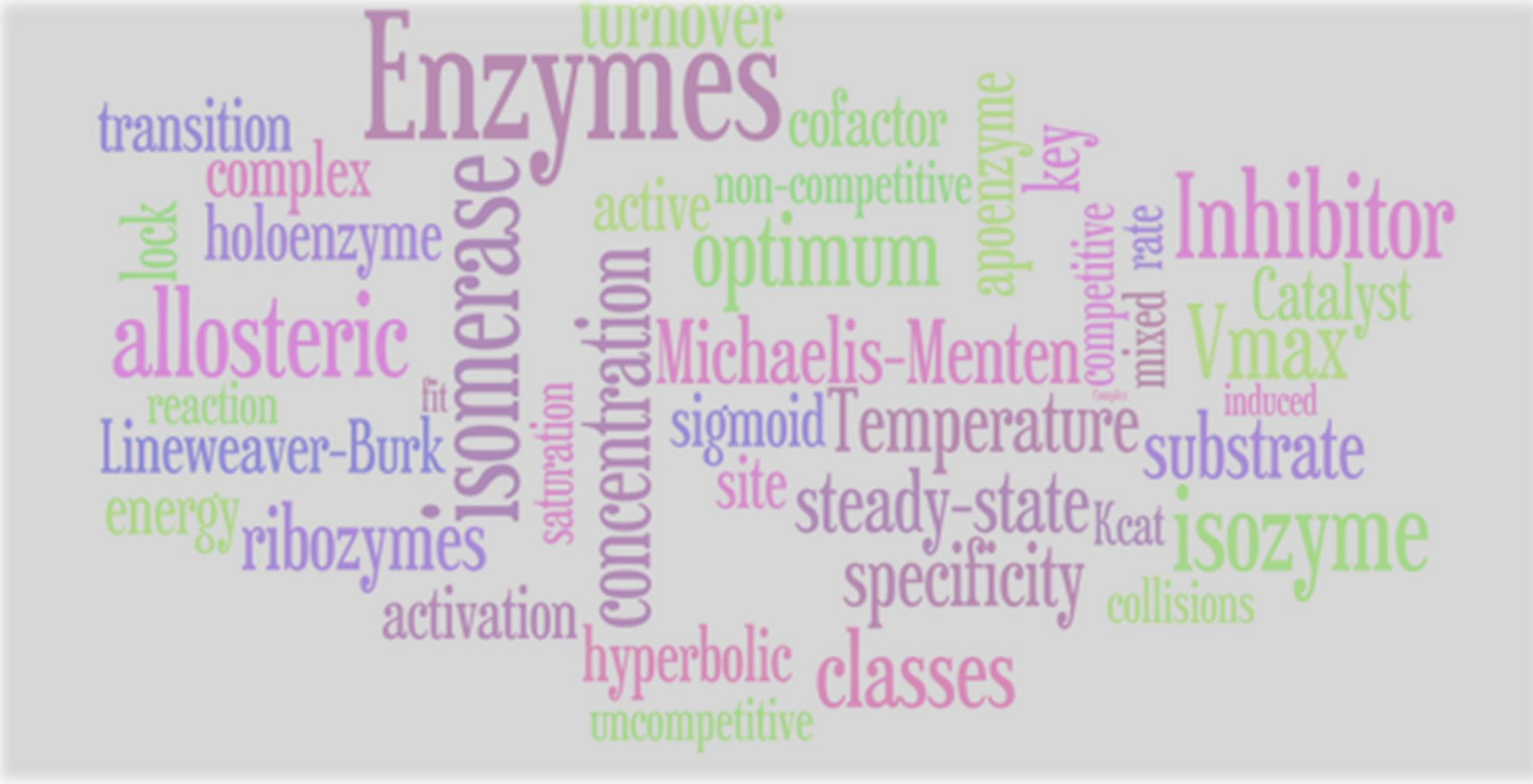
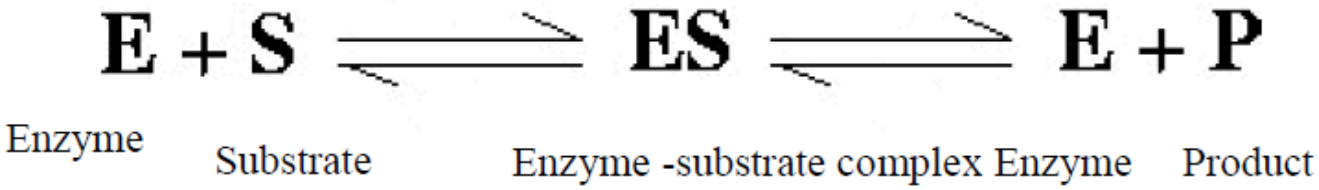
By: Amal Alamri

