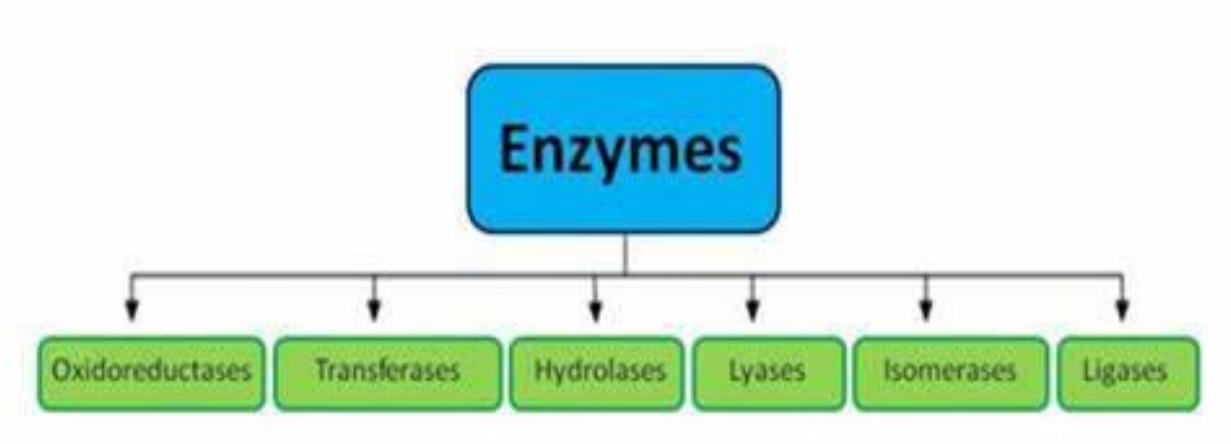
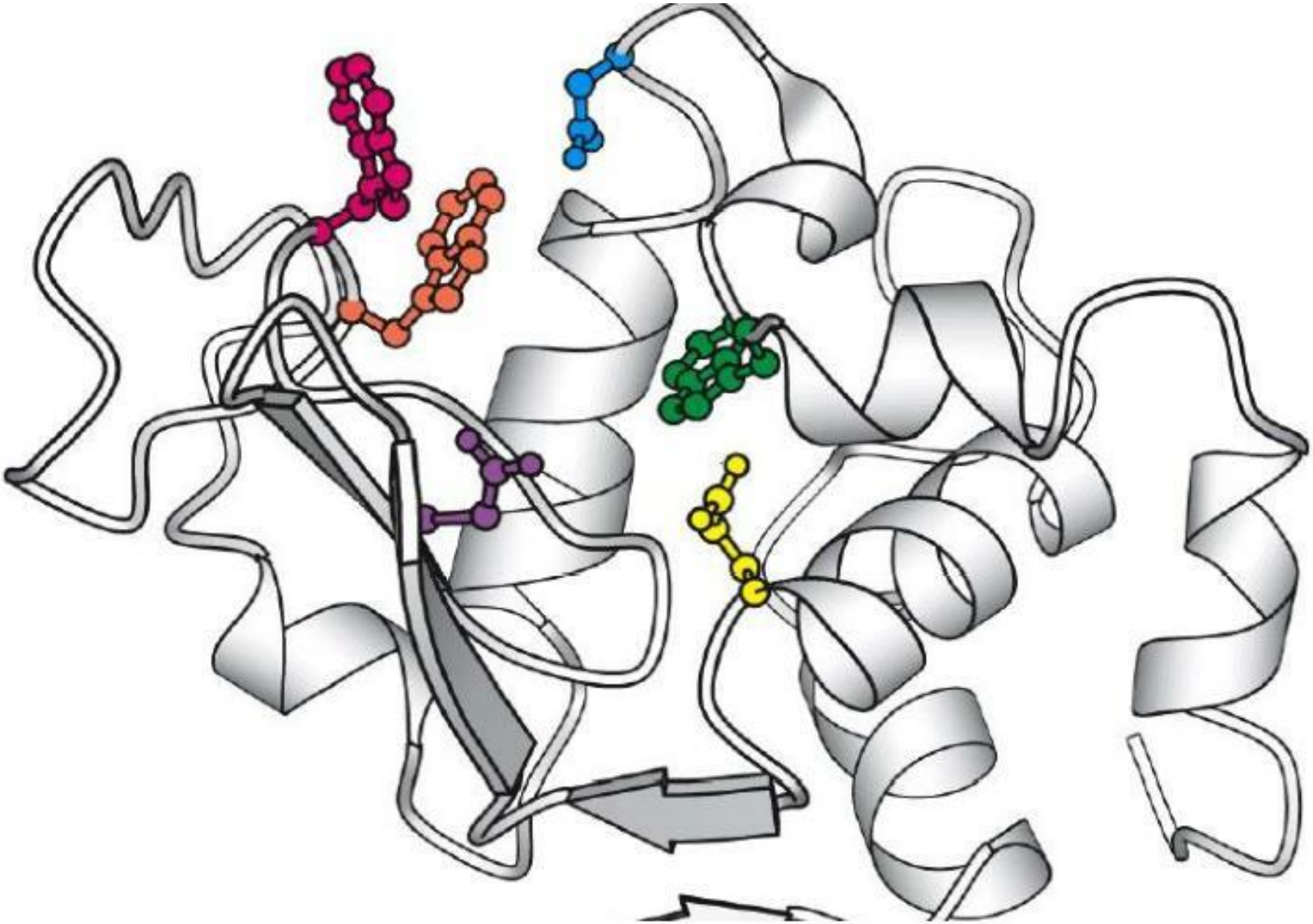
NOMENCLATURE & CLASSIFICATION OF ENZYMES

