

## The Carbon Cycle

**Subject:** Environmental Systems

**Grade Level:** High school (9-11)

**Rational or Purpose:**

Students will investigate biological systems and summarize relationships between systems. Students will analyze the carbon cycle to in order to understand the greenhouse effect.

**Materials:**

- Black balloons (to represent carbon)
- Blue balloons
- White balloons
- Signs to identify principal carbon reservoirs:
  - Atmosphere
  - Land biomass
  - Ocean
  - Fossil fuel
  - Rock

**Lesson Duration:** 50 minutes

**Resources:**

[http://www.planetguide.net/cool/carboncycle\\_activity.html](http://www.planetguide.net/cool/carboncycle_activity.html)

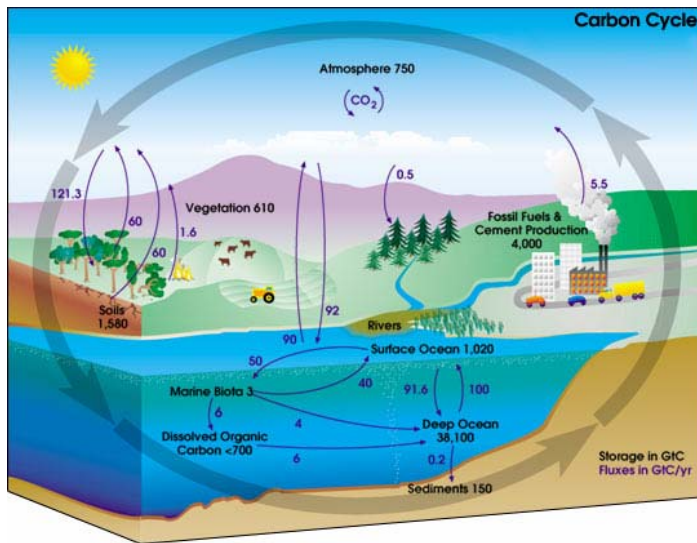
**TEKS Objectives:**

§112.44. Environmental Systems.

(5) (D,E); (6) (A-D); (8) (A,B)

**Background Information:**

Carbon plays a significant role in sustaining life on Earth and exists primarily as carbon dioxide gas in the atmosphere. Carbon storage (in trees and soils) is influenced by a number of processes on different time-scales. Changes in these long term carbon pools by deforestation or temperature-related changes in soil respiration for example, will directly affect global warming. It is also noted that the concentration of greenhouse gases (including methane and chlorofluorocarbons) have been increasing, also contributing to global warming.



Carbon is taken from the atmosphere in many ways. One way is the familiar process of photosynthesis, where plants convert carbon dioxide gas in the atmosphere to produce oxygen. In addition, many organisms reduce carbon to form tissues and hard body parts like shells. Carbon can also be released back into the atmosphere. Plants and animals perform respiration to break down glucose and other organic molecules into carbon dioxide and water. Another way to release carbon back into the atmosphere is decaying animal and plant matter. Fungi and bacteria break down the carbon compounds in dead animals and plants to convert it into carbon dioxide in the presence of oxygen. If oxygen is not present, methane will be released into the atmosphere. One of the most known ways to release carbon into our atmosphere is by burning fossil fuels, which include coal, petroleum products, and natural gas.

### Activity:

The carbon cycle is one of Earth's most important matter cycles. Not only is it vital for life processes such as photosynthesis and respiration, it also plays a crucial role in Earth's global climate because atmospheric carbon dioxide contributes considerably to Earth's greenhouse effect. By participating in and viewing a physical replication of the carbon cycle, students can gain a deeper understanding of the reservoirs and flows of the carbon cycle and subsequently understand its significance when discussing the issue of global warming.

### Procedure:

1. Present the carbon cycle and talk about its importance in the environment. It will be useful to have a diagram so that you may refer to while explaining the steps in the cycle to the students. Have the students pay attention to the different

reservoirs represented in the cycle and the different flow rates. Mention that you will be representing the amounts of carbon in each reservoir.

2. Choose 5 different locations in the classroom for the different carbon reservoirs, taking into consideration the distance between them as you want to easily move balloons from one reservoir location to another. At each location, have a student represent the reservoir by holding a sign to identify the location.
3. State that one black balloon will represent all the carbon in the atmosphere reservoir. Ask the students what form carbon takes in the atmosphere. (Carbon dioxide gas). Place one black balloon with the Atmosphere student.
4. Ask students to approximate how many balloons should be used to represent the carbon in the Land Biomass reservoir. Place 4 black balloons in the reservoir. Ask students to discuss the form of the carbon in this reservoir (cellulose, starch, sugar, protein, etc.) and how the carbon got there (photosynthesis).
5. Ask students to approximate how many balloons should be used to represent the carbon in the Ocean reservoir. (The answer is 50 balloons). Place 2 black balloons and one blue balloon there. State that one blue balloon equals 48 black balloons. Ask students to discuss the form of the carbon in this reservoir. (bicarbonate salt resulting from the absorption of carbon dioxide from the ocean to form carbonic acid which dissociates to  $H^+$  and bicarbonate).
6. Ask students to approximate how many balloons should be used to represent the carbon in the Fossil Fuel reservoir. Place 7 black balloons there. Ask students to discuss the form of the carbon takes in this reservoir (solid coal, liquid hydrocarbon petroleum, and gas hydrocarbon methane). Discuss how the carbon got there (photosynthesis hundreds of millions of years ago and subsequent burial). It is useful to point out that fossil fuel carbon is not part of current carbon flows unless people bring it to the surface by burning it.
7. Ask students to approximate how many balloons should be used to represent the carbon in the Rock reservoir. Place 1 white balloon there. State that one white balloon equals 66,000 black balloons. Discuss the form of the carbon takes in this reservoir (solid carbonate as in limestone).
8. Discuss how carbon flows from one reservoir to another. Take the atmosphere balloon and add it to the Land Biomass reservoir. Say that over the course of seven years, all the carbon in the atmosphere goes into land biomass reservoir through the process of photosynthesis. Ask and discuss why we still have carbon dioxide in the atmosphere. (Over a seven year period, one balloon amount of carbon returns to the atmosphere from land biomass reservoir through the process of respiration). Bring a black balloon from the Land Biomass reservoir back to the Atmosphere reservoir to demonstrate this.

