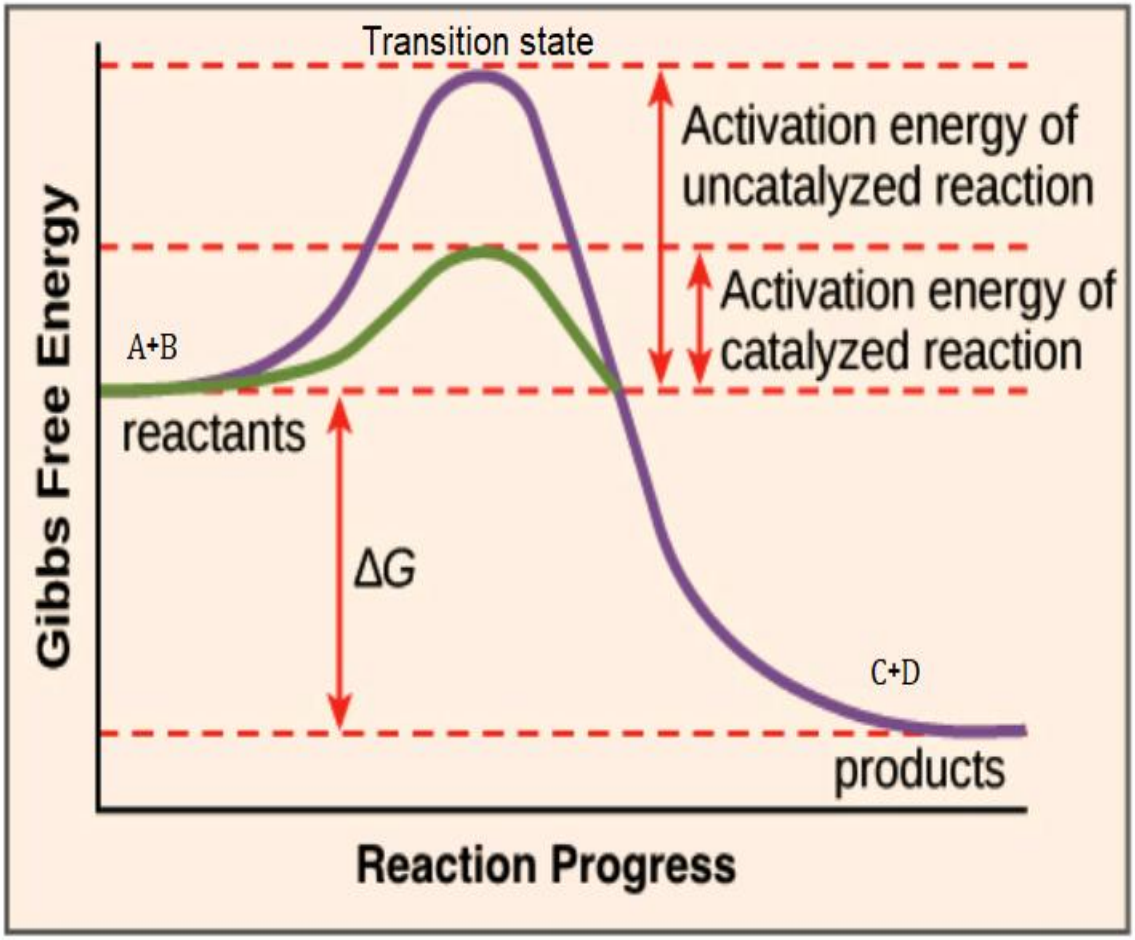
Enzymes

Enzymes: - A substance that speeds up a chemical reaction without being a reactant (without being changed on the reaction) is called a catalyst. The catalysts for biochemical reactions that happen in living organisms are called enzymes. and they are usually proteins.

How enzyme works:-

Enzymes perform the to lowering a reaction's activation energy—that is, the amount of energy that must be put in for the reaction to begin. Enzymes work by binding to reactant molecules and holding them in such a way that the chemical bond-breaking and bond-forming processes take place more readily.