Introduction to Enzymology

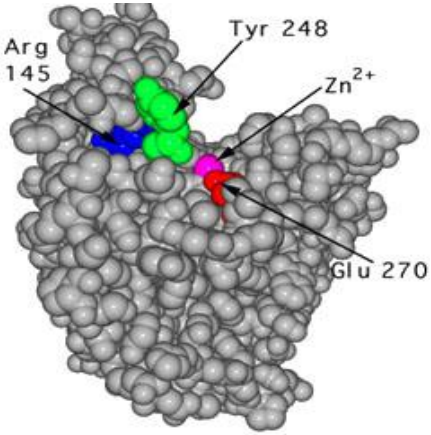


- ***Enzyme:*** a biological molecule that increase the rates of chemical reactions
- ***Substrate*****:** a molecule upon which an enzyme acts.
- ***E-S complex*** :Formed when the substrate molecule binds to the active site of the particular enzyme.
- ***Product:*** Is the molecule "manufactured" by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



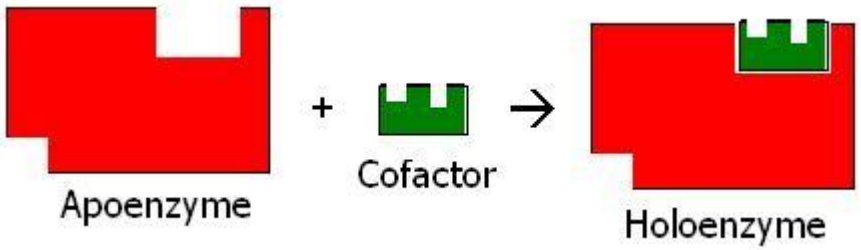
- ***Catalysis:*** the change in rate of a chemical reaction due to the participation of a substance called a catalyst = Enzymes
- ***Activation energy(E_a)*** : energy that must be overcome in order for a chemical reaction to occur/the minimum energy required to start a chemical reaction ,given in units of kilojoules/mole.

- ***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.

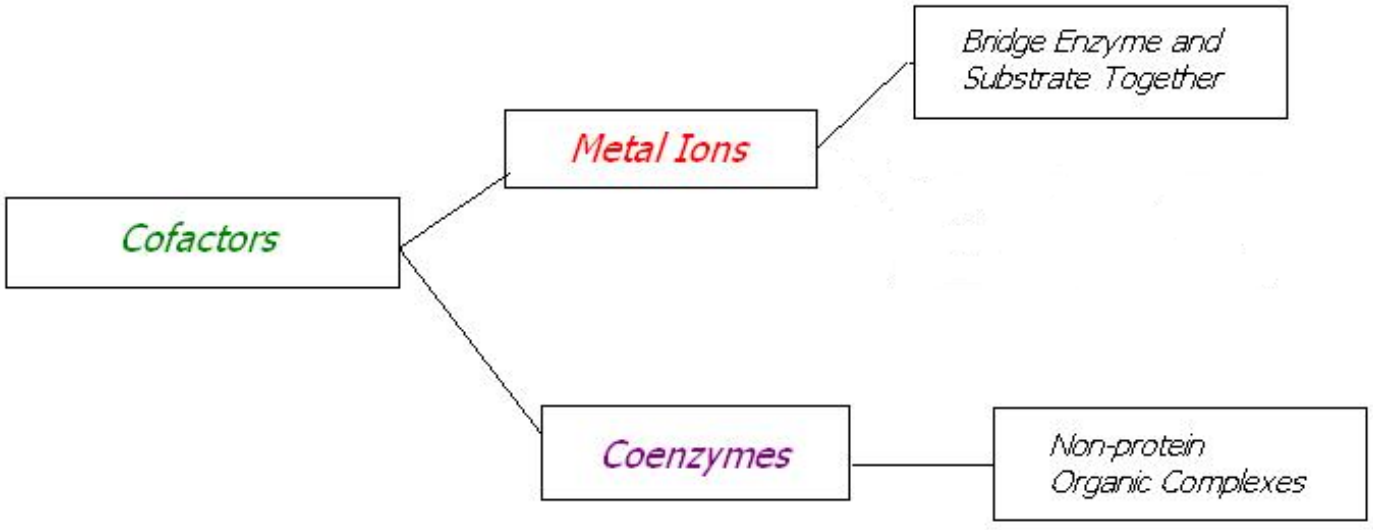


Holoenzyme**:** fully functional enzyme plus the Co-factor.