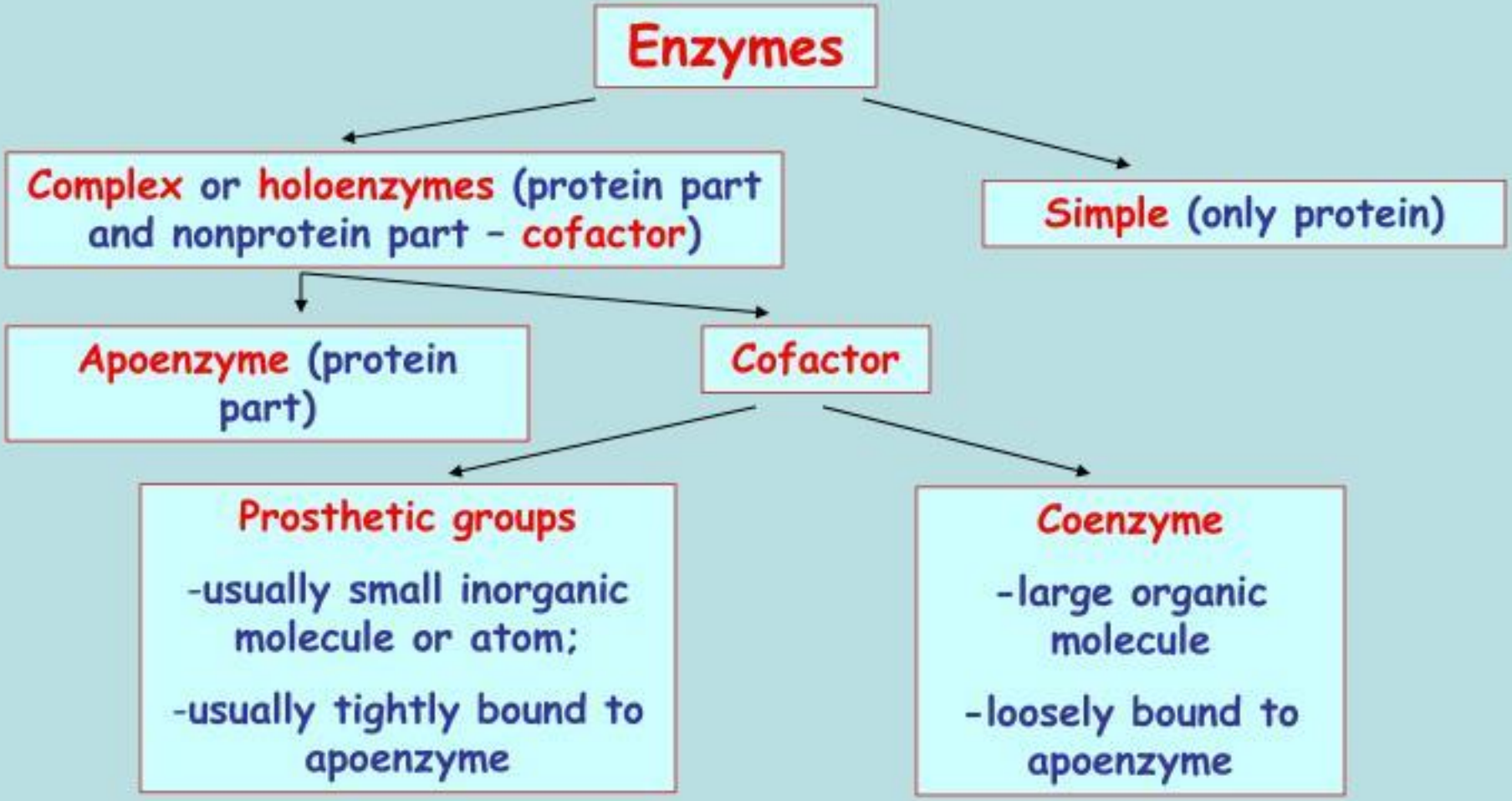


Dr. Zarish Noreen
Atta-ur-Rahman School of Applied Biosciences (ASAB)
National University of Sciences and Technology (NUST), Islamabad



