



**ELSEE**  
Environmental Laboratory for  
Sustainability and Ecological Education

## **Lesson 6: Carbon Cycle**

### **California Education Standards:**

#### **Kindergarten, Earth Sciences**

4. Scientific progress is made by asking meaningful questions and conducting careful investigation. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:

- e. Communicate observations orally and through drawings

#### **Grade 1, Earth Sciences**

3. Weather can be observed, measured and described. As a basis for understanding this concept:

- a. *Students know* the sun warms the land, air, and water.

#### **Grade 3, Earth Sciences**

1. Energy and matter have multiple forms and can be changed from one form to another. As a basis for understanding this concept:

- a. *Students know* energy comes from the Sun to Earth in the form of light.

#### **Grade 4, Earth Sciences**

2. All organisms need energy and matter to live and grow. As a basis for understanding this concept:

- a. *Students know* plants are the primary source of matter and energy entering most food chains.

#### **Grade 5, Earth Sciences**

1. Elements and their combinations account for all the varied types of matter in the world. As a basis for understanding this concept:

h. *Students know* living organisms and most materials are composed of just a few elements.

### **Grade 6, Earth Sciences**

5. Organisms in ecosystems exchange energy and nutrients among themselves and with the environment. As a basis for understanding this concept:

a. *Students know* energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis and then from organism to organism through food webs.

### **Objective:**

Students understand the greenhouse effect and the different phases of the carbon cycle. Students should have a basic idea of the carbon footprint and how to calculate their footprints.

### **Vocabulary:**

**Carbon Cycle** – the biogeochemical cycle by which carbon is exchanged among the biosphere, pedosphere, geosphere, hydrosphere, and atmosphere of the Earth

**Biosphere** – the part of the earth and its atmosphere in which living organisms exist or that is capable of supporting life

**Pedosphere** – layer of Earth where all the soil forming processes occur

**Geosphere** – the solid part of the earth consisting of the crust and outer mantle

**Hydrosphere** – waters of the Earth’s surface

**Atmosphere** – the gaseous mass or envelope surrounding a celestial body, basically the air around us

**Fossil Fuels** – fuels made up of dead plant and animal matter

**Greenhouse Effect** – refers to global warming and the temperature of our Earth based on the gases present in our atmosphere

**Carbon Footprint** – the total set of greenhouse gas (GHG) emissions caused by an organization, event, product or person

### **Lesson:**

All living things are made of carbon. Carbon is also a part of the ocean, air, and even rocks. Because the Earth is a dynamic place, carbon does not stay still. It is on the move!

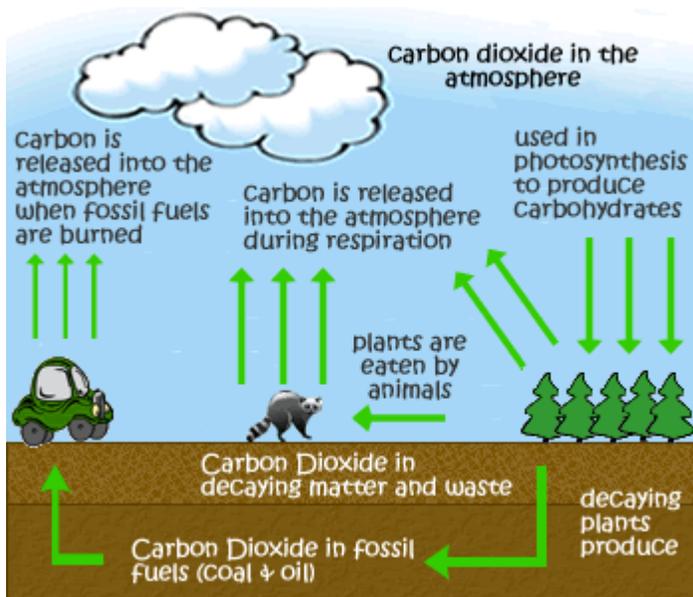
The **carbon cycle** is the biogeochemical cycle by which carbon is exchanged among the **biosphere, pedosphere, geosphere, hydrosphere, and atmosphere** of the Earth. The carbon cycle comprises a sequence of events that are key to making the Earth capable of sustaining life; it describes the movement of carbon as it is recycled and reused throughout the biosphere.

Let's discuss how carbon dioxide moves through the different stages. That is the main focus of this cycle, to understand and learn how carbon dioxide moves throughout earth. Carbon in the earth's atmosphere exists in two main forms: carbon dioxide and methane. Both of these gases absorb and retain heat in the atmosphere, but how does carbon dioxide leave the atmosphere? How do living things obtain carbon?

