

Greenhouse in a Bottle

Subject: Science



OBJECTIVES:

- Create and observe models of the planet using clear 2-liter bottles
- Gain a better understanding of the greenhouse effect
- Understand how their transportation choices affect the greenhouse effect
- Discuss ways to reduce their affect on global climate change



SETTING: outdoors for activity (because it can be messy) - the warmer the better, indoors for discussion



MATERIALS:

- See next page
- Diagram of Greenhouse Effect



ESTIMATED TIME:

1 class period



VOCABULARY:

- Greenhouse Effect
- Carbon Dioxide
- Fossil Fuel
- Alternative Transportation



ACTIVITY SOURCE:

Transportation Authority of Marin's Safe Routes to Schools program

OVERVIEW:

This activity gives students an opportunity to illustrate the phenomenon of the greenhouse effect and discuss global warming. They will learn about the Carbon Dioxide and Oxygen Cycles and the causes and possible solutions of global warming

BACKGROUND:

A greenhouse is a building especially constructed for growing plants when the weather is cold. The walls are made of glass or clear plastic, which sunlight pass through. It is absorbed by the soil and plants, and is then emitted as heat energy which warms the air inside the greenhouse. The walls prevent the heated air from escaping, so it remains trapped inside the greenhouse.

The earth kind of works like a greenhouse because rays from the sun come and enter the earth's thin atmosphere. The rays get absorbed in the surface of our planet and then create new rays, called infrared rays. When these infrared rays try to go back into space, they get trapped in the atmosphere, and they come back down to earth again.

The reason the rays bounce back is because our atmosphere is filled with greenhouse gasses, like carbon dioxide (which is .04% of the earth's atmosphere but plays an important role in supporting life, including being used by plants during photosynthesis). These gasses trap the rays inside the earth, causing the earth to get hotter. This cycle helps to maintain the temperature on the earth mild and suitable for living things.

Human beings have been adding vast quantities of Carbon Dioxide and other greenhouse gasses to the atmosphere in many ways, especially when we use fossil fuels (gasoline) to drive cars and trucks. Burning gasoline creates carbon dioxide and other toxic gases, which come out of the tailpipe of the car and go into the atmosphere. This dramatic increase of greenhouse gases is causing overall temperature to increase, which scientists are calling climate change (or climate chaos). The Bay Area has seen snowfall decrease and a record drought season, while in other parts of the world stronger hurricanes have been on the rise and ice caps and glaciers have been melting for the past several years.

STATE STANDARDS

Science:
Investigation and experimentation:
 6h: Draw conclusions from scientific evidence and investigate whether further information is needed to support a specific conclusion.



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LESSON SET-UP:

1. Call the Safe Routes office if you would like help with this lesson: 707-545-0153.
2. Set up six stations outside with appropriate materials.

MATERIALS NEEDED:

For a class of 24 students, six stations are suggested.

Each station (including a demonstration station for the teacher) needs:

- ✓ Plastic container or cup with 1/2 cup of potting soil.
- ✓ Another plastic container with 2 cups of water
- ✓ A pouring spout (or have funnels on hand)
- ✓ One clear plastic bottle (two liter)
- ✓ One small bucket or bin in which to stand the plastic bottle to catch excess dirt.
- ✓ A tarp or newspapers on the ground, (if you don't want dirt spilled)
- ✓ Plastic caps for half of the bottles (to designate vented from non-vented)
- ✓ Notebook or paper and pencil
- ✓ A utility-knife, for half of the stations
- ✓ Magic markers: one brown, one blue

DISCUSSION: Greenhouse Effect and the Environment

Hold an interactive discussion to explore student understanding of the greenhouse effect. Cover the following questions:

- 1) What four things do all living organisms need? (*sun, soil, water, air*)
- 2) What happens if we take away the air? (*Things die*)
- 3) Introduce the Co₂ and O₂ cycle.
- 4) We have more Co₂ now and not more trees, what happens?
- 5) What is a greenhouse?
- 6) Who has heard of the greenhouse effect? Explain, using the diagram.
- 5) What is causing the greenhouse effect and global warming?