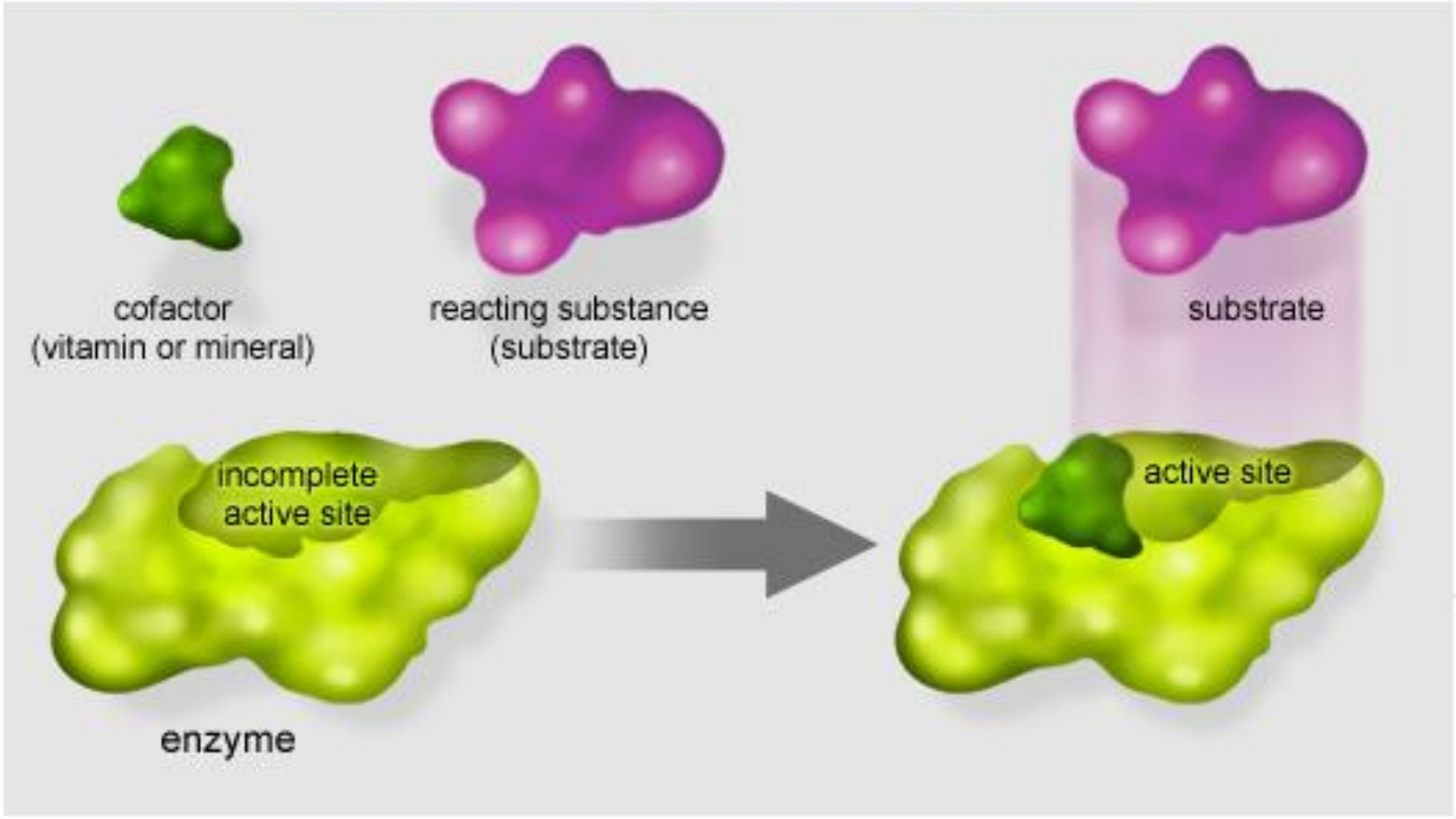
Apoenezyme : the poly peptide chain of the enzyme molecule



- ***Co- factor* :** molecule either inorganic ions ,such as (Fe2+,Mg2+,Mn2+ or Zn2+), or organic molecule called Co-enzymes such as vitamins.
- Some E require both coenzyme and one or more ion for activity. A co-enzyme or ion that is very tightly or even covalently bound to the E is called a **Proesthetic group.** Most vitamins work as coenzymes such as thiamin (B1), riboflavin (B2) , and folic acid (B9).



Vitamin and mineral cofactors make enzymes work

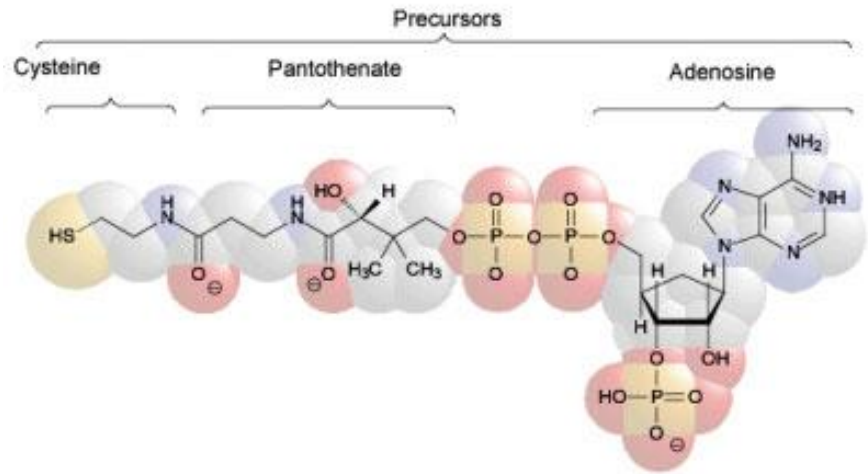


Many enzymes need a cofactor (vitamin or mineral) to activate them. Without the cofactor, the enzyme can't lock the reacting substance (substrate) into its active site, so the reaction can't take place. Most vitamin deficiency diseases happen this way.

