BLOQUE II
TEMA 6: GLUCIDOS, ESTRUCTURA Y FUNCIÓN

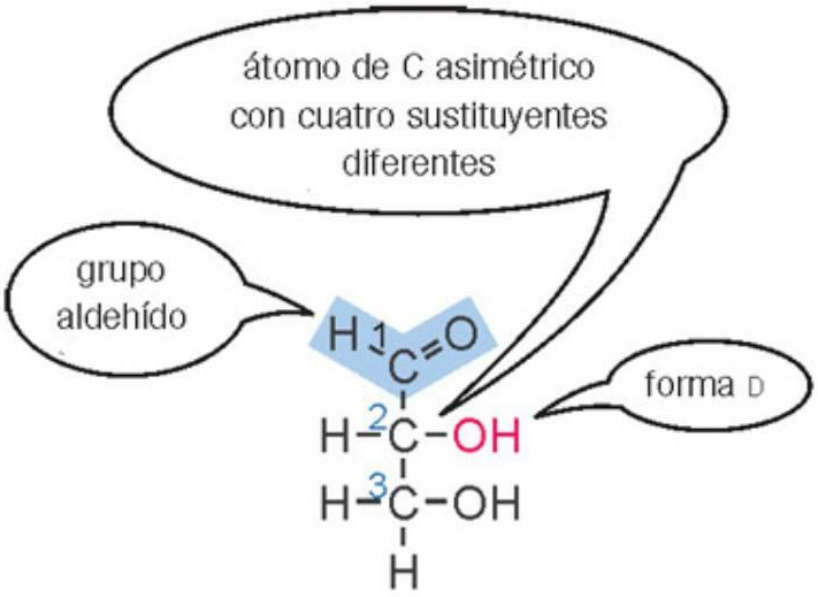
UA | UNIVERSITAT D'ALACANT
Facultat de Ciències
Facultad de Ciencias

INDICE

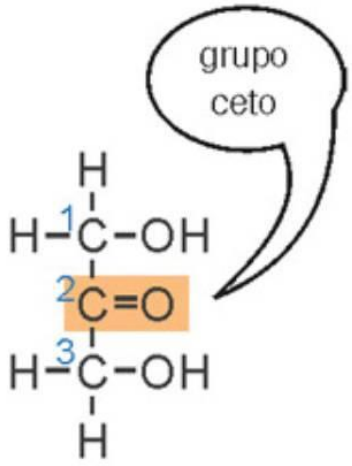
- Características generales de los glúcidos
- Monosacáridos: clasificación y propiedades
- Derivados de monosacáridos
- Enlace glucosídico
- Disacáridos
- Homopolisacáridos: almidón, glucógeno, quitina y celulosa
- Heteropolisacáridos: peptidoglucanos, glucosaminoglucanos, glucoconjugados
- Lectinas

MONOSACÁRIDOS

- Clasificación en función del nº de átomos de C:
- Clasificación según la naturaleza química del grupo carbonilo:



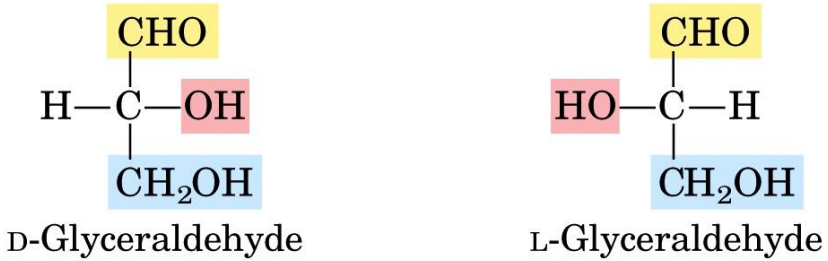
D-gliceraldehído
(una aldotriosa)



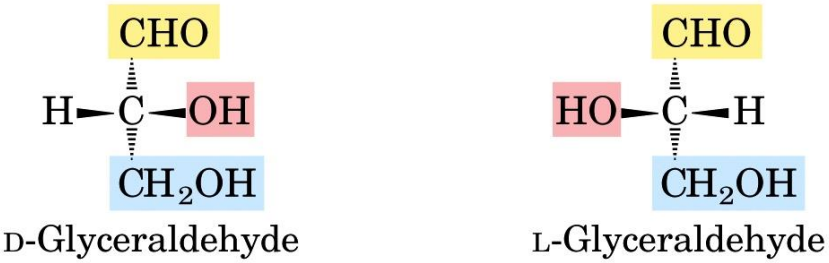
dihidroxiacetona
(una cetotriosa)

MONOSACÁRIDOS

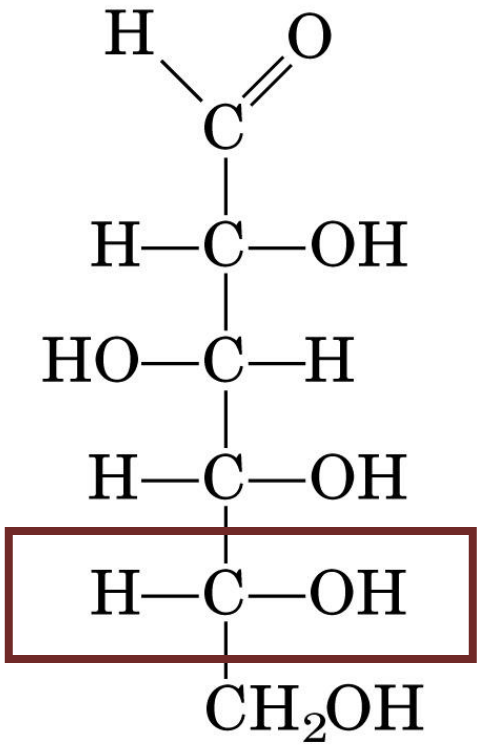
- Presencia de carbonos asimétricos
  ⇨Esteroisómeros



Fischer projection formulas



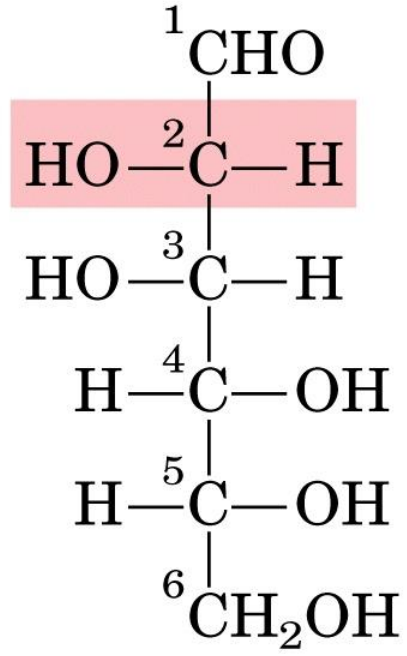
Perspective formulas



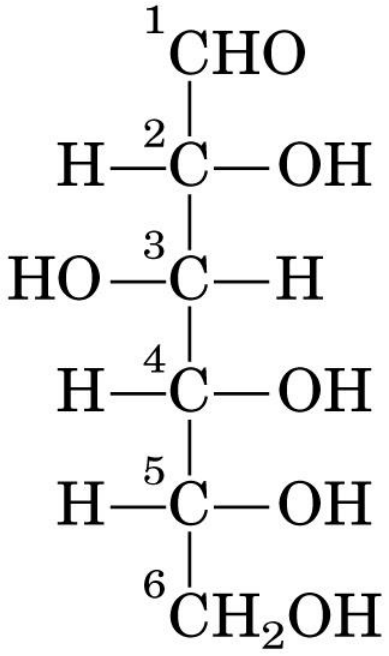
D-Glucosa

MONOSACÁRIDOS

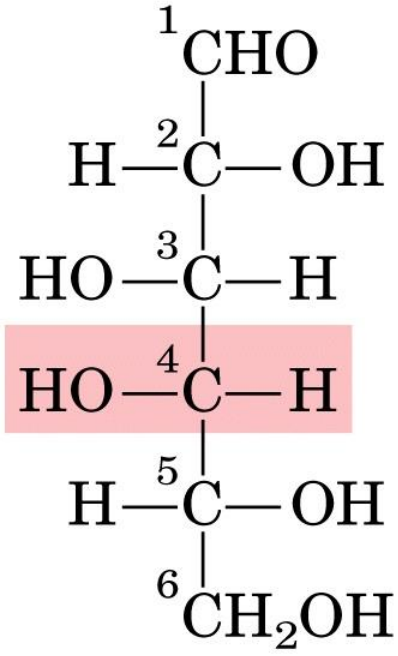
- Azúcares que sólo difieren en la configuración alrededor de un átomo de C ⇨Epímeros



D-Mannose
(epimer at C-2)

