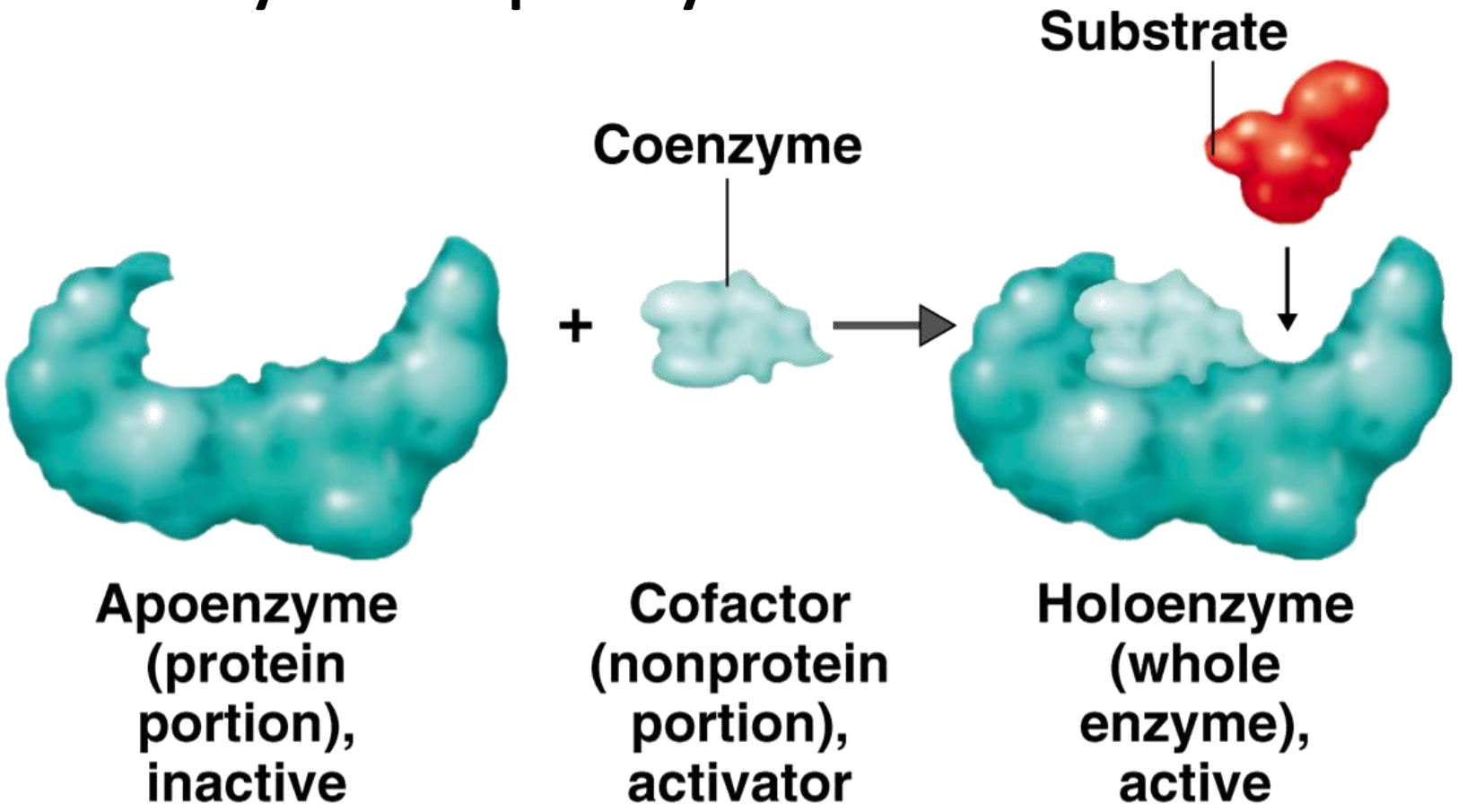
Naming of enzymes

- **In general, enzymes end with the suffix (-ase)**
- **Most enzymes are named for their substrates and for the type of reactions they catalyze, with the suffix “ase” added**
- **For example; ATPase is an enzyme that breaks down ATP, whereas ATP synthase is an enzyme that synthesizes ATP**
- **Some enzymes have common names that provide little information about the reactions that they catalyze**
- **Examples include the proteolytic enzyme trypsin**

