Weather & Climate

The Carbon Cycle

Describe the carbon cycle as students move through different reservoirs of carbon on our planet

Carbon cycle, game, source and sink

Ages 10-14

Math, Earth Science

45 minutes

TEACHER GUIDELINES

In advance, choose twelve station locations in the classroom (number them from 2-13). Discuss the carbon cycle and different components of the carbon cycle. Then, have students to prepare the stations according to directions and move from station to station discussing the carbon cycle.

MATERIALS

- 1 sheet of Carbon Reservoir cards to identify each station
- 12 sheets of Process Cards, one for each station
- 2 dice
- Scissors
- Colored Pencils (optional)

LEARNING OBJECTIVES/ STANDARDS

1. Listen to information about the carbon cycle and follow the carbon cycle diagram background information. (Reproducing)
2. Learn ways in which carbon is stored in reservoirs, also called sources and sinks, and the processes that transport the carbon atom from one location to another. (Understanding)
3. Draw the path of your carbon atoms from one reservoir to another by using different processes linked together. (Creating)

BACKGROUND INFORMATION

The element carbon is an important building block of life, it is a building block of matter, including; diamonds, coal, CO_2, limestone, pencil lead, medicines, and lots more. Carbon can chemically combine with itself, is a source of energy, and is the twelfth most abundant element in Earth's crust. Carbon dioxide, or CO_2, has important effects on the climate. Carbon moves through Earth's atmosphere, oceans, plants, animals, and rocks in a repeating pattern called a cycle. A cycle is not a circle, but a pattern of repetition. For the past half century, researchers have been monitoring and measuring the amount (called the concentration) of CO_2 cycling in Earth's atmosphere. The result of careful measurements shows that the concentration of CO_2 in Earth's atmosphere is not only increasing, but the increase is speeding up.

Since the beginning of the Industrial Revolution, about the year 1750, coal, oil, and gas (also known as fossil fuels), were being used worldwide by more people. These fossil fuels give off CO_2 when burned, and evidence shows that this has affected the Earth's natural energy balance. Fossil fuels form from the decay of plants and animals that have been buried deep underground for millions of years. When heated, fossil fuels combine with oxygen in the atmosphere to release energy in a chemical reaction and carbon dioxide, CO_2. Currently, fossil fuels provide most of our electricity and almost all of the transportation fuels used globally, releasing large amount of CO_2 every year.

Background continued on next page

CREATED BY:

Adapted from NOAA

PROCEDURE

First, go through the background material and have students list all of their current knowledge about the carbon cycle together. Then, students divide into 12 groups to play a game. In this game you walk through an imaginary Carbon Cycle, moving to and from one carbon reservoir to another, like real carbon atoms move through living and non-living matter. There are 12 stations. Each station represents a carbon reservoir, except for the first station which the teacher assigns.

Set up:

1. Cut out the process cards that describe how carbon moves from one reservoir to the next. Leave all of the cards at your first station. The next groups will use these cards.
2. Cut out the reservoir cards and place each card at the station that matches the name and number. Each card goes to a different station. There will be multiple reservoir cards at each station.

To play:

1. Near the center of your paper, draw an oval shape and inside the oval write the name of the carbon reservoir for your initial station and the word "start".
2. There are cards at each station to explain the processes for transporting carbon from one location to another. Look at the process cards and discuss with your group to identify the process or processes that transported your carbon atom to the reservoir where you are. On your paper, draw a rectangle and write the name of the transport process and a description of the journey.
3. When you have finished discussing the processes that brought carbon to your station, take turns rolling the dice roll to find out where your carbon atom will go next. Move to the station that has the number that you rolled. Each station is numbered and represents a different reservoir. If you roll the number of the station where you are at, go to station 13.
4. As you move to a new station, draw an oval to represent the new reservoir you are in, and draw arrows to show the direction of your movement.
5. Again, look at the process cards and discuss with your group to identify the process or processes that transported your carbon atom to the reservoir new where you are. Use rectangles to describe the transport process that moved your carbon atoms from one reservoir to another.
6. Repeat the procedure until time runs out. Try to pass through as many reservoirs (sources and sinks) as possible.
7. Color your carbon cycle as time allows.

RESULT

Students should finish with a diagram of their movement throughout the carbon cycle. An example is on the next page.

DISCUSSION

Have students list their conclusions and new knowledge on the blackboard. Discuss the difference between the prior knowledge and the new understanding about the carbon cycle.