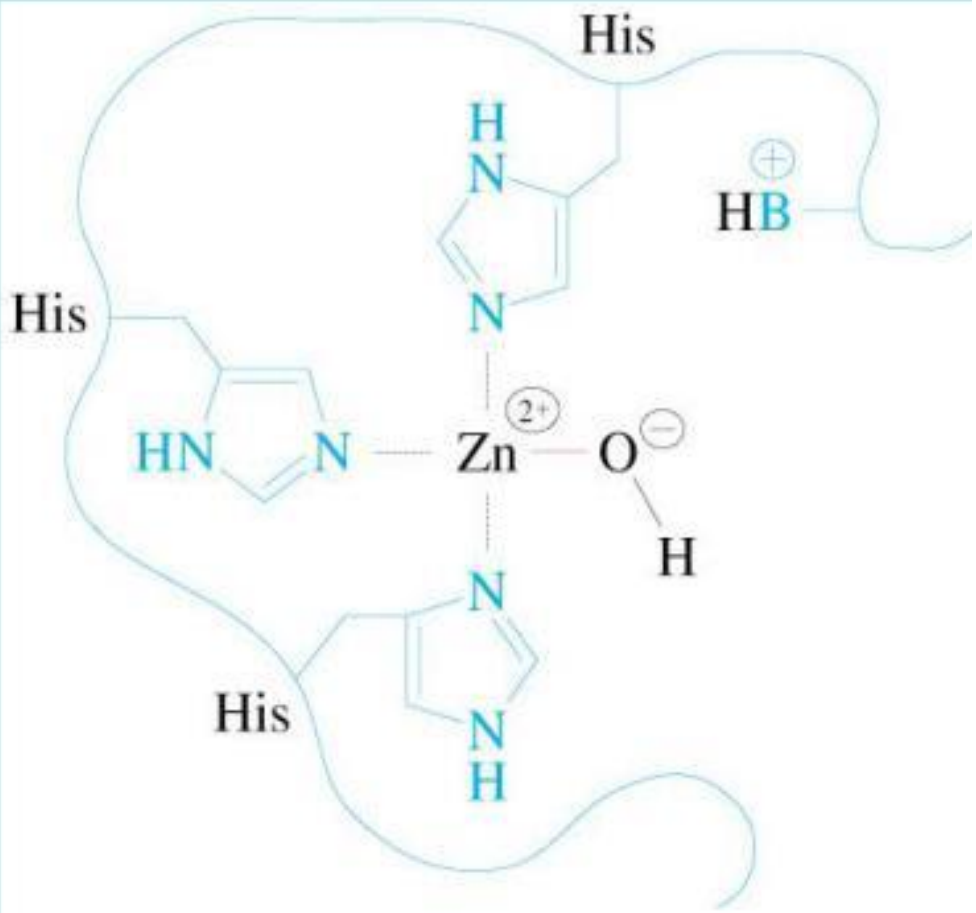
ENZYMES: CLASSIFICATION, STRUCTURE

Structure of enzymes



Example of prosthetic group

Metalloenzymes contain firmly bound metal ions at the enzyme active sites (examples: iron, zinc, copper, cobalt).



Example of metalloenzyme: carbonic anhydrase contains zinc

Coenzymes

- Coenzymes act as group-transfer reagents
- Hydrogen, electrons, or groups of atoms can be transferred

Coenzyme classification

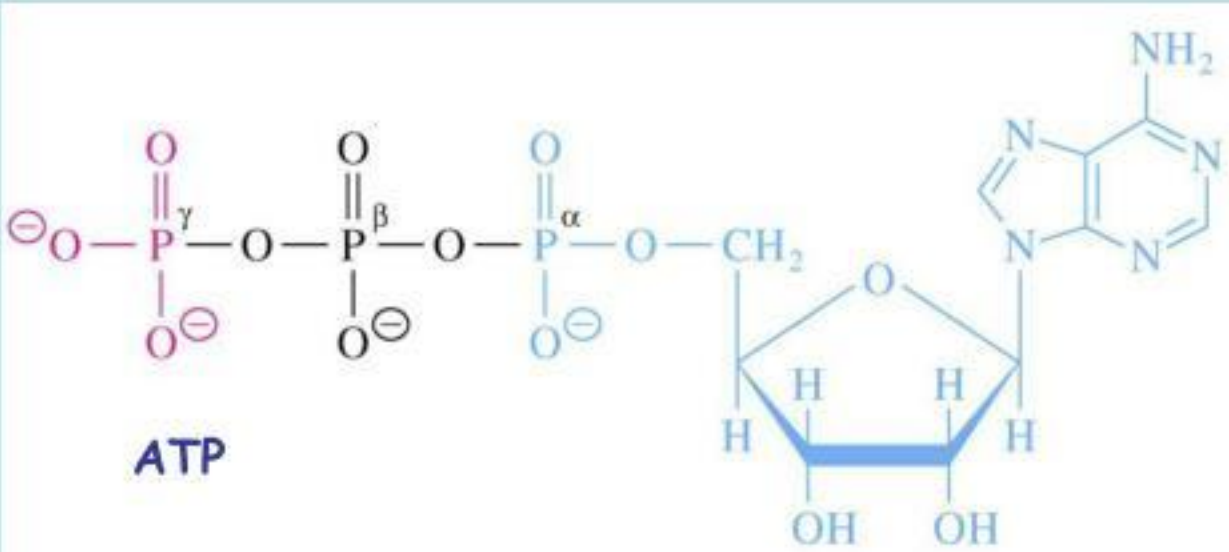
(1) **Metabolite coenzymes** - synthesized from common metabolites

