

Carbohydrates

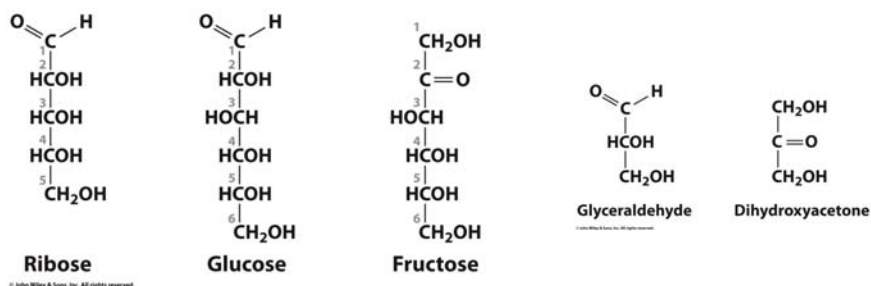
Pratt and Cornely, Chapter 11

Objectives

- Recognize and draw particular carbohydrate structures
- Know general structural elements of straight chain and cyclic monosaccharides
- Draw and name disaccharides
- Understand structure/function relationships of polysaccharides
- Predict the products of glycoside formation and breakdown

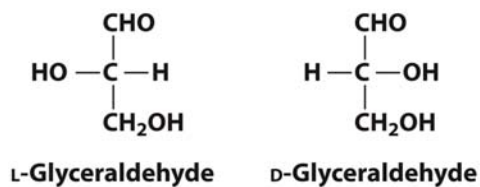
Straight-chain Monosaccharides

- Aldose/ketose terminology
- Triose, tetrose, pentose, hexose
- Recognize isomerization
 - Review mechanism from chapter 6



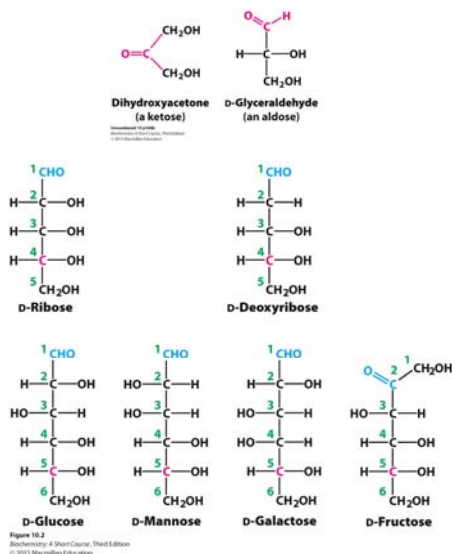
Stereochemistry

- D/L designation
- Fisher Projections
- **Problem 6:** How many stereoisomers are possible for a ketopentose, ketohexose, and ketoheptose?



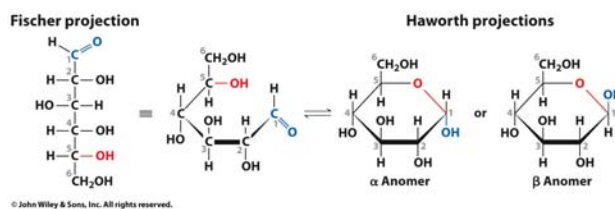
Structures to Know

- Dihydroxyacetone
- D-glyceraldehyde
- D-ribose
- D-glucose
- D-galactose
- D-fructose
- D-mannose



Cyclic Monosaccharides

- Pyranose
- Haworth Projection
- Anomeric carbon
- Alpha and beta anomers

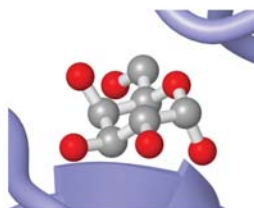
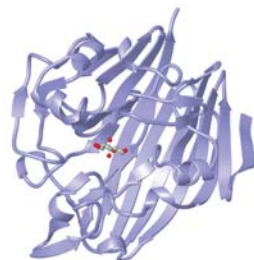


Problem 14

- Draw the mechanism of a cyclization reaction of D-galactose and draw the 2 possible products.