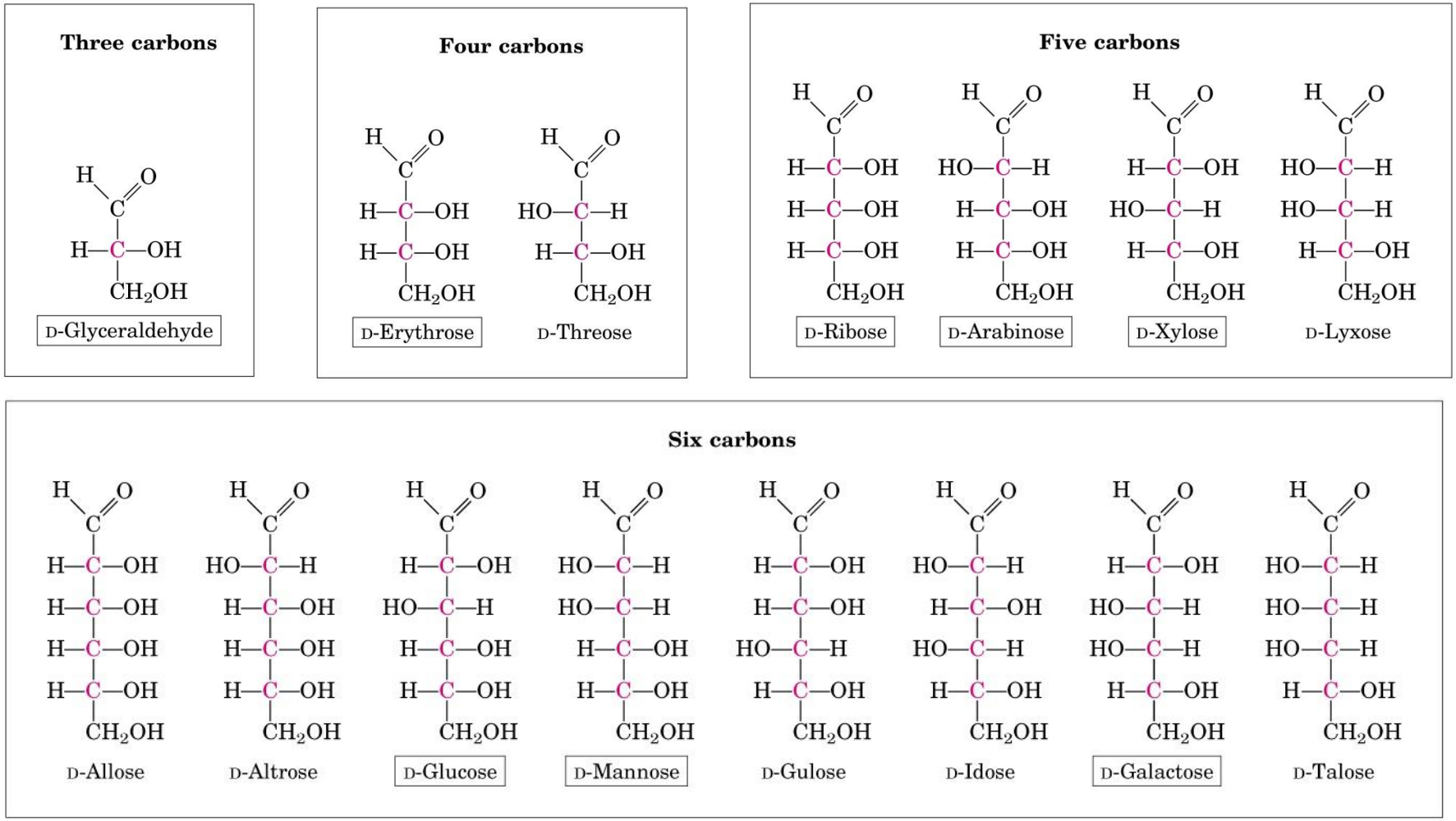


D-Glucose

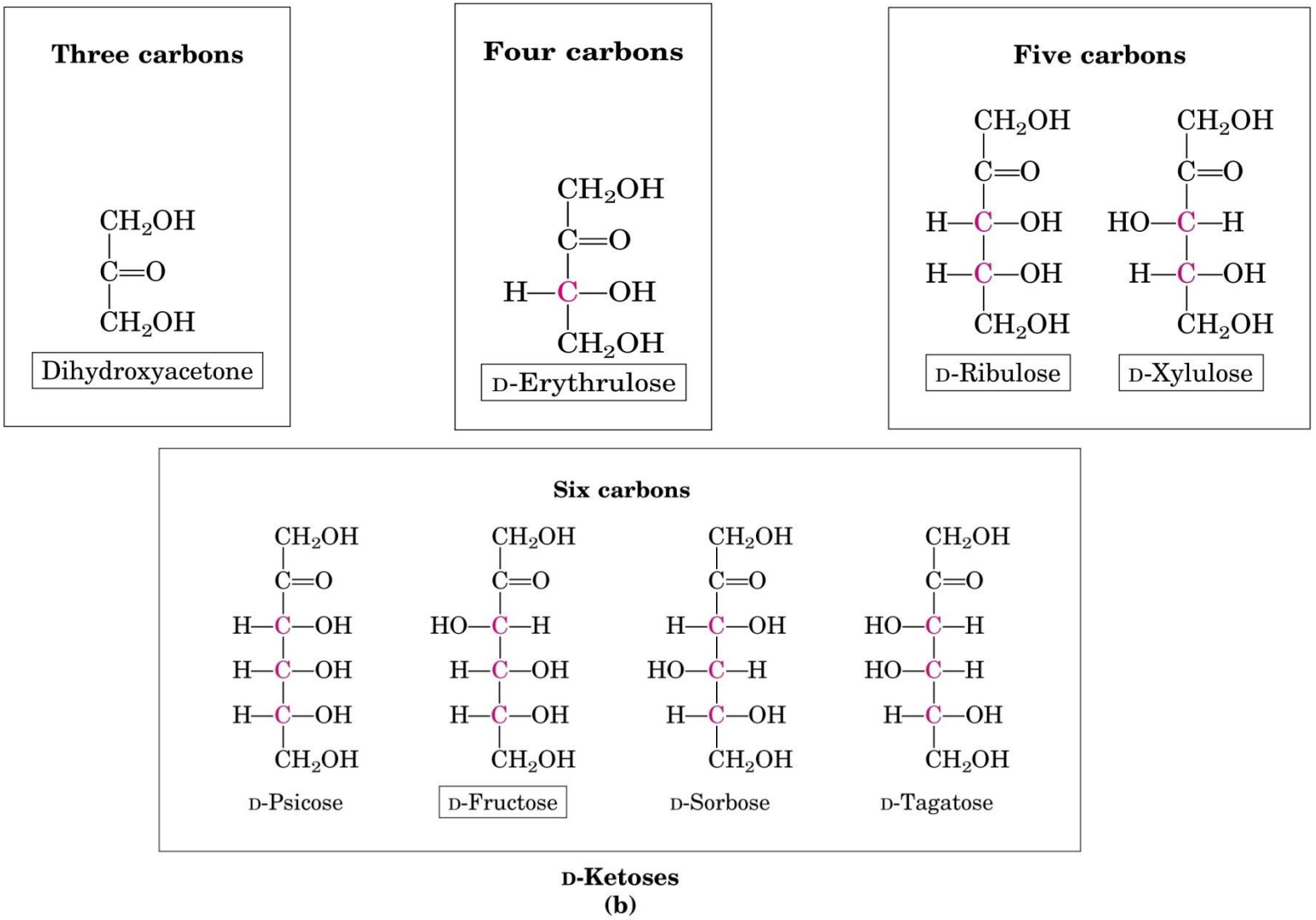


D-Galactose
(epimer at C-4)

MONOSACÁRIDOS

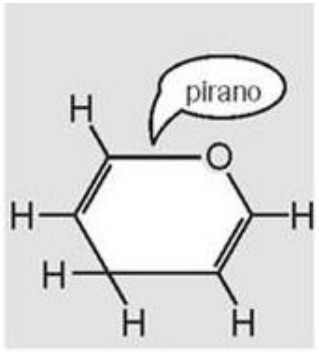


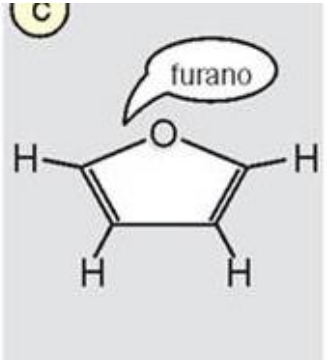
MONOSACÁRIDOS

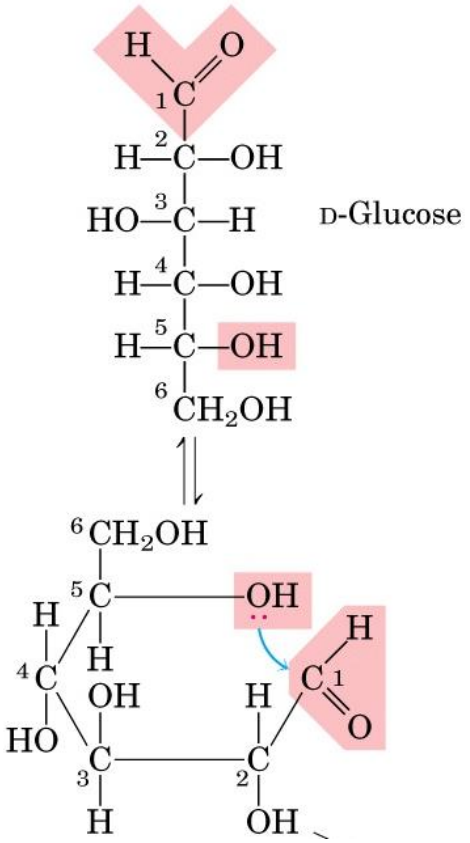


MONOSACÁRIDOS

- Monosacáridos de 5 o más átomos de C disueltos en agua ⇨ Estructuras cíclicas
  - Piranósido = piranosa
  - Furanósido = furanosa

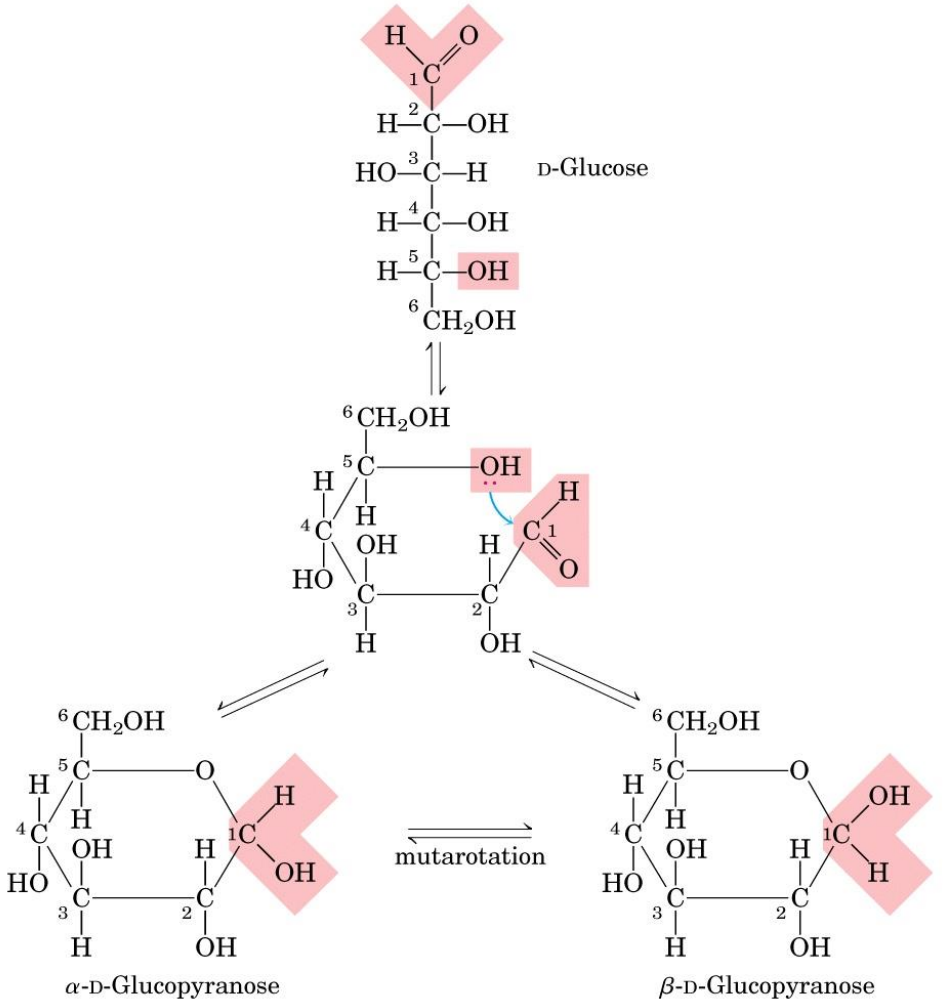






MONOSACÁRIDOS

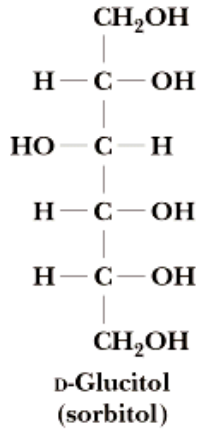
- Grupo carbonilo se transforma en un C asimétrico ⇨ Carbono anomérico
  - Anómero α
  - Anómero β
- Mutarrotación



