Disciplina de Bioquímica Geral

Curso de Ciências Biológicas

Glicoconjugados e Glicobiologia

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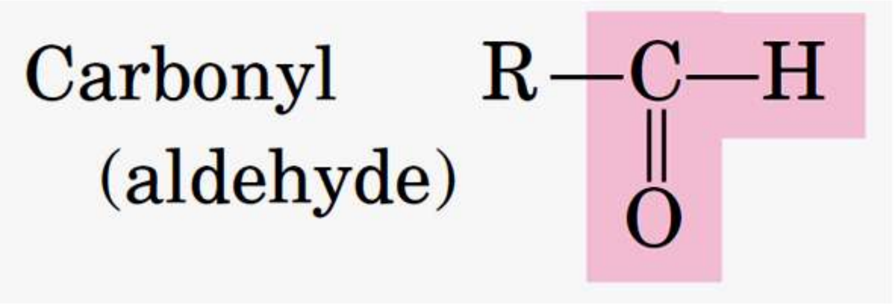
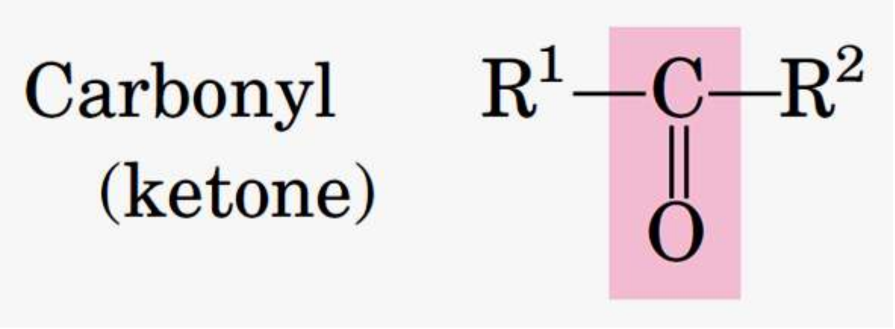
Carboidratos: poliidroxialdeídos ou poliidroxicetonas ou substâncias que liberam estes compostos quando hidrolisadas.

(CH_2O)

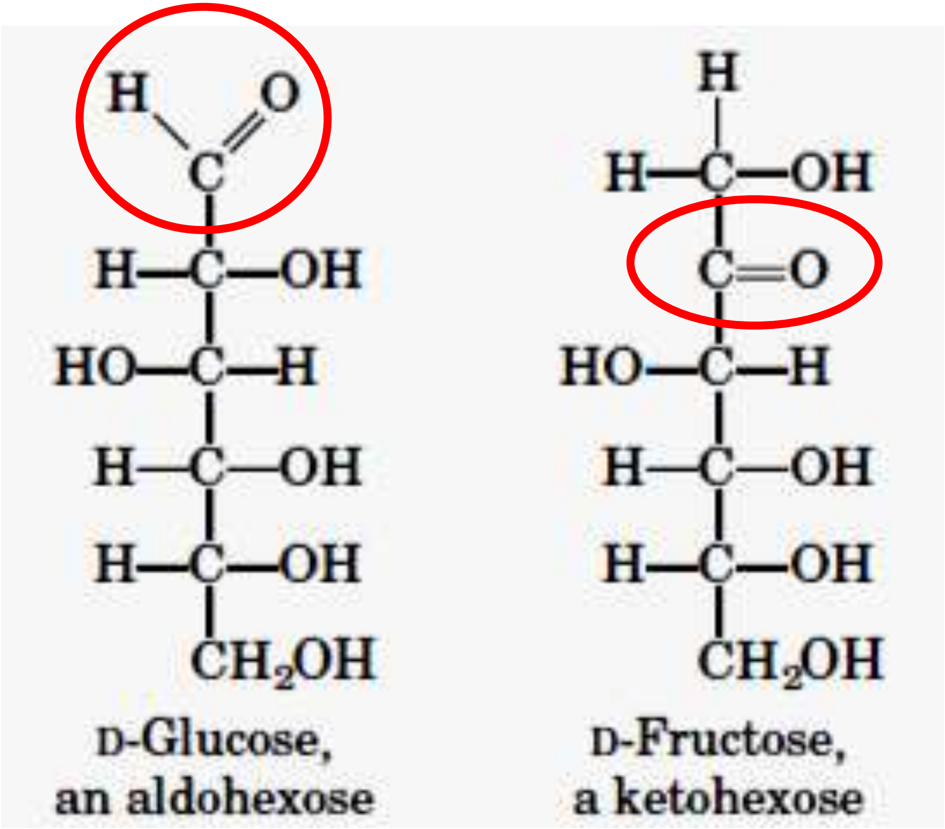
nem todos

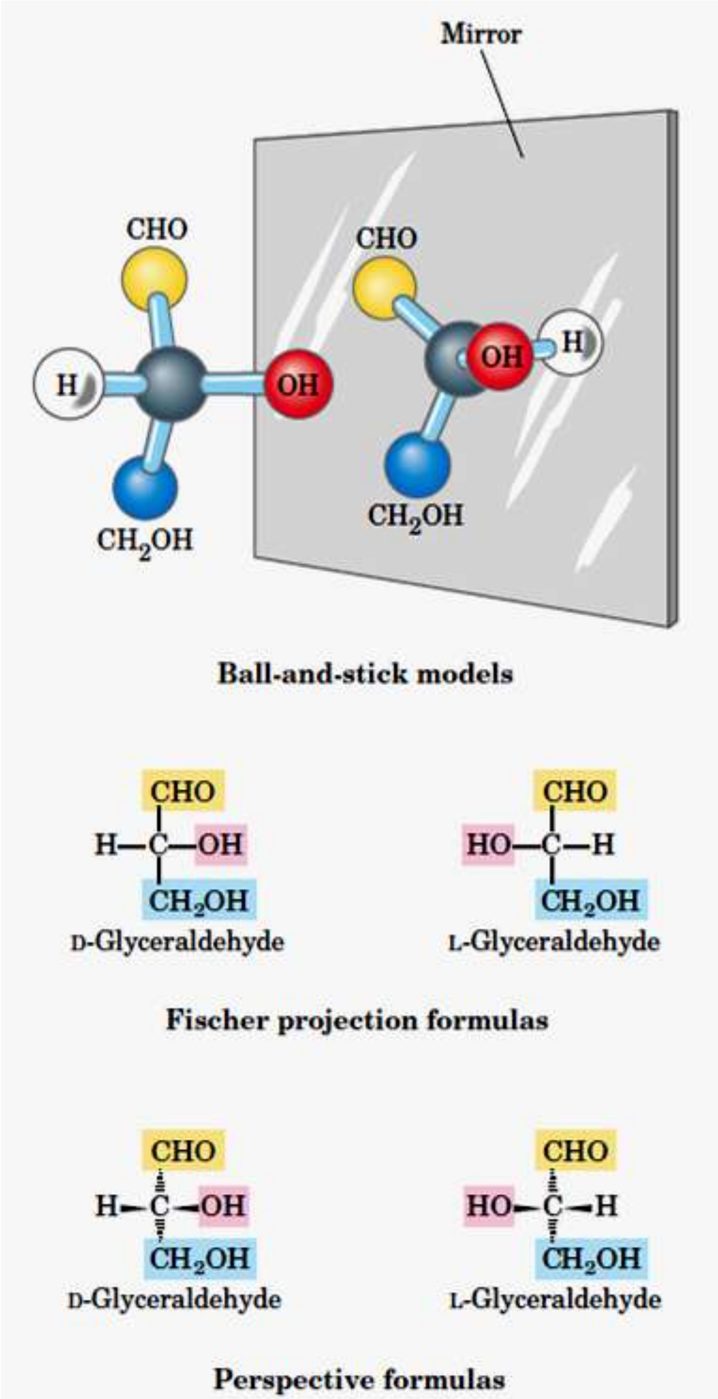
podem ter N, P ou S

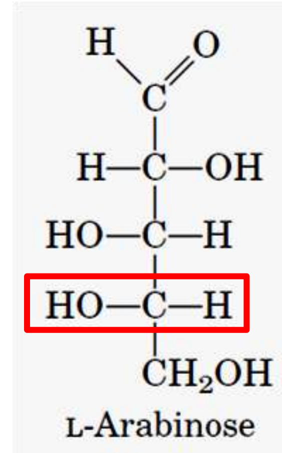




Carboidratos: poliidroxialdeídos ou poliidroxicetonas ou substâncias que liberam estes compostos quando hidrolisadas.







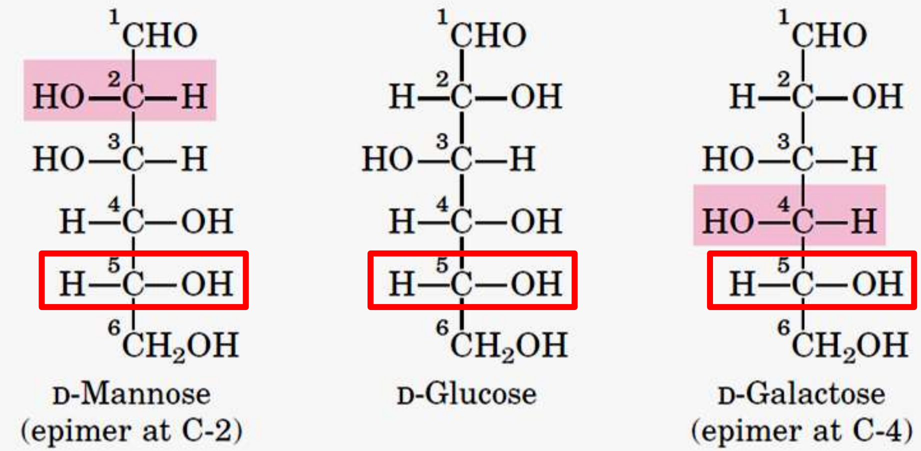


FIGURE 7–4 **Epimers.** D-Glucose and two of its epimers are shown as projection formulas. Each epimer differs from D-glucose in the configuration at one chiral center (shaded red).

Numeração dos carbonos

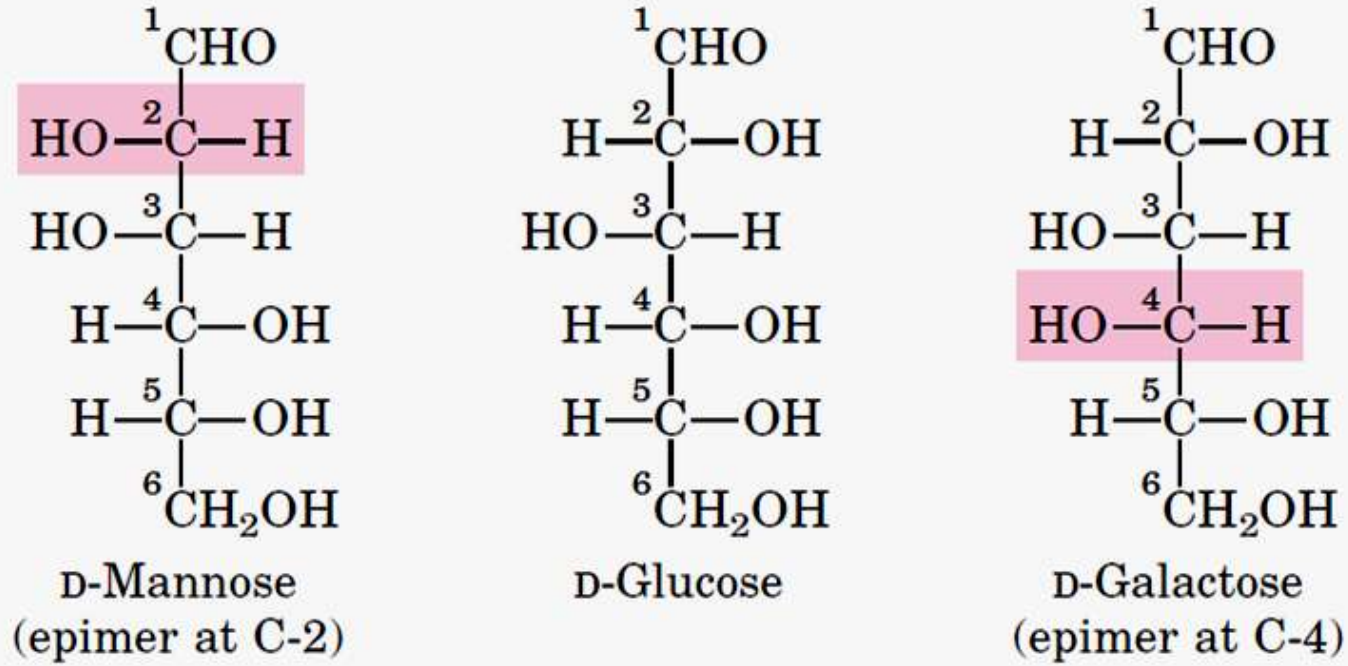
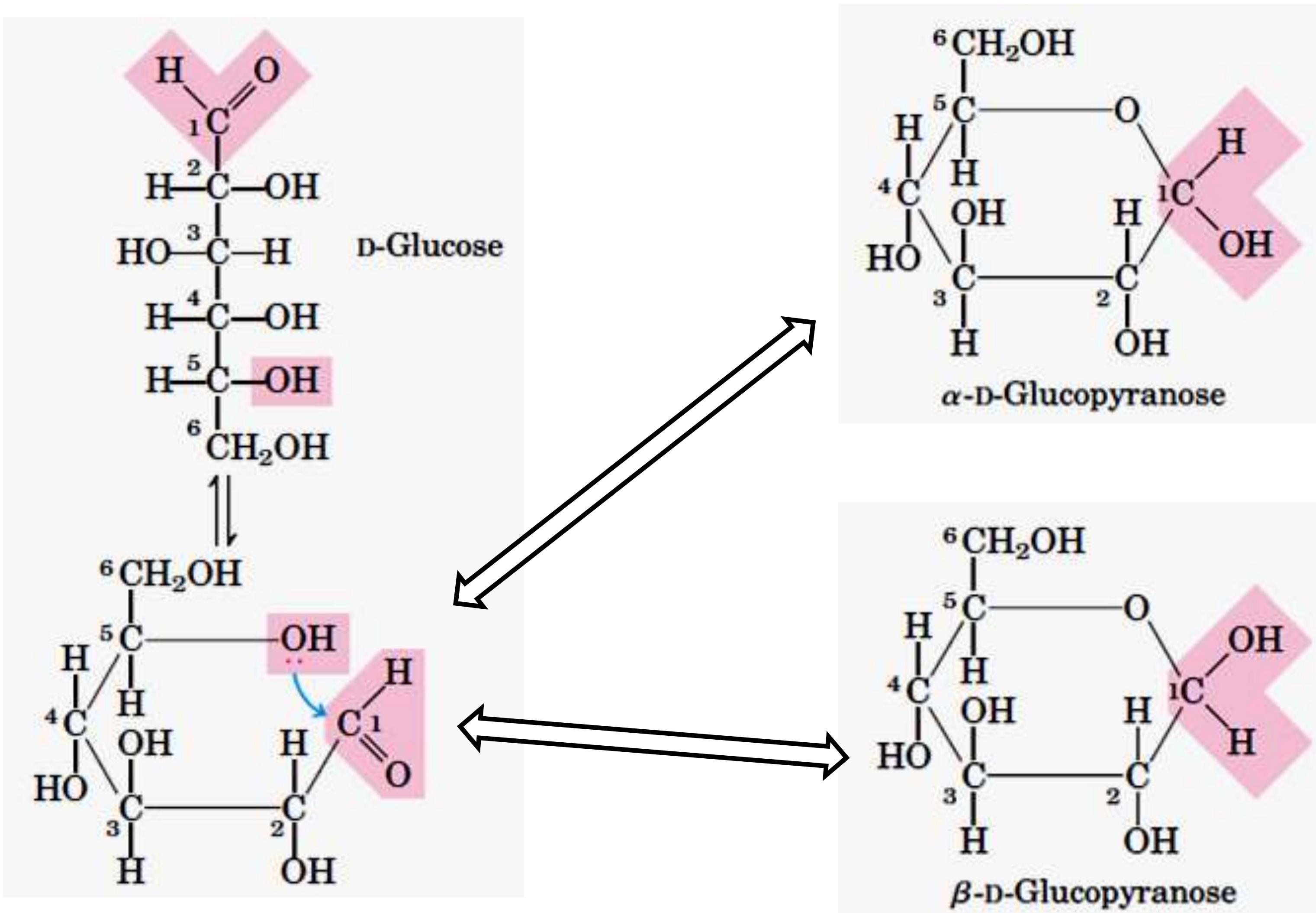


FIGURE 7–4 **Epimers.** D-Glucose and two of its epimers are shown as projection formulas. Each epimer differs from D-glucose in the configuration at one chiral center (shaded red).

Mas as tetroses, pentoses, hexoses e heptoses não são sempre lineares...



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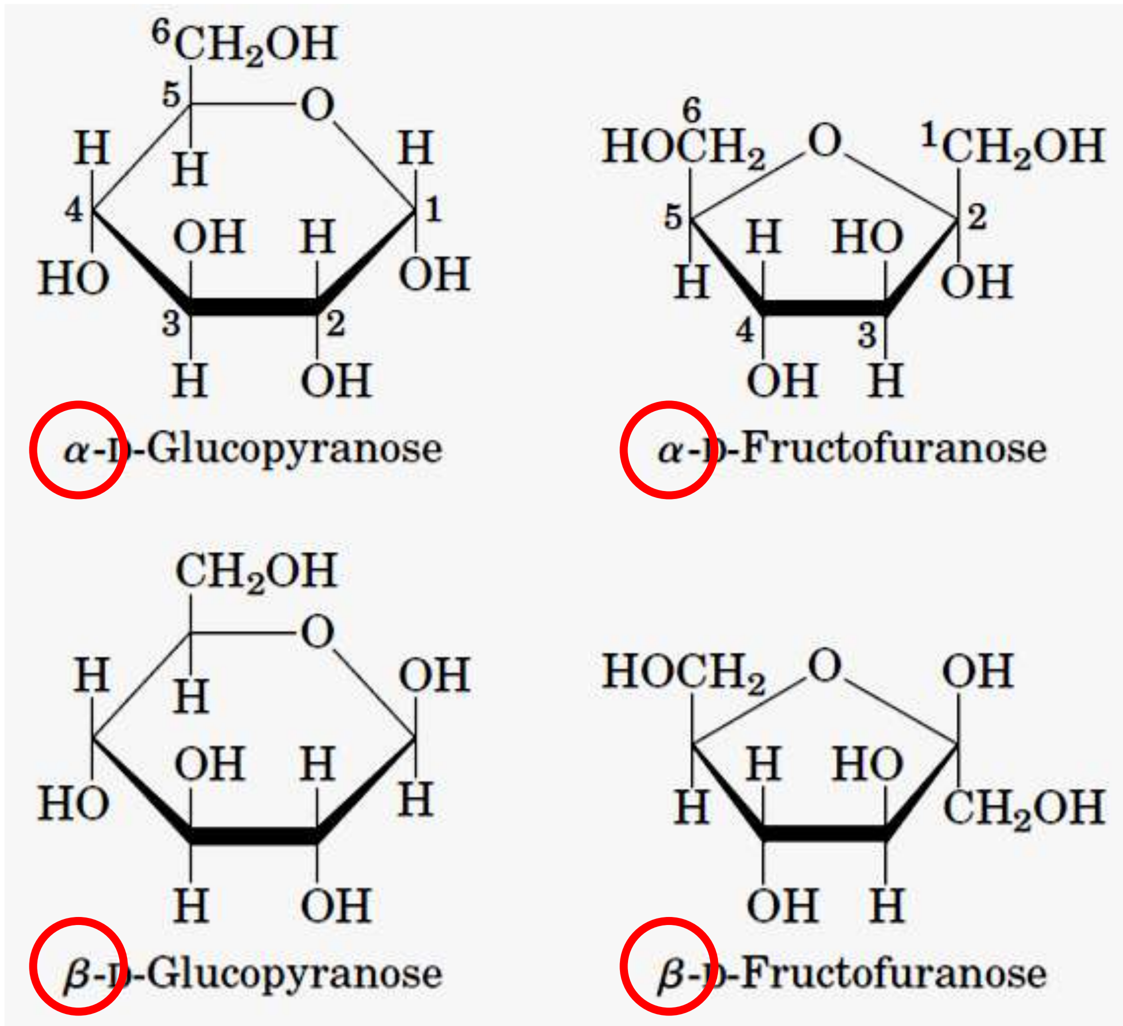
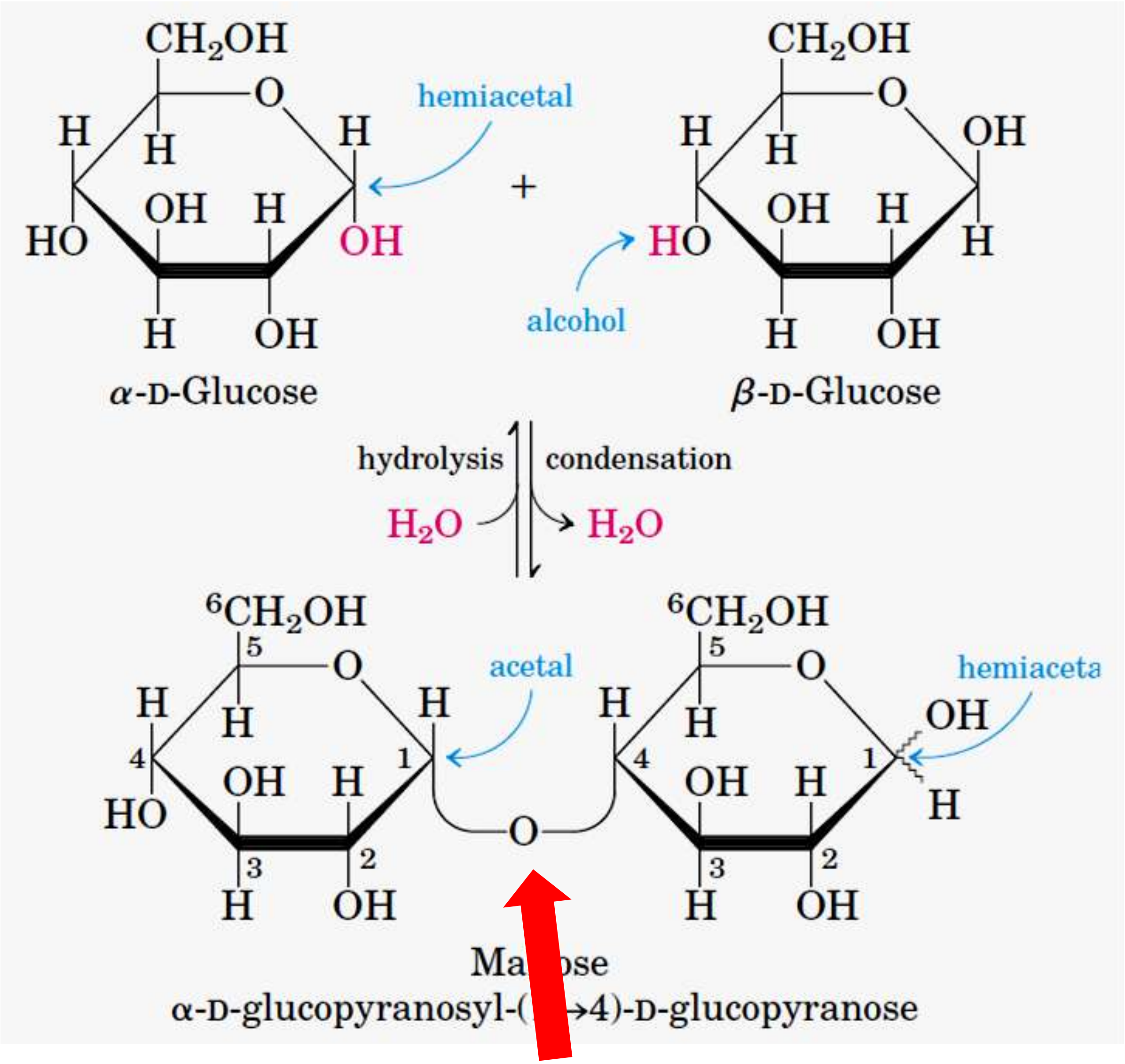
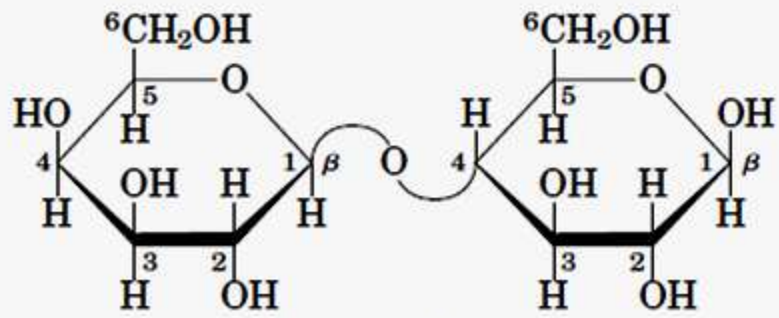


