CHAPTER NO:6 ENZYMES

METABOLISM :- The sum of all biochemical reactions going on within a living organism is called metabolism "OR" The set of biochemical reactions that occur in living organisms in order to maintain life is called metabolism, the term metabolism is derived from greek word meaning "change" the concept of metabolism was of all given by Ibn-e-Natees who stated that "the body and its parts always undergoing change, there are two types of metabolism. catabolism and anabolism.

①: Catabolism :- The process in which large molecules are broken down into simpler molecules by releasing of energy is called catabolism.

Examples: RISPIRATION

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + Energy$$

$$Sucrose + H_2O \longrightarrow Glucose + Fructose + ATP$$

②: Anabolism :- The process in which small molecules combine to form large molecules by utilizing of energy is called anabolism.

Examples: PHOTOSYNTHESIS

WRITTEN BY
SAYED ABDUL MASTAN

$$6CO_2 + 12H_2O \xrightarrow[\text{chlorophyll}]{\text{Sun light}} C_6H_{12}O_6 + 6O_2 + 6H_2O$$

$$Glucose + Fructose + ATP \longrightarrow Sucrose + H_2O$$

The characteristics of all living thing such as breathing, reproduction growth and response to stimuli are the outcome of biochemical reactions taking place inside the body of a living organisms. All these reactions are controlled by specific proteins called enzym

ENZYMES

Enzymes are biological catalyst which speed up a chemical reactions without alter itself. the term enzyme was first of all used by german scientist Winhelm Kuhne in 1878

characteristics of Enzyme

Enzymes are the biochemical catalyst and posses the following important characteristics

① **Nature:-** Enzymes are proteins in nature and are secreted by cells.

② **Catalyst:-** They act like catalyst and speed up a biochemical reactions

③ **Specitic for Reaction:-** Enzymes are specitic in action. they are not specitic only for substrate but also for the kind of biochemical reactions.

④ **Used in small amount:-** Enzymes are requiired in very small amount as compared to the amount of substrate.

⑤ **Specitic active centey:-** Enzyme have specitic active centey called active site. which is attached to the substrate.

⑥ **Sensitivity:-** Enzyme are sensitive to the changing of temperature. PH. etc. these may stop their activity.

⑦ **Intracellular Enzymes:-** some enzyme are found inside the cells called intracellular enzymes. e.g mitochondria enzymes.

⑧ **Extracellular Enzymes:-** some enzymes work outside the cells called extracellular enzymes. e.g lipase, amylase, pepsine, etc

⑨ **Remain unattected:-** Enzymes are not consumed during the biochemical reactions and can be used again and again.

⑩ **Lower the activation energy:-** Enzyme do not initiate the reaction but increase the rate of reactions by lowering the activation energy which is required for substrate.

⑪ **Enzyme Inhibitors:-** Some substances interact with enzyme to prevent it from working is called enzyme inhibitors. e.g, poison, drugs, etc

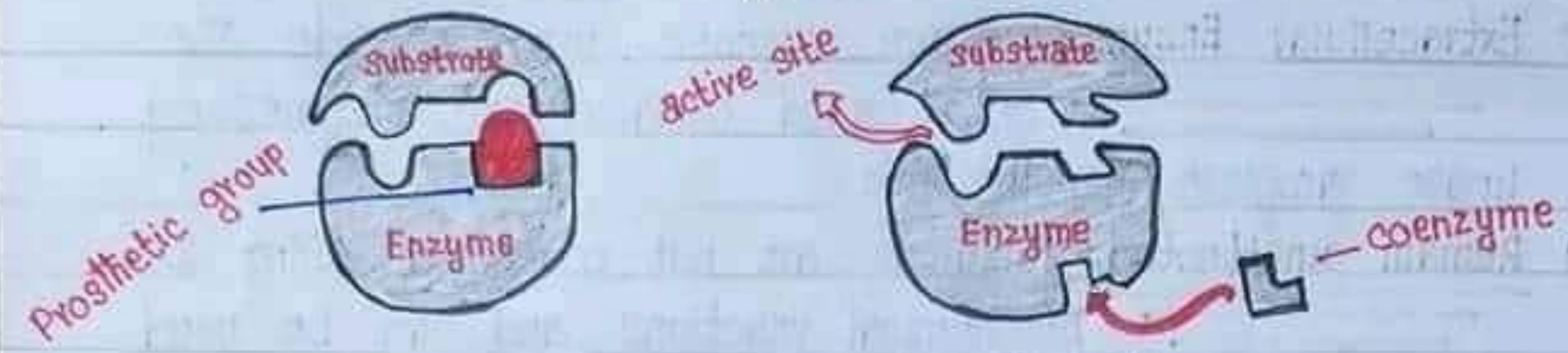
⑫ **Need a factor:-** Some enzymes work properly when a cofactor is attached

Cofactor:- Cofactor is a non-protein organic chemical compound that is required for an enzymes as catalyst. It can be considerd helper molecules for enzymes the main type of cofactor is, prosthetic groups, coenzyme and activators.

