

# THE LEARNING WORKS

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# THE MYSTERIES OF MATTER

## BACKGROUND

Everything is made up of tiny particles called *molecules* and *atoms*. These particles are constantly in motion. Depending on the speed of their movement and the spacing between them, different kinds of matter are formed.

In a *solid*, the particles are close together and moving very slowly. In a *liquid*, the particles are further apart and moving at a medium speed. In a *gas*, the particles are very far apart and moving rapidly.

There are other properties that are characteristic of the three kinds of matter. A solid has a definite shape and can be compressed only with a lot of pressure. A liquid has no definite shape and resists being compressed. Try pressing a puddle of water with your hand. The water squishes out rather than compacting into the smaller space. A gas has no definite shape but can be easily compressed. Scuba divers use tanks of compressed air.

One kind of matter may change to another type just by having the speed of its molecules or atoms change. If water molecules are sped up by the addition of heat energy, they spread apart, forming a gas. If water molecules are slowed down by the subtraction of heat — cooling — they move closer together, forming ice.

When solids form, the atoms arrange themselves into geometric shapes called *crystals*. A crystal for a certain solid always takes the same shape. A crystal of salt, for example, is always a cube.

Students should use all of their senses to examine examples of matter. They should understand, however, that no unknown substance should ever be tasted, no matter how harmless it appears.

There is also a safe way to smell unknowns. Fan your hand over the substance to be smelled. If there is any odour, a little of it will be carried to your nose. The smell won't be as strong as if you leaned close and sniffed, but neither will there be any danger of inhaling a substance that could damage the nasal tissues.

All matter occupies space. The question is how much space does matter take up? An object that floats will displace an amount of water equal to its mass. The term *mass* means how much material the object contains.

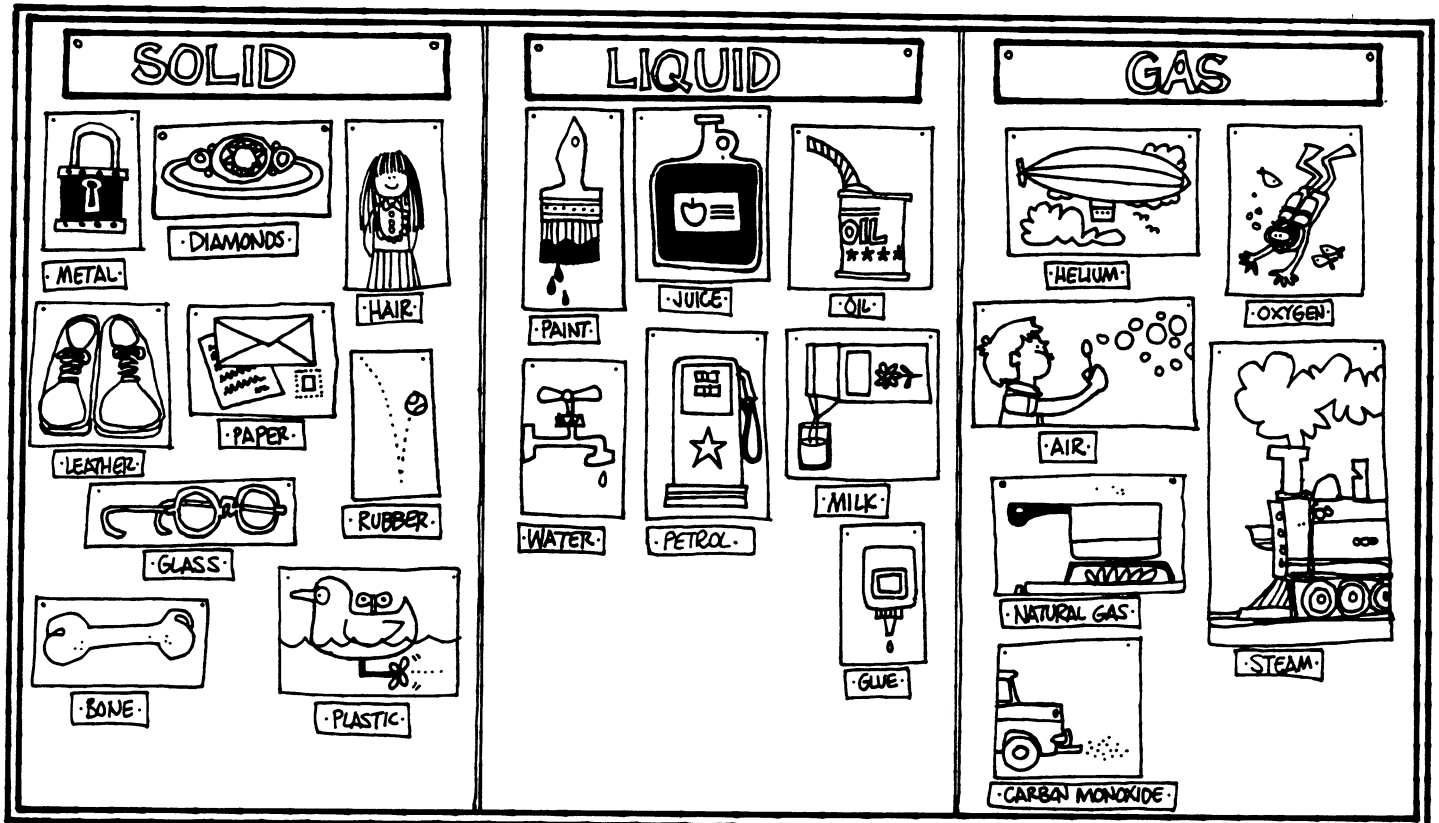
The question of mass is what concerned Archimedes when he tried to find out if the king's crown was pure gold or a mixture of gold and another metal. The story goes that Archimedes figured out the solution to this question while taking a bath. He noticed that the water rose when he got into his tub. He then had a pure gold crown made that was equal in mass to the king's crown. When he tested them, the two crowns displaced different amounts of water. Therefore the two crowns did not have the same density.