Mono X Dissacarídeos

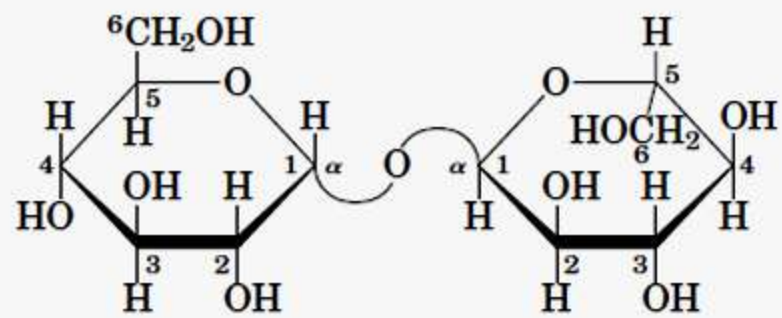


Ligação *O*-glicosídica

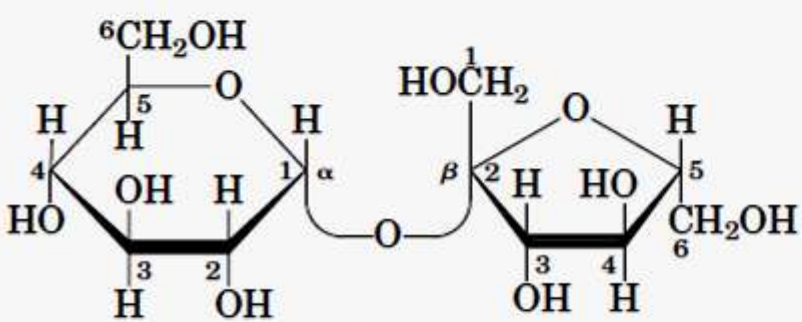
Mono X Dissacarídeos



Lactose (β form)
β-D-galactopyranosyl-(1→4)-β-D-glucopyranose
Gal(β1→4)Glc



Trehalose
α-D-glucopyranosyl α-D-glucopyranoside
Glc(α1↔1α)Glc



Sucrose
α-D-glucopyranosyl β-D-fructofuranoside
Glc(α1↔2β)Fru

Polissacarídeos (glicanos)

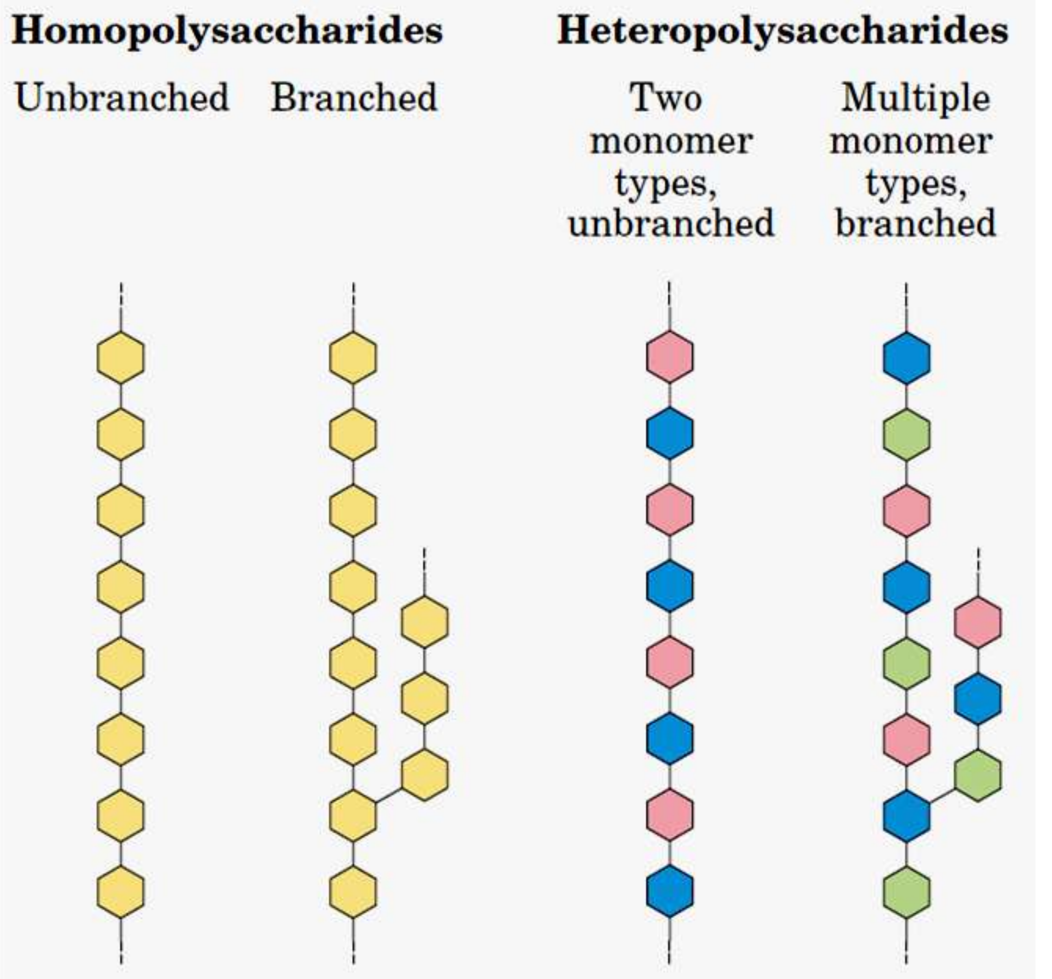


FIGURE 7-13 **Homo- and heteropolysaccharides.** Polysaccharides may be composed of one, two, or several different monosaccharides, in straight or branched chains of varying length.

Homopolissacarídeos de armazenamento

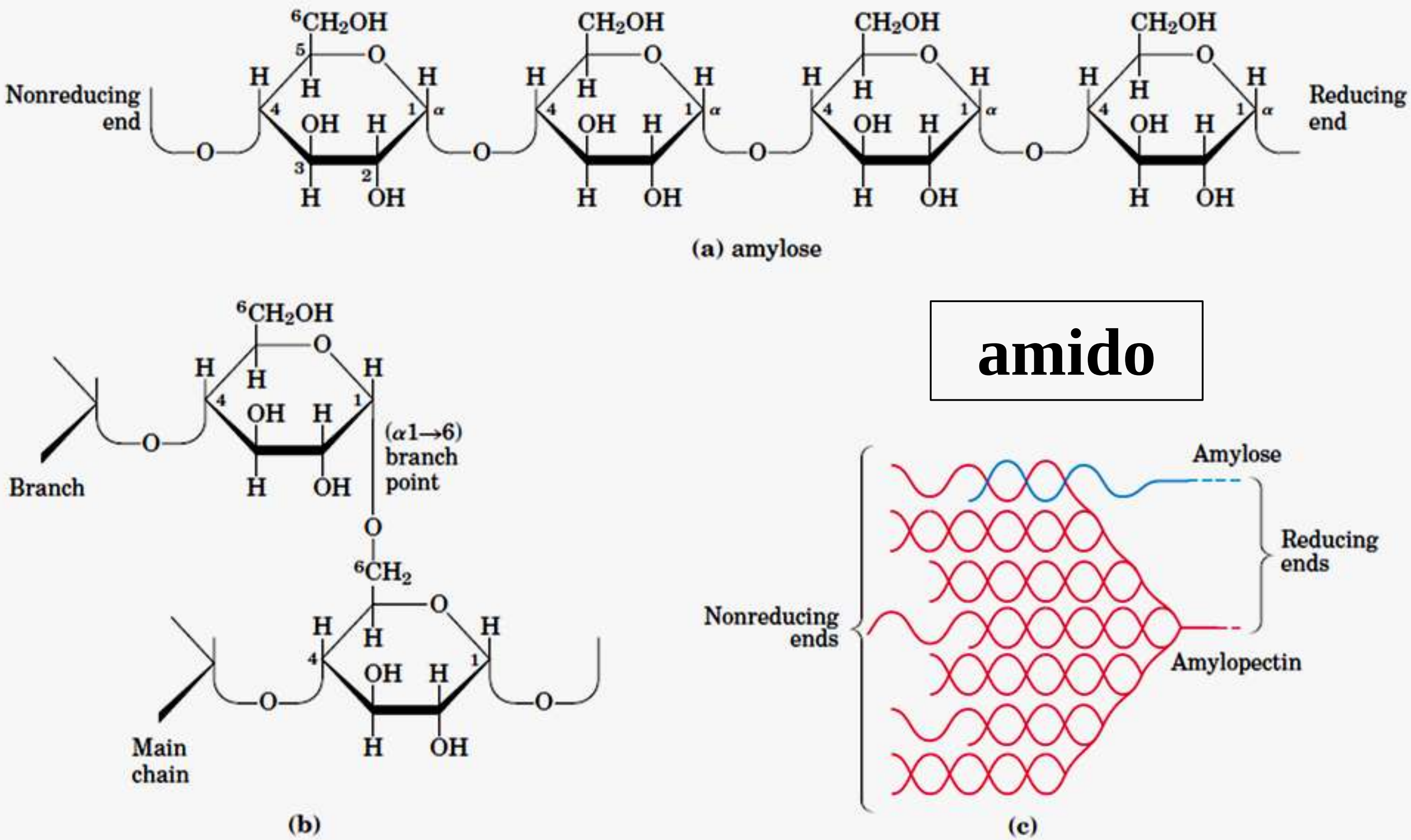
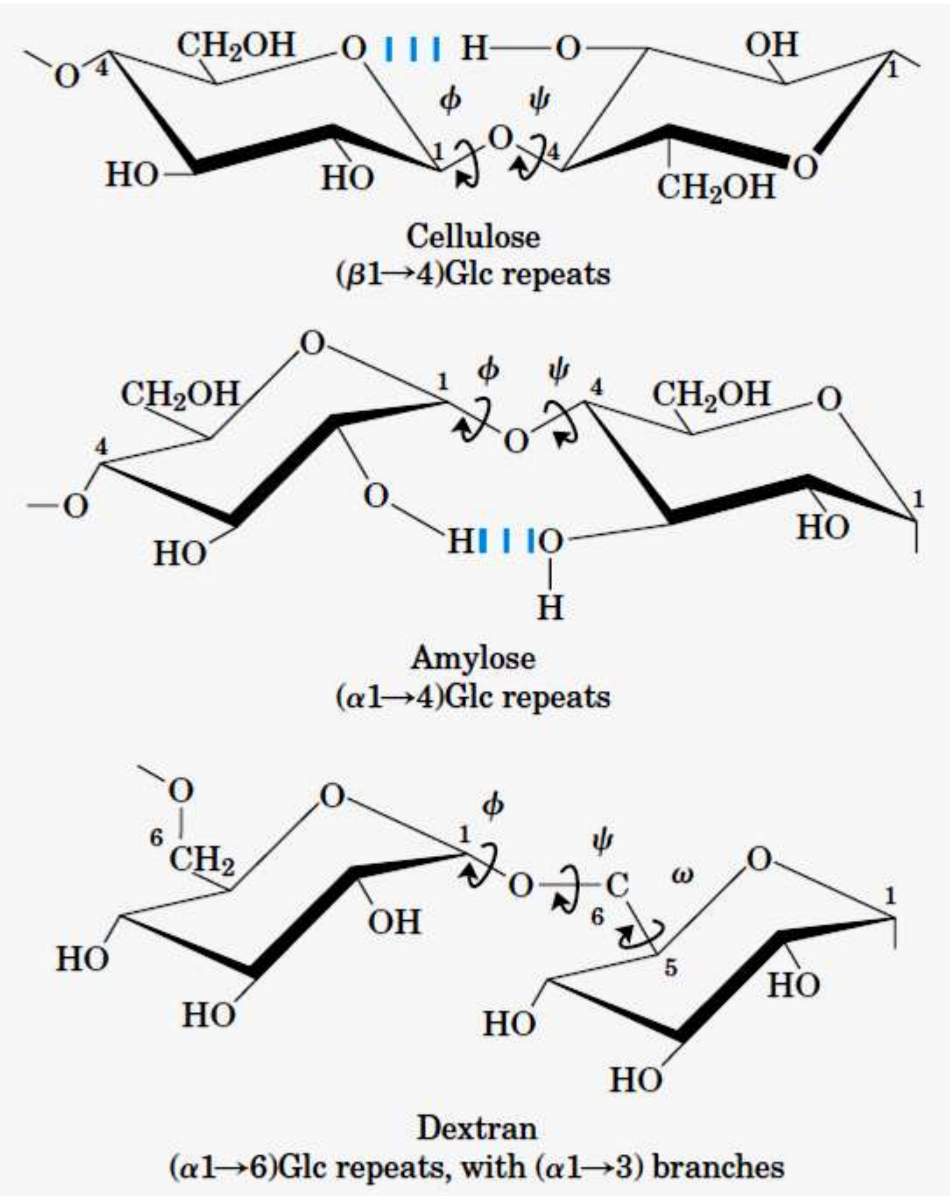
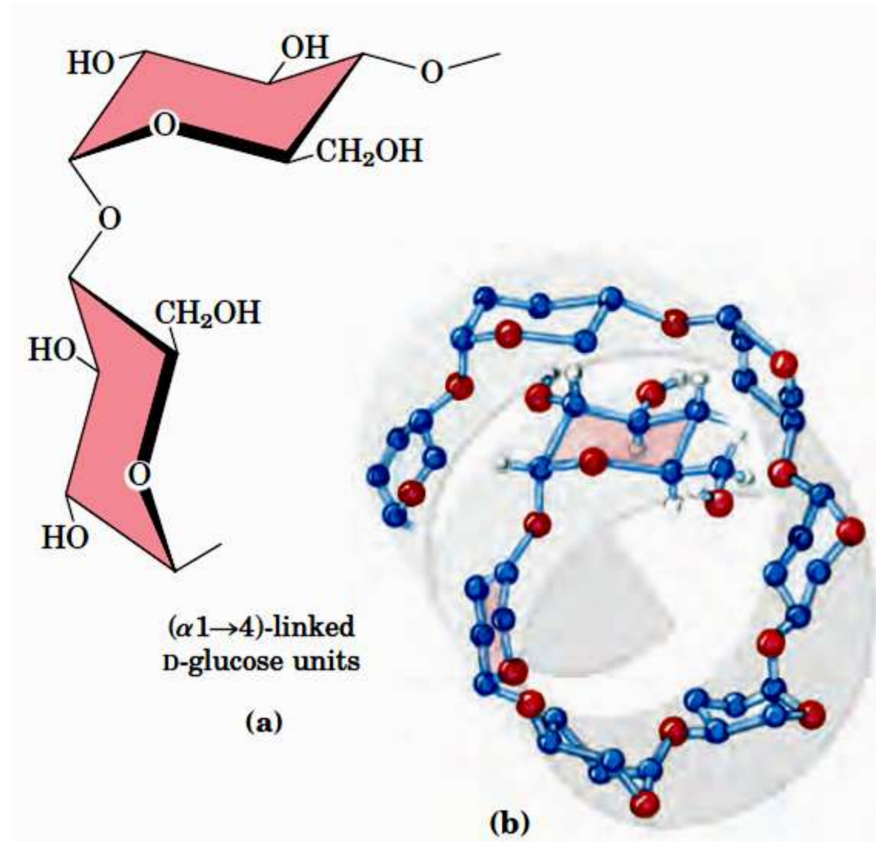
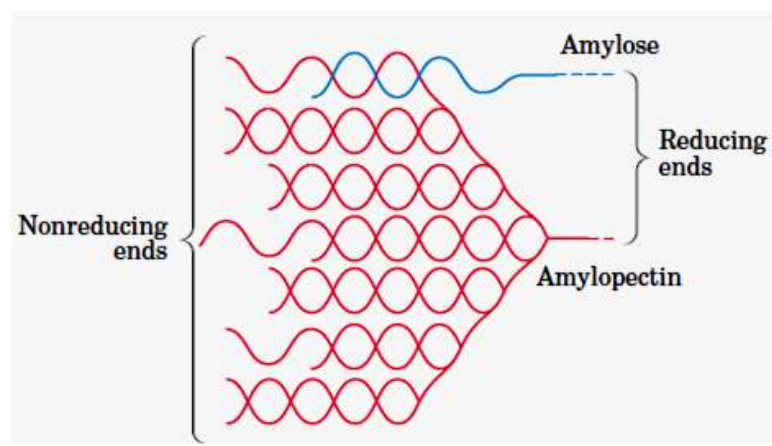


FIGURE 7–15 Amylose and amylopectin, the polysaccharides of starch. (a) A short segment of amylose, a linear polymer of D-glucose residues in (α1→4) linkage. A single chain can contain several thousand glucose residues. Amylopectin has stretches of similarly linked residues between branch points. **(b)** An (α1→6) branch point of amylopectin. **(c)** A cluster of amylose and amylopectin like that believed to occur in starch granules. Strands of amylopectin (red) form double-helical structures with each other or with amylose strands (blue). Glucose residues at the nonreducing ends of the outer branches are removed enzymatically during the mobilization of starch for energy production. Glycogen has a similar structure but is more highly branched and more compact.

