

## 13.3 Carbohydrates

### CARBOHYDRATES

→ Hydrated Carbons

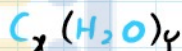
Carbon

Water

- Most abundant organic biological molecule → Carbohydrates
- Present in Each cell
- Each compartment of cell
- Carbohydrates → Primary Product of Photosynthesis
- Nitrogen containing → chitin (cell wall of fungi + Exoskeleton)

Essential Elements →

C : H : O  
2 : 1 (Same as H<sub>2</sub>O)



→ Chemically carbohydrates or polyhydroxy aldehydes or ketones or complex substances which on hydrolysis yield aldehyde or ketonic sub-units.



Aldo group



C<sub>3</sub>H<sub>6</sub>O<sub>3</sub>



Glyceraldehyde  
(Aldo Sugar)



Keto group



Dihydroxyacetone  
(Keto Sugar)

### STRUCTURAL ROLE

- Cellulose
- Chitin
- Nucleotide
- Glyco-calyx

### FUNCTIONAL ROLE

- Energy Source (Glucose)
- Energy Reserves
- Glycogen
- Starch

### CLASSIFICATION

	Simple Sugar	Complex Sugar	Most-Complex
PROPERTY	MONOSACCH.	OLIGOSACCH.	POLYSACCH.
Taste	Sweetest	Less Sweet	Tasteless
Solubility	↑↑↑↑	↑↑	Insoluble
Hydrolysis	X	✓	✓
Glycosidic link.	X	✓	✓
Form	Crystalline Solids	Crystalline Solids	Amorphous
Branching	X	X	✓

Form	Crystalline Solids	Crystalline Solids	Amorphous
Branching	x	x	✓
G. Formula	$(C_2H_2O)_n$ (3 → 7)	$C_n(H_2O)_{n-1}$	$C_x(H_2O)_y$ $x \neq y$
RING FORM.	✓	✓	✓
REDUCING	✓	Sucrose → N.R Remaining → ✓	x
CLASSIFICATION	→ No. of C-atoms → Functional Group	→ No. of mono-saccharides	→ Structural Complexity

### MONOSACCHARIDES

→ All C except 1 have -OH group

Aldo  $\rightleftharpoons$  Keto  
Isomers

No. of C-atoms	Name	C. F.	Aldo Sugar	Keto Sugar
Minimum				
3C	Triose	$C_3H_6O_3$	Glyceraldehyde	DHA
4C	Rare → Tetrose	$C_4H_8O_4$	Erythrose	Erythrulose
5C	most Pentose	$C_5H_{10}O_5$	Ribose	Ribulose
6C	Common Hexose	$C_6H_{12}O_6$	Glucose	Fructose
7C	Heptose	$C_7H_{14}O_7$	Glucosheptose	Sedoheptulose
Maximum				

### PENTOSE

#### RIBOSE (ALDO)

→ Present in Nucleic Acid  
(DNA + RNA)

- $C_5H_{10}O_5$
- Deoxyribose ( $C_5H_{10}O_4$ )
- Dideoxyribose ( $C_5H_{10}O_3$ )

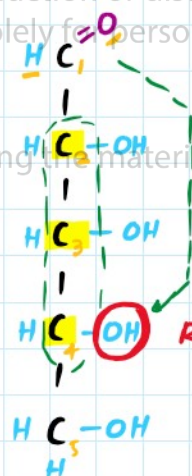
#### RIBULOSE (KETO)

