

## UNIT OVERVIEW

### CHEMISTRY OF MATERIALS

**Unit Issue:** Properties of materials determine their uses and effect on the environment.

**Anchoring Phenomenon:** Different materials are used for different purposes.

Listed below is a summary of the activities in this unit. Note that the total teaching time is listed as 19–24 periods of approximately 45–50 minutes (approximately 4–5 weeks). There are no suggested activities to skip in this unit as skipping an activity in this case would mean losing key NGSS elements of the unit, e.g. the opportunity to practice elements of the PE prior to the activity that assesses it.

Activity Description	Topics	Advance Preparation	Assessment	Teaching Periods
<p>1. <b>Talking It Over: Exploring Materials</b> Students brainstorm and discuss what they know about the properties of aluminum, glass, and plastic as materials for producing single-use drink containers. They discuss their current understanding of the advantages and disadvantages of each material and develop a list of questions needed to decide which is better for single-use drink containers. They then examine four graphs of data on the materials to help inform their choice.</p>	<p>Chemical and physical properties, usefulness of materials, health and environmental impacts of materials</p> <p>LITERACY</p>	<p>Collect sample glass, aluminum, and plastic drink containers to show class.</p>	<p>E&amp;T A2 OEC QUICK CHECK A2</p>	1
<p>2. <b>Laboratory: Investigating Elements</b> Students investigate the physical properties of a set of elements. They investigate physical properties including appearance, malleability, density, and solubility in water at room temperature. They are introduced to the concept that each element is composed of a specific type of atom.</p>	<p>Elements, chemical and physical properties, atomic nature of elements</p>	<p>Prepare Student Sheet.</p>		1–2
<p>3. <b>Laboratory: Physical and Chemical Properties of Materials</b> Students explore the properties of several materials, including compounds and elements. They look at density relative to water, solubility in water, and reactivity. They then analyze data on melting point, boiling point, and flammability.</p>	<p>Chemical and physical properties</p>	<p>Set up demonstration; prepare containers of sodium chloride; prepare Student Sheet.</p>		2
<p>4. <b>Laboratory: Determining Density</b> Students determine the volume and mass of six samples—aluminum, glass, and four types of plastics—and then calculate the density for each object. Based on their calculations, they predict if the objects will sink or float in water and then test their predictions.</p>	<p>Mass, volume, density, physical properties</p>	<p>Choose appropriate materials for demonstration; prepare Student Sheet.</p>	<p>QUICK CHECK A1</p>	1–2

## CHEMISTRY OF MATERIALS (continued)

Activity Description	Topics	Advance Preparation	Assessment	Teaching Periods
<p><b>5. Talking It Over: Evaluating Properties of Materials</b> Students gather information from text and visual resources on aluminum, glass, and plastic. They evaluate the sources of information for point of view and bias, and use the information to inform a debate about which material is the best choice for a reusable drink container.</p>	Chemical and physical properties SENSEMAKING	Prepare Student Sheets.	OEC QUICK CHECK Proc 2-4	2
<p><b>6. Modeling: Modeling Molecules</b> Students begin to explore the organization of atoms and molecules as they use models to investigate atoms, elements, chemical bonds, molecules, and compounds.</p>	Atoms, molecules, elements, chemical bonds, compounds		MOD QUICK CHECK A6	2
<p><b>7. Reading: Structure and Properties of Materials</b> Students integrate information from text and diagrammatic models describing the structures of a variety of substances and relating these structures to the properties of the substances. They organize information about the various structures that are made of individual atoms, molecules, or extended structures.</p>	Atoms, molecules, elements, chemical bonds, compounds, extended structures LITERACY	Prepare models; prepare Student Sheet.	MOD QUICK CHECK A4 MOD A5	2
<p><b>8. Talking It Over: What's in a State?</b> Student groups discuss the three states of matter and characteristics of each. Students examine syringes filled with materials in each state and predict and test whether they can compress the substances. Students then use a simulation to investigate the particles in each substance—how they move and how they interact with each other. Throughout the activity, students draw and revise models of the particles in each state.</p>	States, state changes SENSEMAKING	Prepare the syringes; preview the simulation; prepare Student Sheet.	MOD QUICK CHECK Proc 8	1-2
<p><b>9. Laboratory: Energy and Particle Movement</b> Students investigate the effect of temperature on gas particles through two different investigations. In the first investigation, they observe what happens to a soap film when the container is submerged in hot or ice water. In the second investigation, they observe what happens to air and water inside of a syringe that is submerged in hot, room temperature, or ice water.</p>	State changes, kinetic energy, thermal energy, particle movement	Prepare plastic cup of dish soap and source of hot and ice water; prepare Student Sheet.	MOD QUICK CHECK A3	1-2

## CHEMISTRY OF MATERIALS (continued)

Activity Description	Topics	Advance Preparation	Assessment	Teaching Periods
<p>10. <b>Laboratory: Modeling State Changes</b> Students record the temperature of water over time as they freeze it. They then record the temperature over time as the ice melts. Students graph their data to produce curves that show the freezing and melting temperatures of water.</p>	State changes, pressure, temperature, kinetic energy, thermal energy, particle movement	Prepare Student Sheet.	MOD A3 (Assessment of PE MS-PS1-4)	1–2
<p>11. <b>Laboratory: Making Polymers</b> Having previously investigated properties of two plastics, students cross-link polyvinyl alcohol (PVA) with sodium borate to produce a third polymer similar to the one known commercially as slime. Students are introduced to synthetic chemistry and chemical change as they compare the properties of the starting substances and the product they developed through a chemical cross-linking reaction.</p>	Plastics, polymers	Gather pieces from molecular model set; prepare warm soapy water.	ODA Proc 1 OEC QUICK CHECK Proc 11 & 12	2
<p>12. <b>Modeling: Modeling Polymers</b> Students construct models to study the structure of polymers. Manipulating the models helps them understand how the physical properties of a polymer result from its extended structure. In a second type of model, the class acts as a polymer, with student pairs representing monomers. Students identify the strengths and weaknesses of the models to represent polymers and cross-linking.</p>	Plastics, polymers, chemical and physical properties SENSEMAKING	Prepare Student Sheet.	MOD A3 (Assessment of PE MS-PS1-1)	1
<p>13. <b>Talking It Over: The Impact of Plastics on Society</b> Students gather information from provided text and diagrams to determine the resources used to manufacture a set of four polymers (Teflon, Kevlar, compostable polymers, and polyester), their properties, and their impacts on the environment. Students use this information to assess the benefits and trade-offs of plastics in modern society.</p>	Monomers, polymers, cross-linked polymers, chemical and physical properties, usefulness of materials, health and environmental impacts of materials SENSEMAKING	Prepare room signs for Walking Debate; prepare Student Sheet.	E&T A2 (Assessment of PE MS-PS1-3)	2