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# Ripple Effects: Investigating Ocean Acidification and Aquatic Ecosystems

## Experiment

### Acidification of Acid by CO<sub>2</sub>

- Go Direct® pH Sensor

## Workshop Presenter

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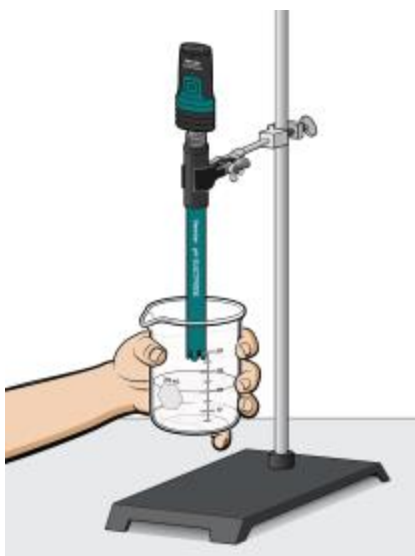
# Acidification of Water by CO<sub>2</sub>

As carbon dioxide gas, CO<sub>2</sub>, dissolves in water, the following reaction occurs:



Carbonic acid, H<sub>2</sub>CO<sub>3</sub>, is a weak acid that as it increases in concentration, can lower the pH of natural bodies of water. As water becomes more acidic this results in damage to phytoplankton, zooplankton, coral, and any organism that has calcium carbonate as part of its body.

The acidity of a solution can be expressed using the pH scale, which ranges from 0 to 14. Solutions with a pH above 7 are basic, solutions with pH below 7 are acidic, and a neutral solution has a pH of 7. In this experiment, you will study how the pH of water changes when CO<sub>2</sub> is dissolved in water.



*Figure 1*


## OBJECTIVES

- Use a pH Sensor to measure changes in pH.
- Study the effect of dissolved CO<sub>2</sub> on the pH of water.
- Learn why some bodies of water are more vulnerable to acidification than others.

## MATERIALS

Chromebook, computer, **or** mobile device  
Graphical Analysis app  
Go Direct pH  
250 mL beaker  
100 mL beaker (rinse beaker)  
125 mL Erlenmeyer flask  
10 mL graduated cylinder  
stopper with tubing  
buffer solution  
2 Alka-Seltzer tablets  
water  
ring stand  
utility clamp  
wash bottle with distilled water  
waste container  
water samples from natural bodies of water (lake, stream, ocean)  
goggles

## PROCEDURE

1. Obtain and wear goggles.
2. Before each use of the pH sensor, you need to rinse the tip of the sensor thoroughly with distilled water. To do this, hold the pH Sensor above a rinse beaker and use the wash bottle to thoroughly rinse the sensor tip. **Important:** Do not let the pH Sensor dry out. Keep it in a 250 mL beaker with about 100 mL of tap water when not in use. The tip of the sensor is made of glass—it is fragile. Handle with care!
3. Launch Graphical Analysis. Connect the Go Direct pH Sensor to your Chromebook, computer, or mobile device.
4. Place one Alka-Seltzer tablet in the Erlenmeyer flask.
5. Put 100 mL of fresh water into a clean 250 mL beaker.
6. Using a ring stand and utility clamp, secure the pH sensor in the beaker. The tip of the sensor should be down in the water sample. Swirl the water around the sensor tip briefly. **Note:** All glassware must be clean in this experiment!
7. Once the pH reading stabilizes, click or tap Collect to start data collection.
8. Quickly place 10 mL of water in the Erlenmeyer flask then seal with the stopper. Place the tubing in the water sample so it starts to bubble the water with the gas being released from the reaction.
9. When data collection is finished, click or tap Graph Options, , and choose Statistics to determine the maximum and minimum pH values. Record the maximum and minimum pH in Table 1.
10. Repeat Steps 4–9 using a different water sample from a natural source in place of fresh water. **Note:** The previous data set is automatically saved.

11. Tap on the y-axis and select all data sets to view all four on the same plot. Use this graph to answer the discussion questions at the end of this experiment.

## DATA

Table 1			
Water Type	Maximum pH	Minimum pH	$\Delta$ pH

## QUESTIONS

1. Calculate the change in pH ( $\Delta$ pH) for each water sample. Subtract the final pH from the initial pH. What conclusion can you make about your breath?
2. Why does the pH change rapidly at first, and remain stable after a time?
3. Compare the  $\Delta$ pH values. Which test gave the largest pH change? Which test gave the smallest pH change?
4. Water from the ocean is said to be “naturally buffered.” From the result of this experiment, what does this mean?
5. How does water from the ocean become buffered?
6. Many aquatic life forms can only survive in water with a narrow range of pH values. In which body of water—lakes or oceans—would living things be more threatened by acidification? Explain.
7. Summarize your conclusions about this laboratory experiment. Use your data to answer the purposes of this experiment.

## EXTENSIONS

1. Test hard and soft water in the same way you tested lake and ocean water. How do they compare?
2. Do research to get more information on the effects of acidification on ocean and freshwater.
3. Do research and prepare a report on “naturally buffered” streams and lakes.