

HOW DO NATURAL CYCLES AFFECT ECOSYSTEMS?



Overview

Students will learn about the carbon cycle and how carbon dioxide enters the atmosphere. (NOTE: This lesson assumes a basic understanding of photosynthesis.)

Objectives

On successful completion of this lesson, students will be able to:

- diagram the carbon cycle; and
- describe the impact of increased atmospheric carbon dioxide.

Alaska Standards

Alaska Science Standards / Grade Level Expectations

[6] SA1.1 The student demonstrates an understanding of the processes of science by: asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

[6] SC3.1 The student demonstrates an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy by: recognizing that organisms can cause physical and chemical changes (e.g., digestion, growth, respiration, photosynthesis) to matter and recognizing the importance of energy transfer in these changes.

Alaska Cultural Standards

[E] Culturally knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them. Students who meet this cultural standard are able to:

[E.2] understand the ecology and geography of the bioregion they inhabit.

Bering Strait School District Scope & Sequence

M.S. Sequence 6.3: Cycling of Matter and Energy

M.S. Sequence 7.7 Atmosphere

Materials

- Candle
- Matches
- Tongs
- Small piece of aluminum foil (approximately 4 in.)
- Potato chips (one needed for demonstration)



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- Peanuts - not dry roasted (one needed for demonstration)
- Crackers (one per student)
- Overhead: Photosynthesis and the Carbon Cycle
- Student Worksheet: Diagramming the Carbon Cycle

Multimedia

REACH Multimedia 4-6: "Photosynthesis"

Available at: www.k12reach.org

Additional Resources

Glencoe Life Science Ch 20

Glencoe Earth Science Ch 12

Activity Preparations

1. Gather materials for the demonstration and make copies of the Student Worksheet.

Whole Picture

The major cycles in nature are the water, carbon and nitrogen cycles. In recent years human activities such as burning fossil fuels, and deforestation, have altered the global carbon cycle, particularly in the atmosphere. Currently CO₂ levels in the atmosphere are rising faster than they ever have in the past. Scientists have determined that CO₂ levels cannot change without affecting global temperatures. Increased levels of carbon dioxide are responsible for increased temperatures. The result has produced rapid changes to the environment, particularly in the Arctic.

Alaska Native people have traditionally expected fluctuations in weather, hunting conditions, ice patterns and animal populations year to year, but many have noted major changes since the 1970s. Observations by Alaska's Native people not only corroborate scientific studies, but provide firsthand evidence that climate change is a reality.

In the last 30 years, Alaska has warmed by about 4 degrees Fahrenheit. The change is profoundly affecting the lives and culture of the people who depend on traditional ways of acquiring and storing their food. For example:

- Thawing permafrost is changing the landscape and the ecology;
- Insect populations are changing, thriving in warmer temperatures;
- Coastal areas are eroding;
- Seasonal ice conditions are changing on both ocean and inland waters; and
- With a decrease in precipitation, the risk of wildfires has dramatically increased.



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Although scientists agree that temperatures increase from processes that release more greenhouse gases into the atmosphere, ideas differ when considering what the implications will be for life on Earth. One idea is that higher temperatures will cause cloud cover to increase and temperatures to decrease. Another idea is that higher temperatures will stop the global circulation of warm and cold ocean currents. This could cause an ice age because warm currents won't be able to reach the polar regions of the planet.

Vocabulary

photosynthesis	process by which plants use sunlight to make food and release oxygen from carbon dioxide and water
decomposition	process of breaking down organic matter by bacteria and fungi
respiration	process of taking in oxygen to break down food for energy and releasing carbon dioxide

