TEKS Lesson 7.5B: Cycles of Matter

All living organisms need certain nutrients to live, grow, and reproduce. Earth has a limited supply of these nutrients. As a result, these nutrients move constantly from living organisms to the nonliving parts of the environment and back again in several cycles.

How are the carbon and oxygen cycles related?
Carbon and oxygen are necessary for life. Carbon combines with oxygen and hydrogen to form the basic compounds that are the building blocks of all living things. For example, carbon is a major component of bones and the proteins that build muscles. Most organisms use oxygen for their life processes. In ecosystems, the processes by which carbon and oxygen are recycled are linked, or related. Read below to learn about the steps involved in these processes.

The Carbon Cycle  The carbon cycle is the continuous movement of carbon in different forms from the nonliving environment (soil, air, water) into organic matter (living things, once-living things, and their wastes) and back again. All of the organic matter in an area is known as biomass. Refer to the diagram as you read about carbon cycling.

1. Producers take in carbon dioxide (CO₂) from the air during photosynthesis. They use carbon from the carbon dioxide to make food: carbon-containing molecules such as sugars and starches. Producers also take up carbon compounds from the soil to use in their life processes.

2. As consumers eat producers, they take in carbon-containing molecules. As the food is broken down, both producers and consumers release carbon dioxide and water into the environment.

3. When organisms die, decomposers break down their remains and return carbon molecules to the soil. Some decomposers also release carbon dioxide into the air. People also help the decay of biomass and the recycling of the nutrients it contains through composting. Compost is partly decomposed organic matter used to enrich soil. People place yard waste and some food scraps into piles or compost bins where decomposers break down the materials.

4. In some cases, sediment buries carbon-containing organic matter. Over millions of years, it can become deposits of fossil fuels. Oil, coal, and natural gas are examples of fossil fuels. The carbon is eventually released back into the atmosphere when the fuels are burned. Wood burning also releases carbon held for many years in the tissues of trees.

5. Link with the Oxygen Cycle  Just as with carbon, oxygen (O₂) cycles through ecosystems. Producers release oxygen as a waste product of photosynthesis. Most organisms then take in this oxygen from the air or water. They use it to carry out their life processes.

1. Explain  Matter cycles between living and nonliving systems. Explain how the carbon in the apple you eat might have once been in the tissues of a bird.

How does nitrogen cycle through ecosystems?
Like carbon, nitrogen is one of the building blocks of living things. For example, nitrogen is an important component of proteins.
The Nitrogen Cycle  In the nitrogen cycle, nitrogen moves from the air, into the soil, into living things, and then back into the air or soil. Look at the diagram below as you read how nitrogen cycles through ecosystems.
1 Plants use simple nitrogen compounds to make proteins and other complex compounds.
2 Consumers eat nitrogen compounds in plants.
3 When organisms die, decomposers return simple nitrogen compounds to the soil.
4 Soil bacteria release some free nitrogen into the air.
5 Bacteria in root nodules fix free nitrogen into simple compounds.

Nitrogen Fixation  The air around you is about 78 percent nitrogen gas. So, you might think it would be easy for living things to get nitrogen. However, most organisms cannot use nitrogen gas. Nitrogen gas is called “free” nitrogen because it is not combined with other kinds of atoms. Most organisms can use nitrogen only after it has been “fixed,” or combined with other elements to form nitrogen-containing compounds. The process of changing free nitrogen into a usable form of nitrogen is called nitrogen fixation. Most nitrogen fixation is performed by certain kinds of bacteria. These bacteria live in bumps called nodules (NAHJ oolz) on the roots of legumes. These plants include clover, beans, peas, alfalfa, peanuts, and some trees.

After nitrogen is fixed, plants can use it to build proteins and other complex compounds. Nitrogen can cycle from the soil to plants and then to animals many times. At some point, however, bacteria break down the nitrogen compounds completely. These bacteria then release free nitrogen back into the air and soil, causing the cycle to continue.

2.Explain  How does nitrogen fixation aid the cycling of matter within the nitrogen cycle?

What processes are involved in the water cycle?
Water is essential for life. The water cycle is the continuous process by which water moves from Earth’s surface to the atmosphere and back again. The processes of evaporation, condensation, and precipitation are parts of the water cycle.

Evaporation  The process by which molecules of liquid water absorb energy and change to a gas is called evaporation. Evaporation is an important part of the water cycle. The energy for evaporation comes from the heat of the sun. As the sun shines on Earth’s surface, liquid water heats up and evaporates from oceans, lakes, and other sources. It forms a gas called water vapor in the atmosphere. Smaller amounts of water also evaporate from living things. Plants release water vapor from their leaves during transpiration. Humans and other animals release liquid water in wastes and when they exhale.
**Condensation**  As water vapor rises higher in the atmosphere, it cools down. The cooled vapor then turns back into tiny drops of liquid water. The process by which a gas changes to a liquid is called **condensation**. The water droplets collect around dust particles and form clouds.

**Precipitation**  As more water vapor condenses, the drops of water in the clouds grow larger. Eventually the heavy drops fall to Earth as **precipitation**. Rain, snow, sleet, and hail are forms of precipitation. Precipitation can fall into oceans, lakes, or rivers. The precipitation that falls on land can soak into the soil and become groundwater. It can also run off the land, flowing back into a river or ocean. Living things use this water for drinking, cleaning, and removal of waste.

**3. Explain**  What three processes are part of the cycling of matter within the water cycle?

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**Lesson Check**

1. **List**  List three cycles that constantly move matter from living organisms to the nonliving parts of the environment and then back again.

2. **Identify**  Which of these is an important product of the decay of biomass?
   - A legumes
   - B compost
   - C decomposers
   - D fixed nitrogen

3. **Summarize**  Why is the cycling of carbon within living systems important?

4. **Predict**  What would be the effect on the cycling of matter within living systems if nitrogen-fixing bacteria were to die off from a disease?

5. **Demonstrate**  Demonstrate the cycling of matter within the water cycle. On the lines below, write the name of the process shown in each lettered section of the diagram.
   - A: ______________________
   - B: ______________________
   - C: ______________________
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1. Demonstrate  Complete the graphic organizer to demonstrate the cycling of carbon within living and nonliving systems.

2. Identify  Which process returns water to Earth’s surface?
   A  condensation  B  evaporation
   C  precipitation  D  transpiration

3. Explain  Explain how the decay of biomass in a compost bin plays a role in both the carbon cycle and the nitrogen cycle. __________________________________________________________
   __________________________________________________________

4. Demonstrate  Complete the graphic organizer to demonstrate the major steps in the cycling of nitrogen within living and nonliving systems.

5. Predict  How would the cycling of water through Earth’s environment change without heat from the sun?
   __________________________________________________________
   __________________________________________________________

6. Carbon and nitrogen are cycling continuously within living systems.
   a. Explain  Explain the need for carbon within living systems. Describe the movement of carbon into plants and how carbon compounds are used by living things.
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   b. Explain  Explain the need for nitrogen within living systems. Describe the movement of nitrogen into plants and how nitrogen compounds are used by living things.
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