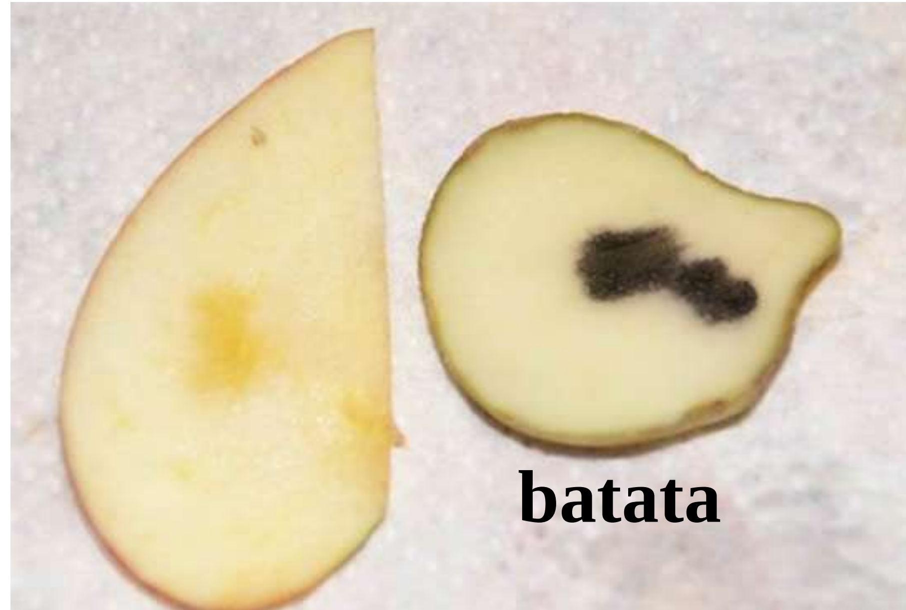
Polissacarídeos: estruturas tridimensionais



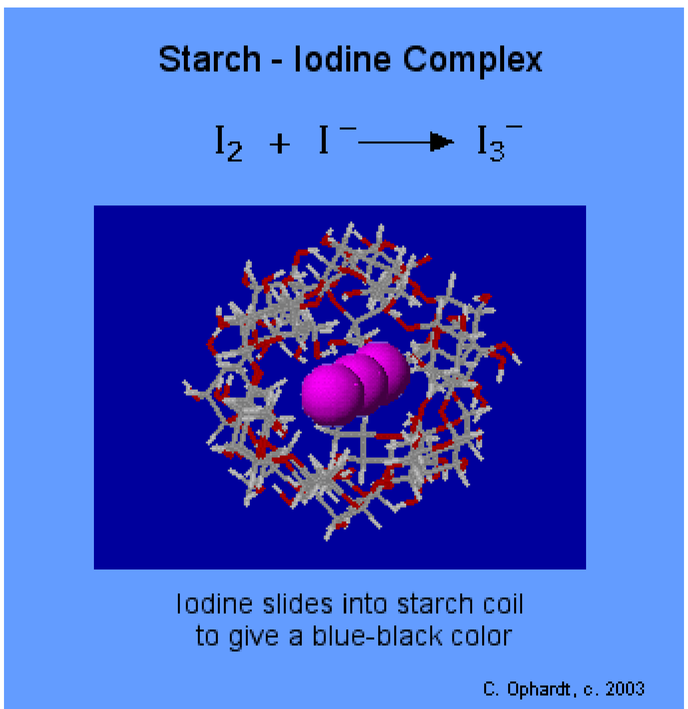


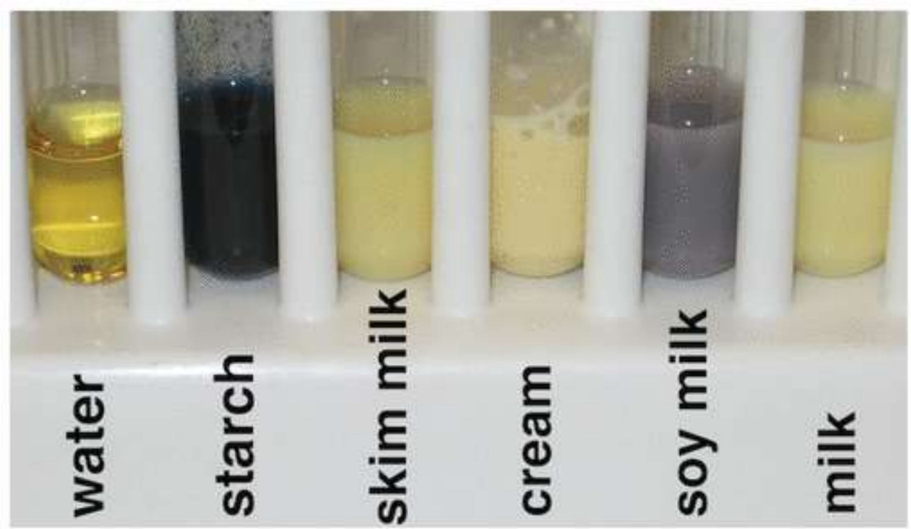


Polissacarídeos: estruturas tridimensionais

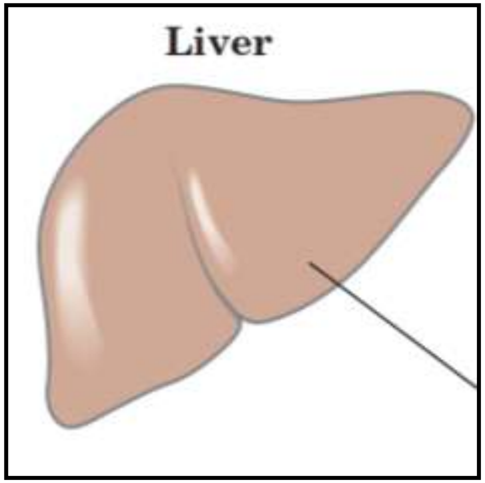


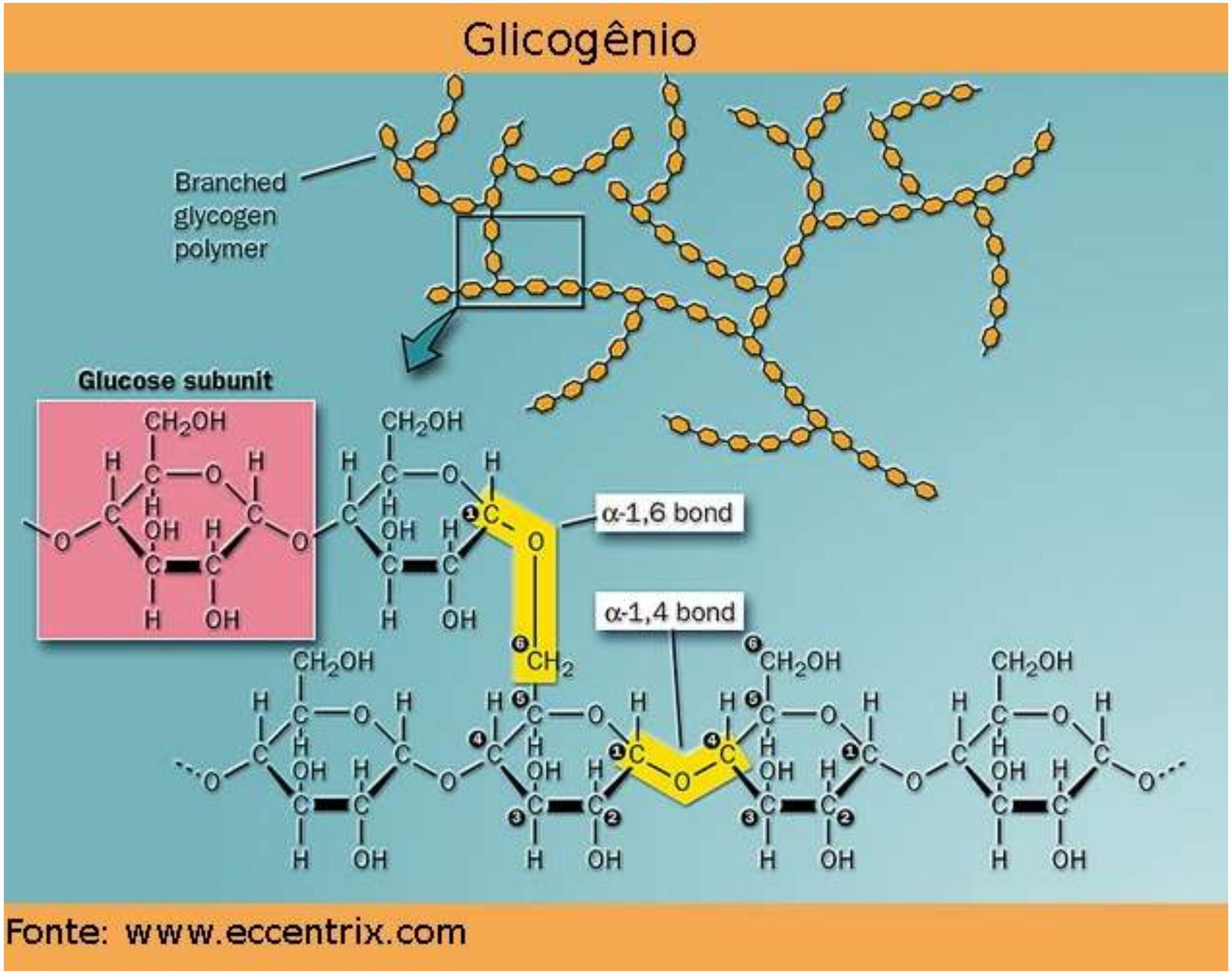
maçã





Homopolissacarídeos de armazenamento





Homopolissacarídeos estruturais

celulose

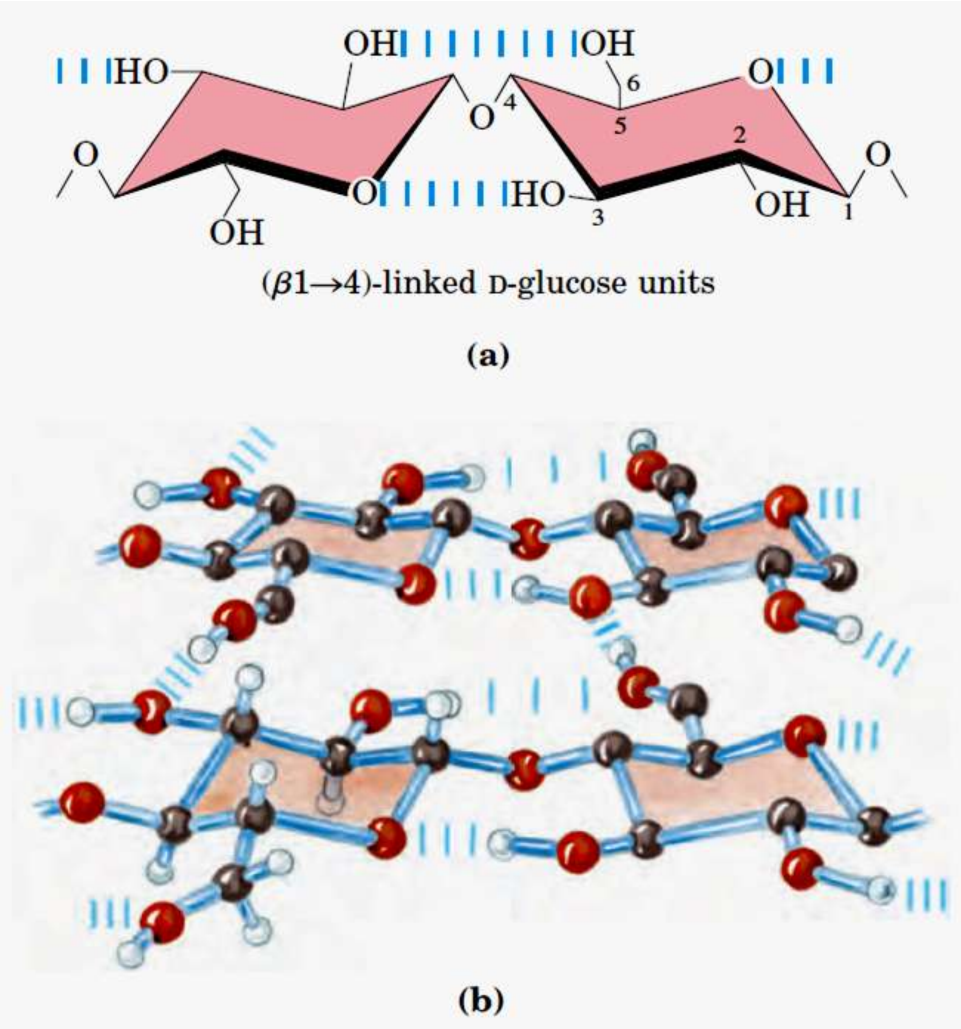


FIGURE 7–17 Cellulose breakdown by wood fungi. A wood fungus growing on an oak log. All wood fungi have the enzyme cellulase, which breaks the (β1→4) glycosidic bonds in cellulose, such that wood is a source of metabolizable sugar (glucose) for the fungus. The only vertebrates able to use cellulose as food are cattle and other ruminants (sheep, goats, camels, giraffes). The extra stomach compartment (rumen) of a ruminant teems with bacteria and protists that secrete cellulase.

Homopolissacarídeos estruturais

quitina

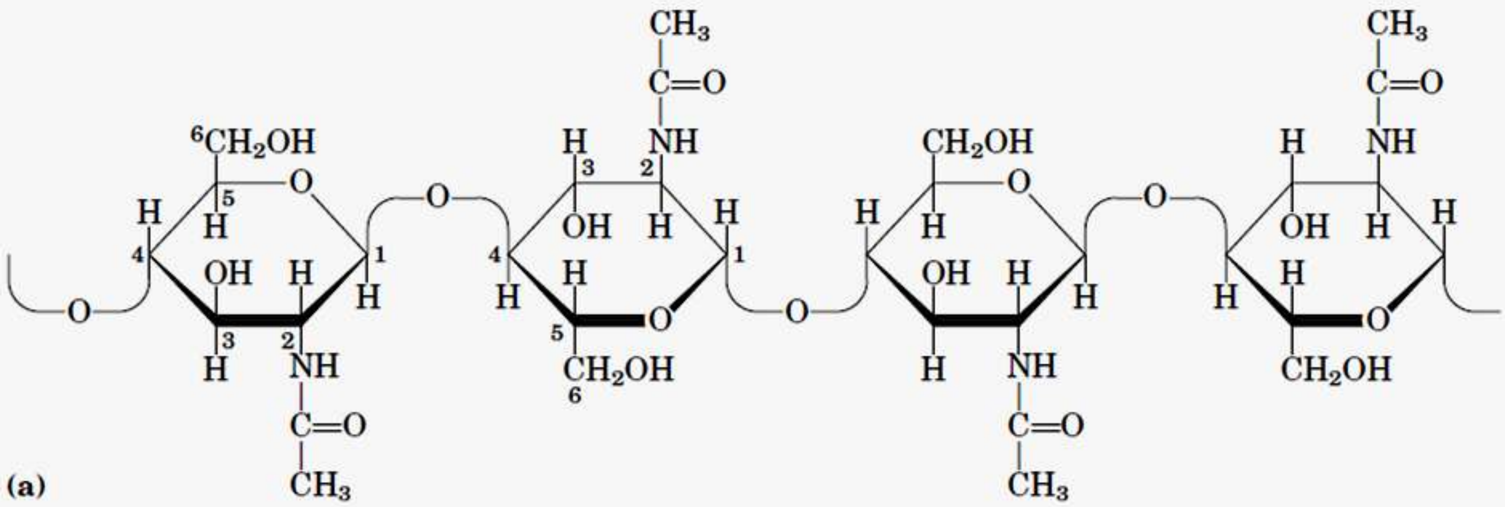


FIGURE 7–18 Chitin. **(a)** A short segment of chitin, a homopolymer of *N*-acetyl-D-glucosamine units in (β1→4) linkage. **(b)** A spotted June beetle (*Pellidnota punetatia*), showing its surface armor (exoskeleton) of chitin.

(b)

