




## Carbohydrates Constituents of Glycoproteins & Proteoglycans 2025

First Name: \_\_Teacher\_\_ Surname: \_\_Teacher\_\_ Group N° \_\_Teacher\_\_ dep Med Bio Chem

A. Task for student practical introduction for the use of Interactive Molecule viewers: RasMac

 (RasMol  for PC) and ChemScape MDLi browser  FireFox, as well MAGE4 

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

<http://aris.gusc.lv/> **B. The Glycoprotein Components** for studies of hetero-polysaccharide structural units and molecules and You have under investigation them.

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.

**GlcUA**, D-glucuronic acid; **IdUA**, L-iduronic acid; **GlcN**, D-glucosamine; **Fuc**, L-fucose  
**GalN**, D-galactosamine; **Glc**, D-Glucose; **Gal**, D-galactose; **Man**, D-mannose;  
**ManN**, D-mannosamine; **Xyl**, D-xylose; **NeuAc**, N-acetyl-Neuraminic acid.

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

| Atom Name     | Symbol                 | Color                        | Valence Number                               |
|---------------|------------------------|------------------------------|--|
| Carbon        | <b>C</b>               | Gray lightly or <b>Black</b> | <b>4</b>                                     |
| Hydrogen      | <b>H</b>               | White                        | <b>1</b>                                     |
| Oxygen        | <b>O</b>               | <b>Red</b>                   | <b>2</b> (donor acceptor ligand up to 4)     |
| Nitrogen      | <b>N</b>               | <b>Bluish</b>                | <b>3 + 1</b> (donor acceptor ligand up to 4) |
| Sulfur        | <b>S</b>               | <b>Yellow</b>                | <b>-2 , +6</b>                               |
| Phosphor      | <b>P</b>               | <b>Yellow Intensive dark</b> | <b>5 ( &amp; 3 )</b>                         |
| Sodium ion    | <b>Na<sup>+</sup></b>  | <b>Blue</b>                  | <b>+1</b> (coordination up to 6)             |
| Magnesium ion | <b>Mg<sup>2+</sup></b> | <b>Green</b>                 | <b>+2</b> (coordination up to 6)             |
| Calcium ion   | <b>Ca<sup>2+</sup></b> | <b>Gray Dark</b>             | <b>+2</b> (coordination up to 6)             |
| Iron ion      | <b>Fe<sup>2+</sup></b> | <b>Yellow Gray</b>           | <b>+2</b> (coordination up to 6)             |
| Iron ion      | <b>Fe<sup>3+</sup></b> | <b>Yellow Gray</b>           | <b>+3</b> (coordination up to 6)             |

the CPK color scheme 1965

**Nature Journal**

publication of scientists  
**Corey, Pauling, Koltun**  
 for atomic modeling

Poly saccharide **Backbone** is

**-O-△-O-△-O-△-O-△-O-**  
**chain of monosaccharide △**  
**glycoside △-O-△ bond**

Inter molecular Forces

active Side groups:

**Polar hydroxyl -OH**

Hydrogen bonds:

**-O-H...O<**

**1. Open task GlycoProteinComponents** for hetero-polysaccharide structure unit investigation:

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

Choose **.mol** type extension files right side in application above: [Hyaluronate3Ca2+HOH.mol](#),  
[Chondroitine4Sulfate2CaHOH.mol](#), [Heparin.mol](#), [Keratan.mol](#), [Mucin3Mann2NAcGal.mol](#),  
[Mucin3Man6\(2Man\)2NAcGal.mol](#), [AnhydroGal2SulfBetGal4Sulf.mol](#),

Studies of seven hetero-polysaccharide structures: **Hyaluronate**, **Chondroitin 4-sulfates**,  
**Heparin**, **Keratan**, **Mucin-linear**, **Mucin-Branched** and **Agarose**. Drawing short cut names  
**four** hetero polysaccharide structural sugar units using JCBN short cut names: **Fuc**, **GlcNAc**,  
**GlcUA**, **GalNAc**, **IdoA**, **Gal**, **GlcNSO<sub>3</sub><sup>-</sup>** as constituents of seven hetero polysaccharides.

<http://aris.gusc.lv/06Daugavpils/Research/ProteoGlycansAS.pdf>: To write the sugar units &  
 show **four 4** glycoside **-O-bond** typing alpha α and beta β type and covalently bound carbon  
 atom numbers (with oxygen glycoside **-O- bond**) between two neighbor mono saccharide  
 carbon atom. Show chain hexoses with sulfate linkage to carbon number |\_Nr-**OSO<sub>3</sub><sup>-</sup>** in mono  
 saccharide:

|                       |              |               |             |              |              |               |             |               |
|-----------------------|--------------|---------------|-------------|--------------|--------------|---------------|-------------|---------------|
|                       | 1            | -----         | 2           | -----        | 3            | -----         | 4           | -----         |
| <b>Nr. Saccharide</b> | <b>unit</b>  | <b>-link-</b> | <b>unit</b> | <b>link-</b> | <b>unit-</b> | <b>-link-</b> | <b>unit</b> | <b>-link-</b> |
| <b>Hyaluronate</b>    | GlcNAc(β1→4) |               | GlcUA(β1→3) |              | GlcNAc(β1→4) |               | GlcUA(β1→3) |               |

