Carbon–The Short and the Long

LESSON

GRADE LEVEL 1-6

CATEGORY Energy, Atmosphere & Climate

TOPIC Climate Change

TIME

- Part 1: 15 minutes
- Part 2: 15 minutes

MATERIALS

- 2 Buckets
- Bucket Signs
- Zone Signs
- 8 coloured pinnies or arm bands
- • Rope
- 100 Popsicle sticks (Carbon tokens)
- 7 Skipping ropes

GROUP SIZE

24+

SETTING

Gymnasium or outdoors

SUBJECT AREAS

Biology, Earth Science, Ecology, Physical Education, Science, Language Arts

KEYWORDS

Carbon cycle, decompose, carbon dioxide, fossil fuels

HCTF Education

Overview

Like the water cycle that makes life on the planet possible, carbon, in the form of carbon dioxide and methane, is continuously recycled on Earth. Have you ever wondered how this cycling works?

Through an active game, students learn that carbon is a building block of life and that cycles on earth. For older students the concept of air being made up of gasses could be introduced with this activity.

Objectives

Students will be able to:

- Classify living and non living things
- Describe the basic needs of plants and animals and how they are met
- Describe some changes that affect animals
- Describe ways in which plants and animals are important to other living things and the environment
- Analyze simple food chains

Making Connections

Carbon is an integral part of life on earth, but where is it? Unlike water, the carbon cycle is hard to observe. However changes in the carbon cycle are having great impact on the climate and an understanding of the cycle is critical to mitigating those changes. In this activity students learn what the carbon cycle is and how it works by moving 'carbon' through Air, Living and Earth Zones.

Background

In the biosphere, the planet's outer shell within which life occurs, animals are made up of about 18% carbon and plants store between 40 - 50% carbon. Carbon is constantly cycling through air, living things and the earth's crust in short and long cycles.

The short carbon cycle

When we eat an apple we take in and use the sugars made by the apple tree during photosynthesis. These sugars contain carbon. When we breathe out we release carbon dioxide (CO_2) as a waste product of the growth and maintenance of our bodies. Plants also use this process of respiration at night, but more significantly, they use carbon dioxide from the air during the day for

photosynthesis, to make carbohydrates (sugars and starches) for growth. Thus plants are an important sink (storage area) for carbon.

Carbon is cycled back into the air when living things die and rot (decompose) in the soil. Carbon, in the form of carbon dioxide (CO2) and methane (CH4), is released through respiration by bacteria and fungi during the decomposition process. This is a short-term carbon cycle.

The long carbon cycle

The long carbon cycle A long-term cycle occurs when animals and plants die, but they do not decompose. If they are in the ocean, they sink to the bottom and become part of ocean sediments that eventually become rocks. Fossils (both ocean and land fossils), limestone, and chalk are evidence of this longterm cycle process. If on land, the dead material may go through sedimentary processes where it becomes part of rocks or, under certain conditions, large deposits of undecomposed animals and plants become fossil fuels such as oil and gas. Carbon dioxide is released into the air when fossil fuels are burned to provide energy.

In this game students move carbon 'tokens' around through air, living, and the earth zones to demonstrate the short and long cycle as well as how each cycle differs and how it can be disrupted.

