



biomolecules

Biomolecule ?

- ❖ Includes Macromolecules and small molecules
- ❖ Carbohydrates – Three major groups
 - Monosaccharaides .
 - Oligosaccharides
 - Polysaccharides

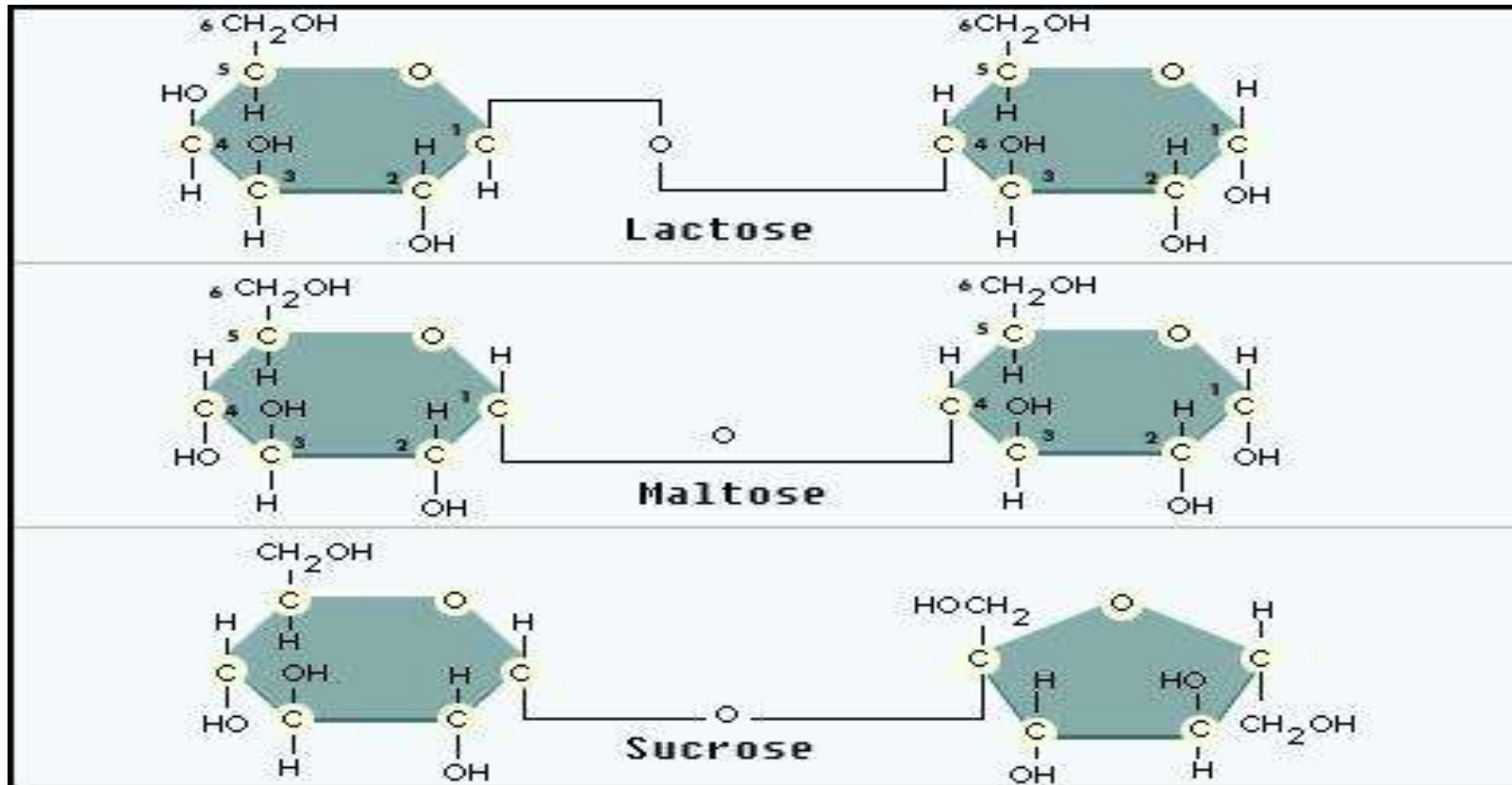
Monosaccharide

- Free aldehyde or ketone group and two or more hydroxyl group
- General formula is $C_nH_{2n}O_n$
- 3 – 7 carbon sugar
- Aldose or ketose based on aldehyde or ketone group

