



Class 11 Academic Program-2020

BIOLOGY

Lecture : B-07

Chapter 3 : Cell Chemistry



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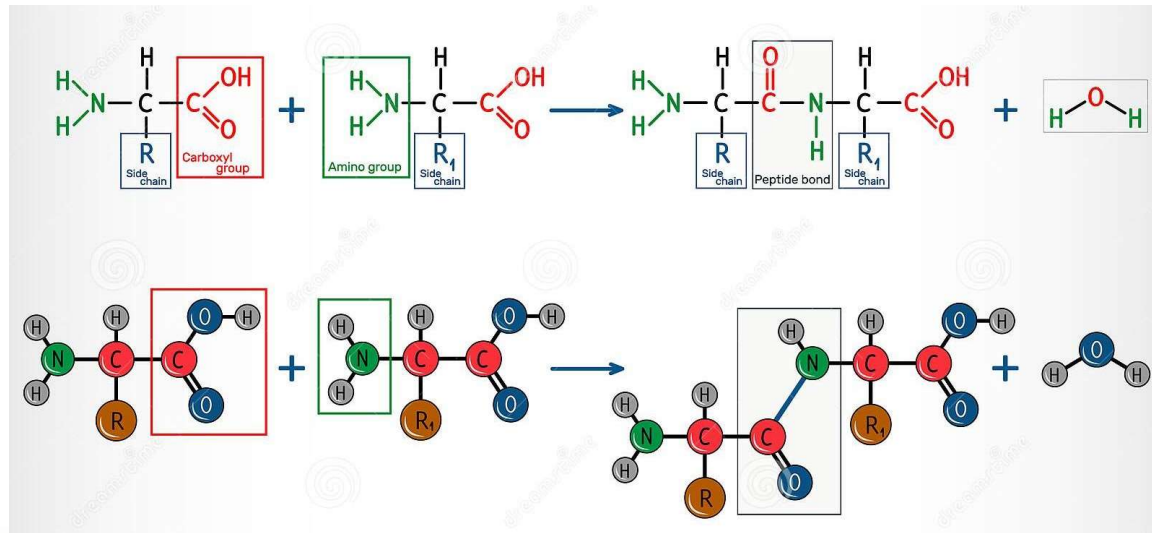
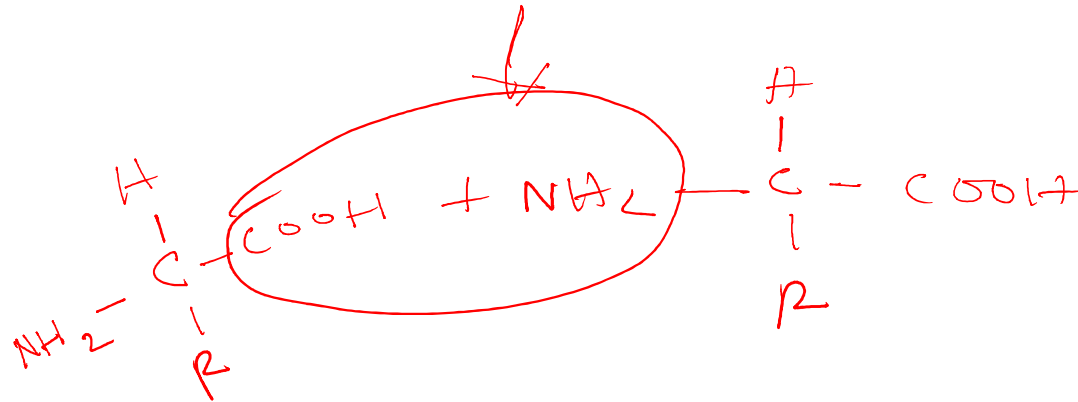
একাডেমিক এন্ড এডমিশন কোয়ার

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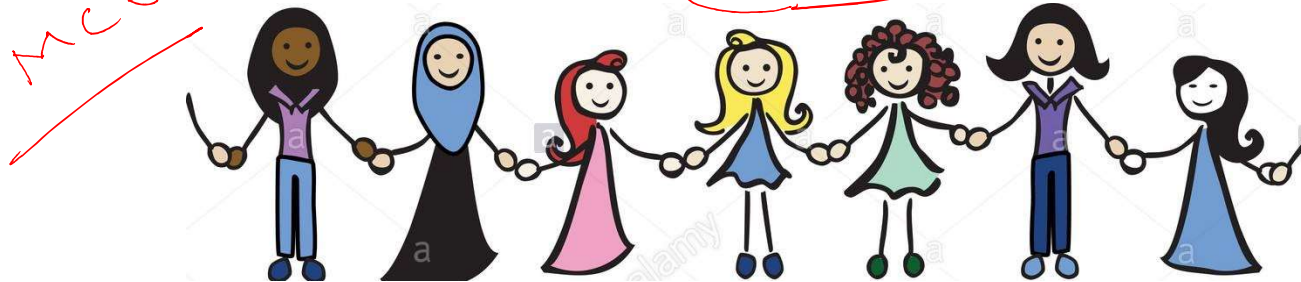


Protein

Peptide bond



- **Peptide bond:** A peptide bond is an amide type of covalent chemical bond formed between two amino acids when the carboxyl group of one amino acid reacts with the amino group of the other amino acid.
- **Peptide :** A linear chain of amino acid residues held together by peptide bond.
- **Dipeptide:** Consists of 2 amino acids. ==
- **Tripeptide:** Consists of 3 amino acids. ==
- **Oligopeptide:** Consists of 4-10 amino acids.
- **Polypeptide:** Consists of more than 50 amino acids.



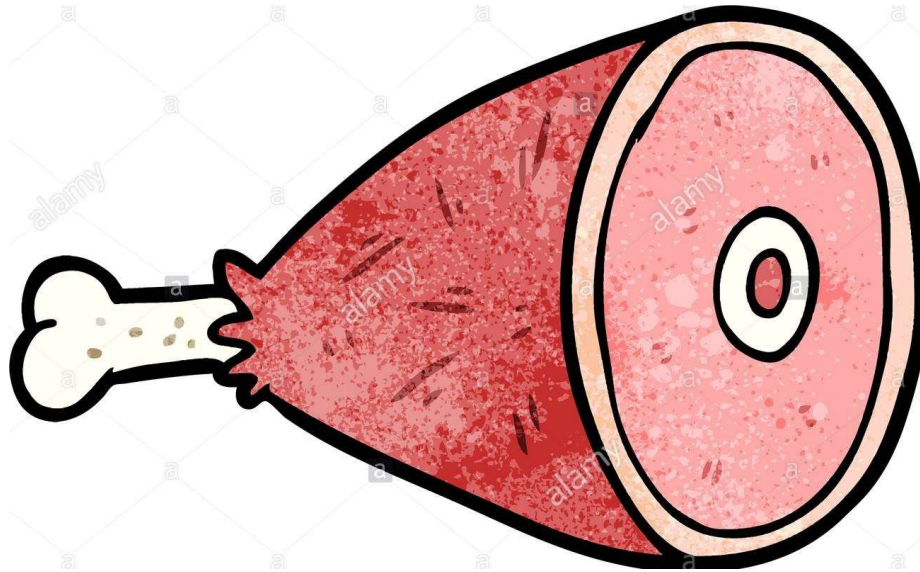
Poll Question-01

Oligopeptide consists of ____

- (a) 3-10 amino acids
- (b) 4-10 amino acids
- (c) 50 amino acids
- (d) More than 50 amino acids

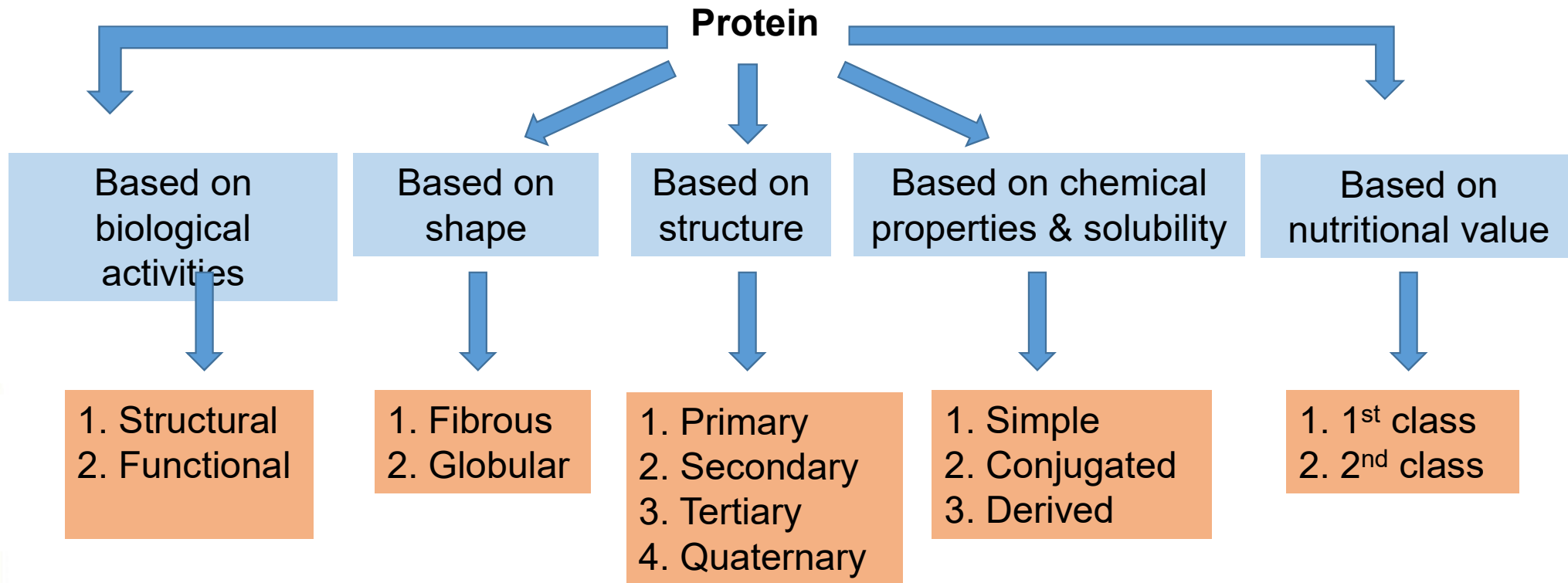
Proteins

Proteins are large organic compounds composed of numerous amino acids. A protein molecule is composed of 100 or more amino acid molecules.



