uBEATS Teacher's Guide:

DNA to Protein

(Grades 9-10)

This teacher guide is a supplementary text to support the use of the uBEATS From DNA to Protein module for grades 9-10.

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

- Recognize the roles of DNA, RNA, and amino acids in the production of proteins.
- Identify a feedback signal as a positive (turns on a gene) or negative (turns off a gene).
- Report that proteins are responsible for the changes of molecules in our bodies and the development of specialized cells.

ubeats@unmc.edu

Introduction

How do the structures of organisms enable life's functions?

Like all living things, we are made up of cells. The more complex the organism the many more types of specialized cells it contains. In this module you will learn about the way DNA in each cell gets expressed differently to produce many different proteins throughout the body.

Prior Knowledge

Before beginning this module, the student should understand the Grade Band Endpoints for Core Idea LS1.B. A Framework for K-12 Science

- ***By the end of grade 2.*** Plants and animals have predictable characteristics at different stages of development. Plants and animals grow and change. Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive.
- ***By the end of grade 5.*** Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles that include being born (sprouting in plants), growing, developing into adults, reproducing, and eventually dying.

Key Terms/Vocabulary

Sexual reproduction, asexual reproduction, pollination, fertilizations, petals, sepals, stamen, anther, filament, pollen, nectar, carpal, pistil, stigma, style, ovary, ovule, gametes, egg cell, sperm cell, fruit, seed, dispersal, vegetative propagation, corms, tubers, stolons, nodes, rhizomes, buds, natural selection, artificial selection.

Science Standards

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

- Structure and Function in Living Things: SC.HS.6.1.A, HS.6.1.B, HS.6.1.C, HS.9.4.A

Next Generation Science Standards (NGSS) featuring Three-Dimensional Learning
Core Idea LS1.A Structure and Function A Framework for K-12 Science Education

- Systems of specialized cells within organisms help them perform the essential functions of life, which involve chemical reactions that take place between different types of molecules, such as water, proteins, carbohydrates, lipids, and nucleic acids.
- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.
- Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.
- Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.

Science and Engineering Practices NGSS

- Developing and using models
- Planning and carrying out investigations
- Constructing explanations and designing solutions
- Scientific investigations use a variety of methods

Crosscutting Concepts NGSS

- Scale, proportion, and quantity
- Systems and system models
- Energy and matter
- Structure and function
- Stability and change

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.
- To learn more about the pathway from DNA to protein, see the uBEATS module RNA.
- To learn more about differences in physical appearance, see the uBEATS module Gene Expression.
- To help the students see personal relevance, suggest that they examine the flowers that appear on the plants that grow in their home and/or around their property.
- The teacher may need to address student misconceptions by emphasizing these important concepts:
    - All of the cells in the body contain the exact same DNA, but the genes in the DNA get expressed differently depending on signals that turn them on or off.
    - Molecules vary in structure. One kind of molecule is protein. Another kind of molecule are nucleic acids (DNA and RNA).

- DNA stores the genetic code within the nucleus of the cell.
- Messenger RNA (mRNA) is the intermediary that carries the information out of the nucleus to the cytoplasm where the proteins are made.
- The cytoplasm contains amino acids from the food you eat.
- The amino acids are assembled into chains to construct proteins.
- Proteins are the workers of the cell that make changes to other molecules.

Enrichment

- For information about Healthcare Career Opportunities, see UNMC Health Career Book.
- To make connections in your community, contact local hospitals, healthcare clinics, zoo, nurses, doctors, veterinarians.
- To show the students their own DNA, conduct a cheek cell DNA extraction in the lab. There are many variations of this activity online. A very simple example is Extract Your DNA.