

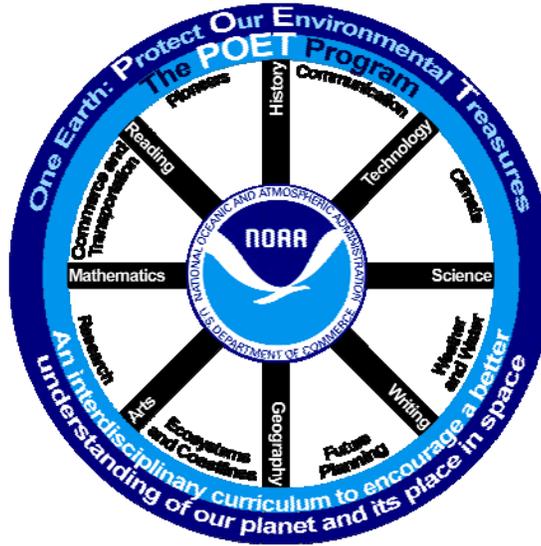
# The Carbon Cycle – CarbonTracker

## Category

Science, Mathematics, Reading

## Real World Connection

Research, Future Planning, Commerce, Climate, Transportation



## Materials

Included:  
CarbonTracker poster, playboard, game questions, footprint symbols

Not Included:  
Bowl-sized container to hold questions

## Problem Question

What is the CarbonTracker?

### Prior Knowledge What I Know

Based on your prior knowledge, answer the problem question to the best of your ability.

### Conclusion What I Learned

Answer the problem question after completing the activity.

## Procedure

To learn about tracking carbon, play the CarbonTracker board game either with other students or by yourself.

### Before You Begin...

Set up the game according to the following directions.

1. Cut out the cards with the CarbonTracker questions (Pages 12-4 and 12-5) and the footprint tabs (Page 12-7).
2. Write your name on the footprint in the blank space and place your footprint tab on the playing board in the "Start" box.
3. Place one set of the question tabs upside-down in some suitable container to prevent a paper mess.
4. Use the game board and a pile of tabs with questions. Scramble the question tabs before beginning and several times during the game.
5. Read and study the CarbonTracker poster (Page 12-3).

### Steps...

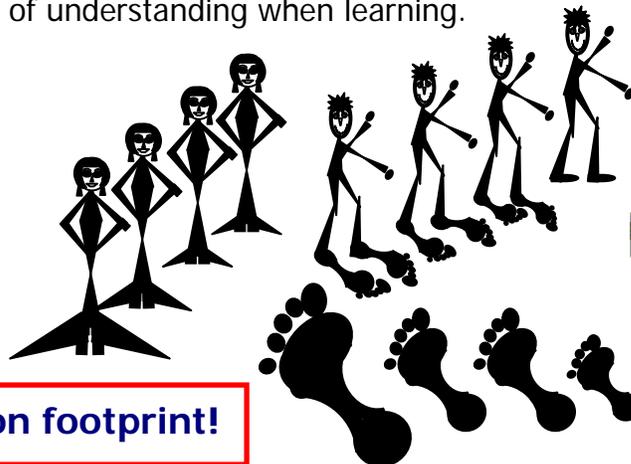
1. The person who goes first picks a question tab, reads the question aloud and answers the question.
2. If correct, then the person moves his/her footprint one space along the path on the poster unless the tab has a box that indicates a two space move.
3. The same person continues until he/she answers incorrectly.
4. The next person then repeats the process.
5. Take turns until you are confident that you know all of the answers.

### NOTE:

If playing in groups, please note the following information:

- Every person should have a poster, but keep it upside-down until the person answering the question is finished.
- Use only one set of questions.
- Everyone playing in a group must agree that an answer given by the person taking a turn is either correct or not before continuing. Know what kind of detail that your teacher expects and use that level of understanding when learning.

**Students  
Joining together  
to reduce carbon  
emissions, will  
make a  
difference!**



**Reduce your Carbon footprint!**

# CarbonTracker Poster

**Scientific Goals:**

**10 11**

- To determine the amount of CO<sub>2</sub> and other greenhouse gases in Earth's atmosphere;
- To better understand how the uptake and release of these gases affect our land, ocean, atmosphere, ecosystems, plants, and animals; and
- To predict future changes in the amount and sources of greenhouse gases.