> 100
molecules
of
Amino Acid

Classification of Protein



Classification of protein based on biological activities

Structural protein

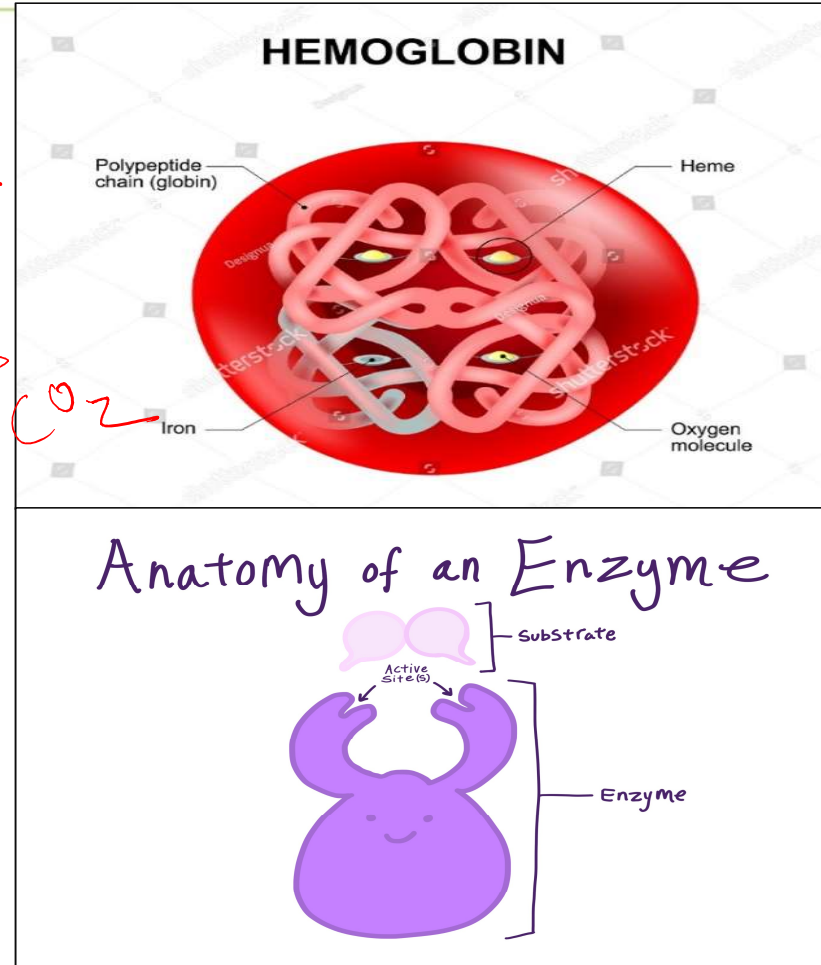
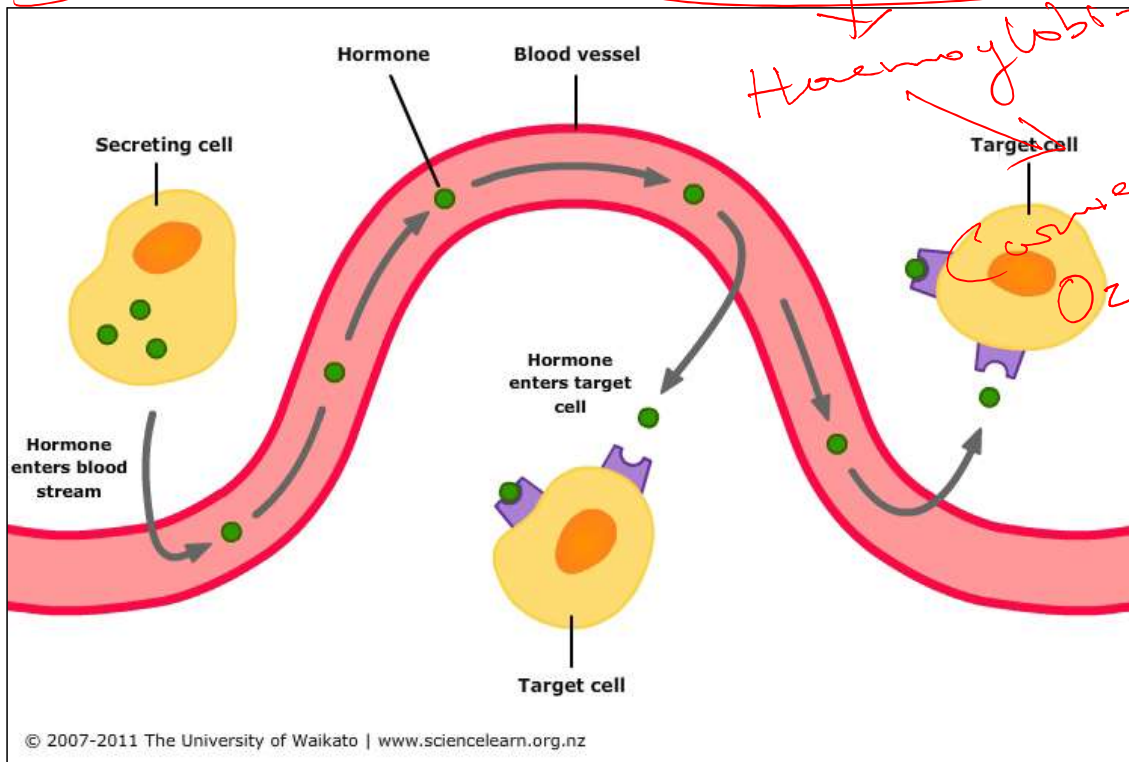
Keratin, collagen, fibrin, sclerotin, chondrin, sein

→ Hair, Nail



Functional protein

Enzyme, hormone, vitamins, respiratory pigments



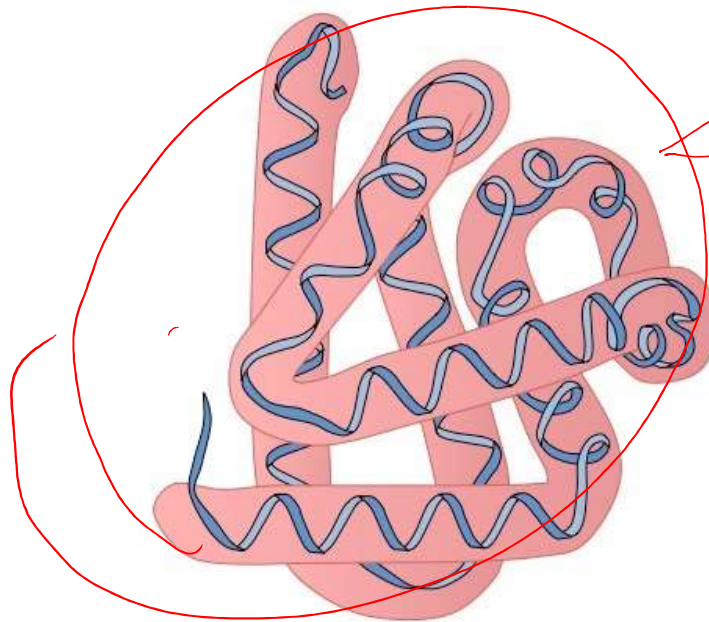
Classification of protein based on shape

Fibrous protein:
Keratin, collagen,
fibrin.



Fibrous Protein

*Hand
Nails
Flesh
Bones*

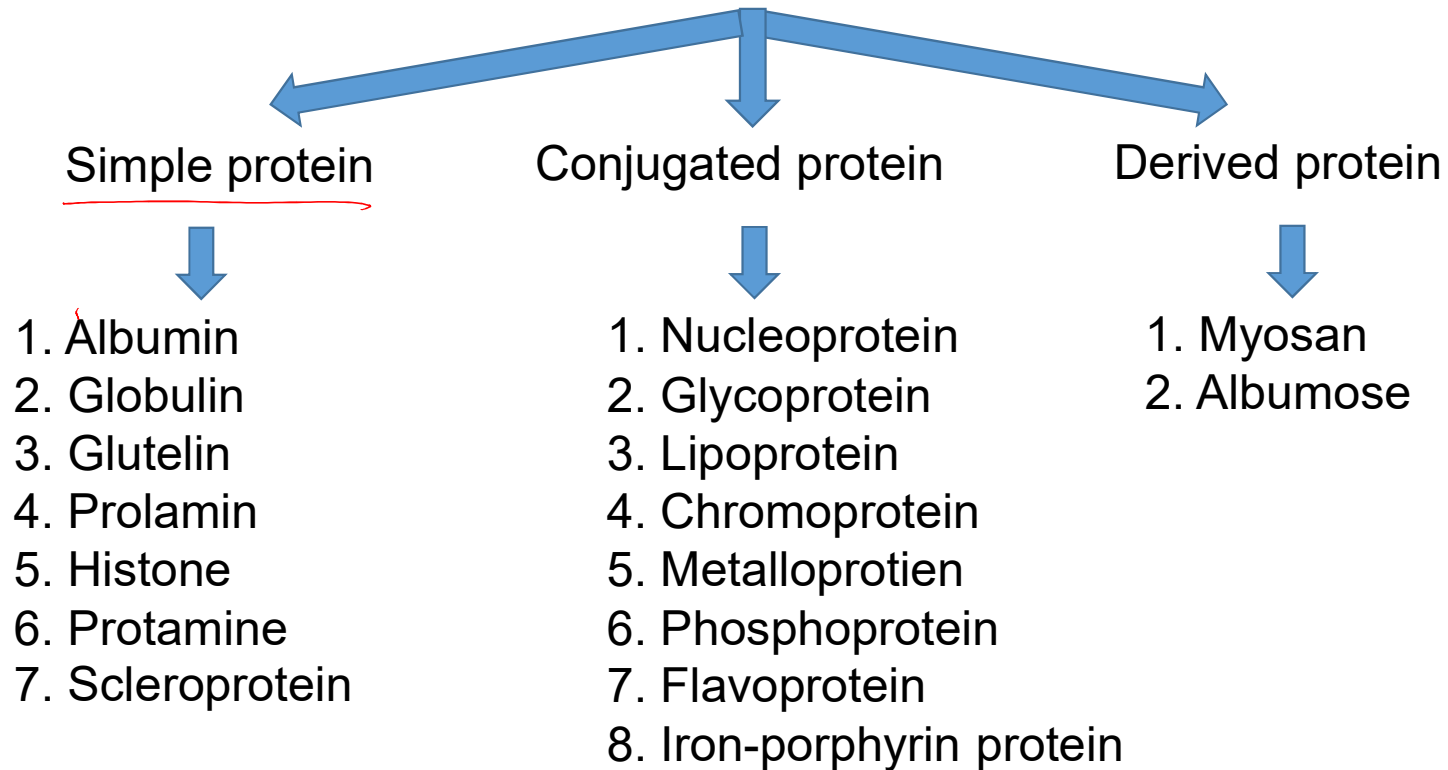


Globular Protein

*Round
Cluster*

Globular protein:
Myoglobin, Insulin,
Hemoglobin.

