

Bringing the Greenhouse Effect Down to Earth

Purpose

To compare the amount of Carbon Dioxide (CO₂) found in four different sources of gases.

Materials

For each team of two to four students:

- 5 vials or test tubes
- A graduated cylinder
- A funnel
- A straw
- A marble-size piece of modeling clay
- 4 different colored balloons
- 4 twist-ties
- A narrow-necked bottle (the neck should be narrow enough for a balloon to fit over it)
- A dropping bottle of bromthymol blue indicator solution
- A dropping bottle of dilute household ammonia (1 part ammonia to 50 parts distilled water)
- 100 mL vinegar
- 5 mL baking soda
- Safety goggles for wear at all times

Lab Procedure

1. Add 15 mL of water and 10 drops of bromthymol blue indicator solution to each vial or test tube. Label the vials A, B, C, D, and Control.
2. Fill each balloon until it has a 7.5 cm diameter.
 - Sample A (Ambient Air) – Use a tire pump to inflate the balloon to the required diameter. Twist the neck of the balloon and fasten it shut with a twist tie. The tie should be at least 1 cm from the opening of the balloon. Record the color of the balloon used for this sample.
 - Sample B (Human Exhalation) - Have one team member blow up a balloon to the required diameter. Twist and tie the balloon, and record the balloon color.
 - Sample C (Automobile Exhaust) - Your teacher will supply you with this balloon. Record the color.
 - Sample D (Nearly pure CO₂) - Put 100 mL of vinegar into the narrow-necked bottle. Using a funnel, add 5 mL of baking soda. Let the mixture bubble for 3 seconds to drive the air out, and then slip the balloon over the neck of the bottle. Inflate the balloon to the proper diameter. Note that it may be easier to first over-inflate the balloon and then let a little gas escape. Twist and tie the balloon, and record its color.
3. Soften the clay and wrap it around one end of the straw to make a small airtight collar that will fit into the neck of a balloon. The collar should look like a cone with the straw in its middle, and it should be large enough to plug the neck of the balloon.
4. Pick up Balloon A. Keeping the tie on, slip the balloon's neck over the clay collar and hold

it against the collar to make an airtight seal. Place the other end of the straw into the vial of water and bromthymol blue labeled A. Have another partner remove the tie and slowly untwist the balloon. Keeping the neck of the balloon pinched to control the flow of gas, gently squeeze the balloon so the gas slowly bubbles through the solution.

5. Repeat the same procedure with the other balloons and their respective vials. In some cases, the bromthymol blue solution will change color – from blue to yellow – indicating the presence of carbonic acid formed from CO_2 .
6. You will now analyze each of the samples by titrating them with drops of dilute ammonia. Ammonia neutralizes the carbonic acid. The bromthymol blue returns to a blue color when all the acid has reacted. Add drops of ammonia to each of the samples that turned yellow. Be sure to carefully count the number of drops needed until each sample is about the same color as the control. Record the results.