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JCBN 1985 recommendations: <http://aris.gusc.lv/06Daugavpils/Research/glycoproteins.pdf> for abbreviations and glycoside -O- linkage type alpha  $\alpha$  or beta  $\beta$  ( $\rightarrow$ ) use on mono mere saccharide units, sulfātu piesaistes oglekļa numuru |\_Nr-OSO<sub>3</sub><sup>-</sup> mono saharīdā:

|                                 | 1   | -----          | 2   | -----          | 3  | -----          | 4                                      | -----                                  |                       |
|---------------------------------|---|----------------|---|----------------|--|----------------|--|--|-----------------------|
|                                 | unit  | -link-         | unit  | -link-         | unit   | -link-         | unit                                   | -link                                  |                       |
| . <b>Hyaluronate</b>            | GlcNAc  | ( $\beta$ 1→4) | GlcUA   | ( $\beta$ 1→3) | GlcNAc   | ( $\beta$ 1→4) | GlcUA                                  | ( $\beta$ 1→3).....                    | 2                     |
| . <b>Chondroitin 4-sulfates</b> | GalNAc( $\beta$ 1→4)                              |                | GlcUA( $\beta$ 1→3)                                     |                | GalNAc( $\beta$ 1→4)                             |                | GlcUA( $\beta$ 1→3)...                 |  | 3                     |
|                                 |   |                | _4-OSO <sub>3</sub> <sup>-</sup>                        |                |  |                | _4-OSO <sub>3</sub> <sup>-</sup> ..... |  |                       |
| . <b>Heparin</b>                | GlcNSO <sub>3</sub> <sup>-</sup> ( $\alpha$ 1→4)  |                | L-IdoA( $\alpha$ 1→4)                                   |                | GlcNSO <sub>3</sub> <sup>-</sup> ( $\alpha$ 1→4) |                | L-IdoA( $\alpha$ 1→4) .....            |  | 4                     |
|                                 |   |                | _6-OSO <sub>3</sub> <sup>-</sup>                        |                |  |                | _2-OSO <sub>3</sub> <sup>-</sup> ..... |  |                       |
| . <b>Keratan</b>                | GlcNAc( $\beta$ 1→3)                              |                | Gal( $\beta$ 1→4)                                       |                | GlcNAc( $\beta$ 1→3)                             |                | Gal( $\beta$ 1→4) .....                |  | 5                     |
|                                 |   |                | _6-OSO <sub>3</sub> <sup>-</sup>                        |                | _6-OSO <sub>3</sub> <sup>-</sup>                 |                | _6-OSO <sub>3</sub> <sup>-</sup> ..... |  |                       |
| . <b>Mucin linear</b>           | Man( $\alpha$ 1→2)                                |                | Man ( $\alpha$ 1→3)                                     |                | Man ( $\beta$ 1→4)                               |                | GlcNAc ( $\beta$ 1→4)                  | GlcNAc- $\beta$ .....                  | 6                     |
| . <b>Mucin branched chaine</b>  | Man( $\alpha$ 1→2)                                |                | Man( $\alpha$ 1→6) .....                                |                |  |                |  |  | 7                     |
|                                 |   |                | ↓   |                |  |                |  |  |                       |
|                                 | Man( $\alpha$ 1→2)                                |                | Man( $\alpha$ 1→2)                                      |                | Man( $\alpha$ 1→3)                               |                | Man( $\beta$ 1→4)                      | GlcNAc( $\beta$ 1→4)                   | GlcNAc- $\beta$ ..... |
| . <b>Agarose</b>                | Gal- $\beta$ (1-4)-3,6-AnhydroGal- $\alpha$ (1-3) |                | Gal- $\beta$ (1-4)-3,6-AnhydroGal- $\alpha$ (1-3) ..... |                |  |                |  |  | 7                     |
|                                 |   |                | _4-OSO <sub>3</sub> <sup>-</sup>                        |                | _2-OSO <sub>3</sub> <sup>-</sup>                 |                | _4-OSO <sub>3</sub> <sup>-</sup>       | _2-OSO <sub>3</sub> <sup>-</sup> ..... |                       |

Student self studies (Home Works 1 and 2)

Home Work task 1 at address: <http://aris.gusc.lv/06Daugavpils/Research/BloodGroups.pdf>

Draw Four Blood groups A,B,AB,O hexa saccharides with Fuc( $\alpha$ 1→2)Gal - immunological marker fucose: <http://aris.gusc.lv/ChemFiles/AOBblood-resus/ImmunABO/2frmcont.htm>. Self

studies at home work hetero-polysaccharide structure units using finish with JCBN short cut names for task 2! Helper for home works 1 and 2: <http://aris.gusc.lv/06Daugavpils/Research/33BloodGroupABO.pdf>

Student self studies (Home Work) task 2.

2. **Blood group A** determinant **GalNAc** and immunological marker L-Fucose link to Gal Fuc( $\alpha$ 1→2)Gal.

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\_\_\_ **Blood group B** determinant **Gal** and immunological marker L-Fucose link to Gal Fuc( $\alpha$ 1→2)Gal.....

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\_\_\_ **Blood group O** determinant and immunological marker L-Fucose link to Gal Fuc( $\alpha$ 1→2)Gal

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\_\_\_ **Blood group AB** determinants and immunological marker L-Fucose link to Gal Fuc( $\alpha$ 1→2)Gal.....

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