

LESSON: A Not-So-Sweet Sweetener?

Summary: Students read a news article about the safety of aspartame, then hunt for items containing aspartame in their homes and daily routines. Then they review the data they have collected and draw conclusions about their collective consumption patterns.

Lesson Type: Experiment—Students collect, manipulate, and/or summarize data from an experiment or activity they conduct.

EHP Article: “Sour Finding on Popular Sweetener”
EHP Student Edition, June 2006, p. A176
<http://www.ehponline.org/docs/2006/114-3/ss.html>

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

1. list populations that may be at increased risk from low doses of aspartame;
2. recognize categories of products that are likely to contain aspartame;
3. identify products in their homes and/or daily routines containing aspartame; and
4. discuss the potential risks based on their findings.

Class Time: 1 hour

Grade Level: 9–10

Subjects Addressed: Health, Nutrition, Biology

► Prepping the Lesson (5 minutes)

INSTRUCTIONS:

1. Download the entire June 2006 *EHP Student Edition* at <http://www.ehponline.org/science-ed/>, or download just the article “Sour Finding on Popular Sweetener” at <http://www.ehponline.org/docs/2006/114-3/ss.html>.
2. Review the Background Information, Instructions, and Student Instructions.
3. Make copies of the Student Instructions.

MATERIALS (per student):

- 1 copy of the *EHP Student Edition* article “Sour Finding on Popular Sweetener”
- 1 copy of the Student Instructions

VOCABULARY:

- aspartame
- carcinogenicity
- carcinomas
- dosage
- epithelium
- hygiene
- hyperplasia
- *in utero*
- leukemia
- lymphoma
- malignant
- olfactory
- oncology



- preneoplastic
- renal pelvis
- schwannomas
- ureter

BACKGROUND INFORMATION:

The artificial sweetener aspartame, marketed under different brand names such as NutraSweet™ and Equal®, has a long history of controversy regarding its safety. It is a chemical compound, originally discovered in 1965, that breaks down in the body to aspartic acid, phenylalanine, and methanol. The metabolite phenylalanine is known to cause a potentially deadly reaction in a very small group of people (phenylketonurics) who lack the ability to break down and excrete this amino acid. Aspartame also breaks down in food products to diketopiperazine, a chemical whose safety is also questioned. Numerous adverse health effects have been attributed to the use of aspartame, including cancer and neurotoxicity; however, there are scientific studies supporting both adverse and no adverse health effects. The *EHP Student Edition* article “Sour Finding on Popular Sweetener” reports on a new study that indicates aspartame could be a significant cancer risk. However, the implications of these new findings have not yet been fully evaluated.

Aspartame is used in approximately 6,000 food products, many of which are not labeled as “diet” or “reduced calorie” products. Some of these products, such as vitamins, are marketed specifically to children. Becoming aware of patterns of consumption of food additives such as aspartame, food colorings, and preservatives is a useful exercise for students who may need to selectively reduce their exposure if they have concerns about health effects possibly linked to diet.

RESOURCES:

Environmental Health Perspectives, Environews by Topic page, <http://ehp.niehs.nih.gov>. Choose Cancer, Food Safety and Regulation

Food Safety Risk Analysis Clearinghouse. Aspartame Risk Assessment Food Safety Analysis Exercise, <http://www.foodriskclearinghouse.umd.edu/powerpoint/PPT/aspartame/ppframe.htm>. An excellent PowerPoint presentation on calculations used to generate estimated daily intake, acceptable daily intake, and reference dose.

National Cancer Institute. Artificial Sweeteners and Cancer: Questions and Answers, <http://www.cancer.gov/cancertopics/factsheet/Risk/artificial-sweeteners>

The Safety of Aspartame [editorial]. *The New York Times*, 21 February 2006,

<http://www.nytimes.com/2006/02/21/opinion/21tues4.html?ex=1298178000&en=9f451174adaa957b&ei=5090&partner=rssuserland&emc=rss>

Wikipedia Online Encyclopedia—Aspartame, <http://en.wikipedia.org/wiki/Aspartame>

► Implementing the Lesson

INSTRUCTIONS:

1. Allow students to read the article in class.
2. Lead a brief discussion about the study. Highlight the study design and the new approach taken in this study, in particular a) the use of a wide variety of dosages to simulate human exposure patterns, b) the observation of the rats until their natural death, and c) the large number (1,800) of animals observed.
3. Lead a discussion about the meaning of this study in terms of what action should be taken. Are one study's results sufficient to require removal of aspartame from the market? Should the study be repeated by other scientists to confirm the validity of the results? What other evidence should be examined before making a decision about the adverse health risks of aspartame? Should a person use these results to take action in reducing their personal intake of aspartame?
4. Assign Steps 2–4 of the Student Instructions.
5. Allow 24–48 hours for data collection.
6. Review the results in a group discussion.
7. Ask students to revise (if necessary) their initial self-classification from Step 2. Ask students if they were surprised by the presence of aspartame in a product. If so, what was the product?

