

3 Chemical Reactions and Energy

TEKS 5(H), 7(D)

Before You Read

You have probably seen video of a building being demolished by an explosion. Describe what happened on the lines below.

Read to Learn

Chemical Reactions—Energy Exchanges

When they are no longer useful, buildings are sometimes demolished with dynamite. A dynamite explosion is an example of a rapid chemical reaction.

Most chemical reactions happen more slowly than a dynamite explosion, but all chemical reactions release or absorb energy. The energy released in a chemical reaction can be in the form of heat, light, sound, or electricity. Wood burns and releases heat and light. A glow stick releases only light.

Chemical bonds are the source of this energy. Most chemical reactions break some chemical bonds in the reactants. It takes energy to break the chemical bonds. That is why many substances need heat to make them react. For products to be produced, new bonds must form. When bonds form, energy is released. The amount of energy required to break the chemical bonds in dynamite is much less than the amount of energy released when new bonds form. The result is a release of energy and sometimes a loud explosion.

More Energy Out

An **exergonic** (ek sur GAH nihk) **reaction** releases energy. In an exergonic reaction, less energy is needed to break the bonds in the reactants than is released when new bonds in the products form. Exergonic reactions give off energy, such as light or heat. An exergonic reaction produces visible light in a glow stick.

What You'll Learn

- energy change sources in chemical reactions
- the difference between exergonic and endergonic reactions
- how catalysts and inhibitors are used

← Focus

As you read this section, underline the information you think is important. When you finish reading, look back at what you underlined.

GET IT?

1. **Infer** Why is a log fire considered to be an exothermic reaction?

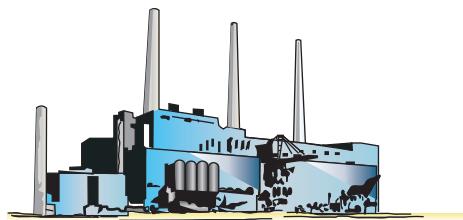
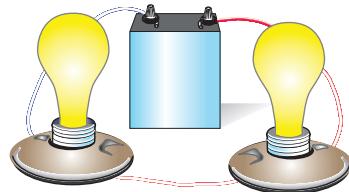
What are exothermic reactions?

In some reactions, the energy is given off as thermal energy. Have you ever used a heat pack? Heat packs release thermal energy. An **exothermic** (ek soh THUR mihk) **reaction** releases thermal energy. Burning wood and exploding dynamite are examples of exothermic reactions. Iron rusting is also exothermic. The chemical reaction that produces rust occurs so slowly that you can't detect the thermal energy.

How are exothermic reactions used?

Have you turned on a light or used a blow-dryer today? The energy you used probably came from exothermic reactions. The power plant the electricity came from probably uses fossil fuels. The carbon in the fossil fuels combines with oxygen to form carbon dioxide gas and energy. This reaction is exothermic.

Other substances in fossil fuels also react. Often, the products of these other reactions are pollutants. Sulfur in fossil fuels reacts with oxygen to form sulfur dioxide, which combines with water in the atmosphere to form acid rain.



Take a Look

2. **Identify** What type of reactions provides the energy for the items in the figures?

Think it Over

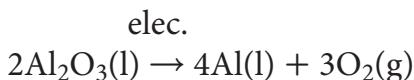
3. **Determine** What happens to energy in an endergonic reaction?

More Energy In

An **endergonic** (en dur GAH nihk) **reaction** absorbs energy. In an endergonic reaction, it takes more energy to break the bonds in the reactants than is released when new bonds in the products form. Endergonic reactions absorb energy such as heat, light, or electricity.

Electricity is often used to supply energy to endergonic reactions. Electricity supplies energy to a reaction that puts a coat of metal onto a surface. This reaction is called electroplating. Electricity also is used to supply energy to separate aluminum metal from its ore.

In the following endergonic reaction, energy from electricity keeps the reaction going.



What is an endothermic reaction?

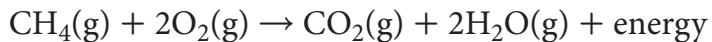
An **endothermic** (en duh THUR mihk) **reaction** absorbs energy, usually as heat. When an endothermic reaction takes place in a beaker, it can make the beaker feel cold. Physical changes also can be described as endothermic. For example, a salt dissolving in water is an endothermic physical change.

An endothermic reaction is used to make homemade ice cream. In an ice-cream maker, salt is added to a bucket of ice and water. The salt dissolves and absorbs heat. This makes the mixture of salt and water colder. Without salt, the ice would not make the ice cream mixture cold enough to freeze.

Some reactions are extremely endothermic. When barium hydroxide ($\text{Ba}(\text{OH})_2$) reacts with ammonium chloride (NH_4Cl) in a beaker of water, it is so endothermic that it causes a drop of water on the outside of the beaker to freeze. Cold packs contain ammonium nitrate crystals and water. They are another example of an endothermic reaction.

How is energy conserved in chemical reactions?

You read in an earlier chapter that energy can change from one form to another, but the total amount of energy never changes. This principle is usually called the law of conservation of energy. Does this mean that the total amount of energy remains constant in chemical reactions, too? Yes. Consider the burning of methane (CH_4) in air. Methane is the major component of natural gas, and is described by the following equation. Note that energy is included as a product and recall that oxygen is in the air.



During this process, some of the chemical energy of the reactants is released as thermal energy and light. However, the sum of the energy released and the chemical energy of the products is exactly equal to the chemical energy of the reactants in an exergonic chemical reaction. In other words, the chemical energy released plus the chemical energy of the products is equal to the chemical energy of the reactants. So the total amount of energy before and after the reaction remains the same. Similarly, the total amount of energy remains the same in endergonic chemical reactions. Sum

Think it Over

4. Compare and Contrast

What is the difference between an endergonic reaction and an endothermic reaction?

After You Read

Mini Glossary

endothermic reaction: a reaction that absorbs energy, usually as heat

endothermic reaction: a reaction that absorbs energy, usually as heat

exergonic reaction: a reaction that releases energy

exothermic reaction: a reaction that releases energy, usually as heat

Review

1. Read and review the terms and their definitions in the Mini Glossary. Write a sentence giving an example of the type of reaction that can cause its container to get cold or freeze water.

2. Complete the table. The first row gives examples of different kinds of reactions. Name the type of reaction for each example. Then describe the reaction.

Chemical Reactions				
Example of Reaction	Glow Stick	Dynamite Exploding	Electroplating Metals	Cold Pack
Type of Reaction	exergonic reaction		endergonic reaction ^a	
Description of Reaction		release energy in the form of heat		

3. What idea was the hardest for you to understand in this section? How would you explain that idea to a friend?