Homopolissacarídeos estruturais

amilose e glicogênio	**X**	**celulose e quitina**

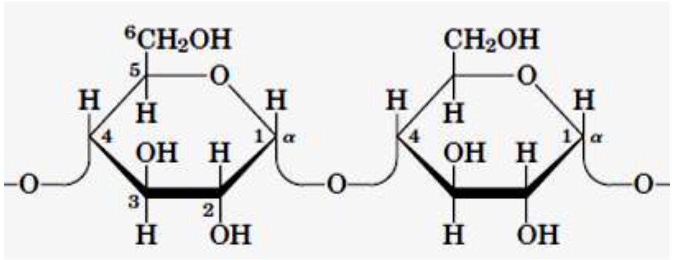
Homopolissacarídeos estruturais

amilose e glicogênio

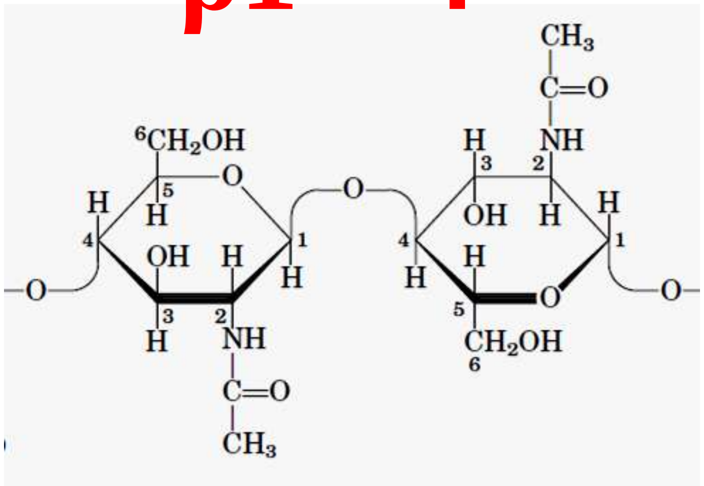
X

celulose e quitina

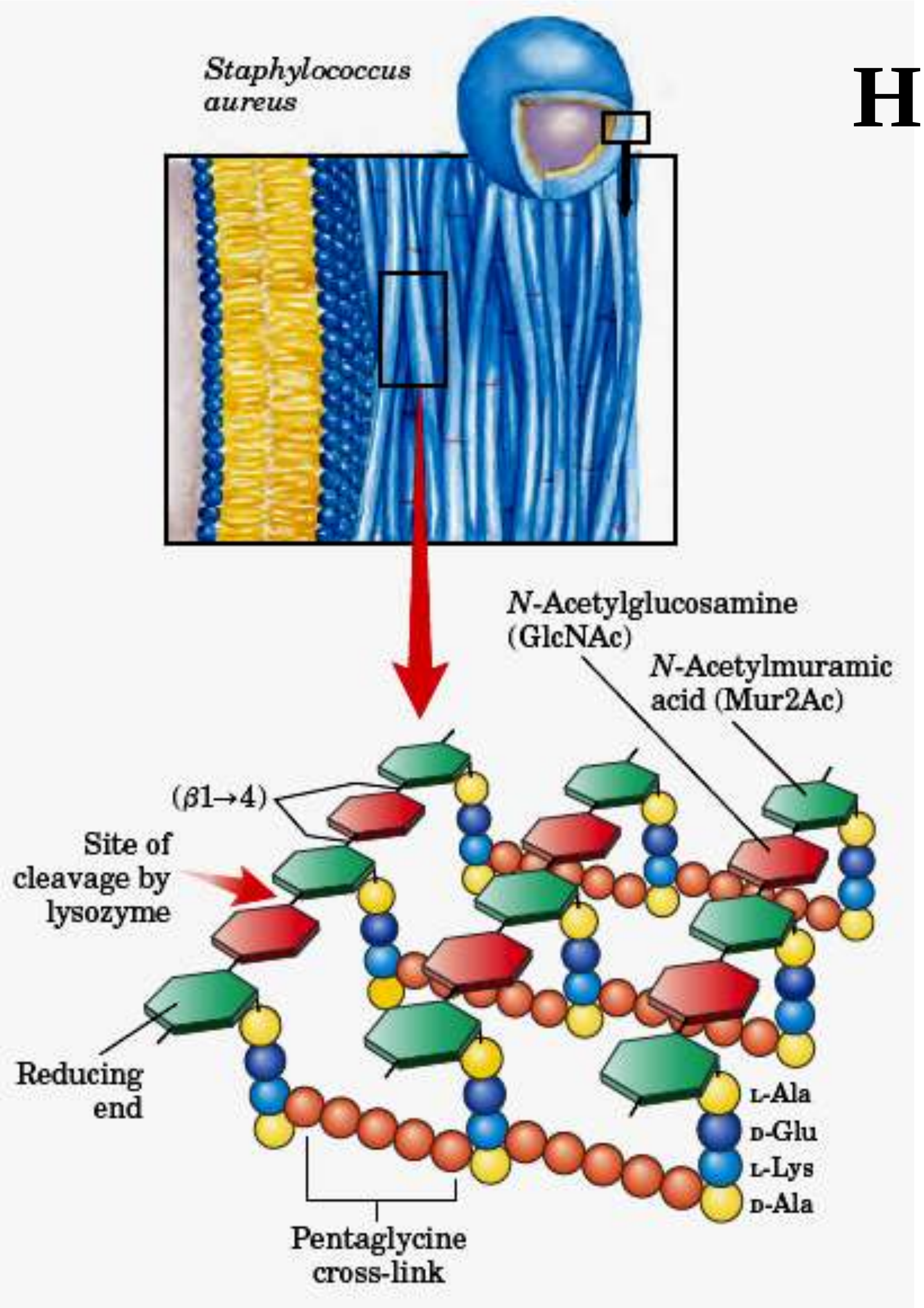
α1→4



β1→4

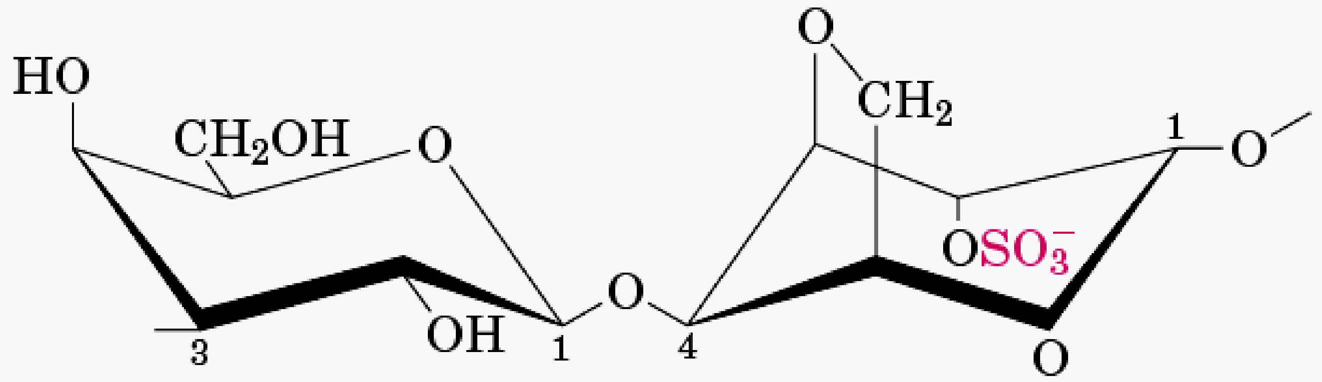


Heteropolissacarídeos



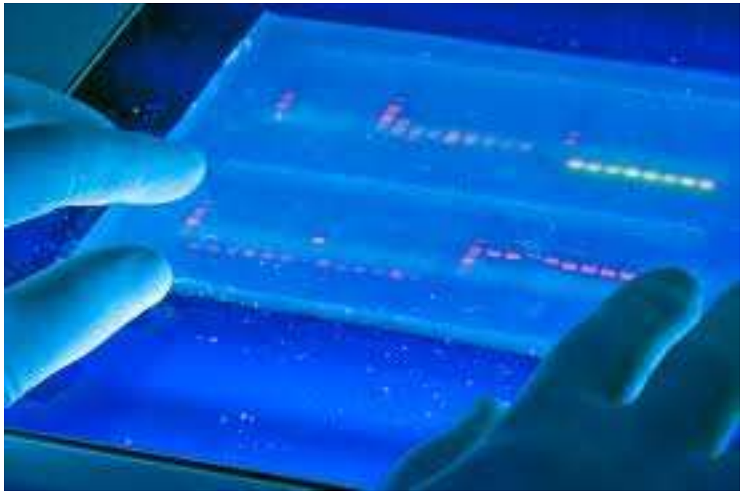
peptideoglicano

Heteropolissacarídeos

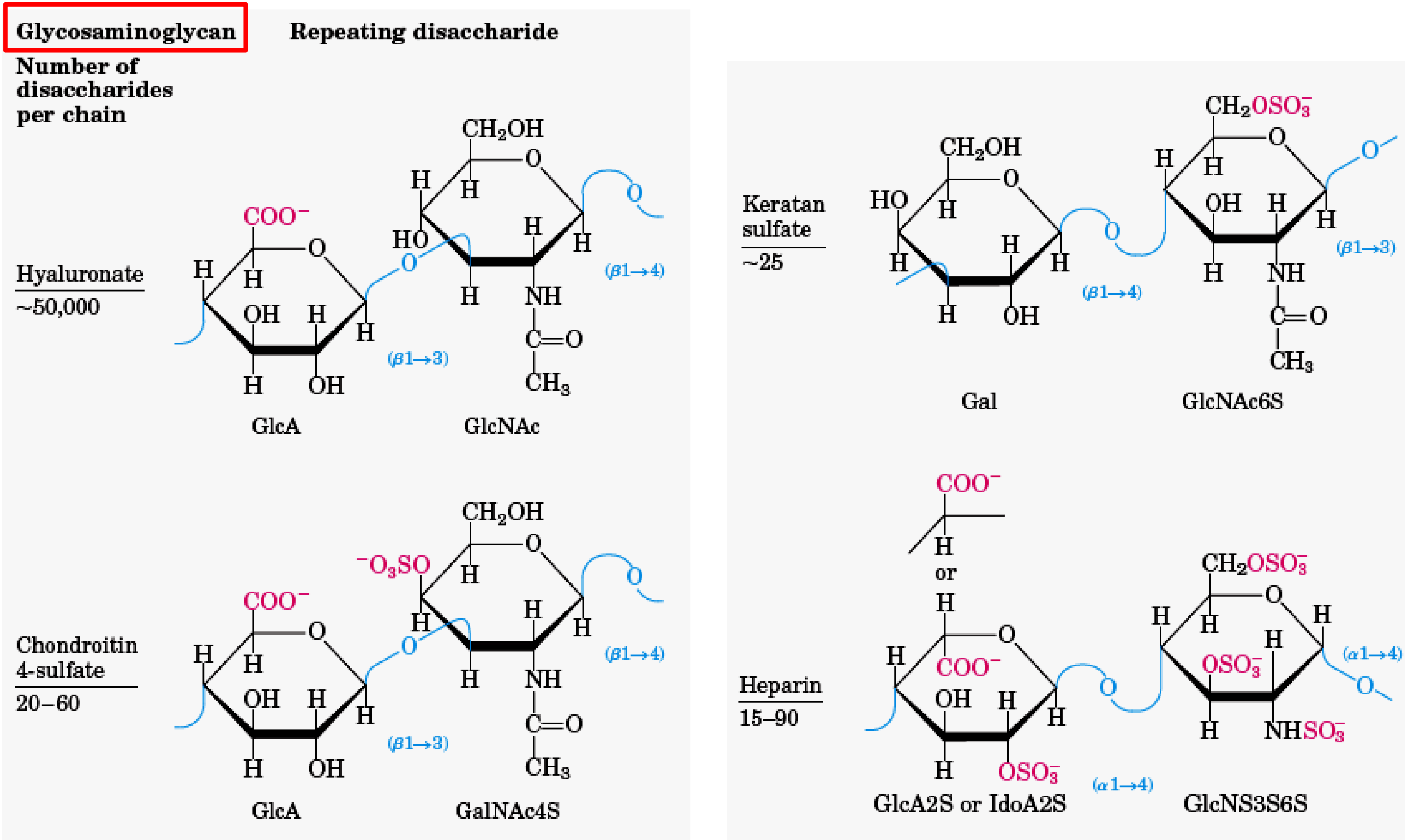


Agarose

3)D-Gal(β1→4)3,6-anhydro-L-Gal2S(α1 repeats

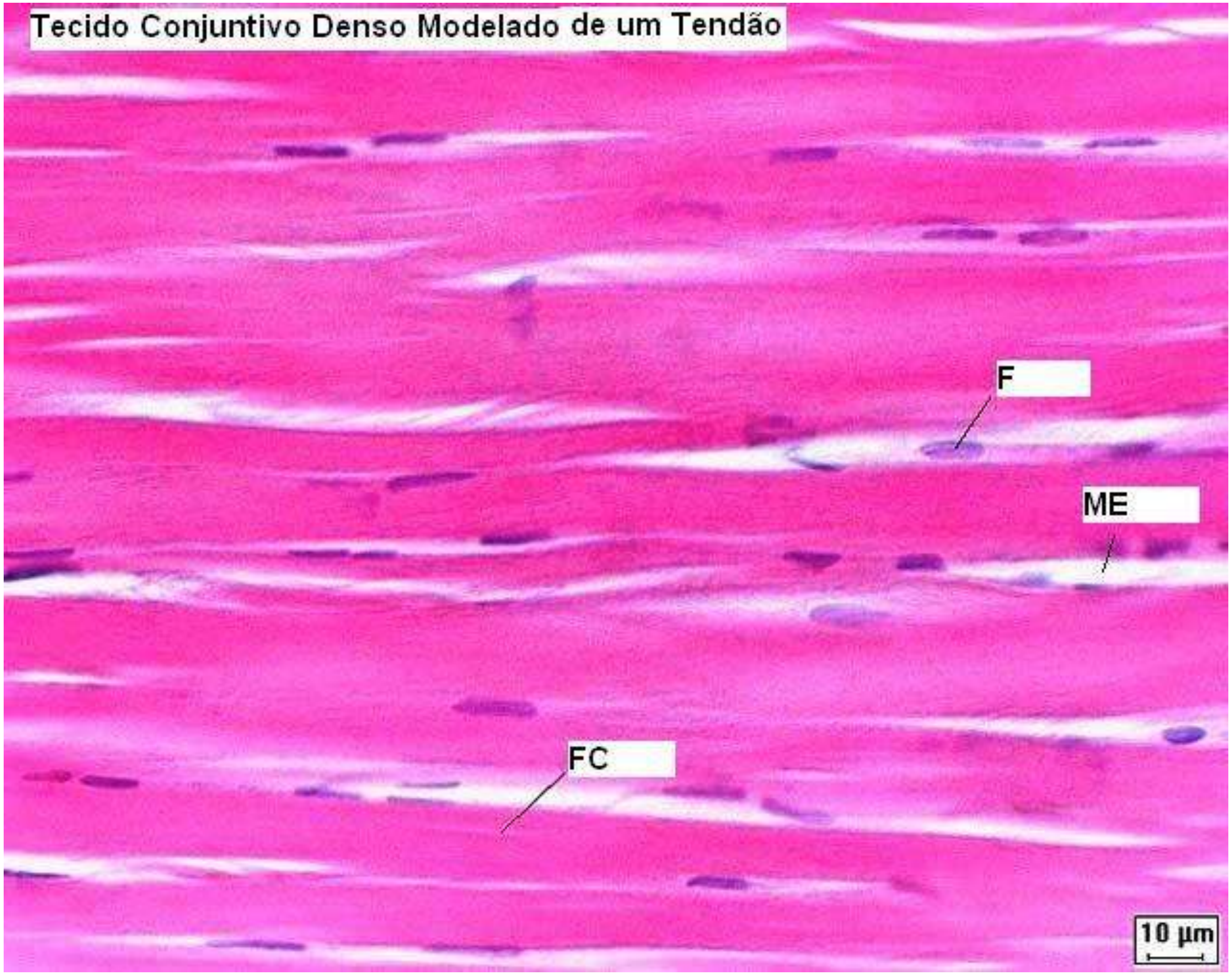


Heteropolissacarídeos



componentes da matriz extracelular

Heteropolissacarídeos



matriz extracelular

TABLE 7-2 Structures and Roles of Some Polysaccharides

Polymer	*Type**	*Repeating unit*†	*Size (number of monosaccharide units)*	*Roles/significance*
Starch				Energy storage: in plants
Amylose	Homo-	(α1→4)Glc, linear	50–5,000	
Amylopectin	Homo-	(α1→4)Glc, with (α1→6)Glc branches every 24–30 residues	Up to 10^6	
Glycogen	Homo-	(α1→4)Glc, with (α1→6)Glc branches every 8–12 residues	Up to 50,000	Energy storage: in bacteria and animal cells
Cellulose	Homo-	(β1→4)Glc	Up to 15,000	Structural: in plants, gives rigidity and strength to cell walls
Chitin	Homo-	(β1→4)GlcNAc	Very large	Structural: in insects, spiders, crustaceans, gives rigidity and strength to exoskeletons
Dextran	Homo-	(α1→6)Glc, with (α1→3) branches	Wide range	Structural: in bacteria, extracellular adhesive
Peptidoglycan	Hetero-; peptides attached	4)Mur2Ac(β1→4) GlcNAc(β1	Very large	Structural: in bacteria, gives rigidity and strength to cell envelope
Agarose	Hetero-	3)D-Gal(β1→4)3,6-anhydro-L-Gal(α1	1,000	Structural: in algae, cell wall material
Hyaluronate (a glycosaminoglycan)	Hetero-; acidic	4)GlcA(β1→3) GlcNAc(β1	Up to 100,000	Structural: in vertebrates, extracellular matrix of skin and connective tissue; viscosity and lubrication in joints

*Each polymer is classified as a homopolysaccharide (homo-) or heteropolysaccharide (hetero-).

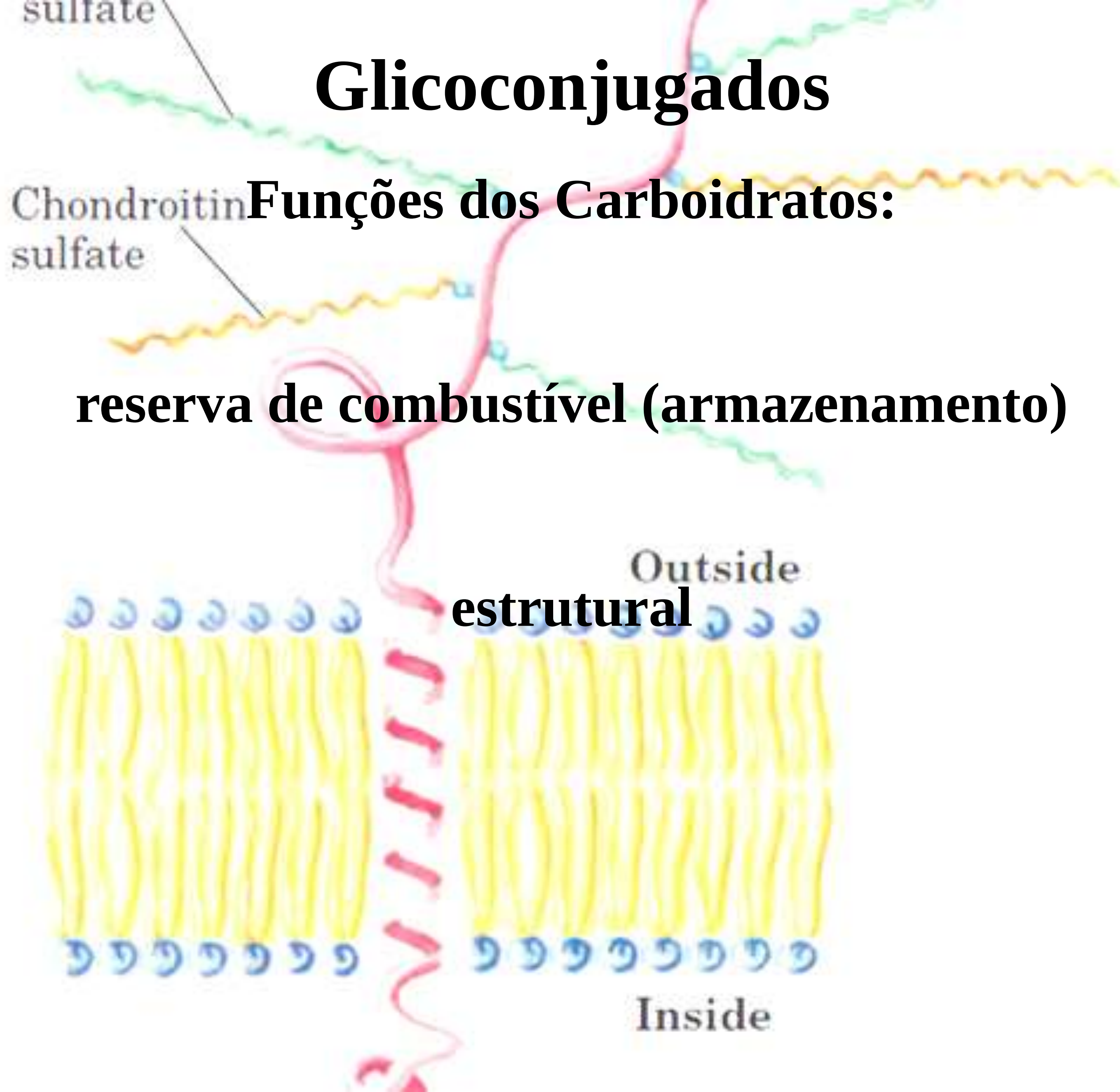
†The abbreviated names for the peptidoglycan, agarose, and hyaluronate repeating units indicate that the polymer contains repeats of this disaccharide unit. For example, in peptidoglycan, the GlcNAc of one disaccharide unit is (β1→4)-linked to the first residue of the next disaccharide unit.

Glicoconjugados

Funções dos Carboidratos:

reserva de combustível (armazenamento)

estrutural



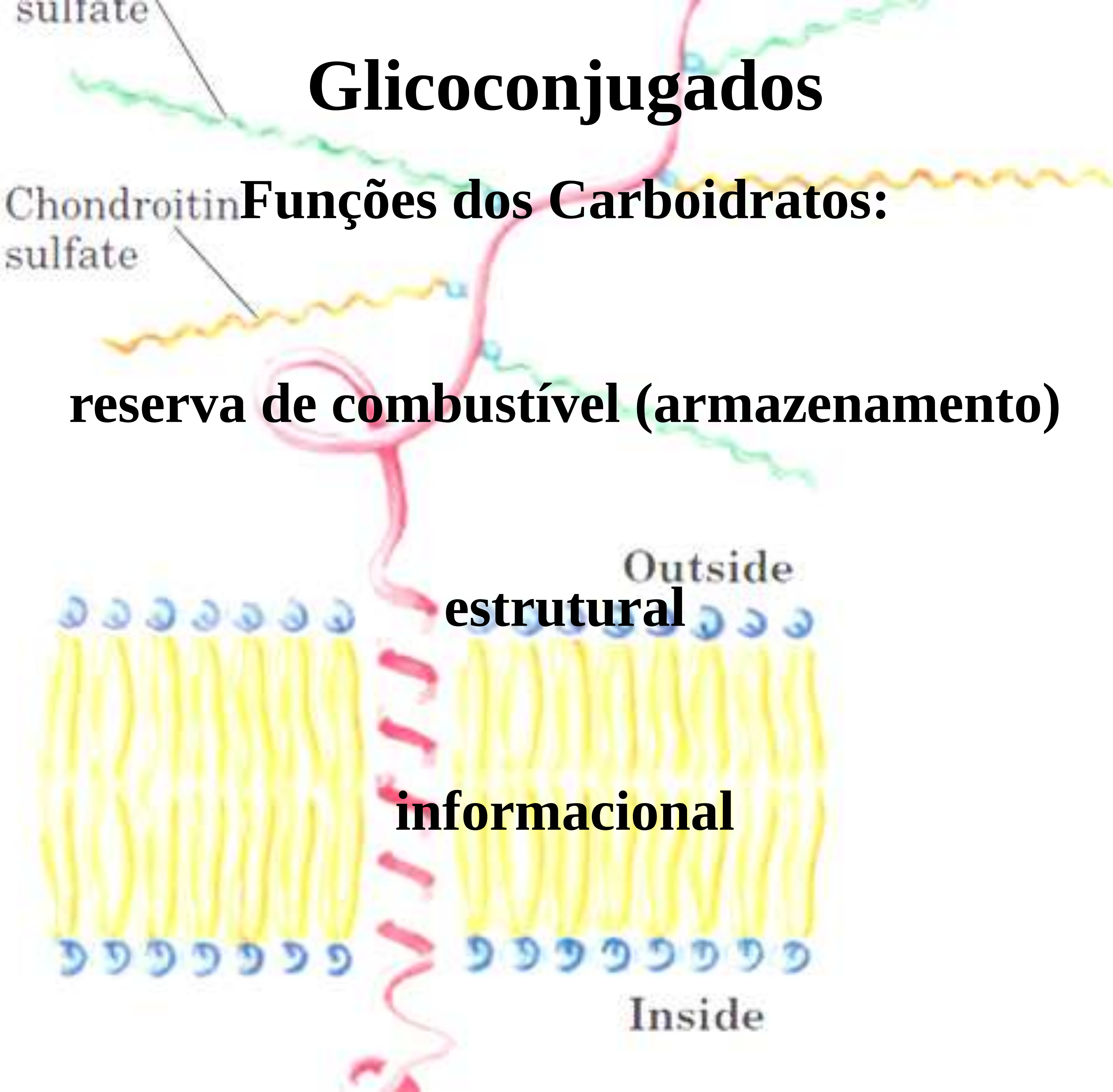
Glicoconjugados

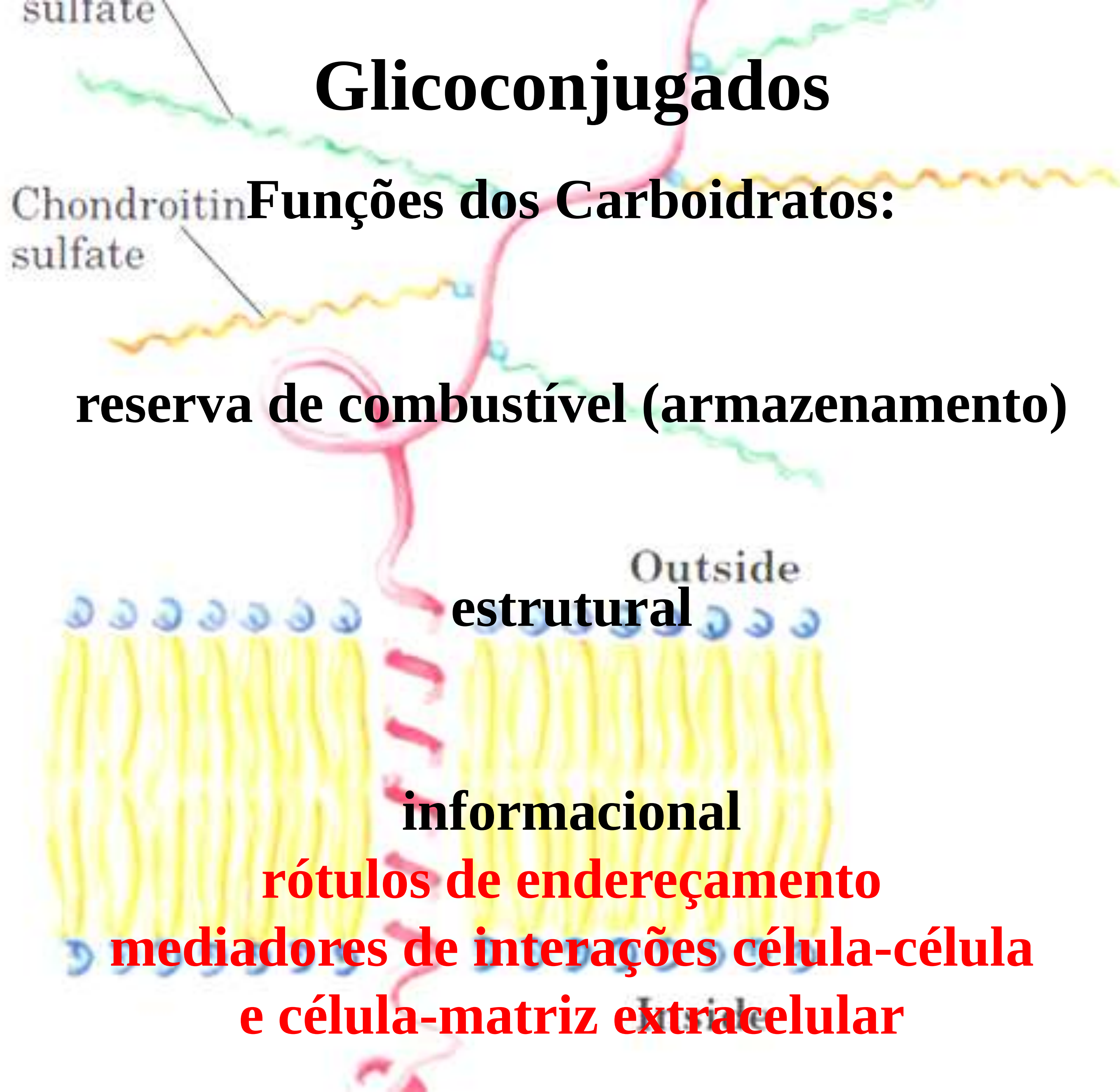
Funções dos Carboidratos:

