uBEATS Teacher's Guide:

Structure and Properties of the Periodic Table

(Grades 9-10)

This teacher guide is a supplementary text to support the use of the uBEATS "Structure and Properties of the Periodic Table" 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.

Objectives

- Describe the role of electrical charges among protons, neutrons, and electrons.
- Discuss the patterns that organize the elements into the periodic table.
- Recognize the importance of chemistry in the field of medicine.

Introduction

This module describes a fictional scenario involving a chemical researcher accidentally trapped in a laboratory room while discovering a cure for a deadly human disease. In order to escape the room and share her findings, she must apply her understanding of the periodic table of elements to answer specific questions that will unlock the door. Students using this module must join in the problem-solving strategies and answer those same questions.

The field of medicine depends heavily on the understanding and application of the relationships among particles of matter. Each drug is composed of protons, neutrons, and electrons that form atoms and molecules. The behavior of these particles determines how the drug interacts with other substances and with various organisms.

Prior Knowledge

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

Core Idea PS1.A: Structure and Properties of Matter A Framework for K-12 Science Education

- All substances are made from some 100 different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. Pure substances are made from a single type of atom or molecule; each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. In a liquid, the molecules are constantly in contact with each other; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and vibrate in position but do not change relative locations. Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.

Key Terms/Vocabulary

Matter, elements, atoms, nucleus, molecules, protons, neutrons, electrons, electrical charges, positive, negative, neutral, mass, atomic weight, families on the period table, electrical configuration, alkali metals, reactive, malleable, electrical conductor, valence electrons, valence electron shell, electron cloud, alkali earth metals, alkaline earth metals, cations, anions, transition metals, oxidation states, melting point, boiling point, electronegativity, metals, metalloids, gases, nonmetals, lanthanides, actinides, noble gases, octet rule, ionic bond, binding energy, chemistry.

Science Standards

Nebraska's College and Career Ready Standards for Science 2017 Nebraska Science Standards

SC.HS.3 Structure and Properties of Matter

- Gather, analyze, and communicate evidence of the structure, properties, and interactions of matter.

Next Generation Science Standards (NGSS) featuring Three-Dimensional Learning

Core Idea PS1.A: Structure and Properties of Matter A Framework for K-12 Science Education.

- Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.
- The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns.
- The repeating patterns of this table reflect patterns of outer electron states.
- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. Stable forms of matter are those in which the electric and magnetic field energy is minimized. A stable molecule has less energy, by an amount known as the binding energy, than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart.

Science and Engineering Practices NGSS

- Developing and using models

Crosscutting Concepts NGSS

- Patterns

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, encourage them to examine nutrition labels at home to identify some of the elements from the periodic table that are found in their food.

- As student misconceptions become apparent, the teacher may need to reinforce these important concepts:
    - The periodic table of elements identifies the 118 kinds of atoms currently known to exist, either in the natural world or synthesized in laboratories.
    - Every atom is made of protons, neutrons and electrons.
    - The protons (carrying a positive electrical charge) and neutrons (no electric charge) are found in the nucleus of the atom, while the negatively charged electrons orbit around the nucleus in the electron cloud.
    - Each element is identified by how many protons are present in the nucleus of its atoms.
    - The mass of each atom is approximately equivalent to the sum of the number of protons and neutrons present in the atom. Electrons are so tiny, compared to protons and neutrons, that their mass does not affect the calculation of atomic mass.
    - The electrons in the electron cloud are organized by "shells" at different distances from the nucleus. The Octet Rule states that the outermost shell tends to gain or lose electrons in order to have a "full" number of 8 valence electrons in the outer shell. This gain or loss of electrons is accomplished by transferring electrons to or from another atom.
    - Binding energy is the amount of electrical and magnetic energy that keeps a nucleus together. In order to break apart the protons and neutrons in an atomic nucleus, energy greater than the binding energy must be applied.

Enrichment

- For information about career opportunities, see UNMC's Careers in Healthcare.
- Students should be watchful in current events for recent stories about chemistry and medicine.
- The American Chemical Society describes a multitude of Periodic Table classroom activities on ACS ChemClub.
- To make connections in your community, contact local universities, medical centers, clinics, drug manufacturers, and pharmacists.