

Greenhouse in a Bottle

Overview

Students will learn about the impact of global warming by simulating the phenomenon of the greenhouse effect. In groups they will create a mini greenhouse. They will learn about the Carbon Dioxide and Oxygen Cycles and look at some of the primary causes of global warming and climate change. Students will look at what can be done to be part of the solution.

Supplies

- ✓ 2 or 3 thoroughly washed and cleaned recycled clear plastic bottles with a small neck (*clear juice bottles or 2-liter soda bottles work well.*)
- ✓ Plastic caps for half of the bottles to designate vented from non-vented
- ✓ Index Cards
- ✓ scissors
- ✓ Potting soil
- ✓ Two different colored markers
- ✓ A small bag of loose gravel
- ✓ Wide tape and scissors
- ✓ Double sided copies of *Mini Greenhouse Observation* and *The Greenhouse Effect* for each student



Greenhouse Gases: What are They?

Read background on greenhouse gases below:

Greenhouse gases, mainly water vapor and carbon dioxide- CO₂, are key to the earth's atmosphere because they trap energy from the sun, creating a natural "greenhouse effect." Without this effect, temperatures would be much lower than they are now, and life as we know it today would not be possible. However, the natural balance of greenhouse gases in the atmosphere has been disturbed by human activity. Since the mid 1800's (*the Industrial Revolution*), humans have been burning fossil fuels, which adds much more CO₂ to the atmosphere than there was before. This increased CO₂ traps additional energy in the lower atmosphere, making temperatures higher than normal.

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 allows sunlight to pass through. The sun's rays are absorbed by the soil and plants, and are then emitted as heat energy which warms the air inside the greenhouse. The walls trap the heated air inside the greenhouse.



The earth is similar to a greenhouse in that the 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 come back down to earth again.

The reason the rays bounce back is because our atmosphere is filled with greenhouse gases, such as carbon dioxide. These gases trap the rays inside the earth causing the earth to get hotter. As previously mentioned, this is a natural cycle that helps to maintain the temperature on the earth that is necessary for human, animal and plant life, but human beings have caused an imbalance in this natural process by adding vast quantities of Carbon Dioxide and other greenhouse gasses to the atmosphere. For example, when we use fossil fuels such as gasoline to fuel our vehicles we create 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 temperatures to increase, causing climate change.

It is also important to remember the significance of the CO₂ / O₂ cycle. In the human respiration process we breathe in oxygen and breathe out carbon dioxide. Plants do the opposite, they take in carbon dioxide and put out oxygen, which is why having trees and plants is so important to our health and the health of the environment. When there is a good balance with this exchange the air is clean.

Activity: Mini Greenhouse

Time: Part 1 - 50 Minutes

Time: Part 2 - 30 Minutes (to be done later in the day)

Discussion Questions:

Time: 10 Minutes

Use the following discussion questions to explore student understanding of the greenhouse effect.

- What does the CO₂ and O₂ cycle look like?
- We have more CO₂ now and less trees, what happened?
- What is a greenhouse?
- Who has heard of the greenhouse effect? Ask for an explanation.
- What is causing the greenhouse effect and global warming?

Note: Ask parents/students to bring in clear plastic bottles.



How to Make a Mini Greenhouse

Time: 20 Minutes

Note: It is best to do this activity when the weather is warm.

- Each student starts with 2 bottles and scissors. It is easiest to set up stations for the gravel and dirt. Follow steps below to create a mini greenhouse.

1. Cut all the way around the bottle to carefully remove the top one-third of the bottle.
2. Place about 1 inch of loose gravel in the bottom of the bottle, then add about 3 inches of potting soil.
3. Add a few drops of water in the bottle, but do not soak the soil. As the bottle will be almost an enclosed garden, only a little bit of water is necessary.
4. Gently place the top part of the bottle back in place on top of the bottom section. Use the wide clear tape to secure the two parts of the bottle together. (*You may need an extra pair of hands for this part.*)
5. Make 3 holes near the top of one bottle, place the cap on the bottle and use a marker to color the top. Put a cap on the other bottle without cutting holes in the bottle. Using the other colored marker, color the top of the cap.
6. Pass out *Mini Greenhouse Observations* and have each student write down their prediction of what will happen to the bottles, which ones might get hotter, and which ones might be cooler.
7. Place the mini greenhouses in a sunny warm location inside or outside the classroom for several hours.
8. While bottles are bathing in the sun, have a discussion about the role of air pollution in global warming. Use the following questions:



- What are some causes of air pollution?
- What happens to air pollution? Where does it go?
- Which bottles represent the earth before there was so much pollution in our air? (*The vented bottles.*)
- Why do the un-ventilated bottles represent the earth now? (*Pollution in the air is insulating the earth and trapping the sun's heat.*)

Effects of Greenhouse Gases

Time: 20 Minutes

- Have students read or read to the class the passage about Climate Change and the Effects of Greenhouse Gases. After reading, ask students to share what they learned. Ask students to share how they feel about greenhouse gases.
- Take ideas for how students could help to reduce air pollution.

Part II: Analysis

Time: 20 Minutes

- Return to the handout and retrieve the bottles from the sun and have students observe all of the bottles to determine which bottles are hotter. Have them write down the details of their observations.
- Are some bottles warmer than others? How can you tell? (*Condensation*)
- Have students look at their predictions. Were their predictions accurate?
- How does this process simulate global warming?
- What does driving have to do with the greenhouse effect and climate change?
- What are some alternatives to driving?
- Driving is easy and convenient, so sometimes we forget how it affects the environment. How can we remember and share the impact that driving has on air pollution?

