CARBON: IS TOO MUCH OF A GOOD THING BAD?

GRADES 6-8

GEORGE DURRETT

TIME ALLOTMENT:

Three 50-minute classes.

OVERVIEW:

The element, carbon, first originating in the stars, has become an integral component to life on Earth. Its cycle, affecting organic and inorganic elements, allows life on our planet to flourish. As phytoplankton in the oceans and plants on land combine it with other elements through photosynthesis, glucose is produced. This fundamental sugar, first manufactured in plants, is the beginning of a complexity of food chains on land and in the oceans. Left undisturbed by man, it completes a balanced cycle through the atmosphere, biosphere, hydrosphere, and geosphere. However, since the industrial revolution, man and his machines have exploited carbon to the detriment of its natural cycle. In recent years, the level of carbon dioxide in the atmosphere has risen to alarming levels seriously altering the containment of heat in the atmosphere and the natural processes of organisms on Earth.

Through the activities in this lesson, students will become familiar with the carbon cycle, the greenhouse effect, and the various ways governments and their people are striving to minimize the negative affects of too much carbon.

SUBJECT MATTER:

Science

LEARNING OBJECTIVES:

Students will be able to:

- Identify the sources of carbon compounds.
- Differentiate between fast track carbon recycling and slow track carbon recycling.
- Explain how photosynthesis affects the food chain.
- Describe the impact of global warming.
- Investigate the various ways that people can help to balance the carbon cycle.

STANDARDS:

National Science Education Standards
http://bob.nap.edu/html/nses/
Content Standard C:
Populations and ecosystems

Louisiana Science Frameworks:
State Standards for Curriculum Development
http:www.doe.state.la.us/doe/assessment/standards/SCIENCE.pdf

SE-M-A4: understanding that human actions can create risks and consequences in the environment.

SE-M-A7: demonstrate knowledge of the natural cycles, such as the carbon cycle, nitrogen cycle, water cycle, and oxygen cycle.

SE-M-A8: investigating and analyzing how technology affects the physical, chemical, and biological factors in an ecosystem.

http://www.envirotaclebox.org

MEDIA COMPONENT:

Video:

Enviro-Tacklebox™, *Carbon: Element of Surprise*

This film introduces students to the importance of the carbon cycle on our planet. It displays the benefits to organic organisms and problems caused by the usage of fossil fuels.

Web site:

Enviro-Tacklebox™ http://www.envirotacklebox.org This is Louisiana Public Broadcasting's Web site providing teaching information, films, articles and student activities involving environmental science.

Find Article. http://www.findarticles.com/cf_0/PI/index.jhtml This is an exciting research Web site that leads to endless articles in every area. Use the search option to direct the research to specific points of interest.

National Geographic Magazine http://www.nationalgeographic.com/ngm/0101/index.html As always, ***National Geographic Magazine*** is a great companion for teaching. This Web site offers an interactive article on the Great Barrier Reef.

Alien Explorer http://www.alienexplorer.com/hp.html This is a student friendly Web site that explores a variety of topics about animals and ecosystems. There are also various art activities and clip art available. For the scientific processes, go to the ***Aliens Explore Earth*** option.

The Convention and Kyoto Protocol http://unfccc.int/resource/convkp.html This Web site provides the documentation of the Kyoto Protocol, which is the united effort of nations around the world to reduce access carbon production.

The Montreal Protocol on Substances that Deplete the Ozone Layer
http://www.ciesin.org/TG/PI/POLICY/montpro.html This Web site provides the documentation on the Montreal Protocol, the first international effort to control damaging emissions in the Earth's atmosphere.

MATERIALS:

Per Student:

- Pencil and paper
- Questions for film

Per Group:

- Piece of wood, plastic, water, fabric, and carbonated beverage
- Two cups
- Worksheet – ***Where's the Carbon?***
- Group assignments with Web sites

PREP FOR TEACHERS:

1. Prior to teaching this lesson, bookmark the web site used in the lesson on each computer in your classroom. Load a media player if the computer does not have one. (available free at www.macromedia.com)
2. View the video becoming familiar with the segments to be used in class.

Prepare the hands-on element of the lesson by:

1. Copying the set of film questions, vocabulary, and quiz for each student.
2. Copy the ***Where's the Carbon?*** Worksheets and group activity sheets for each group.
3. Place materials and the ***Where's the Carbon?*** Worksheet in each group.
4. Have a carbonated beverage and non-carbonated beverage available for the introductory activity.

