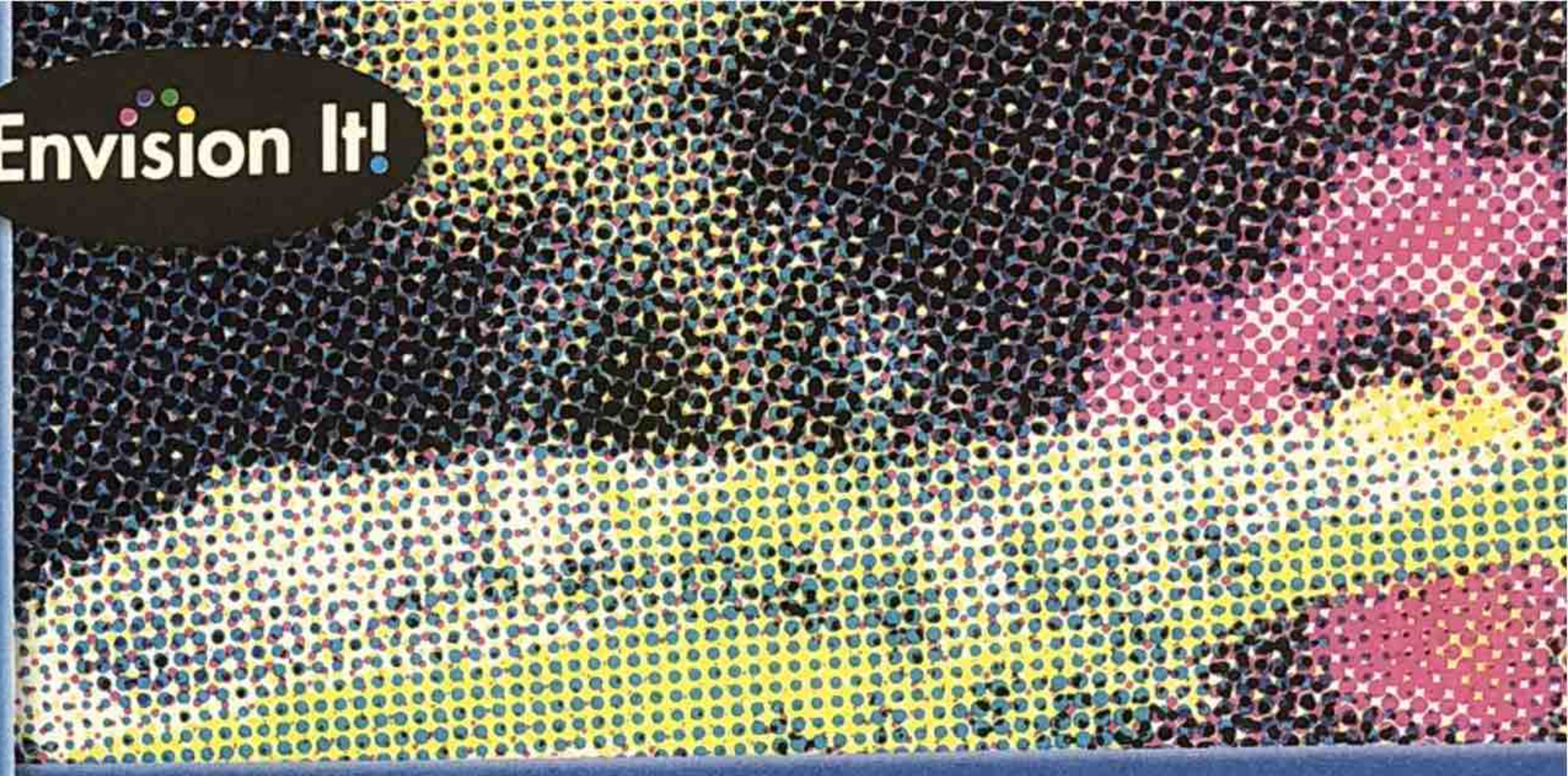
Lesson 1

What makes up matter?

Envision It!



Stand back and look at this picture from a distance. **Tell** what colors you see.

MY PLANET DIARY

FunFact

Have you ever noticed how nice it smells when you walk into some buildings? There is a type of air freshener that comes in solid lumps, about the size of a soap bar. These scented lumps do not melt at room temperature, but microscopic particles of them become loose and are released into the air, where we can enjoy their fragrance. If you keep these particles in a closed container, they will slowly collect on the sides, forming beautiful crystals. The shape of the crystals changes from one week to the next, depending on the temperature of the room.

Describe what you think would happen over time to this air freshener if you left the container open.

Now look at the dots closely. **Tell** what colors you see.

UNLOCK THE BIG ?

I will know that all things are made of very small particles called atoms and molecules, which cannot be seen without magnifying instruments.

Words to Know

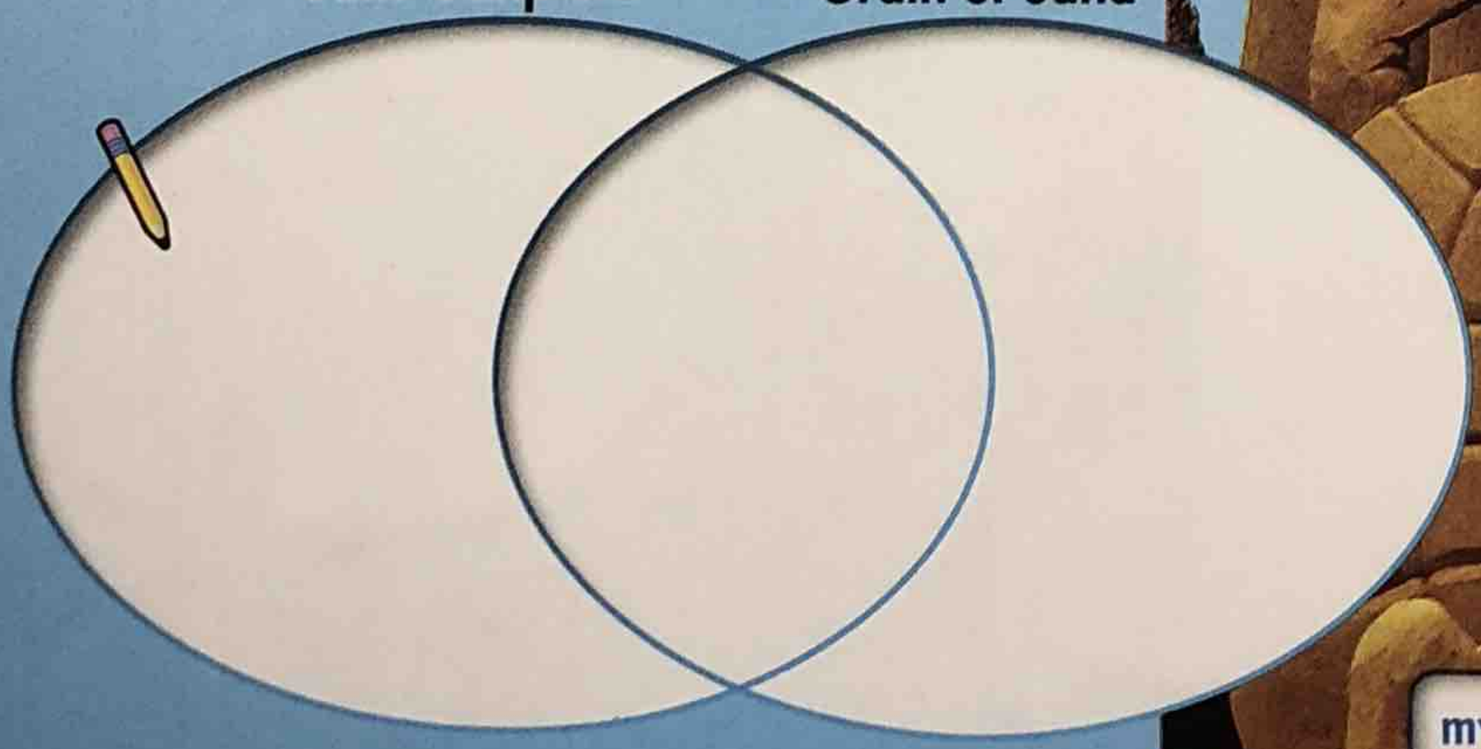
atom
atomic theory
compound
molecule

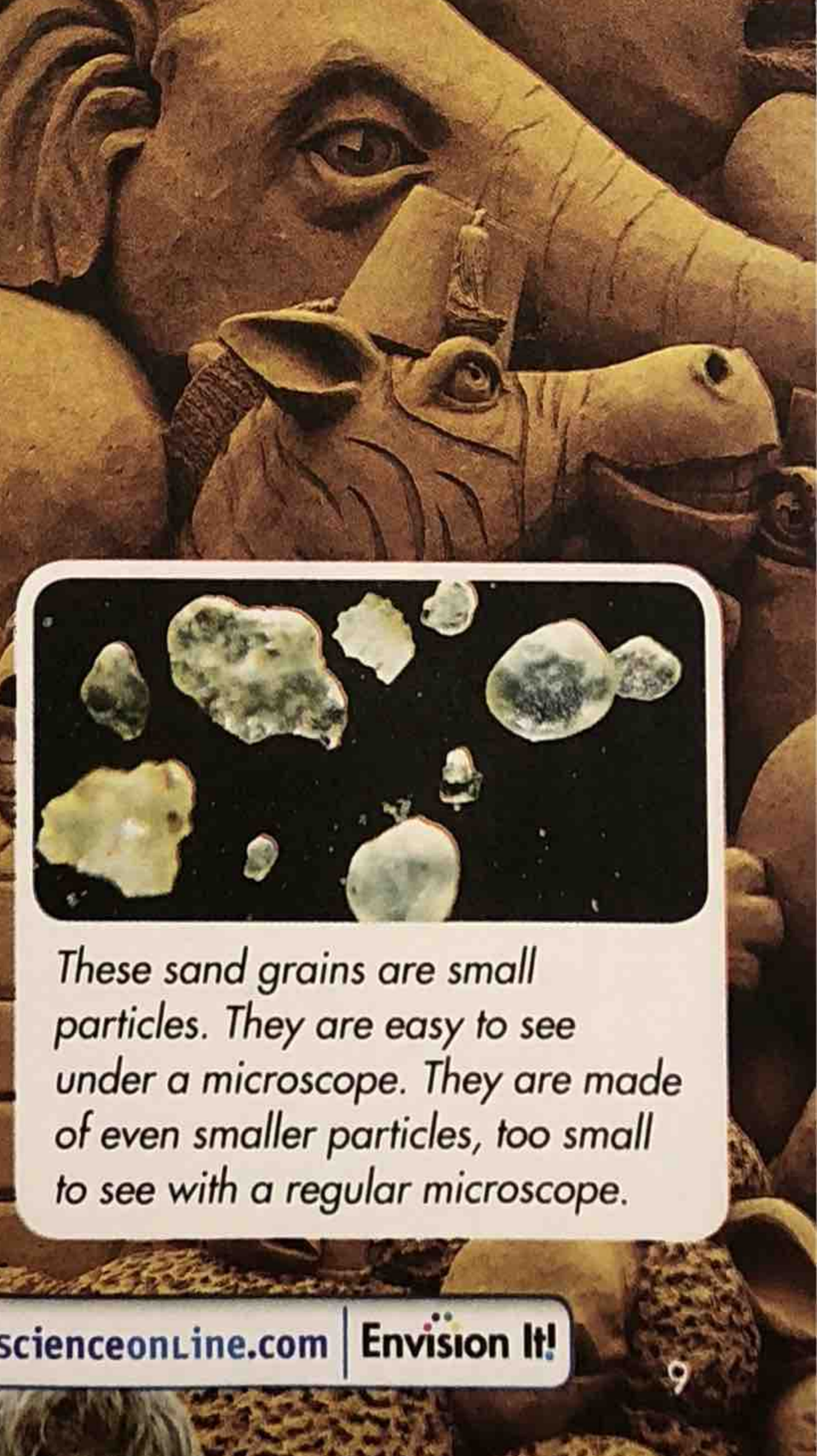
Matter

Like ice, water, and air, you are made of matter. All living and nonliving things are made of matter. Matter is anything that has mass and takes up space. Mass is the amount of matter in an object. Matter includes the food we eat, our homes, our furniture, the sun, the moon, and this book.

A large sand sculpture is made of matter. It takes up a lot of space. It has a large mass. But if you look at it closely, you will see that it is made of tiny sand grains. A sand grain is also made of matter. It is gritty and tan colored, like the sculpture. But unlike the sculpture, a sand grain has a small mass and it does not take up a lot of space. All matter is made of tiny parts.

1. **Compare and Contrast** Use the graphic organizer below to describe how a sand sculpture and a grain of sand are alike and different.





These sand grains are small particles. They are easy to see under a microscope. They are made of even smaller particles, too small to see with a regular microscope.

Elements

You can probably think of many kinds of food, many different medicines, or several types of fabric. Have you ever wondered how many different kinds of matter exist?

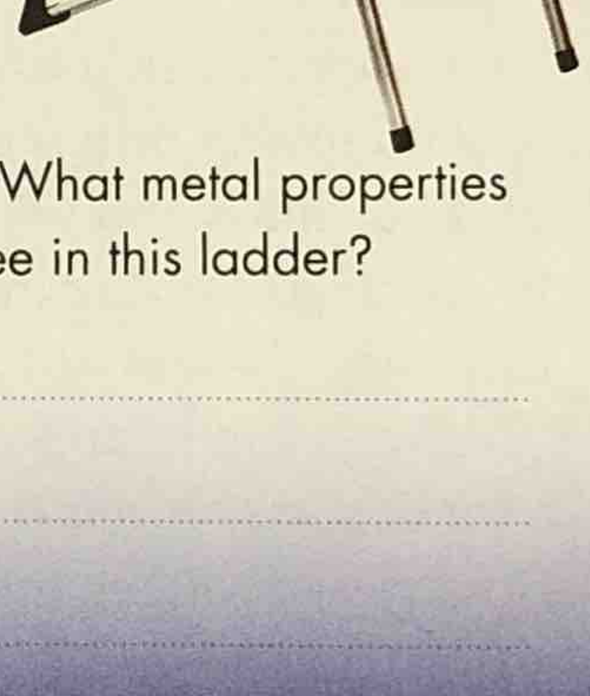
The world around you is made of thousands of materials, but all these materials are made of the same basic kinds of matter, called elements. Elements are the ingredients that make up all the other substances. Elements cannot be broken down into other substances with ordinary physical or chemical processes.

There are over 100 elements. Each element has specific characteristics. Each element will react in its own way with other elements.

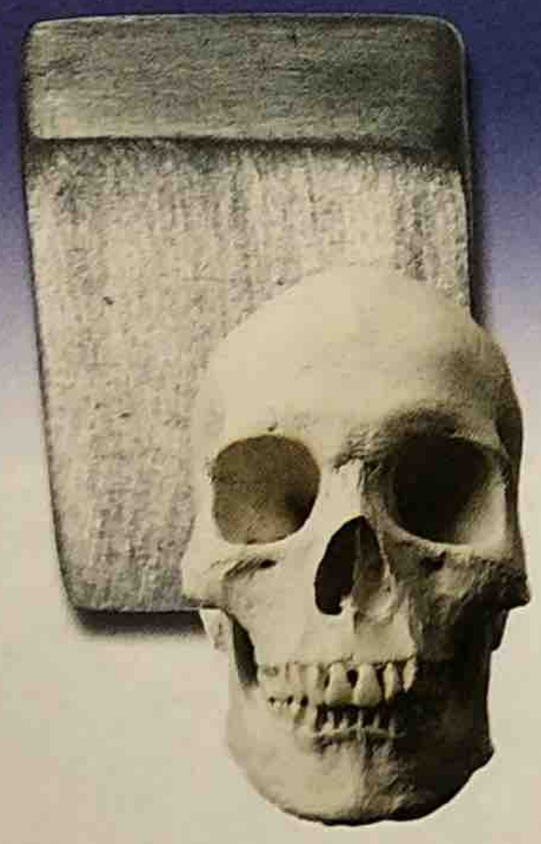
Metals

Most elements are metals. Metals are good conductors of electricity and heat. They can be shaped into sheets or wires that can bend without breaking. Most metals, such as iron, are solids and have a gray color. Smooth metal surfaces can reflect light, which makes them appear shiny.