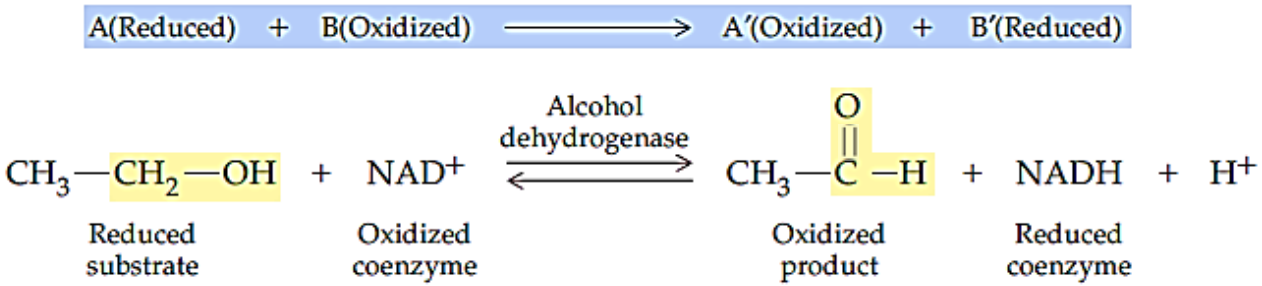
Enzyme Classification (structure)

- **Simple vs. complex (conjugated)**
- **Holoenzyme vs. apoenzyme**

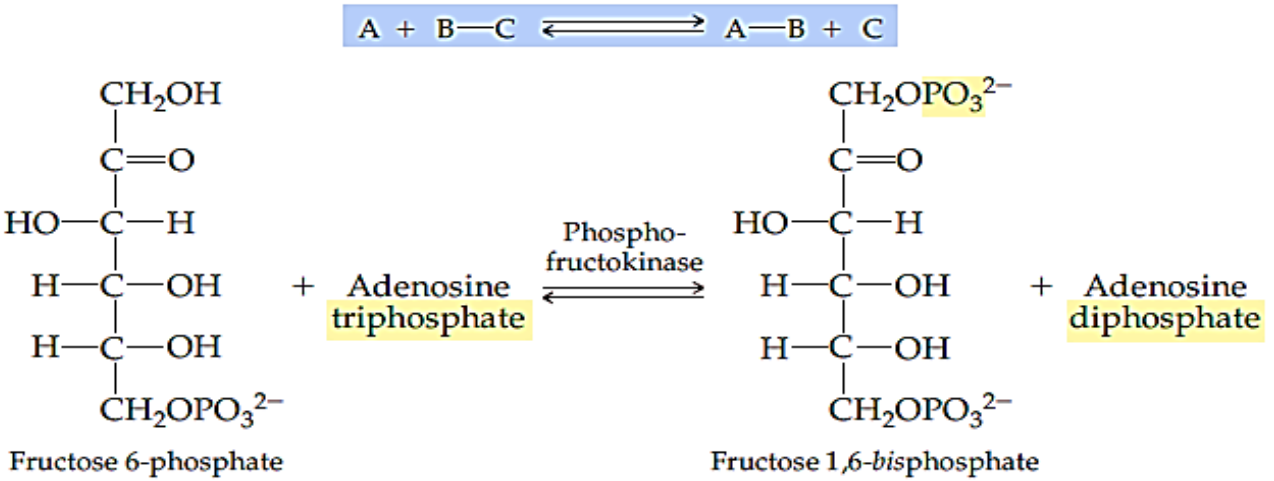


Enzyme Classification (function)

