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 (CO_2) in each gas mix. You will use BTB (bromothymol blue), a chemical indicator that changes color when CO_2 is present but remains blue when there is no CO_2. You will test three different gases: exhaled breath, car exhaust, and the gas that is given off when baking soda and vinegar are combined.

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?

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Part 1: Presence of carbon dioxide

Materials, Activity 1:

Per group:

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

Think it through! Before beginning, read through the procedure for Activity 1. Then draw a picture of what your final lab set up will look like in the box below. Be sure to label the test tubes and what's in them.

Procedure, Activity 1:

1. Label 4 test tubes, A through D. A will be your control. Label a fifth test tube with a V.
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 test tube V 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 test tube V. 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 tubing reaches the bottom of the test tube.
    e. Place a cotton ball into the neck of test tube B.
    f. Mix the vinegar and baking soda by gently swirling test tube V; don't shake the tube. Gas bubbles will begin bubbling into the BTB solution (in test tube B). Observe the bubbling for 20 seconds and note your observations.
5. Test tube C:
    a. Place a straw into test tube C. 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 test tube D, and stopper the test tube with a cotton ball. You can practice this step first with another balloon.
    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 (matching 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 needed to reach original color (mL)
A			
B			
C			
D			

Part 2: Temperature and Carbon Dioxide

Materials, Activity 2:
Per group:

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

Think it through! Before beginning, read through the procedure for Activity 2. Then draw a picture of what your lab set up will look like in the box below.

Procedure, Activity 2:

1. Obtain two Erhlenmeyer flasks.
2. Pour 200 ml of water into one and 200ml of soda into the other.
3. If your liquids were left out overnight, skip this step. Otherwise, to make sure they are at the same starting temperature, place both flasks in a microwave for 15-20 seconds.
4. Stopper each flask. The stopper should have a thermometer in it. Make sure that each thermometer is equally deep 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 the BTB solution 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 the experiment could be improved.
6. In the second activity, which flask became warmer? Why do you think this happened?
7. If you still felt uncertain that higher CO_2 levels increase the temperature, describe another lab experiment that you could do to test this hypothesis.
8. Based on these activities, what can you conclude about global warming?