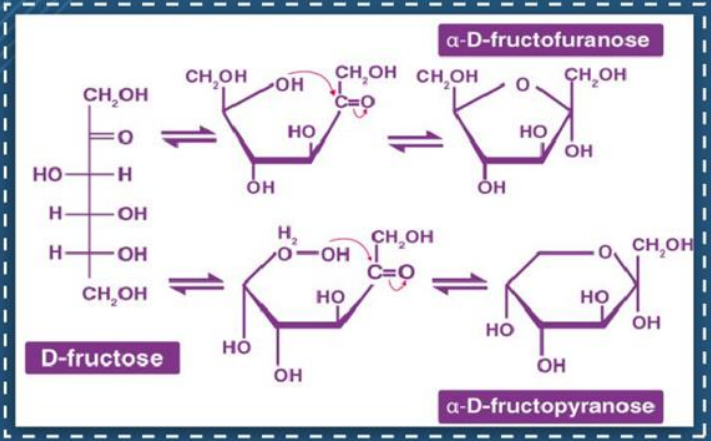
CARBOHYDRATES

MISSION MBBS | 2024

BIOMOLECULES-L2



ZOOLOGY | CLASS 11

PUSHPENDU SIR

MISSION MBBS

MONDAY TO FRIDAY
4 PM - 8 PM

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ZOOLOGY	ZOOLOGY	CHEMISTRY	BOTANY	PHYSICS

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from additional sample papers and detailed solutions

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Projection

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8th June
Onwards

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3rd & 10th July
2:00 to 5:20 PM

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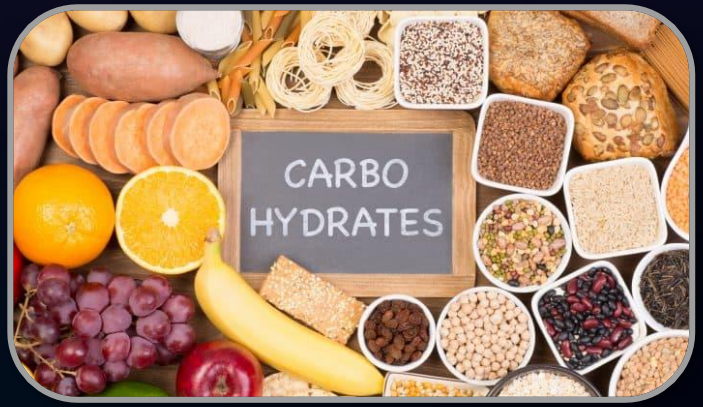
Recall! Carbohydrates

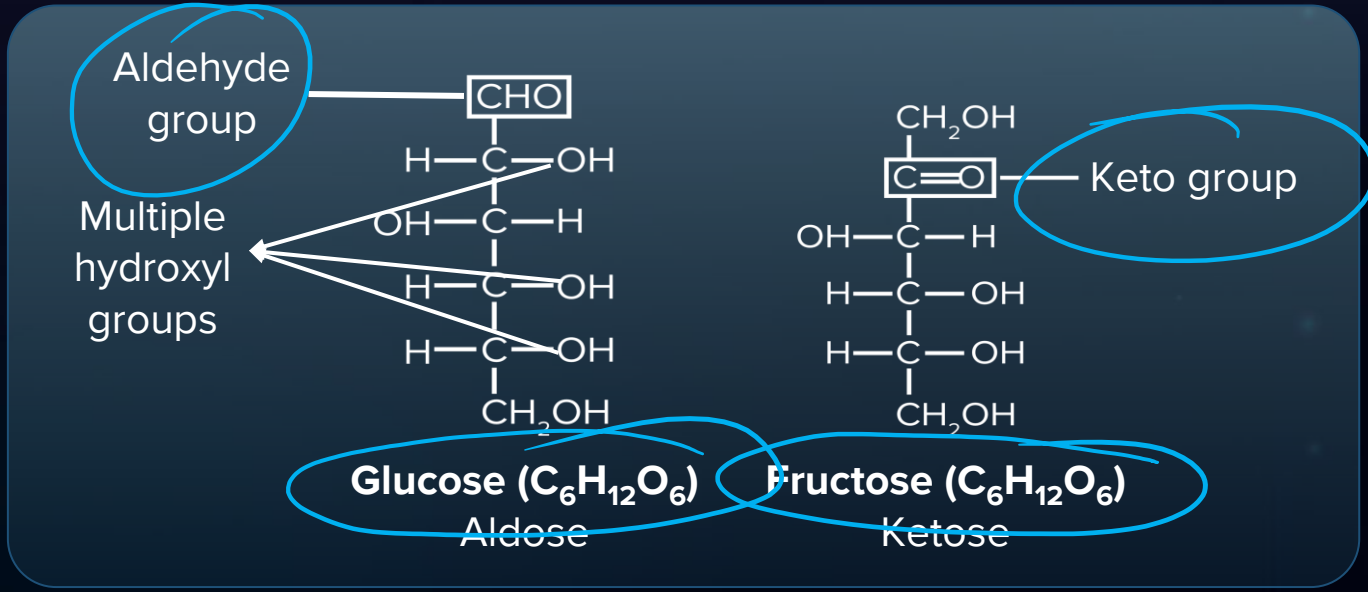
Aldehyde group

- ‘Carbohydrates’ = **Hydrates of carbon**
- Compounds having carbon, hydrogen and oxygen in the ratio **1:2:1**



Carbohydrates: General Structure

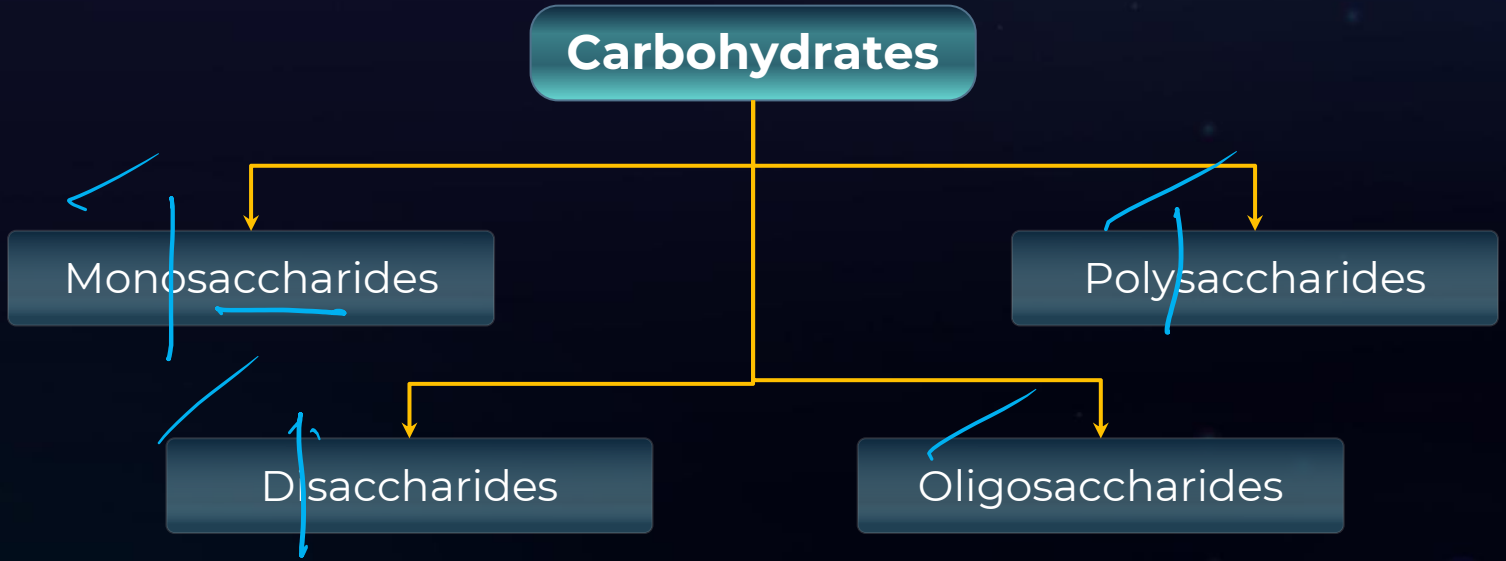
- Atleast **3 carbon** atoms
- Multiple hydroxyl (-OH) groups
- Either an aldehyde (-CHO) group or a ketone (C=O) group