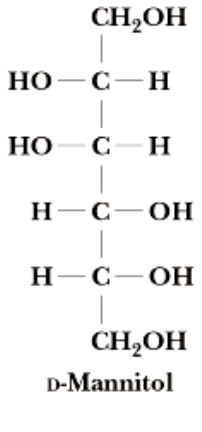
DERIVADOS DE LOS MONOSACÁRIDOS

a) **Reducción**:

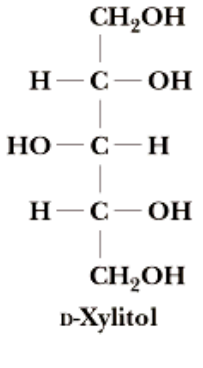
- Alditoles: reducción del grupo carbonilo (CHO) a alcohol (CH_2OH)
  - Nombre del azúcar acabado en –itol (Excepto la glucosa = sorbitol)



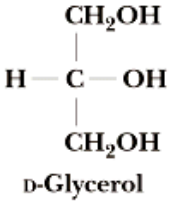
D-Glucitol (sorbitol)



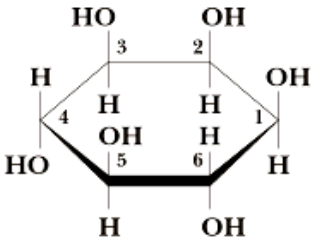
D-Mannitol



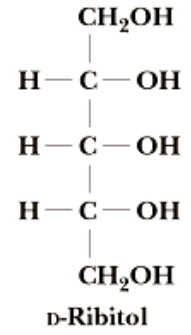
D-Xylitol



D-Glycerol



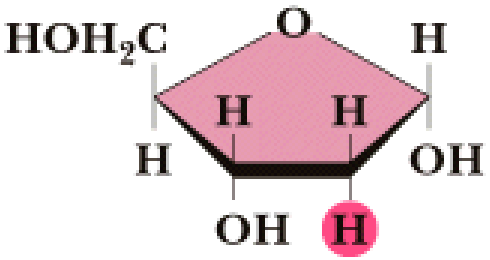
myo-Inositol



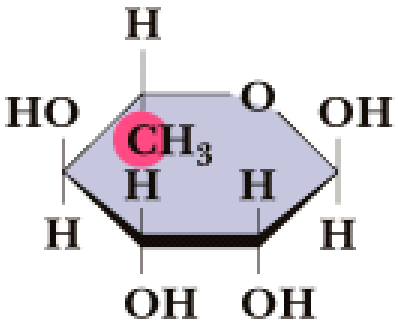
D-Ribitol

DERIVADOS DE LOS MONOSACÁRIDOS

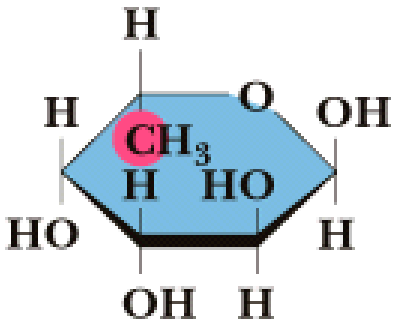
- Desoxiazúcares: Implica la pérdida de algún grupo hidroxilo



2-Deoxy-α-D-Ribose



α-L-Rhamnose (Rha)

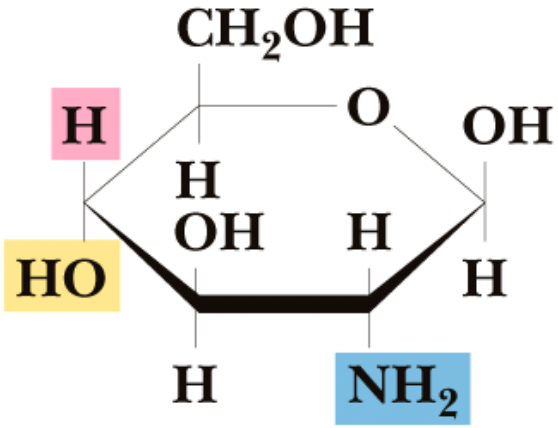


α-L-Fucose (Fuc)

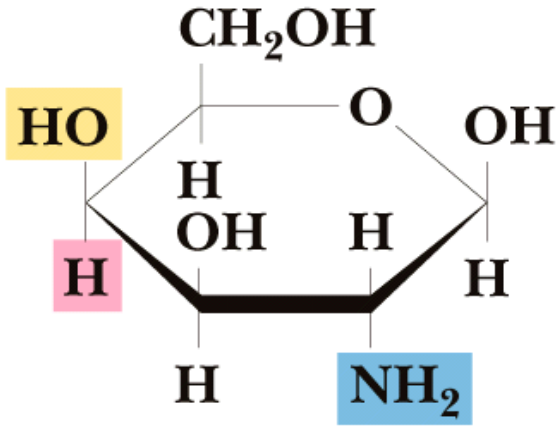
DERIVADOS DE LOS MONOSACÁRIDOS

b) Aminoazúcares:

- Sustitución de OH por NH_2
- Generalmente en C2



β-D-Glucosamine

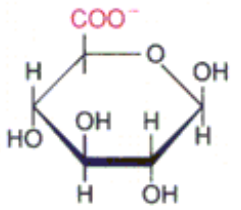


β-D-Galactosamine

DERIVADOS DE LOS MONOSACÁRIDOS

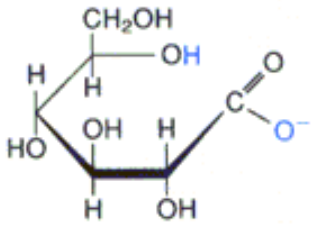
c) Oxidación: oxidación de los carbonos terminales de las aldosas