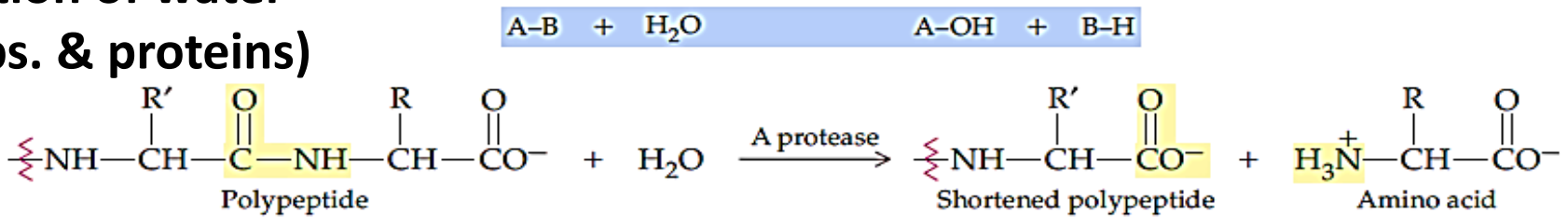
- **Oxidoreductases: addition or removal of O, O_2, H. Require coenzymes (heme)**



- **Transferases*:* transfer of a group from one molecule to another**

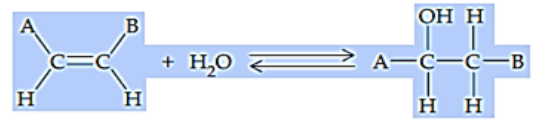


- **Hydrolases: addition of water (carbs. & proteins)**

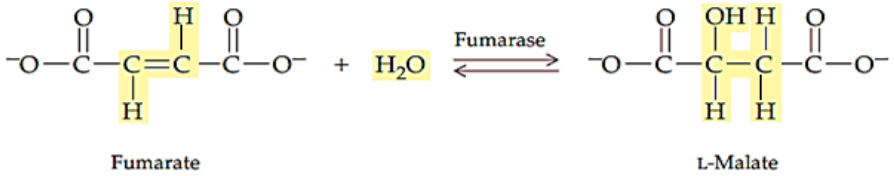


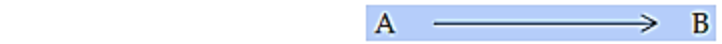
Enzyme Classification (function)

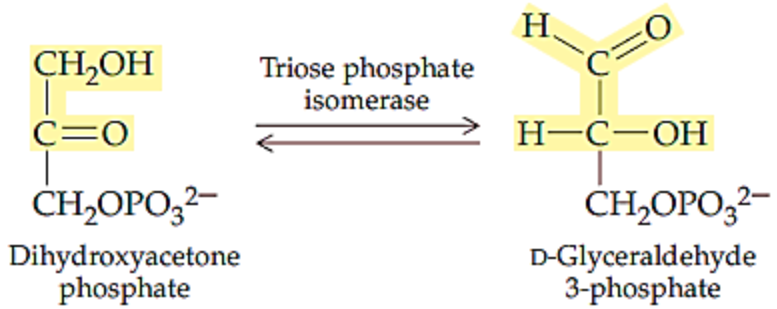
- **Lyases: addition of a molecule (H_2O, CO_2, NH_3) to a double bond or reverse**



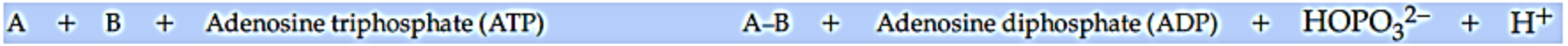
- **Isomerases: one substrate and one product**

