3.1 Cycles in the Biosphere

Think about what balance means to you. Does it mean equality? Does it mean an even distribution of weight, or stability, or counteracting something? The idea of balance was mentioned in the introduction to this chapter. Balance is an important idea to keep in mind as you begin to explore the cycles that constantly occur throughout the biosphere.

Have you ever been given a book that someone finished reading, and enjoyed reading it yourself? Have you ever given a toy that you had outgrown to a younger child who could enjoy playing with it? If so, you were **recycling** — using the same item over and over. The biosphere is excellent at recycling.

The Water Cycle

As Figure 3.1 shows, an apple is 84 percent water, a carrot is 88 percent water, and a tomato is 94 percent water. The human body is 60 to 70 percent water. All living things require water. Water is used for life processes such as supplying food throughout an organism's body in a form it can use in its cells, and carrying away wastes from those cells.

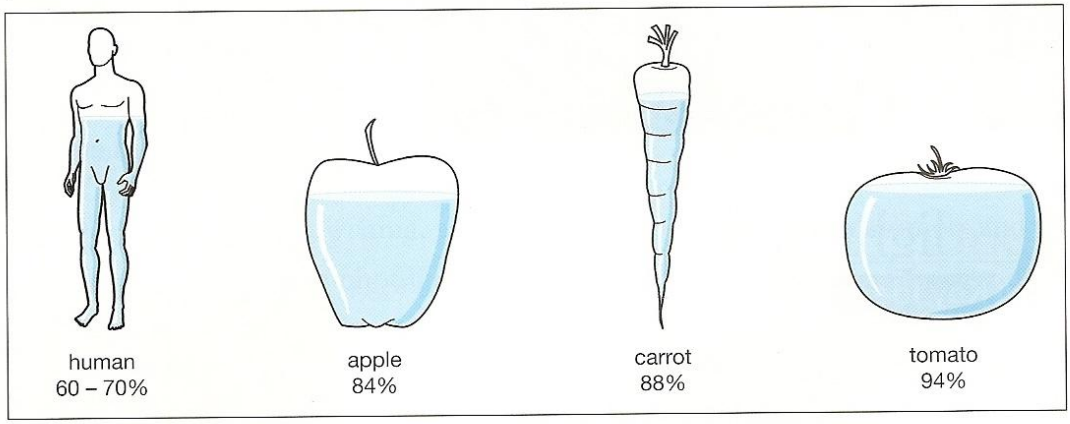

Figure 3.1 The percentages of water in some living things

DidYouKnow?

Does it surprise you to know that the amount of water in the biosphere always stays more or less the same? The same water particles that were present hundreds of years ago are still around today. Hundreds of years ago, your great-great-great-great-great-grandparents drank water. Perhaps you drank some of the same water particles today!

As you may have learned in earlier studies, the **water cycle** is the continuous movement of water through the biosphere. There are four main processes in the water cycle:

1. **Evaporation** is the process of changing a liquid into a vapour (see Figure 3.2). Liquid water evaporates to form invisible water vapour. For example, when laundry is hung in the sunlight, the water evaporates until the laundry is dry. As well, solid water (ice) can change directly into water vapour without going through the liquid stage. This process is called **sublimation.** For example, have you ever noticed that ice cubes shrink in size if the ice-cube tray is left in the freezer for too long? The solid ice cube shrinks as it sublimates into invisible water vapour.

Figure 3.2 Water evaporates from streams and other bodies of water. It forms invisible water vapour.

2. **Transpiration** is the process in which water that is taken in through a plant's roots evaporates from the plant's leaves, stem, and flowers.

3. **Condensation** is the process of changing a vapour to a liquid. Warm air contains water vapour. As air cools, however, it is able to hold less and less water. Condensation happens when air becomes so cool that it can no longer hold as much water vapour, and liquid water is released. The liquid forms clouds, fog, or dew. For example, water droplets form on the outside of a cold glass of juice. As the glass cools from contact with the juice, the air surrounding the glass cools. The cooled air can no longer hold as much water vapour, so the water is released as droplets on the outside of the glass.

4. **Precipitation** is the process in which liquid water forms from condensation occurring inside clouds, and then falls as rain, sleet, snow, and hail.

Figure 3.3 illustrates the water cycle. The first two processes — evaporation and transpiration — move water up from Earth into the atmosphere. The second two — condensation and precipitation — return water to Earth. **Ground water** is water in the soil. Plant roots can grow down to reach ground water. People can reach ground water by digging wells. **Run-off** is water that runs off the ground into lakes, rivers, or streams.

