

SECTION 3

OBJECTIVES

- Describe the role of ATP in cells.
- Explain how energy is released by metabolic reactions.
- Summarize the relationship between anabolism and catabolism.

Metabolism

Metabolism is the sum of all the chemical processes that occur in an organism. Complex molecules are broken down into smaller ones through *catabolism*, and simple molecules are used to build bigger ones through a process called *anabolism*. A *metabolic pathway* is a series of linked chemical reactions that occur within a cell and result in a specific product or products. The major metabolic pathways for most organisms are similar. So, one can study the basic metabolic pathways in simple organisms to get information about the reactions in organisms that are more complex, including humans.

ATP: Energy for the Cell

Just as it takes energy to run a chemical factory, cells require energy to make the proteins, carbohydrates, lipids, and nucleic acids that are necessary for life. In addition, the body needs energy as heat to keep warm, mechanical energy to move muscles and pump blood, and electrical energy to move ions across cell membranes. The original source for almost all of the energy needed by living systems is the sun. **Autotrophs**, such as plants, algae, and photosynthetic bacteria, can use sunlight, water, and CO_2 to make carbon-containing biomolecules, including carbohydrates. This process is called *photosynthesis* and occurs in the cells of plants and algae, such as those shown in **Figure 16**, within structures called *chloroplasts*. Chloroplasts contain *chlorophyll*, an organic molecule that absorbs solar energy. This energy is captured immediately in two compounds, one of which is **adenosine triphosphate (ATP)**. **ATP is a high-energy molecule that plant cells use to make carbohydrates.** The other compound, known as *NADPH*, is also used in carbohydrate-forming reactions.

Unlike plants, animals cannot use the sun's energy to convert CO_2 into food. Animals must get the energy that they need to sustain life by consuming plants and other animals. *Living things, including most microorganisms, which depend on plants or other animals for food, are called heterotrophs.* Heterotrophs use the energy obtained in the breakdown of complex molecules to drive chemical reactions in cells. The carbohydrates, lipids, and amino acids that heterotrophs consume undergo several energy-yielding reactions as they break down into simpler molecules. Some of this energy is stored in the ATP molecules, which cells use to drive a wide variety of metabolic reactions.

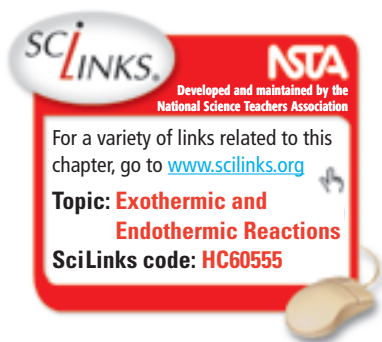


FIGURE 16 The cells of algae and green plants contain chlorophyll, the green pigment that absorbs light energy from the sun.

