

KARACHI EDU COACHING CENTER | CLASS 9 BIOLOGY

Chapter 6: Enzymes

High-detail coaching notes on Biological Catalysts, Characteristics, Mechanism of Action, Factors Affecting Activity, and Inhibitors according to Sindh Textbook Board.

Introduction to Metabolism & Enzymes

Metabolism

Anabolism: Constructive pathways building complex molecules (e.g., Photosynthesis).

Catabolism: Destructive pathways breaking down complex molecules (e.g., Respiration).

What is an Enzyme?

Globular proteins acting as biological catalysts that accelerate biochemical reactions without being consumed or permanently altered in the process.

Characteristics of Enzymes

Protein Nature

Almost all enzymes are globular proteins composed of polypeptide chains folded into specific 3D shapes.

High Specificity

Each enzyme catalyzes only one specific reaction or acts on a specific class of substrates.

Reusable & Potent

Not consumed during reactions; small amounts can convert large quantities of substrate into product.

Activation Energy & Mechanism

Lowering Activation Energy

Enzymes work by lowering the activation energy barrier (the minimum energy required to start a chemical reaction), thus speeding up reaction rates exponentially.

Active Site & Substrate

Active Site: A specialized pocket or cleft on the enzyme surface where reactants bind.

Substrate: The specific reactant molecule transformed into product.

Enzyme Models: Lock & Key vs. Induced Fit

Lock and Key Model (Emil Fischer, 1894)

Proposes that the active site is rigid and exact in shape, matching the substrate precisely like a key fits into a specific lock.

Induced Fit Model (Daniel Koshland, 1958)

More accepted model proposing that the active site is flexible; binding of the substrate induces a conformational shape change in the enzyme for tighter fit.

Factors Affecting Enzyme Activity: Temperature & pH

Effect of Temperature

Optimum Temp: Maximum activity rate (e.g., 37°C in humans).

Denaturation: Excessive heat breaks hydrogen bonds, altering active site shape permanently.

Effect of pH

Optimum pH: Most enzymes work best at neutral pH (6-8), except pepsin (pH 2 in stomach).

Changes in H⁺ concentration alter ionization of active site amino acids.

Factors Affecting Enzyme Activity: Substrate Concentration

Substrate Concentration Dynamics

Increasing substrate concentration increases the rate of reaction initially because more active sites are occupied. However, past a certain threshold, all active sites become saturated, and reaction rate reaches a maximum plateau.

Enzyme Concentration

Directly proportional relationship: doubling the amount of enzyme doubles the rate of reaction, provided substrate is present in excess.

Enzyme Inhibitors: Competitive vs. Non-Competitive

Competitive Inhibitors

Resemble substrate and compete for binding at the active site.

Can be overcome by adding excess substrate.

Non-Competitive Inhibitors

Bind to an allosteric site away from the active site.

Alters enzyme shape so substrate can no longer bind; cannot be overcome by extra substrate.

Specificity & Nomenclature of Enzymes

Naming Convention

Named after their substrate with the suffix "-ase" (e.g., Sucrase digests sucrose, Lipase digests lipids).

Classification

Grouped into functional classes: Oxidoreductases, Transferases, Hydrolases, Lyases, Isomerases, and Ligases.

Industrial Uses

Extensively used in brewing, baking, detergent manufacturing, and textile processing.

End of Chapter 6 Notes

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