CARBOIDRATI

Sono **aldeidi** o **chetoni** con diversi **gruppi ossidrilici**

(formula molecolare di base (CH2O)n, con n =>3)

Funzioni

riserva energetica

combustibili

intermedi metabolici

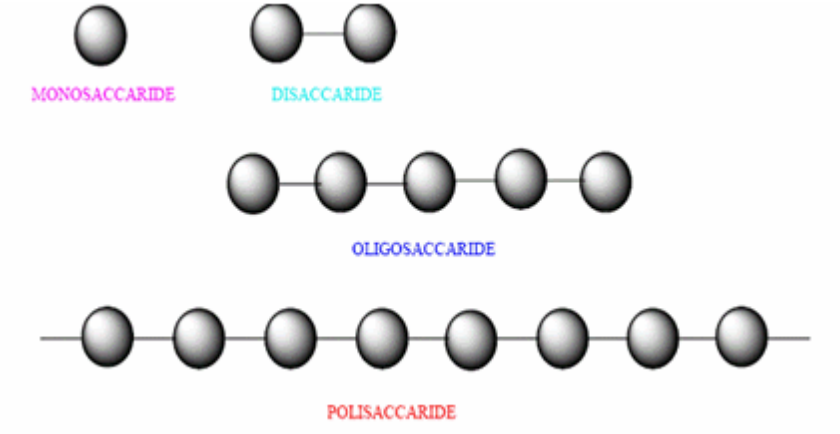
Impalcatura del **DNA** e **RNA**

I polisaccaridi sono **elementi strutturali** nella **parete cellulare** di **batteri** e **piante**

Glicoproteine e glicolipidi

Mediatori delle interazioni cellulari

Monosaccaridi - Oligosaccaridi - Polisaccaridi



I carboidrati sono macromolecole costituite da **unità monomeriche** chiamate monosaccaridi.

Monosaccaridi

Contengono da **3** a **9** atomi di **carbonio**.

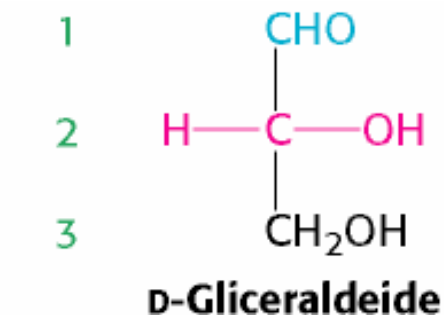
Presentano diversi atomi di carbonio **chirali**.

Possono **legarsi l'uno all'altro** formando strutture **oligosaccaridiche** caratterizzate da **un'elevata diversità** grazie alla quale possono **svolgere svariate funzioni**.

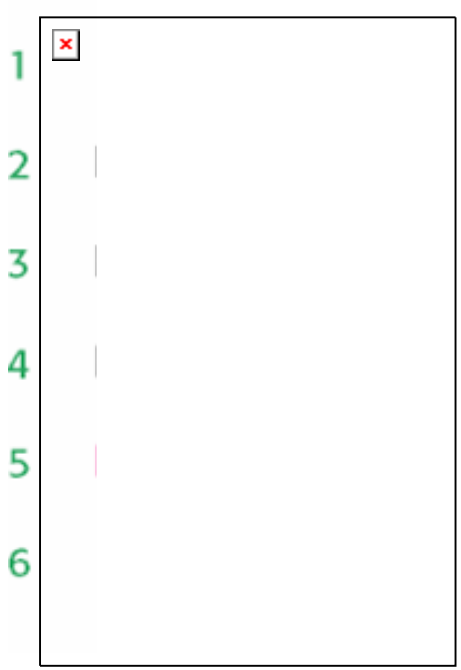
Monosaccaridi

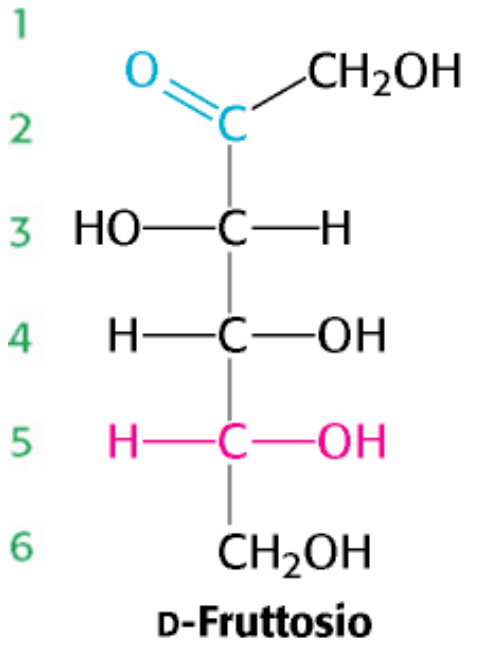
Sono **aldeidi** o **chetoni** che hanno due o più **gruppi ossidrilici**

$(C\text{-}H_2O)_n$



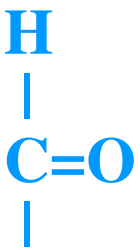
D-Gliceraldeide



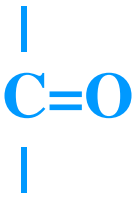


D-Fruttosio

gruppo alcolico



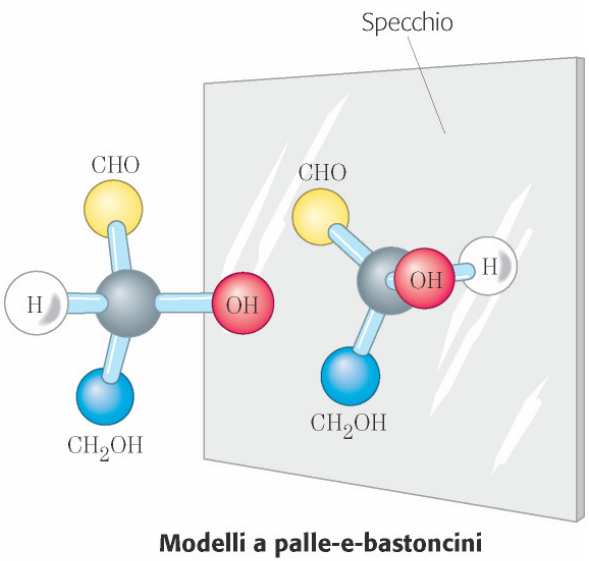
gruppo aldeidico



gruppo chetonico

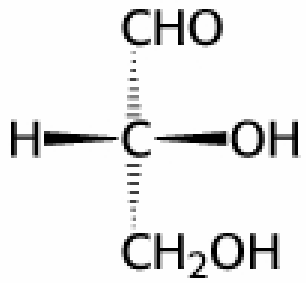
Aldosi e Chetosi a n=3 atomi di carbonio

