Oxidation-Reduction

or **redox**, Any chemical reaction in which the oxidation number of a participating chemical species changes.

Addition of hydrogen or electrons or removal of oxygen is reduction, and removal of hydrogen or electrons or addition of oxygen is oxidation.

The processes always occur simultaneously: one substance is oxidized by the other, which it reduces. The conditions of the substances before and after are called oxidation states, to which numbers are given and with which calculations can be made. (Valence is a similar but not identical concept.)

The chemical equation that describes the electron transfer can be written as two separate half reactions that can in theory be carried out in separate compartments of an electrolytic cell (*see* electrolysis), with electrons flowing through a wire connecting the two.

Strong oxidizing agents include fluorine, ozone, and oxygen itself; strong reducing agents include alkali metals such as sodium and lithium.

Redox reaction is a chemical reaction involving both reduction and oxidation, which results in changes in the oxidation numbers of atoms included in the reaction.

Oxidation is when there is an increase in oxidation number;

Reduction is when there is a decrease in oxidation number.

It is involved in many important biological processes, such as cellular respiration and photosynthesis. In cellular respiration, for instance, redox

reaction occurs when glucose is oxidized to carbon dioxide whereas oxygen is reduced to water. **Variant:** oxidation-reduction reaction

What is oxidation-reduction reaction in biochemistry?

An oxidation-reduction (redox) reaction is **a type of chemical reaction that involves a transfer of electrons between two species**. An oxidation-reduction reaction is any chemical reaction in which the oxidation number of a molecule, atom, or ion changes by gaining or losing an electron.

Table 1: Oxidation vs. Reduction

Oxidation	**Reduction**
In oxidation, the electron is "lost"	In **reduction**, the electron is "gained"
Increased oxidation state of reactants	Decreased oxidation state of reactants
A species that donates the electron and undergoes oxidation is known as the *reducing agent*. Thus, it is also referred to as the *"electron donor"*. When it loses an electron, it is, thereby, *"oxidized"*.	A species that accepts the electron or reduces an atom is called an oxidizing agent. Thus, it is also known as the *"electron acceptor"*. When it accepts an electron, it is, thereby, *"reduced"*.
Examples of reducing agents are electropositive elements, such as sodium, magnesium, and iron	Examples of oxidizing agents are electronegative elements, such as O_2 and F_2

Redox Reactions in Biology

What is the purpose of redox reactions in the cell?

Many biological processes involve redox reactions, such as in cellular respiration and photosynthesis.

Cellular respiration

Cellular respiration ($C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$) is the oxidation of glucose into carbon dioxide (CO_2) and reduction of oxygen (O_2) to water (H_2O). The method of cellular respiration redox is related to the reduction and oxidation of NAD^+ into NADH and vice versa. Below is a schematic diagram of cellular respiration.

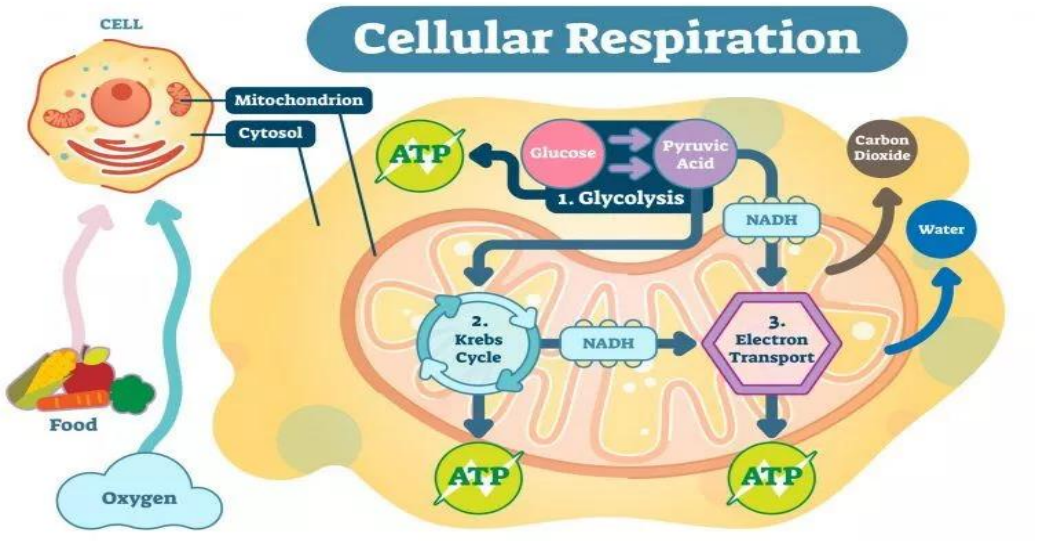

Figure 1: Schematic diagram of aerobic respiration as a form of cellular respiration. There are many instances where in redox occurs in this biological process. An example is the oxidation of glucose during glycolysis where $NAD^+$is *reduced*, thereby, producing NADH. This is also what occurs involving the other electron carriers, such as FAD producing $FADH_2$. And the steps of the citric acid cycle are, in fact, a series of redox reactions.

