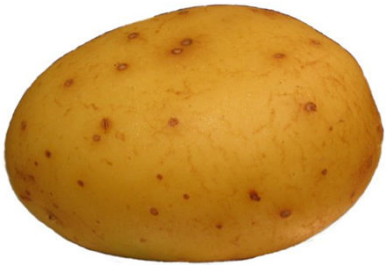
Carbohydrates serve a variety of functions

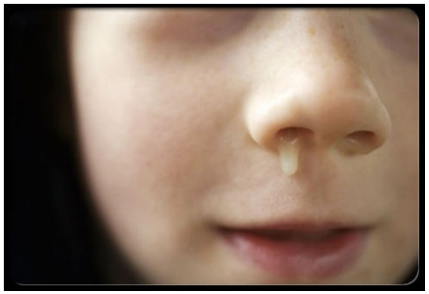


starch

Energy storage and food

Structure and support

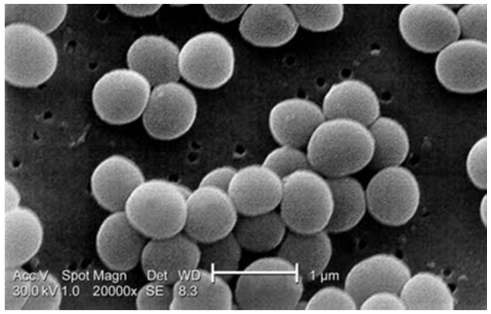
chitin and cellulose



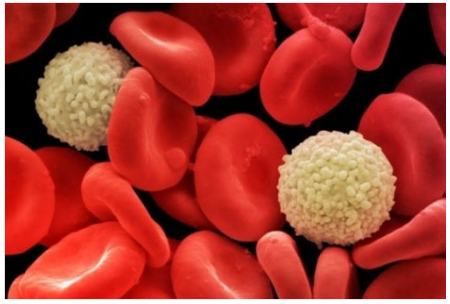
mucin (glycoprotein)

Lubrication

Protection



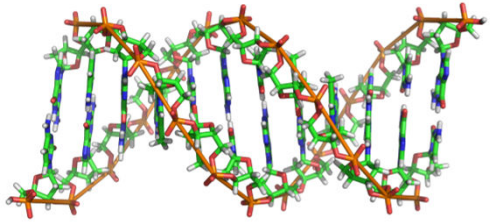
cell wall peptidoglycan



surface glycoproteins

Recognition and signaling

Component of nucleotides



2-deoxyribose

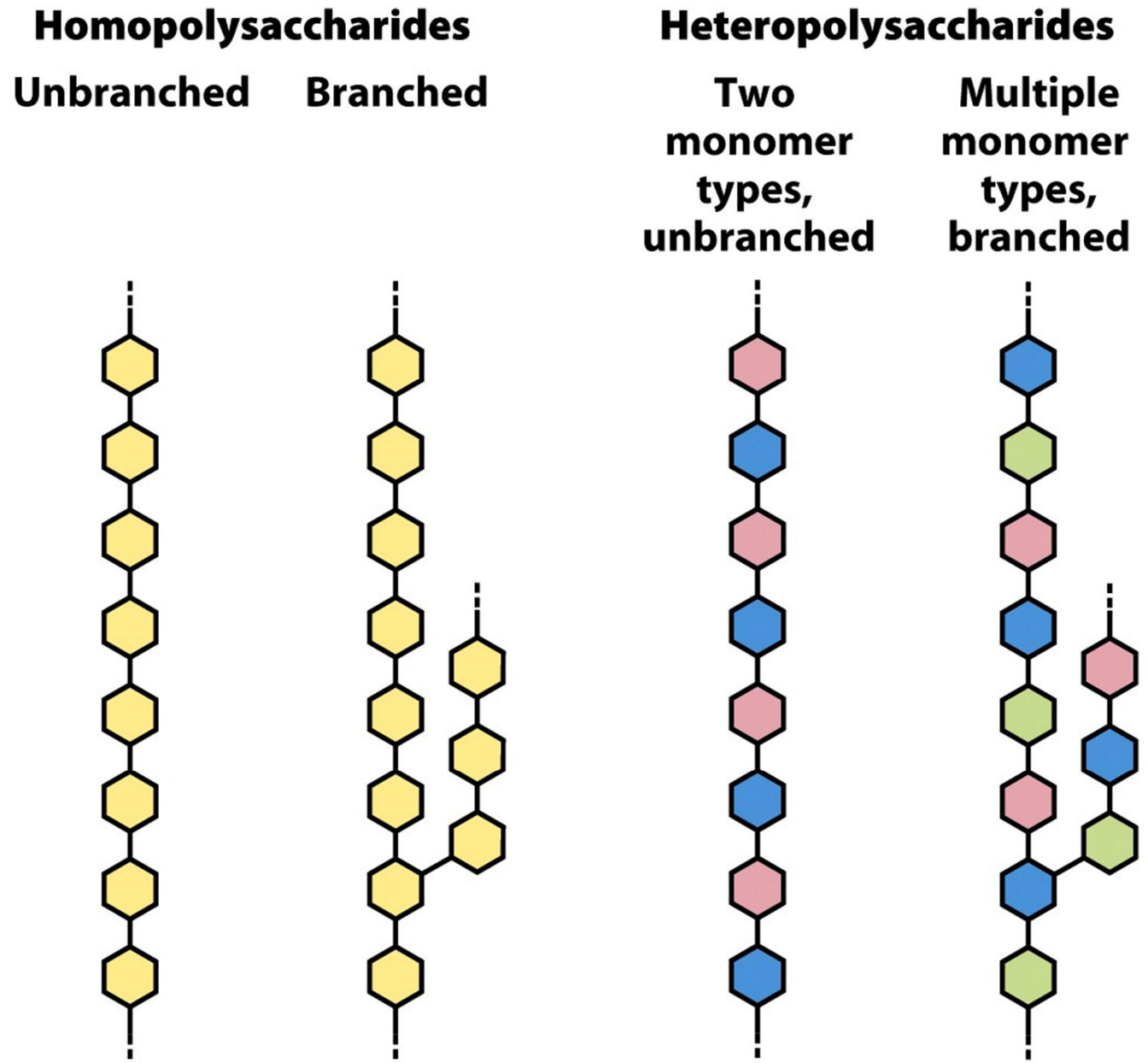


Figure 7-13
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As for polypeptides, torsion angles describe the conformations of polysaccharides