- Ácidos urónicos: oxidación del último C



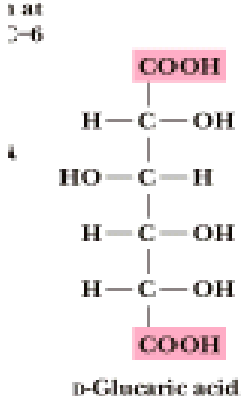
β-D-Glucuronic acid

- Ácidos aldónicos: oxidación del C aldehídico



D-Gluconic acid

- Ácidos aldáricos: oxidación en ambos extremos



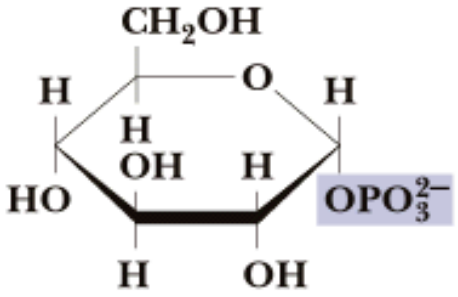
D-Glucaric acid

DERIVADOS DE LOS MONOSACÁRIDOS

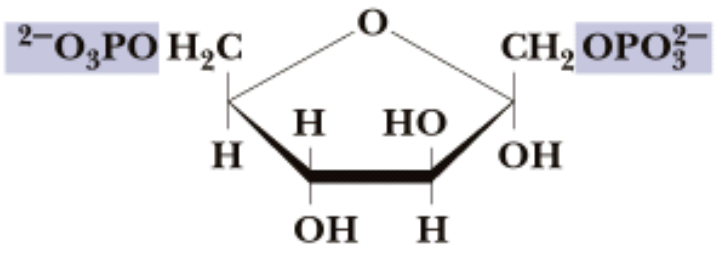
d) Esterificación

- Esterificación de un grupo OH con ácido fosfórico o sulfúrico

Garrett & Grisham: Biochemistry, 2/e
Figure 7.13

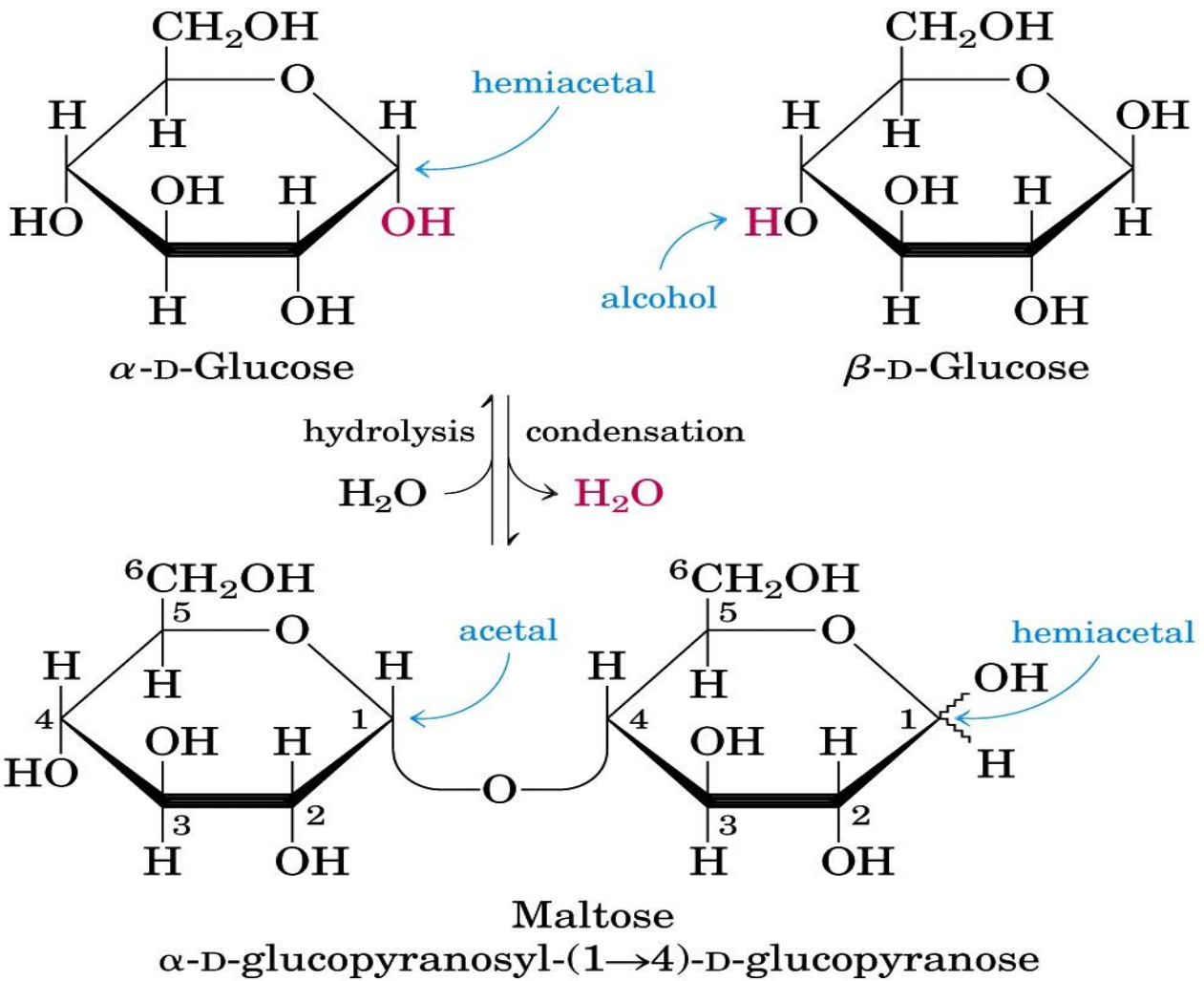


α-D-Glucose-1-phosphate

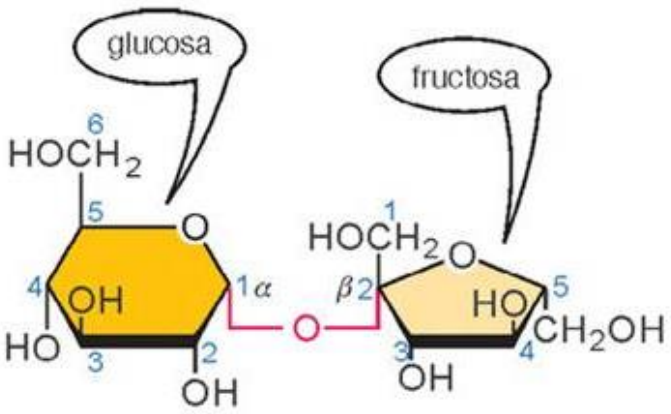


α-D-Fructose-1,6-bisphosphate

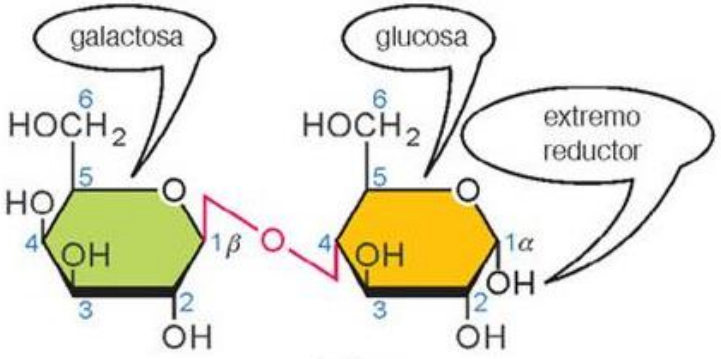
ENLACE GLUCOSÍDICO



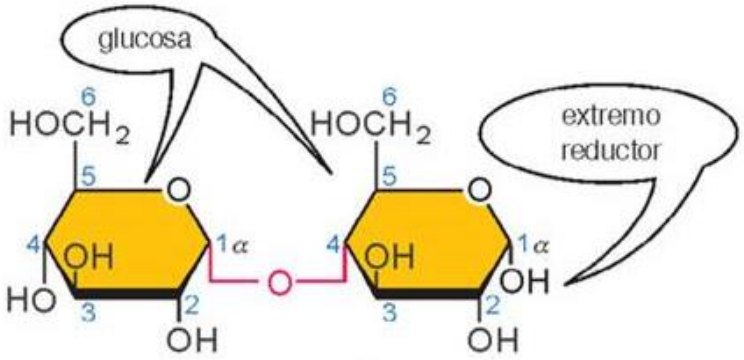
OLIGOSACÁRIDOS: DISACÁRIDOS



sacarosa
(*O*-α-D-glucopiranosil-(1→2)-β-D-fructofuranosa)



lactosa
(*O*-β-D-galactopiranosil-(1→4)-α-D-glucopiranosa)



maltosa
(*O*-α-D-glucopiranosil-(1→4)-α-D-glucopiranosa)

POLISACÁRIDOS

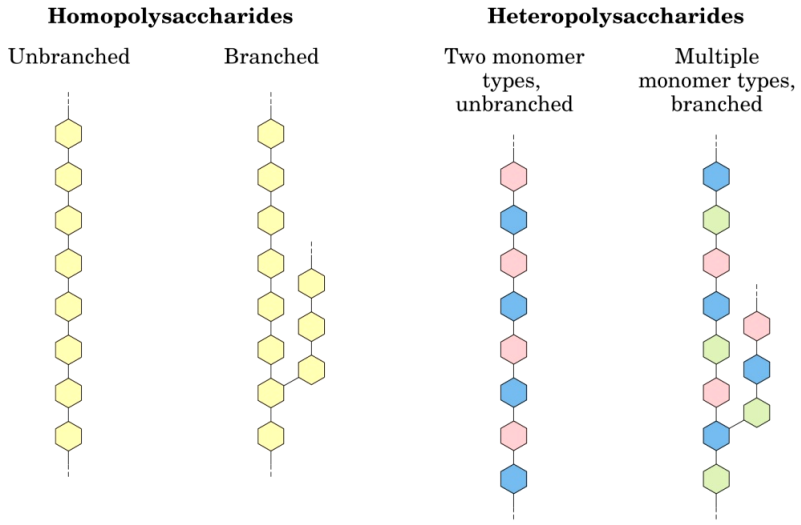
table 9–2

Structures and Roles of Some Polysaccharides

Polymer	Type*	Repeating unit†	Size (number of monosaccharide units)	Roles
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 to 30 residues	Up to 10^6	
Glycogen	Homo-	(α1→4)Glc, with (α1→6)Glc branches every 8 to 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
Peptidoglycan	Hetero-; peptides attached	4)Mur2Ac(β1→4) GlcNAc(β1	Very large	Structural: in bacteria, gives rigidity and strength to cell envelope
Hyaluronate (a glycosamino-glycan)	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

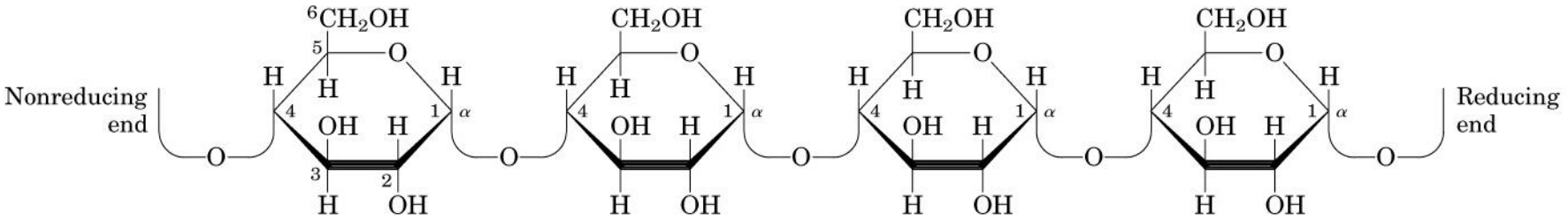
* Each polymer is classified as a homopolysaccharide (homo-) or heteropolysaccharide (hetero-).

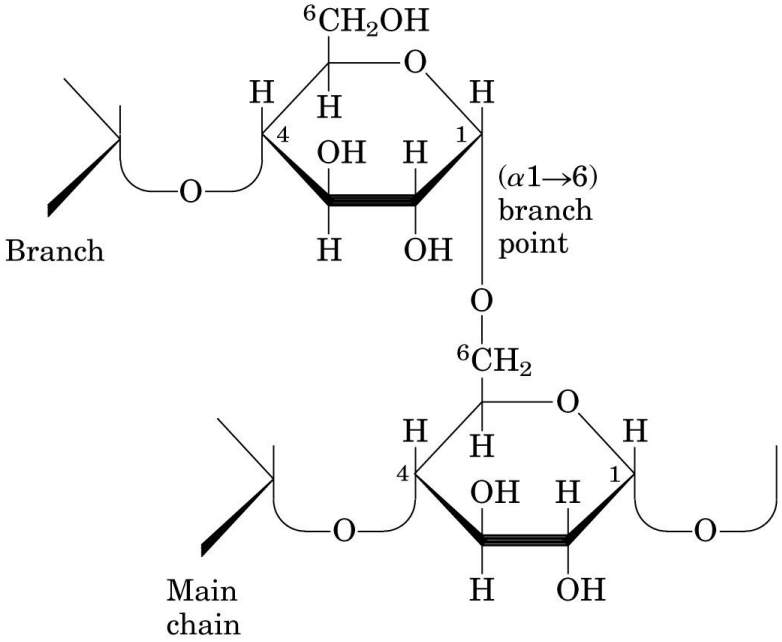
†The abbreviated names for the peptidoglycan and hyaluronate repeating units indicate that the polymer contains repeats of t of one disaccharide unit linked β(1→4) to the first residue of the next disaccharide unit.