Reflection:

Time: 10 Minutes

- Have students write one thing they learned about greenhouse gases.
- Have students write if their prediction was accurate on the *Mini Greenhouse Observations* handout.

Safe Routes to Schools: Extensions and Connections

POLLUTION SOLUTION AMBASSADORS

Do this activity or remind students about this activity prior to a Walk and Roll to School Day. Encourage your students to be Pollution Solution Ambassadors by helping other students figure out how they can get to school in the greenest way possible.



Name: _____

Mini Greenhouse Observations

1. Write your predictions for the greenhouses: the bottles with holes for ventilation and those without ventilation.
2. After you bring in the bottles from the sun, compare the bottles and write down your observations with as much detail as you can.

Prediction:

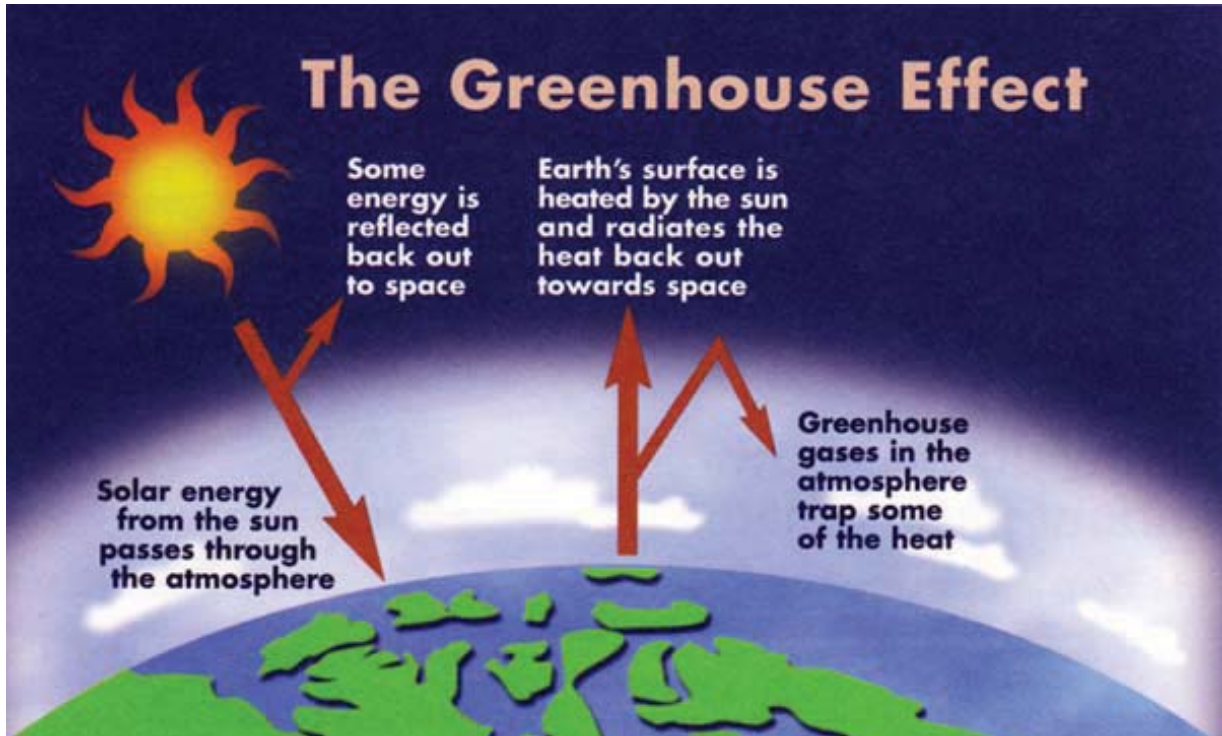
Bottles with holes:

Bottle without holes:

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Was your prediction accurate? Explain.

Name: _____



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Greenhouse gases, (mainly water vapor, and carbon dioxide, CO_2) are key to the earth's atmosphere because they trap the sun's energy, creating a natural "greenhouse" effect. Without this effect, temperatures would be much lower than they are now, and life as we know it today would not be possible.

However, the natural balance of greenhouse gases in the atmosphere has been disturbed by human activity. Since the Industrial Revolution, humans have been burning fossil fuels, which adds much more CO_2 to the atmosphere than there was before. This increased CO_2 traps additional energy in the lower atmosphere, which is making temperatures on earth higher than normal.

List some specific changes we are seeing in our environment due to these higher temperatures on Earth?

Climate Change

“Will Antarctica completely melt because of global climate change?”

Scientists worldwide agree human driven behaviors such as transportation and deforestation have caused changes in Earth’s atmosphere. Increases in greenhouse gas emissions such as carbon dioxide, methane and nitrous oxide have made the Earth warmer. These greenhouse gases remain in Earth’s upper atmosphere and trap the sun’s heat. This increase in temperature has melted ice in Antarctica, as well as at the North Pole.

According to the Environmental Protection Agency, the warmer temperatures have also changed weather patterns throughout the world. As temperatures rise, more moisture evaporates into the air from the land and the oceans. The extra moisture in the air comes back down as additional snow and rainfall, but the extra precipitation is not spread equally around the world. For example, the northeast United States is getting more rainfall than it has in the past, but Hawaii is getting less.

Changes in rain and snowfall patterns can cause serious problems such as flooding. Additionally, people depend on snow and rainfall for drinking water and for crops.

NASA Scientists report that if all greenhouse gas emissions stopped immediately, the Earth would continue to warm for at least the next fifty years because many gases are still trapped in the oceans. Every car trip saved stops the problem from becoming worse.

Sources:

EPA, <http://www.epa.gov/climatestudents/impacts/signs/index.html>

NASA, <http://climate.nasa.gov/climatechangeFAQ>