uBEATS Teacher's Guide:

Chemical Reactions

(Grades 6-8)

This teacher guide is a supplementary text to support the use of the uBEATS Chemical Reactions module for grades 6-8.

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

- Recognize that the new substances produced by a chemical reaction have different properties than the substance that reacted.
- Compare the mass of the reactants to the products in a chemical reaction.
- Discuss the differences in energy flow during different kinds of reactions.

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Introduction

How do chemicals interact with one another? How does one characterize and explain these reactions and make predictions about them?

Understanding chemicals starts with understanding atoms. Atoms are the microscopic material that makes up all matter in the universe. Think of them like the letters of the alphabet. Letters come together to form sentences, and sentences come together to form entire languages. Just like letters, atoms come together to form what are known as molecules, and molecules come together to make up the entire world around us. There are over 100 types of known atoms, each behaving in unique ways similar to the letters of the alphabet. Each letter makes a different sound. For example "A" makes a different sound than the letter "G." Atoms are also each unique. An oxygen atom will interact with other atoms differently than a hydrogen atom will. When differing types of atoms come together, molecules that are formed are held together by bonds. When atoms interact with each other, you get a chemical reaction. A chemical reaction is a process in which a reactant is converted to one or more substances known as products. Reactants are any chemical elements or compounds that actually take part in and undergo change during a chemical reaction. A product is any chemical element or compound formed as a result of the chemical reaction. It is important to note that both reactants and products can be either a single atom or a molecule.

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 2.*** Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible (e.g., melting and freezing), and sometimes they are not (e.g., baking a cake, burning fuel).
- ***By the end of grade 5.*** When two or more different substances are mixed, a new substance with different properties may be formed; such occurrences depend on the substances and the temperature. No matter what reaction or change in properties occurs, the total weight of the substances does not change.

Key Terms/Vocabulary

Chemical reaction, mass, reactant, product, combustion, carbon dioxide, water, acid, base, methane, oxygen, helium, natural gas, pH, solution, substance, energy flow, atom, molecule, element, compound, periodic table, carbon, hydrogen, chemical properties, physical properties, bonds, combination reaction, decomposition reaction, combustion reaction, single-displacement reaction, double-displacement reaction, neutralization reaction, hydrocarbon, photosynthesis, conservation, potential energy, kinetic energy, exothermic, endothermic.

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

- ***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.

Science and Engineering Practices NGSS

- Developing and using models

Crosscutting Concepts NGSS

- Patterns
- Energy and matter
- Stability and change

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:
    - The freezing of water is not a chemical reaction. Freezing is a physical process that seems to form a new substance, but ice is made of the same kinds of water molecules that were present in the liquid water. During a chemical reaction, however, the molecules in the products (entirely different substances) are different from the original reactants.
    - Tearing a sheet of paper into tiny pieces is not a chemical reaction, either. Even though the pile of pieces looks different from the original sheet, the physical properties of the paper have not changed. On the other hand, burning of the paper is a chemical reaction because it makes new substances (products) having new molecules.
    - Different kinds of chemical reactions take place, each involving the breaking and building of molecular bonds. During every kind of chemical reaction, the mass of the original substances (reactants) equals the total mass of the products.
    - As the chemical bonds are broken and new bonds formed, energy is also conserved. Some reactions (exothermic) release heat energy, while other reactions (endothermic) absorb energy. But in both cases, energy is neither being created nor destroyed—the total energy is still the same, but is changing forms.

Enrichment

- For information about career opportunities, see UNMC's Careers in Healthcare.
- Students should be watchful in current events for recent stories about chemical reactions.
- For a refresher on the historical understandings of atoms, watch the 12-minute presentation What is an Atom and How Do We Know?
- An excerpt (3:24) from NOVA: "Hunting the Elements" offers insights into What Makes an Element Reactive.
- PBS Learning Media offers a video about life-altering reactions: Six Chemical Reactions that Changed History.
- Do an online search for classroom activities. One example is a lesson about a tragic 1930 fire at the Homestake Gold Mine in South Dakota: Reaction Rate: Surface Area.
- To make connections in your community, contact local universities, medical centers, or school clubs affiliated with the American Chemical Society.