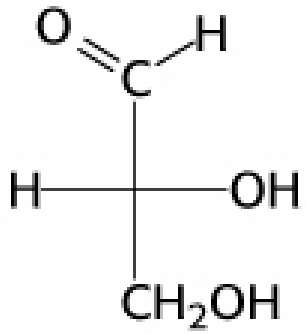
TRIOSI



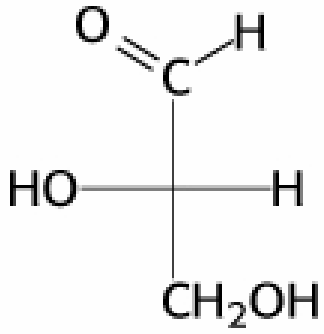
Modelli a palle-e-bastoncini

Proiezioni di Fischer

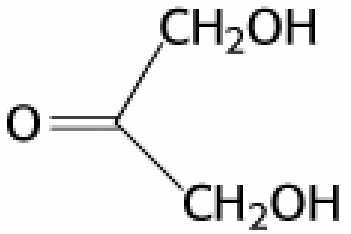




D-Gliceraldeide



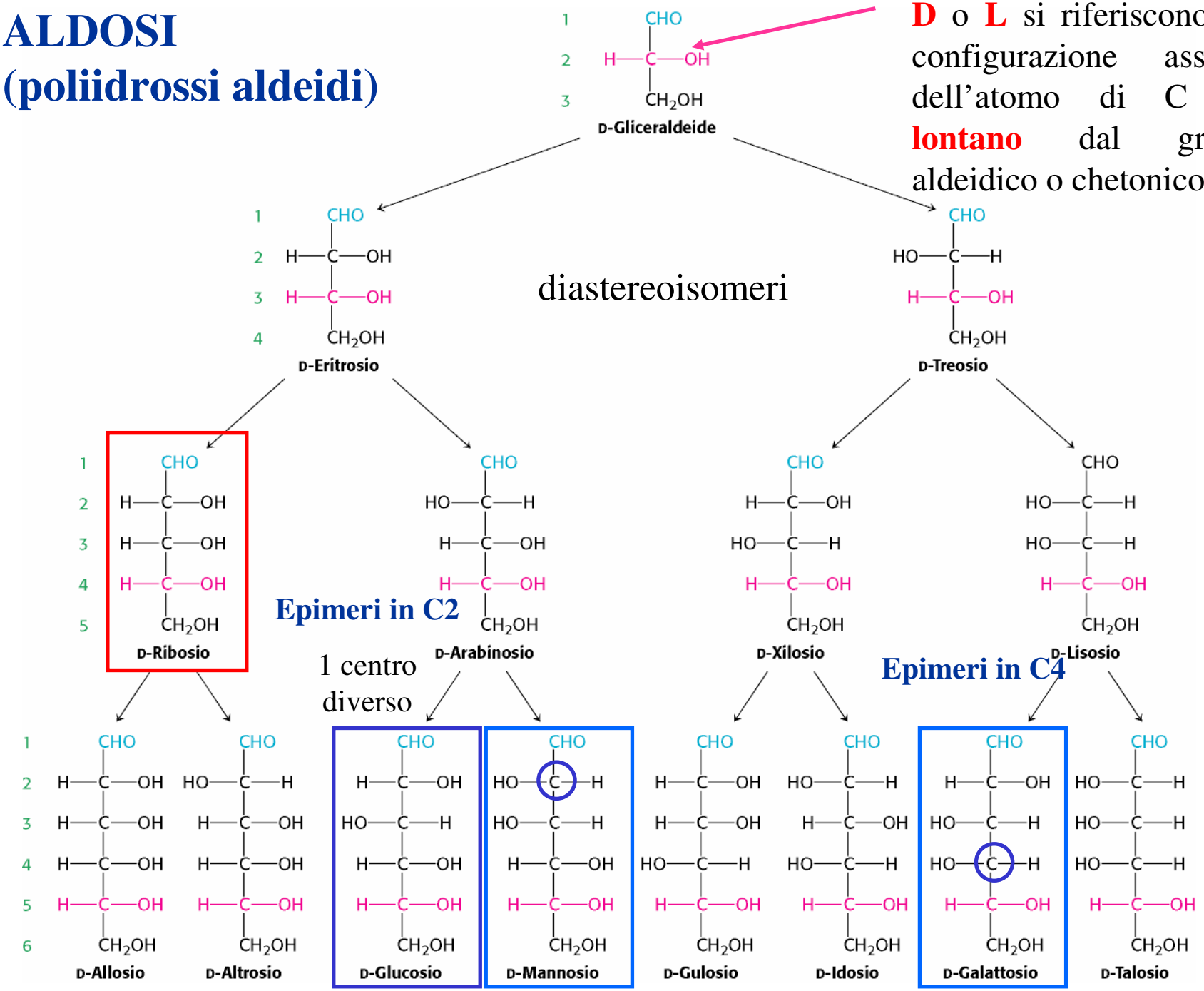
L-Gliceraldeide



Diidrossiacetone

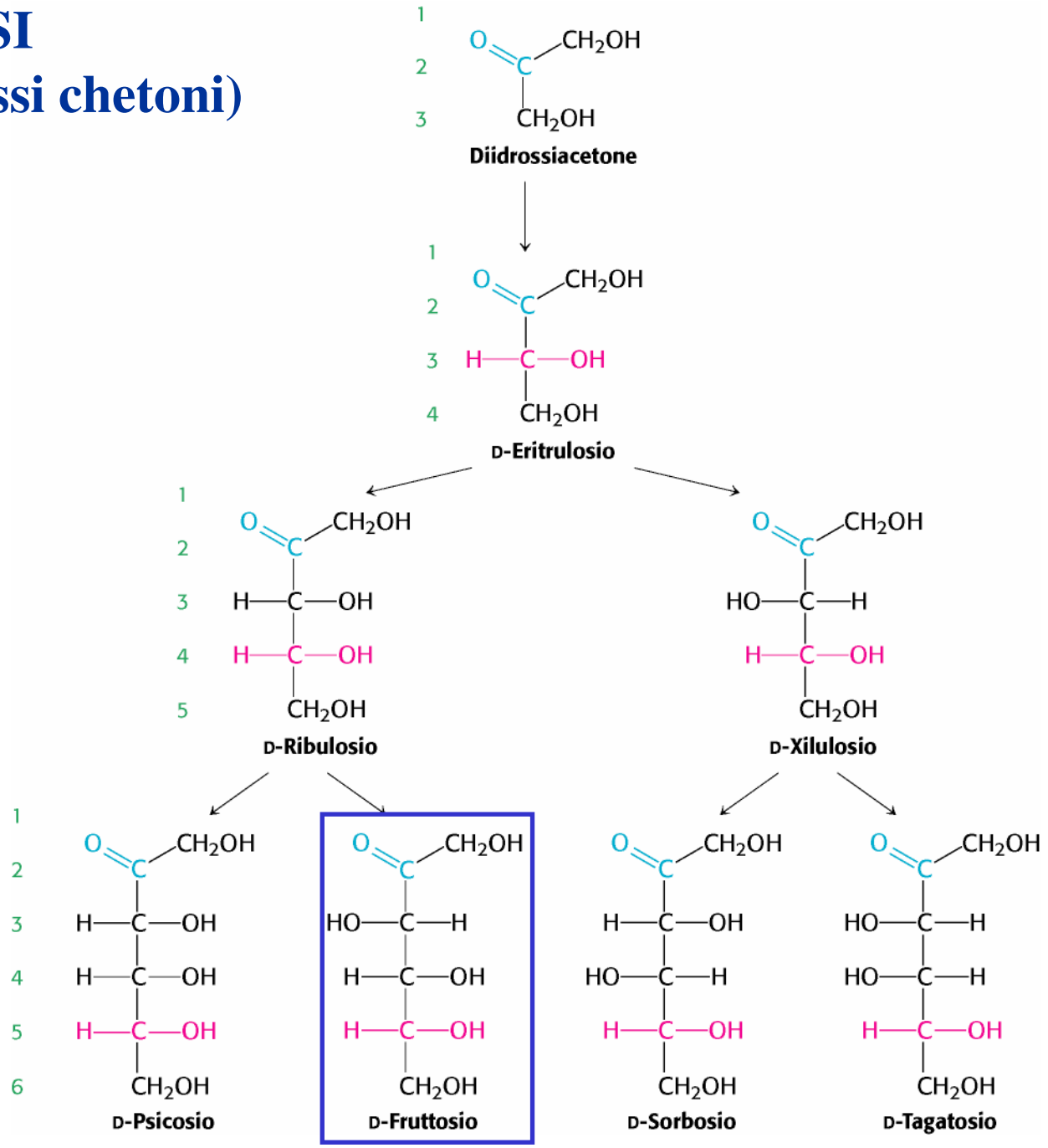
enantiomeri

ALDOSI
(poliidrossi aldeidi)

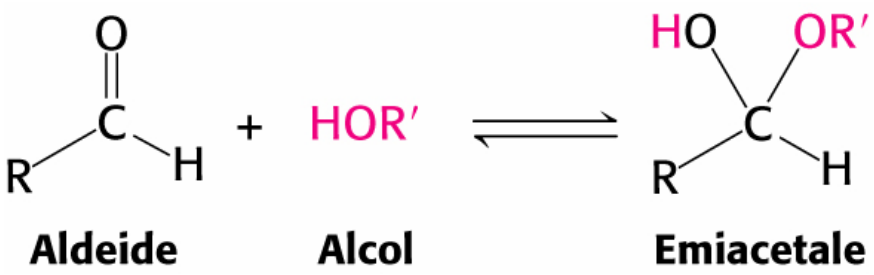


D o **L** si riferiscono alla configurazione assoluta dell'atomo di C **più lontano** dal gruppo aldeidico o chetonico

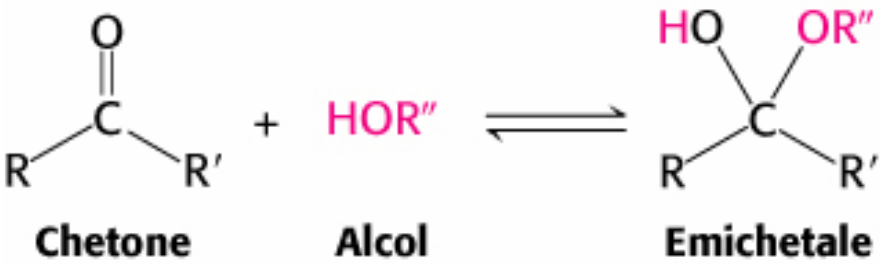
CHETOSI
(poliidrossi chetoni)



Ciclizzazione di pentosi ed esosi



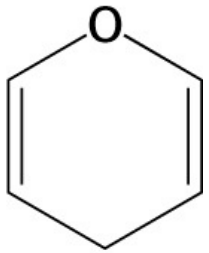
Aldeide **Alcol** **Emiacetale**



Chetone **Alcol** **Emichetale**

Ciclizzazione intramolecolare

Furano

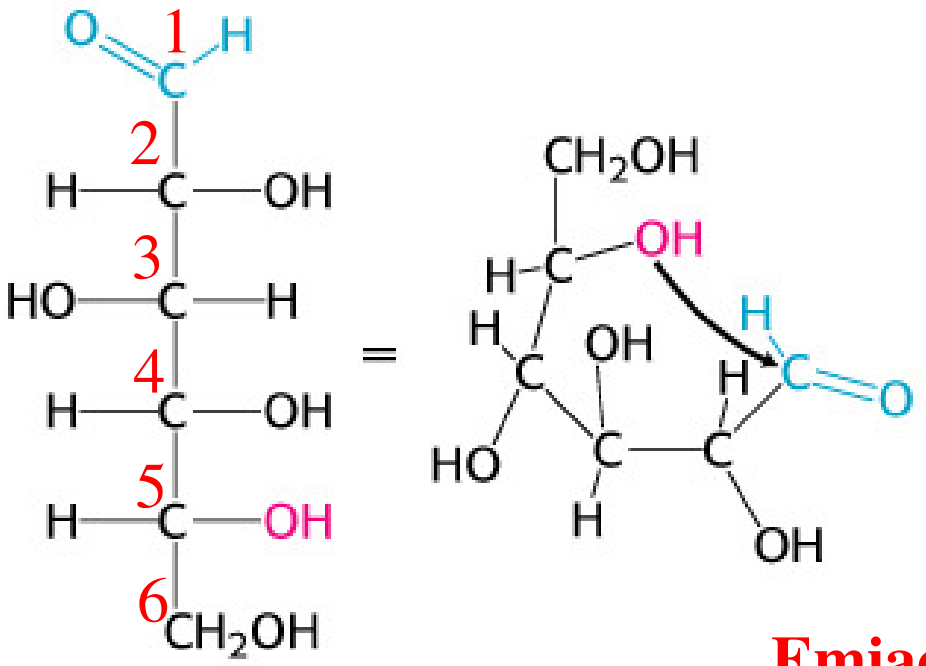


Pirano

Anelli furanosici e piranosici

Ciclizzazione del glucosio

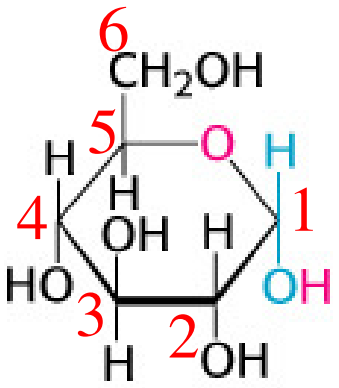
Carboidrati quali il glucosio, il fruttosio ed il ribosio **non esistono in soluzione in forma di catene aperte**, ma tendono a ciclizzare dando **strutture ad anello più stabili.**



D-Glucosio

<1% (forma a catena aperta)

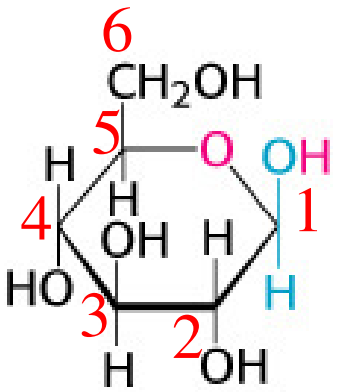
Emiacetale intramolecolare



α-D-Glucopiranosio 1/3

Anomeri al C1

Proiezioni di Haworth

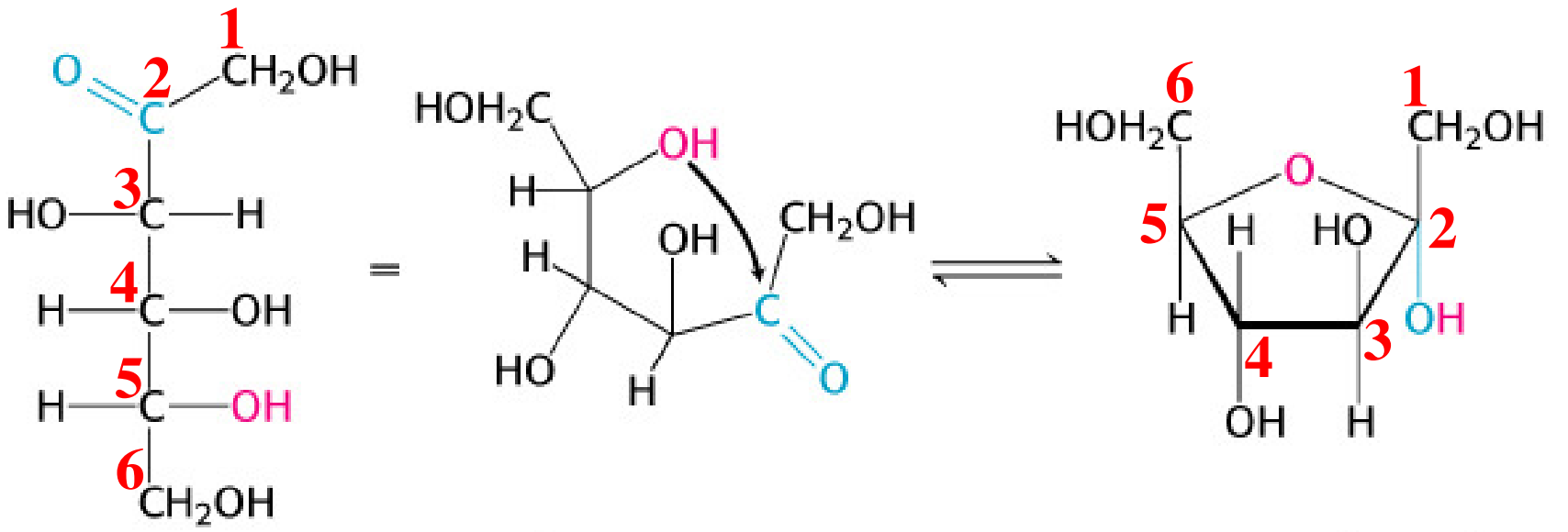


β-D-Glucopiranosio 2/3

Anomero α: il gruppo **OH** al **C1** si trova dal lato opposto dell'anello rispetto al gruppo **CH_2OH** legato al **C** che designa la serie sterica **D**- o **L**.

Anomero β: il gruppo **OH** al **C1** si trova dallo stesso lato dell'anello rispetto al gruppo **CH_2OH** legato al **C** che designa la serie sterica **D**- o **L**.

