

### ● Before You Read

By looking at calendars, you can observe cycles, such as the cycle of the school year and summer vacation. On the lines below, write about cycles in your life. Read about the cycles in nature.

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### ● Read to Learn

#### Cycles in the Biosphere

The law of the conservation of mass states that matter is not created or destroyed. Instead, matter is cycled through the biosphere. **Matter** is anything that takes up space and has mass.

Matter provides the nutrients needed for organisms to function. A **nutrient** is a chemical substance that an organism needs to perform life processes. An organism obtains nutrients from its environment. The bodies of all organisms are built from water and nutrients. Common nutrients include carbon, nitrogen, and phosphorus.

#### How do nutrients cycle through the biosphere?

Nutrients cycle through the biosphere through organisms. Producers begin the cycle. In most ecosystems, plants obtain nutrients from air, water, and soil. Plants convert the nutrients into organic compounds that they use. Most capture energy from the Sun and convert it into carbohydrates. When a consumer eats a producer, the nutrients in the producer pass to the consumer. For example, the nutrients in green grass pass to the cow that eats the grass. The cycle continues until the last consumer dies. Detritivores return the nutrients to the cycle, and the process begins again.

#### MAIN Idea

**Nutrients move through the biotic and abiotic parts of an ecosystem.**

#### What You'll Learn

- the importance of nutrients to living organisms
- the biogeochemical cycles of nutrients

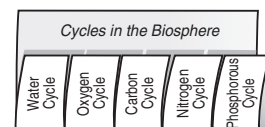
#### Mark the Text

#### Identify Main Ideas

Circle the names of the cycles described in this section. Underline the text that summarizes the steps in each cycle.

#### FOLDABLES™

**Take Notes** Make a five-tab Foldable, as shown below. As you read, take notes and organize what you learn about five cycles in the biosphere.



### ✓ Reading Check

**1. Synthesize** What three processes form the biogeochemical cycle?

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### Picture This

**2. Identify** Complete the figure by labeling the missing steps in the water cycle.

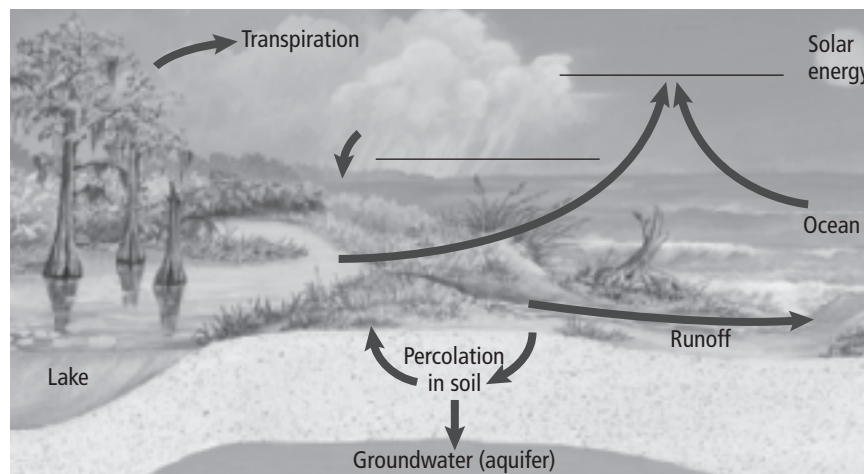
## What is the biogeochemical cycle?

Both biological processes and chemical processes are needed to cycle matter in living organisms. The cycle also requires geological processes such as weathering. Weathering breaks down large rocks into small pieces. Plants and other organisms obtain nutrients from these pieces. Scientists use the name **biogeochemical cycle** to describe the combination of processes that exchange matter through the biosphere. ✓

## How does water cycle?

Evaporation occurs when liquid water changes into water vapor—a gas—and enters the atmosphere. Water evaporates from bodies of water, from water in the soil, and from the surfaces of plants.

As water vapor rises, it begins to cool in the atmosphere. Clouds form when water vapor condenses into droplets around dust particles in the atmosphere. When the droplets become large and heavy, they fall from the clouds as precipitation. Precipitation can be in the form of rain, hail, sleet, or snow. Most falls directly back into the ocean. The figure below shows the water cycle. It is a model that describes how water moves from the surface of Earth to the atmosphere and back to the surface again.



## Why are carbon and oxygen important to organisms?

Living organisms are composed of molecules that contain carbon. Living things also need oxygen for many life processes. Carbon and oxygen make up molecules needed for life, including carbon dioxide and sugar.

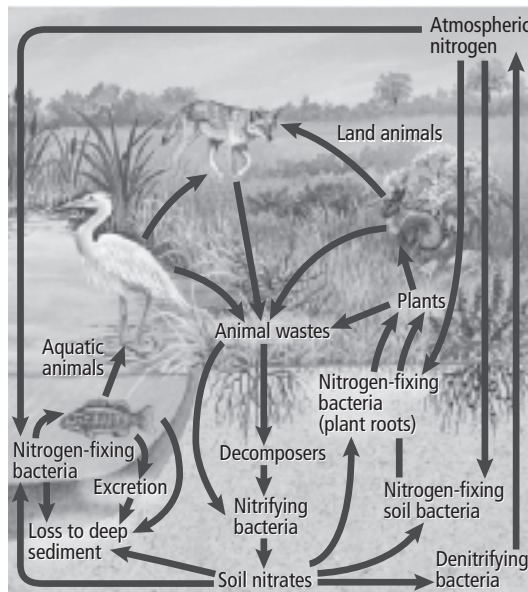
## What are the carbon and oxygen cycles?

