

SNS COLLEGE OF ALLIED HEALTH SCIENCE
Affiliated to The Tamil Nadu Dr M.G.R Medical University, Chennai



DEPARTMENT OF CARDIAC TECHNOLOGY

COURSE NAME: BIOCHEMISTRY

UNIT : 1

TOPIC : CARBOHYDRATES AND ITS CLASSIFICATION

FACULTY NAME: MITHRA V

CARBOHYDRATES (DEFINE)

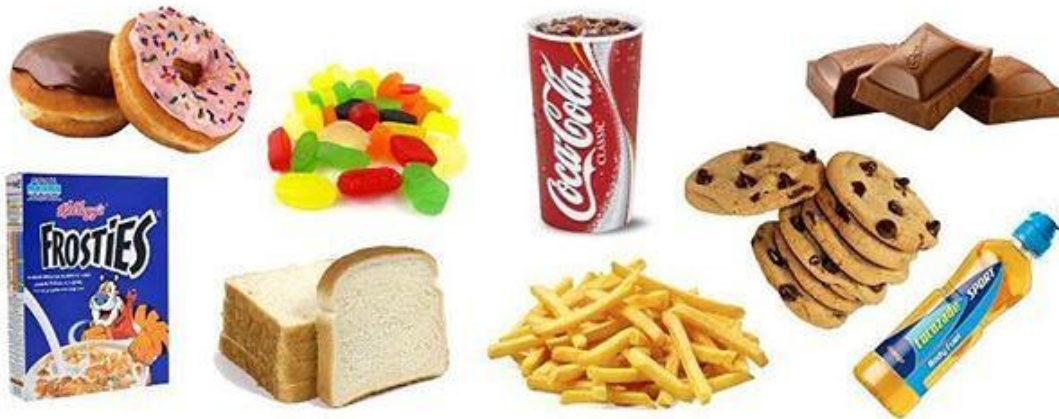
- Sugar molecules, one of three main nutrients (with proteins, fats).
- Broken down into glucose (blood sugar), main energy source for cells, tissues, organs.
- Common sources: Grains, fruits, dairy, legumes, snacks, sweets, starchy vegetables.



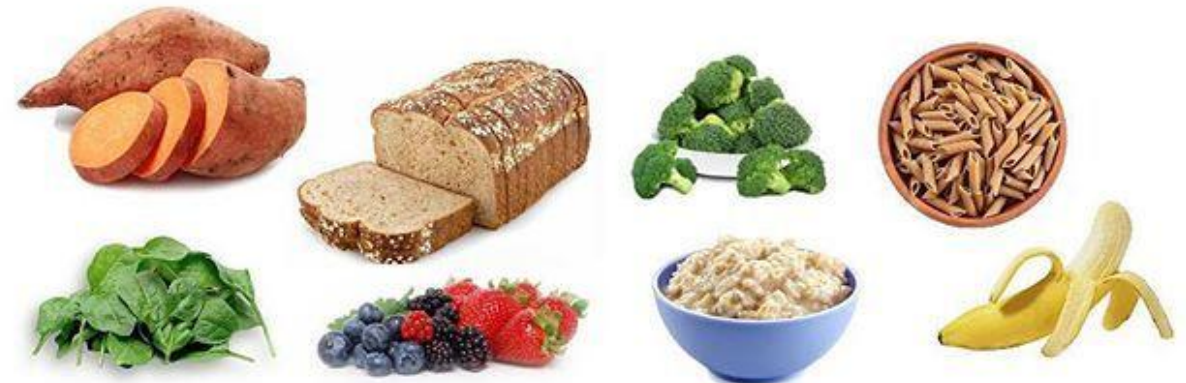
TYPES OF CARBOHYDRATES

- **Sugars:** Simple carbs, found in candy, fruits, vegetables, milk.
- **Starches:** Complex carbs, broken into sugars for energy (e.g., bread, pasta, potatoes).
- **Fiber:** Complex carb, aids digestion, lowers cholesterol/sugar (e.g., legumes, whole grains).

