## What Are Enzymes?

***"Enzymes can be defined as biological polymers that catalyze biochemical reactions."***

The vast majority of enzymes are proteins with catalytic capabilities that are essential for maintaining various life processes. Metabolic processes and other chemical reactions in the cell are carried out by a set of enzymes that are necessary to sustain life.

The initial stage of metabolic process depends upon the enzymes, which react with a molecule and is called the substrate. Enzymes convert the substrates into other distinct molecules and are called the products.

The regulation of enzymes has been a key element in clinical diagnosis because of their role in maintaining life processes. The macromolecular component of all enzymes consists of protein, except in the class of RNA catalysts called ribozymes. The word ribozyme is derived from the ribonucleic acid enzyme. Many **ribozymes** are molecules of ribonucleic acid which catalyze reactions in one of their own bonds or among other RNAs.

Enzymes exist in all fluids and tissues of the body. Intracellular enzymes catalyze all the reactions that occur in metabolic pathways. The enzymes in plasma membrane regulate catalysis in the cells in response to cellular signals and enzymes in the circulatory system regulate clotting of blood. Almost all the significant life processes are based on the enzyme functions.

## Enzyme Structure

Enzymes are a linear chain of amino acids that generate the three-dimensional structure. The sequence of amino acids enumerates the structure, which in turn identifies the catalytic activity of the enzyme. The structure of the enzyme denatures when heated, leading to loss of enzyme activity, which is typically connected to the temperature.

Enzymes are larger than their substrates, and their size varies, which range from sixty-two amino acid residues to an average of two thousand five hundred residues present within fatty acid synthase. Only a small section of the structure is involved in catalysis and are situated next to binding sites. The catalytic site and binding site together constitute the enzyme's active site. A small number of ribozymes exists which serves as an RNA-based biological catalyst. It reacts in complex with proteins.

## Cofactors

Cofactors are non-proteinous substances that associate with enzymes. A cofactor is essential for the functioning of an enzyme. An enzyme without a cofactor is called an apoenzyme. An apoenzyme and its cofactor together constitute the holoenzyme.

There are three kinds of cofactors present in enzymes:

- **Prosthetic groups**: These are cofactors tightly bound to an enzyme at all times. A fad is a prosthetic group present in many enzymes.
- **Coenzyme**: A coenzyme is bound to an enzyme only during catalysis. At all other times, it is detached from the enzyme. $NAD^+$ is a common coenzyme.
- **Metal ions**: For the catalysis of certain enzymes, a metal ion is required at the active site to form coordinate bonds. $Zn^{2+}$ is a metal ion cofactor used by a number of enzymes.

## Functions of Enzymes

The enzymes perform a number of functions in our body. These include:

1. Enzymes help in signal transduction. The most common enzyme used in the process includes protein kinase that catalyzes the phosphorylation of proteins.
2. They breakdown large molecules into smaller substances that can be easily absorbed by the body.
3. They help in generating energy in the body. ATP synthases are the enzymes involved in the synthesis of energy.
4. Enzymes are responsible for the movement of ions across the plasma membrane.
5. Enzymes perform a number of biochemical reactions, including oxidation, reduction, hydrolysis, etc. to eliminate the non-nutritive substances from the body.
6. They function to reorganize the internal structure of the cell to regulate cellular activities.

## Classification of Enzymes

According to the International Union of Biochemists (I U B), enzymes are divided into six functional classes and are classified based on the type of reaction in which they are used to catalyze. The six types of enzymes are oxidoreductases, hydrolases, transferases, lyases, isomerases, ligases.

Following are the enzymes classifications in detail:

| **Types** | **Biochemical Property** |
|---|---|
| Oxidoreductases | The enzyme Oxidoreductase catalyzes the oxidation reaction where the electrons tend to travel from one form of a molecule to the other. |
| Transferases | The Transferases enzymes help in the transportation of the functional group among acceptors and donors molecules. |
| Hydrolases | Hydrolases are hydrolytic enzymes, which catalyze the hydrolysis reaction by adding water to cleave the bond and hydrolyze it. |
| Lyases | Adds water, carbon dioxide or ammonia across double bonds or eliminate these to create double bonds. |
| Isomerases | The Isomerases enzymes catalyze the structural shifts present in a molecule, thus causing the change in the shape of the molecule. |

| | |
|---|---|
| Ligases | The Ligases enzymes are known to charge the catalysis of a ligation process. |

### Oxidoreductases

These catalyze oxidation and reduction reactions,e.g. pyruvate dehydrogenase, which catalyzes the oxidation of pyruvate to acetyl coenzyme A.

### Transferases

These catalyze the transfer of a chemical group from one compound to another. An example is a transaminase, which transfers an amino group from one molecule to another.

### Hydrolases

They catalyze the hydrolysis of a bond. For example, the enzyme pepsin hydrolyzes peptide bonds in proteins.

### Lyases

These catalyze the breakage of bonds without catalysis, e.g. aldolase (an enzyme in glycolysis) catalyzes the splitting of fructose-1, 6-bisphosphate to glyceraldehyde-3-phosphate and dihydroxyacetone phosphate.

### Isomerases

They catalyze the formation of an isomer of a compound. Example: phosphoglucomutase catalyzes the conversion of glucose-1-phosphate to glucose-6-phosphate (transfer of a phosphate group from one position to another in the same compound) in glycogenolysis (conversion of glycogen to glucose for quick release of energy.

### Ligases

Ligases catalyze the joining of two molecules. For example, DNA ligase catalyzes the joining of two fragments of DNA by forming a phosphodiester bond.