Aluminum *is light and strong. It is used to make ladders, airplane parts, and other items that need to be strong without being heavy.*



3. Identify What metal properties can you see in this ladder?



Calcium *is important for strong bones. You get calcium from food, but pure calcium is a metal! The calcium in food is combined with other elements. Dairy products can be good sources of calcium.*

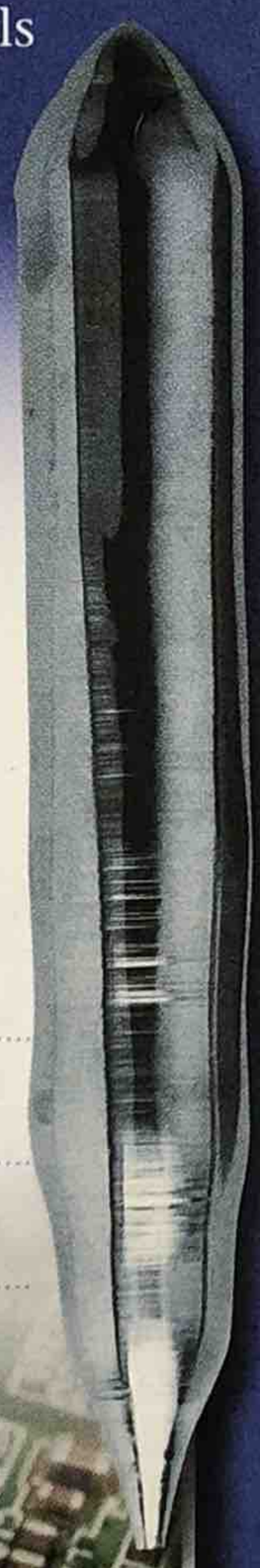
2. List Write one food that is probably rich in calcium.

Mercury *is a liquid metal. It has many uses. For example, it can be used in thermometers and in energy-saving light bulbs. Mercury is toxic and must be handled with care.*

Nonmetals and Semimetals

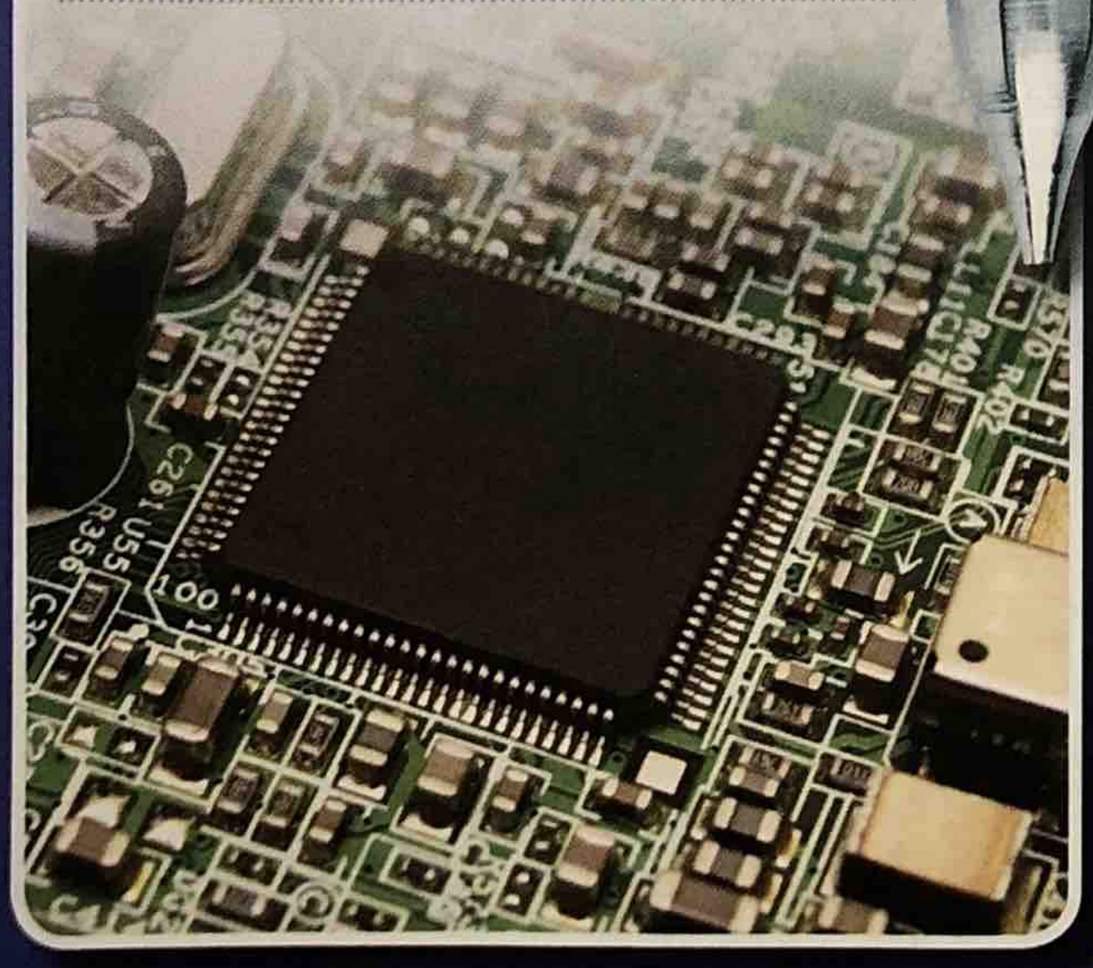
Elements that do not conduct heat or electricity very well are called nonmetals. Some nonmetals are gases. One example is the oxygen you breathe. Other nonmetals, such as carbon, are solid.

Semimetals are elements that are sometimes like metals and sometimes like nonmetals. For example, they may conduct electricity, but only when light is shining on them. One of the most useful semimetals is silicon.



Silicon *can be obtained from sand. The rod on the right is made of purified silicon. It will be used to make chips for electronic devices such as pocket calculators and computers.*

4. Give an Example What other electronic devices might have silicon chips inside?



Sulfur *is a solid nonmetal. It can be found in nature as a mineral. Sulfur is brittle and burns easily. Sulfur compounds are used to make matches.*

5. Interpret What would happen if you tried to break down a sample of sulfur?

Neon *belongs to a group of elements called the noble gases. These gases usually do not combine with other elements. Neon is used in neon signs.*

Atoms

The smallest part of an element that still has the properties of the element is called an **atom.** Atoms are too small to be seen with a regular microscope, but special instruments can show how atoms are arranged.

The atoms of each element are different from the atoms of other elements. However, the atoms of all elements have something in common. They are made of the same three types of particles—protons, neutrons, and electrons.

The number of protons determines what element an atom will be. For example, an atom of carbon always has six protons. No other element has atoms with six protons. Carbon atoms usually have six neutrons and six electrons as well, but some atoms of carbon may have different numbers of electrons and neutrons. As long as an atom has exactly six protons, it will be an atom of carbon.

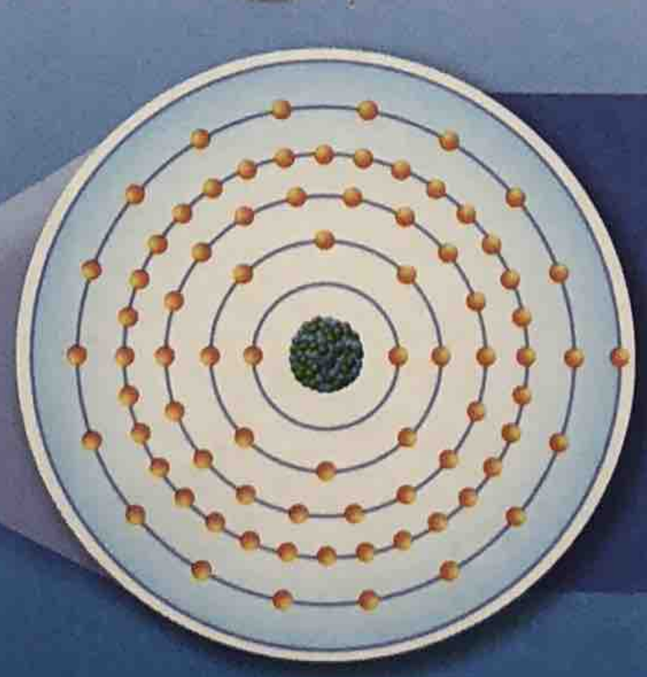
Since all substances are made of elements and all elements are made of atoms, all the matter around you is made of atoms. The idea that everything is made of small particles is known as the **atomic theory.**

6. List What types of particles make up a carbon atom?

7. CHALLENGE Draw what you think a carbon atom might look like. Use the gold atom below as a model.

Gold *is a pure element. All gold is made of the same type of atoms. Every atom of gold has exactly 79 protons.*

This image shows how atoms in a solid are tightly packed.



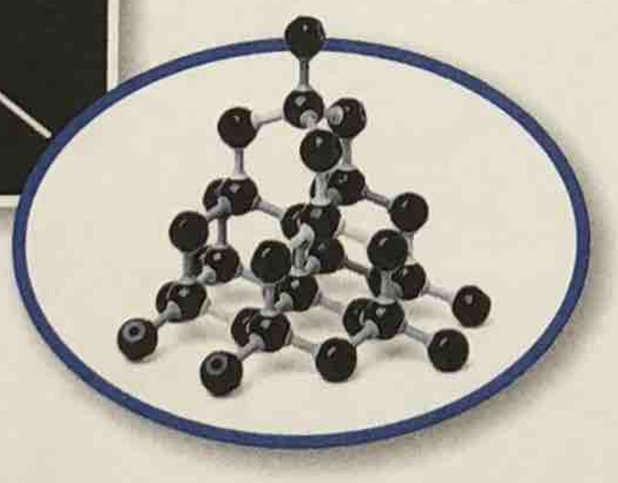
Protons and neutrons cluster at the center of the atom. This cluster is called the nucleus. Electrons move around the nucleus.

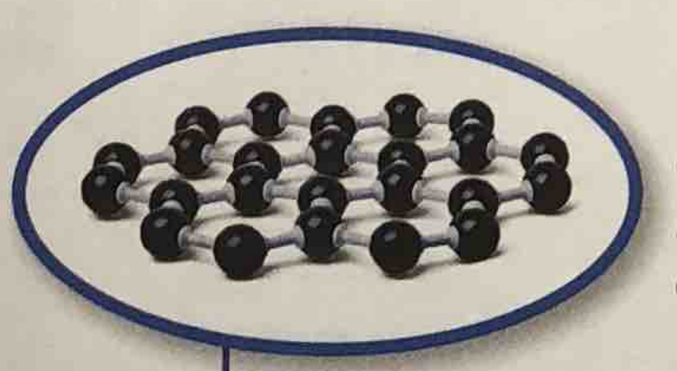
Atomic Arrangement

Atoms are often connected to other atoms in specific ways. The way atoms are connected affects the properties of an element. For example, when carbon atoms are connected as flat sheets, the carbon is soft and black. This form of carbon is called graphite. If the same carbon atoms are connected as pyramids, they form diamonds. Unlike graphite, diamonds are transparent and very hard. However, diamonds and graphite are both made of carbon atoms.

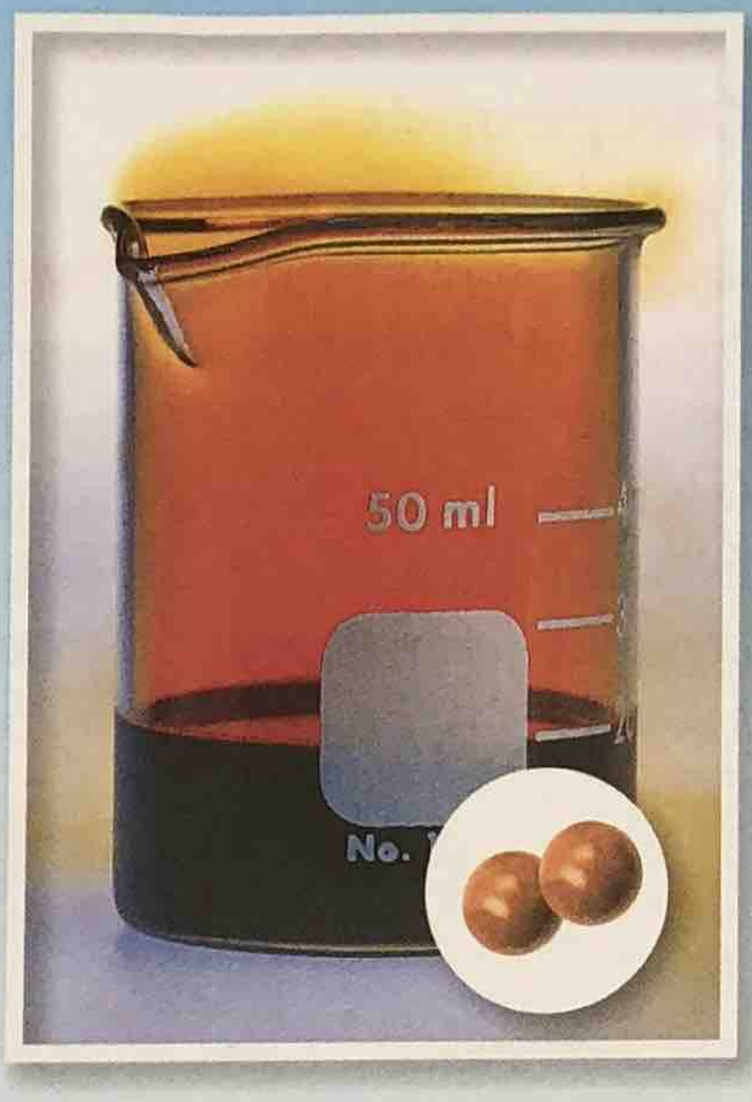
8. **Compare and Contrast** Tell how a diamond and a piece of graphite are alike and different.

Diamonds are used to make jewels. The model below shows how carbon atoms are connected in a diamond.





The "lead" of a pencil is made of graphite. The model on the left shows how carbon atoms are connected in graphite.



Bromine is an orange-red liquid. It evaporates easily. Its atoms are connected in pairs.

9. **Infer** In the picture above, do you think there are more atoms of bromine in liquid or gas form?

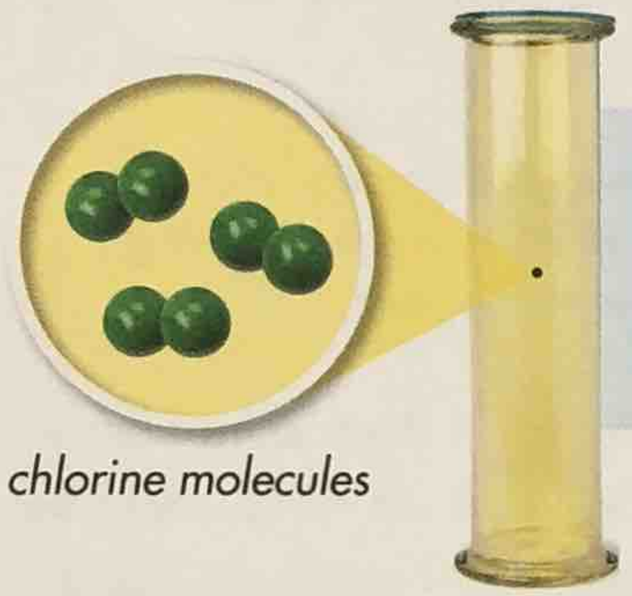
Lightning Lab

Letters and Atoms
There are more than 100 kinds of atoms. Most arrangements are not possible, but there still are millions of ways to combine atoms. Write the letters *A*, *B*, *C*, *D*, and cut them out. How many ways can you put them in order? (Examples: *DBCA*, *CADB*)

Compounds

Most things around you are compounds. A **compound** is a type of matter made of two or more elements. In a compound, the atoms of these elements are joined together in a particular way. Table salt is an example of a compound. It is made of the elements sodium and chlorine.

When elements come together to form a compound, the compound is not simply a mixture of elements. It is a new substance. It is different from its ingredients.