✗ SIMPLE CARBS

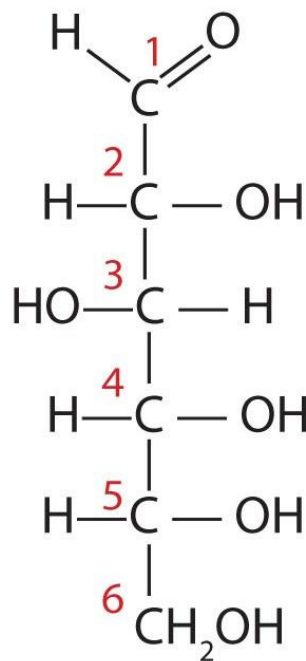


✓ COMPLEX CARBS

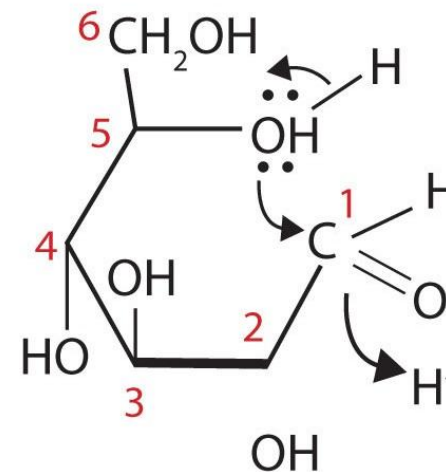


STRUCTURE OF CARBOHYDRATES

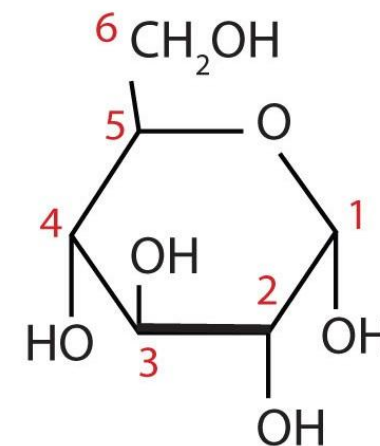
- Empirical formula: $(\text{CH}_2\text{O})_n$
(e.g., Glucose: $\text{C}_6\text{H}_{12}\text{O}_6$).
- Structural forms:
 - Open chain: Straight-chain form.
 - Hemi-acetal: Six-membered glucopyranose ring.
 - Haworth: Pyranose ring (5 carbon, 1 oxygen).



(a) Fischer projection



(b) Three-dimensional representation



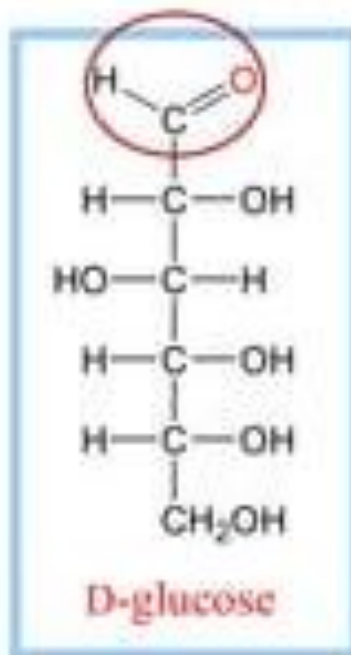
(c) Cyclic monosaccharide

CARBOHYDRATE - CLASSIFICATION

- **Monosaccharides:** Building blocks, aldose (aldehyde) or ketose (ketone)
Eg., Glucose and Fructose

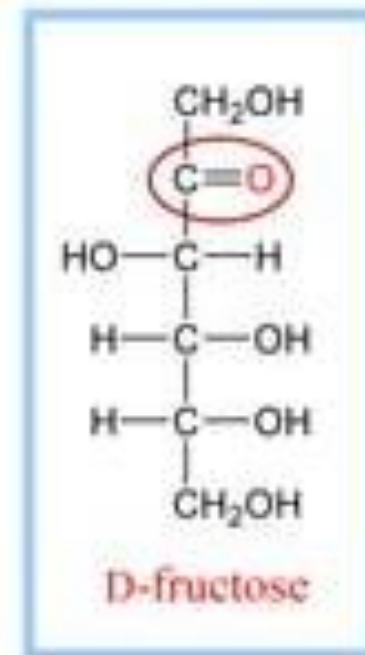
Aldose – Polyhydroxy aldehyde

e.g: **Glucose**



Ketose – Polyhydroxy ketone

e.g: **Fructose**



- **Disaccharides:** Yield 2 monosaccharides on hydrolysis.
Eg., Sucrose (Glucose + Fructose), Lactose (Glucose + Galactose), Maltose.
- **Oligosaccharides:** Yield 2-10 monosaccharides,
Eg., Raffinose (trisaccharide).
- **Polysaccharides:** >10 monosaccharide units, Eg., Starch, Cellulose.
 - Homopolysaccharides:** Same monomer (Eg., Starch, Glycogen).
 - Heteropolysaccharides:** Different monomers (Eg., Hyaluronic acid).

