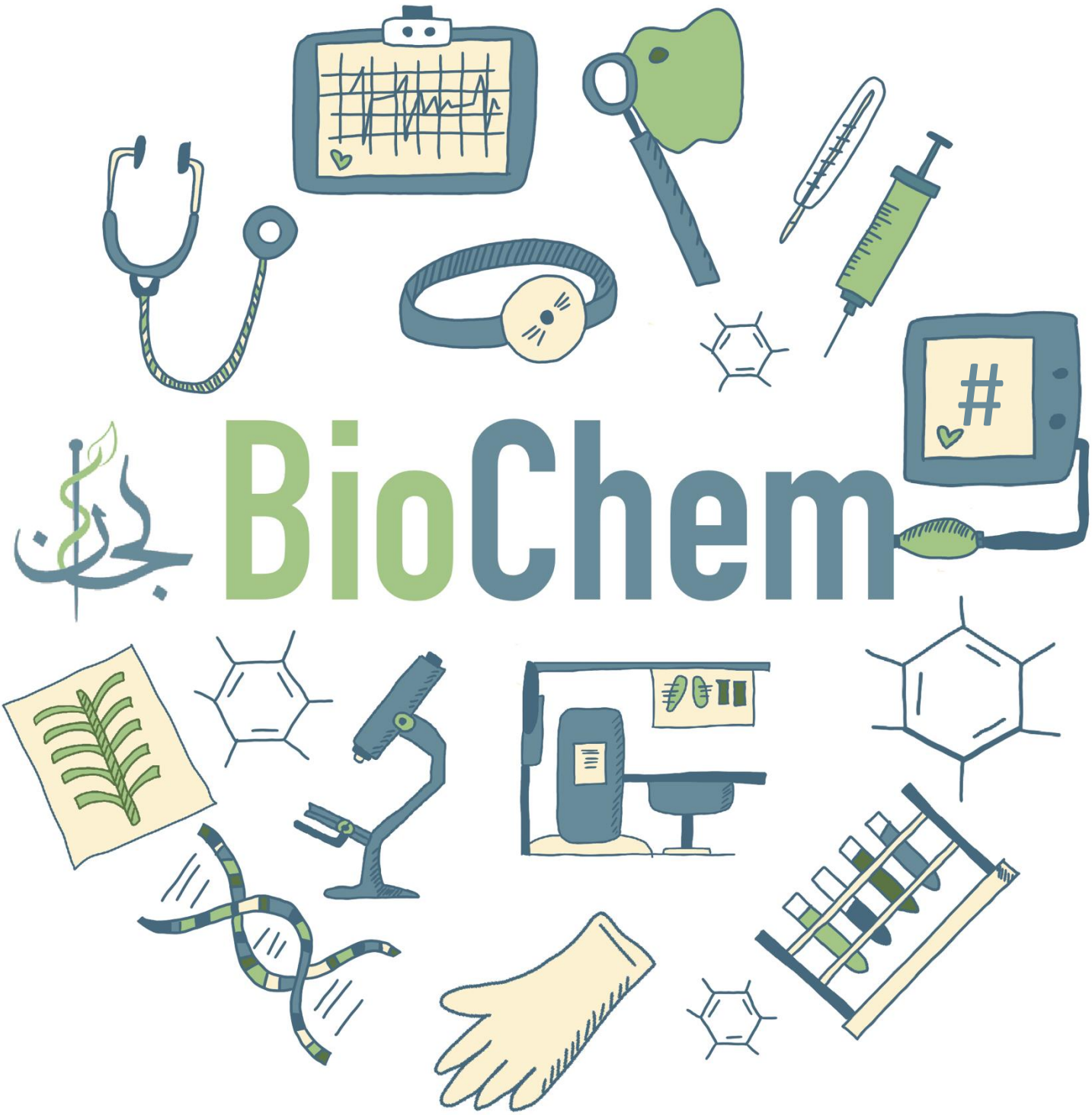


BioChem

Writer: Hala Masadeh

Science: Joud Abu Khass

Grammar: Joud Abu Khass

Doctor: Nafez Abu Tarboush

In the previous sheet we talked about the major classes of enzymes:
1. Oxidoreductases 2. Transferases 3. Hydrolases 4. Lyases
5. Isomerases 6. Ligases 7. Translocases.

And we talked about the minor classification of oxidoreductase, now we are completing the rest.

2.Transferases:

These enzymes transfer a functional group (C, N, P or S) from one substrate to an acceptor molecule.