NOTES & HELPFUL HINTS:

- It can be difficult to assign students an inventory because they can (and may) simply say they “didn't find anything” and yet expect full points for the exercise. Structuring the inventory as a checklist makes students do the legwork of the exercise, even if they don't find any aspartame-containing products.
- A possible extension of this lesson would be a formal debate in which students take opposing sides on the statement: “Aspartame is a safe alternative sweetener.” There is extensive information supporting both sides available on the Internet, and this issue is sure to be in the news as the FDA faces increasing pressure to review its policy on aspartame.



- Another possible debate or research project could be to investigate the risk difference between eating sugar and the possibility of diabetes and eating aspartame and the potential risk of cancer. Is one risk higher than another? Is one more scientifically confirmed than another and should that influence decisions?

▶ Aligning with Standards

SKILLS USED OR DEVELOPED:

- Classification
- Communication (note-taking, oral, written—including summarization)
- Comprehension (listening, reading)
- Critical thinking and response
- Experimentation (conducting, data analysis, design)
- Research

SPECIFIC CONTENT ADDRESSED:

- Food additives
- Food safety
- Animal and human toxicity studies
- Controversy in science
- Environmental health
- Regulation of potentially harmful substances

NATIONAL SCIENCE EDUCATION STANDARDS MET:

Science Content Standards

Unifying Concepts and Processes Standard

- Systems, order, and organization
- Evidence, models, and explanation
- Change, constancy, and measurement
- Evolution and equilibrium
- Form and function

Science As Inquiry Standard

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Science in Personal and Social Perspectives Standard

- Personal and community health
- Environmental quality
- Natural and human-induced hazards

History and Nature of Science Standard

- Science as a human endeavor
- Nature of scientific knowledge

▶ Assessing the Lesson

- Step 1:** Students should exhibit an understanding of the article in class discussion, and of how scientific evidence is used to make decisions about health risks. They should make some connections with the severity of the indicated outcomes (i.e., cancer) and the widespread use of aspartame in American diets.
- Step 2:** Students' initial estimate/self-classification will allow them to compare themselves to other students and their families. They may need to discuss whether this estimate is based on a daily consumption pattern or a "has ever consumed" type classification. A daily consumption estimate is probably most valid here.
- Step 3:** Students should check products from each category listed and make some guesses about other possible categories present in their homes. Items should be listed as product and brand with some indication of how much is consumed daily or weekly. This measure should be consistent. If a product is consumed only by someone other than the student, this should be indicated in some way for each item.



- Step 4:** Students should indicate whether their initial self-classification was altered by the results of their log, and whether they would consider changing their behavior as a result of their findings. Students should again have a discussion of benchmarks, now with some basic data for the class and their households. They should make some guesses about who consumes the most aspartame and the potential health impacts of this trend, should aspartame be proven to be a health hazard. Students may comment on the need for the FDA to set new standards or review scientific evidence with more independent research. Students should write clearly and in complete sentences using logical arguments to explain their answer. You may consider encouraging students to rewrite any answers that are unclear or incomplete, giving them important practice in writing and effectively communicating their thoughts and ideas.
- Step 5:** A complete answer should discuss the class data. Is the amount of products containing aspartame similar across students or is there a lot of variability? A lot of variability may weaken the ability to make generalizations about teens' exposure to aspartame, while consistency or little variability makes it easier to generalize. When students discuss older or younger members of the families who use products with aspartame, they should point out that these people may be more vulnerable to potential toxic effects. The extent to which your students discuss this depends on their experience with environmental health. Students could point out that children, because of their small size, may receive higher doses compared to the adults. Also, since cancer can take 10-20 years to develop any carcinogenic effects from aspartame may show up in the "prime" years of life when children are exposed. Elderly people can be vulnerable because their bodies do not have as effective repair mechanisms.

► Authors and Reviewers

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Give us your feedback! Send comments about this lesson to ehpscienceed@niehs.nih.gov.



STUDENT INSTRUCTIONS: A Not-So-Sweet Sweetener?

- Step 1:** Read the article "Sour Finding on Popular Sweetener."
- Step 2:** Classify your own consumption of aspartame by estimating the number of products containing aspartame that you consume regularly: "None" (0), "Low" (1-5), "Medium" (6-10), or "High" (11+).
- Step 3:** Use the following checklist to track down at least 10 products that contain aspartame. Check for each category of products. List specific product information (including brand names and flavors), and indicate how much you (or someone in your household) consumes daily or weekly. If you classified yourself in Step 2 as consuming "None," and you find no aspartame-containing products in your home, use the shelves at your local grocery store for your hunt.

Instant Powdered Beverages []	Soft Drinks []	Juice Drinks []
Iced Tea []	Ice Cream/Desserts []	Jams/Jellies []
Puddings []	Candy/Chewing Gum []	Vitamins []
Toothpaste []	Mouthwash []	Powdered Sweetener []
Other: _____ []	Other: _____ []	Other: _____ []

- Step 4:** Given your reading about aspartame's possible health effects and your findings above, do you think you need to alter your pattern of aspartame consumption? Explain why or why not?
- Step 5:** Considering the class data, can you make any generalizations about teens' exposure to aspartame? Why or why not? Are there considerations for older and younger members of families who may be using products with aspartame?