Ciclizzazione del Fruttosio



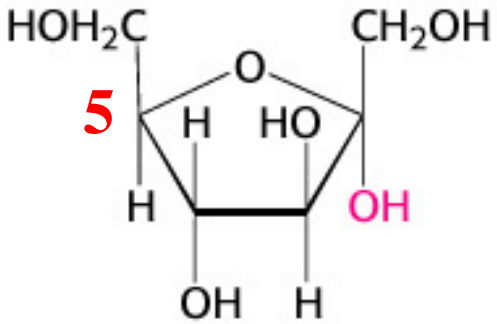
D-Fruttosio
(forma a catena aperta)

α-D-Fruttofuranosio
(una forma ciclica di fruttosio)

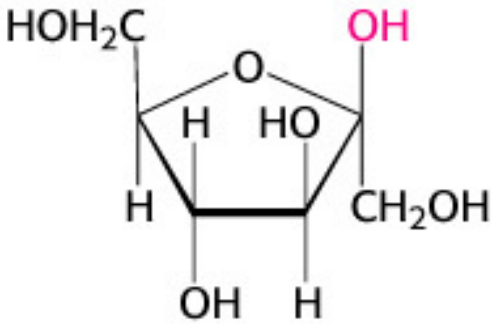
Emichetale intramolecolare

Forme cicliche del Fruttosio

Il fruttosio può ciclizzare dando forme **furanosiche** e **piranosiche**



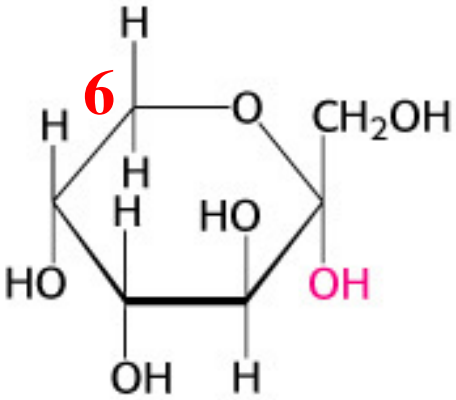
α-D-Fruttofuranosio



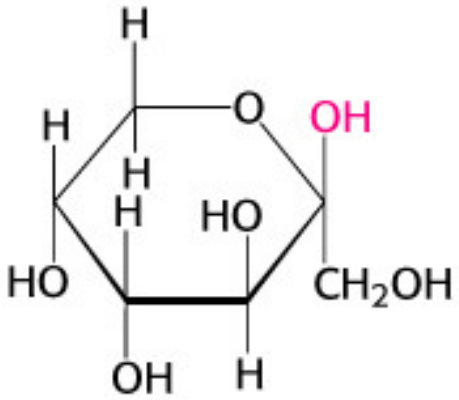
β-D-Fruttofuranosio

Furanosica

Predomina in derivati del fruttosio



α-D-Fruttopiranosio



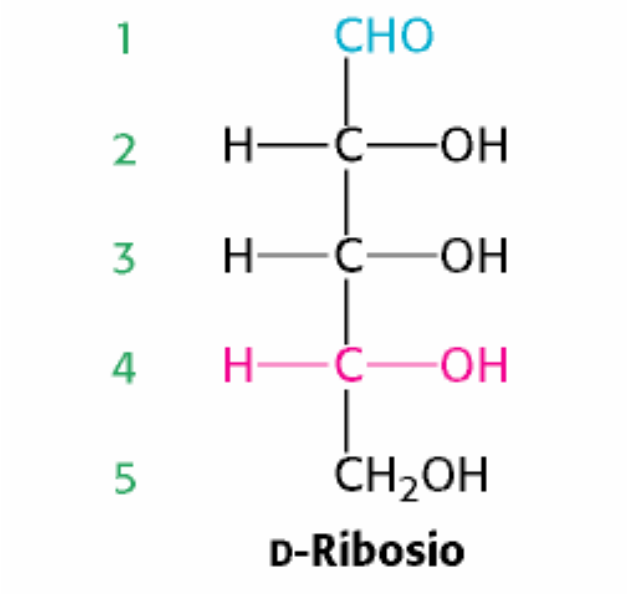
β-D-Fruttopiranosio

Piranosica

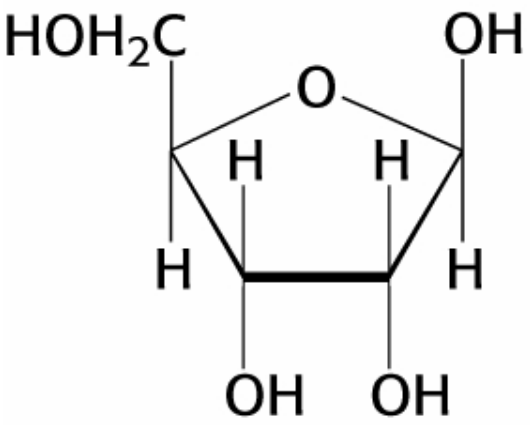
Predomina nel fruttosio libero in soluzione

