Avogadro's Bubbly Adventure

from Celebrating Chemistry

Chemists Celebrate Earth Day

Small amounts of gases are soluble, or dissolve, in water. Two of these gases are oxygen and carbon dioxide. For example, carbon dioxide gas is what gives soft drinks their "fizz". And fish use oxygen dissolved in water for their body chemistry, much like humans do. When there is not enough oxygen dissolved in the water, fish can "suffocate".

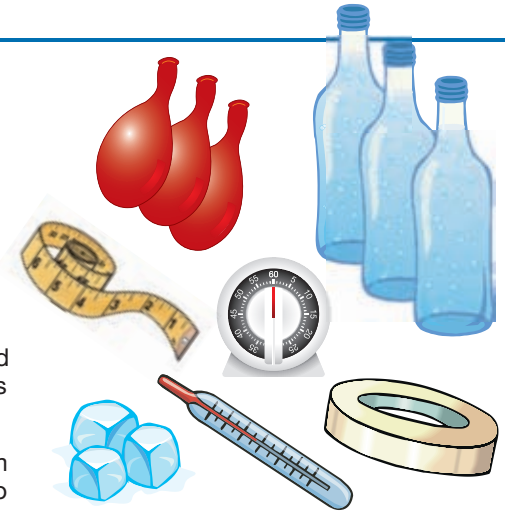
In this activity you will study the solubility of gas in water at different temperatures to see whether temperature changes this property.

Materials

- 3 small (20 oz. or less) unopened plastic bottles of carbonated water (if a soft drink will be used, sugarless and colorless will make less mess)
- 3 medium-sized balloons
- 3 containers to hold water, large enough for the plastic bottle to be mostly surrounded by water
- Masking tape
- Marking pen
- Thermometer with a scale from 0°C (32°F) to at least 50°C (122°F)
- Ice cubes
- Water at room temperature
- Hot tap water
- Clock or timer
- Flexible tape measure (metric)
- *Optional: graph paper*

SAFETY **Be sure to read and follow the Safety Tips on the last page of this activity.**

Procedure



1. Stretch each of the 3 balloons at least 10 times each. Your adult partner can also inflate each balloon the same amount several times.
2. Place one balloon over the cap of each bottle. Use your fingers to stretch the neck of the balloon, and be sure that the lip of the balloon is past the bottom of the cap.
3. Tape all the way around the bottom edge of the balloon on the bottle to make a tight seal.
4. Label the three containers with tape and the marking pen as follows: "ice water", "room temperature water", and "hot water".
5. Add one bottle with balloon to each labeled container.
6. Fill the "ice water", "room temperature water", and "hot water" containers with water of the labeled temperature. Make sure the bottle is submerged at least three-fourths of the way. The hot water should be at least 40°C (104°F).

Do not use boiling water and use caution when handling hot water.

7. Let the bottles sit in the water for 5 minutes. Gently swirl each bottle in its water bath several times during this period. This mixing ensures an equal temperature of liquid in the bottle.
8. At the end of the 5 minutes, measure and record the temperature of each water bath in the "What Did You Observe?" section.
9. For each bottle, carefully grasp the cap through the balloon and unscrew it just until the cap seal snaps. This action will release the gas while keeping the balloon tightly taped.
10. Grasp one bottle around the neck, invert 4 times, and return it to its water bath. Repeat with the other two bottles.
11. Record your observations about what happens to each balloon in the "What Did You Observe?" section.
12. Use the tape measure to determine the circumference (the distance around) of the balloon at its widest point. Record the measurement in centimeters in the "What Did You Observe?" section.
13. Carry the bottle/balloon systems to a sink and carefully remove the balloons from the bottles. Pour the contents of the balloons and bottles into the sink. Pour out the water baths as well. Thoroughly clean the work area and wash your hands.

Avogadro's Bubbly Adventure cont.

What Did You Observe?

1. On another paper, draw a picture of each balloon after you cracked the cap seal and inverted the bottle 4 times.
2. What happened to the amount of gas found in the balloon as the temperature increased?
3. What conclusion can you draw from this observation?

Optional: You can graph this data, placing temperature on the X-axis and circumference on the Y-axis. Work with your adult partner to figure out the proper range and increments for each axis, and then plot the data points.

	Water Temperature	Balloon Circumference
Ice water		
Room temperature		
Warm water		

Where's the Chemistry?

Soft drink bottles contain carbon dioxide under pressure. When you open the cap, carbon dioxide gas enters the balloon. The amount that remains in the soft drink depends on the temperature of the water in the soft drink—the amount of gas that is in the balloon shows how much gas has left the soft drink. This means that the more gas that is in the balloon, the less the gas found in the liquid at that temperature.

In our environment, dissolved gases are very important to animals that live in water. As water warms, such as on a hot day or in an area where hot water is released into a river or lake, the amount of oxygen that stays in water decreases—it is released due to the higher temperatures. Researchers who study global warming are concerned about this effect, too.

And closer to home, this is why you often see thermometers and bubbling aerators in home fish tanks—to monitor the temperature and make sure the water contains enough oxygen for the fish to stay healthy. Look at warm tap water when you pour it into a clear glass. You will be able to observe small bubbles as the dissolved gases leave the water.

The American Chemical Society develops materials for elementary school age children to spark their interest in science and teach developmentally appropriate chemistry concepts. The "Activities for Children" collection includes hands-on activities, articles, puzzles, and games on topics related to children's everyday experiences.

The collection can be used to supplement the science curriculum, celebrate National Chemistry Week, develop Chemists Celebrate Earth Day events, invite children to give science a try at a large event, or to explore just for fun at home.

Find more activities, articles, puzzles, and games at **www.acs.org/kids**.

Safety Tips

This activity is intended for elementary school children under the direct supervision of an adult. The American Chemical Society cannot be responsible for any accidents or injuries that may result from conducting the activities without proper supervision, from not specifically following directions, or from ignoring the cautions contained in the text.

Always:

- Work with an adult.
- Read and follow all directions for the activity.
- Read all warning labels on all materials being used.
- Wear eye protection.
- Follow safety warnings or precautions, such as wearing gloves or tying back long hair.
- Use all materials carefully, following the directions given.
- Be sure to clean up and dispose of materials properly when you are finished with an activity.
- Wash your hands well after every activity.

Never:

- ***Never*** eat or drink while conducting an experiment, and be careful to keep all of the materials used away from your mouth, nose, and eyes!
- ***Never*** experiment on your own!

For more detailed information on safety go to **www.acs.org/education** and click on "**Safety Guidelines**".

