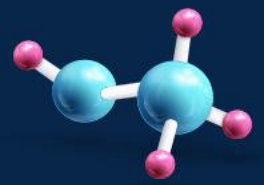
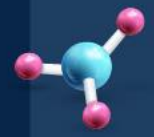
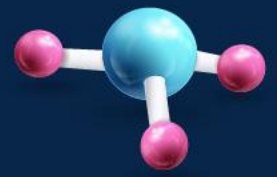
BIOMOLECULE - L1







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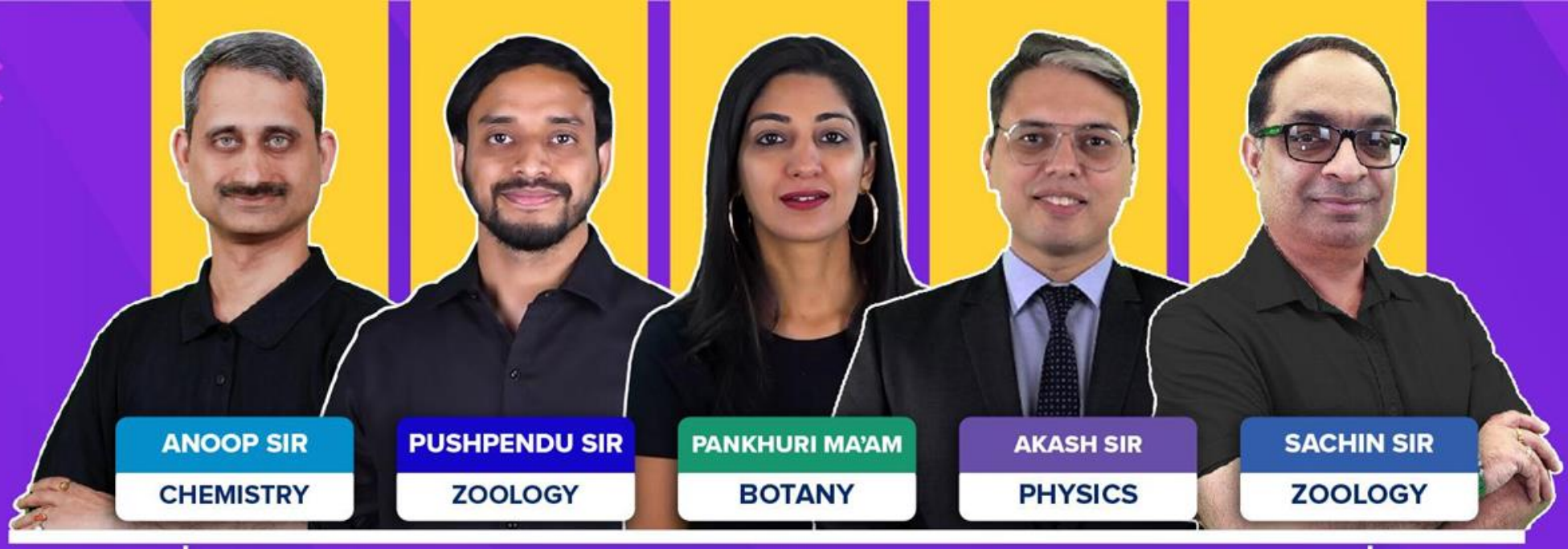


MISSION MBBS

MON - SAT
4PM - 8PM

DROPPERS BATCH

MON - FRI
2PM - 4PM

Aakash BYJU'S

NEET

STUDENTS' SURVEY

LINK IN DESCRIPTION

https://t.me/neetaakashdigital

Biochemistry

Living systems are made up of various **complex biomolecules** like carbohydrates, proteins, nucleic acids, lipids, etc.

These biomolecules **interact** with each other and constitute the **molecular logic** of life processes.

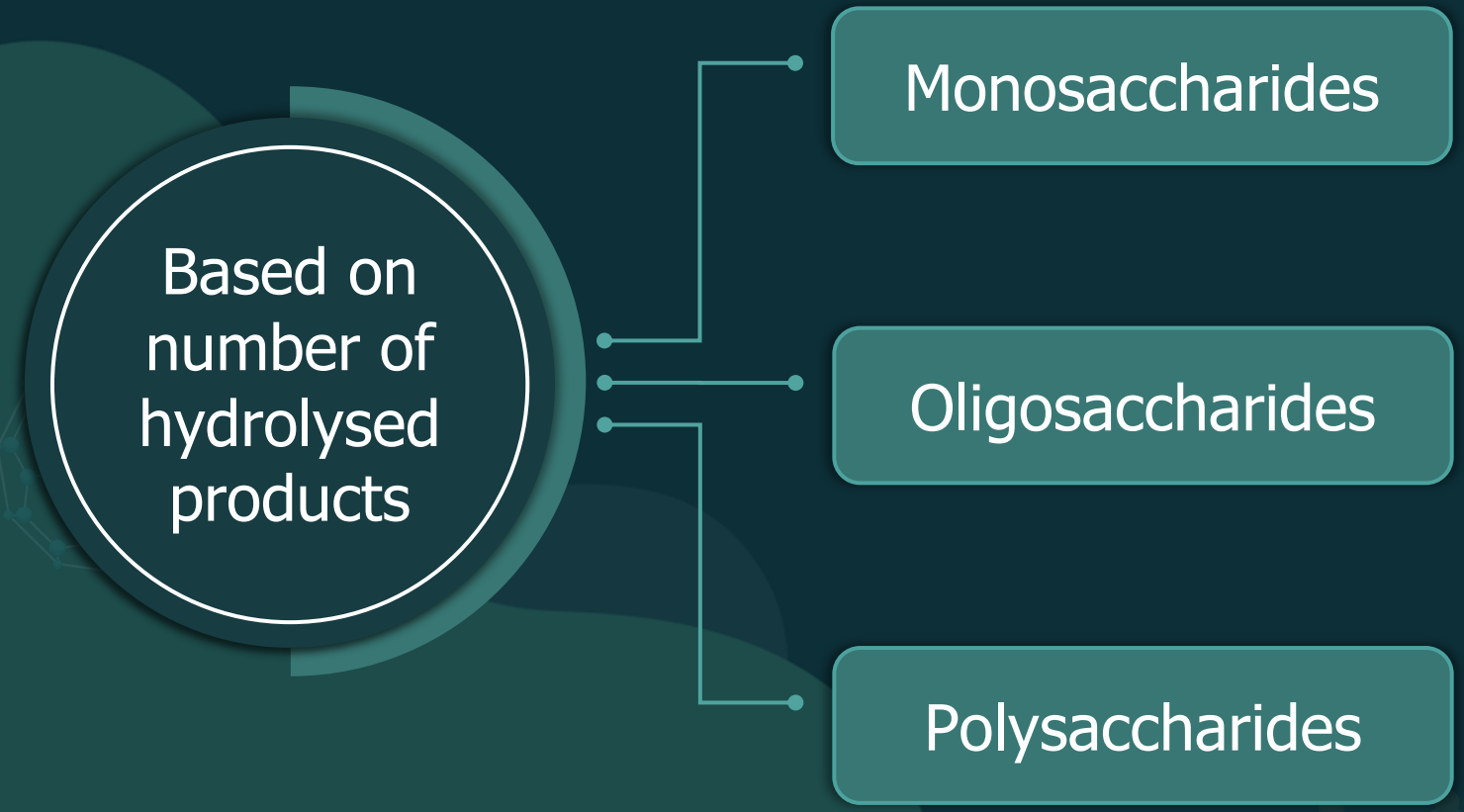

Carbohydrates

Carbohydrates

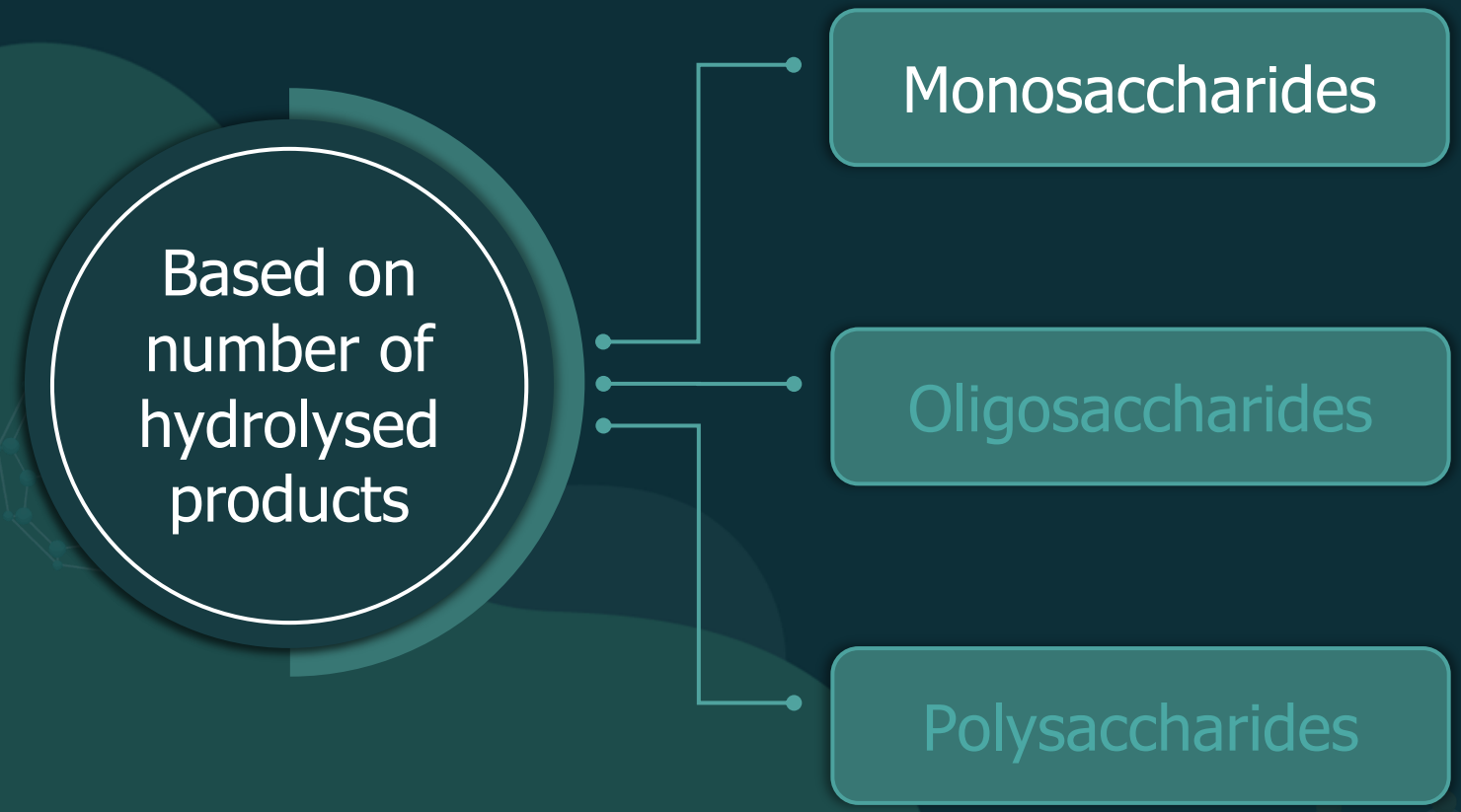
Carbohydrates are usually defined as **polyhydroxy aldehydes** and **ketones** or substances that **hydrolyse** to yield polyhydroxy aldehydes and ketones.