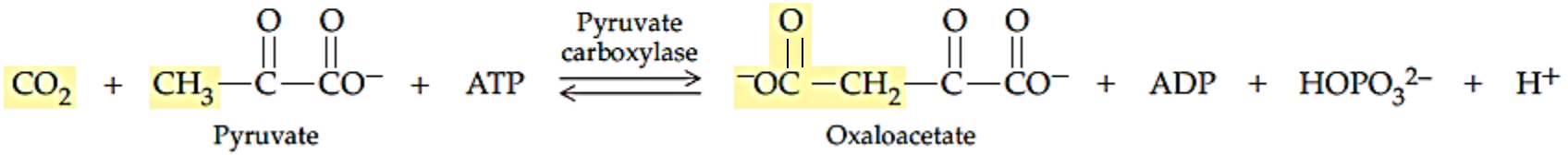






- **Ligases: usually not favorable, so they require a simultaneous hydrolysis reaction**





Oxidoreductases

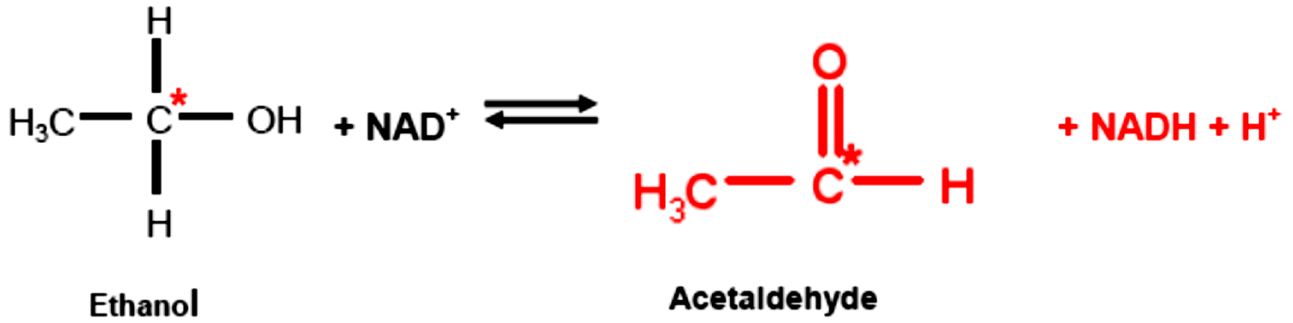
- These enzymes catalyze oxidation & reduction reactions involving the transfer of hydrogen atoms, electrons or oxygen
- This group can be further divided into 4 main classes:
  - ✓ Dehydrogenases
  - ✓ Oxidases
  - ✓ Peroxidases
  - ✓ Oxygenases

Dehydrogenases

- **Dehydrogenases catalyze hydrogen transfer from the substrate to a molecule known as nicotinamide adenine dinucleotide (NAD+)**
- **Lactate dehydrogenase**