During photosynthesis (foh toh SIHN thuh sus), producers change carbon dioxide into carbohydrates and release oxygen into the air. The carbohydrates are a source of energy for all organisms in a food web. Autotrophs and heterotrophs release carbon dioxide into the air during cellular respiration. Carbon and oxygen cycle quickly through living organisms.

Carbon is also part of a cycle that takes much longer. During a process that could take millions of years, carbon is converted into fossil fuels such as gas, peat, or coal. Carbon is released into the atmosphere in the form of carbon dioxide when fossil fuels are burned.

## What is the nitrogen cycle?

Organisms need nitrogen to produce proteins. The atmosphere is 78 percent nitrogen. However, most organisms cannot use nitrogen directly from the air. Nitrogen gas is captured from the air by a species of bacteria, as shown in the figure below. These bacteria live in water, the soil, or grow on the roots of some plants. **Nitrogen fixation** is the process of capturing and changing nitrogen into a form that plants can use. Humans add nitrogen to the soil when they apply chemical fertilizers to a lawn or to crops.



## How does nitrogen enter food webs?

Nitrogen enters the food web through plants. Consumers get nitrogen by eating producers or other animals that contain nitrogen. At each step in the food web, organisms reuse nitrogen to make proteins. The amount of nitrogen is limited, and will often determine the growth of producers.



## Think it Over

**3. Summarize** How do photosynthesis and cellular respiration differ?

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## Picture This

**4. Determine** What captures the atmospheric nitrogen?

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**Reading Check**

**5. Name** the nitrogen compound that is changed by organisms in the soil.


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**Picture This**

**6. Explain** how phosphates are added to water.

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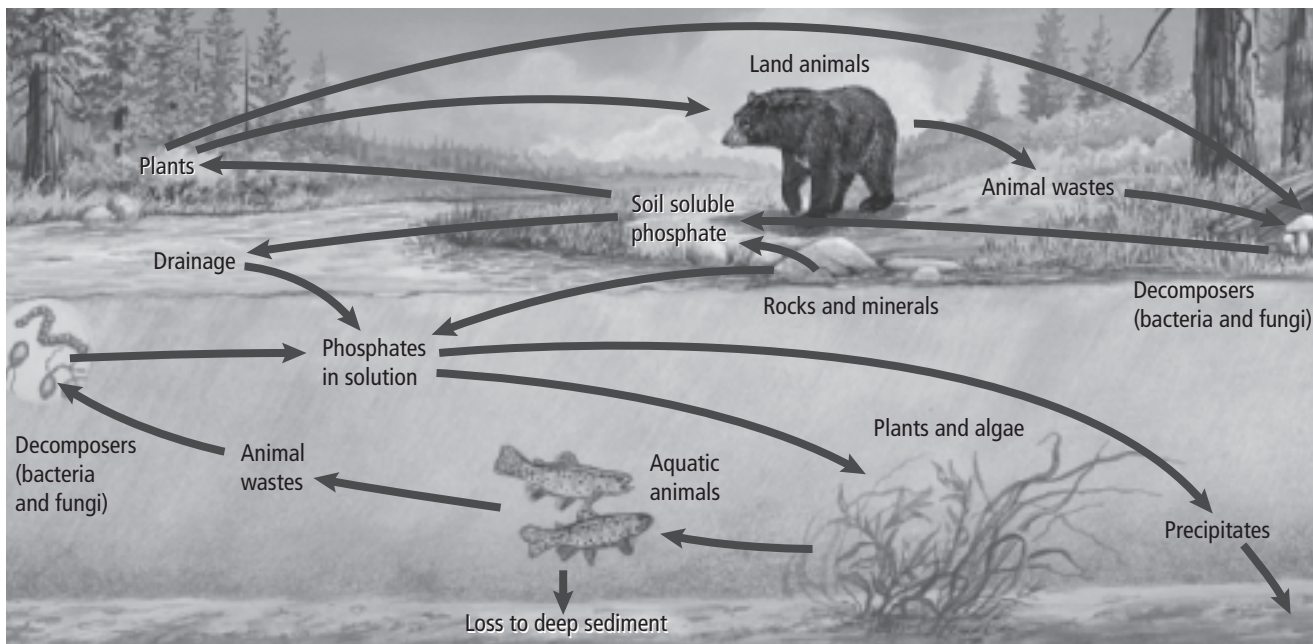
**What is denitrification?**

Nitrogen returns to the soil when animals urinate and when organisms die and decay. When organisms die, decomposers break down matter in the organisms into a nitrogen compound called ammonia. Ammonia is changed by organisms in the soil into nitrogen compounds that can be used by plants. Some bacteria in the soil change nitrogen compounds into nitrogen gas in a process called **denitrification**. This process releases nitrogen into the atmosphere. 

**What is the phosphorus cycle?**

Organisms must have phosphorus to grow and develop. Large amounts are used to build bones and teeth. There are two phosphorus cycles—a short-term cycle and a long-term cycle. In the short-term cycle, phosphorus is cycled from the soil to producers to consumers. Phosphorus returns to the soil when organisms die or produce waste products, as shown in the figure below.

In the long-term cycle, phosphorus is added to soil from weathering or erosion of rocks that contain phosphorus. Weathering and erosion are long processes. They slowly add phosphorus to the soil. Phosphorus does not dissolve in water, and only small amounts are present in soil. The growth of producers is limited by the amount of phosphorus available to them.



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