

# The Carbon Dioxide Game

*A fun, active outdoor game for helping students visualize how human activities enhance the greenhouse effect*



Photos: Alexandra Grindler, The Ecology School

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by Sashi Kaufman

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**C**LIMATE IS ONE of the most influential abiotic factors on our planet. But studying climate and climate change presents unique challenges to educators: How do we bring the vast and multifaceted topic of climate change down to a level where students can explore it in a hands-on interactive way? How do we address in a positive way the role that humans play? By the time they reach middle school, most students have heard of global warming and the greenhouse effect. They have some idea that rising global temperatures are attributed to human activities that have dramatically increased the levels of heat-trapping gases in the atmosphere. However, it is important that students also understand that the greenhouse effect is a positive process by which the atmosphere keeps the planet at a relatively uniform temperature.

The Carbon Dioxide Game is a fun, active way to explain the greenhouse effect and human contribution to global climate change. The game can be played with groups of up to 30 students age 10 and older.

## Goals

- To demonstrate the greenhouse effect by showing how CO<sub>2</sub> in the atmosphere traps heat and insulates the Earth.
- To show that human activities affect the concentration of greenhouse gases in the atmosphere.

**Time:** 20 minutes, including time for debriefing.

**Materials:** An open area, chalk, a small bag with the words “What did humans do?” written on it, and action cards representing human actions that affect CO<sub>2</sub> levels in the atmosphere.

## Procedure

Draw two concentric circles on the ground, one about 2 feet in diameter, and a larger one about 15 feet in diameter. The smaller circle represents the Earth and the larger one represents Earth’s atmosphere.

The game is played in several rounds. For round one, choose two students to be CO<sub>2</sub> molecules, and place them anywhere in the Earth’s “atmosphere.” Once they are in the atmosphere they cannot move their feet. The rest of the students are sunbeams representing energy from the sun.

The object of the game is for the sunbeams to enter the atmosphere, tag the Earth (by touching the inner circle with a foot or hand) and then escape the atmosphere without getting tagged by a CO<sub>2</sub> molecule. Sunbeams who are tagged must stay standing still in the atmosphere. Those who avoid being tagged bounce back out of the atmosphere into space. Each round lasts approximately 30 seconds and during that time the sunbeams try to tag the Earth only once. This simulation recreates the greenhouse effect: energy from the sun is trapped as heat by CO<sub>2</sub> and other gases and particles in the atmosphere.

After the first round, have the escaped sunbeams form a circle around the atmosphere to check how much energy has been trapped. Discuss how this may affect the temperature of the planet. Remind students that a certain amount of CO<sub>2</sub> is necessary to keep the planet consistently warm enough to support life. During the first round, most of the energy will have escaped the atmosphere because CO<sub>2</sub> levels are low. Before continuing the game, clear all the trapped sunbeams out of the atmosphere.

For the second round, increase the number of CO<sub>2</sub> molecules in the atmosphere. Do this by reaching into the “What

did humans do?” bag and pulling out an action card (for this round, include only cards that add CO<sub>2</sub> to the atmosphere). After a student reads the card, increase the number of CO<sub>2</sub> molecules in the game (dictated by card) and play again.

For the third and subsequent rounds, put all of the action cards in the bag so that CO<sub>2</sub> levels will go up or down depending on which card is drawn. Discuss what happens each time. The game should demonstrate that when you increase the amount of CO<sub>2</sub>, more heat gets trapped (illustrated by the student sunbeams standing in the atmosphere) and the Earth warms up. The action cards demonstrate how even small-scale actions can decrease the amount of greenhouse gas that we emit to the atmosphere.

## Wrap-up

Review how energy from the sun gets trapped in the Earth’s atmosphere. Discuss how human actions, particularly burning








fossil fuels, can enhance the greenhouse effect by putting more CO<sub>2</sub> into the atmosphere. The game can be a springboard into a variety of other explorations such as researching alternative energy sources, discussing sustainable lifestyles, and examining the different choices humans can make in relation to the environment.

**Sashi Kaufman** is a middle school teacher and author of young adult fiction in Portland, Maine. While working at The Ecology School in Saco, Maine, she taught hundreds of students to play The Carbon Dioxide Game.

## Reference

Gould, Alan. *Hot Water and Warm Homes from Sunlight*. Berkeley: Lawrence Hall of Science, 1995.

# Action Cards

<p><b>Humans drive cars</b> Every liter of gas puts 2.35 kg of CO<sub>2</sub> into the atmosphere (18.8 lbs per US gallon). (Add two CO<sub>2</sub> molecules)</p> 	<p><b>Humans drive more cars</b> In 1908, Ford built the Model T car. Between 1908 and 1928, 15 million were sold. Today an estimated 500 million cars are in use worldwide. (Add two CO<sub>2</sub> molecules)</p> 
<p><b>Humans cut down trees</b> Trees remove CO<sub>2</sub> from the atmosphere during photosynthesis. Fewer trees means more CO<sub>2</sub>. (Add four CO<sub>2</sub> molecules)</p> 	<p><b>Humans burn trash</b> Burning waste puts CO<sub>2</sub> into the atmosphere along with other pollutants. (Add two CO<sub>2</sub> molecules)</p> 
<p><b>Humans ride bikes</b> Riding a bike is the most energy-efficient form of transportation, and it’s fun! (Remove two CO<sub>2</sub> molecules)</p> 	<p><b>Humans plant trees</b> Trees remove CO<sub>2</sub> from the atmosphere during the process of photosynthesis. More trees means less atmospheric CO<sub>2</sub>. (Remove four CO<sub>2</sub> molecules)</p> 
<p><b>Humans create energy efficient technology</b> (Remove four CO<sub>2</sub> molecules)</p> 	<p><b>Humans recycle</b> Recycling saves energy, reducing our use of fossil fuels. (Remove two CO<sub>2</sub> molecules)</p> 