uBEATS Teacher's Guide:

Pharmacology-Drug composition, properties, and functions.

(Grades 11-12)

This teacher guide is a supplementary text to support the use of the uBEATS "Pharmacology-Drug composition, properties, and functions" 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

- Distinguish between pharmacodynamics and pharmacokinetics.
- Explain the four main processes involved with interactions in the body: absorption, distribution, metabolism, excretion.
- Compare and contrast the different forms of drug administration.

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Introduction

What is Pharmacology?

Well, simply put, it is the study of drugs that integrates relevant information of all the medical sciences in order to effectively treat diseases through the use of drugs. When we use the word "drug", we are referring to any medication used for diagnosing, curing, or treating a disease.

Broadly speaking, pharmacology encompasses the entire study of drugs, but there are several major areas of focus within the field: pharmacodynamics, pharmacokinetics, pharmacotherapy, pharmacogenomics, and toxicology.

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

- Chemical processes, their rates, and whether 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. A Framework for K-12 Science Education

Science and Engineering Practices NGSS

- Constructing explanations and designing solution

Crosscutting Concepts NGSS

- Patterns
- Stability and change

Key Terms/Vocabulary

Drug, medication, pharmacodynamics, pharmacokinetics, curative, prophylactic, diagnostic, palliative, replacement, destructive, drug cycle, absorption, administration, enteral, parenteral, percutaneous, lipid solubility, pH, acid, base, distribution, metabolism, excretion, metabolites, gastrointestinal (GI), oral, rectal, NSAIDS, antibiotics, steroids, laxatives, analgesics, intradermal, intrathecal, intramuscular, intravenous, subcutaneous, narcotic, epinephrine, allergic, anaphylaxis, IV drip infusion, insulin, mucous membranes, inhalation, topical, transdermal, respiratory system, antiasthmatic, cream, ointment, nitroglycerin, estrogen.

Science Standards

This module is related to the content of UNMC High School Alliance: Introduction to Pharmacy Science and Practice.

The profession of pharmacy is quite diverse: from medicinal chemistry and the discovery of novel therapeutic agents to the monitoring of pharmacologic effects in humans. Thus, the purpose of this class is to demonstrate to the student the wide range of expertise needed within profession. Students will walk through the history of pharmaceuticals, how products are discovered and manufactured, and how to implement pharmacology into patient care. Finally, the students will discuss the future of medicine as seen with Personalized Medicine.

Nebraska's College and Career Ready Standards for Science 2017 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 that they reflect privately on the variety of ways medications have been administered to their own bodies.

- As student misconceptions become apparent, the teacher may need to reinforce these important concepts:
    - Throughout this module, the term “drug” refers to a chemical compound or preparation used as medication for diagnosing, curing, or treating a disease.
    - Pharmacodynamics studies how a drug affects an organism, while pharmacokinetics studies how the organism’s body affects the drug.
    - The first step of the drug cycle is absorption. This step refers to the movement of the drug from the site of administration until it enters the bloodstream.
    - The second step of the drug cycle is distribution. Once the drug enters the bloodstream it must be delivered to the appropriate site of need.
    - The third step of the drug cycle is metabolism. During this step the body acts on the drug and transforms it.
    - The final step of the drug cycle is excretion. After the drug has been delivered to the body and has been metabolized by the body, the remaining chemicals must be eliminated from the body.
    - The three basic ways to get a drug into the body are:
        - Place it inside the gastrointestinal tract. (Enteral)
        - Inject it through the skin barrier. (Parenteral)
        - Apply it to the surface of the skin. (Percutaneous)

Enrichment

- For information about career opportunities, see UNMC’s Careers in Healthcare.
- Students should be watchful in current events for recent stories about administration of illegal drugs.
- To make connections in your community, contact local universities, medical centers, clinics, drug manufacturers, and pharmacists.