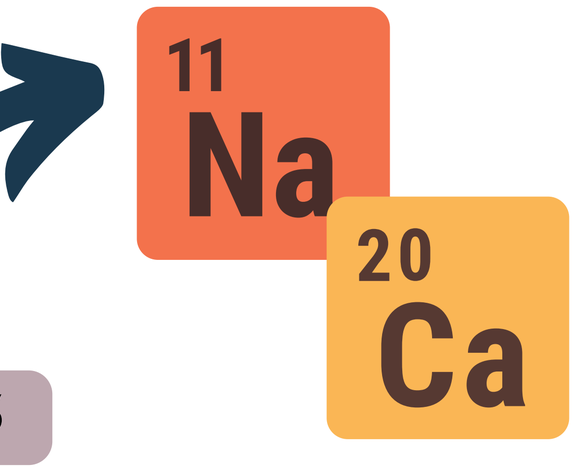
CHEMISTRY

Elements are made of matter. Matter is something you can see, feel, and touch. Atoms are the smallest stable units of elements.

Knowing the structure of an atom is extremely important.

- The nucleus of an atom is positively charged and contains protons and neutrons.
- The nucleus is really small but contains most of the mass of the atom. An atom is mostly empty space.
- Protons are positive, neutrons are neutral, and electrons are negative.
- Electrons occupy energy levels, or shells, around the nucleus of an atom. The outer shell is called the valence shell. The electrons in these are the ones that interact with other atoms.
- The energy of the electron determines which energy level it can be in.
- The reactivity of an atom depends on whether or not the valence shell is full.
    - In general, when the valence shell isn't full, the atom is reactive.
- An element is often represented by a chemical symbol rather than its full name.
    - Na is sodium, Ca is calcium

Hydrogen is the simplest element, consisting of one electron and one proton.



ATOMIC NUMBER IS THE NUMBER OF PROTONS

Terms

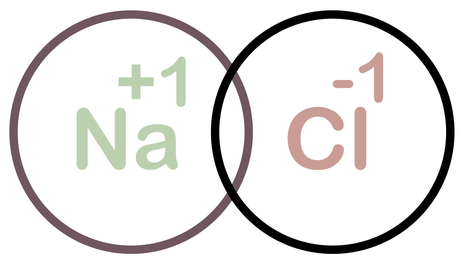
Strong Nuclear Force –	The force that binds protons and neutrons together to form a nucleus.
Weak Nuclear Force –	The force that works inside of the nucleus.
Electromagnetic Force –	The force that occurs between electrically charged particles.
Gravitational Force –	The force of mutual attraction between masses.
Solid –	Atoms or molecules held so tightly together that they hold a fixed shape.
Liquid –	Atoms or molecules are in close contact, but they are able freely move around each other.
Gas –	Atoms or molecules are not in contact with each other. They have a lot of kinetic energy and bounce around, distributing evenly throughout a container.
Energy –	Capacity to perform work.
Kinetic Energy –	Energy of motion.
Potential Energy –	Stored energy.
Hydro –	A prefix meaning "water."
Lysis –	The breakdown of a cell caused by damage to its plasma (outer) membrane.

Terms

Activation Energy –	The minimum amount of energy required to activate reactants and allow the reaction to proceed.
Catalysts –	Accelerate chemical reaction without being changed or consumed.
Exergonic –	A reaction with an overall net release of energy.
Endergonic –	More energy is required to begin than is released. (This includes reactions to build molecules.)
Metabolites –	Substances synthesized or decomposed in living bodies.
Organic Compounds –	Predominantly contain carbon-hydrogen bonds.
Inorganic Compounds –	Don't contain carbon-hydrogen bonds.
Polymer –	Large molecule made up of monomer subunits.
Monomer –	Molecule that can be bonded to other molecules in a chain to form a polymer.
Solvent –	The substance that a solute is dissolved into. This could be in any state but is most commonly liquid.
Solute –	A substance that is separating into individual molecules within a solvent.

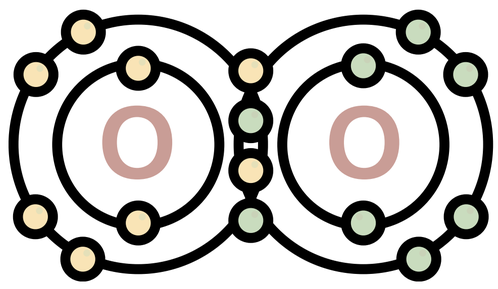
Bonds

Ionic Bonds – A chemical bond resulting from the electrical attraction between cations and anions. In solids, ionic bonds are much stronger than covalent bonds.



