



# 4.4

## Overview of Cellular Respiration

**TEKS** 4B, 9B

### VOCABULARY

- cellular respiration
- aerobic
- glycolysis
- anaerobic
- Krebs cycle

**TEKS 4B** investigate and explain cellular processes, including homeostasis, energy conversions, transport of molecules, and synthesis of new molecules and **9B** compare the reactants and products of photosynthesis and cellular respiration in terms of energy and matter

**KEY CONCEPT** The overall process of cellular respiration converts sugar into ATP using oxygen.

### MAIN IDEAS

- Cellular respiration makes ATP by breaking down sugars.
- Cellular respiration is like a mirror image of photosynthesis.

### Connect to Your World

The term *cellular respiration* may lead you to form a mental picture of cells breathing. This image is not correct, but it is useful to remember. Your cells need the oxygen that you take in when you breathe. That oxygen helps your body release the energy in sugars and other carbon-based molecules. Indirectly, your breathing is connected to the ATP that your cells need for everything you do.

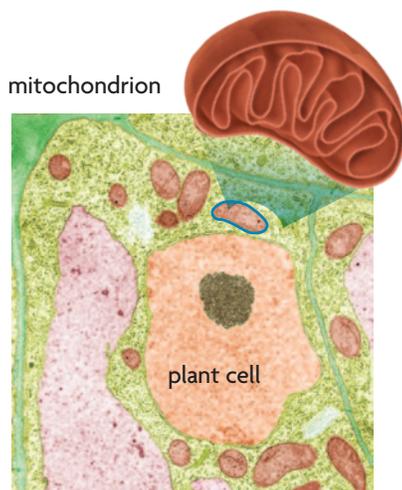
**MAIN IDEA** **TEKS 4B**

## Cellular respiration makes ATP by breaking down sugars.

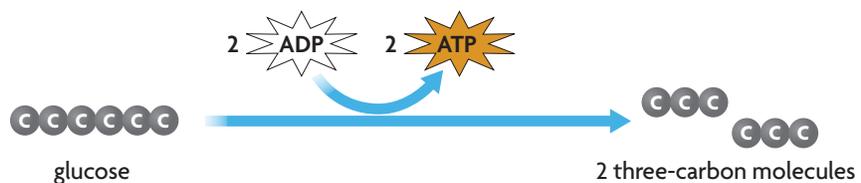
Plants use photosynthesis to make their own food. Animals eat other organisms as food. But food is not a direct source of energy. Instead, plants, animals, and other eukaryotes break down molecules from food to produce ATP.

**Cellular respiration** releases chemical energy from sugars and other carbon-based molecules to make ATP when oxygen is present. Cellular respiration is an **aerobic** (air-OH-bihk) process, meaning that it needs oxygen to take place. Cellular respiration takes place in mitochondria, which are often called the cell's "powerhouses" because they make most of a cell's ATP.

A mitochondrion, shown in **FIGURE 4.1**, cannot directly make ATP from food. First, foods are broken down into smaller molecules such as glucose. Then, glucose is broken down, as shown below. **Glycolysis** (gly-KAHL-uh-sihs) splits glucose into two three-carbon molecules and makes two molecules of ATP. Glycolysis takes place in a cell's cytoplasm and does not need oxygen. Glycolysis is an **anaerobic** process because it does not need oxygen to take place. However, glycolysis is necessary for cellular respiration. The products of glycolysis are broken down in mitochondria to make many more ATP.



**FIGURE 4.1** Mitochondria, found in both plant and animal cells, produce ATP through cellular respiration. (colored TEM; magnification 7000×)



**Explain** What is the function of cellular respiration? **TEKS 4B**

**▶ MAIN IDEA** **TEKS** 4B, 9B

## Cellular respiration is like a mirror image of photosynthesis.

**CONNECT TO**

### PHOTOSYNTHESIS

Review the overall process of photosynthesis in **Section 2**, and compare photosynthesis to cellular respiration.