Classification of Carbohydrates

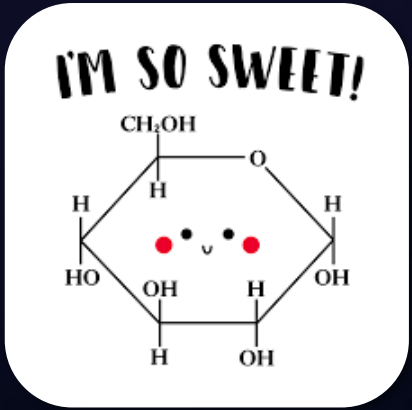
Classification of Carbohydrates

Based on the number of monomeric units



Monosaccharides

Monosaccharides

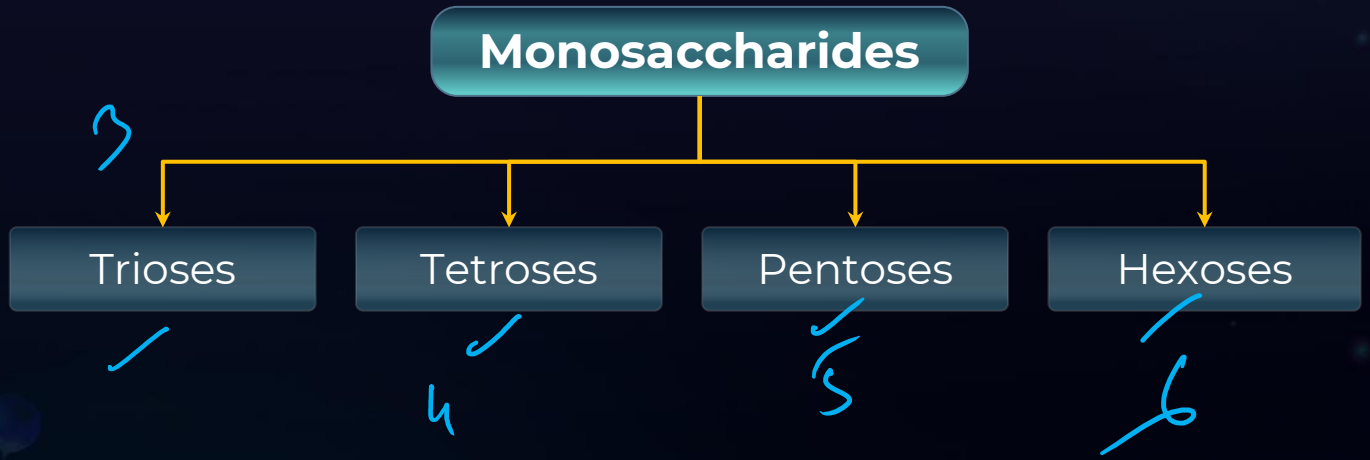


- Mono = Single; Saccharide = Sugar
- **Simplest** carbohydrates
- **Building blocks** of larger carbohydrates

Cannot be hydrolysed.

Monosaccharides

Based on the **number of carbon atoms**

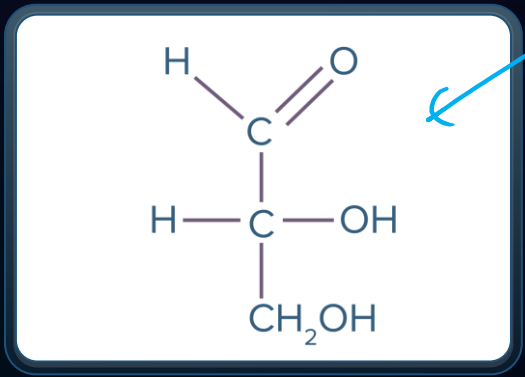


Monosaccharides

Monosaccharides

- **Trioses**
- Tetroses
- Pentoses
- Hexoses

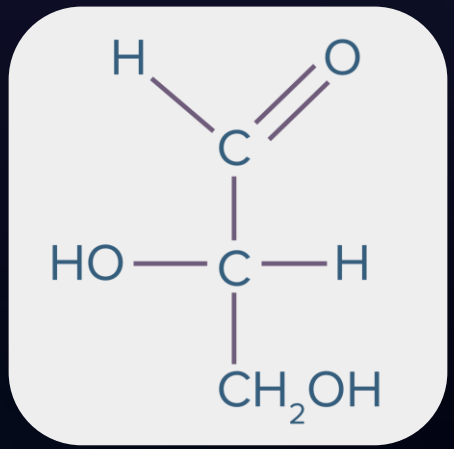
Have 3 carbon atoms



Glyceraldehyde

Optical Activity of Monosaccharides

Two Forms - Enantiomers



L- Glyceraldehyde

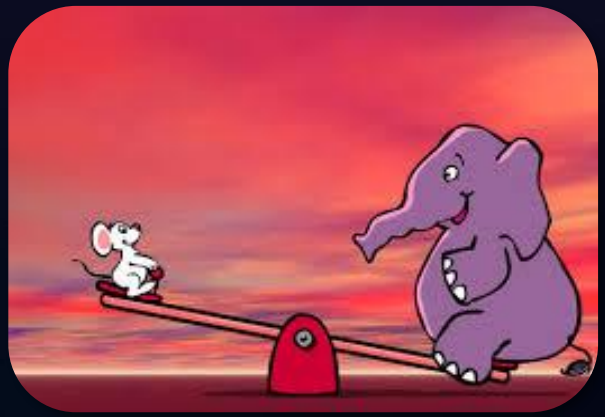
D- Glyceraldehyde

Why have we written the letters ‘L’ and ‘D’ in front of the name of the sugars?

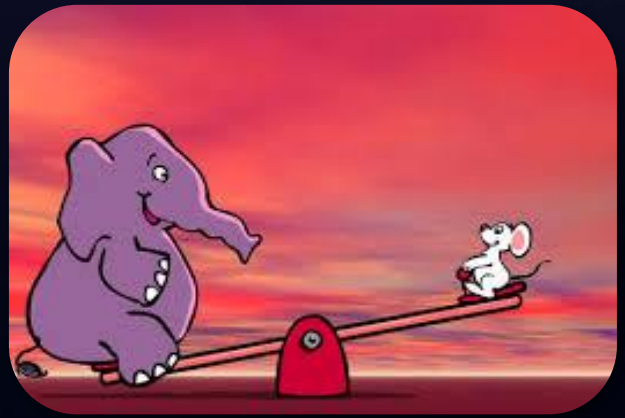
That is a special property of these sugars! Let us see what it is!