Carbon is extracted from the atmosphere by plants through the process known as photosynthesis. We have learned about photosynthesis in Lesson 4: Energy Flow. This carbon is later transferred to animals who consume, or eat plants (plants being the primary source of energy entering most food chains). This is how carbon is transferred from the **atmosphere** to the **biosphere**. The carbon has travelled from the air to the living things on Earth, such as plants and animals. (It's important to keep in mind that carbon is also released when animals take in oxygen and breathe out carbon dioxide.)

Now let's talk about how the carbon becomes trapped within the Earth. When plants and animals die, much of their carbon is returned to the atmosphere as the organisms decompose. Every so often, a plant or animal does not decompose right away. Their bodies are trapped in locations where decomposition can simply not take place. This is most common at the bottom of oceans and seas where the lifeforms become buried by sand.

Instead of returning to the atmosphere, the carbon from these lifeforms is trapped within the Earth. Over millions of years, more and more of the carbon on Earth has been trapped in this manner. Today, almost 99% of all the carbon on Earth has been locked up deep within the Earth.



As rocks weather and erode, this carbon is slowly released back into the atmosphere, creating a balance within the Earth. For the past several hundred million years, the amount of carbon being locked up in the Earth and the amount being released by weathering rocks was almost perfectly balanced.

This extremely important balance has been altered significantly in the past century as humans have begun using fossil fuels to produce energy. **Fossil fuels** are fuels made up of dead plant and animal matter. When plants and animals died, their bodies decomposed and were buried under layers of earth. Millions of years later we have the three forms of fossil fuel: oil, natural gas and coal.

Fossil fuels are used to fuel cars and airplanes, power electricity plants, and heat our homes. They are also used to make medicines, cosmetics, plastics, synthetic fabrics, and lubricants. When you brushed your teeth today, you used a product made from oil – toothpaste. Look at your shoes – they are a product made from oil. In order to make these products, we need to burn fossil fuels. By burning the Earth's store of carbon, mankind is able to create the energy needed to operate our communities. However, we must be careful as we do so. By releasing more carbon into the atmosphere than is being locked up, we risk causing damage to the delicate carbon cycle. It will make an unbalanced amount of carbon that is being shoved into the atmosphere, and there won't be as much being taken out. So there will be an "overload" of carbon in the atmosphere.

What happens when there is an overload of carbon in the atmosphere? Aren't there enough plants that will be able to bring out the carbon dioxide through photosynthesis? The problem is that there aren't. Due to humans overusing nature, its forests and its plants, there isn't a good balance between the number of plants and the carbon in the air. Carbon dioxide retains heat in the atmosphere and is partially responsible for the greenhouse effect. Carbon naturally absorbs and retains heat, so with an overload of carbon in the atmosphere, the greenhouse effect takes place.

The **greenhouse effect** refers to global warming and the temperature of our Earth based on the gases present in our atmosphere. If the greenhouse effect worsens, our Earth will continue to heat up. Certain gases, such as carbon dioxide, are labeled "greenhouse gases" because they trap heat from the sun in the Earth's atmosphere. If the greenhouse effect increases, it could alter Earth's climate, making it warmer overall. Even small changes in temperature can have major effects on Earth, such as raising sea levels or causing droughts.

How can we lower the greenhouse effect? First we need to understand what a **carbon footprint** is. A **carbon footprint** is the total set of greenhouse gas (GHG) emissions caused by an organization, event, product or person. It's basically a calculator of how much carbon one uses

and expels; the smaller the carbon footprint, the better your actions are towards the environment. In order to understand the **carbon footprint**, you can use different websites that help you calculate your own footprint.

**Materials:**

Poster paper, the larger the better  
Markers and colored pencils

**Activities:**

Today the students will be calculating their carbon footprints. Divide the class into groups of no less and no more than 10 students each. There must be an adult with each group, and access to a computer for each group.

Together as a group go to this URL: <http://www.nature.org/greenliving/carboncalculator/index.htm>. With the adult leader, answer the questions on the site. The questions are very specific, so it will be okay to take a vote on any specific question and then answer it in favor of the majority. When the groups have finished the questionnaire, have them come together and make an in-depth poster on what they've found. Have them focus on questions, such as:

*What do they do that negatively impacts their carbon footprint?*

*Why should they care?*

*What are the benefits of composting, buying local organic food, and growing native plants?*

*How do these changes affect the carbon footprint?*

*What daily activities do they think they need to change? Why should they change them? Which ones will be hard to change and which ones will be easy?*

After the posters have been made, the groups will present to each other. Teachers should encourage discussion and questions after each presentation. Put posters on display to further spread knowledge.

**Links and Sources:**

<http://www.youtube.com/watch?v=htDp0ZN0Nf8&feature=related> (video)

[http://www.windows2universe.org/earth/Water/co2\\_cycle.html](http://www.windows2universe.org/earth/Water/co2_cycle.html)

<http://www.elmhurst.edu/~chm/vchembook/306carbon.html>

<http://www.cotf.edu/ete/modules/carbon/efcarbon.html>