Almost all carbohydrates are **chiral** and **optically active**. An **exception** of this is **1,3-dihydroxypropanone**.

Classification of Carbohydrates



Classification of Carbohydrates



Monosaccharides

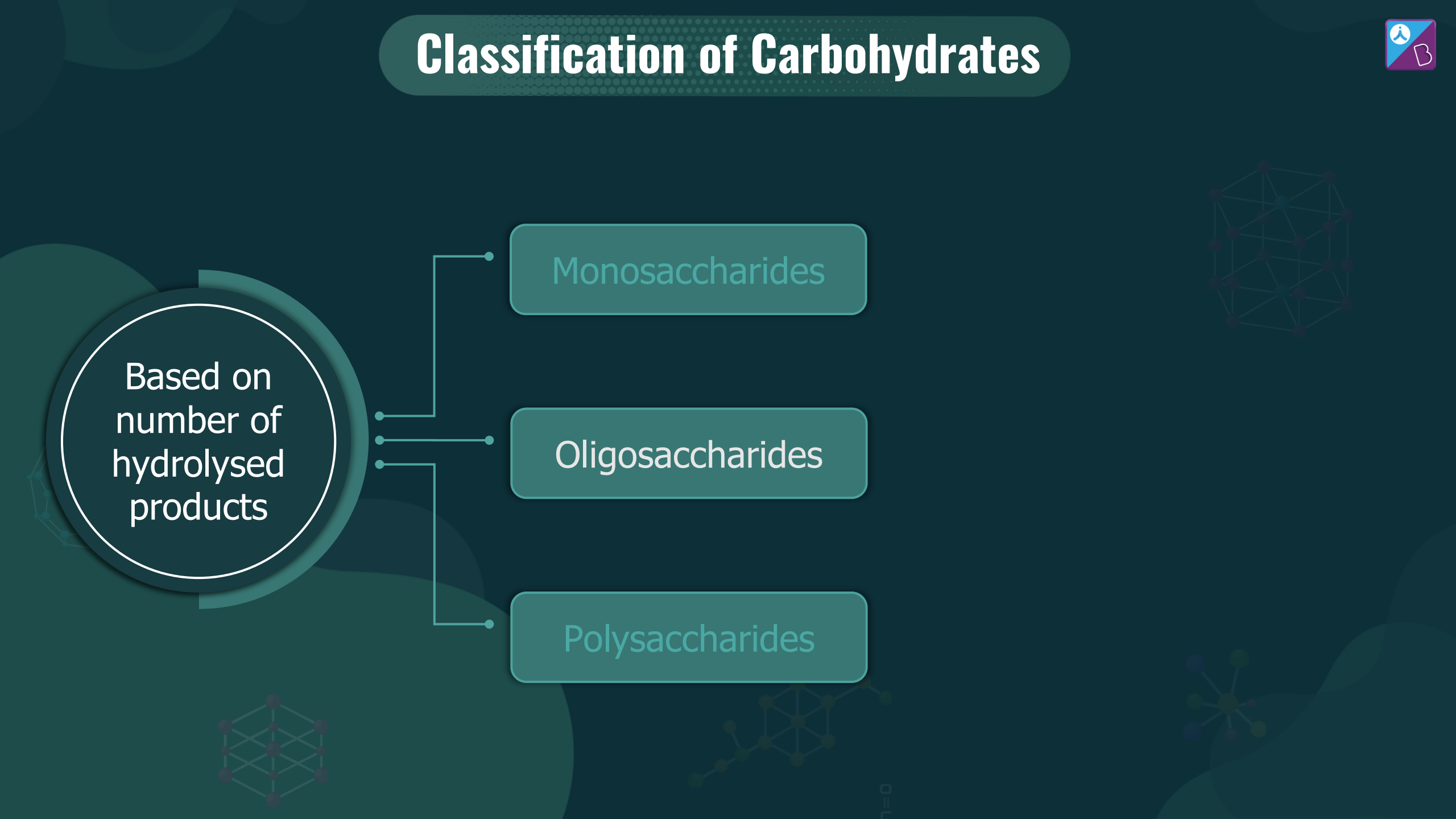
The simplest carbohydrates, that **cannot be hydrolysed** into simpler carbohydrates.

Monosaccharides

Examples

1. Glucose
2. Fructose
3. Ribose

Classification of Carbohydrates



Oligosaccharides

Carbohydrates that hydrolyse to produce **2–10 molecules** of monosaccharide

Oligosaccharides

Disaccharides

Carbohydrates that undergo hydrolysis to produce only **2 molecules** of monosaccharide

Trisaccharides

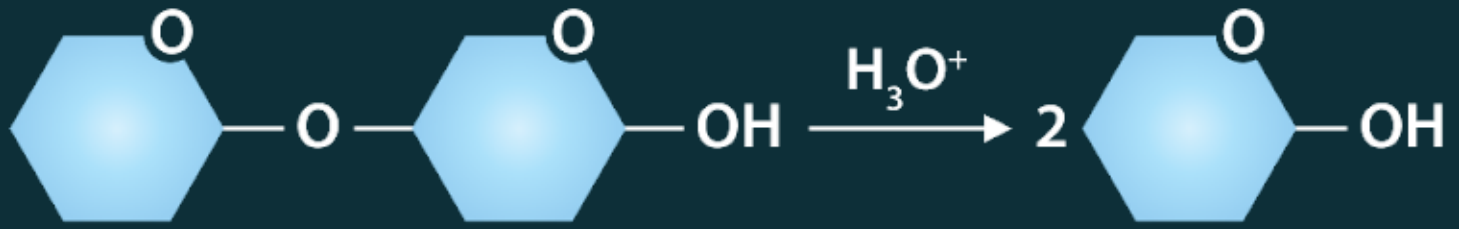
Carbohydrates that undergo hydrolysis to produce only **3 molecules** of monosaccharide.

Oligosaccharides

Examples

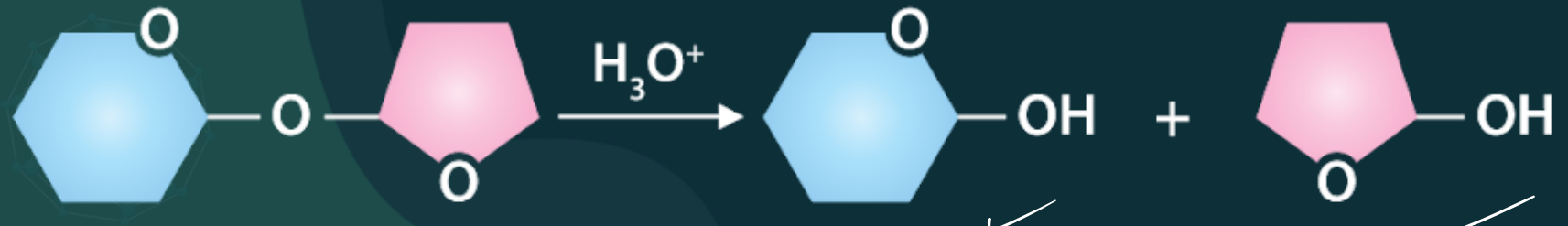
One molecule of **sucrose** on hydrolysis gives one molecule of **glucose** and one molecule of **fructose.**

Maltose on hydrolysis gives two molecules of only **glucose**.