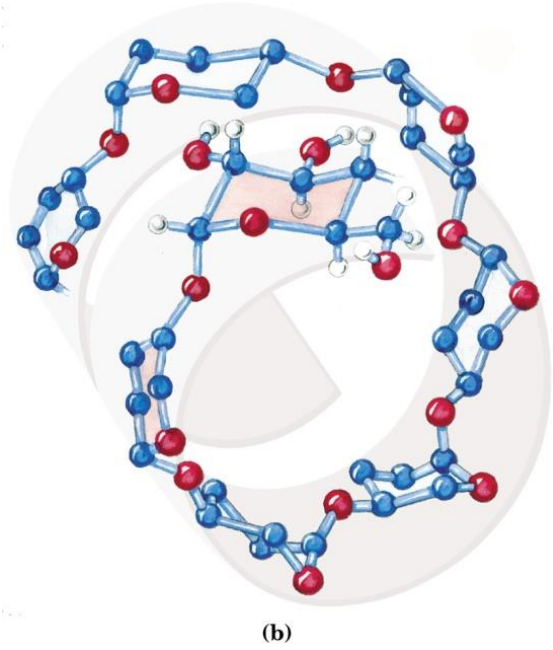


HOMOPOLISACÁRIDOS: Almidón

AMILOSA



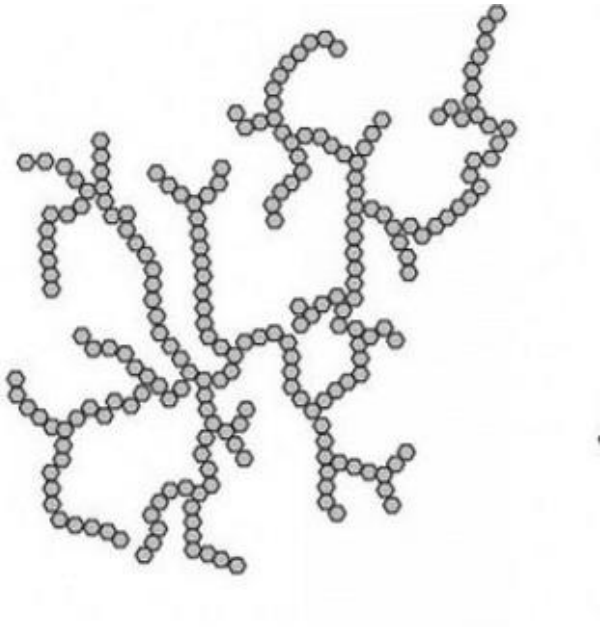



(b)

AMILOPECTINA

HOMOPOLISACÁRIDOS: Glucógeno

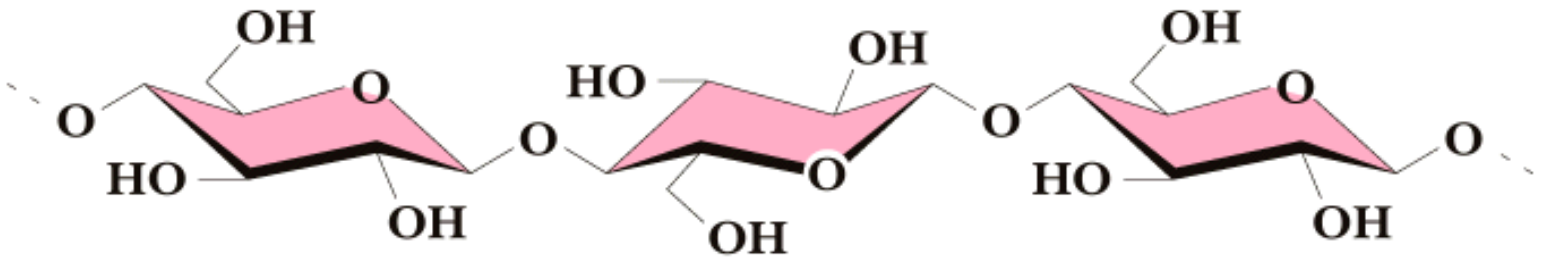
- Similar a amilopectina pero con más ramificaciones: un enlace α(1-6) cada 8-13 unidades de D-glucosa



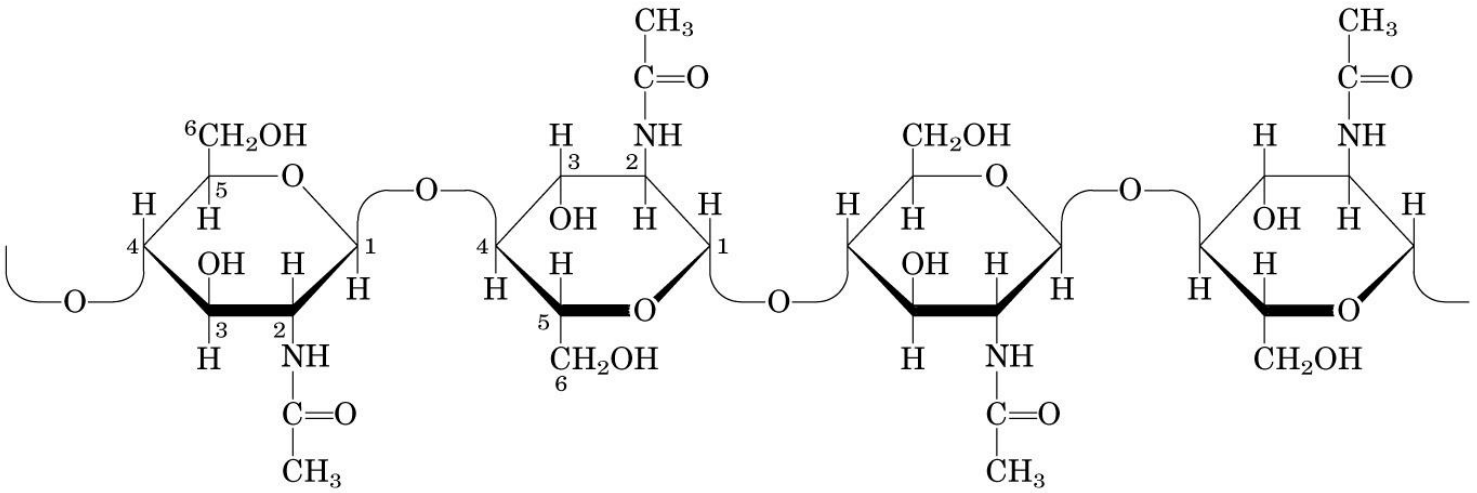
Glucógeno

HOMOPOLISACÁRIDO: Celulosa

- No hidrolizable por enzimas digestivas humanas



HOMOPOLISACÁRIDO: Quitina

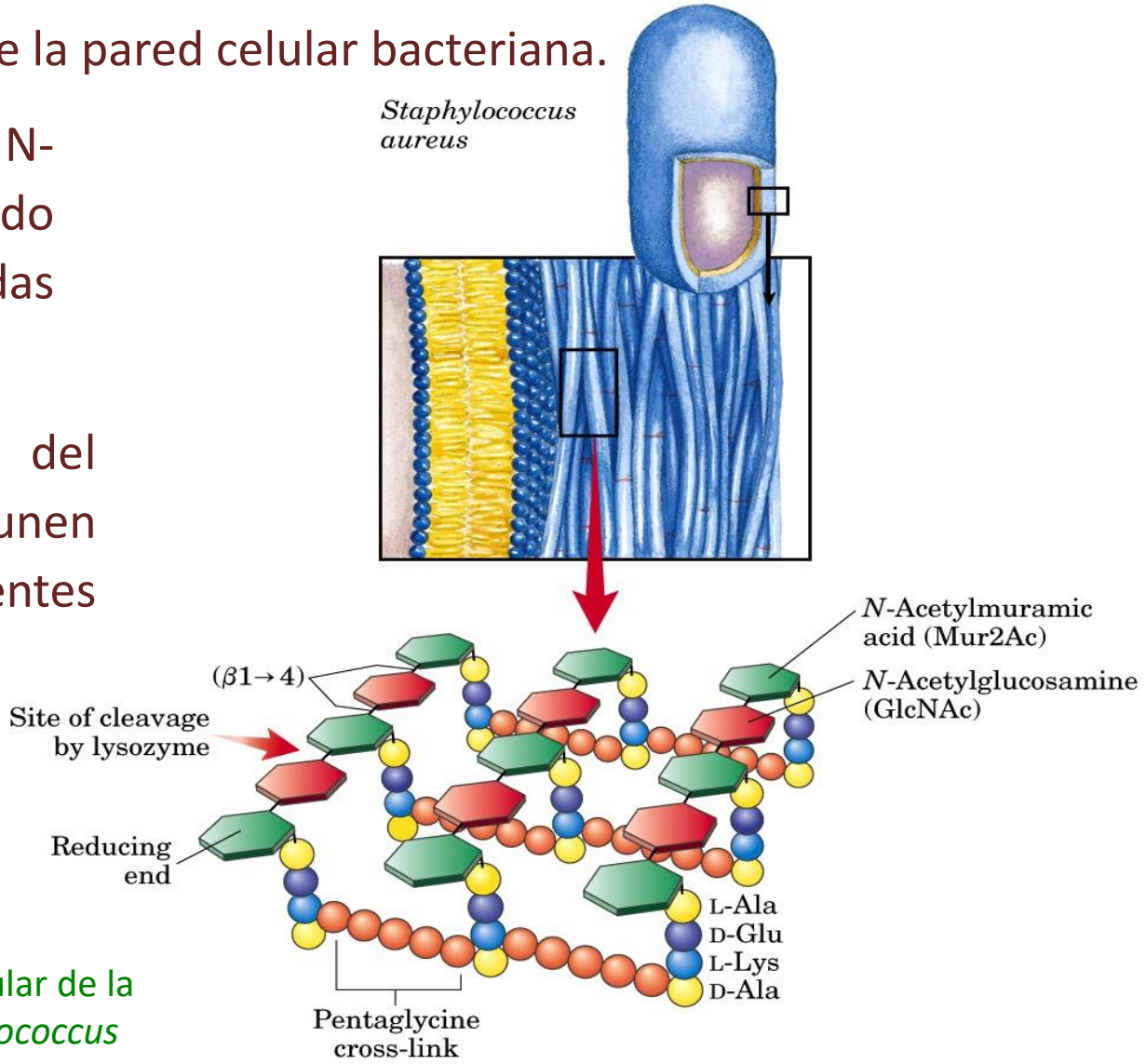


HETEROPOLISACÁRIDOS

- Unidades alternantes de aminoazúcares y de ácidos urónicos
- Frecuentemente unidos a proteinas
- Proteoglucanos o mucopolisacáridos
- Poseen carga
- Elementos de soporte del tejido conjuntivo

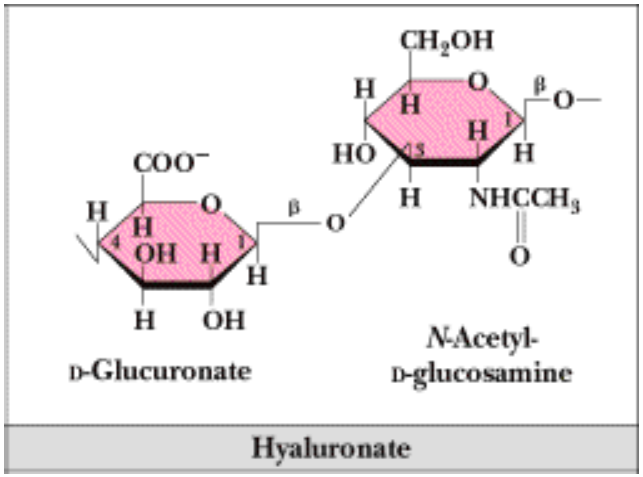
HETEROPOLISACÁRIDOS: Peptidoglucanos

- Componente rígido de la pared celular bacteriana.
- Unidades alternas de N-acetilglucosamina y ácido N-acetilmurámico, unidas por enlaces β(1-4).
- Las cadenas lineales del heteropolisacárido se unen por enlaces covalentes mediante péptidos.
- La lisozima hidroliza enlaces glucosídicos entre unidades.