They are divided into 2 classes:

1. Kinases 2. Transaminases

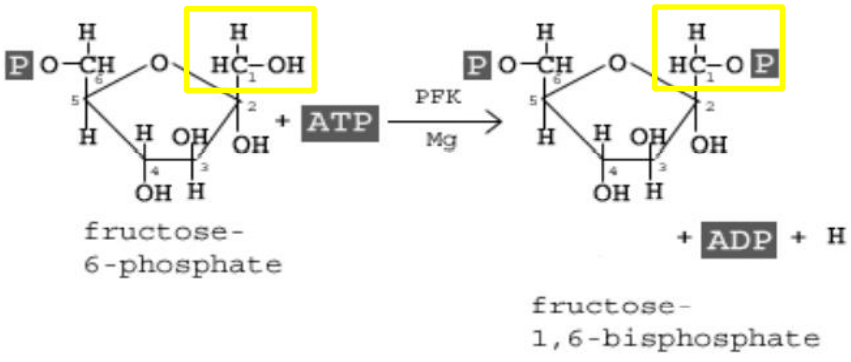
Kinases:

Kinases catalyze the transfer of phosphate group from one molecule to another, usually the donor is ATP.

Example: Phosphofructokinase; catalyzes transfer of phosphate from ATP to fructose-6-phosphate.

We have fructose-6-phosphate, one phosphate is taken from ATP producing ADP and conjugated (attached) to fructose-6-phosphate and we got the product known as fructose 1,6-biphosphate.

➢ Fructose 6-P + ATP ↔ F 1,6 bisphosphate + ADP



Transaminase:

A transaminase transfers an amino functional group from one amino acid to a keto acid, converting the amino acid to a keto acid and the keto acid to an amino acid.

Transaminases catalyze the transfer of amino group from an amino acid creating the structure of a keto acid.

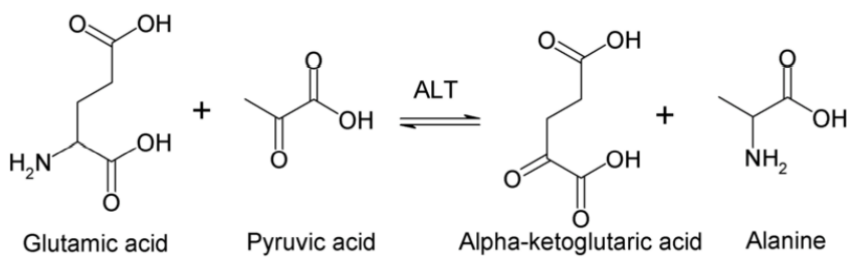
What is the recipient of the amino group? The keto acid

It removes the amino group and converts the amino acid into a keto acid, at the same time it attaches the amino group to the keto acid to become an amino acid (the double bond of oxygen is replaced by the amino group), so it's an interconversion process.

You should memorize these 3 amino acids and their corresponding keto acid.

Amino acid	**Keto acid**
Glutamic acid	Alpha-ketoglutaric acid (key molecule in Krebs cycle)
Alanine	Pyruvic acid (pyruvate: the end product of glycolysis)
Aspartic acid (aspartate) It's a 4-carbon unit molecule	Oxaloacetate (key molecule in Krebs cycle)

- **This allows for the interconversion of certain amino acids**



3. Hydrolases:

These enzymes catalyze cleavage reactions while using water across the bond being broken. (breaks down bonds by adding water)

Logically, the molecules that are broken by adding water are the molecules formed by removing water, so we are talking about all the macromolecules within our body (lipids, carbohydrates, proteins, nucleic acids) *we can't say polymers because lipids are not considered as polymers.

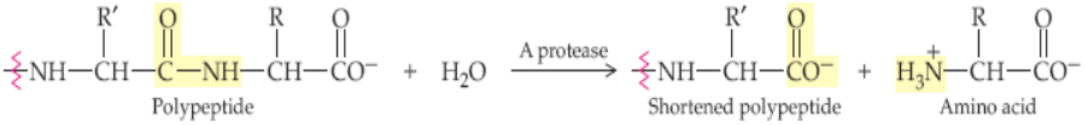
Anything was produced through condensation reaction will break up by hydrolysis

Example: peptidases, esterase, lipases, glycosidases, phosphatases, all these enzymes are named depending on the type of bond cleaved.

- Proteases, peptidases break down proteins.
- Nucleases break down nucleic acids.
- Esterase breaks down ester bonds.
- Glycosidases break down carbohydrates.
- Lipases break down lipids.

Hydrolases break down bonds, so they always result in releasing energy (favorable reaction).

- **These enzymes catalyze proteolysis, the hydrolysis of a peptide bond within proteins**
- **Proteolytic enzymes differ in their degree of substrate specificity**



- **Trypsin, is quite specific; catalyzes the splitting of peptide bonds only on the carboxyl side of lysine and arginine**
- **Thrombin, catalyzes the hydrolysis of Arg-Gly bonds in particular peptide sequences only**

4.Lyases

Catalyze the addition or removal of functional groups from their substrates with the associated formation or removal of double bonds between C-C, C-O and C-N.