1 mol of **maltose (Disaccharide)**

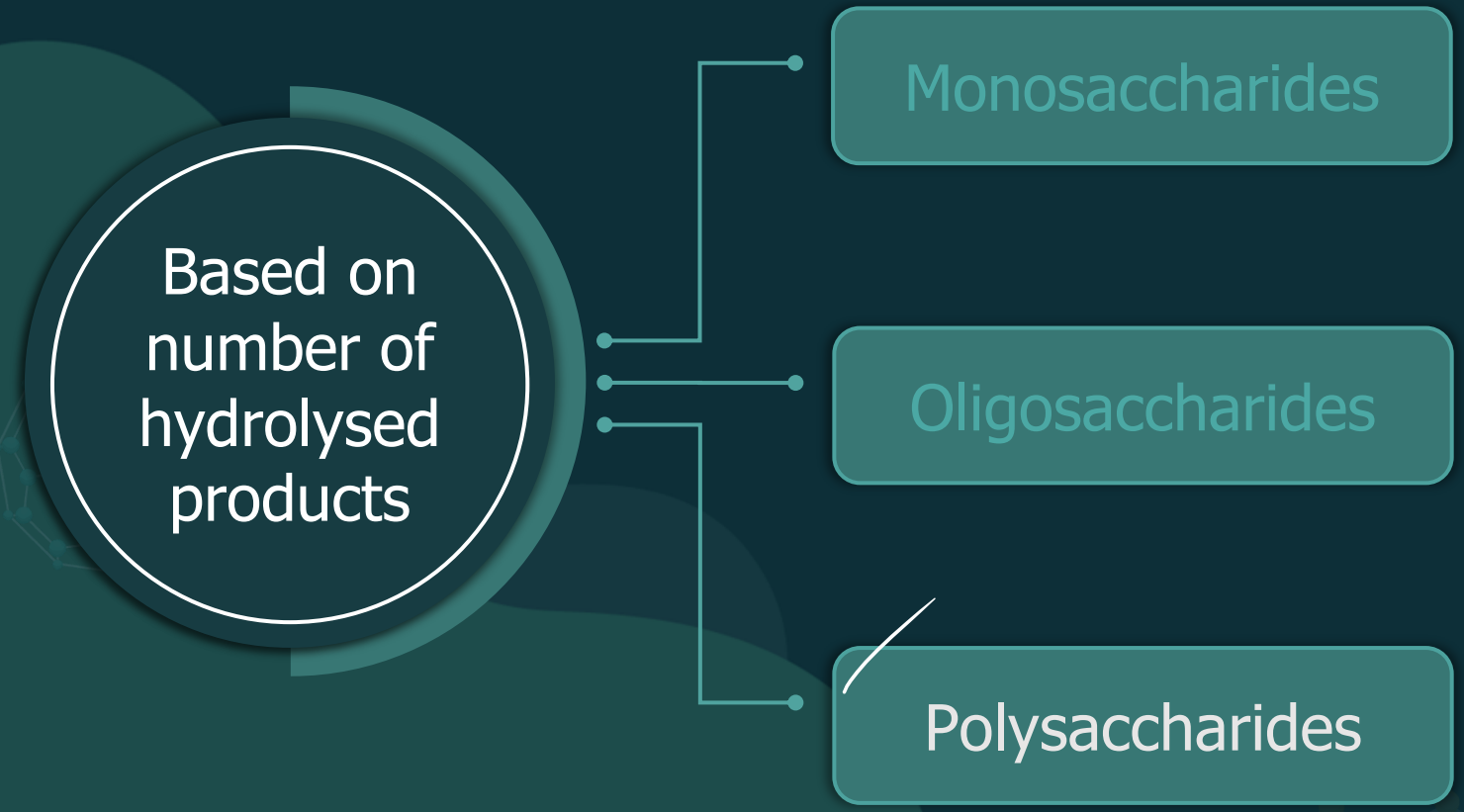
2 mol of **glucose (Monosaccharide)**



1 mol of **sucrose (Disaccharide)**

1 mol of **glucose** 1 mol of **fructose (Monosaccharides)**

Classification of Carbohydrates



Polysaccharides

Carbohydrates that produce a large number of molecules of monosaccharides (> 10) on hydrolysis

Polysaccharides

Examples

1. Starch
2. Cellulose
3. Glycogen

The two monosaccharide units obtained on hydrolysis of disaccharide may be:

a) Same

b) Different

c) Both a) and b)

d) None of these

Monosaccharides

— ose

Classification of monosaccharides according to:

Number of carbon atoms present in the molecule

Functional group present in the molecule

These two classifications are frequently **combined.**

Monosaccharides

No. of 'C' atoms	General term	Aldehyde	Ketone
3	Triose	Aldotriose	Ketotriose
4	Tetrose	Aldotetrose	Ketotetrose
5	Pentose	Aldopentose	Ketopentose
6	Hexose	Aldohexose	Ketohexose
7	Heptose	Aldoheptose	Ketoheptose

Monosaccharides

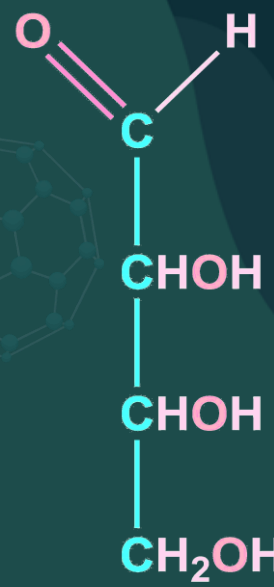
Monosaccharide containing

1. Aldehyde group → **Aldose**
2. Keto group → **Ketose**

Monosaccharides

Example

4 C aldose is called an **aldotetrose**, **5 C** ketose is called a **ketopentose**.



An aldotetrose

A ketopentose

Classification of Carbohydrates

alkaline.

Based on the ability to reduce **Tollens' & Fehling's** reagent, Benedict's, Baeyer's

- Reducing sugar
- Non-reducing sugar

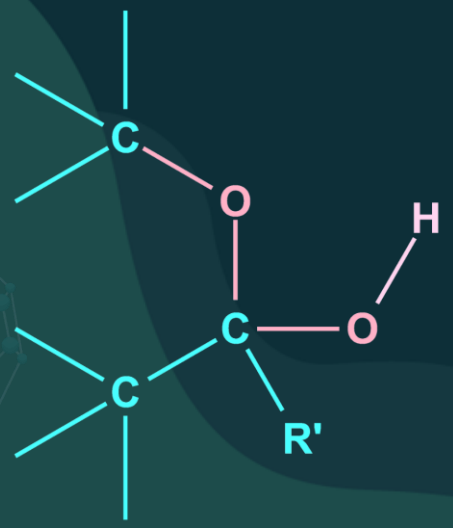
Reducing & Non-reducing Sugars

Reducing sugar	Non-reducing sugar
Reduces Tollens' & Fehling's reagent	Don't reduce Tollens' & Fehling's reagent.
Should have at least one **hemiacetal or hemiketal** functional group.	Should have acetal linkage.
Example: All monosaccharides and oligosaccharides except sucrose	Example: All polysaccharides and sucrose

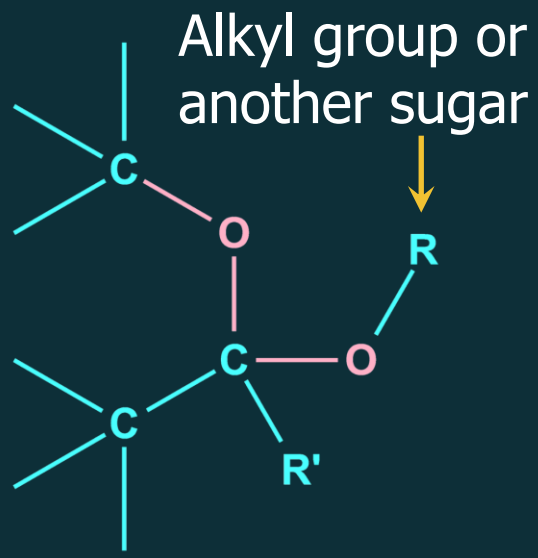
Reducing & Non-reducing Sugars

Reducing sugar

Non-reducing sugar



Hemiacetal
(R′ = H or CH_2OH)



Acetal
(R′ = H or CH_2OH)

Which of the following pairs give positive Tollen's Test?

a) Glucose, sucrose

b) Glucose, fructose

c) Hexanol, acetophenone

d) Fructose, sucrose

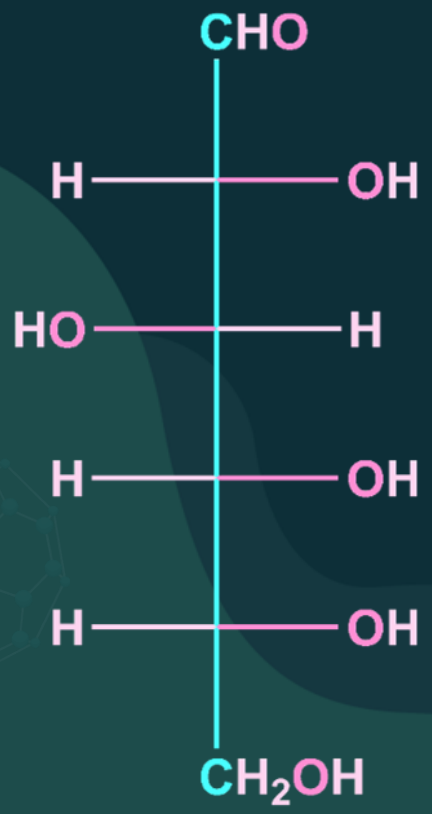
Glucose

Preparation of Glucose

Starch (Polysaccharides) $(C_6H_{10}O_5)_n$ —Diastase→ Maltose (Disaccharides) $(C_{12}H_{22}O_{11})$ —Maltase→ Glucose (Monosaccharides) $(C_6H_{12}O_6)$

$C_{12}H_{22}O_{11}$ (Sucrose) $\xrightarrow{H_2O/H^+}$ $C_6H_{12}O_6$ (Glucose) + $C_6H_{12}O_6$ (Fructose)