Monosaccharides - Glyceraldehyde

- Two **optically active** forms
- **Non-superimposable** mirror images



Dextrorotatory (d)
Turns the plane polarised light to the **right**



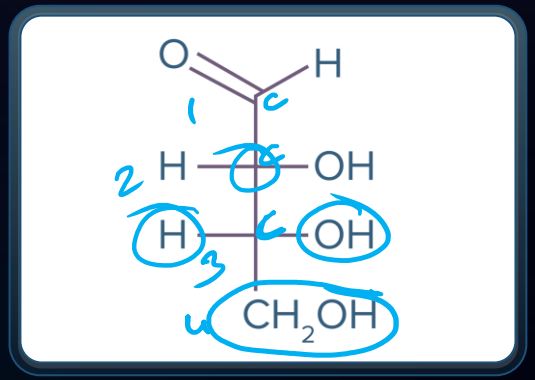
Laevorotatory (l)
Turns the plane polarised light to the **left**

Monosaccharides

Monosaccharides

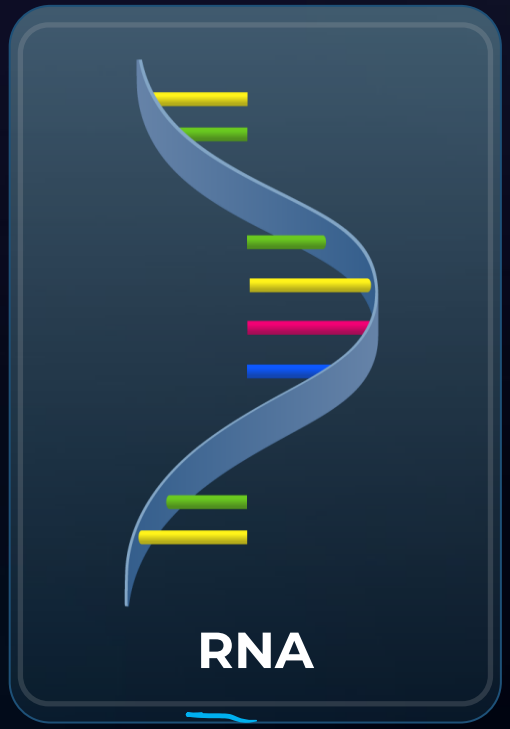
- Trioses
- **Tetroses**
- Pentoses
- Hexoses

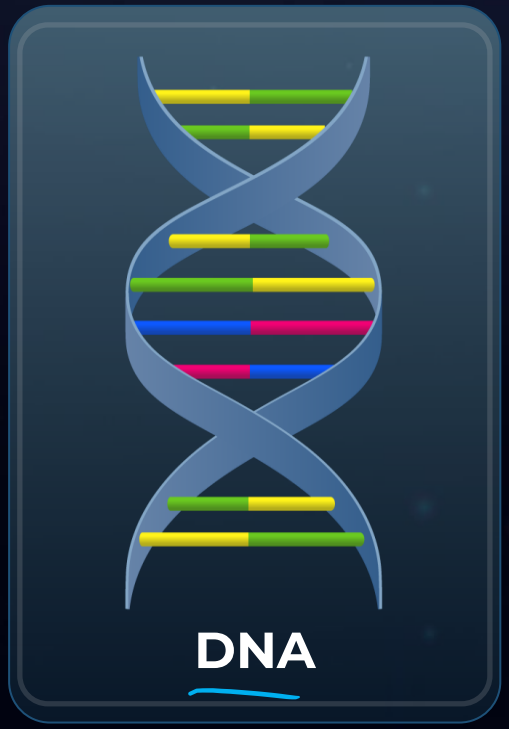
Have 4 carbon atoms



D- Erythrose

Do you know the type of sugar present in RNA and DNA?



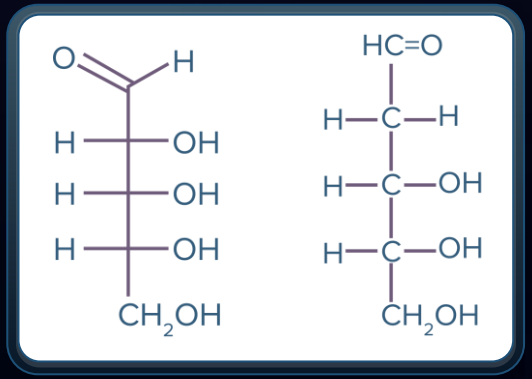


Monosaccharides

Monosaccharides

- Trioses
- Tetroses
- **Pentoses**
- Hexoses

Have 5 carbon atoms



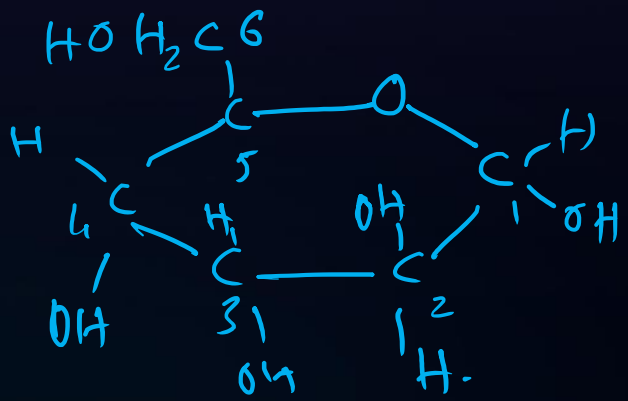
D- Ribose **D- Deoxyribose**

Have you drunk this?

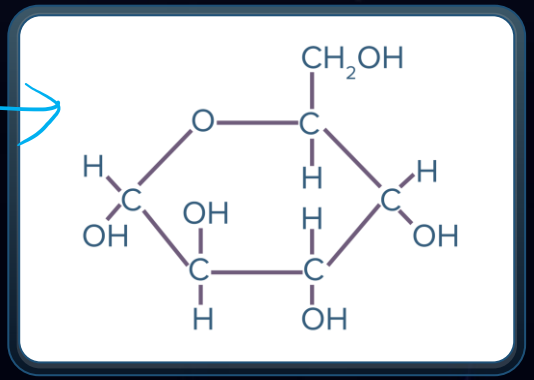
Monosaccharides

Monosaccharides

- Trioses
- Tetroses
- Pentoses
- Hexoses

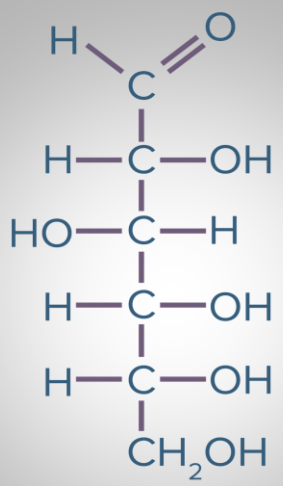


Have 6 carbon atoms

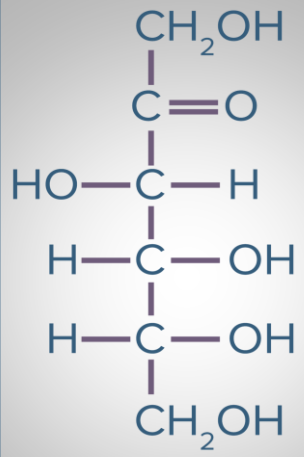


L-Glucose

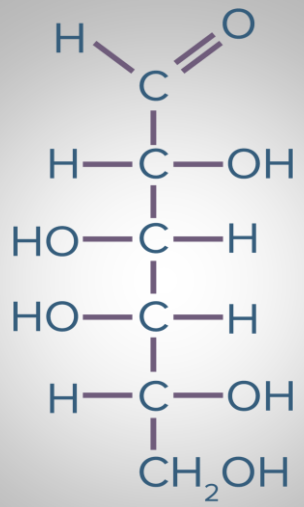
Monosaccharides - Hexoses



Glucose



D-Fructose



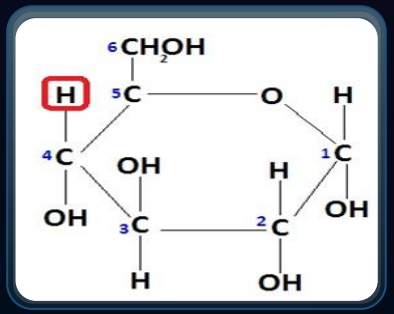
Galactose

Monosaccharides also show reducing property

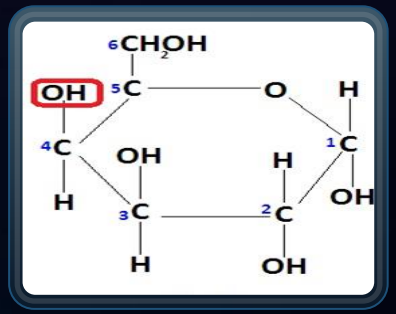
Monosaccharides

- Reducing sugars: **Free aldehyde/ketone group present**
- Non-reducing sugars: **No free aldehyde/ketone** group
- **All monosaccharides are reducing sugars**

