uBEATS Teacher's Guide:

Human Genetics Introduction

(Grades 6-8)

This teacher guide is a supplementary text to support the use of the uBEATS "Human Genetics Introduction" module for grades 6-8.

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

- Examine the relationship between genes, chromosomes, and variations of distinct traits in humans.
- Explain the role mutations in genes have on proteins and the structure and function of different human traits.
- Use a model to describe variations of human inherited (caused by inherited chromosomes and genes) between parent and offspring.

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Introduction

Human Genetics is the science of what makes you unique. From the color of your hair to the shape of your nose, genetics plays a huge role in making you, you!

In this module you'll learn how your genes work as instructions to determine your traits, how changes in these instructions can lead to variations and mutations, and how these instructions are passed from generation to generation until they finally get to you!

Prior Knowledge

Before beginning this module, the student should understand the Grade Band Endpoints for Core Idea LS3.B. A Framework for K-12 Science Education

- ***By the end of grade 2.*** Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways.
- ***By the end of grade 5.*** Offspring acquire a mix of traits from their biological parents. Different organisms vary in how they look and function because they have different inherited information. In each kind of organism, there is variation in the traits themselves, and different kinds of organisms may have different versions of the trait.

Key Terms/Vocabulary

Gene, chromosome, trait, protein, structure, function, variation, inheritance, parent, offspring, codes, alleles, deoxyribonucleic acid (DNA), mutation, lactase persistence, sickle cell disease, cystic fibrosis, somatic cells, sex cells, sperm cells, egg cells, polygenetic, Punnett Squares, dominant, recessive.

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Science Standards

Nebraska's College and Career Ready Standards for Science 2017 Nebraska Science Standards

- Growth, Development, and Reproduction of Organisms: SC.6.9.3.C, SC.8.9.4.A

Next Generation Science Standards (NGSS) featuring Three-Dimensional Learning

Core Idea LS3.A: Inheritance of Traits A Framework for K-12 Education

- Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of a specific protein, which in turn affects the traits of the individual (e.g., human skin color results from the actions of proteins that control the production of the pigment melanin). Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits.

Core Idea LS3.B: Variation of Traits A Framework for K-12 Science Education

- In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other.

Science and Engineering Practices NGSS

- Developing and using models

Crosscutting Concepts NGSS

- Cause and effect

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 help the students see personal relevance, suggest that they have a **private** conversation with their parents to discuss family characteristics, such as facial traits, height, family history of diseases, etc.
- The teacher may need to address student misconceptions by emphasizing these important concepts:

- We can call genes “the building blocks of all living things,” but, the genes themselves are the instructions for putting the building blocks together.
- In sexually reproduced organisms, the offspring MUST be different from each of the parents, because the offspring carries a new combination of DNA from two different sources.
- Chromosomes carry coded instructions because chromosomes are made of long strands of DNA. Sections of DNA are the genes, which are the codes for building specific traits. Alleles are alternate forms of the same gene.
- Just because an individual has a particular allele for a gene does not mean that the allele will show up in their physical appearance.
- Because of mutation, sometimes the offspring has an allele that neither parent had. The new allele can be beneficial, neutral, or harmful.
- All humans are born with the ability to digest milk. As the person gets older, they can eat other foods and some people lose their ability to digest lactose, a sugar found in milk products. They become “lactose intolerant.” On the other hand, Lactase persistence is a trait which allows a person to continue producing lactase, the enzyme for digesting lactose. These people do not have problems with food containing lactose.
- Genes in the DNA of the chromosomes carry specific codes, but those codes must be transcribed by mRNA, which then delivers the message to the cell’s ribosomes where the code is translated into protein molecules that make the traits show up. This is called gene expression. Just because a particular gene is present in an organism’s cells does not mean that the code will become a trait.
- Environmental factors can also influence gene expression.
- Cells throughout the body (somatic cells) carry a double-set of chromosomes, one from each parent. However, the reproductive cells (sex cells) carry only one chromosome from each pair.
- Punnett Squares are tools for making predictions of what combinations of alleles are possible, but they do not predict what will happen.
- The relationship between “dominant” and “recessive” alleles is **not** about strength or domination. It is more about whether the dominant allele is present or not.
- Most body traits are polygenic, influenced by more than one pair of genes.

Enrichment

- For information about Healthcare Career Opportunities, see UNMC health careers guide.
- To make connections in your community, contact local hospitals, healthcare clinics, nurses, doctors.
- For classroom activities, search the Internet for examples of Punnett Square lessons.
- To learn more about the pathway from DNA code to visible physical traits, see the Ubeats Grade 9-10 module From DNA to Protein.
- To explore gene expressions, see the Ubeats Grade 9-10 module Gene Expression.