uBEATS Teacher's Guide:

Genetic Disorders

(Grades 11-12)

This teacher guide is a supplementary text to support the use of the uBEATS "Genetic Disorders" 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

- Identify what genetic disorders are.
- Distinguish among single-gene disorders, chromosomal disorders, and complex multi-gene disorders.
- Identify tests that can detect genetic disorders.
- Discuss options for treating genetic disorders.

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Introduction

This module will be taking you on a learning journey to explore genetic disorders, their causes and effects, as well as ways to treat, prevent or diagnose them. You will also be learning about diseases associated with each type of genetic disorder.

Prior Knowledge

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

Core Idea LS3.B. Variation of Traits

- ***By the end of grade 12***. The information passed from parents to offspring is coded in the DNA molecules that form the chromosomes. In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depend on both genetic and environmental factors. A Framework for K-12 Education.

Science and Engineering Practices NGSS

- Engaging in argument from evidence

Crosscutting Concepts NGSS

- Cause and effect

Key Terms/Vocabulary

Chromosome, gene, inherit, mutation, genetic disorder, DNA sequence, proteins, sickle cell anemia, cystic fibrosis, Punnett square, chromosome, coronary artery, obesity, diabetes, diagnosis, physical examination, CT scan, MRI, clinical testing, screening test, gene therapy, genetic counseling.

Science Standards

This module is related to the content of **UNMC High School Alliance: Introduction to Pathology and Microbiology**

Pathology is the study of disease processes. The field lays the foundation for all of clinical medicine and medical research. All diseases begin at the cellular level and changes in the structure and function of tissues ultimately lead to symptoms that health care providers see on a daily basis. This course will introduce students to medical terminology, normal histology and gross/microscopic pathology, allowing students to correlate the findings they see into basic clinical concepts.

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

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

- Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

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.
- As student misconceptions become apparent, the teacher may need to reinforce these important concepts:
  - Genetic disorders can be passed from generation to generation, but new mutations can also cause disorders that were not present in the parents' genes.
  - Chromosomes contain genes, which are made of DNA molecules that give instructions for the building of proteins that direct the structure and function of the body.
  - Some genetic disorders (such as Sickle Cell Anemia) are caused by a single defect in one gene. Other disorders (such as Down Syndrome) involve an entire chromosome and its long line of genes.
  - Because a person receives two copies of each gene (one from each parent) it is possible to show three different expressions of the disorder: affected by the disorder, not affected by the disorder, or unaffected but carrying the gene.
  - A Punnett square can be used to show probability of what might happen, but it can never be used to make actual predictions of what will happen.
  - The terms "dominant" and "recessive" are used by geneticists to describe probability of trait expression, but they are not descriptors of "strength" and "weakness."

- Some genetic disorders are neither single-gene, nor whole-chromosome in origin. These multiple-factor genetic disorders involve more than one gene, plus influences from environment, lifestyle, etc.
- Gene therapy modifies genes to prevent the disease symptoms from being expressed or to reduce the effects of the harmful gene.
- Genetic counseling assists people with genetic disorders to help them make informed decisions

Enrichment

- For information about Healthcare Career Opportunities, see UNMC's Careers in Healthcare
- Students should be watchful in current events for news regarding genetic abnormalities, genetic testing, and gene therapy.
- For a lab investigation involving genetic disorders, search the Internet for appropriate activities, such as NOVA's Risky Genetics.

To make connections in your community, contact local hospitals, healthcare clinics, nurses, doctors, medical laboratories