	Triose sugars ($C_3H_6O_3$)	Pentose sugars ($C_5H_{10}O_5$)	Hexose sugars ($C_6H_{12}O_6$)	
Aldoses	$ \begin{array}{c} \text{H} \quad \text{O} \\ \diagdown \quad \diagup \\ \text{C} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{H} \end{array} $ Glyceraldehyde	$ \begin{array}{c} \text{H} \quad \text{O} \\ \diagdown \quad \diagup \\ \text{C} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{H} \end{array} $ Ribose	$ \begin{array}{c} \text{H} \quad \text{O} \\ \diagdown \quad \diagup \\ \text{C} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{HO}-\text{C}-\text{H} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{H} \end{array} $ Glucose	$ \begin{array}{c} \text{H} \quad \text{O} \\ \diagdown \quad \diagup \\ \text{C} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{HO}-\text{C}-\text{H} \\ \\ \text{HO}-\text{C}-\text{H} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{H} \end{array} $ Galactose
Ketoses	$ \begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{C}=\text{O} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{H} \end{array} $ Dihydroxyacetone	$ \begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{C}=\text{O} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{H} \end{array} $ Ribulose	$ \begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{C}=\text{O} \\ \\ \text{HO}-\text{C}-\text{H} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{H}-\text{C}-\text{OH} \\ \\ \text{H} \end{array} $ Fructose	

Oligosaccharide

Consist of two to ten monosaccharaides

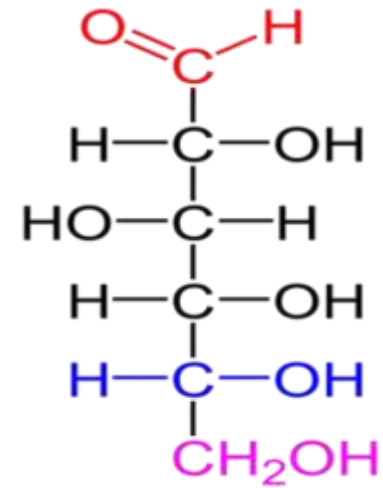
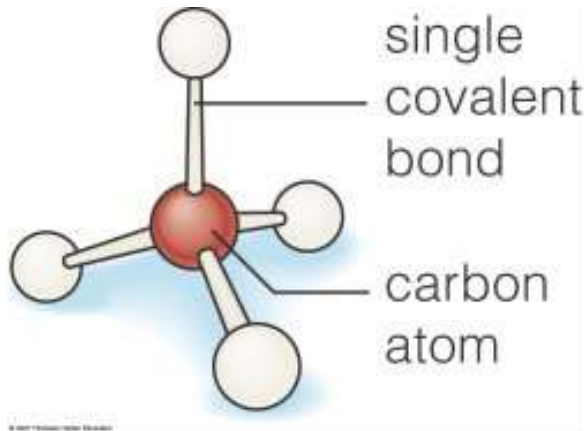


Polysaccharide

- Yield more than 10 monosaccharaides upon hydrolysis
- Homopolysaccharide and
- Heteropolysaccharide

Asymmetry

- Tetrahedral carbon atom



Glucose

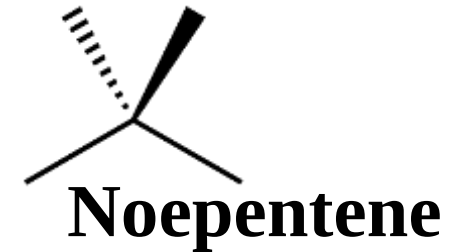
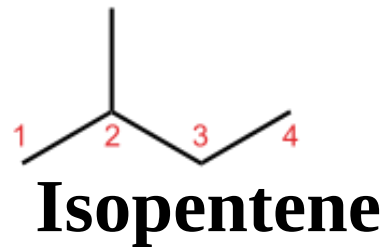
A carbon atom with 4 different atoms or groups attached are called Asymmetric.

Isomerism

- Two different compounds with same molecular formula is called Isomerism
- Presence of asymmetric carbon atoms makes isomers
- Isomerism of two types Structural isomerism and Stereo isomerism

Structural Isomerism

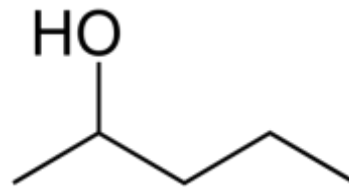
- Possess same molecular formula but different structures
- Chain isomers – carbon chain reordered to create different structure



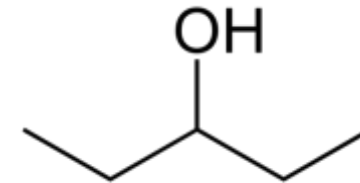
Position Isomers – functional group changes position in parent structure