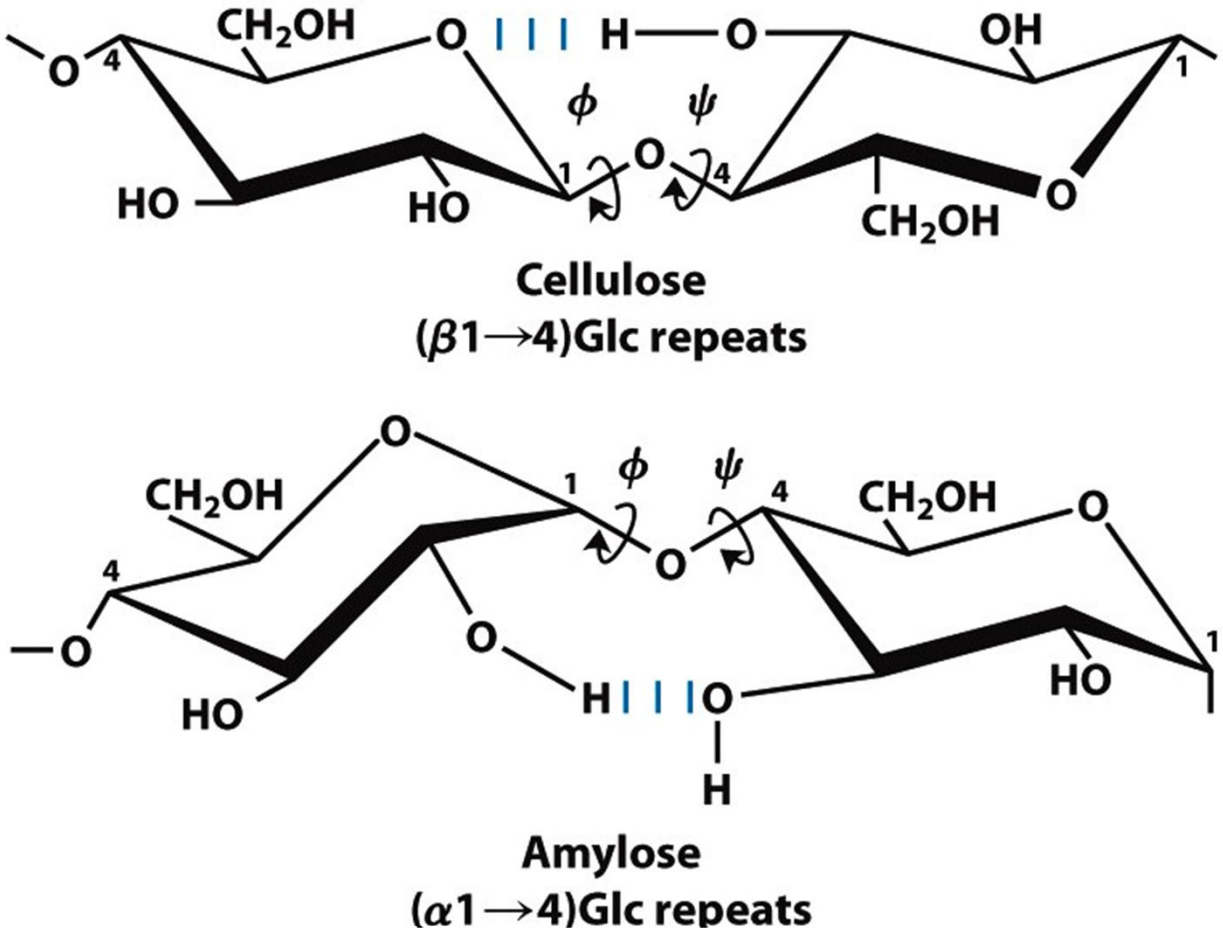
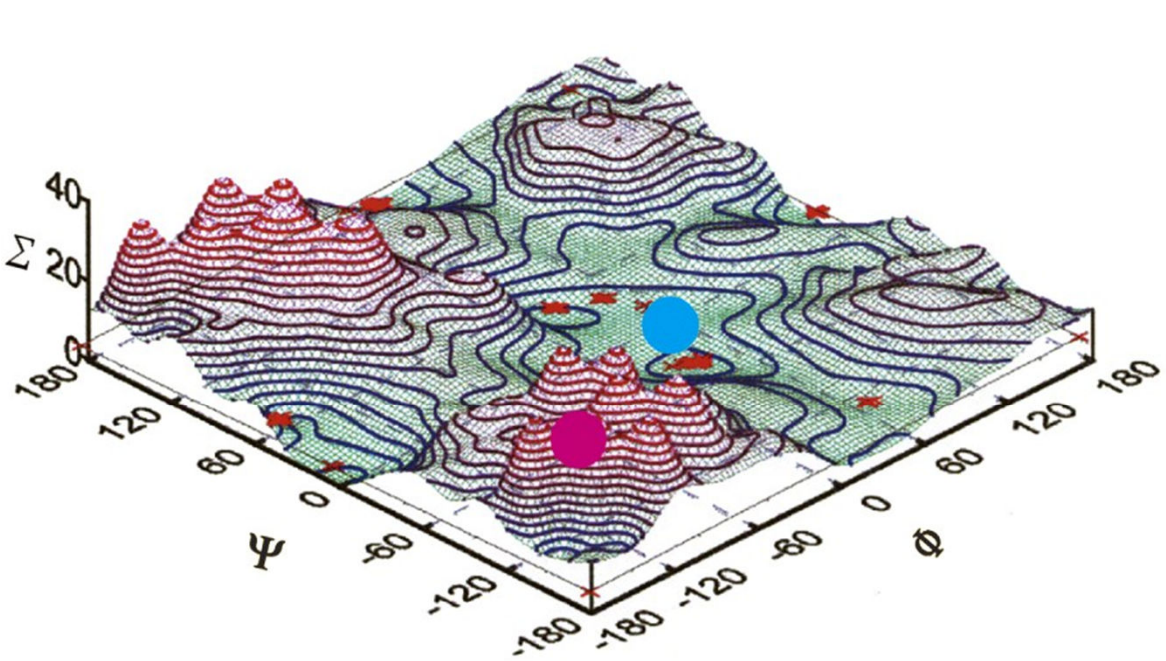
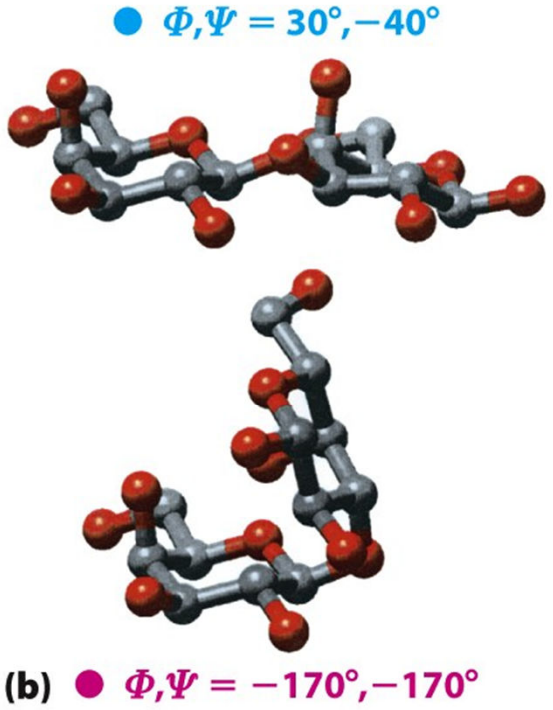


Figure 7-18
Lehninger Principles of Biochemistry, Fifth Edition

Certain conformations (values of ϕ and ψ) are more energetically favored than others



(a)



(b)

Figure 7-19
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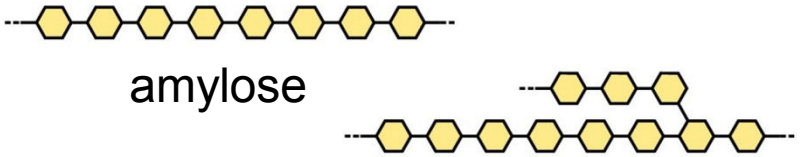
Both the identity of the monosaccharide units and how (where) they are linked will determine which conformations are preferred

We will cover 4 groups of polysaccharides:

Polysaccharides

Energy storage



amylose

glycogen, amylopectin

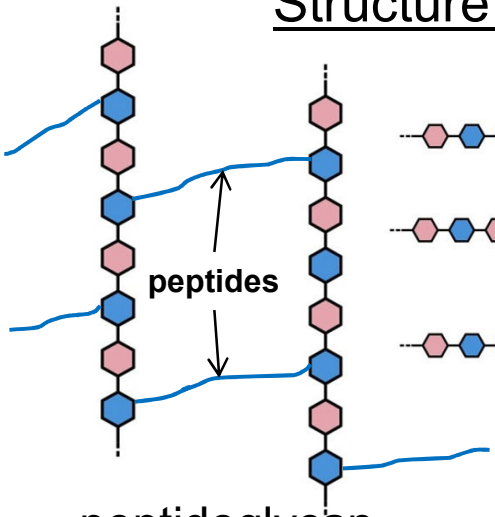
Structure & protection

cellulose, chitin

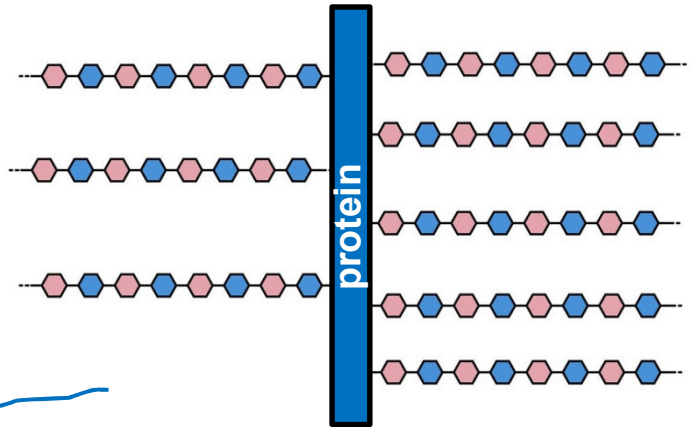
glycosaminoglycans

Glycoconjugates

Structure & protection

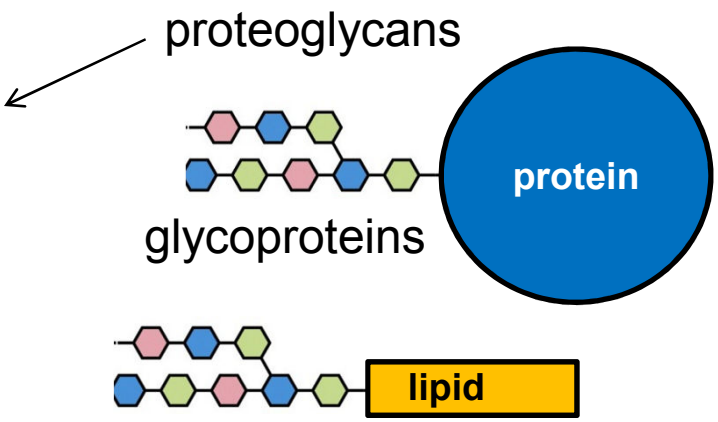


peptidoglycan



proteoglycans

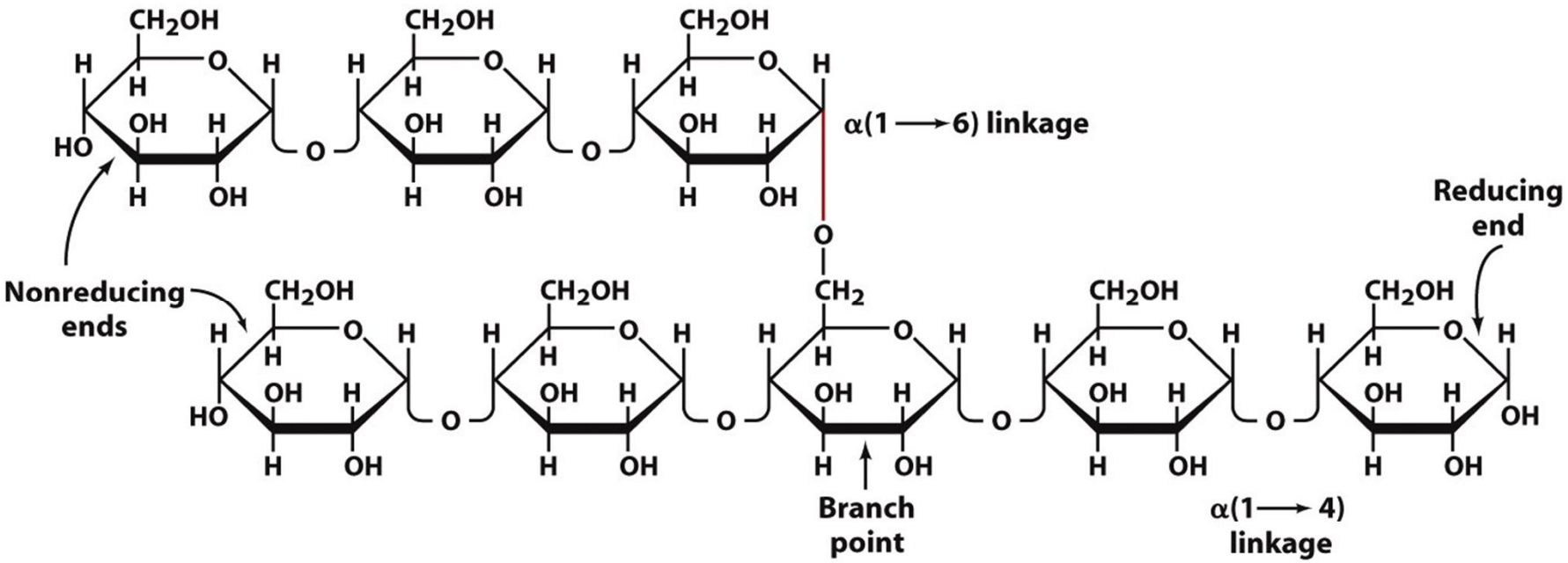
Recognition & adhesion



glycolipids

Energy storage polysaccharides of animals and plants are α-linked polymers of glucose

Animals store glycogen, a branched homopolysaccharide with α1→4 and α1→6 linkages



Energy storage polysaccharides of animals and plants are α-linked polymers of glucose

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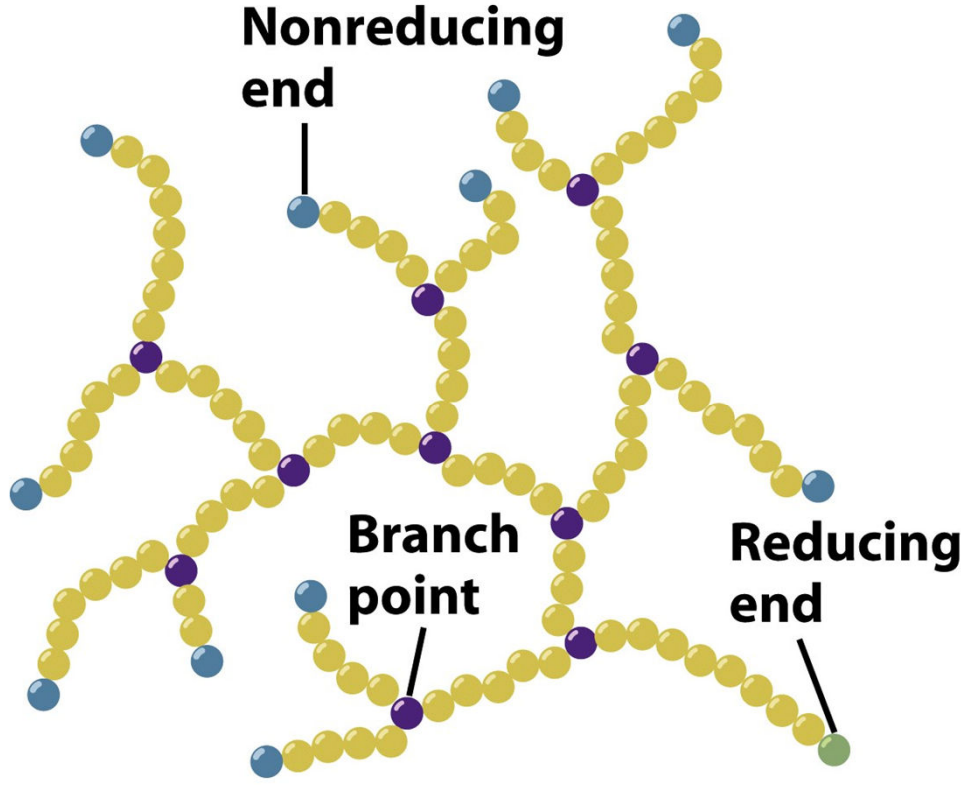
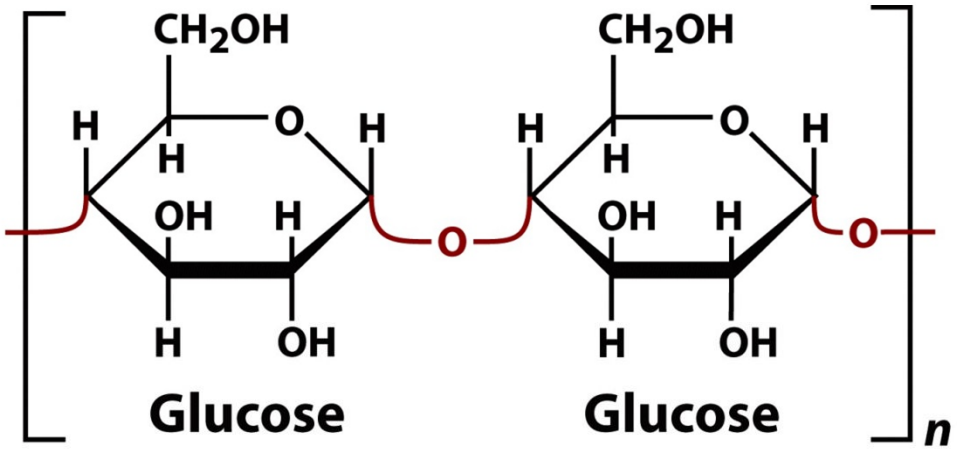
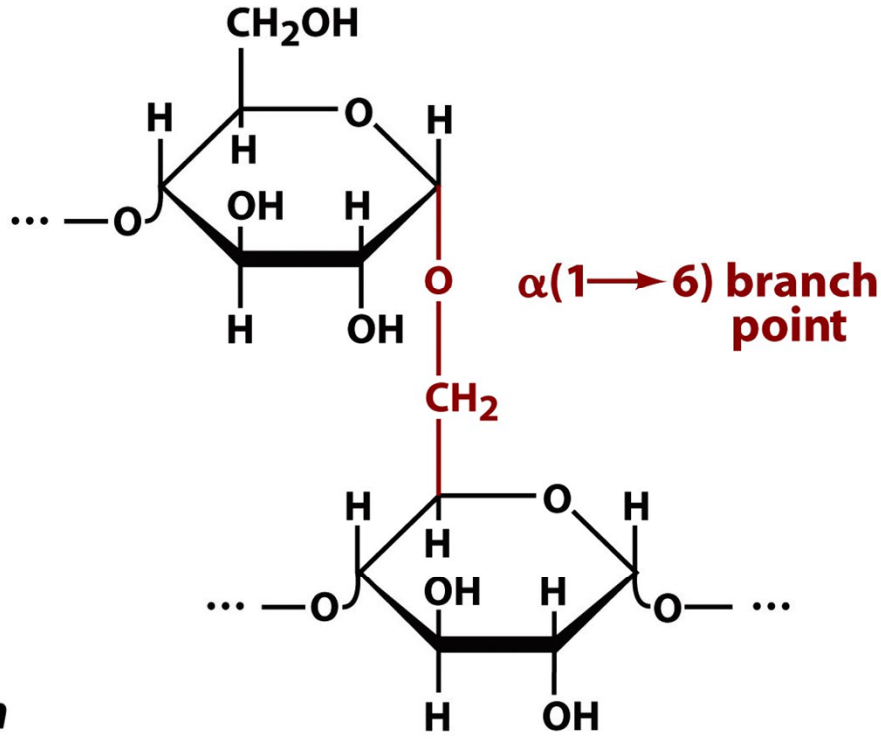


