UNIT

A

PURE SUBSTANCES AND MIXTURES

Unit Preview

Chocolate chip cookies are made from many different ingredients. Some of the ingredients, such as sugar and salt, look very similar. However, each ingredient has a different purpose in the recipe. Sugar makes the cookies sweet. Butter keeps the cookies soft after they are baked.

Each ingredient in the recipe looks like just one type of material. The sugar is made up of small, white crystals. The butter is a soft, yellow solid. When you mix the ingredients, however, you get chocolate chip cookie dough. You can see some of the different ingredients in the dough, like chocolate chips and small pieces of butter. Cookie dough is a particular kind of mixture.

In this unit, you will learn about different pure substances and mixtures in the world around you. You will investigate how to separate mixtures, and what the benefits of separation might be. You will consider the choices involved in making, using, and disposing of many pure substances and mixtures. Finally, you will apply what you learn to help you solve a pollution problem.

BIG Ideas

- ☐ Matter can be classified according to its physical characteristics.
- ☐ The particle theory of matter helps to explain the physical characteristics of matter.
- ☐ Pure substances and mixtures have an impact on society and the environment.
- ☐ Understanding the characteristics of matter allows us to make informed choices about how we use it.

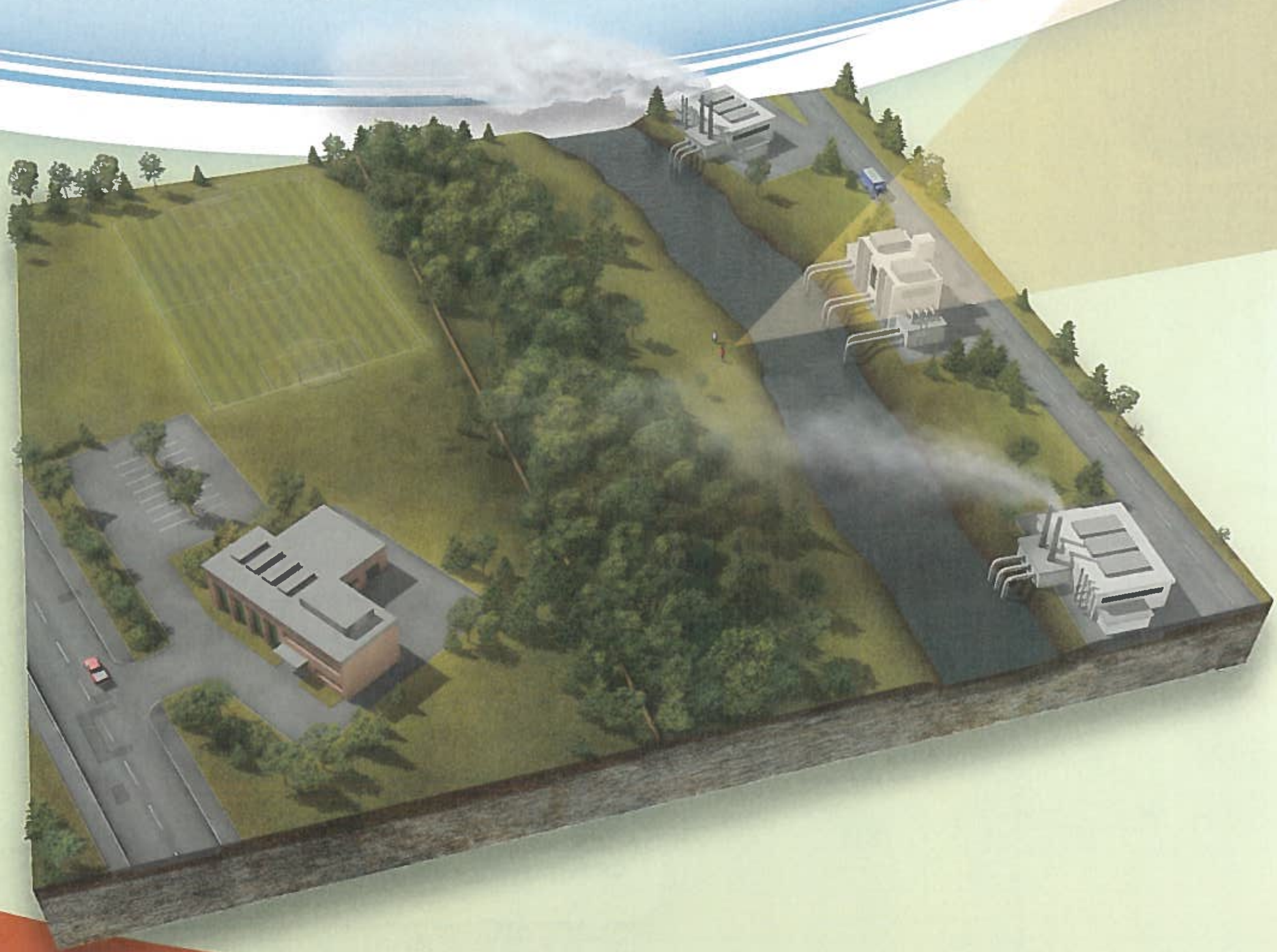
Discover Science and Technology

PROTECTING A RIVER

Raven and Matt like to spend time with their friends in the woodland not far from their school. They enjoy climbing the trees, lounging in the grass, watching the insects, and listening to the birds. Across the river, at the bottom of the woodland, there are factories.

One day, Raven noticed that the river looked different: it was soapy, with white bubbles floating on it. Matt found a dead fish lying on the shore.

Raven and Matt were worried. Unsure what to do, they talked to their teacher at school. The teacher had a suggestion. "We can call the Ministry of the Environment. They will send an environmental scientist to test the river water for pollution. If the river is polluted, they may be able to find out where the problem is, and figure out how to fix it."



LINKING TO LITERACY

Reading Visual Information: Illustration

Examine the illustration on this page. Where are the scientist and students located? Refer to the map on the previous page to help you determine their location. Which way are they facing? What are they standing or sitting next to?

A couple of days later, the environmental scientist came to the school and asked Raven, Matt, and their teacher to come with her to the river. They pointed out the dead fish and the pipes pouring waste water from the factories into the river. "Is the waste water killing the fish?" Matt asked.

"Could be," replied the scientist. "Some chemicals can harm the environment. We need to make sure that the factories remove any harmful material from their waste water before they let it flow into the river."

The scientist collected samples of water from different parts of the river, and took samples of the waste coming out of each factory pipe.

"I'll take these samples to the lab to figure out what's in each one," she explained. "We will find out if any of them contain harmful substances."

A few weeks later, the environmental scientist came back to update Matt and Raven on what had happened. "One of the factories was letting toxic substances flow out in their waste water. We found out which factory it was and fined them. They have figured out a way to remove those substances from their waste mixture, so that they are not polluting anymore. The river is already starting to recover. I'm going to check on it for the next few months to make sure that it stays clean. Thanks for letting us know about the problem. If we work together, we can help protect the environment from pollution."

Exploring Matter

To help you remember what you already know about matter, your teacher will show you three demonstrations similar to those in Figures 1, 2, and 3. Make careful observations, and relate what you see to what you know about matter. Try to answer the questions in the captions.

Figure 1 How are the three samples of water the same? How are they different? How could they change?

LINKING TO LITERACY

Restating Questions

To give better answers, begin by making sure you understand the question. Read the questions in the captions below each picture on this page. Then, restate the questions, using your own words. For instance, for Figure 1 you could ask yourself, "What is the same and what is different in each sample? How could each of these samples change from its current form?"

Figure 2 What happens to salt when it is added to water? If material "disappears," where does it go? Has it really ceased to exist?

Figure 3 When you feel "wind" from a fan, what are you actually feeling? Why? What is air? Is it all the same, or is it made up of more than one substance?

Unit Task Preview

Test a Sample of Industrial Waste

Many jobs involve separating and testing materials to find out what they contain. For example, a food scientist tests foods to find out how much fat, sugar, and fibre they contain. An environmental scientist tests soil and water to look for pollution. A mining engineer designs and tests ways to separate valuable minerals from waste rock.

