

How Can Materials Be Identified?

Fill in the blanks.

1. A characteristic that can be measured or detected by the senses is called a(n) _____.
2. A(n) _____ is the ability of a material to change its chemical makeup.
3. Mass is a measure of the amount of _____ in an object or material.
4. Cubic centimeters (cm^3), liters (L), and milliliters (mL) are units used to measure _____, or the amount of space a sample of matter takes up.
5. Pure water has a(n) _____, or mass per unit volume, of 1 g/mL.
6. The temperature at which a solid substance changes to a(n) _____ substance is known as the melting point.
7. The boiling point of a substance is the temperature at which it changes from a liquid to a(n) _____.
8. The measure of how much of one substance can dissolve in another substance is called _____.
9. _____ is the ability of a material to carry energy.
10. Electrical conductivity refers to carrying electricity, and _____ conductivity refers to carrying heat.

11. Main Idea How are physical and chemical properties of matter useful?

12. Vocabulary How is the density of a substance related to its mass and its volume?

13. Reading Skill: Main Idea and Details What can you conclude about two liquid samples that have different boiling points?

14. Critical Thinking: Apply You should not swim outdoors during a thunderstorm. A lightning strike could send an electric charge through the water to your body. Which physical property of water explains this safety tip?

15. Inquiry Skill: Infer What is the volume, in milliliters, of a rectangular solid that has a length of 3 cm, a width of 2 cm, and a height of 2 cm?

16. Test Prep Which of the following is not a physical property of matter?

- A conductivity
- B density
- C reactivity
- D solubility

What Are Solutions and Mixtures?

Some mixtures are evenly mixed. Other mixtures have different amounts of materials in different places. Mixtures whose molecules are evenly mixed are called solutions.

Types of Mixtures

Look at the salad below. Each vegetable adds to its good taste. Yet if you ate different parts of the salad, you would taste each vegetable by itself. That is because a salad is a mixture. A mixture is a physical combination of two or more substances. The substances in a mixture are not chemically joined as they are in a compound.



Mixtures are heterogeneous or homogeneous. In a heterogeneous mixture, such as a salad, materials are not spread out evenly. Separate pieces are in some parts of the mixture but not in others. A homogeneous mixture is the same all the way through. A sample of one part of the mixture is the same as every other sample from the mixture.

In a mixture, each part keeps its own properties. If you separated all the parts of a salad, the tomatoes would still be tomatoes, and so on.

Mixture or Compound?

Mixtures that are alike can be made of the same materials, but in different amounts. Two salads can both have lettuce and carrots, but one might have more carrots than the other. Two of the same compounds, however, always have the same materials in the same amounts.

Solutions

A solution is a homogeneous mixture, meaning that two or more substances are spread evenly throughout the mixture. The atoms or molecules of the materials mix together.

You make a solution when you make lemonade from a powdered mix. Some particles that mix in the water are molecules of sugar and coloring.

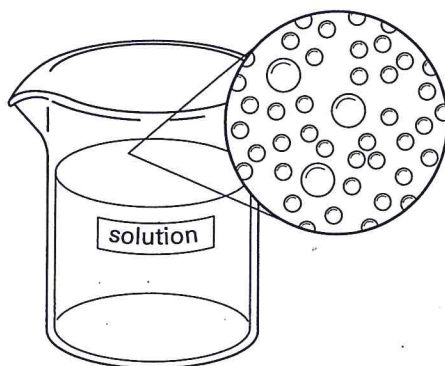
In any solution, the substance being dissolved is the solute. The substance that dissolves the solute is the solvent. In a solution of water and sugar, water is the solvent and sugar is the solute. In a solution, the properties of the substances that make up the mixtures do not change when they are combined.

Many solutions have a liquid solvent and a solid solute. However, solutions can have other kinds of solvents and solutes. Soda water is a solution made of carbon dioxide gas dissolved in water. Air is a solution of different gases. Brass is a solution of two solids—zinc and copper.

Particles in a solution spread evenly through the solution because they mix at the level of their atoms or molecules. When iodine and alcohol are mixed, the iodine dissolves in the alcohol. The particles of iodine spread all through the mixture. The molecules of the two substances have become evenly mixed.

Separating a Solution

To separate a solution, use the properties of the mixed materials. The size of the particles does not help because they are so small, and it is hard to trap and separate them.



You can use other properties. You can allow a liquid solvent to evaporate and leave the solute behind. A simple way to separate most solutions is to use different boiling or melting points of the substance. Sugar is gathered in this way. Sugar cane plants are cut down, and the stems are crushed. The sugar cane juice is heated. The water boils off, leaving solid sugar behind.