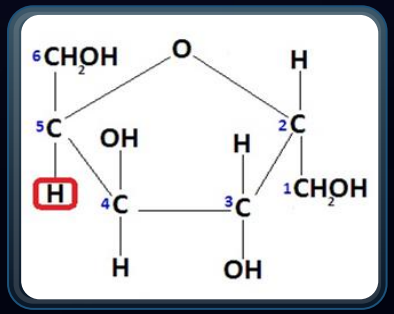
Hemiacetal.



Glucose



Galactose



Fructose


Let’s test the sugars out!

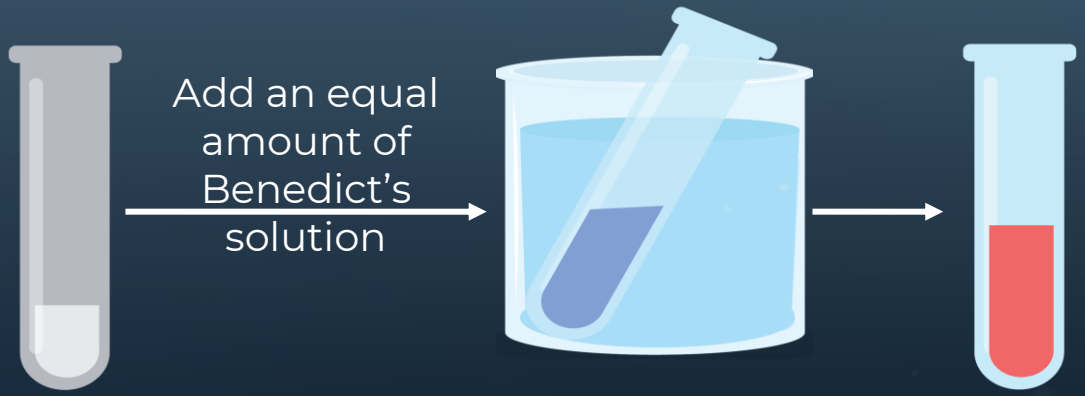
Benedict’s Test

Benedict's Test

Objective: To identify whether a sugar is reducing or non-reducing

Benedict's Test

Experiment



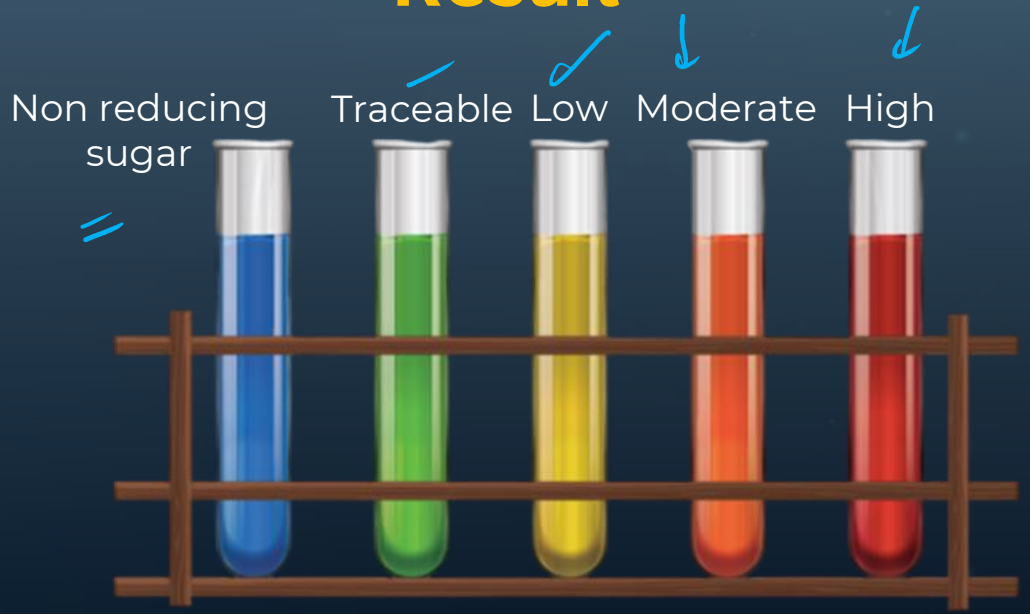
About 2 cm^3 of test solution (glucose)

Heat in water bath

Brick red precipitate

Benedict's Test

Result



QUESTION TIME

Reducing sugars must have:

A. Free aldehyde group only

B. Free ketone group only

C. Either free aldehyde or ketone group

D. Both free aldehyde and ketone groups

Reducing sugars must have:

A. Free aldehyde group only

B. Free ketone group only

C. **Either free aldehyde or ketone group**

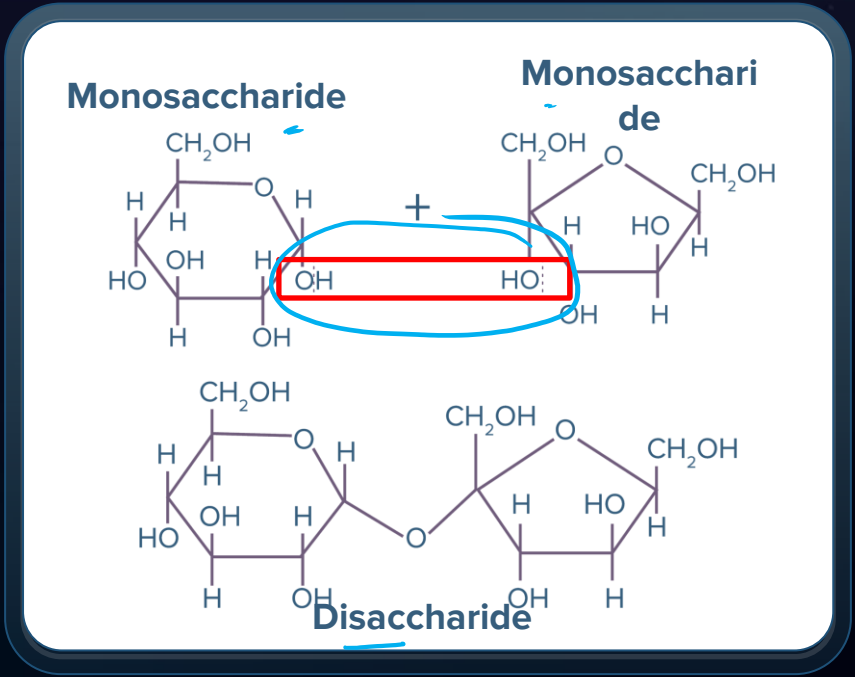
D. Both free aldehyde and ketone groups

Let us see what happens when two monosaccharides unite.