Procedure

Set up

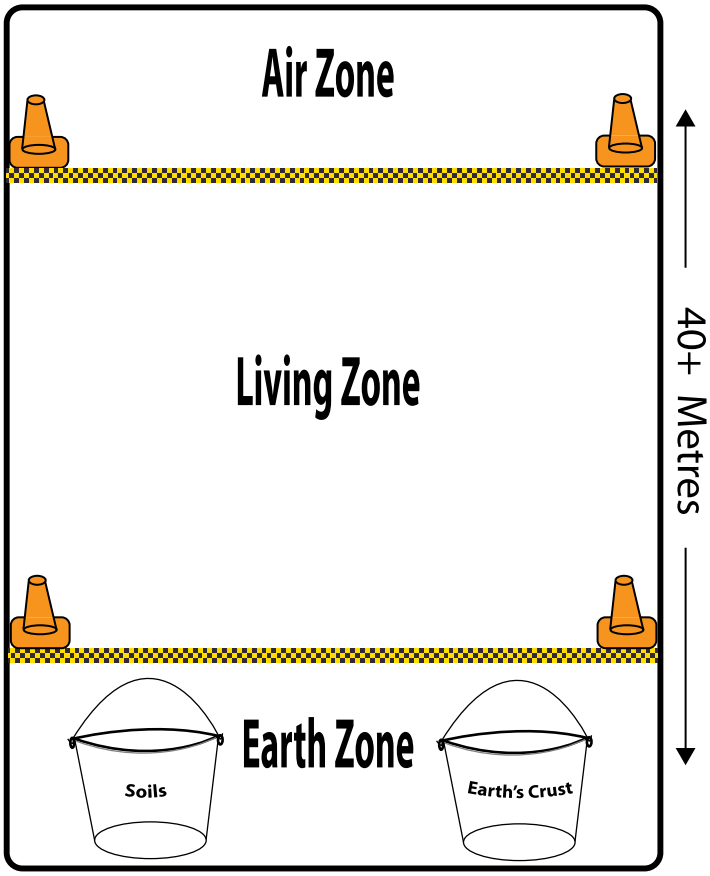
1. Divide a large playing area into three zones. Make the middle section larger than the two outer sections.
2. Define the three zones using rope or pylons. Mark one of the smaller sections as the 'Air Zone'. Mark the larger middle section as the 'Living Zone' – this is where plants and animals live. Mark the third section as the 'Earth Zone' – this is the soil and the earth's crust (sediments/ fossil fuels/ rocks). In this zone place the two buckets labelled 'Earth's Crust' and 'Soils' and the skipping ropes.
3. If your students have not yet mastered skipping, omit the skipping ropes and have them do jumping-jacks. You may wish to label the zones. Label templates provided in the Black Line Masters.
4. Distribute the 84 carbon tokens evenly across the Air Zone.

The Activity

Part1: For younger students

1. Divide the class so that three quarters of the students are plants and the rest are animals. e.g. for a class of 24: 18 are plants and 6 are animals. Visually identify the animal players by giving them coloured pinnies, armbands etc. Explain to the students that plants use air (carbon and oxygen), combined with light and water to produce their 'food' (simple carbohydrates – which are transformed to sugars and starches) in a process known as photosynthesis. Animals cannot make their own food and must eat plants. This means they take in the carbon from the plants.

Activity Layout



Player Action Summary

	Action in Air Zone	Action in Living Zone	Action in Earth Zone
Plant	**Pick up & Drop off C**	2 deep knee bends after obtaining each C token 3C =dies and go to Earth Zone If no C in Air, plant dies, go to Earth Zone	Put 2 C in Soil bucket & 1 C in Earth Crust; do 10 skips or jumping jacks; become another plant; take 1 C from Soil, return it to Air, tag floor in Living Zone, resume C acquisition Do 10 skips or jumping jacks; become another plant, take 1 C from Soil, return it to Air tag floor in Living Zone, resume C acquisition
Animal	**Drop off C**	2 deep knee bends after obtaining each C token from plant 2 C = dies go to Earth Zone If animal has 1 C but no plants, return one C to Air Zone, do 10 jumping jacks If animal is unable to obtain C (no plants), animal dies, go to Earth Zone	Put 1 C in Soil bucket & 1 C in Earth Crust, do 10 skips or jumping jacks; become another animal, take 1 C from Soil, return it to Air, go back to Living Zone, resume C acquisition Do 10 skips or jumping jacks take 1 C from Soil, return it to Air, go back to Living Zone, resume C acquisition

2. Point out the three zones and describe them. Briefly describe the carbon cycle. Explain that plants can take carbon in the form of CO2 from the air and use it to make their food. In this game they show this by picking up a carbon token from the Air Zone, taking it to the Living Zone and doing two deep knee bends. Animals can only use carbon from the Living Zone for growth. In this game they show this by doing two deep knee bends every time they get a carbon token from a plant. Practice doing deep knee bends. Both animals and plants may move carbon from the Living Zone to the Earth Zone and back to the Air Zone, but only plants can take a carbon from the Air Zone. The animals must get their carbon tokens from a plant.

