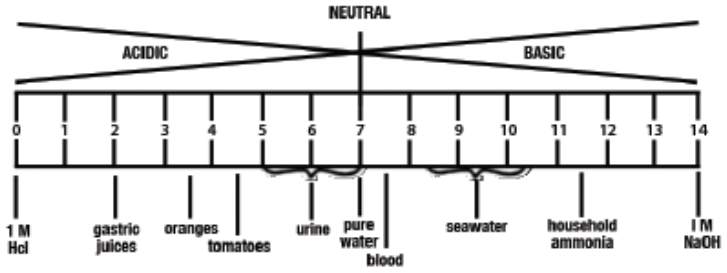
Name: _____ Period: ____ Date: _____

Lab Activity: Ocean Acidification & pH

Background:

pH is the measure of the acidity or alkalinity (basicity) of a solution. It is measured on a scale of 1.0 to 14.0. A pH of 1-6.9 indicates that a solution is acidic, with the lower values indicating a higher acidity. Vinegar and lemon juice are examples of substances with an acidic pH. A pH of 7 indicates that a solution is neutral. Water is an example of a solution with a neutral pH. A pH of 7.0-14 indicates that a solution is alkaline (basic), with the higher numbers indicating a higher alkalinity. Bleach and ammonia are two examples of solutions with a basic pH. Figure 1 shows the pH scale.

Figure 1: pH Scale



Source: http:www.epa.gov/volunteer/stream/vms54.html

Ocean acidification refers to the decrease in pH caused by the uptake of CO_2 into the ocean from the atmosphere. Oceans absorb carbon dioxide, and as more CO_2 dissolves in the oceans, the pH decreases, changing the chemistry of the water. As ocean waters become more acidic, marine life suffers. Corals are very sensitive to changes in pH, and when they die they become white (this is known as 'coral bleaching').

Objective:

In this experiment, you will explore pH changes in a variety of liquids (listed in materials list). On the scale (Figure 1), seawater is shown to be slightly basic, with a pH ranging from 8.5 to 10. In the following experiment, you will investigate what happens to pH levels when carbon dioxide (CO_2) mixes with seawater. Marine life needs a certain range of pH values to survive.

Hypothesis:

Make predictions of what will happen to the pH of each of the three types of water when carbon dioxide is added. Write out a statement for each water type. Do you expect them to react differently? (*3 points*)

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Name: _____ Period: ____ Date: _____

Materials:

- 3 test tubes
- Test tube rack
- pH indicator strips
- 1 dropper of pH indicator
- 3-50 mL beakers
- artificial seawater
- carbonated water
- distilled water
- 1 straw
- Marking pen

Procedure:

1. Working in a small group (3-4 students), label your test tubes with each of the 3 types of water: seawater, distilled water, and carbonated water. These will act as your **control samples**.

2. **Label** and then fill your beakers with **50mL of each type of water**.

3. Add **5-7 drops of the pH indicator** to the waters in the beakers. Once they've mixed, carefully pour half of the water from each beaker into the associated test tubes. Remember, the test tubes will act as your control samples. The beakers are your **experimental samples**.

4. In your data table, under "**Start Color (control)**", record the color of your control samples. These colors should be identical to the colors in the corresponding beakers.

5. Use the **pH color scale** to estimate the pH of each of the samples. Record these values under "**Start pH (color)**".

6. Using a **pH strip**, measure the pH of each of the liquids and record it under "**Start pH (paper)**".

7. Place a straw into the beaker of **seawater**, just below the surface. Exhaling ONLY (do not inhale), blow through the straw into the water. After blowing bubbles for 20-30 seconds, observe and record the color of the water under "**End Color**".

8. Use the **pH color scale** to estimate the pH of the corresponding sample. Record this value under "**End pH (color)**".

9. Using a **pH strip**, measure the pH of the same liquid and record it under "**End pH (pH paper)**".

10. Repeat steps 7-9 for **each** of the water samples.

Name: _____ Period: ____ Date: _____

Data: Record your observations and data in the table below.

Table 1. Changes in pH

Liquid	Start Color (control)	Start pH (color)	Start pH (pH paper)	End Color (after CO_2)	End pH (color)	End pH (pH paper)
Seawater						
Distilled Water						
Carbonated Water						

Discussion Questions:

1. Which sample had the highest pH before bubbling? The lowest pH before bubbling?

2. Did the measuring with pH paper give you approximately the same results as measuring pH with the color change? Explain.

3. Your breath contains carbon dioxide. After bubbling the samples with your breath, describe what happened in the samples compared to your controls.

4. Which sample had the highest pH after bubbling? Which had the lowest pH after bubbling?

5. What happened to the pH of the seawater after bubbling? Was there a big change? Why or why not?

6. CO_2 is released during the burning of fossil fuels. As humans use more fossil fuels, more CO_2 is released into the atmosphere. Oceans naturally absorb CO_2. What do you think will happen to the pH of oceans as CO_2 continues to be released into the atmosphere? Write a couple of sentences to explain your reasoning.