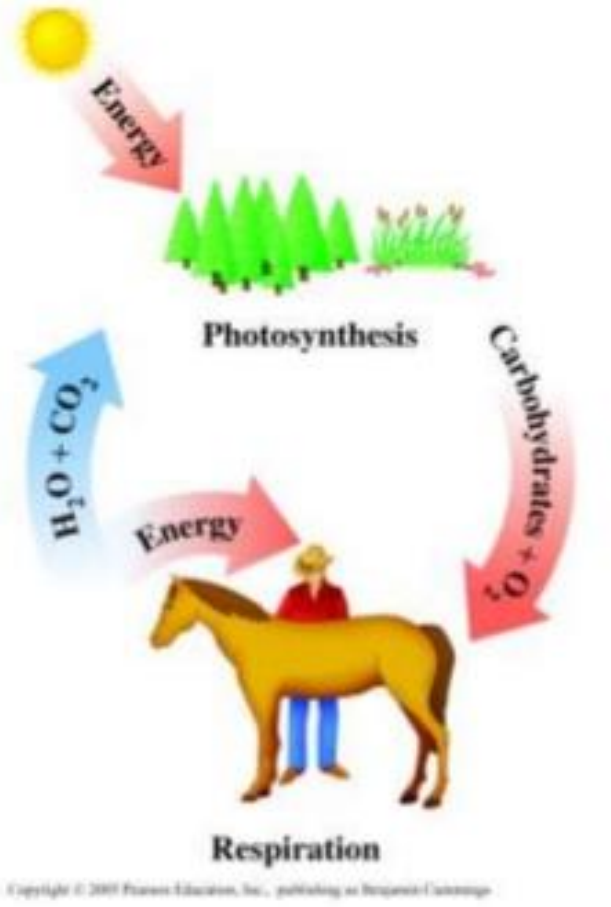
CARBOHYDRATES: INTRODUCTION

For B.Sc. Semester V

Carbohydrates

Carbohydrates

- are produced by photosynthesis in plants.
- such as glucose are synthesized in plants from CO_2, H_2O, and energy from the sun.
- are oxidized in living cells to produce CO_2, H_2O, and energy.



- ***Carbohydrates*** are sugars and provide energy when consumed.

- Our bodies break down carbohydrates to extract energy. Carbon dioxide and water are released in the process.

- ***Glucose*** is the primary carbohydrate our bodies use to produce energy.

- Carbohydrates are classified as biomolecules.

- Carbohydrates are broadly defined as hydrates of carbon as the number of hydrogen and oxygen atoms present is in the ratio of 2:1, like water.
- General formula $C_x(H_2O)_y$
- Functional groups present include hydroxy groups and carbonyl group (aldehyde or ketone)
- Carbohydrates are therefore also defined as polyhydroxides of aldehydes/ ketones or their derivatives or substances that yield one of these compounds.

- Simple carbohydrates are known as sugars or saccharides and their name ends with –ose.
- For example:
- Glucose- sugar present in our blood
- Fructose- sugar present in fruits
- Sucrose- table sugar
- Lactose- sugar found in milk

