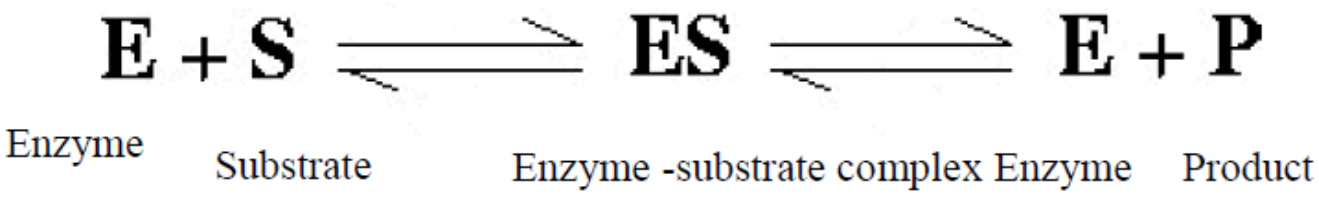
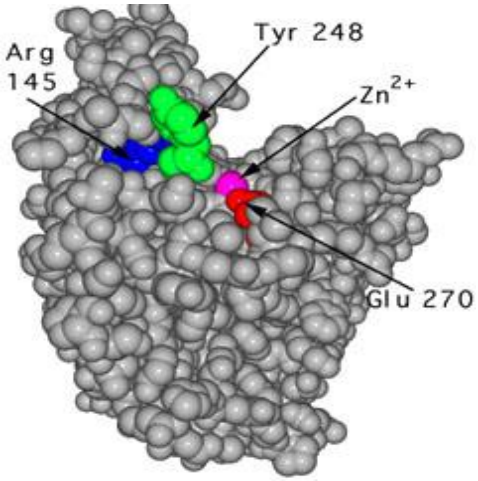
Introduction to Enzymology

- ***Enzyme:*** a biological molecule that increase the rates of chemical reactions
- ***Substrate***: a molecule upon which an enzyme acts.
- ***E-S complex*** :Formed when the substrate molecule binds to the active site of the particular enzyme.
- ***Product:*** Is the molecule "manufactured" by an enzyme from its substrate

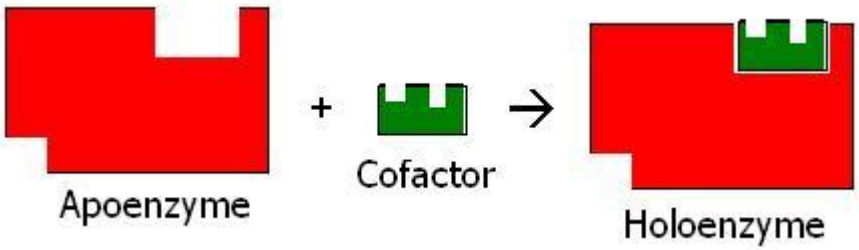


- ***Catalysis***: the change in rate of a chemical reaction due to the participation of a substance called a catalyst = Enzymes

- ***Active site :*** Is the part of an enzyme where substrates bind and undergo a chemical reaction
- ***Inhibitor:*** a substance that binds to an enzyme and decreases the enzyme's activity.

