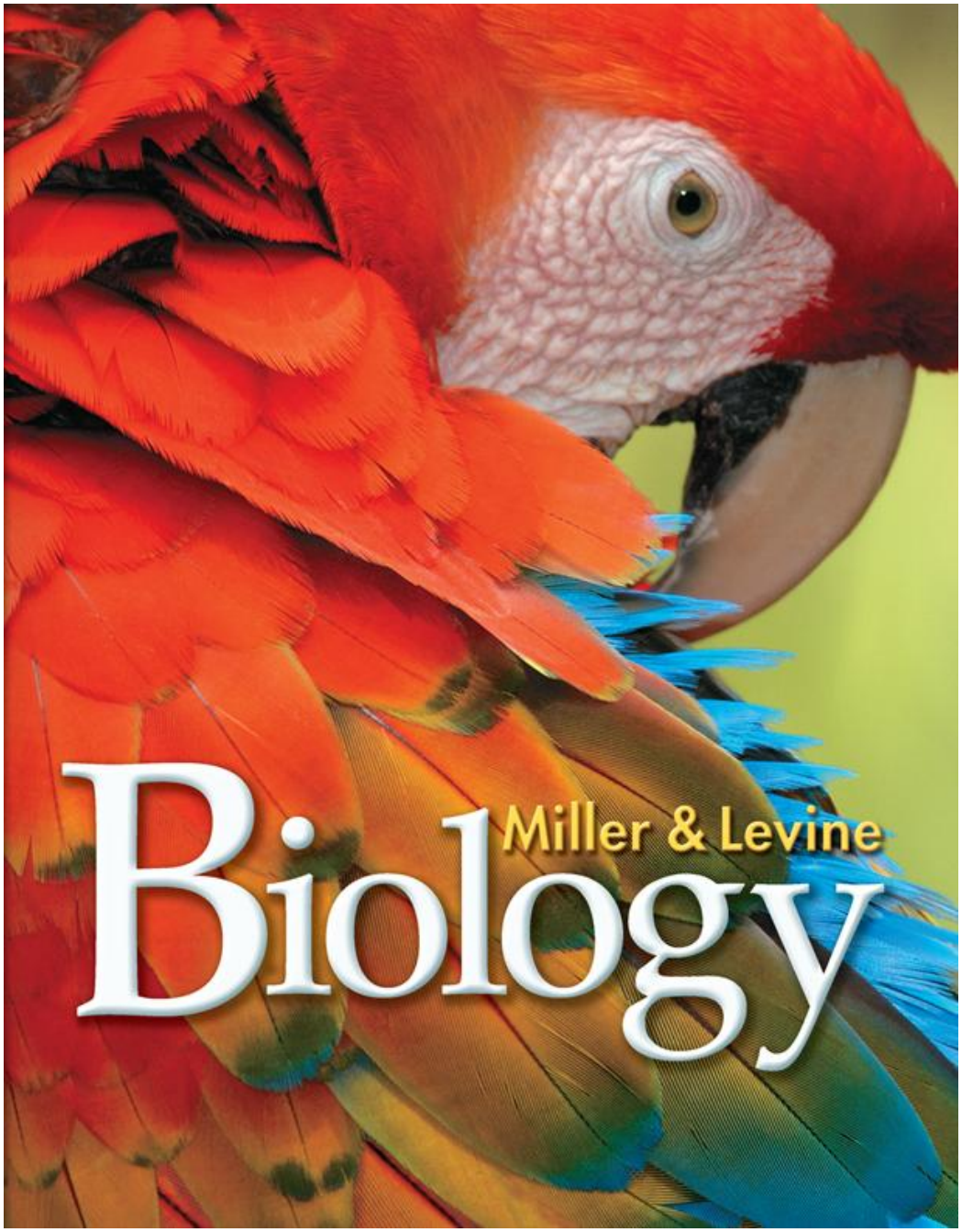


Lesson Overview

2.4 Chemical Reactions and Enzymes

THINK ABOUT IT

Living things are made up of chemical compounds, but chemistry isn't just what life is made of—chemistry is also what life does.

Everything that happens in an organism—its growth, its interaction with the environment, its reproduction, and even its movement—is based on chemical reactions.

Chemical Reactions

- What happens to chemical bonds during chemical reactions?

- Chemical reactions involve changes in the chemical bonds that join atoms in compounds.

Chemical Reactions

A **chemical reaction** is a process that changes, or transforms, one set of chemicals into another by changing the chemical bonds that join atoms in compounds.

Mass and energy are conserved during chemical transformations, including chemical reactions that occur in living organisms.