Alloys

Mixtures of two or more metals are called alloys, which may also be mixtures of a metal and another solid. Alloys often have some of the properties of each material that forms them.

Bronze is an alloy of copper and tin. It has the best properties of both metals. Bronze is a strong alloy. It is also easy to hammer into thin sheets that can be formed into different shapes.

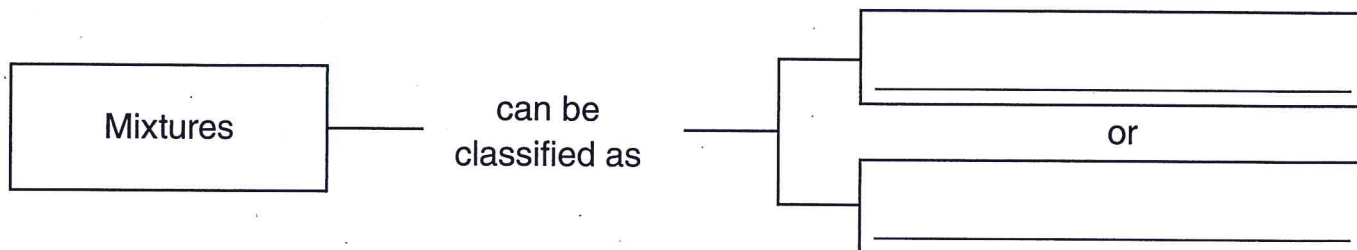
The amounts of each material in an alloy can change its properties. Steel is an alloy of iron, carbon, and other solids. Softer steel is made with less carbon. Harder steel is made with more carbon.

What Are Solutions and Mixtures?

Fill in the blanks with the correct terms.

1. A(n) _____ is a physical combination of two or more substances.

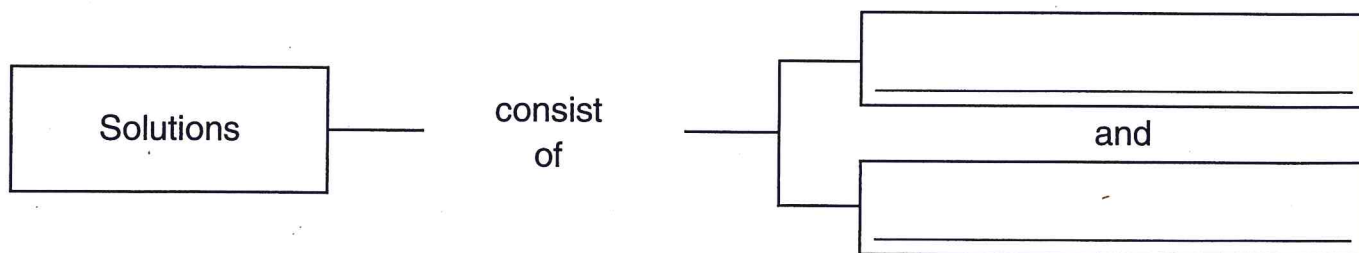
2. Complete the following diagram.



3. Each part of a mixture keeps its original _____.

4. Unlike a compound, the composition of a mixture can _____.

5. Complete the following diagram.



6. Because the substances of a solution are evenly distributed throughout the mixture, a solution is said to be _____.

7. The substance being dissolved in a solution is called the _____.

8. An alloy is a mixture of two or more _____.

9. Main Idea How are solutions different from other mixtures?

10. Vocabulary How do solutes differ from solvents? Include a specific solution in your answer.

11. Reading Skill: Draw Conclusions A mixture is made up of evenly spaced atoms of copper and silver. Is the mixture a solution? Explain your answer.

12. Critical Thinking: Apply Mia makes a delicious soup broth. She wants to separate the solid ingredients from the broth. What method could she use?

13. Inquiry Skill: Predict A student has jars containing different amounts of water. She adds salt to each jar until no more salt will dissolve. She makes the chart below. Predict how much salt will dissolve in 100 mL of water.

Water	25 mL	50 mL	75 mL	100 mL
Salt	9 g	18 g	27 g	?

14. Test Prep Which of the following is a type of alloy?

- A salt water
- B gold
- C iodine
- D bronze

What Are the Three States of Matter?

A state of matter is the physical form that matter takes. Three states of matter are solids, liquids, and gases. All matter is made up of atoms and molecules. These particles are always moving. The state of matter depends on the movement and spacing of these particles.

For most solids, particles are held closely together and do not move around one another. In liquids, particles are close together, but they have space in which to move past one another. In gases, particles are spread far apart. Their arrangements have no order, and they bounce off each other and the sides of their containers.