EUREKA! The king's crown was not pure gold.

*Gravity* is the force that is constantly pulling everything toward the centre of the earth. Every object of matter has a centre point in its mass, its centre of gravity. This centre point has to be taken into consideration to build buildings, construct mobiles, and even balance the human body.

**WORD BOX:**

properties	matter	molecule
liquid	solid	gas
crystal	saturated	solution



## THE MYSTERY OF THE KING'S NEW CROWN

Long ago in Greece there lived a very rich king. One day the king decided that he wanted a new crown. He sent for his goldsmith.

"Use this gold," the king told the goldsmith, "and make me a crown of pure gold."

The goldsmith measured the king's head, took the gold and left.

When the crown was finished, the goldsmith brought it to the king. The crown was beautiful, but the king was not happy.

The more the king looked at the crown, the more he became sure that the goldsmith had cheated him. The crown felt heavy, but the king had a feeling that the crown was not pure gold.

If the king had understood the mysteries of matter, he could have found out for himself.

The king called Archimedes, a very wise mathematics teacher, to help him solve the mystery.

In these experiments, you will investigate matter. Keep the king's problem in mind. See if you can figure out how Archimedes could tell if the king's crown was pure gold or only a mixture of metals.



## WHAT IS MATTER?

Supplies needed:

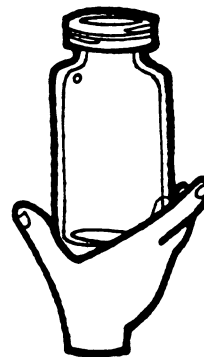
Rock	Cotton balls
Eraser	Bottle of Lemonade
Glass of water	Balloon full of air
Jar (full of air) with a lid	

How to do it:

1. Use your eyes, your ears, your nose, and your fingers to examine each sample, including the air in the jar. Listen to the air in the balloon.
2. After testing, decide whether each sample is a solid, a liquid, or a gas.
3. Write the name of each sample on the chart.

What happens:

1. Tell two ways that a solid is different from a liquid or a gas.
2. Tell two ways that a liquid is different from a solid or a gas.
3. Tell two ways that a gas is different from a solid or a liquid.



Puzzling out the results:

Be a good scientist. Find all the things you can that are solids, liquids, and gases to fill in the chart.

Solid	Liquid	Gas

Make a poster showing pictures of solids, liquids, and gases.