(2) **Vitamin-derived coenzymes** - derivatives of vitamins

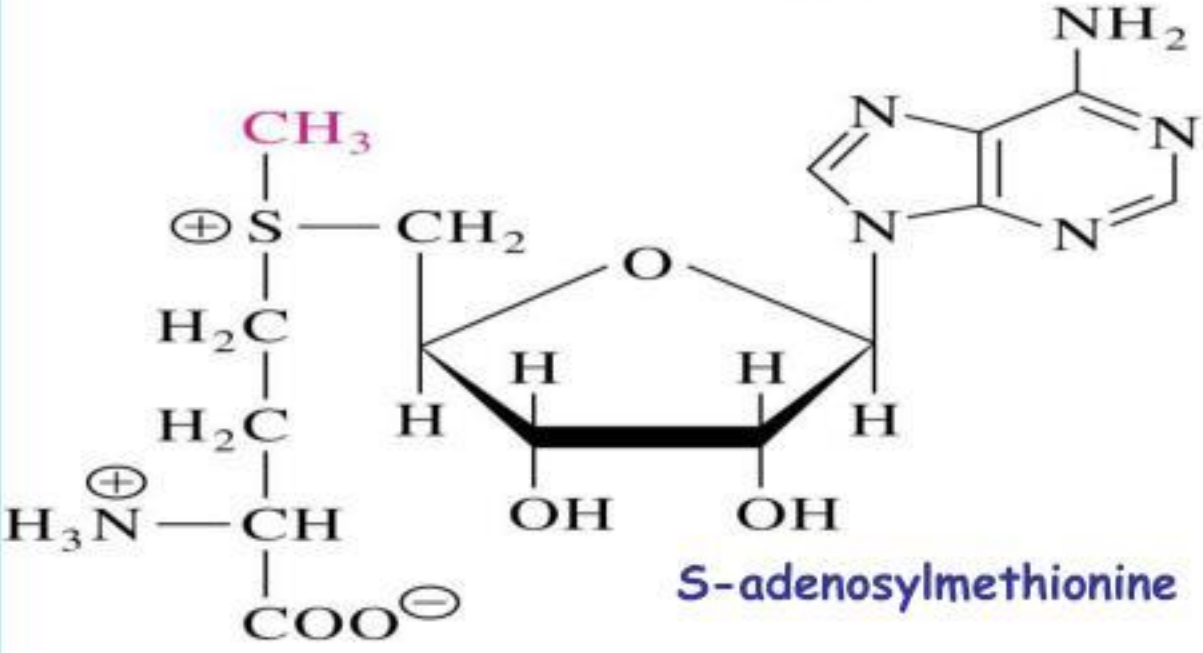
Vitamins cannot be synthesized by mammals, but must be obtained as nutrients

Examples of metabolite coenzymes

ATP can donate phosphoryl group



S-adenosylmethionine donates methyl groups in many biosynthesis reactions



Vitamin-Derived Coenzymes

- Vitamins are required for coenzyme synthesis and must be obtained from nutrients
- Most vitamins must be enzymatically transformed to the coenzyme
- Deficit of vitamin and as result correspondent coenzyme results in the disease

Nomenclature / enzyme classification

IUBMB The **International Union of Biochemistry and Molecular Biology** has recommended system of nomenclature for enzymes.

- classified based on the type of reaction in which they are used to catalyze.
- according to them each enzyme is assigned with two names:

✓ **Trivial name** (common name, recommended

✓ name).

✓ **Systemic name** (official name).

Trival name

- Gives no idea of source, function or reaction catalyzed by the enzyme.
- Example: trypsin, thrombin, pepsin.

Systemic name

Each enzyme is characterized by a code no.called Enzyme Code no. or **EC number** and contain four Figure (digit) separated by a dot.

e.g. **EC m. n. o. p**

First digit represents the class;

Second digit stands for subclass ;

Third digit stands for the sub-sub class or subgroup;

Fourth digit gives the serial number of the particular enzyme in the list.

e.g. **EC 2.7.1.1 for hexokinase**.

Systematic Name

- According to the International union Of Biochemistry an enzyme name has two parts:

  -First part is the name of the substrates for the enzyme.

  -Second part is the type of reaction catalyzed by the enzyme.This part ends with the suffix “ase”.

Example: Lactate dehydrogenase

EC number

- Enzymes are classified into six different groups according to the reaction being catalyzed.
- The nomenclature was determined by the Enzyme Commission in 1961 (with the latest update having occurred in 1992), hence all enzymes are assigned an “EC” number.
- The classification does not take into account amino acid sequence (ie, homology), protein structure, or chemical mechanism.

