

SECTION 1 **Three States of Matter**

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- What is matter made of?
- What are the three most common states of matter?
- How do particles behave in each state of matter?

National Science Education Standards
PS 1a

What Are the Three States of Matter?

Have you ever had a steaming hot bowl of soup and an ice cold drink for lunch? The three most common states of matter are found in this lunch. The soup and the drink are made of water. However, the water exists in three different forms. The soup and the drink are liquids. The ice is a solid. The steam from the soup is a gas.

The substance is the same whether it is a solid, a liquid, or a gas. The substance is just in a different form, or state. The **states of matter** are the physical forms of a substance. The three well-known states of matter are solid, liquid, and gas. ✓

Matter is made up of very tiny particles. These particles are called *atoms* and *molecules*. Atoms and molecules act differently in each state of matter. We cannot see atoms and molecules, but they are always moving. How fast they move depends on the state they are in. The figure below describes the three states of matter and how particles act in each state.

STUDY TIP

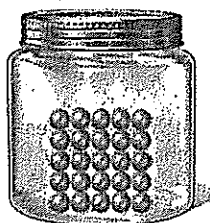
Describe Write a short description of a solid, a liquid, and a gas. Include the motions of the particles and how the motion affects volume and shape.

READING CHECK

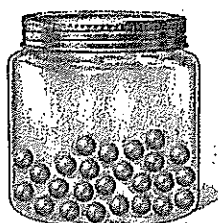
1. **Define** What are states of matter?

Physical forms of a substance
Solid, liquid, and gas

Models of a Solid, a Liquid, and a Gas



Particles of a solid have a strong attraction between them. The particles are closely locked in position and only vibrate.



Particles of a liquid are more loosely connected than those of a solid and can move past one another.



Particles of a gas move fast enough that they overcome the attractions between them. The particles move independently and collide frequently.

TAKE A LOOK

2. **Identify** In which state do the particles move about the most? In which state do they move about the least?

Gas they move most
Solid they move least

SECTION 1 Three States of Matter *continued*

What Are the Properties of Solids?

Any solid material, such as a penny, a rock, or a marble, has a specific shape and volume. For example, if you place a solid marble into a bottle, the marble's shape and volume stay the same. It keeps its original shape and volume no matter where it is placed. A **solid** is the state of matter that has a specific shape and volume.

The particles of a solid are very close to each other. They have a strong attraction for each other. Therefore, the particles of a solid are locked into place. However, they do make small movements called vibrations. Remember, the particles of any substance are always in motion. ✓

✓ **READING CHECK**

3. Describe How do the particles of a solid move?

They vibrate.

What Are the Properties of Liquids?

Ice cubes and liquid water are made of the same material, but they are physically very different. In solids, such as ice cubes, particles are closely locked together and vibrate in place. In liquids, such as liquid water, particles are able to move more freely.

A **liquid** is a substance that has a specific volume, but doesn't have a particular shape. For example, a liter of milk takes the shape of its container. The same liter of milk will take the shape of a bowl it is poured into. The shape of the milk changes. The volume of the milk stays the same. This is seen in the figure below with the juice.

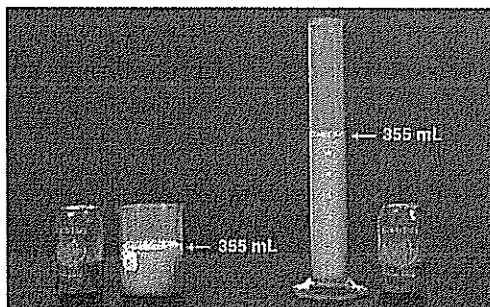
In a liquid, the particles move fast enough to overcome their attraction to each other. As a result, they can move or slide past each other, even though they always stay close together. In liquids, we know that the particles can move past each other because liquids can change shape.

STANDARDS CHECK

PS 1a A substance has characteristic properties, such as density, a boiling point, and solubility, all of which are independent of the amount of the sample. A mixture of substances often can be separated into the original substances using one or more of the characteristic properties.