When using media, provide students with a FOCUS FOR MEDIA INTERACTION, a specific task to complete and/or information to identify during or after viewing of video segments, Web sites, or other multimedia elements.

INTRODUCTORY ACTIVITY:

1. Address the class with bottles of carbonated and non-carbonated beverages in your hands. Ask two students to volunteer. Hand one student a carbonated drink and the other a non-carbonated drink. Tell each student to shake the bottle a few times. Take the non-carbonated bottle from the student and open the cap. Ask the students what has happened. Then take the carbonated drink from the other student and start to open the cap. **(Don't open the cap.)** As the students react, ask them why the cap should not be opened. *Answer: The drink will spew all over the room.*
   (Guide the students to realize that the element, carbon, has been added to the carbonated drink. When shaken, the carbon causes an expansion process that increases the pressure inside the bottle, causing it to spew.)

2. Instruct the students to examine the materials that have been placed in their groups. Read the instructions on the worksheet explaining that they must have an explanation for why or why not certain items contain carbon. Get them started by referring to the carbonated drink in the cup. *(Yes, it does contain carbon. We know this because of the manner in which it reacts when the drink is opened. The bubble and fizz are indications that the drink is carbonated. Guide the students to realize that carbon can appear in other things without bubbling and fizzing. They are to use their prior knowledge of the molecule, carbon dioxide, to hypothesize as to whether the other items contain carbon.)* Tell the students to continue the examination of the other items and determine their hypotheses and explanations.

3. Have the students debate for several minutes using their explanations for each item. *(Guide them to understand that every item on their table contains carbon. Wood contains carbon because it was once a living plant and used carbon dioxide for photosynthesis. Plastic contains carbon because it is processed from the hydrocarbon, oil. Oil is the product of decayed living organisms over thousands and millions of years. Water in the oceans absorb carbon dioxide, which the plants use for photosynthesis beneath the waves. The fabric contains carbon whether it is cotton, polyester, or wool. If it is polyester, it is derived from petroleum. If it is cotton or wool, it is derived from a living organism and all living organisms contain and use carbon for survival.)*

4. Ask the students to name more things in the world around them that could contain carbon.

LEARNING ACTIVITIES:

1. Ask your students if they know how the carbon cycle operates. *(Most students will discuss the process of photosynthesis.)*

2. Tell the students that the carbon cycle is far more extensive than just photosynthesis. Pass out the questions for the film. Direct the students to note as many answers as possible.

3. Insert ***Carbon: Element of Surprise*** into your VCR. *Provide your students with a **FOCUS FOR MEDIA INTERACTION**, asking them to look for the answers to the following questions:*
   a. Where is carbon found?
   b. For what purpose do plants use carbon dioxide?
   c. What percent of all living organisms' dry weight is made up of carbon?
   d. Living things are carbon consumers and_____.
   e. How is carbon dioxide released into the atmosphere?

Start the tape at the beginning and stop it at the three pictures of animals that are titled, Carbon Recyclers. This segment is approximately three minutes. Discuss the answers to the questions with the students.
(Carbon is found everywhere on Earth. Plants use carbon dioxide for photosynthesis. Carbon makes up about fifty percent of the dry weight of all living organisms. Living things are carbon consumers and producers. Carbon dioxide is released into the atmosphere through respiration and decay.)

4. *Provide your students with a **FOCUS FOR MEDIA INTERACTION**, asking them to look for the answers to the following questions:*
   a. What produces the most oxygen on Earth?
   b. What is carbon dioxide?
   c. How is carbon dioxide broken down in a leaf?
   d. What is fast track carbon recycling?

Start the tape at the stopping point and stop it after the explanation of the carbon cycle showing the picture of the man fishing and the cow. This segment is approximately three minutes. Discuss the answers to the questions with the students.
(Plankton, found in the oceans, is the largest producer of oxygen on Earth. Carbon dioxide is a gas composed of one atom of carbon and two atoms of oxygen. Light energy breaks down the carbon dioxide in the leaf allowing oxygen to leave as a by-product and the carbon to begin the process of photosynthesis. Fast track carbon recycling is the process that begins with photosynthesis in plants and phytoplankton carrying on through the animals and ends with the decomposition of animals and wastes.)