Lactate + NAD^+ ⇆ Pyruvate + NADH + H^+

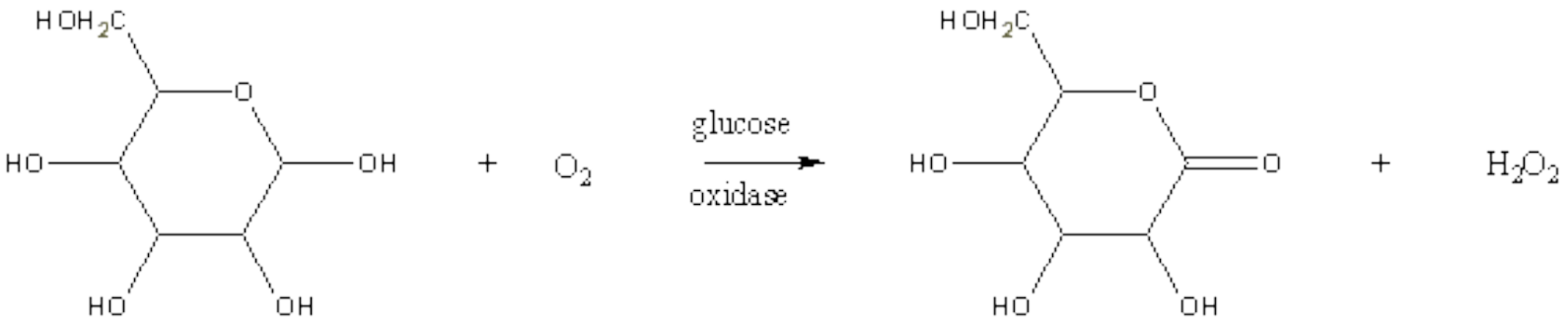
- **Alcohol dehydrogenase**



Oxidases

- **Oxidases catalyze hydrogen transfer from the substrate to molecular oxygen producing hydrogen peroxide as a by-product**
- **Glucose oxidase**

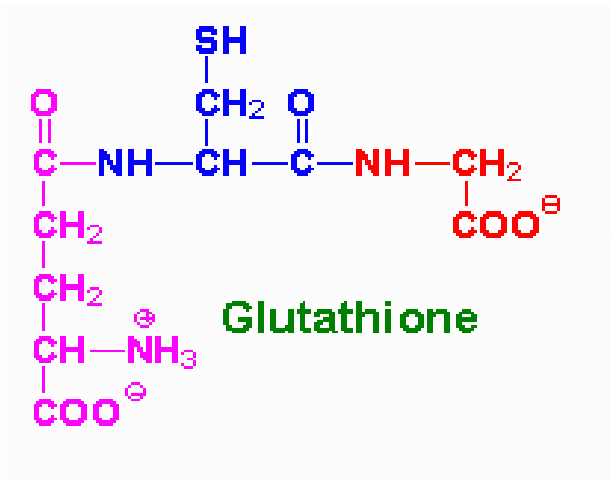
- **β-D-glucose + O_2 ⇆ gluconolactone + H_2O_2**

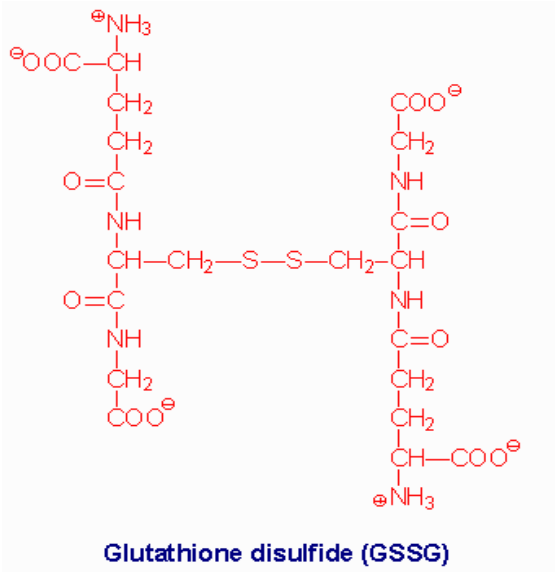


Peroxidases

- **Peroxidases catalyze oxidation of a substrate by hydrogen peroxide**
- **Oxidation of two molecules of glutathione (GSH) in the presence of hydrogen peroxide:**

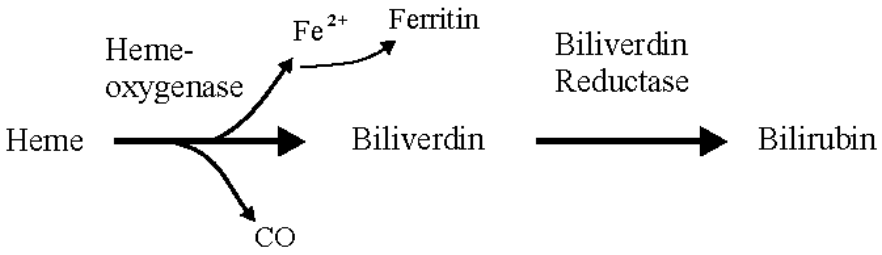
$$2\ GSH + H_2O_2 \leftrightarrows G\text{-}S\text{-}S\text{-}G + 2\ H_2O$$

