

Name: _____ Period: ____ Date: _____

Environmental Science

#7-3: Greenhouse Effect Lab

Introduction

Global climate change is the most serious environmental issue of our time, and as a result, it's also one of the most contentious political issues. Despite the widespread agreement among climate scientists that our carbon emissions are increasing average global temperatures and forcing climate change, misconceptions and outright untruths abound on social media and in the news.

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 concentration in the Earth's atmosphere would raise the average global temperature by 5-6°C. The greenhouse effect also operates on very small scales, so it can be demonstrated using common laboratory equipment.

In this activity, we will simulate the greenhouse effect by filling two plastic bottles halfway with water. We'll add Alka-Seltzer antacid tablets to the water in one bottle to generate carbon dioxide gas; the other bottle will serve as a control. We will then heat both containers with a lamp and compare them 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 greenhouse container? Why or why not?

Equipment

incandescent light bulb
light socket & cord
Vernier LabQuest
ring stand

large plastic bottles with lids
temperature probes, 2
utility clamp

Materials

Alka-Seltzer, 2

Procedure

1. Set up the ring stand and utility clamp so that it can point the light bulb at the middle of the plastic bottles.
2. Attach the light bulb to the utility clamp.
3. Insert each temperature probe all the way into each lid.
4. Connect each temperature probe to the LabQuest.
5. Turn the LabQuest on and set it to record for 1800 seconds (the default setting is 180 seconds).
6. Fill both bottles halfway with water and arrange them so that they're about 3" away from the lamp.
7. Add two Alka-Seltzer tablets to one of the bottles.
8. Quickly put the lids on both bottles and make sure they're securely attached.
9. Once the tablets have fully dissolved, plug in the lamp and begin recording data on the LabQuest by pressing the triangle button.
10. Let the LabQuest collect temperature data for 30 minutes.
11. Unplug the lamp and stop recording data.

12. Dump the water from the bottles into the waste buckets at the front lab station.

Data

Trial	Minimum Temp. (°C)	Maximum Temp. (°C)	Temp. Difference (°C)
Control container			
Greenhouse container			

Questions

1. How did the temperature change in the control container compare to the temperature change in the greenhouse container? Were they similar or different? How?
2. Do you think this experiment accurately simulates the effects of the build-up of carbon dioxide in our atmosphere? Explain why or why not.
3. Water vapor in the air is another significant greenhouse gas. Describe how you could specifically modify this experiment to test the effects of water vapor instead of carbon dioxide.
4. How could we change this experiment to *increase* the greenhouse effect? Why do you think this change would work?
5. How could we change this experiment to *decrease* the greenhouse effect? Why do you think this change would work?
6. Besides global warming, another problem caused by humanity's carbon emissions is ocean acidification, where the water in the ocean becomes more acidic as it absorbs carbon dioxide from the air. Use a strip of pH paper to test the pH of both the greenhouse container water and the control container water. What difference exists between their pH, if any? What do you think this could mean for sea creatures that live in the world's oceans?