EC numbers

- EC numbers are four digits, for example a.b.c.d, where “a” is the class,
- “b” is the **subclass**,
- “c” is the **sub-subclass,**
- “d” is the **sub-sub-subclass.**
- The “b” and “c” digits describe the reaction, while the “d” digit is used to distinguish between different enzymes of the same function based on the actual substrate in the reaction.
- Example: for Alcohol:NAD^+oxidoreductase EC number is 1.1.1.1

Systemic name……

According to the IUBMB system of enzyme nomenclature enzymes are grouped into 6 major classes

EC 1 OXIDOREDUCTASES

EC 2 TRANSFERASES

EC 3 HYDROLASES

EC 4 LYASES

EC 5 ISOMERASES

EC 6 LIGASES

Class	Nature of reaction catalyzed
Oxidoreductases	Oxidation - reduction
Transferases	Group transfer
Hydrolases	Cleavage of chemical bond by hydrolysis
Lyases	Non hydrolytic cleavage of chemical bond
Isomerases	Isomerization of substrates into structural or optical isomers
Ligases	Joining of two substrate molecules by forming new covalent bond

CLASSIFICATION OF ENZYMES

Formulated by the enzyme commission of I.U.B six major classes based on the type of reactions catalyzed

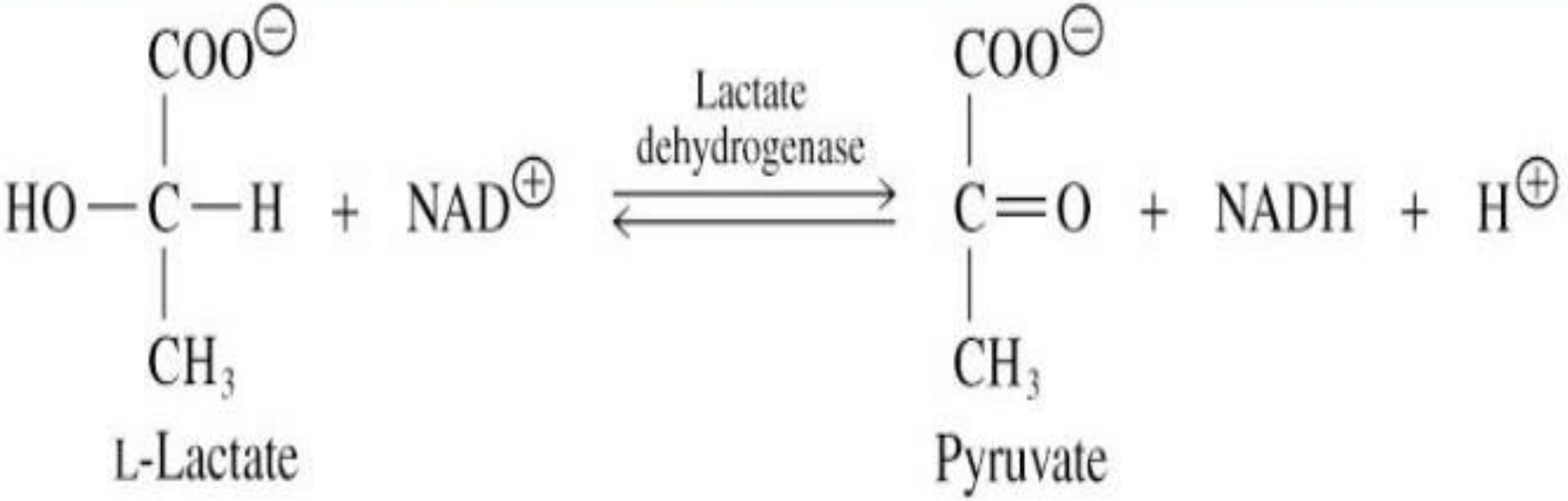
1. **Oxidoreductases**
   - Catalyzing oxidation reduction reactions
2. **Transferases**
   - Catalyzing group transfer
3. **Hydrolases**
   - Catalyzing hydrolytic breakdown

Classification of Enzymes

4. **Lyases**
   - Catalysing removal of groups by mechanism other than hydrolysis and leaving behind double bonds
5. **Isomerases**
   - Catalysing interconversion of isomers
6. **Ligases**
   - Catalysing formation of bonds and new compounds