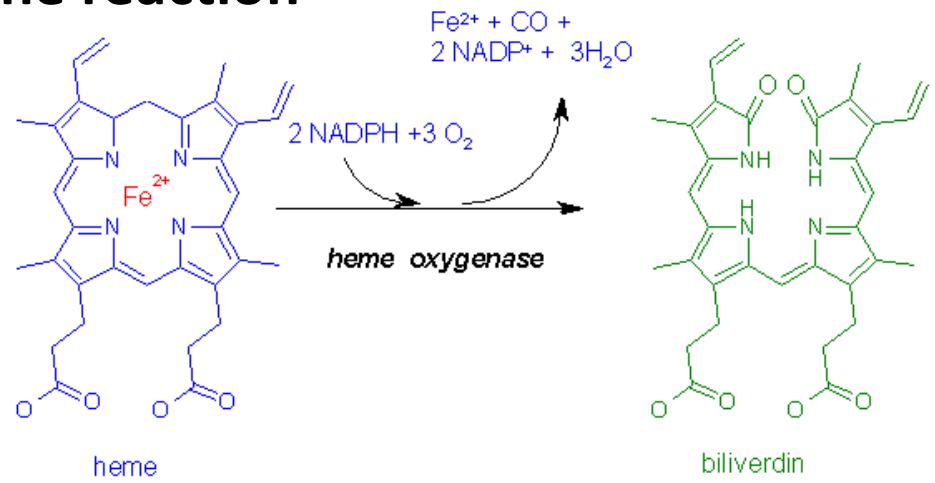




Oxygenases

- **Oxygenases catalyze substrate oxidation by molecular O_2**
- **The reduced product of the reaction in this case is water and not hydrogen peroxide**
- **There are two types of oxygenases:**
- **Monooxygenases; transfer one oxygen atom to the substrate, and reduce the other oxygen atom to water**
- **Dioxygenases, incorporate both atoms of molecular oxygen (O2) into the product(s) of the reaction**

