Topic-Enzyme

Department- Zoology

Semester-IV

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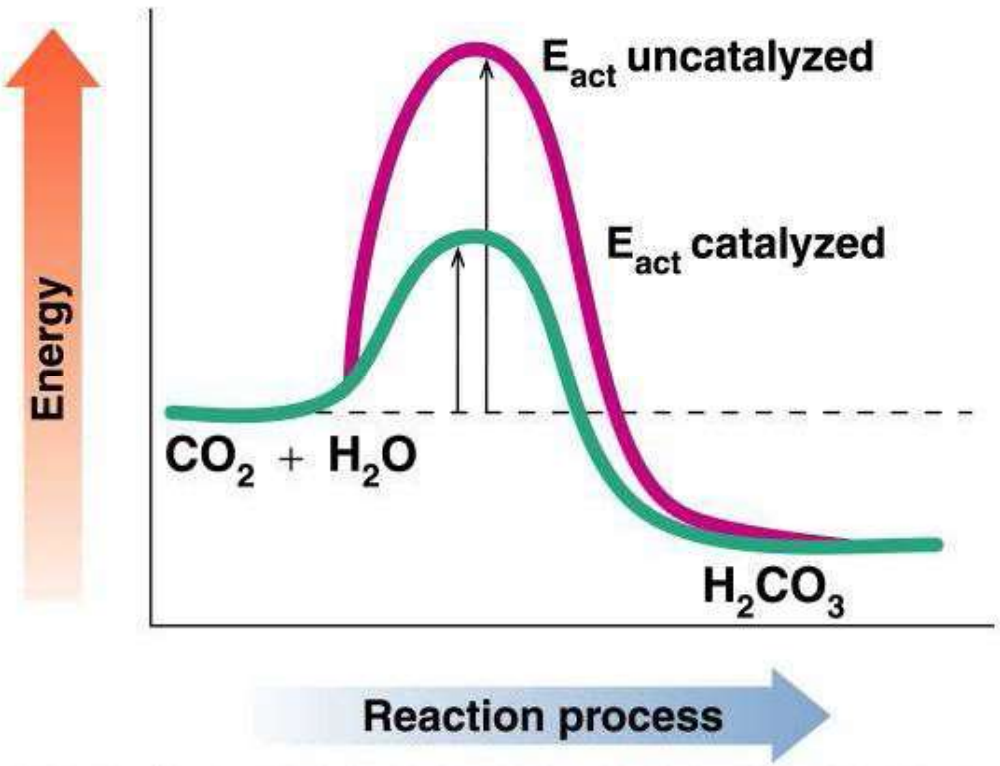
Definition of enzyme

- **Enzymes are biological catalysts.**
- **A Catalyst is defined as "a substance that <u>increases the rate</u> <u>of a chemical reaction</u> without being itself changed in the process."**

Enzymes as Biological Catalysts

- **Enzymes** are proteins that increase the rate of reaction by lowering the energy of activation
- They catalyze nearly all the chemical reactions taking place in the cells of the body
- Enzymes have unique three-dimensional shapes that fit the shapes of reactants (**substrates**)



2. Properties of enzymes (important!)

- **Catalytic efficiency – <u>high efficiency</u>, 10^3 to 10^{17} faster than the corresponding uncatalyzed reactions**

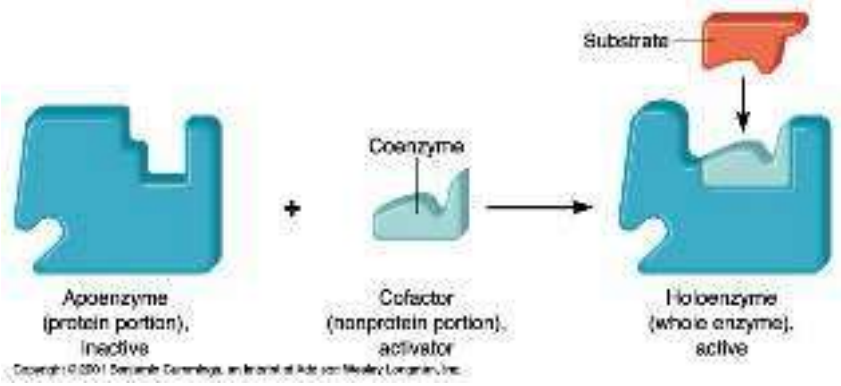
- **Specificity - <u>high specificity</u>, interacting with one or a few specific substrates and catalyzing only one type of chemical reaction.**

