uBEATS Teacher's Guide:

Pharmaceutical Compounding

(Grades 11-12)

This teacher guide is a supplementary text to support the use of the uBEATS "Pharmaceutical Compounding" 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

- Explain the differences between compounding and mass production of medication.
- List various dosing forms of medications: oral, intranasal, ophthalmic, otic, topical, injections, suppository.
- Identify factors that influence the administration of the different dosing forms: age, weight, gender, condition of patient, ease of administration, capsule size, etc.

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Introduction

Did you know that there are over 20,000 different prescription drugs and more than 80 classes of over-the-counter medications? And even though there are so many, there is always a time when none of them will work for a particular patient. This is when pharmaceutical compounding comes in. An entirely new drug can be made to fit the needs of an individual. So, let's see what our options are.

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 solutions

Crosscutting Concepts NGSS

- Patterns
- Stability and change

Key Terms/Vocabulary

Pharmaceutical compounding, mass production, topical, paste, oil, cream, lotion, ointment, foam, gel, powder, spray, suppository, rectum, vaginal canal, urethra, ophthalmic, drops, absorption, otic, outer ear, middle ear, inner ear, oral, tablet, capsule, chewable, lozenge, syrup, time-release, injection, invasive, intradermal, intravenous, subcutaneous, intramuscular, overdose, systemic circulation, intranasal, turbinates.

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.

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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 at home about whether their family uses any compounded medications.
- As student misconceptions become apparent, the teacher may need to reinforce these important concepts:
    - Medications do not have the same effects on everyone.
    - The most efficient way to synthesize FDA-approved drugs is by mass production. However, such drugs produced on an industrial scale sometimes are not able to be administered to certain patients. In order to meet the individual needs of a particular patient, a compounding pharmacy regulated by each individual state can combine, mix, or alter the ingredients of the medication in order to synthesize a form that will be effective for that patient.
    - To achieve the desired effect, a medication must be administered in a way that delivers the correct amount to the target organ.
    - There are many administration methods for delivering a drug. Each method has limitations that must be considered for the specific circumstances of the patient.

Enrichment

- For information about career opportunities, see UNMC's Careers in Healthcare.
- Students should be watchful in current events for recent stories about prescription medications.
- A quick commercial video (1:43) explains What is a Compounding Pharmacy?
- Identify the compounding pharmacies in your local area.
- To make connections in your community, contact local universities, medical centers, clinics, drug manufacturers, and pharmacists.