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Here, enzymes don't change a reaction's ΔG value. That is, they don't change whether a reaction is energy-releasing or energy-absorbing overall. That's because enzymes don't affect the free energy of the reactants or products. Instead, enzymes lower the energy of the transition state, an unstable state that reactants must pass through in order to become products. The transition state is at the top of the energy in the diagram above.

Active sites and substrate :-

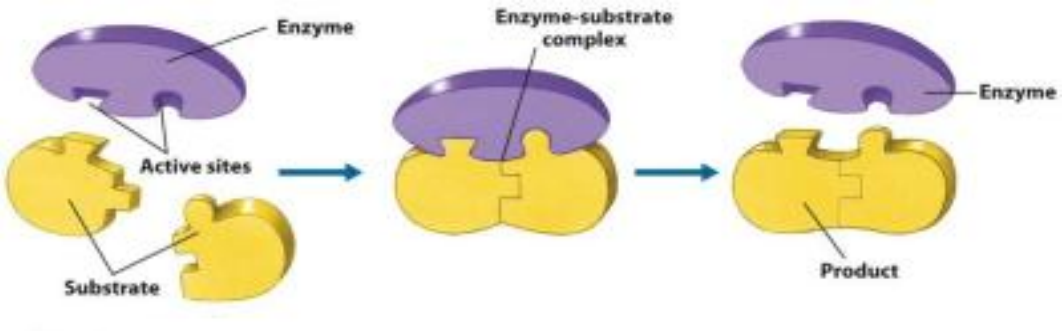
Enzyme molecules contain a special pocket or cleft called as active site.

Proteins are made of units of amino acids and in enzymes that are proteins, the active site gets its properties from the amino acids it's built out of. These amino acids may have side chains that are large or small, acidic or basic, hydrophilic or hydrophobic.

The active site contains three **-** dimensional surface complementary to substrate. The substrate is the reactant in a biochemical reaction.

The active site binds to substrate and forming an enzyme - substrate (ES) complex .ES is converted to enzyme - product complex which subsequently dissociated to enzyme product.

$$E + S \rightleftharpoons ES \longrightarrow E + P$$



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Catalytic Efficiency of Enzymes:-

The reactions catalyzed in presence of enzymes with highly efficient .this processes are take place from 10^3 to 10^8 times faster than uncatalyzed reactions. Typically each enzymes molecule is capable of transforming 100 to 1000 substrate molecules into product each second. the number of substrate molecules that converted to product per enzymes molecules per second is called the turnover number.

Cofactors and coenzymes:-

The first type of enzyme partner is a group called cofactors, or molecules that increase the rate of reaction or are required for enzyme function. Cofactors are not proteins (nonpotein cofactors) some of cofactors include metal ions for examples iron and zinc. and the other specific type of cofactor, coenzymes, are organic molecules that bind to enzymes . Coenzymes are not really enzymes .they work with enzymes. Many coenzymes are derived from vitamins.

- Holoenzyme:- refers to the enzyme with its cofactors
- Apoenzyme :- refers to the protein portion of the holoenzyme . In the absence of appropriate cofactor, the apoenzyme typically does not show biological activity.

Haloenzyme = Apoenzyme (protein part) + Cofactors (nonprotein part)

- Enzyme activity :- is expressed as micromoles of substrate converted to product per minute under specified assay condition . one standard unit (international unit)of enzyme activity (U) is that activity which catalyses transformation of 1 micromole of substrate per minute.

