

UNIT OVERVIEW

All things on Earth consist of matter. Although scientists have identified five states of matter, the most common are solids, liquids, and gases. The Solids, Liquids, and Gases unit is designed to provide students with information and experiences related to these three states of matter. The unit addresses how matter can change from one state to another. Matter in each state has identifiable properties. The unit also explains that when matter combines, a mixture may form. The components of that mixture may retain their individual properties when combined, or the mixture may have new properties.

Certain reading resources are provided at three reading levels within the unit to support differentiated instruction. Other resources are provided as a set, with different titles offered at each reading level. Dots on student resources indicate the reading level as follows:

- low reading level
- middle reading level
- high reading level

THE BIG IDEA

We all see, taste, smell, manipulate, and breathe matter every day, in all aspects of our environment. Since all things on Earth, natural and human-made, consist of atoms in different arrangements, matter exists in many forms. We have so many different things all around us because matter can be found in various states, and it combines with other matter in many ways.

When we prepare a meal, mix soil for a garden, put fluids in our cars, or choose paint for our walls, it is useful to understand how materials may change when combined or when subjected to changes in temperature. This knowledge can keep us safe by preventing accidents and poisonings. Combining matter has led to the development of medicines that help us when we are ill, fuels to power our vehicles, recipes that nourish us, and much, much more.

Other topics

This unit also addresses topics such as: the processes of melting, freezing, condensation, and evaporation; hot-air balloons; solids that behave like liquids; and state changes in lava.

SPARK

The spark is designed to get students thinking about the unit's topics and to generate curiosity and discussion.

Materials

- various solids, liquids, and gases (for example, sand, cotton, wooden block, gravel, peanut butter, juice, soda, empty water bottle, full water bottle, bicycle pump, tetherball)
- empty containers of various shapes and sizes



Activity

Place students in pairs or small groups. Ask them to look carefully at each type of matter. They may also pour items into an empty container to see the shape each one takes. Encourage students to observe the items closely and identify each one as a solid, liquid, or gas. Ask students to share and defend their decisions with the class.

Below are questions to spark discussion.

How did you decide whether to classify an object as a solid, liquid, or gas?

Were any objects a combination of solids, liquids, and/or gases?

What do all the solids have in common?

What do all the liquids have in common?

What do all the gases have in common?

Why do you think some items changed their shape when you put them into the containers and other items kept their shape?

Many of the unit's vocabulary terms are related to the spark activity and can be introduced during the spark. For vocabulary work, see the Vocabulary section in this [Unit Guide](#).

PRIOR KNOWLEDGE

Ask students to suggest some ways they might classify different objects (such as by size, shape, color, weight, natural vs. human-made, durability, buoyancy, flammability, or texture). For each method they share, propose some sample items and ask students how they would classify each one using this method. Then explain that one important way to classify objects is by their state of matter. Explain to students that they will be learning about the three main states of matter. They will also explore how things can change and combine with each other.



Probing Questions to Think About

Use the following questions to have students begin thinking of what they know about matter.

- What are some different types of matter you have at home?
- Think about your most recent meal. What types of matter did you eat?
- How does a block of ice change from a solid to a liquid?

- Why does a puddle of water disappear or dry up?
- Why does a window get foggy when you breathe on it on a cold day but not on a warm day?
- What happens when you add coins to a jar of marbles and shake it up?
- What happens when you stir chocolate powder into a glass of milk?
- What happens when you stir salt into a pot of hot water?

Tell students they will learn more about these topics soon.

UNIT MATERIALS

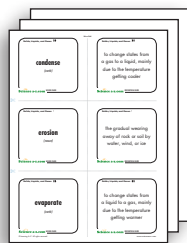
Each unit provides a wide variety of resources related to the unit topic. Students may read books and other passages, work in groups to complete hands-on experiments and investigations, discuss science ideas as a class, watch videos, complete writing tasks, and take assessments.

Resources are available for printing or projecting, and many student resources are also available for students to access digitally on [Kids A-Z](#).

Selected unit resources are available in more than one language.

For a complete list of materials provided with the unit, see the Solids, Liquids, and Gases unit page on the Science A–Z website.

VOCABULARY



Use the terms below for vocabulary development throughout the unit. They can be found in boldface in the *Nonfiction Book*, the *Quick Reads*, and/or other unit resources. These terms and definitions are available on *Vocabulary Cards* for student practice. Additional vocabulary lists are provided in the teaching tips for *Investigation Packs* and *FOCUS Books*.

