

1.2.4 Cell Energy

OBJECTIVES

- Explain the relationship between energy, ATP, and cellular respiration.
- Describe the purpose of enzymes.

VOCABULARY

- **cellular respiration** the breaking down of food molecules by cells into usable energy

It is not hard to tell when you have run out of energy—you feel tired and hungry. Your body uses these feelings to tell you that your cells need energy to carry out the chemical activities needed to live, reproduce, and grow. Energy is the ability to do work. It is the ability to make things happen and to cause processes to occur. A cell is the smallest living unit that uses energy for life.

God designed the sun as the source of energy for life on Earth. Plants capture light energy and change it into food through photosynthesis. In this process plants use energy to change carbon dioxide and water into glucose. Plants then use some of the glucose as food and store some of it as starch. Photosynthesis also produces oxygen.

Cells must be able to convert energy into a form that they can use. The conversion of energy generally happens through **cellular respiration**—the breaking down of food molecules by cells into usable energy. Cellular respiration is not breathing respiration, which is the way your body takes in oxygen and expels carbon dioxide. The two processes are related, however, because breathing supplies an organism's cells with the oxygen needed for cellular respiration.



In most cells, cellular respiration happens in the mitochondria. During cellular respiration, glucose is metabolized into water and carbon dioxide, and energy is released for cellular work. Some of the energy is stored in a molecule called *ATP*. *ATP* (adenosine triphosphate) is the molecule that carries small packets of energy for a cell's activities. Most of the energy is released in the form of heat. In many organisms (humans included), this heat helps maintain body temperature.

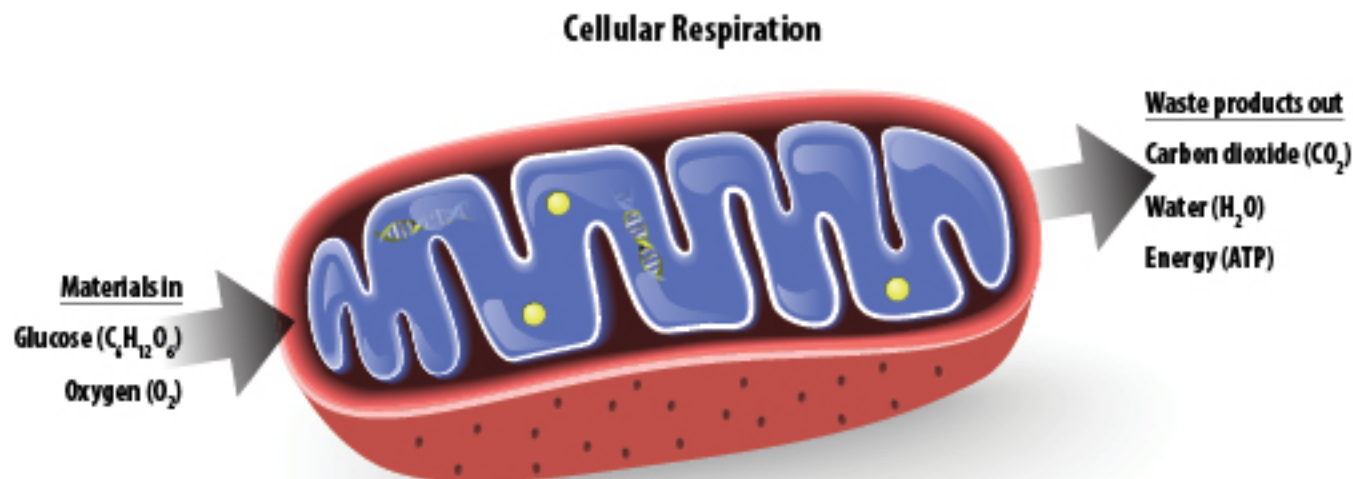
Cells use energy to move materials within their cell membranes through metabolic pathways. A metabolic pathway is a series of chemical reactions that break down or make materials that the cell needs. Metabolic pathways usually contain about a dozen different steps. Plant cells, for example, have metabolic pathways that use energy for building cell walls. Red blood cells have metabolic pathways that use energy to manufacture hemoglobin molecules.

Many of the reactions that take place in a cell involve enzymes, which are special proteins that speed up chemical reactions in an organism or a cell. Enzymes are required to start the many chemical reactions that happen inside each cell. Without enzymes, the reactions inside the cell would not happen fast enough for the cell and the organism to live. Enzymes speed up the metabolic pathways so that the cell flourishes.

Cellular respiration (breaking down sugar to make *ATP*) requires oxygen. Sometimes cells cannot get enough oxygen



A healthy diet gives your cells energy and keeps you feeling good.





FYI

Glucose

Glucose is fuel for your body. The food you eat is broken down into glucose, which enters your bloodstream to fuel cells and release energy for work. But sometimes the body does not process glucose very well. The pancreas secretes insulin that allows glucose to enter cells easily. But in a person with hypoglycemia, the pancreas sends out too much insulin, allowing cells to use glucose too quickly, which eventually starves the cells of sugar. Cell respiration then slows or stops, which can cause depression, dizziness, fainting, nervousness, and other more severe symptoms.

Doctors can diagnose and treat patients with hypoglycemia. People with hypoglycemia may need to eat smaller meals more often throughout the day to keep their glucose levels stable. Your body may be giving you clues that something is wrong, so it is always a good idea to see a doctor if you have any questions about your health.



needed for sufficient cellular respiration to occur. This lack of oxygen causes the production of ATP to diminish. When this happens, cells use fermentation. Fermentation produces a small amount of ATP and other products by partially breaking down glucose without using oxygen. In muscles, fermentation produces lactic acid, which contributes to muscle fatigue. The burning sensation that sometimes occurs after exercise is caused by lactic acid. Some bacteria and yeast also use fermentation for energy. However, alcohol, not lactic acid, is a product of yeast fermentation.

LESSON REVIEW

1. What is cellular respiration?
2. What is a metabolic pathway?
3. Would you expect to find more mitochondria in liver cells, which are very active, or in teeth cells, which are less active? Why?
4. What is the relationship between energy, ATP, and cellular respiration?
5. What is the purpose of enzymes?

Bromelain, an enzyme found in pineapples, is known for its many health benefits. Bromelain is a natural anti-inflammatory that is often used to treat muscle injuries. It also acts as a digestive aid, helps with sinus inflammation, and helps thin blood.