Disaccharides

Disaccharides

- Di = Two; Saccharide = Sugar unit
- **Two monosaccharide** units join with a **glycosidic bond**



H_2O

Disaccharides

Sucrose

Table sugar

Maltose

Maltose syrup

Lactose

Milk products

Disaccharides

Disaccharide	Monomers	Reducing nature
Sucrose	Glucose + Fructose	Non-reducing sugar
Maltose	Glucose + Glucose	Reducing sugar
Lactose	Glucose + Galactose	Reducing sugar


What happens when more than two monosaccharides join?

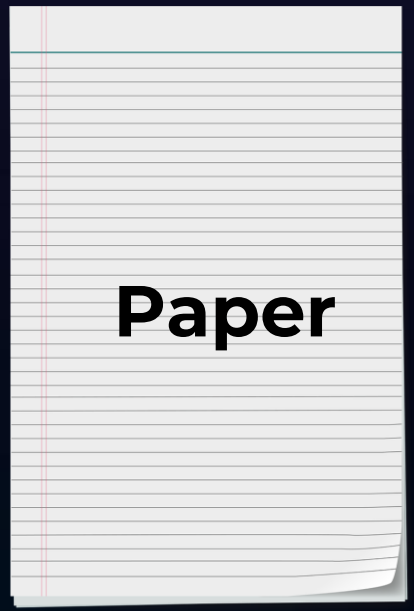
Oligosaccharides

Oligosaccharides

- ‘Oligo’ = Few; ‘Saccharide’ = Sugar
- 3-9 monosaccharide units join by **glycosidic linkage**

Trisaccharide	3 monosaccharide units Raffinose = Glucose + Galactose + Fructose
Tetrasaccharide	4 monosaccharide units Stachyose = Glucose + Galactose + Galactose + Fructose

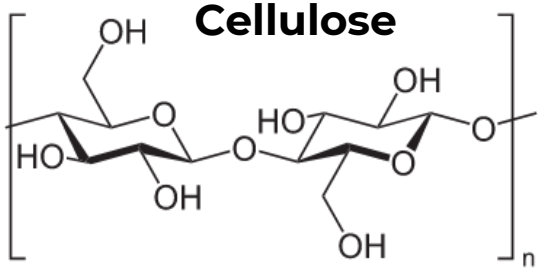
Do you know the common factor in both wood and paper?



Both are derived from trees and are rich in cellulose

Paper

Cellulose



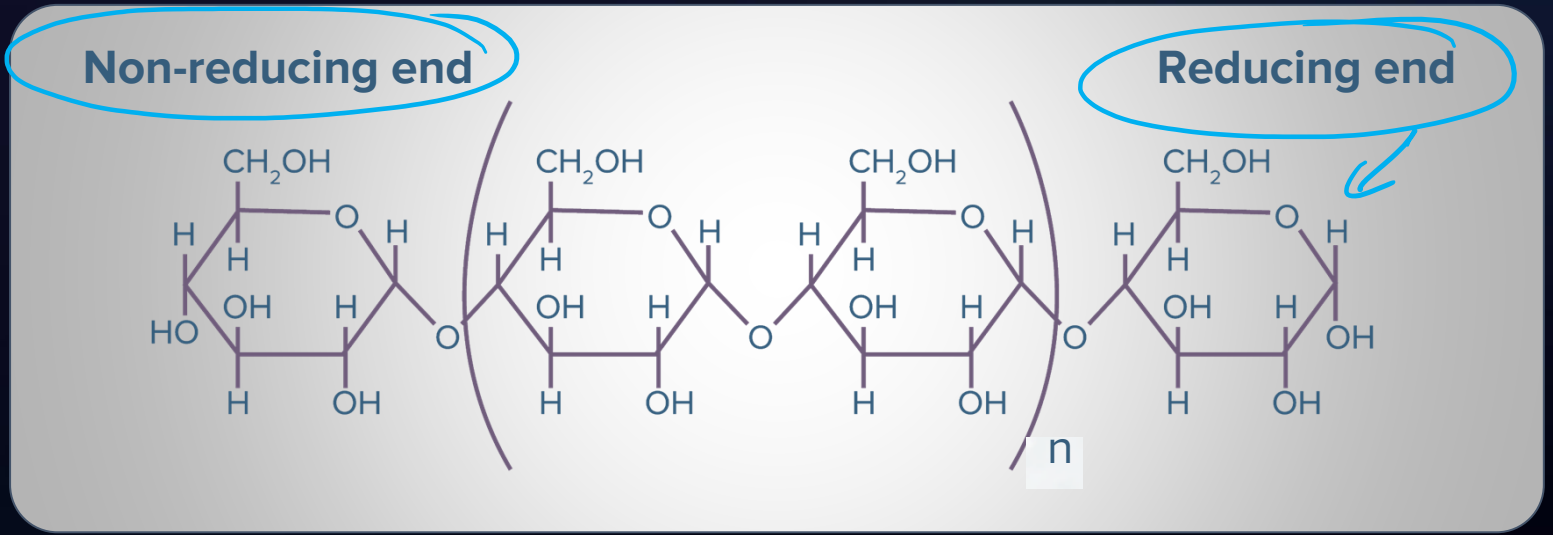
The most abundant biopolymer in nature is cellulose.

Polysaccharides

Polysaccharides

- Polymers of **repeating units** of monosaccharides
- Also called **'glycans'**
- High molecular weight
- Macromolecules

