

A. UNIT NAME: THE PROPERTIES OF MATTER NGSS 8-15

Content Area: **Science**
Course(s):
Time Period: **Trimester 1**
Length: **12 lessons**
Status: **Published**

Unit Overview

In this unit, students investigate some basic properties of matter and the use of these properties to distinguish one substance from another. Students examine physical properties and the characteristic properties of matter, such as: density; melting, freezing, and boiling points; evaporation, and condensation; changes in volume due to temperature; and solubility. These properties are then used to determine the identity of an unknown substance. This unit consists of both laboratory exercises and pointed reading selections.

This unit is mostly laboratory and project based. However, there are many important reading selections from both the STC and Pearson publications. The Pearson Interactive Science series listed in the bibliography is used mainly as a reinforcement for the lab activities and as an additional source of readings, vocabulary, and diagrams. In addition, many other sources of reading materials, videos, and other media are used to enhance the lesson, such as *National Geographic*, *Smithsonian Magazine*, *Science Scope* (NSTA), *BrainPop*, *YouTube*, *Science Illustrated*, and other relevant books and current events.

This unit will be learned in the first trimester.

Essential Questions

- What is matter?
- What are some characteristics of matter?
- How do types of matter differ in respect to their molecular make-up?
- What is the difference between Mass and Weight?
- How does gravity affect weight?
- What is density, and how is it affected by temperature, volume, and mass?
- What is the difference between chemical and physical properties of matter?
- What are the Four States of matter?
- How does a substance change from one state to another?
- What happens to the molecular structure of a substance as it changes from one state to another?
- Are there substances that can change from a solid directly to a gas without first becoming a liquid?

Content

- All matter has mass, regardless of its size.
- Mass is a measure of the amount of matter in an object.
- Gravity affects weight: weight is a measure of the gravitational “pull” on an object. Weight will vary

depending on location in the universe.

- Physical properties of matter, including state of matter, malleability, ductility, electrical conductivity, thermal conductivity, solubility, density.
- Formula and calculation of density of objects, both regular and irregular shapes.
- Formula and calculation of volume of objects, both regular and irregular shapes
- Chemical properties of matter, including chemical reactivity.
- The importance between understanding the relationship between the chemical and physical properties of a substance.
- Physical changes describe changes to a substance that can be undone: no chemical reaction has taken place; chemical bonds have not been rearranged during physical changes.
- Chemical changes indicate a chemical reaction has taken place, and cannot be undone without an additional chemical reactions taking place.
- Chemical reactions occur because of a rearrangement of bonds within or between substances.
- Chemical reactions can be detected by a change in color or smell, bubbling, formation of heat, smoke, flame, sound, and/or light
- Matter can exist in one of four states: liquid, solid, gas, plasma.
- State of matter depends on the temperature of the substance or object.
- Boiling point, freezing point, and melting points are different for every substance, and are related to state of matter, as well as the amount of energy within the molecules of an object.
- Most substances will change from a solid to a liquid (melting), and from a liquid to a gas (vaporization) as their particles gain energy. Some substances will change state directly from a solid to a gas as their particles gain energy (sublimation).
- Most substances will change from a gas to a liquid (condensation), and from a liquid to a solid (freezing) as their particles lose energy.
- The temperature of a substance will determine the arrangement and proximity of the particles of the substance to one another.
- Solids do not change shape or volume when placed in another container.
- Liquids will change shape, but not volume if placed in a different container.
- Gases will change both volume and shape, depending the container of which it is inside.
- Boyle's Law and Charles's Law describes the relationship between temperature, pressure, and volume of a gas.

Skills

- Measure the mass and volume of several objects to determine the density of an object.
- Determine whether a change is a physical or chemical change based on indicators
- Indicate the physical properties of an object, such as malleability, ductility, electrical conductivity, thermal conductivity, solubility, density.
 - Measure the volume and density of regular and irregularly shaped objects
 - Identify the relationship between mass, volume, and density
 - Determine relative density of objects based on their positions within a container after being allowed to settle.
 - Predict a the volume and pressure and temperature of a gas using Boyle's and Charles' mathematical equations

- Identify whether a substance is a solid, liquid, gas, or plasma based on the arrangement and movement of its particles
- Define: evaporation, melting, boiling, freezing, sublimation

Assessments

The majority of this unit is an inquiry-based hands-on approach to learning. It consists of laboratory activities which vary in their intensity, approach, skill, and evaluative measurements. For example, some of the lab activities are “walk-through” labs, where the student is guided through a procedure and a process, and is asked to make connections among the main concepts presented in the activity and associated readings. Other lab activities consist of a problem that is presented to the student, which he or she must solve by designing an experiment (which is then peer and teacher evaluated before proceeding with the lab activity) and collecting data. Regardless of the lab activity, students are evaluated based on the quality and presentation of the collected data in graphic organizers; the efficacy and accuracy of the experimental design; the connections made between the experimental design, the data collected, and the conclusion of the laboratory report- i.e. “tying it all together to see the big picture”; and lab etiquette and adherence to safety rules.

Other evidence for learning includes several short 5-10 question quizzes, and end-of-unit lab practical (hands-on) test, end-of-unit paper test based on the labs, and several creative projects, which may include posters, skits, songs and poems, presentations, and science fair projects (Science Fair projects span several units and may not be completed within any one single unit presented within Folsom School’s Science Curriculum).

Standards

NGSS Standard Correlation

MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures. [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] *[Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete description of all individual atoms in a complex molecule or extended structure is not required.]*

MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] *[Assessment boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]*

MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] *[Assessment Boundary: Assessment is limited to qualitative*

information.]

MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]

MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [*Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.*]

MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.* [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [*Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.*]

Resources

Smithsonian Institution, 2012. *Science and Technology Concepts- Secondary: Exploring the Properties of Matter*. (Smith- Developer of module).

Pearson 2011. *Interactive Science: Introduction to Chemistry*. Upper Saddle River, NJ