9. Take a black balloon from the Atmosphere reservoir and add it to the Ocean reservoir. Say that over the course of seven years, all the carbon in the atmosphere dissolves in the ocean. Ask and discuss why we still have carbon dioxide in the atmosphere. (Over a seven year period, one balloon amount of carbon returns to the atmosphere from the ocean through the process of evaporation of carbon dioxide). Bring a black balloon from the Ocean reservoir back to the Atmosphere reservoir to demonstrate this.
10. Inflate a black balloon and walk over to the Atmosphere reservoir. Discuss how humans have been burning fossil fuels and have consequently released carbon dioxide into the atmosphere. State that today's atmosphere has 30% more carbon dioxide than the pre-industrial atmosphere. Discuss the potential threats of increasing carbon dioxide concentrations in our atmosphere.
11. Review the reservoirs of the carbon cycle and how carbon flows into and out of them from the previous demonstration. Discuss why people care about the increase in carbon dioxide in the atmosphere (enhanced greenhouse effect leading to global climate change).
12. Explore and discuss alternatives that will reduce emissions of carbon dioxide.



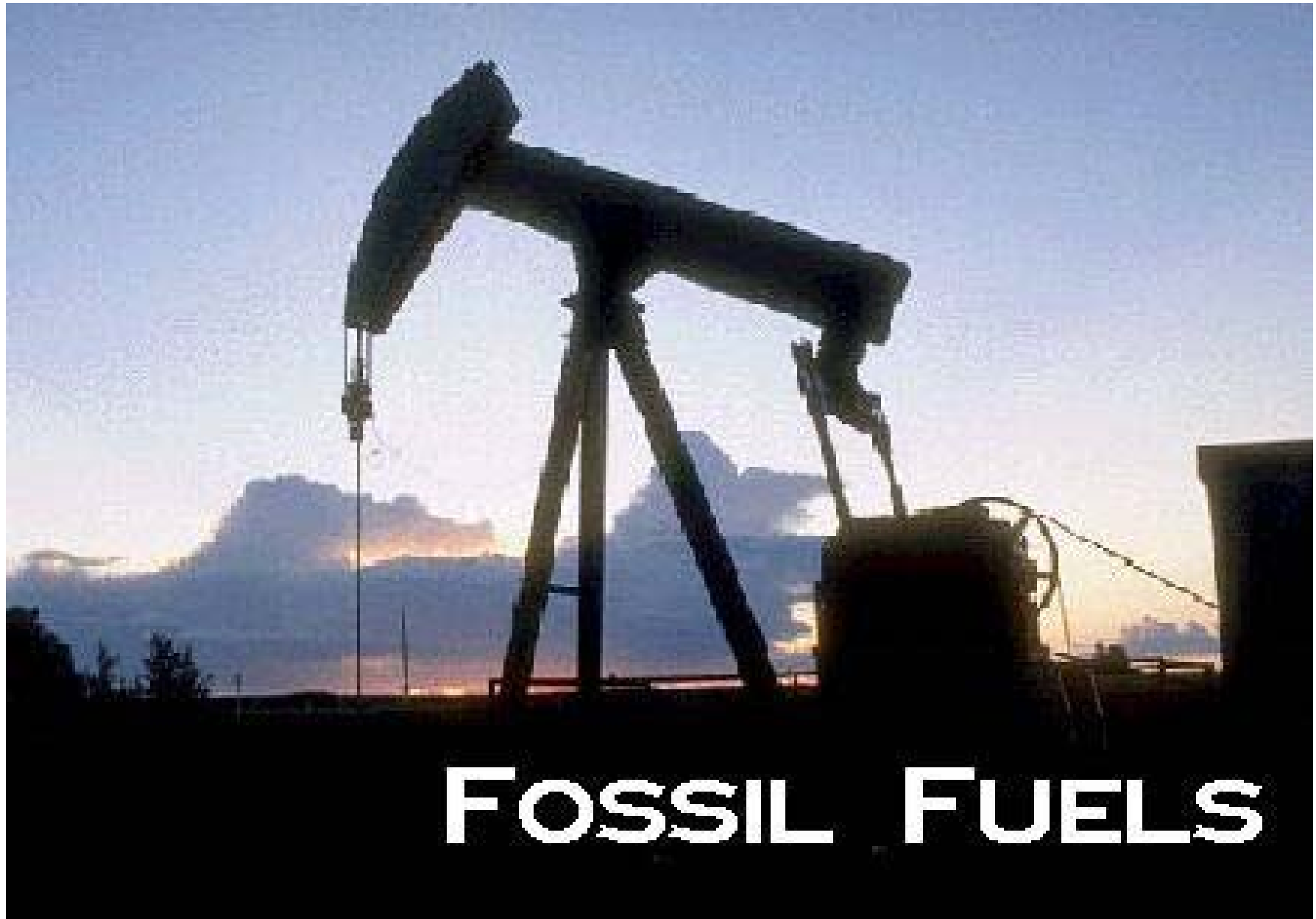
ATMOSPHERE



LAND BIOMASS



OCEAN



# FOSSIL FUELS





ROCK