Chem 452 - Lecture 7
Carbohydrates
Part 2

Question of the Day: What is the molecular basis for the different blood types in humans and why are individuals with blood type "O" considered to be universal donors?

Problem

Question:

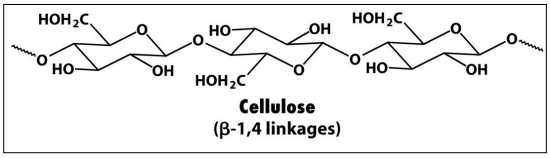
Draw the structure of the β-anomer of the disaccharide formed by linking D-galactose to D-glucose using a β(1->4) glycosidic bond.
(β-D-galactopyranosyl-(1-4)-β-D-glucopyranose)

Name a natural source for this disaccharide.

What is the more common name for this disaccharide?

Complex Carbohydrates

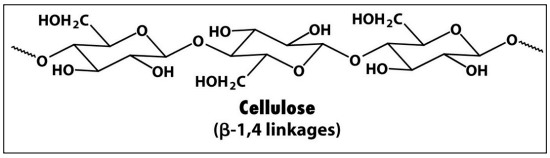
- Multiple monosaccharides can combine using glycosidic bonds to form **oligosaccharides** and **polysaccharides**
  - **Cellulose** is a **homopolymer** of glucose joined by β-1,4 glycosidic bonds.



Cellulose
(β-1,4 linkages)

Complex Carbohydrates

- Cellulose is the most prevalent biomolecule in terms of mass
  - It is very resistant to degradation.
    - Forms insoluble fibers
    - Few organisms have the enzyme (cellulase), required to hydrolyze the β-1,4 linkage



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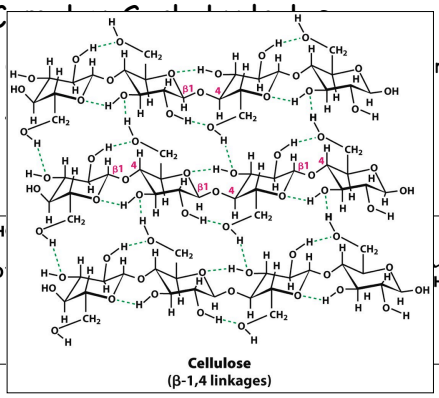

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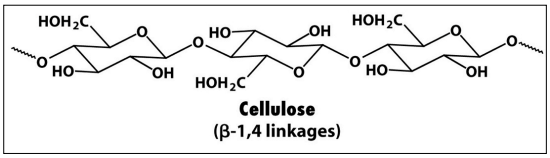
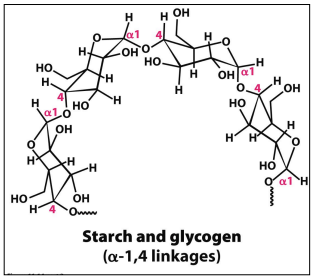


Cellulose
(β-1,4 linkages)

Complex Carbohydrates

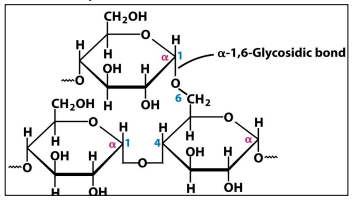
- **Amylose (Starch)** is a **homopolymer** of glucose joined by α-1,4 glycosidic bonds.



Starch and glycogen
(α-1,4 linkages)

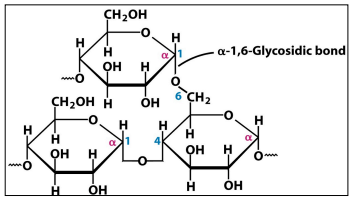
Complex Carbohydrates

- **Amylopectin (another form of Starch)** and **Glycogen are** are **homopolymers** of glucose joined by α-1,4 glycosidic bonds, along with α-1,6 branch points.



Complex Carbohydrates

- Starch (plants) and glycogen (animals) are storage forms of glucose.
  - They are water soluble and easily hydrolyzed
  - They have a very open structure.



Complex Carbohydrates

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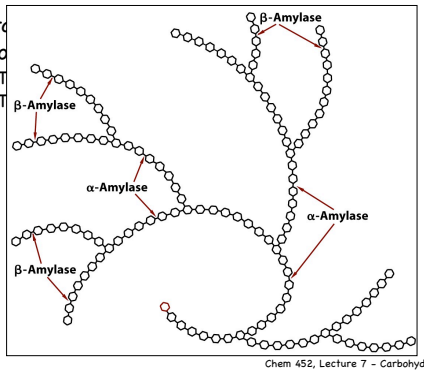

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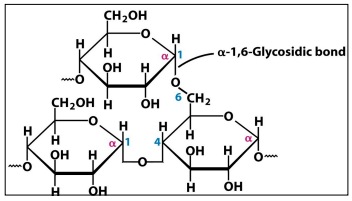

Complex Carbohydrates

- **Proteoglycans** are a combination of protein and oligosaccharides called **glycosaminoglycans**.
  - They are used to cushion and lubricate joins.

