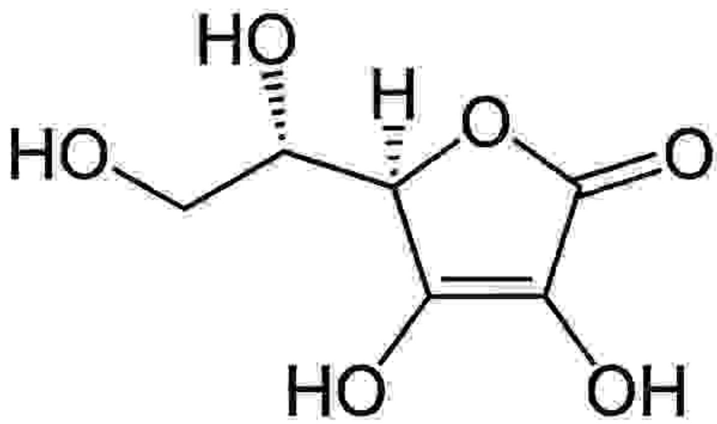
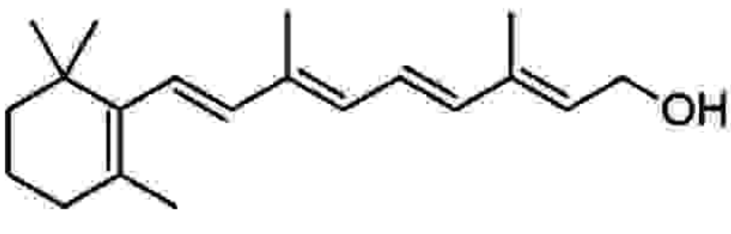
Coenzyme

A coenzyme is a small, organic, non-protein molecule that carries chemical groups between enzymes. It is the cofactor for the enzyme and does not form a permanent part in the enzyme's structure. Sometimes, they are called cosubstrates and are considered substrates that are loosely bound to the enzyme. In metabolism, coenzymes play a role in group-transfer reactions, such as ATP and coenzyme A, and oxidation-reduction reactions, such as NAD^+ and coenzyme Q10. Coenzymes are frequently consumed and recycled. Chemical groups are added and detached continuously by an enzyme. ATP synthase enzyme phosphorylates and converts the ADP to ATP, while Kinase dephosphorylates the ATP back to ADP at continuous rates as well. Coenzyme molecules are mostly derived from vitamins. They are also commonly made from nucleotides such as adenosine triphosphate and coenzyme A.

Through further research in coenzyme activity and its binding effect on the enzyme, more can be revealed about how the enzyme changes conformationally and functionally. An example is of the MAPEG group of integral membrane enzymes. These enzymes are crucial in the catalytic transformation of lipophilic substrates, which are involved in arachidonic acid derived messengers production and xenobiotic detoxification. Through use of a bound detergent to mimic a MAPEG enzyme's cofactor, glutathione, a new active site specific for lipophilic substrate is revealed; thus, further studies can reveal how these substrates bind to this second form of the enzyme [1].



Vitamin C is an important coenzyme



Vitamin A

Metal cofactors

Metal ions are common enzyme cofactors. Some enzymes, referred to as metalloenzymes, cannot function without a bound metal ion in the active site. In daily nutrition, this kind of cofactor plays a role as the essential trace elements such as: iron (Fe^{3+}), manganese (Mn^{2+}), cobalt (Co^{2+}), copper (Cu^{2+}), zinc (Zn^{2+}), selenium (Se^{2+}), and molybdenum (Mo^{5+}). For example, Mg^{2+} is used in glycolysis. In the first step of converting glucose to glucose 6-phosphate, before ATP is used to give ADP and one phosphate group, ATP is bound to Mg^{2+} which stabilizes the other two phosphate groups so it is easier to release only one phosphate group. In some bacteria such as genus *Azotobacter* and *Pyrococcus furiosus*, metal cofactors are also discovered to play an important role. An example of cofactors in action is the zinc-mediated function of carbonic anhydrase or the magnesium-mediated function of restriction endonuclease.

Cofactors can be **metals** or **small organic molecules**, and their primary function is to assist in enzyme activity. They are able to assist in performing certain, necessary, reactions the enzyme cannot perform alone. They are divided into coenzymes and prosthetic groups. A **holoenzyme** refers to a catalytically active enzyme that consists of both **apoenzyme** (enzyme without its cofactor(s)) and cofactor. There are two groups of cofactors: metals and small organic molecules called coenzymes. Coenzymes are small organic molecules usually obtained from vitamins. **Prosthetic groups** refer to tightly bound coenzymes, while **cosubstrates** refer to loosely bound coenzymes that are released in the same way as substrates and products. Loosely bound coenzymes differ from substrates in that the same coenzymes may be used by different enzymes in order to bring about proper enzyme activity.

General formula