Core Science Terms

These terms are crucial to understanding the unit.

condense	to change states from a gas to a liquid, mainly due to the temperature getting cooler
evaporate	to change states from a liquid to a gas, mainly due to the temperature getting warmer
gas	matter that can freely change shape and size; often it can't be seen
liquid	matter that keeps its size but takes the shape of its container
matter	anything that takes up space and has weight
mixture	a combination of substances in which a chemical reaction does not occur
physical change	a change in the size, shape, or color of a substance that does not change it into a different substance

property	a feature or quality that can be used to describe something
solid	matter that keeps its shape and size
solution	a mixture in which one substance is spread evenly through another substance, such as a solid dissolving in a liquid and becoming invisible
state of matter	the solid, liquid, or gaseous condition of a substance
substance	a particular kind of material
temperature	the measure of how hot or cold something is
water vapor	the state of water in which it is an invisible gas

Other Key Science Terms

The following vocabulary is not essential for comprehending the unit but may enrich students' vocabulary.

erosion	the gradual wearing away of rock or soil by water, wind, or ice
freeze	to change states from a liquid to a solid, mainly due to the temperature getting colder
lava	melted, liquid rock that reaches Earth's surface
magma	melted, liquid rock beneath Earth's surface
melt	to change states from a solid to a liquid, mainly due to the temperature getting warmer
pressure	physical force placed on an object
sand	tiny, loose grains worn away from rocks, shells, and other materials
shape	how something looks around the outside
size	how big or small something is
surface	the outside or uppermost part of a thing

Vocabulary Activities

You may choose to introduce all the terms that will be encountered in the unit before assigning any of the reading components. *Vocabulary Cards* with the key science terms and definitions are provided. Dots on the cards indicate the reading levels of the *Nonfiction Book* or the *Quick Reads* in which each term can be found. If all level dots appear, the term may come from another resource in the unit. Students can use these cards to review and practice the terms in small groups or pairs. The cards can also be used for center activity games such as Concentration.



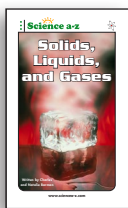
The *Word Work* activity sheets offer fun puzzles and practice with key vocabulary terms from the unit. For further vocabulary practice and reinforcement, you can choose from the vocabulary *Graphic Organizers*. To build customized vocabulary lessons with terms related to the topic, see *Vocabulary A-Z*.

Students can use the *Word Smart* vocabulary *Graphic Organizer* to organize information on the science terms. You may want to assign each student one to three words to share his or her *Word Smart* knowledge with classmates. Students who have the same word should first compare their *Word Smart* sheets with each other and then report to the larger group.

The science terms can be used in oral practice. Have students use each term in a spoken sentence.

As students read, encourage them to create a science dictionary by recording new vocabulary terms and definitions in their *SAZ Journal*.

BACKGROUND AND MISCONCEPTIONS



Use this section as a resource for more background knowledge on unit content and to clarify the content for students if misconceptions arise. Refer to Using the Internet below for more ways to extend the learning.

Q: *Does matter mean the same thing in science as it does when I ask, "What is the matter?" or say, "It doesn't matter" to someone?*

A: What a difference a little article can make! No, the word *matter* is used in everyday conversations, and children understand it to mean that something is wrong or something is important. But in science, the word *matter* refers to any physical substance or material that takes up space. Discuss the different meanings of the term with students.

Q: *Are there more than three states of matter? If so, what other kinds are there?*

A: Most scientists classify matter into five states: solid, liquid, gas, plasma, and Bose-Einstein condensate. The substances that students will encounter most on a daily basis are solids, liquids, gases, and combinations of these three. However, plasma is present at all times. All stars are made up of plasma, and it occurs during lightning flashes as well. Common uses of plasma include fluorescent lamps and neon signs. On the other hand, a Bose-Einstein condensate is a state of matter that doesn't exist naturally in our environment and occurs at temperatures nearing absolute zero.

Q: *Does a substance change into a different substance (chemical change) when it melts, freezes, evaporates, or condenses?*

A: No. State changes are physical changes, which means that the chemical makeup is still the same, even though the substances may look different (for example, solid butter versus melted butter). This unit focuses primarily on physical changes. But chemical changes are important to introduce once students have learned about states of matter and physical changes.

Q: *Do the terms melting and dissolving mean the same thing?*

A: No. Children often experience different types of candy getting sticky or gooey in their hand or mouth. Sometimes the candy *melts* because of the heat of their hand (for example, chocolate), and sometimes the candy *dissolves* due to moisture on their hand (for example, hard candy). Both terms describe a type of physical change, but the former is caused by heat, and the latter is caused by moisture. A solid substance melts into a liquid when the substance's temperature is raised to its melting point (the temperature at which the bonding forces cannot hold the molecules in a rigid pattern, so they begin to flow). Dissolving a solid in a liquid is a process that can occur at any temperature as long as the liquid remains a liquid and as long as the solid is soluble in the liquid (for example, sugar in water). But not all solids dissolve in all liquids (for example, fats are not soluble in water).