Covalent Bonds – This is the most common type of chemical bond, and it involves sharing of electrons between atoms. Single covalent bonds share one pair of electrons.

Double Covalent Bonds – Atoms share two pairs of electrons. These bonds are stronger and shorter than single bonds.



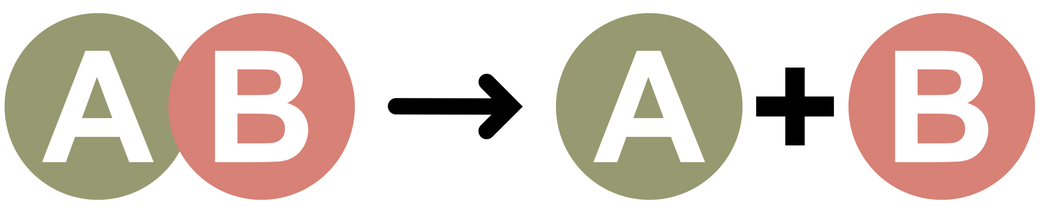
A polar molecule has a separation of electric charge, resulting in a positive end and a negative end.
Water is the 'universal' polar solvent.
For solubility, like dissolves like.
Salt (polar) dissolves in water (polar).
Wax (non-polar) dissolves in oil (non-polar).
Wax doesn't easily dissolve in water and salt doesn't easily dissolve in oil.

Isotopes are atoms with the same number of protons but a different number of neutrons.

Isotopes of an element have identical chemical properties.

Equations and Reactions

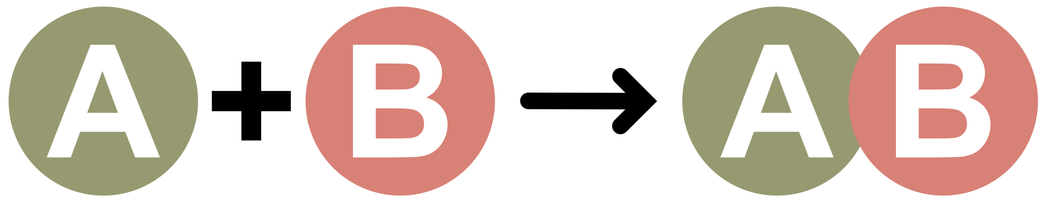
- Mole – abbreviated as 'mol,' this is a quantity of atoms or molecules equal to Avogadro's number. $6.022140857 \times 10^{23}$
  - One mole of a given substance always contains the same number of atoms as one mole of another substance, but they can have different masses.
- Decomposition reaction – breaks a molecule into small fragments. This occurs inside and outside cells.



1 mole of oxygen = 16 g
atomic weight of oxygen = 16 g/mol

1 mole of hydrogen = 1 g
atomic weight of oxygen = 1 g/mol

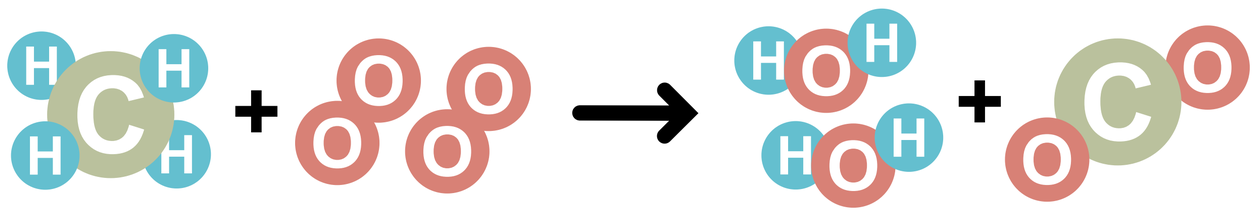
- Hydrolysis – specific type of decomposition reaction that involves water.
- Catabolism – collective term for decomposition reactions in the body.
  - Refers to breaking covalent bonds.
  - Releases energy that can perform work.
  - Living organisms can use that energy for growth and movement.
- Synthesis reactions – opposite of decomposition. Assembles smaller molecules into larger molecules.



- Dehydration synthesis – formation of a complex molecule by removing a water molecule. This is the opposite of hydrolysis.

