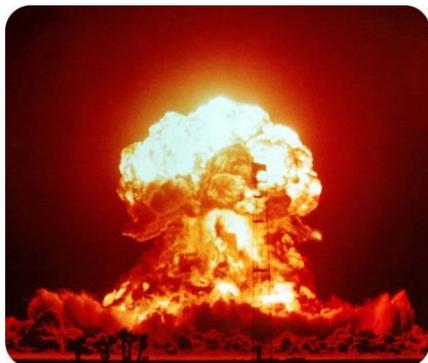


Exothermic Reactions



This mushroom cloud was produced in a 1953 nuclear bomb test in Nevada. There's no doubt that the explosion gave off a huge amount of energy. Although not as impressive as nuclear reactions, many chemical reactions also give off energy. These reactions are called exothermic reactions.

What Is An Exothermic Reaction?

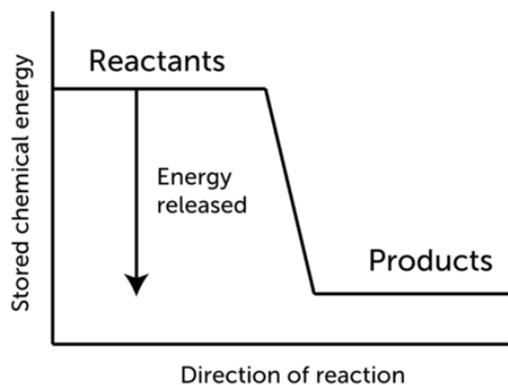
All chemical reactions involve energy. Energy is used to break bonds in reactants, and energy is released when new bonds form in products. In some chemical reactions, called endothermic reactions, less energy is released when new bonds form in the products than is needed to break bonds in the reactants. The opposite is true of exothermic reactions. In an **exothermic reaction**, it takes less energy to break bonds in the reactants than is released when new bonds form in the products.

Energy Change in Exothermic Reactions

The word *exothermic* means “releasing heat.” Energy, often in the form of heat, is released as an exothermic reaction proceeds. This is illustrated in the **Figure** below. The general equation for an exothermic reaction is:



Exothermic Reaction



Combustion as an Exothermic Reaction

All combustion reactions are exothermic reactions. During a combustion reaction, a substance burns as it combines with oxygen. When substances burn, they usually give off energy as heat and light. Look at the big bonfire in the **Figure** below. The combustion of wood is an exothermic reaction that releases a lot of energy as heat and light. You can see the light energy the fire is giving off. If you were standing near the fire, you would also feel its heat.



Endothermic Reactions



Did you ever use an instant ice pack like this one? You don't have to pre-cool it in the freezer. All you need to do is squeeze the pack and it starts to get cold. How does this happen? The answer is an endothermic chemical reaction.

What Is An Endothermic Reaction?

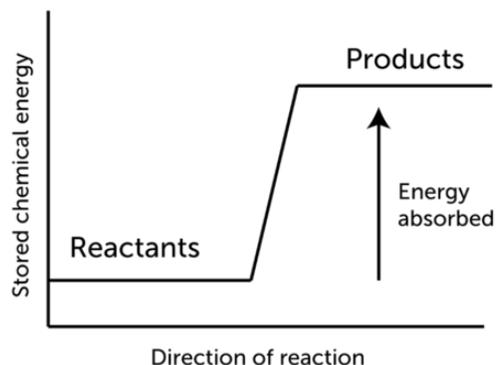
All chemical reactions involve energy. Energy is used to break bonds in reactants, and energy is released when new bonds form in products. In some chemical reactions, called exothermic reactions, more energy is released when new bonds form in the products than is needed to break bonds in the reactants. The opposite is true of endothermic reactions. In an **endothermic reaction**, it takes more energy to break bonds in the reactants than is released when new bonds form in the products.

Energy Change in Endothermic Reactions

The word *endothermic* literally means "taking in heat." A constant input of energy, often in the form of heat, is needed to keep an endothermic reaction going. This is illustrated in the **Figure** below. Energy must be constantly added because not enough energy is released when the products form to break more bonds in the reactants. The general equation for an endothermic reaction is:

Reactants + Energy → Products

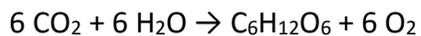
Endothermic Reaction



In endothermic reactions, the temperature of the products is typically lower than the temperature of the reactants. The drop in temperature may be great enough to cause liquids to freeze.

Photosynthesis

One of the most important series of endothermic reactions is photosynthesis. In photosynthesis, plants make the simple sugar glucose ($C_6H_{12}O_6$) from carbon dioxide (CO_2) and water (H_2O). They also release oxygen (O_2) in the process. The reactions of photosynthesis are summed up by this chemical equation:



The energy for photosynthesis comes from light. Without light energy, photosynthesis cannot occur. As you can see in the **Figure** below, plants can get the energy they need for photosynthesis from either sunlight or artificial light.