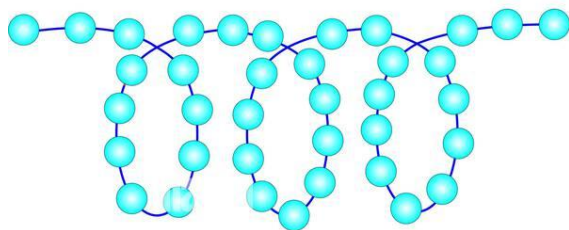
HOMOPOLYSACCHARIDES

- **Homoglycans,,**
- Composed of single type of monomer, containing monosaccharides of same repeating unit
- Single type of monosaccharide is involved in the formation
- Have simple structures
- Examples are starch, glycogen, cellulose, pectin.

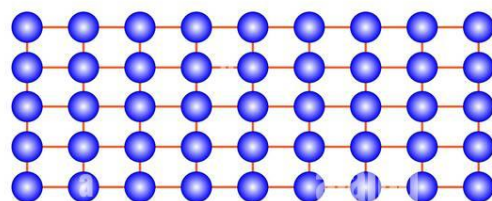
HETEROPOLYSACCHARIDES

- **Heteroglycans.,**
- Composed of different repeating units of two or more different monosaccharides
- Contains more than 10 different repeating units.
- Different types of monosaccharides are involved in the formation
- Have complex structures
- Examples are Hyaluronic acid, Chondroitin.

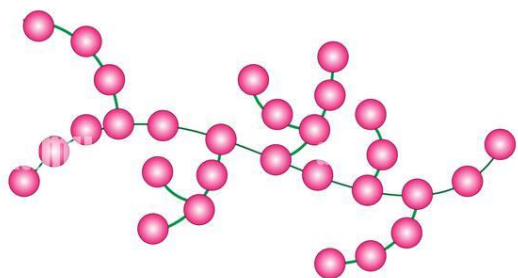
POLYSACCHARIDES



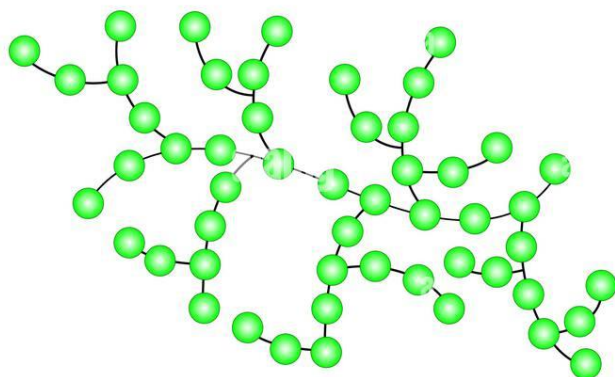
Amylose



Cellulose



Amylopectin



Glycogen

Amylose

1. It is a straight chain polymer of D-glucose units which constitutes about 20% of the starch.



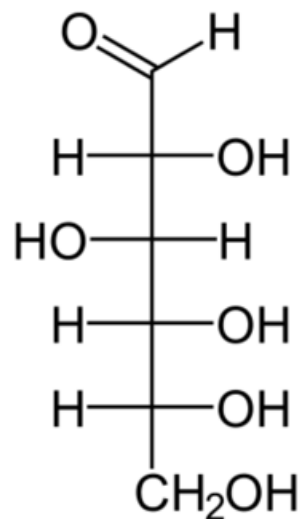
Amylopectin

It is the branched chain polymer of the D-glucose units which constitutes about 80% of the starch.