Before testing a sample, a scientist determines whether it is just one kind of substance, or a mixture of substances. If a sample is a mixture, it can be separated into its different parts. Mixtures can be separated in many ways, as you will discover in this unit. An engineer may help out with the separation process. Scientists and engineers may work together to find the easiest and fastest way to separate a mixture into its different parts.

In the Unit Task, you will play the role of an environmental scientist. Your teacher has a sample collected from a river. The sample contains some factory waste. You will separate the sample into its parts and identify each part. For the Unit Task, you will need to use knowledge and skills that you develop as you work through this unit.

Unit Task By the end of the Pure Substances and Mixtures unit, you will be able to demonstrate your learning by completing this Unit Task. As you work through the unit, continue to think about how you might meet this challenge. Read the detailed description of the Unit Task on page 82, and look for the Unit Task icon at the end of selected sections for hints related to the Task.

Assessment

You will be assessed on how well you

- identify components that can be separated out of a mixture
- plan, test, and adjust your separation procedure
- communicate your separation procedure
- recommend a removal technique for any dangerous components

CHAPTER 1

Classifying Matter

KEY QUESTION: What kinds of matter are around us?

Looking Ahead

- Human production, use, and disposal of pure substances and mixtures have both benefits and costs.
- The particle theory explains the behaviour of particles of matter.
- The skills of analysis can be used to apply the particle theory to changes in matter.
- A pure substance contains only one kind of particle, but a mixture contains more than one kind of particle.
- The skills of scientific inquiry can be used to classify matter as a pure substance or a mixture.
- A mechanical mixture contains different components that you can see.
- A solution is a mixture that looks like a pure substance.

VOCABULARY

matter
chemistry
particle theory of matter
solid
volume
liquid
gas
pure substance
mixture
mechanical mixture
heterogeneous mixture
solution
homogeneous mixture

Take Our Kids to Work Day

Today was Take Our Kids to Work Day. Instead of going to school, Jiao was going to work with her mom.

Jiao's mom had already told Jiao something about her job. "I work in a lab where we design artificial flavours. Remember the strawberry yogurt you had for breakfast? It had real strawberries in it, but it also had artificial strawberry flavour. That flavour was designed by scientists in my lab!"

"How did they do it?" Jiao had wanted to know.

"Strawberries are a mixture of many different substances," said her mom. "The scientists analyzed real strawberries to see which chemicals give the strawberry its smell and taste. Then, they figured out how to make similar chemicals in the lab. The right mixture of chemicals tastes and smells like real strawberries."

When they arrived, Jiao and her mom went into a special room where they both tied their hair back. They put on white lab coats, eye protection, and gloves. Then, they went into the lab.

The lab smelled delicious! Jiao could smell bananas and cherries, and a yummy caramel smell that made her mouth water.

Jiao noticed rows of bottles sitting on shelves all around the room. "What's in all those bottles?" she asked.

"The small bottles hold all the flavours we have designed. It's not safe to taste things in the lab, but you can smell them," said her mom.

Jiao's mom took the lids off two small bottles. Jiao sniffed the first one carefully, wafting the air as her mom had shown her. It smelled like apples. The second smelled like pineapple. "Wow!" said Jiao. "I like your job. Maybe I'll design flavours, too, when I grow up."

LINKING TO LITERACY

Gaining Meaning from Context

You can learn about new or difficult words from the story you are reading without using a dictionary. See if you can figure out what a new word means by using information from the sentence or paragraph.

1. In this story, Jiao learns about substances and chemicals. Read the information in the paragraph that begins with, "Strawberries are a mixture…" Can you tell what the word "substances" means? What might be a good synonym for this word?
2. What other new words did you learn from this story? Work with a partner to compare words you learned about by using information from the text.

1.1 What Is Matter?

You have probably seen, touched, and tasted hundreds of different things in your life. You have touched wood, steel, and ice. You use shampoo, and you drink milk. You breathe air. Have you ever wondered what all these things are made of?

The examples listed above are all made of matter. In fact, all of the objects around you are made of matter (Figure 1). **Matter** is anything that has mass and takes up space. Remember the chocolate chip cookies at the beginning of the unit? All of the ingredients are examples of matter. A mixing spoon is an example of matter. Your entire body is made of matter!

matter: anything that takes up space and has mass

LINKING TO LITERACY

Before Reading: Skimming and Scanning

To improve your understanding of informational text, think of it as a puzzle in which you need to put all of the pieces together. Start by looking at the title. Then, skim and scan the page for more information. Are there captions you can read? Are there subtitles or headings? What about pictures? Are there words that are highlighted or bolded, and that jump out at you from the page? Take a moment to connect all of your thoughts. What have you learned about this text even before beginning to read it?

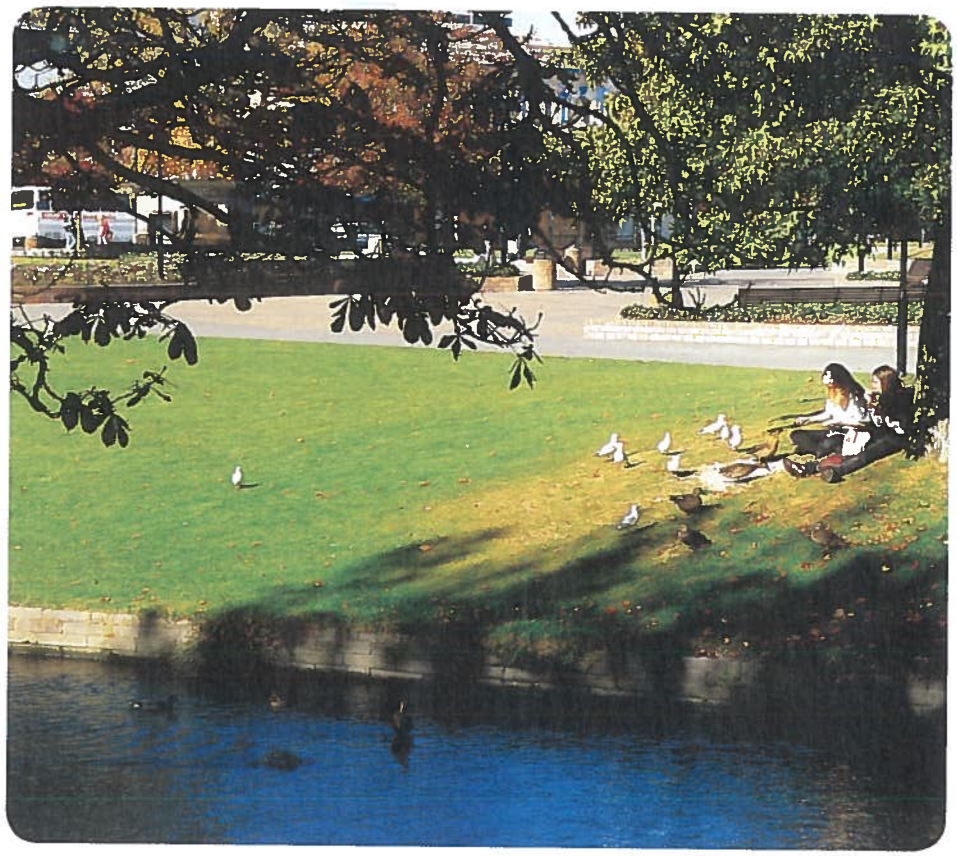


Figure 1 What examples of matter can you see?

The Science of Matter

The study of matter and its changes is called **chemistry**. Scientists who work in chemistry are called chemists. The photograph at the beginning of this chapter shows chemists working in a lab. Knowledge of chemistry is useful in many different careers. People who work in medicine, cooking, art, photography, and solving crimes all use chemistry in some way.

chemistry: the study of matter and its changes

Some chemists use their knowledge about matter to develop new kinds of matter. Often, scientists study matter that is found in nature, and then imitate it. These human-made chemicals are sometimes better than chemicals found in nature. For example, natural almond extract comes from wild almonds. It contains tiny amounts of a dangerous poison called cyanide. Human-made almond extract is a mixture of substances made in a chemistry lab (Figure 2). It is similar to the natural flavour, but it does not contain poisonous cyanide. Human-made chemicals are also sometimes cheaper to obtain than chemicals found in nature.