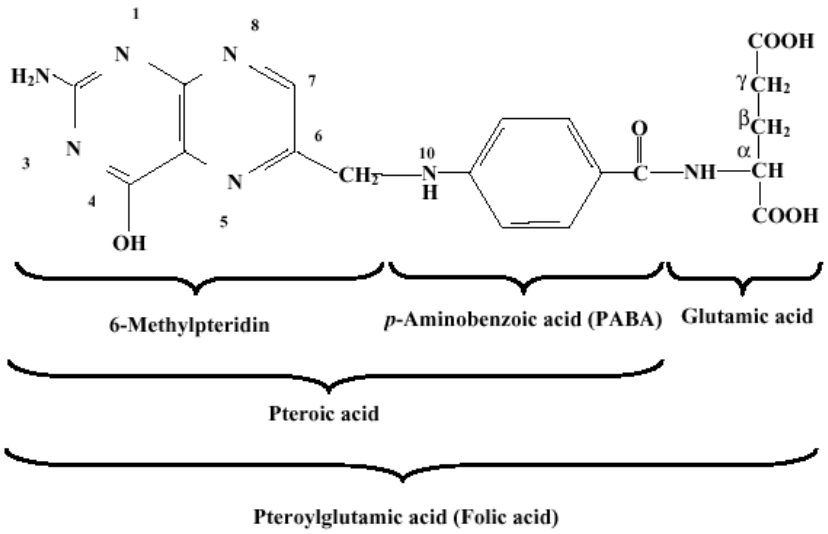


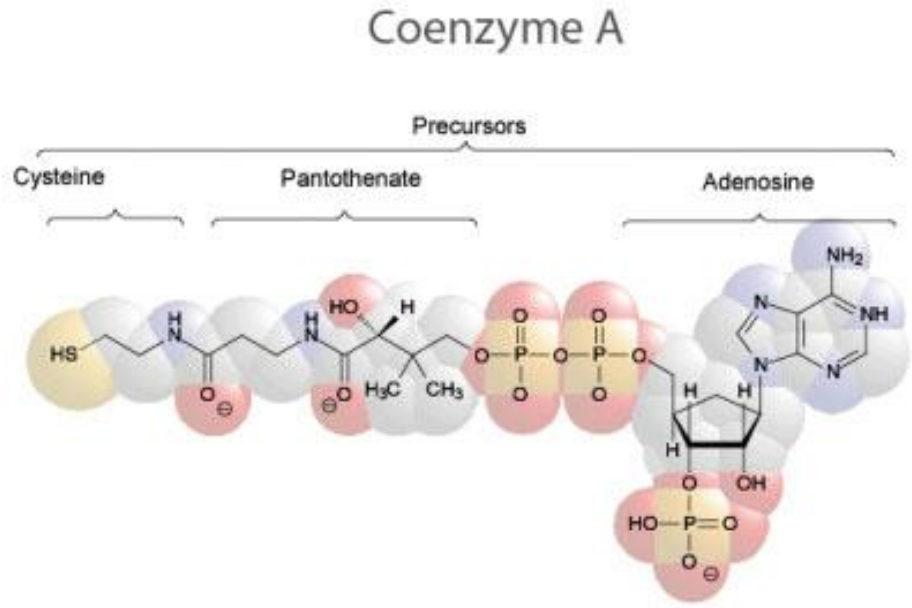
- ***Holoenzyme***: fully functional enzyme plus the Co-factor.
- ***Apoenezyme :*** the poly peptide chain of the enzyme molecule



- ***Co- factor*** : is a **non-organic** molecule bound to a protein and it is required for the Enzyme activity. cofactors can be considered "helper molecules" that assist in biochemical transformations .e.g. (Mg2+).

Co- enzyme organic molecules that can be loosely or tightly bound to an enzyme. Tightly bound coenzymes can be called **allosteric groups**. Coenzymes transport chemical groups from one enzyme to another , Most vitamins work as coenzymes such as thiamin (B1), riboflavin (B2) , and folic acid.



