

Chemistry 1506: Allied Health Chemistry 2

Section 10: Enzymes

Biochemical Catalysts

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Section 10.1 Introduction

- Enzymes
 - Biological Proteinaceous Catalysts
 - Increase rates by 10^{10} to 10^{20}
 - More than 3,000 enzymes in a cell
- Shapes of Proteins
 - Most enzymes globular shapes
 - Structural proteins within cells typically rod like shapes
 - Structural proteins within our bodies typically fibrous shapes

- 6 Major Types of Enzymes
 - Oxidoreductases
 - Do Redox Reactions (Oxidation and Reduction)

 - Transferases
 - Transfer CH_3 , NH_2 , etc., groups

 - Hydrolases
 - Hydrolysis Reactions (add water while breaking bonds)

 - Lyases
 - Double bond addition/elimination reactions

 - Isomerases
 - Isomerizations

 - Ligases/Synthetases

➤ Join Fragments together

- Cofactors
 - Non-protein parts of enzymes
 - Metal salts
 - E.g., Mg^{+2} , Ca^{+2} , Fe^{+2}
 - Organics
 - referred to as **coenzymes**
 - E.g., **heme**.....

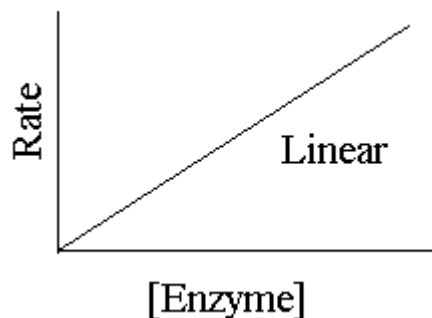
- General Enzyme Structures
 - Active Sites
 - Substrate Binding and Reactivity
 - Regulatory Sites
 - Activator and Deactivator (Inhibitor) Binding Sites

Section 10.2 Factors Effecting Enzyme Activity

- Enzyme Activity (on Conversion of Substrate to Product)

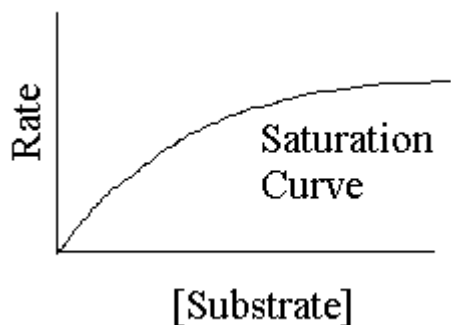


- The effect of the enzyme concentration on the reaction rate
 - Linear dependence of Rate on [Enzyme]



- All enzyme molecules are working at maximum speed and therefore twice as much enzyme will catalyze the reaction twice as fast

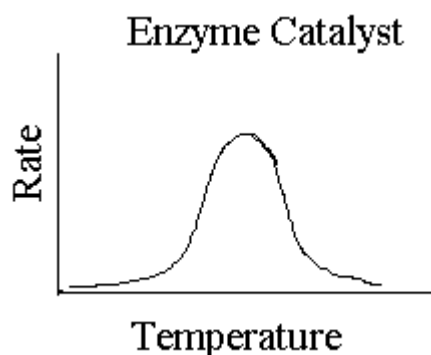
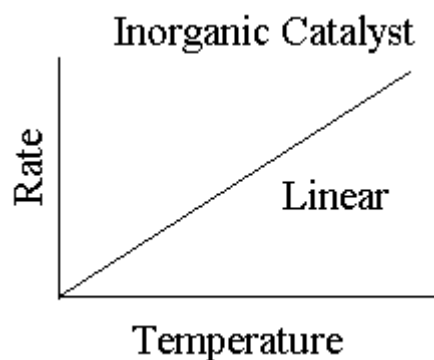
- The effect of the **substrate concentration on the reaction rate**
- **Saturation Curve dependence** seen



- The **maximum rate** (R_{\max}) is observed where all enzyme molecules are fully occupied which requires a certain **substrate concentration**

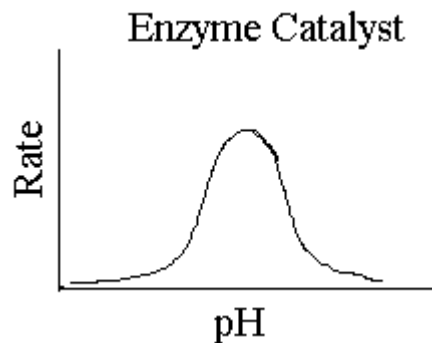
➤ Other Influences on Reaction Rate

➤ Effect of **Temperature on Reaction Rate**



- There is an optimum temperature for each enzyme reaction
 - If the temperature gets a little too high the rate reduction is reversible
 - If the temperature gets a lot too high the rate reduction is **irreversible**

➤ Effect of pH on Reaction Rate



➤ Why

- Because **enzyme shape changes** with the temperature, pH, $[\text{Ca}^{+2}]$, etc.
- This causes the **active site** to change which changes the rate

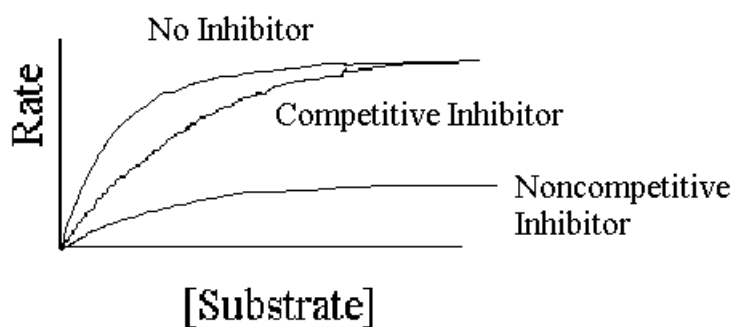
➤ Competitive Inhibition

- Occurs when there is competition for the active site
- **Inhibitor** is almost the same (shape, charge, etc.) as the substrate “key”

➤ Non-Competitive Inhibition

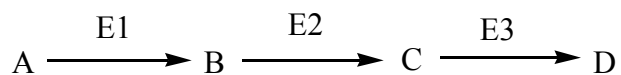
- No competition at the active site
- **Inhibitor** binds somewhere else on the protein
- **Regulatory site**
- This changes the shape of the “lock”

➤ Graph of inhibitor effects on rate



Section 10.4 Enzyme Regulation

➤ Typical Metabolic Pathway



- End Product Inhibition (E1 inhibition by D)
- Starting Materials Activation (E1 activation by A)
- Feedback control

➤ Proenzymes

- Inactive proteins that are cleaved to give active forms when needed
- Very fast way to increase active enzyme concentration
- cf. New synthesis of enzyme

➤ Allosterism

- Binding at non-active site which reversibly speeds/slows reaction

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