- **Mild reaction conditions- 37℃, physiological pH, ambient atmospheric pressure**

3. Chemical composition of enzymes

(1) Simple protein

(2) Conjugated protein

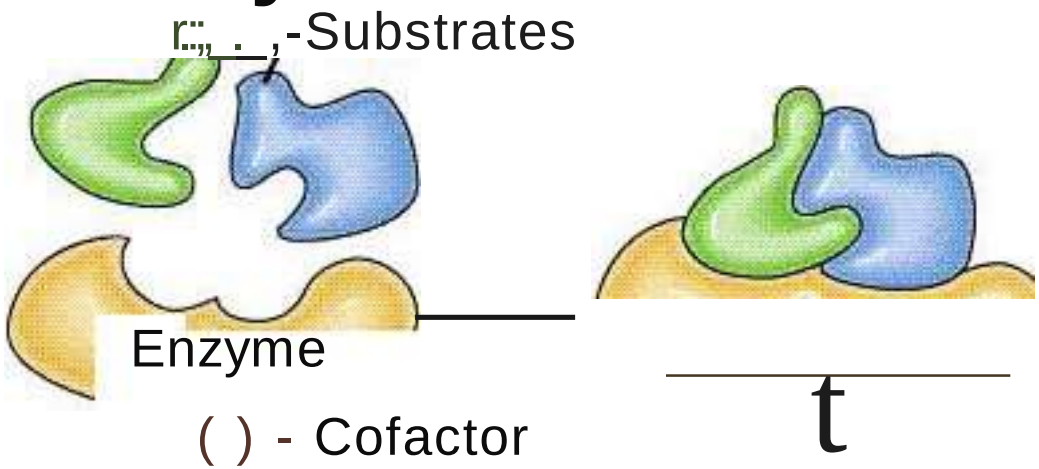


Holoenzyme= Apoenzyme+ Cofactor

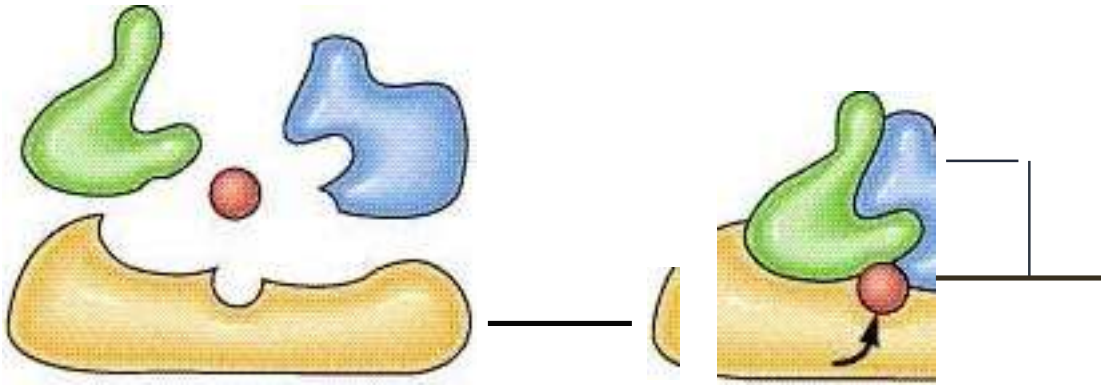
Cofactor

- Coenzyme : loosely bound to enzyme (non-covalently bound).
- Prosthetic group : very tightly or even covalently bound to enzyme (covalently bound)

Roles of Cofactors in Enzyme Function



Cofactor changes conformation of active site.



Cofactor participates in temporary bonding between active site and substrates.

4. Classification of enzymes

(1). By their composition

1). Monomeric enzyme

2). Oligomeric enzyme

3). Multienzyme complex: such as Fatty acid synthase

(2) Nomenclature

- Recommended name
  - Enzymes are usually named according to the reaction they carry out.
    - To generate the name of an enzyme, the suffix -ase is added to the name of its substrate (e.g., lactase is the enzyme that cleaves lactose) or the type of reaction (e.g., DNA polymerase forms DNA polymers).
- Systematic name (International classification)
  - By the reactions they catalyze (Six classes)

