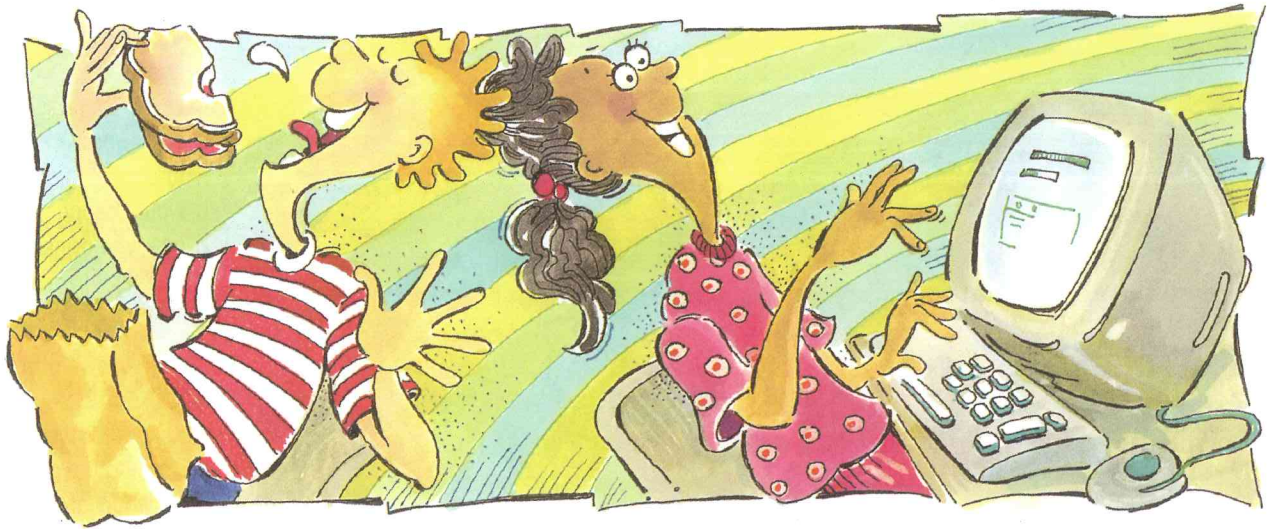


2.2 How Cells Get Energy



How is turning on a computer like eating a sandwich? The common link is energy. Just as electricity supplies the energy that runs the computer, food supplies the energy that the cells of your body need to carry out their activities.

Cells cannot work without energy any more than a computer can work without being plugged in and turned on. The energy that cells use comes from food. What is food? For animals, food may be a sandwich, a mouse, or a blade of grass. For plants, food is carbohydrates made in their leaves by the process of photosynthesis. What all foods have in common, however, is particles that contain chemical energy.

The energy in food can only be released after food particles have entered the cells and have been broken down by a chemical reaction. The process that releases food energy is called **cellular respiration**.

You probably think of respiration as breathing in and out. That is what you and all other air-breathing animals do to obtain oxygen from the air and to get rid of carbon dioxide. Recall that cells carry out all the functions of living things. Your cells use the oxygen that you breathe in for cellular respiration, and they produce the carbon dioxide that you breathe out. Cellular respiration occurs in nearly all living cells of every organism — in plants and micro-organisms, as well as in animals.

Inside cells, oxygen combines with food particles (such as carbohydrates) in cellular respiration. The word equation for this chemical reaction is:



DidYouKnow?

The word *photosynthesis* comes from two Greek words. *Photo* means “light.” *Synthesis* means “putting together.” Recall that in the process of photosynthesis, carbon dioxide and water are put together to make carbohydrates. The energy for this chemical reaction comes from sunlight. The word equation for photosynthesis is:



This chemical change can be compared to the burning of fuel. Like burning, much of the energy from the reaction ends up as heat. Think about what happens when your body demands more energy, such as when you run a race (see Figure 2.8). First, you need a good meal of energy-rich carbohydrates. As you run, you breathe more quickly, pumping in more oxygen for your cells to use. The oxygen and the food particles react inside your cells, producing energy for your muscles. At the end of the race, you feel warm.

No wonder! Every one of the millions of cells in your muscles has been burning food particles at a higher rate, not to mention the trillions of other cells in your body all working to carry out the respiration reaction.



Figure 2.8 Cellular respiration provides the energy to run a race.

Powerhouses of the Cell

Cellular respiration does not take place everywhere inside the cell. It occurs mainly inside the mitochondria (see page 29). Because energy is produced within the mitochondria, these organelles are often called the “powerhouses” of the cell. Different cells use different amounts of energy and have different numbers of mitochondria. Active cells, such as those in muscles, may contain several hundred mitochondria. The energy produced inside the mitochondria can be used by other parts of the cell (see Figure 2.9).

Why do cells need energy? Cell membranes need energy to move materials into and out of cells by active transport. Muscle cells need energy to contract. Sperm cells use energy to swim. Nerve cells use energy to send signals. Most cells also use energy to grow and reproduce. You will study cell reproduction in the next section.

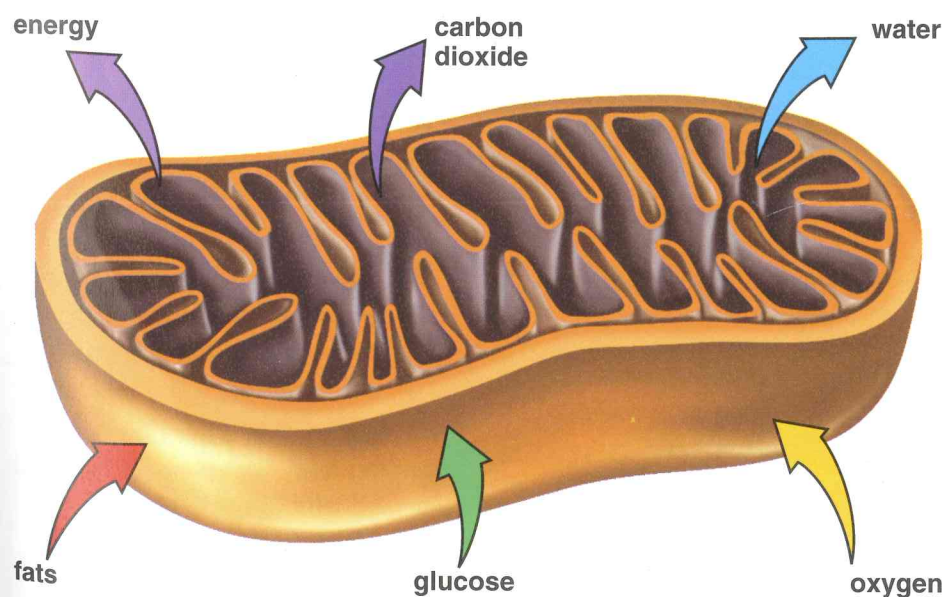


Figure 2.9 Cutaway diagram of a mitochondrion. Fats and glucose are broken down into smaller particles before entering the mitochondria, where cellular respiration occurs.

DidYouKnow?

Have you ever felt stiff and sore after working your muscles harder than usual? This happens because your muscle cells cannot get oxygen fast enough to meet their demand for energy. So, instead of using cellular respiration to release energy from glucose, the muscle cells use a chemical reaction called fermentation. A product of this reaction is a chemical called lactic acid. It is this chemical that makes your muscles feel stiff. However, regular exercise strengthens your muscles and improves the efficiency of your heart and lungs. This helps get more oxygen to your cells faster and reduces the risk of soreness after exercise.