Acids and Bases

by

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Introduction

In our daily lives, we intake many different acids and bases in each meal, and the amount of acids and bases consumed affects our bodily function. Acids and bases also influence many other living organisms. Do you know how the pH level of water affects the living environment? If the pH level of water is not suitable for living organisms, they could die; a change in the environment could lead to an alteration which affects the food chain. If the food chain is affected, then numerous other vital living things will also be affected. This can lead to a vicious cycle of the environment affecting the food chain and the food chain affecting the environment, all due to a change in the pH level. Therefore, an understanding of pH levels in the living environment is necessary.

Background

Here is a scenario which shows the importance of testing pH levels of various substance: There is going to be a Miss New York beauty contest and the contestants want to find out which brand of shampoo is the best for them. The pH level of smooth, shinny and healthy hair is approximately 4.5. Hair may be damaged if the shampoo is too alkaline. You are working in a testing lab and are asked to run tests on some shampoos. You have to find out the pH level of the shampoo and see how it affects the condition of hair. Similar to the living environment, living things are very sensitive to the pH level of water. The pH is a measurement scale which tells you how acidic or alkaline the solution. For acidic solutions, pH is scaled from 0 to 7. Acids are the substances that break into H^+ ions in aqueous solution and have a sour taste to them (for

example, think of lemon juice, a common acidic substance).   For alkaline solution, pH is scaled from 7 to 14.   Bases which are also known as alkaline are the substances that break into hydroxide ions (OH^-) in aqueous solutions. They taste bitter and feel slippery. Both acids and bases can react with metal to produce hydrogen gas and salt. They are also able to conduct electricity in their aqueous states. A pH level of 7 is called neutral and is neither acidic nor alkaline. When acids react with bases, the chemical reaction is called neutralization. If the concentration of acids and bases are equal, the solution will become neutral and contains only water and salt. Note that tap water in NYC has a pH of 5.6 due to the presence of salts. This give NYC water its delicious taste.

Objectives of this lab

1. **To determine the pH level of number of shampoos and conditioners**
2. **To understand how the pH level affects living things and their environment**
3. **To compare the ability of different materials to resist pH changes**

Equipment List

Computer   pH Probe
Vernier computer interface   Distilled water
Logger Pro Software   Two 30ml Beakers
2 Droppers   One 100 ml Graduated Cylinders
Shampoo samples   One stirring rod
Conditioner samples

Experimental Procedure

1. Measure 20 ml of distilled water in 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 1 of the interface.

3. Run the Logger Pro Software and get ready to collect data by opening the file "Acids and Bases" from the Living Environment folder.

4. For each time you use the pH probe, you have to rinse its 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 one 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 ▶ Collect 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. Use a dropper to get some shampoo samples. Add 10 - 15 drops of the shampoo sample to the 20 ml of distilled water and stir it thoroughly using a stirring rod. Again, collect the data by clicking ▶ Collect to measure the pH level for 1 minute.

11. Rinse the pH Probe thoroughly and put it into the mixed solution and repeat Step 4 through Step 11 for the remaining shampoos and conditioners.

12. After recorded all the data, rinse the pH probe thoroughly and wash all the equipment using tap water. Put the pH probe back into the buffer.

pH Probe

Solution
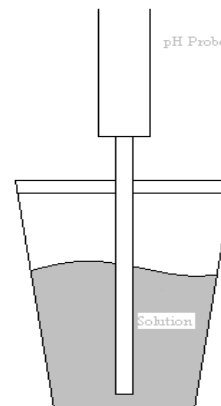
Results

Name: Teacher:

Date: Teaching Assistance:

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

| Table 1			
Samples	General Equation	pH	Acidity Ranking

Analysis

1. What is the reason to measure the pH of distilled water in this experiment?

2. What happened after adding the shampoo sample to the distilled water? Did it increase or decrease the pH level? Why?

3. What happened after adding the conditioner sample to the distilled water? Did it increase or decrease the pH level? Why?

4. Plot a bar graph for each shampoo samples using the data from Table 1.

Bar Graph of Shampoo Samples

5. Plot a bar graph for each conditioner samples using the data from Table 1.

Bar Graph of Conditioner Samples

PH

Name of the Conditioner Samples
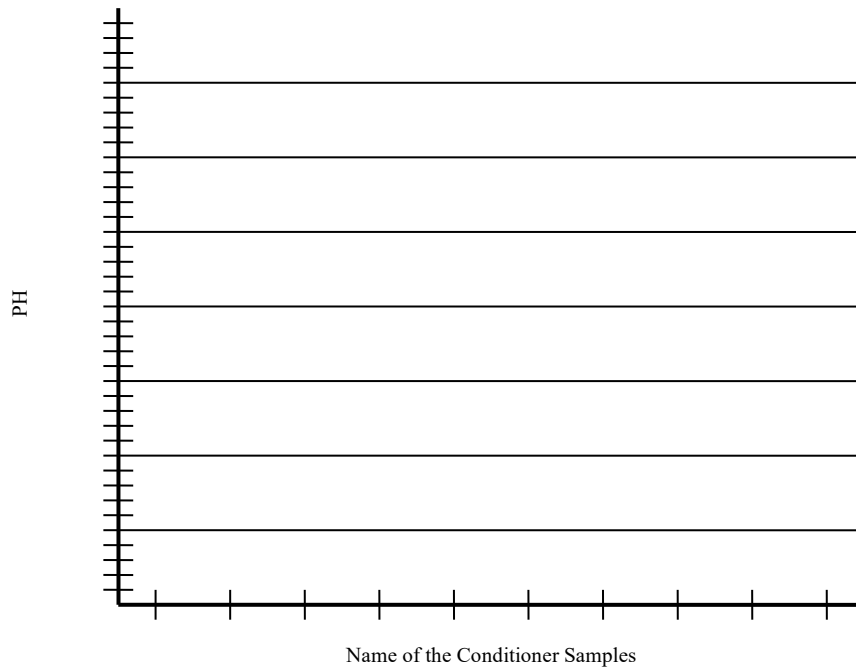
6. Compare the measurements to each other in the bar graph and determine which shampoo is the best for Miss NY if she uses shampoo only without using any conditioner. Explain.

7. Compare the measurements to each other in the bar graph and determine which shampoo is the best for Miss NY if she uses conditioner only without using any shampoo. Explain.

8. Compare the measurements to each other in the bar graph and determine which shampoo and conditioner combinations is the best to Miss NY. Explain.

References

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

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