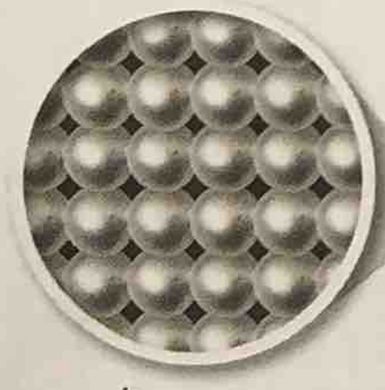


chlorine molecules

Chlorine *is a poisonous gas. It is greenish-yellow. Chlorine reacts strongly with sodium.*

Table salt *is white and solid. It is not poisonous. Chlorine and sodium combine to form ordinary table salt.*

sodium chloride



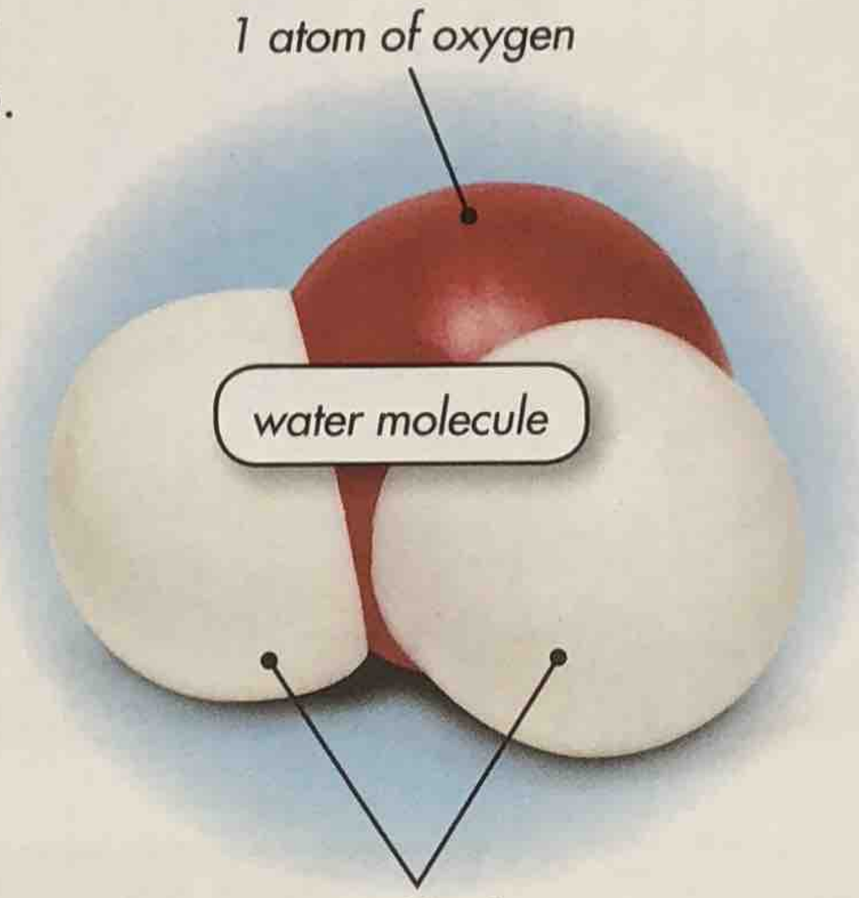
sodium atoms

Sodium *is a soft metal. It can be cut with a knife. It reacts strongly with chlorine.*

10. Contrast List two ways in which salt is different from chlorine.

The smallest particle of a compound that still has the properties of that compound is called a **molecule.** For example, the smallest particle of water is a water molecule. A water molecule only has three atoms, but other molecules, like those of sugar, may have many atoms.

Changing the number, kind, or position of the atoms in a molecule would result in a molecule of a different substance. For example, a water molecule always has one atom of oxygen and two atoms of hydrogen. Adding an extra oxygen atom would turn a water molecule into a molecule of a different substance.



11. Calculate Suppose you count all the hydrogen atoms in a group of water molecules. There are 8 hydrogen atoms in total. How many water molecules are in the group?

Got it?

12. Explain What makes up matter? Use the definition of atomic theory to answer.

13. UNLOCK THE BIG ? A scientist is combining two gray elements. He thinks he will get a gray compound. Use what you learned in this lesson to explain why this prediction may not be correct.

Stop! I need help with .....

Wait! I have a question about .....

Go! Now I know .....

Lesson 2

How can matter be described?

Envision It!

- ☐ Colorful
- ☐ Lighter than air
- ☐ Pointed nose
- ☐ Smooth surface

Four properties are shown. **Check** the one that you think allows the blimp to float in air.

Inquiry Explore It!

What are some properties of solids?

- ☑ **1.** **Observe** the sand and salt. Use a hand lens.
- ☑ **2.** Put 1 spoonful of sand into both Cup A and Cup B. Put 1 spoonful of salt into both Cup C and Cup D.
- ☑ **3.** Fill each cup halfway with water. Stir only Cup A and Cup C. Observe.

Explain Your Results

4. What properties did you **observe**?

Materials

Be careful!

Wear safety goggles. Do not taste.

5. Identify the substance that dissolved. What helped it dissolve? Which substance did not dissolve?

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I will know how to compare and contrast solids, liquids, and gases by using their basic properties.

Words to Know

mass
volume
temperature

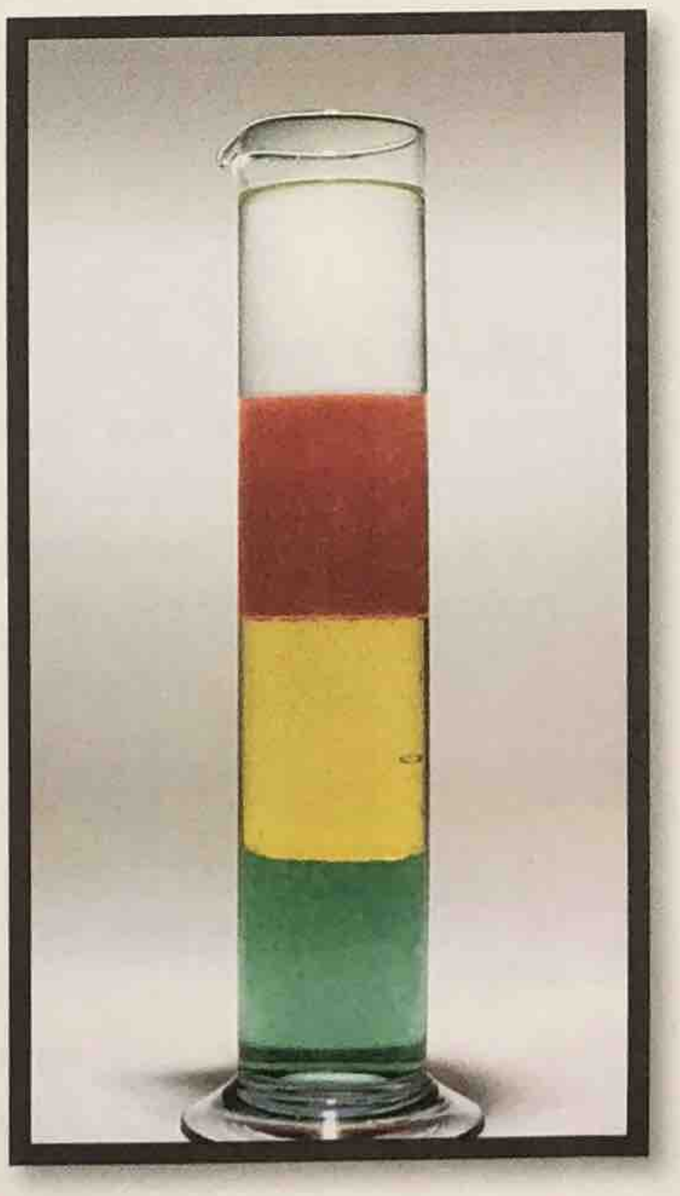
Color

Many solids and liquids have color. Some gases also have color. Color is a physical property of matter. Every solid, liquid, and gas has its own set of physical properties. The physical properties of a material can be observed, described, and measured without changing the material.

Some properties can be measured with tools such as rulers, thermometers, and balances. Color is very useful because you can determine the color of a piece of matter just by looking at it, and color often helps you determine the kind of matter you are looking at, or the state or condition of that piece of matter.

1. Describe The glass cylinder to the right contains a column of liquid. What can you learn from looking at the colors?

The liquids in this cylinder do not mix. They float on top of each other.



Solid iodine is dark purple, almost black. Heat turns it into a purple gas. Solid and gaseous iodine have different colors.

Mass

The amount of matter in a solid, liquid, or gas is called its **mass.** Mass is measured by using a balance, often using units of grams or kilograms.

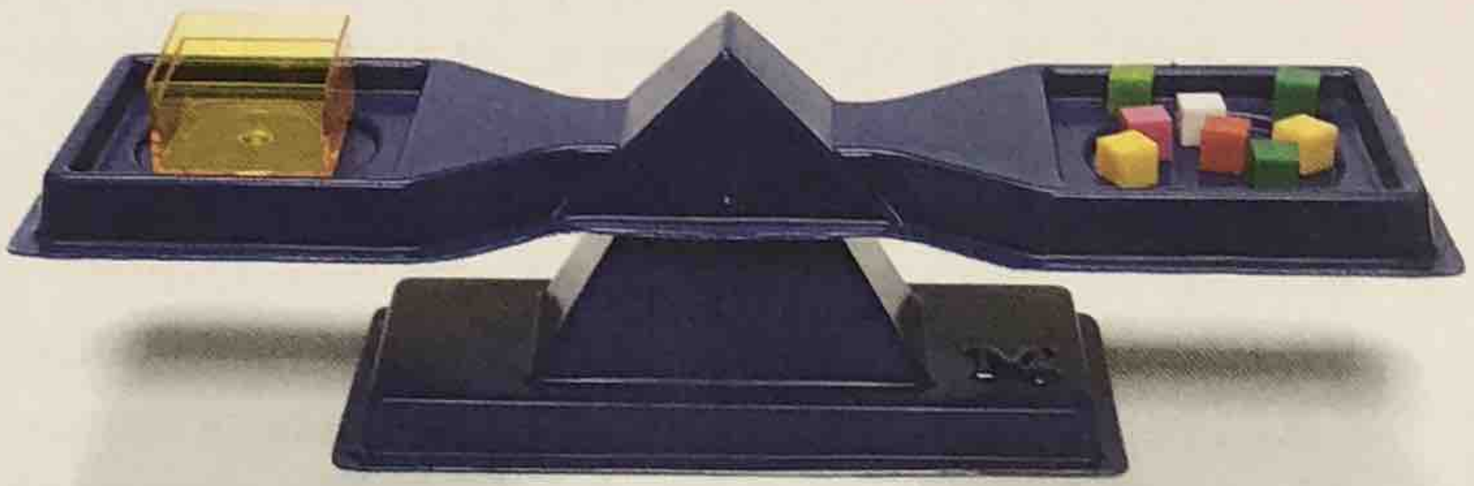
We often weigh objects to get an idea of their mass, but mass and weight are not the same thing. The weight of an object on Earth is different from its weight on Mars, but the mass of the object is the same on both planets.

To find the mass of a solid, such as a toy car, you place the object on one side of a balance. On the other side, you place objects of known mass, such as gram cubes. When the two sides balance each other, the total mass of all the known masses equals the mass of the object.

2. Find Out Look at the balance that has water. Count the cubes. What is the mass of the water inside the container?

Solid

The empty container on the left has a mass of 8 g. We know this because it takes 8 cubes to balance it. Each cube has a mass of 1 g.



Liquid

Now the container has water. More cubes are needed to balance the extra mass. These extra cubes match the mass of the water.

Gas

Gases have mass. This inner tube has more mass when it is pumped full of air than when it is flat.

Volume

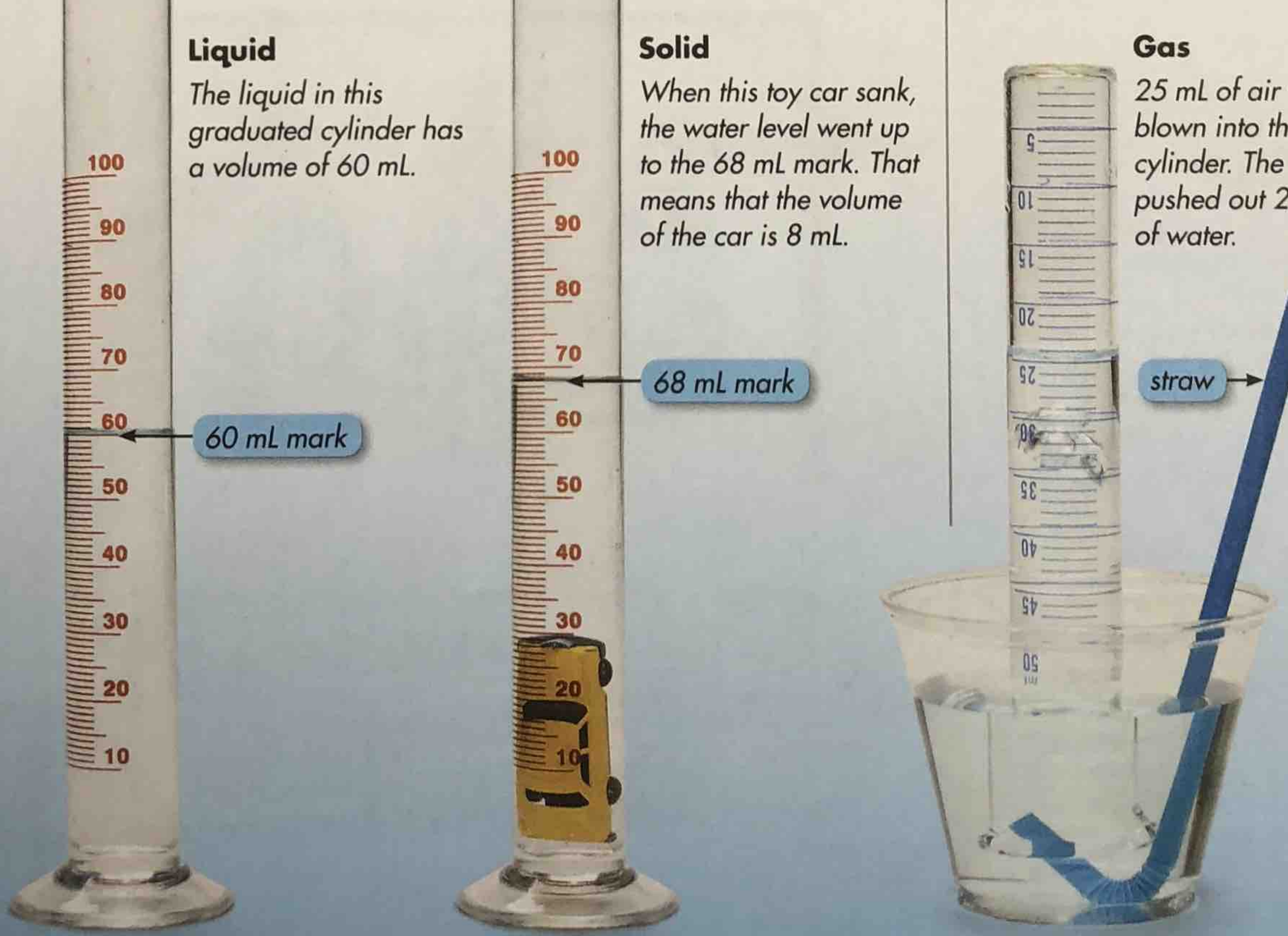
The amount of space an object takes up is its **volume.** Volume can be measured in milliliters (mL).

You can use a graduated cylinder to find the volume of a liquid. You just pour the liquid into the cylinder and read the volume off the scale, at the surface.

Solids also have volume. If you put liquid in a graduated cylinder and let a solid object sink in the liquid, the solid takes up some space. The liquid that was in that space is forced to go up. The change in the height of the liquid column tells you the volume of the solid.

Gases have volume. In fact, a small mass of gas can fill a large volume. You can measure the volume of a gas using an upside-down, partially submerged graduated cylinder filled with water. If you blow air into the cylinder with a straw, the bubbles will push some water out. The volume of water pushed out is the same as the volume of the gas.

3. **Compare and Contrast** Look at the picture below. Explain how the mass and volume of the air in the tube and the water that was pushed down are alike and different.



Liquid

The liquid in this graduated cylinder has a volume of 60 mL.

Solid

When this toy car sank, the water level went up to the 68 mL mark. That means that the volume of the car is 8 mL.

Gas

25 mL of air was blown into this cylinder. The air pushed out 25 mL of water.

Lightning Lab

Do I Need a Thermometer?

Rub a few drops of water and a few drops of cooking oil on the back of your hand. Does one liquid feel colder? Do you get a different result if the oil and water are stored in bottles in the same cabinet for a while, so that they really have the same temperature?

Temperature

The **temperature** of an object is a measure of how fast its particles are moving. The higher the temperature, the faster the particles move. We cannot see the particles that make up the object, but we can tell when they are moving faster because the object becomes hotter.

