Carboidrati, glucidi, zuccheri

Dal punto di vista chimico, i glucidi o glicidi (dal greco *glucùs* = dolce) sono poliidrossialdeidi o poliidrossichetoni, o loro derivati. In quanto tali composti presentano formula bruta $C_n(H_2O)_n$, sono anche chiamati anche carboidrati (da "idrati di carbonio"). Altri nomi con cui sono comunemente designati sono zuccheri o saccaridi (mono-, oligo- e poli-saccaridi).

I glucidi hanno numerose funzioni biologiche, tra cui: funzione strutturale (cellulosa e glucosamminoglicani), funzione energetica (glucosio, glicogeno e amido), funzione informazionale (antigeni del sangue, gangliosidi, ecc.).

Rappresentano l'1% circa del corpo di un mammifero, pur avendo notevole importanza nutrizionale come componenti più rappresentati nella dieta del cane (60-65%).

Category	Percent of Body Weight	Majority of Atoms	Subclass	Subunits
Carbohydrates	1	C, H, O	Monosaccharides (sugars)	
			Polysaccharides	Monosaccharides

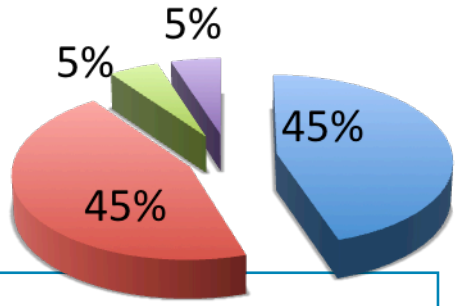
Monosaccaridi

Concetti chiave

• Gli zuccheri sono aldosi o chetosi aventi la formula $(C{\cdot}H_2O)_n$.
• I monosaccaridi ciclizzano per formare anomeri α o β.
• I derivati dei monosaccaridi comprendono gli alditoli, i deossi-zuccheri e gli amminozuccheri.
• I monosaccaridi possono essere legati l'uno all'altro o ad altre molecole non saccaridiche con legami glicosidici (N o O).

• I disaccaridi come il lattosio e il saccarosio sono formati da due zuccheri legati da specifici legami glicosidici.
• La cellulosa è un polimero di residui di glucosio legati da legami β(1→4).
• Nell'amido e nel glicogeno i residui di glucosio sono legati tra loro da legami α(1→4) e nei punti di ramificazione α(1→6) .

Zuccheri e Felini



- Grassi
- Proteine
- Fibre
- Carboidrati

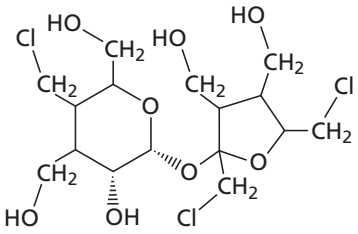
BOX 8.1 THE PROBLEM WITH CATS

One of the characteristics of sugars is that they taste sweet. You certainly know the taste of sucrose and you probably know that fructose and lactose also taste sweet. So do many of the other sugars and their derivatives, although we don't recommend that you go into a biochemistry lab and start tasting all the carbohydrates in those white plastic bottles on the shelves.

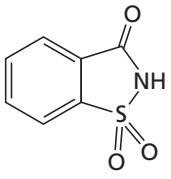
Sweetness is not a physical property of molecules. It's a subjective interaction between a chemical and taste receptors in your mouth. There are five different kinds of taste receptors: sweet, sour, salty, bitter, and umami (umami is like the taste of glutamate in monosodium glutamate). In order to trigger the sweet taste, a molecule like sucrose has to bind to the receptor and initiate a response that eventually makes it to your brain. Sucrose elicits a moderately strong response that serves as the standard for sweetness. The response to fructose is almost twice as strong and the response to lactose is only about one-fifth as strong as that of sucrose. Artificial sweeteners such as saccharin (Sweet'N Low®), sucralose (Splenda®), and aspartame (NutraSweet®) bind to the sweetness receptor and cause the sensation of sweetness. They are hundreds of times more sweet than sucrose.

The sweetness receptor is encoded by two genes called *Tas1r2* and *Tas1r3*. We don't know how sucrose and the other ligands bind to this receptor even though this is a very active area of research. In the case of sucrose and the artifical sweeteners, how can such different molecules elicit the taste of sweet?

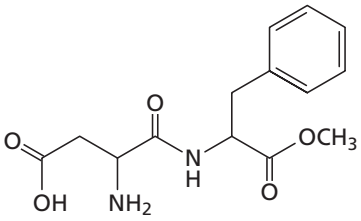
Cats, including lions, tigers and cheetahs, do not have a functional *Tas1r2* gene. It has been converted to a pseudogene because of a 247 bp deletion in exon 3. It's very likely that your pet cat has never experienced the taste of sweetness. That explains a lot about cats.



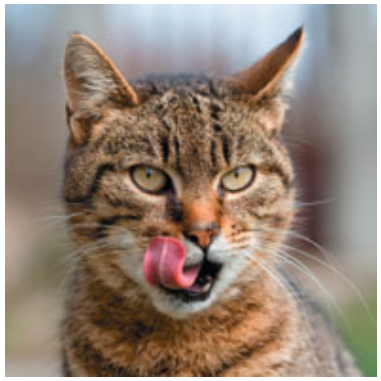
Sucralose



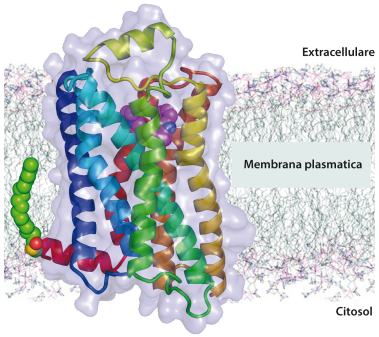
Saccharin



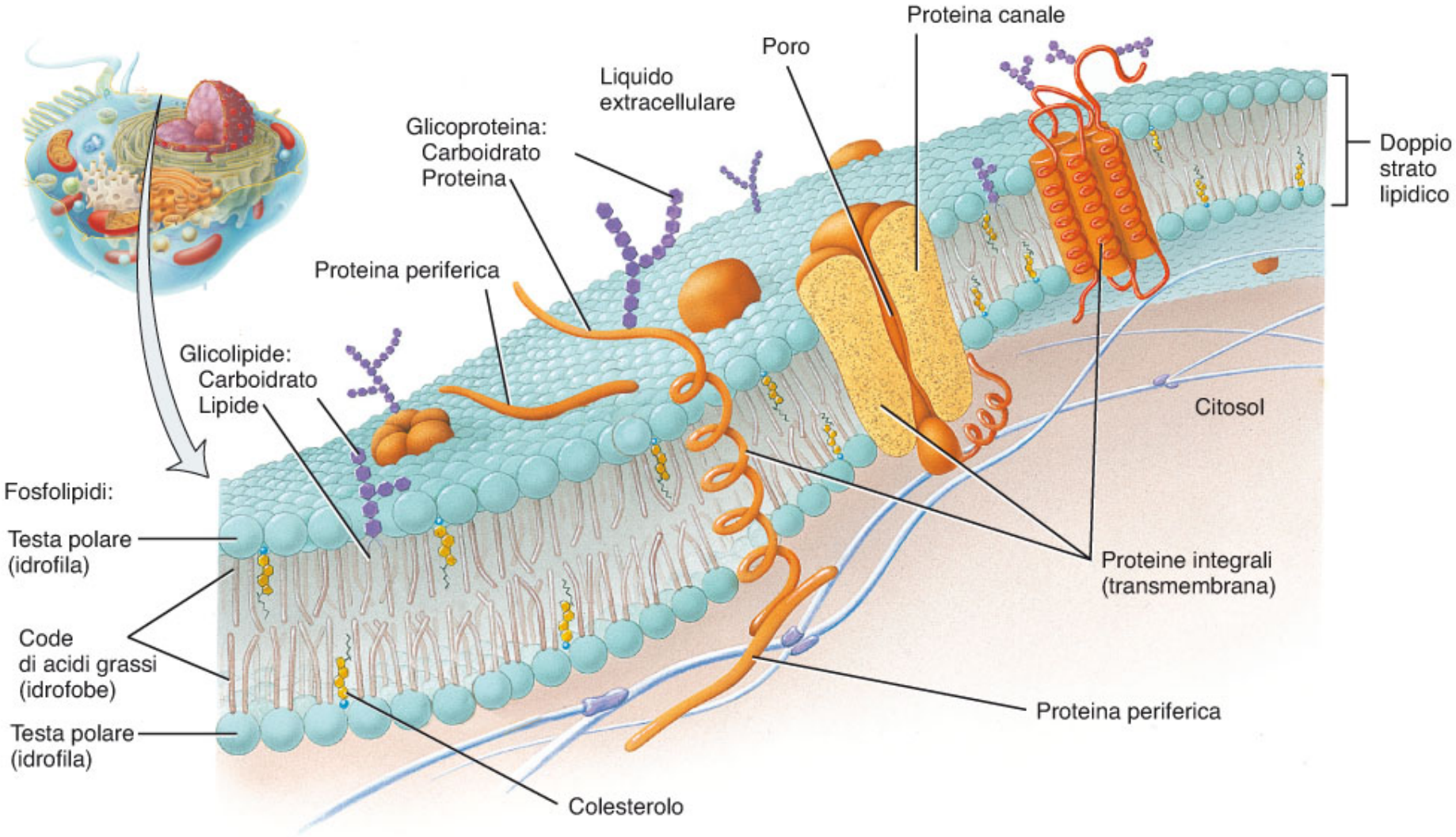
Aspartame



▲ **Cats are carnivores.** They probably can't taste sweetness.