Energy storage polysaccharides of animals and plants are α-linked polymers of glucose

Plants store starch, an aggregate of amylose (linear) and amylopectin (branched)



α-Amylose



Amylopectin

Animals and plants use α-linked glucose polymers for energy storage

Plants store starch, an aggregate of amylose (linear) and amylopectin (branched)

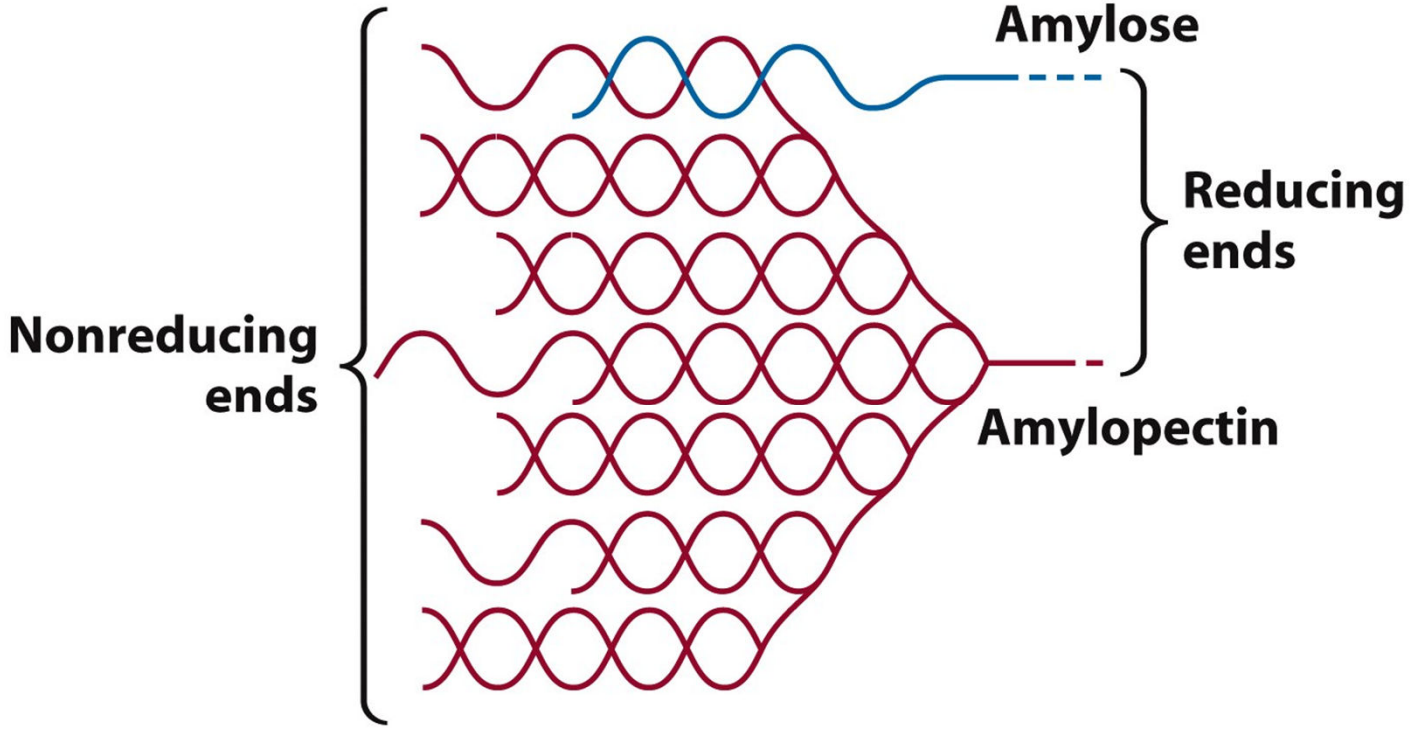


Figure 7-14c
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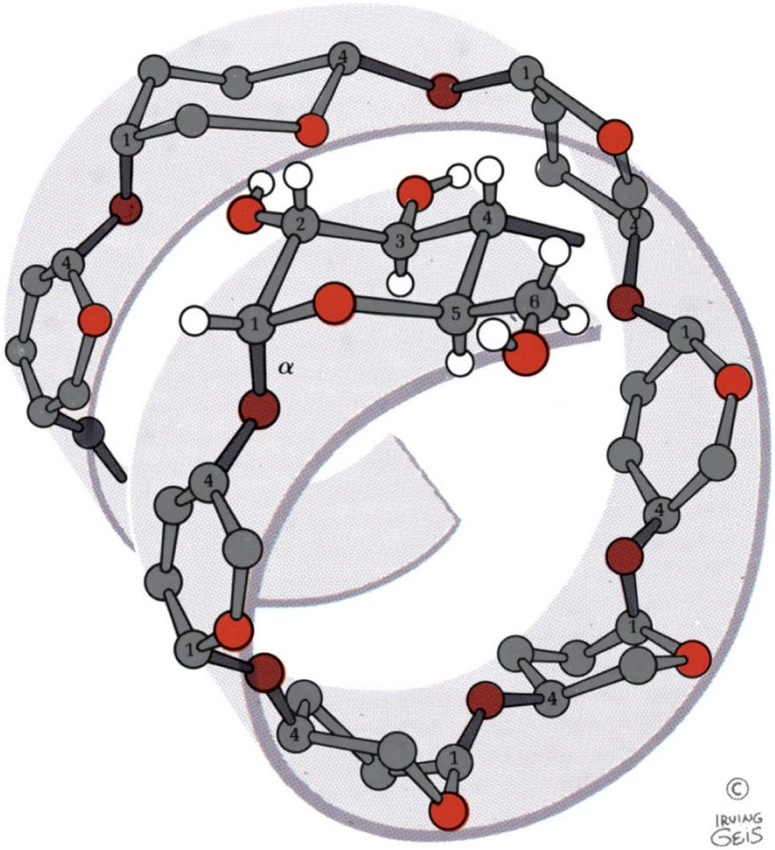
Glycogen and starch adopt loose, hydrated, helical structures that pack into granules