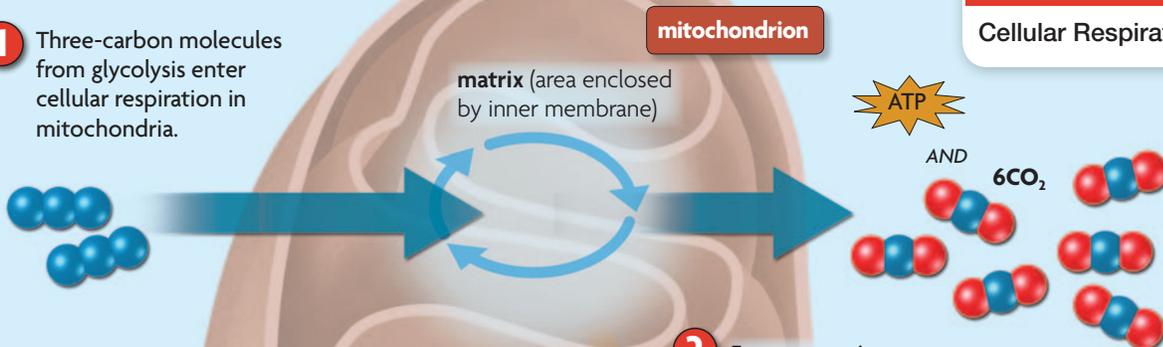
Photosynthesis and cellular respiration are not true opposites, but you can think about them in that way. For example, chloroplasts absorb energy from sunlight and build sugars. Mitochondria release chemical energy to make ATP. The chemical equation of cellular respiration is also basically the reverse of photosynthesis. But the structures of chloroplasts and mitochondria are similar. A mitochondrion is surrounded by a membrane. It has two parts that are involved in cellular respiration: the matrix and the inner mitochondrial membrane. In mitochondria, cellular respiration takes place in two main stages, as shown in **FIGURE 4.2**.

**FIGURE 4.2 Cellular Respiration Overview**

When oxygen is available, ATP is produced by cellular respiration in mitochondria.

### STAGE 1: Krebs Cycle

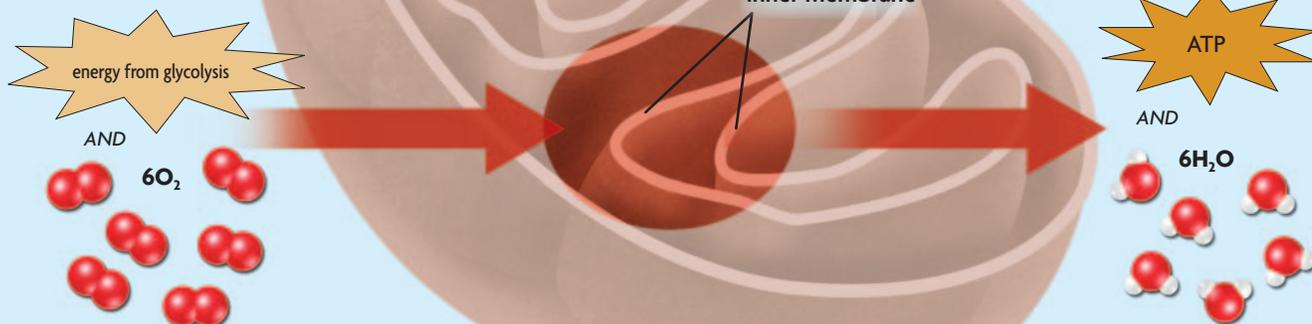
- 1 Three-carbon molecules from glycolysis enter cellular respiration in mitochondria.



- 2 Energy-carrying molecules transfer energy to Stage 2.

### STAGE 2: Electron Transport

- 3 Energy-carrying molecules from glycolysis and the Krebs cycle enter Stage 2 of cellular respiration.



- 4 ATP molecules are produced. Heat and water are released as waste products.

**Identify** What are the reactants and products in cellular respiration? **TEKS** 9B

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