Human-made chemicals, however, are not always better than natural ones. Lemonade made with real lemons includes lots of vitamin C. Lemonade made with artificial flavour may taste almost the same, but will probably not have the same vitamin content.

Figure 2 Artificial almond extract is a kind of matter that chemists copied from nature.

To learn more about artificial flavours,

Go to Nelson Science

The Makeup of Matter

What makes up matter? To help us think about matter, we will look at something made of just one type of matter: aluminum foil (Figure 3). Imagine using stronger and stronger microscopes to examine the foil. What would you see?

With the first microscope, you would see the smooth, shiny surface of the foil, perhaps with some little scratches or marks (Figure 4). With a stronger microscope, the marks would be more visible, but you could still recognize the material as aluminum foil.

What if you used the most powerful kind of microscope available—a scanning probe microscope? You might be surprised at what you would see. Figure 5 shows what a piece of aluminum foil looks like through a scanning probe microscope. The surface is not smooth or silver-coloured. Instead, it is made of many tiny bumps. These bumps show the presence of aluminum particles.

Figure 3 Aluminum foil is made of just one kind of matter: aluminum.

Figure 4 If you look at aluminum foil through a microscope, it still looks like a smooth, silver-coloured metal.

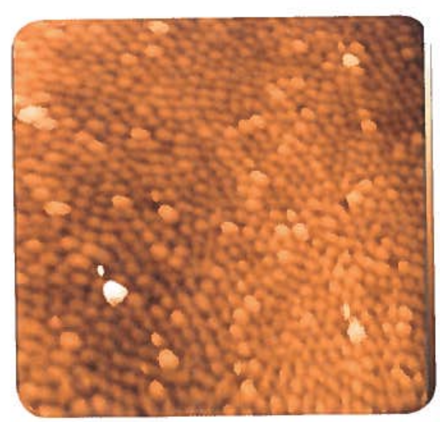


Figure 5 A scanning probe microscope allows you to see the aluminum particles in the foil.

LINKING TO LITERACY

Gaining Meaning from Context

Read the text on this page. Without looking in a dictionary, can you gather enough information to understand what the word "particle" means?

A small piece of aluminum foil contains billions of tiny aluminum particles. All matter is made of particles that are too small to be seen, except through powerful microscopes. These particles of matter are tinier than the smallest thing you can imagine. Imagine a piece of aluminum foil that is 1 cm by 1 cm. If each particle in that piece of foil were expanded to the size of an egg, the eggs would cover the entire surface of Earth to a depth of several metres.

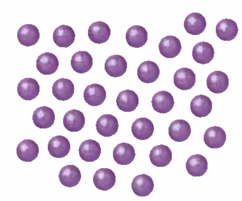
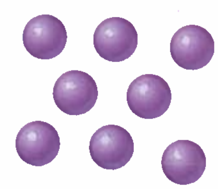
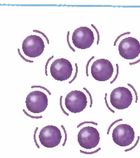
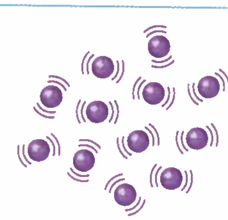
The Particle Theory of Matter

All matter is made of tiny particles. Different kinds of matter are made of different kinds of particles. The particles themselves do not look like the kind of matter they make up. For example, a single particle of aluminum does not look the same as a piece of aluminum. A single particle of water does not look or behave like the water in a lake. Only when large numbers of particles are together do aluminum particles behave like aluminum, or water particles behave like water.

The **particle theory of matter** (also known as "particle theory") helps to explain what scientists have learned about these tiny particles of matter. The main ideas of the particle theory are listed in Table 1.

particle theory of matter: an explanation of what matter is made of and how it behaves; the particle theory states that all matter is made up of tiny particles that are always moving, that attract each other, and that have space between them

Table 1 The Particle Theory

Main idea	Illustration
1. All matter is made up of tiny particles.	
2. Particles have empty spaces between them.	
3. Even though you cannot see them, particles are moving randomly all the time.	
4. Particles move faster and spread farther apart when they are heated.	
5. Particles attract each other, so they tend to stay together rather than fly apart.	

Using the Particle Theory

You can use the particle theory to explain many of the things you observe in everyday life. The following sample problem shows how to use the particle theory to explain an observation.

SAMPLE PROBLEM: Explain an Observation Using the Particle Theory

If you placed a few drops of food colouring in a container of water without stirring, what do you think you would see (Figure 6)?

Solution: Particles of food colouring and particles of water are moving and bumping into each other all the time. This causes the food colouring particles and the water particles to mix together, even without stirring.

Figure 6

Look at the paper in this textbook. Is it hard to believe that the paper is made of billions of invisible particles? If you answered yes, you are not alone. For thousands of years, people did not know that matter is made of particles. Today, we accept the particle theory because it helps scientists to explain many puzzling observations.

TRY THIS: Explain Observations Using the Particle Theory

SKILLS MENU: performing, observing, analyzing, communicating

SKILLS HANDBOOK 2.B.5., 2.B.7.

In this activity, you will make observations and use the particle theory to explain your observations. You may want to review the main ideas of the particle theory in Table 1.

Equipment and Materials: tablespoon; ceramic coffee mug; timing device; sugar; room-temperature water; cold water; ice; hot water

Never taste anything in the science lab. Use care when working with hot water.

1. Stir a level spoonful of sugar into a mug of water at room temperature. At the same time, start timing. Keep stirring until you can no longer see the crystals of sugar. Measure the time it takes for the sugar to completely disappear. Record your observations.
2. Empty the sugar water into the sink and rinse the mug.
3. Repeat steps 1 and 2 using cold water with a couple of ice cubes in it.
4. Repeat steps 1 and 2 using hot water.

A. What did you observe in all three mugs of water?

B. Use the particle theory to explain your observations.

C. In which mug of water did the sugar crystals disappear most quickly?

D. Use the particle theory to explain your observations in part C.

CHECK YOUR LEARNING

1. (a) In this section, you learned that matter is made of very tiny particles. Do you find this idea easy or difficult to understand? Explain why.
   (b) What can you do to help you understand this idea better?
2. (a) What is matter?
   (b) Give three examples of things that are made of matter.
3. In point form, list the five main ideas of the particle theory. You may use diagrams.

1.2

More About Matter

Have you ever seen a snowflake under a microscope? Look at the beautiful snowflake in Figure 1. Can you tell what kind of matter it is made of? If not, how could you find out?

Figure 1 If you held this snowflake in your hand, it would melt into a drop of water. The snowflake is made of the same kind of matter as a drop of water.

Three States of Matter

Snowflakes are a form of solid water. Water particles are always water particles, whether water is in solid (ice), liquid (water), or gas (water vapour) form. All forms of matter, including water, can exist in three different states: solid, liquid, and gas. The particles are exactly the same in each state. Individual particles do not freeze or melt. Instead, their movement changes. Also, the arrangement of particles is different in each state. Matter also behaves differently in each state.

Solids

solid: a state of matter with a definite volume and a definite shape

volume: a measure of the quantity of space occupied by an object

A **solid** has a definite shape and a definite volume. **Volume** is the quantity of space something occupies. For example, a coin is made of metal. The metal is in the solid state. Therefore, the coin's shape and volume remain constant (if the coin's temperature does not change).

Liquids

liquid: a state of matter with a definite volume, but no definite shape; a liquid takes the shape of its container

A **liquid** has a definite volume, but does not have a definite shape. Instead, a liquid takes the shape of its container. Milk is an example of a liquid. If you have 250 mL of milk in a carton, the milk's volume will be 250 mL. The volume does not change if you pour the milk into a cylindrical glass, but the shape will change.

Gases

A **gas** does not have a definite volume or a definite shape. Instead, a gas takes the shape and volume of its container. When a deflated basketball is filled with air, the air particles occupy a spherical space and a volume equal to the volume of the inflated ball.

gas: a state of matter that does not have a definite volume or a definite shape; a gas takes the shape and volume of its container

Particles of Solids, Liquids, and Gases

The particles of a sample of matter always stay the same, whether the matter is solid, liquid, or gas. The difference is in the movement and arrangement of the particles. Particles move differently in solids, liquids, and gases.