The elements or compounds that enter into a chemical reaction are known as **reactants.**

The elements or compounds produced by a chemical reaction are known as **products.**

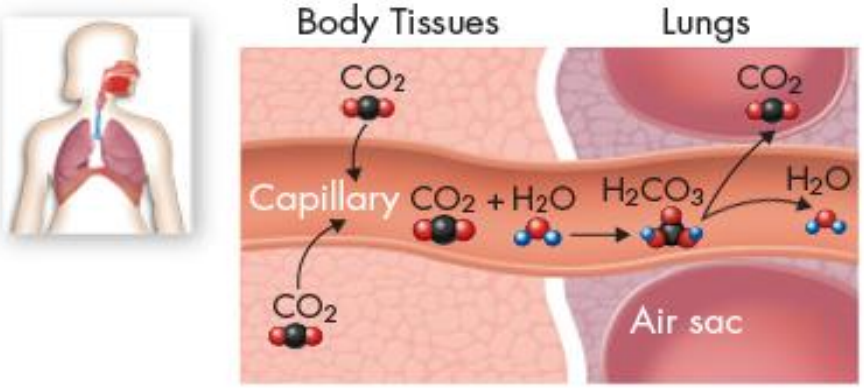
Chemical Reactions

An important chemical reaction in your bloodstream enables carbon dioxide to be removed from the body.

As it enters the blood, carbon dioxide (CO_2) reacts with water to produce carbonic acid (H_2CO_3), which is highly soluble.

This chemical reaction enables the blood to carry carbon dioxide to the lungs.

In the lungs, the reaction is reversed and produces carbon dioxide gas, which you exhale.



Energy in Reactions

- How do energy changes affect whether a chemical reaction will occur?

- Chemical reactions that release energy often occur on their own, or spontaneously. Chemical reactions that absorb energy will not occur without a source of energy.

Energy Changes

Energy is released or absorbed whenever chemical bonds are formed or broken during chemical reactions.

Energy changes are one of the most important factors in determining whether a chemical reaction will occur.

Energy Sources

Every organism must have a source of energy to carry out the chemical reactions it needs to stay alive.

Plants get their energy by trapping and storing the energy from sunlight in energy-rich compounds.

Animals get their energy when they consume plants or other animals.

Humans release the energy needed to grow, breathe, think, and even dream through the chemical reactions that occur when we metabolize, or break down, digested food.

Activation Energy

Chemical reactions that release energy do not always occur spontaneously.

The energy that is needed to get a reaction started is called the **activation energy**.

Takes $ to make $.....

it takes energy to release energy too!

Enzymes

- What role do enzymes play in living things and what affects their function?

- Enzymes speed up chemical reactions that take place in cells.

- Temperature, pH, and regulatory molecules can affect the activity of enzymes.

Enzymes

Some chemical reactions are too slow or have activation energies that are too high to make them practical for living tissue.

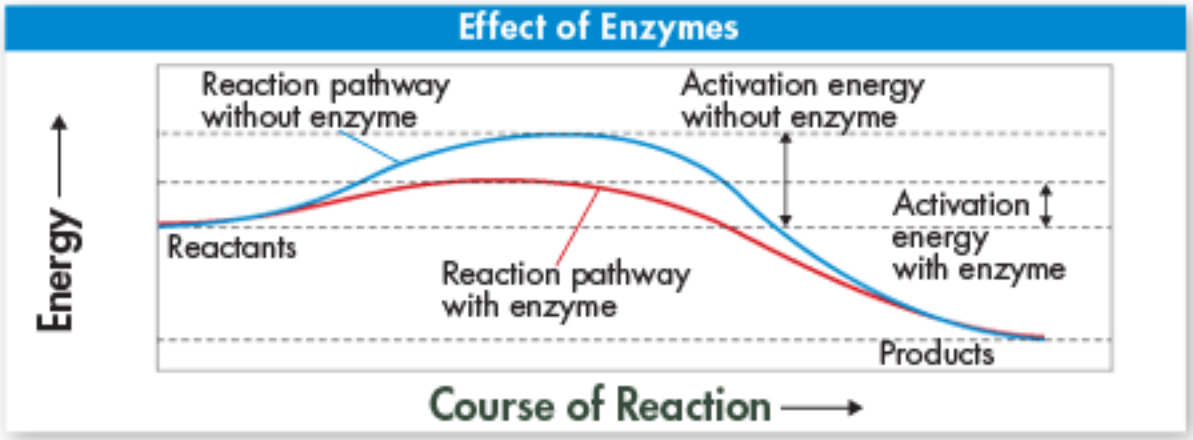
These chemical reactions are made possible by catalysts. A **catalyst** is a substance that speeds up the rate of a chemical reaction.

Catalysts work by lowering a reaction's activation energy.

Nature's Catalysts

Enzymes are proteins that act as biological catalysts. They speed up chemical reactions that take place in cells.