**Trace Gases:**

*Very small amounts of greenhouse gases in Earth's atmosphere. For example, methane, commonly known as "natural gas," is a trace gas that is used as a fuel to heat buildings.*

**4**

**What are "fossil fuels"?**

Coal, oil, and natural gas! Fossil fuels are formed from the decay of plants and animals deep underground for millions of years.

As the coal, oil or natural gas burns, energy that had been stored is released. In the U.S., fossil fuels provide most of our electricity, and all of our transportation fuels.

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**1** **NOAA's CarbonTracker...** 

is a tool to keep track of carbon dioxide and other greenhouse gases globally.

**2** **Greenhouse Gases**

Water vapor is the most abundant greenhouse gas, followed by carbon dioxide (CO<sub>2</sub>) and other trace gases.

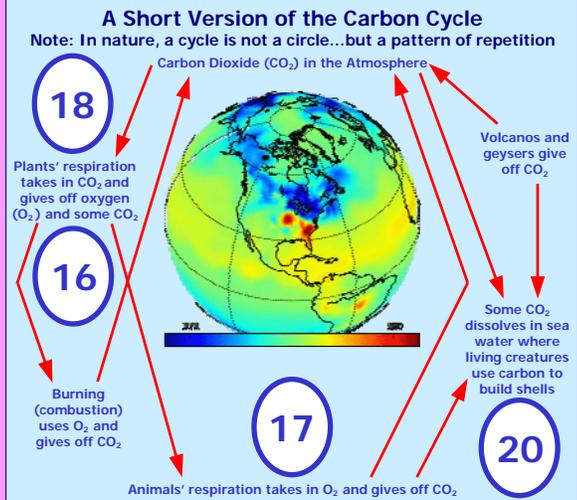
**3**

**Greenhouse Effect**

*Greenhouse gases in Earth's atmosphere absorb radiant energy (heat) from the Sun that would otherwise be radiated into space. These gases act somewhat like the glass in a greenhouse trapping radiant energy (heat).*

CO<sub>2</sub> is a colorless, odorless gas formed by a combination of one atom of carbon and two atoms of oxygen.

**23**



Without a natural greenhouse effect, the average temperature of the Earth would be about zero degrees F (-18°C) instead of its present 57°F (14°C). So, the concern is not with the fact that we have a greenhouse effect, but whether human activities are leading to an enhancement of the of the greenhouse effect.

**6**

**Carbon Cycle History**  
(Atmospheric CO<sub>2</sub> - parts per million [ppm]).

Years Ago	Date	ppm
Currently	2007	384
<b>14</b> 10	1998	363
50	1960	317
150	1850	285
<b>19</b> 120,000	From Ice Core	265

**21**

**5**

Carbon dioxide is the second most abundant greenhouse gas and it absorbs radiant energy (heat). Therefore, when the CO<sub>2</sub> concentration increases, so does atmospheric temperature.

*Human beings complicate the natural carbon cycle because they increase the amount of CO<sub>2</sub> in Earth's atmosphere by burning fossil fuels. Driving automobiles, heating buildings, and producing consumer goods all add to the concentration of CO<sub>2</sub> in Earth's atmosphere.*

**9**

**8**

**15**

**12** *By measuring carbon dioxide frequently and at many places on Earth... CarbonTracker can keep track of uptake (sometimes called a sink) and release (sometimes called a source) of CO<sub>2</sub> for many places on Earth.*

**10** **World leaders will have reliable data to make decisions when planning for the future.**

**How can you help?**

**Reduce your carbon footprint!**

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The carbon dioxide footprint is the sum of all CO<sub>2</sub> produced via energy use. For individuals this includes most of our electricity, transportation, and air travel.