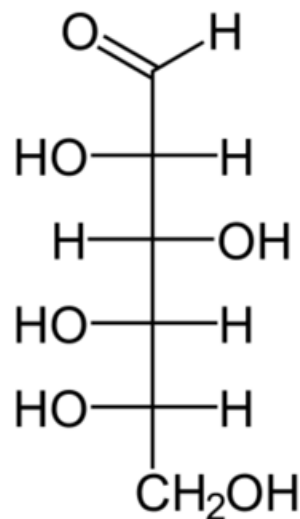


PHYSICAL PROPERTIES

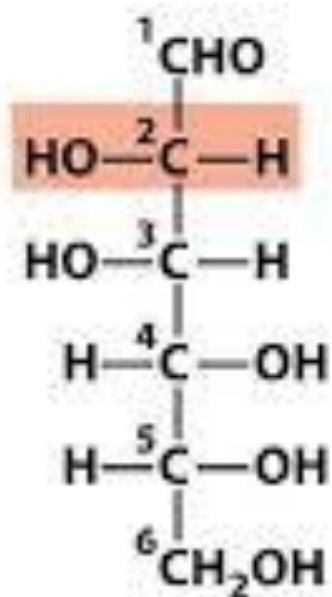
- 1. Stereoisomerism:** Same formula, different spatial configuration (e.g., D-glucose, L-glucose).
- 2. Diastereoisomers:** Configurational changes at C2, C3, or C4 (e.g., mannose, galactose).



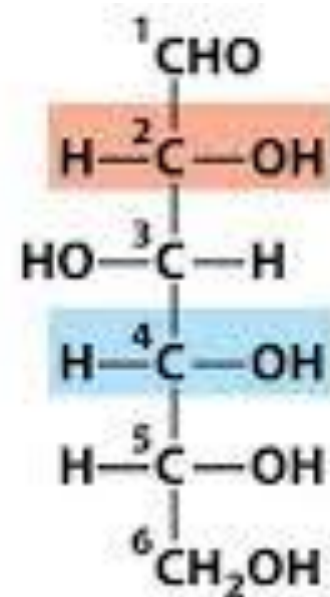
D-Glucose



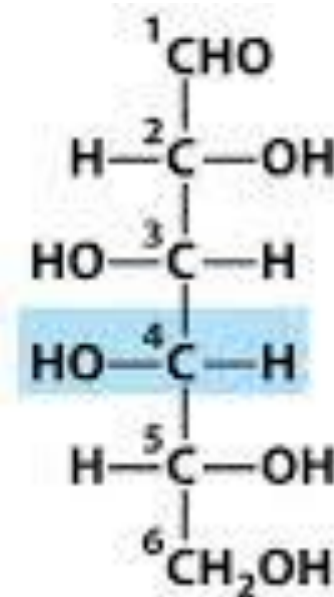
L-Glucose



D-Mannose
(epimer at C-2)