ACTIVITY: Let's observe a model of the greenhouse effect.

1. Student instructions/teacher models:
 - ✓ We are working as teams of scientists sharing responsibilities.
 - ✓ Stuff the soil into the narrow mouth of the 2-liter bottle, keeping the bottle over the bucket so that the spilled dirt is caught. Get as much of the soil into the bottle as possible (up to 1/2 cup).
 - ✓ Pour the water into the narrow mouth of the bottle.
2. Half of the teams: cut holes near the top of the bottle (three crescent-shaped holes about two inches long). Color the top of the bottle blue.
 - ✓ The other teams: put cap on the bottle; color the top of the bottle brown.
 - ✓ All teams place their bottles outside in the sun
 - ✓ All teams predict what will happen inside their bottle.

DISCUSSION: Air Pollution

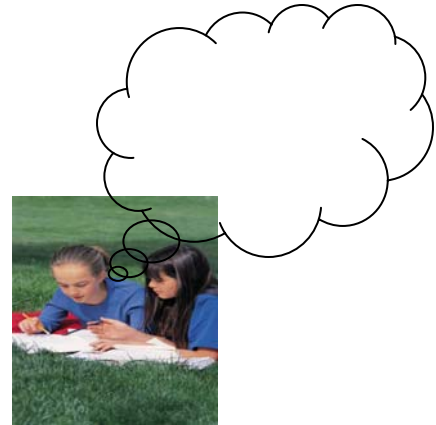
Hold an interactive discussion about the role of air pollution in global warming. Cover these questions:

- ✓ What are some causes of air pollution?
- ✓ What happens to air pollution—does it just float off into space? (*Air pollution stays in the earth's atmosphere and has created an insulating blanket around the planet.*)
- ✓ Which bottles represent the earth the way it was before pollution clouded our skies? (*the vented bottles*)
- ✓ Why do the un-ventilated bottles represent the earth now? (*Pollution in the atmosphere is insulating the earth and trapping the sun's heat.*)

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WRAP-UP

- Retrieve the bottles from outside and have students decide together which bottles are warmer.
 - How do you know which bottles are warmer?
(*there is more condensation*)
 - Were students' predictions about the bottles correct?
 - Which bottles represent the earth the way it was before pollution clouded our skies?
(*the vented bottles*)
 - Why do the un-ventilated bottles represent the earth now? (*Pollution in the atmosphere is insulating the earth and trapping the sun's heat.*)



FINAL DISCUSSION:

- What are some of the real effects of climate change and the Greenhouse Effect?
 - Have students seen any of these effects in the Bay Area, where they live? Do they think that they will see any effects in their lifetimes?
- What does driving have to do with the Greenhouse Effect and climate change?
- What changes have taken place in your life times as a result of the use of cars? (fields that are now parking lots, wider roads, more traffic, fewer trees, worse pollution)
 - What are some other transportation choices we can make?
 - What are some behaviors and attitudes that determine transportation choices?
 - What are some barriers to, or opportunities for, changing our transportation habits?
- What are some other ways that we can "cut out" pollution?



EXTENSION IDEAS

- Have students research information about climate change. They can try and answer some of the following questions:
 - How is global warming affecting some of the island nations from across the globe?
 - How can cities be planned so that they don't rely as much on cars?
 - What are some ways that England is fighting climate change?
 - What percentage of California's total GHG missions in California come from cars? (*roughly 30%: Bay Area Air Quality District*)
 - What percentage of total global emissions is the United States responsible for? (*roughly 23%*)
- Discuss how specifically students can change their habits to live more environmentally-responsible lifestyles. Encourage them to make a pledge to change at least one habit, especially walking or bicycling to school. Have them share this pledge with their parents.