Classification of carbohydrates on basis of nature: Sugars and non-sugars

SUGARS

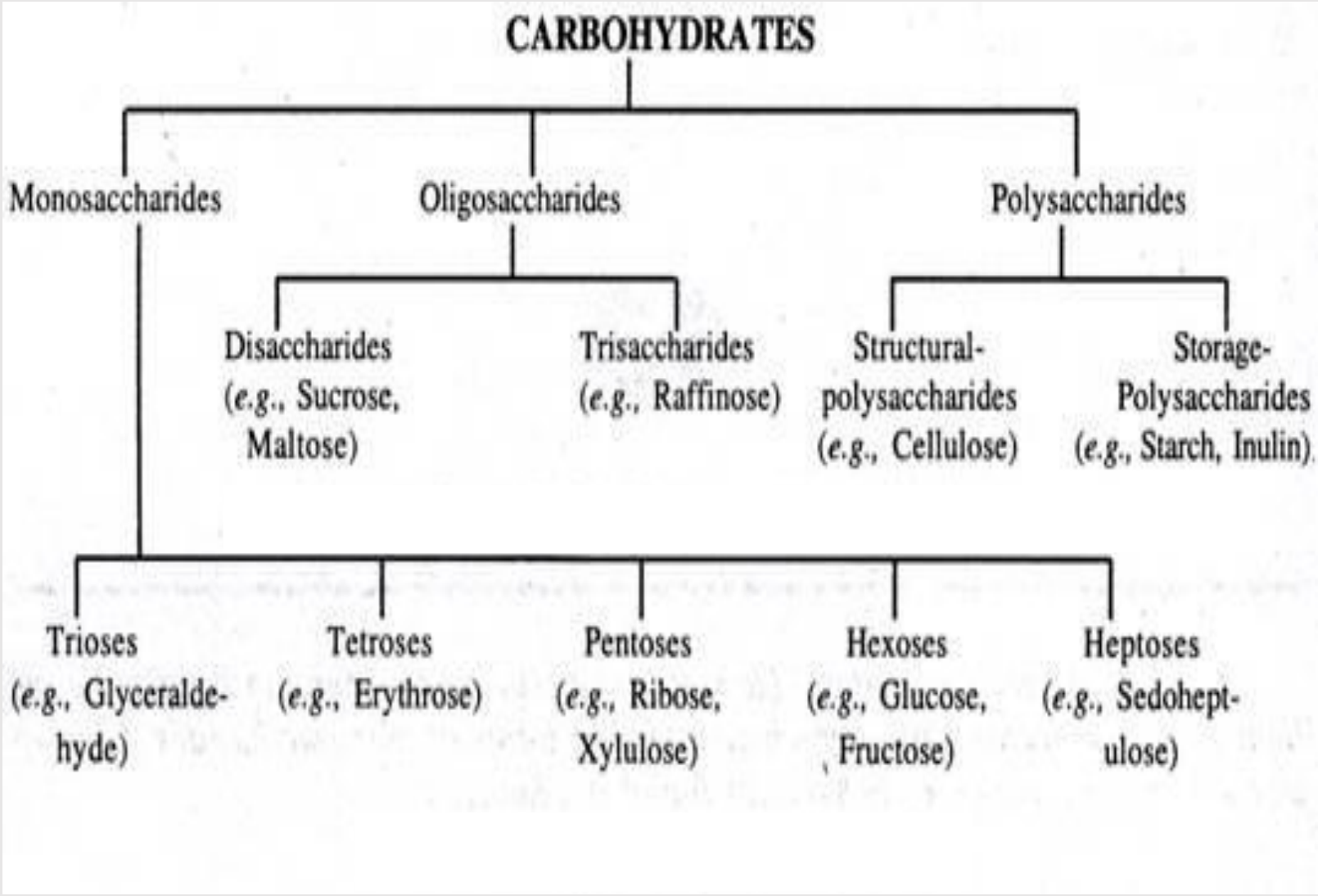
- ***Simple carbohydrates*** are referred to as ***simple sugars*** and are often sweet to the taste.

Examples: glucose, fructose, maltose, sucrose

NON-SUGARS

- They are non-sweet
- ***Complex carbohydrates*** include starches and the plant and wood fibers known as ***cellulose***.

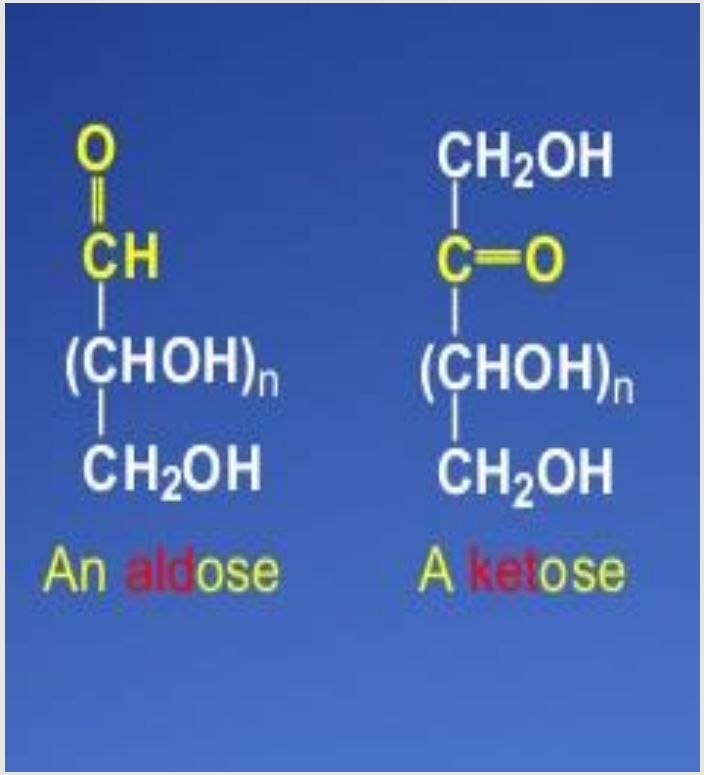
Classification on the basis of number of products formed on hydrolysis