Catalyzes removal or formation of a double bond through adding or removing a functional group which may be water but it's not a hydrolytic reaction.

Divided into 3 classes:

1. Aldolases 2. Enolases 3. Decarboxylases

Decarboxylases

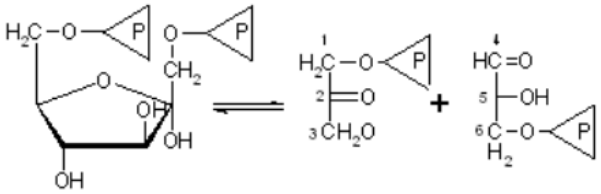
Decarboxylases in general are lyases that remove carboxylic group out of the molecule. (Favorable reaction)

Example: decarboxylation of histidine produces histamine.

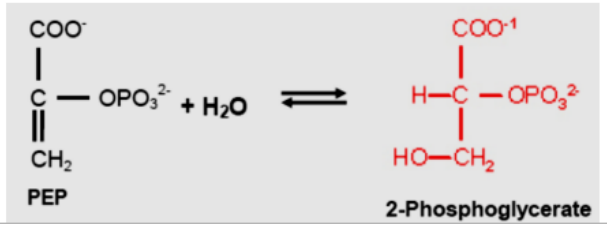
- Catalyze the addition or removal of functional groups from their substrates with the associated formation or removal of double bonds between C-C, C-O and C-N

- Aldolase; breaks down fructose-1,6-bisphosphate into dihydroxyacetone phosphate and glyceraldehydes-3-phosphate

  - F 1,6 bisphosphate ⇆ DHAP + GAP



- Enolase; interconverts phosphoenolpyruvate and 2-phosphoglycerate by formation and removal of double bonds



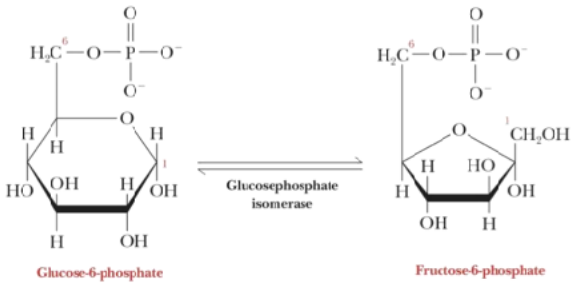
5.Isomerases

Mutases

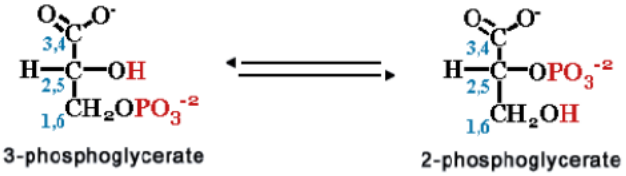
Catalyzes the conversion of one isomer to another, usually these reactions are interconvertible to each other and reversible, go in both directions and they are under equilibrium.

Usually, these names of enzymes will be followed by the name (isomerase), you will put the name of substrate and followed by isomerase.

- Catalyze intramolecular rearrangements
- Glucose-6-phosphate isomerase; isomerizes glucose-6-phosphate to fructose-6-phosphate
- Phosphoglycerate mutase; transfers a phosphate group from carbon number 3 to carbon number 2 of phosphorylated glycerate (BPG intermediate)



- 3-P glycerate ⇆ 2 P glycerate



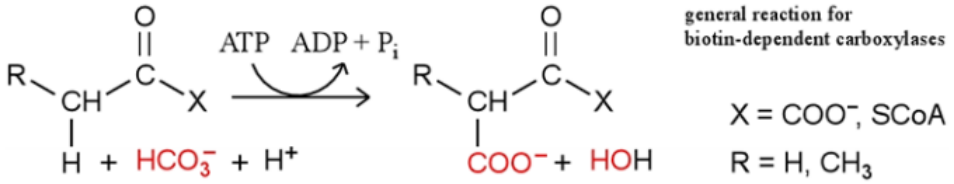
6. ligases

Ligation of molecules together, we are making molecules bigger we are building up, so accordingly we need energy and this is why mostly these reactions utilize ATP as a source of energy.

minor group:

Carboxylase

- Ligases join C-C, C-O, C-N, C-S and C-halogen bonds
- The reaction is usually accompanied by the consumption of a high energy compound such as ATP
- Pyruvate carboxylase
  - Pyruvate + HCO_3^- + ATP ⇆ Oxaloacetate + ADP + Pi



THE END