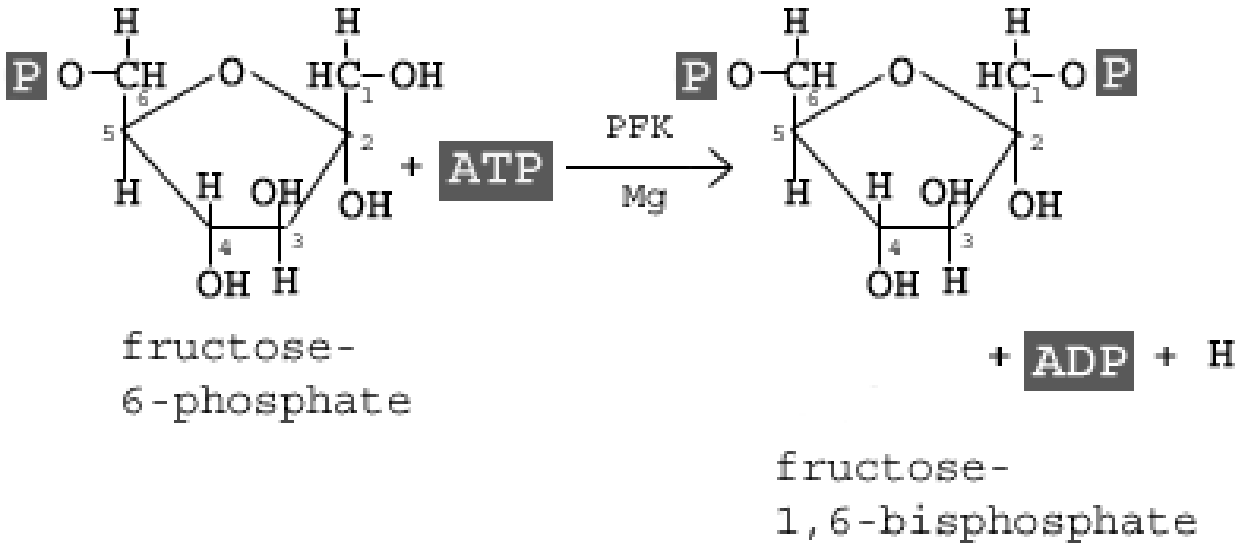




Transferases

- **These enzymes transfer a functional group (C, N, P or S) from one substrate to an acceptor molecule**
- **Phosphofructokinase; catalyzes transfer of phosphate from ATP to fructose-6-phosphate:**

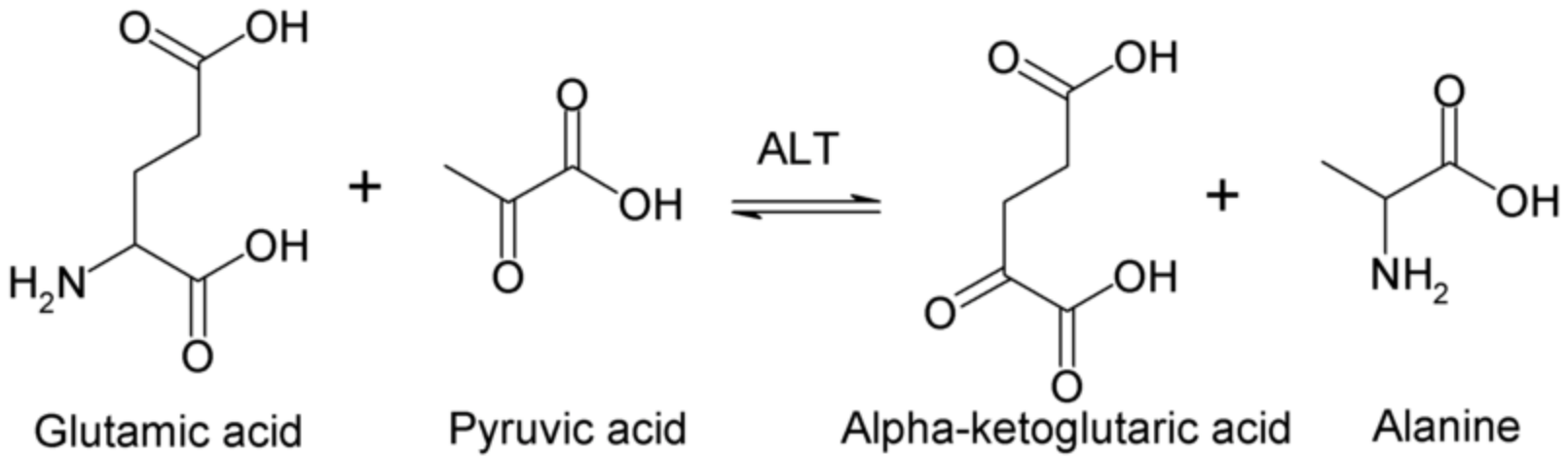
- **Fructose 6-P + ATP ↔ F 1,6 bisphosphate + ADP**



Transaminases

- **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**

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

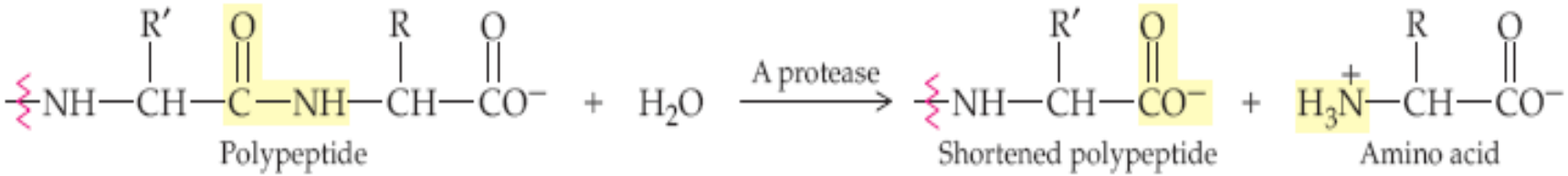


Hydrolases

- These enzymes catalyze cleavage reactions while using water across the bond being broken
- Peptidases, esterases, lipases, glycosidases, phosphatases are all examples of hydrolases named depending on the type of bond cleaved

