



## Chemical Reactions

### *Changing from one thing to another*

Supply list:

- |                   |               |
|-------------------|---------------|
| - Birthday candle | - Vinegar     |
| - Modeling clay   | - Baking soda |
| - Jar             | - Matches     |



**A**s you learned in the past several lessons, elements bond in many different ways depending on their electron structures. When two or more different elements bond together, a chemical reaction takes place and a new substance is formed. In a chemical reaction, the beginning materials are called the reactants and the ending materials are called the products. Some common chemical reactions you are probably familiar with include photosynthesis, bread dough rising, a flame burning, or a firecracker exploding.

Chemical reactions often have a change of energy. If the reaction produces heat the reaction is said to be exothermic. An exothermic reaction is one in which the products are warmer than the reactants. If the reaction uses energy, that is if the products are cooler than the reactants, the reaction is said to be endothermic. Exothermic and endothermic reactions will be discussed more in a later lesson.

Sometimes chemical reactions are reversible. If water is broken apart into oxygen and hydrogen gas, that gas can later be recombined to form water again. Other chemical reactions cannot be reversed. If you cook an egg, the egg cannot be “uncooked.” Some chemical reactions happen very easily. You notice an immediate reaction when you combine baking soda and vinegar. Other reactions are slow or may even require heat, light, or other

stimuli to make them happen. For example, photosynthesis does not occur without sunlight and chlorophyll.

There are many different kinds of chemical reactions. If an element combines with oxygen the reaction is called an oxidation reaction. If oxygen is removed from a substance, such as in the purification of metals, the reaction is called a reduction reaction. If elements other than oxygen combine to form a new substance, the reaction is a composition reaction and if a substance is broken down into individual elements the reaction is a decomposition reaction.

Some reactions happen very quickly, in fact, some are instantaneous, like the explosion of fireworks. Other reactions happen very slowly. A piece of iron, like this iron bucket, will eventually rust away, but depending on how much iron you start with, it may take years or even decades for the metal to all turn to rust. In order for a chemical reaction to take place, the reactants must be in contact with each other. So the speed of the reaction is not only affected by what kind of reaction is taking place, but also by the size and shape of the reactants. A cube of iron will rust much more slowly than a thin sheet of iron containing the same amount of material because the thin sheet has more surface area and the oxygen in the air can react with more of the iron molecules at one time.



Increasing the concentration of reactants will also speed up the reaction. The more molecules of each type of reactant there are, the more likely they are to come in contact with each other and react together. So adding more reactants or pushing them closer together will speed up the rate of the reaction.

In other reactions, heat can speed up the rate at which the reaction takes place. Heat causes the molecules to move more quickly so the reactants come in contact with each other more often and the reaction speeds up. Another way to increase the reaction rate of some chemical reactions is to add a catalyst. A catalyst is a substance that is added that encourages the reaction to occur, but is not used up in the reaction. We will explore catalysts more in a later lesson.

It is important to remember that chemical reactions are taking place all around us and even inside us all the time. These reactions are necessary for life and are designed by God to happen in a very predictable way. So enjoy learning about chemical reactions.



### **Fire Extinguisher in a Jar:**

A flame is a chemical reaction that requires oxygen. Therefore it is an oxidation reaction. If you are trying to build a campfire, you need to make sure that air, which contains oxygen, can reach the wood, paper, and other materials you may be using to build your fire. However, if a fire starts someplace you don't want a fire, one of the quickest ways to put out the fire is to deprive it of

oxygen; then the fire will go out. This is the way that many fire extinguishers work. The fire extinguisher sprays a chemical on the fire that keeps the oxygen away from the flames and allows the flames to go out.

You can help your child build a fire extinguisher in a jar by having him/her do the following:

1. Using a piece of modeling clay, attach a birthday candle to the bottom of a jar.
2. Pour  $\frac{1}{4}$  cup of vinegar into the jar. Be sure not to get the wick of the candle wet.
3. Light the candle.
4. Sprinkle a teaspoon of baking soda into the jar. Be sure not to sprinkle it on the candle.

The candle will quickly go out, even though none of the ingredients you added touched it. The carbon dioxide produced by the reaction of vinegar and baking soda pushes the air out of the jar and deprives the flame of oxygen.



## What did we learn?

What is a chemical reaction? (It is when two or more elements combine together to form a new substance or when a substance is broken down into its separate elements.)

What are the initial ingredients in a chemical reaction called? (Reactants)

What are the resulting substances of a chemical reaction called? (Products)

What is an endothermic reaction? (One that uses up energy – the products are cooler than the reactants.)

What is an exothermic reaction? (One that produces energy – the products are warmer than the reactants.)

## Taking it further

How might you speed up a reaction? (Add heat, add surface area to the reactants by changing their shape – make them thinner or break or crush them, increase the concentration of the reactants, add a catalyst.)

A fire hose usually sprays water on a fire to put it out. Water does not deprive the fire of oxygen, so why does water put out a fire? (Water absorbs the heat from the fire, and heat is another necessary ingredient in producing and sustaining a fire.)

What is one chemical reaction taking place in the making of a loaf of bread? (The yeast reacts with the sugar in the bread dough to produce carbon dioxide.)