1. Oxidoreductases

- Catalyze oxidation-reduction reactions

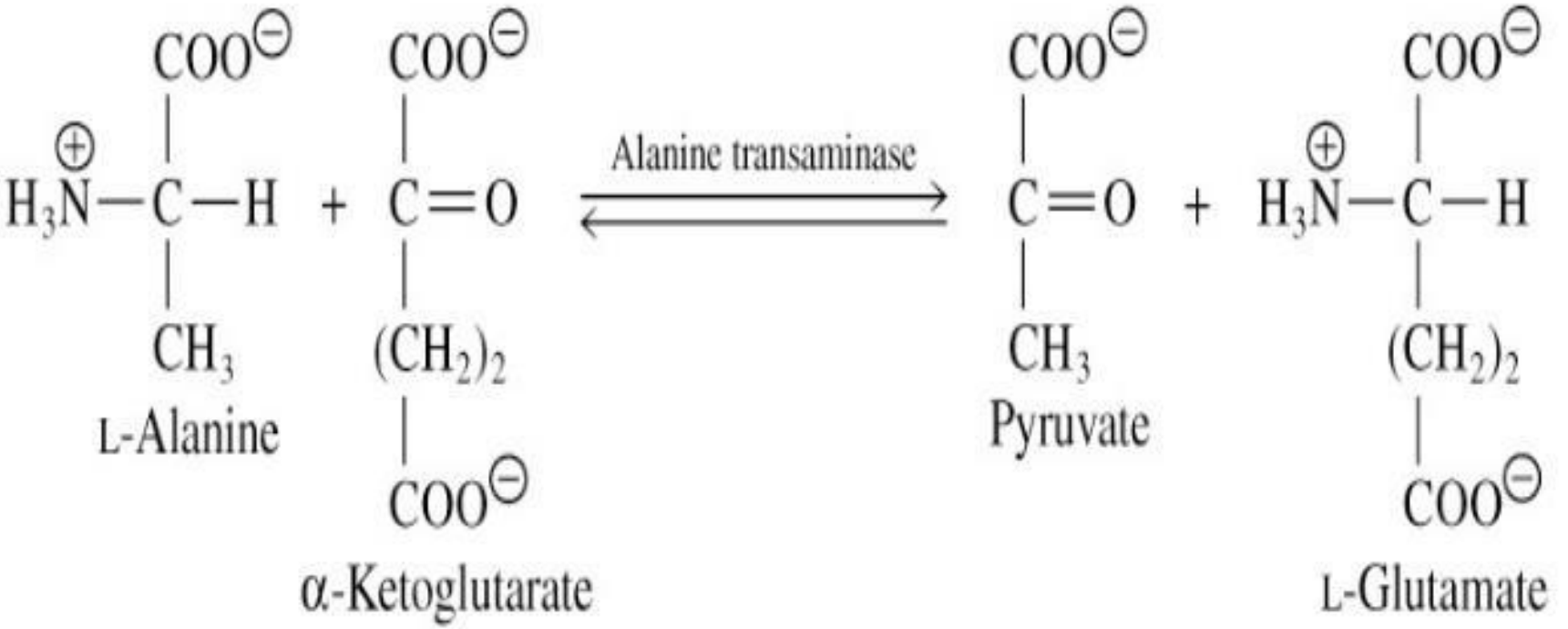


- oxidases
- peroxidases
- dehydrogenases

Catalysing oxidation reduction reaction where one substrate is oxidized and other is reduced

2. Transferases

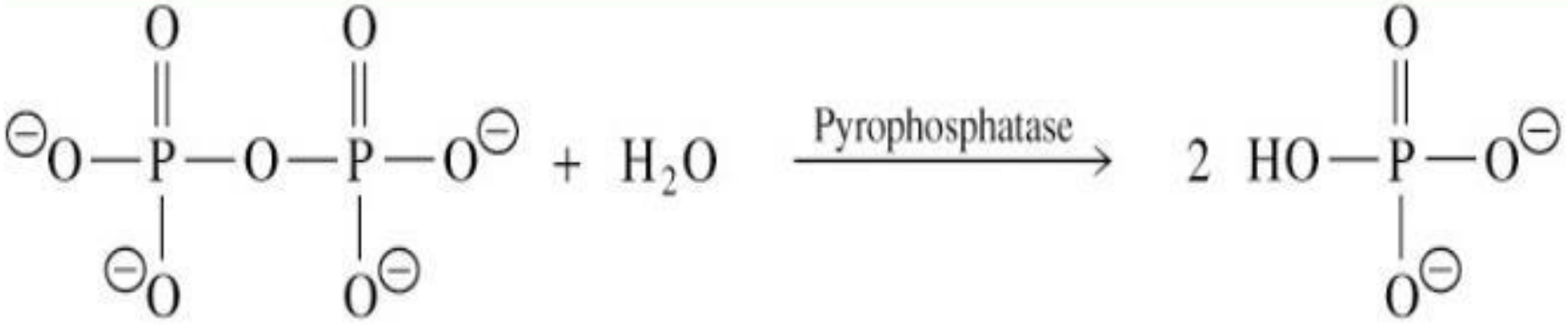
- Catalyze group transfer reactions



(5.2)

3. Hydrolases

- Catalyze hydrolysis reactions where water is the acceptor of the transferred group



