

Introduction to Enzymology

Introduction to Enzymology – Study Notes

1. What Is Enzymology?

- **Definition:** Enzymology is the branch of biochemistry that studies enzymes – the protein (or RNA) catalysts that accelerate biochemical reactions in living cells.
 - **Scope:**
 - Enzyme structure & classification
 - Kinetic behavior & mechanisms
 - Regulation & inhibition
 - Methods for purification, assay, and characterization
-

2. Basic Properties of Enzymes

Property	Description	Typical Example
Biological catalysts	Lower activation energy ($\Delta G^\ddagger$) without being consumed.	Hexokinase phosphorylates glucose.
Specificity	Recognize particular substrates (or a group of related substrates).	Lactase hydrolyzes β -galactosides.
Efficiency	Turnover numbers (k_{cat}) can reach $10^5 s^{-1}$ for diffusion-limited enzymes.	Catalase decomposes $H_2O_2 \sim 10^7 s^{-1}$.
Regulation	Activity modulated by effectors, covalent modification, or changes in expression.	Phosphofructokinase (PFK) allosterically activated by ADP.
Reversibility	Many enzymes catalyze reversible reactions; direction depends on cellular conditions.	Malate dehydrogenase (oxaloacetate $\rightleftharpoons$ malate).
Optimal conditions	Each enzyme has an optimal pH, temperature, and ionic strength.	Pepsin: pH ~ 2 ; DNA polymerase: $37^\circ C$.

3. Enzyme Structure

1. **Primary structure** – linear amino acid sequence.

Introduction to Enzymology

2. **Secondary structure** – α helices, β sheets (stabilized by hydrogen bonds).
3. **Tertiary structure** – overall 3D fold; active site formed by residues from different regions.
4. **Quaternary structure** – assembly of multiple polypeptide subunits (e.g., hemoglobin, γ globin).

Key concept: Active site – a pocket/cleft where substrate binds; often contains catalytic residues (e.g., Ser¹⁹⁵His¹⁹⁶Asp¹⁹⁷ triad in serine proteases).

4. Enzyme Classification (IUBMB System)

EC Class	Reaction Type	Example
EC 1	Oxidoreductases	Alcohol dehydrogenase
EC 2	Transferases	Hexokinase (phosphate transfer)
EC 3	Hydrolases	Lipase (ester bond hydrolysis)
EC 4	Lyases	Fumarase (C–C bond cleavage)
EC 5	Isomerases	Triosephosphate isomerase
EC 6	Ligases (synthetases)	DNA ligase
EC 7	Translocases (2021 addition)	ATP synthase (proton translocation)

Mnemonic: **O**xidoreductases, **T**ransferases, **H**ydrolases, **L**yases, **I**somerases, **L**igases, **T**ranslocases.

5. Enzyme Kinetics

5.1 Michaelis–Menten Model

$$v = \frac{V_{\max}[S]}{K_m + [S]}$$

- v – initial reaction velocity
- $V_{\max}$