Classification of protein based on chemical properties & solubility



Simple protein

Simple protein	Solubility	Heat coagulation
<u>Albumin</u>	• Soluble in water & mild salt solution	✓
<u>Globulin</u>	• Almost insoluble in water • Soluble in mild salt solution	✓
Glutelin	• Insoluble in water & salt solution • Soluble in acid or mild base.	✗
Prolamin	• Insoluble in water & absolute ethanol • Soluble in 70-80% ethanol	✗
Histone	• Soluble in water	✗
<u>Protamine</u> <i>small</i>	• Soluble in water, mild acid & ammonium hydroxide	✗
Scleroprotein	• Insoluble in water & mild salt solution	



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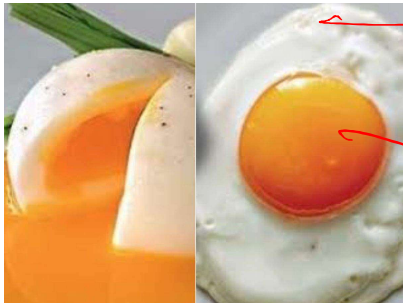
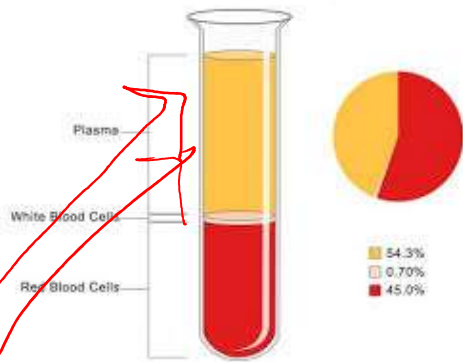
Biology 1st Paper
Chapter 3 : Cell Chemistry

Poll Question-02

2. Heat coagulation occurs in ____

- (a) Protamine
- (b) Globulin
- (c) Histone
- (d) Glutelin

Examples of simple protein



Albumin and globulin are found in serum



Salmine in salmon fish sperm is a protamine

Smallest



Zein from maize is a type of prolamine

2nd

Examples of simple protein

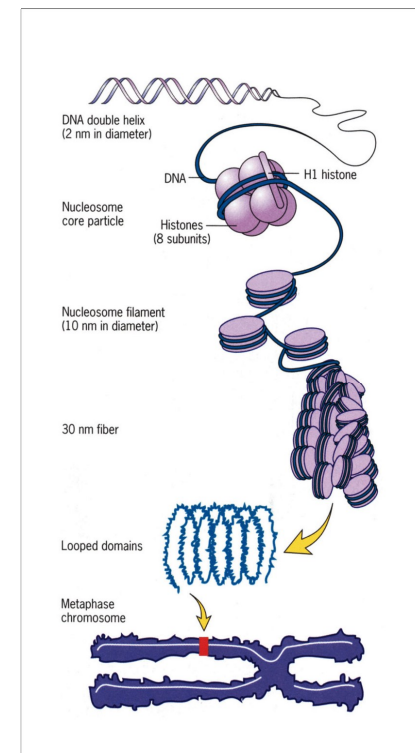


Keratin in hair, horn, nail is an example of sclera protein



Oryzenin in rice is type of glutelin

Wheat + glutelin



DNA winds around histone protein and form chromosome

Poll Question-03

3. Which of the following is a globular protein?

- (a) Keratin
- (b) Collagen
- (c) Insulin
- (d) Fibrin

Conjugated protein

Nucleoprotein



Nucleic acid



Protein

Glycoprotein



Carbohydrate



Protein

Lipoprotein



Lipid



Protein

Chromoprotein



Pigment



Protein



উদ্ভাস

একাডেমিক এন্ড এডমিশন বোর্ড

Conjugated protein

Metalloprotein	→	<u>Metal</u>	+	Protein
Phosphoprotein	→	Phosphoric acid	+	Protein
Flavoprotein	→	^{B₂} ^{Riboflavin} Flavin	+	Protein
Iron-porphyrin Protein	→	Iron-porphyrin compound	+	Protein

Derived protein

- Does not remain free in nature. Obtained by enzymatic or chemical hydrolysis of a larger protein source.
- Example- peptide, protease, peptone, fibrin etc.
- Myosan derived from myosin. Albumose derived from albumin .

Heat

Heat

Heat

Classification of protein based on nutritional value

1st class proteins : Contain all the essential amino acids in adequate proportion. Example- fish, meat, egg, milk, soybean.

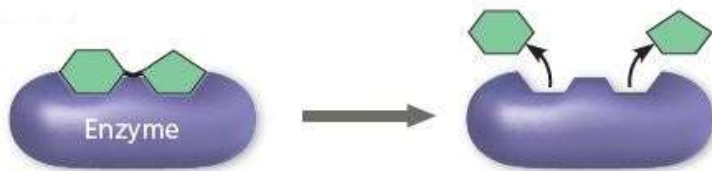
✓ 10 ess. Amino Acid

2nd class proteins : Do not contain all the essential amino acids. Example- most of vegetable proteins.