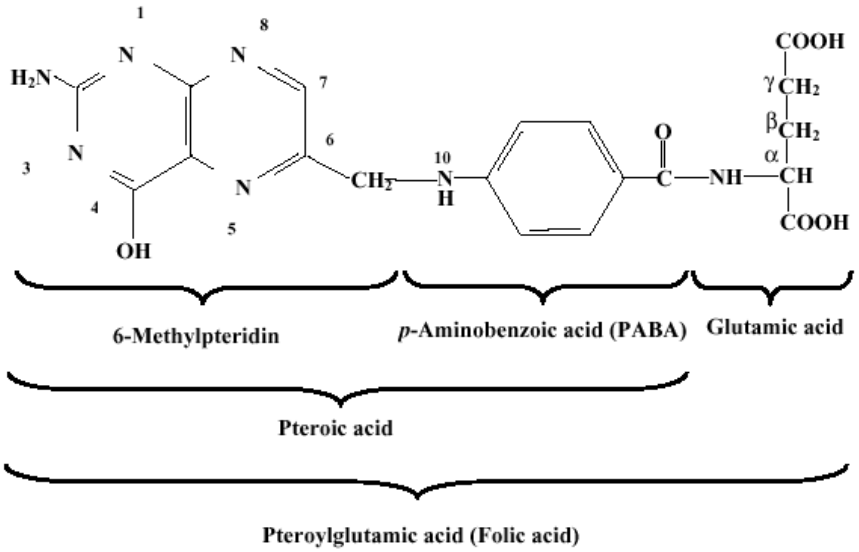
6.1 A Few Examples of Nonprotein Molecular "Partners" of Enzymes

TYPE OF MOLECULE	ROLE IN CATALYZED REACTIONS
Cofactors	
Iron	Oxidation/reduction
Copper	Oxidation/reduction
Zinc	Helps bind NAD
Coenzymes	
Biotin	Carries $—COO^-$
Coenzyme A	Carries $—CH_2—CH_3$
NAD	Carries electrons
FAD	Carries electrons
Prosthetic groups	
Heme	Binds ions, O_2, and electrons; contains iron cofactor
Flavin	Binds electrons
Retinal	Converts light energy