Mutarotase

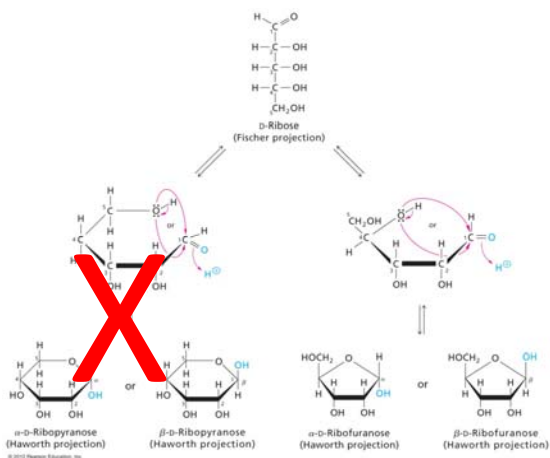
- Reaction of cyclic carbohydrates which equilibrates anomers



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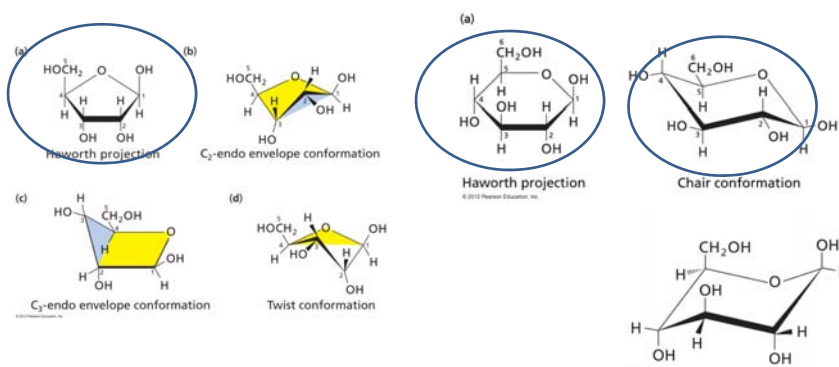
Cyclic Monosaccharides

- Furanose
- Just focus on what is commonly observed
 - Pyranoses: glucose, galactose
 - Furanoses: ribose, fructose

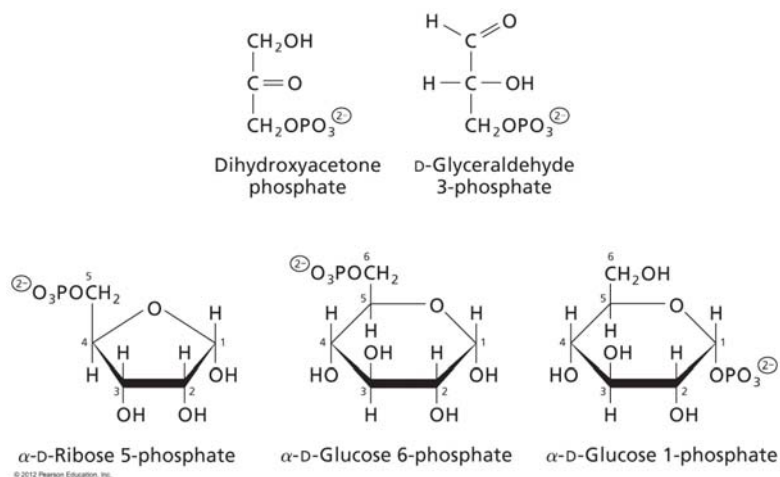


Conformations

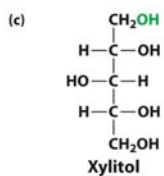
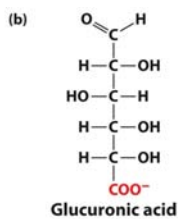
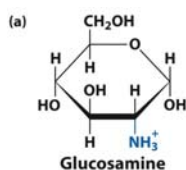
- Haworth and chair (no envelopes, etc)