There are different scales for measuring temperature. In science books, you may find the melting point of a solid in degrees Celsius (°C). In a recipe, you may find a cooking temperature given in degrees Fahrenheit (°F).

Knowing the temperature of solids, liquids, and gases is very useful. For example, the water in a fish tank needs to be kept at the right temperature. A weather report gives us the temperature of the air. And the temperature of your body can help monitor a health problem.

4. Infer Look at the sink below. **Circle** the handle that you should turn on to lower the temperature of the water. Write an X on the handle you should turn off to lower the temperature of the water.

The sun heats the solid pavement. The hot pavement heats up the air closest to it, producing a shimmering effect that looks like water.

Texture

When you touch a solid object, you can feel if it is hard, smooth, lumpy, grooved, spongy, or rough. This surface structure that you can feel by touching a material is its texture.

You can also feel the texture of a liquid by rubbing a drop between two fingers. A drop of shampoo may feel soapy. A drop of oil will feel oily. Other liquids may feel slimy, sticky, or thick. For example, people who make soap may use the texture of the liquid mixture of ingredients to decide when it is ready for the next step in the process.

5. List Write two surfaces with a smooth texture and two surfaces with a rough texture.

The rough texture of sandpaper can scratch other materials.

Many stones can be polished to give them a very smooth texture.

Liquid soap feels slippery.

Got it?

6. Analyze A heavy brick weighs more than a fluffy cushion, but the cushion takes up more space. Which object has more matter? How do you know?

7. UNLOCK THE BIG Which property might be more useful to tell two materials apart: their mass, their temperature, or their color?

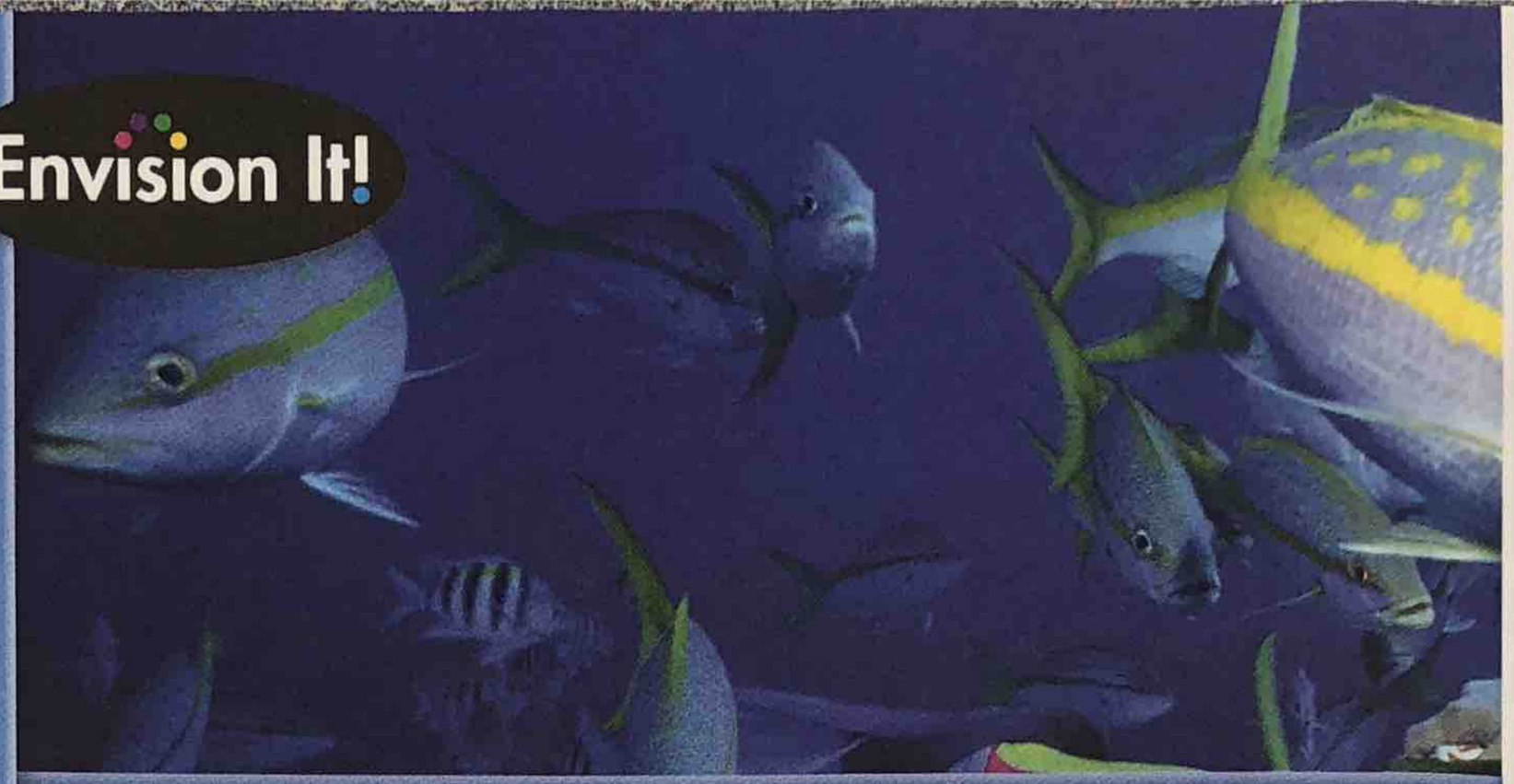
Stop! I need help with .....

Wait! I have a question about .....

Go! Now I know .....

Lesson 3

What are solids, liquids, and gases?



Envision It!

Where are some solids, liquids, and gases in the picture? Tell how you know.

Inquiry Explore It!

How can water change state?

- [ ] **1.** Stick a straw halfway inside a bag. Seal the bag up to the straw.
- [ ] **2.** Slowly exhale through the straw. Remove the straw and seal the bag shut.
- [ ] **3.** Lay the bag on dark paper under bright light. Use a hand lens to **observe.**

Materials

Explain Your Results

4. Communicate What did you **observe**? Explain.

Be careful! Do not use a straw that someone else has used.

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UNLOCK THE BIG QUESTION

I will know some basic properties of solids, liquids, and gases.

Words to Know

solid
liquid
gas

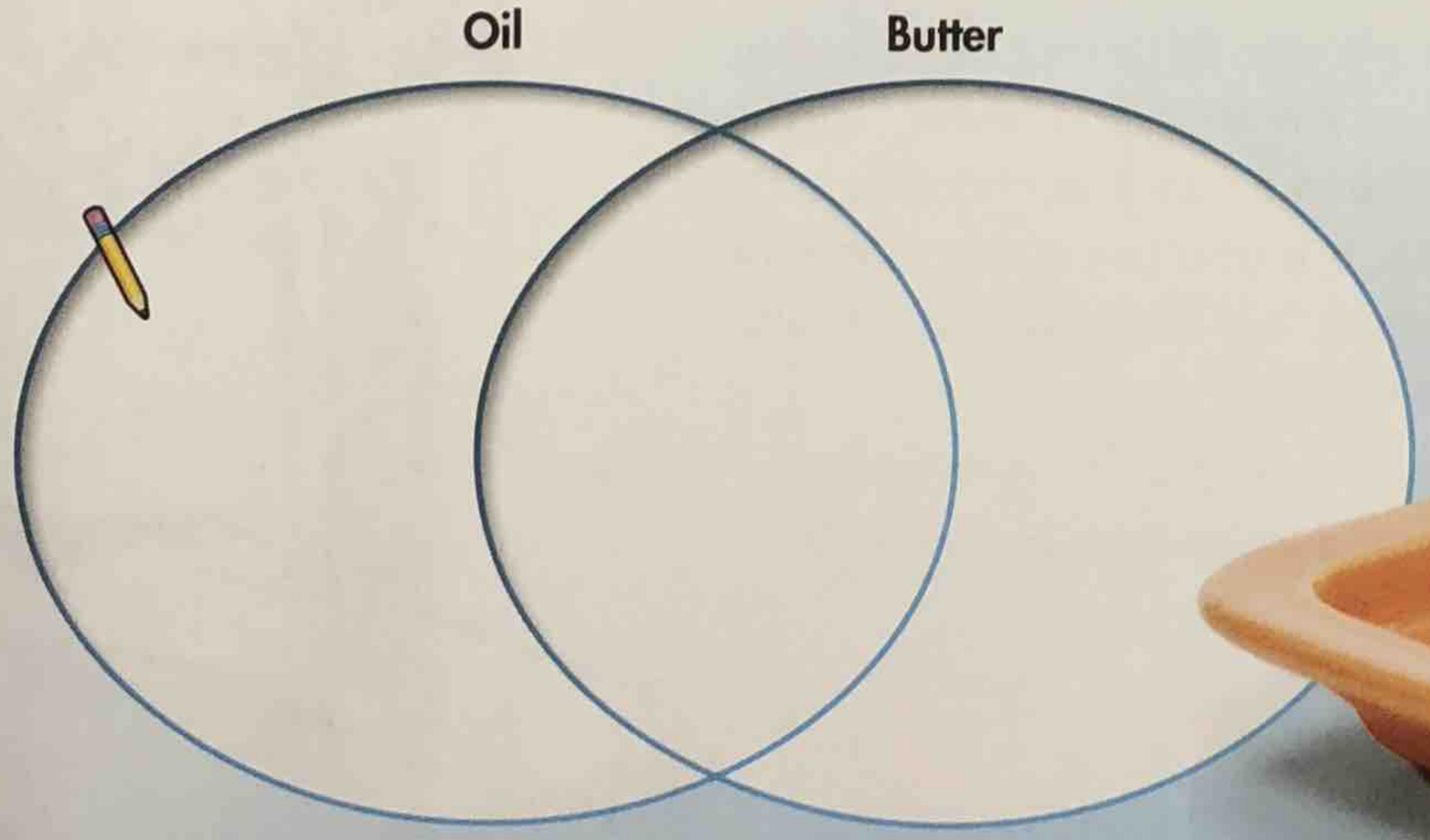
States of Matter

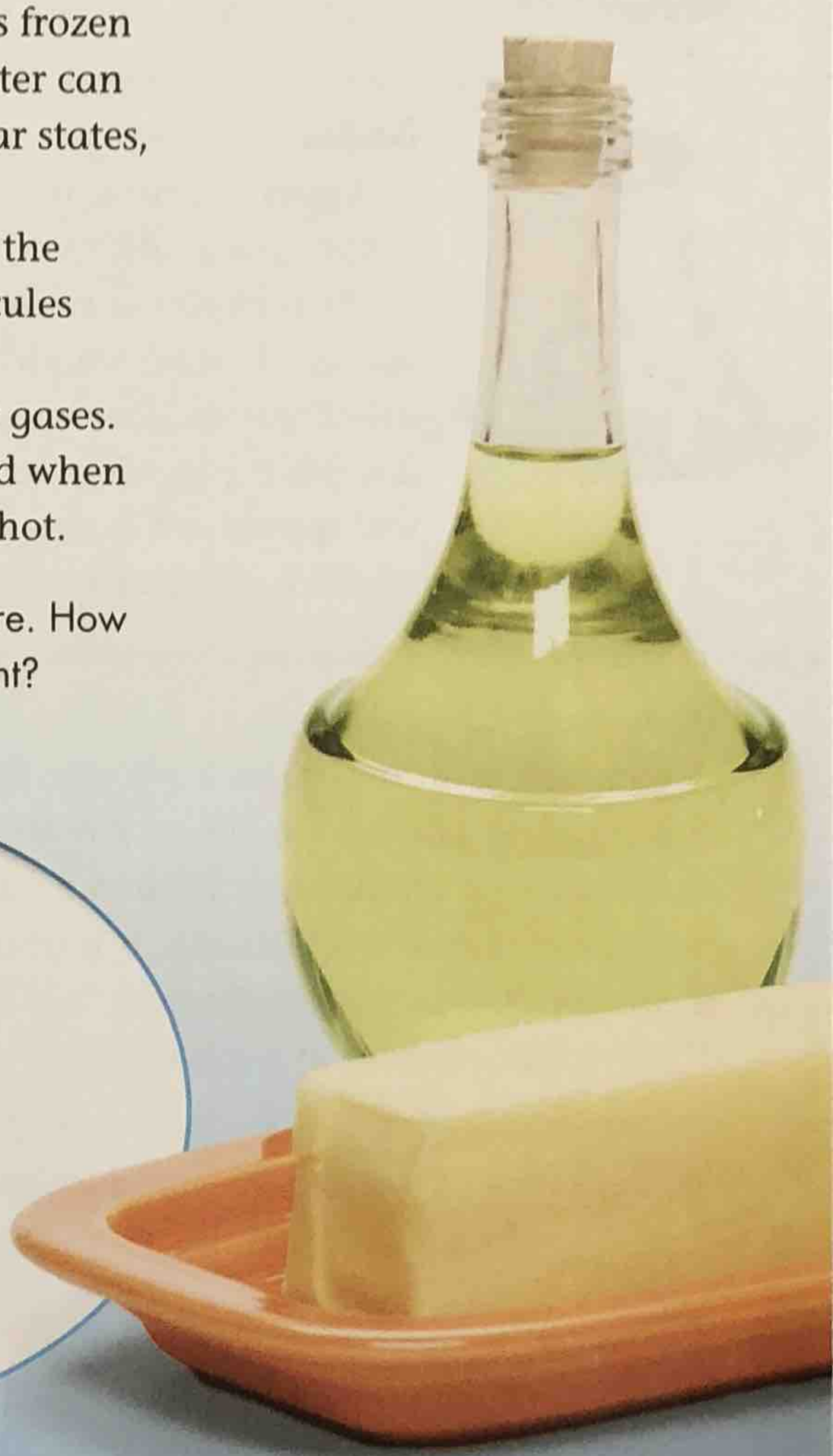
Water has three forms. Water is a solid when it is frozen as ice. Water is a liquid in the ocean. In the air, water can be a gas. Solid, liquid, and gas are the most familiar states, or phases, of matter.

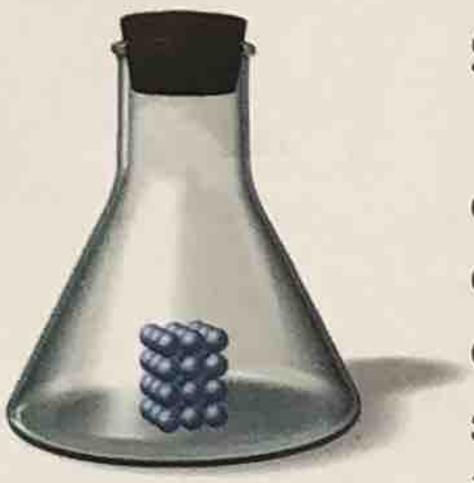
The phase of water, or of any material, is due to the motion and arrangement of its particles—its molecules or its atoms. The particles are always moving.

Most materials around you are solids, liquids, or gases. For example, cooking oil is a liquid. Butter is a solid when it is cold, but butter can turn into a liquid if it gets hot.

1. **Compare and Contrast** Look at the picture. How are the solid butter and liquid oil alike and different?

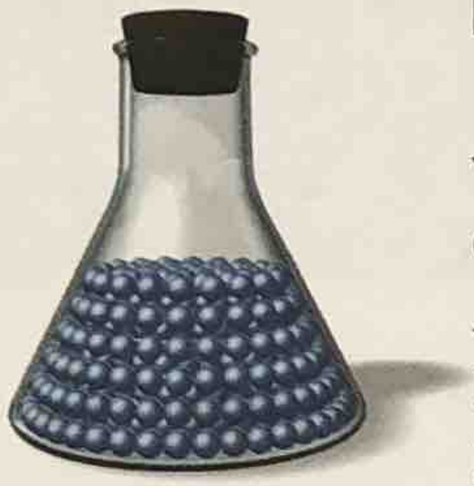






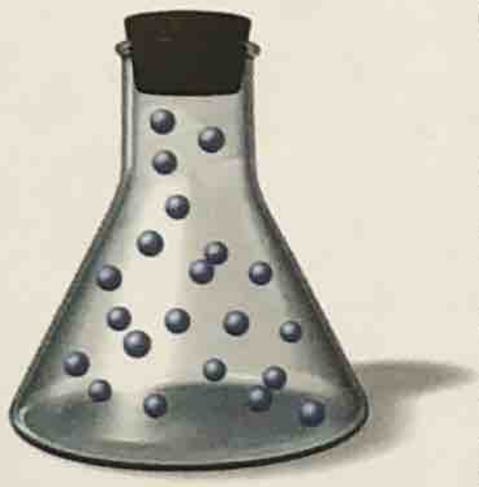
Solids

A **solid** is a substance that has a definite shape and volume. Volume is the amount of space an object takes up. The particles of a solid are very close together. For the most part they stay in the same place. They do not slide easily past each other. However, they vibrate in place.