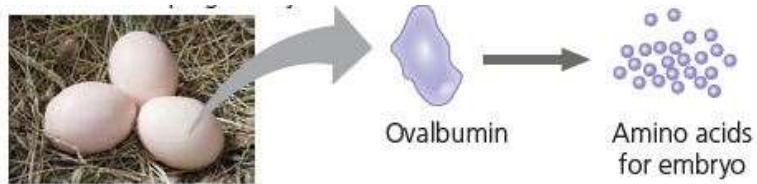
↓
Plant Source

✓ 10 Ess. Amino Acid

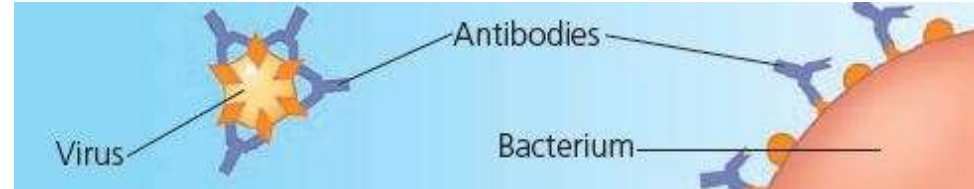
Function of proteins



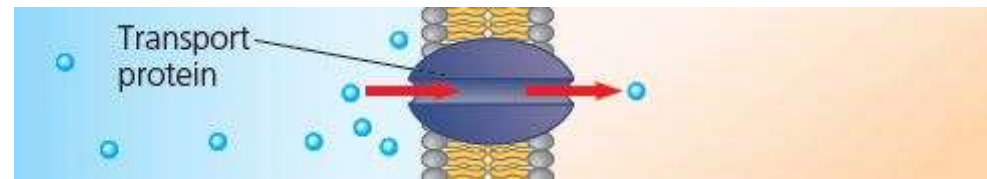
Enzyme



**Storage protein:
Ovalbumin in Egg**

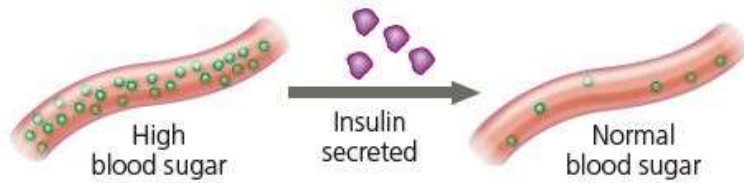


Immunity → **Antibody**

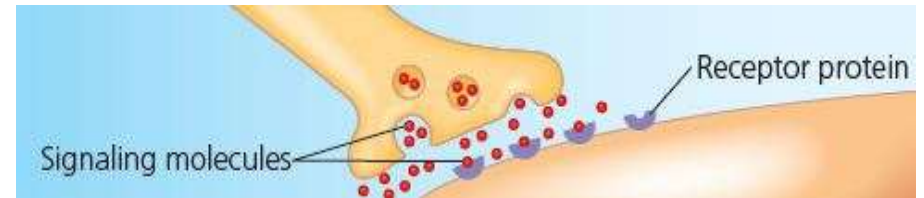


Ca²⁺, Na⁺, K⁺ → **Transport protein**

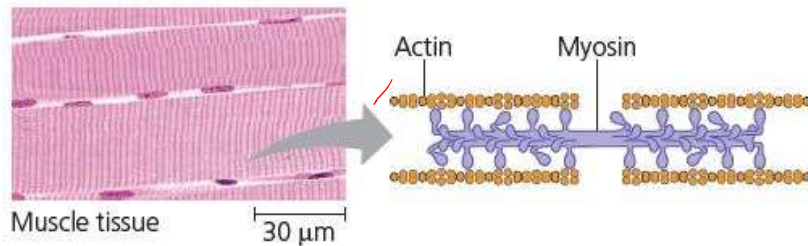
Function of proteins



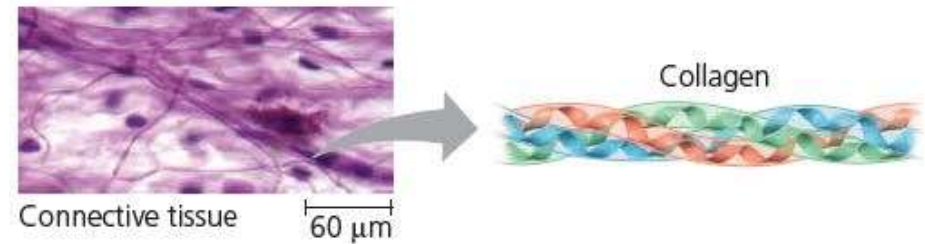
Hormonal protein



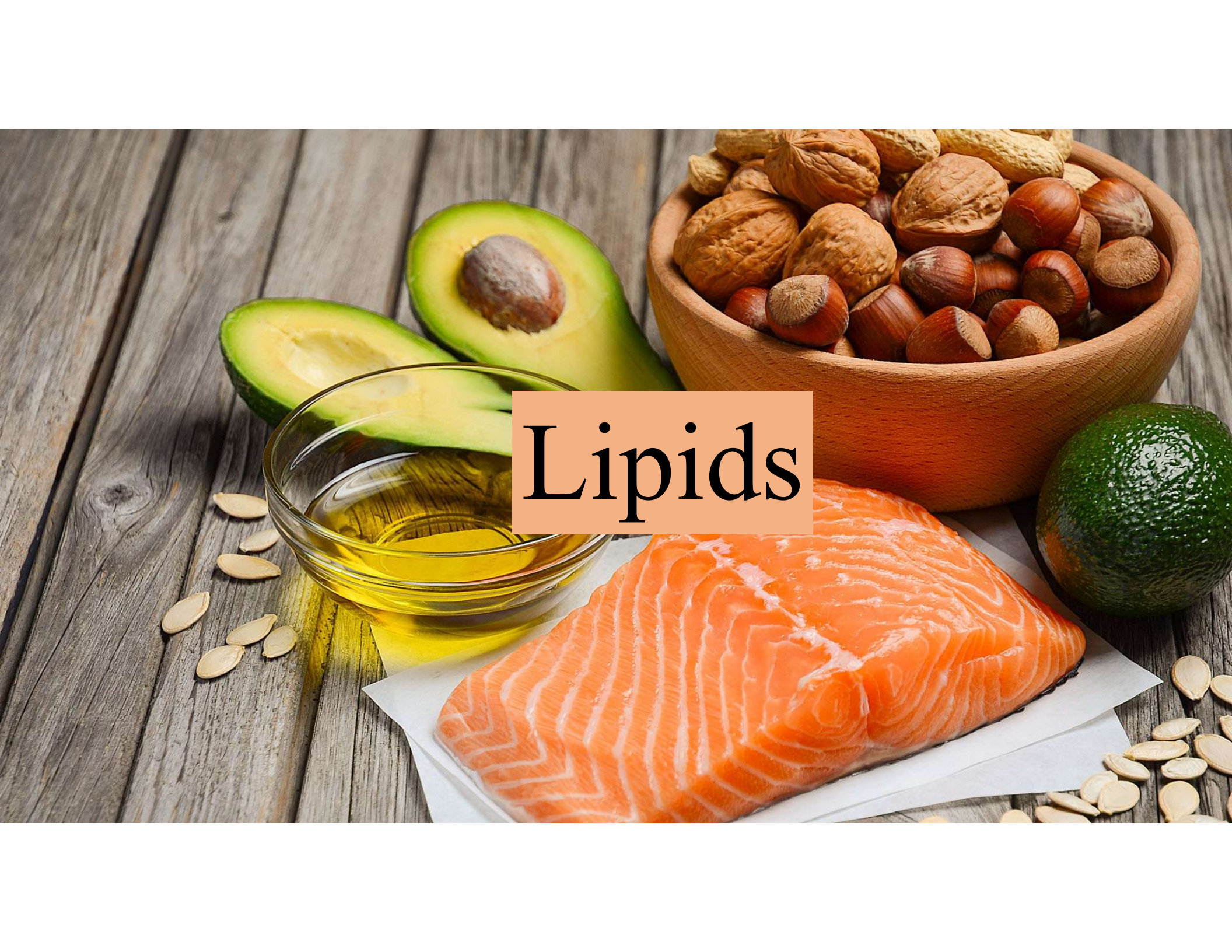
Receptor protein



Motor and contractile protein



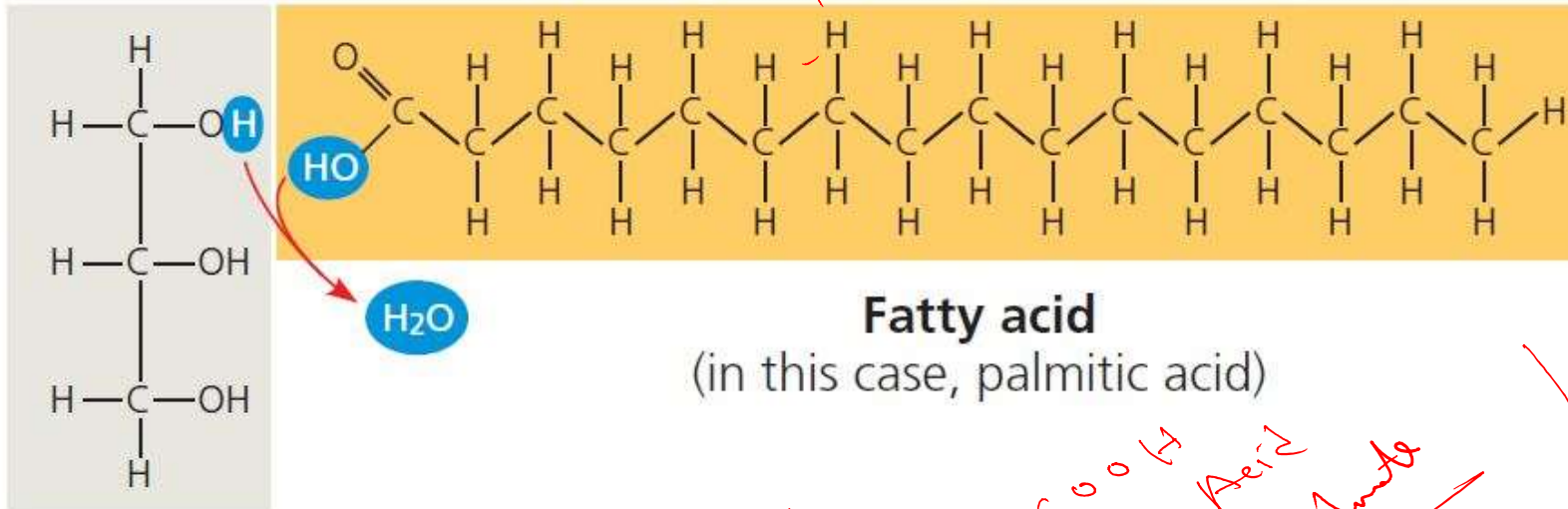
Structural protein

A collage of various food items rich in lipids, arranged on a rustic wooden surface. In the foreground, a large, vibrant orange salmon fillet with distinct white marbling lies on a piece of white parchment paper. To its left, a small glass bowl is filled with clear, golden-yellow oil. Behind the oil, two halves of a ripe avocado are shown, revealing their creamy green flesh and large brown pits. To the right of the oil, a wooden bowl is brimming with a mix of nuts, including walnuts and hazelnuts. A whole, dark green avocado sits to the right of the wooden bowl. Scattered around the main items are several almond slices. The entire scene is set against a background of weathered wooden planks.

Lipids

Lipids

Lipids are ester of alcohol and fatty acid



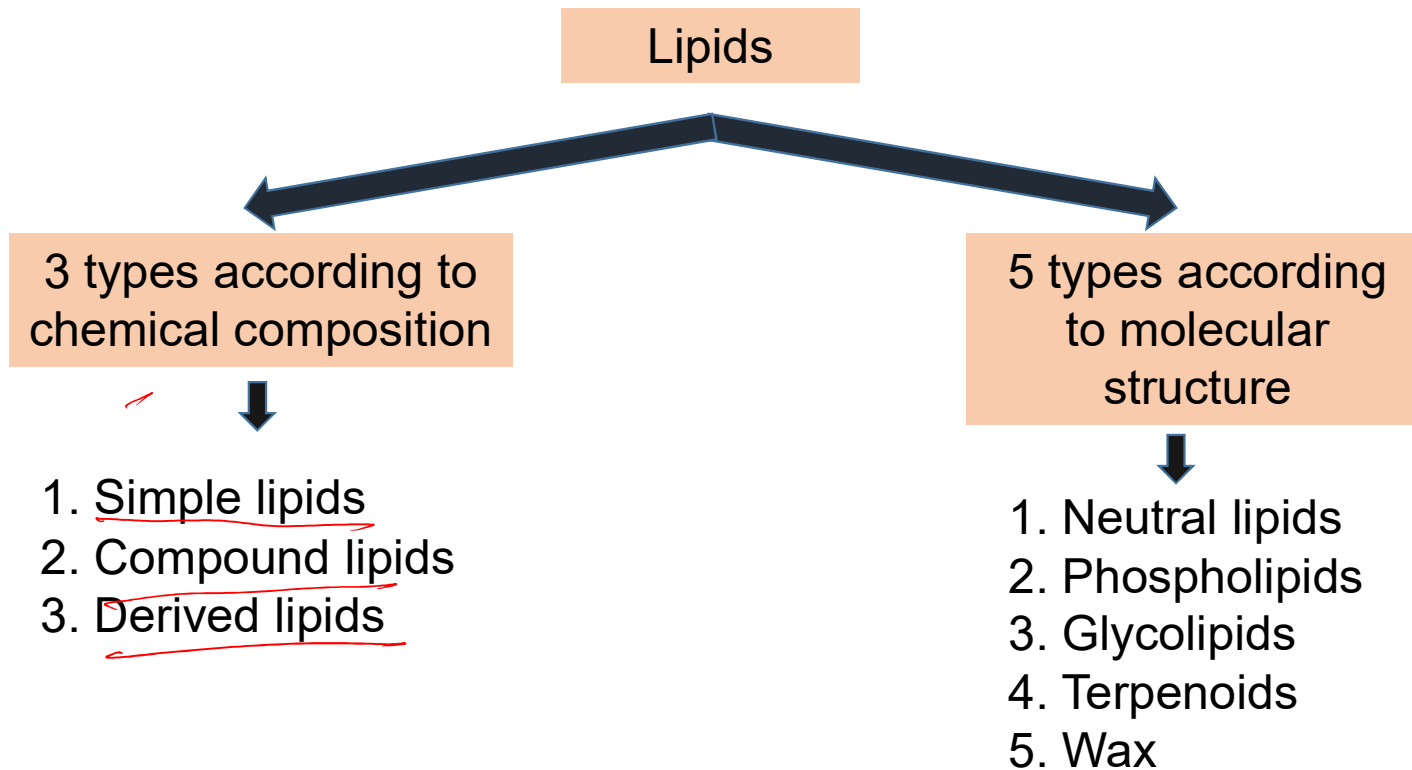
Glycerol

Fatty acid
(in this case, palmitic acid)

$R-OH$ + $R-COOH$
Alc. Fatty Acid
Carbohydrate
 $C:H:O$
1:2:1

Lipid
 $C:H:O$
No
Ratio

Classification of lipids

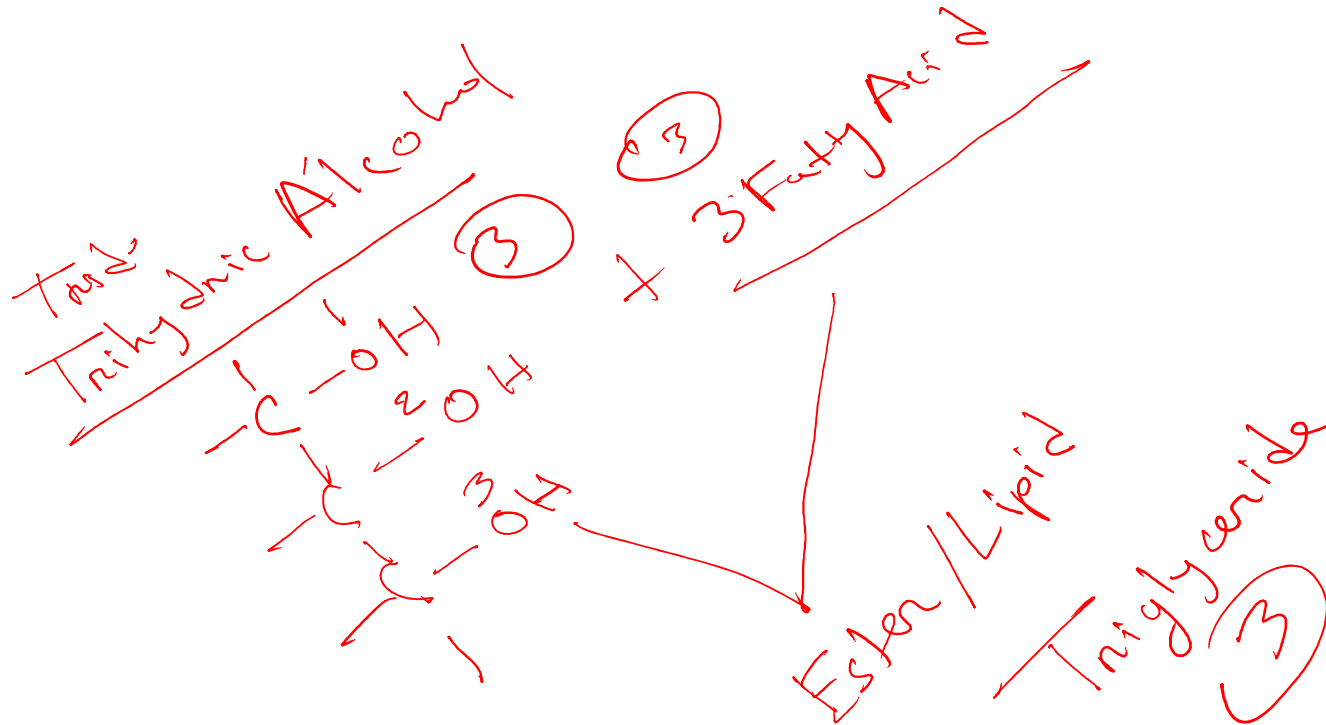


Simple lipids

A simple lipid is a fatty acid ester of different alcohols and carries no other substance. It's of 2 types : (i) Triglycerides (fat & oil) (ii) Wax

Triglycerides

A triglyceride is an ester derived from a glycerol and three fatty acid molecules.