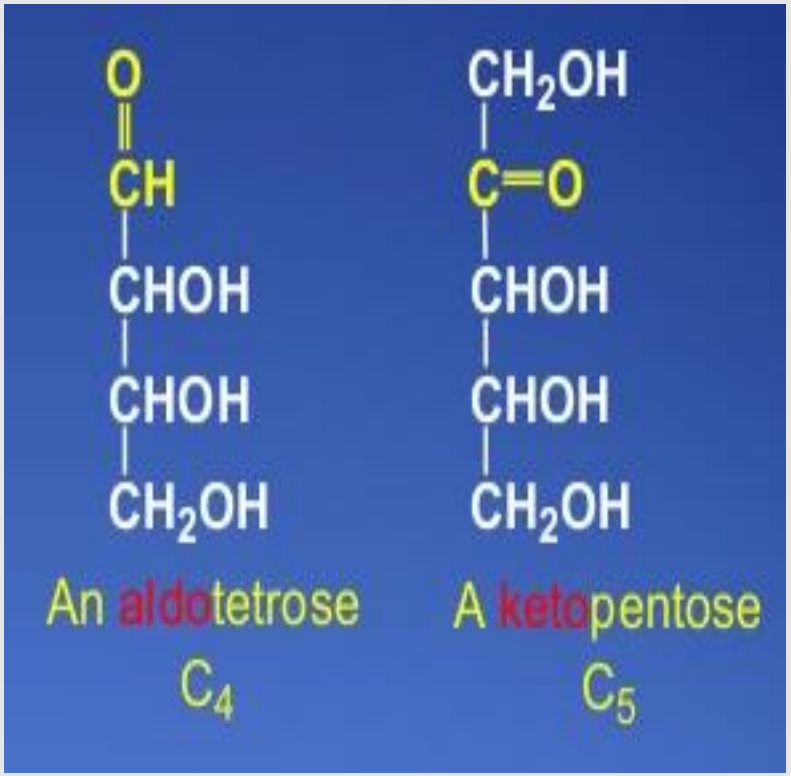
Classification and nomenclature of monosaccharides

Monosaccharides are the simplest carbohydrates that cannot be hydrolysed.
They are classified in the following 2 ways

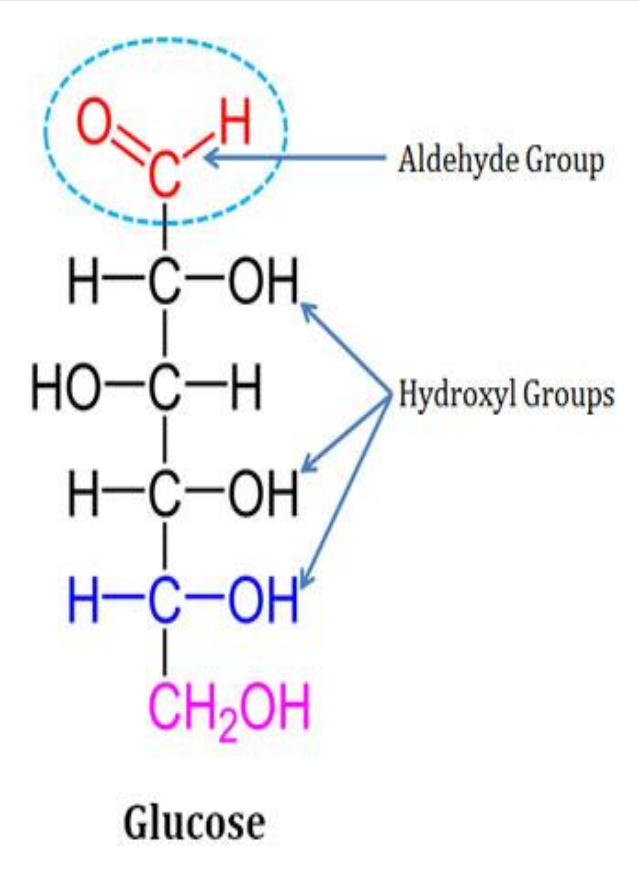
Based on type of carbonyl group present: aldose or ketose