Liquids

A **liquid** is a substance that has a definite volume but no definite shape. The particles of a liquid can move by gliding past each other. A liquid can take the shape of its container. Forces hold liquid particles together, so a liquid keeps a definite volume.



Gases

A **gas** is a substance without a definite volume or shape. The particles of a gas are far apart compared to the particles of solids and liquids. A gas can be squeezed into a smaller volume. Gas particles only affect one another when they collide as they move. If a gas is placed in an empty container, its particles will spread out evenly. The gas will fill all the space and take the shape of that container.

Plasmas

Sometimes atoms break down into parts that have electric charges. This can happen at very high temperatures. This state of matter is called plasma. Plasma is like a gas because it has no volume or shape of its own. It is also like a metal because it can conduct electricity. The sun is made of gas and plasma. There is also plasma in neon lights.

2. CHALLENGE Describe what you think is inside a plasma TV.

Freezing and Melting

As liquids get colder, their particles slow down. At some point they stop gliding past each other and can only vibrate in place. The liquid becomes a solid. The temperature at which a material changes between solid and liquid states has two names. It is called the freezing point when a liquid turns into a solid. It is called the melting point when a solid turns into a liquid. Therefore, the melting point and the freezing point are the same temperature. This temperature is often just referred to as the melting point.

Each material has its own melting point. Therefore, the melting point can be used to help identify a material.

Some materials are more useful in their solid state than in their liquid state. For example, lead is a metal that is dense. Solid lead is used to weigh down or sink fishing hooks.

This lead fishing sinker is solid metal. It keeps its shape and volume.

The melting point of lead is 327°C. At this temperature, solid lead becomes liquid and can be poured into molds to give it any shape we want.

3. Compare What is the difference between the melting point and freezing point of a substance?

4. CHALLENGE Why might you want to consider the melting point of a substance before choosing materials for frying pans or engine parts?

5. Recognize Water has a melting point of 0°C. What is its freezing point?

Lightning Lab

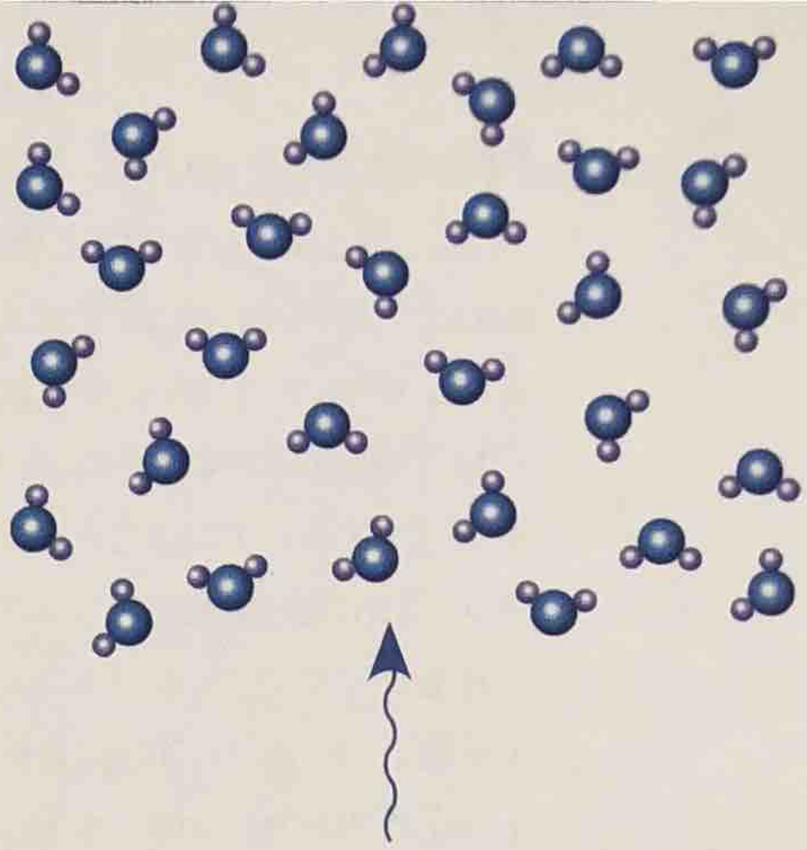
Wandering Ice

Place an ice cube on a dish and set it in a place where it will not be disturbed. Observe how long it takes for the ice cube to melt. Observe how long it takes for the water to evaporate.

Evaporation

Evaporation takes place when particles leave a liquid and become a gas. Particles evaporate from a liquid when they are at the surface of the liquid and are moving upward with enough speed. This is how rain puddles and the water in wet clothes evaporate.

If the temperature of a liquid is high enough, particles will change to a gas not only at the surface, but also throughout the liquid. As gas particles move quickly upward through a liquid, bubbles of gas form under the surface of the liquid. The boiling point of a liquid is the temperature at which this occurs.



Molecules of water evaporate from the clothes as they dry. In water vapor, the molecules of water are far apart.

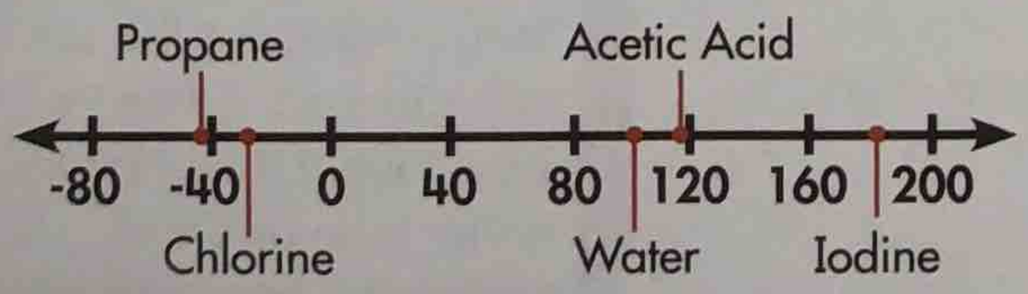
6. Explain How can clothes dry without heating them to the boiling point of water?

Do the math!

Ranges

The chart shows the temperatures at which 5 different substances change form.

Boiling Points (°C)	
Liquid	**Boiling Point**
Water	100°C
Acetic acid (found in vinegar)	118°C
Chlorine	–34°C
Propane	–42°C
Iodine	185°C



1 Which liquid has the highest boiling point?

A. Water
B. Iodine
C. Acetic acid
D. Propane

2 In which temperature range is the greatest gap between boiling points?

F. 185°C to 100°C
G. –34°C to –42°C
H. 118°C to –42°C
I. 100°C to –34°C

3 CHALLENGE Choose a common substance, such as ammonia or rubbing alcohol. Research its boiling point, and add this information to the chart. Plot the new data point on the number line.

Condensation

Condensation occurs when a gas turns into a liquid. This process often occurs when gas particles touch a cold surface and the temperature of the gas drops. Clouds in the sky and dew on the ground form through condensation of water vapor.

As air temperature decreases, the molecules of water vapor come together and condense, forming the liquid water droplets we call dew.

7. Describe What is one thing needed for condensation to occur?

8. Infer The dew on the spider's web formed before sunrise. What might this tell you about the air temperature before sunrise?

Got it?

9. Interpret A substance fills a 1-liter bottle. A scientist transfers the substance to a 2-liter bottle. The substance increases in volume and fills the new space. What is the state of matter of this substance?

10. UNLOCK THE BIG ? Why can you use the melting point to help identify a material?

Stop! I need help with .....

Wait! I have a question about .....

Go! Now I know .....

Lesson 4

What are mixtures and solutions?

Envision It!

Once per year, the Chicago River in Illinois is dyed green. What are the parts of the mixture shown in the picture?

Inquiry Explore It!

How can a mixture be separated?

- [ ] **1.** Place the paper clips and fasteners in a cup. Move the magnet around in the cup slowly. Lift out the magnet. **Observe.**
- [ ] **2.** Fill the cup with water. Observe.

Materials

5 brass fasteners

5 metal paper clips

5 plastic paper clips

magnet

water

plastic cup

Explain Your Results

3. Infer What property made it possible to separate the mixture with a magnet?

4. What property made it possible to use water to separate the mixture?

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UNLOCK THE BIG ?

I will know properties of solutions and that mixtures can be separated based on properties of their parts.

Words to Know

mixture
solution

Mixtures

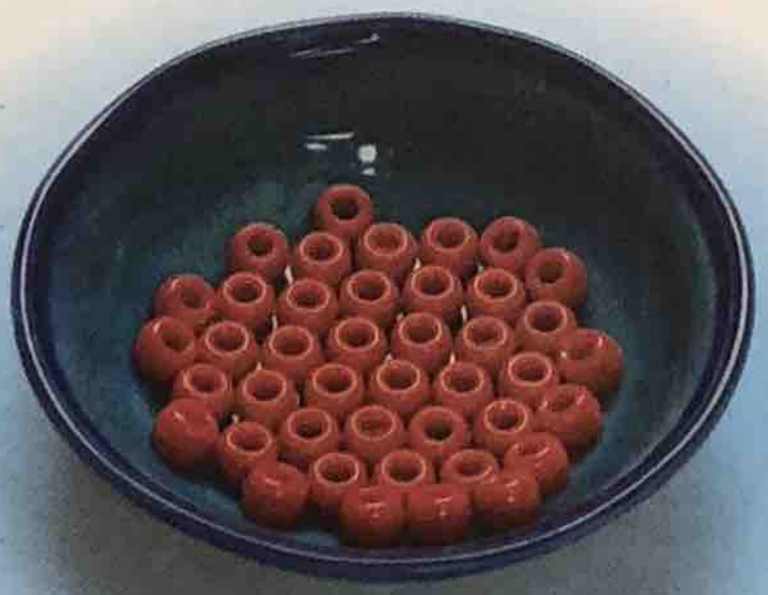
In a **mixture,** different materials are placed together but each material in the mixture keeps its own properties. If vegetables are cut and put together to make a mixture, different vegetables do not change their flavors or colors. Most foods that you eat are mixtures of different materials.

Different parts of a mixture can be separated from the rest of the mixture. Suppose your favorite breakfast is a mixture of cereal and raisins. You could easily separate out the raisins with a spoon to eat them first. The parts of a mixture may be combined in different amounts. The bowl of cereal you eat today could have more raisins than the one you ate yesterday.

The bowl of fruit is a mixture. It contains several different parts.

1. Suggest What mixture is your favorite to eat? List the parts.

2. Support Why is the bowl of beads to the right not a mixture?



At-Home Lab

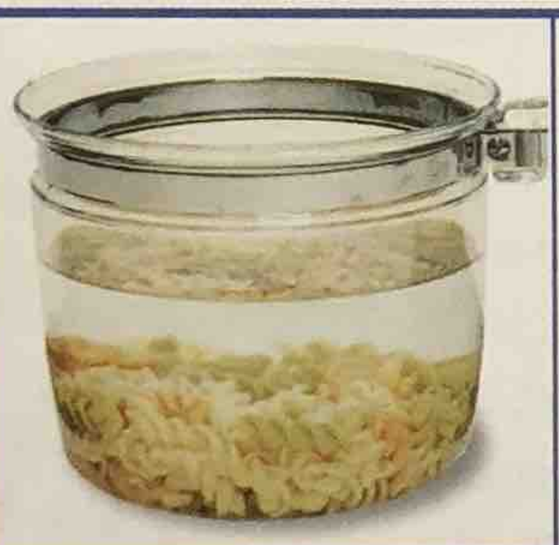
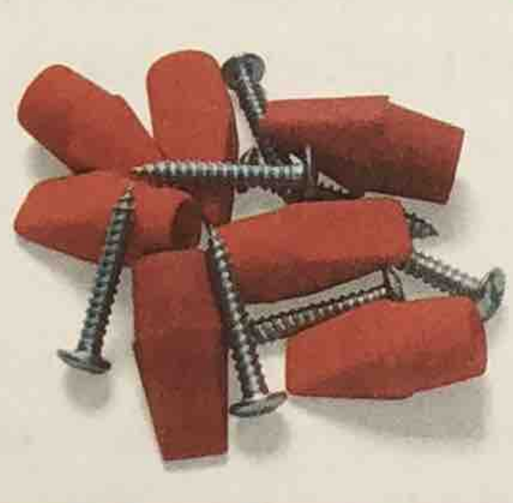
Mixed-Up Foods

Find two different mixtures you eat at home. What are the parts of the mixtures? Tell whether you would ever eat any of the parts separately.

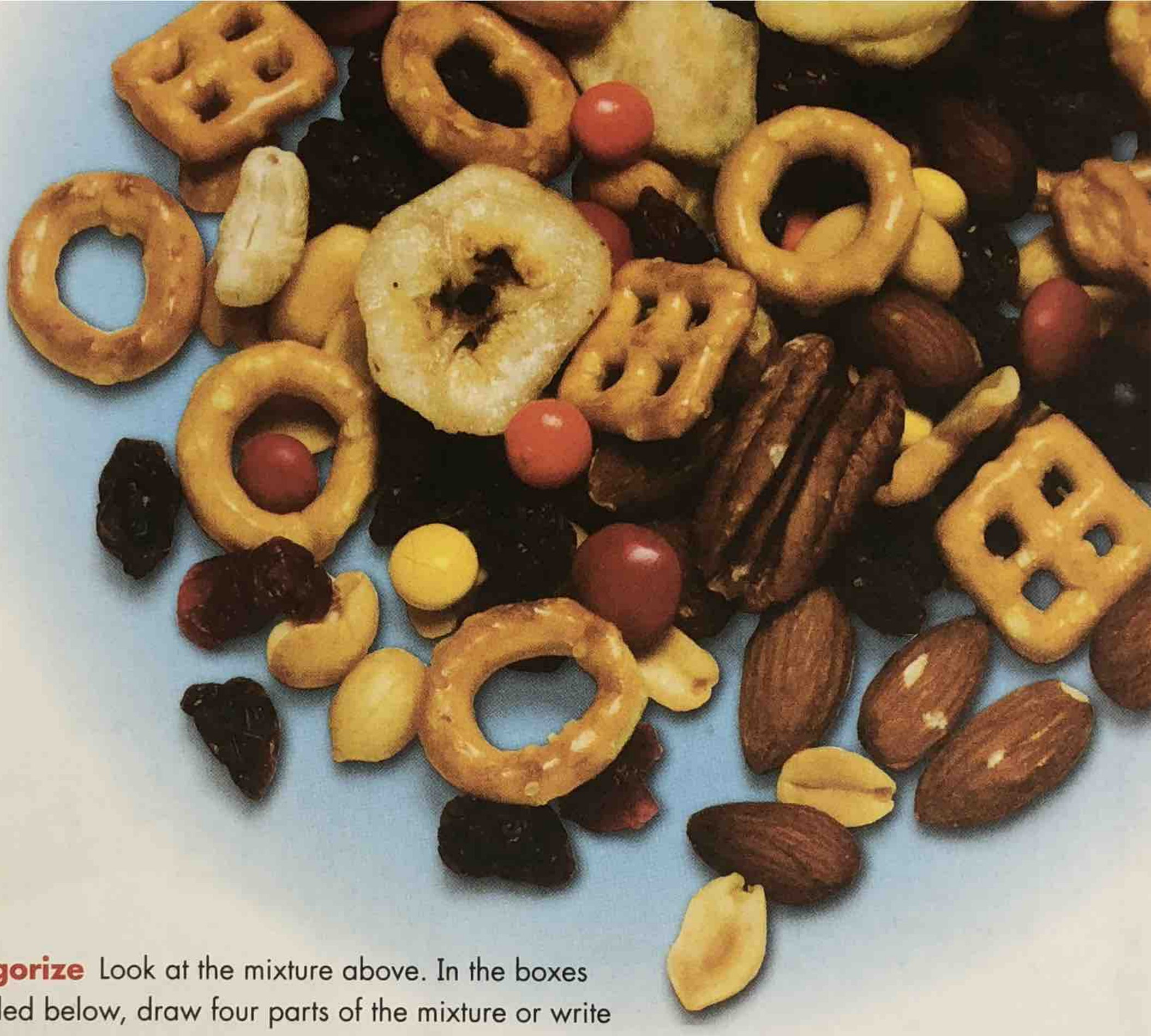
Separating Mixtures

You can use the physical properties of a substance to separate it from a mixture. The materials in a simple mixture can be separated because they have different physical properties. For example, a magnet can separate iron filings from sand. This separation happens because iron has the property of being attracted by magnets. Sand does not have that property. A screen filter can be used to separate a mixture of pebbles and sand. The smaller particles go through the screen but the pebbles do not. Sometimes you can sort the parts of a mixture by hand.