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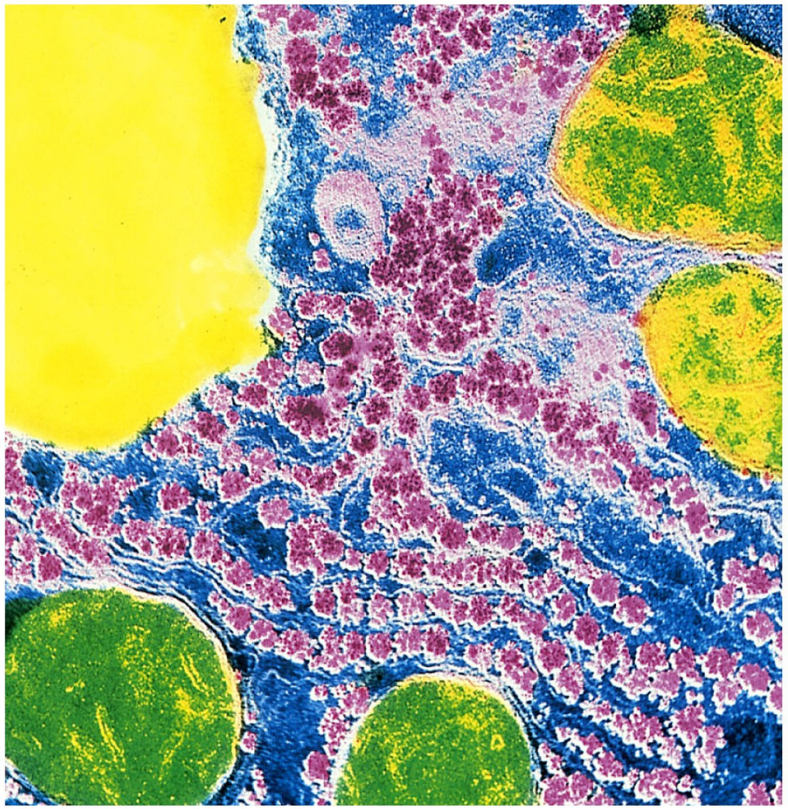
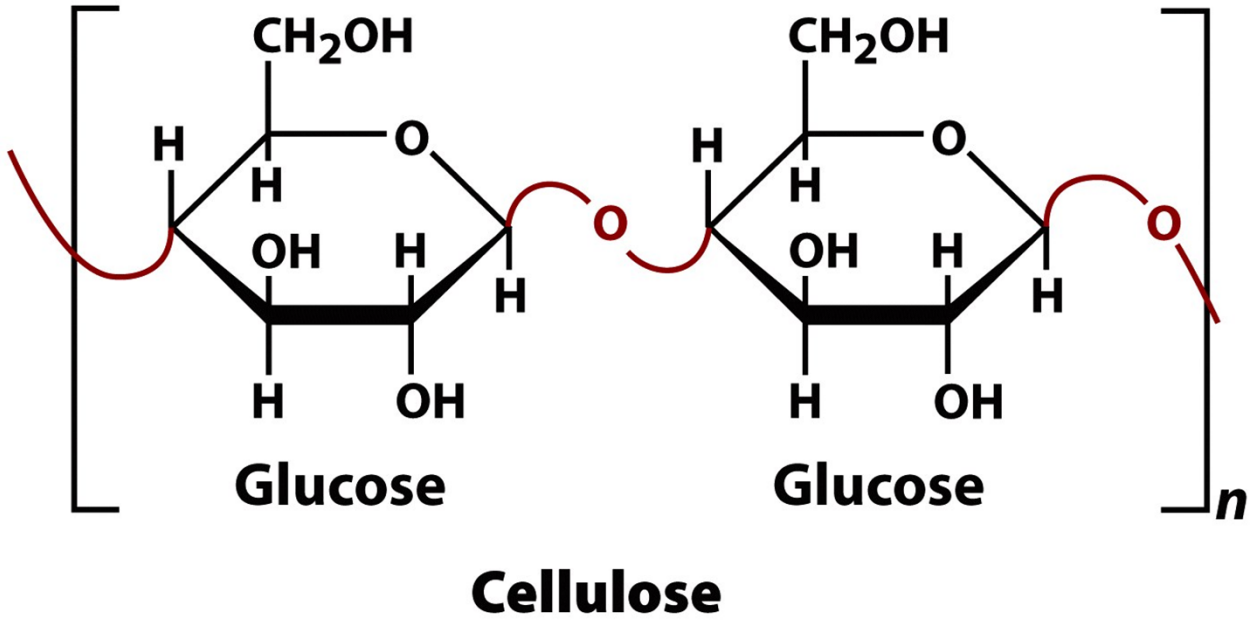


CNRI/Science Photo Library/Photo Researchers

Most structural polysaccharides are unbranched, β-linked polymers

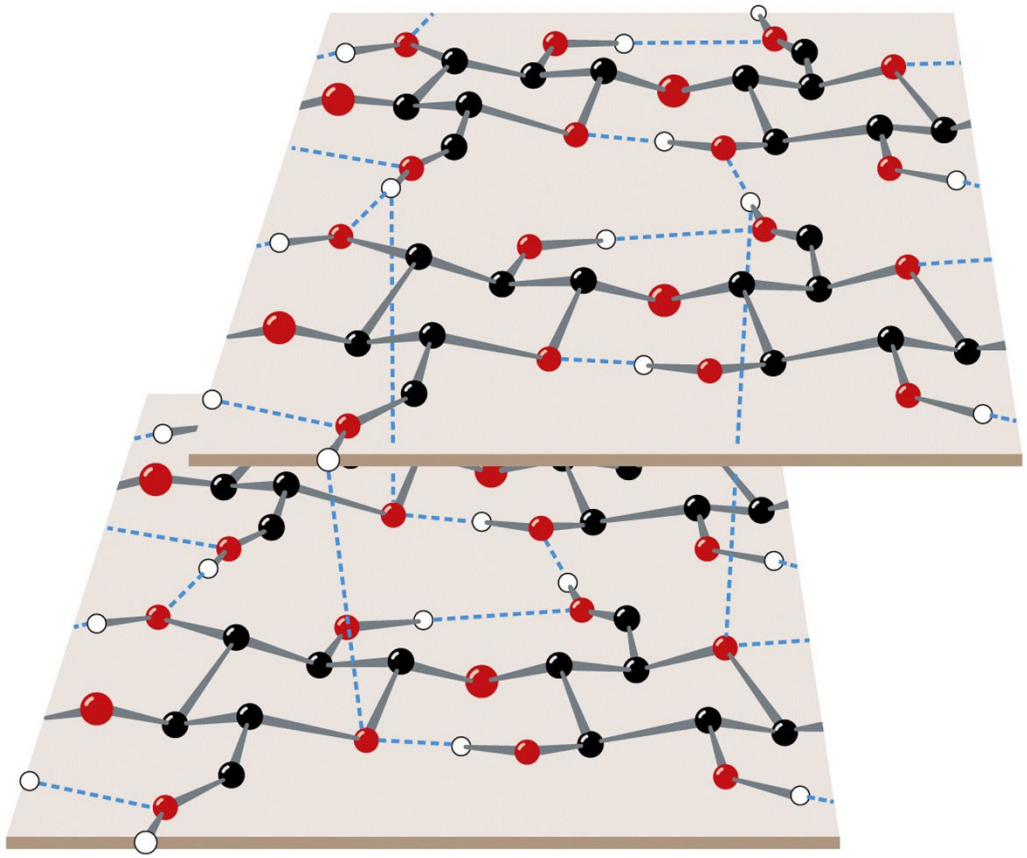
Cellulose, an unbranched glucose homopolymer, provides support and rigidity to plant cell walls

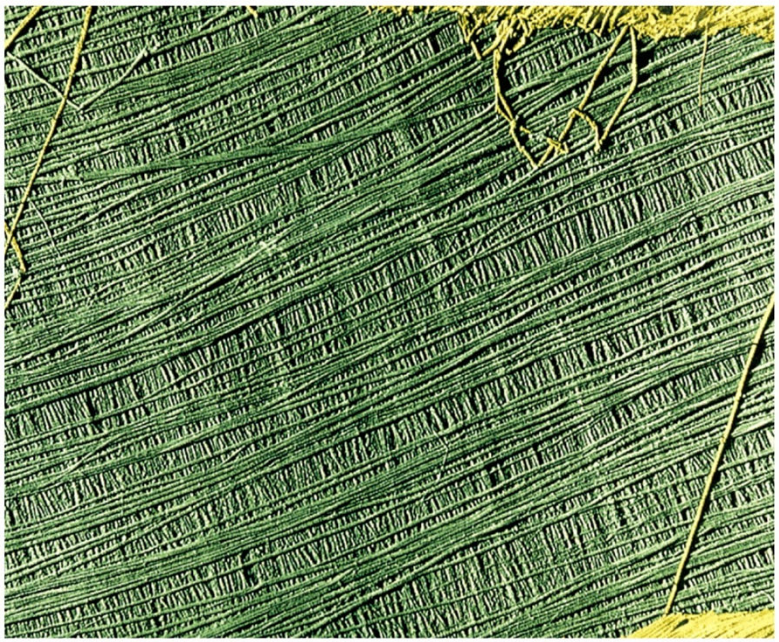


Cellulose

Most structural polysaccharides are unbranched, β-linked polymers

Cellulose chains form intra- and intermolecular H-bonds, stacking to form cohesive and rigid fibers



