



Connections:

***What is going to happen as the CO₂ level in the atmosphere rises?** Carbon dioxide is a greenhouse gas, so as the concentrations of the gas in the atmosphere rise, the global climatic temperature will also rise. Compare our atmosphere to that of Venus. Venus has a runaway greenhouse effect, caused by extremely high amounts of CO₂ in its atmosphere.

***What would our planet be like if it had no atmosphere at all?** If Earth had no atmosphere, there would be extremes in temperature between the day and night. Basically all light waves that reached the earth's surface would be converted to heat, but then would be reflected back into space.

***Are there any planets with little or no atmosphere?** Because of its small size and weak gravitational pull, Mercury does not have an atmosphere. Mars' atmosphere is extremely thin.

Credit: This activity is adapted from an activity originally published in *Simple Weather Experiments* by Muriel Mandell. Published in New York by Sterling Publishing Co. Inc., 1990. Written permission granted by Sterling Publishing.

Carbon Dioxide Game

Goals: To demonstrate the greenhouse effect— how CO₂ in the atmosphere traps heat and insulates the Earth. To show how increasing the amount of atmospheric CO₂ contributes to global warming.

Materials: an open area, chalk, a small bag with the words "what did humans do?" or "bag of fate" written on them. Fate cards to put in bag (pg 110).

Group Size: 10-20 students per group

Estimated Time: 20 minutes

Directions: Draw two concentric circles on the ground, one about 2 feet in diameter, and the other about 15 feet in diameter. The smaller circle represents the Earth, and the larger one represents the planet's atmosphere.

Ask the students what gases make up the atmosphere. Tell them that this activity focuses on the role of carbon dioxide in relation to Earth's climate, but be careful to not reveal what it is the CO₂ does; allow the activity to teach the concept.

Pick two students to be CO₂ molecules, and place them in the "atmosphere". The rest of the students are Sunbeams, each representing energy from the sun. The "sun" is located about 30-40 feet from the atmosphere and is represented by a third circle.

The object of the game is for the Sunbeams to leave the sun, enter the atmosphere, tag the Earth, and then escape back into space without getting tagged by a CO₂ molecule. (CO₂ molecules can pivot on one foot, but may not run around within the atmosphere.) If a Sunbeam is tagged by a CO₂ molecule, it stays standing still in the atmosphere. If not, it bounces back out of the atmosphere. To add a more scientifically accurate spin to this game, instruct the Sunbeams to travel only in a straight line towards the earth's surface, thus illustrating the fact that waves of light travel in a straight line from the sun to the Earth.

This simulation recreates the greenhouse effect where energy from the sun is trapped as heat by CO₂ and other greenhouse gases, such as water vapor, in the atmosphere. After the first round, have students form a circle around the atmosphere to check out how much energy has been trapped. How will this affect the temperature of the planet? During this first round, most of the energy will escape the atmosphere because CO₂ levels are low. Make sure to mention that a certain amount of heat must be trapped to keep the planet's climate warm enough to sustain life.

For the second round, increase the number of CO₂ molecules in the atmosphere from two to four. Do this by inviting a student to reach into the Bag of Fate and pull out a fate card. The cards should say things like "humans drive cars" or "factories are built" or "trees are cut down". Each of the cards represents a human action that might or might not increase the amount of CO₂ in the atmosphere. After a student reads a card you can increase the CO₂ in your game and play again. Try a third round with seven CO₂ molecules. What happens? The game should demonstrate that when you increase the amount of CO₂, more heat gets trapped and the Earth's overall temperature increases.

