

CarboHydrates Mono-Disaccharides & Polysaccharides 2015

First Name: _____ Surname: _____ Group N° _____ dep Physiology & BioChemistry
A. Task for student practical introduction for the use of Interactive Molecule viewers:

RasMac  RasMol  ChemScapemDL  MDL  MDLi  FireFox  MAGE4 

<http://aris.gusc.lv/06Daugavpils/Engl/1Saccharid14LabContA.doc>

<http://aris.gusc.lv/ChemFiles/Saccharides/PolySaccharides/HyalurChondroitHeparKeratMucHTM/0GlycoProteinComponents.html>

Address: <http://aris.gusc.lv/ChemFiles/Saccharides/SSViewer/SSVFrameset.htm>.

Draw the retained saccharide molecules as well as projections of opened or hemiacetal and hemiketal structures.

at Display conditions: **Stick** (on Menu Stripe) **Ball & Stick** **Spacefill**

Atom Name	Symbol	Color	Valence Number
Carbon	C	Gray lightly or Black	4
Hydrogen	H	White	1
Oxygen	O	Red	2 (donor acceptor ligand up to 4)
Nitrogen	N	Bluish	3 + 1 (donor acceptor ligand up to 4)
Sulfur	S	Yellow	-2, +6
Phosphor	P	Yellow Intensive dark	5 (& 3)
Sodium ion	Na+	Blue	+1 (coordination up to 6)
Magnesium ion	Mg2+	Green	+2 (coordination up to 6)
Calcium ion	Ca2+	Gray Dark	+2 (coordination up to 6)
Iron ion	Fe2+	Yellow Gray	+2 (coordination up to 6)
Iron ion	Fe3+	Yellow Gray	+3 (coordination up to 6)

Immunological marker **L-Fucose** and **A,B,AB,O** blood groups antigenic determinants on erythrocyte membrane protein **glycophorin A** surface

<http://aris.gusc.lv/06Daugavpils/Research/33BloodGroupABO.doc>

Nature Journal
 publication of scientists
Corey, Pauling, Koltun
 for atomic modeling
Poly saccharide Backbone is
 $-O-\Delta-O-\Delta-O-\Delta-O-\Delta-O-$
 chain of monosaccharide Δ
glycoside $\Delta-O-\Delta$ bond
Inter molecular Forces active
Side groups:
Polar hydroxyl -OH
 Hydrogen bonds: $-O-H...O <$
 carboxylic, sulfate & amine salt
 salt bridges: $-OSO_3^- +H_3N-$
 $-COO^-...+H_3N-$

Fisher and Haworth projections

IUPAC recommendations suggested by **Joint Commission on Biochemical Nomenclature (JCBN)** 1985 year rules for abbreviations and linkage use on saccharide units and its connections itself into Disaccharides, Trisaccharides, Oligosaccharides and Polysaccharides.

GalNAc, N-acetyl-D-galactosamine;
GlcUA, D-glucuronic acid; **IdUA**, L-iduronic acid; **GlcN**, D-glucosamine; **GlcNAc**, N-acetyl-D-glucosamine;
GalN, D-galactosamine; **Glc**, D-Glucose; **Gal**, D-galactose; **Man**, D-mannose;
ManN, D-mannosamine; **Xyl**, D-xylose; **NeuAc**, N-acetyl-Neuraminic acid. **CPK** color scheme 1965

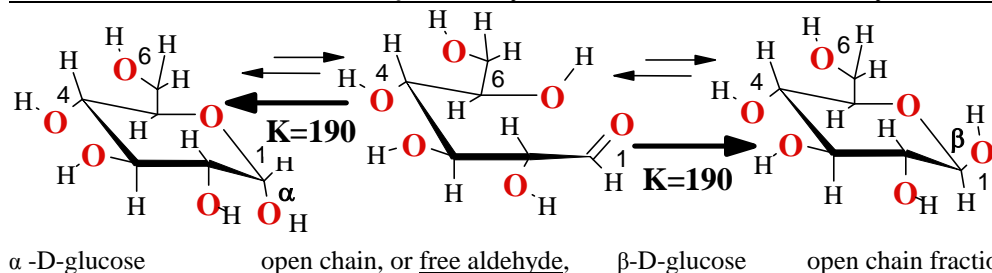


Figure I.1 The cyclic hemiacetal forms \leftrightarrow of D-glucose alpha α - and beta β - in equilibrium with open chain $K \geq 190$

