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# Acid Rain- revised

by

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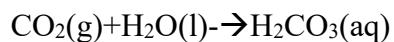
## Introduction

Factories continuously emit many different gases, such as carbon dioxide (CO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>) and nitrogen oxides (NO<sub>2</sub>). When such gases react with the water in the atmosphere, acid rain is formed. The normal acidity level of rainfall has a pH of about 5.6, due to the CO<sub>2</sub> in the atmosphere. However, if the rain reacts with high concentration of SO<sub>2</sub> and NO<sub>2</sub>, the acidity can drop down to a pH of 2, which is very harmful to the living environment. It kills micro-organisms, poisons plants, and damages metals and limestone. For instance, if the acidity of a lake is pH 4.5, fish may still survive there, however, the fish cannot reproduce. If the pH level of the lake remains at 4.5, once the original fish die, there will be no fish remaining in the lake.

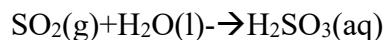
## Background

Water will react with different gases to form acids. Some common acids result from the combination of water with CO<sub>2</sub>, SO<sub>2</sub>, and NO<sub>2</sub>. This combination leads to harmful effects for the living environment in which the acid was formed.

When CO<sub>2</sub> reacts with water, carbonic acid is formed.



When SO<sub>2</sub> reacts with water, sulfurous acid is formed.



When NO<sub>2</sub> reacts with water, nitric acid is formed.



Where: (g) represents the gas state

(l) represents the liquid state

(aq) represents the dissolved state

## Objective

1. To understand how the pH level of an environment affects living organisms.
2. To understand the relationship between the pH level and CO<sub>2</sub> concentration of distilled water.

## Equipment List

Computer	pH Probe
Vernier computer interface	One 100 ml Graduated Cylinders
Logger Pro Software	One stirring rod
Distilled water	1 30 ml Beaker
CO <sub>2</sub> (your breath)	1 Straw

## Experimental Procedure

1. Measure 20 ml of distilled water into a graduated cylinder and pour it into the 30 ml beaker
2. Connect the Vernier computer interface to the computer and connect the pH Probe into Channel of the interface.
3. Run the Logger Pro Software and get ready to collect data by opening the file “Acid Rain” from the Living Environment folder.
4. For each time you use the pH probe, you have to rinse the tip thoroughly with distilled water. When you rinse it, DON’T apply water directly to the tip of the pH probe because the tip of the pH probe is very sensitive. Put it in buffer solution when you are not using it. DON’T let the pH probe dry out. If the probe dries out, it will be damaged and you will have to either buy another or repair it.

5. In the Logger Pro software, a table will appear when you run the program. Label the header of the table by double clicking on the header and typing “Distilled Water” into the window that opens. Put the pH probe into the 30 ml beaker and collect the data by clicking  to measure the pH level for 1 minute.
6. When one minute is over, store the collected data by clicking “Store Latest Run” from “Experiment Menu”.
7. Rinse the pH Probe thoroughly and put it back to the buffer solution.
8. Select the data from the graph which is the most constant values part, and then draw the best fit line by clicking  to get the general equation of your data. The y-intercept is the average pH, if the slope of the best fit line is very small.
9. Record the general equation of the graph into Table 1.
10. Put a straw into the 30 ml beaker. Collect the data by clicking  to measure the pH level while you are blowing your breath into the distilled water.
11. Select the data from the graph, and then draw the best fit line by clicking  to get the general equation of your data. Record the maximum and minimum pH level of the distilled water into Table 1.
12. Rinse the pH Probe thoroughly and wash all the equipment using tap water. Put the pH probe back into the buffer.

## References

Chang, Raymond, Essential Chemistry: A Core Text for General Chemistry 2<sup>nd</sup> edition, 2000, McGraw-Hill Higher Education, New York, New York

Masterman, David, Holman, Scott, Biology with Computers: Biology Experiments Using Vernier Sensors 3<sup>rd</sup> edition, 2003, Vernier Software & Technology, Beaverton, Oregon

**Results**

Name:	Teacher:
Date:	

Please use the data obtained from the experiment and fill in Table 1

Table 1					
Samples	General Equation	Maximum pH	Minimum pH	$\Delta\text{pH}$	Acidity Ranking

**Analysis**

1. What is the reason to measure the pH of distilled water in this experiment?
2. What happened after you blow your breathe into the distilled water? Did it increase or decrease the pH level of the distilled water? Why?
3. Plot a bar graph for each sample using the data from Table 1.

**Bar Graph of Samples**

