Name: _____

Lesson 2
Color change

STUDENT ACTIVITY SHEET

Meet the scientist

Country: Republic of the Fiji Islands
Scientist: Sera Tuikabe

Fiji is a country of more than 300 islands surrounded by the sea. I am a marine chemist. I study the quality of the water and how it affects living things.

Victor taught you that carbon dioxide comes out of volcanoes. CO_2 is a concern for me, too. Cars, factories, and other human activities release a lot of CO_2 into the air. Oceans absorb the gas. That makes the water more acidic, which lowers its pH. These changes spell trouble for corals, starfish, crabs, clams, and other sea creatures. In more acidic water, sea animals grow more slowly. It's also harder for them to build strong shells.

Coral reefs are very important to our country. Tourists come from all over the world to dive here, and we rely on reefs to provide us with food. Many kinds of fish live in and around them.

Fiji's coral reefs are in relatively good condition compared to others in the world. We want to keep it that way. In the next century, some experts predict that acidic water, warmer than normal temperatures, and other factors could destroy our coral reefs.

One part of my research is to test seawater for acidity by using chemical reactions that cause color changes. In this activity, you will learn how to interpret these color changes to measure the pH of a liquid.

Activity

Make an acid and a base solution and then see how many different colors you can make by adding drops of both in a universal indicator solution.

You will need

- Goggles
- Universal indicator solution
- Citric acid
- Sodium carbonate
- Water
- pH color chart
- Small metric measuring cup
- About 15 flat toothpicks
- 2 droppers
- 2 clear plastic cups
- Spot plate

Procedure

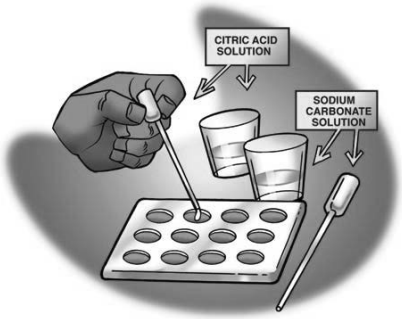
Make a citric acid solution

1. Use your small measuring cup to place 25 mL of water in the cup labeled *citric acid.*
2. Use a flat toothpick to add one "toothpick scoop" of citric acid to the water in the citric acid cup. Gently swirl until the citric acid dissolves.

Make a sodium carbonate solution

3. Use your small measuring cup to place 25 mL of water in the cup labeled *sodium carbonate.*
4. Use a clean, flat toothpick to add one "toothpick scoop" of sodium carbonate to the water in the sodium carbonate cup. Gently swirl until the sodium carbonate dissolves.

Make as many different colors as you can



5. Use a clean dropper to add 10 drops of water to each well of the spot plate.
6. Add 2 drops of universal indicator to each of the wells.
7. Do not add anything to the first well. Then add a single drop of sodium carbonate to the second well. Stir with a toothpick and compare the color of the solution to the color chart. Record this color in the chart below.
8. Add 2 or more drops of sodium carbonate to the third and fourth wells in this row and stir with a toothpick to make other colors. Record the number of drops of sodium carbonate used to make each color.
9. Use drops of citric acid to see how many different colors you can make in the second row. Be sure to record the number of drops used to make each color.
10. In the third row, experiment with drops of both citric acid and sodium carbonate solutions to make as many different colors as you can. Be sure to record the number of drops of each solution used to make each color.
11. Use your pH color chart to estimate the pH of each of the different-colored solutions.

Estimate the pH of your colorful solutions

Drops of sodium carbonate	Drops of citric acid	Color	Approximate pH
0	0	green	7
1	0		
	0		
	0		
0			
0			
0			
0			

Imagine that you add a drop of universal indicator solution to a small sample of water from a swimming pool and the solution turns orange. What could you add to the pool water to make the pH closer to neutral?

The big chemistry idea

Universal indicator is made of a combination of molecules called *pigments*, which give the indicator its green color. When an acid or base reacts with this indicator, the indicator changes to a new substance, which results in a color change. Acids and bases are like chemical opposites. You can make an acidic solution become more neutral by adding a base. You can make a basic solution become more neutral by adding an acid.

Real-world application

The world of medicine offers an example of using color changes in chemistry to help people. A small color-changing test strip called Clinistix can be used by people who have diabetes. People with diabetes need to keep close track of the amount of glucose (a type of sugar) in their blood stream.

For many years, people with diabetes had to draw their own blood to check glucose levels. Now they can do a quick and pain-free test by dipping the end of a Clinistix in a little bit of urine. The Clinistix changes color depending on the amount of glucose present. Because the amount of glucose in urine is related to the amount of glucose in blood, a person with diabetes can painlessly check his or her glucose level. Depending on the results from the Clinistix, a person will know if a change in diet or medication is needed to get his or her glucose level where it should be.

Each Clinistix testing strip contains two *enzymes*. An enzyme is a type of molecule that helps speed up chemical reactions. One of the enzymes causes a chemical reaction with glucose that produces a certain chemical. The second enzyme speeds up a reaction between this chemical and the pigment on the strip, causing the color change.

The intensity of the color produced is related to the amount of glucose present; the darker the color of the test strip, the more glucose is present in the sample.