

READING WARM-UP

Objectives

- Describe photosynthesis and cellular respiration.
- Compare cellular respiration with fermentation.

Terms to Learn

photosynthesis
cellular respiration
fermentation

READING STRATEGY

Discussion Read this section silently. Write down questions that you have about this section. Discuss your questions in a small group.

photosynthesis the process by which plants, algae, and some bacteria use sunlight, carbon dioxide, and water to make food

Cell Energy

Why do you get hungry? Feeling hungry is your body's way of telling you that your cells need energy.

All cells need energy to live, grow, and reproduce. Plant cells get their energy from the sun. Many animal cells get the energy they need from food.

From Sun to Cell

Nearly all of the energy that fuels life comes from the sun. Plants capture energy from the sun and change it into food through a process called **photosynthesis**. The food that plants make supplies them with energy. This food also becomes a source of energy for the organisms that eat the plants.

Photosynthesis

Plant cells have molecules that absorb light energy. These molecules are called *pigments*. Chlorophyll (KLAWR uh), the main pigment used in photosynthesis, gives plants their green color. Chlorophyll is found in chloroplasts.

Plants use the energy captured by chlorophyll to change carbon dioxide and water into food. The food is in the form of the simple sugar glucose. Glucose is a carbohydrate. When plants make glucose, they convert the sun's energy into a form of energy that can be stored. The energy in glucose is used by the plant's cells. Photosynthesis also produces oxygen. Photosynthesis is summarized in **Figure 1**.

Photosynthesis

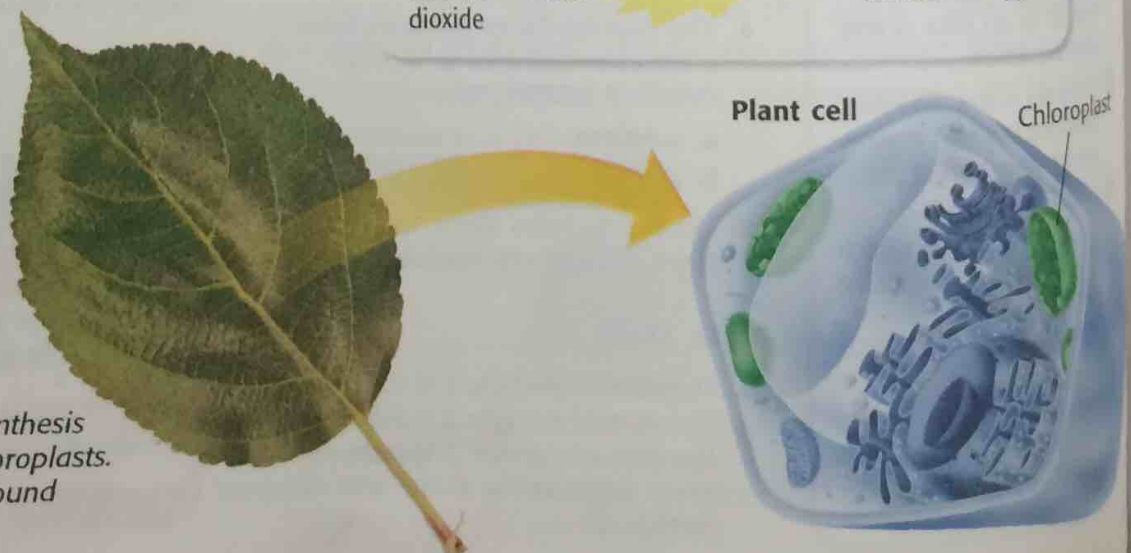
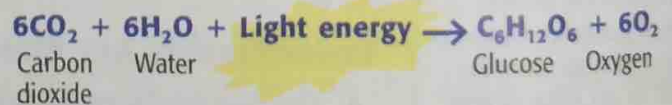


Figure 1 Photosynthesis takes place in chloroplasts. Chloroplasts are found inside plant cells.

Getting Energy from Food

Animal cells have different ways of getting energy from food. One way, called **cellular respiration**, uses oxygen to break down food. Many cells can get energy without using oxygen through a process called **fermentation**. Cellular respiration will release more energy from a given food than fermentation will.