1-Pentanol

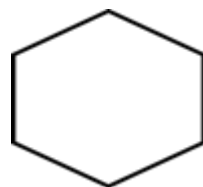


2-Pentanol



3-Pentanol

- Functional Isomers – Same molecular formula but atoms are connected in different ways



Cyclohexane



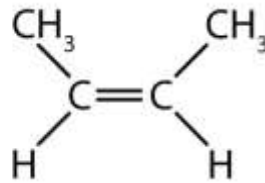
1-hexene

Stereoisomerism

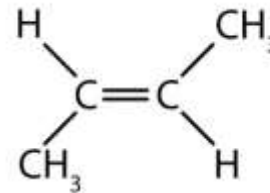
- Have same molecular formula same structure but differ in spatial arrangement.
- Two types of stereoisomers
geometrical and optical isomers

Geometrical

- Geometrical: orientation of functional groups within a molecule
- Cis-Trans Isomerism



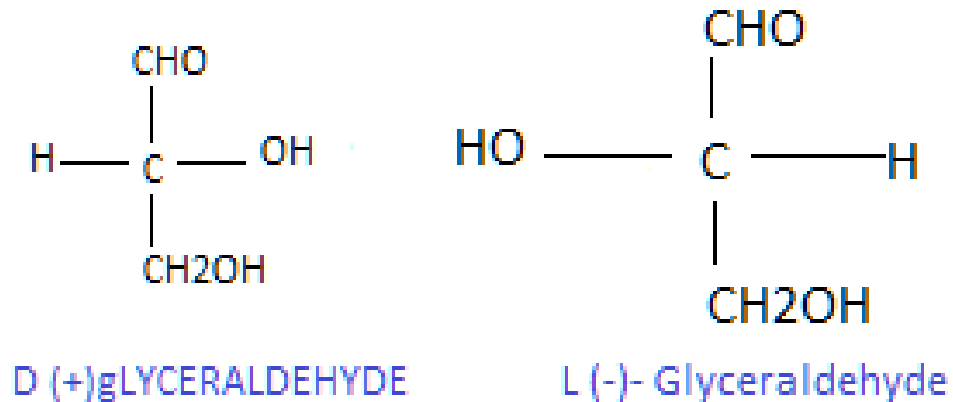
cis-2-butene



trans-2-butene

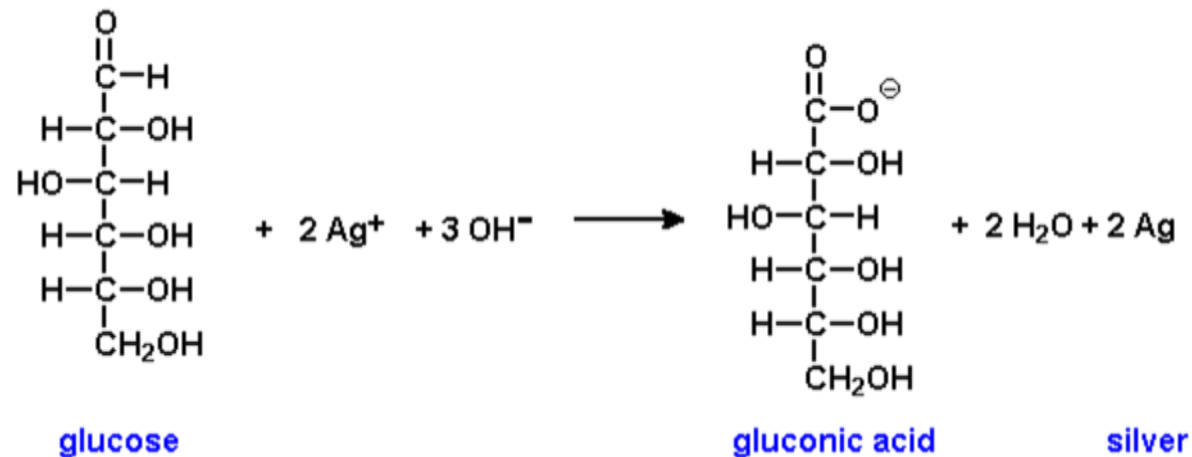
Optical isomers

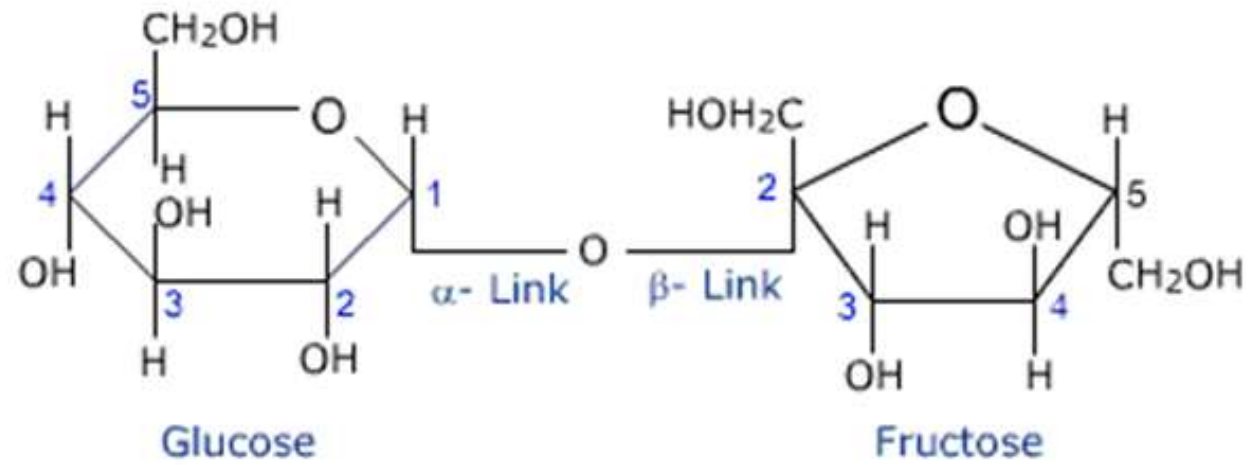
- Optical isomers: disposition of various atoms around asymmetric carbon atoms.
- Mirror image of each other
- D and L form



Reducing and non Reducing sugars

- Any sugar having free aldehyde or ketone group which can be oxidized are called reducing sugar
- Tollen's reagent and Benedict's solution