Forma ciclica del ribosio

Forma anelli furanosici

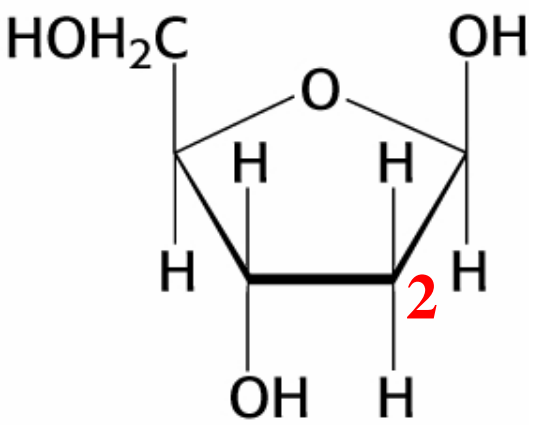


D-Ribosio



D-Ribosio

RNA

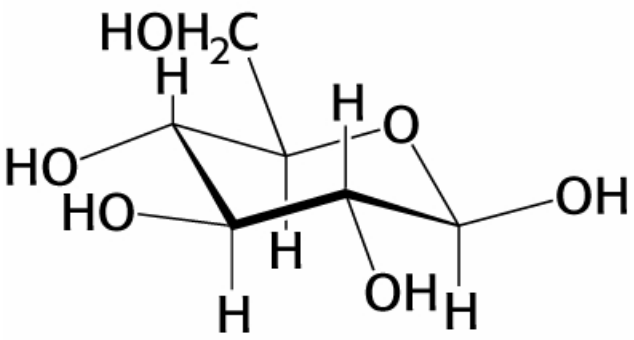


2-Deossi-D-ribosio

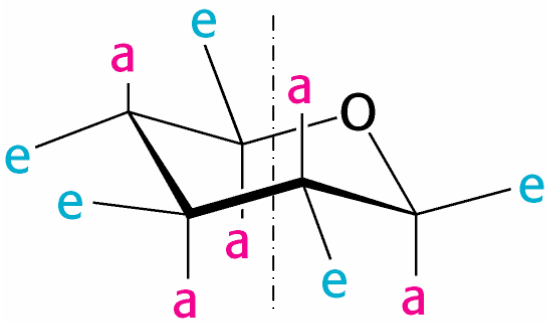
DNA

Gli anelli furanosici e piranosici possono assumere diverse conformazioni

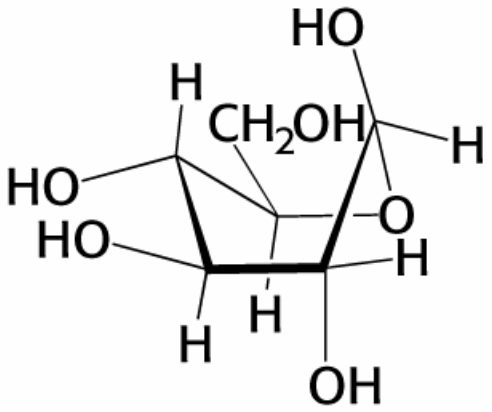
β-D-glucopiranosio



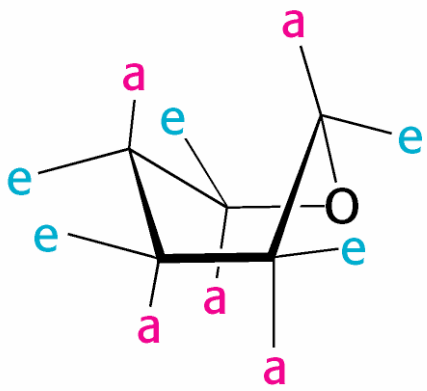
Conformazione a sedia

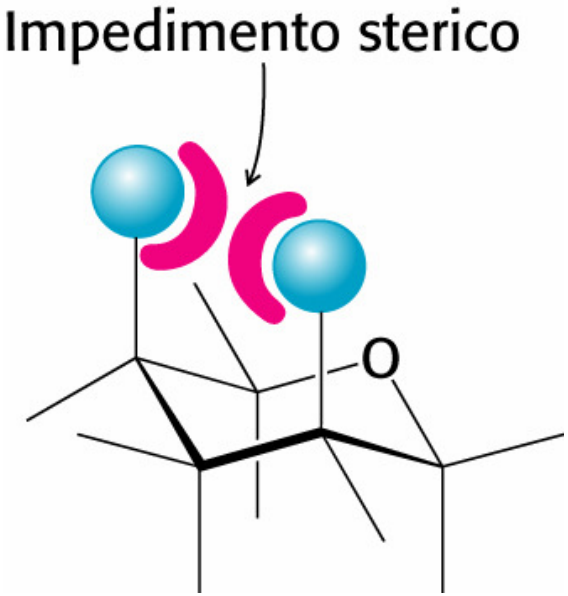


Tutte le posizioni assiali sono occupate da atomi di H

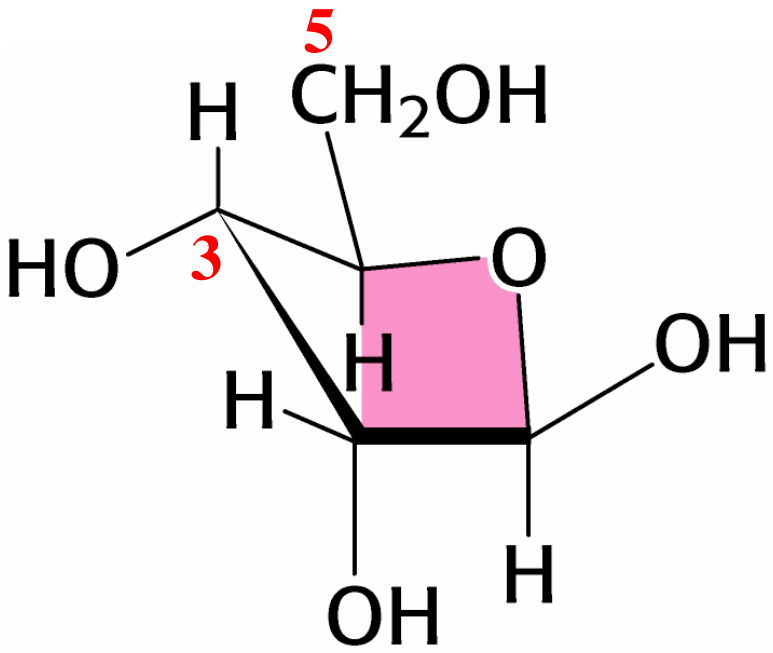


Conformazione a barca

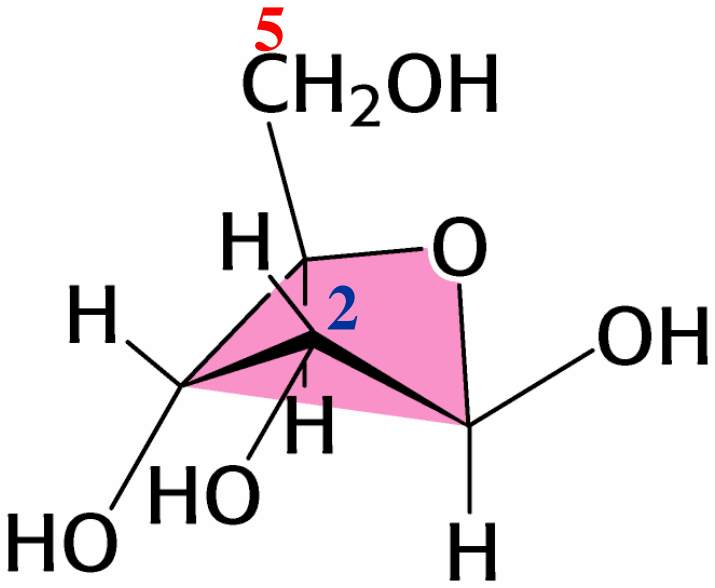




Conformazioni a busta del β-D-Ribosio

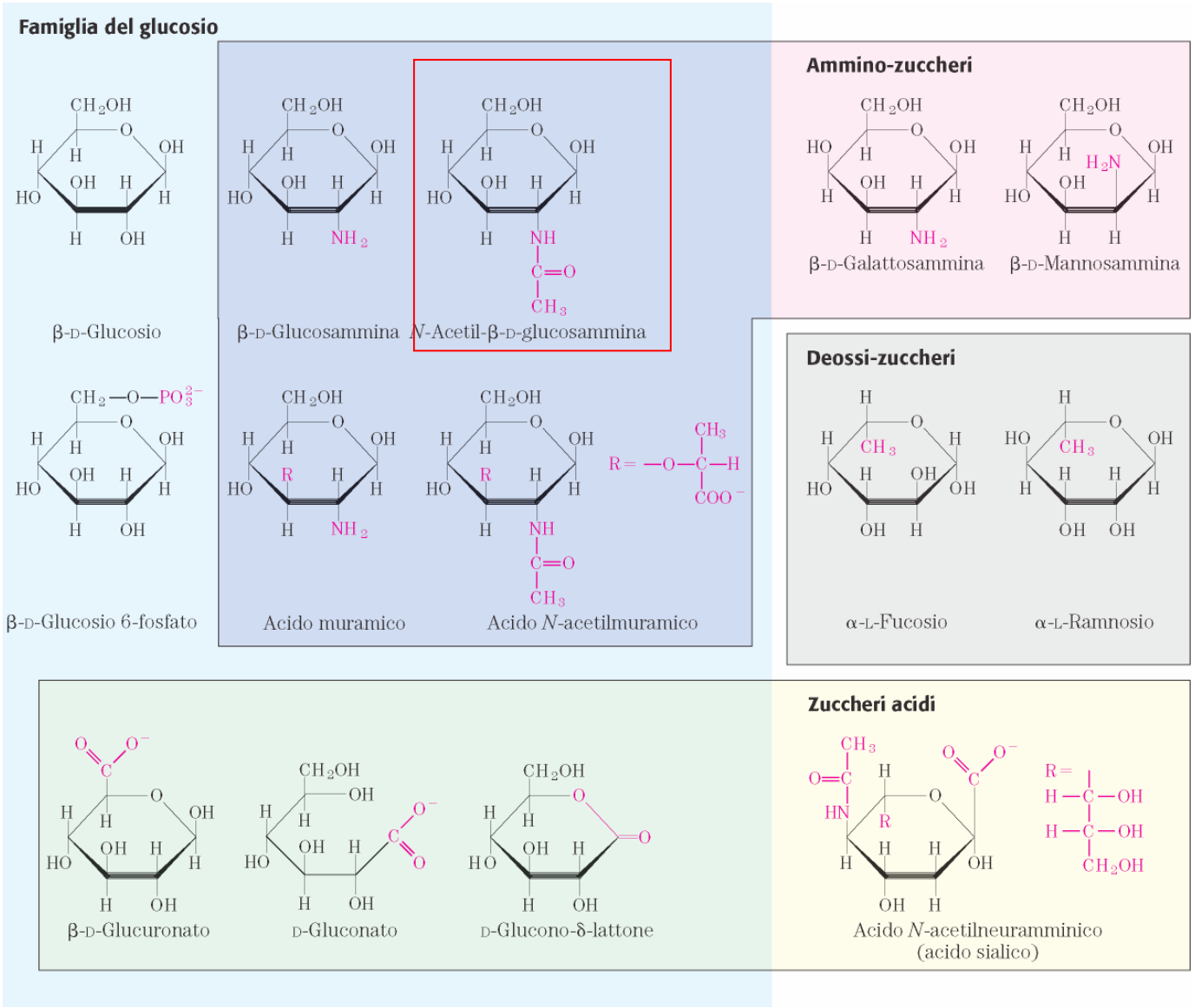


C-3-endo



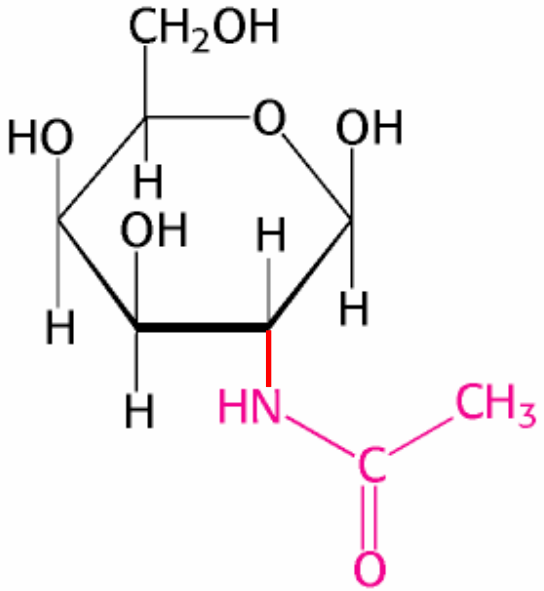
C-2-endo

Derivati biologici degli esosi



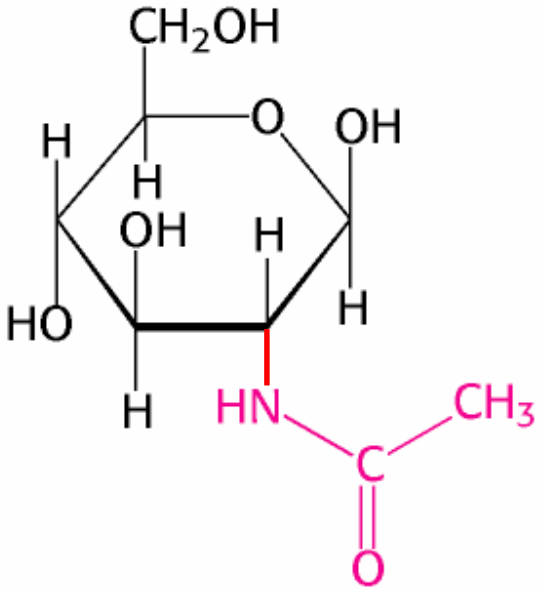
Monosaccaridi modificati

Legame N-glicosidico



β-D-Acetilgalattosammina
(GalNAc)

galattosio

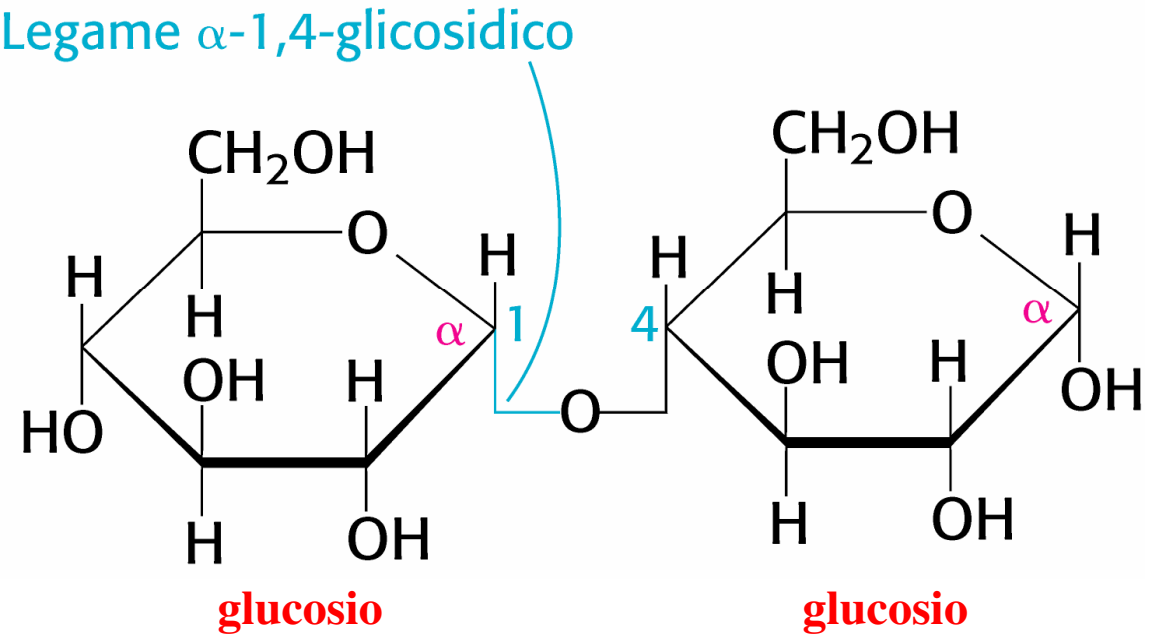


β-D-Acetilglucosammina
(GlcNAc)

glucosio

Oligosaccaridi
Legame O-glicosidico

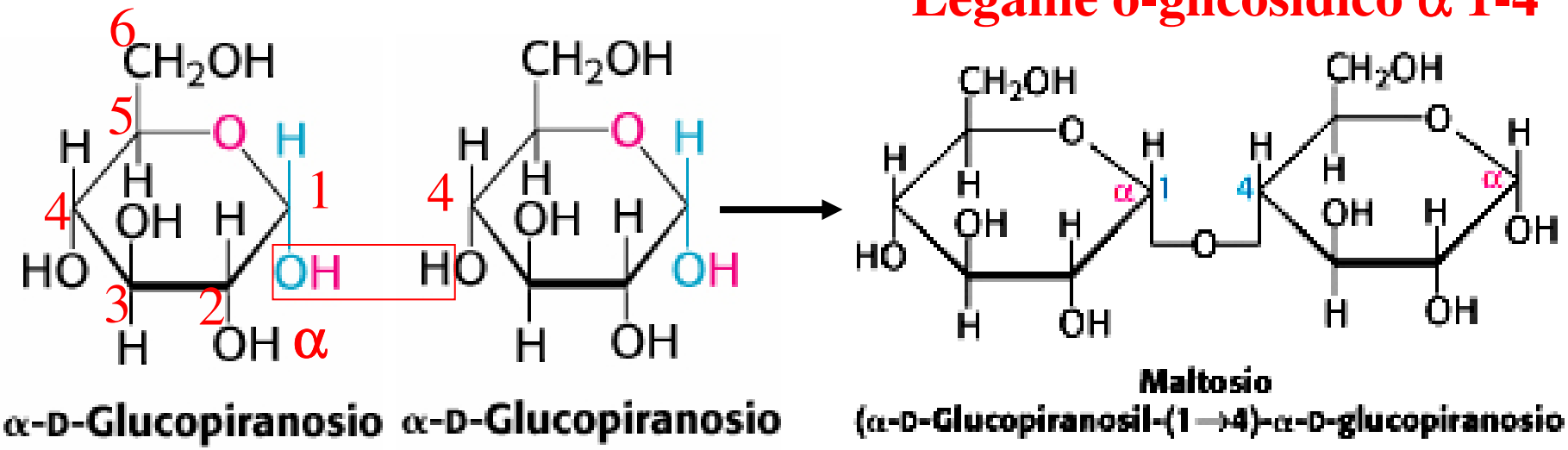
Gli oligosaccaridi sono carboidrati formati da più monosaccaridi legati mediante legami o-glicosidici



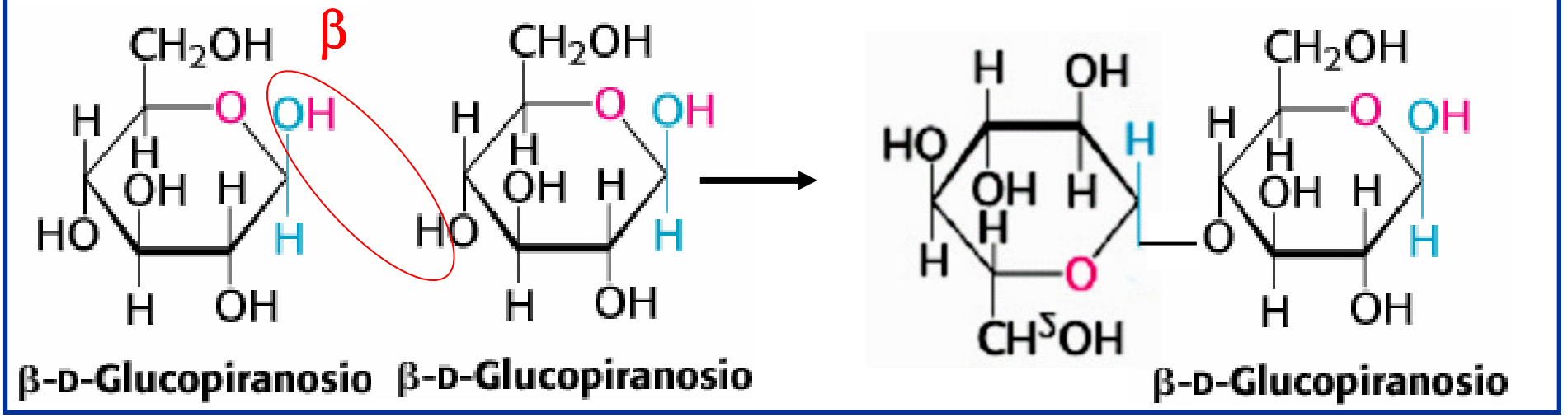
Maltosio

Due molecole di glucosio possono legarsi covalentemente mediante la formazione di legami o-glicosidici