Activity Procedure

1. Explain carbon is essential to life on Earth; all organisms depend on carbon for physical structure (wood, bones, shell) or energy (gained from food, burned for heat). Carbon moves from one system to another in a continuous cycle. It travels from the oceans to the atmosphere, is taken up by vegetation, consumed by animals, and is eliminated or exhaled in a constant rotation called the carbon cycle.
2. Ask students to imagine a carbon atom as it travels through time. Start by exhaling the carbon atom, joined by two oxygen atoms. This breath floats through the air and outside, drifting around until it comes in contact with a blueberry bush. The blueberry bush draws in the carbon dioxide (CO₂) through its leaves. By using energy from the sun and water from the soil, it recombines the atoms to form a sugar. The plant then releases oxygen back out through its leaves. The oxygen mixes with the atmosphere eventually entering the classroom. Breathe in and the oxygen from the plant enters the lungs. Eat the blueberries and the body will extract nutrients and release CO₂ into the bloodstream. Exhale and the CO₂ leaves the lungs again, free to begin the process over.
3. During photosynthesis plants use carbon dioxide and water to produce sugar and oxygen. Display the OVERHEAD: "Photosynthesis and the Carbon Cycle" on the projector and indicate how carbon atoms travel through the cycle. This simple example of the carbon cycle demonstrates how carbon is recycled over and over. The same carbon atom may have passed through the lungs of a caribou last spring, and it may have been part of a tree growing in the forest the year before until a forest fire burned up the tree and released the carbon into the air.
4. Perform the following demonstration in front of the classroom:
 - **STEP 1:** Ask students to explain what plants need to live. (CO₂ in the air, sunlight and water)



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- **STEP 2:** What do plants produce with CO₂, sunlight and water? (sugar and oxygen)
 - **STEP 3:** Using a candle and tongs, burn a potato chip until it is charred. Place the charred chip on some aluminum foil. Ask students what remains of the chip when it's consumed by fire or by digestion? (carbon)
 - **STEP 4:** What do animals need in order to live? (plants or animals that eat plants) Explain that carbon makes up about 50 percent (dry weight) of what plants and animals are made of.
 - **STEP 5:** Hand out crackers for students to eat and ask them if they can explain what happens to the carbon in the cracker when they eat it. (The CO₂ is given off in respiration as a byproduct of metabolism, as well as stored in the tissue of the consumer.)
 - **STEP 6:** Using a candle and tongs, carbonize a peanut. What remains? (carbon)
5. Explain that some carbon is released into the air during the burning process. A forest fire releases CO₂ when it burns a tree, and leaves behind the remaining carbon in the form of burned trees. The dead trees gradually decompose, releasing still more carbon into the air. When forests regrow, they take in this carbon from the air and start the process over.
 6. Carbon also exists in the world's oceans. Just like plants on land, phytoplankton in the ocean convert carbon from the air and water into sugars and release oxygen as a byproduct. Phytoplankton are a food source for many marine species, such as baleen whales and shellfish. Carbon atoms travel from phytoplankton to clams to the otters that eat them and so on. When sea animals die, they often sink to the ocean floor, taking carbon with them where it slowly decomposes and reenters the atmosphere as carbon dioxide. Colder oceans, like the Bering Sea, hold carbon dioxide longer than warmer oceans because decomposition takes longer in colder temperatures.
 7. Hand out the Student Worksheet and have students create their own diagrams of the carbon cycle.

Answers

The carbon cycle diagram should accurately show all the required features (carbon dioxide, oxygen, animal respiration, decomposition, photosynthesis, and fossil fuel).

1. The amount of carbon dioxide has increased.
2. The increased carbon dioxide has increased the temperatures in the Arctic. Answers will vary on the affect; they might include later development of sea ice, thawing permafrost, longer growing season, more insects, etc.

References

"Elder Insights" Accessed from:

http://www.uniteusforclimate.org/pdf/UniteUs_1112_ElderInsights.pdf



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Student Workheet: Diagramming the Carbon Cycle

Name _____

Directions: Use the box below to draw a diagram of the carbon cycle as it relates to the village, ocean and landscape around the village. Include local marine and land animals, plants, the sun, soil, man made structures, and vehicles (snow machines, 4 wheelers, trucks) that use fossil fuels and release CO₂. Include and label the following features:

carbon dioxide

photosynthesis

fossil fuel

animal respiration

plant respiration

decomposition

A large, empty rectangular box with a thin black border, intended for the student to draw a diagram of the carbon cycle. The box is currently blank.

1. What recent changes have there been in the carbon cycle? (Hint: think about the gases in the atmosphere)

2. What effect could this have on the local ecosystem?



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Overhead: Photosynthesis and the Carbon Cycle