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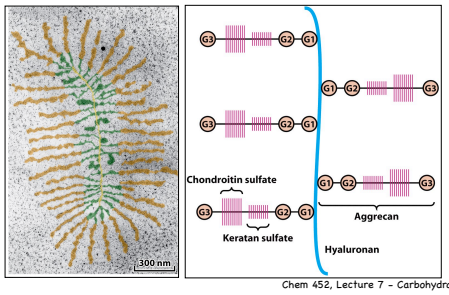
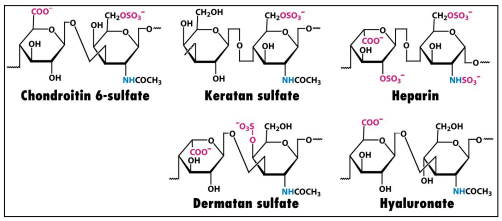


Complex Carbohydrates

- **Glycosaminoglycans** are highly charged and very hydrophyllic



Complex Carbohydrates

- **Glycotransferases** are enzymes used to form glycosidic bond.
  - The monosaccharides are added to the non-reducing end.
  - The monosaccharides are activated with UDP

Complex Carbohydrates

- **Glycotra** to form glycosidi
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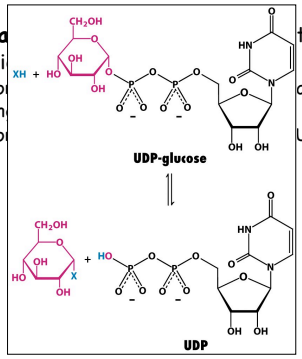
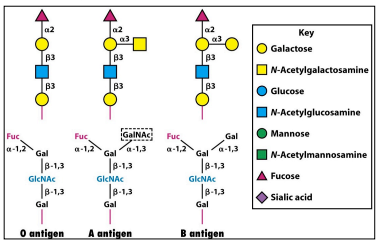


Complex Carbohydrates

- The human ABO blood types are determined by oligosaccharides attached to proteins and membrane lipids.



Complex Carbohydrates

- Question:

Can you speculate on way persons with blood type "O" can serve as universal donors.

A can give blood only to A

B can give blood only to B

AB can give blood to A, B, AB

O can give blood to A, B, AB, O

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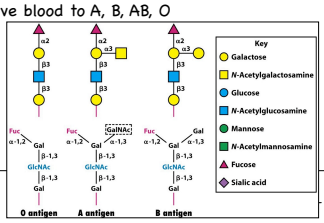

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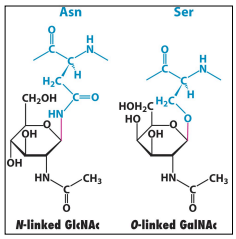
Glycoproteins

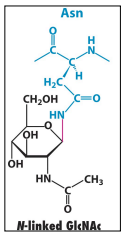
- Membrane and extracellular proteins are often glycosylated with oligosaccharides.
  - These linked to either serine or asparagine residues.



Glycoproteins

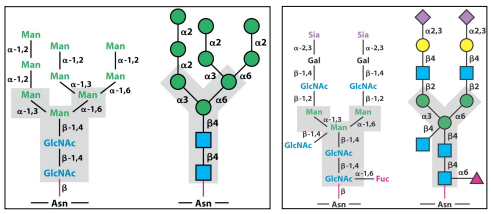
- N-linked oligosaccharides attached at specific sequences.

Asn-X-Ser
Asn-X-Thr



Glycoproteins

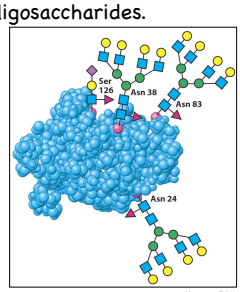
- N-linked oligosaccharides have a pentasaccharide core.



Glycoproteins

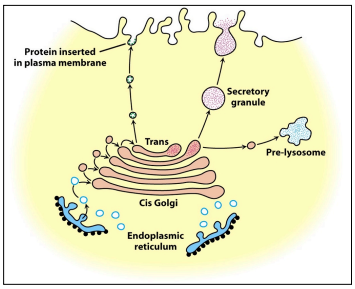
- Erthropoietin stimulates RBC production and contains examples of both N-linked and O-linked oligosaccharides.

Erythropoietin is 40% carbohydrate by weight.



Glycoproteins

- Glycosylation takes place in the endoplasmic reticulum and the Golgi apparatus.



Glycoproteins

- The influenza virus enters its host cells by recognizing specific oligosaccharides on the host cells surface.
  - The viral protein **hemagglutinin** recognizes and binds to the oligosaccharides

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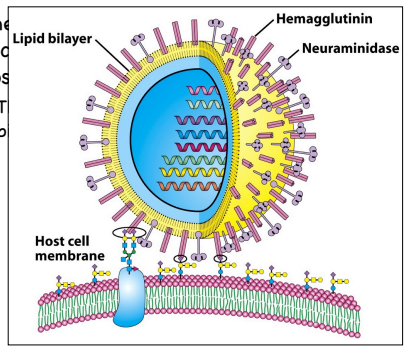

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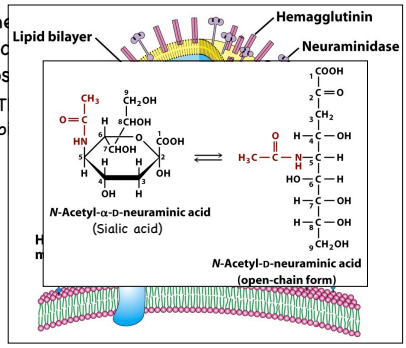

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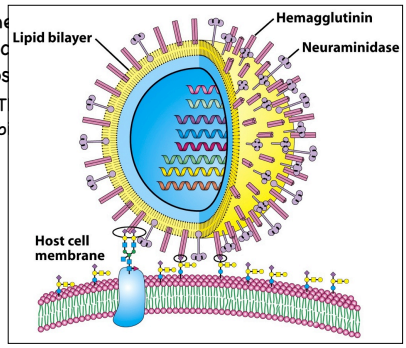

Next up

- Unit IV, Lecture 8 – Lipids and Cell Membranes (Chapter 12)