Solids

A solid is a form of matter that has a definite shape and volume. The way that particles in solids are arranged and the way they move back-and-forth in place gives solids their properties. One property is that solids keep their shape. If you move a solid or place it into a container, its shape will stay the same. Wood is a solid. A block of wood will keep its shape wherever you put it.

Particles in a solid are very close together, so it is hard to compress, or squeeze, them. This is why the shape of a solid does not change.

Another property of solids is that they have definite volume. That is, they take up the same amount of space wherever they are placed. The volume of a solid object stays the same unless you remove a part of the object.

Many solids might seem to change shape and volume. For example, you can squeeze a foam ball into a smaller volume. A pillow changes shape when you rest your head on it. In both cases, however, solid matter is surrounded by “pockets” of air. The air changes its shape and volume. The solid parts do not.

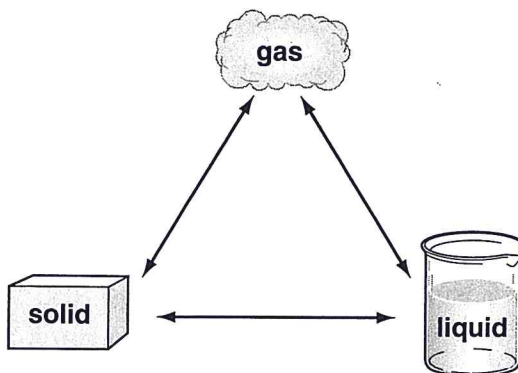
Liquids

What shape is orange juice? You cannot say, because orange juice is a liquid. A liquid is a form of matter that has a definite volume but no definite shape. A liquid will change its shape to match the shape of its container. Think about what happens when you use a straw to drink orange juice from a container. The juice has one shape in the container and a different shape when it is in the straw.

Like solids, each liquid has a volume that does not change. Think about pouring a liquid into bottles of different shapes. Each time, the liquid takes on the shape of the bottle, but the liquid's volume never changes. Liquids are not easy to compress or squeeze. Because the molecules are close together, liquids do not squeeze into smaller volumes very easily.

Gases

A gas is a form of matter that has no definite shape or volume. The particles in gases move around freely and bounce off one another. When a gas is placed in a closed container, the particles spread out to fill the container. They take the shape of the container. Gas particles are easy to compress, so they can be squeezed into a smaller volume.



To understand how gases are compressed and take the shape of containers, think about helium gas. Helium gas is often compressed inside a metal tank. It takes the shape and volume of the tank. If you use the helium to fill balloons, the gas takes on the different shapes and volumes of the balloons.

Changes of State

Matter can change from one state to another when energy is added or removed. Changes of states are always physical changes.

When energy is added to a solid, its temperature rises to a certain point. When the substance reaches its melting point, the solid melts, changing from a solid to a liquid.

When enough energy is added to a substance, a liquid is vaporized. Vaporization changes a liquid to a gas. Rapid vaporization is called boiling. The boiling point of a substance is the temperature at which it boils. Slow vaporization is called evaporation, which takes place on a liquid's surface. When energy is taken from a gas, condensation occurs. Condensation is a change of state from a gas to a liquid.

Skipping a Step

Sometimes matter skips the liquid state! The process of changing from a solid to a gas is called sublimation. For example, "dry ice" is made of solid carbon dioxide, which does not melt into a liquid but becomes a gas when it heats up.

The opposite of sublimation is deposition, the change of state from a gas to a solid. When water vapor touches freezing cold surfaces, it changes into a solid called frost.

What Are the Three States of Matter?

Fill in the blanks.

1. The physical form that matter takes, such as solid, liquid, and gas, is called _____.
2. For most substances, particles are most _____ packed in the solid state.
3. A(n) _____ is a form of matter that has definite shape and volume.
4. A(n) _____ is a form of matter that has a definite volume, but no definite shape.
5. A(n) _____ is a form of matter that has no definite shape or volume.
6. What happens when energy is removed from a liquid?

7. What happens in evaporation?

8. What happens in sublimation?

9. What happens in deposition?

Name _____ Date _____

10. Main Idea What two factors determine the state of matter of an object or sample?

11. Vocabulary Describe the processes of vaporization and condensation.

12. Reading Skill: Cause and Effect When will a liquid evaporate, and when will it boil? Compare the two changes.

13. Critical Thinking: Evaluate Why must a gas be kept in a closed container?

14. Inquiry Skill A solid has undergone a physical change. What observations can you make to determine which change of state took place?

15. Test Prep Solids and liquids are similar because both

- A are fluids.
- B are compressible.
- C have no definite shape.
- D have definite volume.