α -D-glucose: mp 146°C [α]=+112°
 β -D-glucose: mp 190°C [α]=+19°

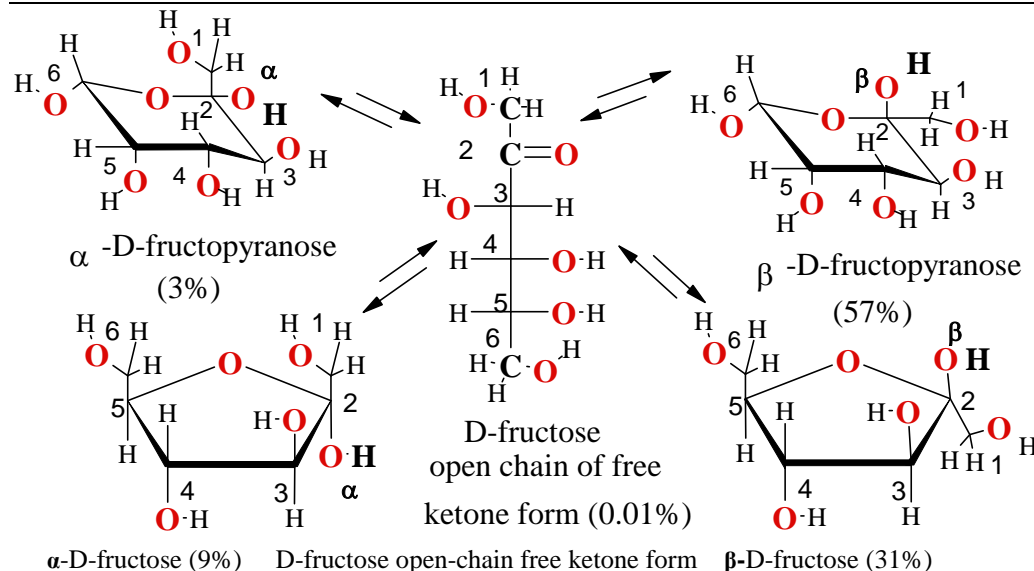
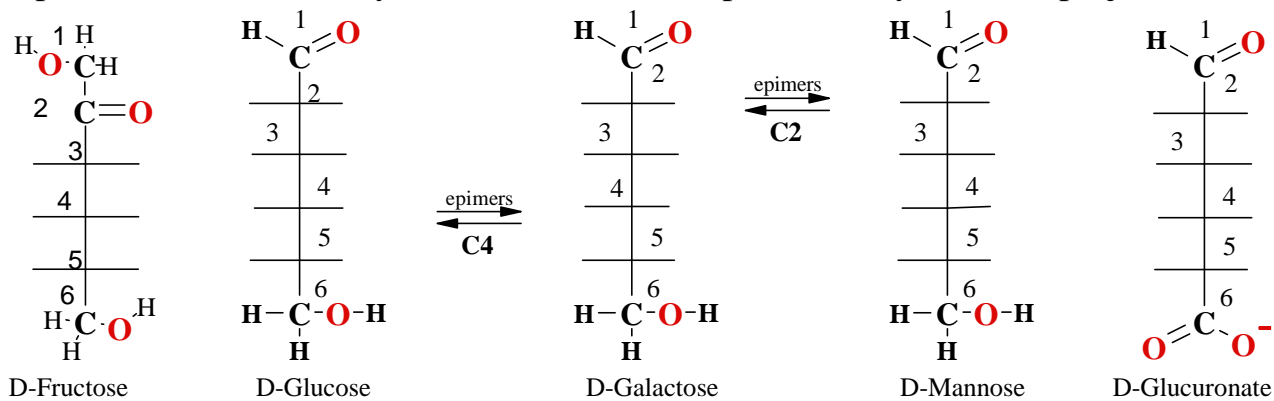


