

UNIT OVERVIEW

Everything is made of matter. Some things are made of just one kind of matter, but most everyday items are made of a mixture of materials. The Mixing Matter unit provides a solid foundation for introducing the principles of chemistry. It allows students to explore what makes up each kind of matter as well as the results that can come from combining matter. The unit addresses the parts of an atom, the formation of molecules and compounds, physical and chemical changes, the mixing of solids and liquids, and several properties of matter. It also provides an introduction to the use of symbols and formulas to identify substances.

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

Everything is made of tiny particles called *atoms*. These atoms combine to form *molecules*. What allows us to have so many different things all around us is that these atoms and molecules combine with other atoms and molecules in many ways.

It is important to understand how materials change when combined. Some materials retain their own properties, such as raisins and peanuts being mixed in a bowl. Other materials form something new when combined, such as water, lemon juice, and sugar becoming lemonade. Throughout our day, we see, use, and even consume combinations of materials. 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 will react when combined. This knowledge can keep us safe by preventing accidents and poisonings. Through the ages, people have researched ways to mix matter that have 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: emulsions and suspensions; mixing materials to use in construction, food, and drink; and properties of matter that allow people to make art and bake.

SPARK

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

Materials

- paper plates
- plastic spoons
- hand lenses (optional)
- microwave oven (optional)
- clear glass filled with tap water
- assortment of small snack foods (for example, chocolate chips, raisins, peanuts*, jelly beans, miniature marshmallows)

**Please substitute another item for peanuts if any students are allergic to them.*

**Activity**

Place students into groups. Give each group a paper plate and a plastic spoon. Ask volunteers from each group to place one spoonful of each snack food onto their plate, keeping each item in its own pile as best they can.

Ask each group to observe one of the items on their plate at a time and discuss its properties. Allow students to use hand lenses if available. They might describe the color, texture, size, weight, and shape of each item (no tasting). Then, as a whole class, record these observations on the board.

Now have each group use its plastic spoon to stir all the snack foods together into a mixture. Invite volunteers to describe the overall mixture using the same properties from earlier. Ask students to observe and then discuss whether the properties of the individual ingredients have changed as a result of being mixed with other ingredients (probably not).

Challenge students to predict how the mixture's properties might change if you stirred it in a cup of water or heated it in a microwave. Then demonstrate each of these tests and ask students to observe and discuss how the mixture and its components have changed.

Below are questions to spark discussion.

Why didn't the properties of the ingredients change when we stirred them together on the plate?

How did the properties of the ingredients change when we stirred them in water? Heated them in a microwave? Why do you think this was so?

How might the results of this activity have been different if we had combined pancake syrup, apple juice, and salt? Why do you think these results would have been different?

During the course of a day, what kinds of things do you mix together?

Use this activity to begin an introductory discussion about mixing matter. Explain that everything students see is made of matter. Some things are made of only one kind of matter, and some things are made of combinations of matter. Some materials' properties change when combined, and other materials retain their properties. Throughout the unit, students will learn more about mixing matter.

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



Invite students to explain their understanding of what happens when various materials are combined. Discuss how students' lives might be different if materials could not be combined.

Probing Questions to Think About

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

- What is matter?
- What is the smallest part of something?
- What is water made of, and why is it called H₂O?
- When a glass breaks, what are the pieces made of?
- Why do you think some metal turns to rust as time passes?
- Is it possible to separate the materials in a tossed salad?
If so, how would you do it? If not, why not?
- Is it possible to separate the materials in a can of soda?
If so, how would you do it? If not, why not?
- How might understanding the ways in which matter can mix help keep you safe?
- Do all cubes that are 1 centimeter on each side weigh the same?
Why or why not?

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 Mixing Matter 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.

atom	the smallest part of an element
bond	a connection between atoms that are joined together to form a molecule
chemical change	a change in the chemical makeup of a substance
chemical reaction	the process by which atoms form bonds
compound	a combination of two or more elements
concentration	how much of a substance is present in a solution
electron	a particle that is part of an atom and that orbits the nucleus; it has a negative electrical charge
element	a substance that cannot be broken down into simpler substances
formula	numbers and letters that describe how many atoms of each element are included in one molecule or compound
matter	anything that takes up space and has weight
mixture	a combination of substances in which a chemical reaction does not occur
molecule	the smallest part of a substance that can exist by itself, made of two or more atoms
neutron	a particle in the nucleus of an atom that has no electrical charge
nucleus	the positively charged central region of an atom, consisting of protons and neutrons, and containing most of the atom's mass
physical change	a change in the size, shape, or color of a substance that does not change it into a different substance
proton	one of the tiny particles that make up the nucleus of an atom; it has a positive electrical charge
saturation	the point at which no more of a liquid, solid, or gas can be absorbed by a solution at a given temperature

solution	a mixture in which the atoms of a solid separate and become invisible in a liquid
suspension	a mixture of a liquid and a solid in which the solid does not dissolve