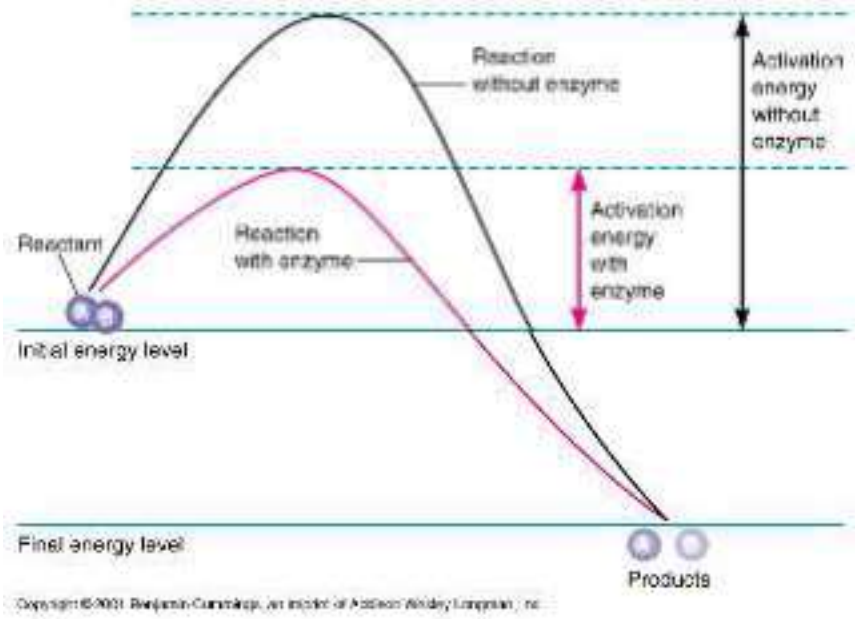
(3) According to reactions they catalyse

Enzymes are often classified by placing them in categories according to the reactions they catalyse.

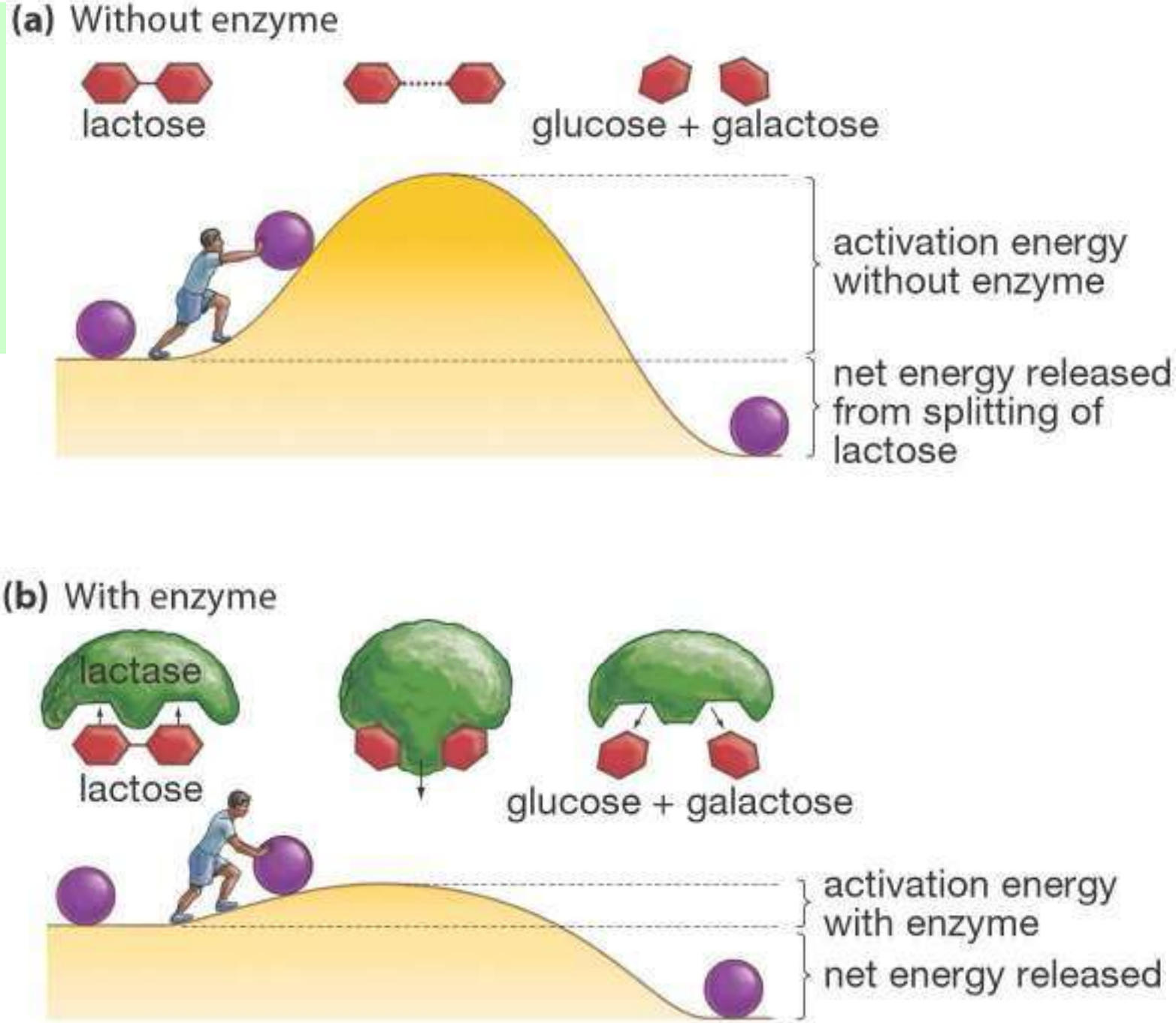
1. **Oxidoreductase**
2. **Transferase**
3. **Hydrolase**
4. **Lyase**
5. **Isomerase**
6. **Ligase**