Figure I.2 The principal forms of D-fructose in equilibrium into aqueous solution. Show the opened chain D-Fructose and β -D-fructose

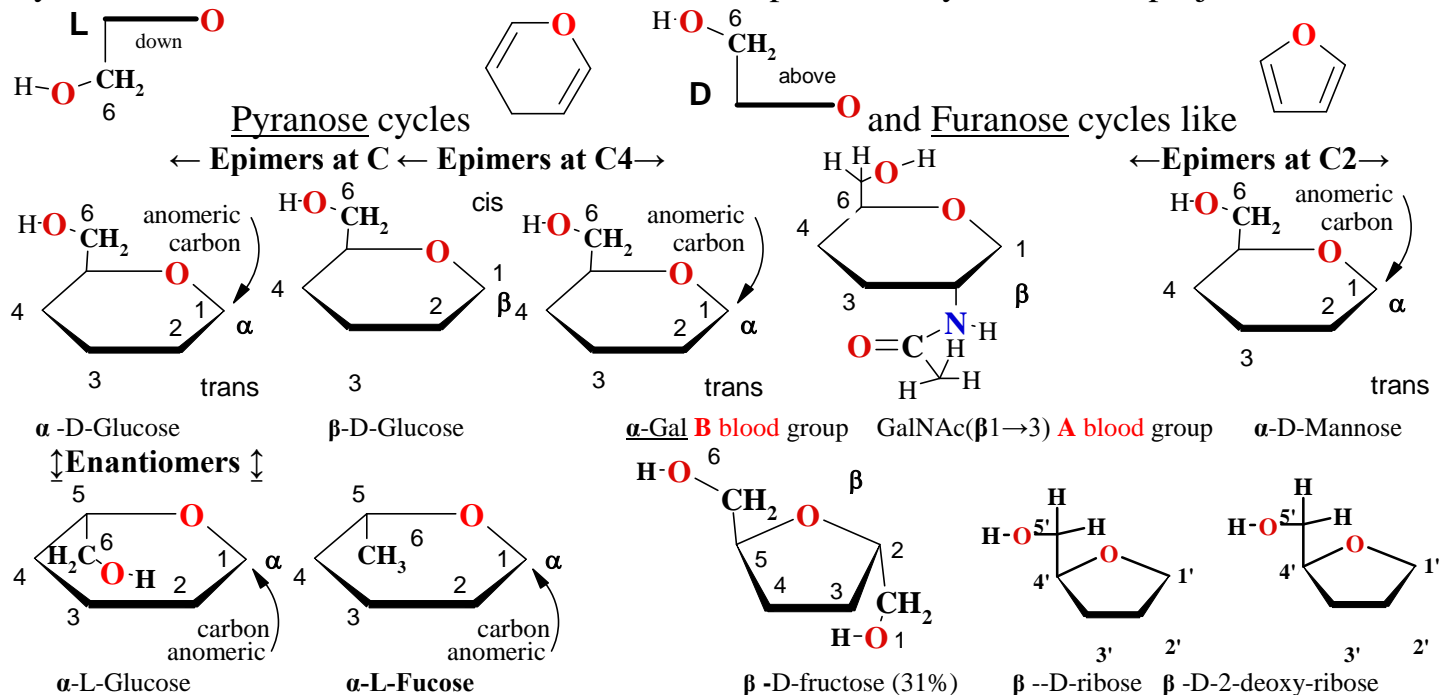
$K = [\text{Cyclic}]/[\text{open}] = 99,99/0.01 = 9999 = K$
Open chain fraction
 $w\% = 1/10000 * 100\% = 0.01\%$

