Carbon Dioxide

Overview:

During this lesson students will use vinegar and baking soda to produce carbon dioxide (CO_2), a gas released by volcanoes. Students will pour CO_2 into a trough to extinguish candles. CO_2 will displace oxygen because CO_2 is more dense than oxygen.

Objectives:

The student will:

- produce carbon dioxide by mixing vinegar and baking soda;
- extinguish candles using carbon dioxide;
- understand that volcanoes also create carbon dioxide;and
- understand that carbon dioxide is more dense than other gases (oxygen).

Materials:

- Baking soda
- White vinegar
- 1 liter beaker or pitcher
- Tea lights or birthday candles
- Matches
- Cardboard or tray
- Books of varying widths
- Clay (optional)
- Student Information Sheet: “Deadly Carbon Dioxide”
- Student Worksheet: “Carbon Dioxide”

Answers to Student Worksheet:

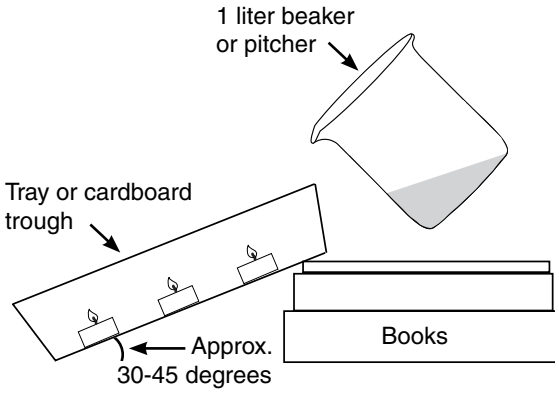
1. More Dense
2. True
3. True

Carbon Dioxide

Activity Procedure:

Note: Practice this activity prior to class demonstration to figure out the best angle for the tray, and how to gradually pour the vinegar using a gentle tipping action.

1. Explain that students will produce carbon dioxide, one of the gases created by volcanoes. Read the Student Information Sheet: "Deadly Carbon Dioxide" to the class.
2. Divide students into groups or pairs. Distribute materials. Each group will need a 1 liter beaker, 1/4 cup of baking soda, 1/4 cup of vinegar, 3 tea light candles, a tray or cardboard trough, some books, and a match to light the candles. (You may wish to light the students' candles rather than distributing matches.)
3. Distribute the Student Worksheet: "Carbon Dioxide" to each student. Ask students to follow the directions on the worksheet to complete their project. You may wish to demonstrate the procedure to students.



4. Circulate and assist.
5. After students have completed the project, discuss results. Ask students what occurred when they poured the carbon dioxide into the tray. They should respond that the candles went out.
6. Ask students if the candles burned out from the lower part of the tray to the top, or from the top part of the tray to the bottom. Explain that carbon dioxide is heavier than other gases. The carbon dioxide students created should have extinguished the top candle first, then flowed to the lower part of the tray, extinguishing the middle, then the lower candle. Explain that fire consumes oxygen as it burns. When students poured carbon dioxide into the tray, it displaced oxygen. Since the area around the flame no longer had any oxygen, the flame went out.
7. Explain that volcanoes create carbon dioxide that sometimes builds up in valleys or enclosed areas. If a human being or animal walks into such an area, they can die from lack of oxygen.
8. Ask students to complete their Student Worksheets: "Carbon Dioxide." Explain that both humans and candle flames require oxygen to survive. Carbon dioxide displaces the oxygen in a space and can cause people to suffocate.

Inquiry Extension: Ask students to brainstorm about methods that could be used to prevent a disaster like the one that occured at Lake Nyos, described on their Student Information Sheet. Discuss the pros and cons of these ideas and decide which ones are the most feasible. One method being used to release carbon dioxide still residing at the bottom of Lake Nyos and Lake Monoun (a nearby lake responsible for 37 deaths) is to release the gas in small quantities. The plan involves sinking five-inch pipes from floating platforms deep into the lake, then pumping the carbon dioxide saturated water up to the surface, releasing the gas slowly, rather than all at one time.

Deadly Carbon Dioxide

On August 26, 1986, more than 1,700 people were killed by carbon dioxide. The people had been living in a valley below Lake Nyos in Cameroon, Africa. The lake is located in the crater of an old volcano. Carbon dioxide released from magma deep inside Earth saturated the waters of the lake. The deadly carbon dioxide solution remained at the bottom of the lake because carbon dioxide saturated water is denser than non-saturated water.

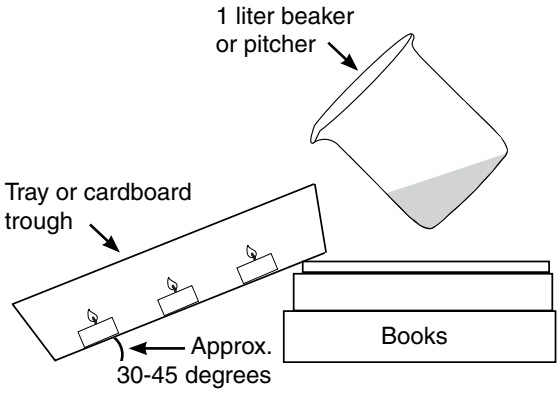
Many believe a landslide disrupted the lake and caused the carbon dioxide-rich water to rise to the surface. A cloud of carbon dioxide was released during the night. Because carbon dioxide is heavier than oxygen, the deadly gas traveled down into the valley near the lake, suffocating all of the villagers and livestock in the area.

Name:_____ **Student Worksheet**

Carbon Dioxide

Procedure:

1. Place three candles in a row in a tray or cardboard trough. Hold the base of each candle in place with clay. Light the candles, then create a slope by propping the end of the tray up on some books.
2. Pour baking soda into a beaker or pitcher, then pour vinegar on top. The fizzing substance has produced carbon dioxide.
3. While the substance in the beaker is still fizzy, tip the beaker gently over the high end of the tray. This will allow the invisible carbon dioxide gas to pour into the tray. Do not pour any liquid or fizz into the tray.
4. Observe what happens to the candles as the carbon dioxide reaches them.



Questions:

1. Circle the correct answer: Carbon dioxide is (more dense / less dense) than oxygen.

2. True or False: Volcanoes release carbon dioxide, a dense deadly gas.

3. True or False: Humans can suffocate in valleys containing carbon dioxide released from a volcano.

