uBEATS Teacher's Guide:

Individualized Drug Therapy

(Grades 11-12)

This teacher guide is a supplementary text to support the use of the uBEATS "Individualized Drug Therapy" pharmacology 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

- Determine the factors that influence drug concentrations (factors like age, weight, gender, body composition, etc.).
- List different types of drug interactions and incompatibilities (drug-drug, drug-food, drug-herbal).
- Describe different applications of pharmacogenomics.
- Explain the basis of therapeutic drug monitoring.

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Introduction

Why is learning about Individualized Drug Therapy so important? As technology and advancements in medical care have developed, so too has the physician's way of approaching treatment. Instead of using a "one-size-fits-all" approach when it comes to prescribing drugs, Individualized Drug Therapy practices allow for a more personalized approach to patient care. By tailoring a treatment plan to a patient, medical providers are better able to meet the patient's specific needs.

Prior Knowledge

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

Core Idea PS1.B: Chemical Reactions A Framework for K-12 Science Education

- Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in total binding energy (i.e., the sum of all bond energies in the set of molecules) that are matched by changes in kinetic energy. In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. Chemical processes and properties of materials underlie many important biological and geophysical phenomena.

Science and Engineering Practices NGSS

- Constructing explanations and designing solution

Crosscutting Concepts NGSS

- Patterns
- Stability and change

Key Terms/Vocabulary

Personalized medicine, generalized medicine, drug concentration, drug interaction, drug incompatibility, body mass index (BMI), dosage, toxicity, drug compounding, apothecary, pharmacist, titration, metabolism, pathogenesis, pharmacodynamics, pharmacokinetics, pharmacogenetics, pharmacogenomics, genetic sequencing, tumor, chemotherapy, complications, genetic variant, breast cancer, leukemia, colon cancer, clinical depression, endocrine disorders, monogenic diabetes, GCK diabetes, insulin, sulphonyl urea, renal, prognosis, mutation, vascular, hyperglycemia, single nucleotide polymorphisms (SNPs), therapeutic drug monitoring.

Science Standards

Nebraska Science Standards

SC.HSP.6 Structure and Function: Anatomy & Physiology

- Gather, analyze, and communicate evidence of the relationship between the structures and physiological processes of the human body systems.

SC.HSP.3 Chemistry: Structure and Properties of Matter

- Evaluate a solution to a complex, real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

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 they have a **private** conversation at home regarding unique medical needs that "run in the family."
- As student misconceptions become apparent, the teacher may need to reinforce these important concepts:
    - Before the Industrial Revolution, medicine was highly personalized. Once mass production became commonplace, universal dosages were determined. More recent advances in technology have encouraged a return to more individualized medication.
    - Physicians now recognize that the patient's age, gender, weight, BMI (body mass index), diet, lifestyle, and other simple factors can affect the way a drug interacts in the body.
    - The stages of the disease itself, the mechanisms of the drug action, and the complexities of genetic coding within the patient also influence the effectiveness of the medicine and its dosing.
    - Genetic screening can be used to inform patients about lifestyle changes and risk-reduction behaviors that can help to prevent the need for medical intervention.
    - Some drugs have a "narrow therapeutic index." In such cases, the dosage and blood plasma concentration must be monitored closely to accomplish the desired therapeutic effect without causing toxic results.

Enrichment

- For information about career opportunities, see UNMC's Careers in Healthcare.
- For a brief 60-second explanation of the role of pharmacogenomics in individualizing drug therapy see Mayo Clinic Minute.
- For a 4-minute presentation by Explaining the Future, see Pharmacogenomics.
- Students should be watchful in current events for recent stories about personalized genetic testing.
- To make connections in your community, contact local universities, medical centers, clinics, drug manufacturers, and pharmacists.