Structure of Glucose



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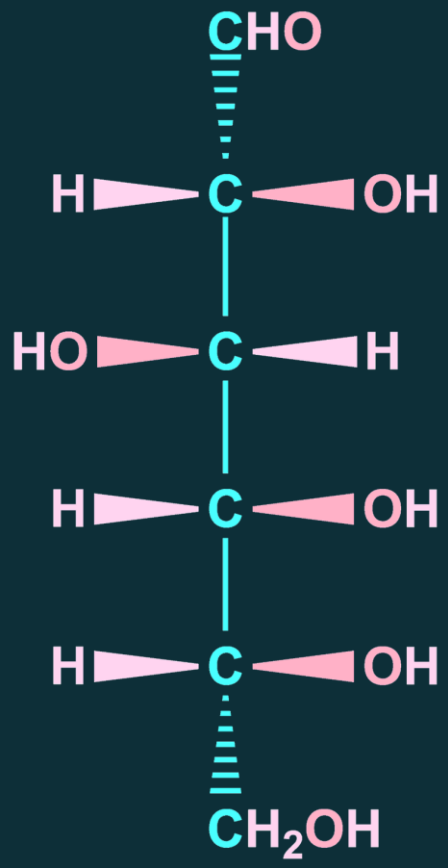
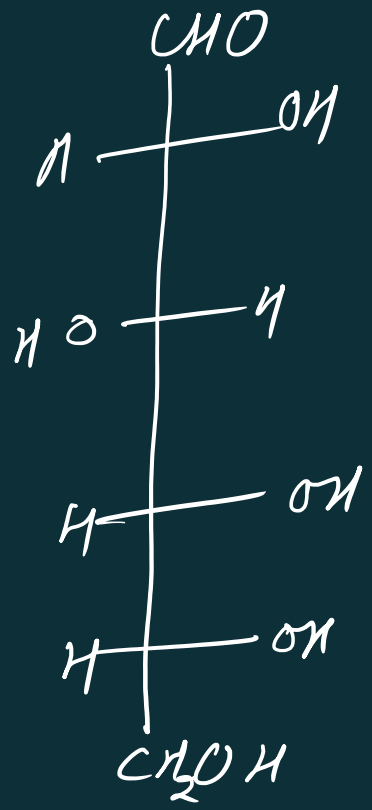
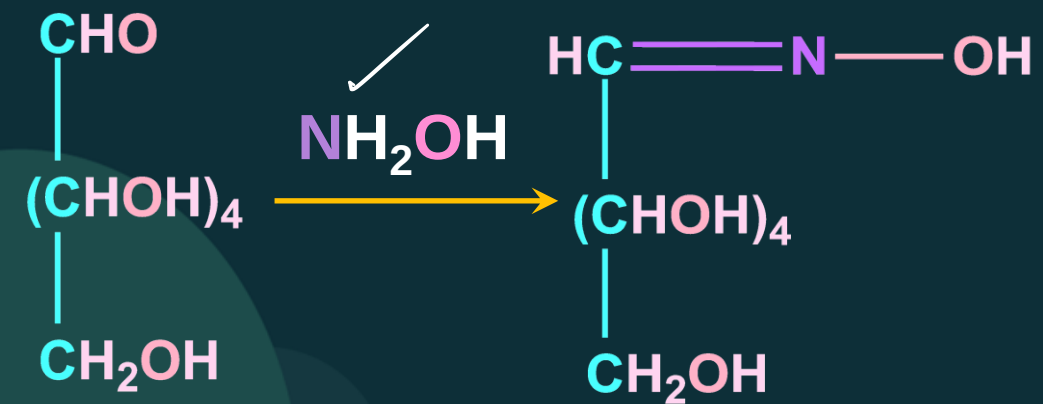




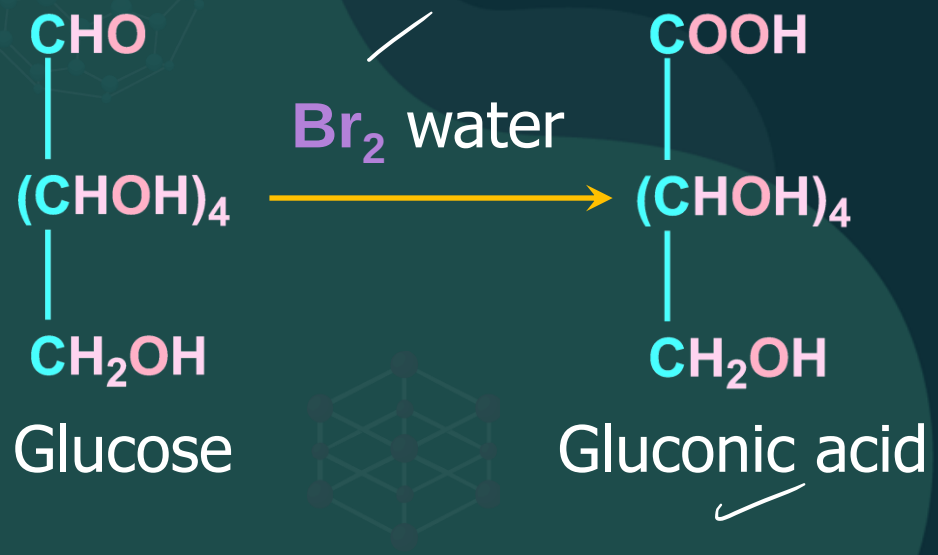
Fischer projection formula

Wedge-dash formula

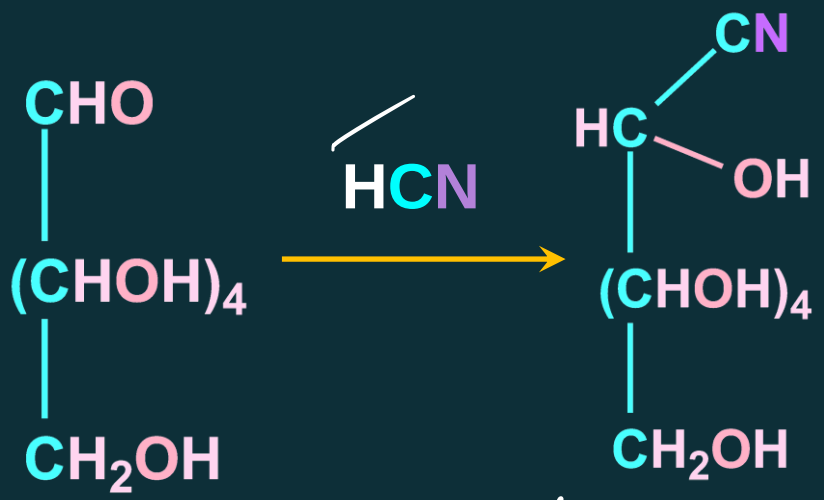
Structure of Glucose



Glucose → Gluco oxime

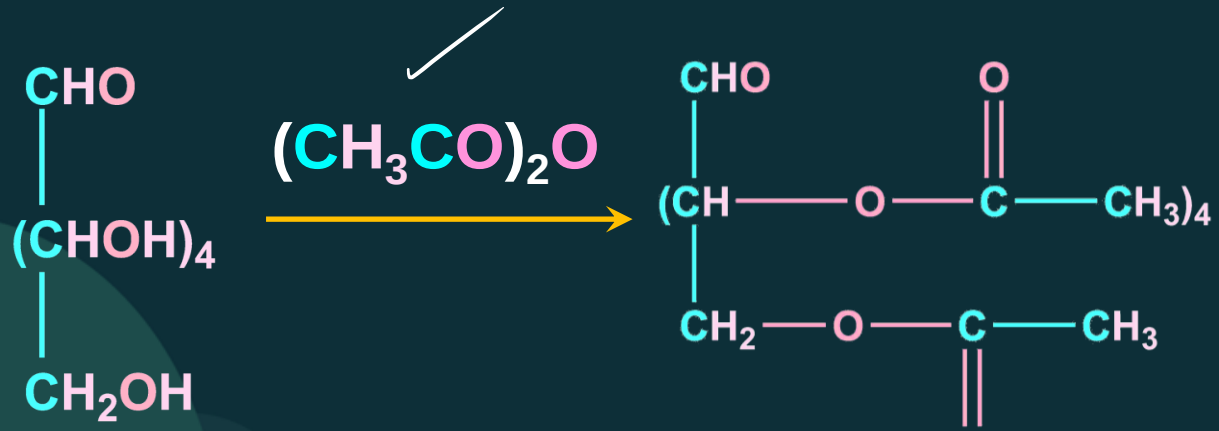


Glucose → Gluconic acid



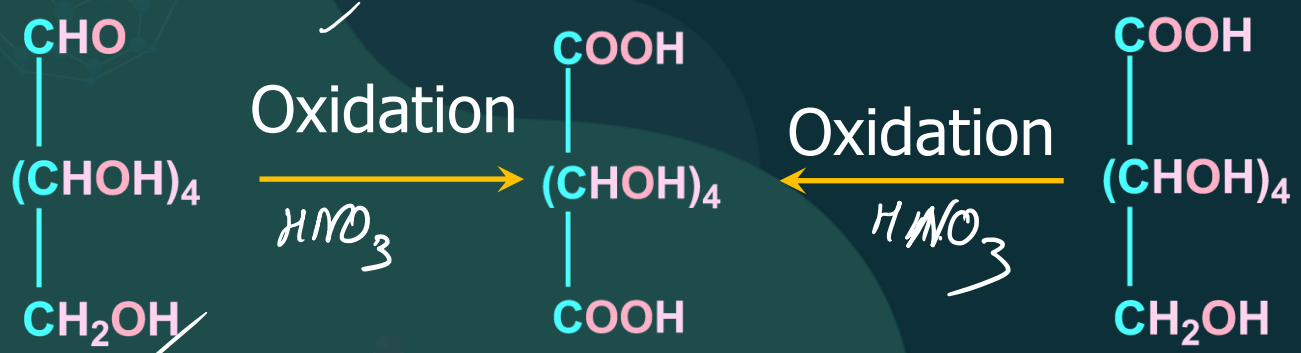
To increase carbon chain length of monosaccharide