Legame o-glicosidico α 1-4

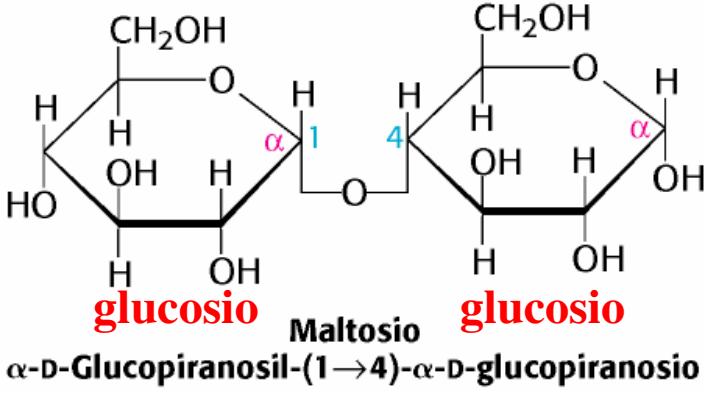


Legame o-glicosidico β 1-4

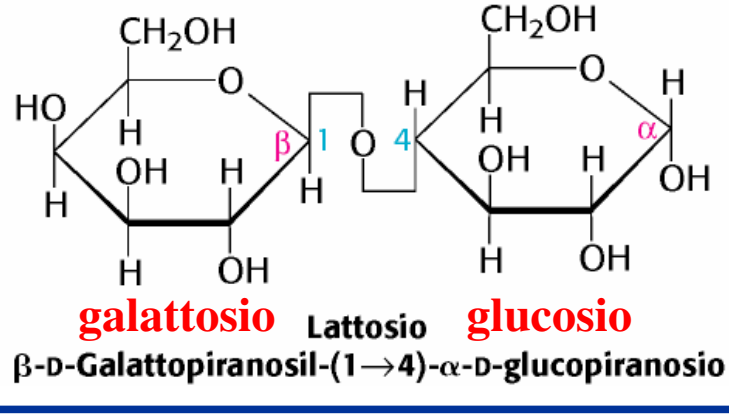


DISACCARIDI

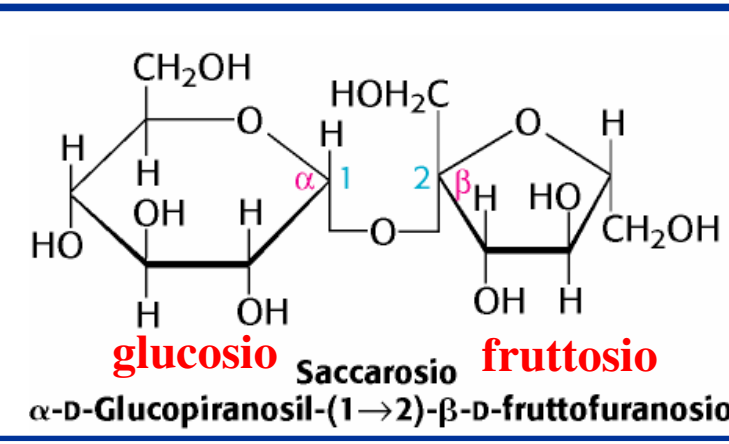
Carbonio anomerico



Legame o-glicosidico α 1-4



Legame o-glicosidico β 1-4

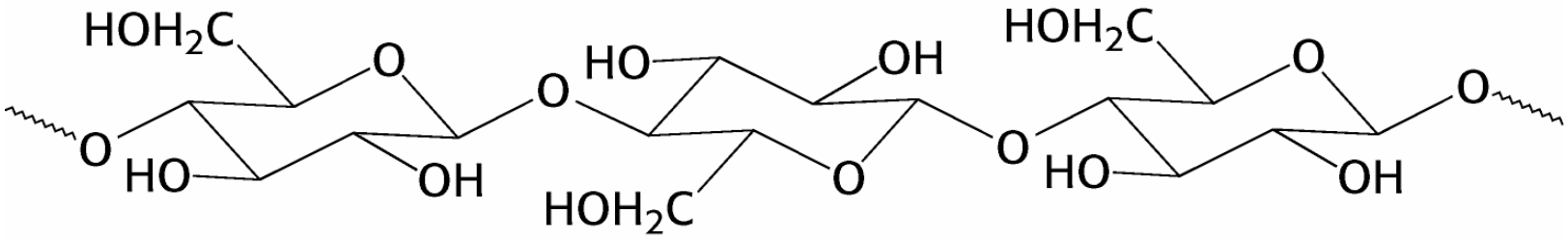


Legame o-glicosidico 1-2 α rispetto al glucosio e β rispetto al fruttosio

Il legame o-glicosidico unisce i due carboni anomerici

POLISACCARIDI

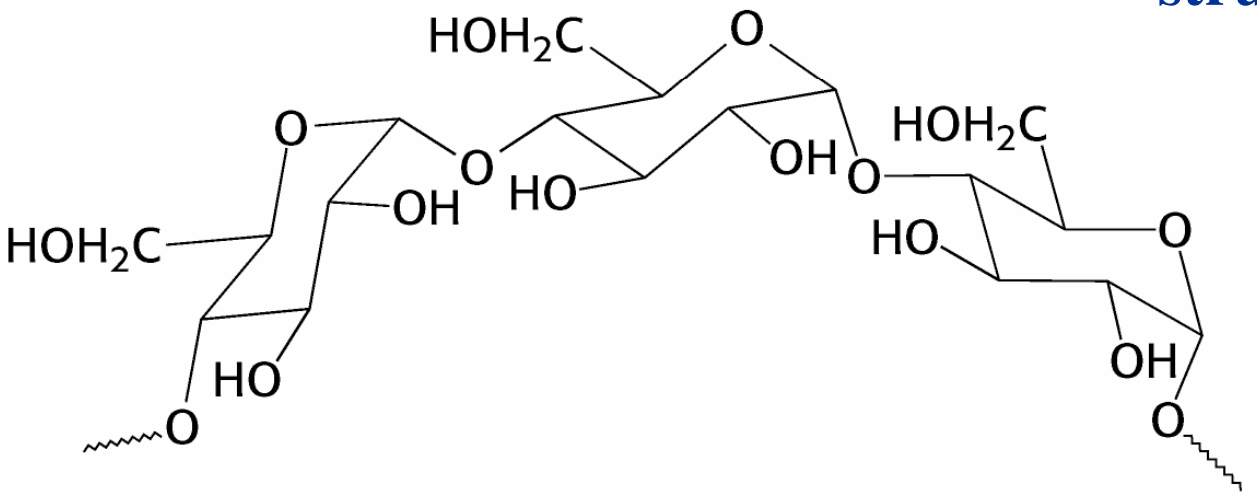
Polimeri del glucosio



Cellulosa
(legami β-1,4)

β

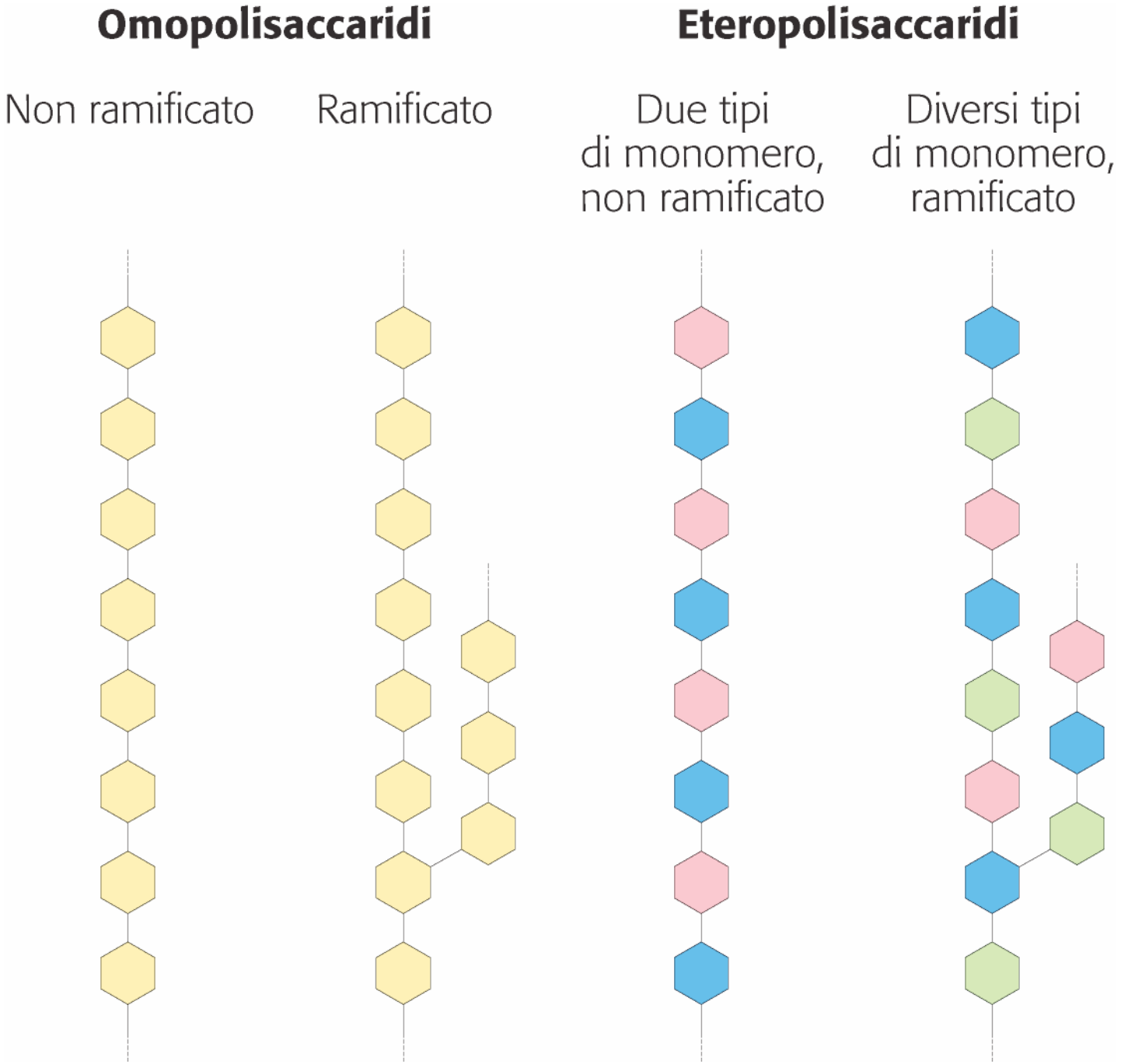
Funzione strutturale



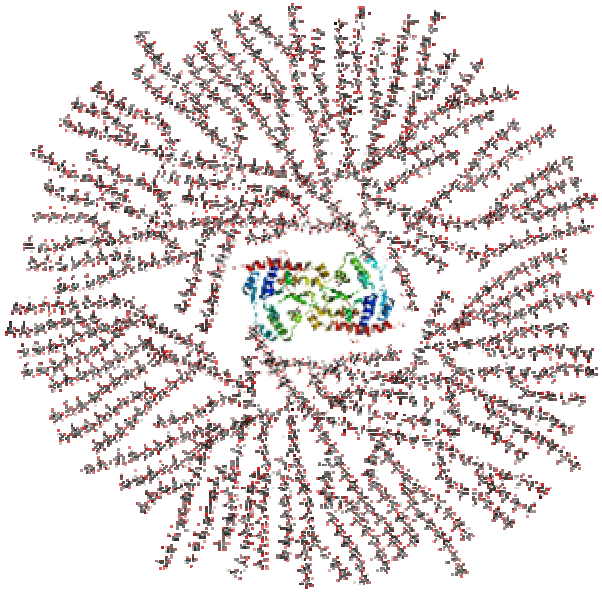
Amido e Glicogeno
(legami α-1,4)

α

Funzione di riserva


Omopolisaccaridi
Eteropolisaccaridi
Non ramificato
Ramificato
Due tipi di monomero, non ramificato
Diversi tipi di monomero, ramificato