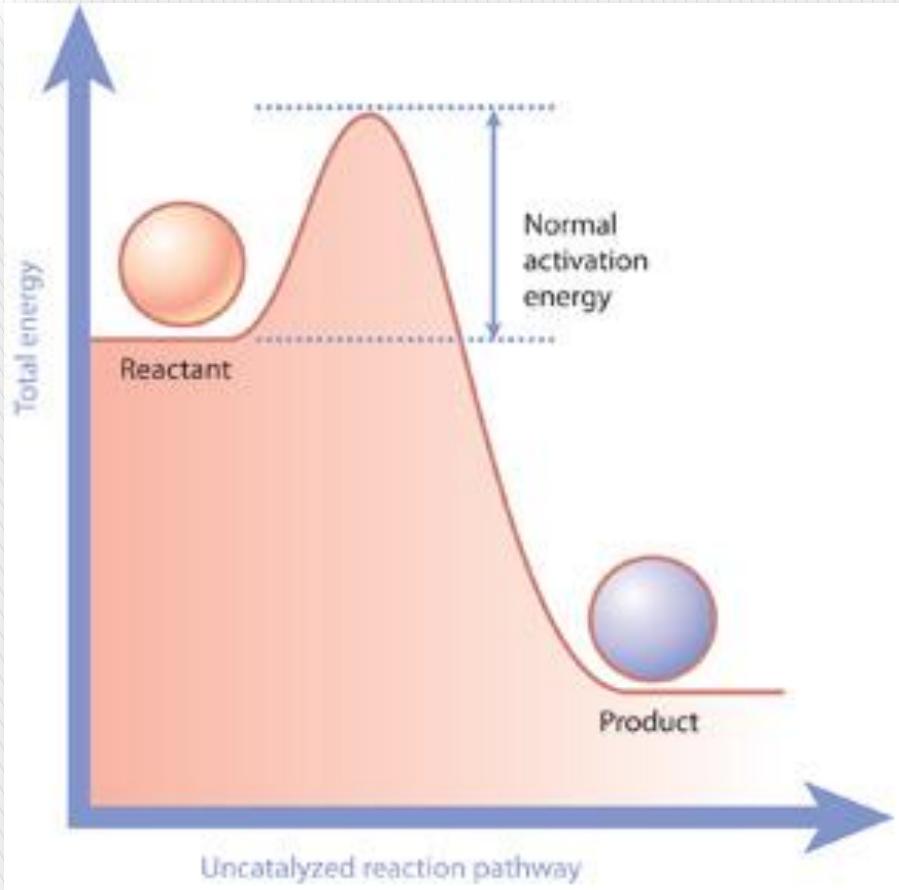


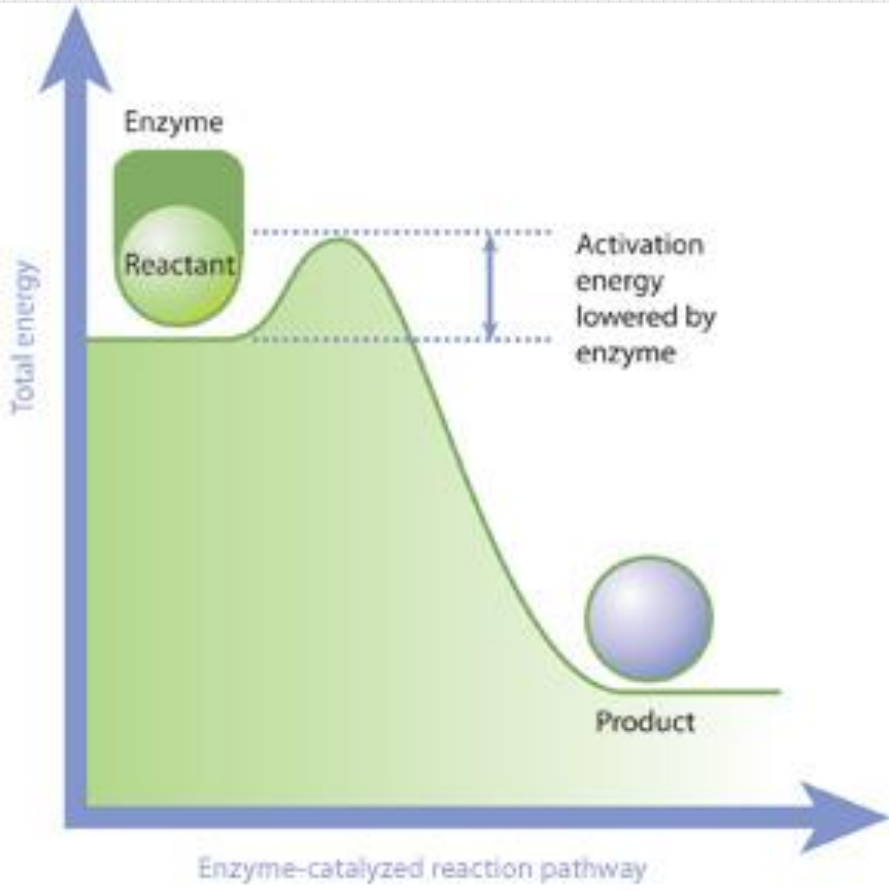
Quick Review

- **Enzyme (E)** catalyzed reactions in the living cell
- The reacting substances, upon which an enzyme acts, are termed the **substrates (S)**.
- The substances produced as a result of the reaction are the **products (P)**.
- Enzyme catalyzed reactions are mostly reversible and involve the formation of an intermediate **enzyme-substrate complex (ES).**

How can enzyme increase the rate of a biochemical reactions??

