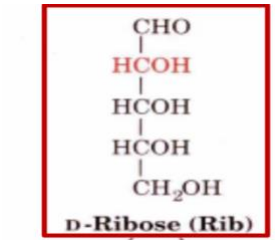
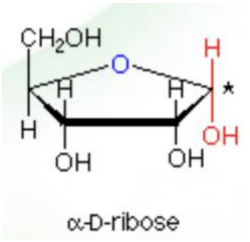
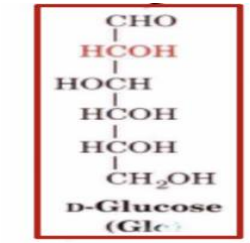
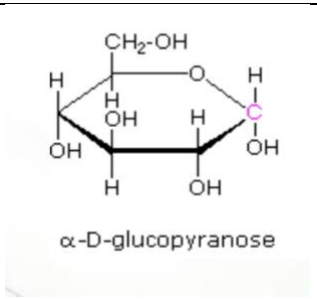
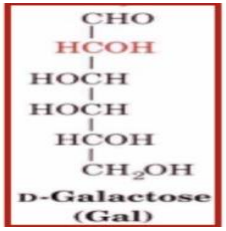
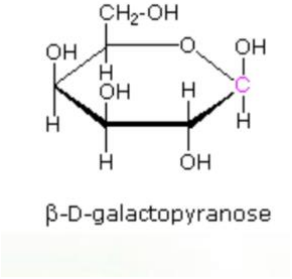
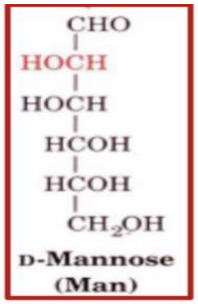
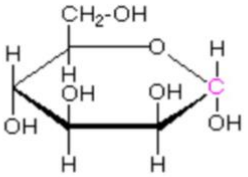
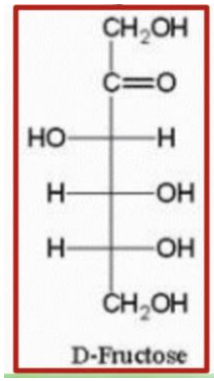
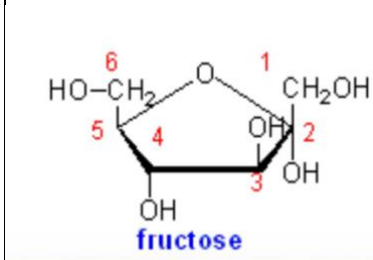
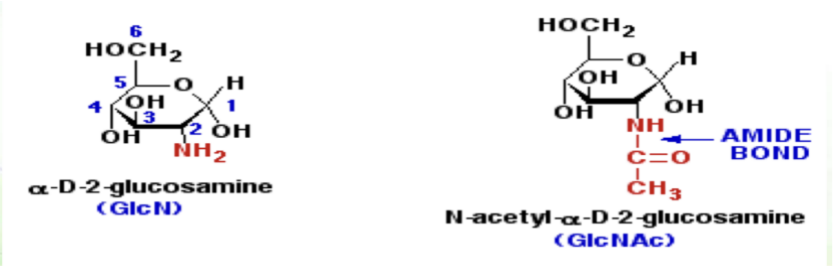
Carbohydrates:

Monosaccharides:

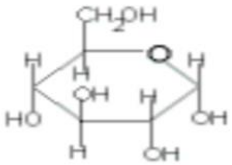
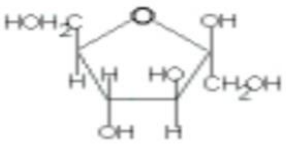
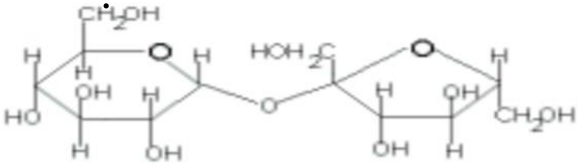
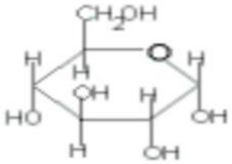
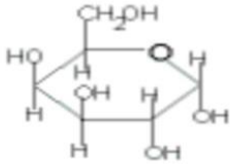
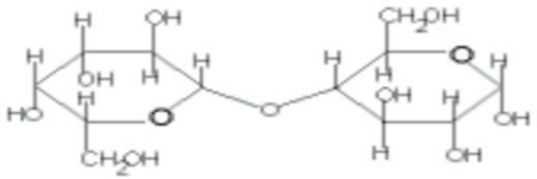
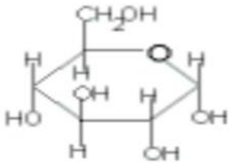
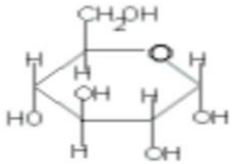
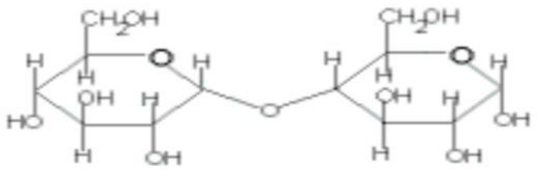
	Structure	Functional group	Cyclic	Properties
Ribose		5 carbons Aldose		-
Glucose		6 carbons Aldose Right, left, right.		Mild sweet Blood sugar Essential energy source Found in every disaccharide and polysaccharide
Galactose		6 carbons Aldose Right,left,left.		Hardly tastes sweet Rarely found as single sugar