Glicogeno



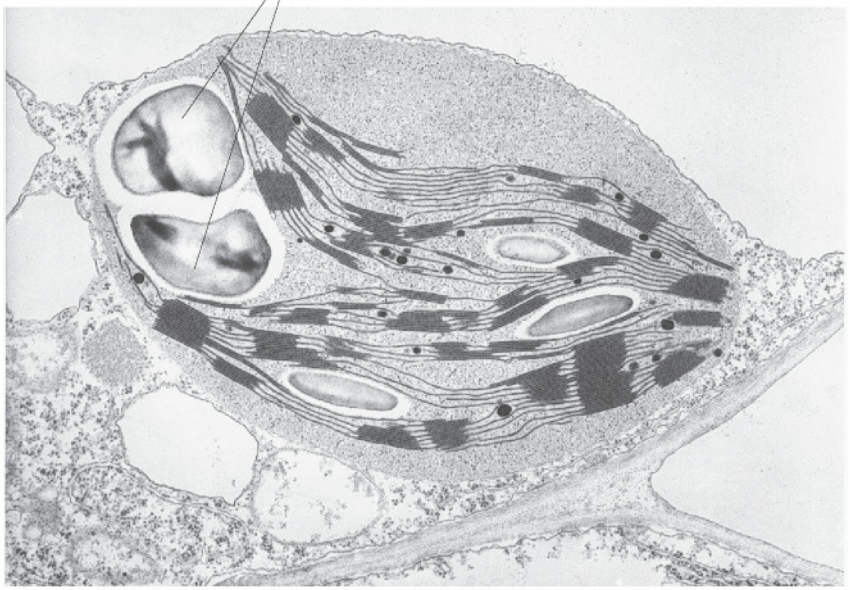
È il polisaccaride di riserva degli animali

Molecole di glucosio unite da legami:
1,4 α-glicosidici
1,6 α-glicosidici

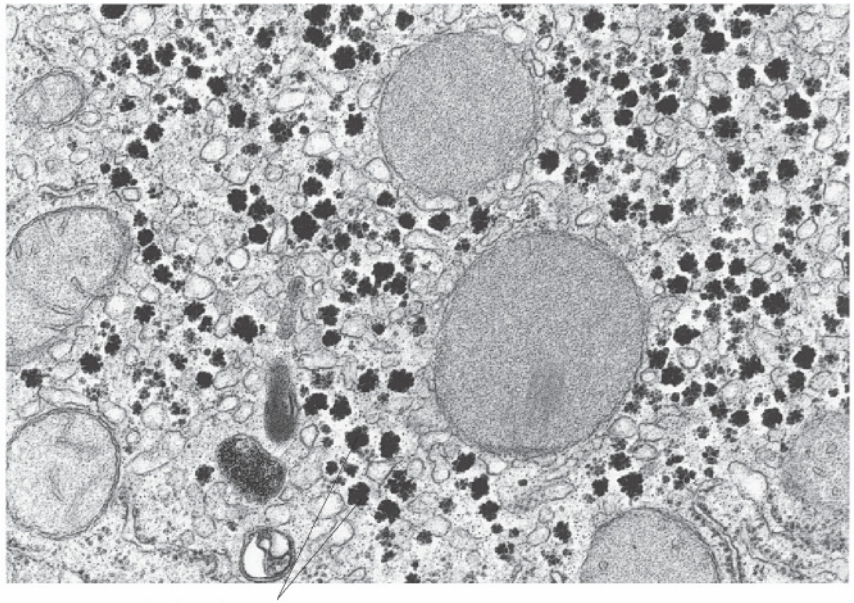
Struttura:
molto ramificata (una ramificazione ogni 8-12 unità di glucosio)
Massa molecolare:
molto elevata (fino a 100.000 unità di glucosio)

*Il glicogeno contribuisce alla **omeostasi del glucosio** nell'organismo, riducendone l'eccesso fornito dal cibo ingerito; accumulandolo e restituendolo al sangue quando le cellule dell'organismo ne necessitano:*

Granuli di amido



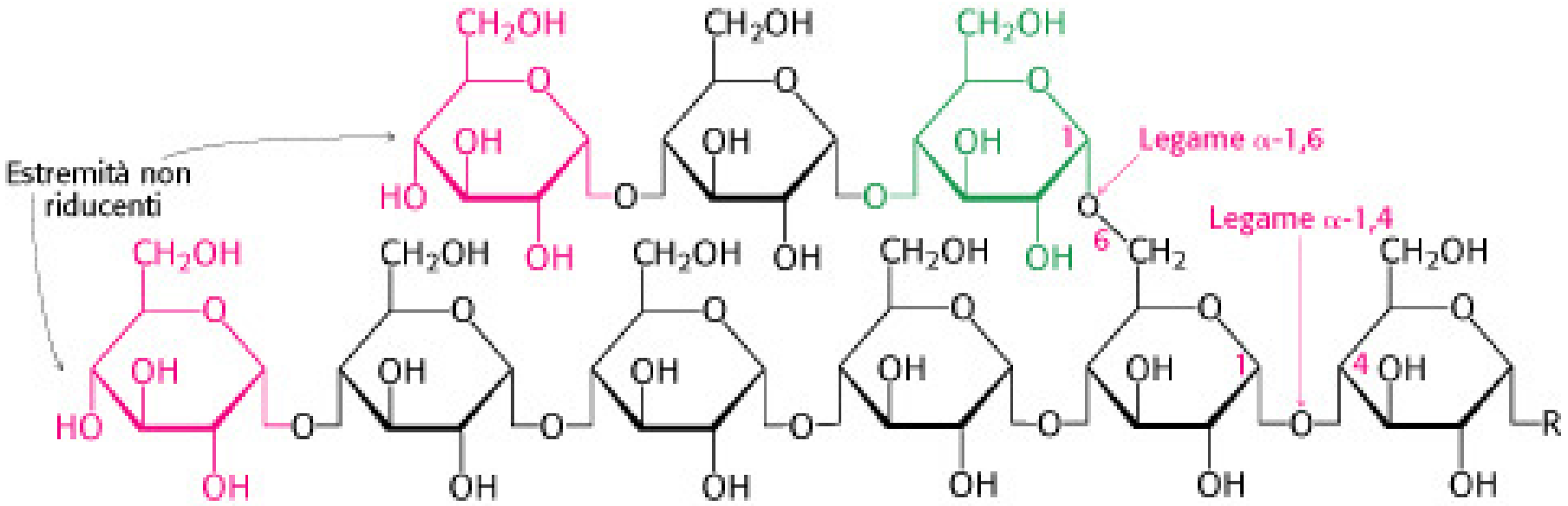
(a)



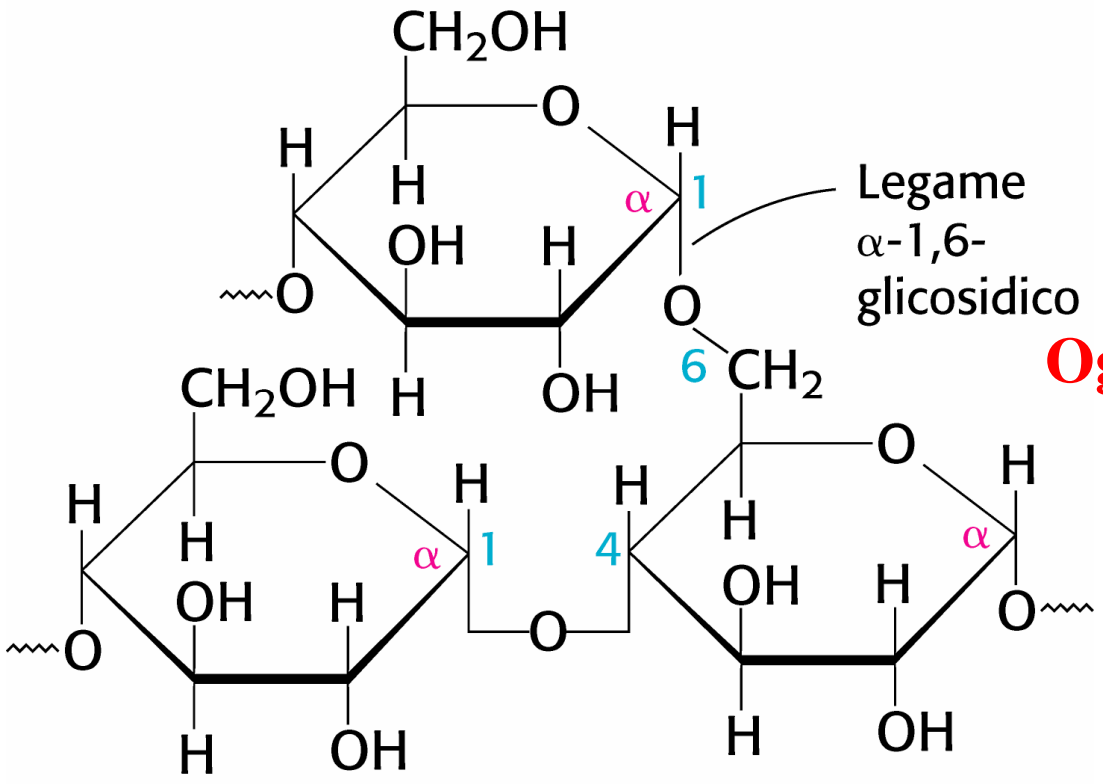
(b)

Granuli di glicogeno

Il glicogeno ramificato



Il glicogeno contiene ramificazioni



Ogni 10 residui

Amido Amilosio (lineare)

Amilopectina (ramificato ogni 30 residui)

Amido

È il polisaccaride di riserva delle piante

Molecole di glucosio unite da legami:

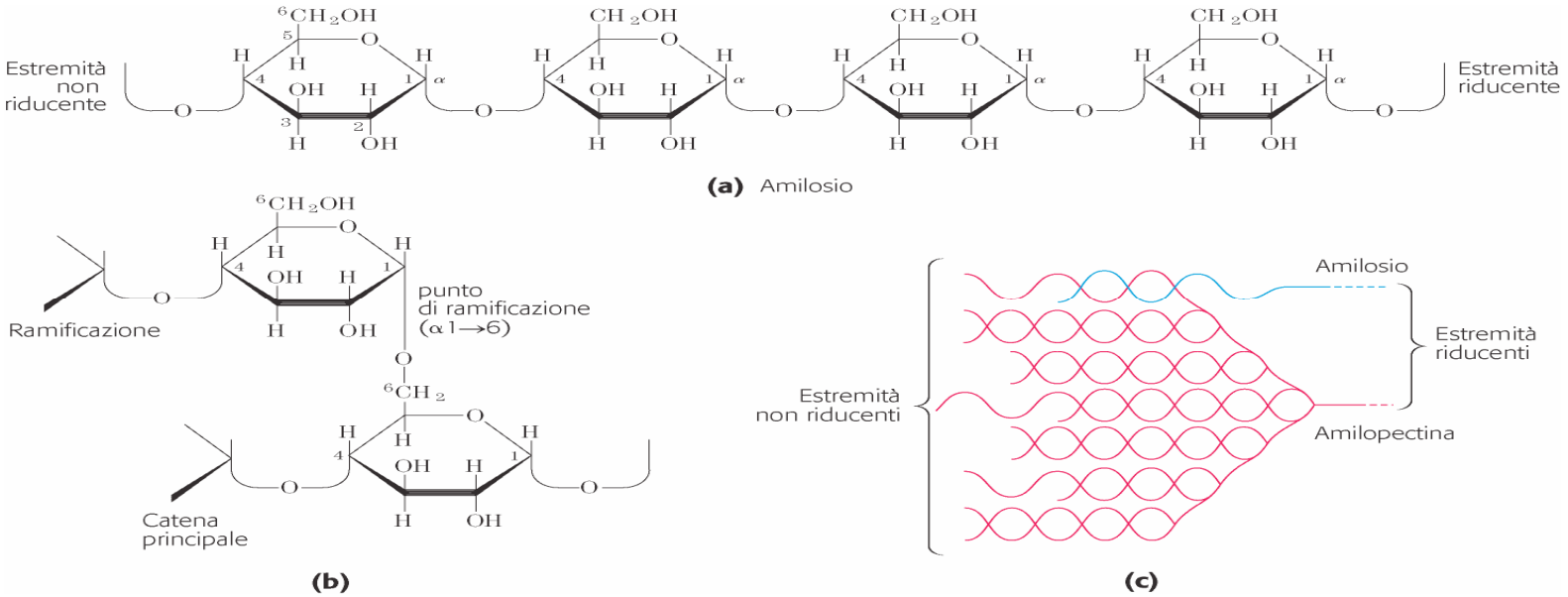
1,4 α-glicosidici

1, 6 α-glicosidici

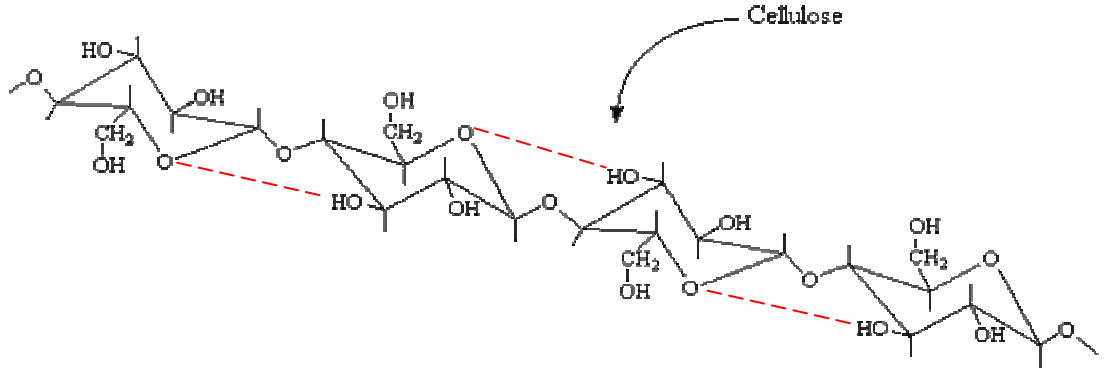
Struttura:

