

Introduction

Look around you. Everything you see is **matter**. What is matter? Matter is anything that has **mass** and **volume** (takes up space). Mass is the amount of matter in an object. Remember that **weight** is the force of **gravity** pulling on the object. An object's weight depends on its mass and whether gravity is pulling on it. Earth does not pull on stars that are far away. Because of this, we cannot really talk about their weight. They do have mass, though, and they are matter. All matter takes up space. That means it has volume. So we have learned that all matter has mass and volume.

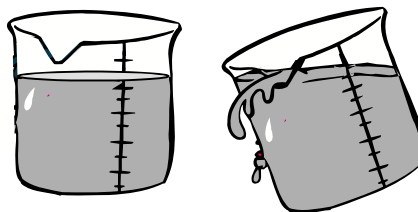


Even air is matter. It has mass and it takes up space. An empty balloon has less mass than a balloon that has been filled with air. The difference between the two is the mass of the air. The full balloon takes up more space than the empty balloon. You can see that air takes up space.

Not all matter is the same. Look at the different kinds of matter in the room. Books, tables, the air you are breathing, and the water in the sink are all different **forms** or **states** of matter. Scientists call the form of matter its **phase**. There are four phases of matter. **Gases, liquids, and solids** are all phases of matter commonly found on Earth. The fourth phase of matter is **plasma**. It is a form of matter found in stars. Although plasma is common in the universe, we have little chance to observe plasma. On Earth, plasmas usually do not occur naturally except in parts of flames and in lightning bolts.

A *solid* must have a definite shape and take up a definite amount of space. Look at a rock. It has a definite shape, and it takes up a definite amount of space. Therefore, it is a solid. Rocks are hard, but cotton is soft. Is cotton a solid? Think. Cotton has a definite shape. It takes up a definite amount of space, so cotton is also a solid. Can you change the shape of a rock or of cotton? Because the shape can change does not make the shape indefinite. If something or someone did not change them, then their shapes would remain the same. This is what is meant by a definite shape.

Matter can be a liquid. Pour one liter of water into a liter beaker. It takes up space. Tilt the beaker. The water changes shape. Pour the water into a bowl. It still is a liter of water, but it has a different shape. Liquids have a definite volume but not a definite shape.



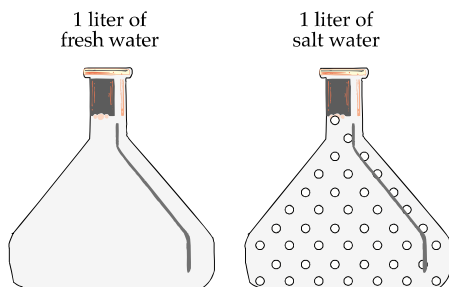
A cup of water takes up space in a beaker. Tilt the beaker. The water changes shape but it is still the same amount of water.

Some matter is in the form of gas. Blow up a balloon. The air takes up space or volume. The air inside the balloon has mass. It does not have its own shape. Gases take on the shape of whatever they are in at the moment. They also fill whatever they are in. It is possible for a beaker of water to be half empty. However, this could not occur in a balloon which had been filled with air. Even when a balloon gets smaller, the new shape is always completely full of gas.

Physical Properties

Now we know that matter commonly exists as a solid, a liquid, or a gas and that it has mass and volume. In what other ways can you describe matter? Suppose you have a few solids in front of you. How could you describe them? You probably will begin by describing their color, shape, size, or degree of hardness. The characteristics that you observe without changing the matter are called **physical properties**. It is easy to see color, shape, and size, and to feel hardness. Another physical property is **density**. Density is the amount of mass of a certain material in a certain volume.

For example, two liter containers are filled with liquids. One container is filled with fresh water. The other container is filled with salt water. The container filled with salt water has more mass than the one with fresh water. That's because salt water has more density than fresh water. The containers have the same volume, but different masses. The difference is in the density of the liquids.



These containers have the same volume (1 liter), but have different masses. Saltwater has a much greater density.

Density is a physical property of matter. Density helps determine the use of many different materials. For example, the comparison of the density of wood and the density of Styrofoam can determine *how* each material is used, and for *what purpose*.

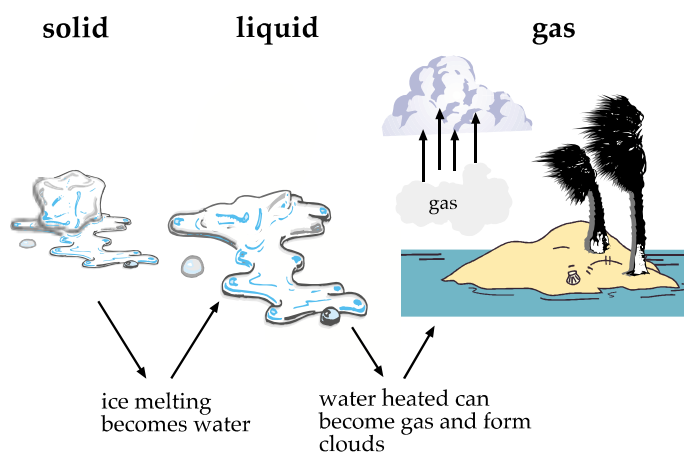
Chemical Properties

We learned that **chemistry** investigates how matter changes. **Chemical properties** of matter depend on how one substance **reacts** with other substances. Paper burns. That is because it reacts with oxygen in the air.

Iron rusts when it reacts with oxygen. Rusting is a result of a chemical property change in which a different substance is produced and the matter changes. Some materials produce gases or metals when they react with other materials. **Chemists** study these changes. Sometimes they can improve products by using the chemical properties of matter.

Changes in the Phases of Matter

We know that matter on Earth normally exists as a solid, a liquid, or a gas. Matter can be changed from one phase to another. For example, water can be a liquid. If it is frozen, it will become a solid. Remember that as substances cool they lose heat. This means they lose energy. Ice has less heat energy than liquid water. When water is heated, it can become a gas and form clouds. As substances like water warm up, they gain heat. Boiling water produces water, gas, or steam. Steam has more heat energy than ice or liquid water. Other materials can be changed from one form to another. When a material melts, it changes from a solid to a liquid. The temperature at which this happens is called the **melting point**. When a substance reaches its **freezing point** or **boiling point**, it also undergoes a physical change from one phase to another, changing some of its physical properties.



Summary

In this unit, we learned how to recognize matter in its different phases. We found out that matter has mass and volume. We are beginning to recognize some of the physical and chemical differences of matter.