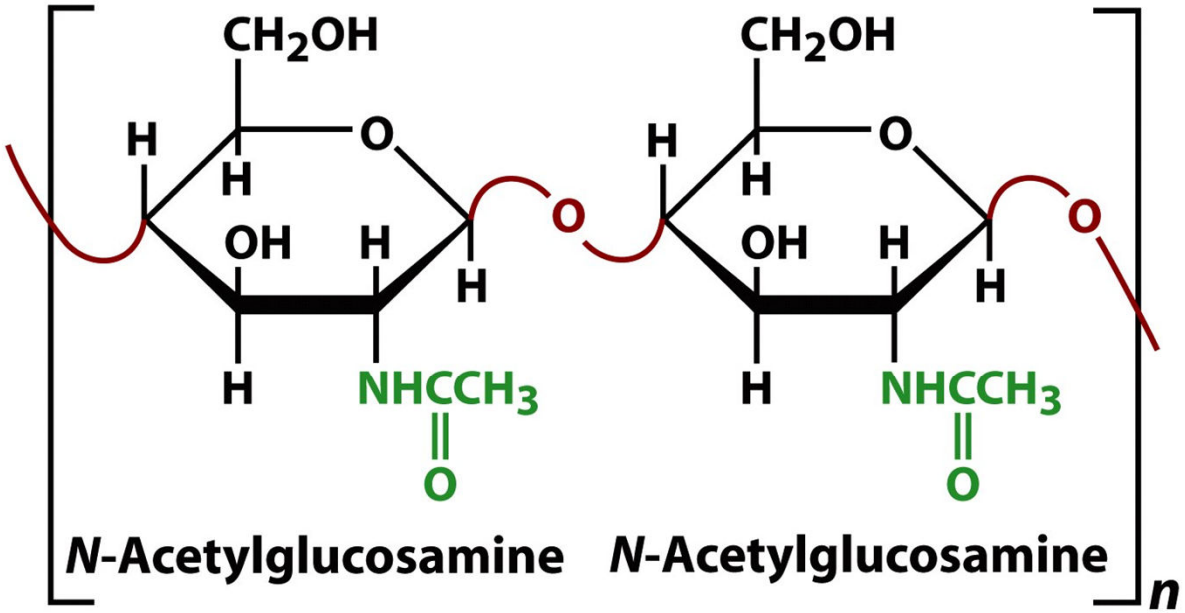


Biophoto Associates/Photo Researchers

Most structural polysaccharides are unbranched, β-linked polymers

Chitin gives rigidity to crustacean and insect exoskeletons and to the cell walls of fungi and algae

Linear homopolymer of GlcNAc; packing is similar to cellulose



Chitin

Figure 7-17b
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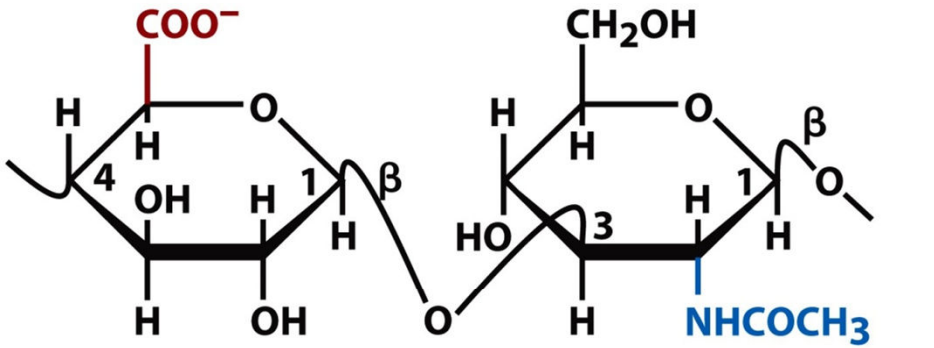
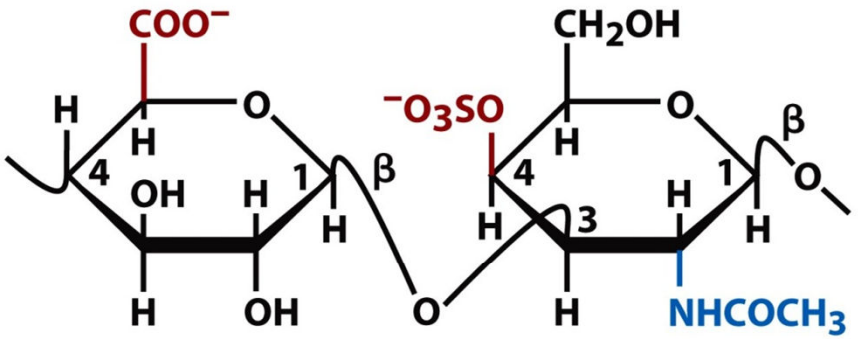
Most structural polysaccharides are unbranched, β-linked polymers

Glycosaminoglycans act as shock absorbers and lubricants in the extracellular spaces of tissues