Zuccheri nella cellula



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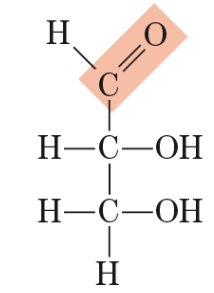
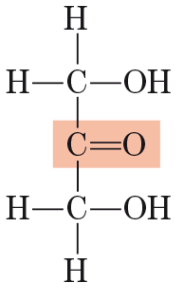
Monosaccaridi: Aldosi e Chetosi

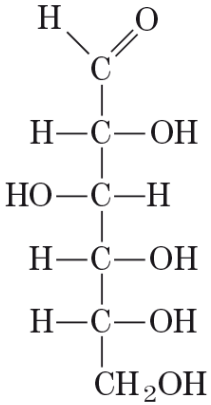


D-Gliceraldeide,
un aldotriosio

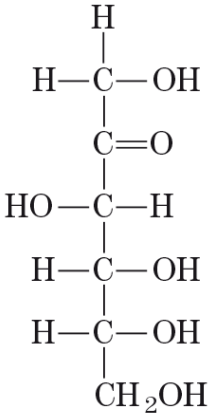


Diidrossiacetone,
un chetotriosio

(a)

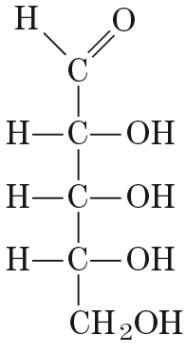


D-Glucosio,
un aldoesosio

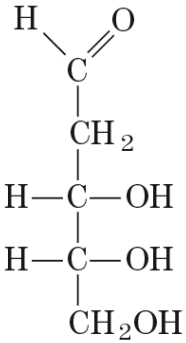


D-Fruttosio,
un chetoesosio

(b)



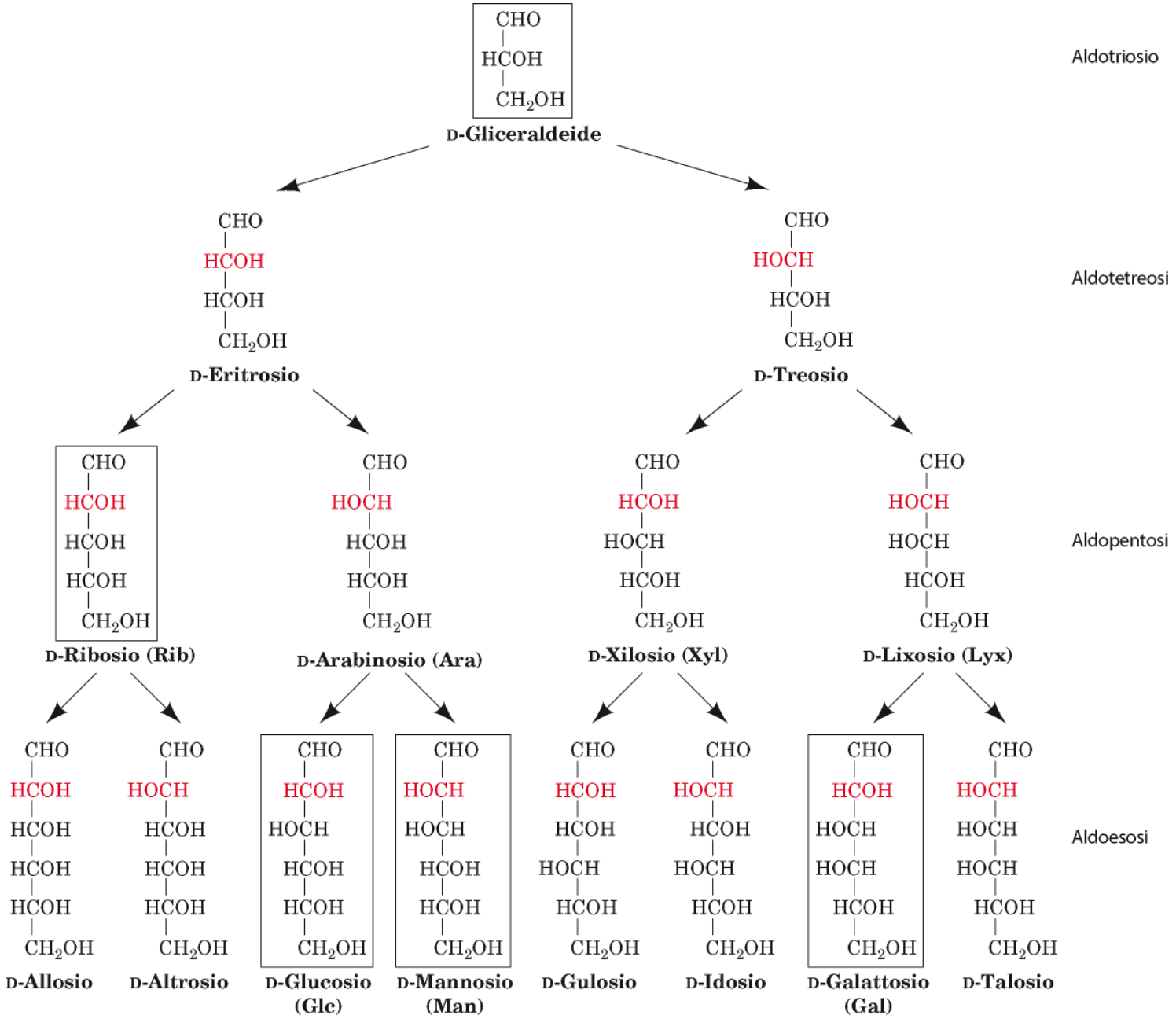
D-Ribosio,
un aldopentosio



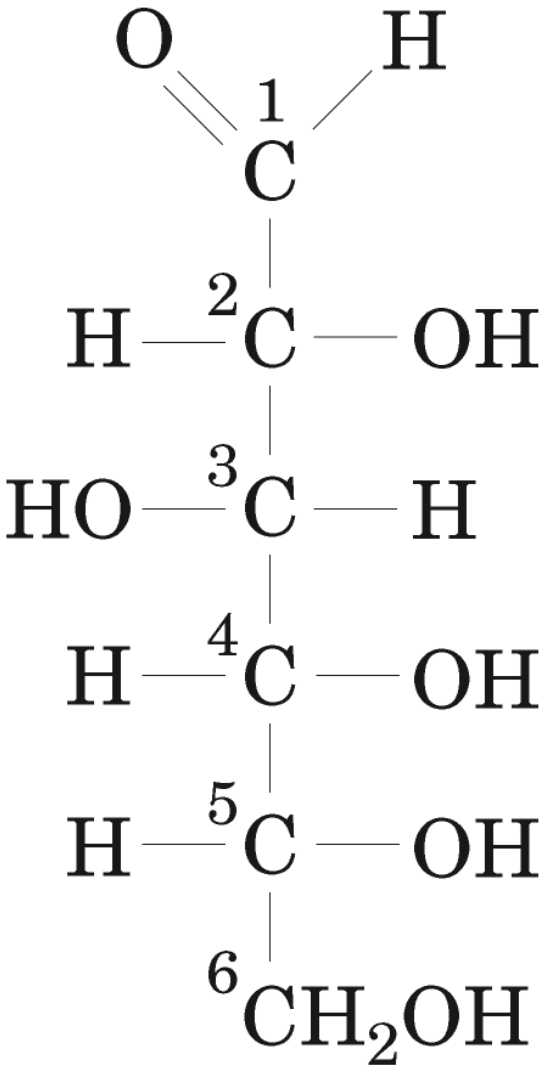
2-Deossi-D-ribosio,
un aldopentosio

(c)

I D-aldosi a 3-6 atomi di carbonio



Il D-glucosio $(C \bullet H_2O)_6$



D-Glucosio

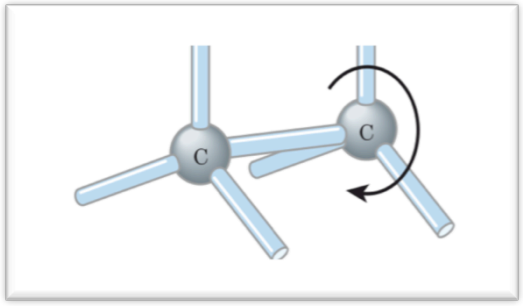
Conformazione e Configurazione

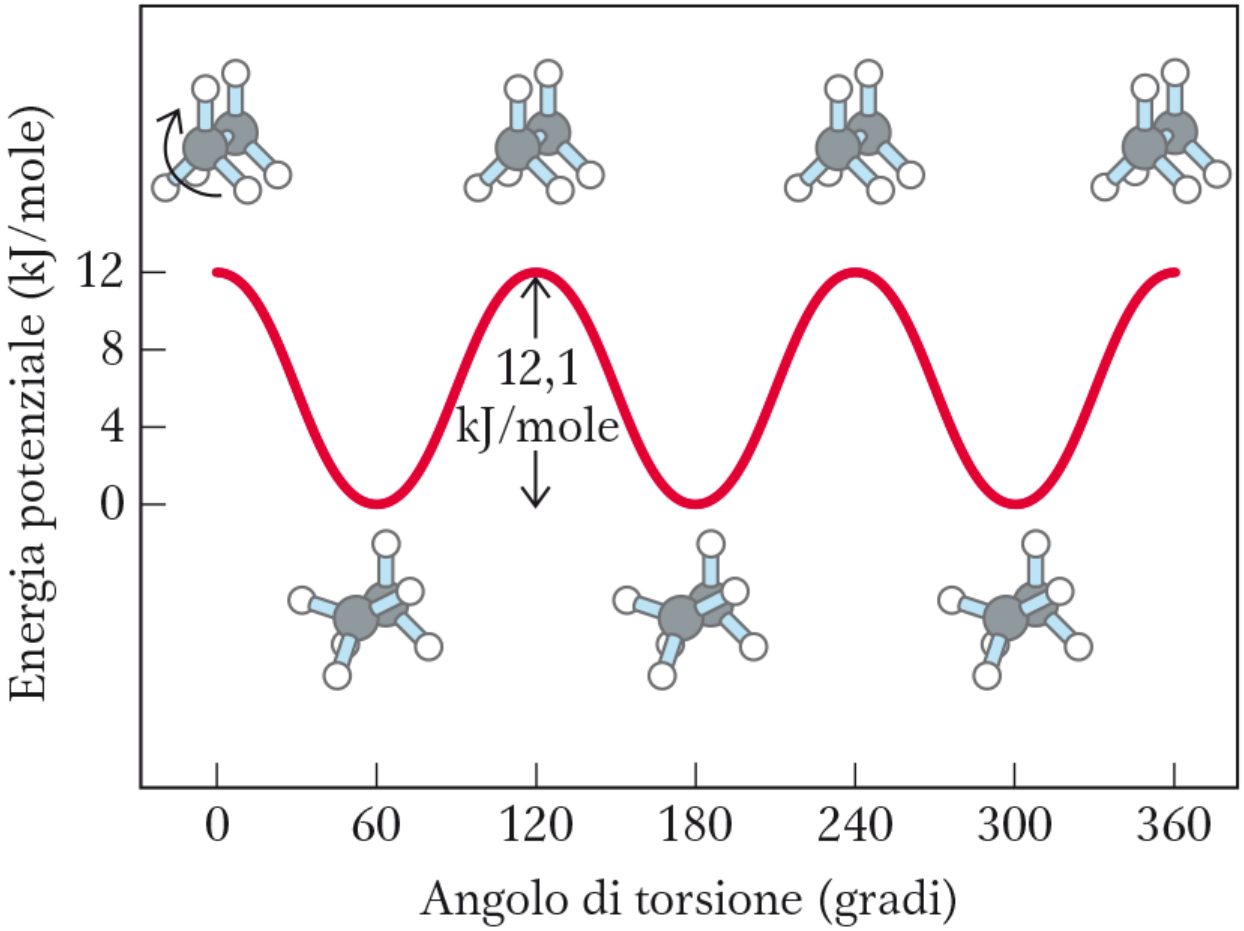
- Due composti sono **stereoisomer**i, se hanno uguale **formula di struttura (quindi sono uguali per l'ordine con cui sono legati gli atomi gli uni agli altri)**, ma diverse configurazioni, ossia differiscono nel modo in cui gli atomi sono disposti (orientati) nello spazio.

