

Greenhouse Gases Lab

Objective:

Explore the contribution of atmospheric gases to the greenhouse effect using three different gases.

Materials:

- (6) 20 oz clear plastic bottles with caps
- methane
- white vinegar
- baking soda
- (6) sponges
- (6) Celsius thermometers
- tool to make a hole in the caps for thermometers
- (4) desk lamps
- (4) 60 watt incandescent bulbs
- (4) beakers (150-200 mL)
- scoopula
- spreadsheet
- putty/clay



SAFETY

Students should wear safety goggles, aprons, and gloves. Methane is extremely flammable. Special care should be taken to keep the methane gas away from any source of flame.

Carbon Dioxide Bottle Setup:

1. To make carbon dioxide, pour 30 mL of vinegar into a beaker.
2. Add 0.5 teaspoons of baking soda. When the fizzing has stopped, carefully pour the freshly made CO₂ into a bottle.
3. Do not pour any of the liquid out of the beaker. Instead, tilt the beaker to pour only the carbon dioxide gas into the bottle. Carbon dioxide is heavier than air and will pour normally even though you cannot see the gas as it transfers.
4. Repeat this procedure two more times to make sure that you have collected enough carbon dioxide. Then tighten the cap on the bottle, insert the thermometer, and seal the hole with putty.

Methane Bottle Setup:

1. To fill a bottle with methane, invert the bottle over a gas jet in the lab and allow natural gas to flow into the bottle for ten seconds. Natural gas is less dense than air, so add the bottle cap, thermometer, and putty while the bottle is held upside down.
2. Use caution to keep the methane away from any source of flame, as it is extremely flammable.

Water Vapor Bottle Setup:

1. To fill a bottle with water vapor, place a very wet sponge, at least three centimeters in diameter, at the bottom of the bottle.
2. Tighten the cap, insert the thermometer, and seal the hole with putty.

Air Bottle Setup:

1. The control bottle already has air inside. Insert a thermometer into that bottle, and seal it as well.

Procedure:

1. After the bottles have been prepared, record the initial temperature for the gas in each bottle. Your initial temperature will simply be room temperature and will likely be between 20 and 25°C.
2. Place the bottles 30 centimeters away from the incandescent lights, one on each side. It is important that all of the bottles are the same distance from the light.
3. Heating the bottled gases with the incandescent lights mimics the heating of the earth's atmosphere by the sun. Use the data table to record temperatures in each bottle every minute over a period of 25 minutes.
4. Next, turn off the incandescent lights and monitor the temperatures for an additional 10 minutes. This mimics the setting of the sun.
5. When you have finished collecting data, enter it into your spreadsheet.

Questions:

1. What trends do you notice in the data you collected?

2. How do the trends for the four different gases differ from each other?