Ministry of Higher Education and Scientific Research
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Department of Biochemistry

Physical Chemistry

Lecture 8

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First semester

Mechanism of enzyme action

By

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Mechanism of enzyme action and enzyme unit

Active Site

- Small region at which the substrate binds and participate in catalysis

Characteristic

- It consist of two parts.

(*a*) **Catalytic site.** It is the portion (part) of the enzyme that is responsible for catalysis & determine reaction specificity

(*b*) **Binding site.** It is the part of the enzyme that binds with substrate and determines substrate specificity

- Clefts/crevices within the enzyme molecule

- consists of few amino acid residues only

- three dimentional

- The active site is contributed by amino acid residues that are far apart in the enzyme molecule
- The amino acids at the active site are arranged in a very precise manner so that only specific substrate can bind at the active site
- Active site is flexible not rigid in shape & structure
- Substrate binds at active site by weak non covalent bonds
- Usually serine, histidine, cysteine, aspartate or glutamate residues make up active site. Enzymes are named according to the active site amino acid. For example, trypsin is a serine protease and papain is cysteine protease

Reaction Rates and the Transition State

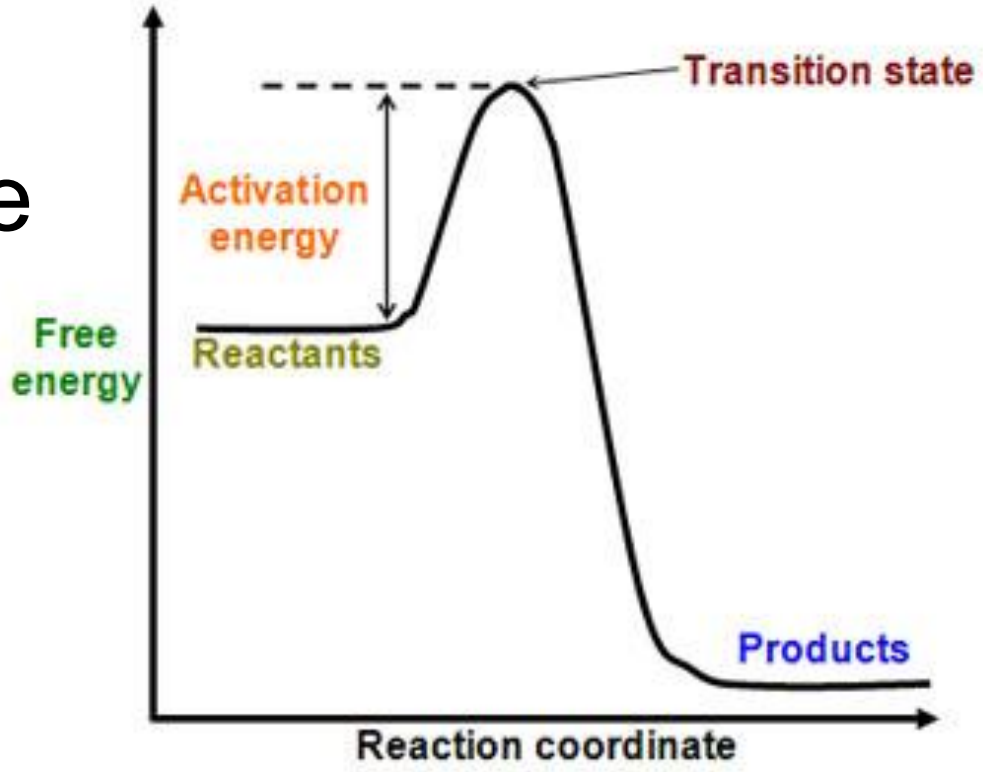
- Enzymes speed up reactions enormously.
- To understand how they do this, examine the concepts of activation energy & the transition state.

- In order to react, the molecules involved are distorted, strained or forced to have an unlikely electronic arrangement.
- That is the molecules must pass through a *high energy state*.