ⓐ **Prosthetic groups:-** It is a type of cofactor that is firmly bound to enzyme and can not be removed without denaturing is called prosthetic groups, e.g. Flavin mononucleotide (FMN) Flavin adenine dinucleotide (FAD)

ⓑ **Coenzyme:-** type of cofactor derived from vitamins that is loosly bound to the enzymes and can be readily separated from enzyme is called coenzyme

ⓒ **Activators:-** These are metal ions which form temporary attachment with enzyme, e.g. Zinc, Iron, etc.

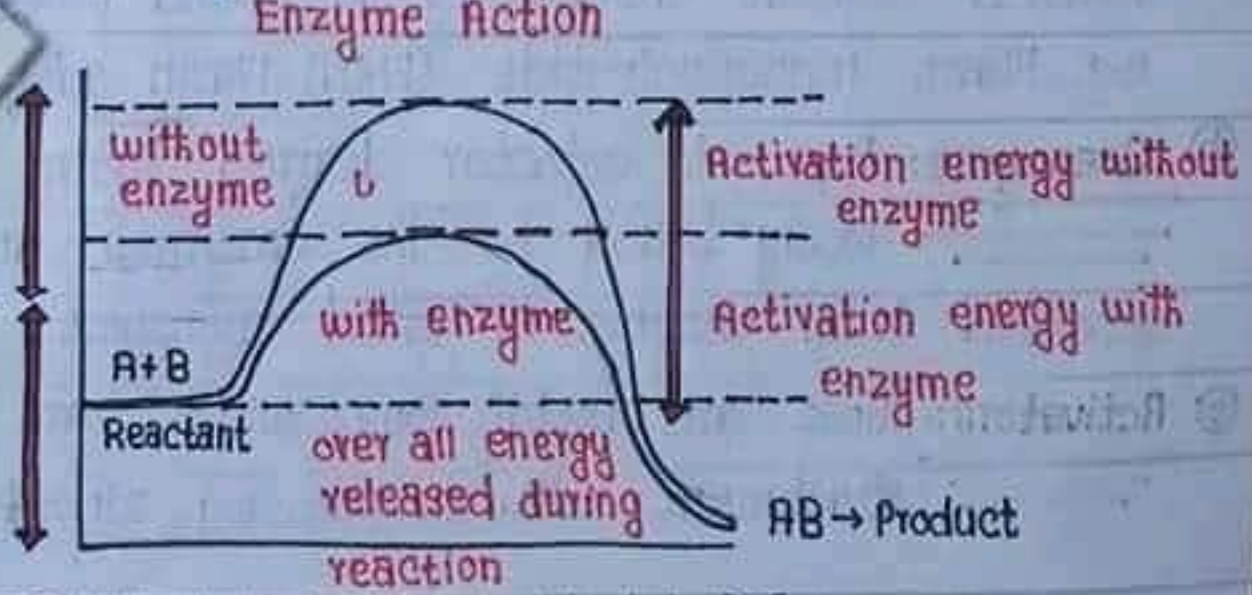


ACTIVATION ENERGY

The energy required to initiate chemical reaction is called activation energy. All chemical reaction required activation energy.

Enzyme lower activation energy:- When chemical reaction take place some amount of energy is required to break chemical bonds in reactant (substrate) such energy is called activation energy. Enzymes lower off the amount of activation energy. thus in the presence of enzymes reaction proceed at a faster rate. Enzymes act in many ways to lower the activation energy. for example. they change the shape of substrate molecules or bring them in correct orientation.

Example:- For the reaction $2H_2O_2 \longrightarrow 2H_2 + O_2$ the activation energy is 86kj/mole is required without catalyst and just 1kj/mole energy is required in the presence of enzyme.