Lowering the activation energy





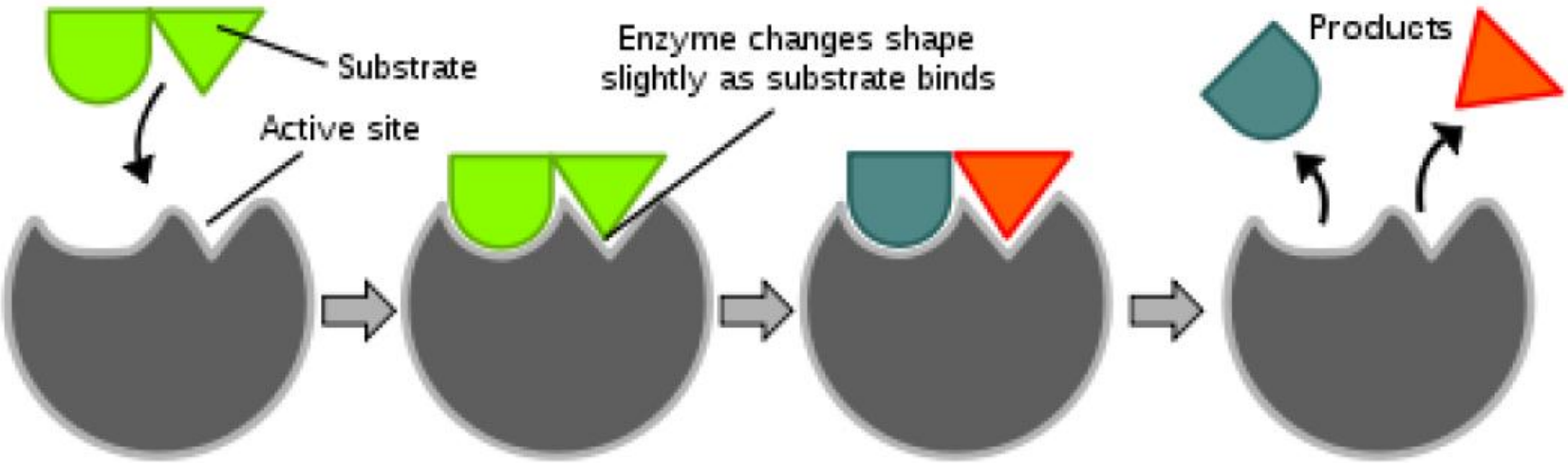
Turnover Number

- It is the **total number of substrate** molecules that an enzyme **can convert to product per minute**, when the enzyme is fully saturated with substrate.
- It varies from enzyme to another.
- Many enzymes have a high turnover number. For example, **catalase** has a turnover number of 5 million per minute.
- Thus enzymes are generally effective in relatively minute concentrations in the living cell.

Turnover numbers of some enzymes

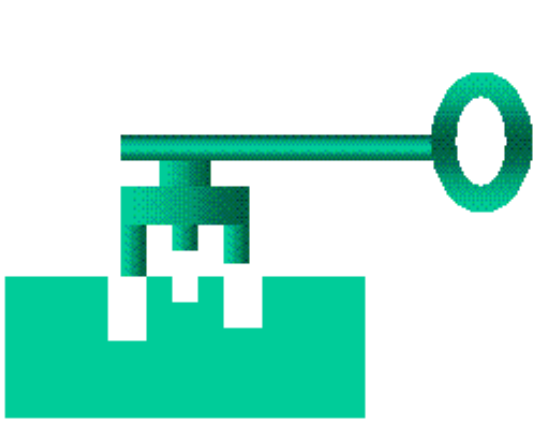
Enzyme	Turnover number (per second)
Carbonic anhydrase	600,000
3-Ketosteroid isomerase	280,000
Acetylcholinesterase	25,000
Penicillinase	2,000
Lactate dehydrogenase	1,000
Chymotrypsin	100
DNA polymerase I	15
Tryptophan synthetase	2
Lysozyme	0.5

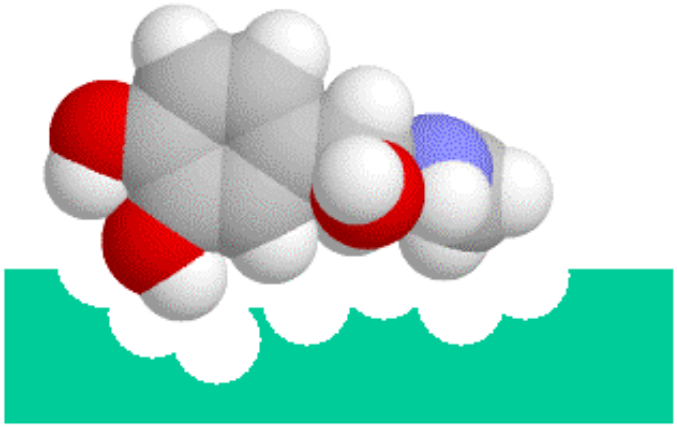
- The formation of enzyme-substrate complex is confined to relatively small areas of the enzyme molecule, known as active sites. The structure of a particular substrate may induce the enzyme to "mold" itself over the substrate.