## CarbonTracker Question Tabs

<p><b>Fill In:</b></p> <p>CarbonTracker is...</p> <p>(1)</p>	<p>What is a fossil fuel?</p> <p>(7)</p>	<p>Name two scientific goals for the CarbonTracker?</p> <p>Move Two Spaces (11)</p>	<p>What has happened to the CO<sub>2</sub> concentration since 1850?</p> <p>Move Two Spaces (22)</p>	<p><b>Fill In:</b></p> <p>The sum of all the CO<sub>2</sub> produced by a person is...</p> <p>(15)</p>
<p>Name the most abundant greenhouse gas.</p> <p>(2)</p>	<p>What happens to coal as it burns?</p> <p>(7)</p>	<p>Name three scientific goals for the CarbonTracker?</p> <p>Move Two Spaces (11)</p>	<p>Define CarbonTracker.</p> <p>Move Two Spaces (1)</p>	<p>Name two greenhouse gases.</p> <p>(2)</p>
<p>Name the second most abundant greenhouse gas.</p> <p>(5)</p>	<p>What fraction of U.S. electricity is produced by fossil fuel?</p> <p>(7)</p>	<p>What is meant by a carbon dioxide footprint?</p> <p>(15)</p>	<p>How can you help?</p> <p>(24)</p>	<p>Why should we collect data on Earth's surface temperature over time?</p> <p>(11) (10)</p>
<p>What is a trace gas?</p> <p>(4)</p>	<p>How do humans influence the amount of CO<sub>2</sub> in the atmosphere?</p> <p>Move Two Spaces (9)</p>	<p>What role do plants play in the carbon cycle?</p> <p>(16)</p>	<p>Name two fossil fuels.</p> <p>(7)</p>	<p>Why should we collect data on greenhouse gases?</p> <p>Move Two Spaces (10)</p>
<p>Name one trace greenhouse gas?</p> <p>(2)</p>	<p><b>Fill In:</b></p> <p>Leaders will have reliable data to...</p> <p>(10)</p>	<p>What role do animals play in the carbon cycle?</p> <p>(17)</p>	<p>Name three fossil fuels.</p> <p>(7)</p>	<p>How do human beings complicate the carbon cycle?</p> <p>Move Two Spaces (9)</p>

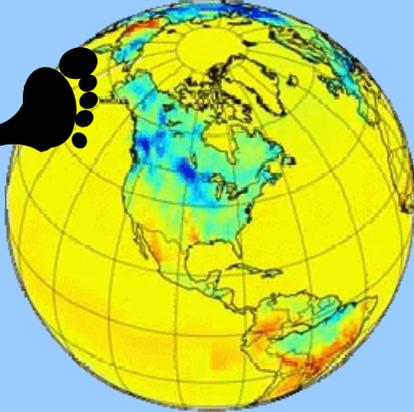


### CarbonTracker Question Tabs - Continued

<p>Without the natural greenhouse effect, what would Earth's temperature be? <b>6</b></p>	<p>What is meant by a CO<sub>2</sub> sink? <b>12</b></p>	<p>What role do sea plants play in the carbon cycle? <b>18</b></p>	<p>What is CO<sub>2</sub>? <b>23</b></p>	<p>What is CO<sub>2</sub> uptake? <b>12</b> <i>Move Two Spaces</i></p>
<p>What does "ppm" stand for in a concentration? <b>21</b></p>	<p>What is meant by a CO<sub>2</sub> source? <b>12</b> <i>Move Two Spaces</i></p>	<p>What role do sea animals play in the carbon cycle? <b>20</b></p>	<p>What is the sum of all the CO<sub>2</sub> produced by a person called? <b>15</b></p>	<p>What is meant by CO<sub>2</sub> emissions? <b>12</b> <i>Move Two Spaces</i></p>
<p>Atmospheric CO<sub>2</sub> concentration in 2007: _____ <b>21</b></p>	<p>If CO<sub>2</sub> increases in the atmosphere, what happens to the temperature? <b>5</b></p>	<p>What concentration of CO<sub>2</sub> was there 120,000 years ago? <b>19</b></p>	<p>What is methane used for? <b>4</b></p>	<p>Why is CO<sub>2</sub> part of the carbon cycle? <b>16, 17, 18, 20</b></p>
<p>Atmospheric CO<sub>2</sub> concentration in 1998: _____ <b>14</b></p>	<p>What is the greenhouse effect? <b>3</b></p>	<p>What concentration of CO<sub>2</sub> was there in 1850? <b>22</b></p>	<p>What is the chemical symbol for carbon dioxide? <b>2</b></p>	<p>Where does almost all of Earth's energy come from? <b>3</b> <i>Move Two Spaces</i></p>
<p>Atmospheric CO<sub>2</sub> concentration in 1960: _____ <b>13</b></p>	<p>Name a goal for scientists who use CarbonTracker? <b>11</b> <i>Move Two Spaces</i></p>	<p>What concentration of CO<sub>2</sub> was there in 1998? <b>14</b></p>	<p>What is the average temperature of Earth's atmosphere? <b>6</b></p>	<p>What could a person do to reduce his/her personal carbon footprint? <b>8</b> <i>Move Two Spaces</i></p>



