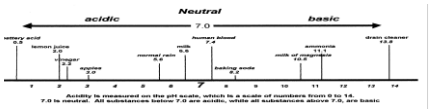
Acids & Bases

pH is a measure of the concentration of ***hydrogen ions*** in a solution.

Acids taste sour, are soluble in water and undergo similar chemical reactions and have a pH of less than 7.

Bases taste bitter, are soluble in water, feel slippery, react with acids and have a pH of more than 7'



Substances that are neither acidic nor basic, such as water are **neutral** with a pH of close to 7.

To identify a substance as an acid, a base, or neutral, an indicator is used. It changes color according to the type of substance it is put into. Indicators can be solids, such as **litmus paper**, or **universal indicator** (which change color over a wide pH range can identify many different substances and is more precise), or they can be liquids, such as **phenol red**.

Neutralization

Acids and bases react together when they are mixed. This type of reaction is called neutralization. When the acid and the base are used up, **sal**t and **water** are produced. Acid in your stomach has a normal pH of 2. This acid helps in the digestion of food and kills off bacteria. If you eat too quickly, or are under stress, your stomach produces an excess amount of gastric acid (giving you heartburn).

To neutralize the excess acid, a mild base, an **antacid** tablet, is chewed and swallowed.

(eg. Tums, Rolaids, Pepto Bismal)

$HCl + NaOH \dashrightarrow NaCl + H_2O$

Hydrochloric Acid + Sodium Hydroxide ---» Salt + Water

Neutralizing Acid Rain

Rainwater is naturally slightly acidic. When this water combines with chemicals in the atmosphere such as sulfur dioxide or nitrogen dioxide, the effect results in Acid Rain (with a pH as low as 3 - in some parts of Canada).

To neutralize this acid rain, **lime** (calcium hydroxide - which is a base) is added to lakes.

$Ca(OH)_2 + H_2SO_4$ ----» $CaSO_4 + H_2O$

Calcium Hydroxide + Sulfuric Acid ----» Calcium Sulfate + Water

This is not necessary in certain parts of the Rockies because the mountains contain rich deposits of **limestone**, making the water naturally basic. When the acid rain falls, it is neutralized almost immediately.

Essential Elements

Humans need about 25 different chemicals for normal growth. The complex organization of these chemicals produces **organic compounds** which contain Carbon, as well as mostly Oxygen and Hydrogen. Substances that do not contain Carbon are called **inorganic compounds**.

Macronutrients - Nutrients, which are made up of elements and compounds, help living organisms survive. Plants obtain carbon, oxygen and hydrogen from the air, and nitrogen, phosphorus, potassium, magnesium, calcium and sulfur from the soil. These nine elements are called macronutrients (because they are in needed in large quantities) are essential for plants to grow.

Micronutrients - Other elements that are also needed, but not in large quantities. These elements are called micronutrients.

Macronutrient Elements

Nutrient	Importance in Plants
Nitrogen (N)	- proteins & chlorophyll - leaf and stem growth
Phosphorus (P)	- root and flower growth - cellular respiration & photosynthesis
Potassium (K)	- stimulates early growth - starch and protein production - disease resistance - chlorophyll production & tuber formation
Magnesium (Mg)	- chlorophyll structure - photosynthesis
Calcium (Ca)	- cell wall structure - cell division
Sulfur (S)	- production of fruits and grains

Macronutrient Elements

Nutrient	Importance in Humans
Nitrogen (N)	- composition of proteins & nucleic acids - growth and repair of tissue
Phosphorus (P)	- composition of bones, teeth & DNA - metabolic reactions
Potassium (K)	- muscle contraction & nerve impulses
Magnesium (Mg)	- composition of bones & teeth - absorption of calcium & potassium
Calcium (Ca)	- composition of bones & teeth - blood clotting - muscle & nerve function
Sulfur (S)	- protein synthesis - enzyme activation - detoxification

Organisms Take In Substances

Plants take in inorganic compounds to make organic compounds. Consumers use the organic compounds made by plants for their energy, growth and repair. **Diffusion -** Nutrients enter the roots by diffusion - the movement of molecules from an area of high concentration to an area of low concentration. This action continues until the areas are equal concentrations. **Osmosis -** Water moves through plants by a special type of diffusion, called osmosis. In this process, water moves through the walls of the plant's roots from an area where there are more water molecules to an area where there are fewer water molecules. As the plant uses the water it draws more up from its roots. **Active Transport -** Plants need high concentrations of some nutrients in their roots. These nutrients may have higher concentrations in the roots than in the surrounding soil. To maintain these high concentrations, plants move more nutrients into their roots from areas of lower concentration by a process called active transfer. This process requires energy.

Organic Molecules

Class	Description	Example
Carbohydrate	- made of atoms of carbon, hydrogen, and oxygen	sugar, starch, cellulose, glucose
Lipid	- compounds composed of many carbon, hydrogen, and oxygen atoms	fats, oils and waxes
Protein & Amino Acid	- protiens are made up of amino acids - functions include growth and repair, as well as a source of energy	enzymes
Nucleic Acid	- large complicated molecules that play a major role in heredity and in controlling the cell's activities	**DNA** (deoxyribo-nucleic acid) **RNA** (ribonucleic acid)

Ingestion and Absorption - The process of taking in the nutrients (elements and compounds) we need is called **ingestion**. These compounds are broken down chemically in the digestive system by a process called **hydrolysis**. Substances broken down by hydrolysis have been hydrolyzed.

(example) Maltose + Water ------ » Glucose

$C_{12}H_{22}O_{11} + H_2O$ ------ » $2C_6H_{12}O_6$

Nutrients such as glucose and amino acids are absorbed through cell membranes and into the bloodstream, which carries them to where they will be used or stored.

Taking In Nutrients - Where organisms live affects how and when they can obtain the nutrients they need. Some organisms get the nutrients they need often by restricting other organisms from getting the same nutrients (reducing the competition).

Substrate - A substrate is a material on which an organism moves or lives. Some organisms attach themselves to the substrate, others obtain their nutrients from their substrate.