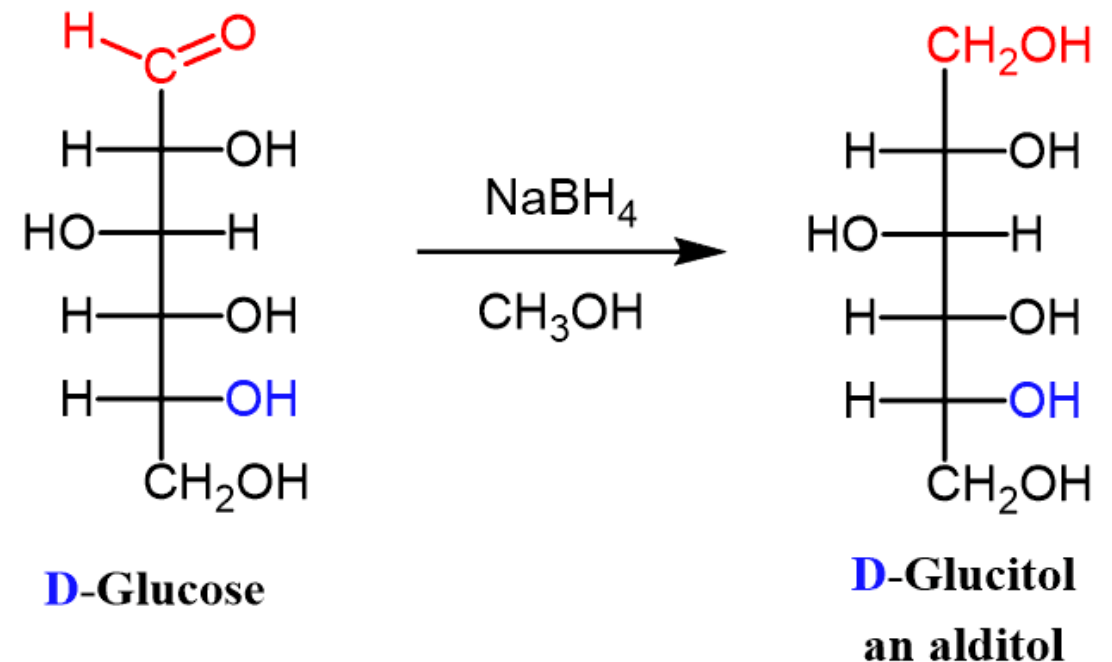
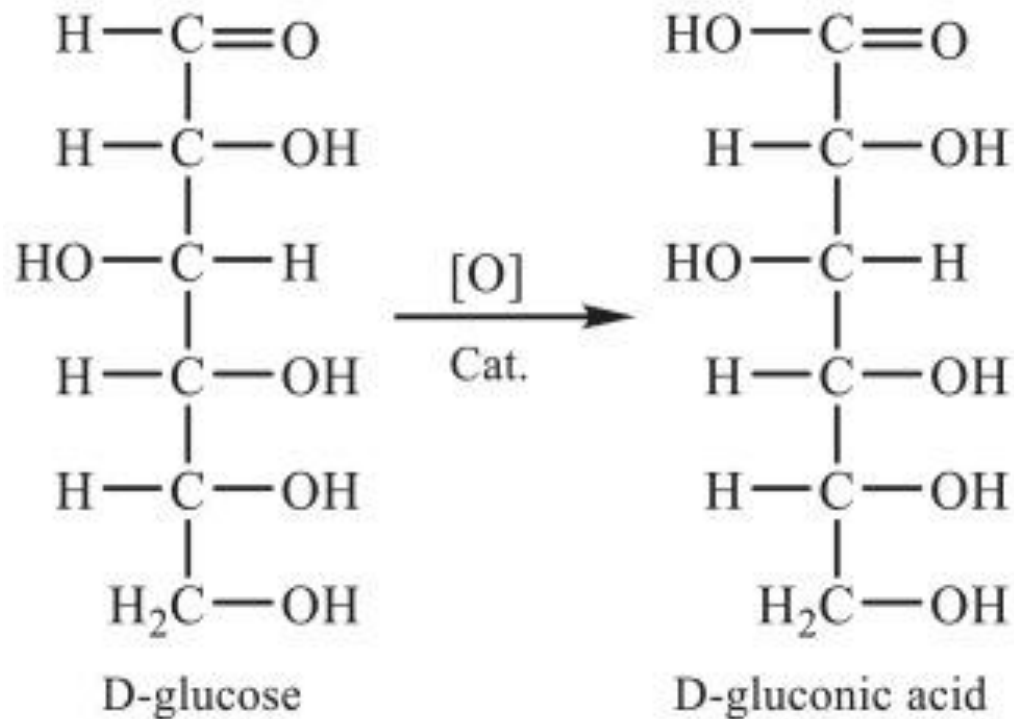
D-Glucose



D-Galactose
(epimer at C-4)

