



## uBEATS Teacher's Guide:

# Structure and Properties of Matter

## (Grades 6-9)

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

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## Objectives

- Distinguish between physical and chemical properties of pure substances.
  - Describe the relative positions of particles within solids, liquids, and gases.
  - Explain how variations in temperature or pressure can cause states of matter to change.
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## Introduction

Atoms are the smallest units of matter. Molecules are composed of atoms; there are anywhere from two atoms to thousands of atoms in each molecule. Pure substances are made of only one kind of atom or molecule.

## Prior Knowledge

Before beginning this module, the student should understand the Grade Band Endpoints for **Core Idea PS1.A: Structure and Properties of Matter** [A Framework for K-12 Science Education](#)

- **By the end of grade 2.** Different kinds of matter exist (e.g., wood, metal, water), and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties (e.g., visual, aural, textural), by its uses, and by whether it occurs naturally or is manufactured. Different properties are suited to different purposes. A great variety of objects can be built up from a small set of pieces (e.g., blocks, construction sets). Objects or samples of a substance can be weighed, and their size can be described and measured.
- **By the end of grade 5.** Matter of any type can be subdivided into particles that are too small to see, but even then, the matter still exists and can be detected by other means (e.g., by weighing or by its effects on other objects). For example, a model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon; the effects of air on larger particles or objects (e.g., leaves in wind, dust suspended in air); and the appearance of visible scale water droplets in condensation, fog, and, by extension, also in clouds or the contrails of a jet. The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish (e.g., sugar in solution, evaporation in a closed container). Measurements of a variety of properties (e.g., hardness, reflectivity) can be used to identify materials.

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## Key Terms/Vocabulary

Matter, pure substances, physical properties, chemical properties, solids, liquids, gases, particles, temperature, pressure, fluidity, melting, solidification, evaporation, sublimation, condensation, deposition.

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## Science Standards

Nebraska's College and Career Ready Standards for Science 2017 [Nebraska Science Standards](#)

SC.7.3 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 -12 Science Education](#).

- **By the end of grade 8.** 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.

Science and Engineering Practices [NGSS](#)

- Developing and using models

Crosscutting Concepts [NGSS](#)

- Patterns
- Energy and matter
- Structure and function



## 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 with their family to compare and discuss the physical properties of the medications in their home. Are they solids, liquids, gases? What do they feel like, smell like, taste like, etc.?
- As student misconceptions become apparent, the teacher may need to reinforce these important concepts:
  - Pure substances are made of the same kinds of atoms. However, the arrangement of those atoms within the substances can result in different properties. For example, graphite is a pure substance made entirely of carbon atoms. Diamonds are also pure substances made entirely of the same carbon atoms. The arrangement of those carbon atoms in each of those pure substances creates different structures, so graphite and diamond have different physical properties even though they are both pure substances made of the same kinds of atoms.
  - Fluidity is the state of being able to flow. Liquids have fluidity; liquids are fluid.
  - “We can turn water into ice by applying tons of pressure.” However, the amount of pressure needed to squeeze water into ice is so great that we do not encounter this transformation in normal life. That’s why “hydraulic pressure” is used in many systems: if you squeeze the liquid in a hydraulic jack, instead of turning that liquid solid, it gets pushed into the system and can lift an automobile!
  - Increasing temperature can turn a solid into liquid, and then the liquid into gas. But a solid can turn into gas even without raising its temperature. Sublimation allows some of the solid’s molecules to escape (evaporate) without melting in between. That’s why ice cubes in your freezer slowly shrink over time. Likewise, water vapor can turn into solid frost crystals (deposition) without passing through a liquid stage in between.

## Enrichment

- For information about career opportunities, see UNMC’s [Careers in Healthcare](#).
- Students should be watchful in current events for recent stories about lake ice.
- Students should be watchful in current events for recent stories about freezing and melting.
- To explore changes in states of matter, search the Internet for classroom activities using dry ice.
- To make connections in your community, contact local public works street maintenance department to find out how your community treats icy roads to make them safer.