- **Conformazione**: ognuna delle possibili disposizioni nello spazio degli atomi di una molecola. Un cambiamento di conformazione richiede la rotazione di uno o più legami singoli.

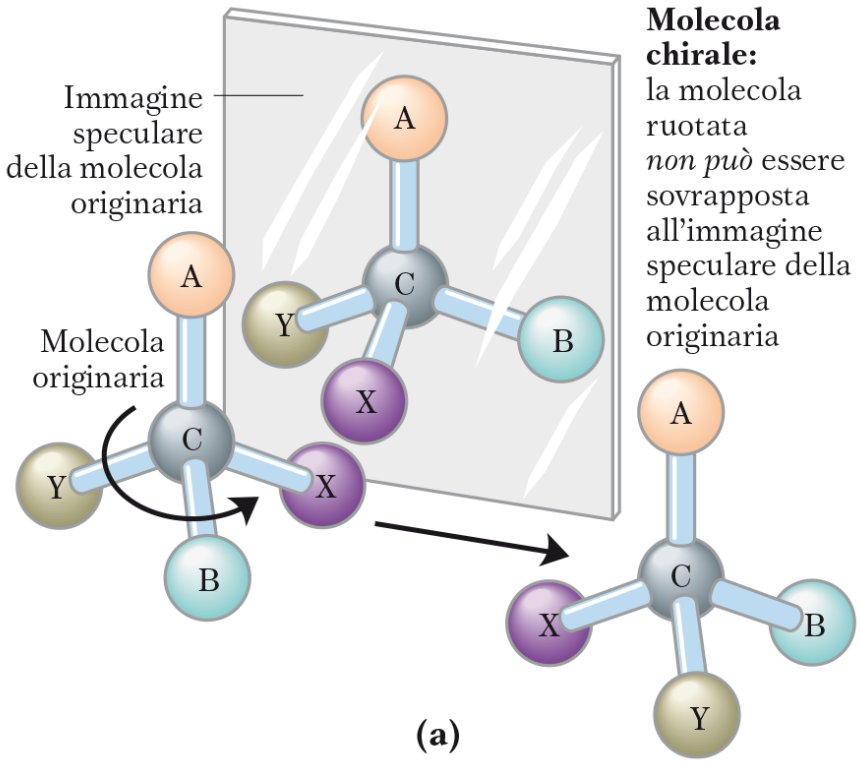
- **Configurazione**: la sistemazione degli atomi che caratterizza un dato stereoisomero si chiama la sua configurazione. Il passaggio da una configurazione ad un'altra richiede la rottura e formazione di legami covalenti.