Proteases

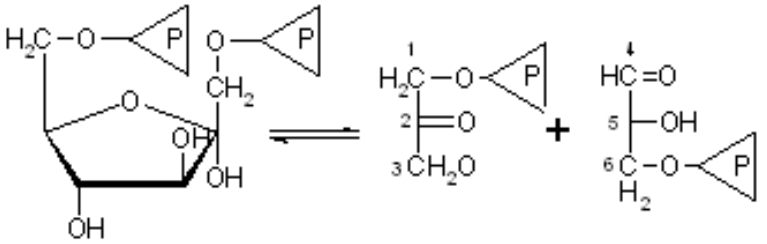
- **These enzymes catalyze proteolysis, the hydrolysis of a peptide bond within proteins**
- **Proteolytic enzymes differ in their degree of substrate specificity**



- **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**

Lyases

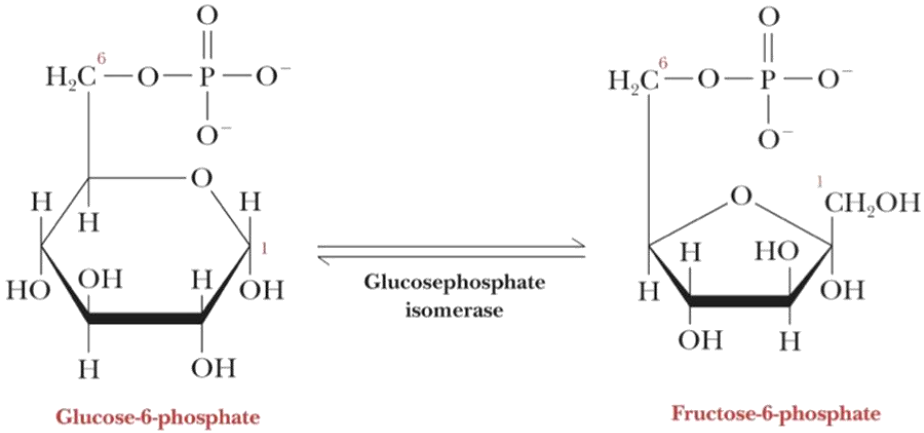
- **Catalyze the addition or removal of functional groups from their substrates with the associated formation or removal of double bonds between C-C, C-O and C-N**
  - **Aldolase; breaks down fructose-1,6-bisphosphate into dihydroxyacetone phosphate and glyceraldehydes-3-phosphate**
    - **F 1,6 bisphosphate ⇆ DHAP + GAP**

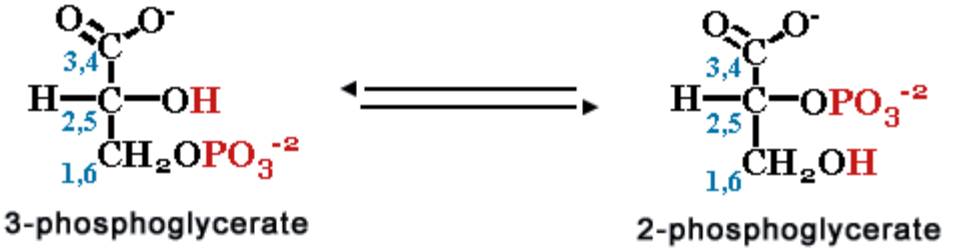


  - **Enolase; interconverts phosphoenolpyruvate and 2-phosphoglycerate by formation and removal of double bonds**

Isomerases

- **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**





Ligases

- **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**