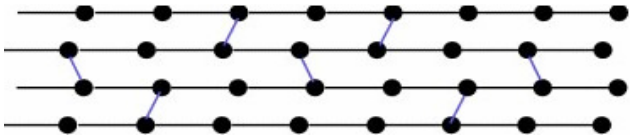
80% amilopectina (catene ramificate con c.a 5000 unità di glucosio)

20% di AMILOSIO (catene lineari da c.a 300 unità di glucosio)



Cellulosa: legami β1-4 e struttura





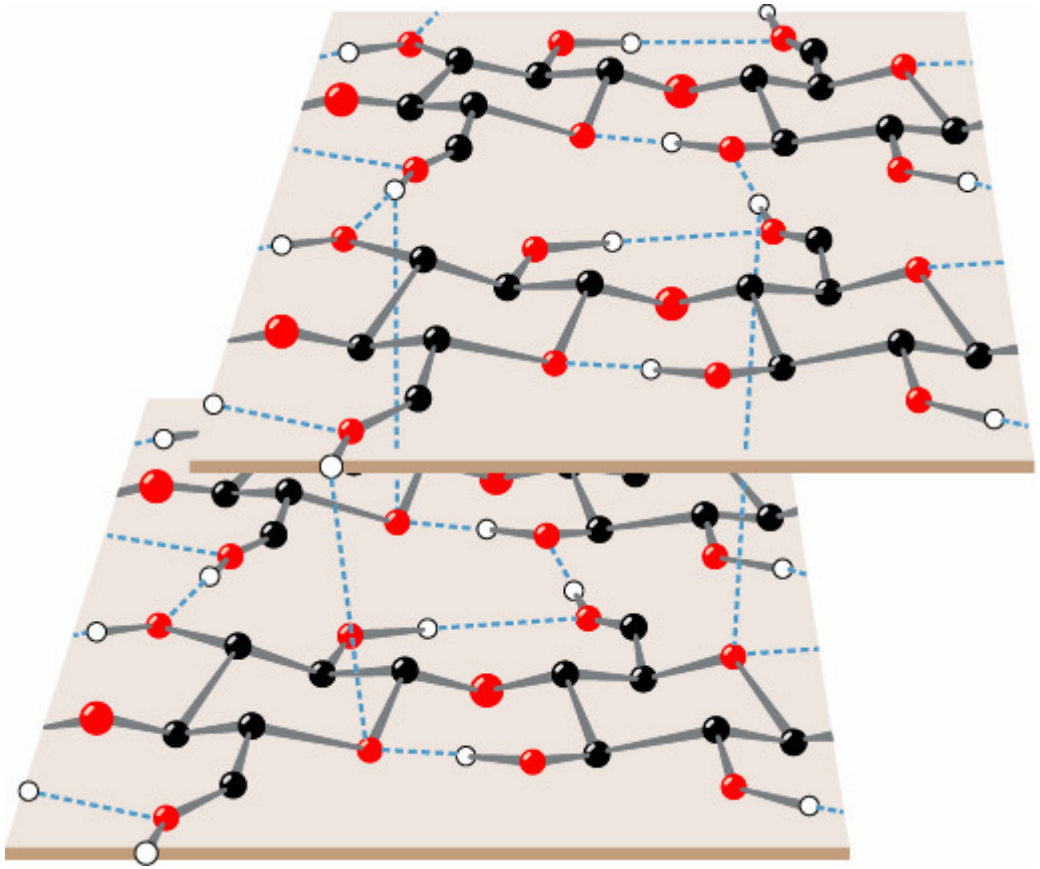
Cellulosa
È il polisaccaride strutturale delle piante
(legno cotone, canapa, lino, paglia)
Legami:
1, 4-β-glucosidici
Struttura:
Catene lineari (non ramificate) di c.a 5000 unità di glucosio
È in grado di formare FIBRILLE:
Macromolecole lineari strutturate da legami H ed avvolte a spirale

Differenze tra amido e cellulosa

UNICA DIFFERENZA CHIMICA
fra **AMIDO** (legami α-glucosidici) e **CELLULOSA** (legami β-glucosidici):

La ***STEREOCHIMICA*** del legame glucosidico sul ***C1***
delle unità di glucosio

L'uomo possiede gli enzimi capaci di idrolizzare unicamente i legami α-glucosidici.

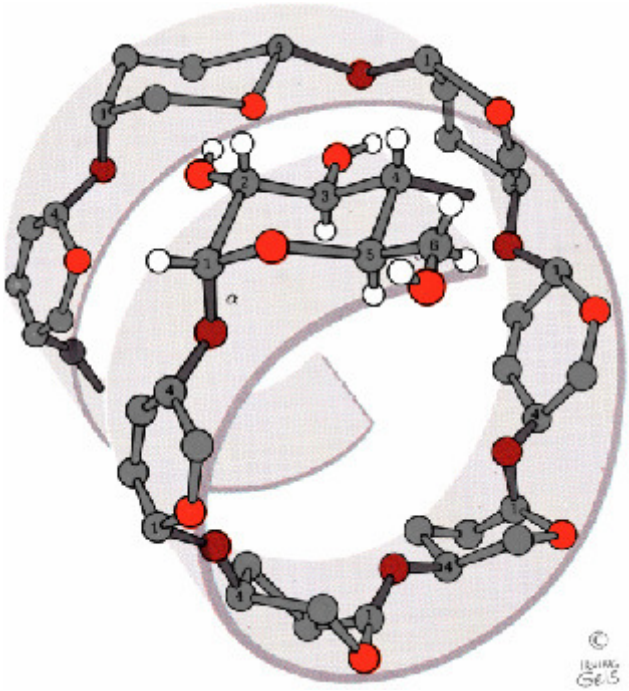


Cellulosa

I mammiferi non hanno
le cellulasi per degradare
la cellulosa

Elica aperta
accessibile
agli enzimi

Glicogeno



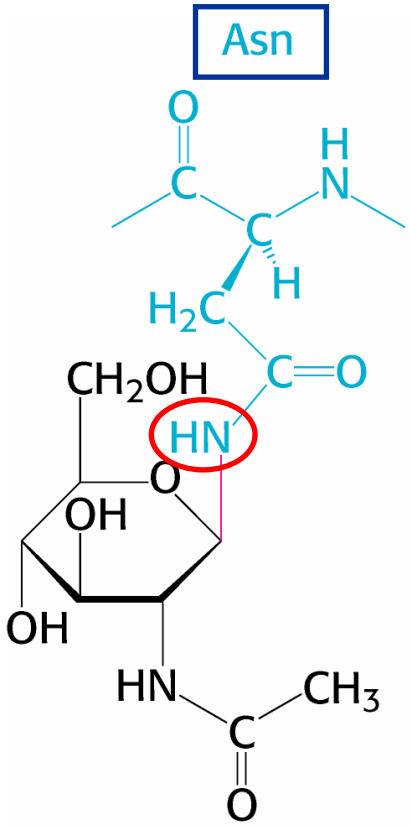
Glicoproteine

La glicosilazione delle proteine avviene all'interno del reticolo endoplasmatico (ER) e nell'apparato di Golgi