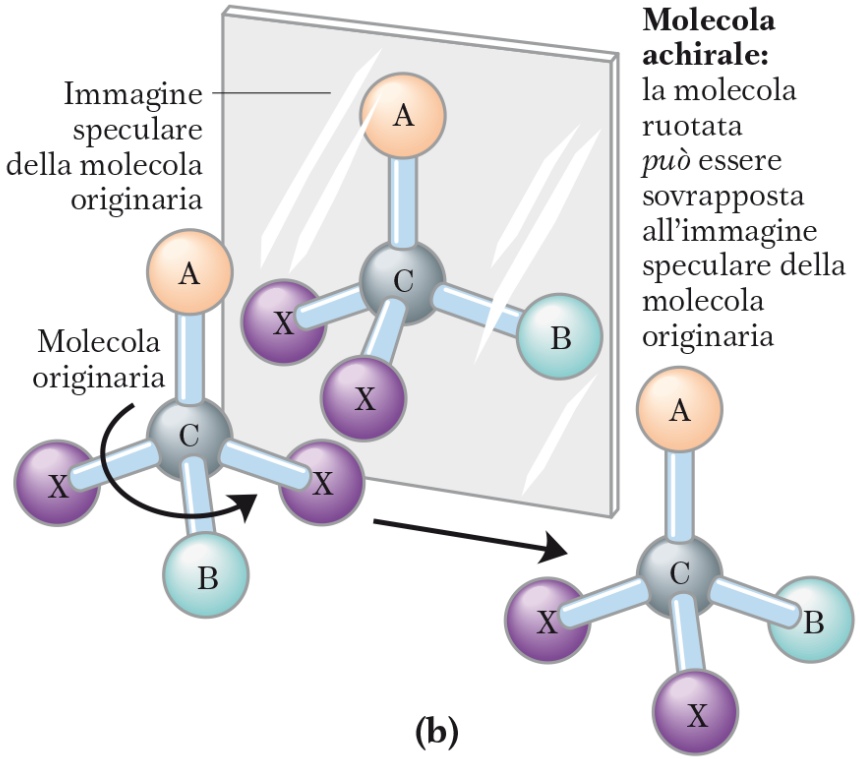
CONFORMAZIONE

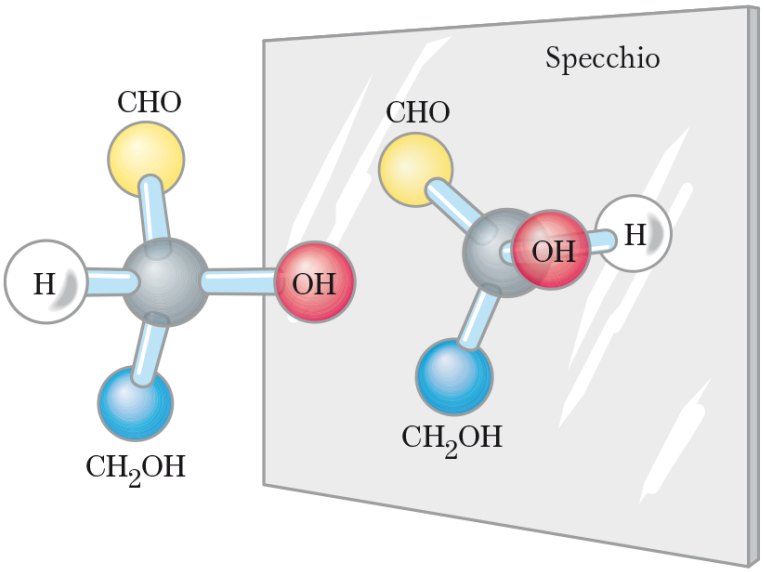




Stereoisomeri: enantiomeri





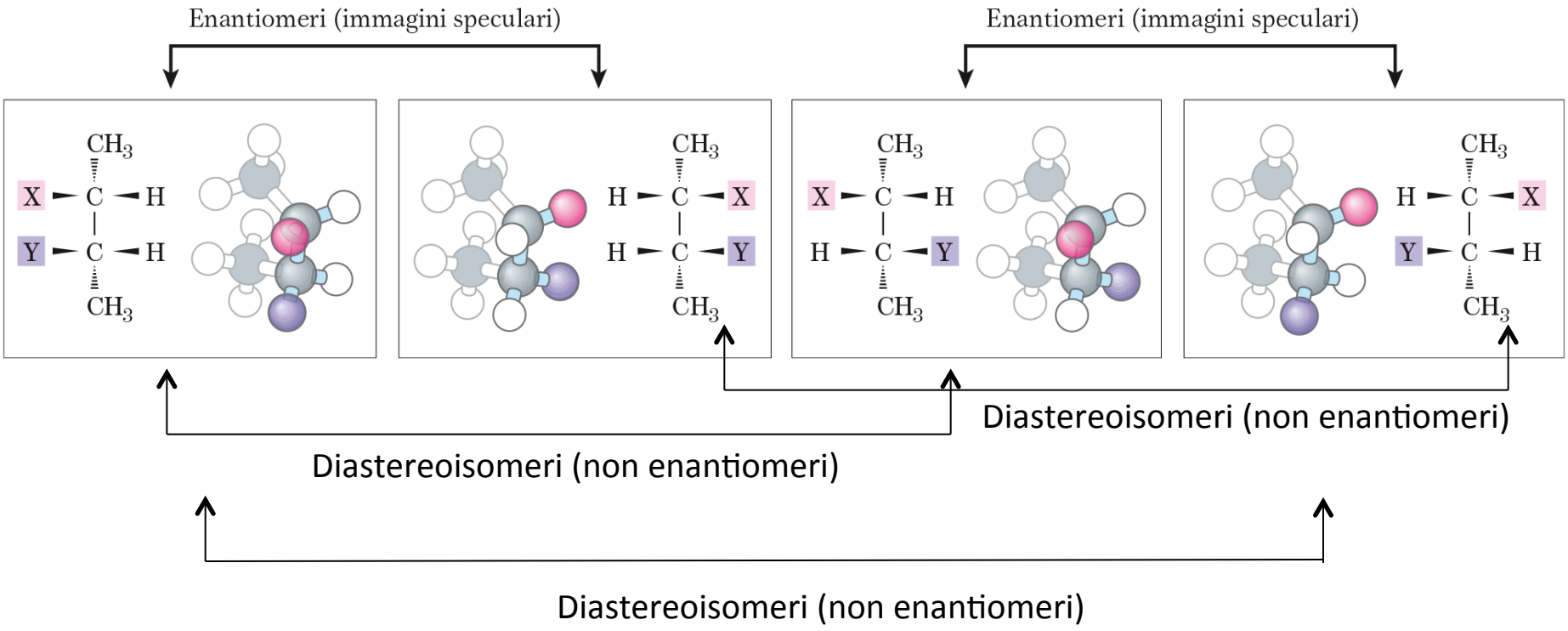


Modelli a palle e bastoncini

Formule proiettive di Fischer

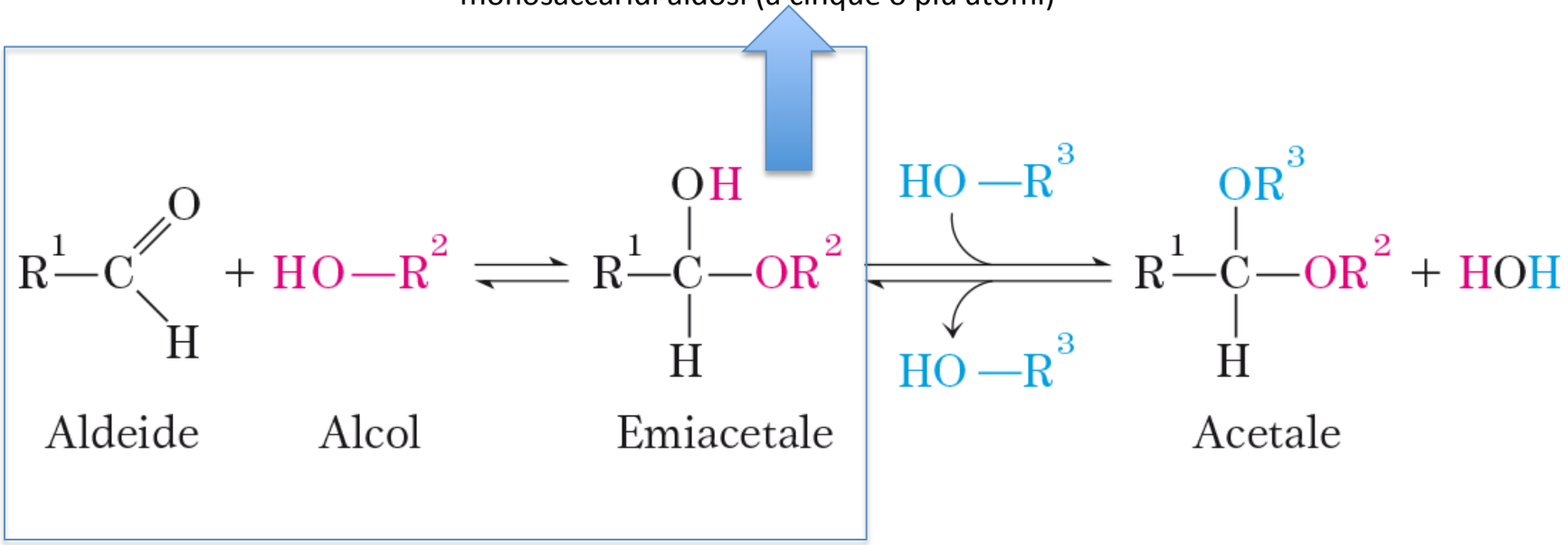
Formule prospettiche

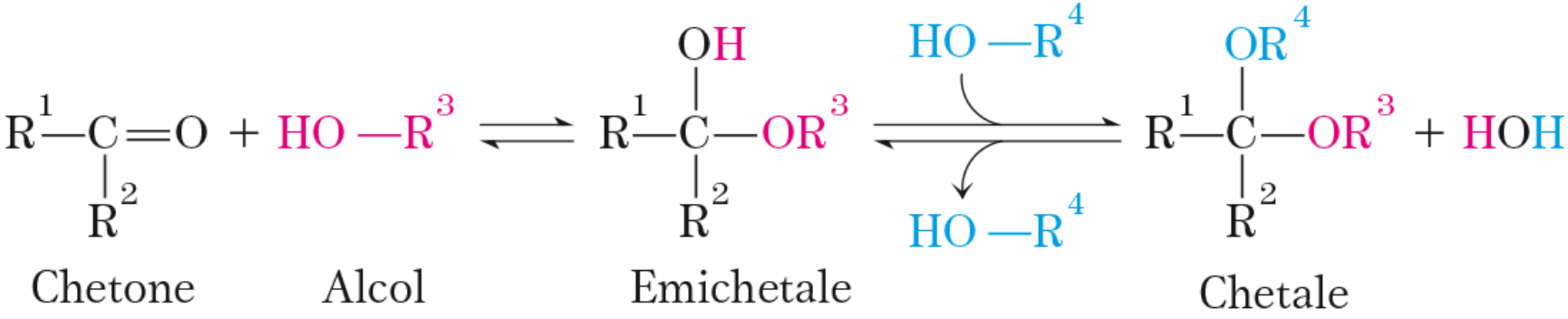
Enantiomeri e Diastereoisomeri



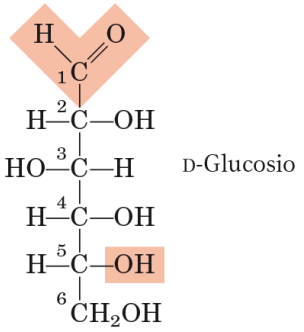
Se i due stereoisomeri sono l'uno l'immagine speculare dell'altro, si dicono enantiomeri, altrimenti si dicono diastereoisomeri

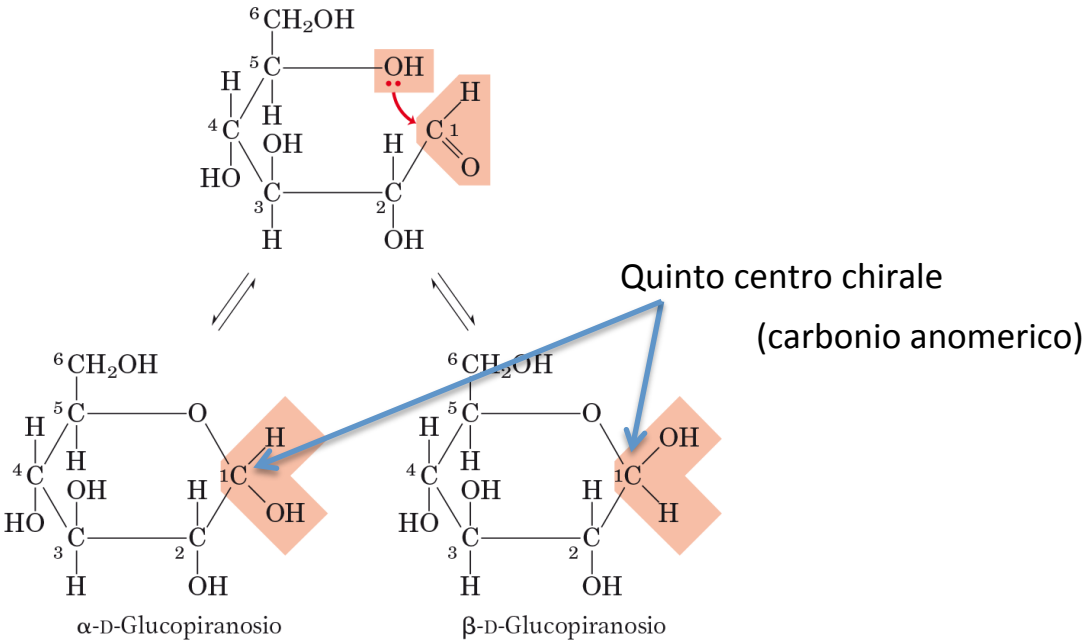
Ciclizzazione catena carboniosa dei monosaccaridi aldosi (a cinque o più atomi)