reserva de combustível (armazenamento)

estrutural

informacional





Glicoconjugados

Funções dos Carboidratos:

reserva de combustível (armazenamento)

estrutural

informacional

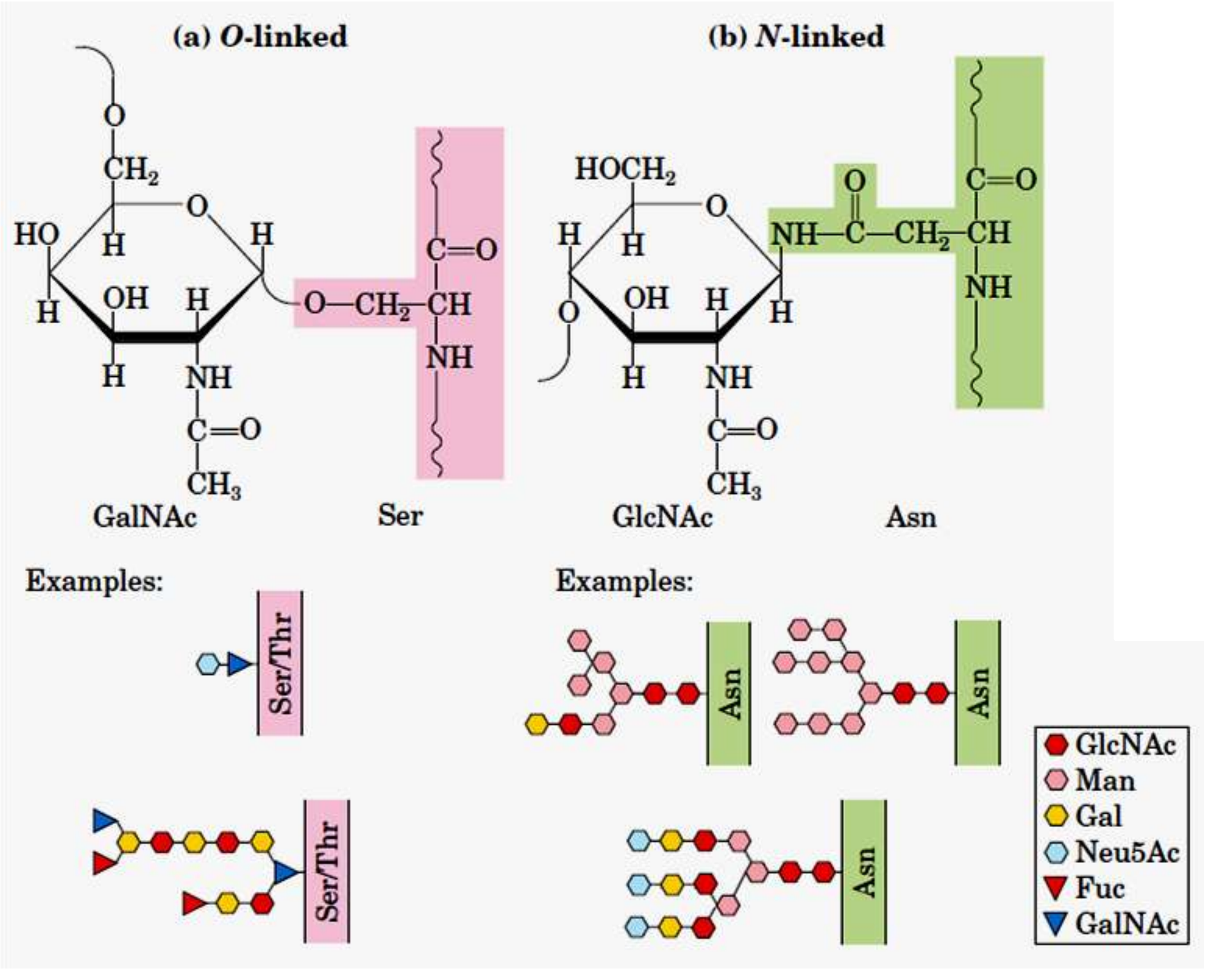
rótulos de endereçamento

mediadores de interações célula-célula

e célula-matriz extracelular

Glicoconjugados

Carboidrato sinalizador covalentemente ligado a uma proteína ou a um lipídeo

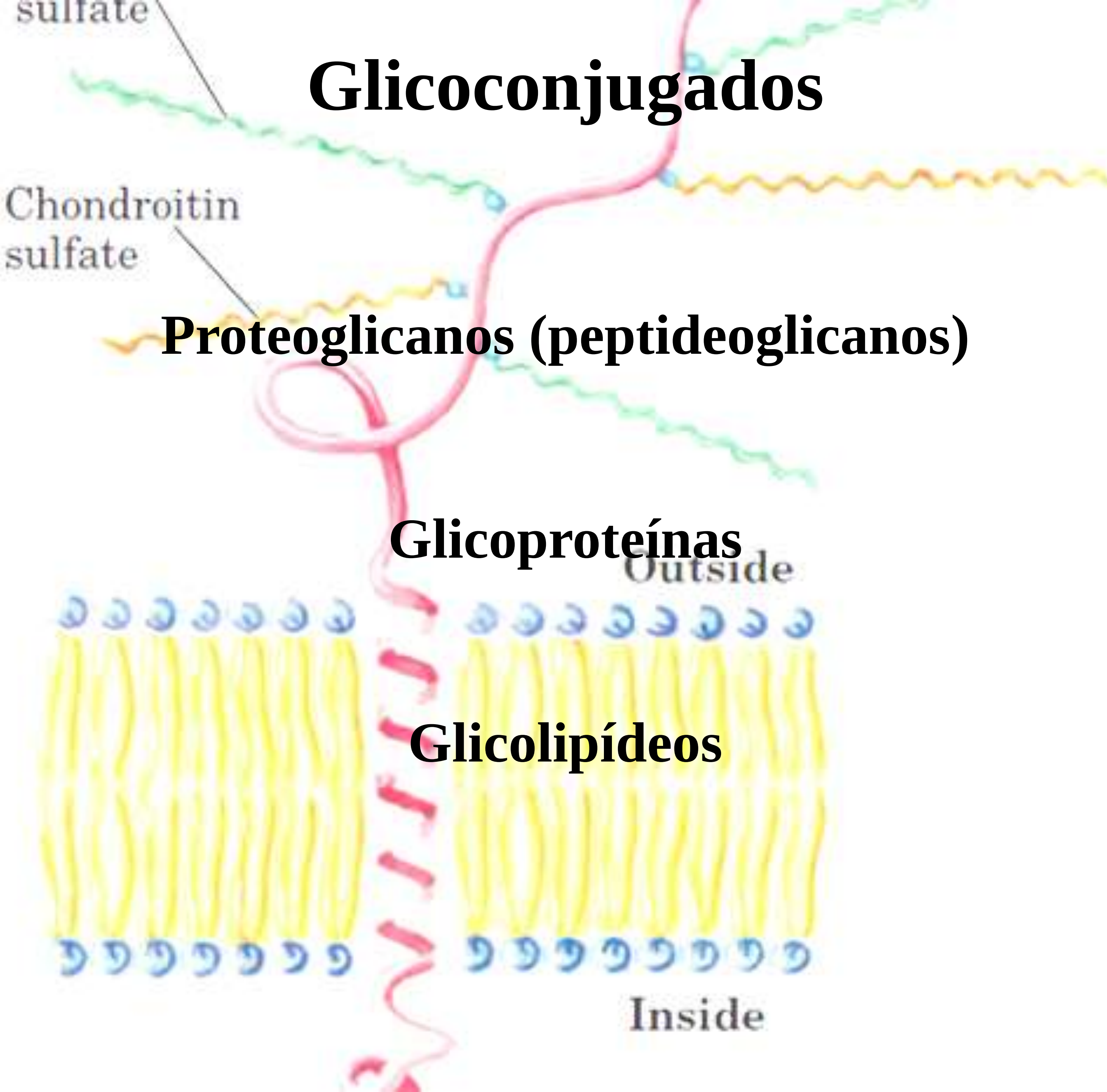


Glicoconjugados

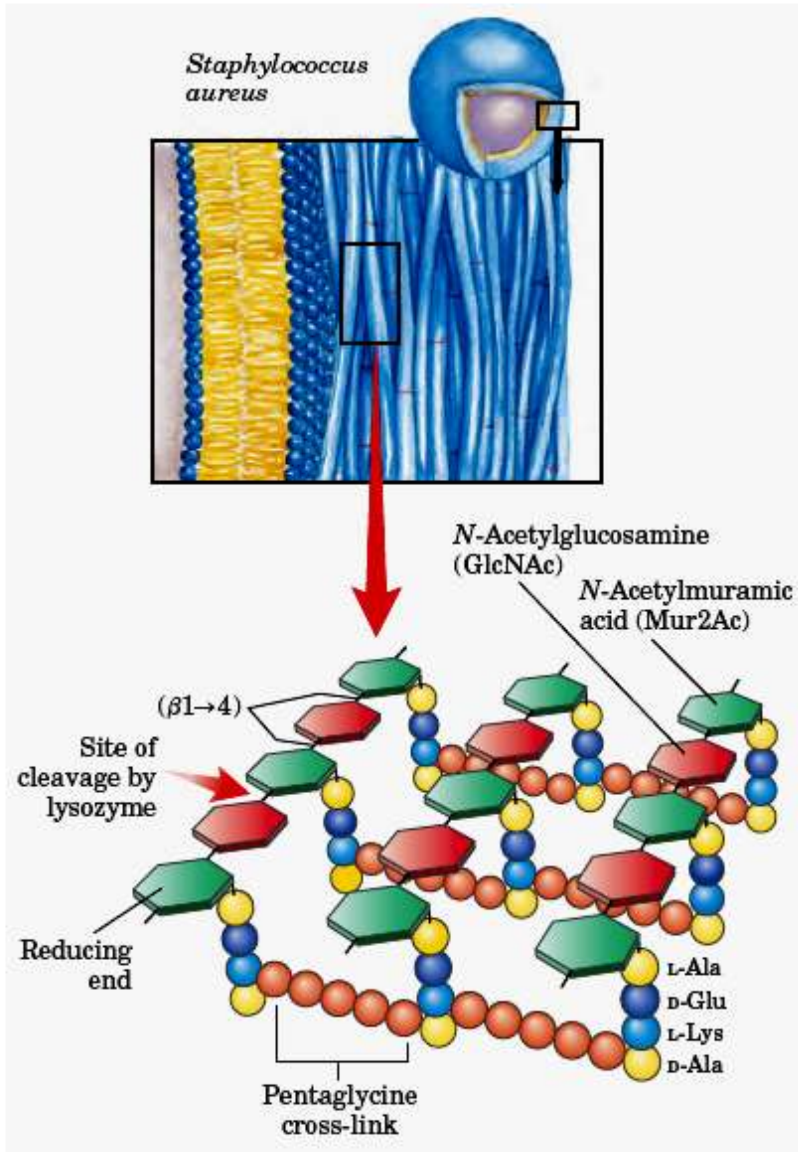
Proteoglicanos (peptideoglicanos)

Glicoproteínas

Glicolipídeos

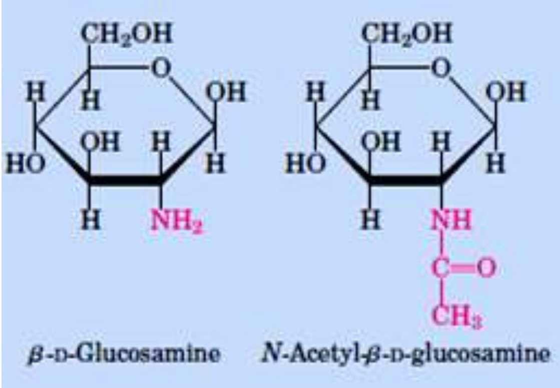


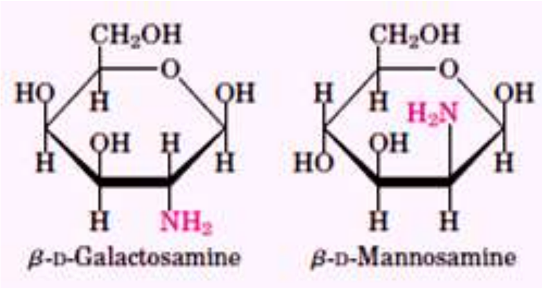
Proteoglicanos

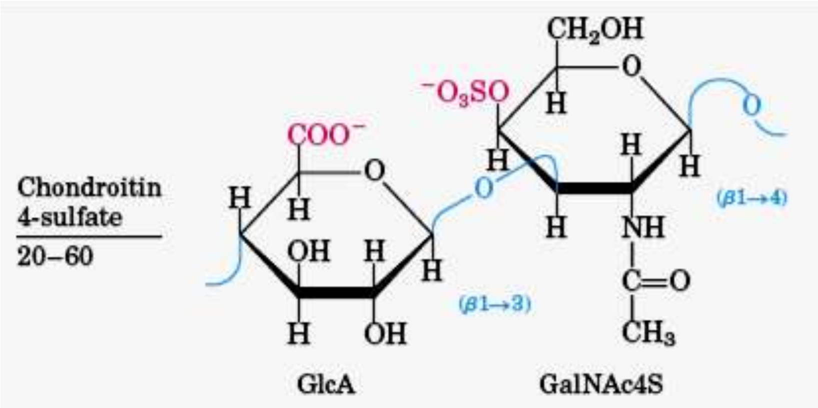


Proteoglicanos

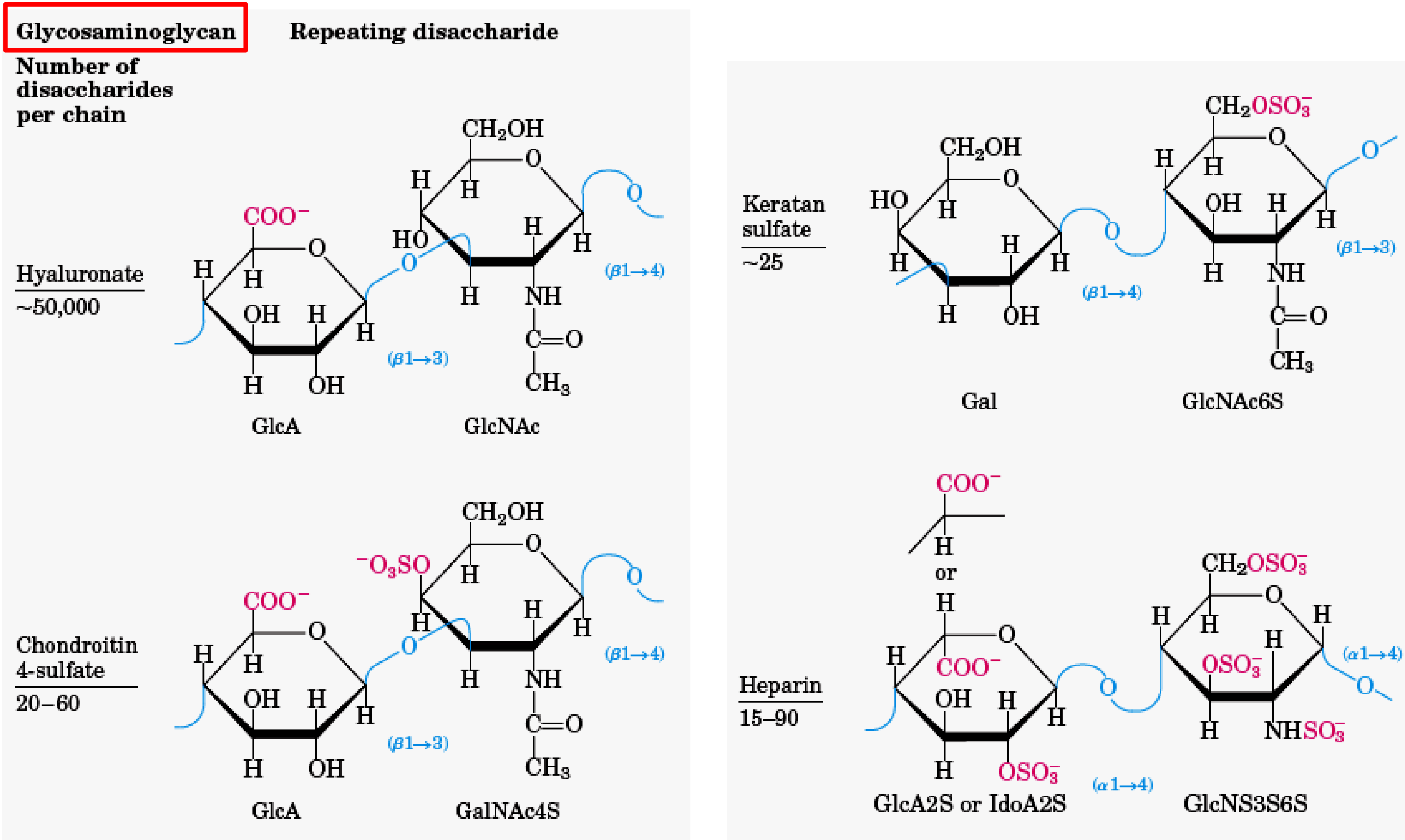
superfície das células e matriz extracelular mamíferos
contém glicosaminoglicanos