5. How enzymes work (important!)

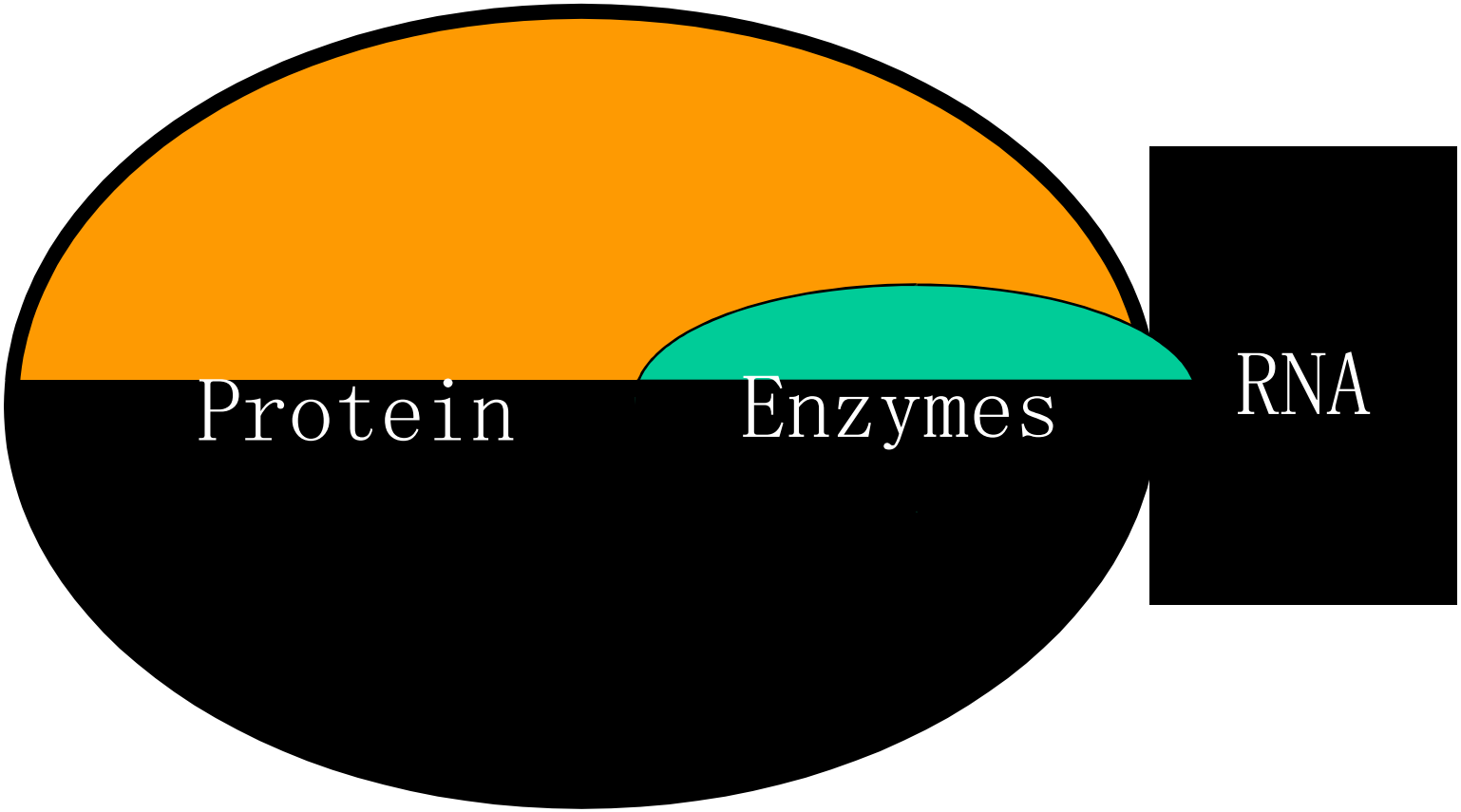
1) Enzymes lower a reaction's activation energy
   - All chemical reactions have anenergybarrier, called the activation energy, separating the reactants and the products.
   - activation energy: amount of energy needed to disrupt stable molecule so that reaction can take place.