Coenzyme A



Examples of Co-enzymes



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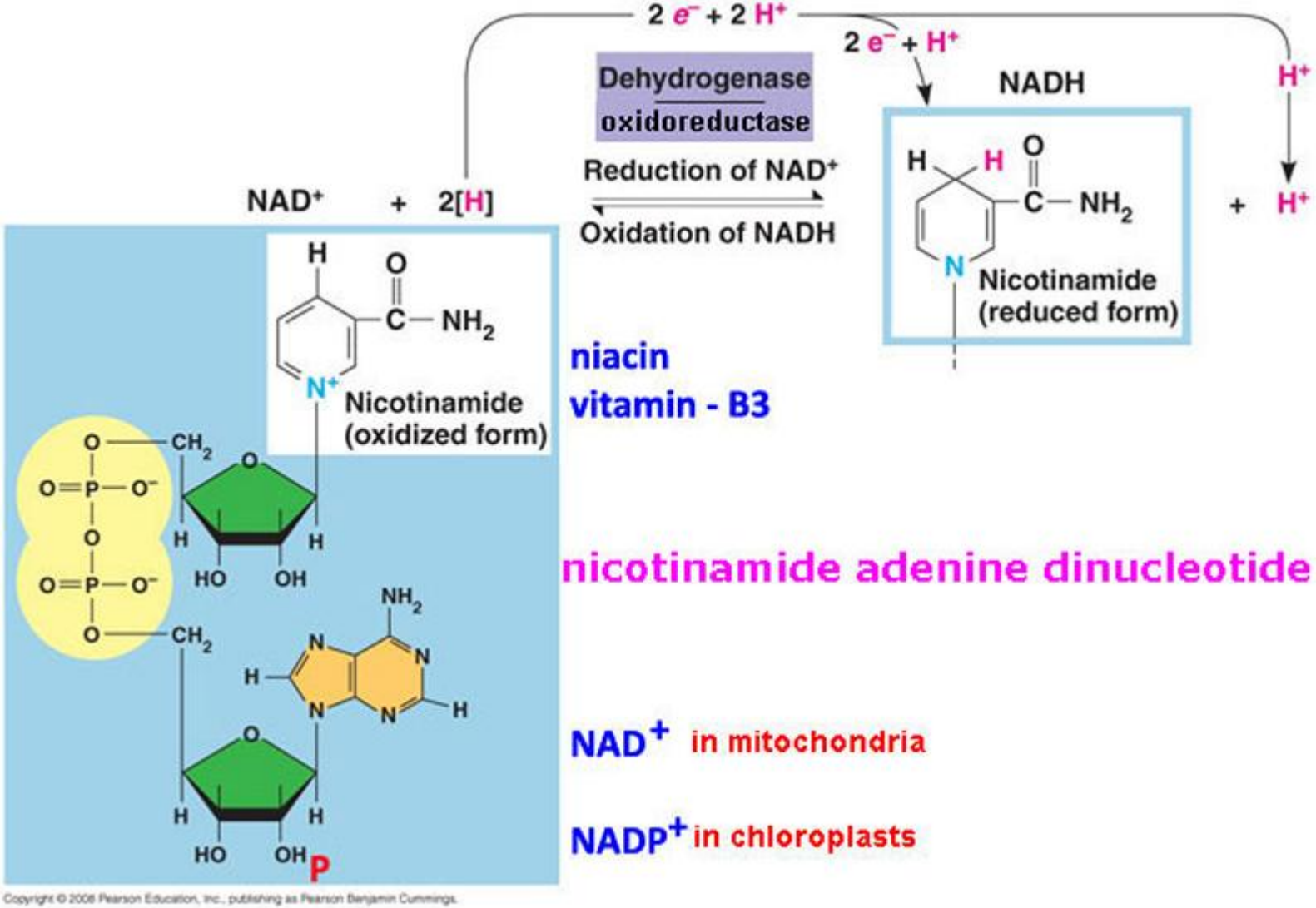