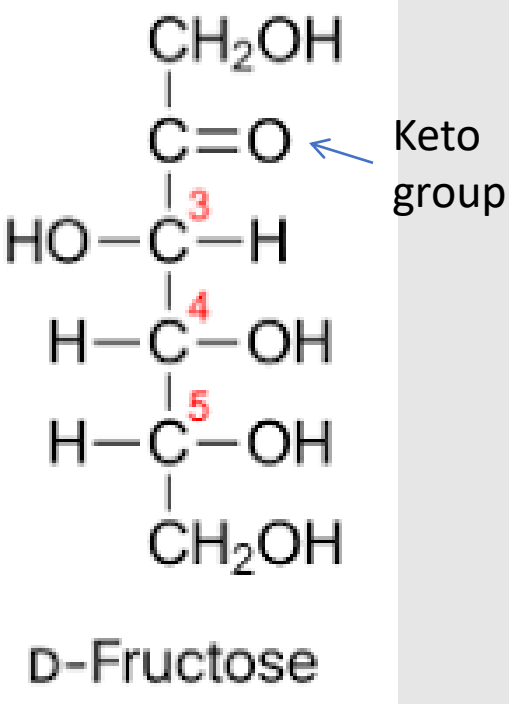


Based on number of carbon atoms present: triose, tetrose, pentose,hexose

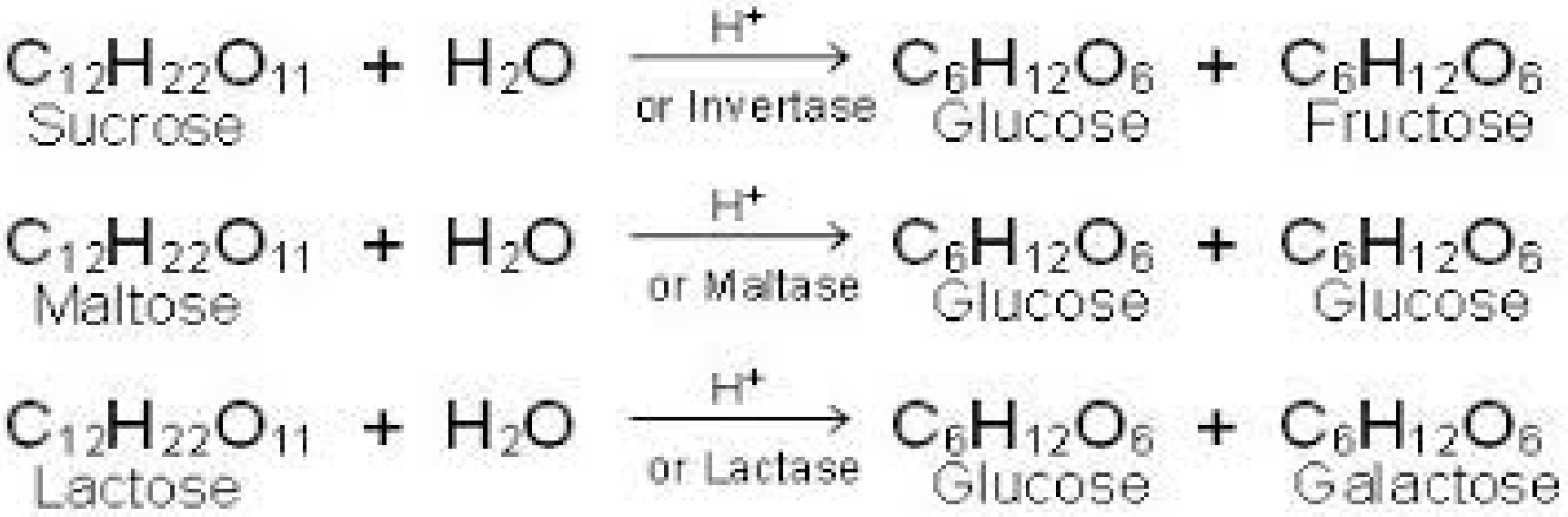


- Aldotetrose: threose, erythrose
- Aldopentose: ribose, arabinose, xylose
- Aldohexose: glucose, mannose, galactose
- Ketohexose: fructose





Oligosaccharides contain 2-10 monosaccharide molecules, which are liberated on hydrolysis. Based on number of monosaccharide units they are further classified as Disaccharides, Trisaccharides, etc.



