

Name: _____

Date: _____

Environmental Science

Global Warming – Greenhouse Effect Lab

Introduction

Global climate change is one of the most contentious scientific and political issues of our time. Despite the widespread discussion of climate change issues in the news and in scientific journals, or very possibly because of it, misconceptions and outright untruths abound.

Burning fossil fuels that release carbon dioxide is the primary cause of global warming and climate change. The resulting greenhouse effect is a physical process that has been well known by scientists for over a century. For example, in 1896, the Swedish scientist Svante Arrhenius calculated that doubling the CO₂ concentrations in the Earth's atmosphere would raise average global temperature by 5-6°C. The greenhouse effect also operates on very small scales, so that it can be demonstrated using common laboratory equipment.

In this activity, we will simulate the greenhouse effect by generating carbon dioxide in a small container. We will then heat the container with a lamp and compare it to a control to determine if there is any difference in temperature between the two.

Prediction

Do you think we will detect a temperature difference between the control container and the CO₂ -filled container? Why or why not?

Equipment

light bulb, 100W
light socket & cord
PC with Vernier Logger Pro
ring stand
scoopula or spoon

small beaker, plastic
stirring rod
temperature probe
terrarium or aquarium
utility clamp

Materials

baking soda
rubber mulch
vinegar

Procedure – Trial 1

1. Apply a layer of rubber mulch to the terrarium so that it completely covers the bottom.
2. Set up the ring stand and utility clamp so that it can point the light socket at the terrarium without touching or melting it.
3. Hang the temperature probe over the side of the terrarium so that it is just above the mulch but not touching it. Make sure the PC is on, the probe is securely connected to it, and Logger Pro is running.
4. Record the starting temperature in your Data Table.
5. Plug in the lamp to turn it on and begin recording data in Logger Pro.
6. Let the PC collect temperature data for at least 10 minutes.
7. Unplug the lamp and stop recording data.
8. Determine the maximum temperature and subtract the starting temperature to calculate the temperature difference. Record both in your Data Table.

Procedure – Trial 2

1. Air out the terrarium so that no warm air remains.
2. Add 20 mL of baking soda to the plastic beaker and place it in the center of the terrarium.
3. Record the starting temperature in your Data Table.
4. Add 100 mL of vinegar to the beaker and stir with the stirring rod. Make sure you do not disturb the terrarium during the experiment!
5. Plug in the lamp to turn it on and begin recording data in Logger Pro.
6. While gently stirring the vinegar and baking soda mixture, let the PC collect temperature data for at least 10 minutes.
7. Unplug the lamp and stop recording data.
8. Determine the maximum temperature and subtract the starting temperature to calculate the temperature difference. Record both in your Data Table.

Clean Up & Disposal

1. Dispose of the vinegar and baking soda mixture down the drain and rinse the beaker with water.
2. Air out the terrarium so that no carbon dioxide or warm air remains.

Data Table

Trial	Starting Temp. (°C)	Max Temp. (°C)	Temp. Difference (°C)
Control container			
CO₂ container			

Questions

1. How did the temperature curve in the control container compare to the curve in the CO₂-filled container? Were they similar or different? How?
2. Why do you think we were able to do this experiment without a lid on the container?
3. Water vapor (steam) is another significant greenhouse gas. Describe how you could specifically modify this experiment to test its effects.
4. How could we change the substrate (bottom layer) to increase the greenhouse effect? How could we change it to decrease the greenhouse effect?
5. Do you think this simulation accurately emulates the effects of the build-up of carbon dioxide in our atmosphere? Explain why or why not.