The particles of a solid are like students sitting in a movie theatre watching a movie (Figure 2). The students have a bit of distance between them, they can fidget in their seats, but they cannot move around very much.

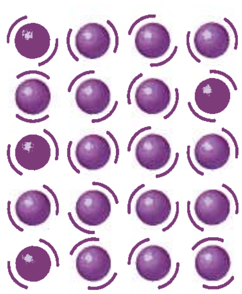
The particles of a liquid are like students moving through a crowded shopping mall (Figure 3). The students can walk around, but they are still close together.

The particles of a gas are like students running out of the school building on the last day of school (Figure 4). The students can move quickly, and in all different directions.

LINKING TO LITERACY

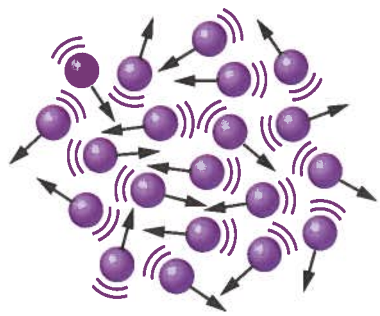
Synthesizing Information

When you read text that presents new information, you compare it to what you have already read or already know. Use the text on this page, the diagrams, and what you already know to help you understand particles in solids, liquids, and gases.



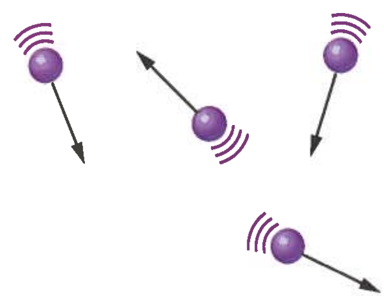
particles of a solid

Figure 2 The particles of a solid are closely packed together. The particles stay in the same positions, but they vibrate all the time.



particles of a liquid

Figure 3 The particles of a liquid are still close together, but they can move around each other in all directions.



particles of a gas

Figure 4 The particles of a gas are very far apart. They have lots of energy and move very fast in all directions. The particles can even leave their container if it is not sealed.

The particles are also arranged differently in each state of matter. Particles are closer together in solids and liquids than in gases. Because of this closeness, the forces of attraction among the particles hold the particles together. This explains why the volume of a solid or a liquid does not change much. The particles of gases are farther apart, so the forces of attraction cannot hold the particles together in a fixed volume.

To learn more about the particle theory and the states of matter,

Go to Nelson Science

Changes in State

Matter can change from one state to another. A change in state can happen when a sample of matter is heated or cooled.

TRY THIS: Changes in State

SKILLS MENU: **observing, analyzing, communicating**

SKILLS HANDBOOK 5.A., 5.B.

What happens when matter changes state from a solid to a liquid to a gas?

Equipment and Materials: microwave oven; small plastic sandwich bag; rubber band; small ice cube or ice chip

Be careful when handling items that have been heated in a microwave oven. Some parts may be much hotter than others. Do not use a metal tie to seal the sandwich bag. Do not try this investigation at home without responsible adult supervision.

1. Put a small piece of ice in a plastic sandwich bag. Squeeze all the air out and tie the top of the bag tightly shut with a rubber band.
2. Put the bag in the microwave oven for 60 s or more, until the bag appears to inflate. Observe through the door of the microwave oven. Record your observations.
3. Stop the microwave as soon as you see the bag inflate, and open the door. Take the bag out carefully and hold it in your hand. Record your observations.

A. What changes of state took place in the ice? Use the particle theory to explain what happened to the ice particles during the changes you observed.

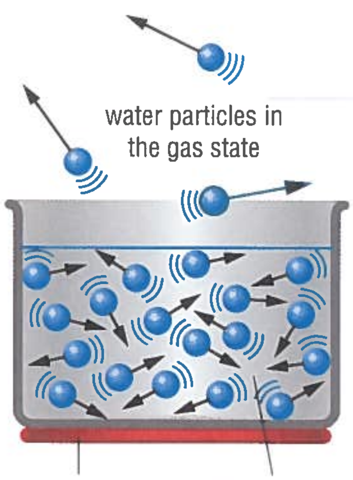


Figure 5 Water changing state from liquid to gas

When ice is heated, the water particles move faster, so the water changes from solid to liquid. More heating makes the particles move even faster and farther apart, so the liquid water changes to a gas. The particles of a gas are much farther apart than the particles of a solid or a liquid.

If the gas is cooled, the attractive forces pull the particles closer together, and the gas changes back into a liquid. What would happen if you cooled the liquid water even more by placing it in a freezer? The particles would slow down: the water would change from a liquid to a solid. When a sample of matter changes state, the particles themselves remain the same. The number of particles also remains the same. It is the arrangement and speed of the particles that changes. Figure 5 shows water changing state from liquid to gas. As liquid water is heated, water particles start to move faster. They leave from the surface moving very quickly. (This is shown by longer arrows.) As more and more particles leave from the surface, the liquid water boils and becomes water vapour.

CHECK YOUR LEARNING

1. In this section, you learned that particles are moving all the time, even in the solid state. Do you find this easy or difficult to believe? Discuss this with a classmate or your teacher, and explain why or why not.
2. What are the three states of matter?
3. In your own words, use the particle theory to explain why water changes from a solid (ice) to a liquid (water) when it is heated.
4. Identify the state of each of the following materials:
   (a) a rock
   (b) grape juice
   (c) air
5. Draw a diagram that shows particles of a solid, a liquid, and a gas. Your labels should describe the motion of the particles in each state and the attraction among the particles.

AWESOME SCIENCE

Other States of Matter

You have just learned about solids, liquids, and gases. Scientists have found other states of matter that have unique properties.

A gas that is electrically charged is called plasma. Plasma is sometimes considered to be a fourth state of matter. It is found mainly in stars and nebulas in outer space.

Plasma (which is different from blood plasma) has fascinated people for thousands of years. The northern lights are an example of plasma in nature (Figure 1). Traditionally, Inuit have believed that the northern lights were the torches of spirits guiding souls to a land of happiness and plenty.

Figure 1 The northern lights (aurora borealis)

Today, you can find plasma in many manufactured items, such as fluorescent lights, neon signs (Figure 2), and plasma television screens.

Figure 2 Neon lights contain plasma.

According to the particle theory, particles move more slowly when they are cooled. Experiments have shown that this is true. Scientists have cooled particles until they almost stopped moving completely. If you drew a graph showing the movement of particles against temperature, the graph would indicate that the particles would stop moving at approximately –273 °C. This temperature is called absolute zero. Absolute zero is the coldest possible temperature that could ever exist. Scientists believe that even the coldest places in our universe are warmer than absolute zero.

In 1924, Albert Einstein predicted that if you cooled particles down to absolute zero, a new state of matter would form. In 1995, scientists Eric Cornell and Carl Wieman finally managed to cool down a sample of particles to a temperature very close to absolute zero. Einstein was right: the particles formed a new state of matter!

This exciting new state of matter is called a Bose–Einstein condensate. Scientists think that this discovery may lead to very tiny computer chips in the near future.

To read more about these strange states of matter,
Go to Nelson Science

Testing the Particle Theory

In this investigation, you will explore what happens to the mass of a sample of matter when it changes state. You will also explore what happens when two samples of matter are added together. You will use the particle theory to analyze your observations.

SKILLS MENU

- ☐ Questioning
- ☑ Hypothesizing
- ☑ Predicting
- ☐ Planning
- ☐ Controlling Variables
- ☑ Performing
- ☑ Observing
- ☑ Analyzing
- ☐ Evaluating
- ☑ Communicating

Testable Questions

Part A: What happens to the mass of a solid when it melts?

Part B: How does mixing a solid and a liquid together (until the solid disappears) affect the total mass of the mixture?

Hypothesis/Prediction

SKILLS HANDBOOK 2.B.3.

