ehp.niehs.nih.gov/docs/2005/113-4/forum.html#perc.

Step 2: Ubiquitous means "being present everywhere at once." Would you say that perchlorate is ubiquitous in the environment? Justify your answer with data from the article.

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