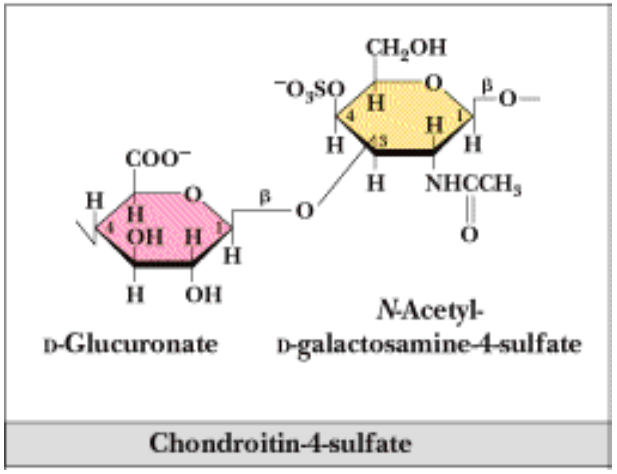


Peptidoglucano de la pared celular de la bacteria gram-positiva *Staphylococcus aureus*.

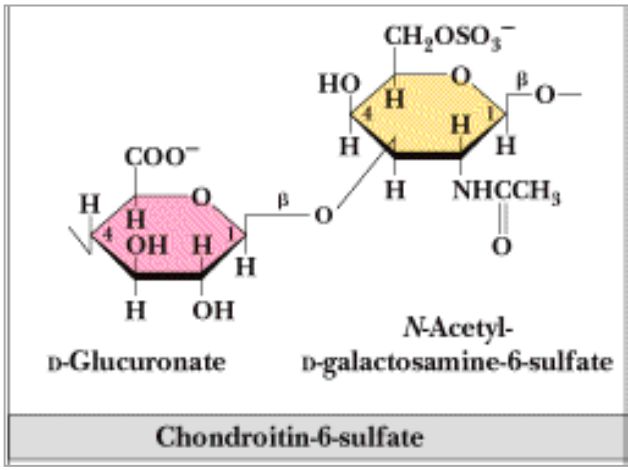
HETEROPOLISACÁRIDOS: Glucosaminoglucanos



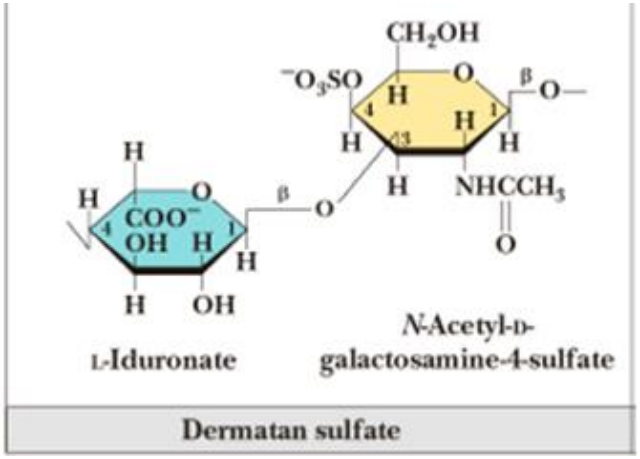
Hyaluronate



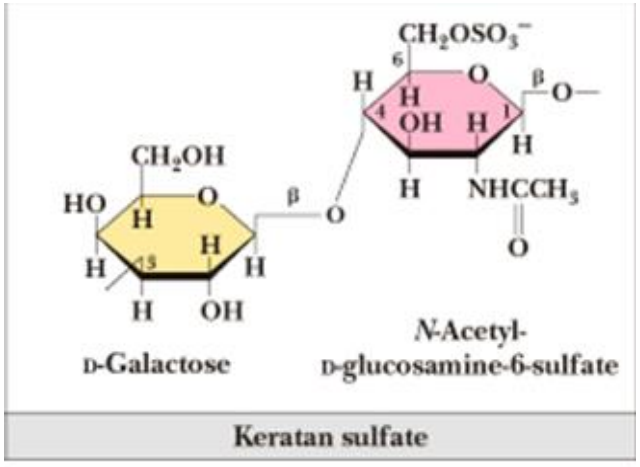
Chondroitin-4-sulfate



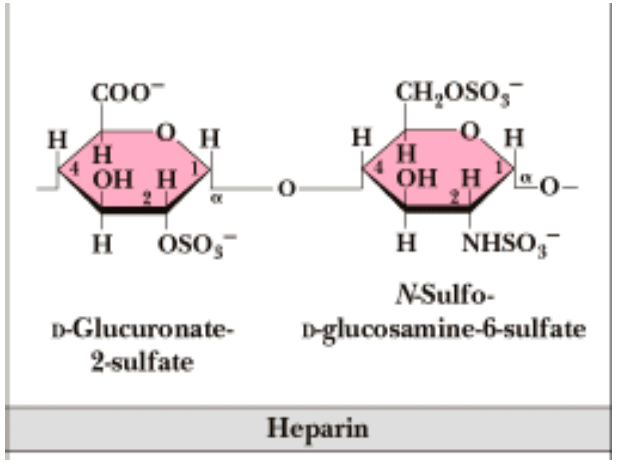
Chondroitin-6-sulfate



Dermatan sulfate



Keratan sulfate



Heparin

HETEROPOLISACÁRIDOS: Glucoconjugados

- Siempre orientados hacia el exterior celular.

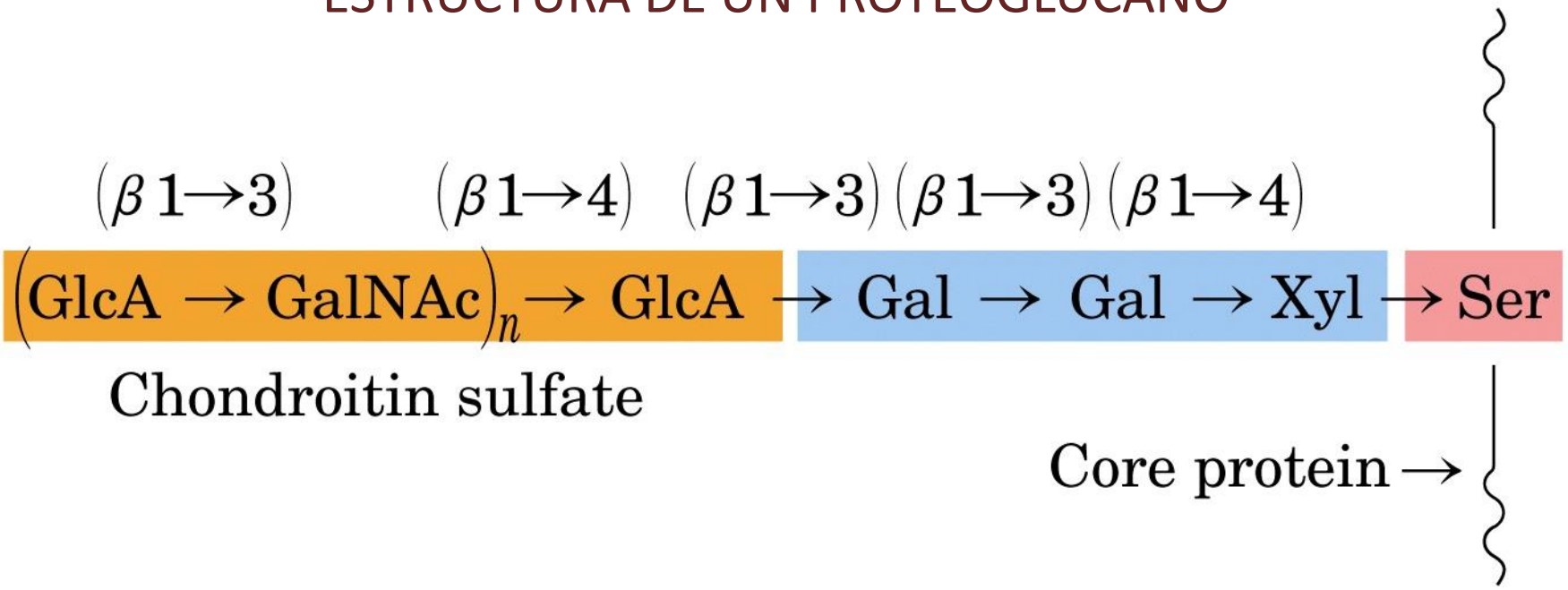
  - **Proteoglucanos**: proteínas unidas a polisacáridos GAG.

  - **Glucoproteínas**: proteínas unidas covalentemente a oligosacáridos.