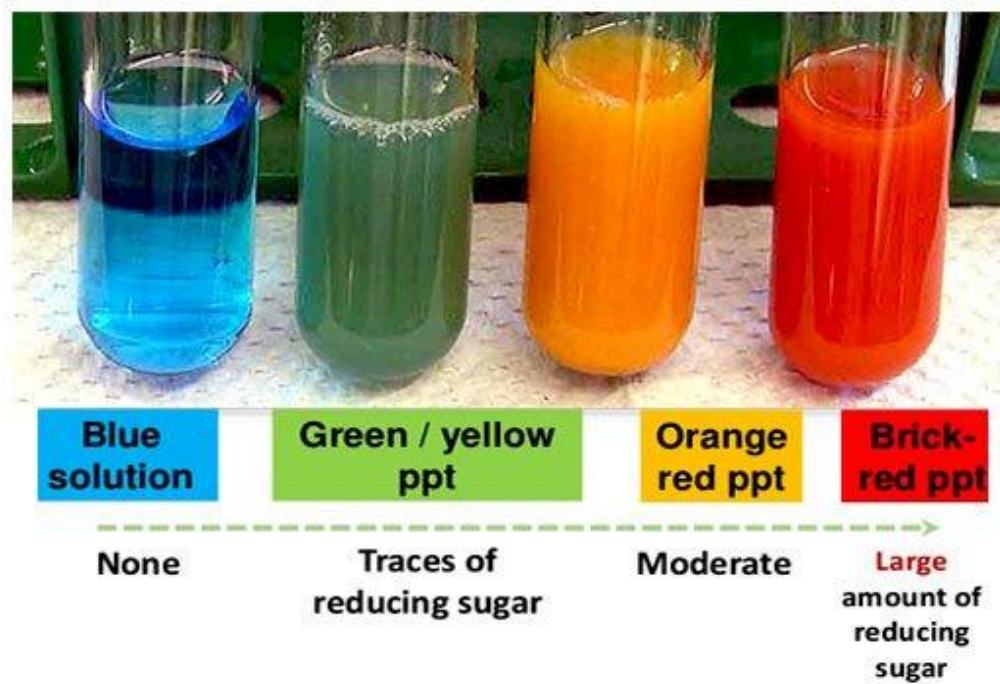
CHEMICAL PROPERTIES

- 1. Oxidation:** Monosaccharides oxidize to carboxylic acids (e.g., glucose to gluconic acid).
- 2. Reduction:** Carbonyl groups reduce to alcohols (alditols) using NaBH_4 or hydrogenation.



