POLAR TREC
Learning Resources

Details

Completion Time: Less than a week

Permission: Download, Share, and Remix

Can Carbon Dioxide Really Act Like A Greenhouse?

Overview

Textbooks say that carbon dioxide is a greenhouse gas and can make earth's climate hotter. Try this lab to see if carbon dioxide gas can really act like a greenhouse.

Objectives

Students should be able to make a hypothesis, perform an experiment, analyze data and write a conclusion based on the evidence from their experiment.

Lesson Preparation

The teacher should try this lab in advance before trying it with students. Some things to consider:

1. Make sure that the water is at room temperature.
2. Make sure the light source is shining equally on both 2-liter bottles.
3. We used chairs to clip the clamp light on. You may have to experiment to see what works best in your classroom.
4. We used wooden test tube racks to hold our thermometers in place. Again, you will need to experiment in advance to see what works best in your classroom.

This lesson works well if the students have prior knowledge of greenhouse gases and the greenhouse effect. The day before the experiment, students should complete the introduction and write a hypothesis to the question: Can carbon dioxide really act like a greenhouse and make the climate warmer?

The teacher should do the pre lab set up before the day of the lab.

Pre Lab Set Up

1. Carefully cut off the tops of the empty two-liter bottles so they are about eight inches in height. Punch a

Materials

- Student Lab Report Handout for each student
- Lab materials for each group:
- Two 2-liter bottles
- Ruler
- Two thermometers
- One 100 watt incandescent light bulb
- One clamp light
- A clock or watch
- Four cups of dark, dry soil
- Rubber or flexible plastic tubing (like the aquarium tubing for an air pump)
- One glass flask with a 1-hole rubber stopper
- Three alka-seltzer tablets
- Water at room temperature
- One stand for the thermometer (like a wooden test tube rack)

small hole in each bottle about 5 inches up from the bottom (although you may need to adjust this hole location slightly depending on what you use to hold the thermometers in place).
2. Label one of the bottles "Earth with Air". Label the other bottle "Earth with Extra CO2".
3. Place about 2 inches of dry, dark soil in the bottom of each plastic bottle. Insert the thermometer through the holes in the bottles so that the end of each thermometer is in the middle of the air space.
4. Place the light about 8 to 10 inches from the top of the bottles so that the light will shine equally on both bottles.
5. Connect the tubing to the hole in the rubber stopper. Place the other side of the tubing (without the stopper) in the bottle labeled "Earth with Extra CO2".
6. Fill the glass flask halfway with water. The water should be at room temperature.

Procedure
1. Divide the students into groups. Groups of 4 work well.
2. Make sure each student has a handout.
3. Pre-Lab Checklist. After each group has their materials, have them check to see that:
a. the lamp is placed 8 to 10 inches from the 2-liter bottles and that the light is an equal distance from each bottle.
b. The lamp is turned off.
c. The thermometer end is in the middle of the air space in the bottle.
d. One end of the tube is two inches from the bottom of the bottle labeled "Earth with Extra CO2" and the other end of the tube is in the hole of the rubber stopper.
4. Students should place one alka-seltzer tablet in the flask and cover it with the stopper. Wait 90 seconds. Then, students repeat this step with the second and third tablet making sure to wait 90 seconds each time.
5. Students remove the tube from the 2-liter bottle labeled "Earth with Extra CO2" so no more carbon dioxide can enter the container.
6. Students turn on the light. Students should observe and record the temperature of the gases in each bottle every minute for ten minutes and record them in the student handout.
7. Students discuss their results with their group and complete the rest of the lab report. They can then share their group's results with the class.

Extension
Students can graph their results.

Assessment
The teacher can use the student lab report to assess student understanding.

Credits
This lesson was adapted from the Connecticut Department of Transportation's lesson entitled "Can Gases Act Like A Greenhouse?" which can be downloaded at www.planetconnecticut.org/teachersadministrators/pdfs/lesson1.pdf

Learning Resources

National Science Education Standards (NSES):

Content Standards, Grades 5-8

Content Standard A: Science As Inquiry
a. Abilities necessary to do scientific inquiry
b. Understandings about scientific inquiry