# CarbonTracker Game Board

 <p><b>Ecosystems Changing</b></p>	<p><i>Start</i> <i>Follow the Footprints</i></p>		 <p><b>Students learn to collect atmospheric data</b></p>
 <p><b>Sea Horse: Uses carbon to build its shell</b></p>	<p><b>CarbonTracker</b></p>  <p><b>Successfully Completed</b></p>		 <p><b>Plants need sunlight and CO<sub>2</sub> to grow</b></p>
 <p><b>CO<sub>2</sub> is a molecule with one carbon atom in the center and two oxygen atoms – one on each side.</b></p>	 <p><b>Venus has a runaway greenhouse effect. Lead melts in its atmosphere.</b></p>	 <p><b>Needed - Cooperation</b></p>	
 <p><b>Fossil Fuels</b></p>	 <p><b>People use fossil fuels.</b></p>		



### Footprint Tabs



Name



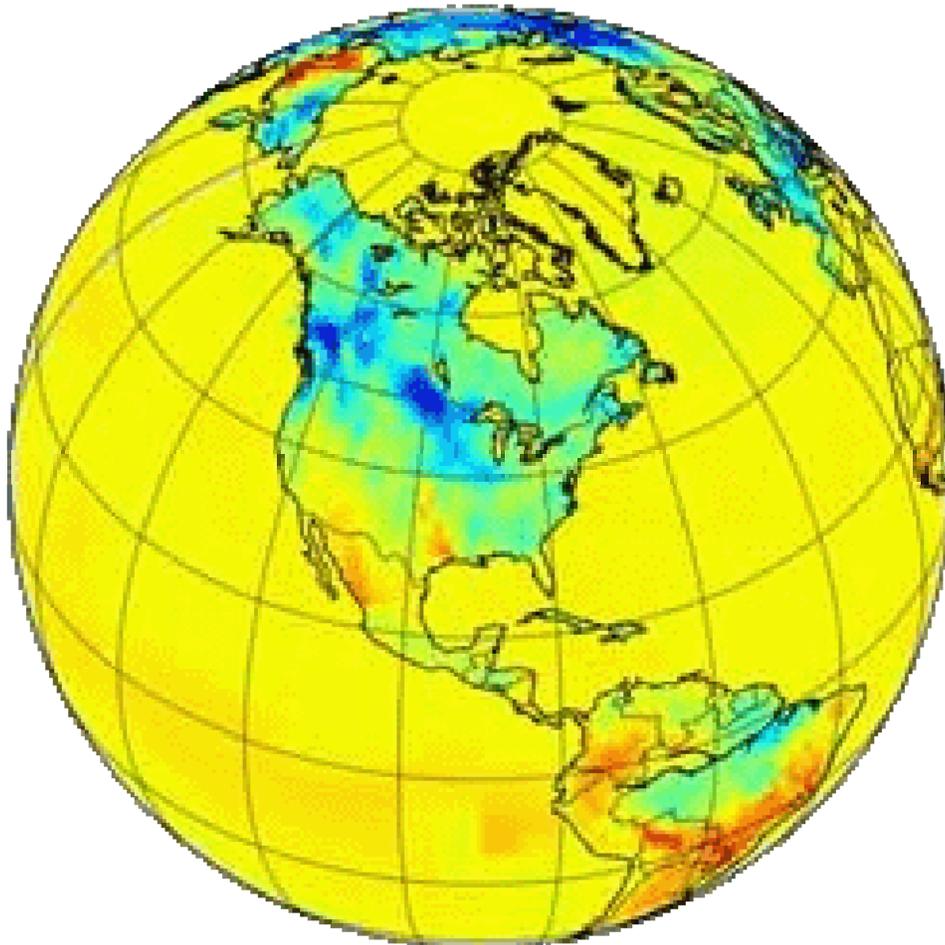
Name



Name



Name



For more information and to see  
CarbonTracker in motion,  
visit the web at...

<http://www.esrl.noaa.gov/gmd/ccgg/carbontracker/>

