

Tutorial 24: Enzymes

Goals:

- ✓ To understand the induced fit theory of enzyme activity.
- ✓ To learn about cofactors and coenzymes, and to understand the oxidation and reduction of NAD⁺ and FAD which will be integral in the study of catabolism.
- ✓ To understand the different classes of enzymes.

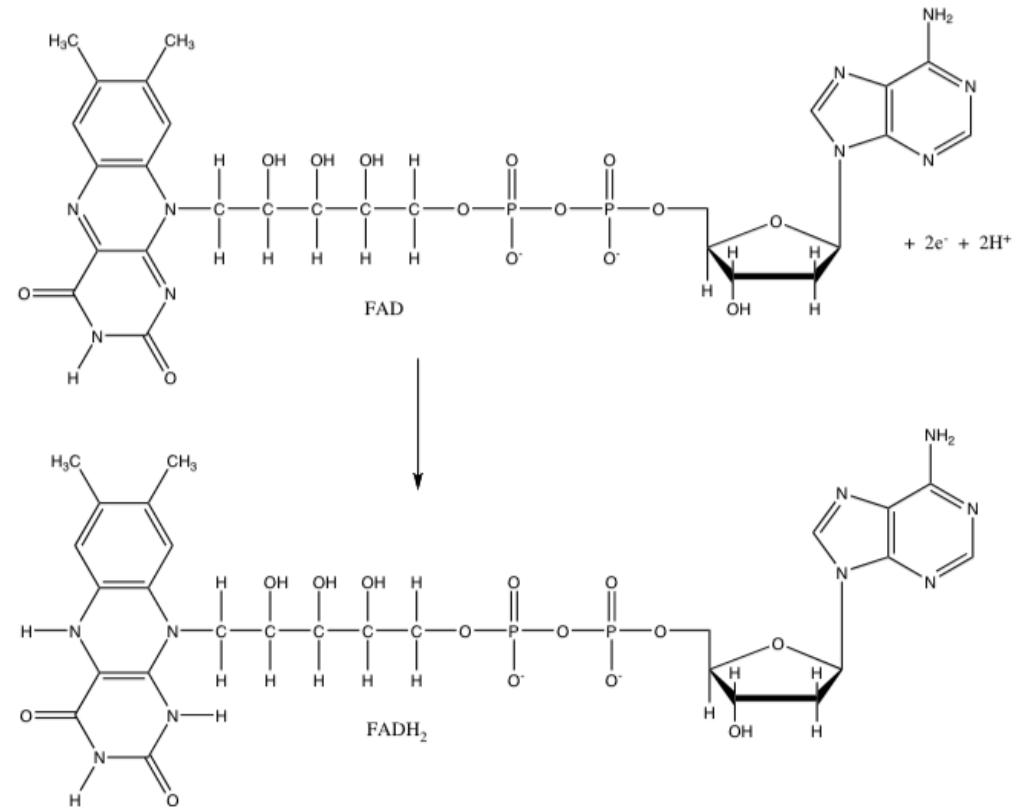
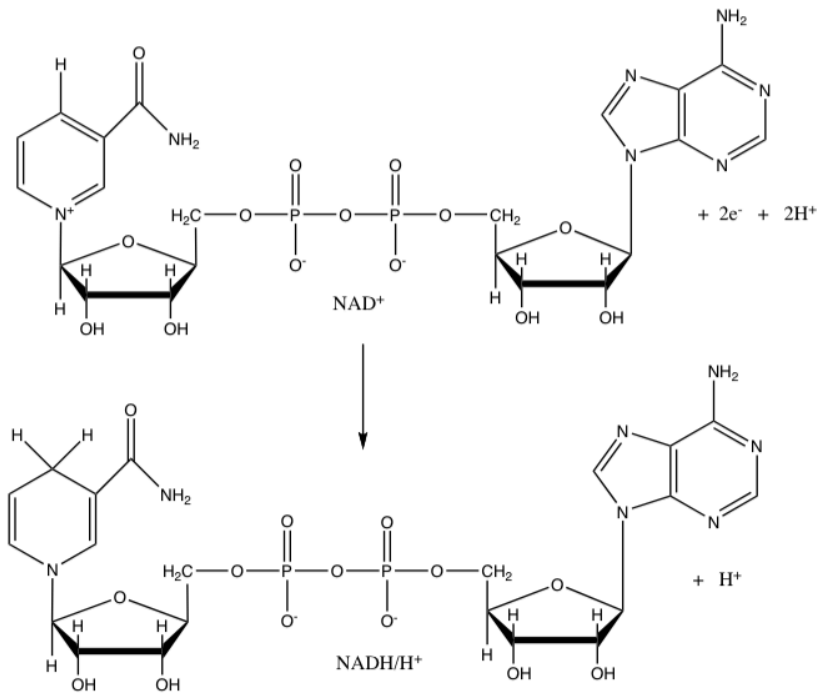
Enzymes and the Induced Fit Theory

- 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 DOES affect 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 chemical change.
- The substrate approaches the active site. Noncovalent interactions between the substrate and enzyme hold the complex together and induce a structural change in the enzymes shape. This structural change forces the substrate into a less stable shape, and allows old bonds to break and new bonds to form more readily as substrate is turned into product. The product is then released and the enzyme resumes its original conformation.



Cofactors and Coenzymes

- **Cofactors:** Metal ions and organic molecules (more specifically called coenzymes) are essential to the catalytic activity of many enzymes. Many vitamins function as part of coenzymes.
- Two coenzymes that we will encounter frequently when covering catabolism are nicotinamide adenine dinucleotide and flavin adenine dinucleotide.



Classes of Enzymes

1. **Oxidoreductases:** catalyze oxidation-reduction reactions of substrate molecules. Recall that oxidation and reduction occur together, so these enzymes 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
2. **Transferases:** catalyzes the transfer of a group from one molecule to another.
 - Subcategories of Transferases:
 - Transaminases: Transfer of an amino group
 - Kinases: Transfer of a phosphoryl group
3. **Hydrolases:** catalyzes the **hydrolysis** of substrates; recall that this is the breakage of bonds by the addition of water.
 - Subcategories of hydrolases:
 - Lipases: Hydrolyze the ester group of lipids
 - Proteases: Hydrolyze the peptide bonds of proteins
 - Nucleases: Hydrolyze the phosphate ester bonds in nucleic acids
4. **Lyases:** catalyze the addition of a molecule to a double bond (or the reverse).
 - Subcategories of lyases:
 - Dehydrases: Removal of water
 - Decarboxylases: Removal of carboxyl group
 - Synthases: Addition of molecule to a double bond
5. **Isomerases:** catalyzes the isomerization of a substrate (recall that an isomer is just a different arrangement of atoms, but the same molecular formula)
6. **Ligases:** catalyze the bonding together of two substrates using energy from ATP.
 - Subcategories of ligases:
 - Synthetases: General synthesis reaction
 - Carboxylases: Synthesis reaction where carbon dioxide is added to substrate to form carbonyl group