3. **Classify** Complete the chart below. Draw a mixture in the first row. Write how to separate the erasers and screws and the items in the new mixture.

Mixture			
How Can You Separate?	Pour through a strainer.		

4. CHALLENGE Suppose you had a mixture of sand and small, hollow beads. How might you separate the mixture?



5. **Categorize** Look at the mixture above. In the boxes provided below, draw four parts of the mixture or write their names.

6. **Infer** A compound forms when two or more elements combine to form a new substance with new properties. How is a compound different from a mixture?

.....

.....

.....

Solutions

A mixture in which substances are spread out evenly and will not settle is called a **solution.** In a solution, the substance that is dissolved is called the *solute*. The substance in which the solute is being dissolved is called the *solvent*. In a solution of sugar and water, the solute is sugar and the solvent is water. Water is sometimes called a "universal solvent" because it can dissolve many substances.

Solutions of a Solid in a Liquid

When a solid dissolves, individual particles separate from the solid and spread evenly throughout the liquid. You can make solids dissolve in a liquid faster by stirring or heating the solution. Grinding a solid into smaller pieces will also help it dissolve faster.

These crystals dissolve easily in water.

7. Draw what you think the mixture of purple solid and water will look like after stirring.

Other Solutions

Not all solutions are made by dissolving a solid in a liquid. Two liquids can make a solution. For example, vegetable oils used in cooking might be a solution of soybean and sunflower oils. A gas can also dissolve in a liquid. For example, water can contain dissolved oxygen and carbon dioxide gases.

8. Infer Why do you think it is important for sea organisms that some gases dissolve in water?

This toy has a colorless liquid floating on a blue-colored liquid. The colorless liquid and the plastic figures will not dissolve in the blue liquid. They are insoluble *in it.*

Solubility

Many materials can make solutions with water. You can dissolve more of some materials than others in the same amount of water. Some materials will not dissolve in water at all. This describes a material's solubility in water. Different substances can have different solubility in other solvents.

9. CHALLENGE The plastic figures in the picture are insoluble in the blue liquid. What else can you tell about their solubility?

Got it?

10. Predict To make a gelatin dessert, first you must boil water and then dissolve the gelatin powder in it. What do you think might happen if the water were not hot?

11. UNLOCK THE BIG ? Write one way you can use properties of matter to separate mixtures.

Stop! I need help with .....

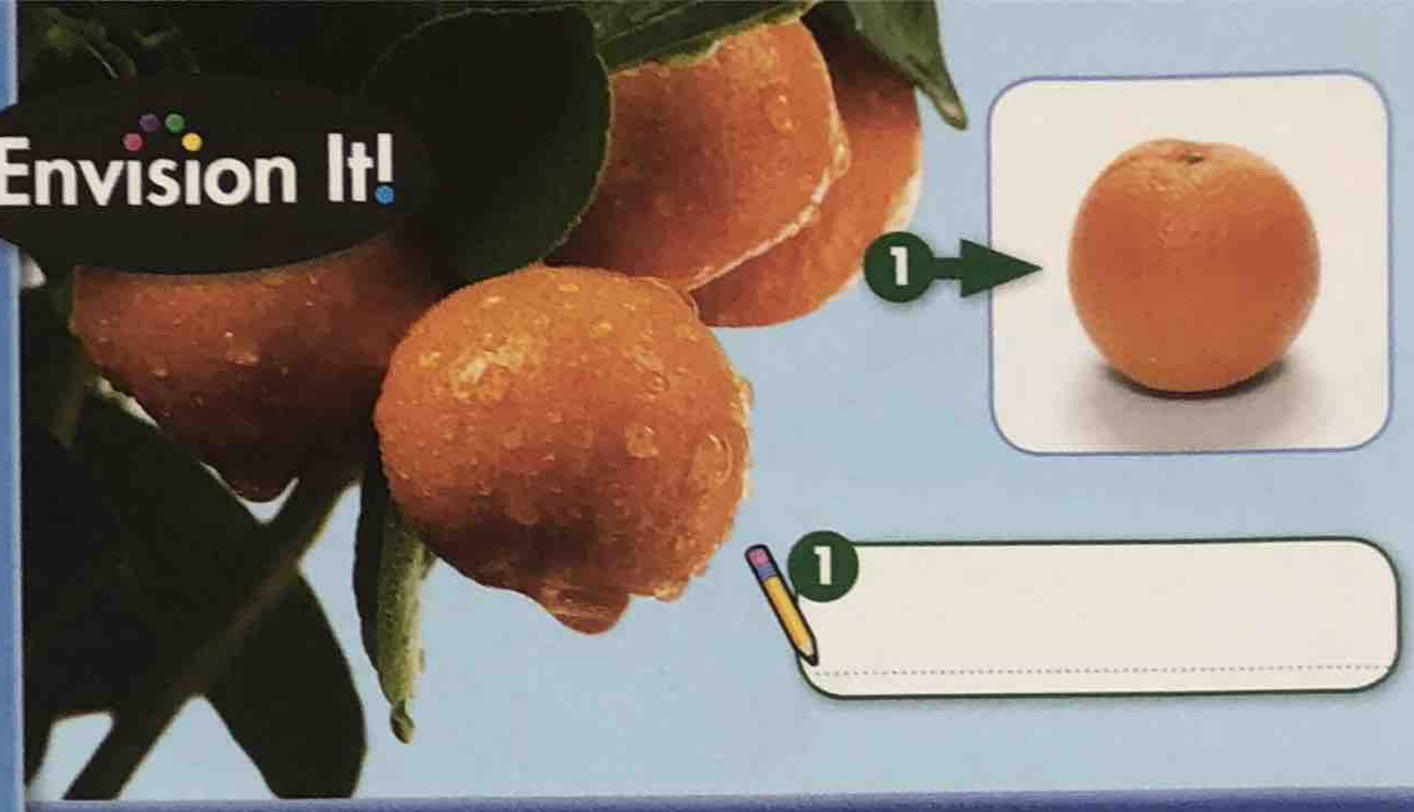
Wait! I have a question about .....

Go! Now I know .....

Lesson 5

How does matter change?

Envision It!



The pictures above show a possible series of steps in the process of preparing to eat an orange. **Label** the steps.

Inquiry Explore It!

What happens when air heats up?

- [ ] **1.** Stretch a balloon over the top of each bottle.
- [ ] **2.** Set 1 bottle in each bowl. Wait 1 minute. **Observe.** Look closely.

Explain Your Results

3. Compare your **observations** of the balloons.

4. Infer How did temperature affect the air in the bottles?

5. Was the change you observed a physical or chemical change? Explain.

Materials


2 balloons


bowl with warm water


2 plastic bottles


bowl with room-temperature water


timer, stopwatch, or clock with second hand

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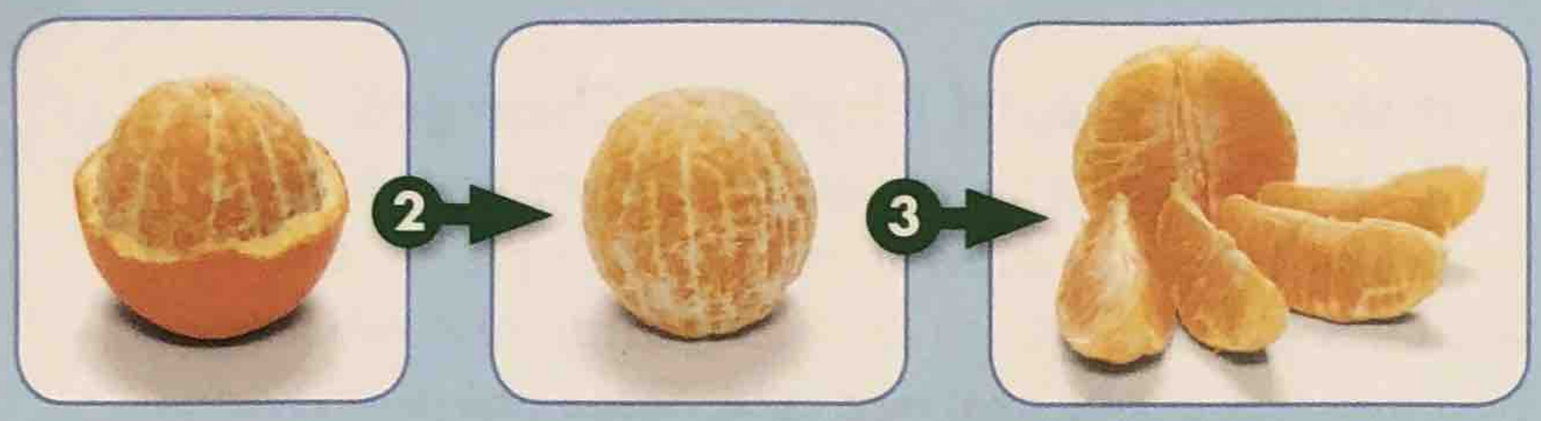


2 _____

3 _____

UNLOCK THE BIG ?

I will know that many physical changes are affected by temperature. I will know that many chemical changes are affected by temperature.

Words to Know

physical change
chemical change

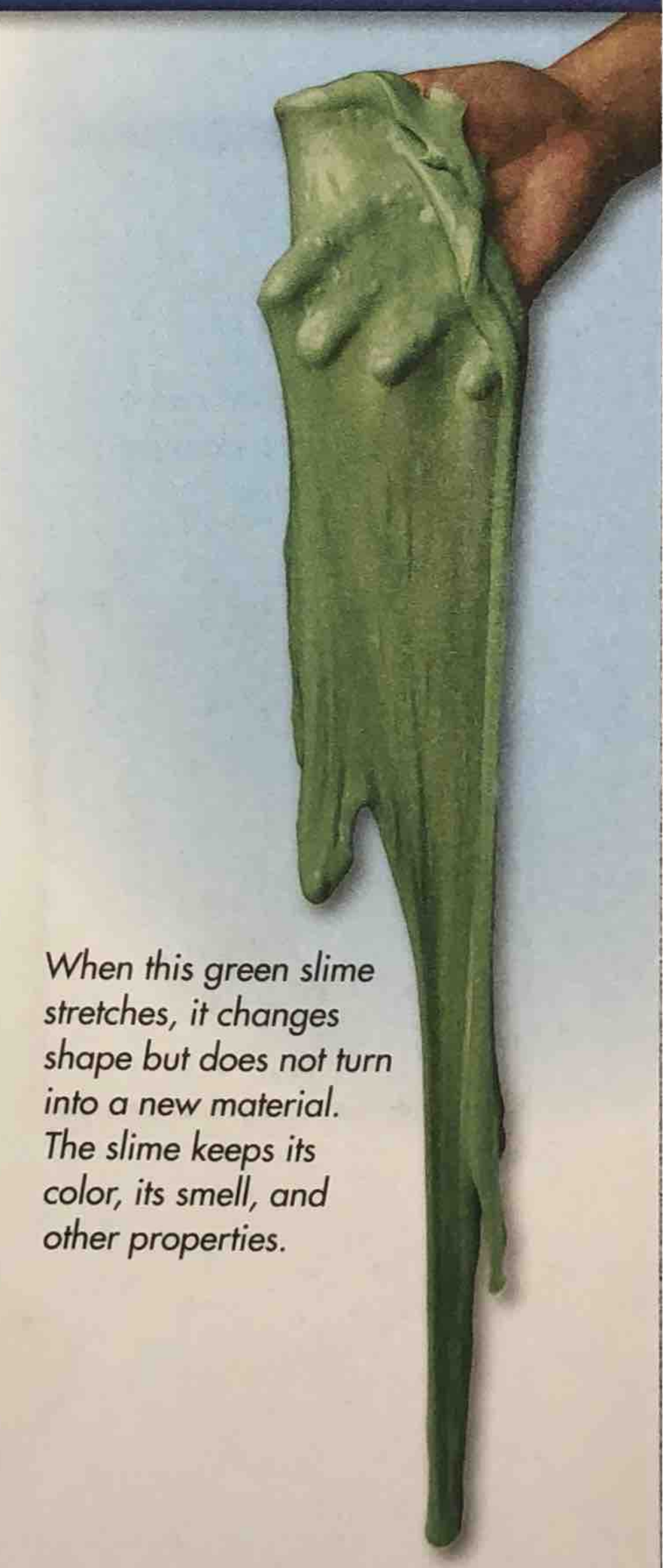
Physical Changes

Matter changes all the time. Some changes are physical changes. A **physical change** is a change in some properties of matter without forming a different kind of matter. There are many kinds of physical changes.

When you cut a piece of paper into smaller pieces, you do not produce a new material. You still have paper. The paper has undergone a physical change. Some of its properties have changed, but the properties that make it paper are still there. For example, the cut pieces are smaller than the original sheet and do not have the same shape. However, these pieces can burn or absorb water. They also keep their original color.

Breaking glass and stretching a rubber band are also physical changes. After breaking glass or stretching a rubber band, you still end up with glass or rubber.

1. **Compare and Contrast** How are the physical properties of a small piece of paper similar to those of a large piece of the same paper? How are they different?



When this green slime stretches, it changes shape but does not turn into a new material. The slime keeps its color, its smell, and other properties.

At-Home Lab

Twin Balloons
Blow up two balloons to the same size. Put one of the balloons in the refrigerator. Leave the other at room temperature. After an hour, compare the sizes of the balloons. Share your findings with your class.

Temperature and Physical Changes

Physical changes may happen more or less easily depending on the temperature. For example, butter becomes easier to spread as it gets warm, and rubber becomes less elastic as it gets cold. Some physical changes cannot even happen unless the temperature is right. For example, under normal conditions ice does not melt until its temperature rises above its melting point, 0°C.

Melting, freezing, evaporation, and condensation are all physical changes. For example, when water evaporates, it results in water vapor. We may call it water vapor, but it is just water that has gone through a physical change. The total amount of water stays the same when it changes form, even when it seems to disappear through evaporation. Another example is candle wax. The melted wax of a candle still is wax. It hasn't turned into a new substance. It has just become liquid for a while. It becomes solid again as soon as it cools off. The total weight of wax stays the same even when it changes form from solid to liquid and back to solid.

2. Infer What physical change do you think is happening to this scented oil below? How does the candle help?

Heated milk dissolves cocoa powder. The cocoa does not stir easily into cold milk.

Chemical Changes

To form a new substance, a chemical change has to happen. In a **chemical change,** one or more types of matter change into other types of matter with different properties. When a chemical change occurs, atoms rearrange themselves to form new kinds of matter. In chemical changes, the total amount of the substances involved does not change.

It is not always easy to tell if a substance has changed chemically. Evidence of chemical change may include the release of heat and light, a change in color, a new smell, gas bubbles, or the formation of a solid.

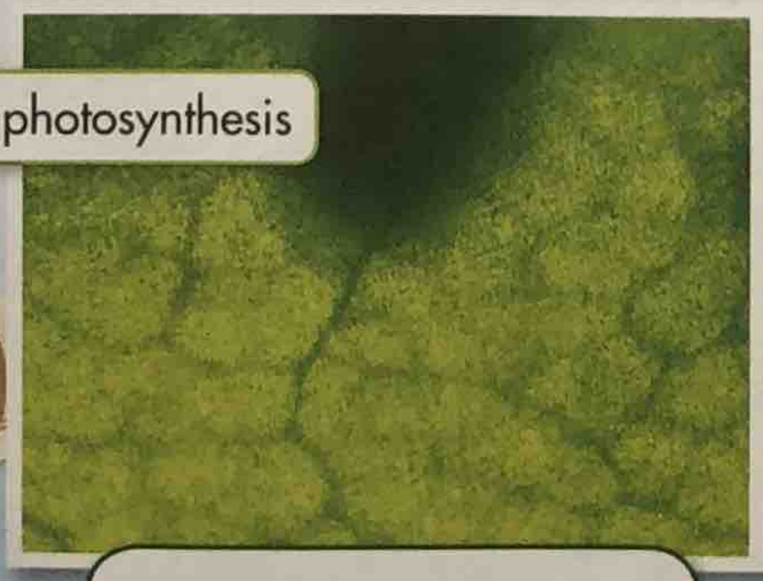
Chemical changes happen all the time around us. The rusting of iron is a familiar chemical change. When you leave an iron object outside, it slowly becomes rusty. Rust is red and brittle. It is a new substance. The process of photosynthesis, in which plants use water and carbon dioxide, is a chemical change because a new substance is made—sugar. When newspapers burn, they also go through a chemical change. They change into ash.

