

## EXPLANATIONS

### Cycling of Matter in Ecosystems

Earth constantly receives energy from the sun. In contrast, the amount of matter on Earth does not change. Matter is recycled from organisms to the environment and back again. Earth's ecosystems cycle carbon, nitrogen, and water. These materials are important to all organisms.

#### *The Carbon Cycle*

Carbon is found in every living organism. Carbon is also found in the atmosphere, in gasoline, and in many kinds of rock. One common form of carbon is carbon dioxide. Recall that carbon dioxide is released into the air as a waste product of cellular respiration. In this process, cells break down sugar to get energy. In the opposite process of photosynthesis, producers such as plants use carbon dioxide from the air to make sugar.

The carbon stored in organisms cannot be reused until the organisms are eaten or decomposed. Bacteria and other decomposers break down dead organisms in a process called decomposition. Carbon dioxide is released into the atmosphere in this process. Carbon moves among the air, the ground, and plants and animals in the carbon cycle.

Combustion, or burning, is part of the carbon cycle. When wood or other organic material burns, it releases carbon dioxide. By burning coal and oil, people put large amounts of carbon dioxide into the atmosphere. Recall that coal and oil are fossil fuels. They developed from the remains of plants and animals that died millions of years ago. Carbon from those organisms is stored in the fossil fuel. When fossil fuels are burned, they release most of the carbon as carbon dioxide. Cars, buses, coal-burning power plants, and oil furnaces all affect Earth's carbon cycle. Carbon dioxide from burning fossil fuels is also thought to contribute to global climate change.

#### *The Nitrogen Cycle*

Nitrogen is found in many places on Earth and in many different forms. Most of Earth's nitrogen is in the atmosphere, in the form of nitrogen gas. All living things use nitrogen to make materials such as proteins, but most organisms cannot use nitrogen gas. A natural process converts nitrogen from the atmosphere into forms that are useful to a variety of organisms. This process is called nitrogen fixation. It produces compounds such as ammonia and nitrates. Some bacteria perform nitrogen fixation. Lightning can also cause this process to occur. The energy in lightning can cause a chemical reaction between oxygen and nitrogen in the air.

Bacteria make nitrogen available to the roots of plants. Animals get nitrogen by eating plants. Substances containing nitrogen can be found in animal wastes, including urine. In this way, animals return nitrogen to the soil for plants to use. When a plant or animal dies, the remains decay and become part of the soil. The nitrogen in the remains is recycled and can also be used by plants. Human activities also add nitrogen to the soil. Many fertilizers contain nitrates. When fertilizers are spread on soil, the nitrogen content of the soil is increased.

Several factors increase the amount of nitrogen in the soil. Other processes take nitrogen out of the soil. Denitrification takes nitrogen from nitrates and other compounds in the soil and releases it as nitrogen gas. Then the nitrogen gas returns to the atmosphere. Denitrifying bacteria live deep in the soil and ocean floor, where there is no free oxygen. They use nitrate compounds to get oxygen for cellular respiration. They produce nitrogen gas as a waste. These bacteria complete the nitrogen cycle.