

## Activity 3 - pH Test

### Introduction

The pH test measures the  $H^+$  ion concentration in liquids and substances. All measured liquids or substances are given a pH value on a scale that ranges from 0 to 14.

Water ( $H_2O$ ) contains both  $H^+$  (hydrogen) ions and  $OH^-$  (hydroxyl) ions, Pure de-ionized water contains equal numbers of  $H^+$  and  $OH^-$  ions, and has a pH of 7. This makes it neutral, neither acidic nor basic. If a water sample has more  $H^+$  than  $OH^-$  ions, it is considered acidic and has a pH less than 7. If the sample contains more  $OH^-$  ions than  $H^+$  ions, it is considered basic with a pH greater than 7.

It is important to understand that for every one unit change on the pH scale, there is in fact an approximately ten-fold change in how acidic or basic the sample is. This can be understood when considering the average pH of rainfall over much of the northeastern United States. This is 4.3, or roughly ten times more acidic than normal rainfall of 5.0-5.6. Lakes of pH 4 (acidic) are roughly 100 times more acidic than lakes of pH 6.

In the U.S., the pH of natural water is usually between 6.5 and 8.5, although wide variations can occur. Increased amounts of nitrogen oxide ( $NO_x$ ) and sulfur dioxide ( $SO_2$ ), primarily from automobile and coal-fired power plant emissions, are converted to nitric acid and sulfuric acid in the atmosphere. These acids combine with moisture in the atmosphere and fall to earth as acid rain or acid snow.

It is because of acid rain that thousands of lakes in eastern Canada, northeastern United States, Sweden, and Finland have become acidic. In many areas of the United States, the type of rocks and minerals present determine the acidity of the local water. If limestone is present, the alkaline (basic) limestone neutralizes the effect the acids might have on lakes and streams. However, usually the areas which are most hit by acid rain and snow are downwind of urban/industrial areas and do not have any limestone to reduce the acidity of the water.

Changes in the pH value of water have an important effect on the organisms living within it. Most organisms have adapted to life in water of a specific pH and may die if it changes even slightly. This has happened to brook trout in some streams in the Northeast.

In lakes with a pH below 5, and in streams that receive a massive acid dose as the acidic snow melts in the spring there can be serious consequences. Immature stages of aquatic insects and young fish are extremely sensitive to pH values below 5. At extremely high or low pH values (e.g., 9.6 or 4.5) the water becomes unsuitable for most organisms.



Furthermore, acidic waters can also cause heavy metals, such as copper and aluminum, to be released into the water. Again the consequences this has on fish life can be serious as heavy metals can accumulate on the gills of fish or cause deformities in young fish, reducing their chance of survival.

<b>pH</b>	<b>Effect on aquatic life</b>
3.0 – 3.5	Unlikely that fish can survive for more than a few hours. Some plants and invertebrates can be found.
5.0 – 6.5	Bottom-dwelling decomposing bacteria begin to die off. Plankton begin to disappear. No freshwater shrimp.
6.5 – 8.5	Largest variety of animals. Fish, shrimp, plankton, bacteria survive.
8.5 – 10.5	Bottom-dwelling decomposing bacteria begin to die off. Plankton begins to disappear. No freshwater shrimp.
10.5 – 11.5	Unlikely that fish can survive for more than a few hours. Some plants and invertebrates can be found.

## Equipment

- MultiLogPRO
- pH sensor
- 250mL beaker or cup
- Wash bottle with distilled water

## MultiLogPRO Setup

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### Sensors

Input 1: pH

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### Rate:

Every second

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### Recording time:

20 samples (20s)

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## Experimental Procedure

### Sampling procedure

The water sample for the pH test should be collected away from the river bank and below the surface. If possible, use an extension rod sampler.

The sample must be measured immediately because changes in temperature can affect the pH value. If pH must be measured later, the sample should be placed on ice and measured as soon as possible.

### Testing Procedure

1. Turn on MultiLogPRO
2. Connect the pH electrode to the pH adaptor, then plug the pH sensor into input 1 (I/O-1) of MultiLogPRO
3. Set MultiLogPRO up according to the setup specified above
4. Remove the pH electrode from the storage bottle. Rinse the tip of the electrode with stream water
5. Place the pH electrode in to a beaker with sample water
6. Push **Enter**  on MultiLogPRO's keypad to begin recording
7. When logging ends record the pH level in your data sheet