Q: *Why does butter melt in a metal pan, but the metal pan doesn't melt on the stove?*

A: Solid objects are not all made of the same type of atoms and molecules. Each type of atom and molecule has a different temperature at which it changes from a solid to a liquid. In the case of butter, it changes state at a temperature that can be created by the stove. The metal pan, on the other hand, requires a much higher temperature to change state—a temperature that is usually too high to create on a common stove.

Q: *When I drink a cold can of soda, I often see liquid on the outside of the can. Also, when I breathe on a cold window, it gets foggy and wet. Where does all that liquid come from?*

A: Many people believe that moisture passes through the walls of the can, but this is not true. The air around us contains water vapor, the gaseous state of water. If a soda can is colder than the air around it, the water vapor in the air comes into contact with the can and condenses into liquid water, forming water droplets on the can. Similarly, when the outside air is cold and we exhale onto a window, it gets foggy. This happens because the cold temperature of the glass causes the water vapor in our breath to condense into liquid water. The moisture on the glass fades quickly, however, when the warmth in our home or car causes the droplets to evaporate into water vapor once more.

Q: Does it have to be hot for water to evaporate? Fish tanks are not hot, and my pool's water level drops, even in winter.

A: Heat energy does increase the rate at which water evaporates. However, water at cooler temperatures will also evaporate, although it will take longer for the evaporation to occur.

Q: How can I tell whether something has gone through a physical change or a chemical change?

A: In simplest terms, if the materials that have been mixed retain their own properties, a physical change has occurred. If the combination of materials forms something new and takes on new properties, a chemical change has occurred. One way students might decide whether an item has undergone a physical or chemical change is to ask, "Can I easily identify the materials that make up this item?" If the answer is no, a chemical change most likely took place.

Q: Can all liquids mix with all other liquids? What about solids and gases?

A: Many liquids do mix with other liquids to form new substances. Such is true for milk and chocolate syrup, for example. But some liquids, such as oil and vinegar, do not mix when poured into one container; they stay separate and retain their own properties. Many gases also mix with one another fairly easily. When exhaust is released from a car, it quickly mixes with the surrounding air, as does the helium from a balloon that pops. But solids do not mix as easily with one another to create a new substance. Solids often have to be melted into liquids, combined, and then cooled back into a solid to blend together. This is the case with the brass (an alloy of copper and zinc) in a musical instrument and the steel (an alloy of iron and carbon, primarily) in a building's frame. Many solids, such as wood and rock, can only be mixed physically.

EXTENSION ACTIVITIES



Using the Internet

Most search engines will yield many results when a term such as *solid*, *liquid*, or *gas* is entered individually, but these results may not all be related to the unit's content. You can search for information on a known substance or mixture, such as salt water or chocolate. Be aware that some sites may not be educational or intended for the elementary classroom. More specific inquiries are recommended, such as:

- solids, liquids, and gases
- chemistry for kids
- water cycle model/diagram
- melting point of _____
- mixtures, solutions, and suspensions
- condensation and evaporation
- saturation and concentration
- boiling point of _____



Projects and Activities

- **Arts:** Have students create a storyboard or comic strip about water that illustrates what happens to water when it is boiling, freezing, and at room temperature.
- **Arts:** Have pairs or small groups of students brainstorm examples of how mixing materials can be dangerous. Then invite students to design and display posters cautioning others to avoid potential dangers that can result from mixing the wrong things together.
- **Guests:** Invite professionals who rely on mixing or separating materials in various states of matter to discuss their work with the class. Examples might include a chemist, pharmacist, baker, mining engineer, or waste-management worker.
- **Field Trip:** Bring students to a factory or other location to help them learn how various materials are combined to produce something new.
- **Project/Inquiry Science:** Provide students with two identical transparent containers (such as glass or plastic jars or bowls). Have them fill both containers with the same volume of water and mark the starting water level. Help students cover one container with transparent plastic wrap and place a small weight (such as a marble or pebble) in the center. The small weight will create a dip in the center of the wrap where evaporated water can collect on its underside. Students should leave the other container uncovered. Have them mark daily changes in the water levels for one week. Changes in the water level will indicate that water is evaporating, or changing from a liquid to a gas (water vapor). Condensation and precipitation may also be observed as water droplets form on the underside of the plastic wrap and drip back into the standing water.
- **Project/Home Connection:** Ask students to make a list of different types of matter they consumed for dinner. Ask them to identify the state of matter of each food and drink. They might determine the kinds of mixtures that were present in their dinner. They can also identify the types and states of matter found in the dishes, utensils, glasses, and napkins they used during the meal. Invite students to share their results with the class in a visually appealing way.
- **Research/Home Connection:** Students can conduct research as a family/home project or in the library/media center to extend the learning about a topic in one of the *Quick Reads* or other unit resources.