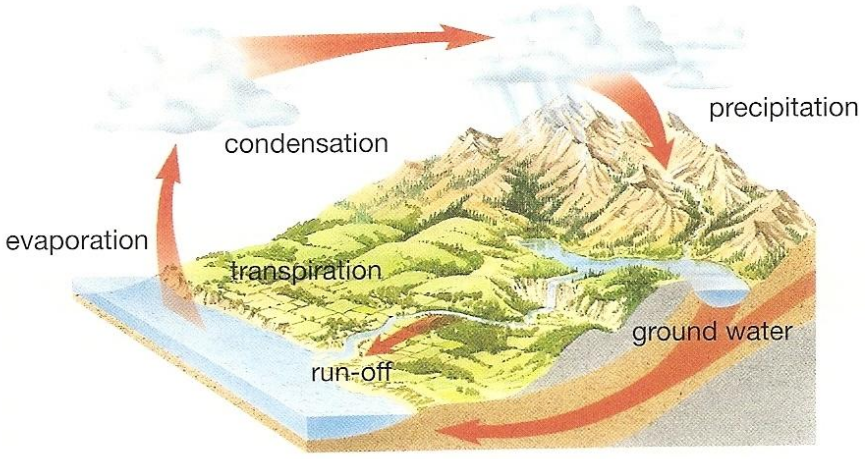

Figure 3.3 The water cycle

The Carbon Dioxide and Oxygen Cycle

In the late eighteenth century, scientists discovered that a mouse could not survive in a closed container in which a candle had been burned. However, when a plant was left to grow in the container for eight or more days, a mouse could survive.

We now know that living things, including you, need oxygen to survive (see Figure 3.4). The burning candle used up the oxygen in the container, so the oxygen was not available for the mouse to breathe. Why do you think the plant made it possible for the mouse to survive in the container? Another major cycle constantly occurs on Earth, and it will help you answer this question. The **carbon dioxide and oxygen cycle** is the process by which carbon dioxide and oxygen are cycled and recycled in the biosphere.

Figure 3.4 Like many other living things, you require oxygen for your life processes.

When you breathe, you — like the mouse — take in oxygen. Your body cells use this oxygen, in a process called respiration, to release energy from food. **Respiration** is the oxygen-using process, shown in Figure 3.5, that takes place in the cells of living things to get the energy out of food. All living things — both animals and plants — must respire all the time. Fish, algae, and plankton in the water respire. So do the decomposers — bacteria, fungi, yeasts, and moulds — that you explored in Chapter 2.

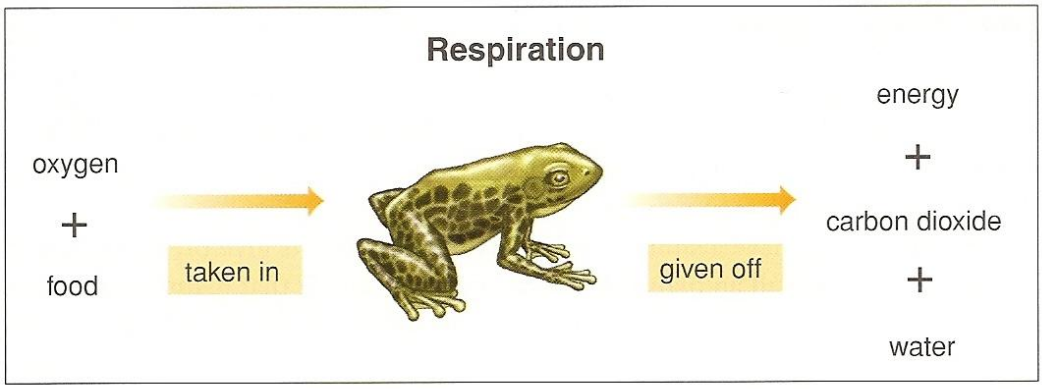

Figure 3.5 The process of respiration

The process of respiration is much like the process of burning a candle. Wax is the fuel for the burning candle shown in Figure 3.6. What do both burning and respiration take out of the air? Do Figures 3.5 and 3.6 help to explain what happened to the mouse when it was placed in a container after a candle was burned?

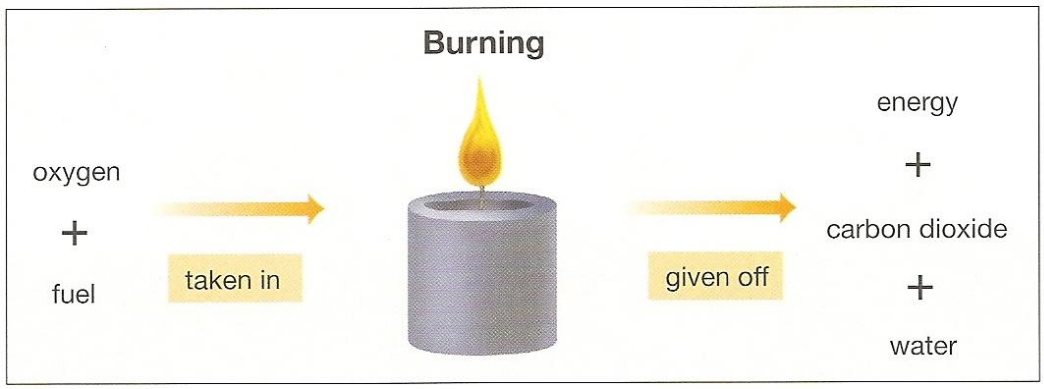

Figure 3.6 The process of combustion (burning)

Pause& Reflect

Think about what you have learned about the water cycle and the carbon dioxide and oxygen cycle. Summarize what you know about these cycles by drawing a diagram or making a flowchart in your Science Log.