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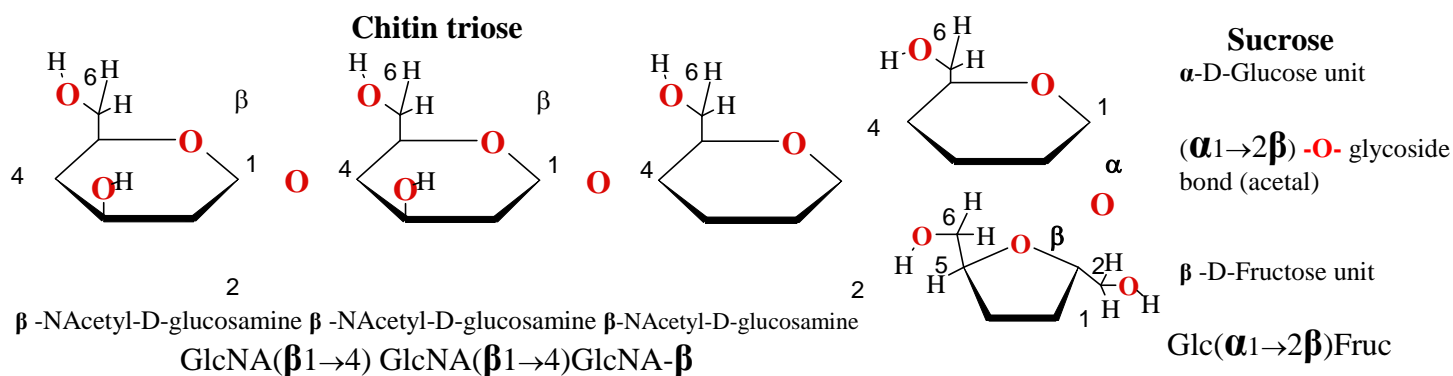
Opened chain free aldehyde monosaccharides presented by Fisher's projection



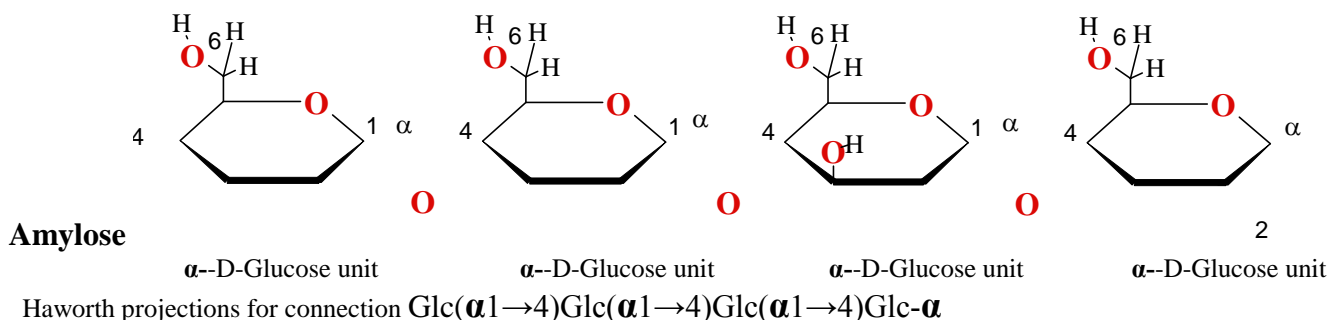
Cyclic hemiacetal or hemiketal monosaccharides presented by Haworth's projection



α -L-Fucose unit is linked (α 1 \rightarrow) as side group on oligosaccharide chains in extra cellular space of human organism as **Immunological marker** for host molecular bodies recognition and non-host bodies removing.