Polysaccharides

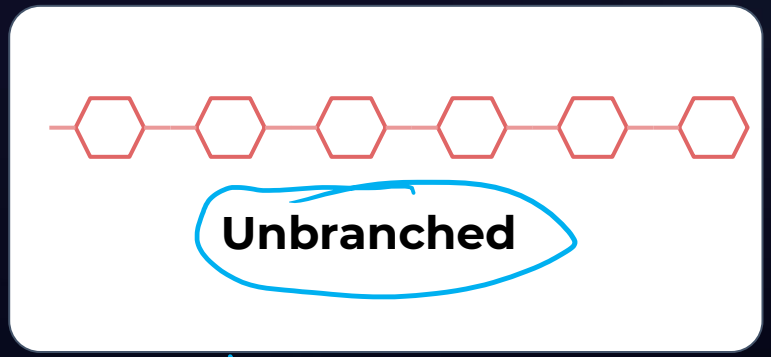


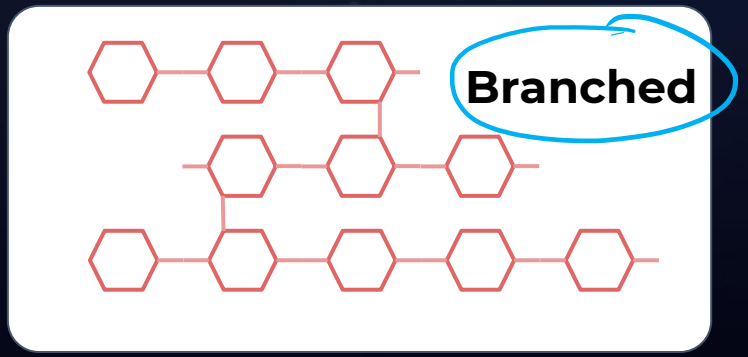
Polysaccharides

Polysaccharide

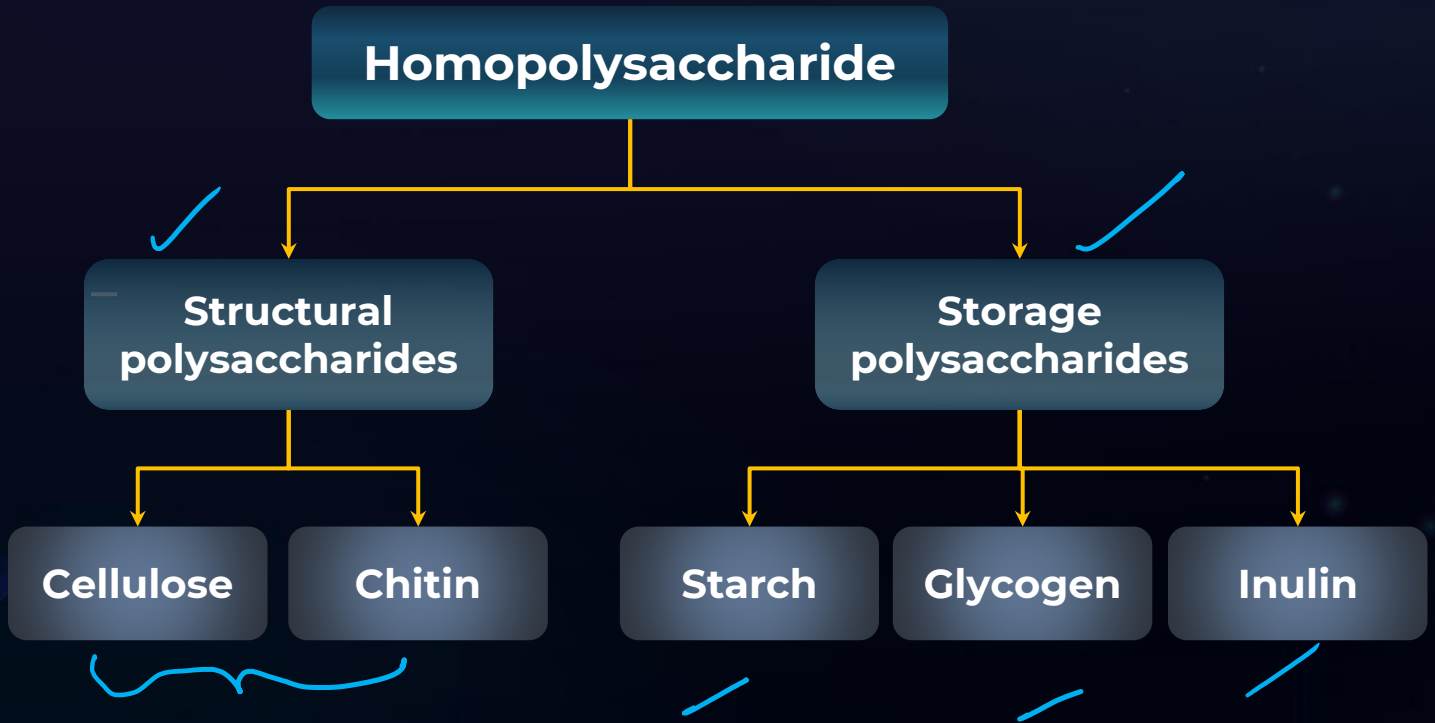
- Homopolysaccharide
- Heteropolysaccharide

Homopolysaccharide

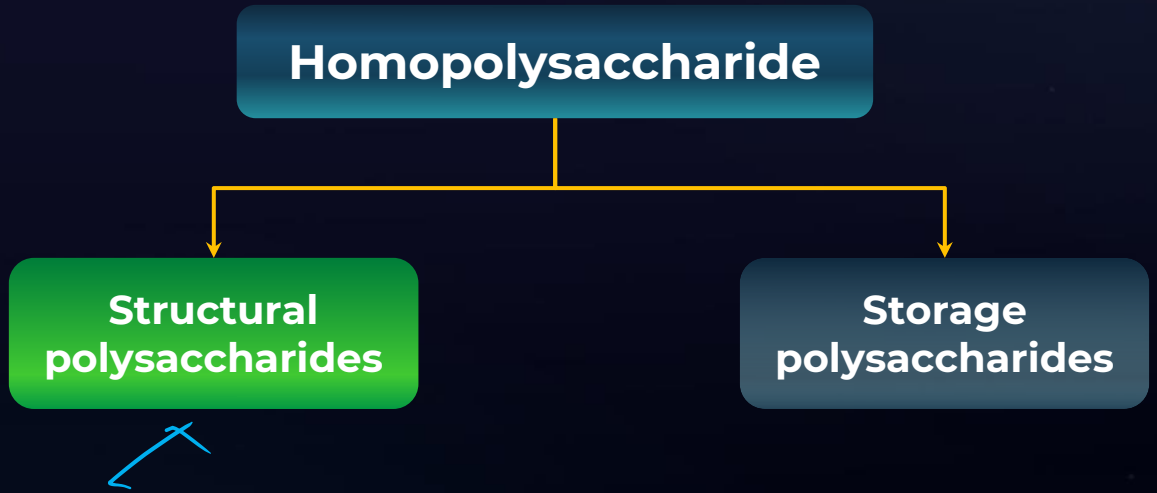




Homopolysaccharide



Homopolysaccharide



Structural polysaccharides - Cellulose

Cellulose in plants

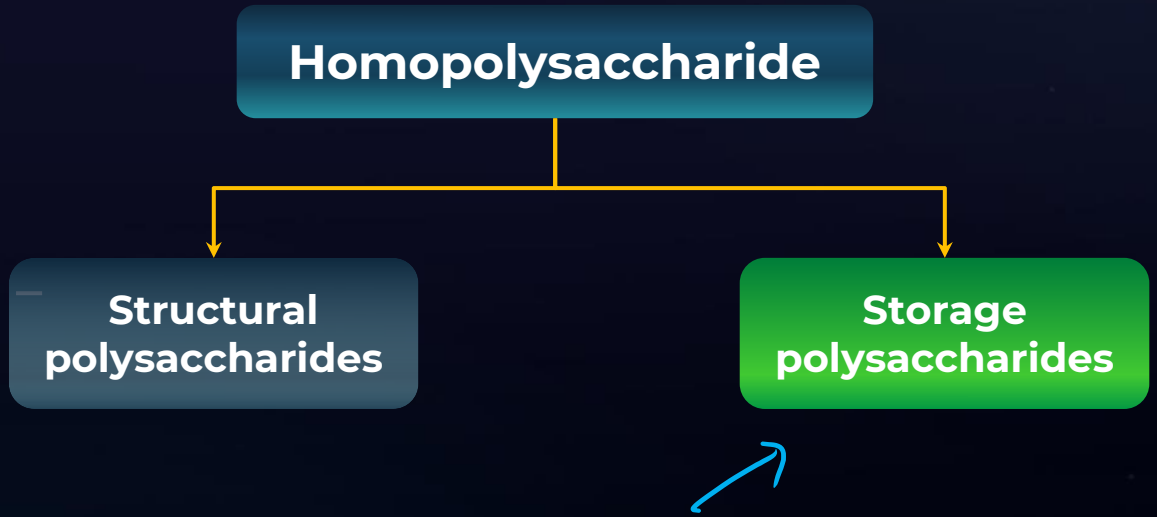
- Most **abundant biomolecule** on the earth
- Forms the **structural part** of the living organisms
- Polymer of **glucose units**
- Straight chain, Unbranched

Structural polysaccharides - Chitin

Chitin in exoskeleton of insects

- **Second most** abundant organic substance
- Polymer of **N-acetyl glucosamine**