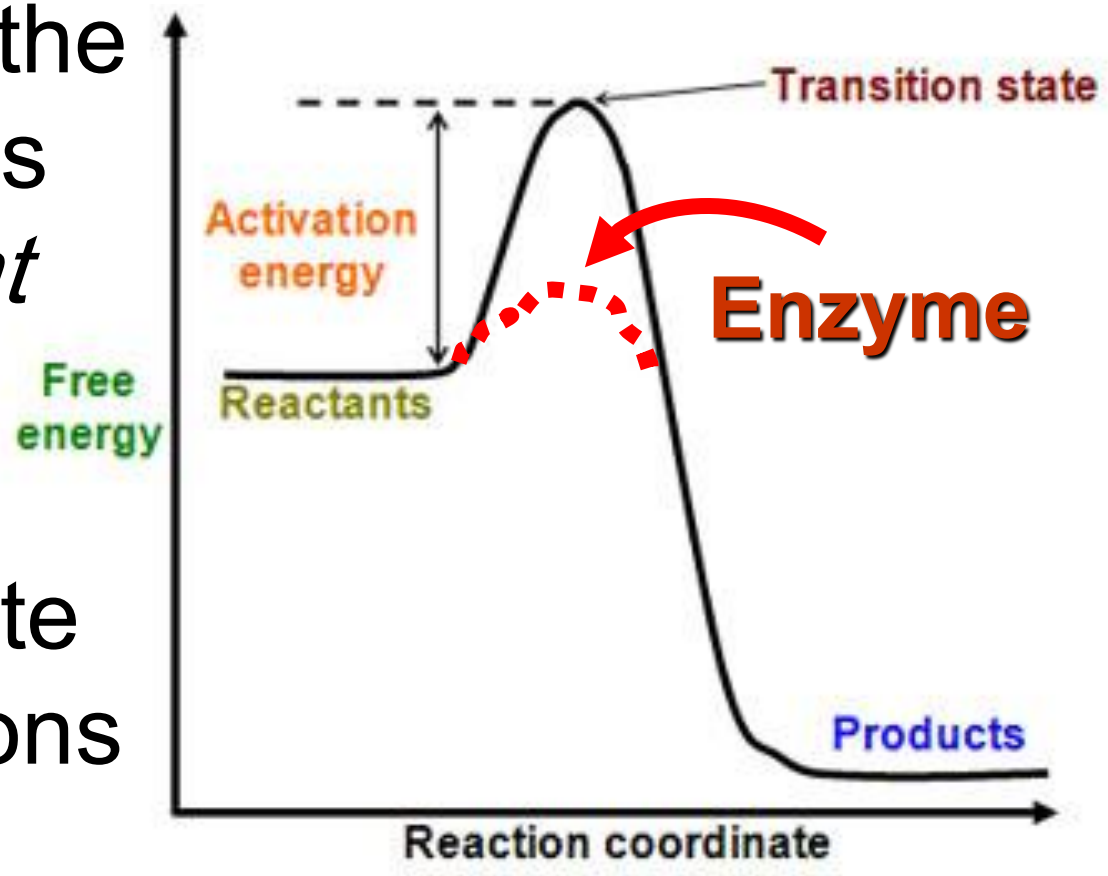
♦This high energy state is called the **transition state**.

♦The energy required to achieve it is called the **activation energy** for the reaction.

♦The *higher* the free energy change for the transition barrier, the *slower* the reaction rate.



Enzymes *lower* energy barrier by forcing the reacting molecules through a *different transition state*.



This transition state involves interactions with the enzyme.

- Reaction intermediate--- transient chemical species
- Rate limiting step
- Lowering activation energy is by binding energy

Modes of Enzymatic Enhancement of Rates

1) general acid and general base catalysis-- good proton *donors* & *acceptors positioned* just right.

2) covalent catalysis- *unstable intermediate – cysteine, serine, histidine*

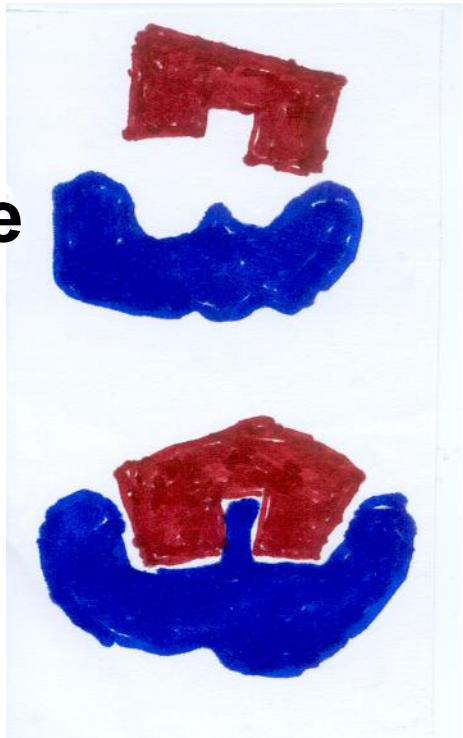
3) metal ion catalysis

- *electron donor* or *acceptor*

Models of Enzymatic reaction

Lock & Key Model- Fischer

- **induced fit**- enzyme changes its conformation to accept the *transition state* of substrate/product well.
- Enzyme conformational change works to distort and strain substrate forcing it into transition state
- Simultaneous
- Koshland



Substrate strain theory

Enzyme Units

- Expressed in terms of the activity
- **One International Unit-** *the amount of Enzyme that catalyzes the formation of 1 micromole of product in 1 minute*
- **Katal-** *amount of enzyme catalyzing the conversion of 1 mole of substrate to product in 1 second*
- 1 katal = 6 X 10^7 international units

Thank you