Enzymes act by lowering the activation energies, which has a dramatic effect on how quickly reactions are completed.



Nature's Catalysts

Enzymes are very specific, generally catalyzing only one chemical reaction.

Part of an enzyme's name is usually derived from the reaction it catalyzes.

The Enzyme-Substrate Complex

For a chemical reaction to take place, the reactants must collide with enough energy so that existing bonds will be broken and new bonds will be formed.

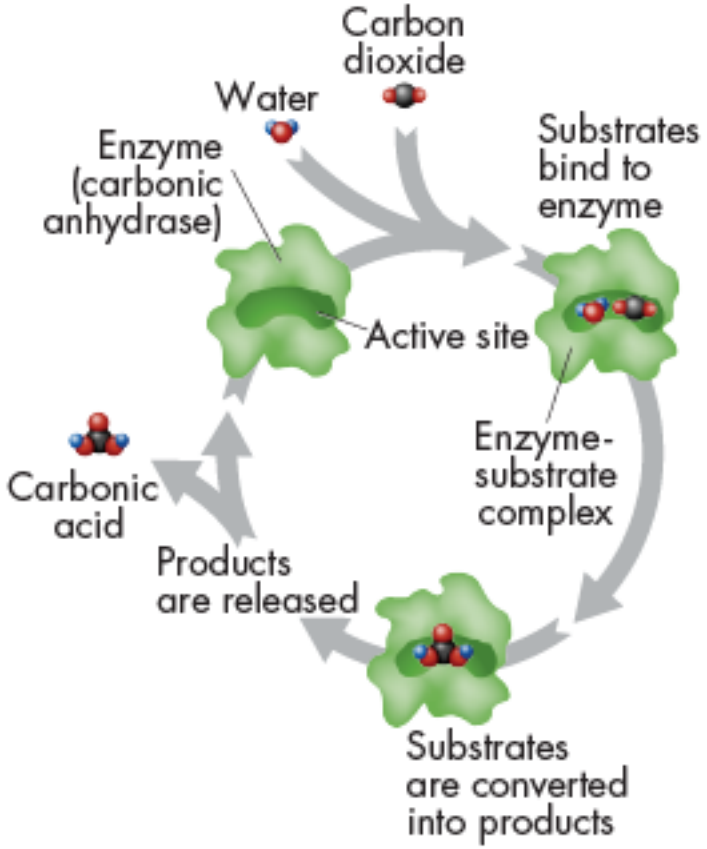
If the reactants do not have enough energy, they will be unchanged after the collision.

Enzymes provide a site where reactants can be brought together to react. Such a site reduces the energy needed for reaction.

The Enzyme-Substrate Complex

The reactants of enzyme-catalyzed reactions are known as **substrates**.

For example, the enzyme carbonic anhydrase converts the substrates carbon dioxide and water into carbonic acid (H_2CO_3).

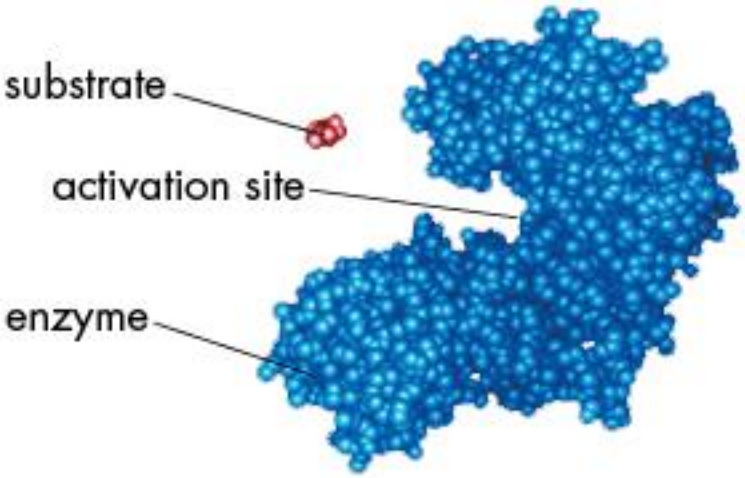


The Enzyme-Substrate Complex

The substrates bind to a site on the enzyme called the active site.

The active site and the substrates have complementary shapes.

The fit is so precise that the active site and substrates are often compared to a lock and key.



Regulation of Enzyme Activity

Temperature, pH, and regulatory molecules are all factors that can affect the activity of enzymes.

Enzymes produced by human cells generally work best at temperatures close to 37° C, the normal temperature of the human body.

Enzymes work best at certain pH values. For example, the stomach enzyme pepsin, which begins protein digestion, works best under acidic conditions.

The activities of most enzymes are regulated by molecules that carry chemical signals within cells, switching enzymes “on” or “off” as needed.