## uBEATS Teacher's Guide:

# GMOs in Food

## (Grades 11-12)

This teacher guide is a supplementary text to support the use of the uBEATS GMOs in Food module for grades 11-12.

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 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 the benefits of genetically modified (GM) food crops.
- Explain the risks involved with genetically modified (GM) food crops.
- Discuss the impact of genetically modified food organisms on Earth's biodiversity.


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# Introduction

*How do science, engineering, and the technologies that result from them affect the ways in which people live? How do they affect the natural world?*

In this module, we will be discussing briefly the history of genetically modified organisms (GMOs) in addition to the benefits and risks of GMOs in food. In addition, you will learn about how GMOs allow for the preservation of biodiversity in Nebraska by allowing natural plant life to grow and flourish while limiting the usage of potentially harmful pesticides and herbicides.

# Prior Knowledge

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

**Core Idea** ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World. A Framework for K-12 Education

- All human activity draws on natural resources and has both short- and long-term consequences, positive as well as negative, for the health of both people and the natural environment. The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions.
- Thus technology use varies from region to region and over time. Technologies that are beneficial for a certain purpose may later be seen to have impacts (e.g., health-related, environmental) that were not foreseen. In such cases, new regulations on use or new technologies (to mitigate the impacts or eliminate them) may be required.

**Science and Engineering Practices** **NGSS**

- Analyzing and interpreting data
- Constructing explanations and designing solutions
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

**Crosscutting Concepts** **NGSS**

- Patterns
- Cause and effect

# Key Terms/Vocabulary

Genome, genetic modification, biodiversity, pesticide, insecticide, herbicide, agriculture, monoculture, crop yields, natural selection, artificial selection, protein synthesis, hybridization, CRISPR, editing technology, plant enhancement, bacteria, virus, lysogeny, phage, allergy, allergen, resistance, tolerance, antibiotic, vaccine, species barrier, coevolution.

# Science Standards

**Nebraska's College and Career Ready Standards for Science 2024** Nebraska Science Standards

Inheritance and Variation of Traits SC.HSP.9.4.B

- Ask questions to clarify relationships about the role of DNA and chromosomes in coding for instructions for characteristic traits passed from parents to offspring. (Corn, apple varieties, wheat, pesticide application)

Biological Evolution SC.HSP.10.5.E

- Evaluate evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
- Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.

Biological Evolution SC.HSP.10.5.F

- Develop and use models to illustrate patterns in the evolutionary history of biological diversity.
- Emphasis is on how the structure and function of bacteria, archaea, protists, fungi, plants, and animals are used in and are related in the tree of life.

# 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 classroom word games during review sessions.
- For a lab activity, see Genetically-Modified Foods.pdf.

- To help the students see personal relevance, suggest that they talk with their family about the food items in their home, identifying which are GMO, which are not GMO, and which are not labeled either way.

- The teacher may need to address student misconceptions by emphasizing these important concepts:
    - This controversial topic has passionate advocates on both sides of the GMO issue. From a scientific perspective, valuable research will continue to provide new data for years and decades to come. In the meantime, all stake-holders need to be aware as new discoveries are made. The decisions regarding GMO food can have powerful effects, both positive and negative.
    - The food supplies in our biosphere are dependent on plants and animals whose bodies are constructed by DNA. Just because we eat an organism with DNA in its tissue does not cause our own DNA to change. (For example, eating chicken does not make us grow wings or feathers.) Consuming food that has modified DNA poses no threat to our own DNA.
    - However, the way an organism's DNA builds that creature's body is by directing the construction of the proteins that compose the body. When we eat those proteins, there is no danger that they will change our own DNA; but there is always a real

danger that some of those new proteins might trigger an allergic reaction within us. We are already aware of many food allergies. When a new protein is created within an organism by genetic engineering, years of testing will reveal whether or not people are affected by that protein entering their digestive systems. This is not a blanket concern about GMO in general – each and every new protein in our food will need its own history of research.

- The multiple benefits of GMO crops are well-documented. People have been eating GMO foods for 20 years. Farmers have been able to increase yields, reduce energy usage, improve efficiency, lessen their dependence on agricultural chemicals, and enhance the nutrient content in the foods they grow.
- The ecological impact is more difficult to measure. For example, a new GM protein that acts as an insecticide might have a wide range of effects on multiple species that encounter the GMO plant in the fields.
- The actual success of the GMO organism carries with it an accompanying danger: the GMO strain can become so widely used that there is little genetic diversity within the species. Lack of diversity exposes an entire species to new threats that come along, whether they be biological or environmental threats.
- Although humans have been modifying the genes of their plants and animals for thousands of years, the changes have been slow and have given the environment time to adapt. Direct introduction of never-before-encountered traits is immediate. These new traits are also permanent when they are able to be passed on by reproduction.
- We can view it as “natural” when a virus such as chicken pox can cross the species barrier, but what is “unnatural” about engineering a new genome is that we are at the first point in history where humans have the power to control evolution. In other words, the effects of a virus can remain in a person until death, but the effects of a new genome can be carried forward into future generations.

# Enrichment

- For information about Healthcare Career Opportunities, see the UNMC Health Career Book.
- To make connections in your community, contact plant science programs at local universities, university extension services, local seed companies, agriculture organizations, breeders associations, local hospitals, healthcare clinics, nurses, doctors.
- Encourage students to check current events for the latest research involving glyphosate in the food chain.