These two solutions have no color. A bright yellow substance forms when we mix them. This suggests that a chemical change has happened.

3. **Compare and Contrast** How are physical and chemical changes alike? How are they different?

4. **Describe** Write whether each image below shows a physical change or chemical change.

rolling paper



photosynthesis

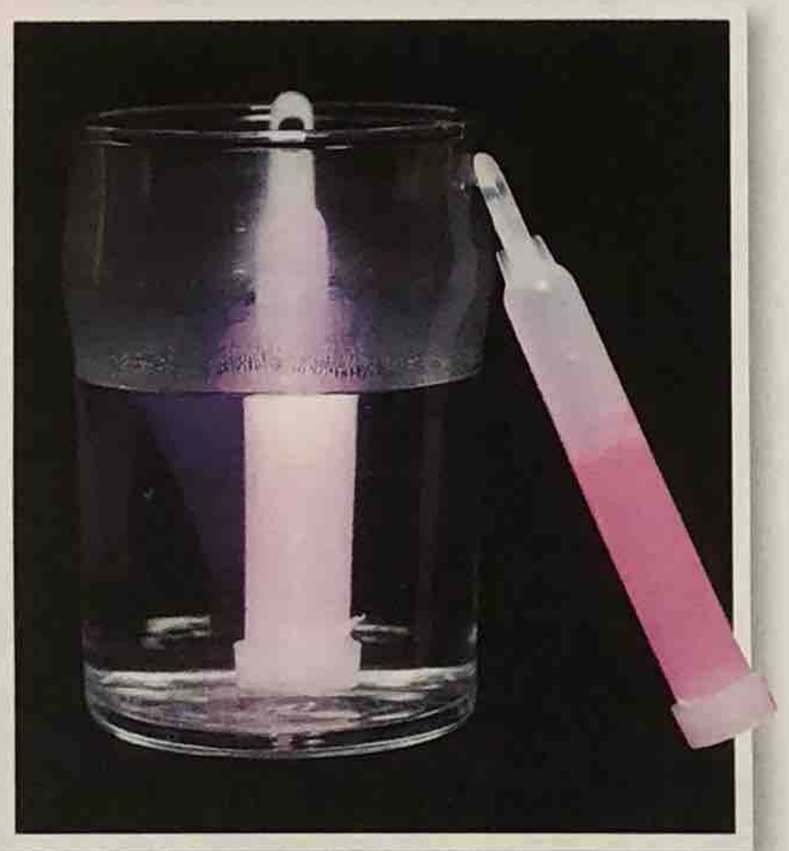
rusting metal

Temperature and Chemical Changes

When a candle burns, it goes through a chemical change that releases light and heat. But this chemical change cannot start on its own. You need to light the candle with a match. The flame of the match is hot enough to start the burning. After the burning starts, the reaction keeps itself going by the heat it releases.

Many chemical changes can happen without high temperatures, but they often happen faster if the temperature increases. Remember that particles move faster in a material when the temperature rises, so they may have more chances to rearrange themselves into new substances quickly. For example, if you put a fizzy antacid tablet in a glass of water at room temperature, the bubbles will form faster than if you used cold water.

A chemical reaction inside these glow sticks causes them to glow. The faster the reaction, the brighter the glow.



5. Conclude The glow sticks to the left were started at the same time, but the one in water glows more brightly. What does this suggest about the water temperature?

6. CHALLENGE Look at the picture below. As a candle burns, it becomes shorter and shorter. Does it disappear? Explain.

Lightning Lab

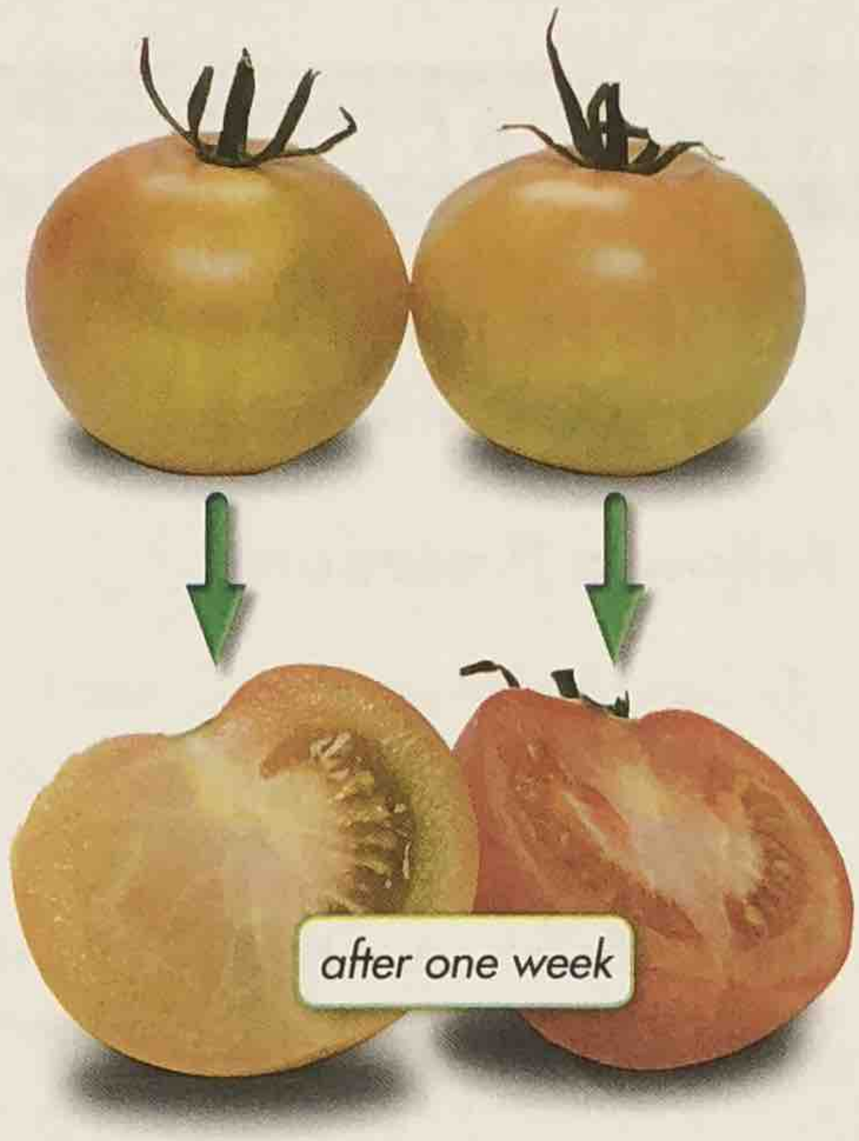
Comparing Apples and Lemons?

Cut an apple into 6 pieces. Swab 3 pieces with lemon juice. Put these on a plate labeled *Lemon Juice*. Use a new swab. Swab the other 3 pieces with water. Put these on a plate labeled *Water*. Observe the wedges in 15 minutes. Explain what happened.

The tip of this candle is still burning. When a candle burns, the wax and the wick combine with oxygen in the air to become smoke, soot, and hot gas.

Just as higher temperatures can speed up a chemical change, low temperatures can slow it down. When you buy fruit that is not ripe, you can often let it ripen in the kitchen at room temperature. Ripening involves chemical changes that slowly change the color and flavor of a fruit. If you place unripe fruit in a refrigerator, the fruit will often ripen more slowly than if you leave it on the kitchen counter.

7. Look at the pictures to the right. **Circle** the tomato that was stored in the refrigerator. Tell how you know.



One of these tomatoes was kept in a refrigerator. The other was kept at room temperature.

8. Infer Why do you think medicine labels usually say, "Store in a cool, dry place"?

Got it?

9. Summarize How can temperature affect many kinds of chemical changes?

10. UNLOCK THE BIG ? What properties might change during a chemical reaction?

Stop! I need help with .....

Wait! I have a question about .....

Go! Now I know .....

Inquiry Investigate It!

What are some ways to separate a mixture?

Follow a Procedure

- [ ] **1.** Label the 4 cups *A*, *B*, *C*, and *D*.
In Cup A place 1 spoonful of salt, 2 spoonfuls of sand, 3 marbles, and 100 mL of water.

- [ ] **2.** Carefully make 4 holes in the bottom of Cup B by pushing a pencil through the bottom of the cup from the inside.

- [ ] **3.** Hold Cup B over Cup C. All at once, pour the mixture from Cup A into Cup B. Move Cup B around to clean the marbles. **Record** the part of the mixture that was removed by straining.

Materials


safety goggles


spoon


4 plastic cups


warm water and graduated cylinder


salt


sand


3 metal marbles


coffee filter and a rubber band


pencil


foil

Wear safety goggles.

Be careful!

Do not taste.

Be careful with sharp objects.

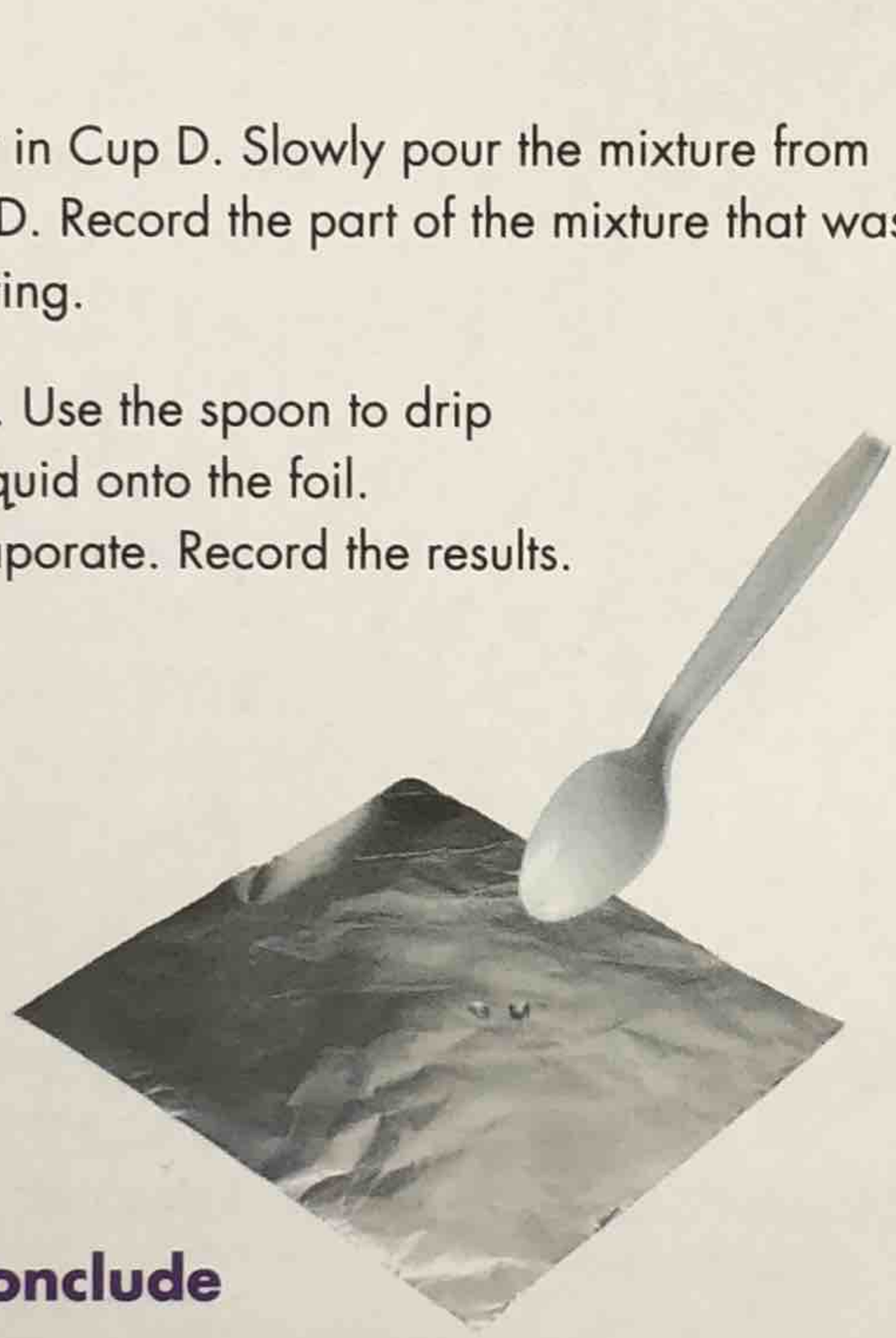
Inquiry Skill

Scientists record data on charts and use the data to help **make inferences.**

Results of Separation		
Separating Method	**Part Removed**	**Part Not Removed**
Straining		
Filtering		
Evaporation		

- [ ] **4.** Put a coffee filter in Cup D. Slowly pour the mixture from Cup C into Cup D. Record the part of the mixture that was removed by filtering.

- [ ] **5.** Remove the filter. Use the spoon to drip 2 drops of the liquid onto the foil. Let the liquid evaporate. Record the results.



Analyze and Conclude

6. Communicate Name a property you used to separate parts of the mixture.

7. Infer Describe another mixture. How could the properties of matter help you separate it into its parts?

Science in Your Backyard

Sidewalks & Playgrounds

Concrete is everywhere in our world. Highways, skyscrapers, sidewalks, and skate parks are often made of concrete. Ancient Romans used materials similar to concrete to build structures. Some of those structures are still standing today.

Concrete is made of many different materials. The main ingredient is cement—a human-made material. Cement is a fine powder that includes several different minerals. To make concrete, cement is mixed with sand, gravel, crushed rock, and water. Once concrete is set, or hardened, it is very strong and long-lasting.

What makes concrete so strong? One of the materials that makes it so strong is water. Surprised? When workers pour concrete it is very wet, but days later it is dry. The water does not just evaporate—it changes chemically! The water and cement react to form a gel. As the water and cement continue to react, they harden into concrete.

REVIEW THE BIG ?

How does mixing water and cement change their properties?

Vocabulary Smart Cards

atom
atomic theory
compound
molecule
mass
volume
temperature
solid
liquid
gas
mixture
solution
physical change
chemical change

Play a Game!

Cut out the Vocabulary Smart Cards.

Work with a partner.

Player 1 chooses a Vocabulary Smart Card.

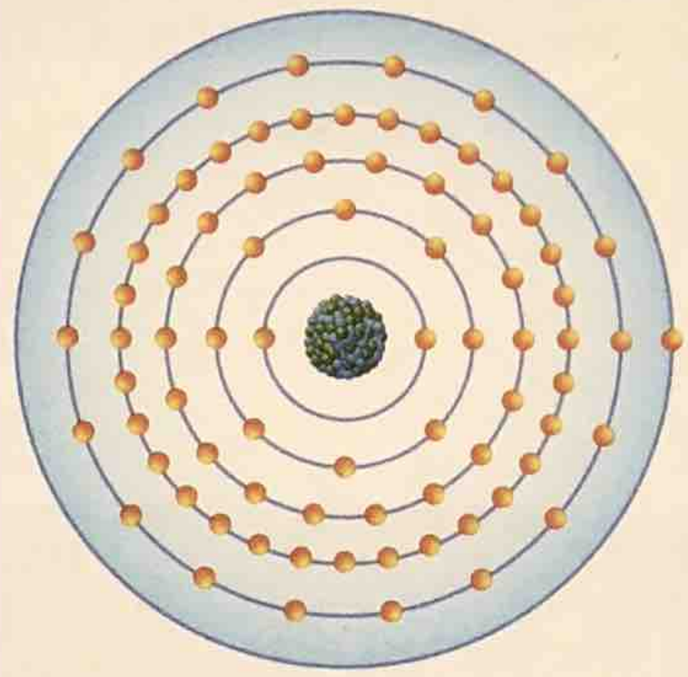
Say as many words as you can think of that describe that vocabulary word to Player 2.