Fat



- ✓ The triglycerides that are made up of saturated fatty acids and solid or semi-solid at room temperature (20°C) are called fat.
- ✓ Higher melting point.
- ✓ Example- Vegetable fat, palm oil, coconut oil.

Oil



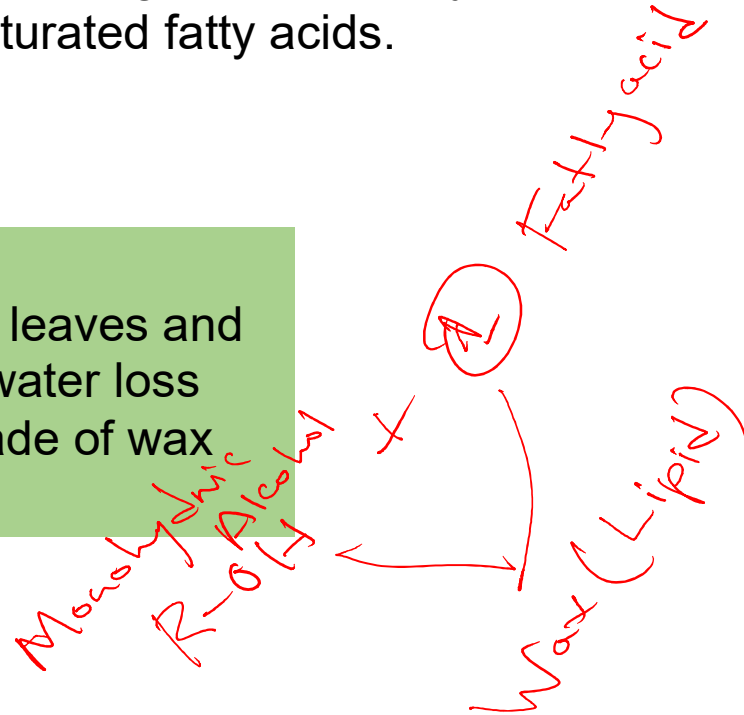
- ✓ The triglycerides that are made up of unsaturated fatty acids and liquid at room temperature (20°C) are called oil.
- ✓ Lower melting point.
- ✓ Example- common edible oil

Wax

- ✓ A wax is an ester of a long chain monohydric alcohol and a fatty acid.
- ✓ Composed of unsaturated fatty acids.

Function of wax

- ✓ Wax coating on leaves and fruits prevents water loss
- ✓ Candles are made of wax
- ✓ Cosmetics



Compound lipids

Compound lipids are esters of fatty acids and alcohols containing additional groups.

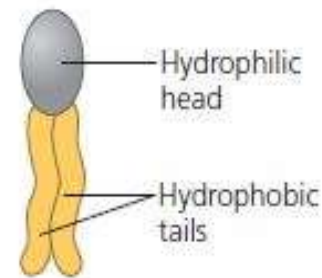
Phospholipids

A phospholipid is composed of two fatty acids, a glycerol unit, a phosphate group and a polar molecule.

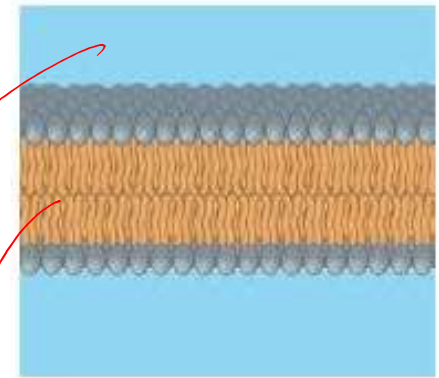
Example- lecithin, cephalin, plasmalogen.

Functions of phospholipid

- ✓ Component of cell membrane, cell organelle membrane
- ✓ Ion carrier
- ✓ Prosthetic group of some enzymes
- ✓ Help in blood clotting



(c) Phospholipid symbol



(d) Phospholipid bilayer

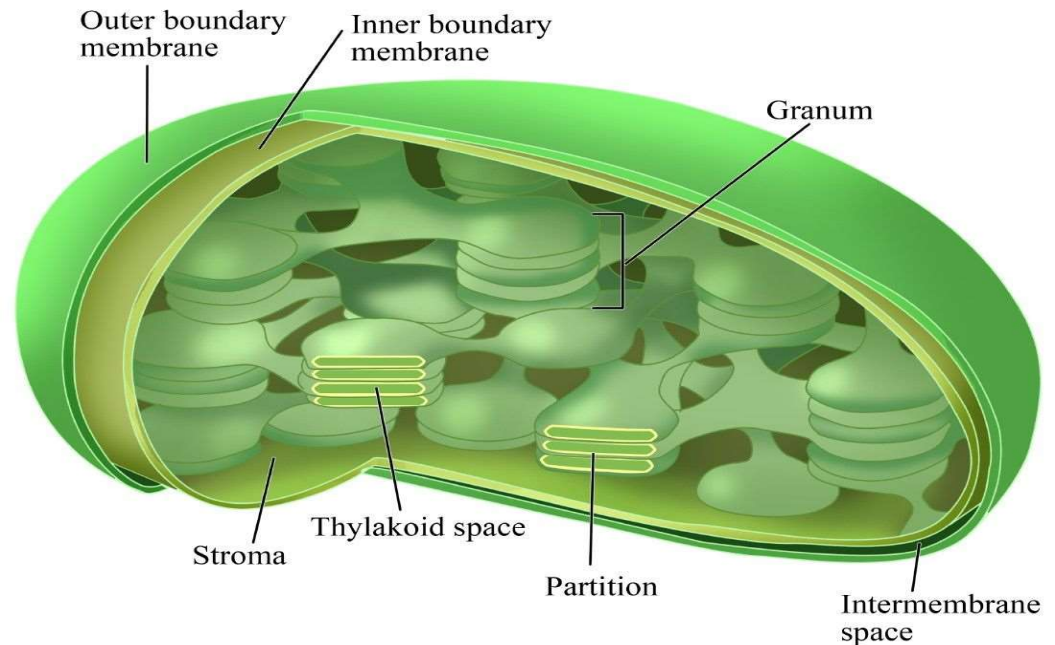
*Cell membrane
Fluid Mosaic
model*

Glycolipid

- Glycolipids are any of a group of lipid containing a carbohydrate group.
- Glycolipids are high in chloroplast membranes
- If it contains galactose, it is called galactolipid.
- Glycoproteins and glycolipids are collectively called glycocalyx

Functions of glycolipid

- ✓ Has a role in the formation of photosynthetic organelles
- ✓ Help in photosynthesis



Sulpholipids

- ✓ A glycolipid which bears sulfur molecule is called a sulpholipid
- ✓ Its presence is restricted to chloroplast

Lipoprotein

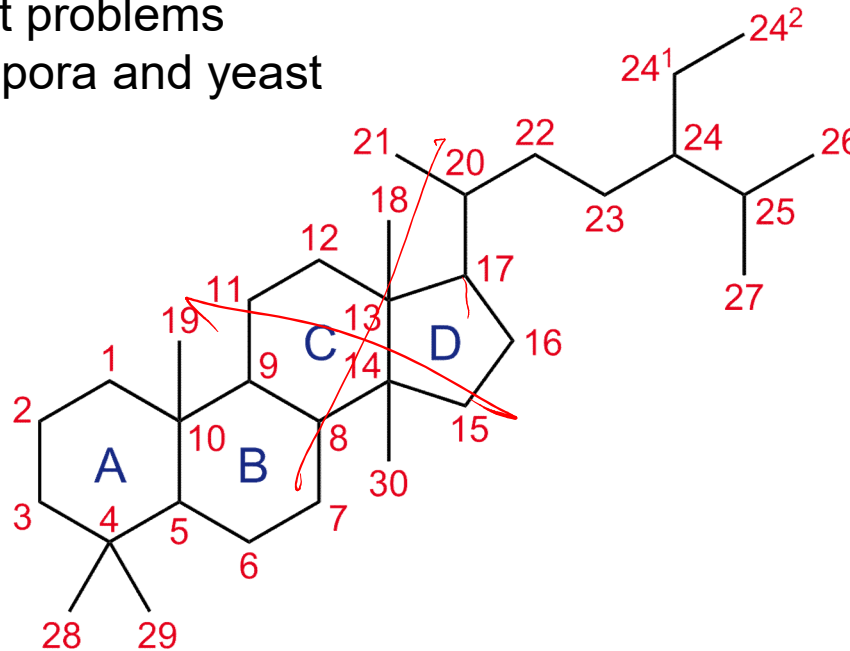
- ✓ A lipoprotein is a biochemical assembly that contains both proteins and lipids
 - ✓ In most cases, the lipid components are composed of cholesterol, esters and phospholipids.
 - ✓ Mitochondria and chloroplast membrane contain lipoproteins.
- MCQ*

Derived lipid

Hydrolytic products of simple and compound lipids are known as derived lipid

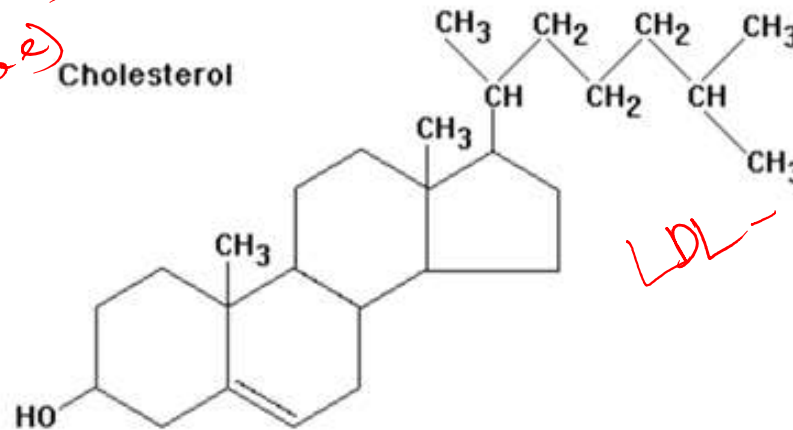
Steroids

- ✓ These are a type of derived lipid with four rings arranged in a specific molecular configuration.
- ✓ The steroids that contain– OH group are called sterol.
- ✓ Cholesterol, stigmasterol, ergosterol, β -sistosterol, digitalin are example of steroid
- ✓ Digitalin is used to treat heart problems
- ✓ Ergosterol is found in neurospora and yeast



Cholesterol

- ✓ Cholesterol is a common sterol present in animal fats.
- ✓ It is an important component of plasma membrane, bile. It is an precursor of vitamin D.
- ✓ It's of two types: (i) Low density lipoprotein (LDL) and (ii) High density lipoprotein (HDL)
- ✓ Having high HDL in the blood is not bad but having high LDL is very harmful.
- ✓ Women have high HDL and low LDL in their blood. That is why women have less heart disease than men.