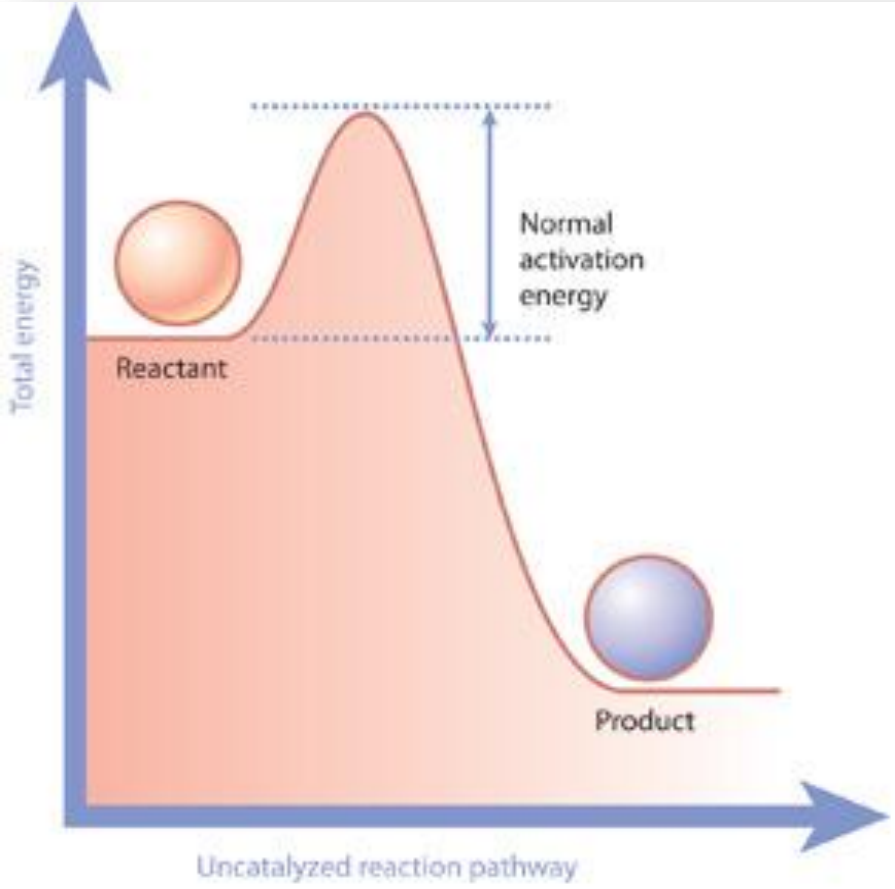
Quick Review

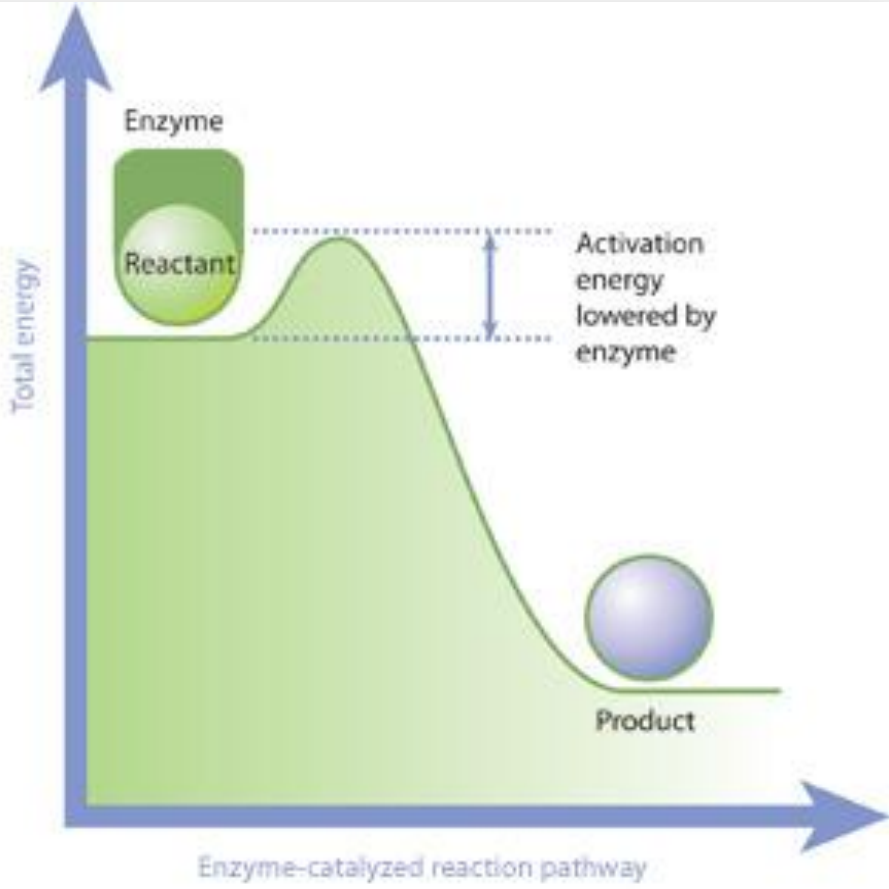
- **Enzyme (E)** catalyzed reactions in the living cell
- The reacting substances, upon which an enzyme acts, are termed the **substrates (S)**.
- The substances produced as a result of the reaction are the **products (P)**.
- Enzyme catalyzed reactions are mostly reversible and involve the formation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