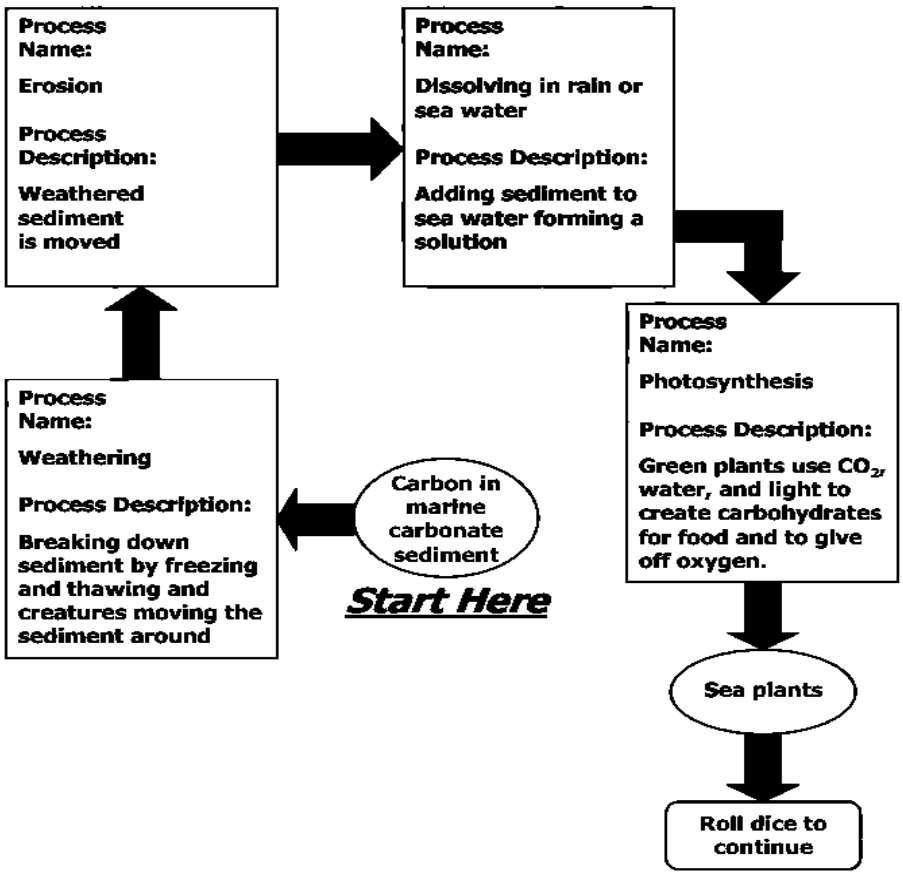
BACKGROUND continued

Why is this all this important? Carbon dioxide traps and absorbs (takes in) invisible energy in the atmosphere. The invisible energy is in the form of infrared radiation (heat). Some of this infrared energy flows from the Earth back into space. However, since the CO2 concentration has been increasing, more energy is being absorbed, and the atmosphere is warming. In addition to absorbing more infrared radiation, Earth is also absorbing heat from the sun in the form of visible rays - just as it has millions of years ago. The combined effect of absorbing these different forms of heat from the sun is called global warming. As Earth's atmosphere warms up, other changes occur. Weather and climate change. In turn, the sea level rises, droughts and floods may become more frequent, storms may become more intense. These events will affect all living organisms, including ourselves. For example, food crops may fail to grow, or grow in unexpected places; diseases like yellow fever and malaria may show up in new and different places. These changes, and others, can have a lasting effect on our lives, including where and how we live.

Example finished student worksheet.

Sample Worksheet for the Carbon Cycle

1. **Do NOT copy this pattern.**
2. **Draw your own carbon cycle on your blank worksheet based on the path of your carbon atom.**
3. **Notice that there may be more than one process (in the rectangle) to move a carbon atom from one reservoir to another, and that there are many different possibilities for a diagram like this one.**



Carbon Cycle Process Cards

Absorption: Uptake of substances into cells or across tissues such as skin, intestines, and kidneys.	**Weathering:** Breaking down rocks and minerals by the action of the atmosphere (weather) and living things.
Dissolving in rain or seawater: Adding a solid substance into a solvent (usually a liquid) to form a solution. For example, dissolving salt in water yields a saltwater solution.	**Burial and decomposition:** Fossil fuels form from the fossilized remains of dead plants and animals, under tremendous heat and pressure, over millions of years.
Burial and rock formation: Sediments compact (squeezed together) under pressure, become cemented and slowly form solid rock.	**Combustion (burning)**: A chemical process called oxidation that releases energy. It is used to describe a fuel in a state of combustion.
Photosynthesis: Green plants use carbon dioxide, water, and light to create carbohydrates for food and to give off oxygen.	**Volcanoes:** Lava, ash, and gases, that include carbon dioxide (CO_2), erupt through an opening in the Earth's Crust.
Respiration (breathing): Taking up oxygen (O_2) and giving off carbon dioxide (CO_2) in order to provide energy.	**Death, decomposition, and excretion of organisms**: Breaking down organic material, such as dead plant or animal tissue, into small parts.
Erosion: Transporting (moving) weathered rock and minerals to a different location.	**Consuming (Eating)**: Taking in food to convert into energy.

Carbon Cycle Reservoir Cards

Carbon dioxide (CO_2) in the atmosphere 2	Carbon in limestone (carbonate rock on land) 3
Carbon in the ocean where small plankton flourish 4	Carbon on land – consumers (including human beings) 5
Carbon, or CO_2 from the atmosphere, dissolved in seawater – volcano spewing CO2 bubbles that dissolve in seawater 6	Carbon in marine carbonate sediment – small broken sea shell particles, sometimes combined with minerals and debris 7
Carbon in green plants on land 8	Carbon in coal – a fossil fuel (coal, oil, and natural gas) 9
Carbon in marine mammals 10	Carbon in sea plants growing on the sea floor 11
Carbon in rivers and lakes (fresh water) 12	Carbon in soil 13