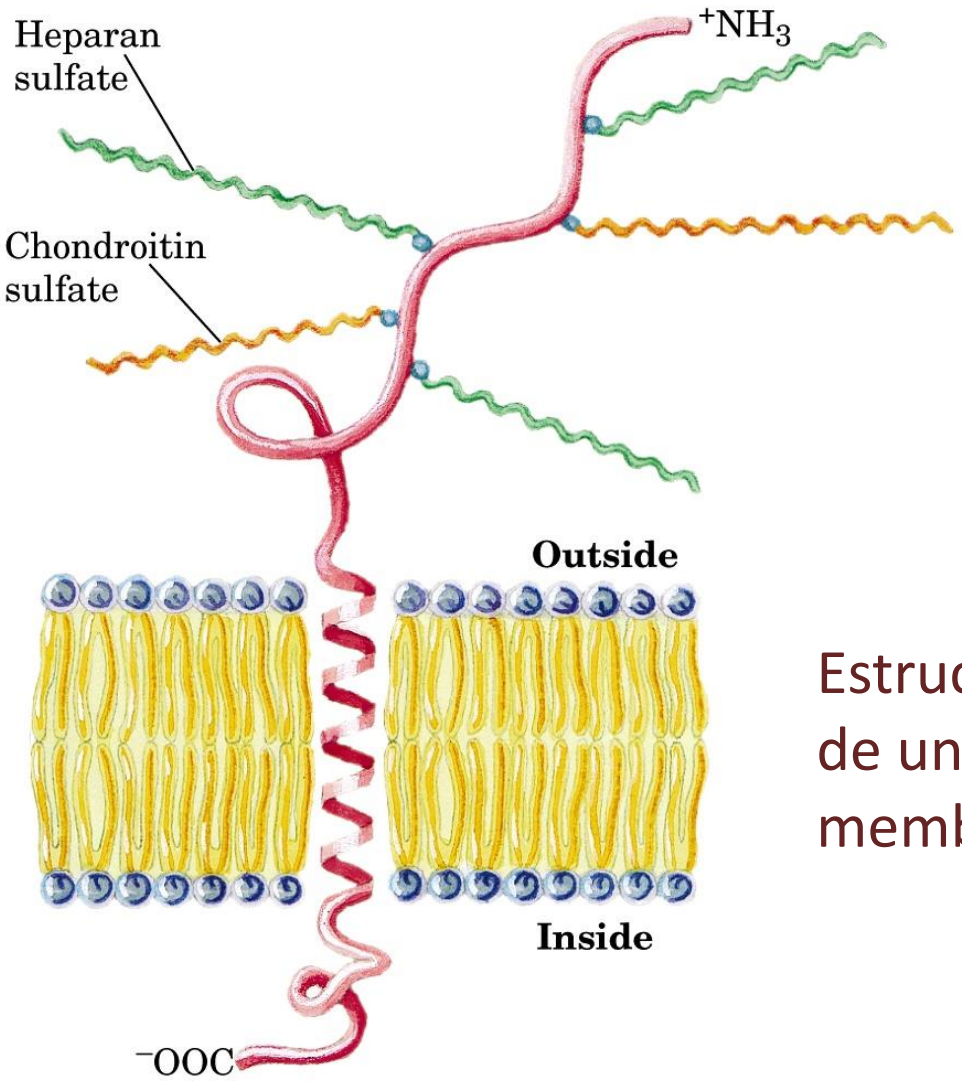
  - **Glucolípidos**: lípidos de membrana (esfingolípidos) unidos covalentemente a oligosacáridos.