HDL - High Density Lipoprotein (+ve)
Good Cholesterol (-ve)
40 mg/dL

LDL -

Low Density Lipoprotein (-ve)
Cholesterol (+)
- Bad
100 mg/dL

Poll Question-04

4. What is the normal range of ~~HDL~~ in human body ?

LDL

- (a) >100 (mg/dl)
- (b) >145 (mg/dl)
- (c) <100 (mg/dl)
- (d) <145 (mg/dl)

/

Terpenes

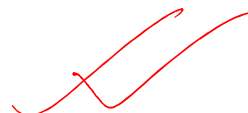
- ✓ Terpenes are isoprenoid compounds with 10 to 40 carbon atoms.
- ✓ General formula $(C_5H_8)_n$
- ✓ Terpenes are found as volatile oil in mint, basil etc.
- ✓ Used in making perfumes and varnishes.

Rubber

- ✓ It's composed of 3000-6000 thousand isoprene units
- ✓ Rubber is used to make tires for trucks, buses, automobiles, rickshaws, bicycles, etc.

Role of lipids in the living organism

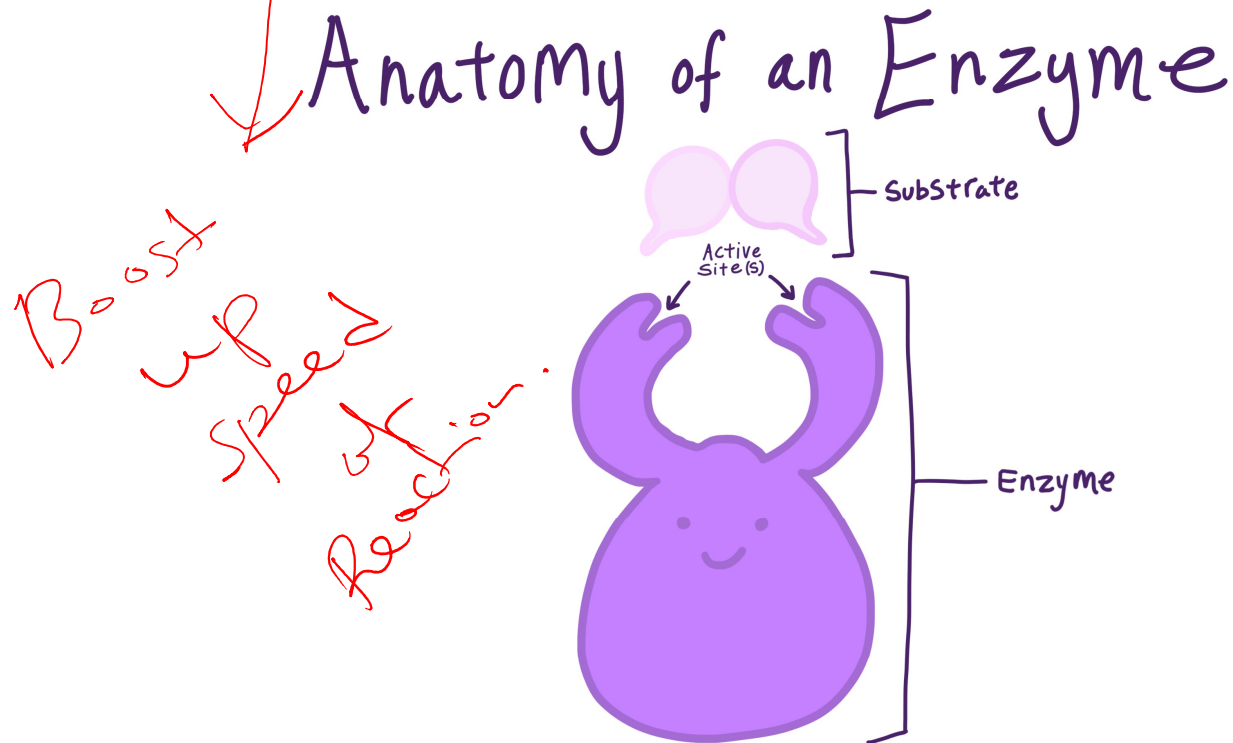
- ✓ Energy storage
- ✓ Phospholipids act as building block of cell membrane
- ✓ Glycolipid helps in photosynthesis
- ✓ Phospholipids act as ion carrier
- ✓ Vitamin A, D, E and K are soluble in lipid
- ✓ The fat stored under the skin of the animal acts as a heat insulator.
- ✓ Wax reduces the transpiration in plants.
- ✓ Terpenes produces fragrance



ENZYMES

Enzyme

Enzymes are proteins produced by living cells that accelerate the rate of a chemical reaction without itself undergoing any permanent chemical change. Enzymes are called biocatalyst or organic catalyst.



Characteristics of enzyme

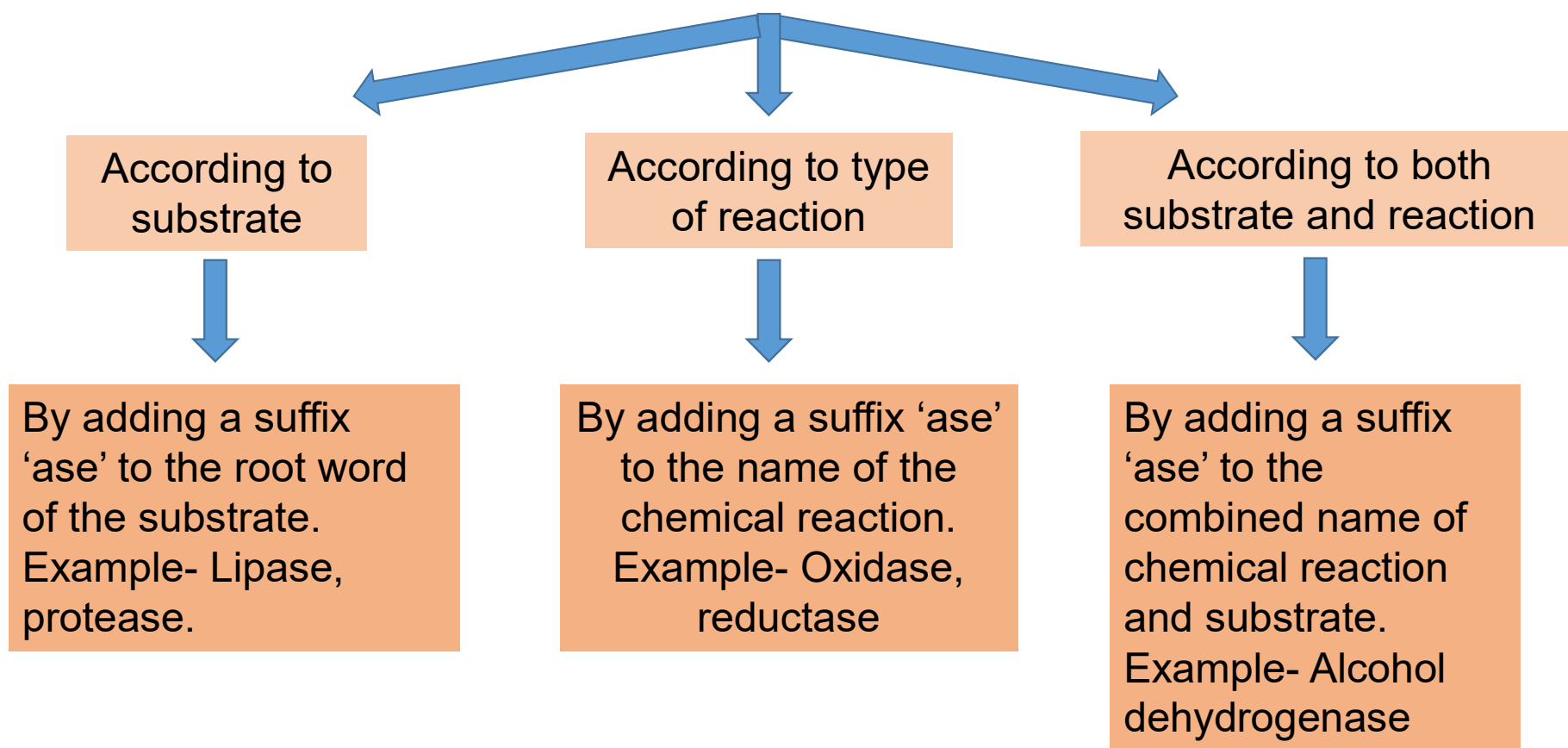
- ✓ Protein in nature.
- ✓ Colloidal.
- ✓ The catalytic power of enzyme is limited to specific pH value. Optimum pH for most of the enzymes is 6-9.
- ✓ Heat sensitive. Optimum temperature 35°C- 40°C. Extreme heat causes denaturation.
- ✓ A small amount of enzyme is needed in a specific reaction
- ✓ It can accelerate the speed of reaction but cannot alter the state of equilibrium.
- ✓ Highly reaction specific.
- ✓ Produced only in living cell
- ✓ Almost all of them are water soluble.
- ✓ Enzymes can be denatured by UV ray

Poll Question-05

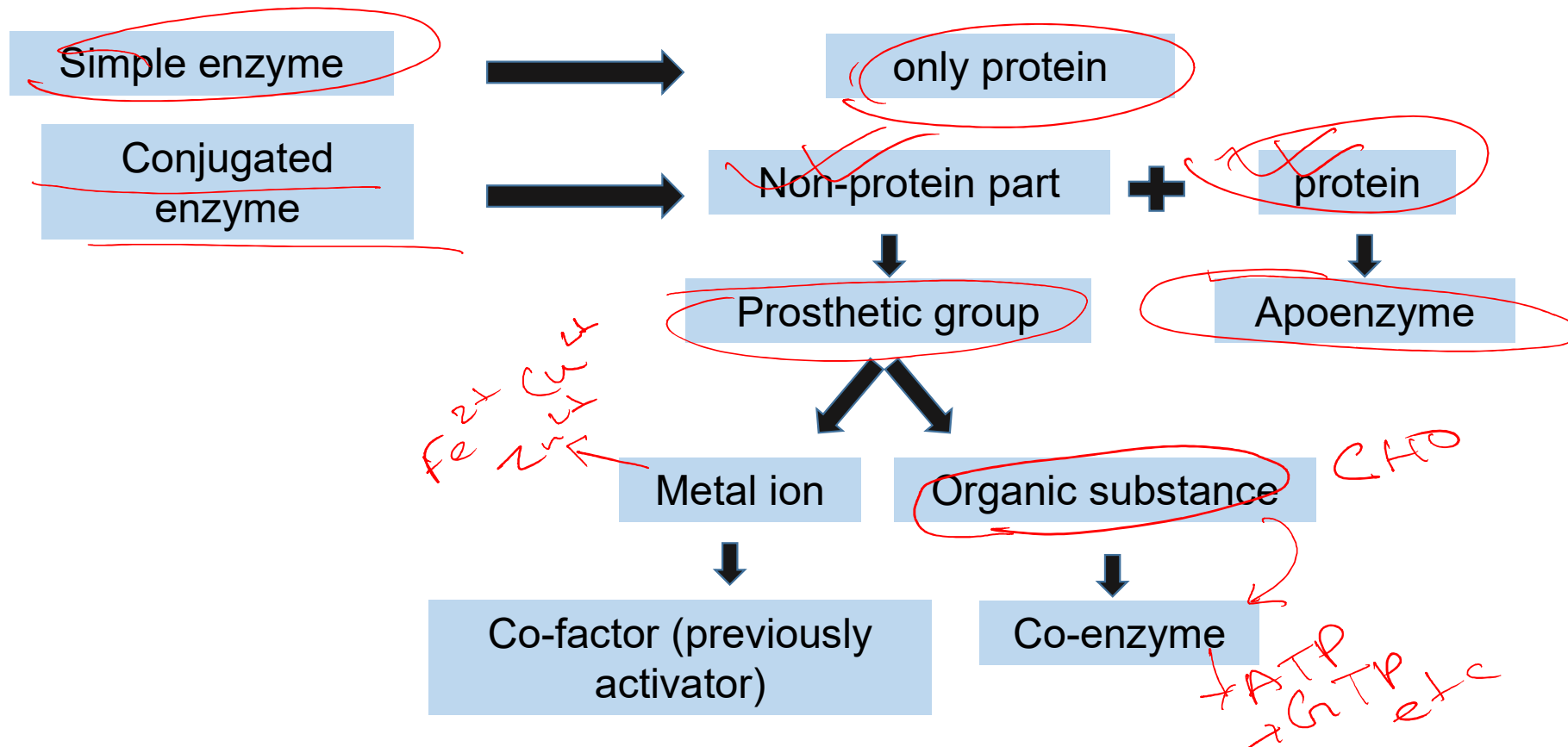
5. Which of the following statement about enzyme is incorrect ?