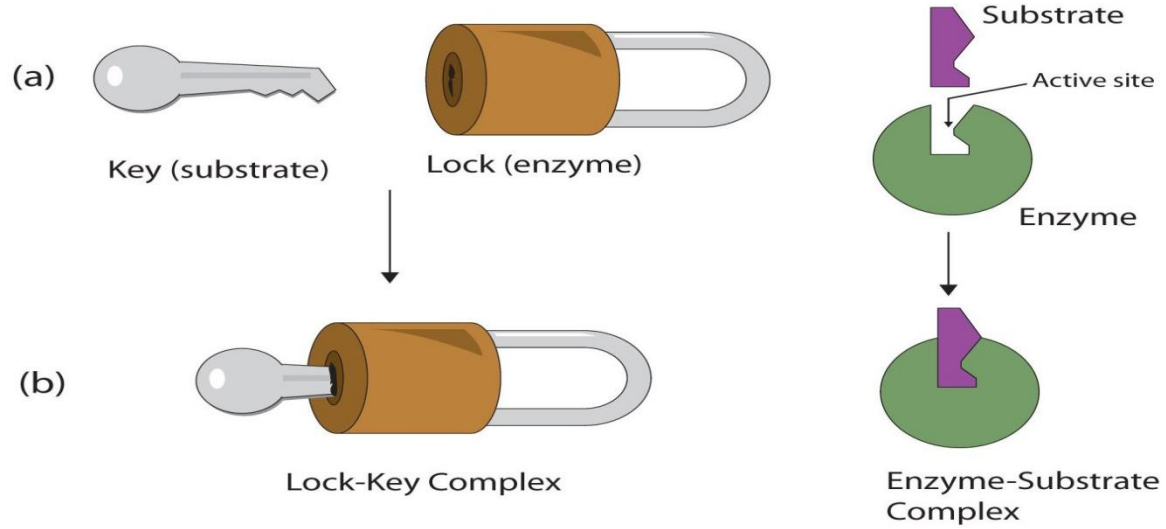
Enzymes

Theories of enzyme actions

1. Lock and key model or Fischer's template theory

This theory was proposed by a German biochemist Emil Fischer in 1894 This is in fact the very first model proposed to explain an enzyme catalyzed reaction. According to this model, the structure of the enzyme is rigid. The substrate fits to the binding active site just as a key fits into the proper lock or a hand into the proper glove. This model does not give any scope for the flexible nature of enzymes,

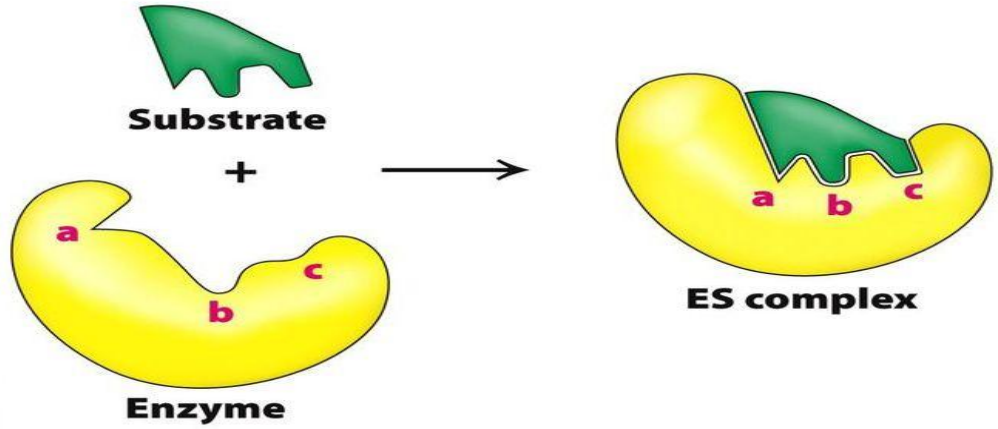
Hence the model totally fails to explain many facts of enzymatic reactions.



2. Induced fit theory or Koshland's model

Koshland, in 1958, proposed a more acceptable and realistic model for enzyme substrate complex formation. as per this model. the active site is not rigid .the essential features of the substrate binding site are present at the nascent active site. The interaction of the substrate with the enzyme induces a fit or a conformation change in the enzyme, resulting in the formation of a strong substrate binding site.

Evidence from the X-ray diffraction studies .Koshland's model also explains the action of competitive inhibition on enzymes.



3. Substrate strain theory

In this model, the substrate is strained due to the induced conformation change in the enzyme. It is also possible that when a substrate binds to the preformed active site, the enzyme induces a strain to the substrate. The strained substrate leads to the formation of product. in fact, a combination of the induced fit model with the substrate strain is considered to be operative in the enzymatic action.