The Key and lock hypothesis

- suggests that this was because both the enzyme and the substrate possess specific complementary geometric shapes that fit exactly into one another



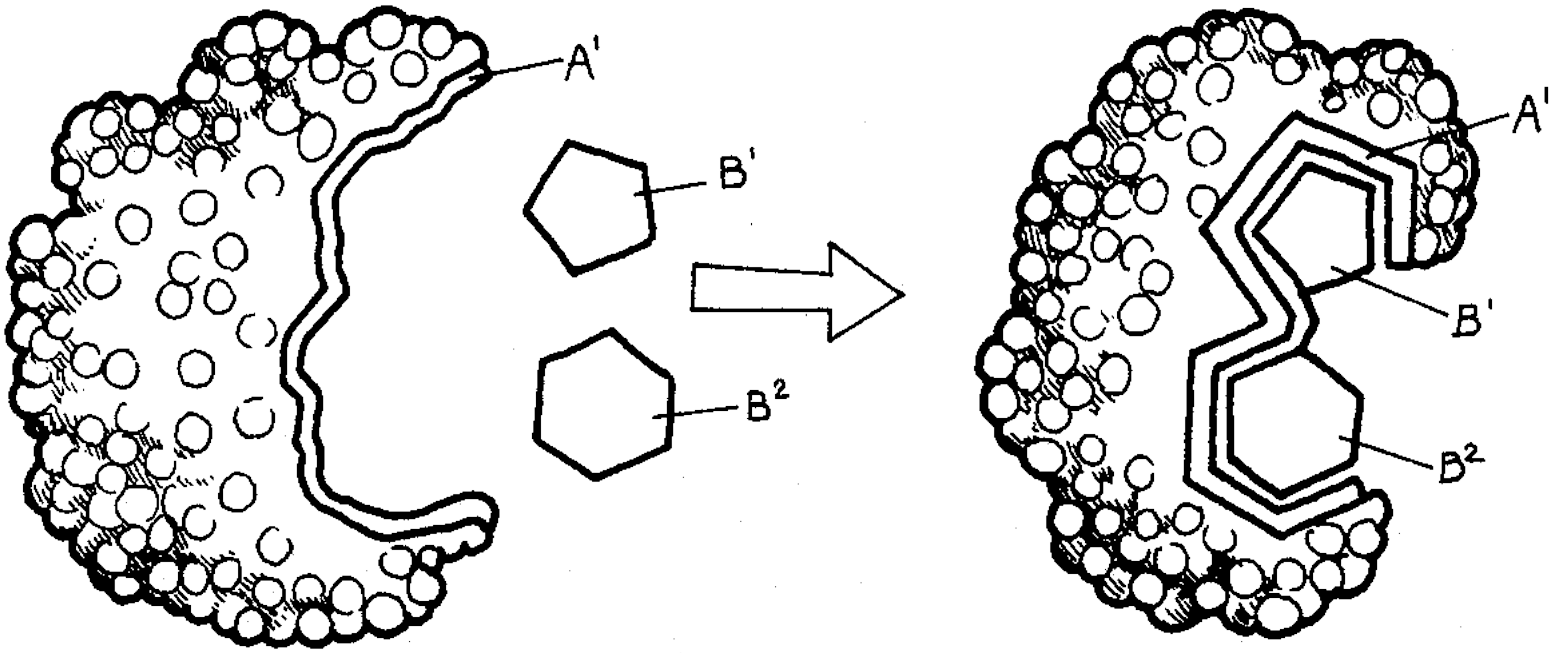


The "induced fit" hypothesis

suggests that differences in the surface configuration (three- dimensional shape) of the **active site** are essential to **specificity.**

➔only certain types of substrate molecule would be able to establish a close fit with a given type of enzyme molecule.

INDUCED-FIT THEORY★



Studying Enzymes

Because hundreds of reactions are simultaneously carried out in the living cell, it becomes difficult to study a single reaction in an intact living cell.

However, it is **possible to extract** enzymes from cells and thus study enzyme catalyzed reactions in a test tube.

Thank You