Write a hypothesis for each of the Testable Questions. Each hypothesis should include a prediction as well as a reason for your prediction based on the particle theory.

Experimental Design

Part A: You will take measurements to compare the mass of a sample of frozen water with the mass of the same sample when it is liquid.

Part B: You will take measurements to compare the actual mass of a salt-and-water mixture with the predicted mass.

Equipment and Materials

SKILLS HANDBOOK 5.B.

- eye protection
- apron
- beaker (100 mL)
- triple beam balance
- hot plate
- beaker tongs
- weighing papers
- stirring rod
- graduated cylinder (100 mL)
- 6 ice cubes
- water
- 20 g of salt

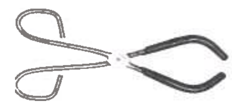

eye protection


apron

beaker (100 mL)


triple beam balance


hot plate


beaker tongs


weighing papers


stirring rod


graduated cylinder (100 mL)


6 ice cubes


water


20 g of salt

Be careful when using a hot plate. Do not touch the heated surface, even when it is not plugged in; it could still be very hot. Do not unplug the hot plate by pulling on the electrical cord. Pull the plug itself. Use caution when handling glassware. Report any broken glassware to your teacher.

Procedure

SKILLS HANDBOOK 6.A.3., 6.D.1.

Part A: Melting Ice

1. Read the complete investigation and construct a suitable table called Table 1 for recording your observations. Ask your teacher to approve your table before you continue.
2. Put on your eye protection and apron. Measure and record the mass of an empty, dry beaker.
3. Add one piece of ice to the beaker. Measure and record the total mass.
4. Place the beaker on the hot plate, and then turn the heat to low. Allow the ice to melt completely. Do not let the water boil. Remove the beaker from the hot plate using beaker tongs. (It could still be hot.) Measure and record the total mass of the beaker and melted ice.
5. Pour the water into the sink and dry the beaker completely.
6. Repeat step 4 using the same beaker. This time, use five pieces of ice all at once, instead of one piece. Again, record your observations.

Part B: Salt in Water

7. Read the rest of the investigation and construct a suitable table called Table 2 for recording your observations. Ask your teacher to approve your table before you continue.
8. Measure and record the mass of an empty, dry beaker.
9. Measure 50 mL of water into a graduated cylinder, and then pour the water into the beaker. Measure and record the total mass.
10. Measure and record the mass of a weighing paper. Add 5 g of salt to the weighing paper. Add the salt to the water and stir. Measure and record the total mass of the beaker, water, and salt.
11. Pour the salt water into the sink. Rinse and dry the beaker.
12. Repeat steps 8 to 11, but this time using 100 mL of water and 10 g of salt.

Analyze and Evaluate

SKILLS HANDBOOK 2.B.7., 2.B.8.

(a) Using your measurements in steps 2 and 3, calculate the mass of the single piece of ice. Record this value in Table 1.

(b) Using your measurement in step 4, calculate the mass of the melted ice. Record this value in Table 1.

(c) Repeat (a) and (b) for the five pieces of ice.

(d) Using your measurements in steps 8 and 9, calculate the mass of 50 mL of water. Record this value in Table 2.

(e) Calculate the total mass of the beaker, the water, and the salt before mixing. Record this value in Table 2.

(f) Using your measurements in step 10, calculate the mass of the beaker, the water, and the salt after mixing. Record this value in Table 2.

(g) Repeat (d), (e), and (f) for 100 mL of water and 10 g of salt.

(h) Use your results to answer the Testable Questions. Compare your answers to your Hypothesis/Prediction. Account for any differences.

(i) Why do you think you repeated each experiment with different masses?

Apply and Extend

(j) If you froze the water in Part A and then determined its mass again, what would you observe?

(k) If you left the mixed liquid in Part B in a warm place for a long time and then measured the mass, what would you observe?

1.4 Pure Substances and Mixtures

Figure 1 Does "100 % pure apple juice" contain only one type of particle?

The apple juice in Figure 1 is labelled as 100 % apple juice. Does this mean that the juice is made of only one kind of matter? Does it have only one kind of particle in it?

Apple juice is actually a mixture of water particles, sugar particles, flavour particles, and vitamin particles. Apple juice may look like one kind of matter, but it contains many kinds of particles all mixed together.

Pure Substances

Figure 2 Aluminum foil, table sugar, and distilled water are pure substances and are each made of one kind of particle.

pure substance: matter that contains only one kind of particle

Most examples of matter in everyday life contain more than one kind of particle. Some types of matter, however, do contain only one kind of particle (Figure 2). A piece of aluminum foil contains only one kind of particle. Each aluminum particle is the same as every other aluminum particle. White table sugar is made of only sugar particles.

Aluminum and table sugar are both examples of pure substances. A **pure substance** is a type of matter that contains only one kind of particle (Figure 3(a)). Other examples of pure substances include distilled water and salt. Uranium, used in nuclear power stations to produce electricity, is another pure substance.

Water from your tap is not a pure substance. It contains water particles and a number of other kinds of particles, too. Distilled water, however, has had all of the "non-water" particles removed: it is pure water.

Mixtures

mixture: matter that contains two or more pure substances mixed together

When you stir a spoonful of sugar into a glass of distilled water, the sugar disappears and the water tastes sweet. Now there are two kinds of particle in the glass. The sweetened water is not a pure substance anymore. It is a mixture containing sugar particles and water particles.

A **mixture** is a type of matter that contains more than one kind of particle. A mixture is made of two or more pure substances mixed together (Figure 3(b)).

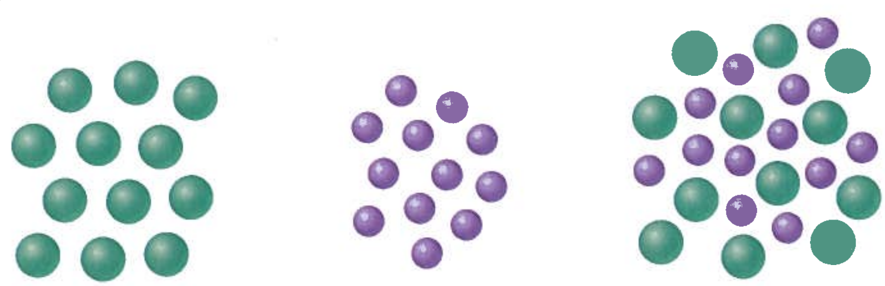


Figure 3 (a) Pure substances contain identical particles. (b) Mixtures contain more than one kind of particle.

TRY THIS: Test a Sample of Matter

SKILLS MENU: performing, observing, analyzing

SKILLS HANDBOOK 2.B.7.

You can test the ink in a black marker to determine if it is a pure substance.

Equipment and Materials: water-soluble black marker; colourless drinking glass or beaker; 10 cm strip of filter paper; tap water

1. Use the marker to draw a horizontal black line about 3 cm from the bottom of the strip of filter paper.
2. Pour water into the glass to a depth of about 1 cm.
3. Carefully stand the strip of filter paper in the glass of water. The black line should be close to the water, but not touching it (Figure 4).

A. What happens to the black line on the paper after 1 min? After 5 min?

B. Is the ink in a black marker a pure substance or a mixture? What evidence supports this?

Figure 4 Use the clip on the marker lid to hold the paper away from the side of the glass.

Mixtures can be solids, liquids, or gases, or even combinations of these. Steel, batteries, and cookies are all mixtures in the solid state. Antifreeze and milk are mixtures in the liquid state. The air you breathe is a mixture of gases.

Many mixtures that we use, such as the mixtures inside compact fluorescent light bulbs (CFLs) and batteries, include some pure substances that can be harmful if they escape into the environment. CFLs contain mercury. Some batteries contain cadmium while others contain lead. Mercury, cadmium, and lead are all pure substances that are toxic to both animals and people. We should not dispose of CFLs and batteries in the regular garbage. We should carefully collect them and deposit them at special recycling stations, where their components can be separated out and recycled.

LINKING TO LITERACY

After Reading: Summarizing

After you finish reading the section "Pure Substances and Mixtures," work with a partner to summarize all of the key ideas. The text subheadings will help to guide your thinking. Develop one sentence for each of the subheadings in the text.