→ Precursors in

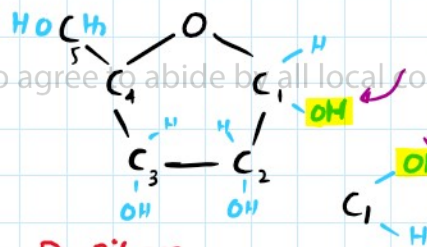
- Calvin Cycle
- Photorespiration

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Right → D-Ribose



5C Ring → Furan Ring

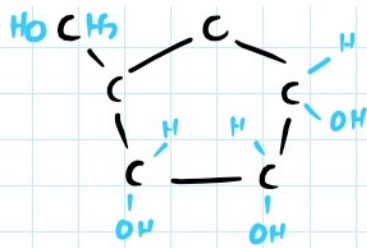
→ 4C in Ring  
→ 1 O in Ring

Isomers =  $2^n$   
=  $2 \times 2 \times 2 = 8$

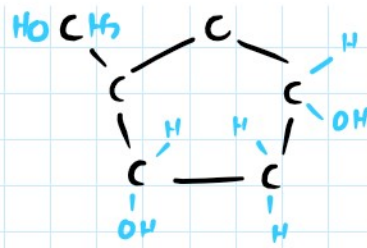
$n = \text{chiral carbon}$

$\alpha$  → animal  
 $\beta$  → birds

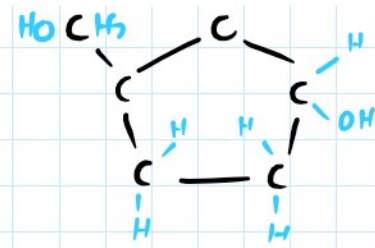




**Ribose Sugar**  
 $C_5H_{10}O_5$



**Deoxy Ribose Sugar**  
 $C_5H_{10}O_4$



**Dideoxyribose Sugar**  
 $C_5H_{10}O_3$

**HEXOSE**

**GLUCOSE (Aldo)**

- 0.08%
- Free Form
- Combined Form
- Dextrose
- Dates
- Figs
- Grapes

Pyran Ring

5C

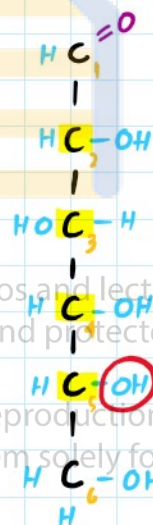
1O

**FRUCTOSE (Keto)**

- Sweetest Sugar
- Semen
- Spermatozoa nourishment.

