


NAME: _____

 Before You Read



What is Matter?

1. Complete each sentence with a word from the list. Use a dictionary to help you.

atom

mass

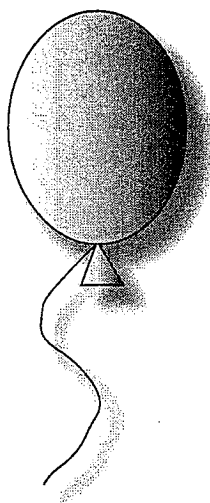
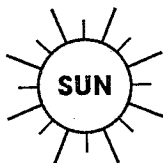
matter

molecule

particle

- a) _____s are made up of more than one atom.
- b) The scientific word that is closest to the everyday word "stuff" is _____.
- c) _____s cannot be divided into smaller bits with everyday tools.
- d) Atoms and molecules are very small _____s.
- e) _____ is the property of an object that tells how much matter it contains.

2. The picture below shows sunlight shining on a balloon. Circle **Yes** or **No** to the following questions.



- | | | |
|------------|-----------|---|
| Yes | No | a) Is the balloon made of matter? |
| Yes | No | b) Is there any matter inside the balloon? |
| Yes | No | c) Is the sunlight made of matter? |
| Yes | No | d) Is there matter in the air that surrounds the balloon? |
| Yes | No | e) Does the balloon have mass? |



What is Matter?

Matter is what people often call "stuff." In fact, "stuff" sounds almost like the German word for matter, "Stoff." All objects and materials we can touch are made of matter, and all matter takes up space. Rocks, trees, bugs, water, and air are all forms of matter. You are matter. Light, sound, heat, ideas, and wishes are not matter.

Different objects have different amounts of matter. When we measure the amount of matter in something, we say we measure the **property** called **mass**. As long as nothing is added to or removed from an object, its mass does not change. Later, we will look at other properties of matter like **density** and **weight**.



Name **TWO** things that have mass and **ONE** thing that does not have mass.



People have always wanted to know the true nature of matter. For thousands of years most people thought that matter could be divided into smaller and smaller pieces forever. When scientists had better tools, they found that matter is really made of tiny bits. These bits, called **atoms**, cannot be divided into smaller parts with everyday tools. Atoms are one kind of **particle**. When atoms stick together in a group, they form another type of particle called a **molecule**. All the particles in a pure material are the same.

Atoms are very, very small. They are so small that billions of them make up a speck of dust. If you had one penny for every atom in a penny, you would have much more money than everyone in the world put together!

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After You Read 



What is Matter?



1. Put a check mark (✓) next to the answer that is most correct.

a) It is possible to measure the mass of all of these things, *except*

- ☐ A a fly
- ☐ B a sunbeam
- ☐ C a polar bear
- ☐ D a cotton ball

b) Which of these is a property?

- ☐ A atom
- ☐ B mass
- ☐ C molecule
- ☐ D particle

c) Which of these pairs of words *both* refer to kinds of particles?

- ☐ A matter and mass
- ☐ B mass and atom
- ☐ C atom and molecule
- ☐ D molecule and matter

2. a) ~~Cross out~~ the words for things that have no mass.

air sound the planet Earth a deep thought an ant an elephant

b) Circle the words for things that have the property of mass.

air sound the planet Earth a deep thought an ant an elephant

c) Underline the words for things made of matter.

air sound the planet Earth a deep thought an ant an elephant



What Is Matter?



3. Imagine trying to divide a piece of gold into smaller and smaller pieces. Even if you could see and cut the smallest pieces of gold, you would reach a point where you would have to stop. Explain why you would have to stop dividing the gold.

4. A cookie has a certain mass. Explain why breaking the cookie in half does not change its mass.

Extensions & Applications

5. People have been trying to understand the true nature of matter for a long time. People in ancient Greece thought about matter more than 2000 years ago. The big question was whether matter is made of the small bits we call atoms or whether it is just some sort of uniform stuff that can be divided again and again without end. If matter can be divided forever, we would say it is **continuous**. So is matter separate bits, or is it continuous?

a) Study the history of this question by learning what a few famous thinkers and scientists had to say about it.


FIRST, find out what two ancient Greeks, named **Democritus** and **Aristotle** thought. Also try to find out which one most people believed.

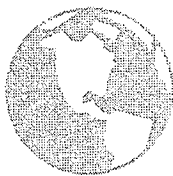
NEXT, learn what **John Dalton** said about matter and atoms 200 years ago. Did other scientists believe him?

Show what you found out about the history of ideas about matter by writing names in the table on the next page.

b) We know now that matter is made of separate bits called atoms. Suppose you didn't know this. Which would make more sense: that things are made of separate bits or that things are continuous? Tell why you think this.

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What Is Matter?

IDEAS ABOUT MATTER

Question	Name of the person or persons that answers the question
A. Who thought matter is made of particles?	
B. Who thought matter is continuous?	
C. Who did most people believe in ancient times?	
D. Who used experiments and scientific tools to study matter?	
E. Whose ideas about matter were most like what scientists think today?	



Democritus



John Dalton



Aristotle



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 _____.

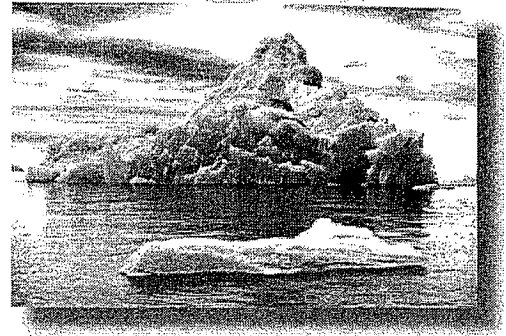
c) When something **freezes**, it goes from a _____ to a _____.

NAME: _____



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.

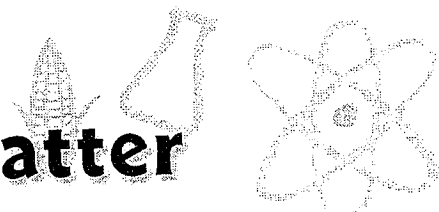
State of Matter	Does it have a fixed shape?	Does it have a fixed volume?
Solid		
Liquid		
Gas		



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**).



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
freezing

condensing
melting

evaporating

- _____ 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

you must do this part! ↓

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.

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After You Read 



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

The Solid State