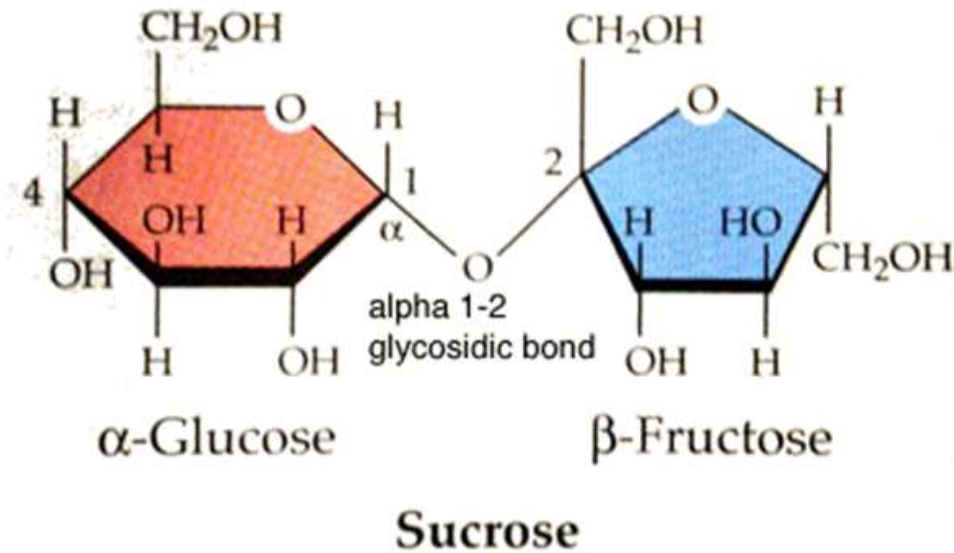




Chemistry of Oligosaccharide

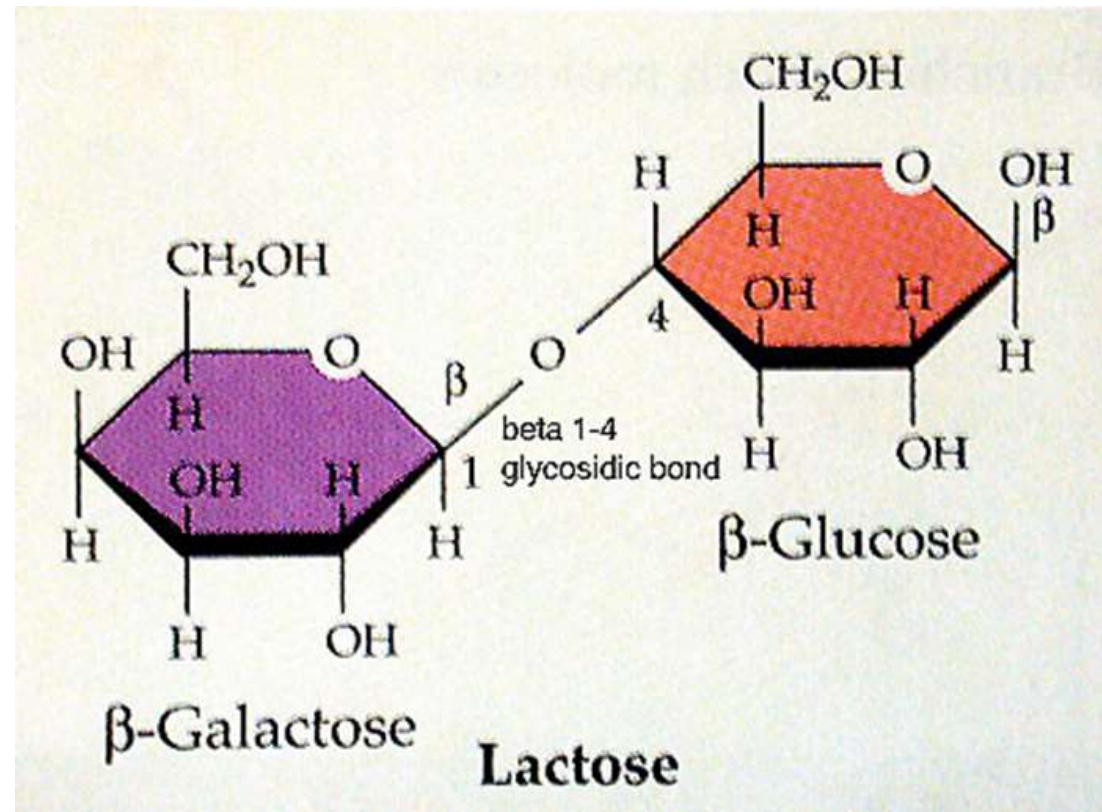
- Sucrose

Sucrose has the molecular formula $C_{12}H_{22}O_{11}$



Hydrolysis yields glucose and fructose

