

3.4 Cycles of Matter

Lesson Objectives

- Describe how matter cycles among the living and nonliving parts of an ecosystem.
- Describe how water cycles through the biosphere.
- Explain why nutrients are important in living systems.
- Describe how the availability of nutrients affects the productivity of ecosystems.

Lesson Summary

Recycling in the Biosphere Matter, unlike energy, is recycled within and between ecosystems. Elements pass from one organism to another and from one part of the biosphere to another through biogeochemical cycles, which are closed loops powered by the flow of energy.

The Water Cycle Water moves between the ocean, the atmosphere, and land. Evaporation is the process in which water changes from a liquid to a gas. Transpiration is the process in which water evaporates from the leaves of plants.

Nutrient Cycles The chemical substances that an organism needs to survive are called nutrients. Like water, nutrients pass through organisms and the environment.

- ▶ **Carbon Cycle:** Carbon is a key ingredient of all organic compounds. Processes involved in the carbon cycle include photosynthesis and human activities such as burning.
- ▶ **Nitrogen Cycle:** Nitrogen is needed by all organisms to build proteins. Processes involved in the nitrogen cycle include nitrogen fixation and denitrification.
 - In nitrogen fixation, certain bacteria convert nitrogen gas into ammonia.
 - In denitrification, other soil bacteria convert nitrogen compounds called nitrates back into nitrogen gas.
- ▶ **Phosphorus Cycle:** Phosphorus is needed for molecules such as DNA and RNA. Most of the phosphorus in the biosphere is stored in rocks and ocean sediments. Stored phosphorus is gradually released into water and soil, where it is used by organisms.

Nutrient Limitation A nutrient that, in short supply, can limit the productivity of an ecosystem is called a limiting nutrient.

Recycling in the Biosphere

For Questions 1–3, write True if the statement is true. If the statement is false, change the underlined word or words to make the statement true.

1. The four elements that make up over 95 percent of the body in most organisms are oxygen, sulfur, nitrogen, and hydrogen.
2. Matter moves through an ecosystem in cycles.
3. Chemical and physical processes in biogeochemical cycles include the formation of clouds and precipitation, “burning” food, and the flow of running water.

4. Explain why Earth is considered a closed system.

5. How might building a new highway affect the cycles of matter?

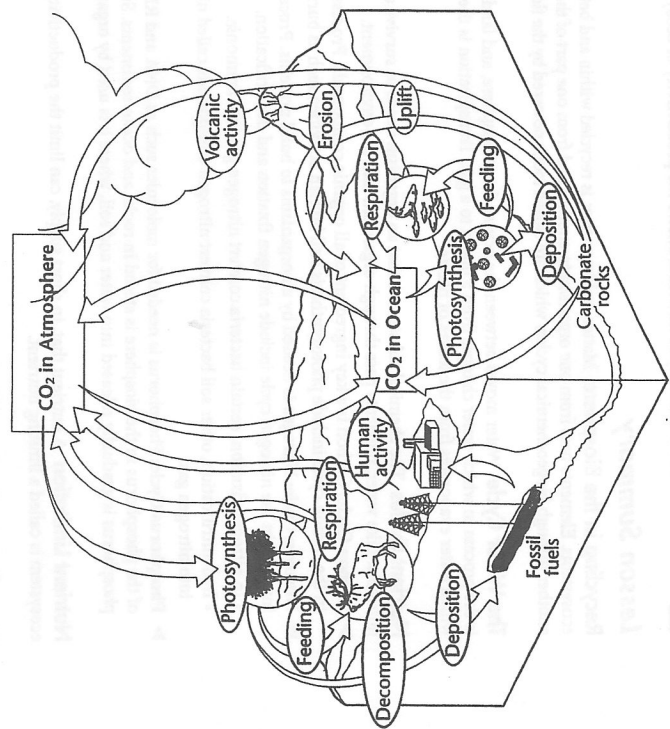
The Water Cycle

6. What role do plants play in the water cycle?

7. Draw a diagram explaining the water cycle. Label the processes involved as biological or physical/chemical.

11. What happens to the carbon in an organism's body after it dies?

The carbon cycle describes how carbon moves between the atmosphere, the ocean, land, and living things.
 Color the arrows that show carbon moving into the atmosphere blue.
 Color the arrows that show carbon moving out of the atmosphere yellow.



Use the diagram to answer the questions. Circle the correct answer.

12. Which process releases carbon into the atmosphere?

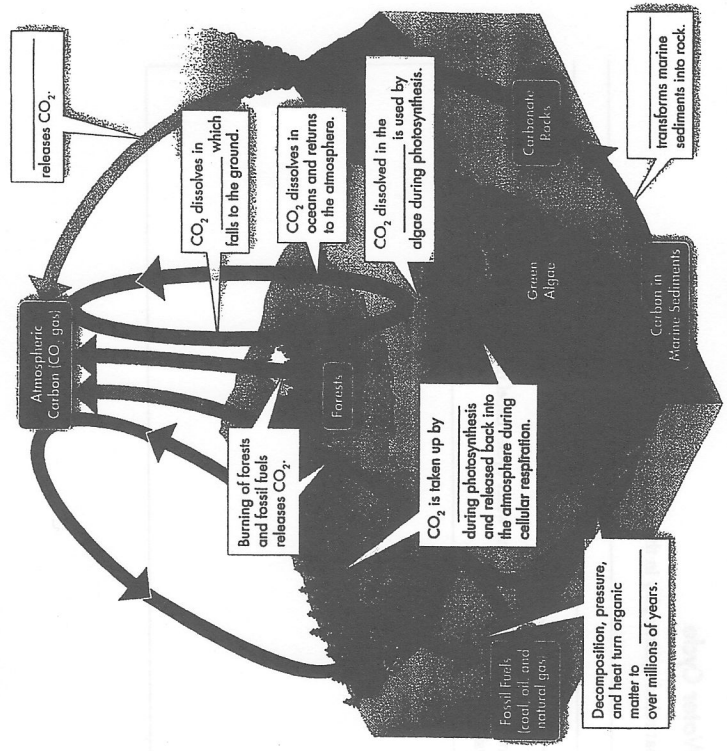
- photosynthesis
- respiration

13. Which process removes carbon from the land?

- human activity
- deposition

Nutrient Cycles

The diagram below shows the major processes involved in the carbon cycle. Label the diagram with the following terms: *producers, fossil fuels, rainwater, oceans, and geological activity.*



8. What organisms remove carbon from the atmosphere? What organisms release carbon into the atmosphere?

9. How are fossil fuels made?

10. How does geological activity contribute to the carbon cycle?