Structure of Glucose



Glucose

Glucose Pentaacetate

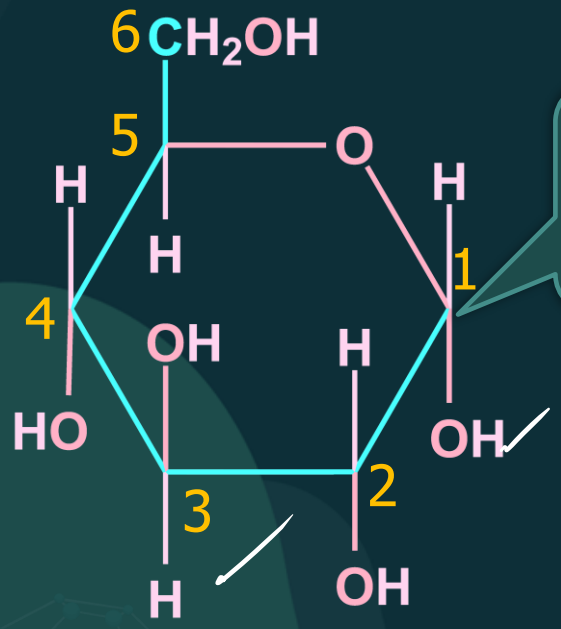


Glucose

Saccharic acid

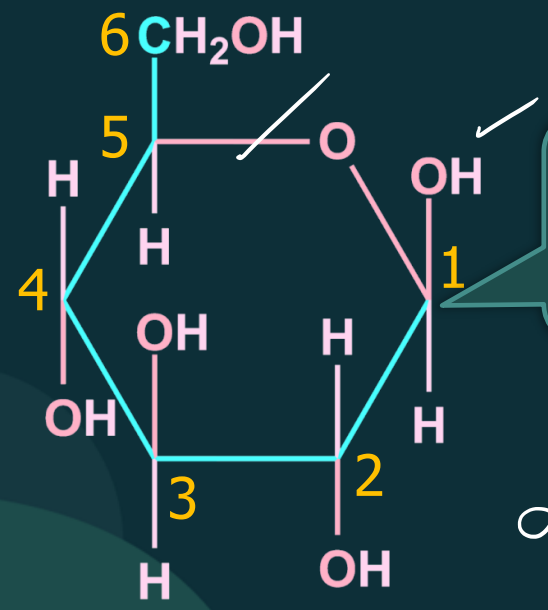
Gluconic acid

Cyclic Structure of Glucose



Anomeric carbon

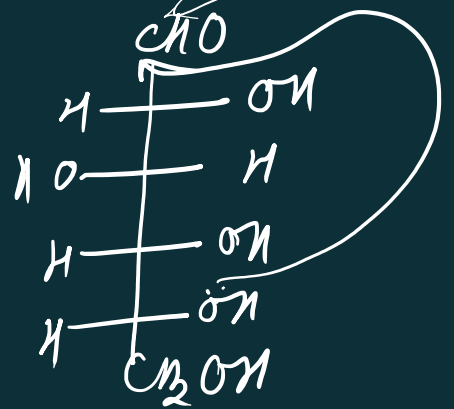
α-D-Glucose
α-D-glucopyranose



Anomeric carbon

β-D-Glucose
β-D-glucopyranose

4 chiral carbon



anomeric carbon

compounds which differ only in config. at anomeric carbon are anomers.

pyran

furan

The α–D-glucose and β–D-glucose differ from each other due to the difference in carbon atoms with respect to its:

a) Number of -OH groups

b) Size of hemiacetal ring

c) Conformation

d) Configuration at anomeric carbon.

Fructose

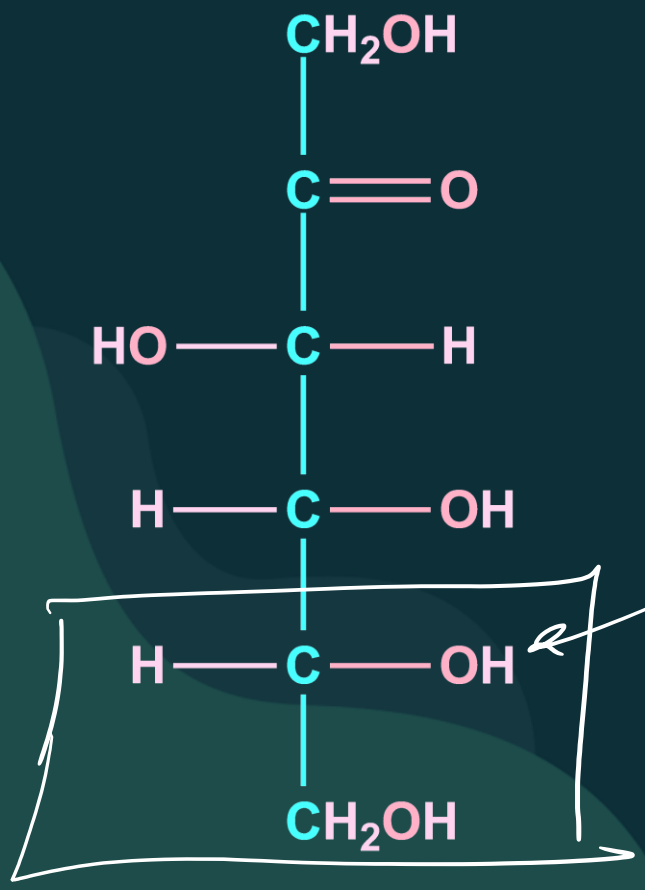
Fructose

Fructose is an **important ketohexose**. It is obtained along with glucose by the **hydrolysis** of disaccharide, **sucrose**.

Molecular formula: $C_6H_{12}O_6$

It is a natural monosaccharide found in **fruits**, **honey,** and **vegetables**. In its pure form, it is used as a **sweetener**.

Structure of Fructose



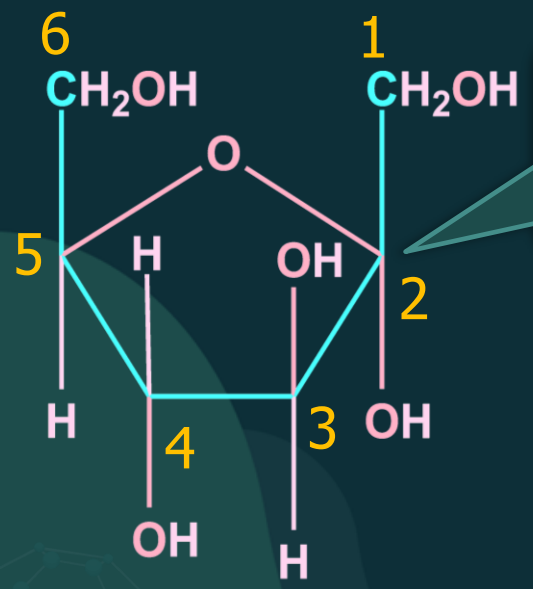
D-(−)-Fructose

It belongs to **D-series** and is a **laevorotatory** compound.

D & L are mirror images of each other

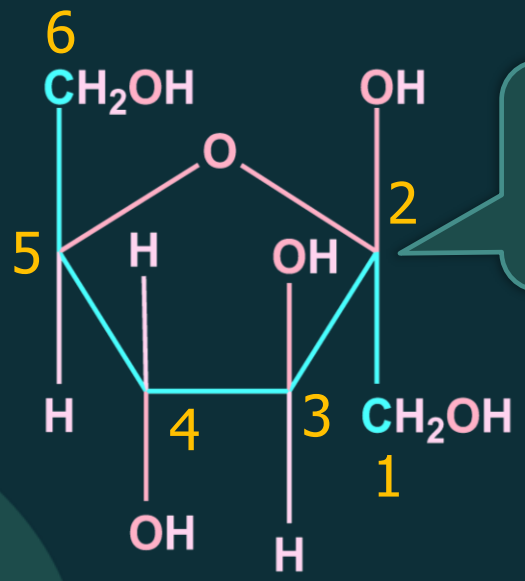
Right

Cyclic Structure of Fructose



Anomeric carbon

α-Fructose
α-Fructofuranose



Anomeric carbon

β-Fructose
β-Fructofuranose

Disaccharides

Disaccharides

Condensation of two molecules of either the **same or different monosaccharides** produce disaccharides.