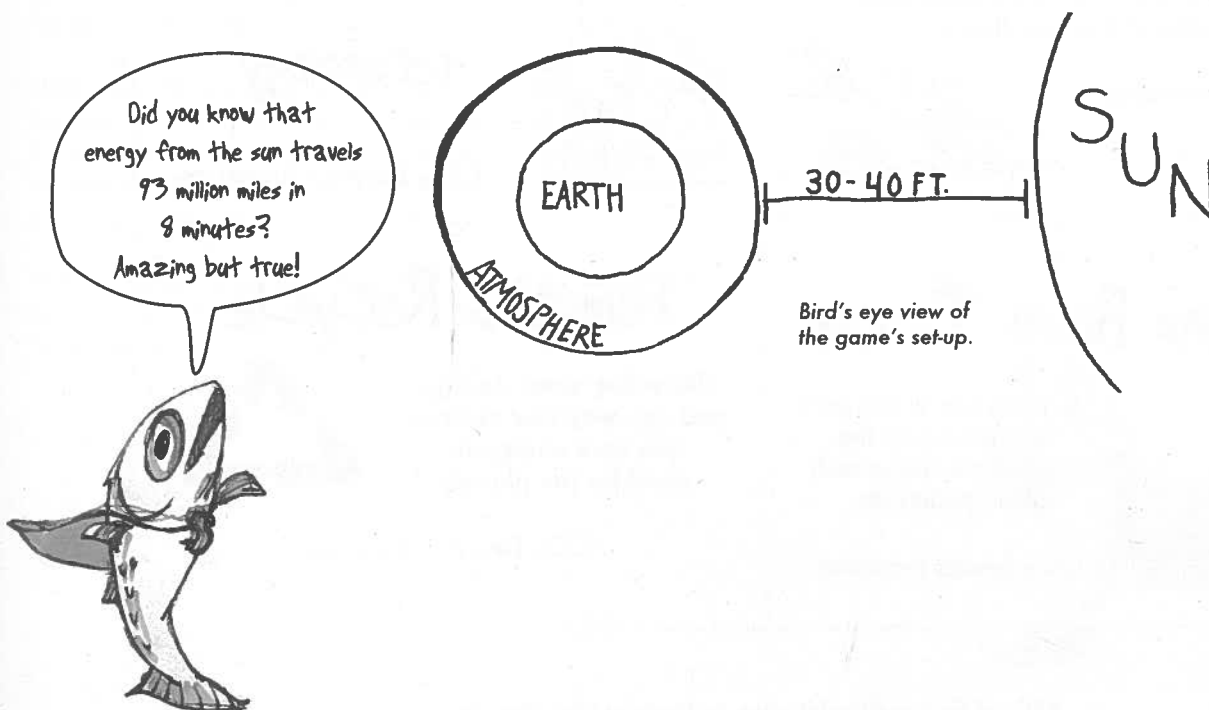
Note: While some aspects of this game are fictitious, such as carbon dioxide molecules not being able to move about the atmosphere, the game does illustrate concrete concepts regarding the greenhouse effect and the correlation between increased levels of carbon dioxide and increased global temperatures. If you do have a more active group of students, allow the carbon dioxide molecules to move around the atmosphere by walking. Or, you could have a really windy day during which the carbon dioxide molecules are allowed to move quickly through the atmosphere.

Connections: Review how the energy from the sun gets trapped within the Earth's atmosphere. Discuss with the students how humans can influence the greenhouse effect and global warming—how burning fossil fuels puts more CO₂ into the atmosphere. Wrap-up by discussing/researching alternative energy sources.

Credit: This activity is a Ferry Beach Ecology School original, created by staff naturalists, Amos Wright and Sashi Kaufman.



Graph the correlation between the number of carbon dioxide molecules and the number of sunbeams trapped.



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Fate Cards

Humans Drive Cars

*Every gallon of gas puts 22 pounds of CO₂ into the atmosphere.

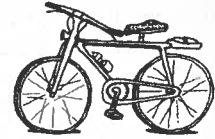
Increased CO₂ Levels



Humans Ride Bikes

*Riding a bike is the most energy efficient form of transportation— and it's fun!

CO₂ Levels stay the same



Humans Drive More Cars

*In 1908 Ford built the Model T car. Between 1908 and 1928, 15 Million were sold.



Increased CO₂ Levels

Humans Plant Trees

*Trees remove CO₂ from the atmosphere during the process of photosynthesis.

More trees means less atmospheric CO₂.

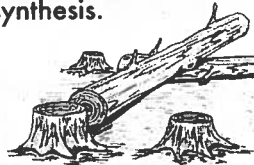
CO₂ Levels Decrease



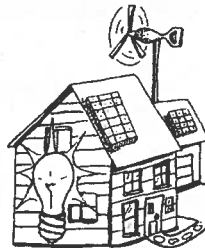
Humans cut down Trees

*Trees remove CO₂ from the atmosphere during the process of photosynthesis.