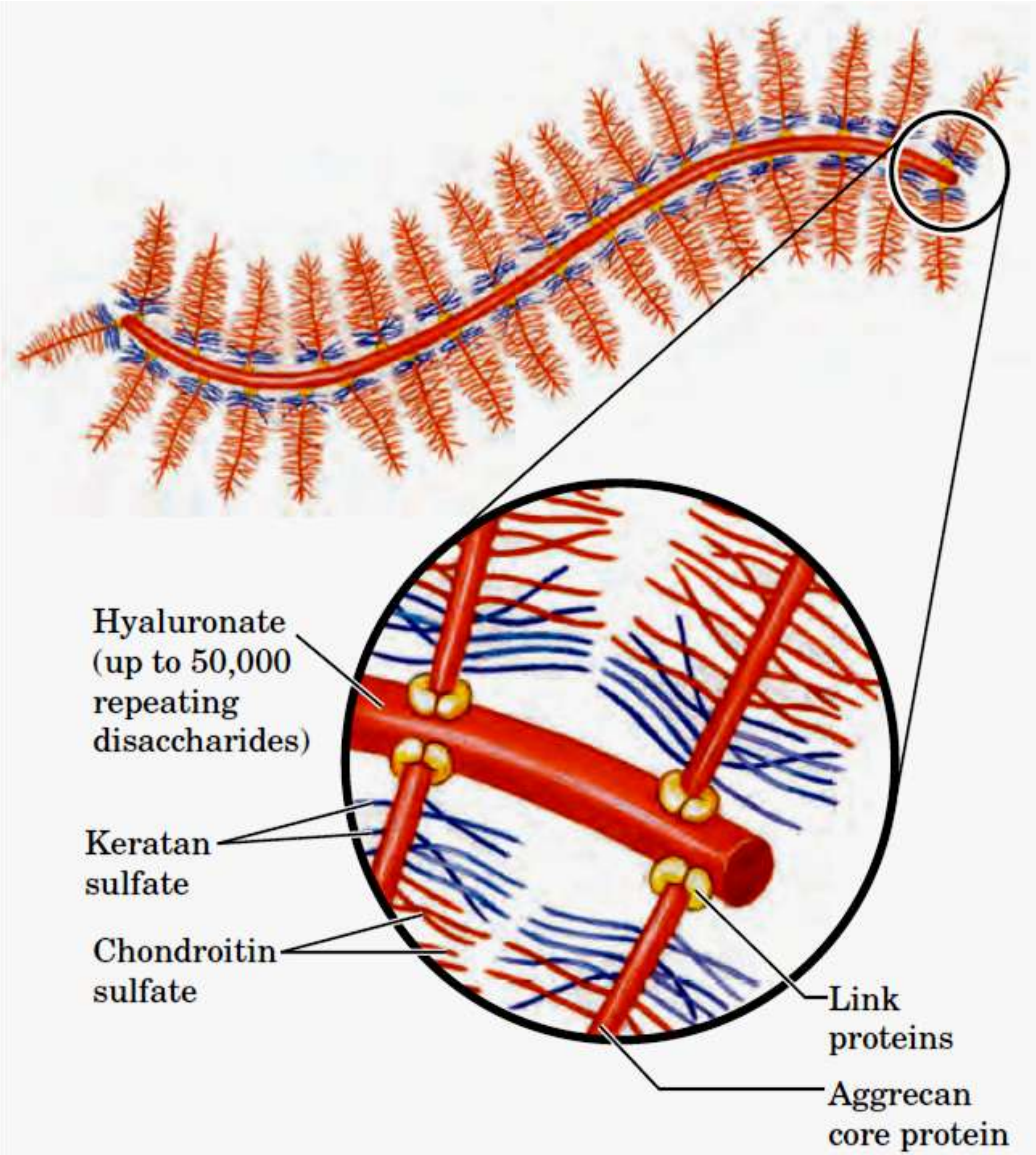


Heteropolissacarídeos



componentes da matriz extracelular

Proteoglicanos



Proteoglicanos

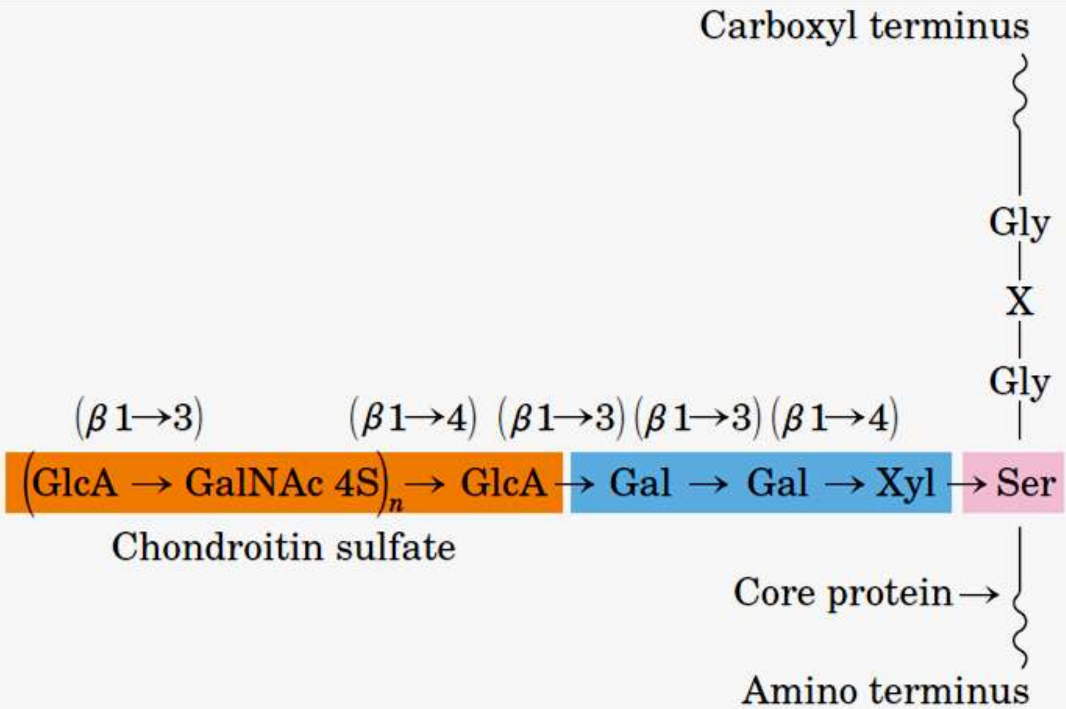
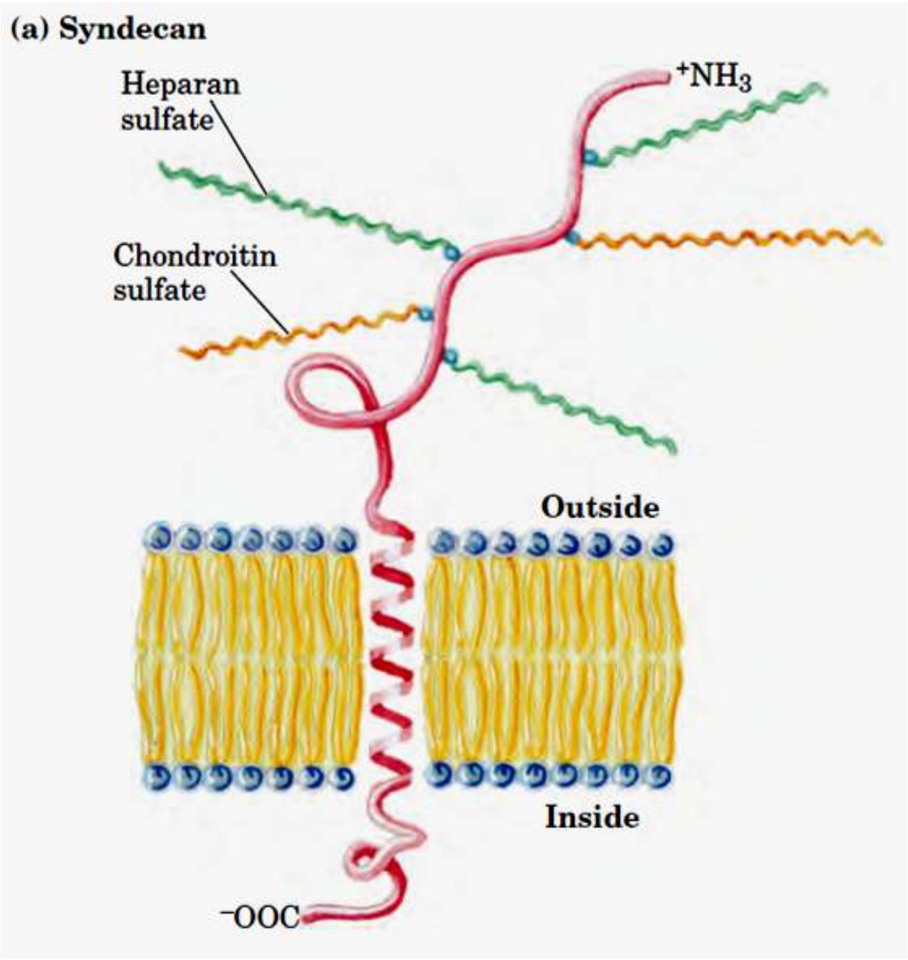
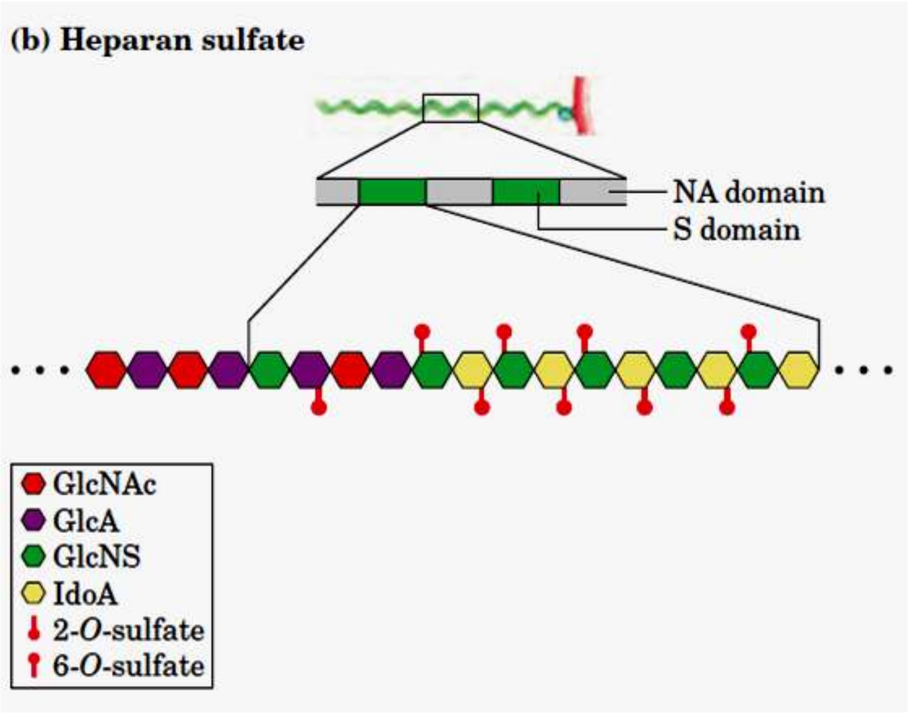


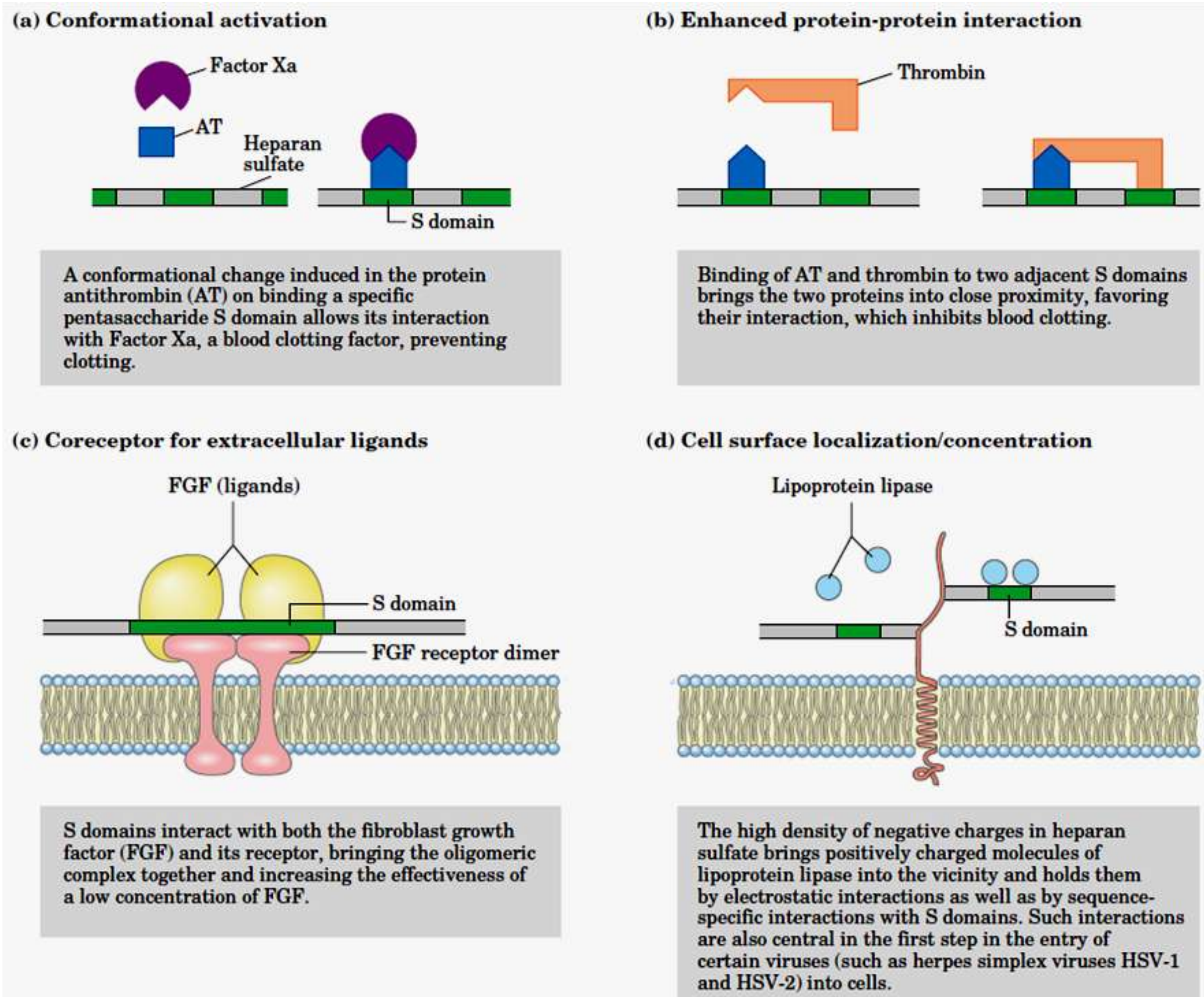
FIGURE 7–26 Proteoglycan structure, showing the trisaccharide bridge. A typical trisaccharide linker (blue) connects a glycosaminoglycan—in this case chondroitin sulfate (orange)—to a Ser residue (red) in the core protein. The xylose residue at the reducing end of the linker is joined by its anomeric carbon to the hydroxyl of the Ser residue.

Proteoglicanos





Proteoglicanos



(a) Conformational activation

A conformational change induced in the protein antithrombin (AT) on binding a specific pentasaccharide S domain allows its interaction with Factor Xa, a blood clotting factor, preventing clotting.

(b) Enhanced protein-protein interaction

Binding of AT and thrombin to two adjacent S domains brings the two proteins into close proximity, favoring their interaction, which inhibits blood clotting.

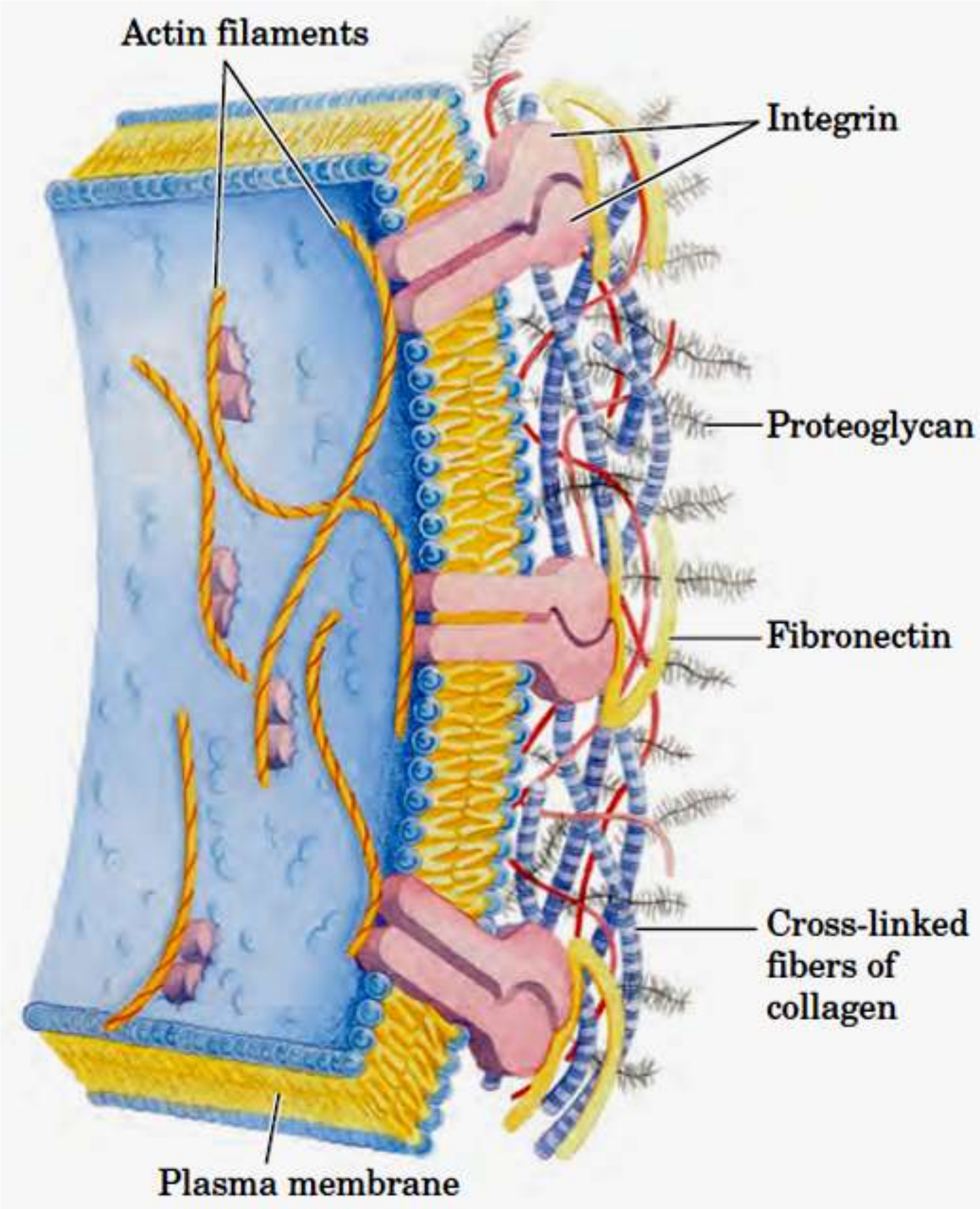
(c) Coreceptor for extracellular ligands

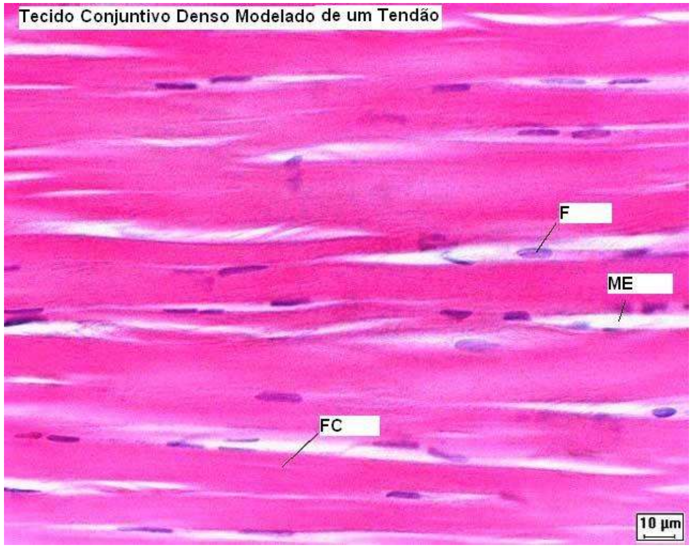
S domains interact with both the fibroblast growth factor (FGF) and its receptor, bringing the oligomeric complex together and increasing the effectiveness of a low concentration of FGF.

(d) Cell surface localization/concentration

The high density of negative charges in heparan sulfate brings positively charged molecules of lipoprotein lipase into the vicinity and holds them by electrostatic interactions as well as by sequence-specific interactions with S domains. Such interactions are also central in the first step in the entry of certain viruses (such as herpes simplex viruses HSV-1 and HSV-2) into cells.

