

Name _____

Date _____

What about carbon dioxide?

Background: In this lab activity, you will first test different types of mixed gases to find out the relative amounts of carbon dioxide in each gas mix. You will use BTB (bromthymol blue), which is a chemical indicator that changes color in the presence of carbon dioxide, but remains blue when there is no CO₂. You will test three different gases: exhaled breath, car exhaust, and the gas that is given off by baking soda and vinegar.

Which gas mix do you think has the highest concentration of carbon dioxide?

In the second part of the activity, you will observe the differences in temperature between a flask with regular air and one with extra carbon dioxide. Which flask do you think will become warmer faster?

Part 1: Presence of carbon dioxide**Materials, Activity 1:**

Per group:

- | | |
|---------------------------|------------------------------|
| -five test tubes | -vinegar |
| -test tube rack | -foil square (1"x1") |
| -BTB solution | -test tube stopper with tube |
| -graduated cylinder | -ammonia |
| -4 cotton balls | -1 mL pipette |
| -balloon with car exhaust | -straws |
| -baking soda | |

Procedure, Activity 1:

1. Label 4 test tubes, A through D. A will be your control. A fifth test tube will not be marked.
2. Place the test tubes in a test tube rack.
3. Fill test tubes A through D about 1/3 of the way with the BTB solution. Make sure they are all filled to the same level.
4. Test tube B:
 - a. Fill the unmarked test tube about 1/4 of the way with vinegar.
 - b. Using the foil square, make a small foil cone for the baking soda. Fill the cone about halfway with baking soda. The cone needs to be small enough to fit inside of the test tube.
 - c. Slide the cone inside the test tube with the vinegar. Cap the tube with the stopper that has the tubing attached.
 - d. Place the free end of the tubing into test tube B, making sure the end of the tube reaches the bottom of the tube.
 - e. Place a cotton ball into the neck of the tube with the BTB.
 - f. Mix the vinegar and baking soda by gently swirling the tube; don't shake the tube. Gas bubbles will begin bubbling into the BTB solution. Keep bubbling for 20 seconds. Note your observations.

5. Test tube C:
 - a. Place a straw in the test tube. Cover the opening with a cotton ball.
 - b. GENTLY blow into the straw for 20 seconds. Write down your observations.
6. Test tube D:
 - a. Your teacher will give you a balloon filled with car exhaust. Carefully untie the neck of the balloon, making sure the gas doesn't escape.
 - b. Insert a straw into the neck of the balloon (DON'T release the neck of the balloon yet!). Insert the other end of the straw into tube D, and stopper the tube with a cotton ball. You can practice this step with another balloon if you need to.
 - c. Have one team member pinch the side of the balloon to keep it flush with the straw. Gently release the air from the balloon for 20 seconds, and write down your observations.
7. After you have finished your observations, you will titrate the solutions back to their original color (match with Test Tube A), noting the amount of ammonia it takes for each test tube. Add 0.01 mL of ammonia and swirl after each addition.

Test Tube	Original Color	New Color	Amount of ammonia to reach original color
A			
B			
C			
D			

Part 2: Temperature and Carbon Dioxide

Materials, Activity 2:

Per group:

- 2 Erlenmeyer flasks
- graduated cylinder
- 2 stoppers with thermometers
- light source (lamp or sunlight)
- 200 ml of water
- 200 ml of soda
- watch
- optional: microwave
- parafilm

Procedure, Activity 2:

1. Obtain two Erlenmeyer flasks.
2. Pour 200 ml of water into one, and 200ml of soda into the other.
3. Place both flasks in a microwave for 15-20 seconds, just to make sure they are at the same starting temperature. If your liquids were left out overnight, you can skip this step.
4. Stopper each flask. The stopper should have a thermometer in it. Make sure that each thermometer is at the same location in the stopper, so that neither one is further in the flask than the other. Seal the edges of the stopper with parafilm.
5. Place each flask in a light source, making sure to place both flasks the same distance from the light. You can also place the flasks in sunlight.

6. Observe the flasks for 10-15 minutes, writing down the temperature every 5 minutes.

Time	Temperature of water flask	Temperature of soda flask

Discussion questions:

1. Which gases caused BTB to turn yellow?
2. Which test tube (A,B,C,D) turned the most yellow? Why do you think this happened?
3. Which test tube required the most ammonia to go back to blue?
4. Based on this activity, which gases contain carbon dioxide? Which gas contains the most carbon dioxide?
5. Are there any problems with this experiment? Suggest ways in which to improve the experiment.
6. In the second activity, which flask became warmer? Why do you think this happened?
7. Explain another lab experiment that you could do to test the idea that more carbon dioxide causes higher temperatures.
8. Based on these activities, what can you conclude about global warming?