CO₂ Levels Increase

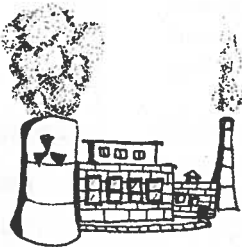


Humans create energy efficient technology



CO₂ Levels Decrease

Humans Burn Trash



*Burning our waste puts CO₂ back into the atmosphere along with other pollutants.

CO₂ Levels Increase

Humans Recycle

*Recycling saves energy, and any way that humans can save energy is good for the planet!

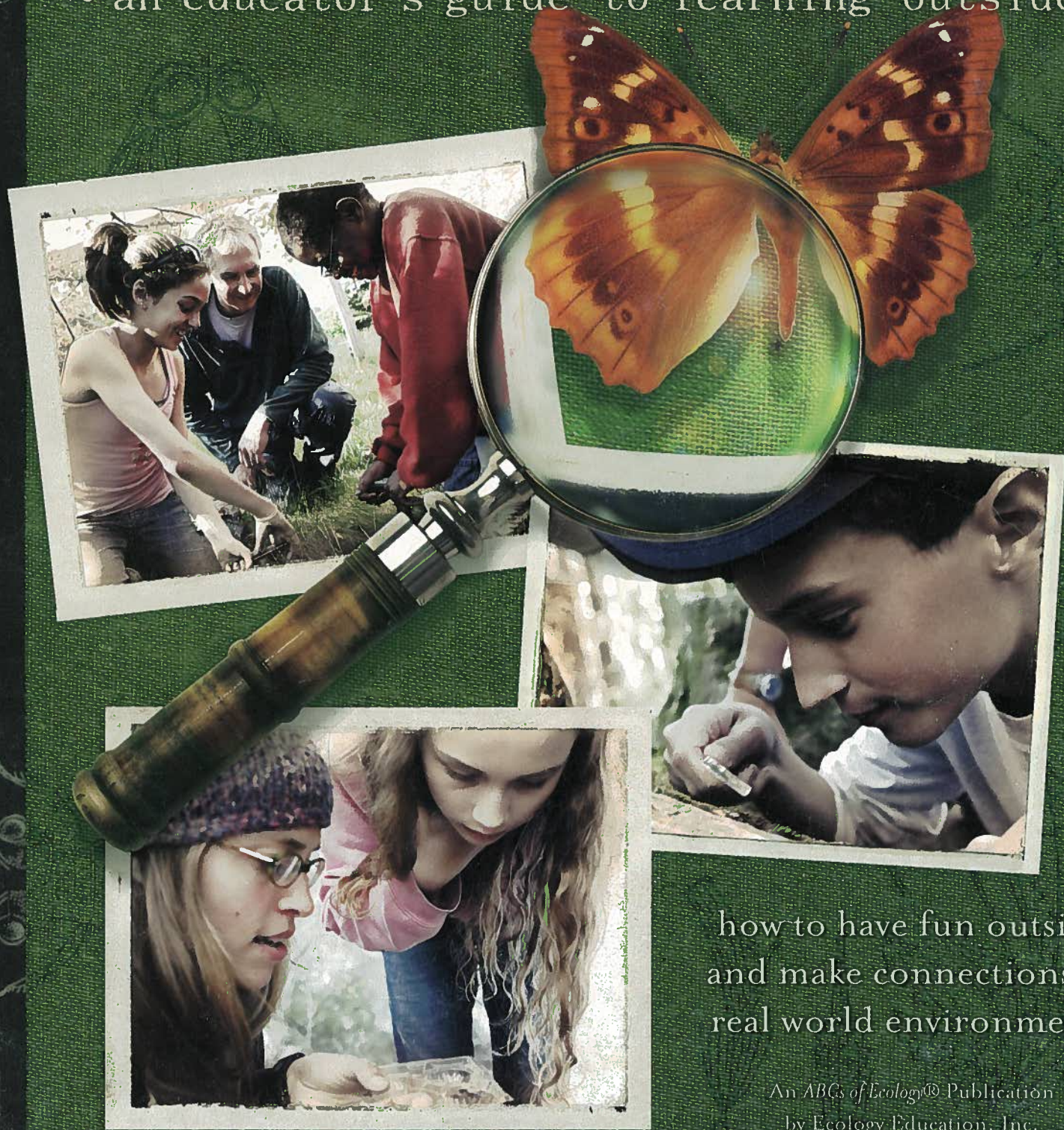


CO₂ Levels Decrease

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