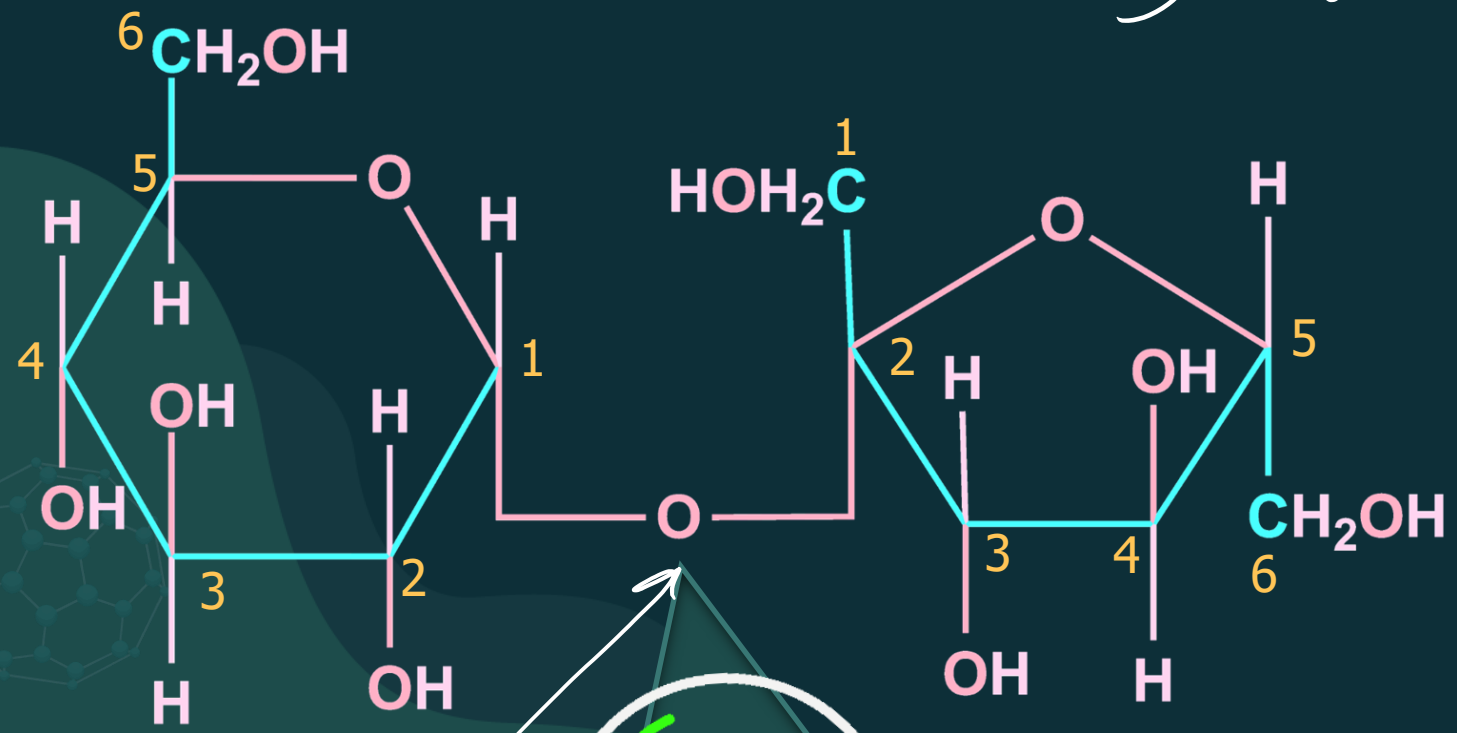
Examples

Sucrose, maltose, lactose, cellobiose

Sucrose

Sucrose

non reducing sugar



ether

Glycosidic linkage

Glycosidic Linkage

In sucrose, condensation reaction takes place between **C-1** of **α-D-glucose** and **C-2** of **β-D-fructose.**

The two monosaccharides are joined together by an **oxide linkage** formed by the loss of water molecule. Such linkage through oxygen atom is called **glycosidic linkage**.

Note

Sucrose is **not** a **reducing sugar** i.e., it will not reduce Fehling's or Tollens' reagent.

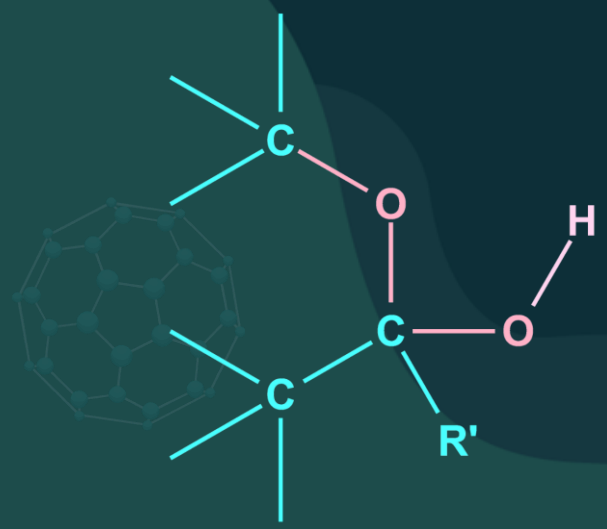
↓

Hemiacetal group is **absent.**

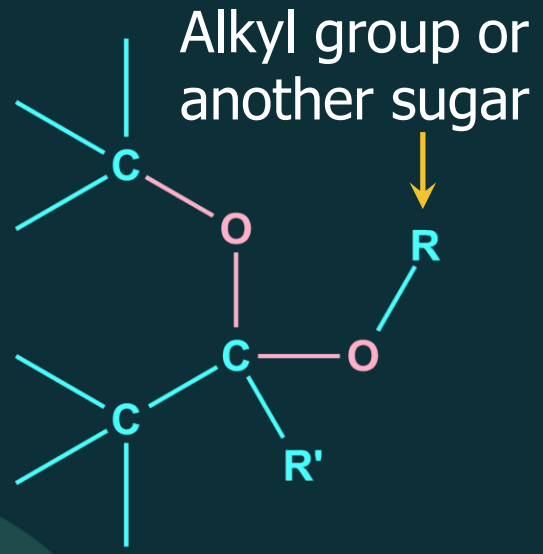
Reducing & Non-reducing Sugars

Reducing sugar

Non-reducing sugar



Hemiacetal
(R′ = H or CH_2OH)

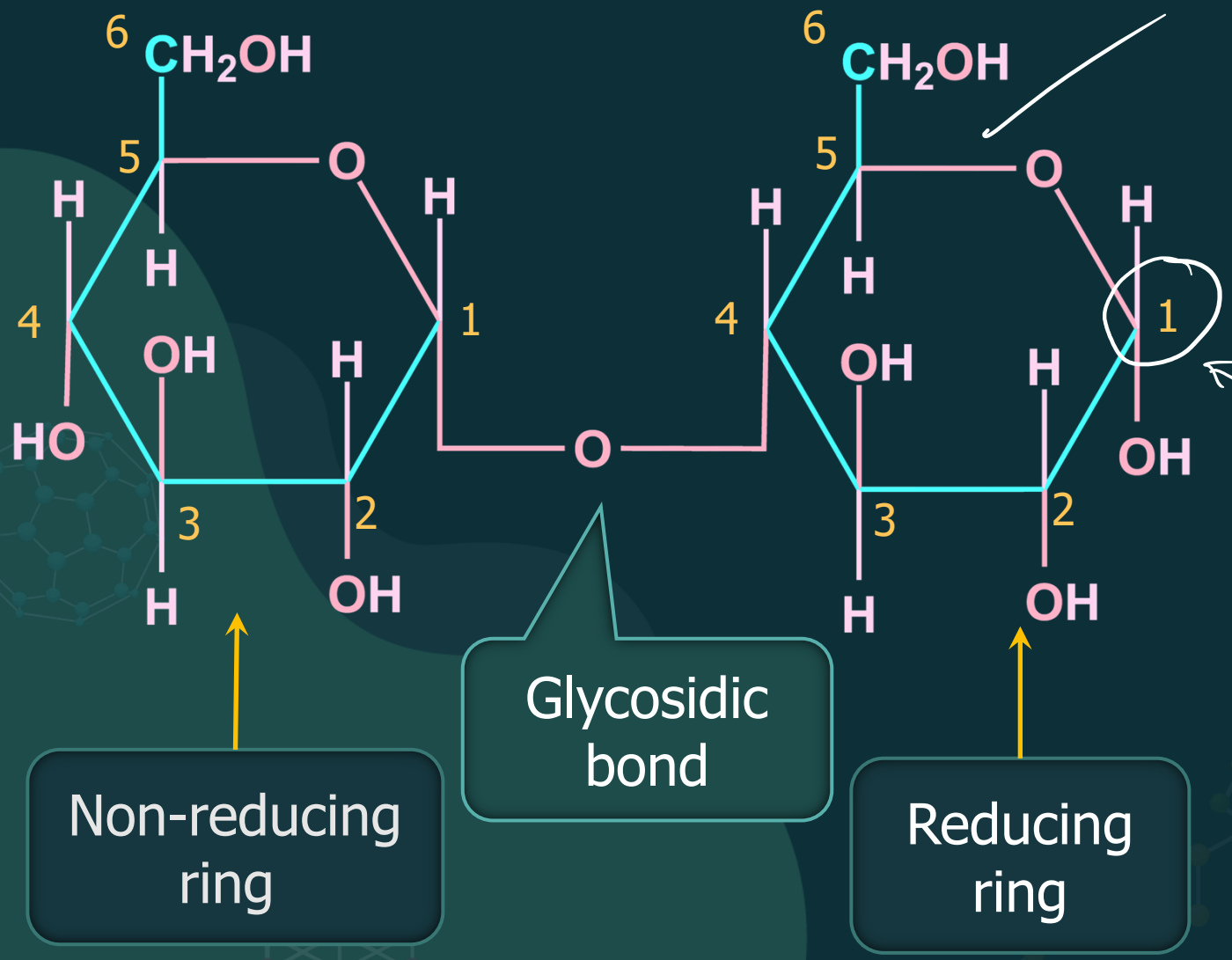


Acetal
(R′ = H or CH_2OH)

Maltose

mutarotation

Maltose: (Malt Sugar)



In maltose, glycosidic linkage is between **C1** of **α-D-glucose** and **C4** of **α-D-glucose.**