To learn more about disposing of dangerous substances,
Go to Nelson Science

Unit Task Think about the Unit Task. How will this information about pure substances and mixtures be useful as you work on the task?

CHECK YOUR LEARNING

1. **(a)** What is a pure substance? Give three examples.
   (b) What is a mixture? Give three examples.
2. In your notebook, draw a sample of matter that is a pure substance. Make sure you show the types of particles present in the pure substance. Explain why your drawing shows a pure substance and not a mixture.
3. Is milk a pure substance or a mixture? Explain how you know.
4. **(a)** Why should you not place used batteries in the regular garbage?
   (b) How should you dispose of batteries?

1.5 PERFORM AN ACTIVITY

Identifying and Classifying Matter

SKILLS MENU

- [x] Questioning
- [ ] Hypothesizing
- [ ] Predicting
- [x] Planning
- [ ] Controlling Variables
- [x] Performing
- [x] Observing
- [x] Analyzing
- [ ] Evaluating
- [x] Communicating

All samples of matter are either pure substances or mixtures. Sometimes, two pure substances mix so completely that the resulting mixture looks like a pure substance. In this activity, your teacher will give you six samples of matter labelled A, B, C, D, E, and F. You will use information about the different types of matter, and design your own tests to identify the six samples. Some of your tests will involve making mixtures. Using the equipment and materials listed, you will perform your tests. When you have tested and identified each sample, you will examine the mixture(s) that you made. You may discover that there are different types of mixtures.

Purpose

To plan and perform tests to identify six unknown samples of matter.

Equipment and Materials

SKILLS HANDBOOK 5.B.

- eye protection
- apron
- gloves
- 6 test tubes with stoppers
- test-tube rack
- spoon
- beaker (250 mL)
- magnifying glass
- 6 samples of matter (labelled A, B, C, D, E, and F)
- water

eye protection

apron

gloves

6 test tubes with stoppers

test-tube rack

spoon

beaker (250 mL)

magnifying glass

6 samples of matter

water

Never taste anything in the science lab. Some of the samples could be toxic. Handle glassware carefully. Report any broken or chipped glassware to your teacher. Use rubbing alcohol very carefully.

Procedure

Part A: Identify the Samples

1. Samples A to F are the six substances listed in Table 1. You will use the information in Table 1 to identify the six unknown samples. Design at least one test for each sample. (Hint: Your tests might involve mixing pairs of the samples. See Figure 1. Do not mix more than two samples together.) Write the steps of your procedure. Include any safety precautions you will need to take. Create a table in which to record your observations.

Table 1

Sample of matter	Properties
distilled water	• colourless liquid • mixes completely with sugar
rubbing alcohol	• colourless liquid • does not mix completely with sugar
glycerol	• thick, colourless liquid • mixes completely with water
castor oil	• thick, pale yellow liquid • does not mix completely with water
sugar	• white powder • mixes completely with water
flour	• white powder • does not mix completely with water

Figure 1 To mix samples in a test tube, fill the tube no more than halfway. Put a stopper in the test tube, and put your thumb firmly over the stopper. Holding the test tube away from you, gently turn it upside down two or three times. Wear gloves when mixing samples this way.

2. When your teacher has approved your procedure, perform the tests. Record your observations as you go along.
3. Keep the mixtures in the test tubes. You will need them for the next part of the activity.

Part B: Examine the Mixtures

4. Use a magnifying glass to examine each mixture that you made in Part A. Record your observations.

Analyze and Evaluate

SKILLS HANDBOOK 2.B.7.

(a) Identify each sample of matter in Part A.

(b) Was any sample of matter particularly easy to identify? Why?

(c) Was any sample of matter particularly difficult to identify? Why?

(d) Using your observations in Part B, classify the mixtures into groups.

(e) How did you classify the mixtures into groups?

(f) Not all of the samples were pure substances. Explain how you can tell which ones were mixtures.

(g) Can you always tell the difference between a pure substance and a mixture? Explain why or why not.

Apply and Extend

SKILLS HANDBOOK 2.B.

(h) Imagine that you are a scientist in a forensics lab. You have a beaker with a clear, colourless liquid. Suggest a test that might help to identify the liquid. Remember: You should *never* taste anything in a lab.

(i) Make a list of what you have learned in this chapter about safety in the science lab. Include a description of the following:

- wearing protective clothing
- caution around glassware
- checking labels for warning symbols

1.6 Mechanical Mixtures and Solutions

Mixtures are an important part of food preparation. Figure 1 shows a mixture of eggs, vegetables, and cheese cooking on a stove to make an omelette. Figure 2 shows a glass of grape juice. How are these mixtures the same? How are they different?

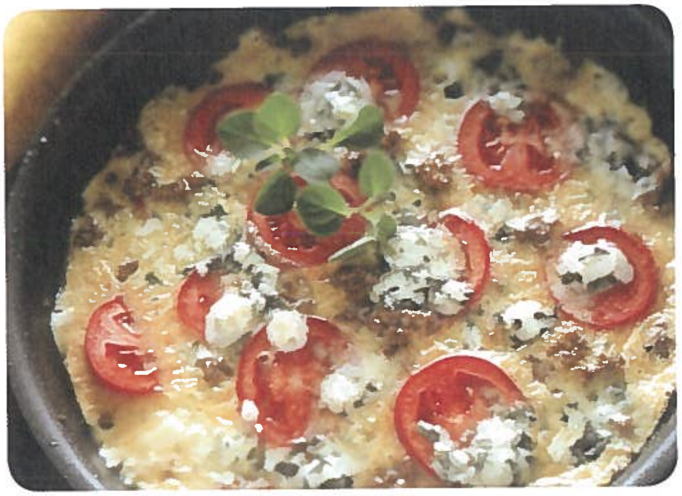


Figure 1 This omelette is a mixture of eggs, vegetables, and cheese. You can see the different parts of this mixture.

Figure 2 Grape juice is a mixture of water, sugar, and flavour particles. This mixture looks like just one kind of matter.

Scientists classify mixtures into two main groups: mechanical mixtures and solutions. Both are mixtures because both are made up of two or more different kinds of particles.

Mechanical Mixtures

mechanical mixture or **heterogeneous mixture:** a mixture with different parts that you can see

Sometimes it is easy to tell whether something is a mixture, but at other times it is more difficult. You can tell that the soil in Figure 3 is a mixture because you can see the different parts. If you can see different kinds of matter in a mixture, it is called a **mechanical mixture**. Mechanical mixtures are also called **heterogeneous mixtures**.

LINKING TO LITERACY

During Reading: Monitoring Comprehension

As you read through this page, stop from time to time to think about what you are reading. Can you put the pieces of information together to make sense? Good readers stop to think when something does not make sense. They look for key words to help their understanding. Often they reread text and locate information from titles, pictures, captions, and tables.

Figure 3 You can see sand, little stones, twigs, and bits of leaves mixed together in this mechanical mixture.

You see and use mechanical mixtures almost every day. To find a mechanical mixture, you could look inside your closet at home or inside your pencil case at school. Maybe you ate a mechanical mixture for breakfast, such as cereal and milk, or a raisin bran muffin. Figure 4 shows three more examples of mechanical mixtures.

Figure 4 How can you tell that each example is a mechanical mixture?

Solutions

Some mixtures do not look like mechanical mixtures. They look like pure substances. Like the grape juice in Figure 2, clear shampoo looks like only one kind of matter. However, both grape juice and clear shampoo are mixtures. Grape juice contains water particles, sugar particles, and flavour particles. Shampoo contains water particles, detergent particles, colour particles, and scent particles.

Mixtures that look as though they are pure substances are called solutions. A **solution** contains more than one kind of particle, but it looks like a pure substance. Solutions are sometimes called **homogeneous mixtures**. Both steel and seawater are solutions. Think back to the black marker ink that you tested in Section 1.4. What evidence do you have that marker ink is a solution, rather than a pure substance or a mechanical mixture?

solution or **homogeneous mixture:** a mixture that looks like a single pure substance; a uniform mixture of two or more pure substances

Clear apple juice is a solution. The air you breathe is also a solution. More examples of solutions are shown in Figure 5. Try to think of three solutions that you have seen today.