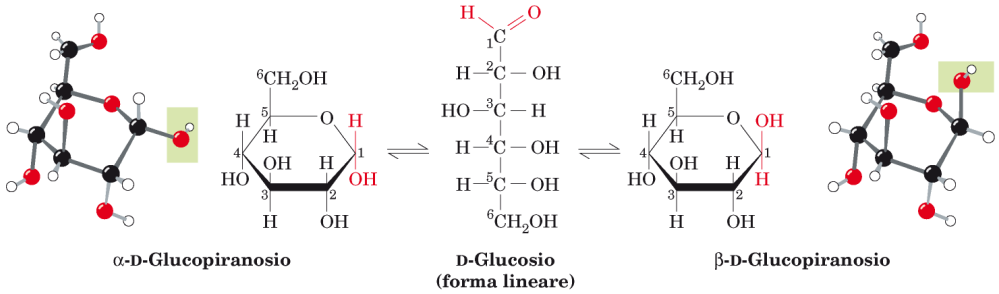


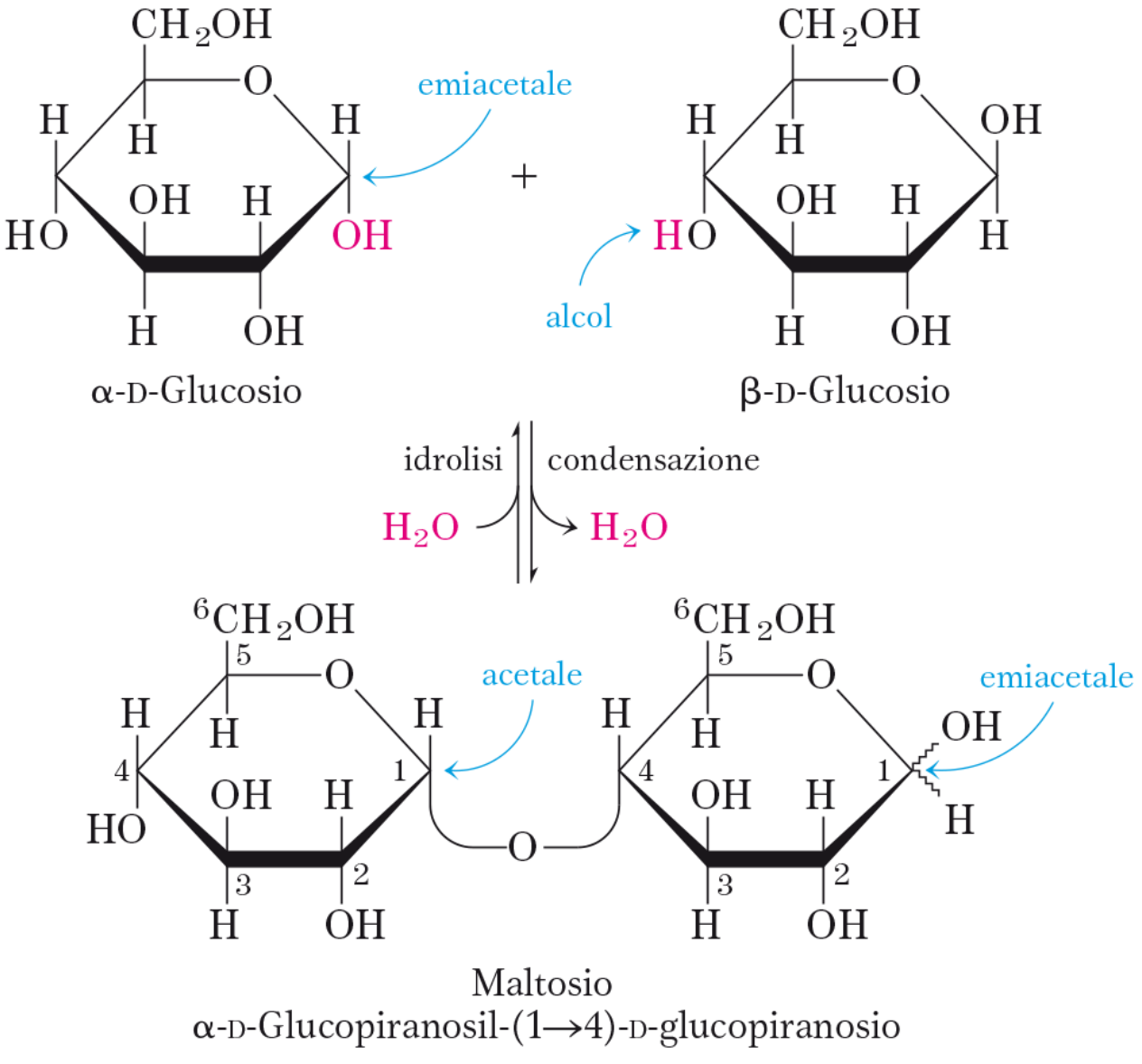


Gli anomeri α e β possono interconvertirsi



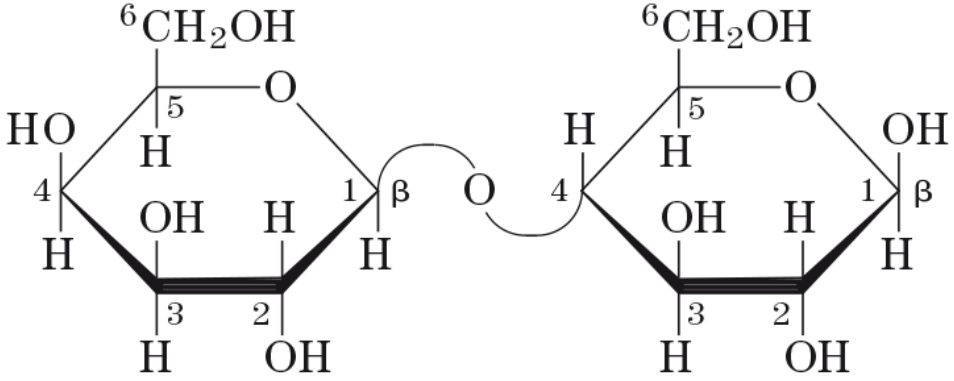




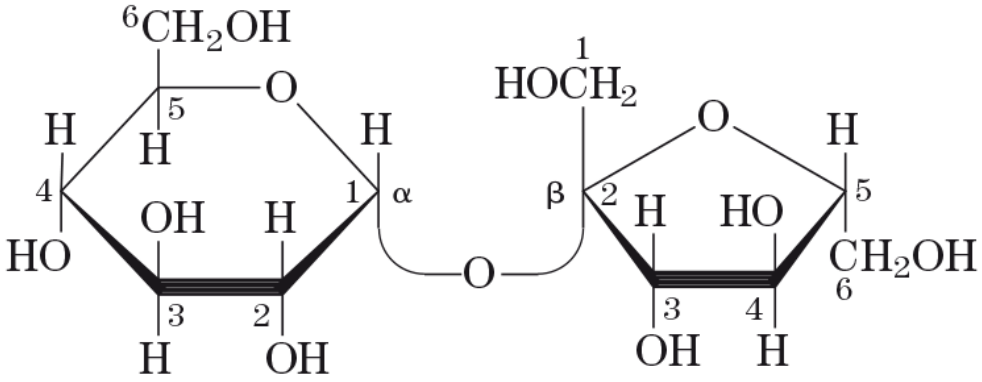

emiacetale
alcol
α-D-Glucosio
β-D-Glucosio
idrolisi
condensazione
H_2O
H_2O
acetale
emiacetale
Maltosio
α-D-Glucopiranosil-(1→4)-D-glucopiranosio

Prebiotici F.O.S.
(fruttoligosaccaridi)
aiutano a mantenere
regolari le funzioni
intestinali

Disaccaridi

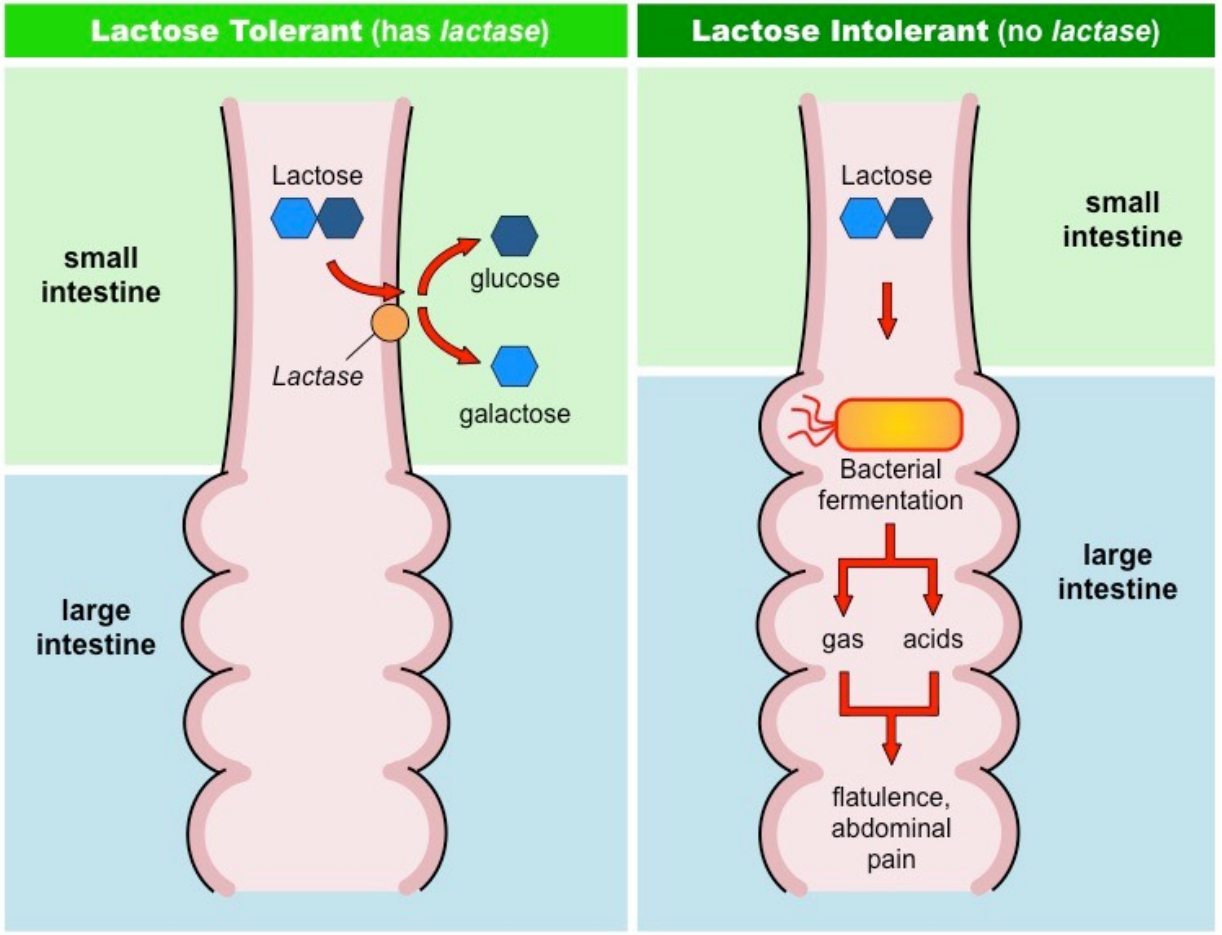


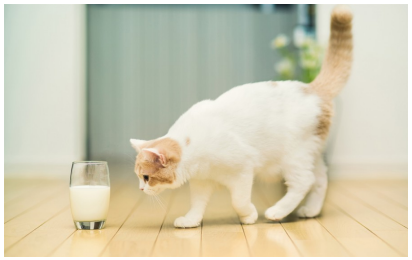
Lattosio (forma β)
β-D-galattopiranosil-(1→4)-β-D-glucopiranosio
Gal(β1→4)Glc