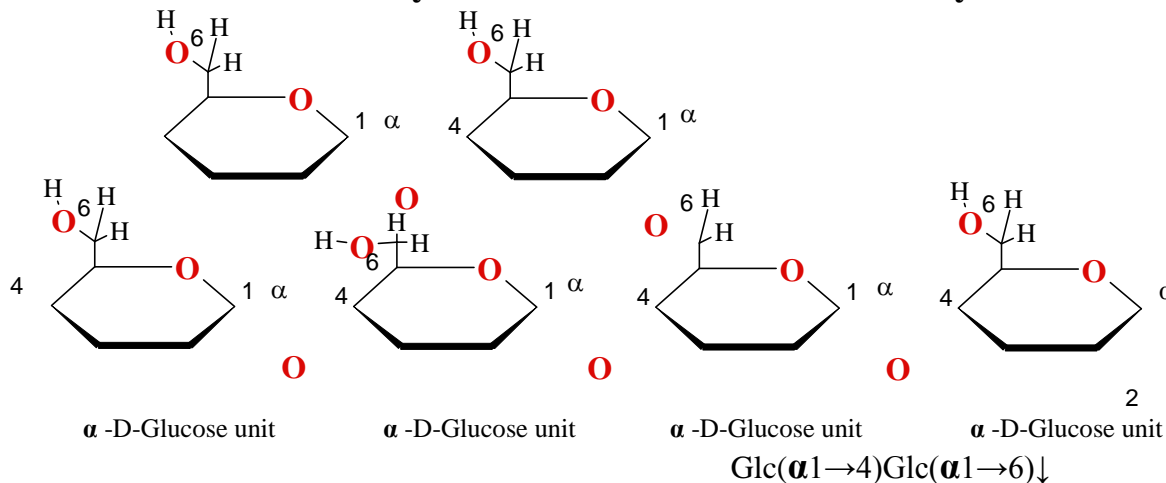


Haworth projections for connection -O-



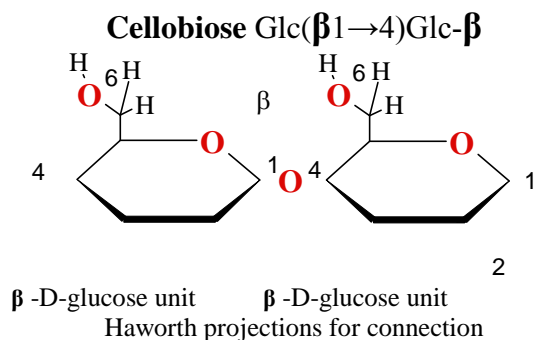
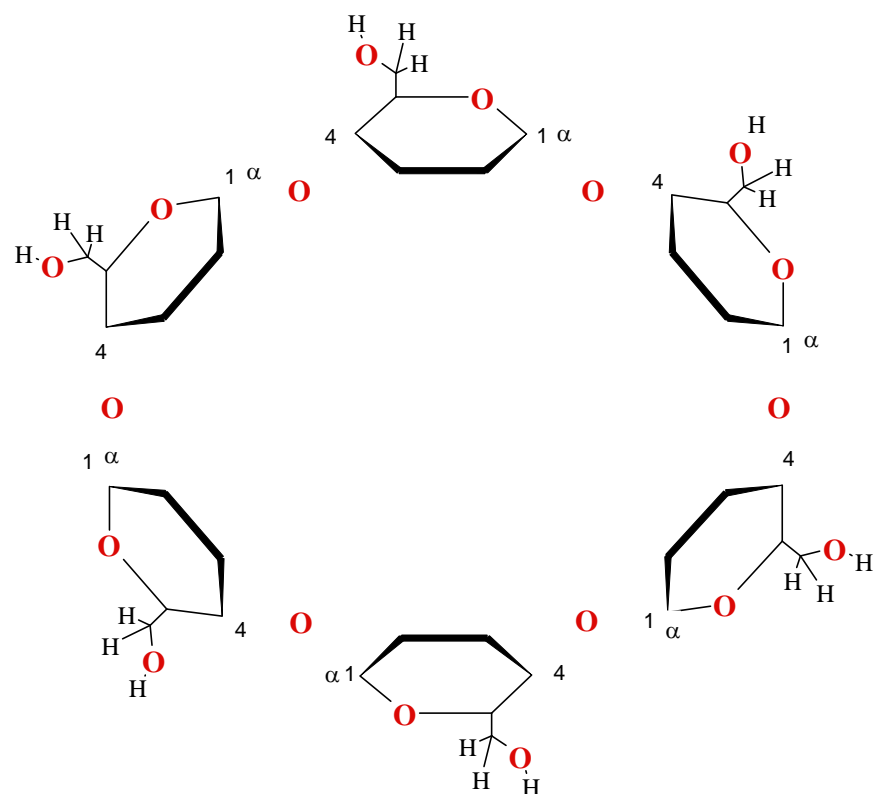
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Haworth projections for connection
-O-

