



Three States of Matter

1. Materials can be solids, liquids, or gases. Write **S** after each material that is a solid. Write **L** after each material that is a liquid. Write **G** after each material that is a gas.

- a) water _____
- b) air _____
- c) sand _____
- d) cooking oil _____
- e) candle wax _____
- f) steam _____
- g) ice _____

2. Fill in each blank with a word from the list.

solid	liquid	gas
-------	--------	-----

- a) When something melts, it goes from a _____ to a _____
- b) When something boils, it goes from a _____ to a _____
- c) When something freezes, it goes from a _____ to a _____

Three States of Matter

You may know that most materials can take three different forms called **solid**, **liquid**, and **gas**. These forms are known as the three **states of matter**. We are most familiar with the three states of water. Solid water is ice; we drink liquid water; and water as a gas is called steam or water vapor. Some people think fog and clouds are gas, but they are actually very small drops of liquid water.



Each state of matter has its own **properties**. Solids have a **fixed shape** and a **fixed volume**. This means that a solid's shape and volume always stay the same.

Liquids do not have a fixed shape: they take the shape of their container. Liquids do have a fixed volume.

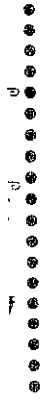
Gases take the shape of their container, and they completely fill their container. So gases do not have a fixed shape or a fixed volume.

Show the properties of the three states of matter by writing **YES** or **NO** in each box of the table below.



State of Matter	Does it have a fixed shape?	Does it have a fixed volume?
Solid		
Liquid		
Gas		

But why are there different states of matter? What makes a material change from one state to another? We can answer these questions by looking at the behavior of the **particles** in each state. Remember that all matter is made up of very small particles called atoms and molecules.



Three States of Matter

Particles are always moving, but they move differently in different states. In solids, particles move back and forth in the same spot. They cannot change positions or move from one place to another. Because the particles cannot change positions, solids cannot change their shape.

In liquids, particles move more freely and are able to change positions with each other. Because particles can change position, liquids can change shape. In both solids and liquids, particles are kept close together by the **forces** between them. These forces pull the particles together, keeping the volume small.

The particles of gases move fastest and most freely. Gas particles are far apart and so do not pull on each other very much. Because gas particles move so freely, they can race off to fill every part of their container. When a liquid becomes a gas, it fills about a thousand times more space.

We can understand why materials change state by thinking about how particles move. When we add heat to a material, its particles begin to move faster. As particles speed up, the temperature of the material rises. In other words, temperature measures particle speed. When the particles in a solid reach a certain speed, they break free of their fixed positions. This is when something **melts**. The temperature at which particles move fast enough to melt is called the **melting point**. The melting point of water is 32°F.

When the particles in a liquid move fast enough to break away from the pull they have on each other, they go into the gas state. If the particles break free slowly, one at a time, this is called **evaporation**. If particles break free suddenly, in large groups, this is called **boiling**. The temperature that moves particles fast enough to boil is called the **boiling point**. The boiling point of water is 212°F.

Removing heat can change a gas to a liquid (**condensation**) and can change a liquid to a solid (**freezing**).

NAME: _____

After You Read

Three States of Matter

1. Circle **T** if the statement is **TRUE** or **F** if it is **FALSE**.

- T** **F** a) Particles in a solid cannot move.
- T** **F** b) Particles in a gas are much farther apart than particles in a liquid.
- T** **F** c) Liquids have fixed shape that cannot change.
- T** **F** d) Materials lose mass when they go from liquid to gas.
- T** **F** e) When particles of a material move faster, the temperature of the material goes up.

2. Use the words in the list to answer each question. Two words will be used more than once.

- | | | |
|----------|------------|-------------|
| boiling | condensing | evaporating |
| freezing | melting | |

- a) _____ Which is a change from liquid to solid?
- b) _____ Which is a change from gas to liquid?
- c) _____ Which can happen when heat is added to a solid?
- d) _____ Which **two** things can happen when heat is added to a liquid?
- e) _____ What happens when particles break free from their fixed positions?
- f) _____ What change is happening when clouds form in the sky, dew forms on grass, or water droplets form on a bathroom mirror?



Three States of Matter

3. Why can't solid things change their shape? Use the word "particles" in your explanation.

4. The temperature of a bowl of hot soup goes down after the soup is poured into a bowl. What is happening to the motion of the particles in the soup as it cools?

5. Gases have very low densities. What does this show about the distance between gas particles?

Extensions & Applications

6. a) Use the graphic organizer on the next page to organize what you have learned about states of matter. The arrows show the **direction of change** from one state to another. Write the name of each change. Tell whether the change is caused by adding heat or removing heat. Tell whether the change makes the particles move faster or slower. Some of the answers have been done for you.

b) We can understand how particles move in the three states by thinking of something we can see that moves the same way. For example, particles in a solid move like people riding in a bus on a bumpy road.

The people in the bus are always in motion because the bus is in motion. Yet, they never change position because they don't change seats. The speed of the bus is like temperature. The greater the bus speed, the faster the people bounce around.

Now do the same for the other two states of matter.

Think of a type of motion you can see that is like the **motion of particles in a liquid**. You may write a complete description of the motion, or draw a detailed picture of the motion.

Think of a type of motion you can see that is like the **motion of particles in a gas**. You may write a complete description of the motion, or draw a detailed picture of the motion.



Three States of Matter

The Gas State

A. Name of change:

B. Heat added or removed?

C. Particles move faster or slower?

J. Name of change: **boiling or evaporation**

K. Heat added or removed?

L. Particles move faster or slower?

The Liquid State

D. Name of change:

E. Heat added or removed?
removed

F. Particles move faster or slower?

G. Name of change:

H. Heat added or removed?

I. Particles move faster or slower? **faster**