Enzymes Lower a Reaction's Activation Energy



What is the difference between an enzyme and a protein?

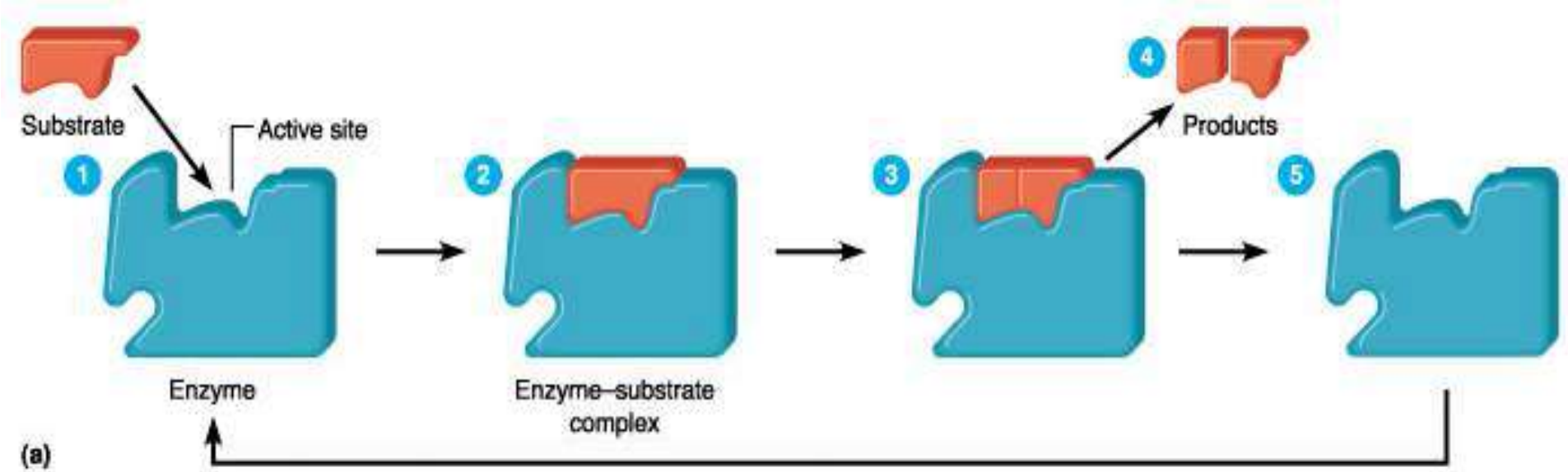


- **All enzymes are proteins except some RNAs**
- **not all proteins are enzymes**

2) The active site of the enzyme

- Enzymes bind substrates to their active site and stabilize the transition state of the reaction.
- The active site of the enzyme is theplacewherethe substratebindsandatwhichcatalysisoccurs.
- The active site binds the substrate, forming an enzyme-substrate(ES) complex.

Enzymatic reaction steps



1. Substrate approaches active site
2. Enzyme-substrate complex forms
3. Substrate transformed into products
4. Products released
5. Enzyme recycled

6. Enzyme activity

- Enzymes are never expressed in terms of their concentration (as mg or μg etc.), but are expressed only as activities.
- Enzyme activity = moles of substrate converted to product per unit time.
  - The rate of appearance of product or the rate of disappearance of substrate
  - Test the absorbance: spectrophotometer

7. Factors affecting enzyme activity

- Concentration of substrate
- Concentration of enzyme
- Temperature
- pH
- Activators
- Inhibitors

Enzymes in clinical diagnosis

- An enzyme test is a blood test or urine test that measures levels of certain enzymes to assess how well the body's systems are functioning and whether there has been any tissuedamage. (why?)

- Common enzymes used for clinical diagnosis include:
  - alanine aminotransferase(ALT,also called glutamate pyruvate transaminase,GPT)
  - alkaline phosphatase
  - amylase
  - aspartate aminotransferase
  - creatine kinase
  - lactate dehydrogenase

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