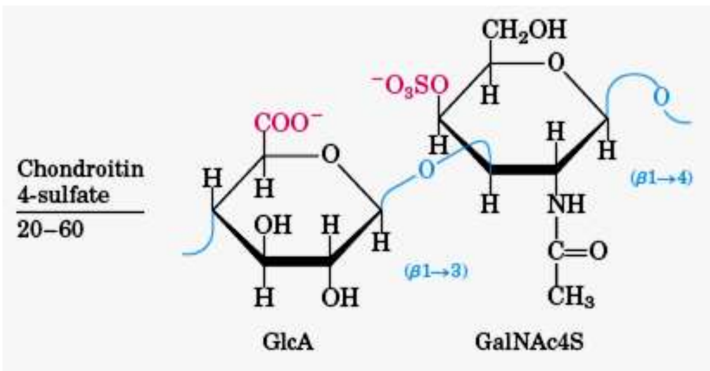
Proteoglicanos

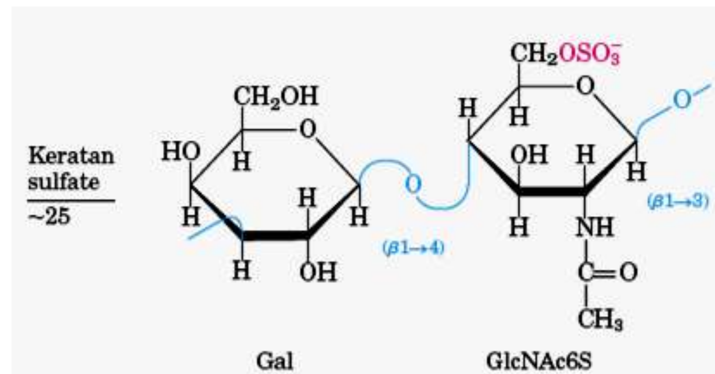


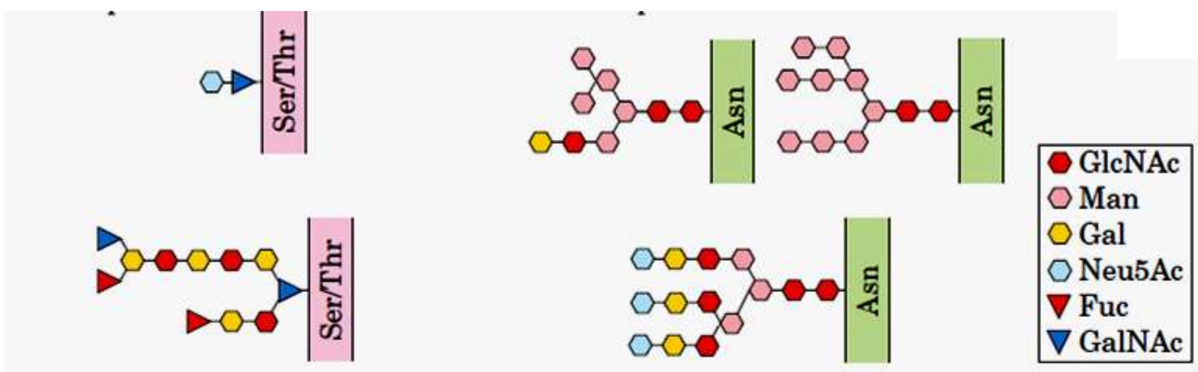


Glicoproteínas

porção carboidrato menor
estruturalmente mais variados que os glicosaminoglicanos

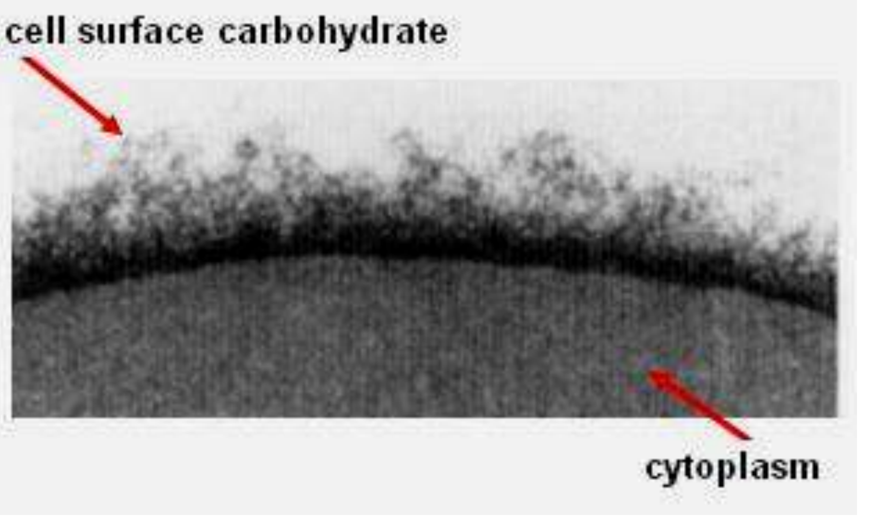




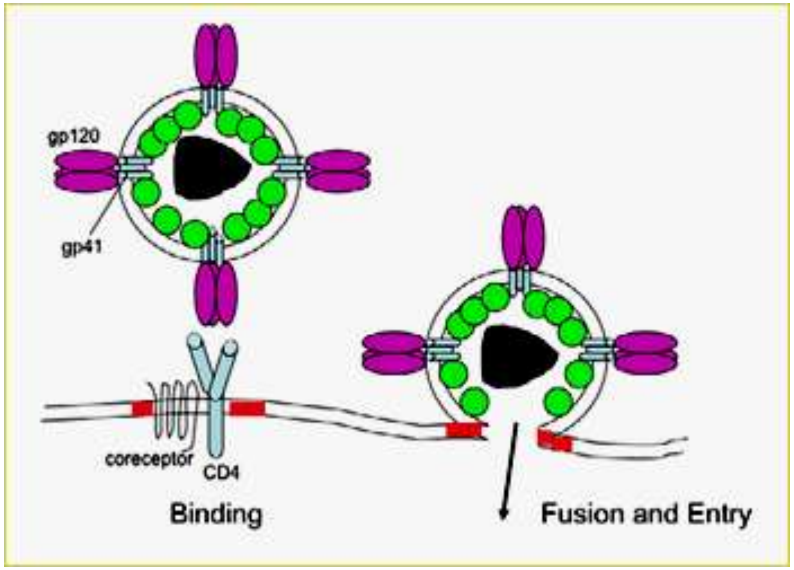


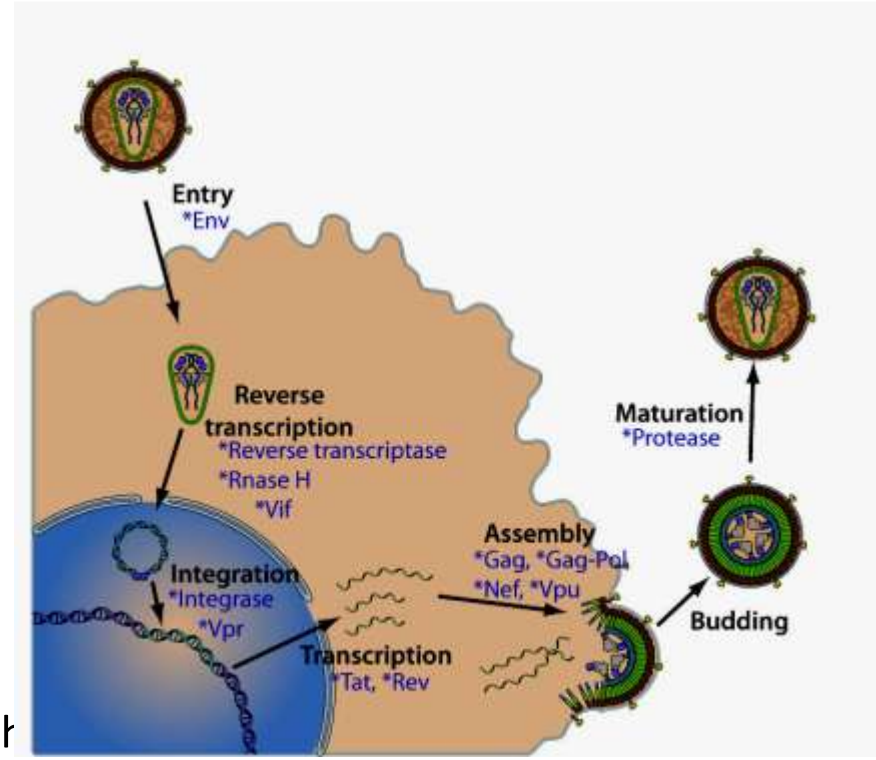
Glicoproteínas

maioria das proteínas do plasma sanguíneo
imunoglobulinas
hormônios
proteínas do leite
proteínas do lisossomo



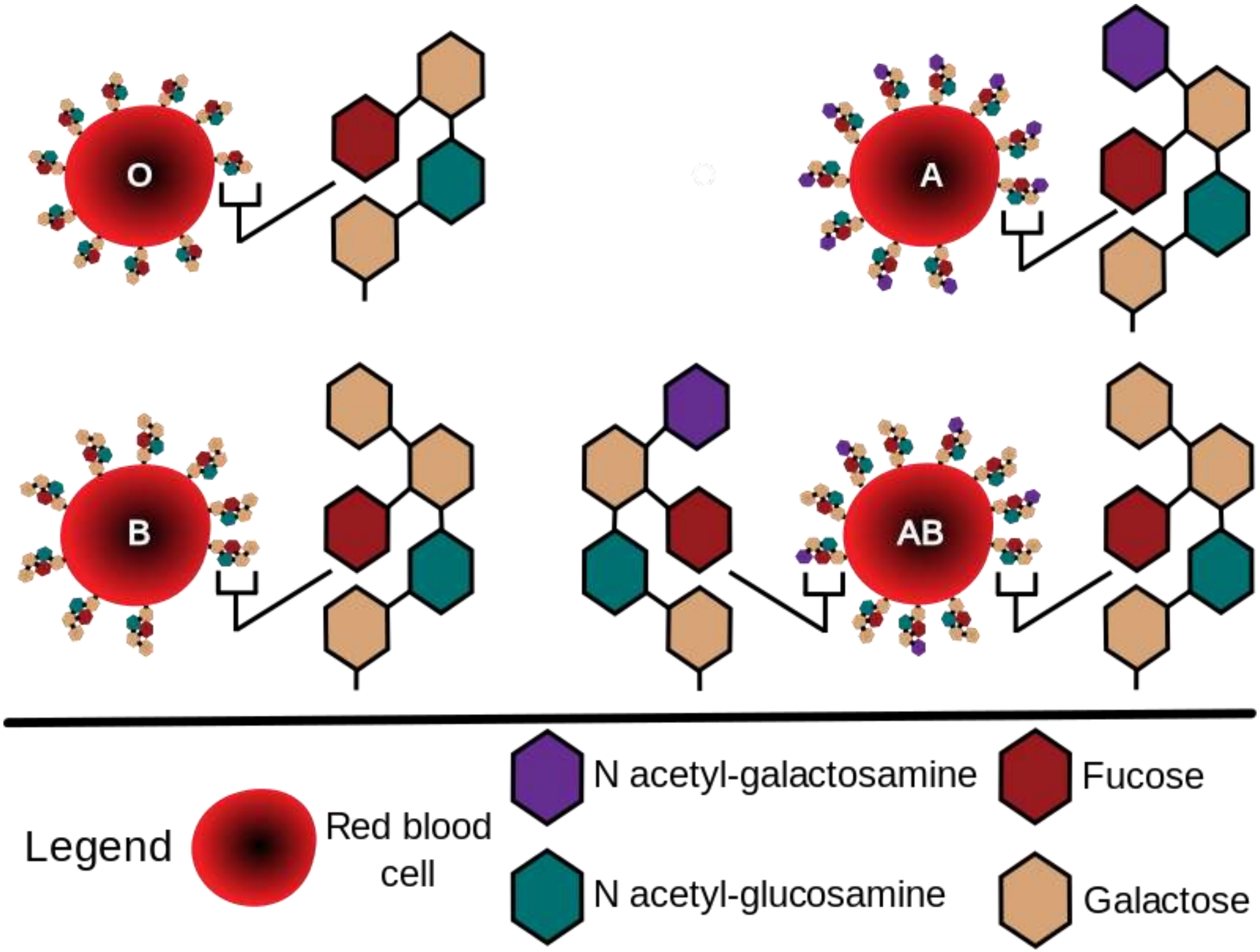
Glicoproteínas



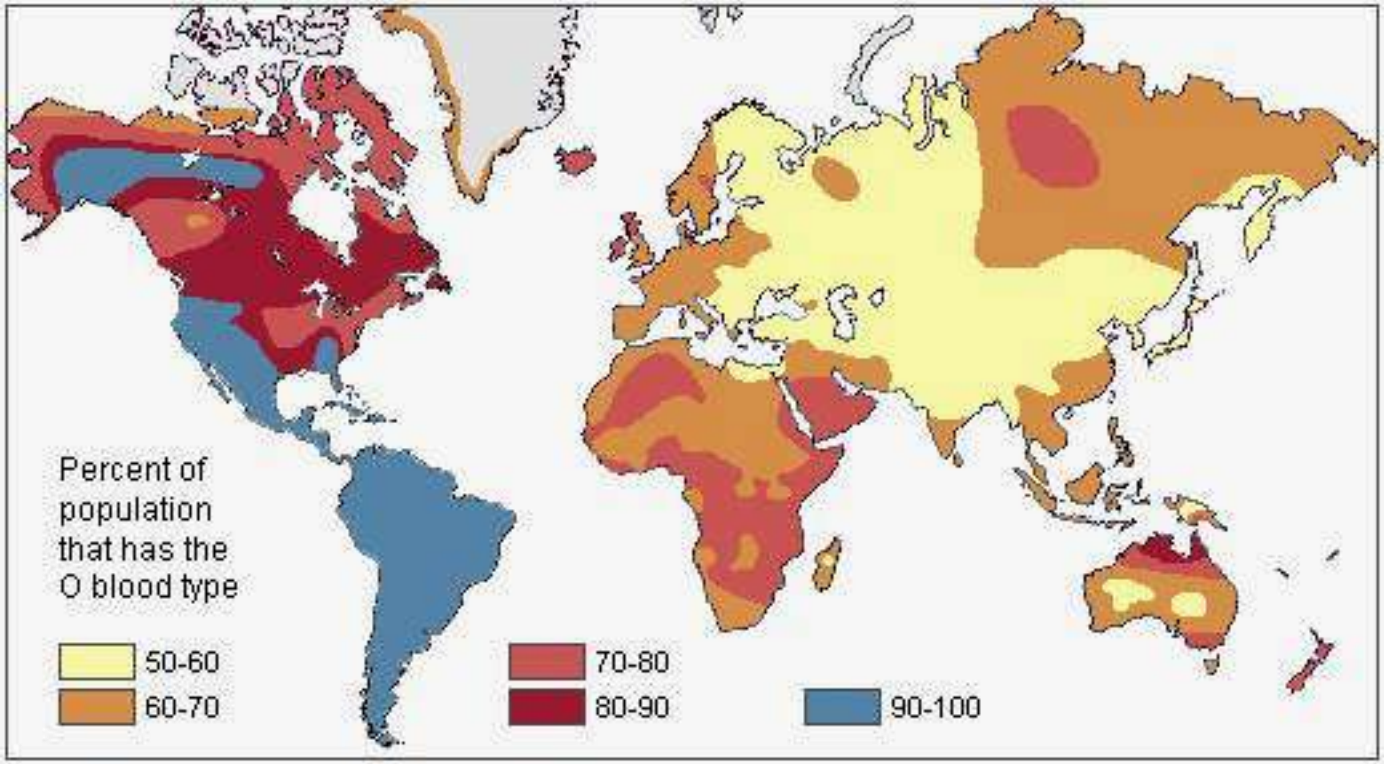


http://home.ccr.cancer.gov/inthejournals/archives/Freed_02.asp

Glicoproteínas

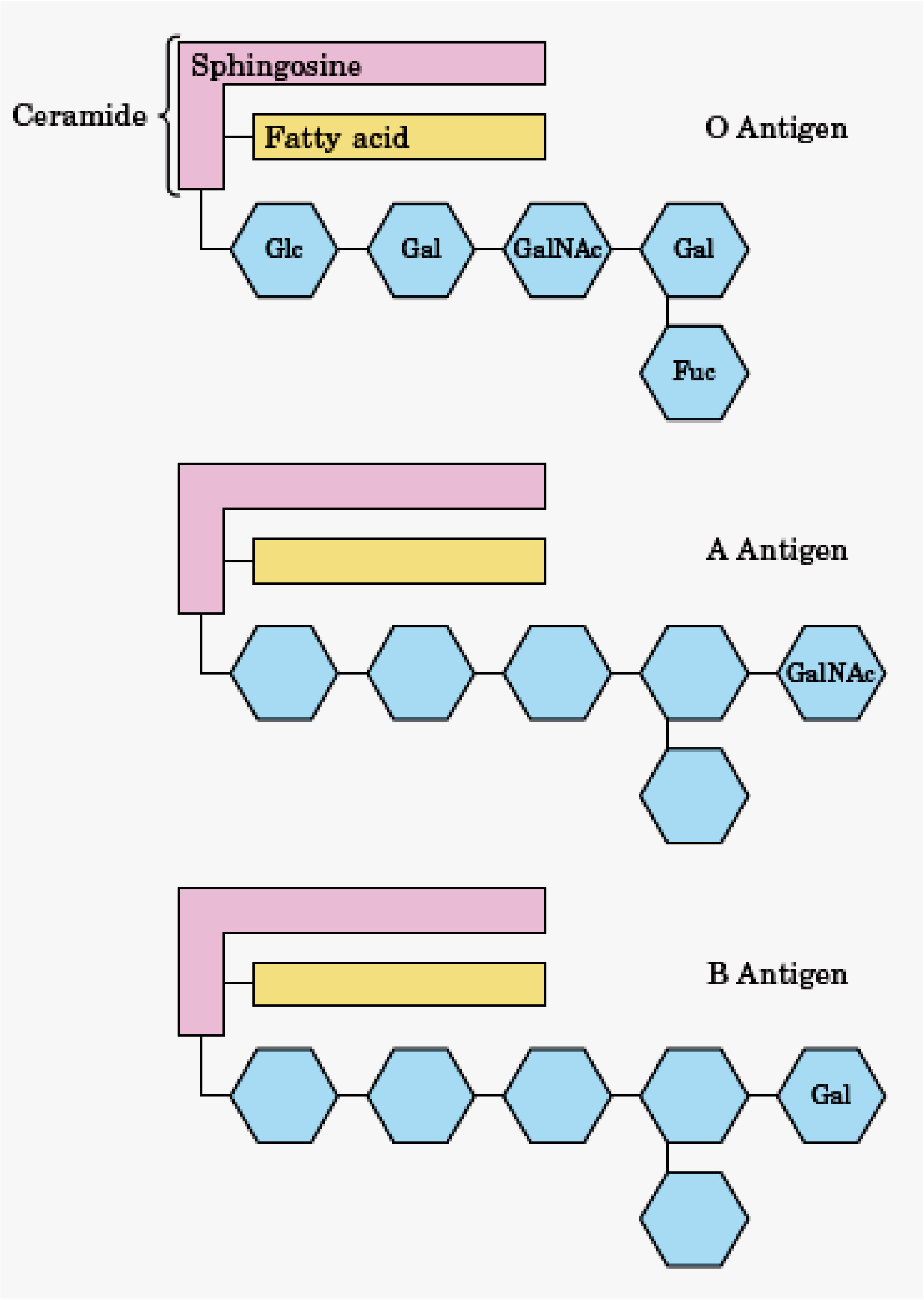


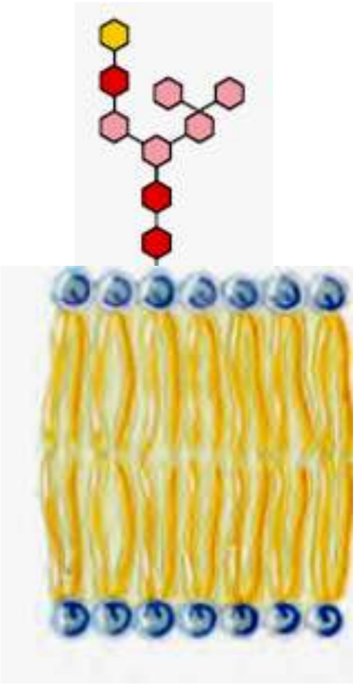
Glicoproteínas



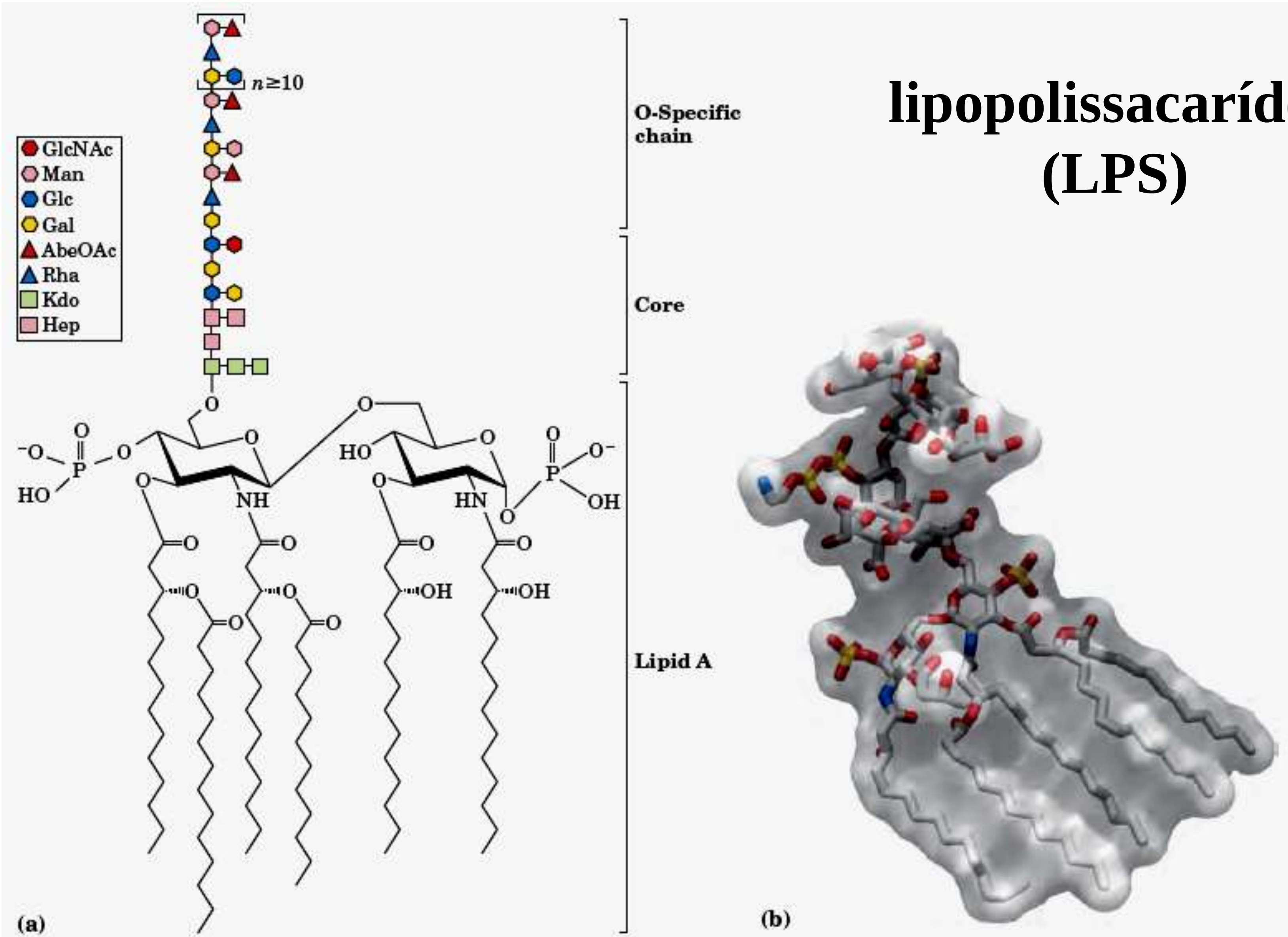
Percentage of the native population with the O allele.
http://anthro.palomar.edu/vary/vary_3.htm