hemiacetal

Non-reducing ring

Glycosidic bond

Reducing ring

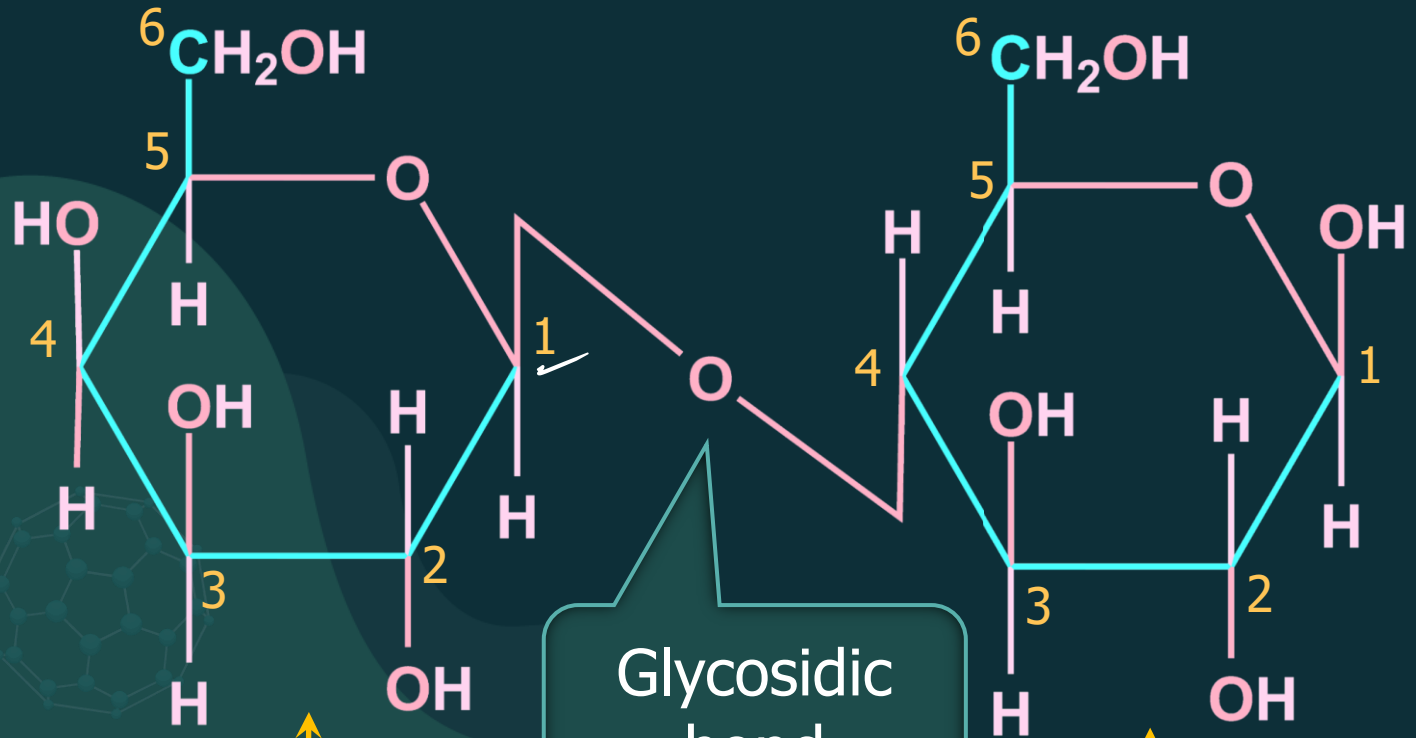
Maltose: (Malt Sugar)

Maltose is a **reducing sugar** i.e., it reduces Fehling's or Tollen's reagent.

At least one **hemiacetal group** (of the two glucose molecules) is present.

Lactose

Lactose (Milk Sugar)



Glycosidic bond

Non reducing ring

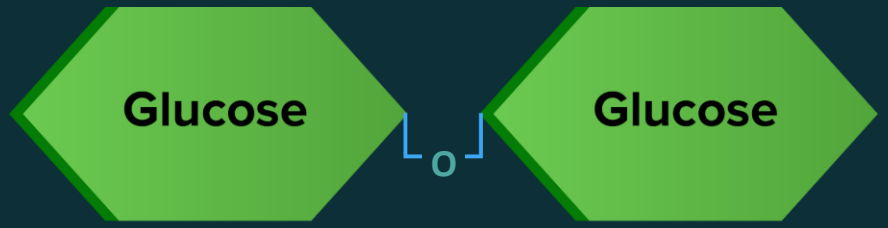
Reducing ring

In lactose, glycosidic linkage is between **C1** of **β-D-galactose** and **C4** of **β-D-glucose.**

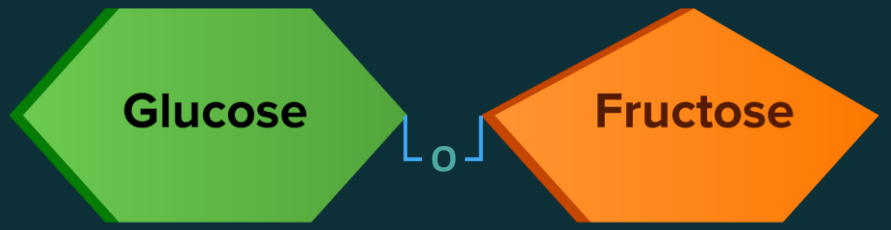
Lactose (Milk Sugar)

Lactose is a **reducing sugar**, i.e., it **reduces Fehling's** or **Tollens' reagent**.

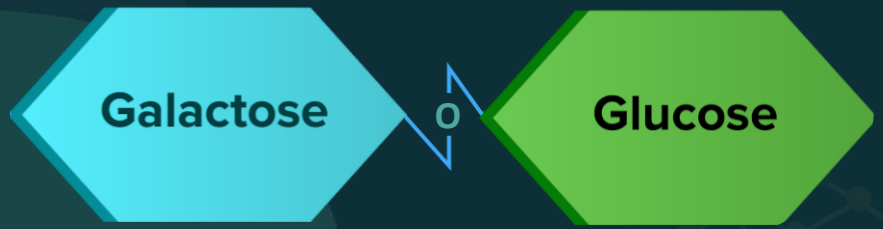
Maltose



Sucrose



Lactose



Polysaccharides

Polysaccharides

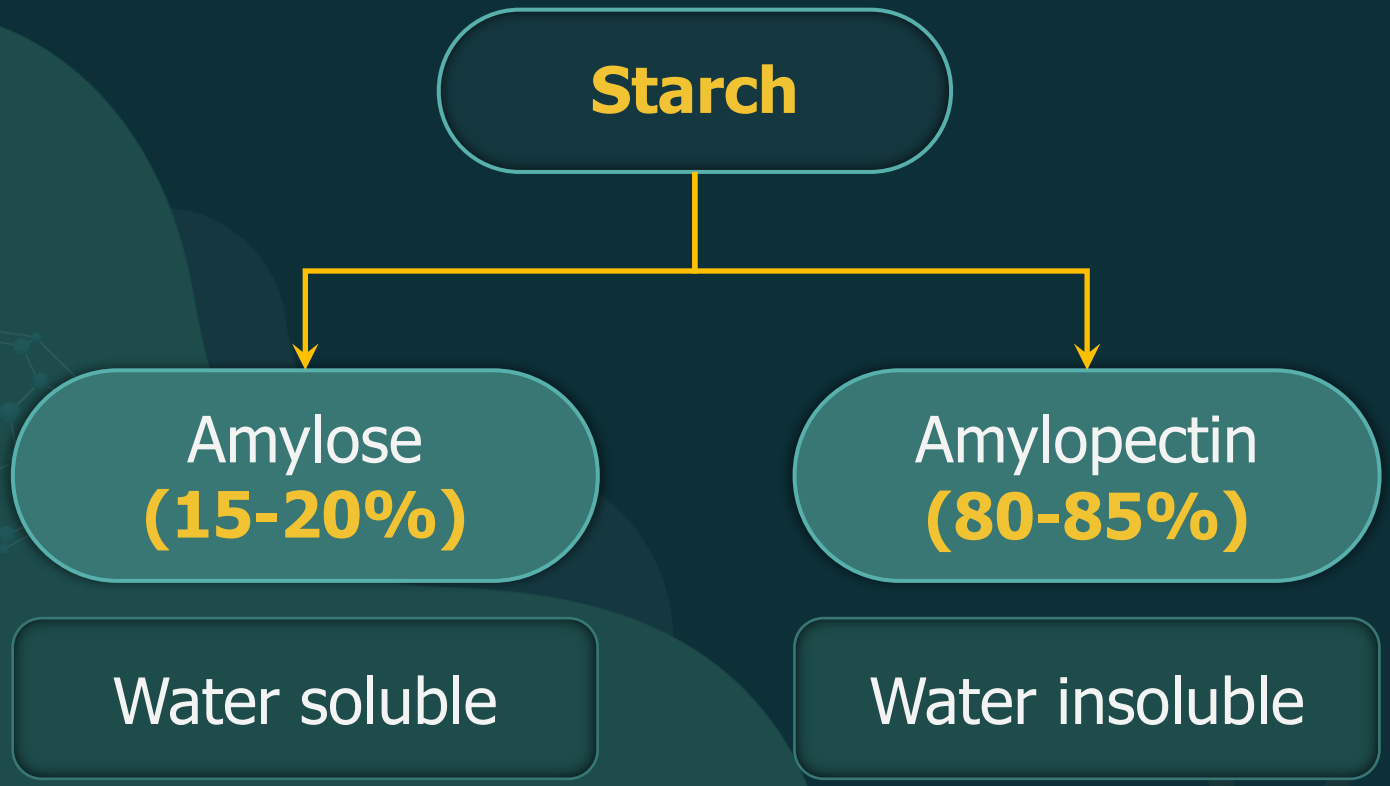
It contains large number of **monosaccharide units** joined together by **glycosidic linkage**. They mainly act as the **food storage** or **structural materials**.