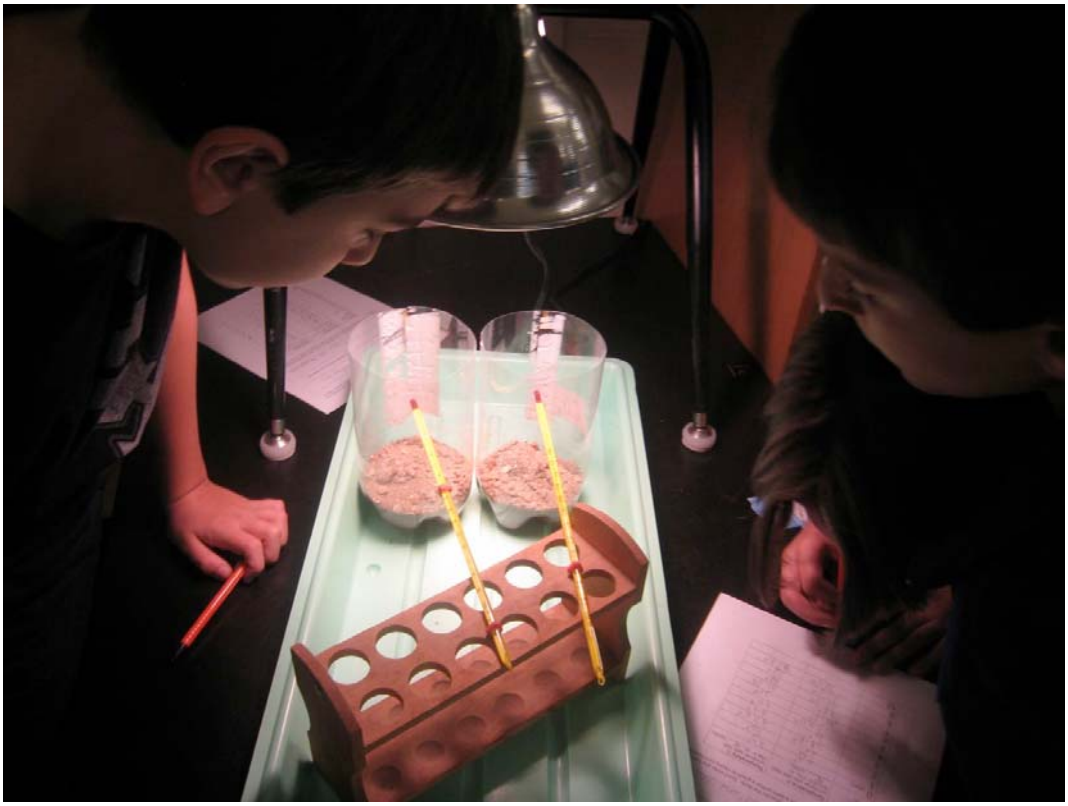
Content Standard B: Physical Science
c. Transfer of energy

Content Standard G: History and Nature of Science
b. Nature of science

Georgia Performance Standards

S6CS5. Students will use the ideas of system, model, change, and scale in exploring scientific and technological matters.

S6CS9. Students will investigate the features of the process of scientific inquiry.



Greenhouse Gas Experiment Report

Name: _____ _____Date: _____ Class:_____

Title: Write a descriptive, interesting title.

Introduction: The purpose of the introduction is to give background information on the lab activity. Write an explanation of what greenhouse gases are (use your notes to help!).

Purpose: Write a question that this experiment will help you answer.

Can carbon dioxide gas act like a greenhouse and trap heat?

Hypothesis: Write an educated guess to your question.

Materials: List all the materials that are needed to perform this experiment.

Procedures: Draw and label a picture of your set-up.

Independent Variable (also called the experimental variable): The independent variable is the one thing that you are changing. To help find it, you should look for the one different thing between your control setup and your experiment setup.

The independent variable in this experiment is:

Dependent Variable: The dependent variable is the effect that you are measuring.

The dependent variable in this experiment is:

Results: Describe what happened. Only describe the facts. Don't write any opinions in this section. If you have data, organize it into a table and/or a graph to clearly communicate your results.

Time in _____ (units)	**Temperature** in container with AIR AND ADDED CO_2 in _____ (units)	**Temperature** in container with AIR ONLY in _____ (units)
0 (start)		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Conclusion: This is by far the most important section of the lab report and should receive the most work.

1. What is a good answer to your question?

2. What evidence do you have that supports your answer?

3. Were there any errors or mistakes in your experiment that could have messed up the results?

4. What changes would you make to your experiment?

5. Why is your experiment important? Explain what you have learned, what you would hope to learn in future experiments.