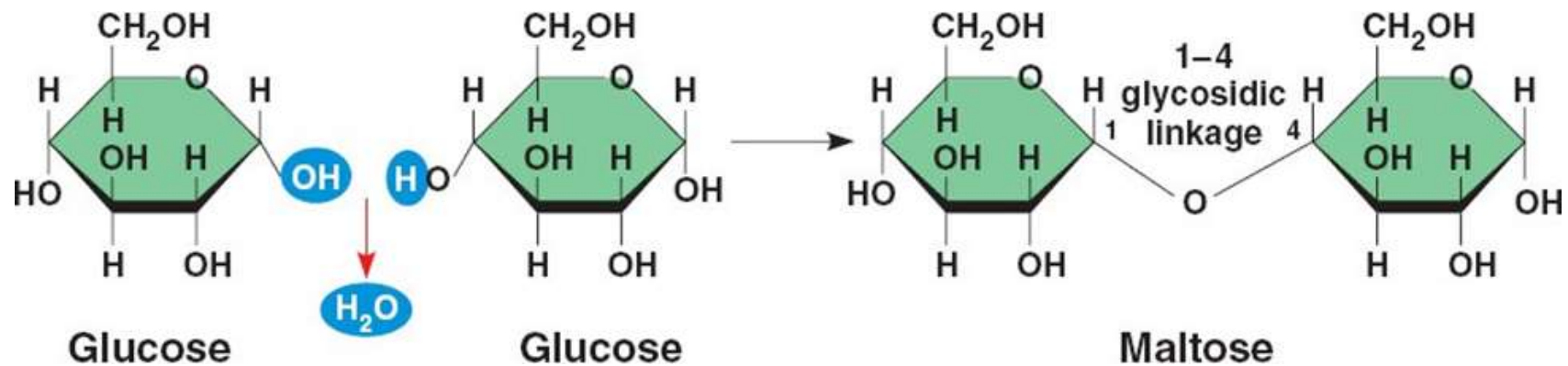
Lactose



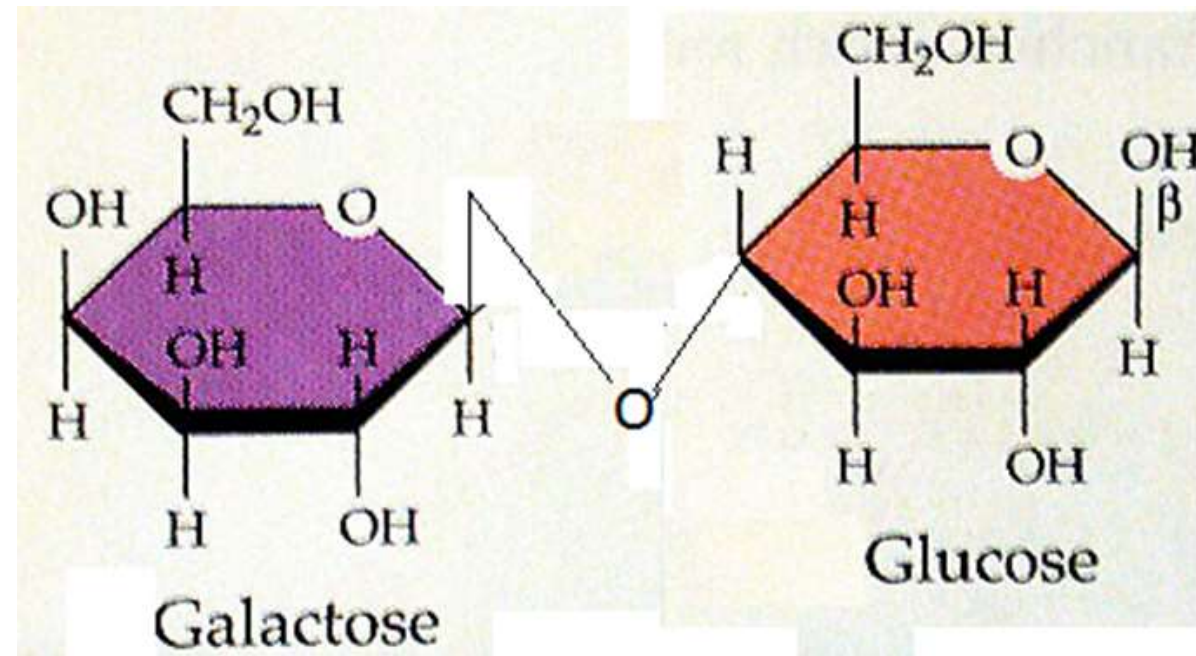
Hydrolysis yields glucose and galactose

Maltose

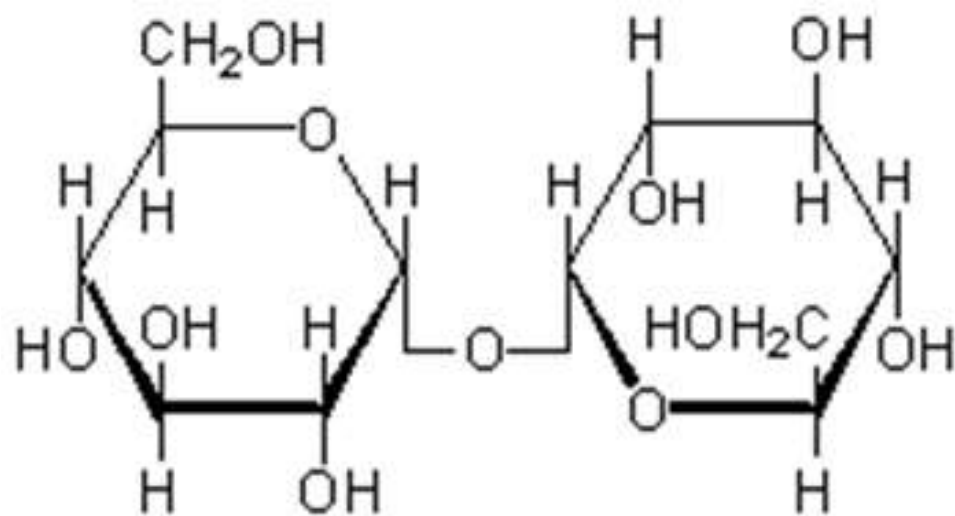
- Major product of hydrolysis of starch



Cellobiose



Trehalose



Polysaccharide

- High molecular weight carbohydrates
- Differ each other by molecular weight, nature of chain, type of glycosidic bond, type of linkage.
- Distinguished in to
 - Homopolysaccharide
 - Heteropolysaccharide