In addition to energy, respiration has two other products: carbon dioxide and water (refer back to Figure 3.5). Carbon dioxide is a gas made up of carbon and oxygen. Plants need carbon dioxide, along with other substances, to make their own food in a process called **photosynthesis**. In some ways, photosynthesis (shown in Figure 3.7) is the reverse of respiration because the plant takes in carbon dioxide and releases oxygen. Does Figure 3.7 help explain what happened to the mouse in the container after a growing plant had been left in the container for eight or more days?

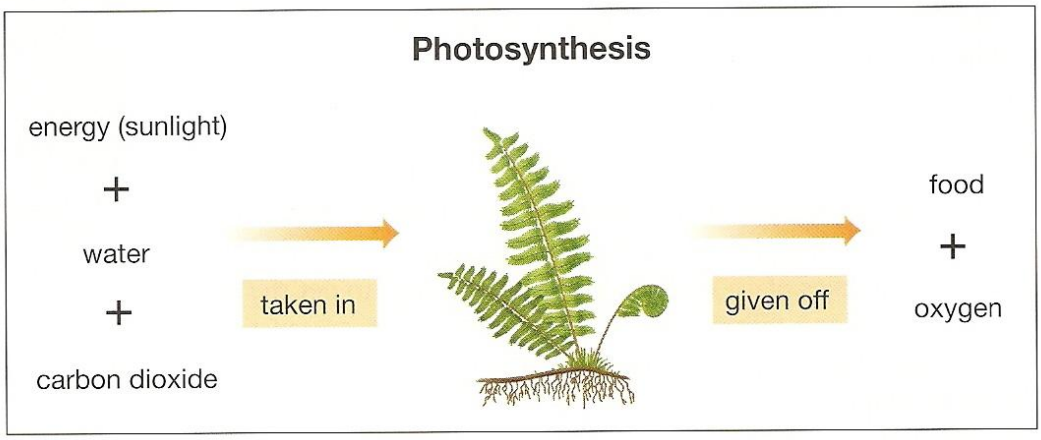

Figure 3.7 Photosynthesis occurs in plants, algae, and some bacteria that contain green chlorophyll.

Imagine that you are preparing a labelled diagram as part of a project. You really need a green pencil, but you do not have one. A classmate has a green pencil that she is not using. She needs a brown pencil, which you have and do not need. You and your classmate exchange pencils.

Plants and animals have a similar useful relationship. Plants give off the oxygen that animals require, and animals give off the carbon dioxide that plants require. Figure 3.8 shows the entire carbon dioxide and oxygen cycle. In nature respiration and photosynthesis are more or less balanced. When the Sun is shining, plants can use the carbon dioxide about as quickly as it is produced.

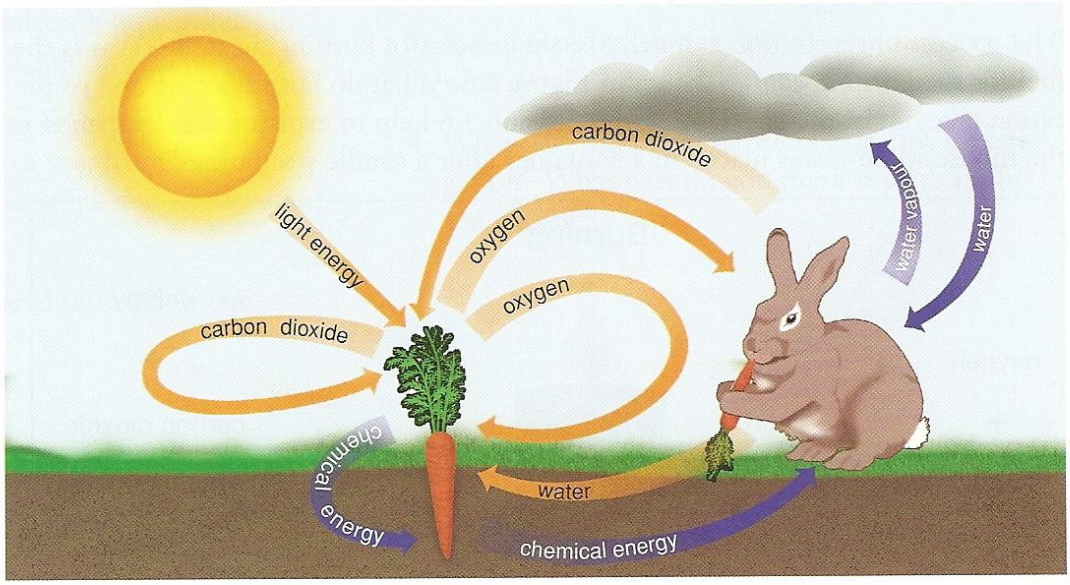

Figure 3.8 The carbon dioxide and oxygen cycle. The chemical energy is food energy.