Player 2 guesses the word.

molecule

molécula

atom



átomo

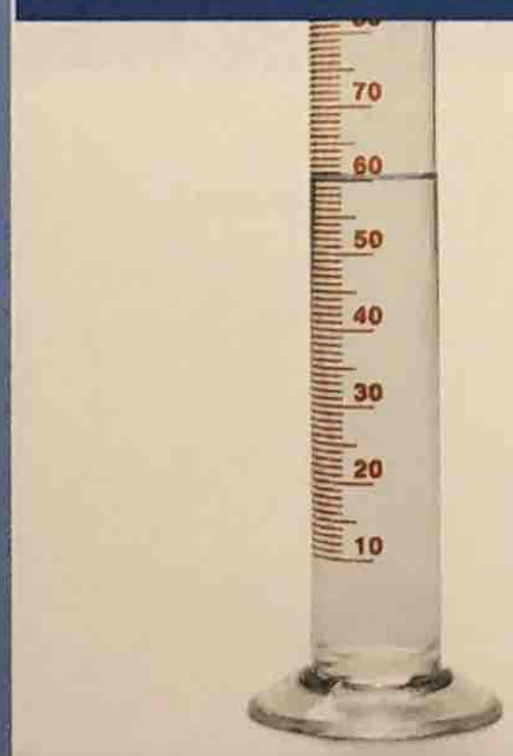
mass

masa

atomic theory

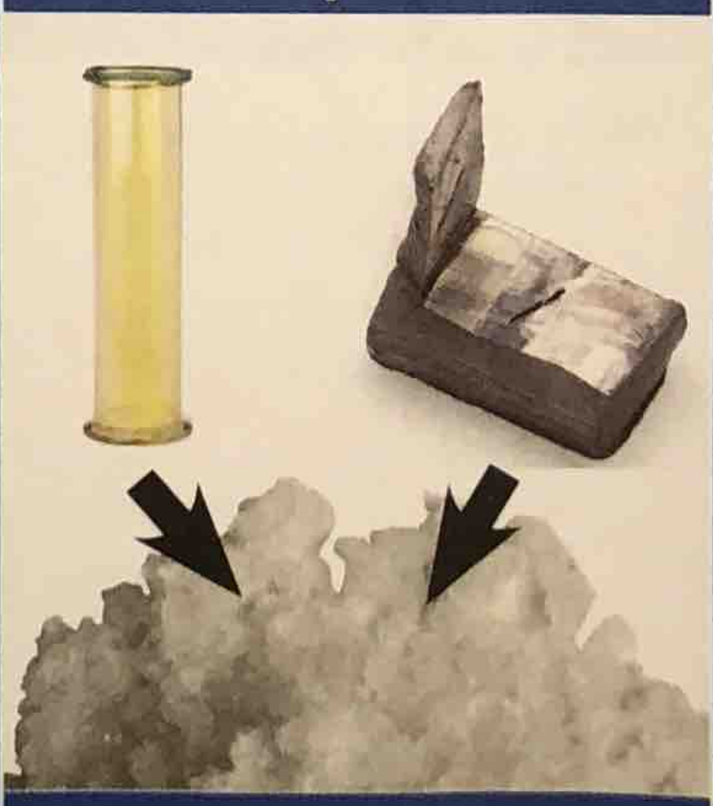
teoría atómica

volume



volumen

compound



compuesto

the smallest part of an element that still has the properties of the element

Write a sentence using this word.

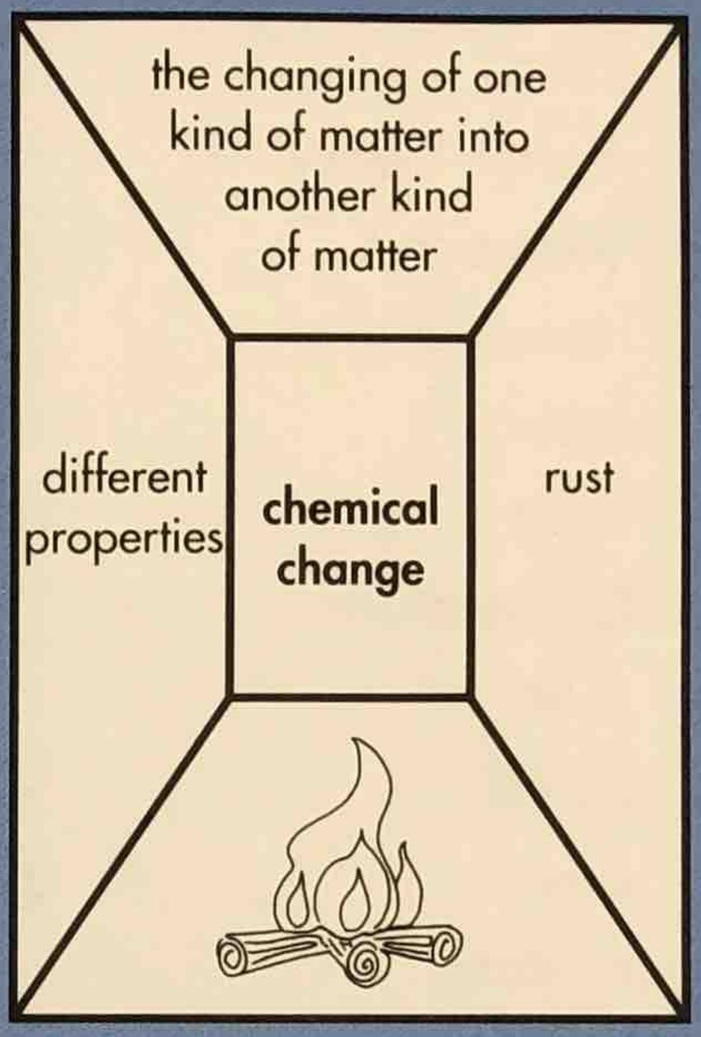
la partícula más pequeña de un elemento, que todavía tiene las propiedades de ese elemento

the smallest particle of a compound that still has the properties of that compound

Draw an example of this word.

la partícula más pequeña de un compuesto, que todavía tiene las propiedades de ese compuesto

Interactive Vocabulary



Make a Word Frame!

Choose a vocabulary word and write it in the center of the frame. Write or draw details about the vocabulary word in the spaces around it.

the idea that everything is made of small particles

Write a sentence using this term.

la idea de que la materia está formada por partículas pequeñas

the amount of matter in a solid, liquid, or gas

Write a sentence using this word.

cantidad de materia que tiene un sólido, líquido o gas

a type of matter made of two or more elements

Write a different meaning of this word.

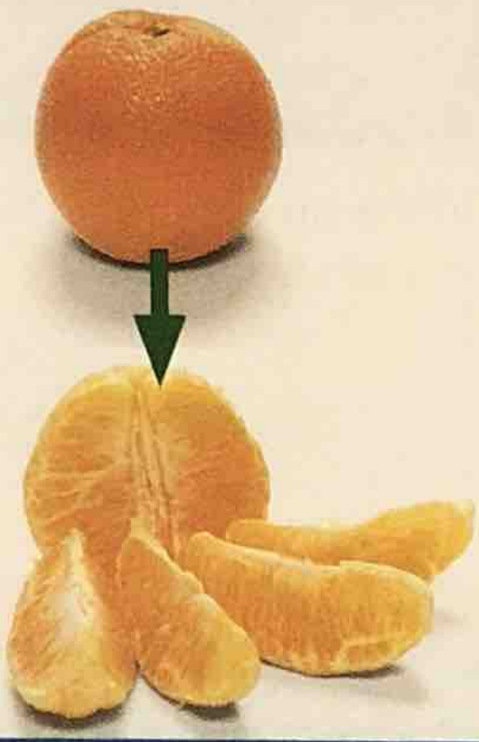
tipo de materia formada por dos o más elementos

the amount of space an object takes up

What is a different meaning of this word?

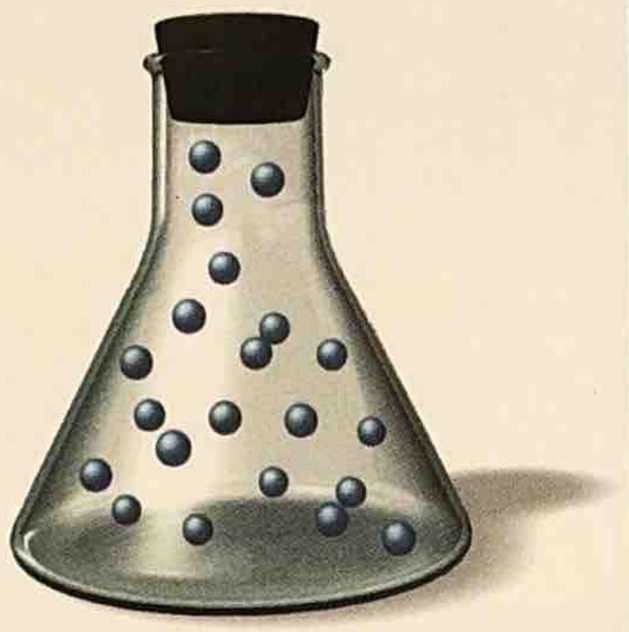
el espacio que ocupa un objeto

physical change



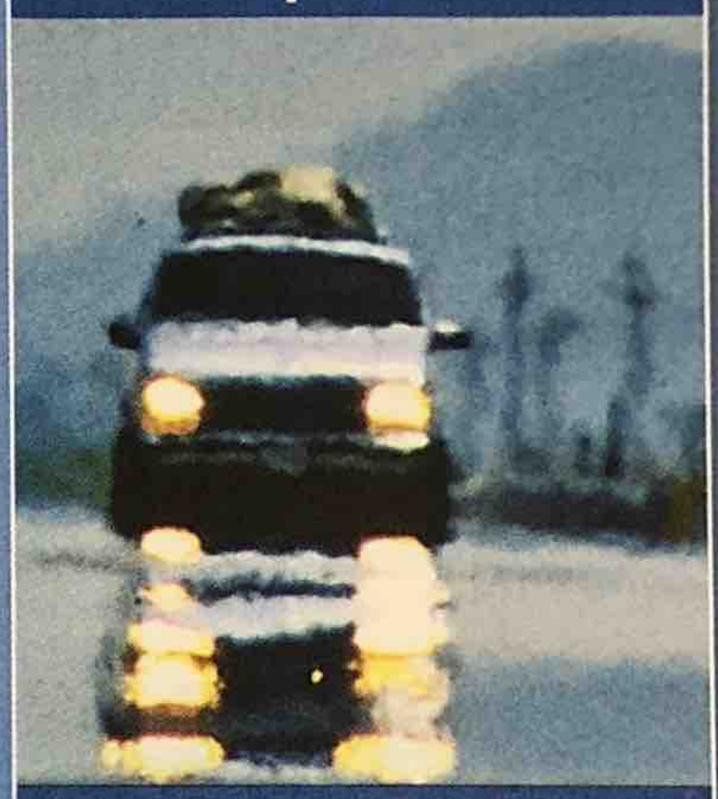
cambio físico

gas



gas

temperature



temperatura

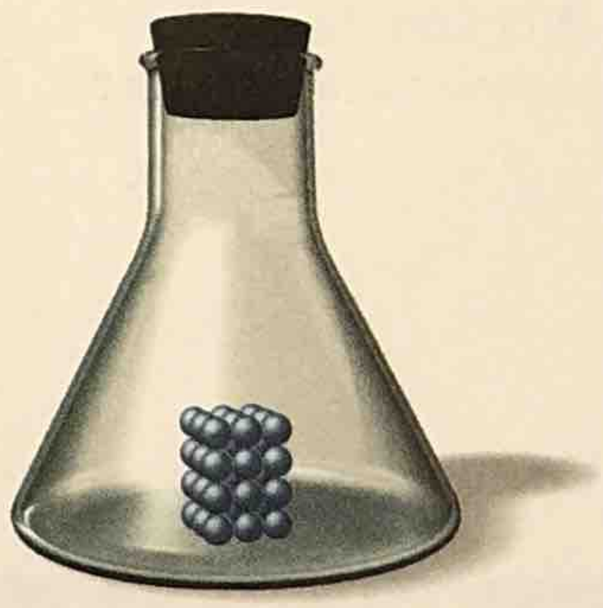
chemical change

cambio químico

mixture

mezcla

solid



sólido

solución

liquid

líquido

a measure of how fast the particles in an object are moving

Write a sentence using this word.

medida de la rapidez con que se mueven las partículas de un objeto

a substance without a definite volume or shape

Write an example of this word.

sustancia que no tiene ni volumen ni forma definidos

a change in some properties of matter without forming a different kind of matter

Write an example of this term.

cambio de algunas de las propiedades de la materia sin que se forme un nuevo tipo de materia

a substance that has a definite shape and volume

What are two other meanings of this word?

sustancia que tiene una forma y un volumen definidos

different materials placed together, but each material keeps its own properties

Write three other forms of this word.

unión de materiales diferentes en la cual cada material mantiene sus propiedades

a change of one or more types of matter into other types of matter with different properties

Write an example of this term.

cambio de uno o más tipos de materia a otros tipos de materia con propiedades diferentes

a substance that has a definite volume but no definite shape

Draw an example.

sustancia que tiene un volumen definido pero no una forma definida

a mixture in which substances are spread out evenly and will not settle

What is a different meaning of this word?

mezcla en la cual una sustancia se dispersa de manera uniforme en otra sustancia y no se asienta

Chapter 1

Study Guide

REVIEW THE BIG ?

What are the properties of matter?

Physical Science

Lesson 1

What makes up matter?

- Matter is made of atoms. Atoms may combine to form molecules.
- Elements are basic kinds of matter. Each element has different atoms.
- Compounds are made up of two or more elements.

Lesson 2

How can matter be described?

- Mass is the amount of matter in an object.
- Volume is the amount of space an object takes up.
- Temperature is a measure of how fast the particles of an object move.

Lesson 3

What are solids, liquids, and gases?

- States of matter include solid, liquid, gas, and plasma.
- Changes in state are caused by changes in the motion of particles.
- Melting, freezing, evaporation, and condensation are state changes.

Lesson 4

What are mixtures and solutions?

- A mixture is made up of two or more materials.
- The parts of a mixture can be separated.
- A solution is a type of mixture. Parts do not settle out of a solution.

Lesson 5

How does matter change?

- Physical changes do not change materials into new materials.
- In a chemical change, one or more new substances form.
- Temperature can affect physical and chemical changes.

Chapter Review

REVIEW THE BIG ?

What are the properties of matter?

Lesson 1

What makes up matter?

1. **Summarize** Your classmate has a magnifying glass, and he is looking for atoms. What would you tell him?

2. **Predict** A scientist finds that a sample of matter contains three types of atoms. The sample can be any of the following except
   A. a compound.
   B. a molecule.
   C. an element.

Lesson 2

How can matter be described?

3. **Vocabulary** The amount of matter an object has is its
   A. weight.
   B. volume.
   C. size.
   D. mass.

4. **Describe** What does the property of volume tell you about an object?

Lesson 3

What are solids, liquids, and gases?

5. **Compare and Contrast** Write two ways water and ice are different and two ways they are the same.

6. **Infer** A substance has a melting point of 104°C. Its freezing point will be
   A. lower than 104°C.
   B. higher than 104°C.
   C. 104°C.

Do the math!

7. What is the range of temperature between the boiling points of –42°C to 118°C?
   A. 42°C
   B. 18°C
   C. 118°C
   D. 160°C

8. **Compare** How are liquids and solids alike? How are liquids and gases alike?

Lesson 4

What are mixtures and solutions?

9. Explain Sulfur burns easily. Iron is attracted by magnets. The mineral below is made of sulfur and iron, but it does not burn and it is not attracted by magnets. Is it a mixture? Why or why not?

Lesson 5

How does matter change?

10. Vocabulary In a chemical change

A. materials retain their properties.

B. the new material has different properties.

C. materials always change states.

11. Classify List three examples of physical changes.

12. APPLY THE BIG QUESTION What are the properties of matter?

Think about the materials used to make a car. Some materials are glass, steel, leather, and paint. Choose any three materials. For each one, describe one property that makes it useful in the car. For example, windshield glass is clear so that people can see through it.

Oklahoma Test Prep

Read each question and choose the best answer.

1 A gas

A does not have a definite volume.
B does not have a definite shape.
C fills its container.
D does all of the above.

2 Which of the following statements is true?

A Atoms are made of molecules.
B Atoms can join to form molecules.
C Atoms contain more than one element.
D Some atoms do not have protons.

3 Fill in the blank: When two materials mix evenly and do not settle, that mixture is called a _____.

A solution
B compound
C sugar
D solute

4 What can affect the rate of a chemical change?

A color
B texture
C temperature
D gas bubbles

5 Suppose you boil an egg. What kind of change is taking place?

A physical and chemical
B chemical
C physical
D No change is occurring.

6 Describe how you would separate a mixture of water, sand, pebbles, and paper clips.