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Explains the concepts of acidity and pH, compares acids and bases, and identifies the role of acids and bases in enzyme action in living things.

Acids and Bases

Assign to Class

Acids and Bases in Biology

Acids and bases. Why are these important in biology?

It comes back to a number of biological processes. For example, enzymes work best at specific levels of acids or bases. Take your stomach, a very acidic environment. The enzymes that work in that environment could not work in your mouth. What would your food taste like if your mouth was also a very acidic environment?

Acids and Bases

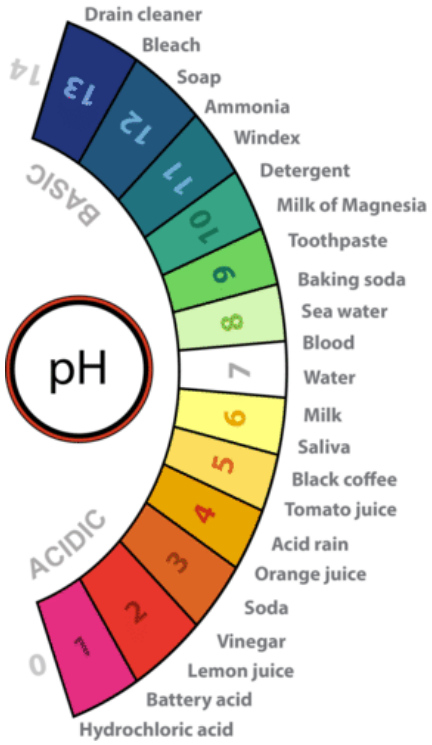
Water is the main ingredient of many solutions. A **solution** is a mixture of two or more substances that has the same composition throughout. Some solutions are acids and some are bases. To understand acids and bases, you need to know more about pure water. In pure water (such as distilled water), a tiny fraction of water molecules naturally breaks down to form ions. An **ion** is an electrically charged atom or molecule. The breakdown of water is represented by the chemical equation

$$2\ H_2O \rightarrow H_3O^+ + OH^-$$

The products of this reaction are a hydronium ion (H_3O^+) and a hydroxide ion (OH^-). The hydroxide ion, which has a negative charge, forms when a water molecule gives up a positively charged hydrogen ion (H^+). The hydronium ion, which has positive charge, forms when another water molecule accepts the hydrogen ion.

Acidity and pH

The concentration of hydronium ions in a solution is known as **acidity**. In pure water, the concentration of hydronium ions is very low; only about 1 in 10 million water molecules naturally breaks down to form a hydronium ion. As a result, pure water is essentially neutral. Acidity is measured on a scale called **pH**, as shown in **Figure** below. Pure water has a pH of 7, so the point of neutrality on the pH scale is 7.



Acidity and the pH Scale Water has a pH of 7, so this is the point of neutrality on the pH scale. Acids have a pH less than 7, and bases have a pH greater than 7. Approximate pHs of examples are shown.

Acids

If a solution has a higher concentration of hydronium ions than pure water, it has a pH lower than 7. A solution with a pH lower than 7 is called an **acid**. As the hydronium ion concentration increases, the pH value decreases. Therefore, the more acidic a solution is, the lower its pH value is. Did you ever taste vinegar? Like other acids, it tastes sour. Stronger acids can be harmful to organisms. For example, stomach acid would eat through the stomach if it were not lined with a layer of mucus. Strong acids can also damage materials, even hard materials such as glass.

Support

Bases

If a solution has a lower concentration of hydronium ions than pure water, it has a pH higher than 7. A solution with a pH higher than 7 is called a **base**. Bases, such as baking soda, have a bitter taste. Like strong acids, strong bases can harm organisms and damage materials. For example, lye can burn the skin, and bleach can remove the color from clothing.

Acids and Bases in Organisms

Acids and bases are important in living things because most enzymes can do their job only at a certain level of acidity. Cells secrete acids and bases to maintain the proper pH for enzymes to work. For example, every time you digest food, acids and bases are at work in your digestive system. Consider the acidic environment of the stomach. The acidic environment helps with the digestion of food. The enzyme pepsin, which helps break down proteins in the stomach can only function optimally in the low pH environment. The stomach secretes a strong acid that allows pepsin to work, and the stomach to do its job. However, when stomach contents enter the small intestine, the acid must be neutralized. This is because enzymes in the small intestine need a basic environment in order to work. An organ called the pancreas secretes a strong base into the small intestine, and this base neutralizes the acid.

Acids, Bases, and pH