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

1. **Lowering the activation energy**

2. **Reducing the chance in the collisions of molecules or ions**

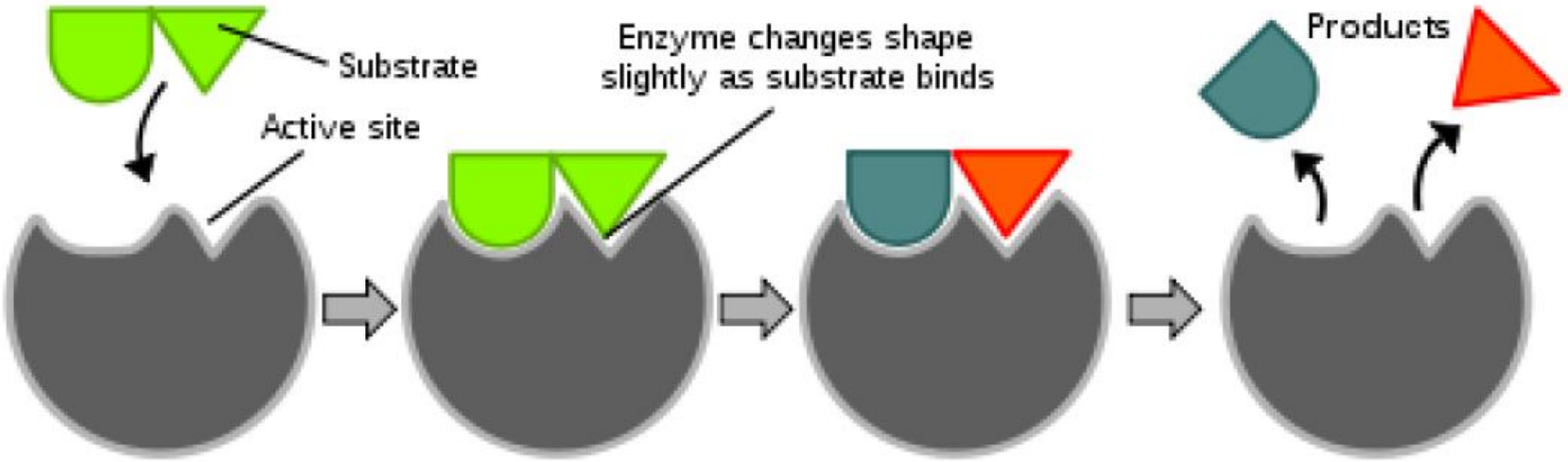




Turnover Number

- **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

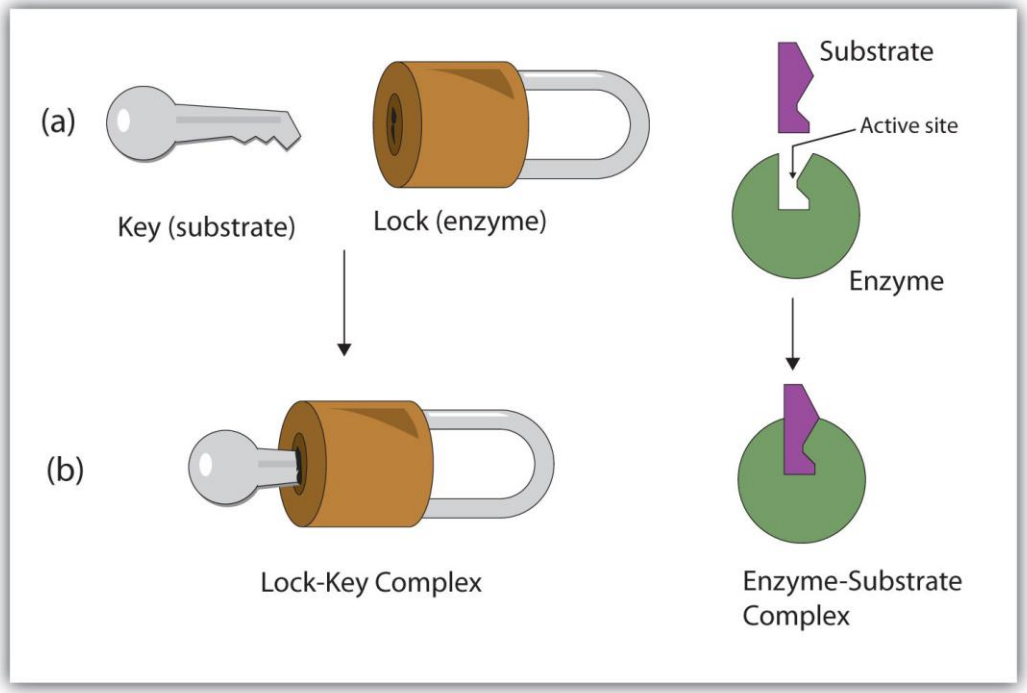
- The formation of enzyme-substrate complex is confined to relatively small areas of the enzyme molecule, known as active sites. The structure of a particular substrate may induce the enzyme to "mold" itself over the substrate.