Glucoconjugados: PROTEOGLUCANOS

ESTRUCTURA DE UN PROTEOGLUCANO



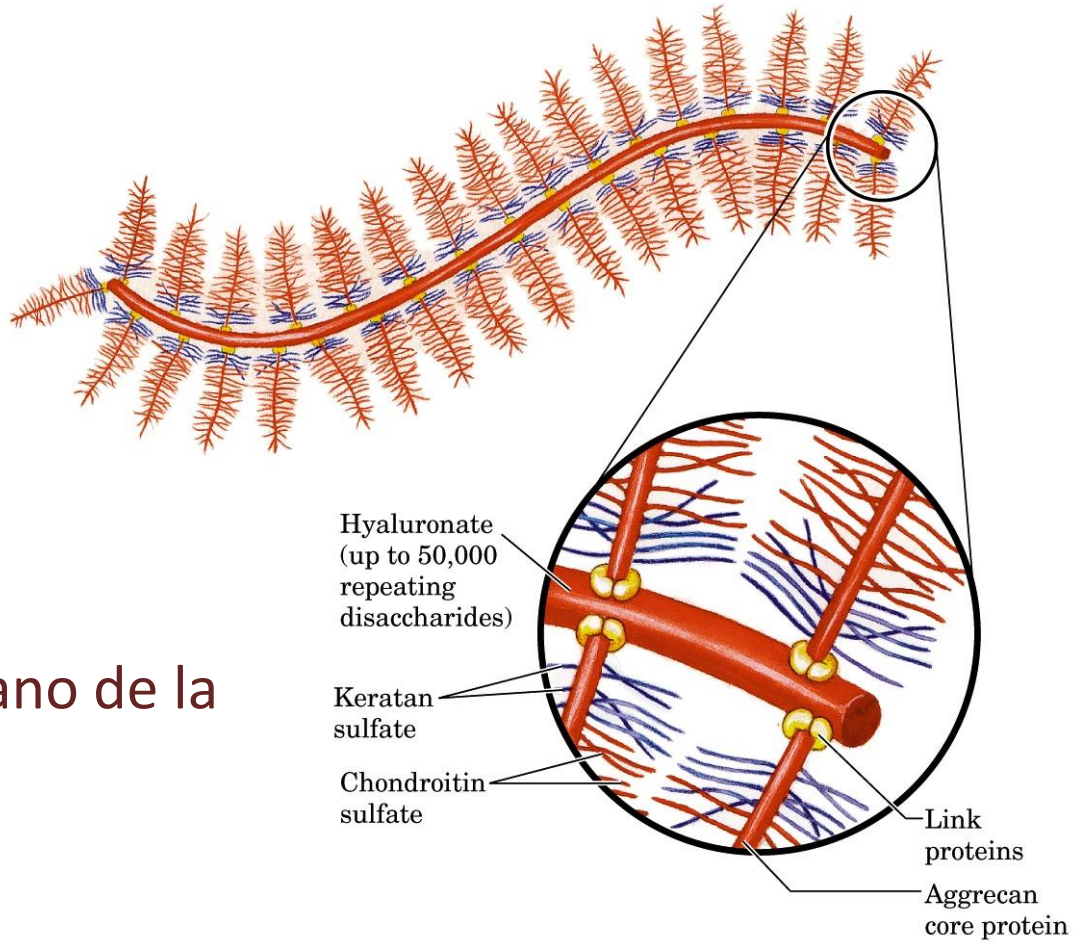
Glucoconjugados: PROTEOGLUCANOS



Estructura de un proteoglucano de una proteína integral de membrana

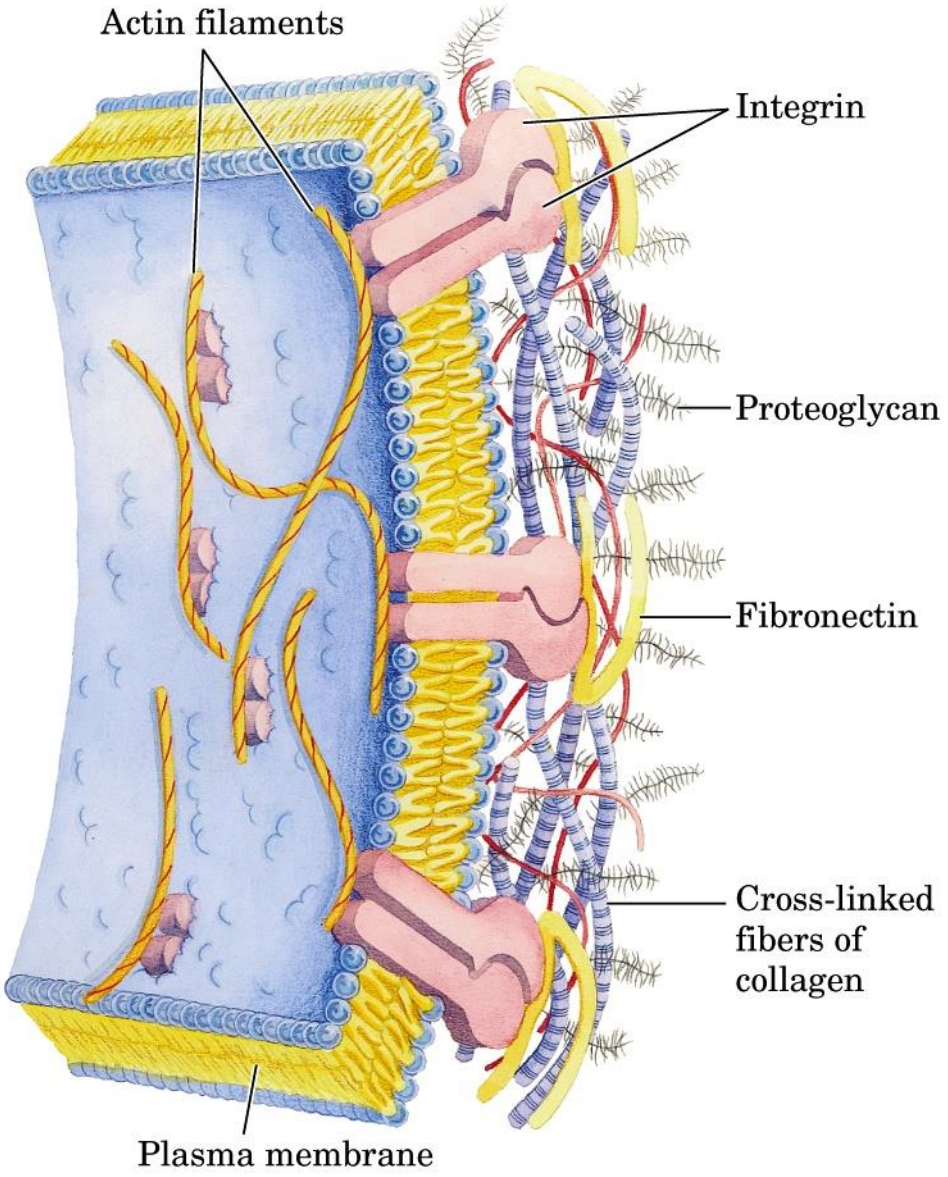
Glucoconjugados: PROTEOGLUCANOS

Agregado de proteoglucano de la matriz extracelular

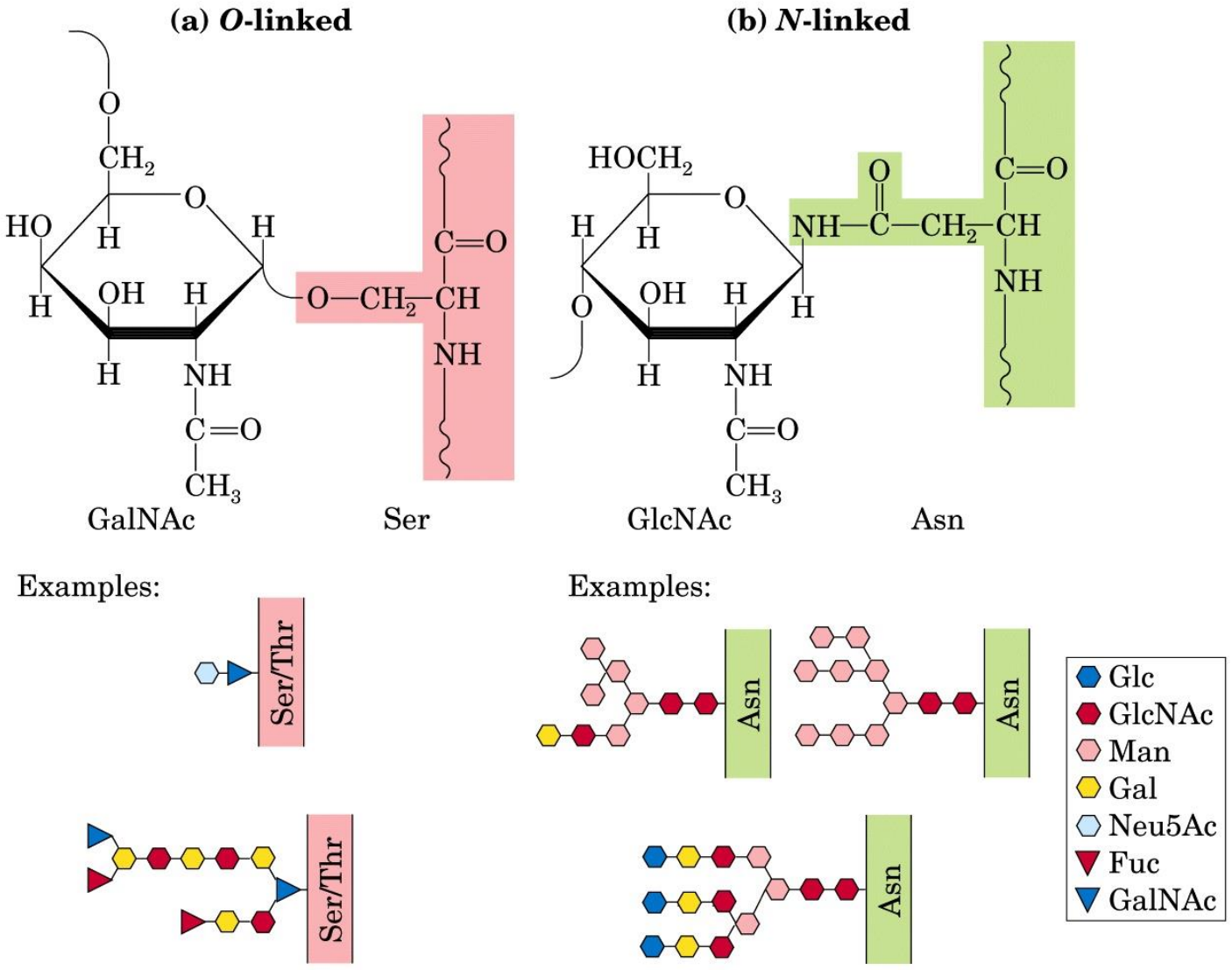


Glucoconjugados: PROTEOGLUCANOS

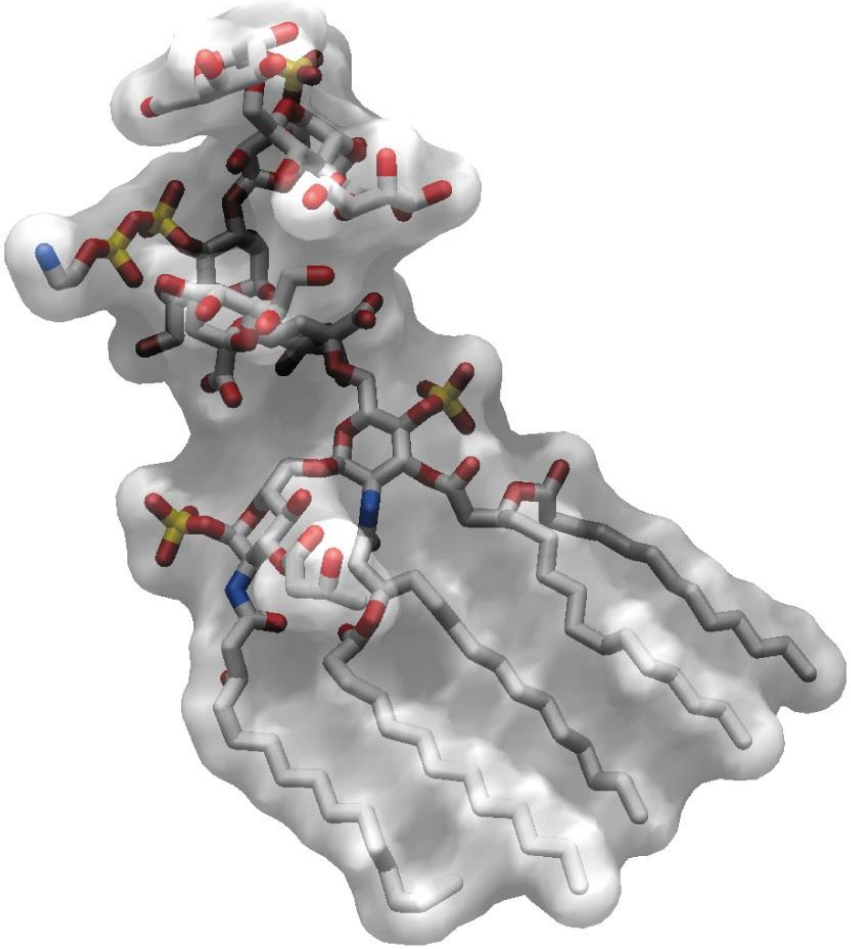
Interacciones entre las células y la matriz extracelular



Glucoconjugados: GLUCOPROTEÍNAS



Glucoconjugados: GLUCOLÍPIDOS



(b)

LECTINAS

Proteínas que se unen a carbohidratos de la superficie celular con elevada especificidad a través de interacciones débiles.

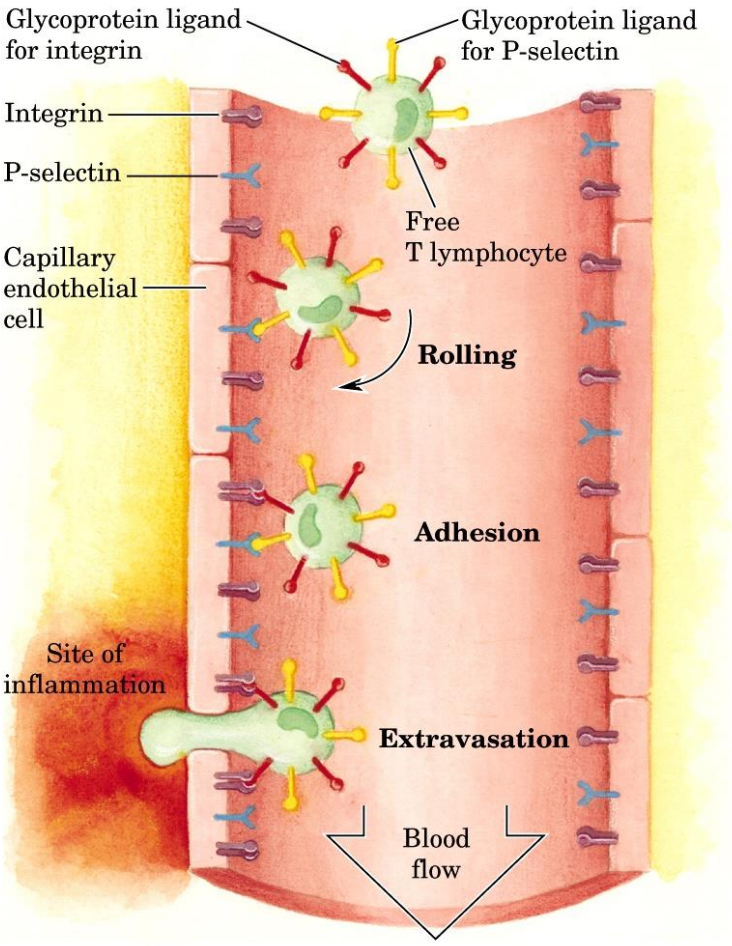
table 9–3

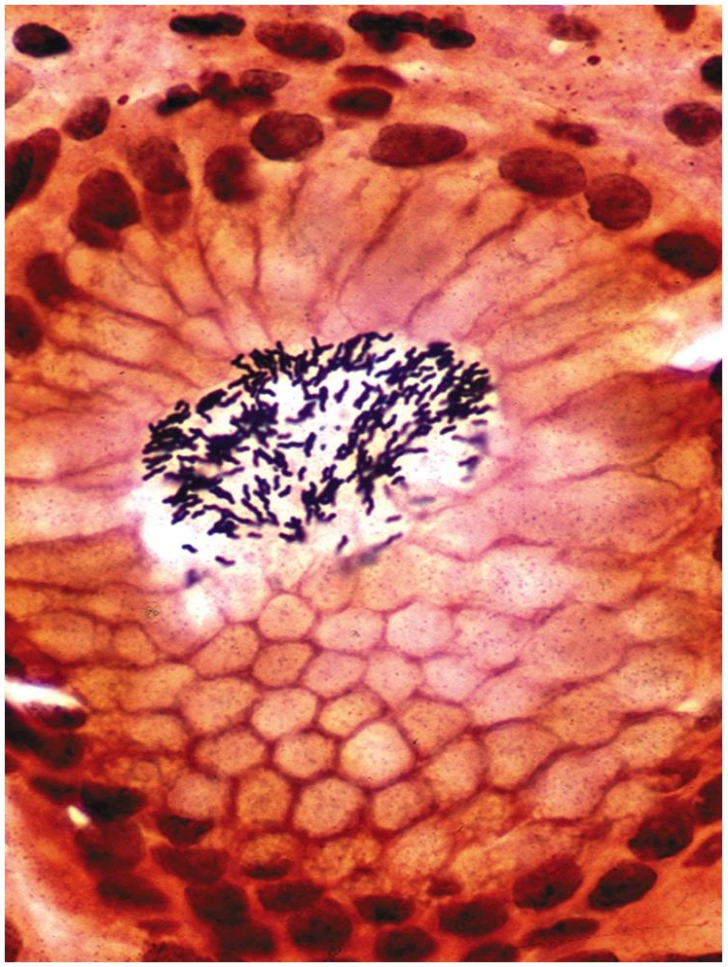
Lectins and the Oligosaccharide Ligands That They Bind

Lectin family 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.

LECTINAS


Glycoprotein ligand for integrin
Glycoprotein ligand for P-selectin
Integrin
P-selectin
Capillary endothelial cell
Free T lymphocyte
Rolling
Adhesion
Site of inflammation
Extravasation
Blood flow



Papel de los oligosacáridos en el reconocimiento y adhesión a la superficie de la célula