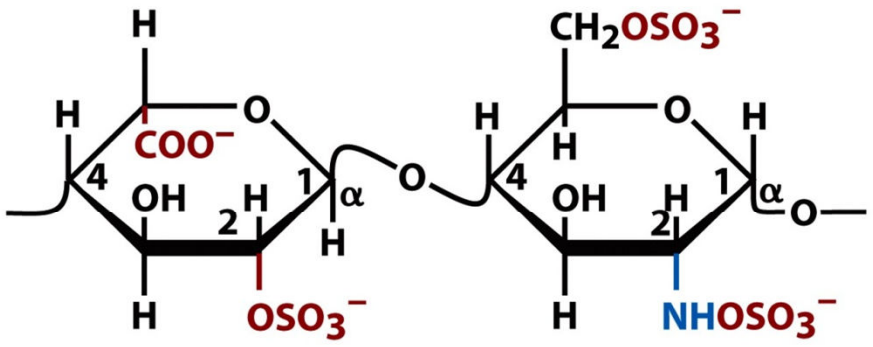
Hyaluronate

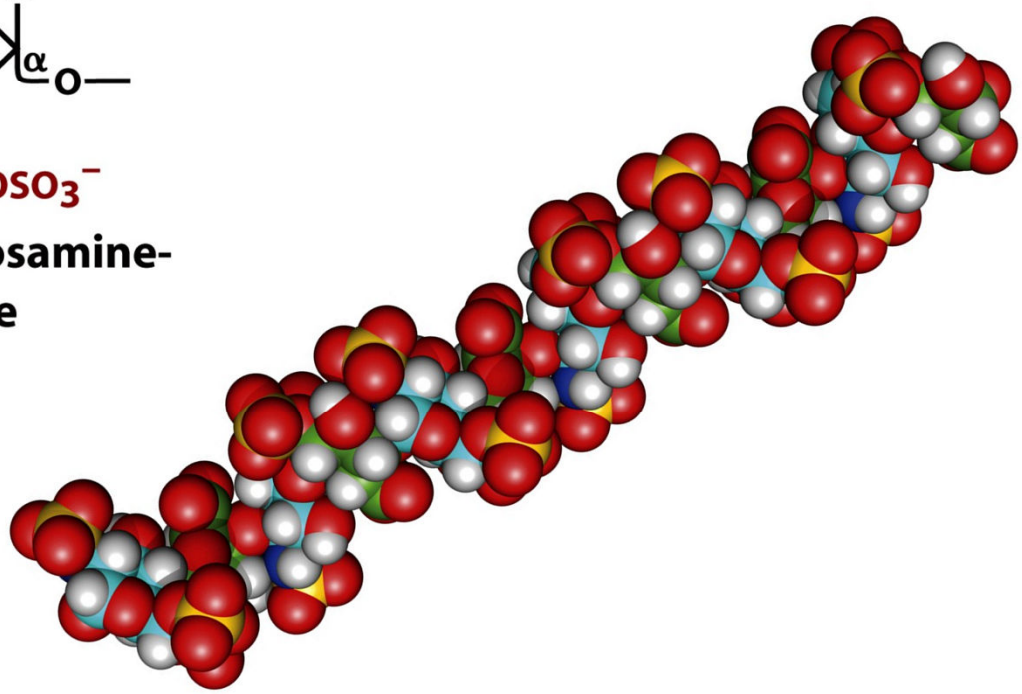


Chondroitin-4-sulfate

Most structural polysaccharides are unbranched, β-linked polymers

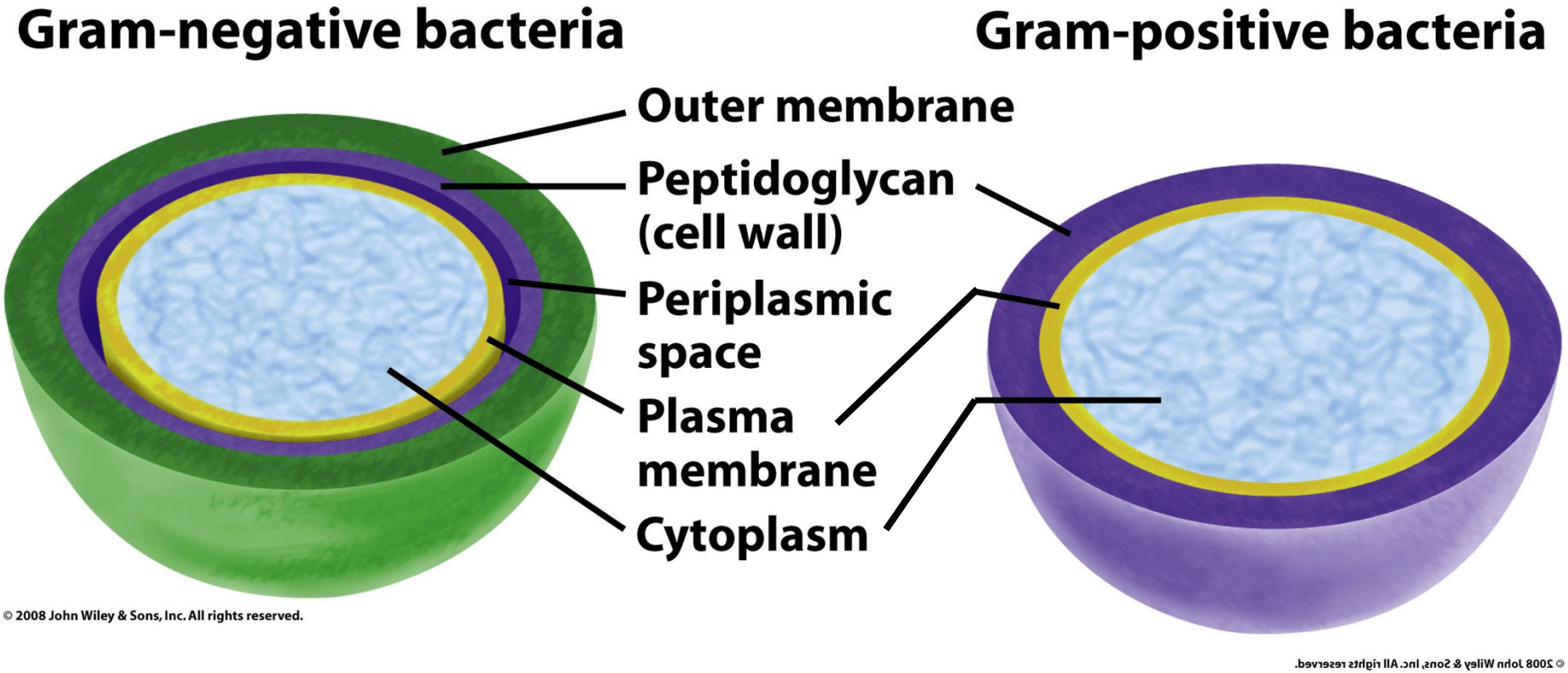
Abundance of negative charge keeps glycosamino-glycan chains extended, separated, and hydrated



