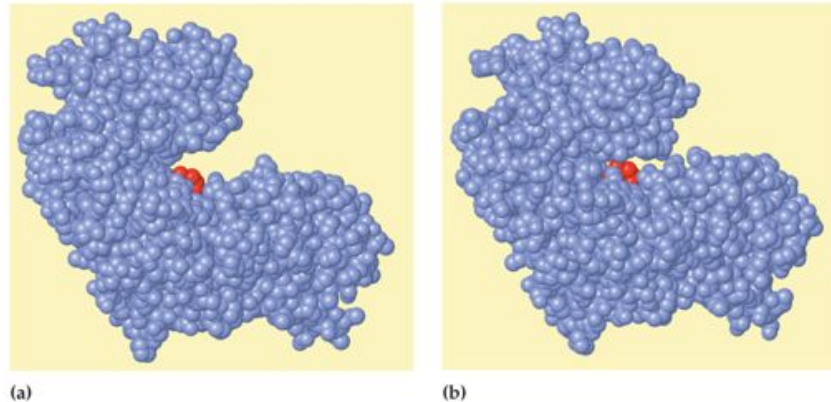
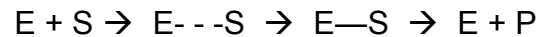


Enzymes

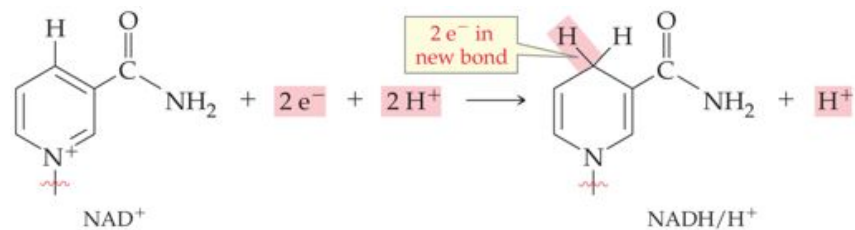
- Enzymes are biological catalysts. Recall that a catalyst speeds up the rate of a reaction by decreasing the activation energy needed for the reaction to occur. A catalyst remains unchanged in a reaction and does not affect the amount of product formed, but only the rate at which the product forms.
- Almost all enzymes are large globular proteins with an active site. The active site is the region where the reaction takes place.
- All enzyme names end in –ase (sucrase, lactase, etc...)
- The substrate is the reactant that fits into the active site of an enzyme and undergoes a change.
- The induced fit theory explains that the substrate approaches the active site, interactions between the substrate and enzyme hold the complex together and induce a structural change in the enzymes shape. Bonds break/form in the substrate. The product is then released and the enzyme resumes its original conformation.



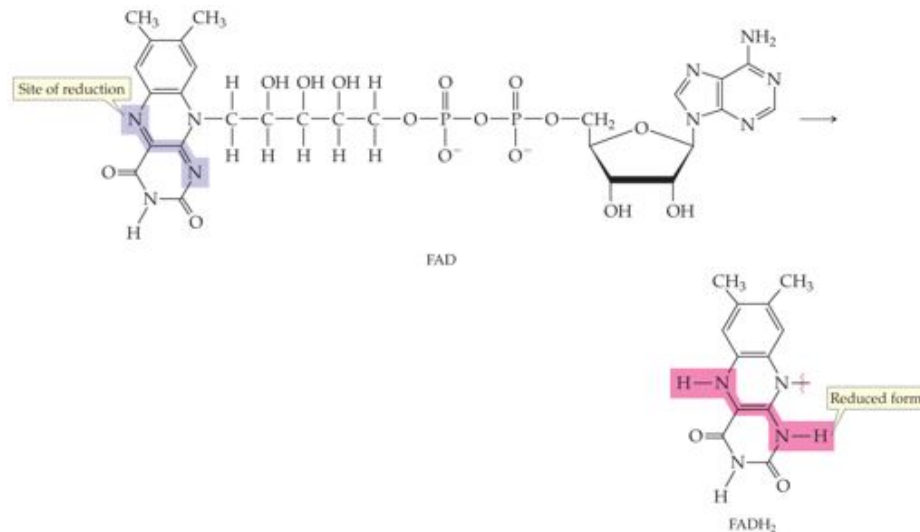
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Cofactors and Coenzymes

- Cofactors & Coenzymes: Metal ions (cofactors) and organic molecules (coenzymes) are essential to the catalytic activity of many enzymes.
- Two coenzymes that we will encounter later are below:



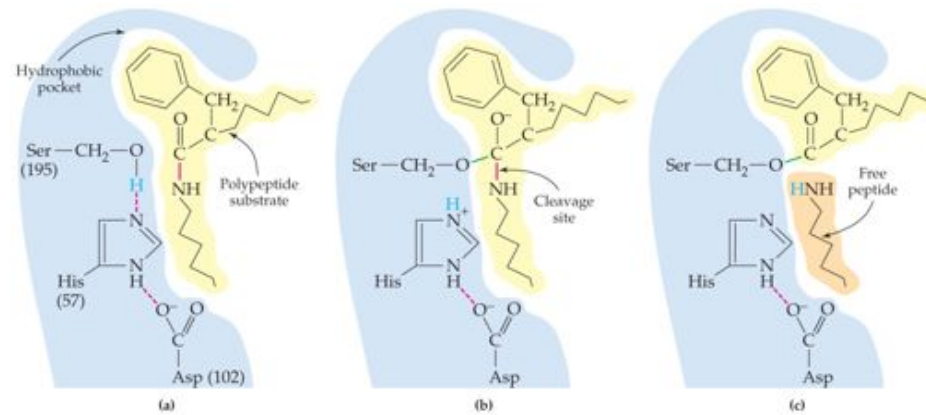
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Enzymes Continued

- Enzyme Specificity:
 - Absolute specificity: Catalyze one reaction for a particular substrate only.
 - Stereochemical specificity: Catalyze the reaction for one stereoisomer of a particular substrate only.
 - Group specificity: Catalyze the reaction for different substrates that have similar functional groups.

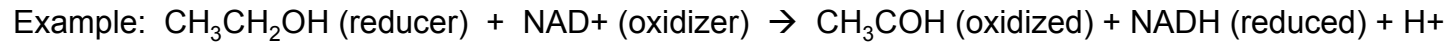


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- Linkage specificity: Catalyze the reaction for one particular type of bond (linkage). We would say that this is the least specificity.

Classes of Enzymes

- Oxidoreductases: catalyze oxidation-reduction reactions of substrate molecules. Recall that oxidation and reduction occur together, so these enzymes usually have coenzymes that are oxidized or reduced as the substrate is reduced or oxidized.



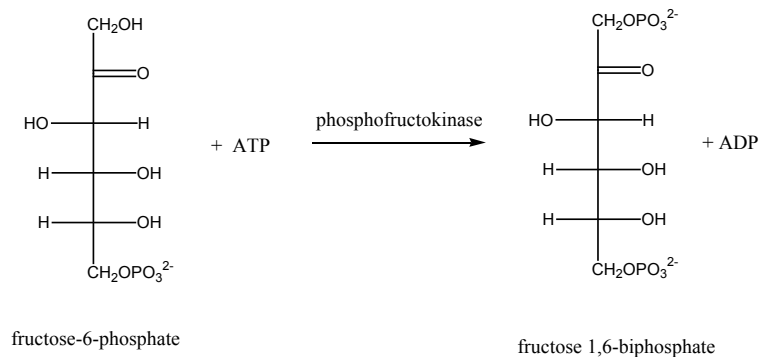
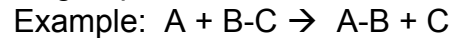
Subcategories of Oxidoreductases:

Oxidases: Oxidation of a substrate

Reductases: Reduction of a substrate

Dehydrogenases: Removal of hydrogen from a substrate to form a double bond

- Transferases: catalyzes the transfer of a group from one molecule to another.



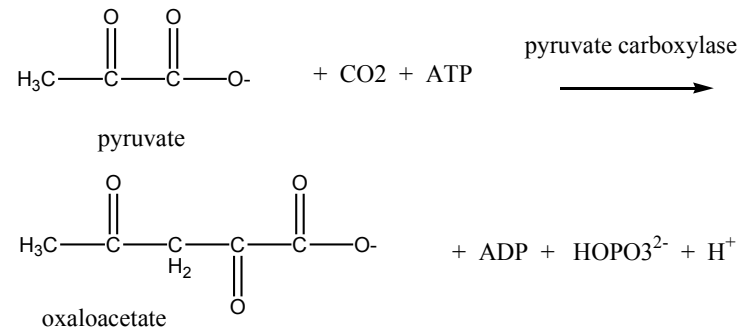
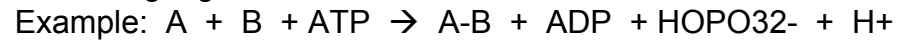
Subcategories of Transferases:

Transaminases

Kinases

Classes of Enzymes

6. Ligases: catalyze the bonding together of two substrates; almost all need the energy from ATP.

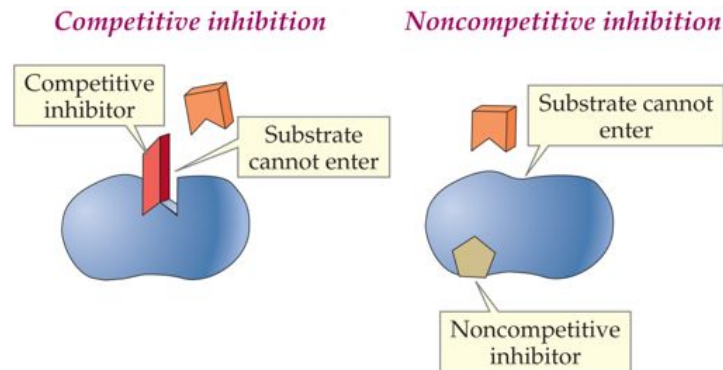


Subcategories of ligases:

synthetases
carboxylases

Enzyme Inhibitors

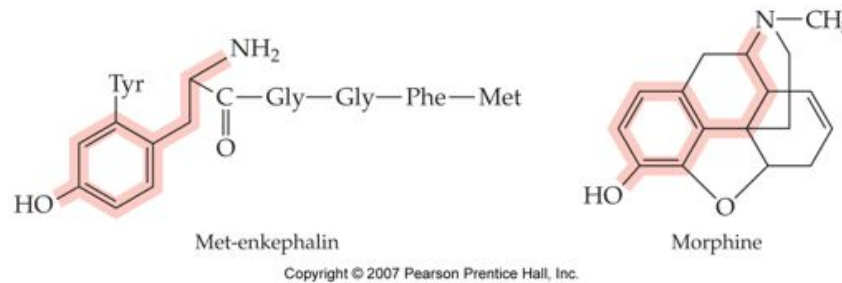
- Compounds that cause Enzyme Inhibition:
 - Irreversible inhibition: An irreversible inhibitor is a compound that inactivates an enzyme by forming covalent bonds to a particular group at the active site. Since the covalent bond is irreversible, the enzyme is rendered useless indefinitely.
 - Reversible inhibition: A reversible inhibitor is a compound that inactivates an enzyme by forming noncovalent interactions with the enzyme. Many enzymes use this for natural regulation of enzyme activity, and many drugs are reversible inhibitors
 - Competitive inhibitors: compete with the substrate for binding at the active site
 - Noncompetitive inhibitors: do not compete for the active site, but bind somewhere else on the enzyme and alter the shape so that the substrate no longer fits into the active site



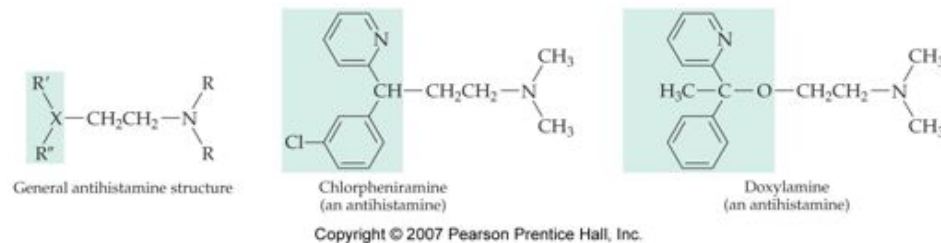
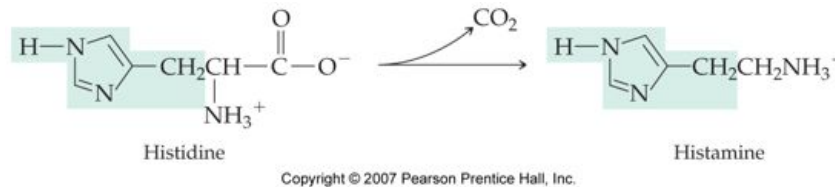
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Receptor Agonists and Antagonists

- Not all inhibitors are enzyme inhibitors. Some inhibit other functions such as hormones or neurotransmitters that act to bring a chemical message to a target via interaction with a receptor.
- Agonists: Substances that act to produce or prolong the normal biological response of a receptor.
 - Morphine and other opium derivatives are agonists of the opiate receptors. They bind in place of neurotransmitters known as enkaphalins and produce the normal euphoric response.



- Antagonists: Substances that inhibit the normal biological response of a receptor.
 - Anti-histamines are antagonists of histamine receptors. They bind in place of the neurotransmitter histamine and block the normal allergic response.



Problems

1. The first step of alcohol metabolism requires alcohol dehydrogenase to convert ethanol into ethanal. This reaction will not take place without NAD⁺ turning into NADH.
 - a. What is the enzyme?
 - b. What is the substrate?
 - c. What is the product?
 - d. What is the coenzyme?
 - e. Is the coenzyme oxidized or reduced in this reaction?

2. Protease inhibitors are used to treat HIV. Protease inhibitors target the virus's protease enzyme needed for replication. Protease inhibitors are _____.
 - a. Receptor agonists
 - b. Receptor antagonists
 - c. Enzyme inhibitors
 - d. All of the above