Cellular Respiration

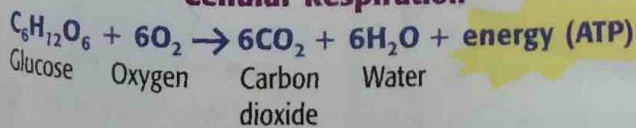
The word *respiration* means “breathing,” but cellular respiration is different from breathing. Breathing supplies the oxygen needed for cellular respiration. Breathing also removes carbon dioxide, which is a waste product of cellular respiration. But cellular respiration is a chemical process that occurs in cells.

Most complex organisms, such as the cow in **Figure 2**, obtain energy through cellular respiration. During cellular respiration, food (such as glucose) is broken down into CO_2 and H_2O , and energy is released. Most of the energy released maintains body temperature. Some of the energy is used to form adenosine triphosphate (ATP). ATP supplies energy that fuels cell activities.

Most of the process of cellular respiration takes place in the cell membrane of prokaryotic cells. But in the cells of eukaryotes, cellular respiration takes place mostly in the mitochondria. The process of cellular respiration is summarized in **Figure 2**. Does the equation in the figure remind you of the equation for photosynthesis? **Figure 3** on the next page shows how photosynthesis and respiration are related.

Reading Check What is the difference between cellular respiration and breathing? (See the Appendix for answers to Reading Checks.)

Cellular Respiration



Mitochondria

Animal cell

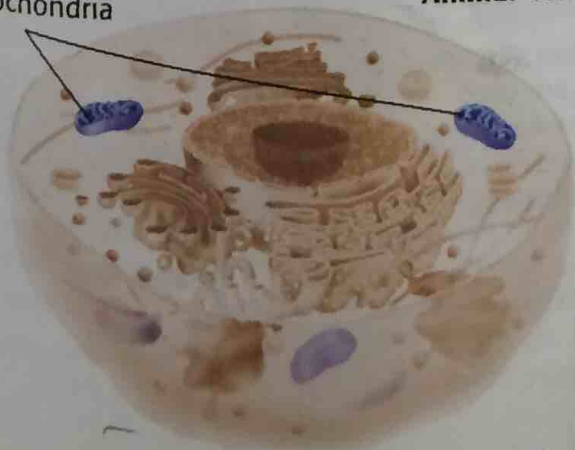


Figure 2 The mitochondria in the cells of this cow will use cellular respiration to release the energy stored in the grass.

