Acid Rain* Lab - LabQuest

Theory:

Water is able to absorb a large variety of chemicals, leading us to call it the "universal solvent". In this lab we will be looking at how water absorbs CO_2 gas. We will be observing the pH level of the water sample as CO_2 is absorbed, forming carbonic acid and lowering the overall pH level. This lab will point the way to other gases being absorbed and similarly being converted to acidic compounds.

Purpose:

Study the absorption of CO_2 by water

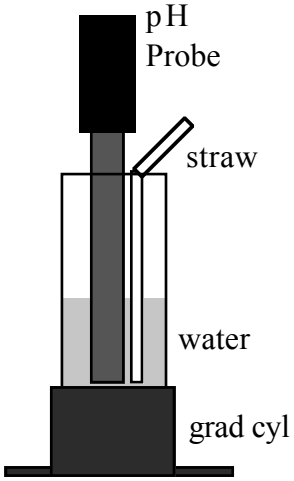
Equipment:

pH Sensor, LabQuest, 50-ml grad cylinder, water, straw

Procedure:

1. Plug the pH Sensor into any of the analog channels of your LabQuest. Launch the LabQuest App. When the application launches successfully, the sensor screen should show the pH sensor connected and a default data collection scheme.

2. Tap on the Data Collection box on the right side of the screen. This will bring up a window in which you can change the settings. Set the length for data collection to 240 seconds (4 minutes). A rate of 1 sample per second is good. Tap [Done] to set this data rate.



3. Put 10 ml of pure water at room temperature in the graduated cylinder. Put a similar amount of water in a test tube and place in an ice water bath. Prepare another test tube but place it in a hot water bath.

4. Rinse the pH Sensor well using pure water. The keeper solution is pH 4, so it will introduce an acid if not rinsed completely.

5. Insert the pH Sensor in the room temperature water. Also insert the straw so that it is fully below the water line. Begin collecting pH readings by tapping the Collect icon or pressing the Collect button. After about 30 seconds, begin blowing gently through the straw, bubbling into the water. Note changes in the pH readings. Keep blowing gently for one or two minutes. Then let things settle out for the last minute of data collection.

6. Once data collection is completed, the graph will autoscale, scaling the graph so your data fills it completely. Go to Analysis questions 1 and 2. Then return to the next step of this procedure.

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7. Tap on the file cabinet icon to "Store Latest Run". This will allow a second run to be collected while saving the first run in the application memory. The Data Collection window should show "Run 2".

8. Rinse the bulb of your pH Sensor with pure water, then repeat steps 5 & 6 for the water that was stored in the ice water bath. Complete Analysis question 3. Then go to the next step of this procedure.

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9. Store that latest run, too. Rinse the bulb of your pH Sensor with distilled water, then repeat steps 5 & 6 for the water that was stored in the hot water bath. Complete Analysis question 4.

Analysis:

1. What was the pH reading of your pure water? Does this reading indicate the water is acidic, basic or neutral?

2. Describe the graph generated as you blew air through the water. Note that the CO_2 in your breath was combining with water molecules to form carbonic acid, H_2CO_3. Does the direction of the graph indicate that carbonic acid is being formed?

3. How does the pH change of the cold water compare to the pH change for the room temperature water? If it was a larger change, what does that indicate about the amount of CO_2 that was absorbed?

4. How does the pH change of the hot water compare to the pH change for the room temperature water? If it was a larger change, what does that indicate about the amount of CO_2 that was absorbed? Is hot water or cold water able to absorb more CO_2, based on your experimental results?

Extension:

Compare the rate at which the pH changes if you have been resting recently with the rate if you have been exercising. For example, run in place, run around the building or do some jumping jacks immediately before blowing into the straw. What does this say about the amount of CO_2 that you have in your breath?

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*This isn't really an Acid Rain Lab. The process of absorbing CO_2 by water and forming carbonic acid means that airborne water is slightly acidic. In a similar manner, SOx and NOx are both absorbed forming acidic compounds that contribute to the problem we call acid rain. The more SOx and NOx in the air as a result of burning fuels, the more acid rain we generate.

Compare this lab with #22 in the Chemistry with Vernier lab manual.

For "pure water", we have often used bottled water although tap water can also be used very successfully. Clearest results ensue if the initial water is very slightly basic.

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