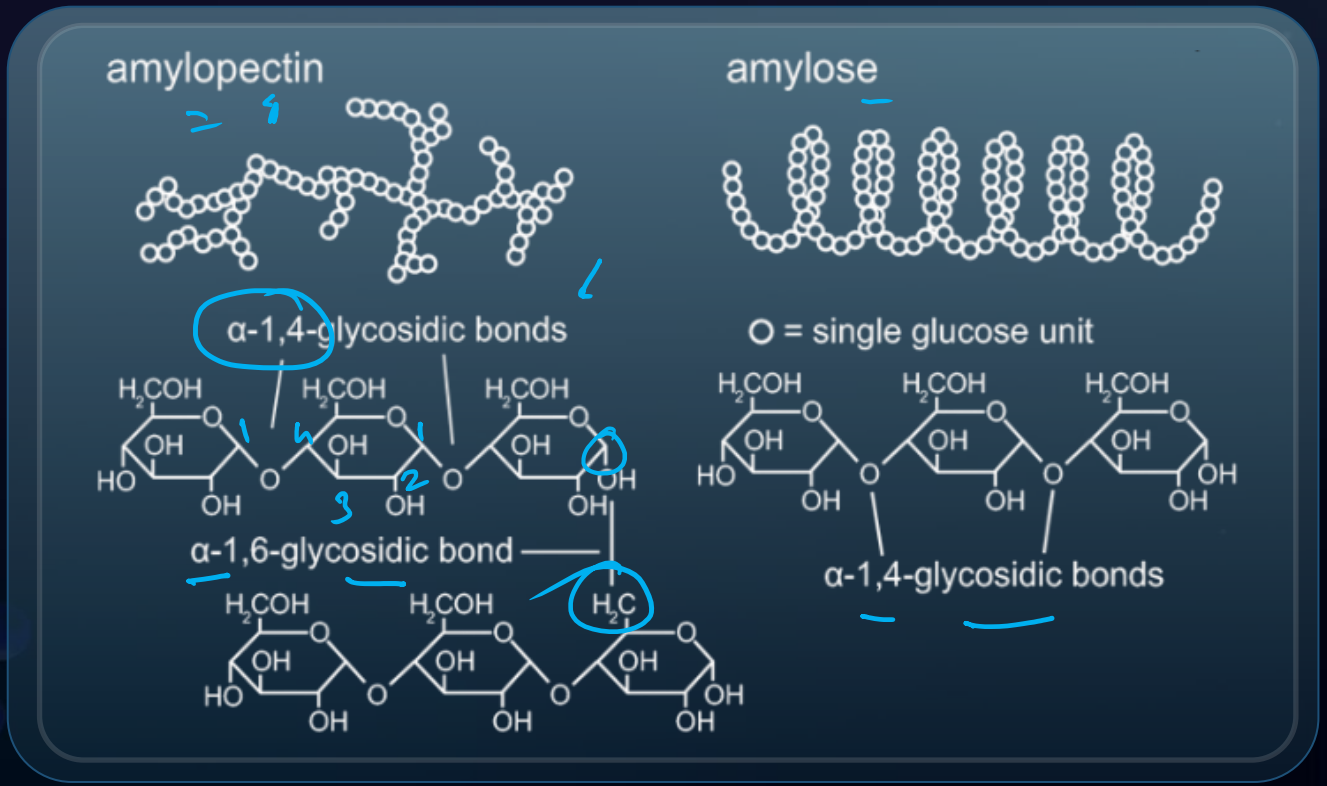
Homopolysaccharide



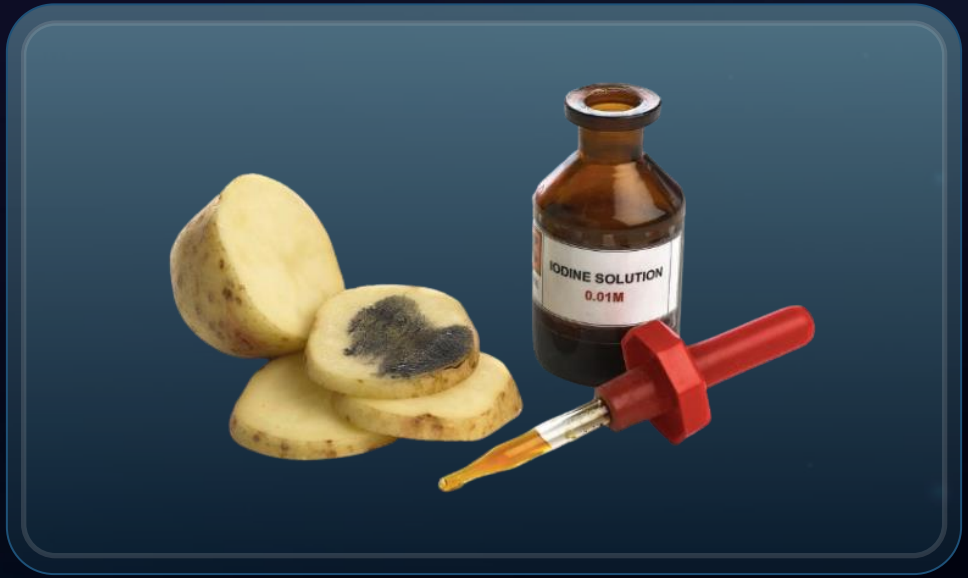
Storage Polysaccharide: Starch

- **Polymer of glucose**
- Food reserve in plants
- Consists of:
  - **Amylose - 20% - 30%**
  - **Amylopectin- 70% - 80%**

Storage Polysaccharide: Starch

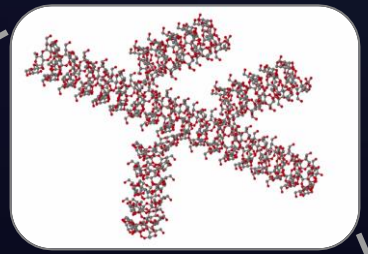


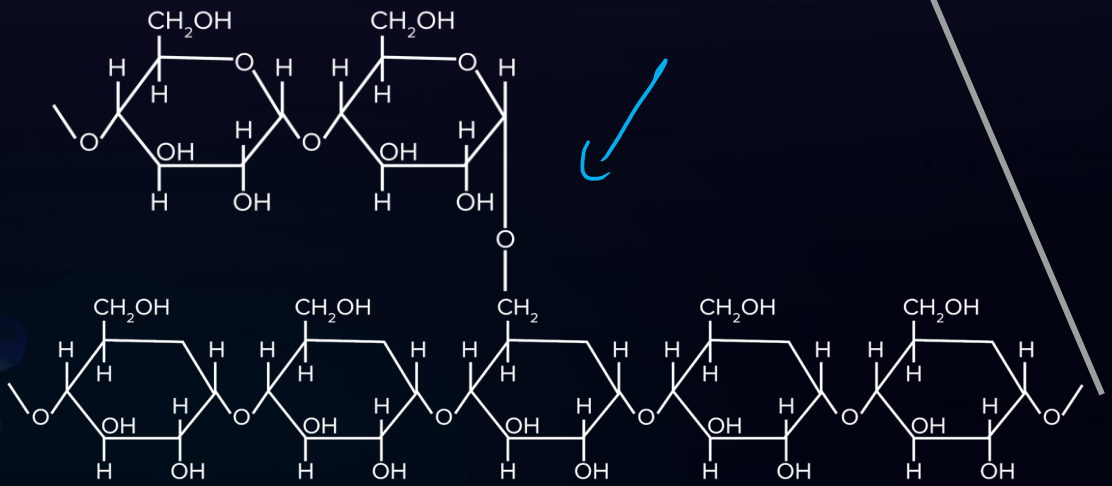
Did you know?



The starch helices in potato can hold Iodine and it turns blue-black.

Storage Polysaccharide: Glycogen





- Polymer of **glucose**
- Food reserve in animals
- Stored in **liver and muscles**
- **Highly branched**

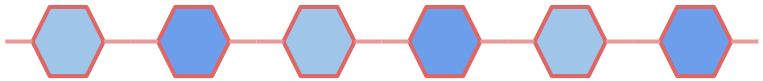
Storage Polysaccharide: Inulin

- Polymer of **fructose**
- Stored in roots of *Dahlia*, Dandelion and Artichoke
- **Not metabolised** in human body

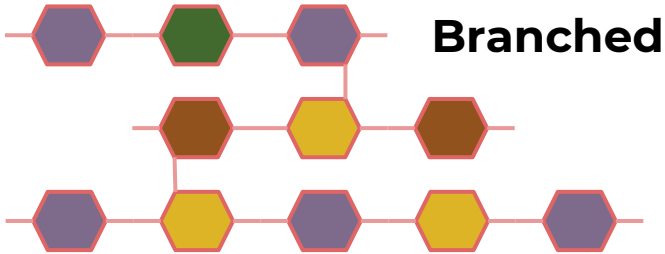
What if a polysaccharide has different repeating units?

