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Activity: Ocean Acidification in a Jar

What happens when you open a bottle of a carbonated drink (soda, carbonated water, etc.)?

(Think of your answer before reading on…)

Usually, when you open a bottle of something carbonated, it makes a hissing sound, like air escaping. Then, bubbles appear in the drink, and start floating to the top. But what makes the sound, and where did the bubbles come from?

It turns out that gases like oxygen and carbon dioxide can actually be *dissolved* in water, just like solids (like sugar in tea) can. If you've ever had a pet fish, maybe you've seen the little air pump that sends air into the fish tank–some of the oxygen in the air bubbles dissolves in the water, and the water stays nice and oxygenated for the fish! In a carbonated drink, the gas is *carbon dioxide,* also called CO_2. Before you open the bottle there's actually more carbon dioxide in the water than the water can hold, and the drink is actually under pressure in the bottle (because the carbon dioxide wants to escape). Once you open the bottle, it's no longer under pressure (causing the hissing sound as the pressure is released), and carbon dioxide starts to leak out of the liquid (forming delicious bubbles). If you leave the drink out for long enough, all of the extra carbon dioxide has been released to the atmosphere, and the drink is "flat" (no more bubbles).

What does a bottle of soda have to do with the ocean, though?

Well, just like soda or the fish tank, the ocean has gases dissolved in it, including oxygen and carbon dioxide. Some of those gases can end up changing the chemical properties of the ocean water, and this can affect the things that live there. In this activity, you will investigate how gases can affect the chemical properties of water.

Carbon dioxide air pollution

There are many different sources of carbon dioxide in the atmosphere. A very common human-made source of carbon dioxide is the burning of fossil fuels (coal, oil, gasoline, natural gas) in power plants, cars, water heaters, etc.

In this activity, you will use alkaseltzer tablets to simulate the emission of carbon dioxide into the atmosphere.

Materials

- 1 large jar for holding your "ocean water"
- 1 small beaker for holding your carbon dioxide source
- 4 alka-seltzer tablets
- Water
- Bromothymol blue solution (to add to your ocean water)

Bromothymol blue is a special chemical that changes color when things get more or less acidic. In acid solutions, it turns yellow. In neutral solutions, it is a greenish mixture of blue and yellow. In non-acidic solutions (called "basic" solutions), bromothymol blue turns blue.

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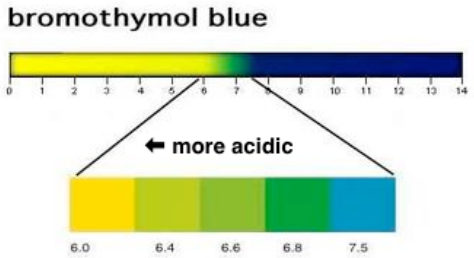

Figure 1. Bromothymol blue in an acidic solution (left), neutral solution (center-right), and basic solution (right).

Objectives

1) Determine the effect on the ocean of increased carbon dioxide in the atmosphere.
2) Explain what happens to carbon dioxide in your model system.

Procedure

Follow this procedure once, and document your observations, before investigating other questions on your own.

1) Pour about 1 inch of tap water into your large jar.
2) Add about several drops of bromothymol blue, and mix it with your stirrer. This is your model "ocean." What color is your "ocean" when you start? Estimate the pH from Figure 1.
3) Put the small beaker in the center of your ocean, representing land where CO_2 is being emitted. Fill the beaker half-way with water.
4) Add the alkaseltzer tablets to the water in the beaker, and loosely cover the large jar (with your ocean, land, and carbon dioxide source in it) with the lid. Do not tighten the lid.

What is the color of the "ocean water" with the bromothymol blue before releasing the CO_2?

Wait 15 minutes after adding the alkaseltzer to the beaker and record the color of the "ocean water' with the bromothymol blue after the release of CO_2?

What does the change in color represent?

Explain why the "ocean" experienced a change in its acidity.