# chapter 8 Cellular Energy

## section 1 How Organisms Obtain Energy

## Before You Read

Think about the objects in your home that use energy. On the lines below, describe the ways that these objects get energy. Then read about how organisms obtain energy.

_____

_____

MAIN Idea

**All living organisms use energy to carry out all biological processes.**

### What You'll Learn

- the two laws of thermodynamics
- the difference between autotrophs and heterotrophs
- how ATP works in a cell

## Read to Learn

### Transformation of Energy

Cells need energy. They need energy to move molecules across membranes and to make and break down molecules. **Energy** is the ability to do work. **Thermodynamics** is the study of how energy flows and changes in the universe.

#### What are the laws of thermodynamics?

Two laws of thermodynamics explain the flow of energy. The first law states that energy can change form, but it cannot be created or destroyed. For example, your body changes the chemical energy in food into a more useable form. Then when you move, your body changes that energy into mechanical energy.

The second law of thermodynamics states that systems change from states of order to states of disorder on their own. This disorder is known as entropy (EN truh pee). Entropy is always increasing. This means that when your body changes forms of energy, some of the energy is lost as heat. The energy is still present, but it can no longer be used.

#### How do organisms get energy from the Sun?

Nearly all the energy for life on Earth comes from the Sun. Some organisms make their own food. Some autotrophs use inorganic substances as a source of energy. Other autotrophs change light energy from the Sun into chemical energy. Plants and some bacteria are autotrophs.

Study Coach

**Create a Quiz** After you read this section, create a quiz based on what you have learned. Then be sure to answer the quiz questions.

Reading Check

**1. State** the first law of thermodynamics.

_____

_____

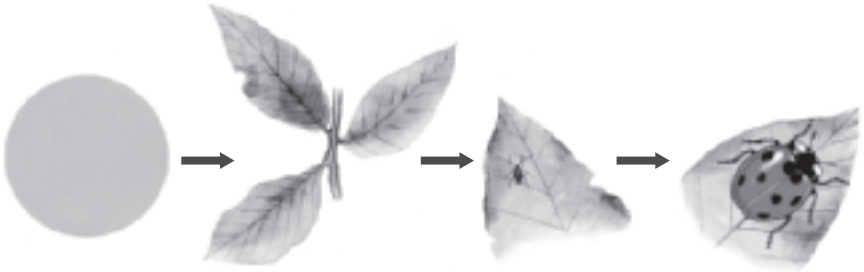
_____

Copyright © Glencoe/McGraw-Hill, a division of The McGraw-Hill Companies, Inc.

Heterotrophs get their energy by eating food. Heterotrophs get energy from the Sun indirectly. They do this by eating autotrophs. Animals are heterotrophs. The figure below shows the relationship between autotrophs and heterotrophs.

## Picture This

**2. Circle** the organism that makes its own food.



The Sun | Autotroph | Heterotroph | Heterotroph

## Metabolism

All of the chemical reactions that go on inside a cell are known as the cell's **metabolism**. A series of reactions in which the product of one reaction becomes the reactant for the next reaction is called a metabolic pathway.

### What are the two metabolic pathways?

There are two types of metabolic pathways: catabolic (ka tuh BAH lik) pathways and anabolic (a nuh BAH lik) pathways. In catabolic pathways, energy is released by breaking larger molecules into smaller molecules. In anabolic pathways, the energy released by catabolic pathways is used to build larger molecules from smaller molecules.

Reading Check

**3. Compare** the energy usage in anabolic and catabolic pathways.

Energy flows between the metabolic pathways of organisms in an ecosystem. Photosynthesis is an anabolic pathway. Cellular respiration is a catabolic pathway. These pathways work together to meet the energy needs of cells.

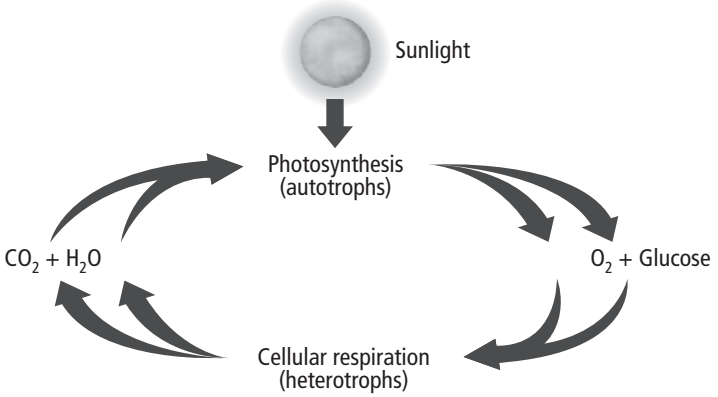
### How is energy changed during photosynthesis?

**Photosynthesis** is a series of reactions that change light energy from the Sun into chemical energy that can be used by the cell. During photosynthesis, light energy, carbon dioxide, and water are changed into organic molecules and oxygen. The energy stored in organic molecules made during photosynthesis can be passed to other organisms. When an animal eats a plant, the plant's stored energy is passed to the animal.

Copyright © Glencoe/McGraw-Hill, a division of The McGraw-Hill Companies, Inc.

## What happens during cellular respiration?

**Cellular respiration** is a series of reactions that break down organic molecules into carbon dioxide, water, and energy. The energy is used by the cell. The processes of cellular respiration and photosynthesis form a cycle, which is shown in the figure below. The products of photosynthesis are the reactants for cellular respiration, and the products of cellular respiration are the reactants for photosynthesis.




## Picture This

**4. Identify** Draw a circle around the anabolic process and a square around the catabolic process.

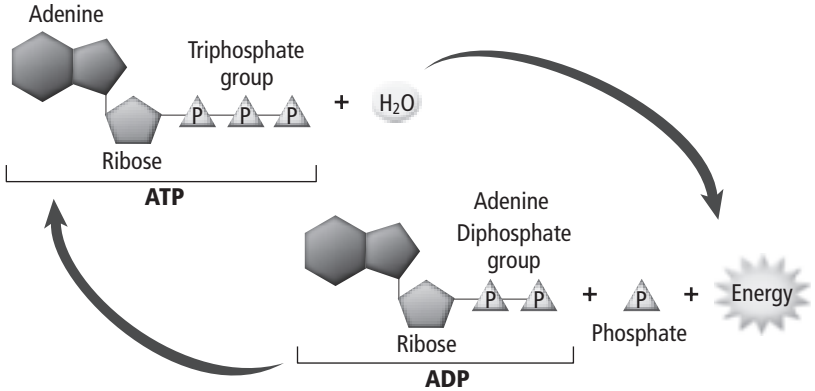
# ATP: The Unit of Cellular Energy

Cells store chemical energy in biological molecules. The most important biological molecule is **adenosine triphosphate** (uh DEN uh seen • tri FAHS fayt), or **ATP**.

## How does ATP store energy?

ATP is the most abundant energy-storing molecule. It is found in all kinds of organisms. The structure of ATP is shown below. It is made of an adenine base, a ribose sugar, and three phosphate groups.

ATP releases energy when the bond between the second and third phosphate groups is broken, forming a molecule called adenosine diphosphate (ADP). ADP can be changed back into ATP by adding a phosphate group.




## Picture This

**5. Identify** Circle the high-energy bond that is broken when ATP is converted to ADP.

Copyright © Glencoe/McGraw-Hill, a division of The McGraw-Hill Companies, Inc.