Figure 5 Stainless steel is made of iron, chromium, and nickel particles. Tea is made of water, caffeine, and flavour particles. Clear nail polish is made of nitrocellulose, resin, colour, and acetate particles.

You have probably realized that homogeneous mixtures, or solutions, can be in any of the three states: solid, liquid, or gas. However, in any one solution, there is only one state visible. This is not the case for heterogeneous mixtures, which can include different states in one mixture.

TRY THIS: Explore Mixtures at Home

SKILLS MENU: observing, communicating

SKILLS HANDBOOK 2.B.6.

In this activity, you will explore mixtures in your home.

1. Search your home for at least four different mixtures. Try to find a variety of mixtures, including the following:
   - a mixture of two or more solids
   - a mixture of two or more liquids
   - a mixture made by mixing a solid and a liquid
   - a mixture made by mixing a liquid and a gas
2. Copy and complete Table 1 in your notebook, adding details about the four mixtures. If you do not know the components of the mixture, look at the container or label (if there is one) to find out.

Table 1 Mixtures at Home

	Mixture 1	Mixture 2	Mixture 3	Mixture 4
Name of mixture				
Mechanical mixture or solution?				
Components of the mixture				
Safety warning (if present)				

Particles of Mixtures

Maybe it surprises you that clear apple juice, air, and steel are homogeneous mixtures, and not pure substances. The different kinds of matter are not visible in a solution like apple juice. Why not? Figure 6 may help you to answer this question. It compares the distribution of the particles of a solution with the distribution of the particles of a mechanical mixture.

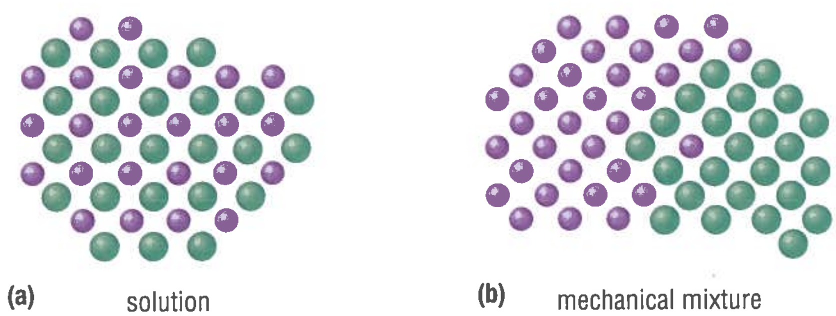


Figure 6 (a) The different particles of a solution are evenly mixed. (b) The different particles of a mechanical mixture are unevenly mixed.

In a solution, the different kinds of particles are mixed together evenly. Individual particles are too small to see, so when you look at a solution, it looks like just one kind of matter. You will learn more about the particles of solutions in Chapter 2.

In a mechanical mixture, the different kinds of particles are not mixed evenly. Instead, they stay together in groups and are distributed unevenly. As a result, when you look at a mechanical mixture, you can usually see the different kinds of matter.

To learn more about mechanical mixtures and solutions,
Go to Nelson Science

TRY THIS: Make a Mixture

SKILLS HANDBOOK 2.B.6., 2.B.7.

SKILLS MENU: observing, analyzing, communicating

In this activity, you will make your own mixture and observe its properties.

Equipment and Materials: apron; clear drinking glass or beaker; spoon; water; cooking oil; food colouring; liquid dish detergent

1. Put on your apron. Pour water into a glass until it is half full.
2. Add a spoonful of oil to the water and stir. Record your observations.
3. Add a few drops of food colouring to the mixture and stir. Record your observations.
4. Add a few drops of dish detergent to the mixture and stir. Record your observations.

A. In step 2, what kind of mixture did you make?

B. In step 3, did the food colouring mix with the water or the oil? What kind of mixture did the food colouring form?

C. What happens to the mixture when the dish detergent is added in step 4?

Classifying Matter

You have learned that matter can be classified as either a pure substance or a mixture. Mixtures can be further classified as mechanical mixtures or solutions. Pure substances can combine to form mixtures. Figure 7 summarizes what you have learned about classifying matter.

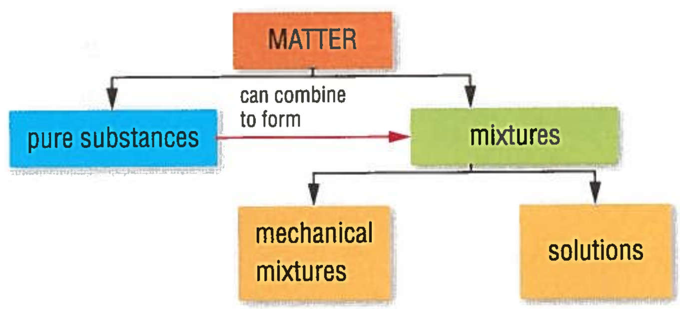


Figure 7 Classification of matter

Unit Task How do you think this information about mechanical mixtures and solutions will be useful as you work on the Unit Task?

CHECK YOUR LEARNING

1. (a) Which ideas did you find easiest to understand as you learned about the arrangements of the particles of mixtures?
   (b) Which ideas did you find most difficult to understand as you learned about the arrangements of the particles of mixtures? Explain why.
   (c) Suggest a strategy to help you better understand the arrangement of the particles of mixtures.
2. Describe each of the following types of mixture:
   (a) a mechanical mixture
   (b) a solution
3. Copy Figure 7 (above) into your notebook. Add two examples of each type of mixture and two examples of a pure substance.
4. (a) What is the difference between the arrangement of the different particles of a mechanical mixture and the arrangement of the different particles of a solution?
   (b) Draw diagrams of the particles of a mechanical mixture and the particles of a solution.
5. Identify each of the following as a mechanical mixture or a solution:
   (a) stainless steel
   (b) a granola bar
   (c) clear apple juice
   (d) an omelette
   (e) soil from your backyard

1.7 EXPLORE AN ISSUE CRITICALLY

Using Compact Fluorescent Light Bulbs

SKILLS MENU

- Defining the Issue
- Researching
- Identifying Alternatives
- Analyzing the Issue
- Defending a Decision
- Communicating
- Evaluating

Pure substances and mixtures affect the world around you. Using pure substances and mixtures involves both benefits and costs. A benefit is a good or positive result. A cost is a bad or negative result. Some pure substances are harmful to the environment or to human health. Some mixtures contain pure substances that could pollute the air, soil, or water. Often, a mixture or a product containing a mixture has both benefits and costs associated with it. For example, compact fluorescent light bulbs (CFLs) use much less energy than incandescent bulbs (Figure 1). However, CFLs contain a mixture of gases and mercury—a toxic pure substance that can pollute the environment when the bulb is thrown away (Figure 2). Are the benefits of using CFLs worth the costs?

Figure 1 A compact fluorescent light bulb (CFL)

Figure 2 Heavy metals, such as mercury, can pollute both land and water.

LINKING TO LITERACY

Organize Your Thinking

As you read, make a t-chart to show the benefits (column 1) and costs (column 2) of using CFLs. When you have completed your chart, reflect on what the chart shows. You can use this information to conduct your cost-benefit analysis.

The Issue

The town council of a small Ontario town is having a meeting to discuss whether to promote the use of energy-saving CFLs and how to handle the disposal of CFLs. You are a concerned resident in the town. You and a small group of townspeople have been asked by the town council to research these issues. Your group has been asked to summarize your research and present it at the town council's next meeting. You are also expected to recommend a position on each issue.

To prepare for the meeting, you will research the benefits and costs of using CFLs in place of incandescent light bulbs. You should also research the disposal options for CFLs.

Goal

To research CFLs, and to develop and present a cost-benefit analysis of the use and disposal of CFLs.

Gather Information

Working as a group, you will gather information on the issue. Use newspapers and books, as well as the Internet, to find information. Remember that when searching for information using the Internet, some sites will be more trustworthy than others. It is important to seek accurate information when doing research. Educational or government sites are often good places to start.

