

ENZYMES' Classifications Summary

EC1 — OXIDOREDUCTASES: catalysis of redox reactions.

Subtype	Function	clue	Examples	Pictures
Dehydrogenases	Transfer H as hydride (H^-) or hydrogen atoms using electron-transfer coenzymes	$NAD^+/NADH$ or $FAD/FADH_2$ or FMN or $NADP^+$	Lactate dehydrogenase alcohol dehydrogenase succinate dehydrogenase	$lactate + NAD^+ \rightleftharpoons pyruvate + NADH + H^+$ $ethanol + NAD^+ \rightleftharpoons acetaldehyde + NADH + H^+$ $succinate + FAD \rightleftharpoons fumarate + FADH_2$
Oxidases	Transfer H from substrate to oxygen (O_2)	Peroxide (H_2O_2) in the products	Glucose oxidase	$glucose + O_2 \xrightarrow{glucose\ oxidase} gluconolactone + H_2O_2$
Oxygenases	Oxidize substrate by introducing oxygen into it	Oxygen becomes part of substrate (monooxygenation and dioxygenation)	Monooxygenase (Lactate-2-monooxygenase) Dioxygenase (Tryptophan 2,3-dioxygenase)	$lactate + O_2 \xrightarrow{monooxygenase} 2-hydroxylactate + H_2O$ $tryptophan + O_2 \xrightarrow{dioxygenase} 2,3-dihydroxytryptophan + H_2O$
Peroxidases	Oxidize substrate using hydrogen peroxide	H_2O_2 is a substrate	Glutathione peroxidase (cysteine related)	$2\ glutathione + H_2O_2 \xrightarrow{glutathione\ peroxidase} 2\ oxidized\ glutathione + 2\ H_2O$
Reductases	Catalyze reduction of substrate	Reduction reactions (hydrogen addition)	Glutathione reductase	$oxidized\ glutathione + NADPH + H^+ \xrightarrow{glutathione\ reductase} reduced\ glutathione + NADP^+$
Hydroxylases	Add a hydroxyl group to substrate	Product gains OH	Phenylalanine Hydroxylase (Remember the phenylketonuria disease)	$phenylalanine + O_2 + H_2O \xrightarrow{phenylalanine\ hydroxylase} tyrosine + H_2O_2$

EC2 — TRANSFERASES: changing the place of the functional groups

Type	Function	clue	Pictures
Kinases	ATP's Phosphate $\rightarrow$ transferred to substrate	Substrate becomes phosphorylated	$fructose-6-phosphate + ATP \xrightarrow{fructose-6-phosphate\ kinase} fructose-1,6-bisphosphate + ADP$
Transaminases	Amino group ($-NH_2$) Amino acid + keto acid $\rightleftharpoons$ keto acid + amino acid	NH_2 moves from amino acid to keto acid	$glutamate + oxaloacetate \rightleftharpoons aspartate + pyruvate$

EC3 — HYDROLASES : Bond breaking by H₂O hydrolysis

Proteases ,Glycosidase, Lipases, Esterases& Phosphatase.

EC4 — LYASES: cleave C-C, C-O, C-N, and other bonds by means other than Hydrolysis oxidation & add groups to double bonds without hydrolysis our doctor said any enzyme u can't classify it will probably be a lyase because it is a broad range of enzymes.

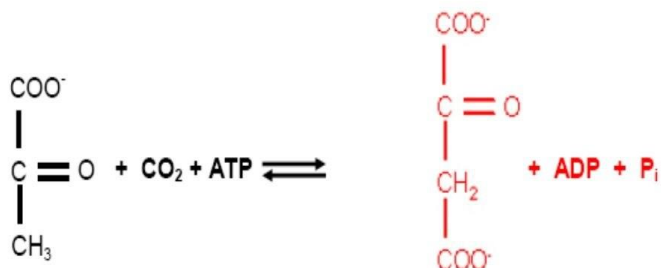
Subtype	What happens	Recognition clue	Example	Pictures
Dehydrase	H ₂ O removed from substrate → double bond formation	H ₂ O → C=C forms	Enolase	
Decarboxylase	Carboxyl group is replaced by H (CO ₂) release	Carboxyl group removal	Pyruvate decarboxylase	
Synthase	Addition of molecule to double bond (formation of C—C bond)	Bond formation without ATP-	Citrate synthase	
Aldolase	Fructose-1,6-bisphosphate → DHAP + glyceraldehyde-3-phosphate	Glycolysis cleavage	-----	

EC5 — ISOMERASES: changing the bond pattern(Intramolecular rearrangement)

Type	What changes?	Example	Pictures
Isomerase	Arrangement of bonds & atoms within a compound	Phosphoglucoisomerase: Glu-6-phosphate $\rightleftharpoons$ fru-6-phosphate	Diagram illustrating the isomerization of Glucose-6-phosphate (Glu-6-P) to Fructose-6-phosphate (Fru-6-P) catalyzed by Phosphoglucoisomerase (PGI). The reaction is reversible and involves the transfer of a phosphate group from C6 to C2.
Mutase	Reposition of phosphate within same molecule in a different atom	Phosphoglycerate mutase: Glycerate-3-phosphate $\rightarrow$ Glycerate-2-phosphate	Diagram illustrating the conversion of 3-Phosphoglycerate (3PG) to 2-Phosphoglycerate (2PG) catalyzed by Phosphoglycerate mutase (PGM). The reaction is reversible and involves the transfer of a phosphate group from C3 to C2.

EC6 — LIGASES: join C-C, C-O, C-N, C-S, and C-halogen bonds by consumption of a high-energy compound such as ATP.

Synthetase: derives energy from the cleavage of high-energy phosphate bonds.



Non categorized comparisons

- KINASE vs Ligase

Feature	Kinase(Transferase)	Ligase
Purpose of ATP phosphate	Donates phosphate group	Provides energy for joining
Phosphorylation	Phosphate becomes part of substrate	Free phosphate is produced
Function	YES	NO
	ATP for P transfer	ATP for energy for bond formation

- Synthase vs Synthetase

Feature	Synthetase	Synthase
Purpose	Uses The cleavage energy to form once	Forms bonds by the addition of molecules
ATP need	Needs ATP for energy	No need
Class	Ligase	Lyase

- EXCEPTIONS

Type	Description	Function
Abzyme	Antibody(immunoglobulin) acting as an enzyme, produced against transition-state analogs	Mimics enzyme active-site binding to transition state(cocaine esterase)
Ribozyme	RNA molecule acting as enzymes	RNA splicing and catalysis in ribosomes

Quiz time,,,,,,Good Luck👍

<https://share.gemini.google/ie17rsFOZGPN>

All the info. in this file is based on my perception of Dr. Mamoun's lecture and slides.

اللهم إني أسألك موجبات رحمتك
وعزائم مغفرتك والغنيمة من كل بر
والسلامة من كل إثم
اللهم لا تدع لي ذنبا إلا غفرته
ولا هما إلا فرجته
ولا حاجة هي لك رضا
إلا قضيتها يا أرحم الراحمين

