# ACIDS AND BASES

The science laboratory is not the only place where acids and bases are found. Many items commonly found at home are acids or bases. For example, many of the foods you eat contain acids. Many commonly used cleaning products owe their effectiveness to the fact that they are alkaline, or contain bases. Indicators are special chemicals that can show whether a given substance is an acid, a base, or neither. Indicators usually react with an acid or a base to form a slightly different chemical with a different color. Two examples of indicators are litmus paper (blue and red) and Universal Indicator. Blue litmus paper turns red in an acid and stays blue in a base. Red litmus paper turns blue in a base and stays red in an acid. Universal Indicator turns a different color at each of several pH values ranging from 1 to 11.

How acidic or basic a solution is depends on the number of **hydrogen ions** (**$H^+$**) that it contains. The hydrogen ion forms when a few molecules of water ionize:

$$2H_2O == H^+ + OH^-$$

Because pure water has the same number of hydrogen ions and **hydroxide ions** ( **$OH^-$**), it is considered neutral. If a solution has a greater concentration of $H^+$ than $OH^-$ it is considered acidic. If a solution has more $OH^-$ than $H^+$ it is considered basic.

The pH scale uses numbers to indicate the relative concentration of $H^+$.

**0** **7** **14**

neutral

<---- more acidic more basic ---->

**PROBLEM**:

How can you determine whether a solution is an acid or a base?

**PRELAB PREPARATION**

1. In terms of $H^+$ and $OH^-$ concentrations, why are some substances acids?
2. Why are some substances bases?
3. What is alkaline?
4. What does it mean to say that distilled water is neutral? What pH should it have?
5. For the following solutions, how would you describe $H^+$ concentration? Label them as acidic, basic, or neutral.
   - Solution A - pH 10
   - Solution B - pH 7
   - Solution C - pH 3

**MATERIALS**

Chemlab test plate
Universal Indicator
pH color chart
12 solutions to test
Safety goggles*

Solutions: Distilled water, Alcohol, Lemon lime soda, Salt water, Dish soap, Tomato juice, Ammonia, Milk of Magnesia, Bleach, Baking soda, Vinegar, Lemon Juice

*Whenever you handle acids and bases, no matter how common, you must protect your eyes.

**PROCEDURE**

1. Make a table like the one below.
2. Fill in the "Substance" column with the solutions from the materials list above.
3. There are 12 wells on the Chemtest Plate. Number each solution in the order in which you fill each well. NOTE: It is important to keep track of each solution so you can make accurate measurements of the pH.
4. Take your Chemtest Plate to the side bar and put three to four drops of each solution into the corresponding well.
5. Add one drop of Universal Indicator to each well.
7. Fill in your data table with the results of each pH you measured.

**SAMPLE DATA TABLE**

| SUBSTANCE | COLOR OF SOLUTION AND INDICATOR | APPROXIMATE pH OF SUBSTANCE |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

8. Rinse your Chemtest plate well and leave it in the proper area to dry.
9. Throw away all used pH papers and return vial of **unused** pH paper to side counter.

**FOLLOW UP QUESTIONS**

1. Which substances are acids?
2. Which substances are bases?
3. Which substances are neutral?
4. Which substance is probably the strongest acid ? Explain.
5. Which substance is probably the strongest base? Explain.
6. Is litmus paper useful in determining the exact pH of a substance? Explain.
7. List in order from most acidic to most alkali the substances you tested.
8. What do acids have in common?
9. What do bases have in common?

**APPLICATION**

10. Describe three situations in which acid-base indicators might be useful in everyday life.
11. Suppose you are manufacturing a certain type if cosmetic. You know that is can be slightly acidic, but it should not be strongly acidic. Which indicator -Litmus Paper or Universal Indicator- should you use and why?