N-glicosilazioni

Asn-X-Ser

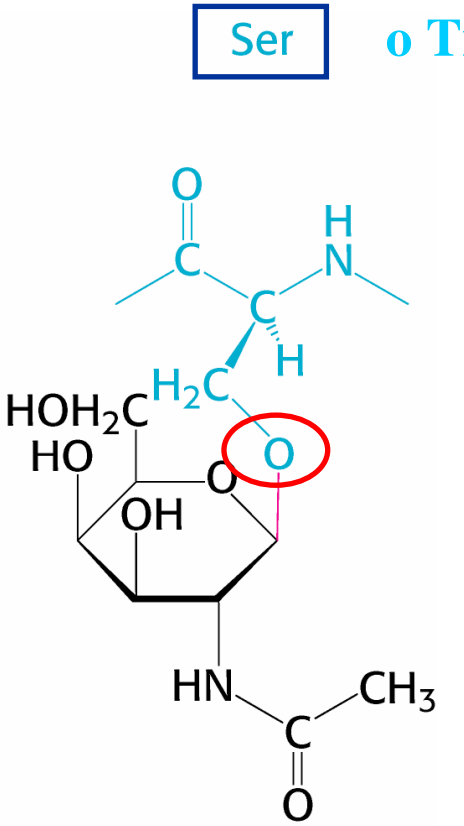
Asn-X-Thr



GlcNAc legato in *N*

RE e Golgi

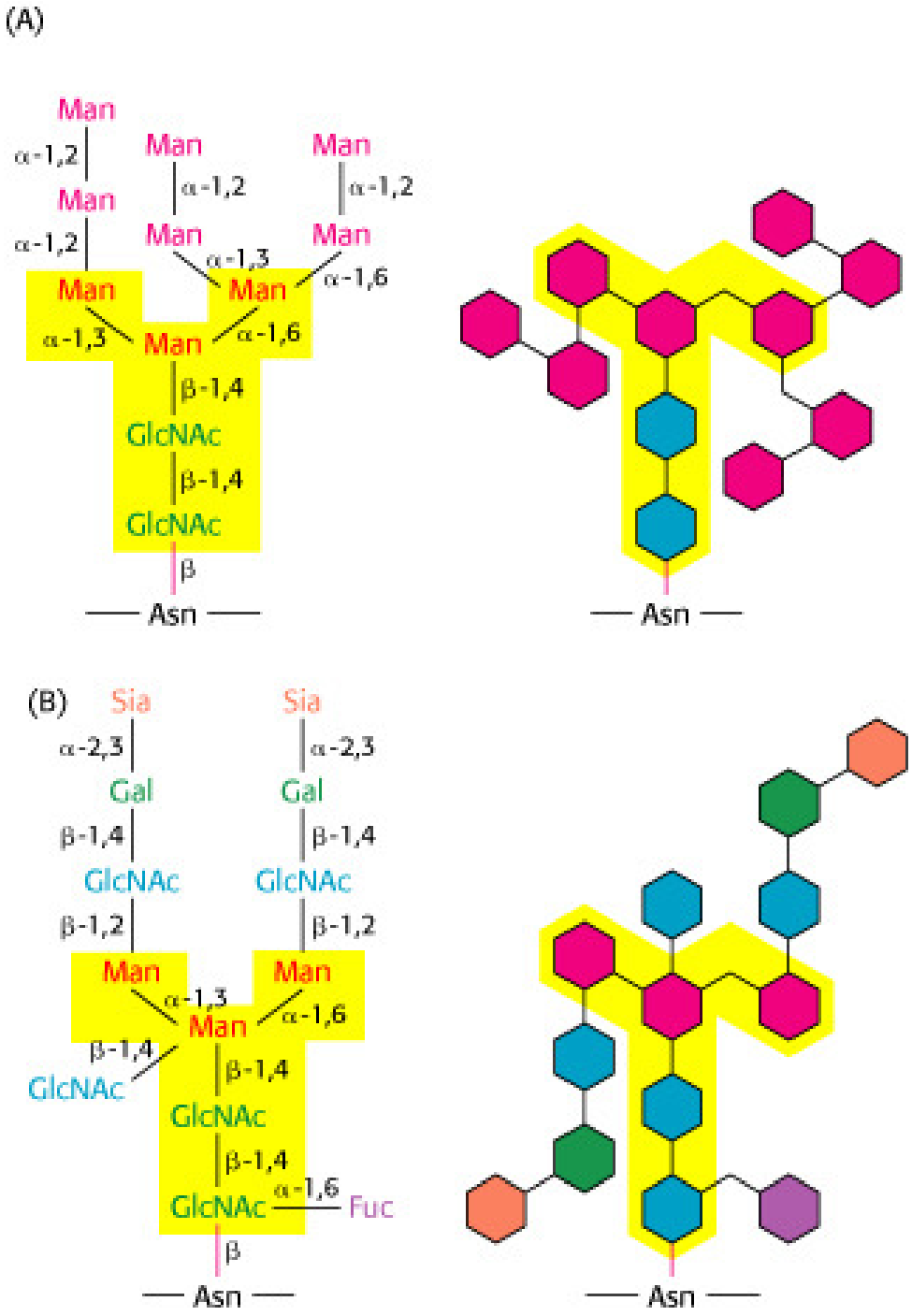
O-glicosilazioni



GalNAc legato in *O*

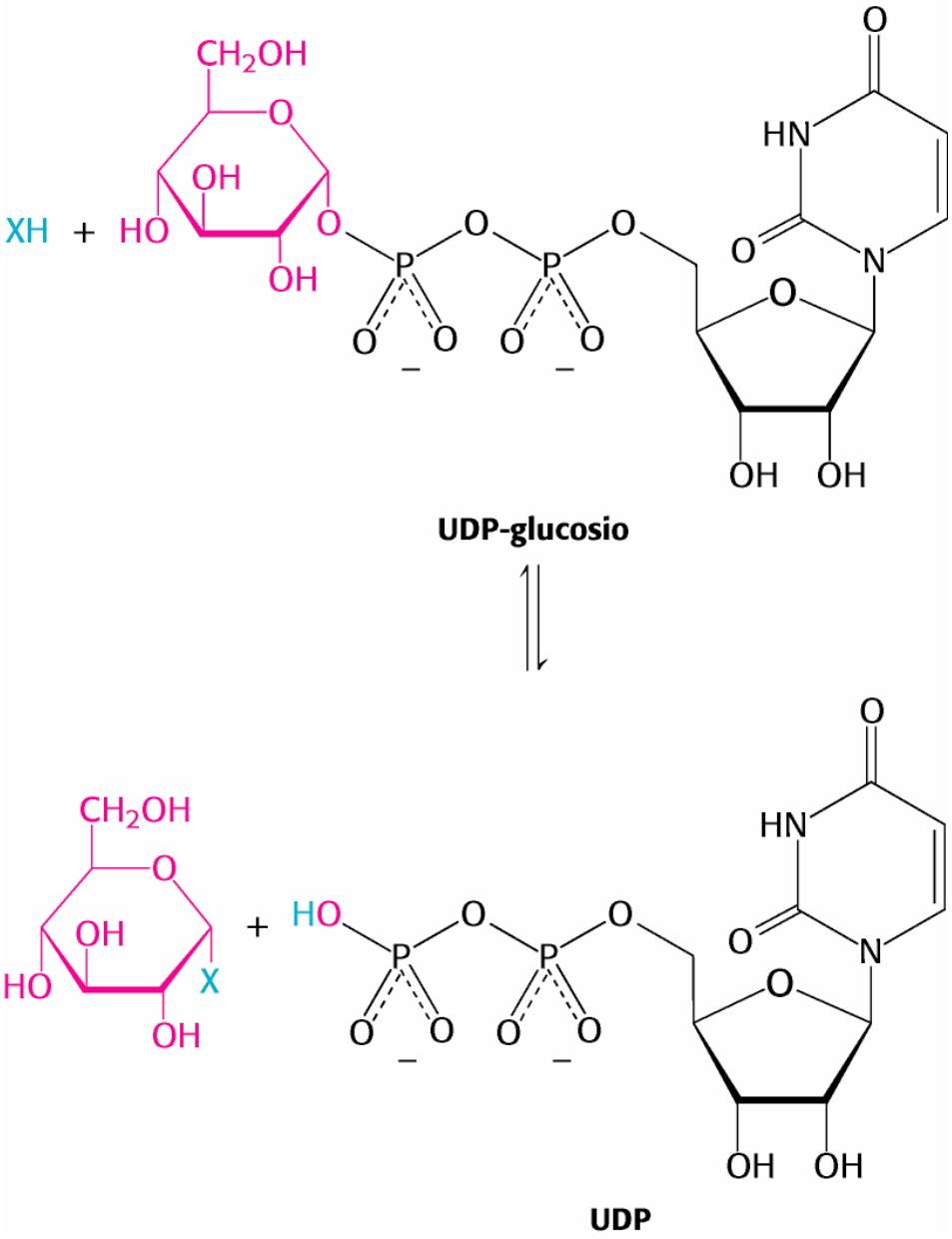
Golgi

Nucleo pentasaccaridico nelle N-glicosilazioni



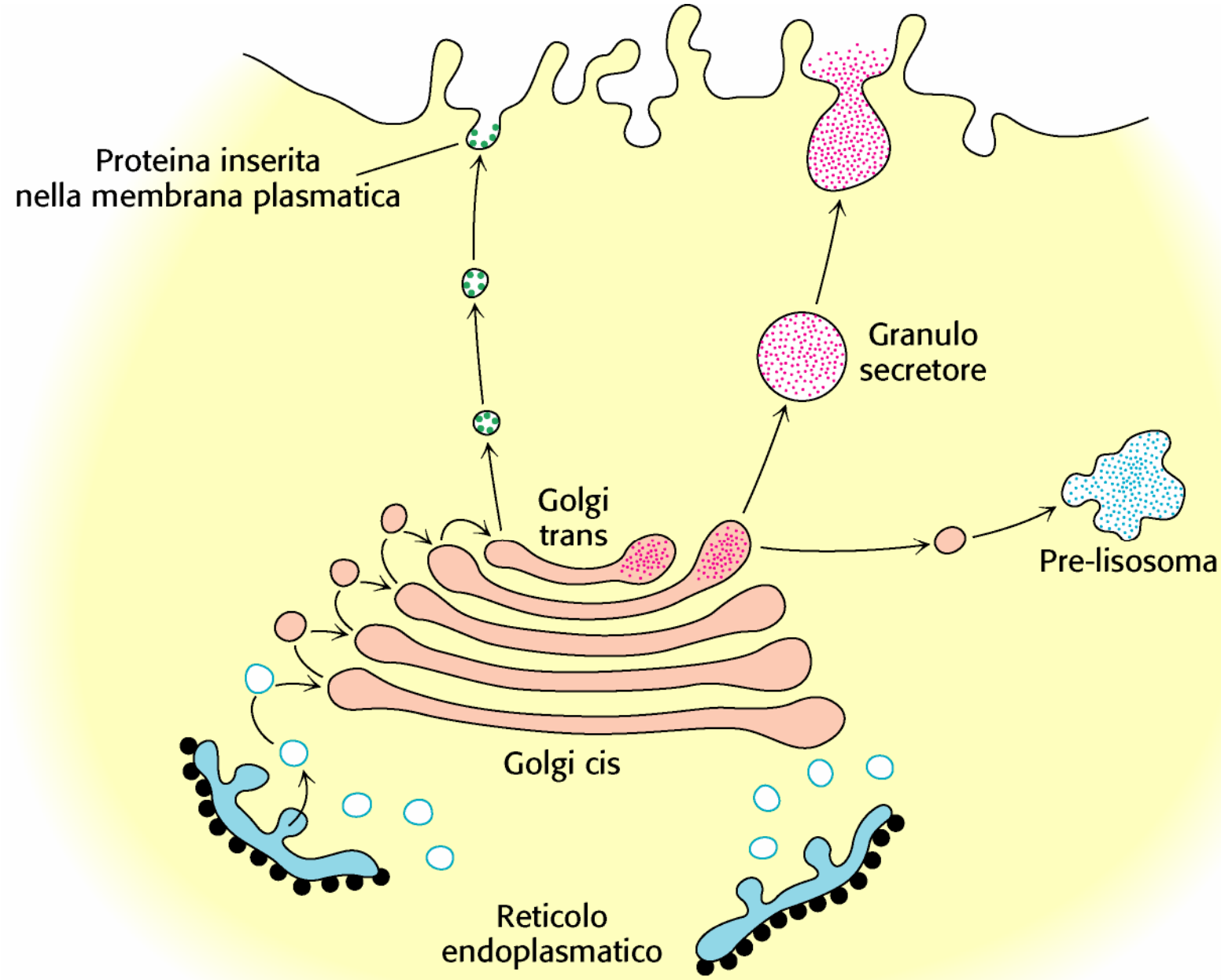
OLIGOSACCARIDI
legati a proteine

Glicosiltransferasi



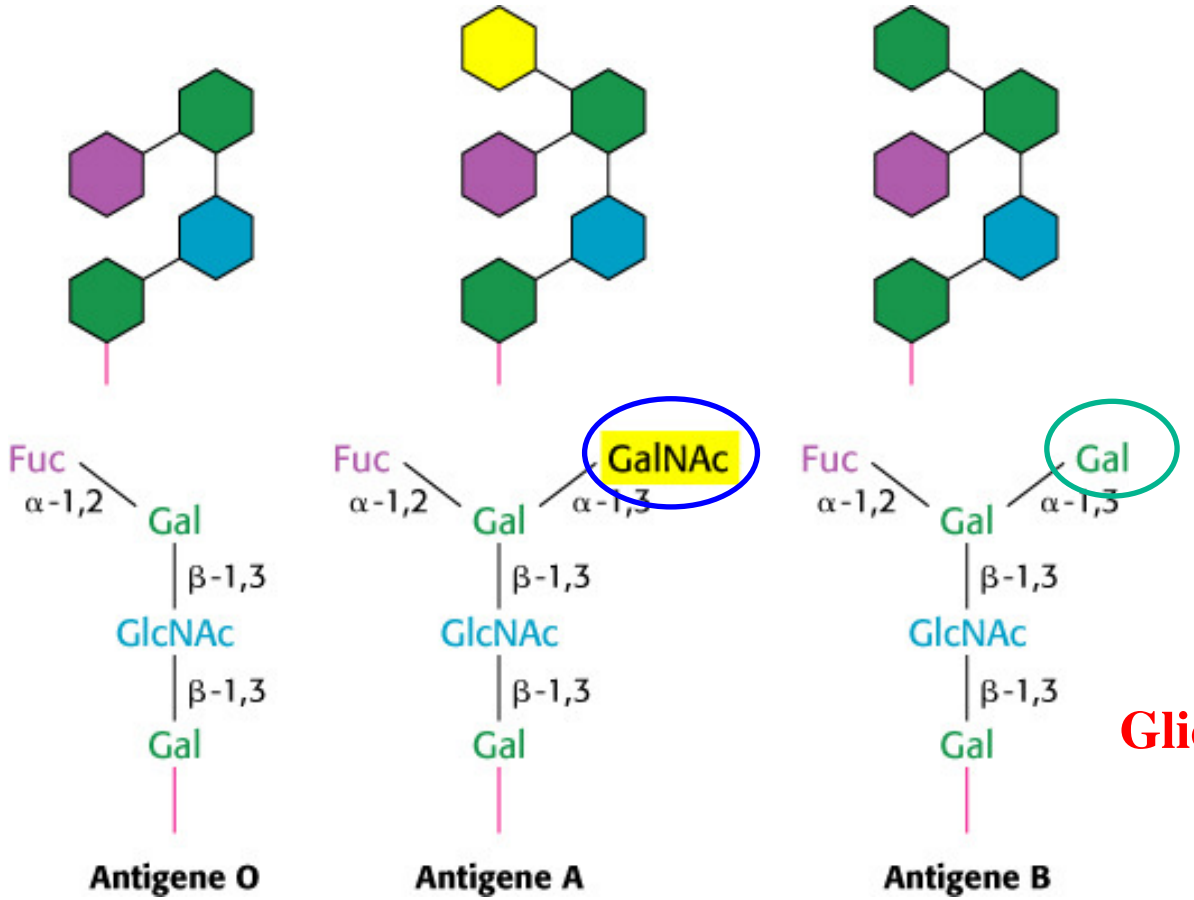
Sono **enzimi specifici** che catalizzano la formazione dei legami glicosidici

Attivazione di uno zucchero con un **nucleotide**


Proteina inserita
nella membrana plasmatica
Granulo
secretore
Golgi
trans
Pre-lisosoma
Golgi cis
Reticolo
endoplasmatico

OLIGOSACCARIDI

presenti sulle membrane dei globuli rossi



Glicosiltransferasi specifiche