3. Benedict's Test: Reducing sugars change color(blue → brick-red) due to copper reduction.

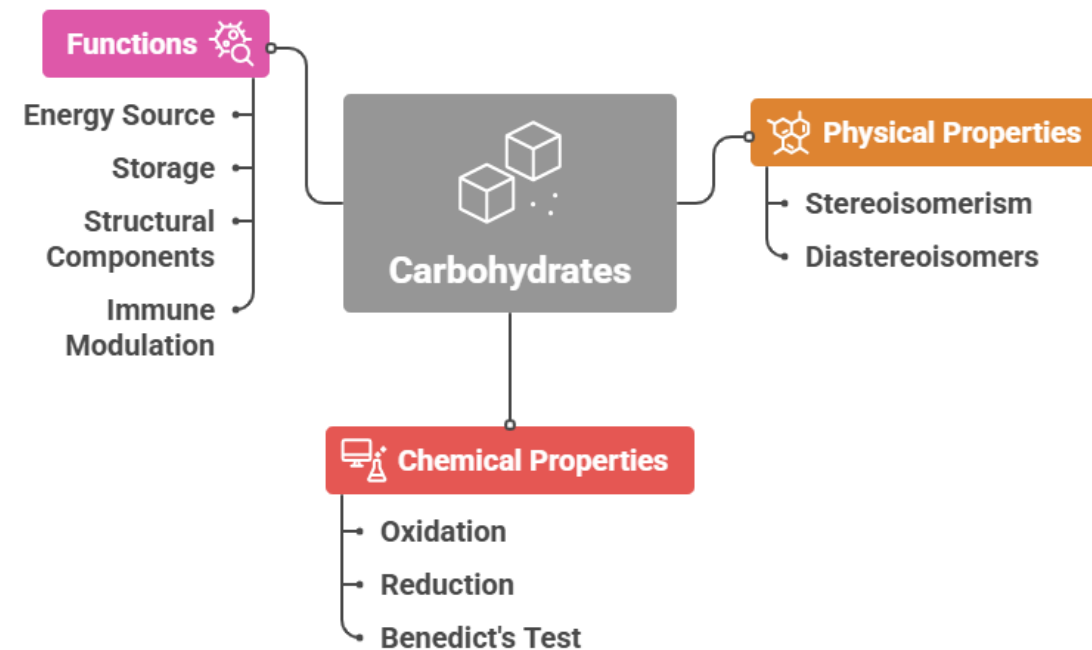
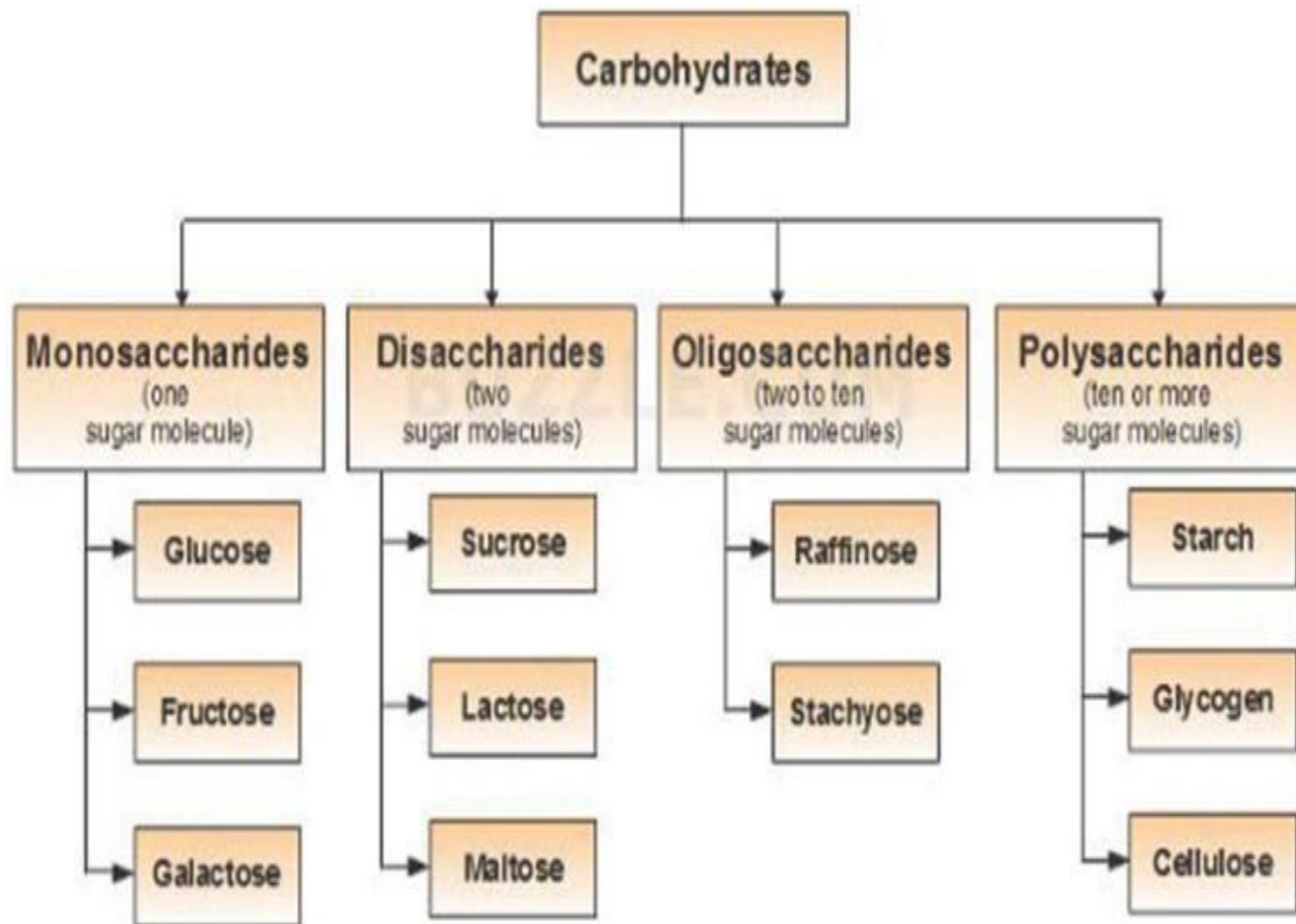
- It is a mixture of sodium citrate, sodium carbonate, and copper(II) sulfate pentahydrate.
- When heated with a reducing sugar, the reagent changes color from blue to brick-red due to a reduction reaction that forms a copper(I) oxide precipitate.



FUNCTIONS

- Primary energy source (4 kcal/gram), broken down via glycolysis/Kreb's cycle.
- Stored as glycogen (animals) or starch (plants).
- Structural components: Cell walls (plants: cellulose, bacteria: peptidoglycan).
- Form RNA/DNA framework, connective tissues.
- Modulate immune system.

SUMMARY



REFERENCES

- Nelson, D. L., & Cox, M. M. (2017). *Lehninger Principles of Biochemistry* (7th ed.).
- Boons, G.-J. (1998). *Carbohydrate Chemistry* (1st ed.). Springer.
- PubChem - Carbohydrates: <https://pubchem.ncbi.nlm.nih.gov>
- ChemLibreTexts - Carbohydrates:
[https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental Modules \(Organic_Chemistry\)/Carbohydrates](https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_(Organic_Chemistry)/Carbohydrates)
- Biology Online - Carbohydrates: <https://www.biologyonline.com/dictionary/carbohydrate>

THANK YOU