Saccarosio
β-D-fruttofuranosil α-D-glucopiranoside
Fru(2β⟷α1)Glc ≡ Glc(α1⟷2β)Fru

Intolleranza al lattosio





Polisaccaridi

Riso
cereale nobile per eccellenza, ricca fonte di carboidrati

Omopolisaccaridi

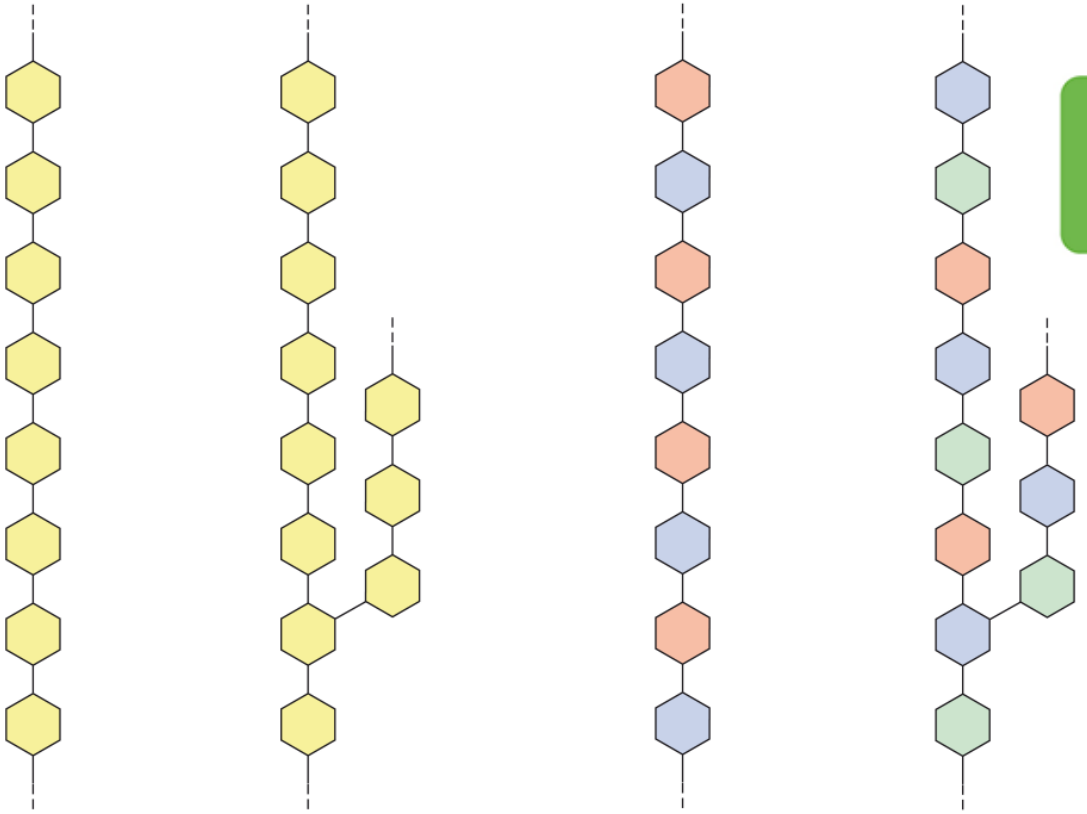
Non ramificato

Ramificato

Eteropolisaccaridi

Due tipi di monomeri non ramificati

Diversi tipi di monomeri ramificati



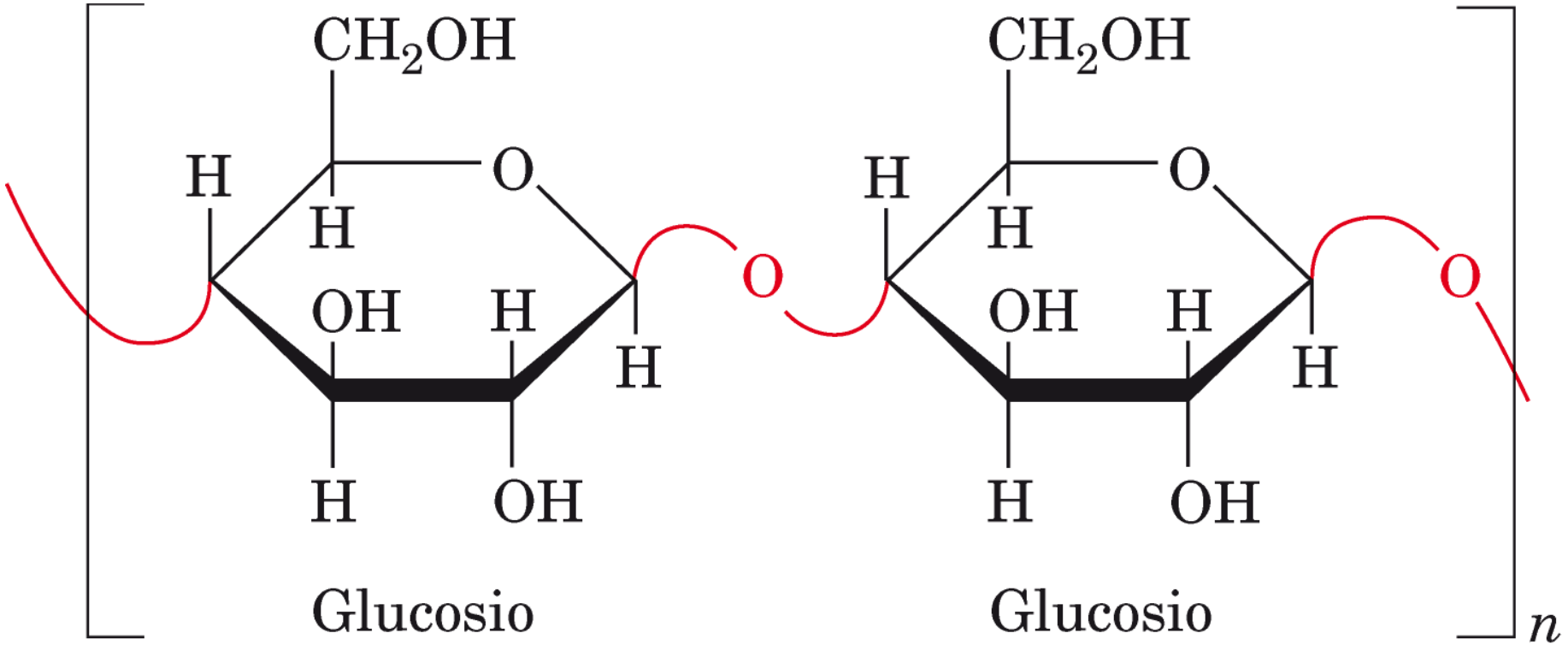
Prebiotici F.O.S.
(fruttoligosaccaridi) aiutano a mantenere regolari le funzioni intestinali

FOS: oligo- e polisaccaridi del fruttosio

Amilosio

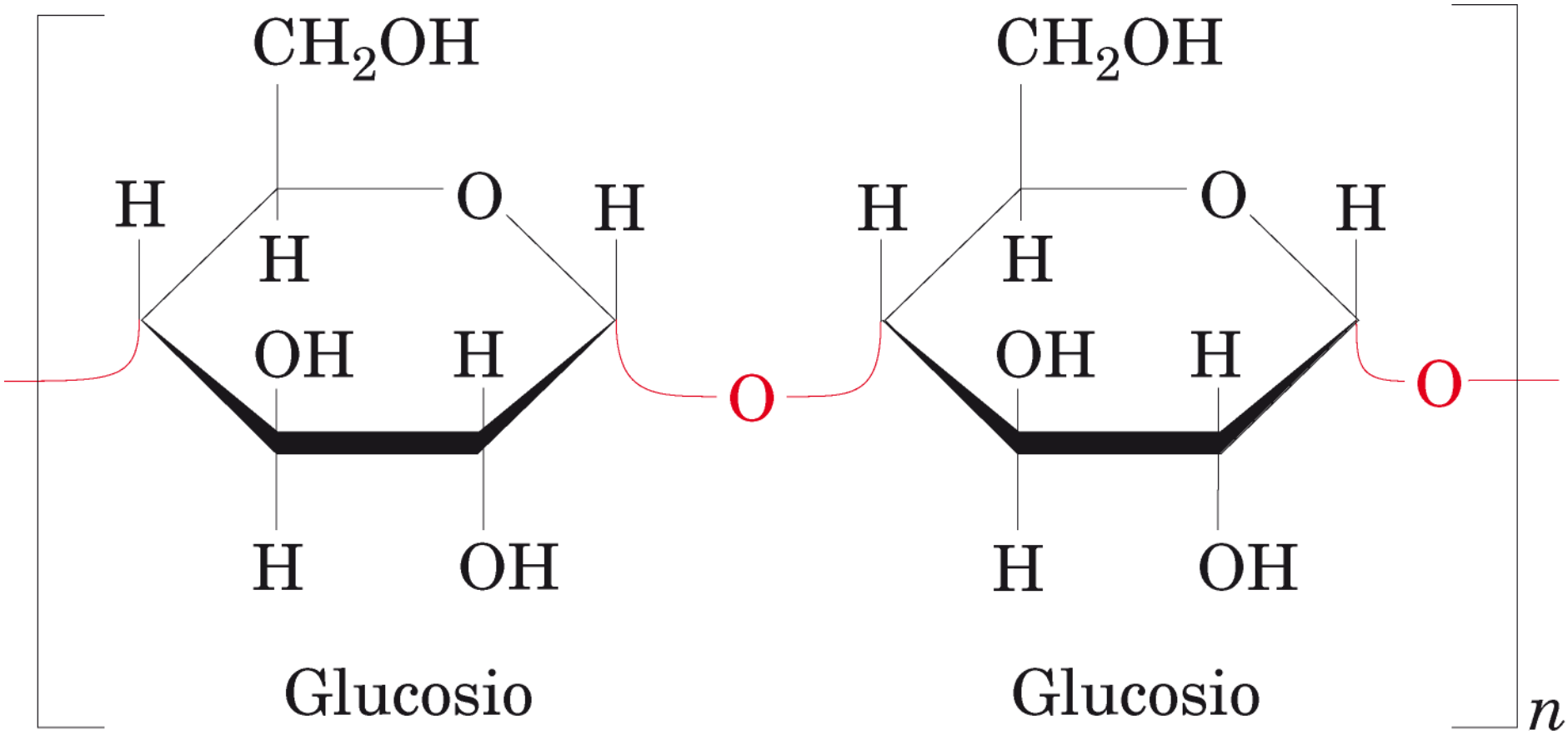
Glicogeno, amilopectina, cellulosa (fibre alimentari)

La cellulosa: un polimero di D-glucosio con legami β(1→4)