5. *Provide your students with a **FOCUS FOR MEDIA INTERACTION**, asking them to look for the answers to the following questions:*
   a. What is slow track carbon recycling?
   b. How does carbon return to the atmosphere?
   c. What is a carbon sink?
   d. How is the ocean a recycler?
   e. What are organic recyclers and what are inorganic recyclers?

Start the tape at the stopping point and stop it at the pictures of the diamonds. This segment is approximately four minutes. Discuss the answers to the questions with the students.
(Slow track carbon recycling involves carbon trapped in the Earth's crust for thousands and sometimes millions of years. Carbon is returned to the atmosphere by man through mining and drilling for oil and gas. A carbon sink is an area that absorbs carbon in water or on land and does not recycle. The ocean is a recycler when the carbon dioxide is absorbed into the water and ocean plants use it for photosynthesis. This is the beginning of the ocean food chain. Atmosphere and oceans represent the inorganic storing of carbon and plants and animals represent the organic storing of carbon.)

6. *Provide* a **FOCUS FOR MEDIA INTERACTION**, telling the students to look for the answers for the following questions:
   a. What are hydrocarbon compounds?
   b. Why is carbon dioxide called a greenhouse gas?
   c. What are the sources of excess carbon dioxide?
   d. What is the international community doing about it?
   e. What are the four different spheres?

Start the tape at the stopping point and stop it at the picture of white coral. Discuss the answers to the questions with your students as a review.
(Hydrocarbon compounds are molecules made of hydrogen and carbon atoms. General examples are oil and gas. From oil and gas, we derive plastics. Carbon dioxide absorbs heat from the sun and warms the Earth: the more carbon dioxide in the atmosphere, the warmer the temperature. Because of this warming effect, it is called a greenhouse gas. The sources of excess carbon dioxide in the atmosphere are caused by automobile and industrial plant emissions, and the world-wide burning of coal. The international community has taken measures in the past few years. They have convened and tried to make arrangements to reduce carbon emissions. The four different spheres of carbon are the atmosphere, biosphere, geosphere, and hydrosphere.)

7. *Provide a **FOCUS FOR MEDIA INTERACTION**, telling the studentsTo look for the answers for the following questions:*
   a. What elements other than oxygen does carbon bond with?
   b. What is the food chain in the ocean?
   c. What can we do about the over abundance of carbon in our spheres?

Start the tape at the stopping point and stop it at the end. Discuss the answers to the questions with the students.
(Carbon bonds with calcium, hydrogen, and interacts with limestone. The food chain in the ocean begins with the plants that are food for krill. The krill are eaten by fish; and the fish are eaten by penguins and seals. The way we can help reduce an excess of carbon in our spheres is to conserve energy, manage forests well, and find alternative energy sources.)

CULMINATING ACTIVITIES:

1. In order to fully understand the impact of increased carbon dioxide in our environment, the students will more fully research photosynthesis, the causes of global warming, coral reefs, the growth effects of carbon dioxide on plants, techniques in planting and farming to reduce carbon dioxide in the atmosphere, and international efforts to reduce global warming.
   The attached group assignments are designed to adapt to various learning styles. Groups one, four, and five are assignments geared to regular academic achievers. Group three is geared toward high academic achievers. Group two is designed for more kinesthetic and tactile learners. Group six allows for students that process at a slower pace. Divide your class into the six groups. Pass out the attached group assignments. This is a good activity for the computer lab. The students will go to the assigned Web sites and print the necessary information. If the students do the research in a one or two computer classroom, direct the groups to define the vocabulary words while waiting for their computer time.

2. The students will work in groups to complete their presentations. Posters should include pictures, diagrams, and summaries of the information as they apply to the topic.

3. The students will take turns presenting the assignments to the class. Direct the students to the information on which they will be assessed.

4. Assessment of this lesson can be based on the attached quiz and group assignments.

CROSS-CURRICULAR EXTENSIONS:

LANGUAGE ARTS:

- **Write a story with the element carbon going through the carbon cycle. The students may choose fast track carbon recycling or slow track carbon recycling. The story must include scientific facts about the carbon cycle.**

MATHEMATICS:

- **Have students discuss the ratios of carbon to hydrogen found in glucose.**

TECHNOLOGY:

- **Research articles through Science News to find more extensive information on carbon's impact in the world.**

VISUAL ART:

- **Create a collage of the pictures depicting the greenhouse effects on the biosphere, hydrosphere, geosphere, and atmosphere.**

COMMUNITY CONNECTIONS:

- Plan a field trip to an anaerobic wastewater management site. Find out the benefits of this system as opposed to the traditional methods of handling a community's waste.
- Invite an environmental scientist visit the class and explain efforts that are being made in your community to reduce excess carbon dioxide.
- Contact the parish or county officials to research local laws that limit carbon emissions.
- Form a group of interested students to encourage a community plan to plant more trees in commercial areas.