Heteropolysaccharide

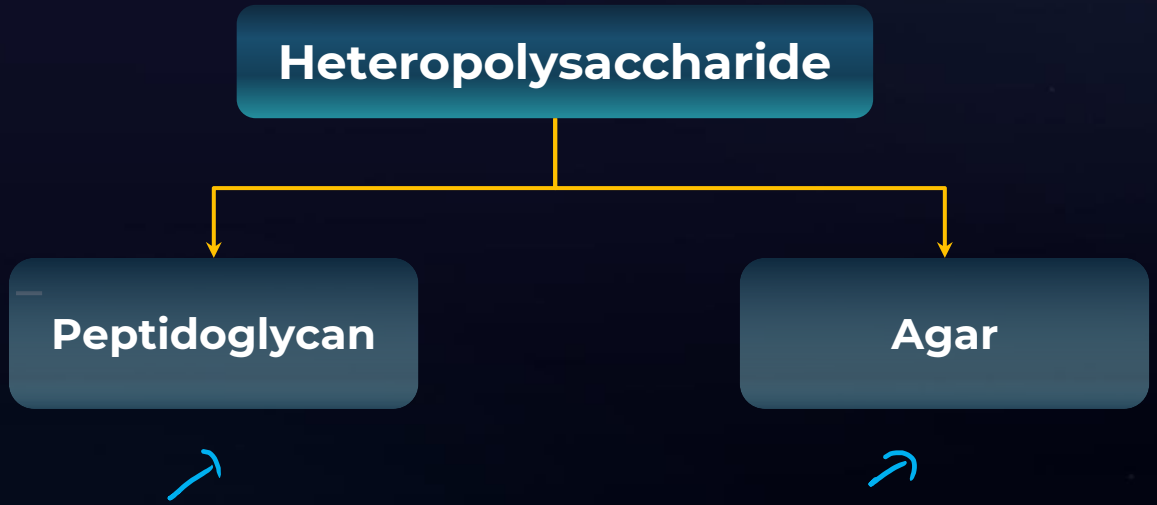
Heteropolysaccharide



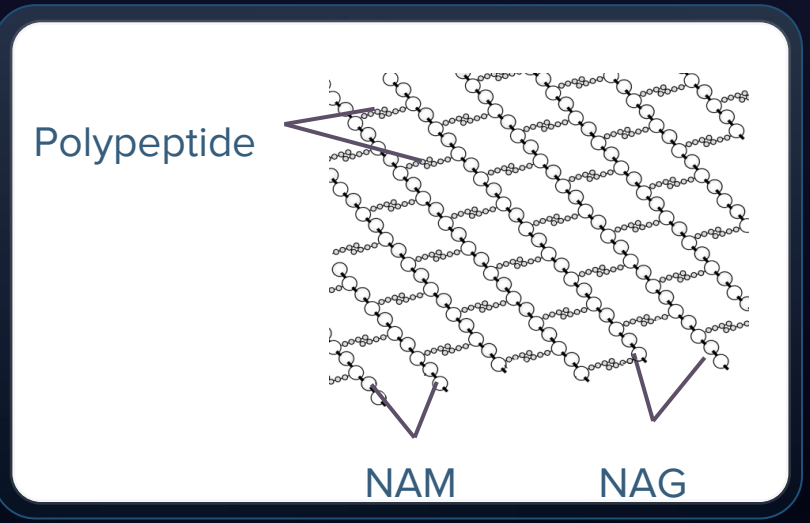
Unbranched



Heteropolysaccharide



Heteropolysaccharide: Peptidoglycan



- Component of bacterial cell wall
- Made of two different kind of repeating units
  - **N- Acetyl glucosamine (NAG)**
  - **N-Acetyl muramic acid (NAM)**

Heteropolysaccharide: Agar

- Obtained from the red algae: ***Gelidium*** **and** ***Gracilaria***
- Made of two different units:
  - **Galactose**
  - **3,6-anhydro-L-galactopyranose**

Past Year Questions

Which among the following is not a reducing sugar?(NEET-2014)

A Maltose

B Lactose

C Ribose

D Sucrose

Which among the following is not a reducing sugar?(AIPMT-2014)

A Maltose

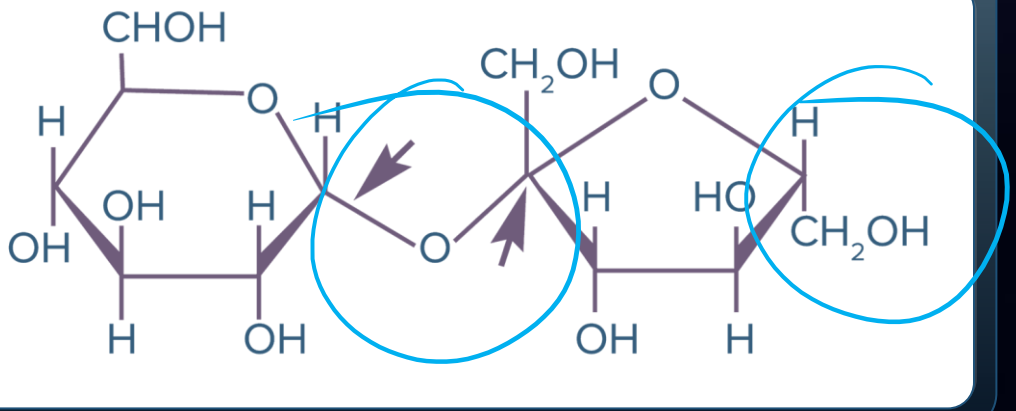
B Lactose

C Ribose

D **Sucrose**

Discussion

- Glucose + Fructose = Sucrose
- Non-Reducing sugar as there is **no free aldehyde or ketone group**



Macromolecule in chitin is (NEET-2013)

A. nitrogen containing polysaccharide

B. phosphorus containing polysaccharide

C. Sulphur containing polysaccharide

D. Simple polysaccharide

Macromolecule in chitin is (NEET-2013)

A. nitrogen containing polysaccharide

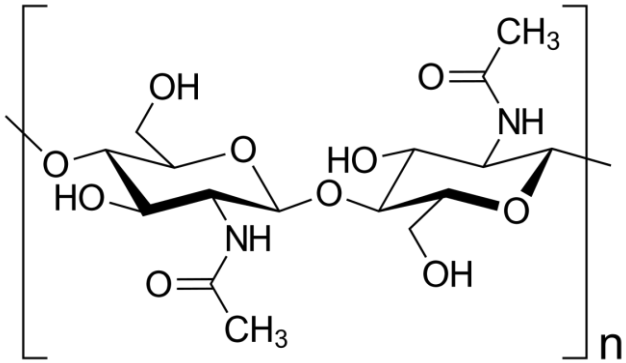
B. phosphorus containing polysaccharide

C. Sulphur containing polysaccharide

D. Simple polysaccharide

Discussion

Chitin



- Long-chain polymer of a **N-acetylglucosamine**
- **Nitrogen containing polysaccharide** and a derivative of glucose

Summary

What we have learnt so far

1. Monosaccharides
2. Disaccharides
3. Oligosaccharides
4. Polysaccharides


Keep
Learning!