



**SAFE ROUTES
TO SCHOOLS**

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Greenhouse in a Bottle

Grade level: 5-10

Introduction: This exercise gives students an opportunity to experience the phenomenon of the greenhouse effect and discuss global warming.

Objective: Clear plastic bottles containing soil and water represent the earth and our atmosphere. Students ventilate half of the bottles, allowing the heat to escape, the way heat radiated off of the planet before an insulating layer of pollution formed in our atmosphere. The other half of the bottles are left unventilated, demonstrating the way heat is now trapped in our environment, as evidenced by the condensation of moisture in the bottle. Moisture will not condense in the ventilated bottle

Set Up: This activity is best conducted entirely outdoors because there is a mess factor.

Materials:

For a class of 24 students six stations are suggested. Each station (including a demonstration station for the teacher) needs:

- A bright sunny day, the warmer the better. (heat lamps can be used if its cloudy)
- Plastic container with about two cups of potting soil
- Another plastic container with about two cups of water
- One clear plastic bottle (two liter)
- One small bucket or other device to stand the plastic bottle in (in order to catch excess dirt)
- A tarp or newspapers on the ground if you don't want dirt spilled
- One inch square piece of aluminum foil
- Notebook or paper and pencil
- Every other station will require a utility-knife

Discussion:

- Ask who knows what percentage of the earth's surface is covered in water (about 75%). Explain that the bottles represent the earth because we have a ratio of about three quarters water to soil (have the students convert the percentage to a fraction).
- Ask the class what they think happens to air pollution, does it just float off into space? Explain that air pollution stays in the earth's atmosphere and has created an insulating blanket around the planet.
- Explain that the un-ventilated bottles represent the earth now that the pollution in the atmosphere is insulating the earth by trapping the heat from the sun.

- Tell the students to work as a team to predict what will happen to their bottle under the heat lamp, record this in their notebook.
- Ask them to work as a team to predict what will happen to the earth if heat cannot escape, record this in their notebook.
- While waiting for the experiment to happen, hold a discussion on the affects of pollution on the environment. Talk about global warming, air and water pollution and how cars are a major contributing factor and that the CO₂ they emit is a major heat trapping gas. Ask them how it feels to be walking where there are a lot of speeding cars.

Instruction/Modeling:

- Instruct the class that we will be conducting an experiment in which we simulate the greenhouse effect. Ask if anyone can explain the greenhouse effect.
- Instruct the class to work as teams of scientists, that there are plenty of jobs, that they should take turns with responsibilities. They should first decide who will perform the first task of putting the dirt in the bottle. Explain that science can be messy but that we will do our best to contain the mess.
- Model stuffing the dirt into the narrow mouth of the bottle, keeping the bottle over the bucket so that the spilled dirt is caught. Instruct the class to get as much dirt into the bottle as possible, about half a cup is good.
- Next, model pouring the water into the narrow mouth of the bottle, making a spout by squeezing the plastic container. Have another member of the team add the water.
- Have a third team member place the tin foil tightly over the mouth of the bottle.
- Explain that science can also be dangerous and we are trusting them to use the knives as tools. Model cutting holes near the top of the bottle (three crescent shaped holes about two inches long will work well). ASK if everybody knows how to use a utility knife. Distribute knives only after all students have agreed to be careful with the knives, giving them to every other team. Explain that every other group will be ventilating their bottles, we will be comparing them to the un-vented bottles. Make sure they understand that only half of the stations are to make holes in their bottle.
- Have all teams place their bottles outside in the sun.

- While waiting for the experiment to happen, hold a discussion on the affects of pollution on the environment. Talk about global warming, air and water pollution and how cars are a major contributing factor and that the Co2 they emit is a major heat trapping gas. Ask them how it feels to be walking where there are a lot of speeding cars.
- Returning to the experiment ask the students to observe the difference between their bottle and their neighboring teams bottle. Record the difference in their notebooks.

Assessment:

- Did they record the difference in condensation between the two bottles? Were they able to make predictions which related to the experiment and discussion?

Closing:

- Ask the class to name some places that have changed in their life times (fields that are now parking lots, wider roads, more traffic, fewer trees).
- Ask what this means to them?
- Ask how they might live differently than recent generations in order to prevent this kind of change.

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