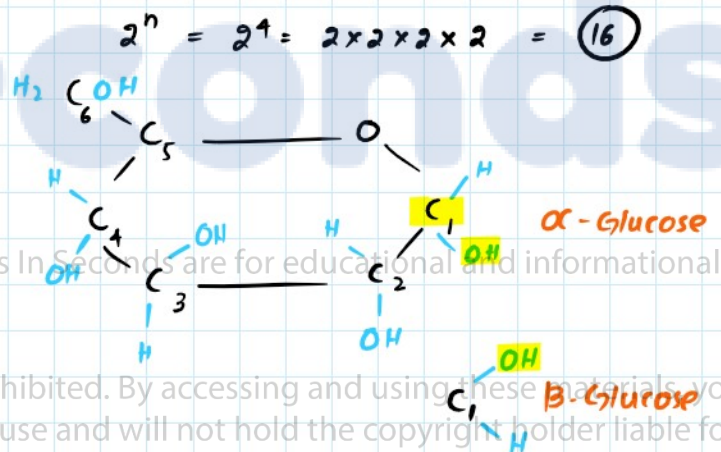
• Glucose → Product of Photosynthesis

**Straight chain Structure**



Chiral Carbons → 4

Solution

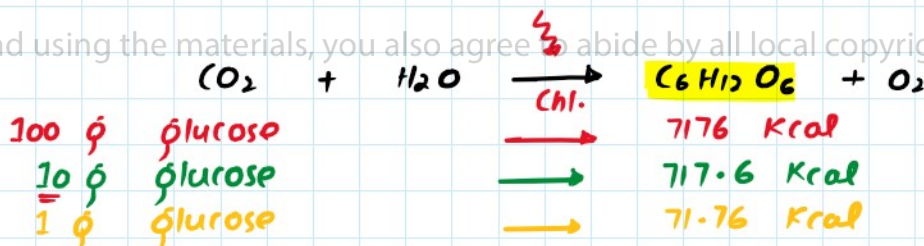


$$2^n = 2^4 = 2 \times 2 \times 2 \times 2 = 16$$

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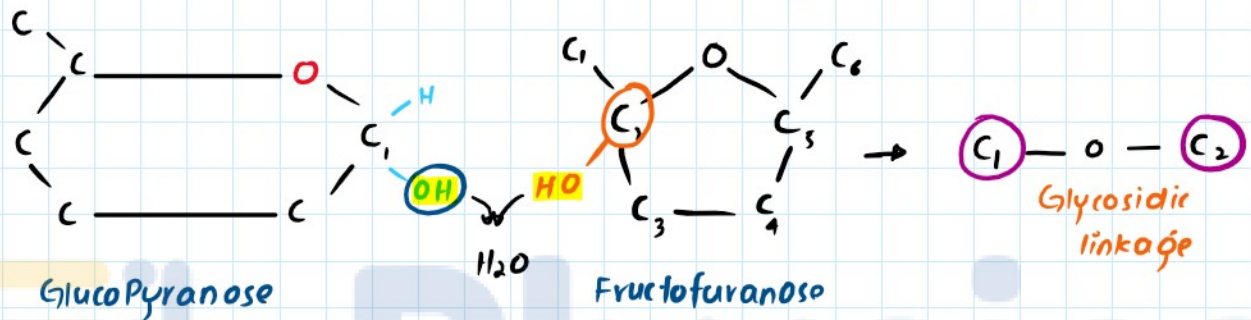
**OLIGOSACCHARIDES**

→ No. of monosaccharide units

- Glycosidic linkage →
  - o - glycosidic linkage (C-O) → Sugar + Sugar
  - N - glycosidic linkage (C-N) → Sugar + N-Base

- Glycosidic linkage  $\rightarrow$ 
  - O-glycosidic linkage (C-O)  $\rightarrow$  sugar + sugar
  - N-glycosidic linkage (C-N)  $\rightarrow$  sugar + N-Base

**SUCROSE** (Glucose + Fructose)  $\rightarrow$  1,2 Glycosidic linkage



**L**  $\downarrow$  milk sugar  
**Lactose** (1,4)  
 $\swarrow \searrow$   
 Galactose Glucose  
 $C_{12}H_{22}O_{11}$

**M**  $\downarrow$  malt sugar  
**Maltose** (1,4)  
 $\swarrow \searrow$   
 Glucose Glucose  
 $C_{12}H_{22}O_{11}$

**S**  $\downarrow$  cane sugar  
**Sucrose** (1,2)  
 $\swarrow \searrow$   
 Glucose Fructose  
 $C_{12}H_{22}O_{11}$

**POLYSACCHARIDES**  $\rightarrow$  most complex, Tasteless

- HomoPolysaccharide  $\rightarrow$  Same kind of monomers (Starch, Glycogen...)
- HeteroPolysaccharide  $\rightarrow$  Different kind of monomers.  
 Agar, Peptidoglycan, pectin

**STORAGE POLYSACCH.**

**STRUCTURAL POLYSACCH.**

**GLYCOGEN**

**STARCH**

**CELLULOSE**

**CHITIN**

Same as Amylopectin  $\rightarrow$  1,4, 1,6  
 Same as Amylose  $\rightarrow$  1,4

$\downarrow$   
 Insoluble

$\downarrow$   
 Insoluble in both  
 (Hot + cold)

$\downarrow$   
 Soluble in Hot water

$\downarrow$   
 Insoluble

$\downarrow$   
 Insoluble

• Red colour

$\rightarrow$  Animal Starch

$\rightarrow$  Liver

$\rightarrow$  muscle

• Blue colour

$\rightarrow$  Plant storage

• No colour

$\rightarrow$  Cell wall

• No colour

$\rightarrow$  Fungi

$\rightarrow$  Insects

Monomer

$\alpha$ -Glucose

$\alpha$ -Glucose

$\beta$ -Glucose

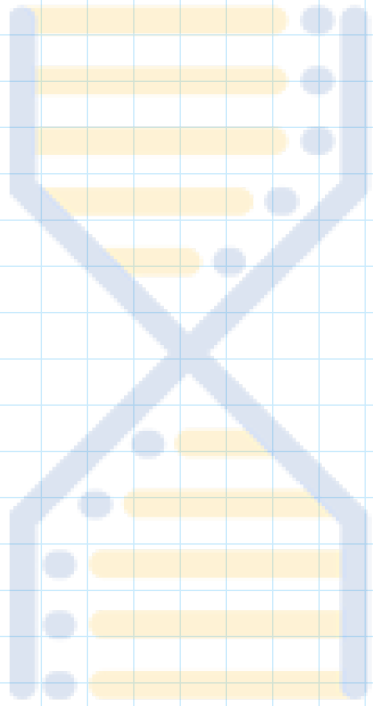
$\beta$ -N-acetyl-glucosamine

$\alpha$ -Glucose

$\alpha$ -Glucose

$\beta$ -Glucose

$\beta$ -N-acetyl -  
glucosamine



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