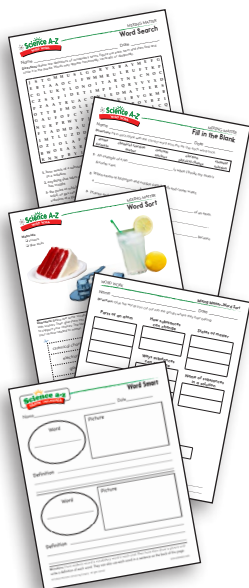
Other Key Science Terms

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

aggregate	bits of rock, gravel, or sand that are mixed with cement and water to make concrete
cement	a powder of limestone and clay with which water and gravel can be mixed to make concrete
concrete	a rough, heavy building material usually made of a mixture of water, cement, and bits of rock
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
mass	the measure of the amount of matter in an object
property	a feature or quality that can be used to describe something
solid	matter that keeps its shape and size
solute	any substance that is dissolved into a liquid or gas, creating a solution
solvent	in a solution, the liquid or gas into which a solid, liquid, or gas is dissolved
state of matter	the solid, liquid, or gaseous condition of a substance
substance	a particular kind of material

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.



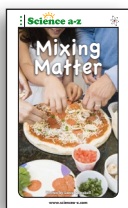
The *Word Work* activity sheets offer fun puzzles and practice with key vocabulary terms from the unit. For further vocabulary practice and reinforcement, you can choose from the vocabulary *Graphic Organizers*. To build customized vocabulary lessons with terms related to the topic, see *Vocabulary A-Z*.

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: *Is all matter made of multiple types of chemical elements?*

A: No. Most common items are made of more than one element. But elements can and do exist in their purest form, such as pure carbon, pure gold, and pure iron. In its pure form, a substance is made of only one kind of atom throughout.

Q: *Are chemical formulas as complex as they seem?*

A: No, not at all. A chemical formula simply expresses the types and quantities of chemical elements found in a molecule of a substance. The letters represent certain elements, and the number of atoms of each element within the molecule is indicated with numbers, often written in subscript. For example, the formula for common table sugar (sucrose), $C_{12}H_{22}O_{11}$, simply tells us that one sugar molecule contains twelve carbon atoms, twenty-two hydrogen atoms, and eleven oxygen atoms, all bound together.

Q: *Are atoms really the smallest parts of matter?*

A: Atoms are often described as being the smallest parts of matter. Technically, the parts within an atom (protons, neutrons, and electrons) are smaller than the atom itself. And even tinier particles such as quarks are thought to exist and to be even smaller. But for practical purposes, it is reasonable to say that atoms are the smallest building blocks of all matter.

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, it is a physical change. If the combination of materials forms something new and takes on new properties, it is a chemical change. One way students might decide whether or not an item has undergone a chemical change is to ask, "Can I easily identify the materials that make up this item?" For example, when looking at the contents of a box of cereal, it may be easy to identify bran flakes and raisins. But when looking at a plastic shopping bag with a painted logo on the side, it is not immediately obvious which materials were used to make the bag or the logo because these materials underwent chemical changes.

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. This 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 (CO_2) 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. Often, solids 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.

Q: *Can I see atoms?*

A: You cannot see atoms with your eyes alone. But high-powered microscopes do allow scientists to see materials at the atomic level.

Q: *I have learned that all matter is made of atoms and molecules. But I've also heard that living things are made of cells. Which is correct?*

A: Both are correct. All living and nonliving things are made of atoms. Atoms join to form molecules. In living things, certain molecules have combined to form cells. Cells are the smallest components of living things.

EXTENSION
ACTIVITIES

Using the Internet

Most search engines will yield many results when a term such as *matter* or *mixtures and solutions* is entered. You can search for information on a known mixture or compound, such as salt water or carbon monoxide. Be aware that some sites may not be educational or intended for the elementary classroom. More specific inquiries are recommended, such as:

- mixtures, solutions, and suspensions
- chemistry for kids
- periodic table of the elements
- saturation and concentration
- protons, neutrons, and electrons model
- diagram of an atom
- chemical formula of _____ (for example, table salt)
- how to measure volume/weight/density/magnetism



Projects and Activities

- **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.
- **Arts:** Have students clip pictures from magazines showing items that have been combined. They can classify the pictures based on any logical criteria. Then students can glue the pictures onto posterboard to create a collage, or they can make a mobile with a picture on one side of each card and an explanation of the mixture on the other.
- **Guests:** Invite professionals who rely on mixing or separating 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/Research:** Let students invent and play a mixing matter game. For example, students might create paper cards with the names of various elements on them. After researching a variety of chemical compounds, you can read off the chemical formula for a compound and see which group can compile their cards the fastest to show the correct composition of the compound.

- **Project/Home Connection:** Invite students to bring in a homemade food or drink to share with the class. Have each student describe the concoction to the class and have the rest of the students try to guess its ingredients. Challenge students to identify which items are mixtures, solutions, and suspensions. Then enjoy a class feast!
-  ▪ **Project/Technology:** Encourage students to monitor newspapers and selected websites for current news stories and advertisements related to chemicals, mixtures, solutions, and other concepts from the unit. Then have groups of students each create and videotape a newscast of real and/or invented news related to mixing matter, including weather, sports, and human-interest stories.
- **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.

