uBEATS Teacher's Guide:

DNA and Proteins

This teacher guide is a supplementary text to support the use of the uBEATS "DNA and Proteins" 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.

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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 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 LS3.A A Framework for K-12 Science

- In all organisms, the genetic instructions for forming species' characteristics are carried in the chromosomes. Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. DNA molecules contain four different kinds of building blocks, called nucleotides, linked together in a sequential chain. The sequence of nucleotides spells out the information in a gene. Before a cell divides, the DNA sequence of its chromosomes is replicated, and each daughter cell receives a copy. DNA controls the expression of proteins by being transcribed into a "messenger" RNA, which is translated in turn by the cellular machinery into a protein. In effect, proteins build an organism's identifiable traits.

Key Terms/Vocabulary

DNA, RNA, amino acids, proteins, genes, feedback signals (positive and negative), molecules, cells, specialized cells, nucleus, membrane, mitochondria, energy, template, replication, accuracy, DNA sequence, genetic code, biochemistry, construction proteins, tissue, organs.

Science Standards

Nebraska's College and Career Ready Standards for Science 2017 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 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
- Constructing explanations and designing solutions

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.
- The teacher may need to address student misconceptions by emphasizing these important concepts:
    - All 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 according to the information on the RNA 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, zoos, 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.
- 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.