- (a) Protein in nature
- (b) pH 6-9
- (c) A small amount of enzyme is needed in a specific reaction
- (d) Alter the state of equilibrium

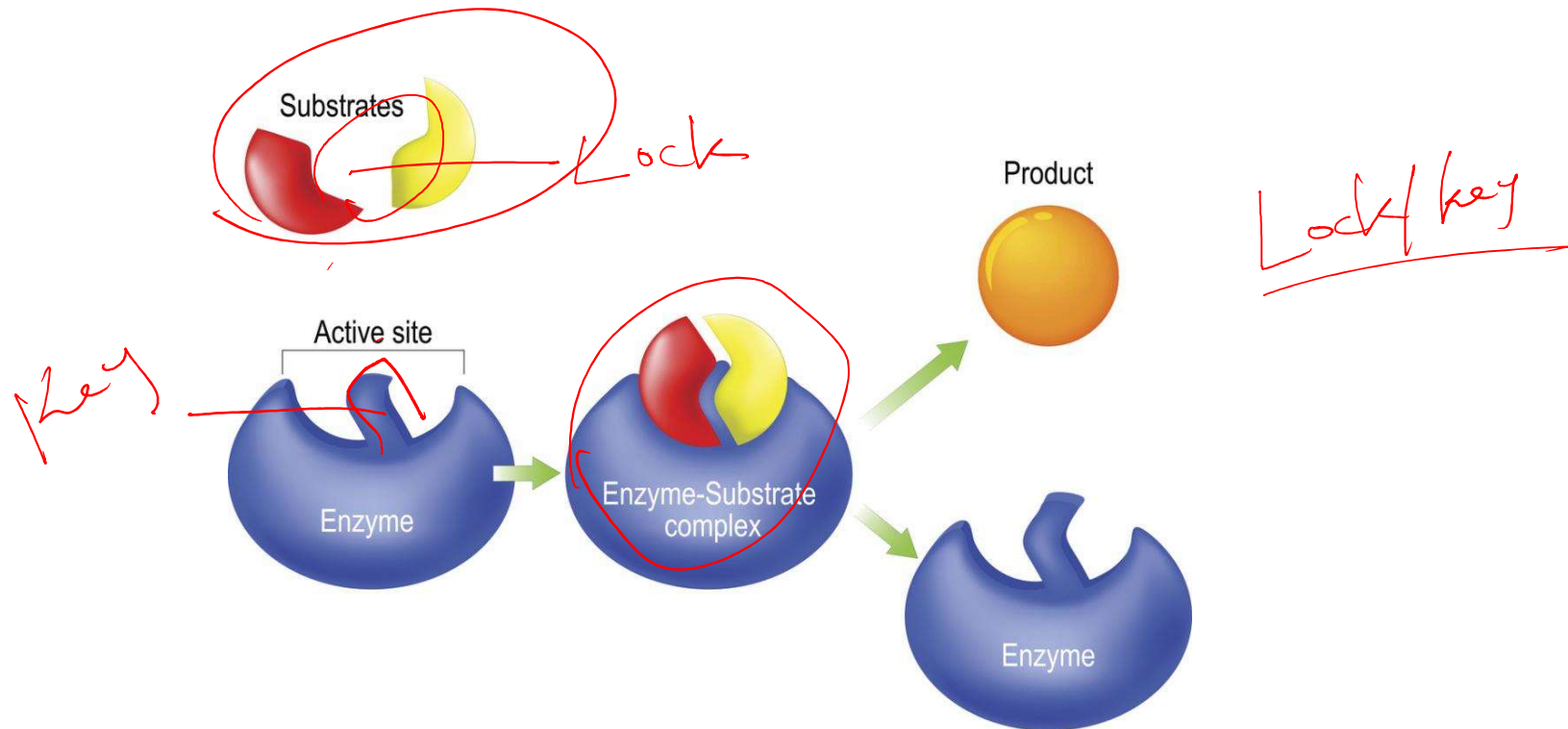
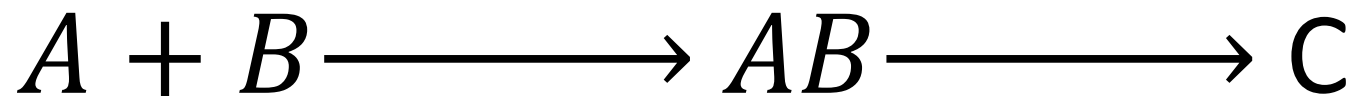
Nomenclature of Enzyme