MECHANISM OF ENZYME ACTION

There is a small portion in enzyme that is involved in catalysis. It is in the form of a depression or "pocket" on the surface of enzyme molecule. When an enzyme attached with the substrate, it form enzyme substrate complex (ES) the active site of enzyme catalyzes the reactions and into product, the enzymes substrate complex breaks and the enzyme and the product are released

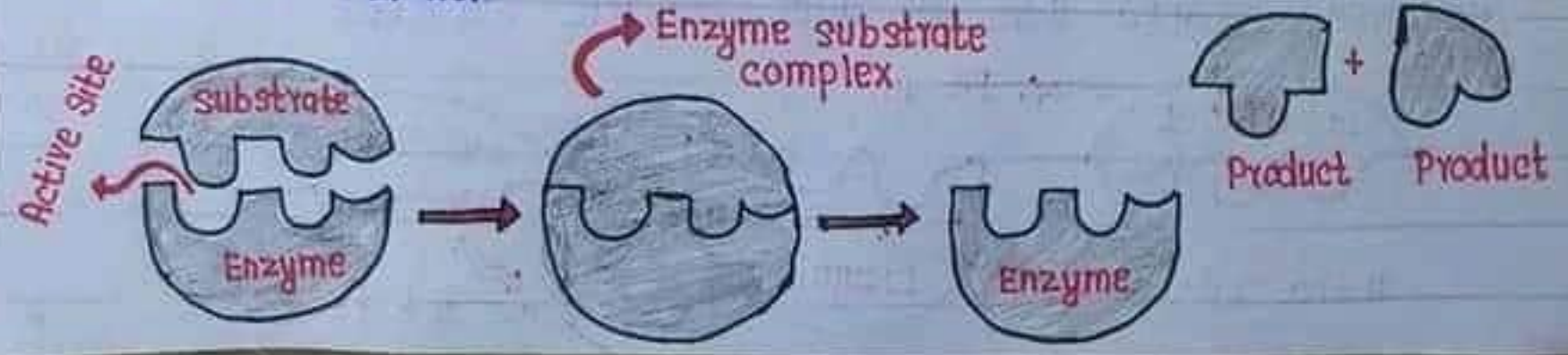
Enzyme + Substrate ⟶ Enzyme–Substrate ⟶ Enzyme + Product
(Active Site) Complex

There are two models which explain mechanism of enzyme action.

Lock and Key model:- This model was presented by a german scientist Emil Fisher in 1894 According to this model enzyme act as a lock and substrat act as key.

Main Points:- As one specific key can open only a specific lock. In the same manner the specific enzyme can transfer only specific substrate into products
The enzyme must have the correct geometric shape to fit the substrate

According to this model the active site has rigid structre. There is no modification in the active site before, during or after the reaction.



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SPECIFICITY OF ENZYMES

Enzyme are generally very specific in their action. They are specific not only for substrate but also for the kind of reaction. Every enzyme due to its special chemical structure can recognize a particular substrate. Enzyme that catalyse one reaction may not catalyse another.

Examples:-

① **Catalase:-** Catalase is an enzyme which only catalyze the decomposition of hydrogen peroxide

$$H_2O_2 \xrightarrow[H_2O]{\text{catalase}} H_2 + O_2$$

② **Protease:-** It is an enzyme which convert proteins into amino acids.

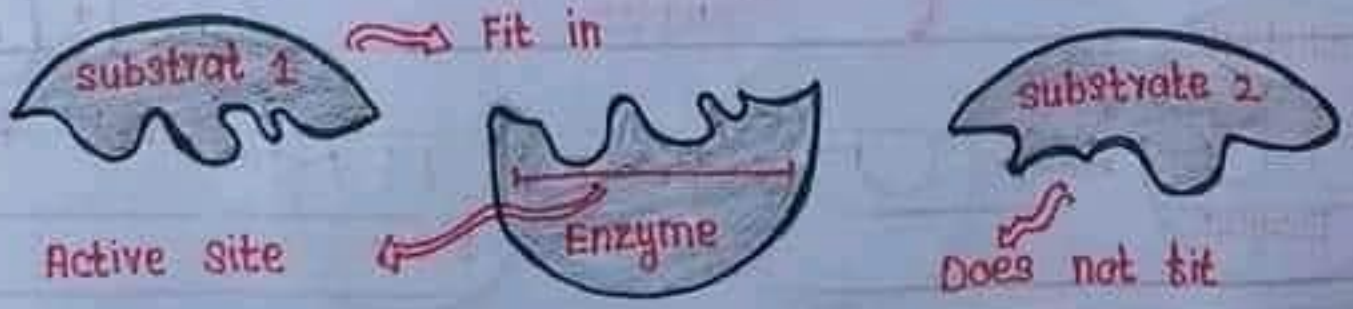
$$\text{Proteins} \xrightarrow[H_2O]{\text{Protease}} \text{Amino acids} + \text{Energy}$$

③ **Amylase:-** Amylase enzyme work only for the digestion of starch.

④ **Lipase:-** Lipase enzyme converts lipids into ami' fatty acid and glycerol

$$\text{Lipids} \longrightarrow \text{fatty acids} + \text{Glycerol}$$

The specificity of different enzymes is determined by the shape of theire active site. the active site posses specific geometric shapes that fit with specific substrate.



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