Derivatives: Sugar Phosphates



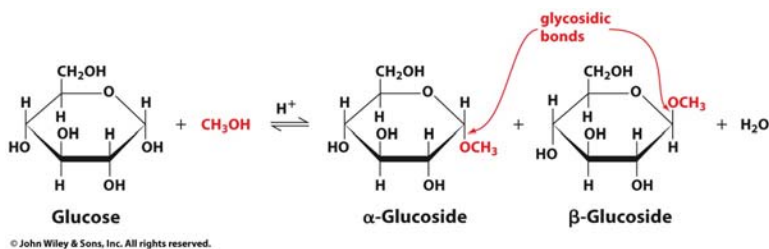
Other Derivatives



- **Problems 27-28:** Draw these products: a. gluconate (oxidation product of the aldehyde of glucose); b. sorbitol (reduction product of glucose)

Structure of Disaccharides

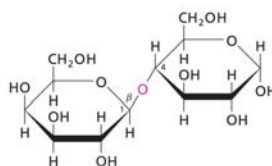
- Condensation of Monosaccharides
 - Loss of anomeric hydroxyl group and proton of nucleophilic alcohol
 - Glycosidic Bond



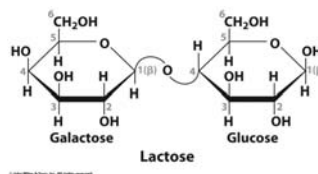
Structure of Disaccharides

- Nomenclature of linkage
 - Find the acetal!
 - Number and linkage
- Reducing sugar
 - Find the hemiacetal!
- Lactose

(c)

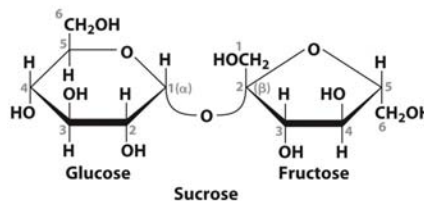


α anomer of lactose
(β -D-Galactopyranosyl-(1 \rightarrow 4)- α -D-glucopyranose)



Sucrose

- Non-reducing sugar
 - No hemiacetal
 - Notice that fructose is upside down



Polysaccharides

Table 8.2 Structures of some common polysaccharides

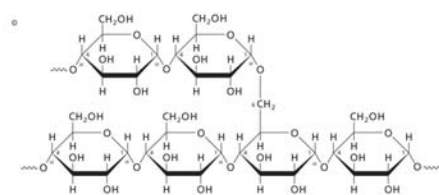
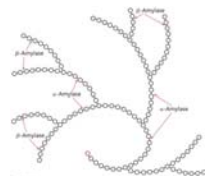
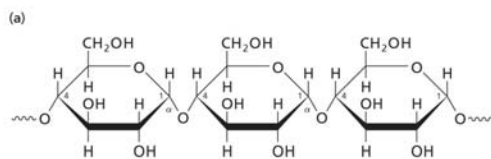
Polysaccharide ^a	Component(s) ^b	Linkage(s)
Storage homoglycans		
Starch		
Amylose	Glc	α -(1 \rightarrow 4)
Amylopectin	Glc	α -(1 \rightarrow 4), α -(1 \rightarrow 6) (branches)
Glycogen	Glc	α -(1 \rightarrow 4), α -(1 \rightarrow 6) (branches)
Structural homoglycans		
Cellulose	Glc	β (1 \rightarrow 4)
Chitin	GlcNAc	β (1 \rightarrow 4)
Heteroglycans		
Glycosaminoglycans	Disaccharides (amino sugars, sugar acids)	Various
Hyaluronic acid	GlcUA and GlcNAc	β (1 \rightarrow 3), β (1 \rightarrow 4)

^aPolysaccharides are unbranched unless otherwise indicated.

^bGlc, Glucose; GlcNAc, N-acetylglucosamine; GlcUA, D-glucuronate.

