Cycles of Matter

Guide for Reading

- What three major processes make up the water cycle?
- How are carbon and oxygen recycled in ecosystems?
- What is the nitrogen cycle?

Matter is recycled in ecosystems. Matter includes water, oxygen, carbon, nitrogen, and many other substances. Three of the most important cycles of matter are the water cycle, the carbon-oxygen cycle, and the nitrogen cycle.

The **water cycle** is the continuous process by which water moves from Earth’s surface to the atmosphere and back. The processes of **evaporation, condensation, and precipitation** make up the water cycle. Evaporation is the process by which molecules of liquid water absorb energy and change to the gas state. Water evaporates from Earth’s surface and forms water vapor, a gas, in the atmosphere. The process by which a gas changes to a liquid is called **condensation**. When water vapor in the atmosphere cools, it turns back into tiny droplets of liquid water. As more water vapor condenses, the drops grow larger and heavier. Eventually, the heavy drops fall back to Earth as a form of **precipitation**—rain, snow, sleet, or hail.

Carbon is the building block for the matter that makes up the bodies of living things. **In the ecosystem, the processes by which carbon and oxygen are recycled are linked.** Producers, consumers, and decomposers play roles in recycling carbon and oxygen. Producers take in carbon dioxide from the atmosphere during photosynthesis. In this process, the producers use carbon from the carbon dioxide to produce other carbon-containing molecules. These molecules include sugars and starches. Consumers obtain energy from these molecules by breaking them down into simpler molecules. The consumers release water and carbon dioxide as waste products of the process. At the same time, producers release oxygen during photosynthesis. Other organisms take in oxygen from the atmosphere and use it in their life processes.

Like carbon, nitrogen is a necessary building block in the matter that makes up living things. **In the nitrogen cycle, nitrogen moves from the air to the soil, into living things, and back into the air.** Most organisms cannot use nitrogen gas in the air. Nitrogen gas is called “free” nitrogen because it is not combined with other kinds of atoms. Most organisms can use nitrogen only when it has been “fixed,” or combined with other elements to form nitrogen-containing compounds. The process of changing nitrogen gas into a usable form of nitrogen is called **nitrogen fixation**. Most nitrogen fixation is performed by certain kinds of bacteria. Some of these bacteria live in bumps called nodules on the roots of certain plants. Once the nitrogen has been fixed, it can be used by organisms to build proteins and other complex substances. Decomposers break down these complex compounds. Decomposition returns simple nitrogen compounds to the soil. Certain types of bacteria break down the nitrogen compounds completely. These bacteria release free nitrogen back into the air, and the cycle starts again.