Equations and Reactions

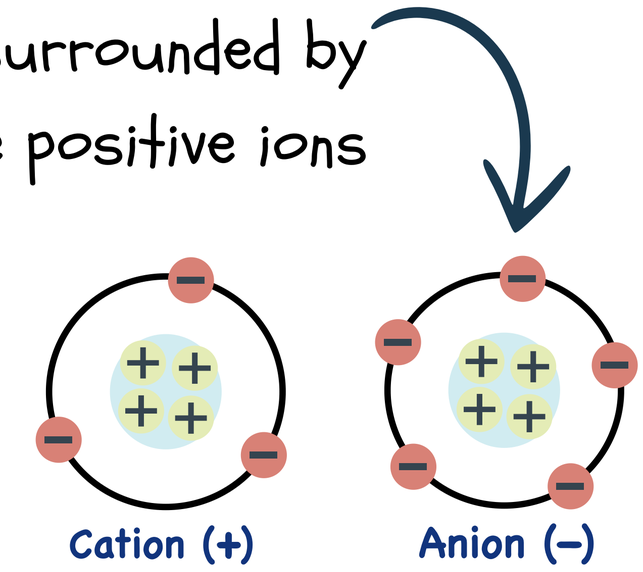
- Anabolism is the process of simpler molecules being combined to form more complex molecules within living organisms.
  - This requires energy, as molecules are being built instead of broken down.
  - It forms new chemical bonds and makes new components of the body.



- Decomposition and synthesis reactions are often coupled together.
- Equilibrium is when the rates of forward and reverse reactions are in balance.
  - A reaction continues until equilibrium is reached.
- Enzymes are specialized proteins that promote chemical reactions by lowering the activation energy.
  - Enzymes function as catalysts.
  - Example: The starter in an engine doesn't keep the engine turning, but it helps it get going. Then the engine keeps itself running.

- In an aqueous solution, anions are negative ions surrounded by positive poles of water molecules, and cations are positive ions surrounded by negative poles of water molecules.

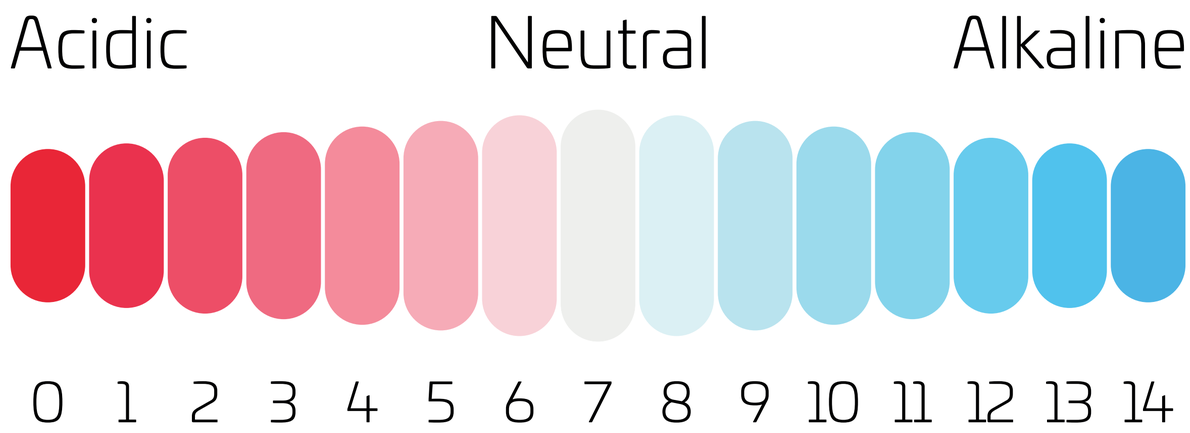
  - Electrolytes are soluble inorganic substances whose ions will conduct electrical current.



Equations and Reactions

pH measures the acidity of fluids by determining the concentration of hydrogen ions (H+). The pH scale ranges from 0 to 14.
On the pH scale, 7 is neutral, <7 is acidic, and >7 is alkaline (basic).
The normal pH of blood is 7.35–7.45, so it is slightly basic.

pH scale



- Many organic molecules lack or have very few polar covalent bonds.
- Non-polar molecules have no positive or negative poles.
- Colloid – mixture containing evenly dispersed proteins or other large molecules that are suspended but NOT dissolved.
  - Milk is a colloid

Water is the most important component of the body. It makes up around 2/3 of your total body weight. It is a reactant or solvent used in many biological reactions.
Water is polar due to the polar covalent bonds.
Hydrophilic – means easily dissolved by water. Hydrophobic is the opposite.