Raffinose $C_{18}H_{32}O_{16} \longrightarrow$ glucose+ fructose +galactose

III. Polysaccharides

Polysaccharides are polymers of monosaccharide unit

They have high molecular weight(up to a million)

They are usually tasteless(non-sugars) and form colloids with water

Polysaccharides are two types **homopolysaccharides** and **heteropolysaccharides**

$$(C_6H_{10}O_5)_n \longrightarrow n\ C_6H_{12}O_6$$

Eg. Starch, cellulose, glycogen

Stereochemistry

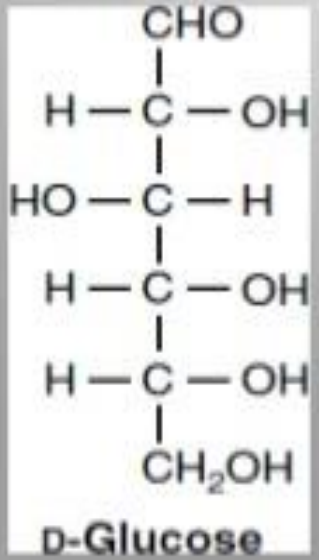
ISOMERISM

compounds that have the same chemical formula but different structures are called isomers. e.g. fructose, glucose, mannose, and galactose are isomers of each other having formula $C_6H_{12}O_6$

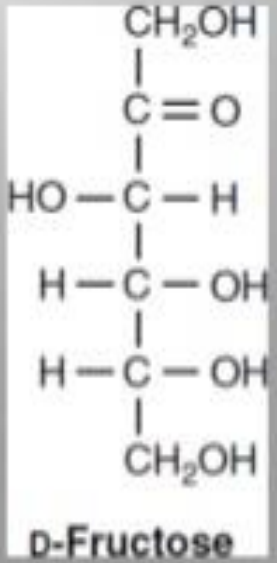
- ✓ Structural isomerism
- ✓ Stereoisomerism

STRUCTURAL ISOMERISM

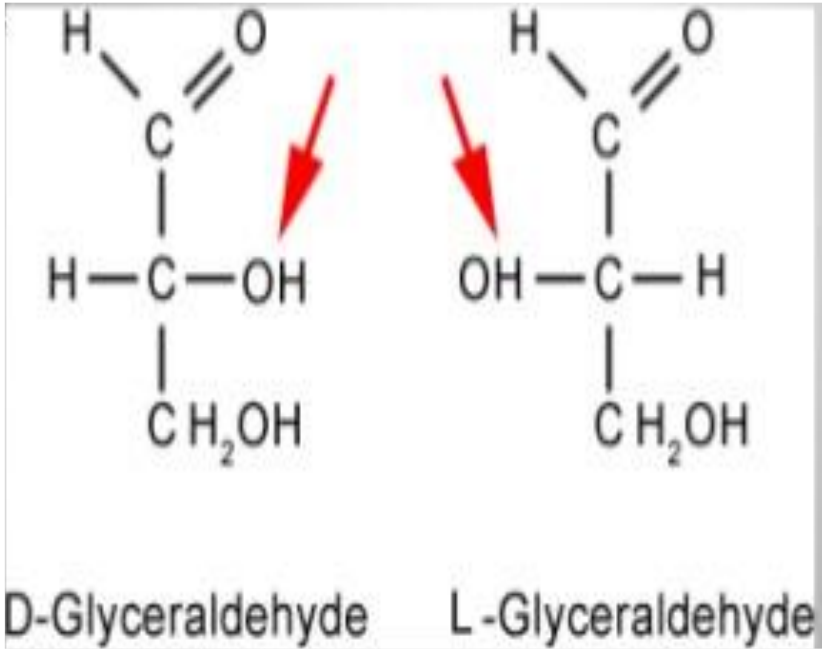
✓ Same molecular formula but differ from each other by having different structures.