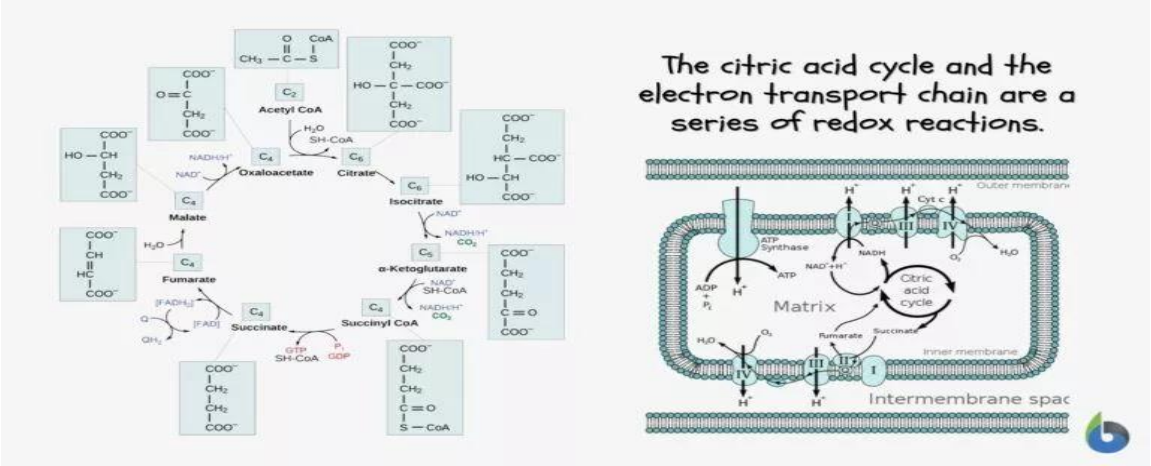

Figure 2: Citric acid cycle (left) and electron transport chain (right) are shown to illustrate redox reactions.

Photosynthesis

In redox reactions in photosynthesis

($6\ CO_2 + 6\ H_2O$ + light energy $\rightarrow C_6H_{12}O_6 + 6\ O_2$),

Carbon dioxide is reduced into sugar and water oxidation gives molecular oxygen. The number of electrons in oxygen is 8. Although cellular

respiration and photosynthesis appear like opposite reactions, these two processes are not reverse of each other.

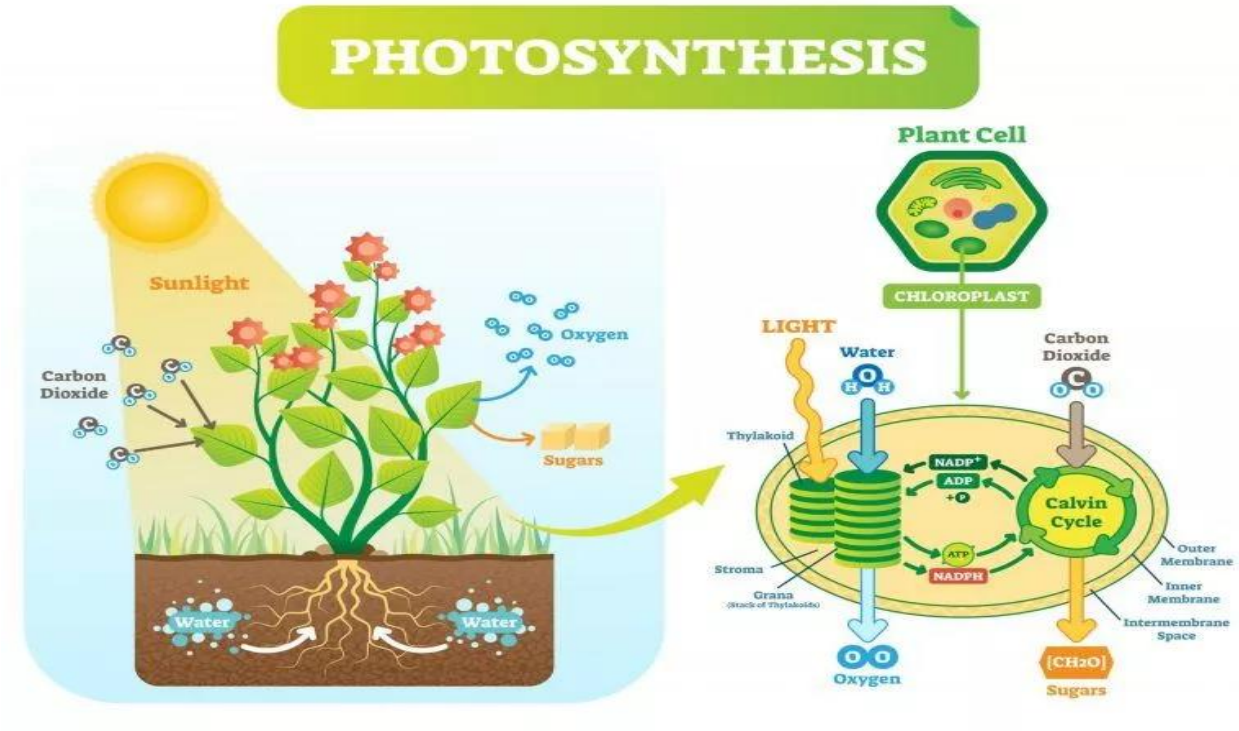

Figure 3: Photosynthesis involves the losing and gaining of electrons, which unlike in cellular respiration, is driven by light (photon).