Examples

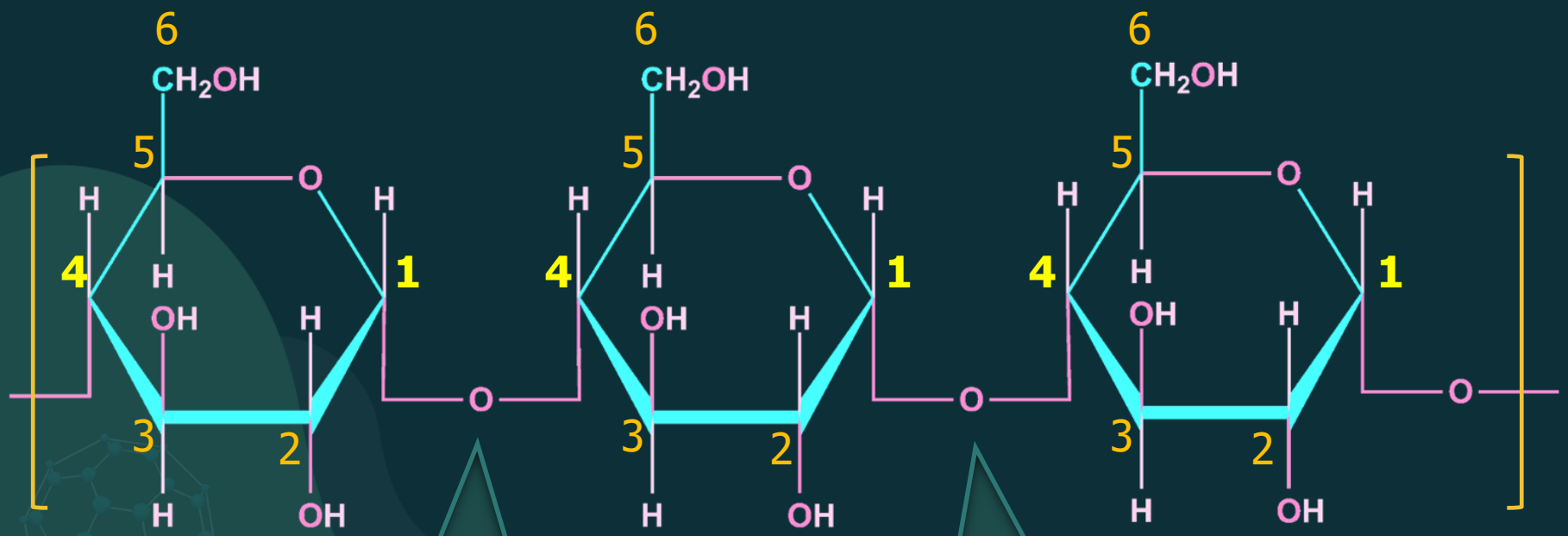
Starch, cellulose, glycogen

Starch

Starch $(C_6H_{10}O_5)_n$ - Composition



Amylose

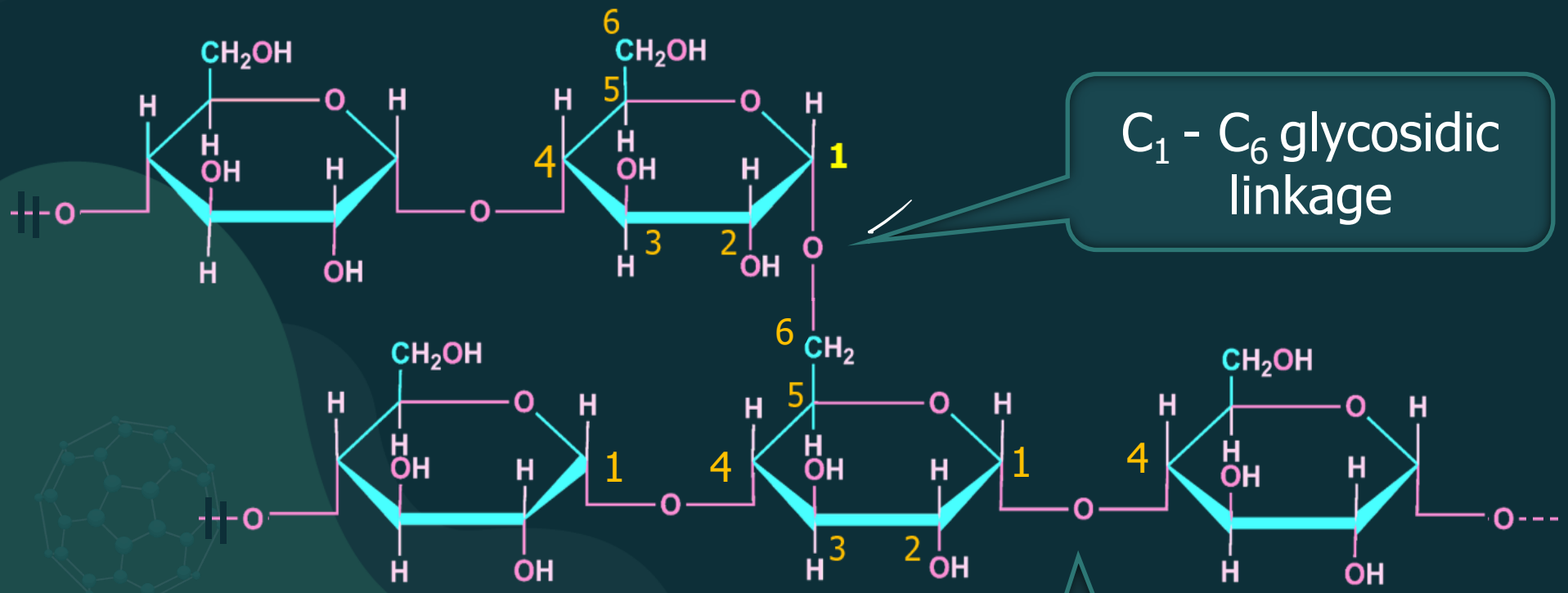


$C_1 - C_4$ glycosidic linkage

$C_1 - C_4$ glycosidic linkage

α-glycosidic linkage

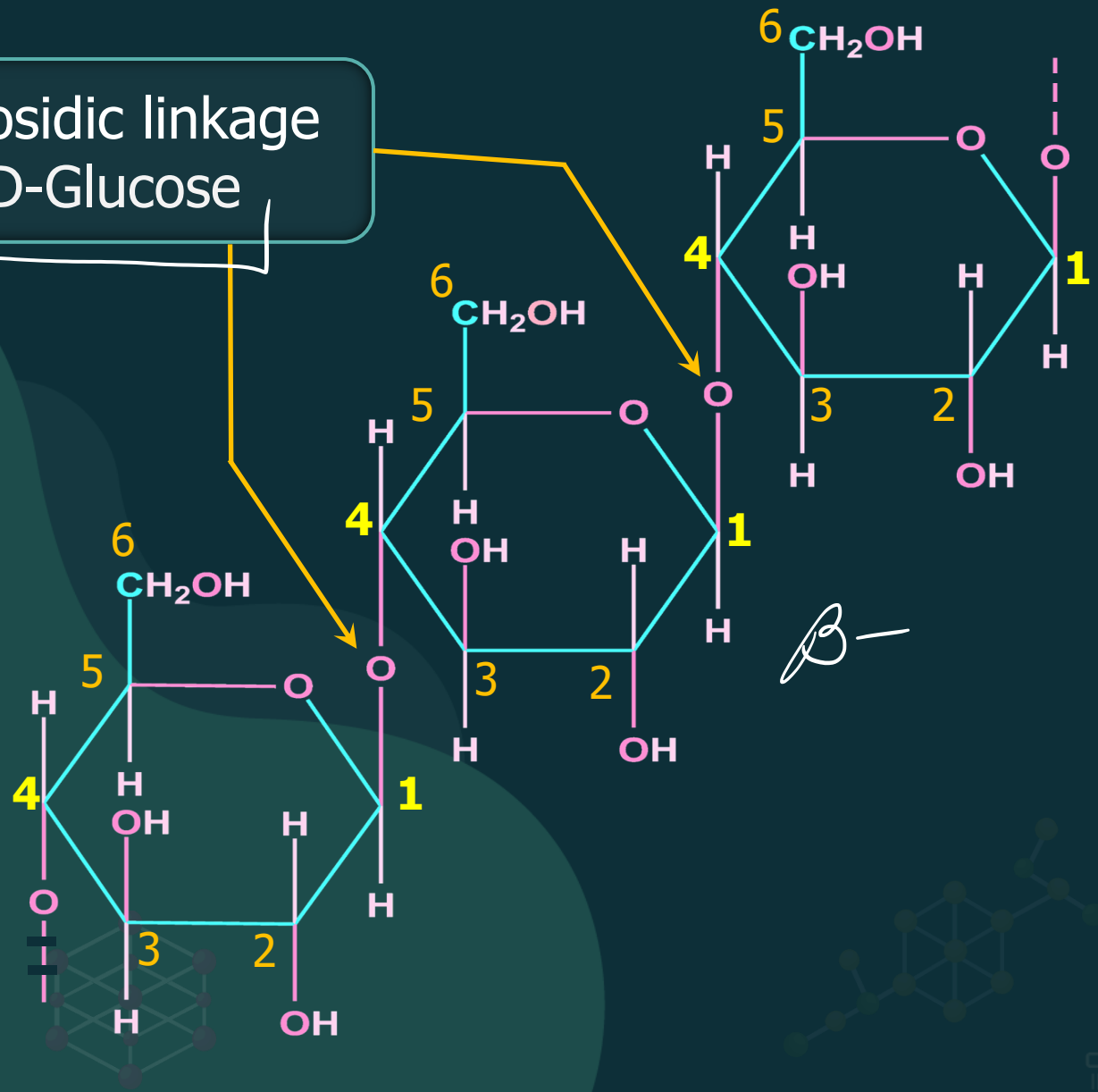
Amylopectin



Cellulose

Cellulose $(C_6H_{10}O_5)_n$

1,4 glycosidic linkage of β-D-Glucose



Glycogen

Glycogen (Animal Starch)

Carbohydrates are stored in an animal body as **glycogen**.

When the body needs **glucose**, enzymes break **glycogen** down to glucose.

Glycogen (Animal Starch)

Structure is similar to amylopectin, but **branching** takes place after every **5-6 glucose units**.

Highly branched

Select the correct statement(s) about starch.

a) It is a pure single compound.

b) It is a mixture of two polysaccharides of glucose.

c) It involves the (C1–C4) glycosidic linkage between two α-D-glucose units.

d) It involves branching by (C1–C6) glycosidic linkage.

On hydrolysis of starch, we finally get:

AIPMT 1991

a) Glucose

b) Fructose

c) Both (a) & (b)

d) Sucrose

Select the correct statement(s).

a) Cellulose and amylose have 1,4-glycosidic linkage.

b) Lactose contains β-D-galactose and β-D-glucose.

c) Maltose and lactose have 1,4-glycosidic linkage.

d) Sucrose and amylose have 1,2-glycosidic linkage.

“Stay Positive, Work Hard. Make It Happen!”

THANK YOU