STUDENT MATERIALS:

- Handout 1: ***WHERE'S THE CARBON?***
- Handout 2: ***FILM QUESTIONS*** Activity Sheet
- Handout 3: ***GROUP ASSIGNMENTS***
- Handout 4: ***THE CARBON CYCLE VOCABULARY***
- Handout 5: ***THE GREAT CARBON CYCLING QUIZ***

WHERE'S THE CARBON?

Directions: Examine each item to determine whether it contains carbon. Explain your answer.

1. Coke Yes No

_____
_____
_____

2. Plastic Yes No

_____
_____
_____

3. Water Yes No

_____
_____
_____

4. Fabric Yes No

_____
_____
_____

5. Wood Yes No

_____
_____
_____

FILM QUESTIONS

*1. Where is carbon found?

2. For what purpose do plants use carbon dioxide?

3. What percent of all living organisms' dry weight is made up of carbon?

4. Living things are carbon consumers and_____.

5. How is carbon dioxide released into the atmosphere?

*6. What produces the most oxygen on Earth?

7. What is carbon dioxide?

8. How is carbon dioxide broken down in a leaf?

9. What is fast track carbon recycling?

*10. What is slow track carbon recycling?

11. How does carbon return to the atmosphere?

12. What is a carbon sink?

13. How is the ocean a recycler?

14. What are organic recyclers and inorganic recyclers?

*15. What are hydrocarbon compounds?

16. Why is carbon dioxide called a greenhouse gas?

17. What are the sources of excess carbon dioxide?

18. What is the international community doing about it?

19. What are the four different spheres?

*20. What elements other than oxygen does carbon bond with?

21. What is the food chain in the ocean?

22. What can we do about the overabundance of carbon in our spheres.

GROUP ASSIGNMENTS

GROUP 1 – Photosynthesis
Your mission is to go to the *Alien Explorer* Web site and find the *Aliens Explore the Earth* link. Find the steps in photosynthesis and print. Construct a poster that illustrates the purpose of carbon dioxide during this process.
Alien Explorer http://www.alienexplorer.com/hp.html

GROUP 2 – The Greenhouse Effect
Your mission is to go to the EPA Web site and find the animated film link. Find Greenhouse Effect and construct a poster illustrating man's contribution to excess carbon in the atmosphere. Present the film to the class, followed by a review with the poster.
EPA Global Warming Kids Site http://www.epa.gov/globalwarming/kids/

GROUP 3 – International Efforts to Control Global Warming
Your mission is to visit these Web sites and find the basic steps to control global warming agreed to by the international community.
The Convention and Kyoto Protocol http://unfccc.int/resource/convkp.html
Go to Web site and click on English text of the Protocol. It will come through Adobe Acrobat Reader. Go to Article Two, highlight, and print. Make a poster size document explaining the agreements to reduce emissions in your own words.
The Montreal Protocol on Substances that Deplete the Ozone Layer
http://www.ciesin.org/TG/PI/POLICY/montpro.html
Go to the Web site and click on The Fourth Meeting of the Parties to the Montreal Protocol. Highlight and print the first three paragraphs. Prepare a presentation to explain the purpose and significance of the conference.

GROUP 4 – The Great Barrier Reef
Your mission is to explore effects of the carbon on the hydrosphere via the Great Barrier Reef.
National Geographic Magazine
http://www.nationalgeographic.com/ngm/0101/index.html
Go to the Web site and click on The Great Barrier Reef. Present the interactive film to the class
Find Article.
http://www.findarticles.com/cf_0/PI/index.jhtml
Go to the Web site and type in the Search area, "Carbon Dioxide Build-up Harms Coral Reefs". Present this article after viewing the National Geographic film.

GROUP 5 – What Our Community Can Do
Your mission is to find what citizens can do within their community to lessen the carbon dioxide problem.
Find Articles http://www.findarticles.com/cf_0/PI/index.jhtml
Go to the Web site and type in the Search area the following articles: "Parks as Lungs", "The Tilling Fields", and "Leafless Wonder." Print these articles and design a poster presentation.

