Redox (reduction-oxidation)

Redox (reduction-oxidation) reactions include all chemical reactions in which atoms have their oxidation state changed. This can be either a simple redox process, such as the oxidation of carbon to yield carbon the reduction of dioxide (CO₂) or carbon by hydrogen to yield methane (CH₄), or a complex process such as the oxidation of glucose $(C_6H_{12}O_6)$ in the human body through а series of complex electron transfer processes.

Fundamentally, redox reactions are a family of reactions that are concerned with the transfer of electrons between species. The term comes from the two concepts of reduction and oxidation.^[1] It can be explained in simple terms:

- **Oxidation** is the *loss* of electrons or an *increase* in oxidation state by a molecule, atom, or ion.
- **Reduction** is the *gain* of electrons or a *decrease* in oxidation state by a molecule, atom, or ion.

Although oxidation reactions are commonly associated with the formation of oxides from oxygen molecules, these are only specific examples of a more general concept of reactions involving electron transfer.



Reduction Oxidant + e⁻ -----> Product (Electrons gained; oxidation number decreases)

Redox reactions, or oxidation-reduction reactions, have a number of similarities to acid-base reactions. Like acid-base reactions, redox reactions are a matched set, that is, there cannot be an oxidation reaction without a reduction reaction happening simultaneously. The oxidation alone and the reduction alone are each called a *half-reaction*, because two half-reactions always occur together to form a whole reaction. When writing half-reactions, the gained or lost electrons are typically included explicitly in order that the half-reaction be balanced with respect to electric charge.

Though sufficient for many purposes, these descriptions are not precisely correct. Oxidation and reduction properly refer to a change inoxidation state — the actual transfer of electrons may never occur. Thus, oxidation is better defined as an increase in oxidation state, and reduction as a decrease in oxidation state. In practice, the transfer of electrons will always cause a change in oxidation state, but there are many reactions that are classed as "redox" even though no electron transfer occurs (such as those involving covalent bonds).