

Chemistry of life

Chemical composition of living things

- 98% H,O,C,N (**bioelements**)
- ~2% S, P, Na, Cl, Ca, K, Mg, Fe (**macroelements**)
- ~0.02% I, F, Co, Mn, Mo, B, Zn (**microelements**)
- In very small amounts Ag, Se, Hg(**ultramicroelements**)

Chemical reactions

- A **compound** is formed when molecules are rearranged or bonds form between atoms. The formation of bonds is termed a **chemical reaction**

Types of reaction

- Oxidation - reduction (redox) reactions
- Anabolic - catabolic reactions
- Hydrolysis - dehydration synthesis

Oxidation - reduction (redox) reactions

- A chemical reaction involves **physical changes** to all the **reactants** involved. For example, a compound may **receive** or **donate** electrons. Such reactions are known as **oxidation-reduction** reactions or redox reactions. The compound donating electrons is said to be *oxidised* while the compound accepting electrons is said to be *reduced*.
- Ex:
- $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \longrightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{Energy}$ (Oxidation of glucose)

Anabolic - Catabolic Reactions

- **Catabolic Reactions**

- Organic compounds are **broken down** to their monomers by catabolic reactions, most of which result in energy release.
- EX: $C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + \text{Energy (38 ATP/686 Kcal/mol)}$

- **Anabolic Reactions**

- All reactions in a cell that **build** new molecules are known as anabolic reactions.
- EX:
• $6CO_2 + 6H_2O + \text{Light energy (686 Kcal/mol)} \longrightarrow C_6H_{12}O_6 + 6O_2$

Hydrolysis - Dehydration Synthesis

- Chemical reactions can also be categorised according to the behaviour of **water** in the reaction. For example in catabolic reactions, water is **split** by hydrolytic enzymes and its components are added to the bonds that are to be broken. This is known as **hydrolysis**
- EX: $C_{12}H_{22}O_{11} + H_2O \longrightarrow 2 C_6H_{12}O_6$ (hydrolysis)
- Anabolic reactions, the condensation of two amino acids or carbohydrates for example, involves the **formation** of new bonds and the formation and release of water. This is known as **dehydration synthesis**
- EX: $aa_1 + aa_2 \longrightarrow \text{dipeptide} + H_2O$ (dehydration)