

23A – GREENHOUSE GASES

INQUIRY

What are the greenhouse gases? How do they affect the temperature of our atmosphere?

MATERIALS

- Device with SPARKvue software
- Temperature sensor
- Beaker, 250-mL
- Erlenmeyer flasks, 250-mL (3)
- One-hole rubber stoppers to fit flasks (3)
- Vinegar
- Baking soda
- Sponge
- Lamp with 60-W incandescent bulb
- Plastic teaspoon



BACKGROUND

Common greenhouse gases include carbon dioxide, water vapor, methane, and nitrous oxide. While they make up less than 1% of our dry atmosphere, greenhouse gases play a vital role in climate and weather patterns. As sunlight travels to the earth, it easily penetrates these gases, but the infrared radiation being reflected back from the earth gets trapped by these gases. The reflected energy that hits the greenhouse gases causes them to vibrate and heat up. This increases the temperature of the atmosphere. In this activity, you will compare and contrast the ability of two different greenhouse gases to absorb infrared radiation compared to dry air.

SAFETY

Follow these important safety precautions in addition to your regular classroom procedures:

- Wear safety goggles at all times.

PROCEDURE

1. Open SPARKvue.
2. Open the 23A Greenhouse Gases lab file in SPARKvue.
3. Use the Bluetooth icon to connect the Temperature sensor.
4. Label the 3 flasks as dry air, saturated air (water vapor), and carbon dioxide.
5. Prepare each flask:
 - Seal the flask labeled "dry air" with a rubber stopper.
 - Saturate the sponge with water and place it in the flask labeled "saturated air." Seal with a stopper.
 - Collect about 50 mL of vinegar in a beaker. Set it aside with the flask labeled "carbon dioxide".

PROCEDURE

6. Place the "dry air" flask 6-8 inches away from the lamp bulb. Make sure this distance remains the same for each flask. Keep other flasks away from the light.
7. Insert the temperature sensor into the stopper hole.
8. Turn the lamp on and start collecting data. Monitor data collection. After 15 minutes, turn the lamp off and continue recording temperature for another 5 minutes. Data collection will stop automatically after 20 minutes.
9. Record the starting and maximum temperatures in Table 1 on your answer sheet. Then select the data in the last 5 minutes of the run where temperature begins to decrease. Determine the rate of temperature decrease in $^{\circ}\text{C}$ per second. Enter the rate in Table 1.
10. Remove the sponge from the flask labeled "saturated air". Repeat steps 6-9 with the "saturated air" flask.
11. Add 1/2 spoonful of baking soda to the beaker with vinegar. Wait for the reaction to finish without disturbing the beaker. The reaction is complete when the bubbling stops.
12. When the reaction stops, an invisible layer of CO_2 gas is floating above the liquid. Carefully pour the CO_2 created into the flask labeled "carbon dioxide." Do not pour any liquid into the flask. Seal the flask with a stopper.
13. Pour the beaker contents down the drain. Collect another 50 mL of vinegar in the beaker and add a half spoonful of baking soda. Repeat the reaction and carbon dioxide collection process two more times for a total of three carbon dioxide additions to the flask.
14. Repeat steps 6-9 with the flask labeled "carbon dioxide."
15. Make sure all runs are visible in SPARKvue and scale the graph. Sketch your results in Graph 1 on your answer sheet. Include numbers at an appropriate range on the x- and y-axis, and fill out the legend.

ANALYSIS

Complete the analysis on your answer sheet.

QUESTIONS

Answer the questions on your answer sheet.