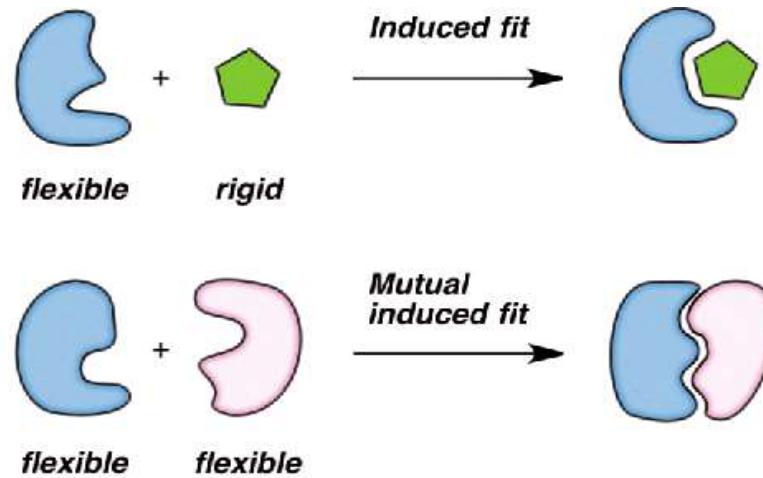
Prosthetic group, Co-factor, Co-enzyme



Enzyme's mechanism of action

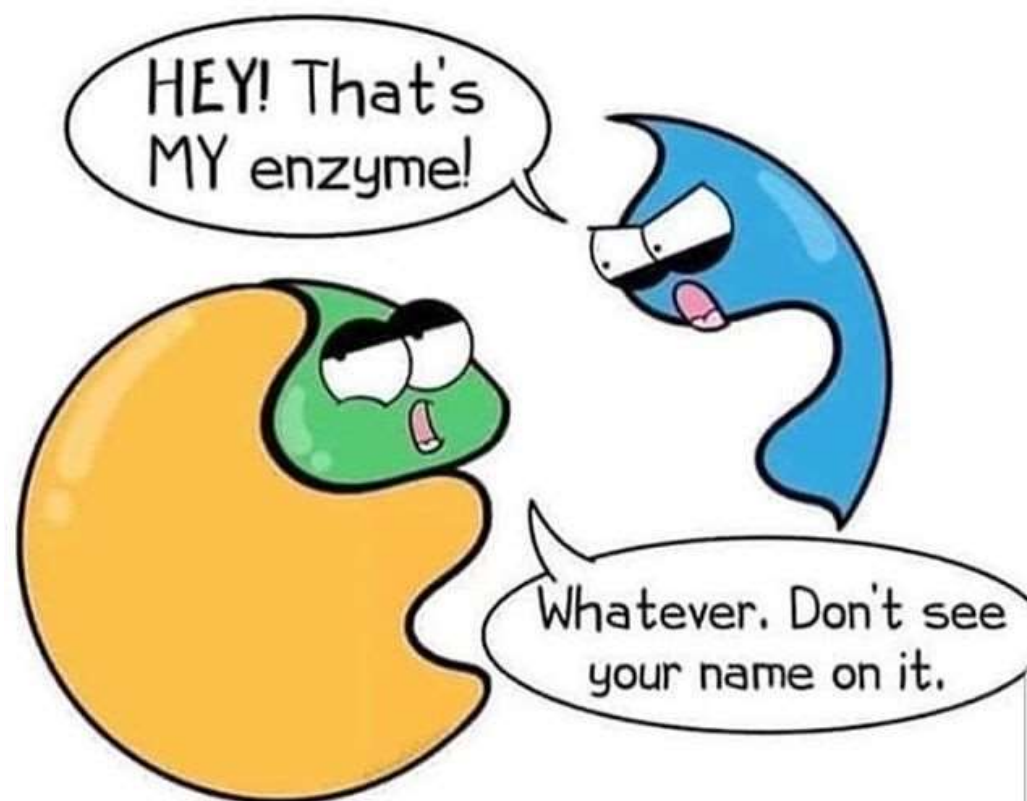


Induced fit



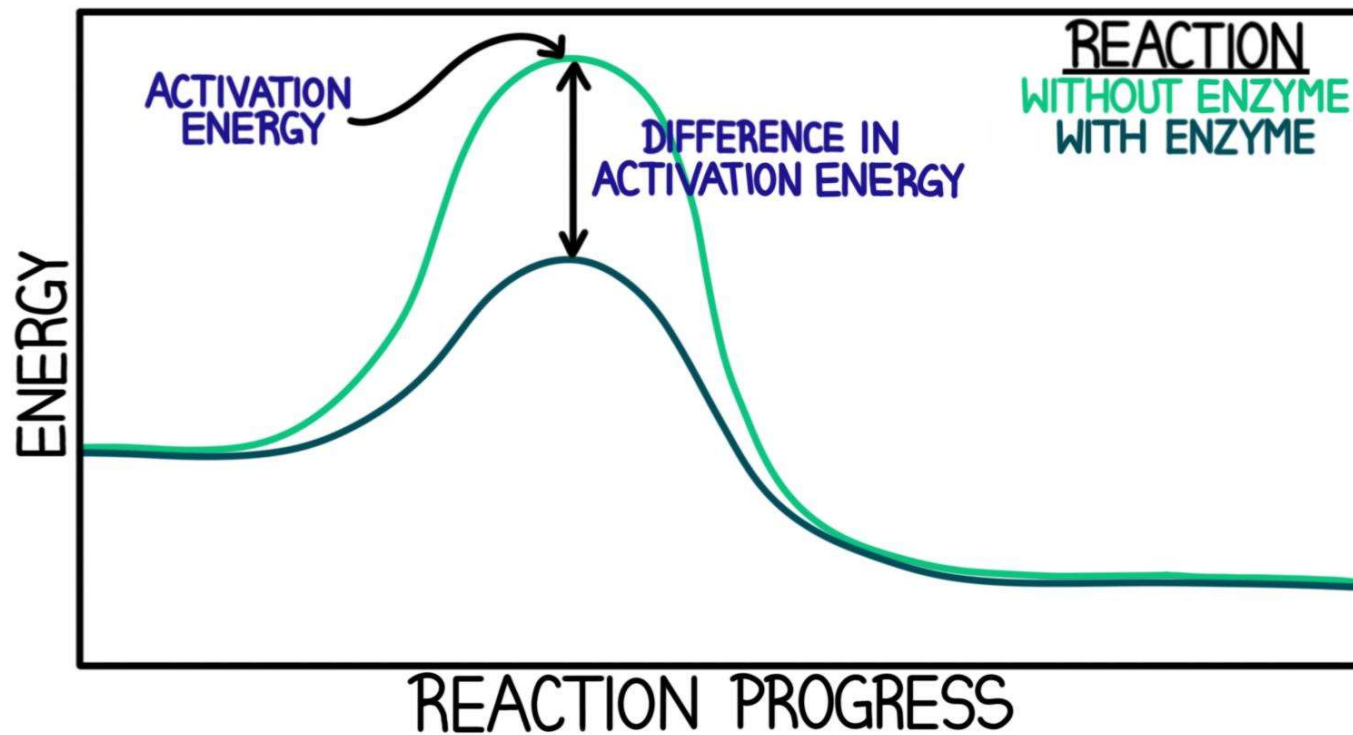
1. *Diagram illustrating the induced fit model.*

Enzyme inhibitor

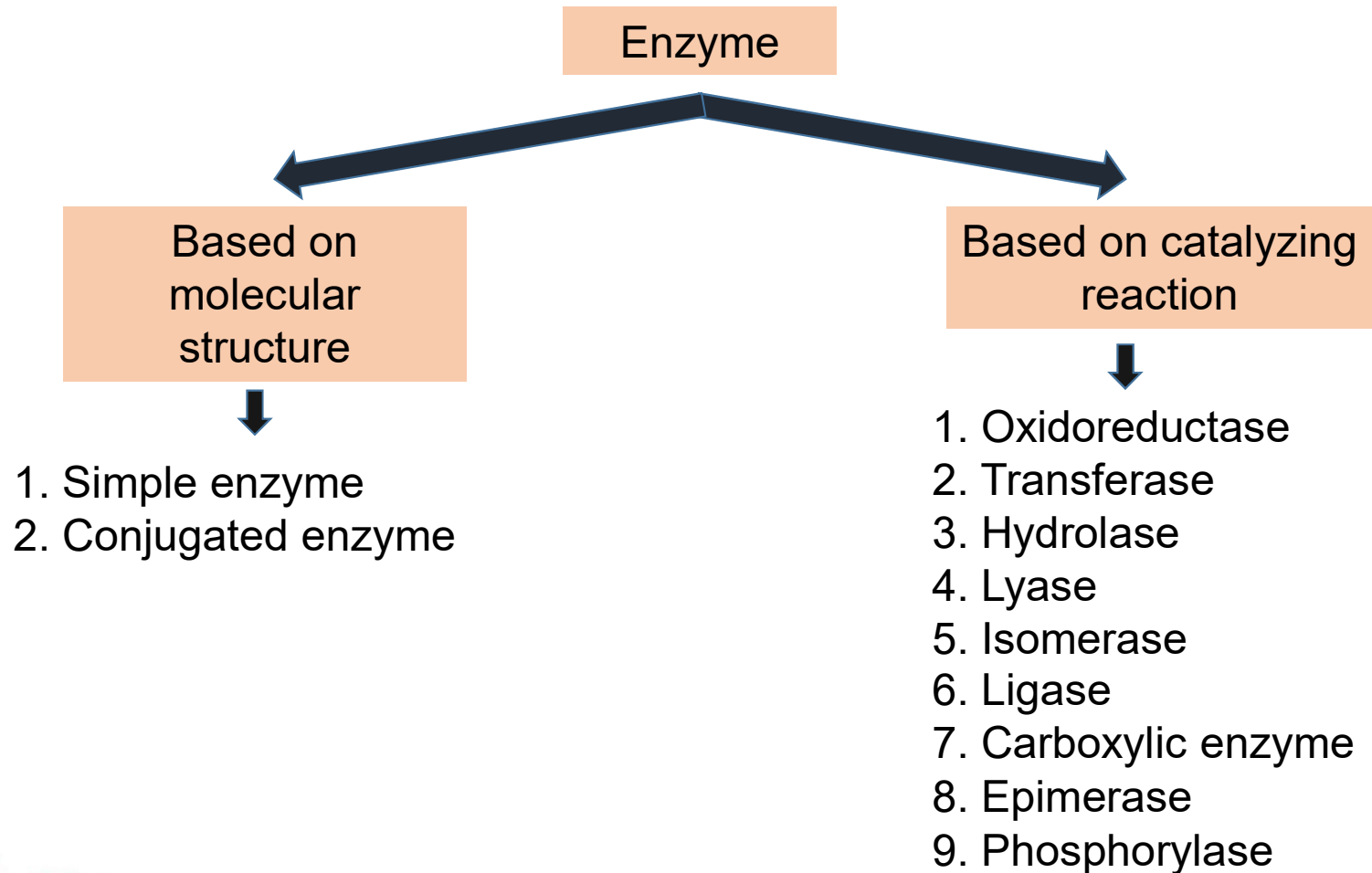


Competitive Inhibitors: If it fits, it sits.

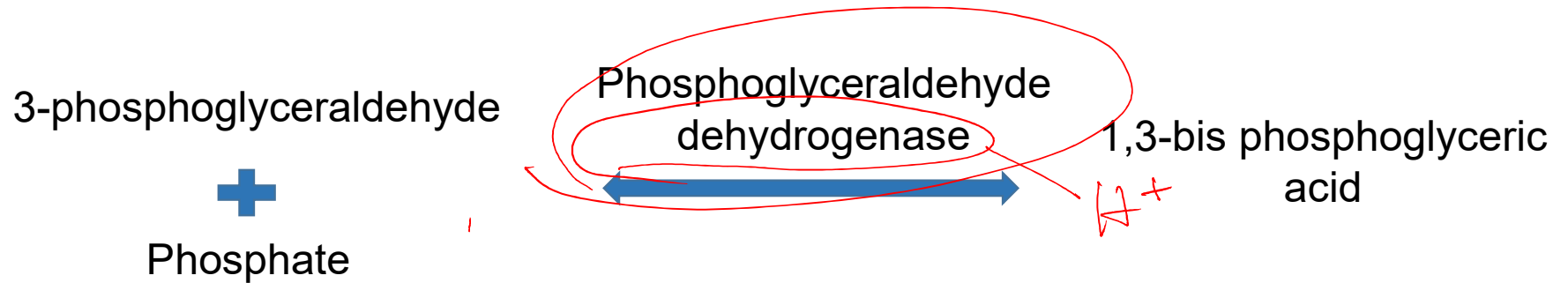
Activation energy



Classification of enzyme



Oxidoreductase



Transferase



Hydrolase



Lyase

Fructose 1,6- bis
phosphate

Aldolase

3-phosphoglyceraldehyde

+
Dihydroxyacetone
phosphate

Isomerase

Glucose-6-phosphate

Phosphogluco isomerase

Fructose-6-phosphate

Ligase

Synthesis

Glutamic
acid

+

NH₃

+

ATP

Glutamic synthetase

Glutamin

+

ADP

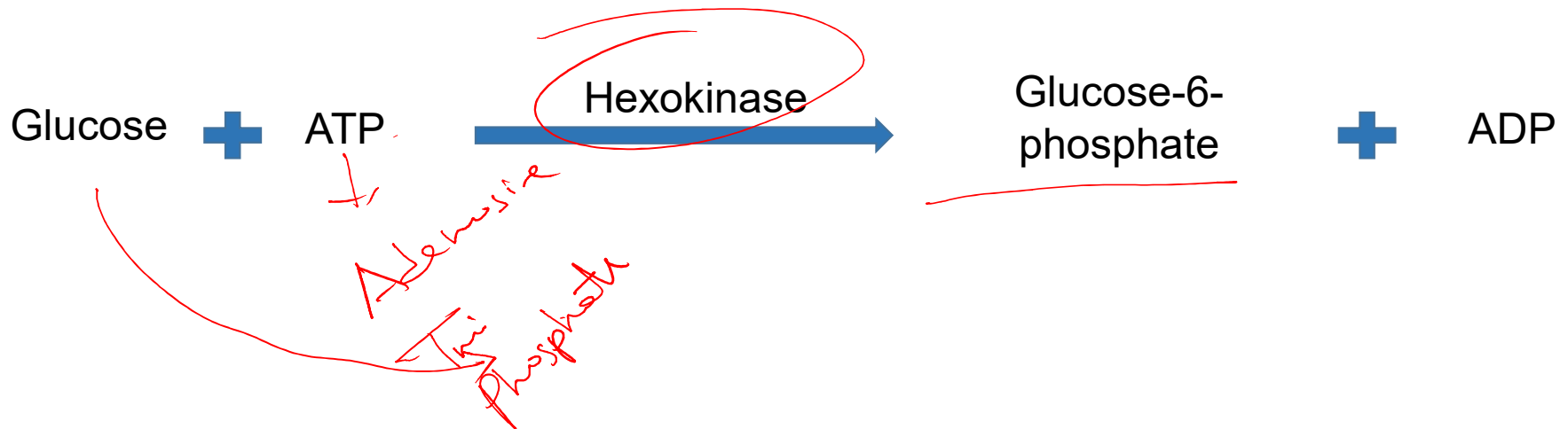
+

Pi

Carboxylic enzyme



Phosphorylase



Factors affecting enzyme activities

- ✓ Temperature $35^{\circ}\text{C} - 40^{\circ}\text{C}$
- ✓ pH $6 - 9$
- ✓ Water
- ✓ Metal ion
- ✓ Substrate conc.
- ✓ Enzyme conc.
- ✓ Product conc.
- ✓ Activator
- ✓ Inhibitor



Application of enzyme

- ✓ ~~Fruit juice~~ — *Pectine*
- ✓ Cheese
- ✓ Removing stain from clothes
- ✓ Dehairing hide
- ✓ Digestive problems
- ✓ Biochemical analysis
- ✓ Cataract → *Trypsine*
- ✓ Medical science



Application of enzyme

- ✓ ~~Ice cream~~ and candy
- ✓ ~~Photographic~~ industry
- ✓ ~~Paper~~ industry
- ✓ ~~Rubber~~ industry
- ✓ ~~Environment~~ protection
- ✓ ~~Biotechnology~~ → *restriction*
- ✓ Detergent

লেগে থাকো সৎ ভাবে,
স্বপ্ন জয় তোমারই হবে।



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