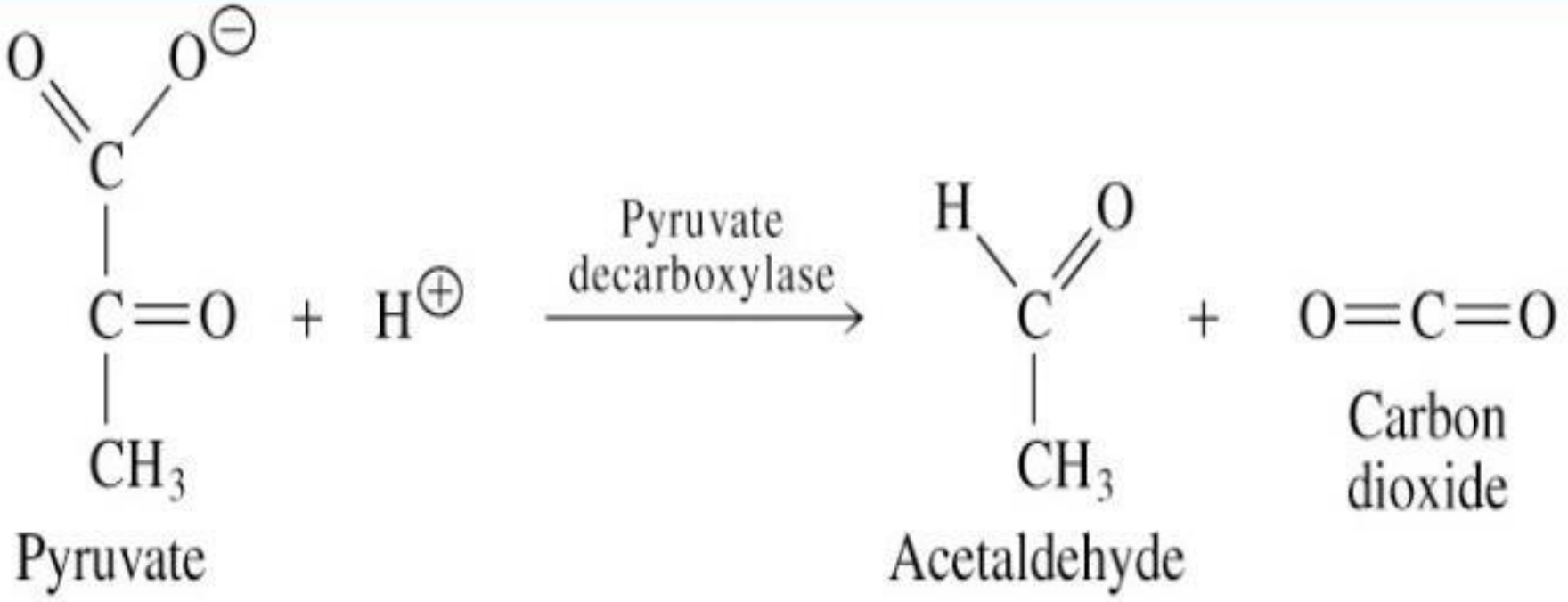
Pyrophosphate

Phosphate

- esterases
- peptidases
- glycosidases

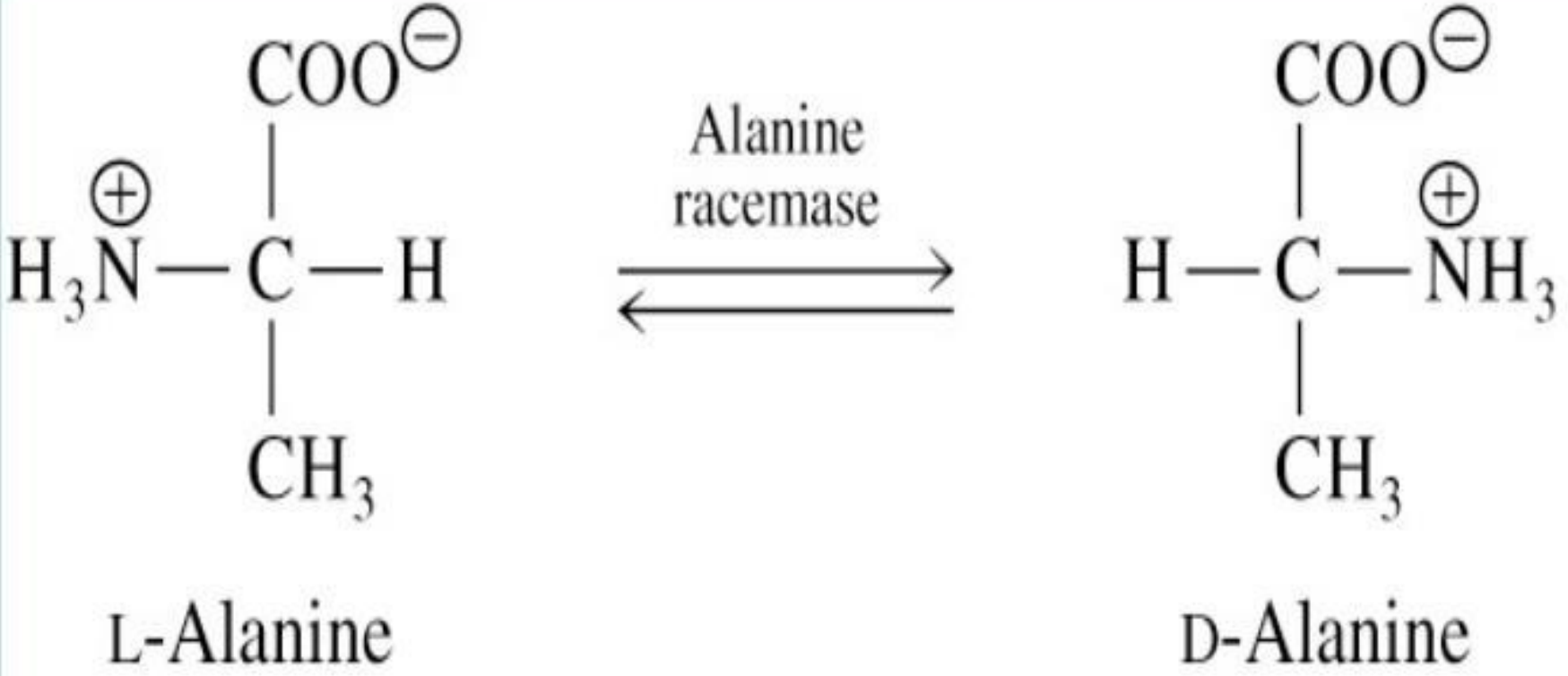
4. Lyases

- Catalyze lysis of a substrate, generating a double bond in a nonhydrolytic, nonoxidative elimination