GROUP 6 – The Effect of Excess Carbon Dioxide on Plants
Your mission is to explore the effect of excess carbon dioxide to the food chain.
Find Articles http://www.findarticles.com/cf_0/PI/index.jhtml
Go to the Web site and type in the Search area, "For plants, C[O.sup.2] means bigger, not better." Print article and design a poster that explains the food chain problem.

THE CARBON CYCLE VOCABULARY

Carbon – a nonmetallic chemical element found in many inorganic compounds and all organic compounds.

Carbon dioxide – a colorless, odorless, incombustible gas, somewhat heavier than air that passes out of the lungs in respiration and is used in plants for photosynthesis.

Greenhouse Effect – the result of excess carbon dioxide in the atmosphere causing global warming.

Hydrocarbons – any compound containing only hydrogen and carbon.

Fast track carbon recycling – the process that begins with photosynthesis in plants and phytoplankton, carries on though the animals, and ends with decomposition of plants, animals, and wastes.

Slow track carbon recycling – carbon trapped in the Earth's crust for thousands and sometimes millions of years. Carbon is returned to the atmosphere by man's mining and drilling for oil and gas.

Carbon sink – an area that absorbs carbon in water or on land and does not recycle.

Organic recyclers – plants and animals.

Inorganic recyclers – the atmosphere and oceans

Geosphere – the Earth's crust

Hydrosphere – water bodies

Biosphere – all living things

Atmosphere – the air surrounding the Earth's crust.

THE GREAT CARBON CYCLING QUIZ

DIRECTIONS: Circle the correct answer.

1. Carbon is found in the
   a) hydrosphere
   b) geosphere
   c) biosphere
   d) all of the above

2. Plants use which gas for photosynthesis?
   a) hydrocarbons
   b) carbon dioxide
   c) oxygen
   d) carbon monoxide

3. What percent of all living organisms' dry weight is made up of carbon?
   a) 70%
   b) 90%
   c) 50%
   d) 35%

4. Carbon dioxide is released into the atmosphere through
   a) respiration and decay.
   b) light energy absorbtion.
   c) evaporation.
   d) photosynthesis.

5. What produces the most oxygen on Earth?
   a) respiration
   b) plants
   c) phytoplankton
   d) fast track carbon recycling.

Fill in the blanks with the appropriate words. A word may be used more than once or not at all.

Carbon sink	producers	plants	penguins	greenhouse gas	krill	animals
Seals	hydrogen	oxygen	carbon calcium	geosphere	atmosphere	

6. Carbon bonds with oxygen, _____, and _____.

7. Living things are carbon consumers and _____.

8. Phytoplankton is a major food source for _____.

9. In the ocean food chain, krill is a major food source for fish that are then eaten by _____ and _____.

10. Hydrocarbon compounds are molecules made of _____and _____.

11. Carbon dioxide is called a _____because it absorbs heat from the sun and warms the Earth.

12. The sources of excess _____ are automobile and industrial plant emissions and world-wide coal burning.

13. An area that absorbs carbon in water or on land and does not recycle is a _____.

14. Slow track carbon recycling occurs in the _____.

15. Fast track carbon recycling occurs in _____and _____.

Fill in the blank with the appropriate word for the corresponding definition.

carbon	carbon dioxide	greenhouse effect	biosphere	
hydrosphere	atmosphere	fast track	carbon recycling	carbon sink
hydrocarbons	slow track	carbon recycling	geosphere	atmosphere

16. _____ The sphere related to the Earth's crust.

17. _____The result of excess carbon dioxide in the atmosphere causing global warming.

18. _____A nonmetallic chemical element found in many inorganic compounds and all organic compounds.

19. _____Any compound containing only hydrogen and carbon.

20. _____carbon trapped in the earth's crust for thousands and sometimes millions of years. Carbon is returned to the atmosphere by man's mining and drilling for oil and gas.

21. _____The air surrounding the Earth's crust.

22. _____a colorless, odorless, incombustible gas, somewhat heavier than air that passes out of the lungs in respiration and is used in plants for photosynthesis.

23. _____The process that begins with photosynthesis in plants and phytoplankton, caries on through the animals, and ends with decomposition of plants, animals, and wastes.

24. _____ The sphere related to water bodies.

25. _____ The sphere related to all living things.