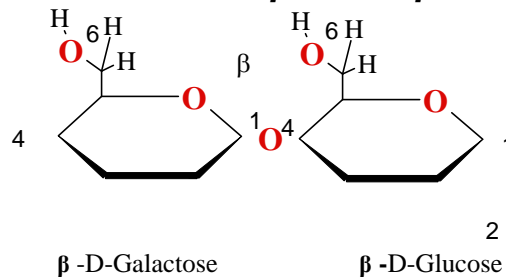


AmyloPectin

Glc(α 1 \rightarrow 4) Glc(α 1 \rightarrow 4)Glc(α 1 \rightarrow 4)Glc- α
Cyclo Hexa Amylose α -D-Glucose \rightarrow α -D-Glucose \rightarrow α -D-Glucose \rightarrow

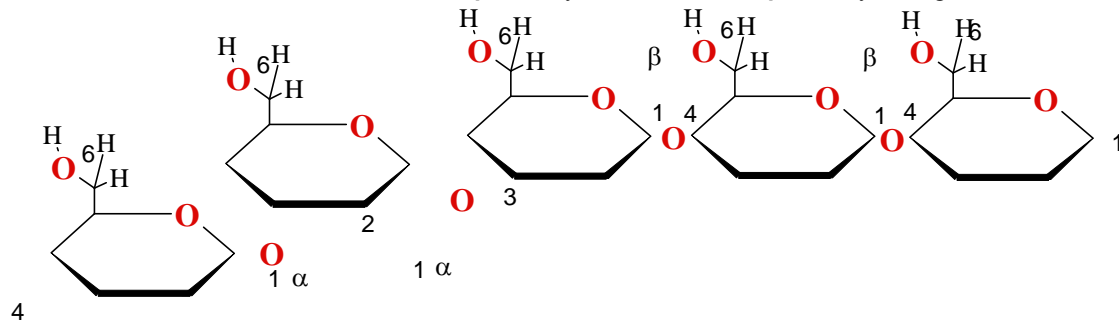


Lactose Gal(β 1 \rightarrow 4)Glc- β



Glc(α 1 \rightarrow 4)Glc(α 1 \rightarrow 4)Glc(α 1 \rightarrow 4)
 Glc(α 1 \rightarrow 4)Glc(α 1 \rightarrow 4)Glc(α 1 \rightarrow 4)

α -D-Mannose α -D-Mannose α -D-Mannose β -N-Acetyl-D-Glucosamine β -N-Acetyl-D-Glucosamine



Man(α 1 \rightarrow 2)Man(α 1 \rightarrow 3)Man(β 1 \rightarrow 4)GlcNAc(β 1 \rightarrow 4)GlcNAc- β

Mucin linear

Mucin branched (forked) fragment

α -D-Mannose α -D-Mannose β -N-Acetyl-D-Glucosamine
 α -D-Mannose β -N-Acetyl-D-Glucosamine

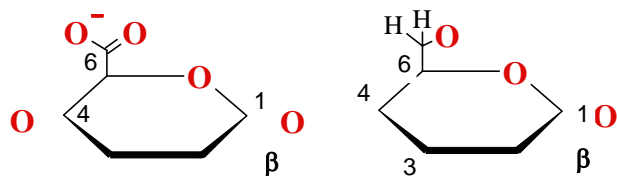
α -D-Mannose unit Man(α 1 \rightarrow 2)Man(α 1 \rightarrow 6)

Haworth projections for connection Man(α 1 \rightarrow 2) Man(α 1 \rightarrow 2)Man(α 1 \rightarrow 3)Man(β 1 \rightarrow 4)GlcNAc(β 1 \rightarrow 4)GlcNAc- β

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Show the eight given disaccharide units of Proteoglycan components - only as Haworth projections!

Chondroitin 6-sulfate

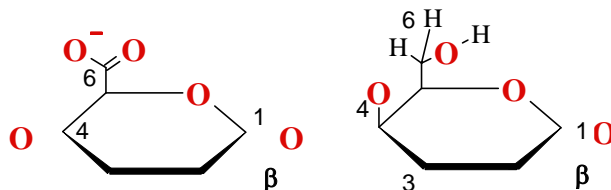


β -D-Glucuronate

2

β -N-Acetyl-D-Galactosamine-6-sulfate
GlcUA(β 1 \rightarrow 3)GalNAc(β 1 \rightarrow 4)
└ 6-O-Sulfate