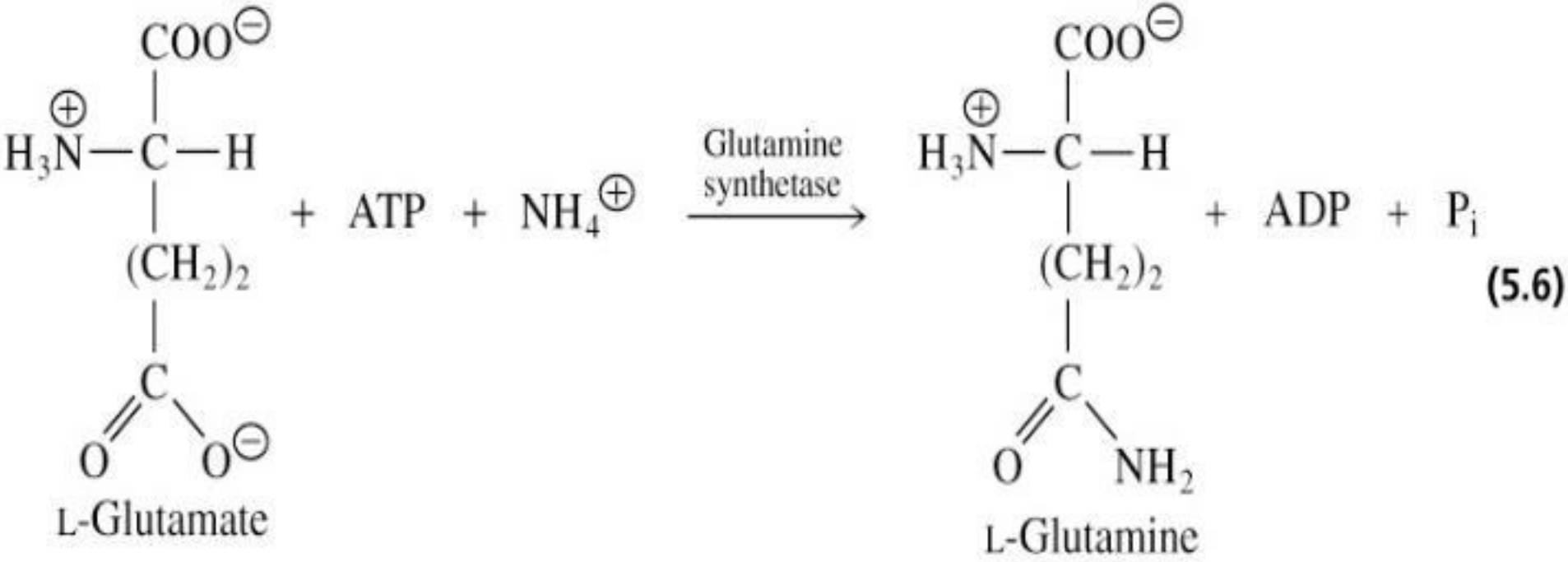
5. Isomerases

- Catalyze isomerization reactions



6. Ligases (synthetases)

- Catalyze ligation, or joining of two substrates
- Require chemical energy (e.g. ATP)



EC

- Every enzyme code consists of the letters "EC" followed by four numbers separated by periods. Those numbers represent a progressively finer classification of the enzyme.
- For example, the tripeptide aminopeptidases have the code "EC 3.4.11.4", whose components indicate the following groups of enzymes:
- *EC 3* enzymes are hydrolases (enzymes that use water to break up some other molecule)
- *EC 3.4* are hydrolases that act on peptide bonds
- *EC 3.4.11* are those hydrolases that cleave off the amino-terminal amino acid from a polypeptide
- *EC 3.4.11.4* are those that cleave off the amino-terminal end from a tripeptide

Examples of Enzymes

Following are some of the examples of enzymes:

Beverages

Alcoholic beverages generated by fermentation vary a lot based on many factors. Based on the type of the plant's product, which is to be used and the type of enzyme applied, the fermented product varies.

For example, grapes, honey, hops, wheat, cassava roots, and potatoes depending upon the materials available. Beer, wines and other drinks are produced from plant fermentation.

Food Products

Bread can be considered as the finest example of fermentation in our everyday life.

A small proportion of yeast and sugar is mixed with the batter for making bread. Then one can observe that the bread gets puffed up as a result of fermentation of the sugar by the enzyme action in yeast, which leads to the formation of carbon dioxide gas. This process gives the texture to the bread, which would be missing in the absence of the fermentation process.

Drug Action

Enzyme action can be inhibited or promoted by the use of drugs which tend to work around the active sites of enzymes.


Thank You!