Go to Nelson Science

Identify Solutions

SKILLS HANDBOOK 3.J.4., 3.J.6.

The following questions may help you to conduct your cost-benefit analysis and to find possible solutions:

- What are the benefits of using CFLs?
- How can the benefits of using CFLs be maximized?
- What are the costs, or drawbacks, of using CFLs?
- How can the costs of using CFLs be minimized?
- What are the disposal options (both safe and dangerous) for CFLs (Figure 3)?
- What are the best available alternatives?

Figure 3 If your town decides to promote CFLs, how will you dispose of used or broken bulbs?

Make a Decision

Are the benefits of using CFLs worth the costs? Is there a safe way to dispose of broken CFLs? How did you decide?

Communicate

SKILLS HANDBOOK 3.J.7., 8.

With your group, prepare a presentation on the issues. Decide how you will make your presentation: a brochure, an audiovisual presentation, a poster, a video, or something else. Your report should include the following information:

- benefits and costs of CFLs
- information on the safe disposal of CFLs
- your opinion on what the town should do about the issue

Present your report at a town meeting. Other groups will also present their reports. Together, you will decide what the town will do about the issue.

CHAPTER 1 SUMMARY

Classifying Matter

BIG Ideas

- Matter can be classified according to its physical characteristics.
- The particle theory of matter helps to explain the physical characteristics of matter.
- Pure substances and mixtures have an impact on society and the environment.
- Understanding the characteristics of matter allows us to make informed choices about how we use it.

Looking Back

Human production, use, and disposal of pure substances and mixtures have both benefits and costs.

- We use pure substances and mixtures in everything we do.
- Some mixtures contain pure substances that are harmful to people and the environment.
- Some pure substances are beneficial but are also potentially dangerous.

The particle theory explains the behaviour of particles of matter.

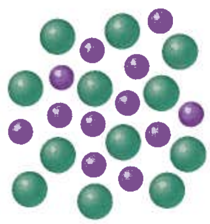
- Everything that has mass and takes up space is made of matter.
- The particle theory states that all matter is made up of tiny particles that are separated by empty spaces. These particles are attracted to one another.
- The particle theory states that particles are in constant motion, and move faster and farther apart when they are heated.
- Three states of matter are solid, liquid, and gas.

The skills of analysis can be used to apply the particle theory to changes in matter.

- Changes in mass observed during investigations can be explained using the particle theory.

A pure substance contains only one kind of particle, but a mixture contains more than one kind of particle.

- Aluminum, table sugar, salt, and distilled water are all examples of pure substances.
- The particles of pure substances do not change, regardless of their state of matter.
- Mixtures can be mechanical mixtures (heterogeneous mixtures) or solutions (homogeneous mixtures).
- Chocolate chip cookies, steel, salad dressing, pop, and ketchup are examples of mixtures.



The skills of scientific inquiry can be used to classify matter as a pure substance or a mixture.

- Pure substances and mixtures can be identified using observation skills.
- Different properties of pure substances and mixtures can be determined by mixing them together.

A mechanical mixture contains different components that you can see.

- A granola bar, cooking oil with herbs, and a children's ball room are all examples of mechanical mixtures.
- A mechanical mixture is also called a heterogeneous mixture.

A solution is a mixture that looks like a pure substance.

- Stainless steel, clear tea, and clear nail polish are all solutions.
- A solution is also called a homogeneous mixture.

VOCABULARY

matter, p. 10
chemistry, p. 10
particle theory of matter, p. 12
solid, p. 14
volume, p. 14
liquid, p. 14
gas, p. 15
pure substance, p. 20
mixture, p. 20
mechanical mixture, p. 24
heterogeneous mixture, p. 24
solution, p. 25
homogeneous mixture, p. 25

CHAPTER 1 REVIEW

The following icons indicate the Achievement Chart categories: K/U Knowledge/Understanding T/I Thinking/Investigation C Communication A Application

What Do You Remember?

1. What is matter? K/U
2. (a) List the five main ideas of the particle theory. K/U
   (b) Choose one idea of the particle theory. Draw a diagram that illustrates this idea. C
3. (a) List, compare, and contrast the three states of matter.
   (b) Give an example of matter in each of the three states. K/U
4. What are the main differences between the particles of a solid and the particles of a gas? K/U
5. (a) What is a pure substance?
   (b) What is a mixture? K/U
6. Draw a picture to show the difference between the particles of a pure substance and the particles of a mixture. K/U C
7. Is clear apple juice (Figure 1) a pure substance or a mixture? Explain your answer. K/U

Figure 1

8. Tap water contains small amounts of minerals and other chemicals. Is tap water a pure substance or a mixture? K/U
9. (a) What is a mechanical mixture?
   (b) How is a mechanical mixture different from a solution? K/U
10. Classify each of the following mixtures as a mechanical mixture or a solution:
    (a) a fruit salad
    (b) clear liquid hand soap
    (c) an oil-and-vinegar salad dressing K/U
11. List two solutions that you can drink. K/U
12. Use the particle theory to explain why you can see the different parts of a mechanical mixture, but not the different parts of a solution. K/U
13. Draw a picture to show the difference between the arrangement of particles of a mechanical mixture and the arrangement of particles of a solution. K/U C
14. Based on what you learned in this chapter, list three things that a piece of wood, a bowl of salad, and your body all have in common. K/U

What Do You Understand?

15. Classify the following materials into three groups: pure substances, mechanical mixtures, and solutions.
    (a) copper wire
    (b) iced tea
    (c) seawater
    (d) fruit salad
    (e) table sugar
    (f) salad dressing K/U
16. Jonas blew up a balloon in his room. When he took the balloon outside, it got bigger. Was it hotter or colder outside than in his room? Use the particle theory to explain your answer. K/U A
17. When an ice cube melts, do the particles of the ice cube change to a different type of particle? Explain why or why not. K/U
18. Janice says that a glass of orange juice with pulp in it is a solution. Pedro says that it is a mechanical mixture. Do you agree with Janice or Pedro? Explain why. K/U

19. Can you tell if a liquid is a pure substance or a solution by looking at it? Explain why or why not. K/U

20. Madur stirred together flour, oil, green peas, chopped onion, and some spices to make dough for pakoras. Is the final mixture a mechanical mixture or a solution? Explain why. K/U

21. (a) Jing has a brand-new, unopened bottle of ginger ale. Is the pop a solution or a mechanical mixture? Explain.

(b) Jing opens the bottle, and the pop starts to fizz (Figure 2). Is the pop a solution or a mechanical mixture now? Explain why. A

Figure 2

22. Ken added a spoonful of salt to a glass of water. He stirred until the water was clear again. What kind of mixture did Ken make? Explain your answer. K/U A

23. Tina says, "A solution can have only two different kinds of particles." Deepa says, "A solution can have many different kinds of particles." Whom do you agree with? Explain why. K/U A

24. Lakisha says, "You can have a mechanical mixture that has both solids and liquids in it." Kris says, "A mechanical mixture has to be all solids or all liquids, not both." Whom do you agree with? Give an example to explain why. K/U A

Solve a Problem!

25. Jayzee's old kettle developed a crusty white layer on the inside after years of boiling tap water (Figure 3). The white solid would not wash out, even with soap and water.

Figure 3

(a) What may have caused the white solid to build up on the inside of the kettle? T/I

(b) If Jayzee buys a new kettle, what could she do to prevent the same white solid from building up in this kettle as well? A

Create and Evaluate!

26. Create a rap, rhyme, or jingle describing the particle theory, then explain how well your rap, rhyme, or jingle describes the particle theory. K/U A C

Reflect on Your Learning

27. In this chapter, you learned about pure substances, mechanical mixtures, and solutions.

(a) Which of these three things do you find the easiest to understand? Explain why.

(b) Which of these three things do you find the hardest to understand? Explain why.

(c) What can you do to help you understand these three things better?

28. Think back to the Key Question on the first page of this chapter.

(a) In a brief paragraph, answer the Key Question. You may use diagrams.

(b) Write one or two more questions about the topic of this unit that you would like to explore.