Mannose		Aldose 6 carbons Left left right	 α-D-mannopyranose	-
Fructose		Ketose 6 carbons		Sweetest Fruit and honey Added to soft drinks and desserts.

Modified sugars :

Oxidation (sugar acids) Oxidation of glucose c1 aldhyde —> gluconic acid (gluconate) Weak oxidizing agent Oxidation of c6 OH —> glucuronic acid (glucuronate) Enzymes Oxidation of c1 and c6 —> glucaric acid Strong oxidizing agent	Reduction 1- Sugar alcohols: sorbitol , mannitol , xylitol 2- Deoxysugars: one or more hydroxyl groups are replaced with hydrogen
Esterification (sugar esters) Phosphate esters When carbon no 1 (anomeric carbon) is esterified, it turns into phosphoacetal When carbon no 6 is esterified , it is turns into phosphate ester.	Glycosides O glycoside N glycoside C glycoside Anomeric carbon !!!
Amino sugars Adding N to any carbon except anomeric Further modification can occur through acetylation (Chitin,	

Disaccharides

Name	Formula	Formed from			Structure
		glucose	+	fructose	---> sucrose + H_2O
sucrose	$C_{12}H_{22}O_{11}$		+		
		glucose	+	galactose	---> lactose + H_2O
lactose	$C_{12}H_{22}O_{11}$		+		
		glucose	+	glucose	---> maltose + H_2O
maltose	$C_{12}H_{22}O_{11}$		+		

1,2

1,4

1,4

Sucralose	Sucrose عليه Cl	
Lactulose	Isomerization of Lactose (Glucose to fructose)	Health benefits It is used in treating constipation by increasing water absorption in the colon. It promotes the growth of health-promoting gut bacteria. It increases the production of small-chain fatty acids and the removal of toxic ammonia. It modulates the immune system

Oligosaccharides :

1-**Raffinose** : glucose + galactose + fructose
Found in beans and vegetables
Humans lack the enzyme alpha galactose dash that is needed to break raffinose but intestinal bacteria ferment it hydrogen methane and other gases

2- **Streptomycin erythromycin** (antibiotics)
3-**Doxorubicin** (chemotherapy)
4-**Digoxin** (cardiovascular disease)

Polysaccharide:

	Monomer	***Bonds***	***Purpose***	***Homo,hetero***	***More info***	
Glycogen	Glucose	Alpha 1,4 1,6 branches	Storage mammals	Homo	Extensively branched	Alpha bond is flexible
Starch	Glucose	Alpha 1,4 1,6 branches	Storage plants	Homo	Amylose Amylopectin	Alpha (can be bent)
Dextran	Glucose	Alpha 1,6 Branches 1,2 1,3 1,4	Storage yeasts and bacteria	Homo	Branching points are variable	
Cellulose	Glucose	Beta 1,4	Structural plants	Homo	No branches	Beta (not flexible)
Chitin	N-acetyl-b-d-glucosamine	Beta 1,4	Structural Exoskeleton	Homo	Amino sugars	
Pectin	Methyl galactoronate And Galactoronate	Alpha 1,4	Bacteria Plants Jello	Hetero	Sugar acid	
GAGs	Derivatives of amino sugars	All beta except heparin alpha	ECM	Hetero	Contain negatively charged carboxylate or sulfate	Repeated disaccharide
Bacterial cell wall	NAM NAG			Hetero	Rigid	Contains oligopeptide

GAG	Localization	Comments
Hyaluronate	synovial fluid, **vitreous humor,** **ECM of loose connective tissue**	**the lubricant fluid , shock absorbing** As many as 25,000 disaccharide units
Chondroitin sulfate	**cartilage**, bone, heart valves	**most abundant GAG**
Heparan sulfate	basement membranes, components of cell surfaces	contains higher acetylated glucosamine than heparin
Heparin	component of intracellular granules of mast cells lining the arteries of the lungs, liver and skin	**A natural anticoagulant**
Dermatan sulfate	skin, blood vessels, heart valves	
Keratan sulfate	cornea, bone, cartilage aggregated with chondroitin sulfates	Only one not having uronic acid