Production of Carbon Dioxide

Carbon dioxide can be produced with common household chemicals. This experiment observes some of its easily observable properties.

Materials
- Sodium hydrogencarbonate (3g)
- Acetic acid (0.80 M)
- 125 mL Erlenmeyer flask
- Beral pipette
- Wood splints
- Matches and a candle

Substitutions
- baking soda
- vinegar
- small jar
- medicine dropper
- toothpicks

Procedure
1. Measure approximately 3 grams (1/2 tsp.) of sodium hydrogencarbonate and place it in the flask.

2. Using the pipette, add a few drops of acetic acid to the sodium hydrogencarbonate. Gas bubbles will be formed.

3. Light a wooden splint or toothpick from the candle.

4. Carefully tip the flask and insert the burning splint into the neck of the flask and observe the effect of the gas (carbon dioxide) upon the flame.

5. Using the candle, relight the splint and test the gas again.

Questions
1. Write the equation for the reaction occurring in the above experiment.
2. Describe the effect of carbon dioxide on the burning splint?
3. What property of carbon dioxide allowed us not to use a stopper or lid?
4. Since carbon dioxide is often used in fire extinguishers; describe how you could use this experiment to create your own extinguisher.
5. Other chemicals can react to produce carbon dioxide. Compare this reaction with the one used in Experiment 5 of this book.
Teacher's Notes
1. The equation for this reaction is:
   \[ \text{NaHCO}_3 (s) + \text{HC}_2\text{H}_3\text{O}_2 (aq) \rightarrow \text{NaC}_2\text{H}_3\text{O}_2 (aq) + \text{CO}_2 (g) + \text{H}_2\text{O}(l) \]
2. Carbon dioxide does not support combustion. Oxygen is the substance that is necessary for any burning to take place. The splint should be extinguished.
3. The density of carbon dioxide is 1.56 g/mL while that of air is 1.0 g/mL. Since the carbon dioxide is denser than air, it will remain below the air in the container.
4. For the extinguisher, use a plastic drink bottle. Drill a small hole in the screw top, and insert a drinking straw. Place a small amount of baking soda in the bottom of a plastic drink bottle. Add to the container a small container of vinegar. To initiate the extinguisher, tip the bottle to start the reaction, and the carbon dioxide will be formed.

Safety Precautions
1. Proper ventilation is required due to the odors of vinegar.
2. The reaction containers should be wrapped with tape. Pressure will increase if the containers are sealed.

Disposal
The solutions can be poured down the sink with subsequent flushing with water. Unreacted sodium hydrogencarbonate may be dissolved in water and poured down the sink. Solid residues may be placed in the trash can.