CONNECTION TO Chemistry

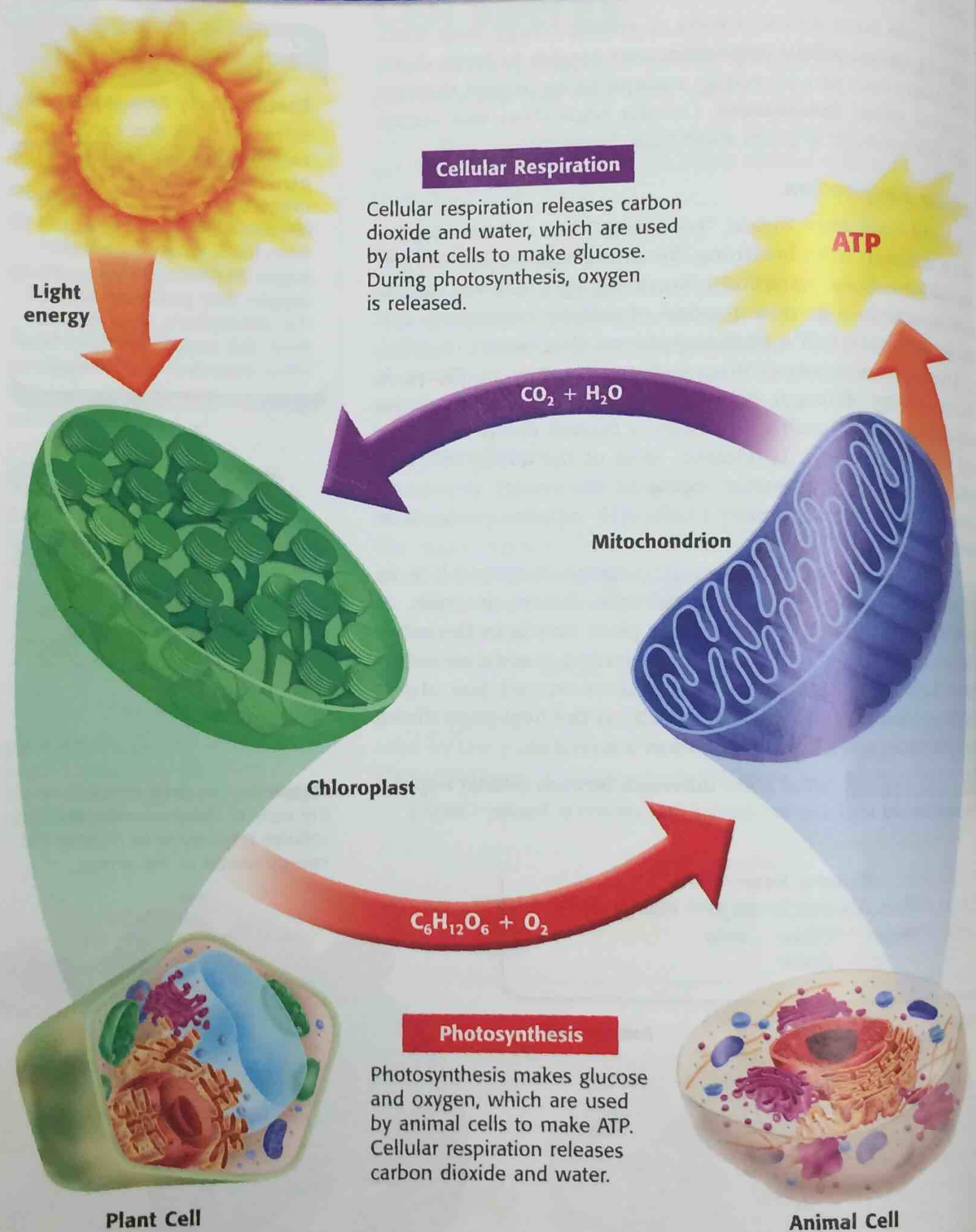
Earth's Early Atmosphere

Scientists think that Earth's early atmosphere lacked oxygen. Because of this lack of oxygen, early organisms used fermentation to get energy from food. When organisms began to photosynthesize, the oxygen they produced entered the atmosphere. How do you think this oxygen changed how other organisms got energy?

cellular respiration the process by which cells use oxygen to produce energy from food

fermentation the breakdown of food without the use of oxygen

Figure 3 The Connection Between Photosynthesis and Respiration



Connection Between Photosynthesis and Respiration

As shown in **Figure 3**, photosynthesis transforms energy from the sun into glucose. During photosynthesis, cells use CO_2 to make glucose, and the cells release O_2 . During cellular respiration, cells use O_2 to break down glucose and release energy and CO_2 . Each process makes the materials that are needed for the other process to occur elsewhere.

Fermentation

Have you ever felt a burning sensation in your leg muscles while you were running? When muscle cells can't get the oxygen needed for cellular respiration, they use the process of fermentation to get energy. One kind of fermentation happens in your muscles and produces lactic acid. The buildup of lactic acid contributes to muscle fatigue and causes a burning sensation. This kind of fermentation also happens in the muscle cells of other animals and in some fungi and bacteria. Another type of fermentation occurs in some types of bacteria and in yeast as described in **Figure 4**.

Reading Check What are two kinds of fermentation?



Figure 4 Yeast forms carbon dioxide during fermentation. The bubbles of CO_2 gas cause the dough to rise and leave small holes in bread after it is baked.

SECTION Review

Summary

- Most of the energy that fuels life processes comes from the sun.
- The sun's energy is converted into food by the process of photosynthesis.
- Cellular respiration breaks down glucose into water, carbon dioxide, and energy.
- Fermentation is a way that cells get energy from their food without using oxygen.

Using Key Terms

- In your own words, write a definition for the term *fermentation*.

Understanding Key Ideas

- O_2 is released during
 - cellular respiration.
 - photosynthesis.
 - breathing.
 - fermentation.
- How are photosynthesis and cellular respiration related?
- How are respiration and fermentation similar? How are they different?

Math Skills

- Cells of plant A make 120 molecules of glucose an hour. Cells of plant B make half as much glucose as plant A does. How much glucose does plant B make every minute?

Critical Thinking

- Analyzing Relationships** Why are plants important to the survival of all other organisms?
- Applying Concepts** You have been given the job of restoring life to a barren island. What types of organisms would you put on the island? If you want to have animals on the island, what other organisms must you bring? Explain your answer.

SCILINKS

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Topic: Cell Energy; Photosynthesis
SciLinks code: HSM0237; HSM1140