Introduction

Every day you cause changes in **matter**. *Matter* is anything that has both **mass** and **volume**. *Mass* is the amount of matter in a substance. *Volume* is the amount of space that matter takes up. There are many ways to change matter. This unit will discuss what these changes are and how they are different. Matter may change from one **phase** to another by either gaining or losing heat energy.

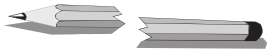
Physical Changes in Matter

Matter does not always stay the same. The form of matter can be changed by temperature or **pressure**. Squeeze a ball of clay, break a pencil, or drop a glass. What happens? The clay is still clay, the pencil is still a pencil, and the glass is still glass. The size and shape of each piece has changed. These kinds of changes are called **physical changes**. Any change in the form or *phase* of matter is only a *physical change*. There is no change in the **composition** of the matter. No new **substances** are formed. The *substances* remain the same.

A broken plate, cup, or bottle has changed shape, but there is no change in the composition.

Dissolving is a physical change. When you stir salt into water, the salt dissolves and seems to disappear. But the salt is still there. If you leave the salt water exposed to air for several days, the water will evaporate. There will be salt left on the bottom of the container. No new substances are formed in dissolving.

Physical Change in Matter



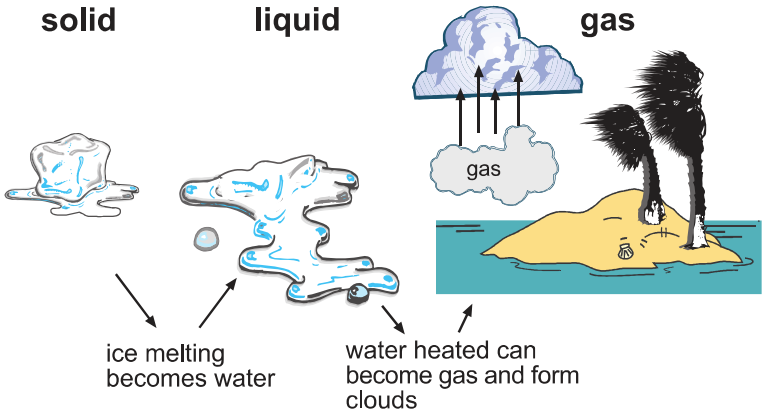
- no change in the composition
- no new substances are formed
- substances remain the same

Changes in the Phases of Matter

We know that matter on Earth normally exists as a **solid**, a **liquid**, or a **gas**. A *solid* substance tends to have less energy than the *liquid* phase of that same substance. A *gas* usually has more energy than the liquid phase of the same substance. The energy content is responsible for the different phases of matter. That is why substances can be made to change phases by adding or taking away energy. Changing the energy content does not change the composition of a substance. All that changes is the nature of the *attraction* or the movement of molecules towards each other. For example, the attraction between the **molecules** is strong in a solid and almost nonexistent in 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, 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.



Chemical Changes in Matter

What happens when a piece of paper is burned? Heat, light, and smoke are given off. When the burning is complete, we can say that **combustion** is complete. After combustion there is only a pile of ashes left. Where has the paper gone? The appearance has changed, but much more has happened. The composition of the matter has changed. New substances have been formed. **Carbon dioxide**, water vapor, and ashes are produced. In **chemical changes**, energy moves and/or changes form, and a new substance is produced. Sometimes we see this energy as light. An example of this is the beautiful colors and forms produced by fireworks as a result of chemical changes. At other times, the energy is heat. Combustion is an example of a chemical change that produces heat. Burning wood can warm us. Can you think of a chemical change that takes heat away?

When food is cooked, chemical changes take place. A piece of broiled meat is chemically different from a raw piece of meat. Did the meat produce heat? No, you had to provide the heat to change it. Cooking food is an example of a chemical change that absorbs heat, or takes heat away. Another chemical change occurs when a metal rusts. Oxygen in the air combines with the iron to form a new substance, rust.

Remember, during a chemical change, new substances are formed.

Chemical Change in Matter

- change in the composition
- new substances are formed
- substances do not remain the same

The Laws of Conservation of Mass and Energy

Law of Conservation of Mass

The total mass of all matter stays the same before and after a change. Iron rusts and paper burns, but no matter is destroyed in either reaction. There is always the same total mass of matter at the end of a reaction as there

was in the beginning. This is called the **law of conservation of mass**. It states that matter cannot be created or destroyed during a physical or chemical change.

Law of Conservation of Energy

During a physical or chemical change, energy may be converted from one form to another. However, the total amount of energy before and after the change is always the same. This is called the **law of conservation of energy**. It states that energy cannot be created or destroyed during a physical or chemical change.

Summary

There are two ways to change matter. In physical changes, the phase or shape of the substance is altered. No new substance is produced. In chemical changes, new substances are created. A common way to cause chemical changes is through combustion. During a physical or chemical change, mass and energy cannot be created or destroyed.