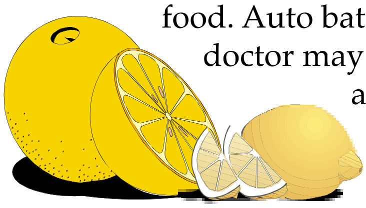
Introduction

This unit will focus on **acids**, **bases**, and **salts**. These compounds are important to our understanding of chemistry and the behavior of ions. These compounds particularly demonstrate the behavior of electrons.

Acids

Acids are a group of many different compounds. Despite the differences in the composition or make-up of acids, they all have similarities. When an acid dissolves in water, it releases a positively charged hydrogen atom (an H^+). This atom is known as an **ion** because it carries an electrical charge. We can tell that it is positively charged because there is a small plus sign (+) written by the ion. It is the ions of acids that make them important to us. Along with this, acids that are safe to eat or drink taste sour. Also, acids react with metals. This reaction produces hydrogen gas (H_2). The hydrogen comes from the acid.

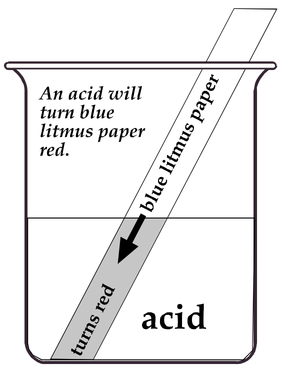
Acids are found in many parts of our daily life. Vinegar contains acetic acid (CH_3COOH). Citrus fruits (such as lemons and oranges) contain citric acid. The hydrochloric acid (HCl) in your stomach helps to digest food. Auto batteries contain sulfuric acid (H_2SO_4). Your doctor may tell you to use a boric acid (HBO_3) solution as an eyewash. If you are given acetylsalicylic acid, don't worry. It's aspirin! Sour milk tastes sour because the sweet sugar lactose has become the bitter lactic acid ($C_3H_6O_3$).



Acids can be harmful. Always use them carefully. Never taste a solution to see if it contains an acid. Many acids are poisonous. They can burn skin, eyes, and other sensitive organs. Many household products contain some acid. Read the label carefully before you use a product.

Acid Indicators

There are simple tests to find out if something contains acid. Dip a piece of blue **litmus paper** in vinegar. The paper will turn red. Litmus is called an **indicator** because it shows if an acid is present.



Another test for acid is the metal test. Acids will wear away metals. You may have seen car parts that were corroded by battery acid. This is an example of a acid wearing or eating away a metal. If you place a piece of metal in acid, a chemical change will take place.

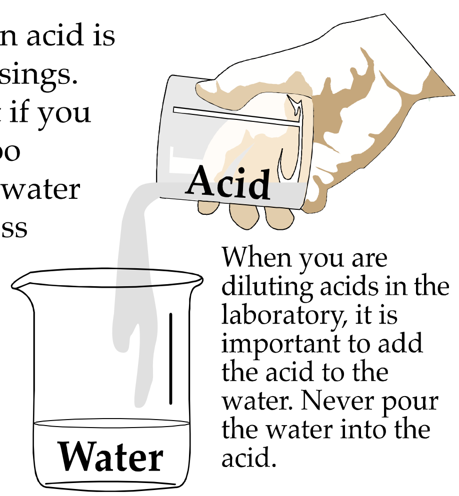
The litmus and the metal test are indicators for acids. They will only work on acids that are dissolved in water.

Diluted and Concentrated

Acids can be harmful. Yet, we know that we have acids in our body. We eat foods containing acids. We even use medicines that are made from acids. The amount of acid being used often determines whether it will be harmful or helpful. The amount of acid in a solution is called its **concentration**. The more acid, the higher the concentration. Think of two solutions. The first solution has five parts water and two parts boric acid. The second solution has five parts water and three parts boric acid. Which solution has the higher concentration of boric acid? The second solution has a higher concentration than the first solution.

As we discussed earlier, the medicine aspirin is actually an acid. If you take aspirin, it goes into your stomach. There it encounters hydrochloric and other acids. If a patient takes too much aspirin, the concentration of the acids will increase. This may make the patient's stomach painful and can even cause bleeding in the stomach. When the aspirin is taken as recommended, however, it is helpful. When the aspirin is in the right concentration, it is helpful.