How can enzyme recognize its Substrate

1- 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

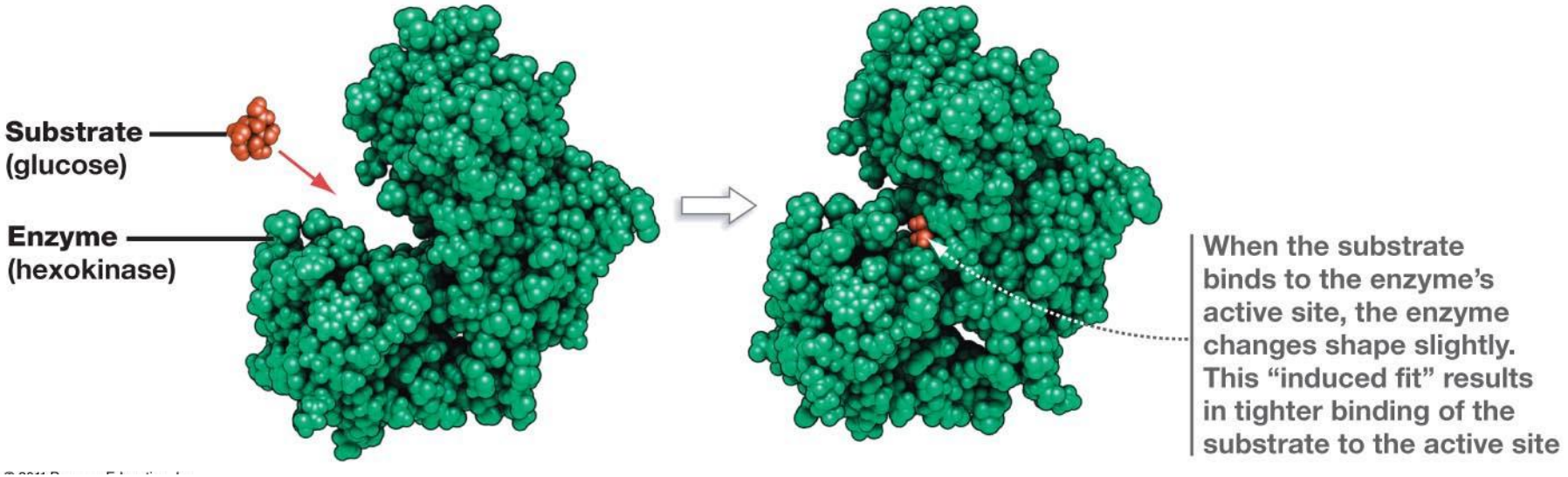


How can substrate bind to the Enzyme

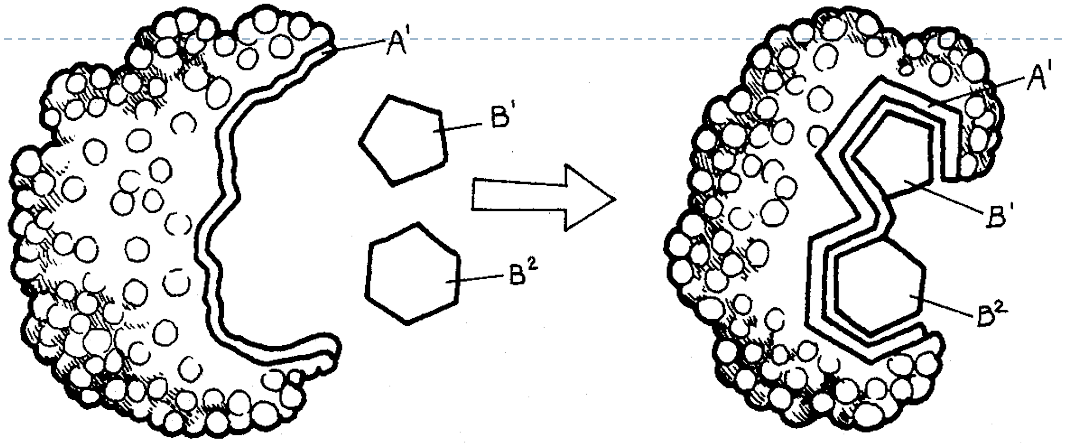
2- The "induced fit" hypothesis

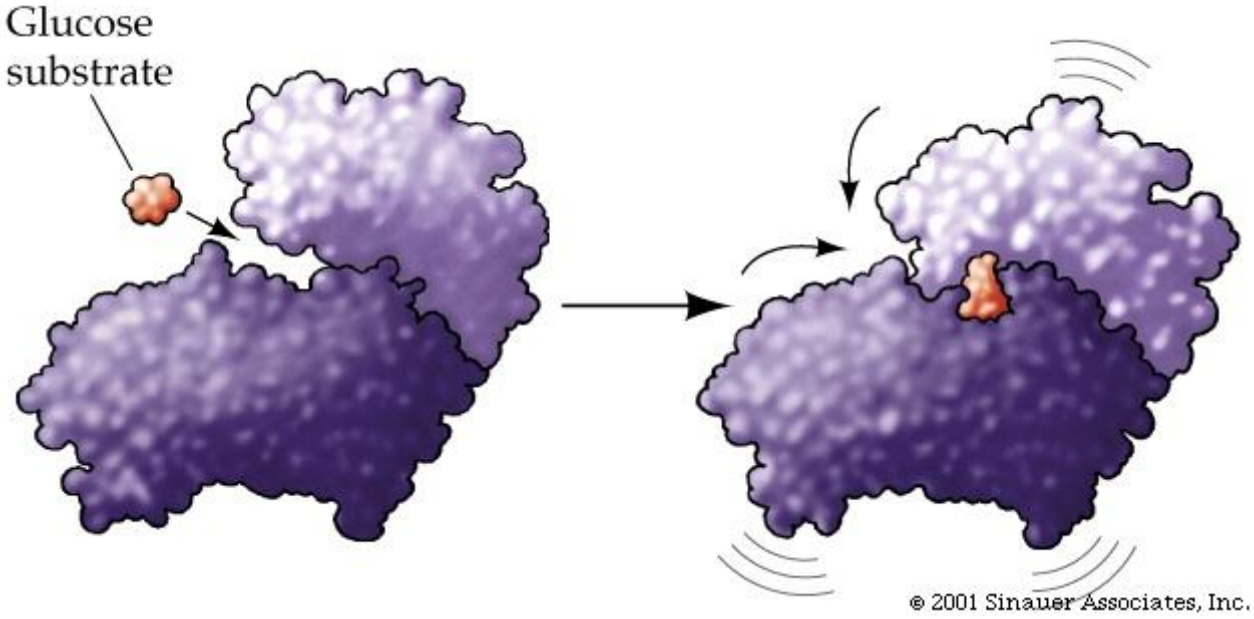
suggests that differences in the surface configuration (three-dimensional shape) of the **active site** are essential to **specificity**.

➔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