

Investigation 5.A: Gases Released During Photosynthesis and Cellular Respiration

Question: How can you identify the gases released by plants and animals?

Safety Precautions

- NaOH(aq) is caustic and will burn skin. If contact occurs, inform your teacher immediately and wash your skin under cold running cold water for 10 min.
- When you blow into any solution, *do not inhale* at any time.

Materials

- 600 mL beaker
- NaHCO₃(s)
- *Cabomba* (or other aquatic plant)
- bright lamp (or grow light) and stopper
- test tube and stopper
- short stemmed funnel
- wooden splint
- matches
- 0.1 mol/L NaOH(aq) in dropping bottle
- 50 mL Erlenmeyer flask and stopper
- bromothymol blue
- straw

Procedure

Part 1: Gas Released by Plants

The first 5 steps must be completed the day before the remainder of the investigation is completed.

1. Fill a 600 mL beaker with aquarium water or tap water. Add 2 g of sodium hydrogen carbonate to the water.
2. Hold the small branches of *Cabomba* (or other aquatic plant) under water and clip off the ends of the stems so that air bubbles do not block the vessels.
3. Place a short-stemmed funnel over the branches.
4. Fill a test tube with water and cover the top while you invert it. Hold it under water and position it over the stem of the funnel as shown. Be sure there is no air in the test tube.
5. Place the apparatus in bright light and leave it until the next class period.
6. After about 24 h, carefully remove the test tube, keeping it inverted, put your thumb over the mouth of the test tube, and stopper it. Follow the directions below to test for the type of gas in the tube. Record your results on the following page.

Testing for Gases

Note: For safety purposes, your teacher may conduct some or all of these steps.

1. Wear goggles.
2. Keep the stoppered test tube containing a collected gas inverted and clamp it to a ring stand.
3. Ensure that there are no flammable materials, other than those with which you are working, in the room.
4. Light the wooden splint. Let it burn briefly then blow out the flame. The splint should still be glowing.
5. Gradually insert the glowing splint up into the inverted test tube. Observe the reaction.
 - If the gas is hydrogen, you will hear a loud pop when the splint reaches the gas.
 - If the gas is carbon dioxide, the splint will go out.
 - If the gas is oxygen, the splint will burn faster and you will see a flame.

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Observations: _____

Identity of gas: _____

Part 2: Gas Exhaled by Animals

1. Add about 35 mL of water to a 50 mL Erlenmeyer flask. Add a few drops of bromothymol blue to the water and swirl. (Place the flask on a piece of white paper to see the colour more clearly.)
2. Add sodium hydroxide one drop at a time and gently swirl the flask. Stop adding the sodium hydroxide when the water turns a deep greenish-blue colour.
3. Obtain a straw and blow gently into the flask. *Do not suck on the straw.* Continue to blow into the solution until you can no longer see any colour change.
4. Add a piece of *Cabomba* to the water and stopper the flask. Place it in a brightly lighted place. Leave it in place until you see a change. Record any changes over the next 24 h.

Analysis

1. What happened when you inserted the glowing splint into the test tube that had been collecting gas from the *Cabomba* plant? What is the identity of the gas?

2. Bromothymol blue is called a pH indicator because it changes colour with changes in pH (acidity) of a solution. It is a dark greenish-blue colour in a basic solution and a pale yellow colour in an acidic solution. What happened when you blew into the flask?

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HANDOUT		

3. Read the following points, then identify the gas in your exhaled breath.
 - Oxygen gas has very low solubility in water and does not react chemically with water.
 - Hydrogen gas is nearly insoluble in water and does not react with water.
 - Carbon dioxide is relatively soluble in water and reacts with water to produce carbonic acid.

Conclusion

4. Explain the source of the gas that you collected in the test tube over the *Cabomba* plant.

5. Explain the source of the gas that you exhaled.

6. Explain any changes in the appearance of the solution after Step 4 of Part 2.