Sometimes, though, the concentration of an acid is too high or strong. Think about salad dressings. Many salad dressings include vinegar, but if you poured vinegar on a salad it might taste too strong. Instead, the vinegar is mixed with water and oil. The taste of the vinegar is made less strong. This is an example of an acid being **diluted** to make it less powerful. When you are diluting acids in the laboratory, it is important to add the acid to the water. Never reverse this process by pouring the water into the acid because this could cause the solution to splash due to a dangerous reaction.



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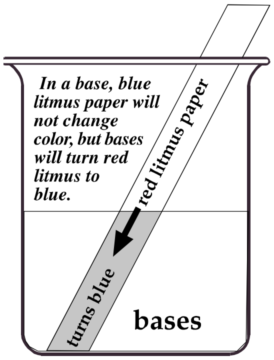
Bases

We know that acids release H^+ ions in water. *Bases* contain a hydroxide (OH), which is a hydrogen and oxygen atom that are bonded together. When bases are dissolved in water, they release the hydroxide as a negatively charged ion (OH^-). Those bases that are safe to eat or drink have a bitter taste. Soapsuds would taste bitter because they contain a base. Also, bases usually feel slippery. Bases are found in such things as lye, ammonia, and milk of magnesia. Deodorants contain the base aluminum hydroxide ($Al[OH_3]$). Like acids, bases can cause burns. They may also be poisonous.



Remember that an acid will turn blue litmus paper red. Blue litmus will not change color in a basic solution. Bases will turn red litmus to blue. **Phenolphthalein** (fee-nol'-thal-e-un) is a useful indicator for bases. Phenolphthalein will stay clear in an acid solution. However, if phenolphthalein is put into a basic solution, it will turn dark pink. Acids wear away metals. Many bases will not wear away metal.

You may see that bases often act as the opposites of acids. In some ways, this is because the ion produced by a base, OH^-, is the opposite of an acid's ion, H^+. Remember that we discussed that sulfuric acid from batteries often corrodes car metal. The sulfuric acid makes the battery work, but some may leak out of the battery. When cleaning around a car battery, some mechanics use a mild solution of baking soda. The baking soda is a base. It reacts with the acid. This stops the acid from corroding the car metal. This is a helpful use of a base; however, if the baking soda were to get into the battery, it would destroy the battery. When using chemicals, both mechanics and students must be careful.

Remember: Because bases act as opposites to acids in many ways, it does not make them more or less dangerous. Nor does it make them more or less helpful. Instead, it means that bases can be as helpful or dangerous as acids, but in different ways.

Neutralization and Salts

Neutralization is a chemical reaction between an acid and a base. When the sulfuric acid of a car battery reacts with the base of the baking soda, this reaction is known as a neutralization. Because the OH^- and H^+ ions have combined, they form water. A *salt* has also been formed. Because the salt is now in the water made by the reaction, it is in solution. When the quantities of H^+ and OH^- ions are the same, then there will be no acid or base left over. Such a solution would be a **neutral solution**. The equation below shows a neutralization. It is the neutralization of hydrochloric acid (HCl) and sodium hydroxide (NaOH):

$$HCl + NaOH \longrightarrow H_2O + NaCl$$

The type of salt formed in this reaction was sodium chloride, the common table salt with which you are probably familiar. However, sodium chloride (NaCl) is only one type of salt. If we altered the base and acid that we used in the neutralization, then we would produce different salts. Whatever base and acid we use, though, we know we will always produce the following products:

- salt
- water

Salt water is a neutral solution that will not react with litmus paper. It is neither acidic nor basic. Although we can produce neutral solutions by the reaction of a base and an acid, some substances are naturally neutral.

Water that has been distilled is naturally neutral. By distilling water, everything is removed from the water. The water is only H_2O and has no other substances dissolved within it. This makes the water neutral.

Summary

In this unit, we have learned the difference between an acid and a base. We have discussed what a salt is and you have learned that salts and water are products of neutralization reactions.

The chart below shows the measure of acidity of common acids and bases. Distilled water is neutral and is in the middle of the chart.