3. Start the game with plants only and have the animals watch from the sidelines. Plants begin in the Living Zone and go into the Air Zone and collect one carbon token at a time. The plant brings the carbon token to the Living Zone and uses it by doing two deep knee bends. It then returns to the Air Zone to collect another token. When it has 3 tokens and has completed six deep knee bends, the plant has lived a full life and it dies. It now goes to the Earth Zone and put two tokens into the Soil bucket and one token into the Earth's Crust bucket. It then skips rope or does jumping-jacks 10 times to signify the process of decomposition and of carbon becoming rock or fossil fuel deposits. When it has fully decomposed, the plant picks up one carbon token from the Soil bucket and takes it back into the Air Zone. It returns to the Living Zone, tags the floor and goes back to the Air Zone to pick up a carbon token, returns to the Living Zone to do two deep knee bends and the cycle continues. When the plants understand what they are doing, the animals enter the game.

4. An animal must tag a plant after the plant has done its two deep knee bends and before it has returned to the Air Zone or moved on the Earth Zone. If an animal successfully tags a plant, it receives one carbon token from the plant. When the animal receives a carbon token, it does two deep knee bends before moving on to tag another plant. When an animal has two tokens it has lived a full life and dies. It now goes to the Earth Zone and puts one token into the Soil bucket and one token into the Earth's Crust bucket. It then skips rope or does jumping-jacks 10 times to signify the process of decomposition and of carbon becoming rock or fossil

fuel deposits. When it has fully decomposed, the animal picks up one carbon token from the Soil bucket and takes it back into the Air Zone. It returns to the Living Zone and looks for a plant to tag. An animal may never remove a carbon token from the Air Zone.

5. If there are no tokens in the Air Zone for a plant it dies and goes directly to the Earth Zone. As before it skips rope or does jumping-jacks 10 times and when it has fully decomposed, it picks up a carbon token from the Soil bucket and takes it back into the Air Zone, etc.
6. If an animal only has one token and there are no plants available to get a token from, the animal must deposit its token back into the Air Zone and move back to the Living Zone and do ten jumping jacks. Then the animal can then tag a plant for a token if any are available.
7. If the animal player has no tokens left and there is and no plant available to tag in the living zone, the animal must die and go directly to the Earth Zone. It then skips rope or does jumping-jacks 10 times and when it has fully decomposed, the animal picks up one carbon token from the Soil bucket and takes it back into the Air Zone, goes back to the Living Zone, etc.
8. Play for at least one 7-minute round.

   Note: For younger students, explain the game and walk the students through the activity once, practicing all the actions (deep knee bends, skipping rope or jumping-jacks) before playing the game. You may also wish to eliminate the role of animals if desired and make everyone plants.

Wrap Up

Discuss with the students how important plants are to animals and also that carbon moves through the earth in two types of cycles, long term and short term. Notice that there are always some carbon tokens in the air but not very many. Most carbon is stored in some form in the Living or the Earth Zones of the earth. This is an important part of the natural greenhouse effect that keeps our planet warm enough to support life.

Part2: For older students

1. Lead a discussion as to how the carbon cycle could get disrupted. Two common ways that students will have observed are the use of fossil fuels for transportation (cars, airplanes, etc) and generating electricity, and the removal of plants and trees for harvest or development. These human activities result in more carbon being released into the air than occurs in the natural carbon cycle. Carbon dioxide is a greenhouse gas. As more carbon is released into in the atmosphere, more of the sun's heat gets trapped, thus contributing to global climate change.
2. Play another round of the game but this time, during play, remove a few handfuls of carbon tokens from the Soil and Earth's Crust buckets and scatter them in the Air Zone. Alternately, reduce the number of players that are plants and make them animals. Either of these adaptations will result in more carbon in the Air Zone.

Wrap Up

After playing this round, discuss with students which human actions are contributing to climate change and what people could do to lessen the release of carbon into the atmosphere.

Assessment

Have students create an illustration of the carbon cycle. They should include examples of both the long and the short carbon cycles. The movement of carbon through the cycle can be shown with arrows.