# pH Experiment – ACIDS, BASES & pH

**Introduction**
Many common substances are either acids or bases. Some acids, like stomach acid are necessary for our health, while others, like sulfuric acid are dangerous and can cause burns and other injuries. The easiest way to determine if a substance is acidic or a basic is to use an indicator. Indicators are *organic molecules* that change color in an acid or a base. When an indicator is placed on paper, it provides a fast way to determine if a substance has acidic or basic (alkaline) properties.

The most common acid/base indicator paper is called litmus paper, therefore a litmus test could be the first test used to determine acidic or basic properties. The strength of an acid or base is measured in **pH**, which is the *concentration of the hydrogen ion* ($H^+$). A high pH indicates a strong base, while a low pH indicates a strong acid. A pH of seven indicates a neutral substance (like water).

Indicators work because they are weak acids which, when in solution, exist in equilibrium with their conjugate base. The acid and its conjugate base each have different colors, and as the equilibrium shifts from one direction to the other, the color of the indicator solution changes. pH paper consists of strips of filter paper which have been soaked in an indicator. A drop of an unknown solution can be placed on the pH paper and the resulting color compared to a chart. By matching the color of the paper to a color on the chart, the pH of the solution can be determined.

**Purpose**
In this experiment you will learn to use different types of indicators to test the pH of common household substances.

**Objectives**
The Students will:

- Use several indicators to test for acid, base and neutral substances.
- Use pH paper to test for the pH of a substance.
- Explain the difference between tests using litmus paper, pH paper, and chemical indicators.
- Collect and evaluate the data in a *data table, pH chart and complete lab report*.

**Materials**

- Safety Equipment
- Several pieces of litmus paper (pink and blue)
- 2" pieces of pH paper
- Red Cabbage Indicator
- pH color charts made by student
- Various lab compounds and household chemicals
- Beakers, test tubes, test tube rack, pipettes (well plates may be substituted for test tubes)

**Procedure**
Determine the pH of lab chemicals and household substances. In this experiment you are to work at the lab stations in groups of no more than 4. You will be using both pH paper and natural indicators prepared from plant extracts. Follow the steps outlined below to determine the pH each of each of these substances.

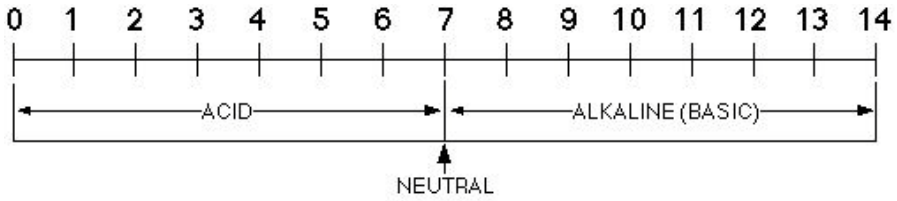
Test each sample using litmus paper first, then pH paper and last test with a few drops of red cabbage indicator. State whether the sample is acidic (strong or weak), basic (strong or weak), or neutral based on your findings.

Name _____ Period _____ Date _____

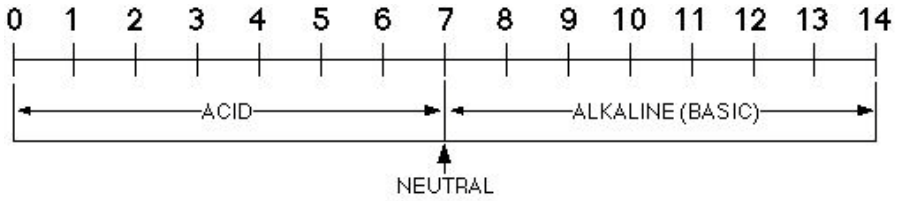
***Graphing & charting skills***

**First complete the 2 color charts:** Use colored pencils to display the proper color changes of the pH paper **and** Cabbage indicator. **Next, indicate** the results for the pH of each of the compounds below ranked from lowest to highest pH on the number lines below. Be sure to show the pH results of all substances and where they lie on both pH paper graph and Cabbage Indicator. *Neatness counts*.

**pH paper**




**Cabbage Indicator**




**Data Analysis**

Test each sample using litmus paper first, then pH paper and last test with a few drops of red cabbage indicator. State whether the sample is acidic (strong or weak), basic (strong or weak), or neutral based on your findings. Record your results in the data table below.

| Solutions Tested | Indicators | | | | | | Determine if Acid, Base or Neutral & Strong or Weak |
|---|---|---|---|---|---|---|---|
| | Red Litmus + or -- | Blue Litmus + or -- | pH paper color and | pH# | Red Cabbage color and | pH# | |
| 1. example | + | - | olive green | 8 | blue | 8 | Weak base |
| 2. | | | | | | | |
| 3. | | | | | | | |
| 4. | | | | | | | |
| 5. | | | | | | | |
| 6. | | | | | | | |
| 7. | | | | | | | |
| 8. | | | | | | | |
| 9. | | | | | | | |
| 10. | | | | | | | |

**Analysis & Discussion**

*Answer the following questions **completely**. Refer to your notes and textbook for help.*

1. Which has a higher concentration of $H^+$, acids or bases?

2. Which pH has a higher numerical value, acids or bases?

3. How does an increase in the concentration of $H^+$ affect the number on the pH scale?

4. Even though a tiny amount of water does break down into $H^+$ and $OH^-$ why is it neutral?

5. What is the pH of pure water?

6. Explain why changes in pH can affect biological systems (i.e.: human cells).

7. Which substances tested were acids? Which was the strongest?

8. Which substances tested were bases? Which was the strongest?

***Relating your experimental data to the real world.***

9. Why would it be important for humans to have a balanced pH in saliva? What is the significance of being high or low on the pH scale?

10. How would lakes and rivers (or swimming pools) be affected by fluctuating pH?