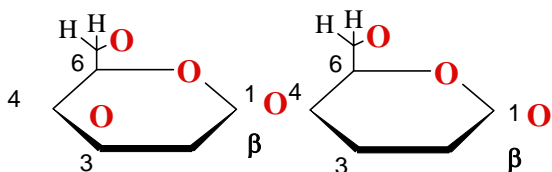
Chondroitin 4-sulfate



β -D-Glucuronate

β -N-Acetyl-D-Galactosamine-4-Sulfate
GlcUA(β 1 \rightarrow 3)GalNAc(β 1 \rightarrow 4)
└ 4-O-Sulfate

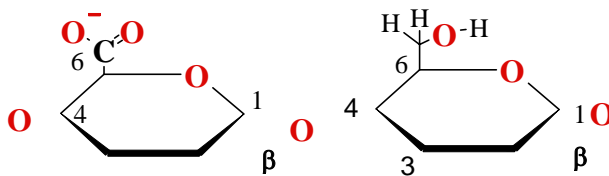
Keratan 6-Sulfate



β -D-galactose

β -N-Acetyl-D-Glucosamine (-6-Sulfate)
Gal(β 1 \rightarrow 4)GlcNAc(β 1 \rightarrow 3)
└ 6-O-Sulfate └ 6-O-Sulfate

Hyaluronate 50000 disaccharide units polysaccharide

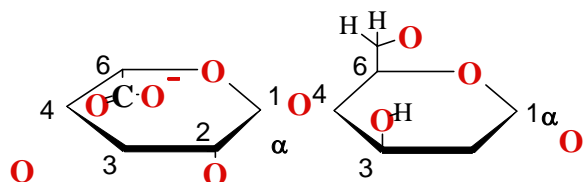


β -D-Glucuronate

β -N-Acetyl-D-Glucosamine
GlcUA(β 1 \rightarrow 3)GlcNAc(β 1 \rightarrow 4)

Heparin

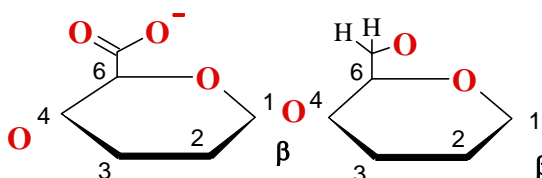
α -L-Iduronate



2

α -N-Acetyl or N-sulfo-D-Glucosamine
(α 1 \rightarrow 4)IdUA(α 1 \rightarrow 4)GlcNSO₃⁻(α 1 \rightarrow 4)
└ 2-O-Sulfate └ 6-O-Sulfate

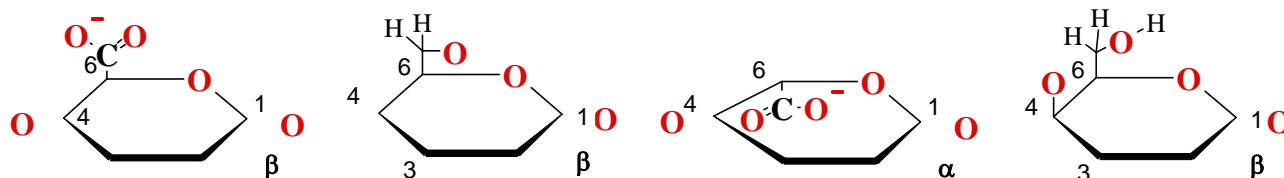
Heparan sulfate



β -D-Glucuronate

β -N-Acetyl or N-sulfo-D-Glucosamine
(α 1 \rightarrow 4)GlcUA(β 1 \rightarrow 4)GlcNSO₃⁻(β 1 \rightarrow 4)
└ 6-O-Sulfate S

Dermatan sulfate



β -D-Glucuronate

β -N-Acetyl-D-Galactosamine-6-sulfate
GlcUA(β 1 \rightarrow 3)GalNAc(β 1 \rightarrow 4)
└ 6-O-Sulfate

α -L-Iduronate

β -N-Acetyl-D-Galactosamine-4-sulfate
IdUA(α 1 \rightarrow 3)GalNAc(β 1 \rightarrow 4)
└ 4-O-Sulfate