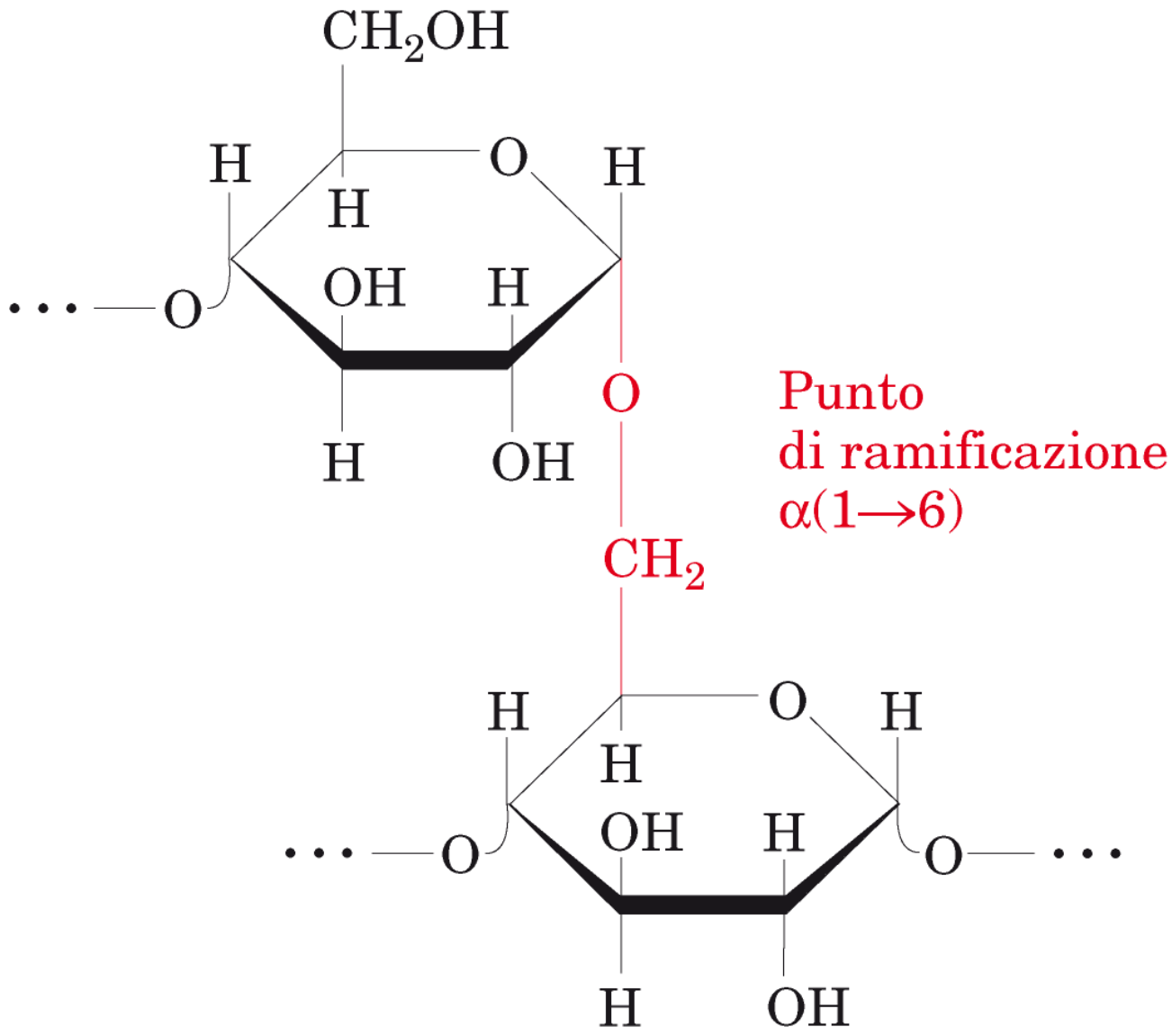
Cellulosa

L'α-amilosio: un polimero di D-glucosio con legami α(1→4)