4. Identify How are the particles in a liquid different from the particles in a solid?

They move faster and can slide past one another.



Although their shapes are different, the beaker and the graduated cylinder each contain 355 mL of juice.

SECTION 1 Three States of Matter *continued*

THE UNIQUE PROPERTIES OF LIQUIDS

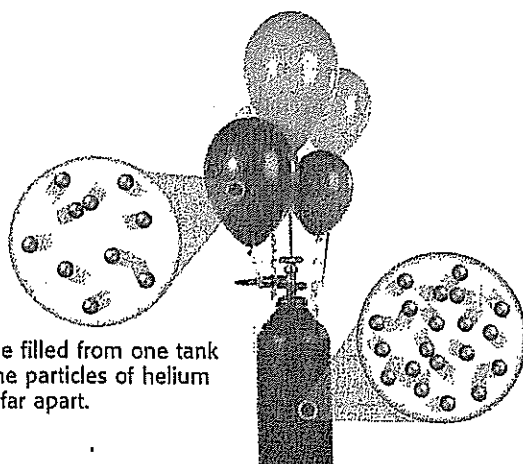
Liquids have special properties that the other states of matter do not have. One special property of liquids is surface tension. **Surface tension** is a force that acts on the particles at the surface of a liquid. Water has a high surface tension, causing it to form spherical or oval-shaped drops. You may have seen beads of water on an object. Each liquid has a different amount of surface tension. Gasoline has a low surface tension and forms flat drops. ✓

Another special property of liquids is viscosity. **Viscosity** is a liquid's resistance to flow. Liquids that are "sticky" usually have a high viscosity. The particles in these liquids have a strong attraction for each other. For example, honey flows more slowly than water. So the viscosity of honey is greater than that of water.

What Are the Properties of Gases?

The properties of a gas are different from the properties of other states of matter. A **gas** has no specific shape or volume. All gases take on the shape of the container they are put in. This is because their particles have little attraction for each other.

A gas that you might know about is helium. Helium is the gas that is used to fill birthday balloons. When the helium is in the tank, the particles are close to each other. As the helium particles fill a balloon, they spread out. So the amount of space between the helium particles in the balloon increases.



Many balloons can be filled from one tank of helium because the particles of helium gas in a balloon are far apart.

✓ **READING CHECK**

5. Describe What is surface tension?

A force that acts on particles at the surface of a liquid.

Critical Thinking

6. Apply Concepts Put the following in order from lowest to highest viscosity: syrup, water, and cream.

Syrup - Cream - Water

TAKE A LOOK

7. Describe What happens to the space between particles when helium moves from the tank into the balloon?

The space increases particles get further apart.

Section 1 Review

SECTION VOCABULARY

<p>gas a form of matter that does not have a definite volume or shape</p> <p>liquid the state of matter that has a definite volume but not a definite shape</p> <p>solid the state of matter in which the volume and shape of a substance are fixed</p>	<p>states of matter the physical forms of matter, which include solid, liquid, and gas</p> <p>surface tension the force that acts on the surface of a liquid and that tends to minimize the area of the surface</p> <p>viscosity the resistance of a gas or liquid to flow</p>
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1. **Identify** Name the three states of matter and give an example of each.

Solid - Spoon, Table
 Liquid - milk, Water
 Gas - Air, Helium

2. **Identify** What is one property that all particles of matter have in common?

They are made of Atoms.

3. **Compare** How are the particles of a liquid different from the particles of a solid?

Liquid particles move faster and can slip past one another
 Solid particles move slower and are locked in place

4. **Compare** How are the particles of a liquid different from the particles of a gas?

liquid particles move slower and remain in contact
 gas particles move faster and are free to move away from the other particles

5. **Identify** What property of water causes it to form beads on the leaves of the plants?

Surface Tension

6. **Describe** Indicate how the shape and volume of each state of matter are different.

State of matter	Definite shape	Definite volume
solid	Yes	Yes
liquid	no	Yes
gas	no	no