Glicolipídeos





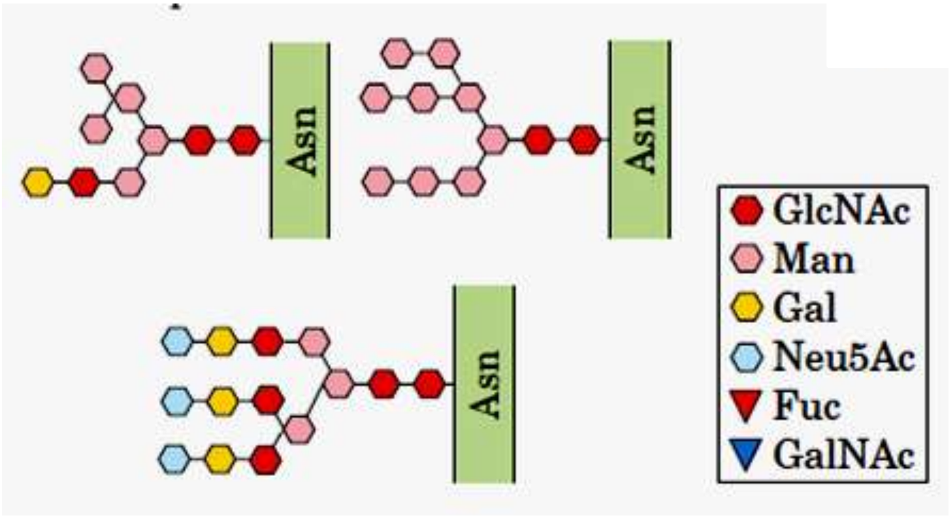
Glicolipídeos



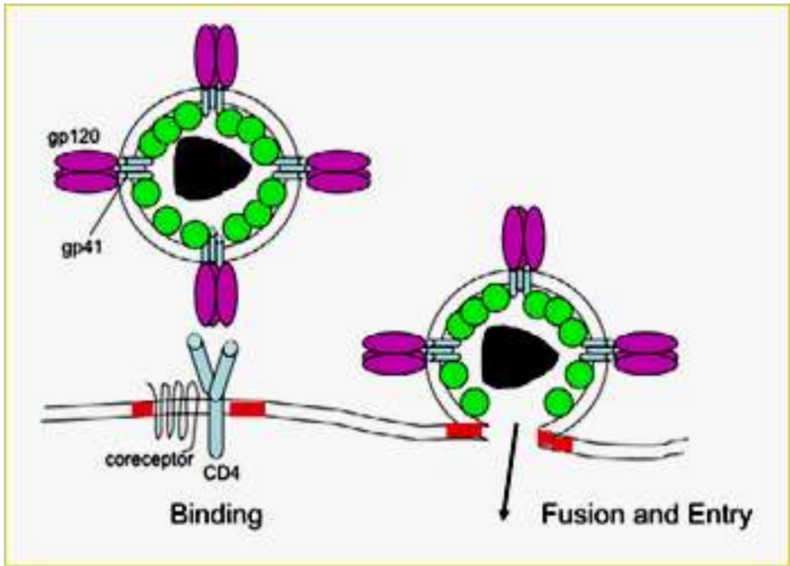
lipopolissacarídeo (LPS)

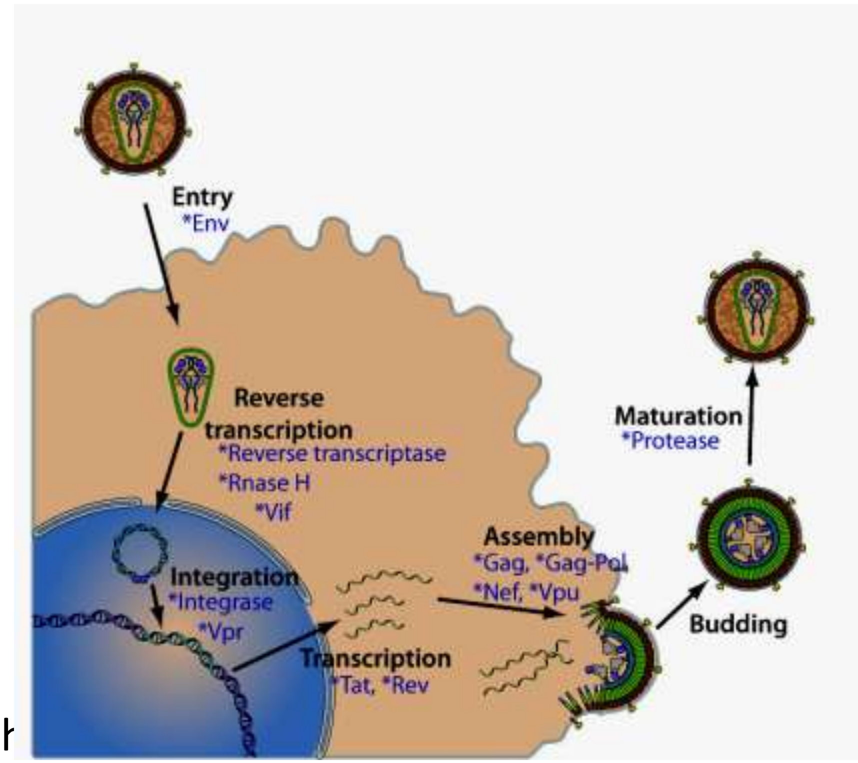
O código de açúcares

Glicobiologia: estudo da estrutura e função dos glicoconjugados



O código de açúcares





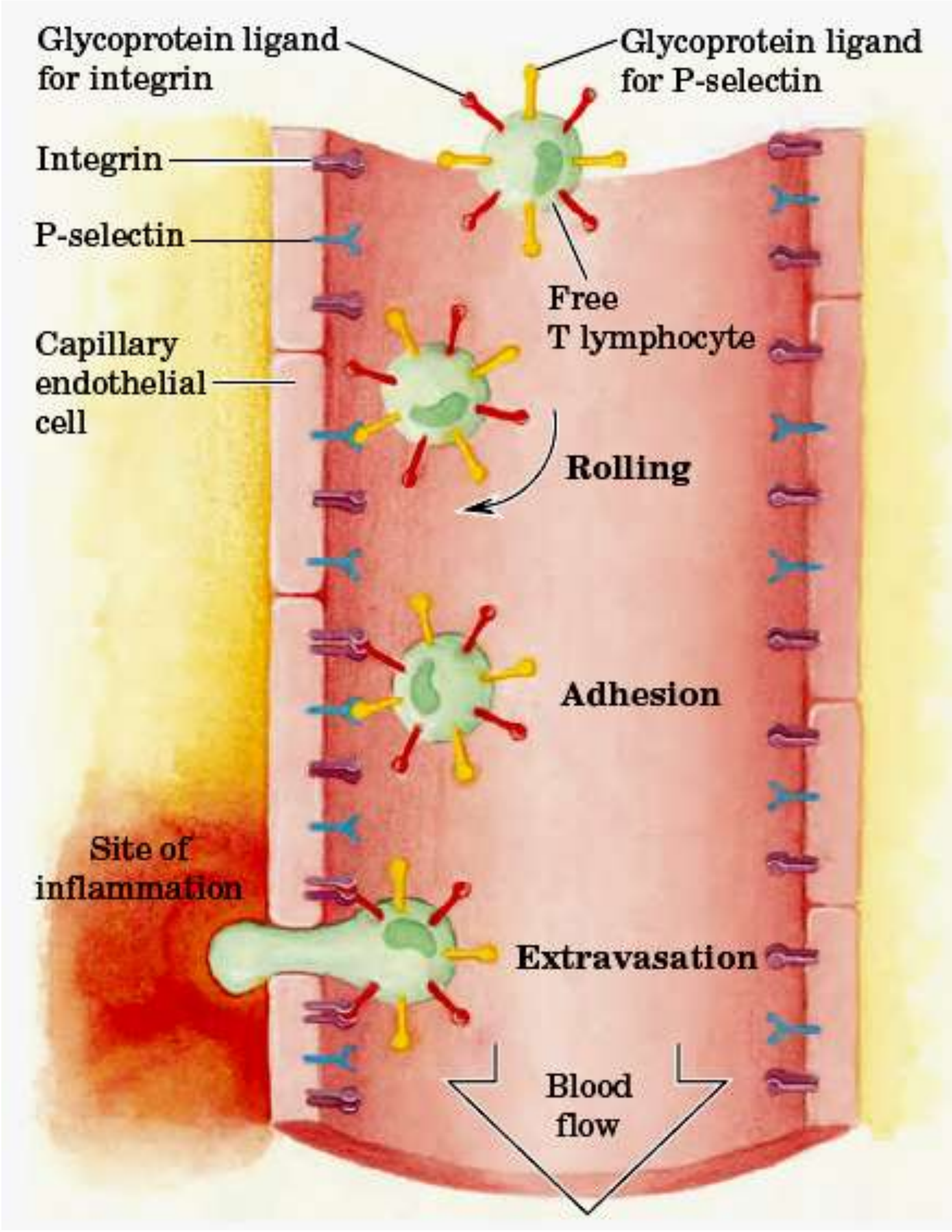
http://home.ccr.cancer.gov/inthejournals/archives/Freed_02.asp

O código de açúcares

TABLE 7–3 Some Lectins and the Oligosaccharide Ligands They Bind

Lectin source and lectin	*Abbreviation*	*Ligand(s)*
Plant		
Concanavalin A	ConA	Manα1—OCH_3
Griffonia simplicifolia lectin 4	GS4	Lewis b (Le^b) tetrasaccharide
Wheat germ agglutinin	WGA	Neu5Ac(α2→3)Gal(β1→4)Glc GlcNAc(β1→4)GlcNAc
Ricin		Gal(β1→4)Glc
Animal		
Galectin-1		Gal(β1→4)Glc
Mannose-binding protein A	MBP-A	High-mannose octasaccharide
Viral		
Influenza virus hemagglutinin	HA	Neu5Ac(α2→6)Gal(β1→4)Glc
Polyoma virus protein 1	VP1	Neu5Ac(α2→3)Gal(β1→4)Glc
Bacterial		
Enterotoxin	LT	Gal
Cholera toxin	CT	GM1 pentasaccharide

Source: Weiss, W.I. & Drickamer, K. (1996) Structural basis of lectin-carbohydrate recognition. *Annu. Rev. Biochem.* **65,** 441–473.



O código de açúcares

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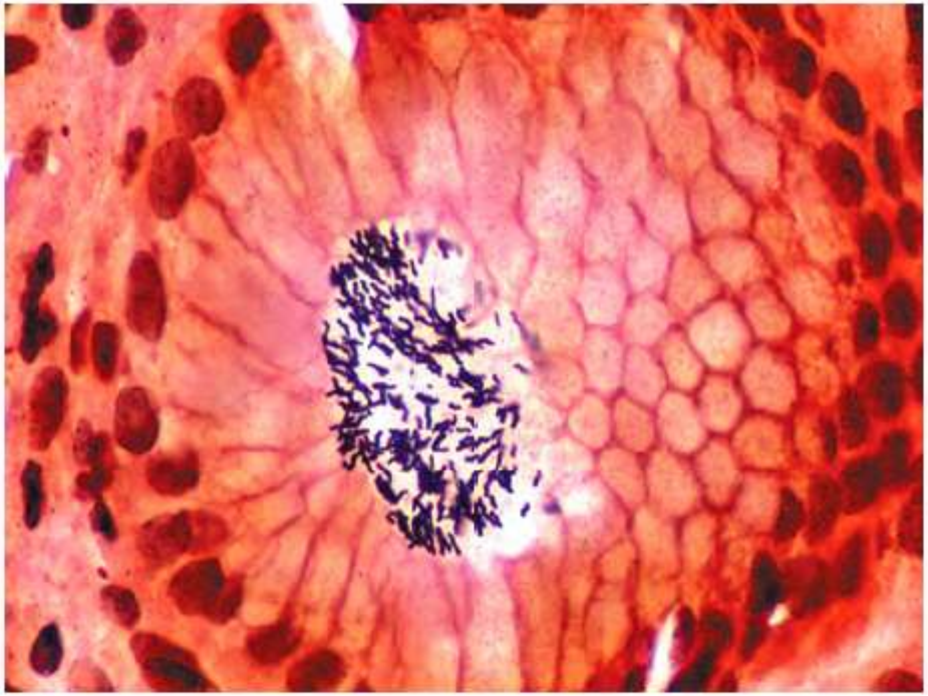
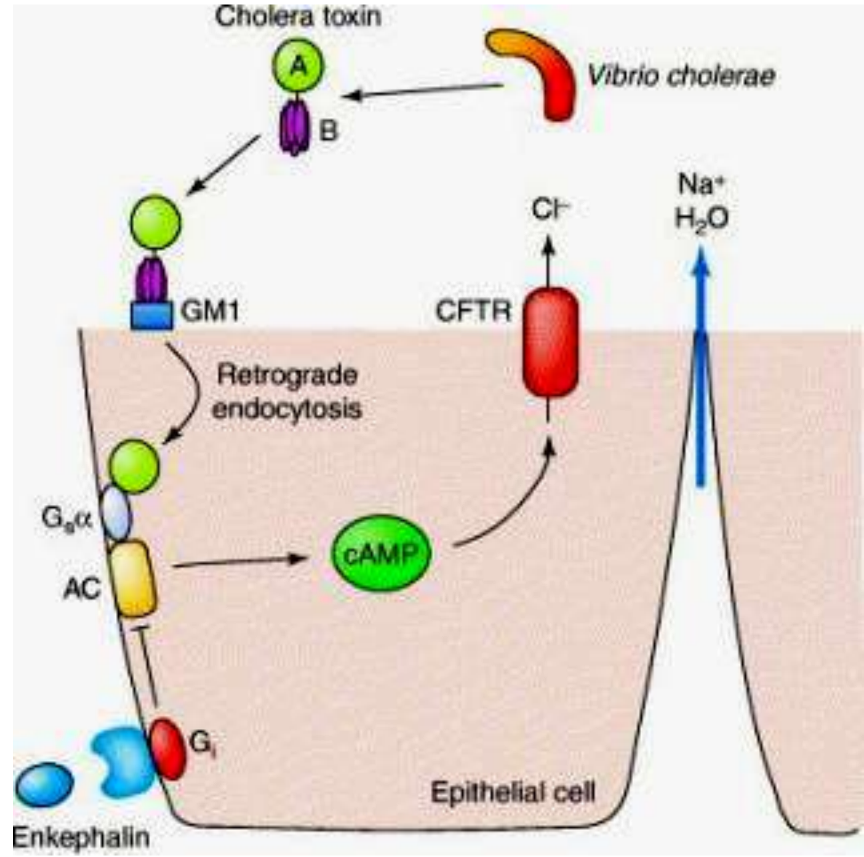


FIGURE 7-34 An ulcer in the making. *Helicobacter pylori* cells adhering to the gastric surface. This bacterium causes ulcers by interactions between a bacterial surface lectin and the Le^b oligosaccharide (a blood group antigen) of the gastric epithelium.



http://www.ebi.ac.uk/interpro/potm/2005_9/Page2.htm

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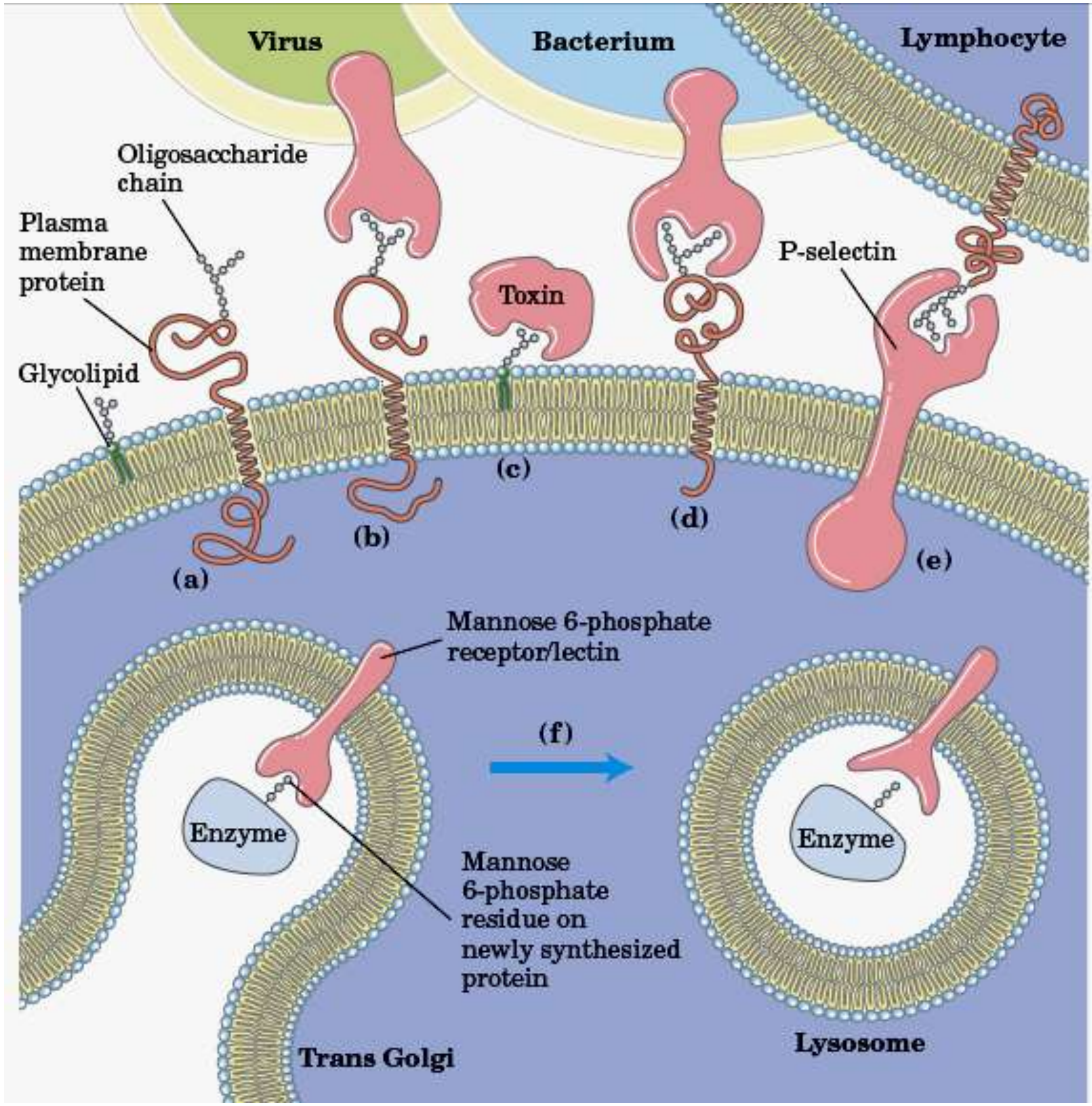

FIGURE 7–37 Roles of oligosaccharides in recognition and adhesion at the cell surface. **(a)** Oligosaccharides with unique structures (represented as strings of hexagons), components of a variety of glycoproteins or glycolipids on the outer surface of plasma membranes, interact with high specificity and affinity with lectins in the extracellular milieu. **(b)** Viruses that infect animal cells, such as the influenza virus, bind to cell surface glycoproteins as the first step in infection. **(c)** Bacterial toxins, such as the cholera and pertussis toxins, bind to a surface glycolipid before entering a cell. **(d)** Some bacteria, such as *H. pylori*, adhere to and then colonize or infect animal cells. **(e)** Selectins (lectins) in the plasma membrane of certain cells mediate cell-cell interactions, such as those of T lymphocytes with the endothelial cells of the capillary wall at an infection site. **(f)** The mannose 6-phosphate receptor/lectin of the trans Golgi complex binds to the oligosaccharide of lysosomal enzymes, targeting them for

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