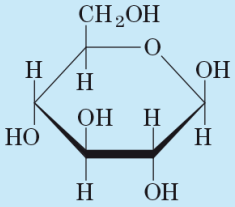
α-Amilosio

Ramificazioni α(1→6) dell'amilopectina

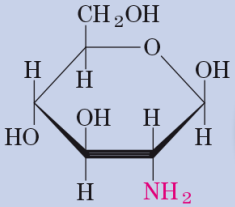


Amilopectina

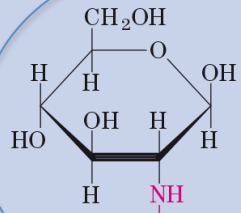
Famiglia del glucosio



β-D-Glucosio

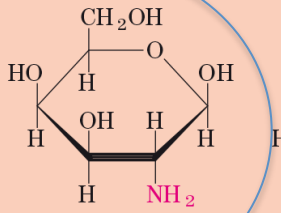


β-D-Glucosammina

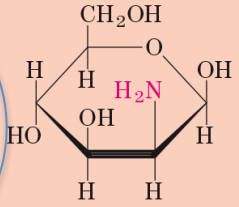


N-Acetil-β-D-glucosammina

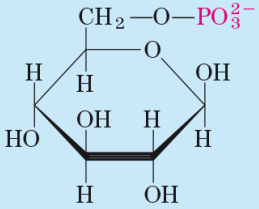
Amminozuccheri



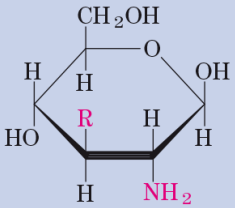
β-D-Galattosammina



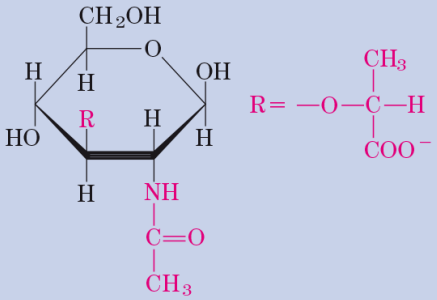
β-D-Mannosammina



β-D-Glucosio 6-fosfato

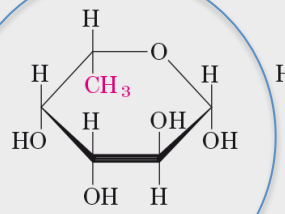


Acido muramico

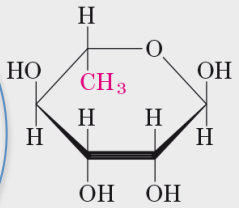


Acido *N*-acetilmuramico

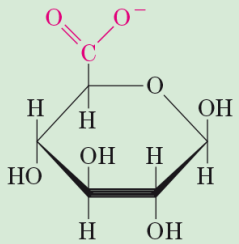
Deossizuccheri



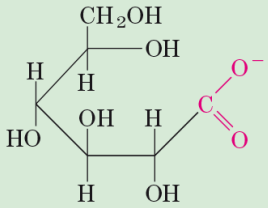
β-L-Fucosio



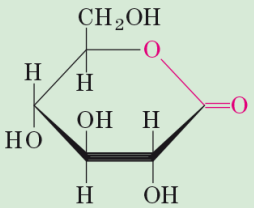
α-L-Ramnosio



β-D-Glucuronato

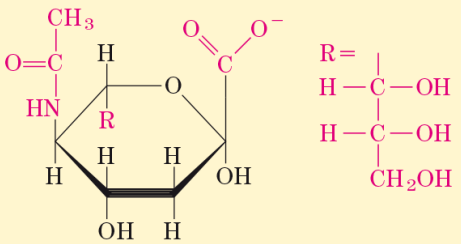


D-Gluconato

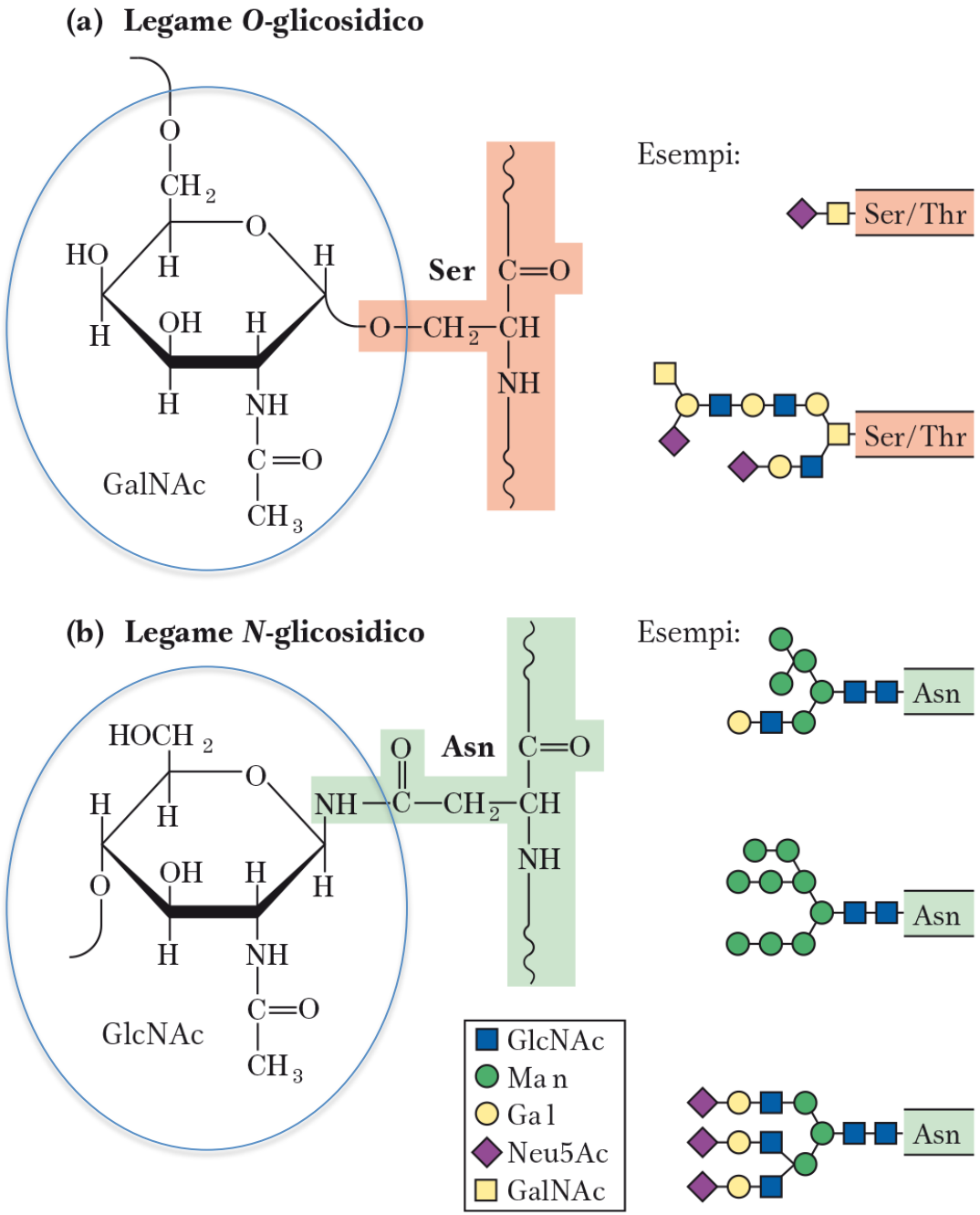


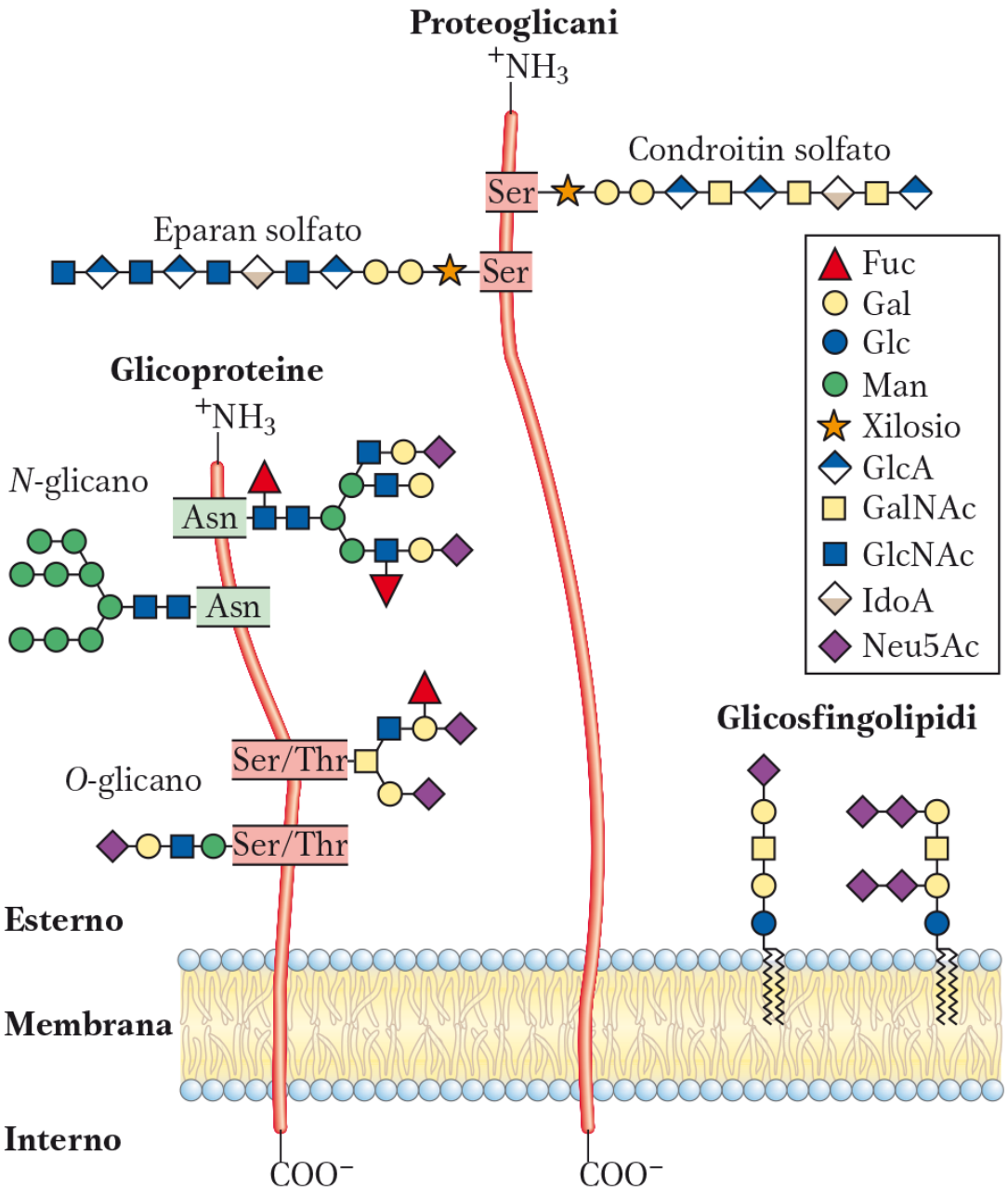
D-Glucono-δ-lattone

Zuccheri acidi

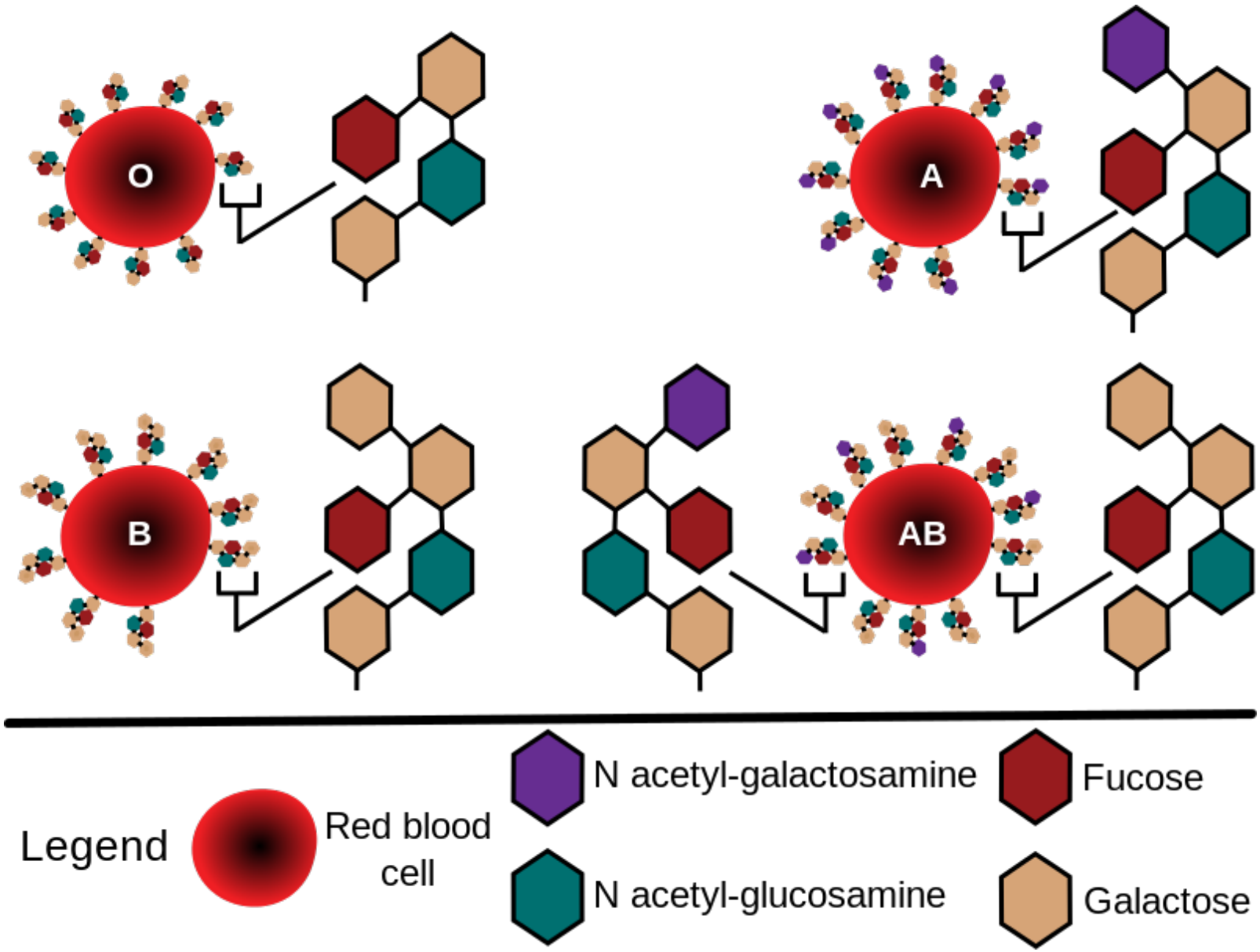


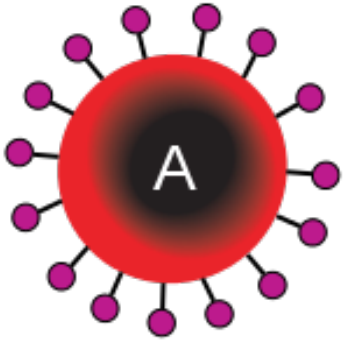
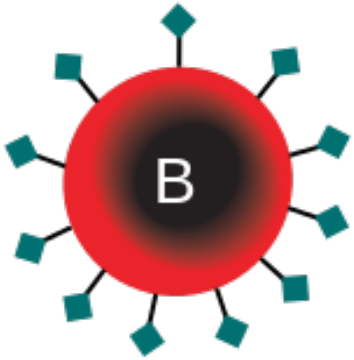
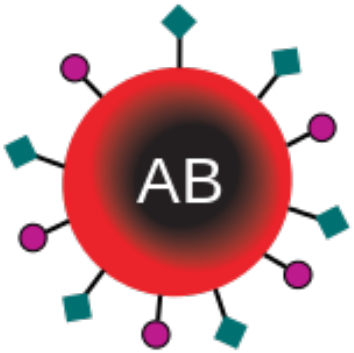
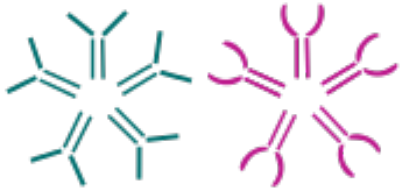
Acido *N*-acetilneuramminico
(acido sialico)


(a) Legame O-glicosidico
Esempi:
Ser/Thr
Ser/Thr
GalNAc
Ser
(b) Legame N-glicosidico
Esempi:
Asn
Asn
Asn
GlcNAc
Asn
GlcNAc
Man
Gal
Neu5Ac
GalNAc


Proteoglicani
+NH3
Condroitin solfato
Ser
Eparan solfato
Ser
Fuc
Gal
Glc
Man
Xilosio
GlcA
GalNAc
GlcNAc
IdoA
Neu5Ac
Glicoproteine
+NH3
N-glicano
Asn
Asn
Glicosfingolipidi
Ser/Thr
O-glicano
Ser/Thr
Esterno
Membrana
Interno
COO−
COO−

BIOCHIMICA DEI GRUPPI SANGUIGNI



	Group A	Group B	Group AB	Group O
Red blood cell type				
Antibodies in Plasma	Anti-B	Anti-A	None	 Anti-A and Anti-B
Antigens in Red Blood Cell	A antigen	B antigen	A and B antigens	None