D-Glucose



D-Fructose

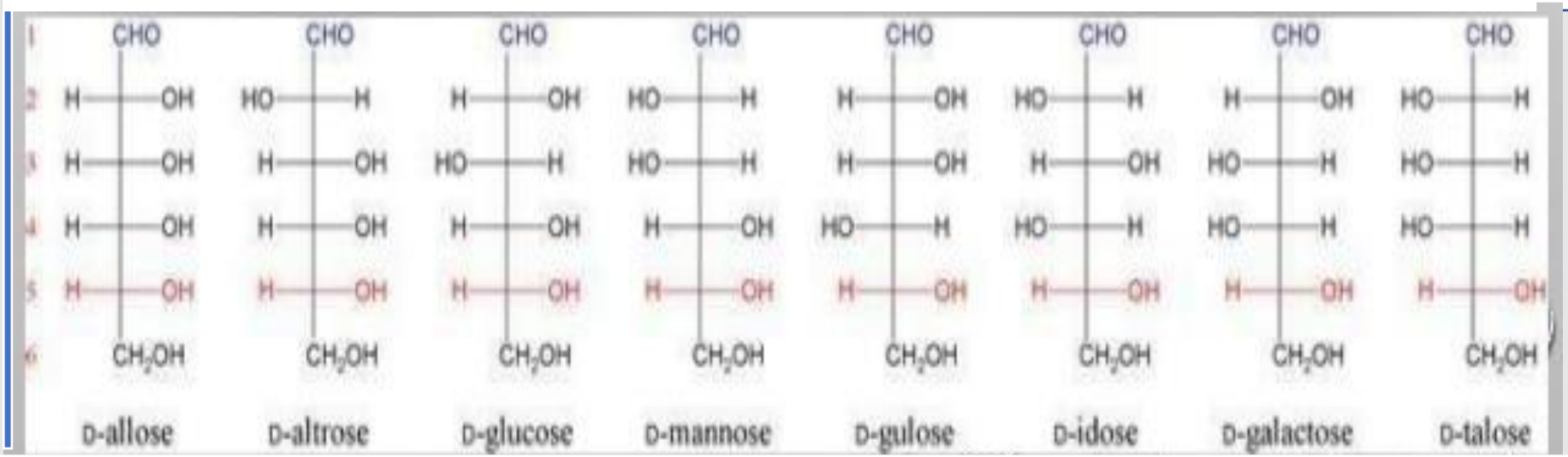


Max number of optical isomers= 2^n

n is no.of chiral carbon atoms

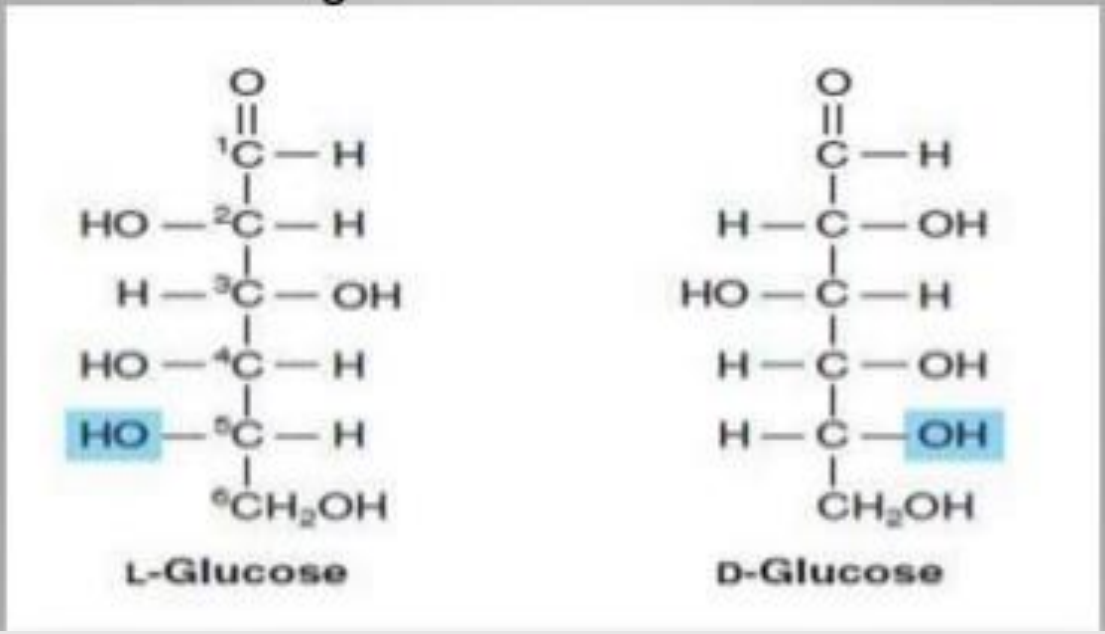
C3 has 2^1= 2

C6 has 2^4= 16



D AND L ISOMERISM

- ✓ D and L isomers are mirror images of each other. The orientation of –H and –OH group on the penultimate carbon atom(C5) determines whether the sugar is D or L isomers.



EPIMERISM

- ✓ Epimerism is the stereoisomerism if two monosaccharides differ from each other in their configuration around a single specific carbon(other than anomeric) atom.