uBEATS Teacher's Guide:

Nitrates and Cancer

This teacher guide is a supplementary text to support the use of the uBEATS "Nitrates and Cancer" module for grades 9-12.

To help students develop the knowledge necessary for an incredible future in health care, we created UNMC Building Excellence in Academics Through STEM (uBEATS), an online health science resource for Nebraska students.

UNMC uBEATS modules are short (15 minutes or less), interactive online health science modules to supplement curriculum taught in grades 6 – 12. These do not replace curriculum, but they are a supplement for teachers and students incorporating evidence-based information and UNMC expert guided material. Each module is chunked into sections with formative and summative assessments with immediate feedback provided.

Tips on how to utilize uBEATS modules:

- Internet access is required to view uBEATS modules.
    - For those who have access to one-to-one technology, modules can be used in or outside of the classroom as a topic introduction, extension, or review. For classrooms without individual student devices, modules can be used in whole group instruction. Formative assessment questions can use the teacher's preferred call-and-response method and summative assessment questions can be displayed on the board and answered individually by students or printed and distributed to students after viewing the module.

Objectives

- Describe what nitrates are, and where they come from.
- Explain how nitrates can enter our water systems and affect our health.
- Summarize how to sample for nitrates and reduce nitrate levels in our surface waters.

Introduction

This module is about nitrates and how they can get into our water system. When nitrates are in our water, they may be a factor that makes it more likely for you to get cancer. So that might sound a little bit scary. Well, don't worry. As with most risk factors, knowledge is the key to keeping you and your family safe and healthy. Nitrates can harm human and animal health. In order to know how to prevent nitrate contamination of water (nitrate's presence in our environment), we must learn more about it.

Prior Knowledge

Before beginning this module, the teacher should understand the Next Generation Science Standards (NGSS) featuring Three-Dimensional Learning.

Dimension 3: Disciplinary Core Ideas—Life Sciences. A Framework for K-12 Science Education

LS4.D. Human beings are part of and depend on the natural world. Biodiversity—the multiplicity of genes, species, and ecosystems—provides humans with renewable resources, such as food, medicines, and clean water. Humans also benefit from “ecosystem services,” such as climate stabilization, decomposition of wastes, and pollination that are provided by healthy (i.e., diverse and resilient) ecosystems. The resources of biological communities can be used within sustainable limits, but in many cases humans affect these ecosystems in ways—including habitat destruction, pollution of air and water, overexploitation of resources, introduction of invasive species, and climate change—that prevent the sustainable use of resources and lead to ecosystem degradation, species extinction, and the loss of valuable ecosystem services.

National Academies of Sciences, Engineering, and Medicine. 2012. A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Washington, DC: The National Academies Press. https://doi.org/10.17226/13165.

Science and Engineering Practices NGSS

1. Asking questions (for science) and defining problems (for engineering)

6. Constructing explanations (for science) and designing solutions (for engineering)

8. Obtaining, evaluating, and communicating information

Crosscutting Concepts NGSS

2. Cause and effect

6. Structure and function

7. Stability and change

Key Terms/Vocabulary

Nitrates, carcinogens, toxins, fertilizer, atmosphere, elements, compounds, nitrogen, hydrogen, natural gas, contamination, surface runoff, nitrate transport, aquifer, groundwater, surface water, Environmental Protection Agency (EPA), regulatory limit, parts per million (ppm), ingestion, gastrointestinal system, circulatory system, nitric oxide, cellular functions, nitrites, amines, N-nitroso compounds (NOCs), municipal water system, private wells, professional inspector, continuous monitor, nitrate electrode, nitrate test kit, strip test, mitigation, ion exchange, reverse osmosis, electrodialysis, faucet filter, field buffer, filtration system.

Science Standards

2024 Nebraska College and Career Ready Science Standards **Nebraska Science Standards**

- SC.HSP.7.2. Gather, analyze, and communicate evidence of interdependent relationships in ecosystems.
- SC.HSP.17.1. Gather, analyze, and communicate evidence of the connection between health science careers and engineering.

National Consortium for Health Science Education **NCHSE**

- Foundation Standard 1: Academic Foundation
    - 1.2.1 Describe etiology, pathology, diagnosis, treatment, and prevention of common diseases and disorders, including, but not limited to, cancer.

Extensions of the lesson

To help students become more familiar with the Key Terms of this module, the teacher can use the vocabulary list for a classroom Word Wall or integrate the vocabulary into review sessions.

Encourage students to check current events for the latest news involving nitrogen fertilizer and cancer rates.

As student misconceptions become apparent, the teacher may need to reinforce these concepts:

- Nitrogen is the single most important, naturally occurring element in making sure that we can produce large amounts of food for the world's growing population.
- Nitrates are the main source of nitrogen for plants.
- While nitrates are essential in healthy farm fields, those same nitrates become harmful to humans when they contaminate our drinking water. This occurs by surface runoff and nitrate transport.

- Low levels of nitrates are produced in the body for normal cell function, but ingesting extra nitrates can cause cancer.
- All drinking water should be tested for nitrates, and nitrate mitigation methods can reduce the amounts of nitrates in the water.
- Inexpensive faucet filters do not remove nitrates, but successful reductions can be achieved by treatments such as ion exchange, reverse osmosis, and electrodialysis.

Enrichment

- Watch a 4-minute video about the Nitrogen Cycle.
- To learn more about nitrates in drinking water, see Drinking Water and Human Health.
- The **Iowa Environmental Council** provides more information in Nitrate in Drinking Water.
- The United States **Environmental Protection Agency (EPA)** discusses the problem in Sources and Solutions: Agriculture.
- **Nebraska Public Media** presented another view of the situation in Nebraska's nitrate problem is serious, experts say. Can we solve it?
- **WebMD.com** explains nitrates in Foods High in Nitrates.