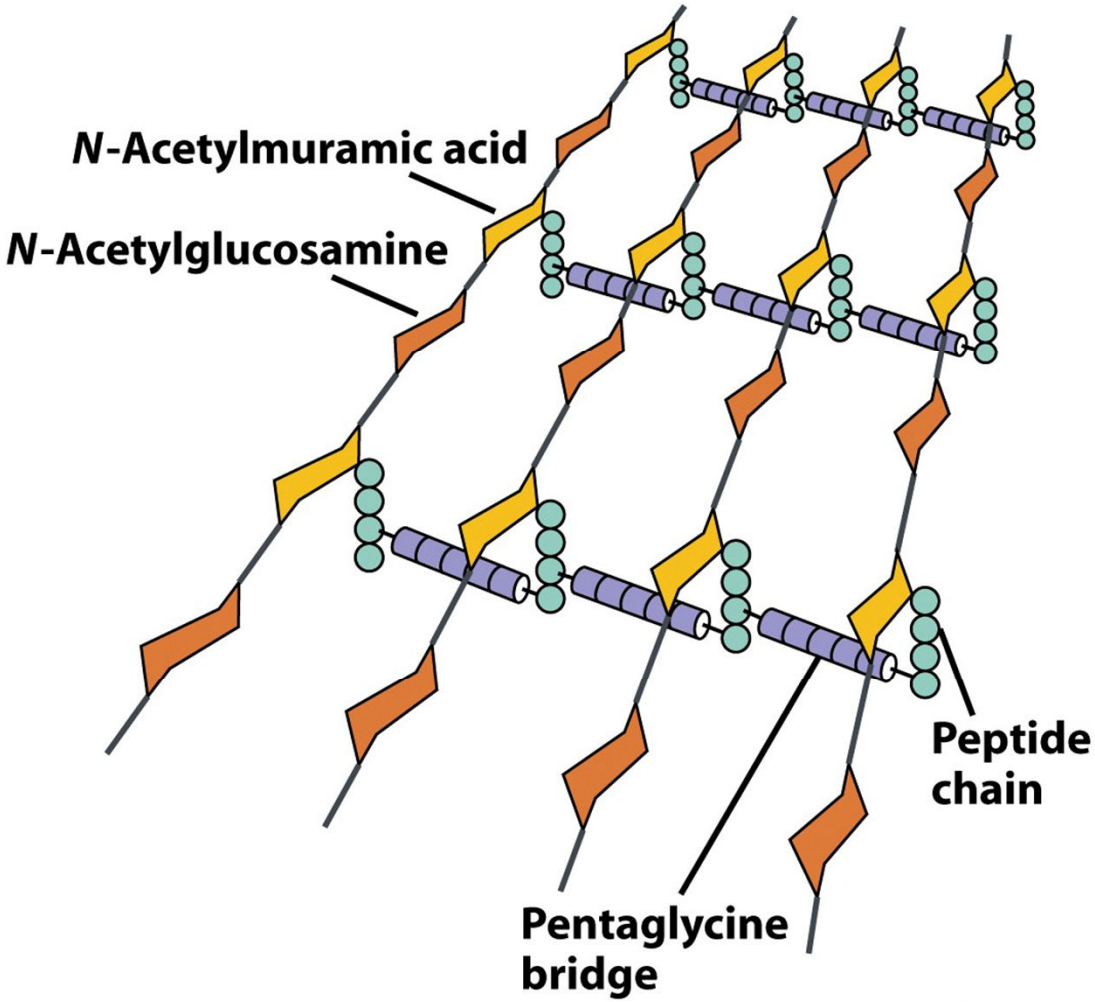


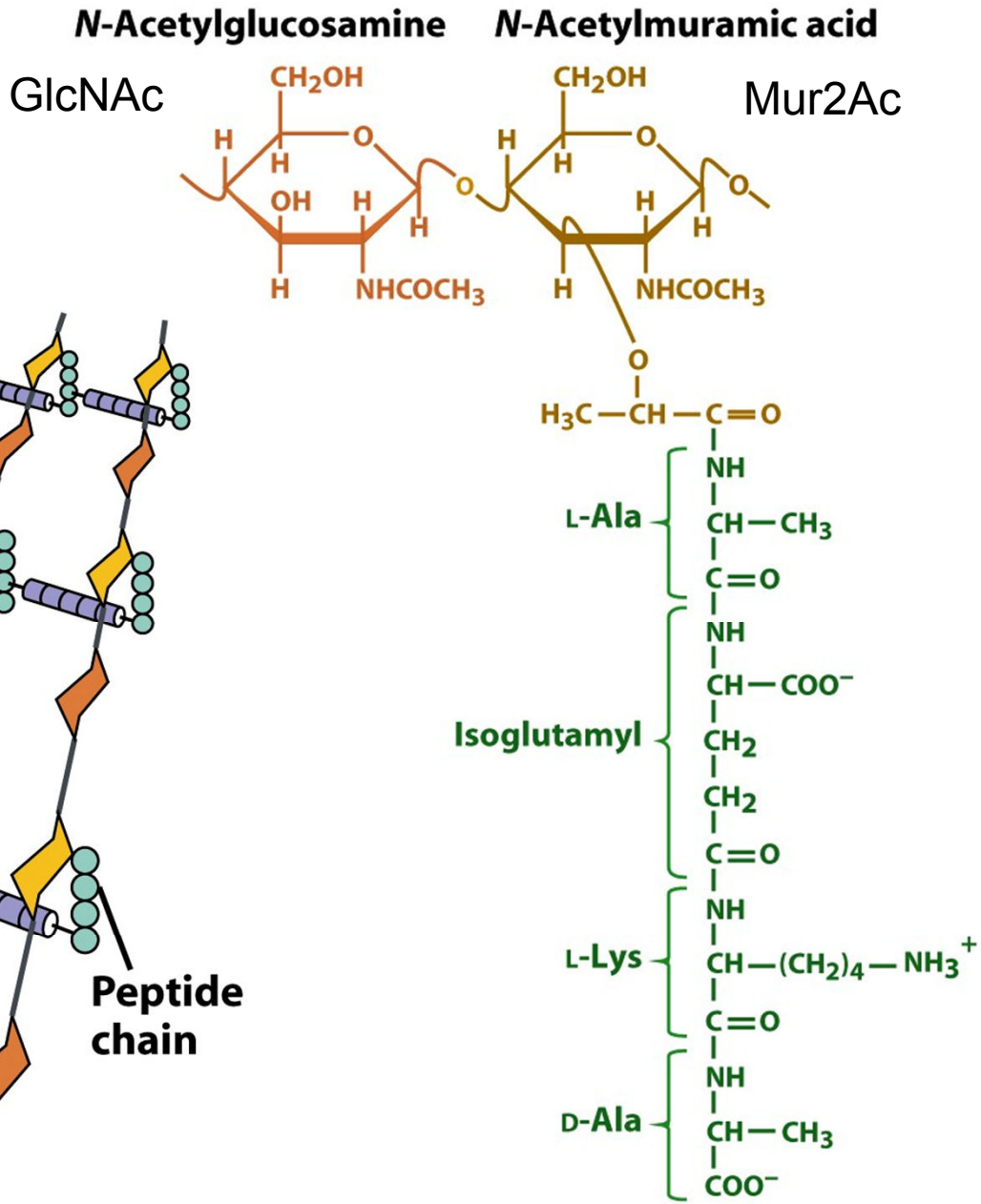
Glycoconjugates have polysaccharides covalently bonded to other molecule types

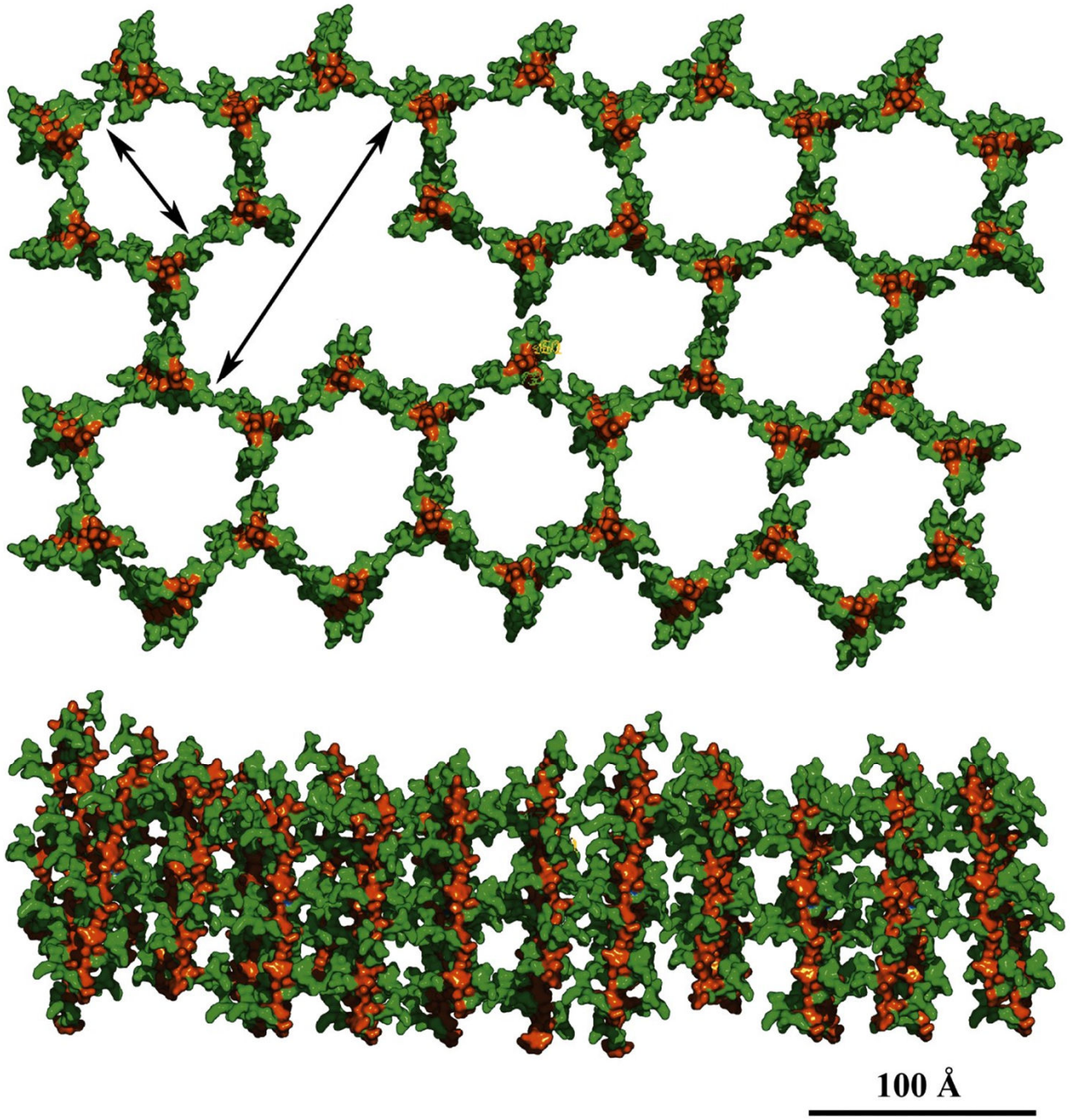
Peptidoglycan, composed of polysaccharides linked by peptides, comprises the bacterial cell wall



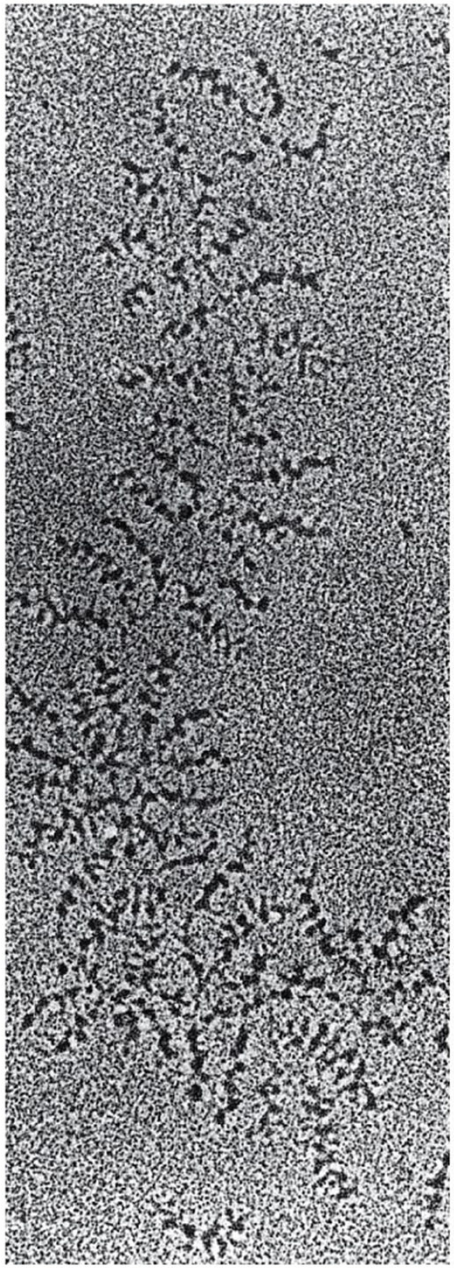
S. aureus peptidoglycan







Courtesy of Shahriar Mobashery, University of Notre Dame



From Caplan, A.I., *Sci. Am.* 251(4), 87 (1984).

Proteoglycans are conjugates of proteins and glycosaminoglycans

Proteoglycans are major components of connective tissue