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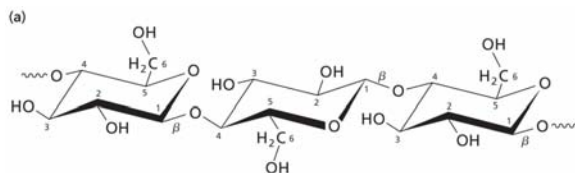
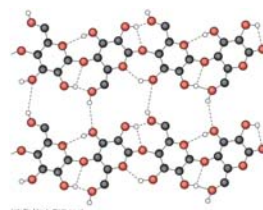
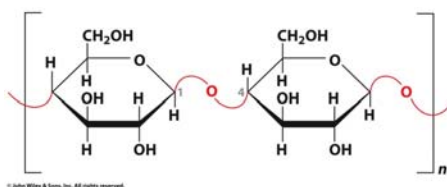
Starch and Glycogen



Compact storage

Cellulose

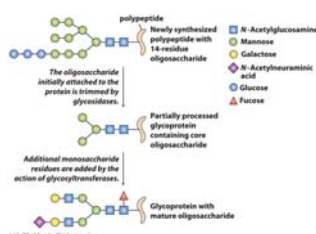
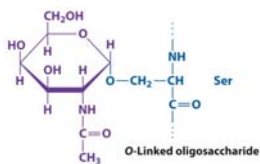
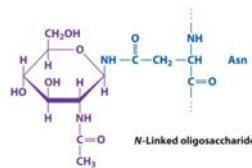
- Watch structure carefully!



Function:
structural support

Glycoproteins

- Protection and Recognition
- N-linked—Asn
 - Processed
 - Glycosidases, glycotransferase
- O-linked—Ser, Thr
 - Very large (80% of mass)



Blood types

- Genes for different glycosyltransferases
- Blood type: difference in antigen on surface of red blood cells
- Transfusions

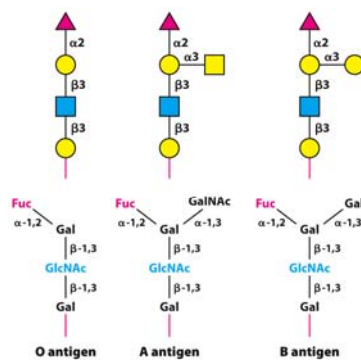
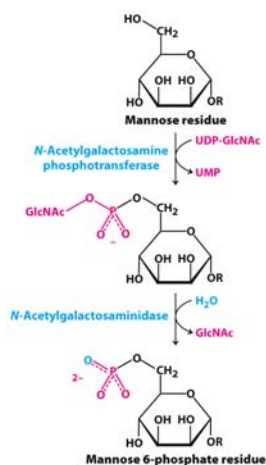


Figure 19.24
Biochemistry: A Short Course, Third Edition
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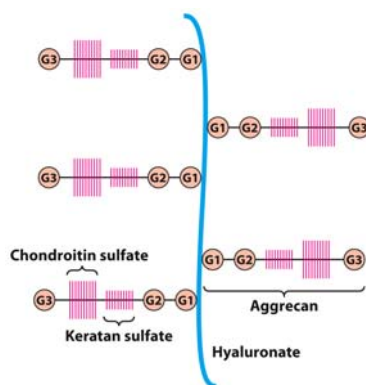
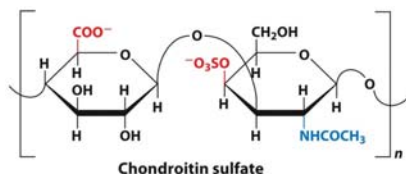
Congenital Disorders of Glycosylation



- Lysozyme digestive enzymes are marked for delivery by mannose-6-P
- A **lectin** (protein that selectively recognizes a glycan) on the lysozyme surface directs delivery
- If not phosphorylated, enzymes sent to wrong place and therefore...
- Lysozymes cannot degrade glycosaminoglycan...
- Buildup leads to skeletal and psychomotor retardation

Proteoglycan

- Mostly carbohydrate
- Highly charged
- Acts as sponge in joints



Peptidoglycan

- Bacterial cell wall
- Target for penicillin

