

Introduction to Enzymology

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The study of enzymes is called *enzymology*

Definition

- **Biological catalysts**
- Accelerates the rate of chemical reactions
- Capable of performing multiple reactions (recycled)
- Final distribution of reactants and products governed by equilibrium properties
- **Enzymes are biological catalysts** –
- Proteins, (a few RNA exceptions)
- Orders of magnitude faster than chemical catalysts -
Act under mild conditions (temperature and pressure)
- Highly Specific
- Tightly Regulated

History

- **Berzelius in 1836 coined the term catalysis (Gk: to dissolve).**
- **In 1878, Kuhne used the word enzyme (Gk: in yeast) to indicate the catalysis taking place in the biological systems.**
- **Isolation of enzyme system from cell-free extract of yeast was achieved in 1883 by Buchner. He named the active principle as zymase (later found to contain a mixture of enzymes), which could convert sugar to alcohol.**
- **In 1926, James sumner first achieved the isolation and crystallization of enzyme urease from jack bean.**

Importance of enzymes

- **Enzymes are critical for every aspect of cellular life Enzyme**
- **Cell shape and motility**
- **Surface receptor**
- **Cell cycle**
- **Metabolism**
- **Transcription**
- **Hormone release**
- **Muscle contraction**
- **Protein synthesis**

Properties

- **Vital for chemical reactions to occur in the cell (the breaking, forming and rearranging of bonds on a substrate (reactant))**
- **Modified substrate (now a product) often performs a different task**
- **Consequence: ☐ Transformation of energy and matter in the cell ☐ Cell-cell and intracellular communication ☐ Allows for cellular homeostasis to persist**

Classification of Enzymes

- **Enzymes can be classified using a numbering system defined by the Enzyme Commission.**
- **This system consists of a four digit number which classifies based on the type of reaction the enzyme catalyzes**

Different classes of enzymes

- **EC 1. Oxidoreductases** – Transfer electrons (Redox reactions)
- **EC 2. Transferases** – Transfer functional groups between molecules
- **EC 3. Hydrolases** – Break bonds by adding H₂O
- **EC 4. Lyases** – Elimination reactions to form double bonds
- **EC 5. Isomerases** – Intramolecular rearrangements
- **EC 6. Ligases** – Join molecules with new bonds

Enzyme Nomenclature

EC 3.2.1.1

Type of general reaction
(eg. Hydrolase)

Subclass of enzyme reaction
(eg. glycosidase)

Sub-Subclass of enzyme reaction
(eg. hydrolyze O glycosyl groups)

Indicates specific
enzyme
(eg. Alpha
Amylase)



EC 1. Oxidoreductases

- **Catalyze oxidation/reduction reactions**
- **Oxidation** is the *loss* of electrons or an *increase* in the oxidation state of an atom, an ion, or of certain atoms in a molecule.
- **Reduction** is the *gain* of electrons or a *decrease* in the oxidation state of an atom, an ion, or of certain atoms in a molecule.
- **Eg. Alcohol dehydrogenase EC 1.1.1.1.**
- **Cytochrome oxidase**
- **Amino acid oxidases**

EC 2. Transferases

- Involved in transfer of functional groups between molecules
- Eg. :-
 - **Hexokinase EC 2.7.1.1.**
 - **Transaminases**
 - **Phosphorylase**

EC 3. Hydrolases

- Break bonds by adding H₂O
- Eg:-
- **Lipase (triacylglycerol acyl hydrolase E.C. 3.1.1.3)**
- **Choline esterase**
- **Acid and alkaline phosphatase**
- **Pepsin**
- **Urease**

EC 4. Lyases

- Elimination reactions to form double bonds
- Eg.-
- **Aldolase (E.C. 4.1.2.7)**
- **Fumarase**
- **Histidase**

EC 5. Isomerases

- Intramolecular rearrangements
- Eg:-
- **Triose phosphale isomerase EC 5.3.1.1.**
- **Phosphohexose isomerase**

EC 6. Ligases

- Join molecules with new bonds
- Eg:-
- **Glutamine synthetase EC 6.3.1.2.**
- **Succinate thiokinase**
- **Acetyl CoA carboxylase**



THANK YOU