



## uBEATS Teacher's Guide:

# Chemical Processes

## (Grades 9-10)

This teacher guide is a supplementary text to support the use of the uBEATS Chemical Processes module for grades 9-10.

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.

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## Objectives

- Describe how the rearrangement of atoms during a chemical reaction involves changes in energy.
  - Give an example of conservation of atoms during a chemical reaction.
  - Discuss how the understanding of chemical processes influences the practice of pharmacy and medicine.
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## Introduction

What is a chemical?

When people think of chemicals, toxic substances like bleach and acid may come to mind. However, chemicals surround us and are part of our everyday lives. Chemicals are substances that are made up of atoms arranged in a certain way and held together by chemical bonds. Chemical reactions occur when these chemical bonds are broken and the atoms are arranged in new ways. For example, the food we eat can be broken into carbon compounds, one of the most simple being glucose, or  $C_6H_{12}O_6$ . When glucose reacts with oxygen ( $O_2$ ) in the cells, it produces carbon dioxide ( $CO_2$ ) and water ( $H_2O$ ).  $C_6H_{12}O_6$  plus 6 oxygen molecules produces 6 carbon dioxide molecules plus 6 water molecules plus energy. We use the energy to fuel out bodies' needs, and we breathe out the generated carbon dioxide as gas. Understanding how chemicals react with one another helps us to understand our bodies, medicine, nature, and the world around us. Learning chemistry can even save your life!

## Prior Knowledge

Before beginning this module, the student should understand the Grade Band Endpoints for **Core Idea PS1.B: Chemical Reactions** [A Framework for K-12 Science Education](#)

- **By the end of grade 8.** Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. The total number of each type of atom is conserved, and thus the mass does not change. Some chemical reactions release energy, others store energy.

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## Key Terms/Vocabulary

Chemical, atom, molecule, molecular bonds, energy, chemical reaction, conservation of atoms, conservation of mass, substances, properties, glucose, enzymes, ATP, metabolism, reactant, product, chemical change, aqueous, reactivity, catalyst, activation energy, proteins, combustion, decomposition, double replacement, single replacement, anion, cation, endothermic, exothermic, potential energy, kinetic energy, collision theory, reaction rate, Le Chatelier's Principle, equilibrium, pressure, concentration, temperature, hemoglobin, synthesis reaction, Haber-Bosch process, ammonia.

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## Science Standards

Nebraska's College and Career Ready Standards for Science 2024 [Nebraska Science Standards](#)

SC.HS.5 Chemical Reactions

Gather, analyze, and communicate evidence of chemical reactions

**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](#)

- Developing and using models

**Crosscutting Concepts** [NGSS](#)

- Patterns
- Energy and matter
- Stability and change

**National Health Science Standards (NCHSE)**

- 1.1.1. Describe the organization of the human body and directional terms.
  - a. Identify levels of organization.



b.

## 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 identify the kinds of atoms that are present in a medication (either prescribed or OTC) that they have taken. This information can be found in drug information sheets that accompany a purchase, or in an online search.
- As student misconceptions become apparent, the teacher may need to reinforce these important concepts:
  - All matter—including the human body-- is composed of atoms. Atoms combine to form molecules. Chemistry studies the bonds and energy in the molecules.
  - Molecules have specific properties.
  - Conservation of mass means that when the molecules in the reacting substances are changed into different substances, the number of each kind of atom present in the original substance is the same number as in the produced substances.
  - After a chemical reaction, the chemical properties of the new substances are different from the chemical properties of the original substances.
  - Endothermic reactions absorb energy from the surroundings, causing the area to feel cooler.
  - Exothermic reactions release energy into the surroundings, causing the area to warm up.
  - Using hydrogen peroxide as an antiseptic destroys the cell walls of bacteria. However, the chemical reaction also destroys healthy skin cells and is no longer recommended for cleaning wounds.
  - Hemoglobin reactions in the blood are reversible—depending on conditions of temperature, pressure, and relative concentration, hemoglobin has the ability to either take up oxygen or to release it.

## Enrichment

- For information about career opportunities, see UNMC's [Careers in Healthcare](#).
- Students should be watchful in current events for recent stories about side-effects of medications.
- Do an online search for classroom activities using hydrogen peroxide to study chemical reactions.
- To make connections in your community, contact local universities, medical centers, clinics, drug manufacturers, and pharmacists.