



# CLS 431 - Lecture 2

## Classification of Enzymes

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# Chemical Reactions - Types

- A chemical reaction is a process that is usually characterized by a chemical change in which the starting materials (reactants) are different from the products.
- Chemical reactions tend to involve the motion of electrons , leading to the formation and breaking of chemical bonds.
- There are several different types of chemical reactions and more than one way of classifying them.

# Chemical Reactions - Types

- The entire chemistry of life can be “shortlisted” into 6 different types of chemical reactions:

1. **Redox** reactions (transfer of electrons)

2. **Transfer** of functional groups

3. **Hydrolysis**

4. Chemical **decomposition**

} cleavage of covalent bonds

5. **Isomerization**: structural rearrangements (without changing the net atomic composition)

6. Joining molecules together (**ligation**); combination

# Enzyme classification

- The International Union of Biochemistry and Molecular Biology have developed a nomenclature for enzymes, the **EC numbers**
- Each enzyme is described by a sequence of four numbers preceded by "EC". The first number broadly classifies the enzyme based on its mechanism.

## Major enzyme classes

- **EC 1 *Oxidoreductases***: catalyze oxidation/reduction reactions
- **EC 2 *Transferases***: transfer a functional group (*e.g.* a methyl or phosphate group)
- **EC 3 *Hydrolases***: catalyze the hydrolysis of various bonds
- **EC 4 *Lyases***: cleave various bonds by means other than hydrolysis and oxidation
- **EC 5 *Isomerases***: catalyze isomerization changes within a single molecule
- **EC 6 *Ligases***: join two molecules with covalent bonds.

[https://www.youtube.com/watch?v=X\\_34rolpfnw](https://www.youtube.com/watch?v=X_34rolpfnw)

Group	Reaction catalyzed	Typical reaction	Example(s)
<b>EC 1</b> <b><i>Oxidoreductases</i></b>	To catalyze oxidation/reduction reactions; transfer of H and O atoms or electrons from one substance to another	<ul style="list-style-type: none"> <li>- <math>AH + B \rightarrow A + BH</math> (<b>reduced</b>)</li> <li>- <math>A + O \rightarrow AO</math> (<b>oxidized</b>)</li> </ul>	dehydrogenase, oxidase
<b>EC 2</b> <b><i>Transferases</i></b>	Transfer of a functional group from one substance to another. The group may be methyl-, acyl-, amino- or phosphate group	$AB + C \rightarrow A + BC$	transaminase, kinase
<b>EC 3</b> <b><i>Hydrolases</i></b>	Formation of two products from a substrate by hydrolysis	$AB + H_2O \rightarrow AOH + BH$	lipase, amylase, peptidase
<b>EC 4</b> <b><i>Lyases</i></b>	Non-hydrolytic addition or removal of groups from substrates. C-C, C-N, C-O or C-S bonds may be cleaved	<ul style="list-style-type: none"> <li>- <math>RCOCOOH \rightarrow RCOH + CO_2</math></li> <li>- <math>[X-A-B-Y] \rightarrow [A=B + X-Y]</math></li> </ul>	decarboxylase
<b>EC 5</b> <b><i>Isomerases</i></b>	Intramolecule rearrangement, (i.e.) isomerization changes within a single molecule	$AB \rightarrow BA$	isomerase, mutase
<b>EC 6</b> <b><i>Ligases</i></b>	Join together two molecules by synthesis of new C-O, C-S, C-N or C-C bonds with simultaneous breakdown of ATP	$X + Y + ATP \rightarrow XY + ADP + Pi$	synthetase

# Enzyme Classes

**TABLE 10.1 • Summary of the Enzyme Classes and Major Subclasses**

## 1. Oxidoreductases

Dehydrogenases  
Oxidases  
Reductases  
Peroxidases  
Catalase  
Oxygenases  
Hydroxylases

## 2. Transferases

Transaldolase  
and transketolase  
Acyl, methyl,  
glucosyl, and  
phosphoryltransferases  
Kinases  
Phosphomutases

## 3. Hydrolases

Esterases  
Glycosidases  
Peptidases  
Phosphatases  
Thiolases  
Phospholipases  
Amidases  
Deaminases  
Ribonucleases

## 4. Lyases

Decarboxylases  
Aldolases  
Hydratases  
Dehydratases  
Synthases  
Lyases

## 6. Ligases

Synthetases  
Carboxylases

## 5. Isomerases

Racemases  
Epimerases  
Isomerases  
Mutases (not all)