

# CARBOIDRATI 1

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sotto forma di zucchero e amido rappresentano una tra le principali fonti di calorie per l'uomo e la maggior parte degli animali e anche per molti microorganismi.

Sono al centro del metabolismo delle piante verdi.

fotosintesi



carboidrati



fonte di energia  
per cellule non fotosintetiche

## FUNZIONI

- 1) fonte di energia
- 2) riserva di glucosio (amido e glicogeno)
- 3) struttura e supporto (pareti cellulari batteri e piante, tessuti connettivi animali)
- 4) lubrificazione articolazioni (acido ialuronico)
- 5) informazione: tra cellule ed ambiente circostante
  - marcano proteine (per trasporto o catabolismo)
  - siti di riconoscimento

# PROPRIETÀ GENERALI

1. Ogni monosaccaride può avere più di un carbonio chirale; la configurazione dei gruppi intorno a ciascun atomo di carbonio determina il modo in cui il composto interagisce con altre biomolecole. Quasi tutti gli zuccheri hanno la configurazione assoluta D
2. Monosaccaridi = i mattoni costitutivi di polisaccaridi. Le proprietà e quindi la funzione del polimero sono determinate dallo specifico monosaccaride, dal modo in cui le subunità si legano tra loro e dalla presenza di ramificazioni.
3. Conservazione di energia sotto forma di polisaccaridi e non di monosaccaridi evita l'aumento di osmolarità
4. Le sequenze di polisaccaridi complessi sono determinate dagli enzimi deputati alla loro biosintesi. Questo aspetto contraddistingue i polisaccaridi da DNA, RNA e proteine, che sono sintetizzati su stampi che dirigono la loro sequenza.
5. I polisaccaridi assumono strutture tridimensionali caratterizzate dalle conformazioni con la minore energia, determinate da legami covalenti, legami idrogeno, interazioni tra cariche elettriche e fattori sterici. Nella maggior parte dei casi NON sono così regolari come nelle proteine e nel DNA.
6. La complementarità molecolare è cruciale per la funzione. Interazione altamente specifica tra lectina (proteina che lega gli zuccheri) e ligando.
7. A partire da un piccolo numero di monosaccaridi può essere costruita una gamma quasi illimitata di strutture diverse.

# CLASSIFICAZIONE

poliidrossi-aldeidi

ALDOSI

poliidrossi-chetoni

CHETOSI

**monosaccaridi**: zuccheri semplici, consistono di una singola unità di poliidrossi aldeide o poliidrossi chetone  
es: glucosio, mannosio, galattosio, fruttosio

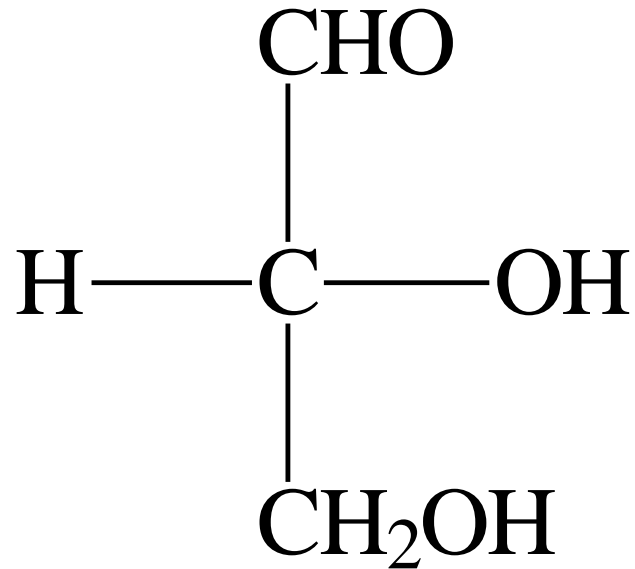
**oligosaccaridi**: corte catene di monosaccaridi legati da legami covalenti.

Es di disaccaridi: saccarosio, maltosio, lattosio

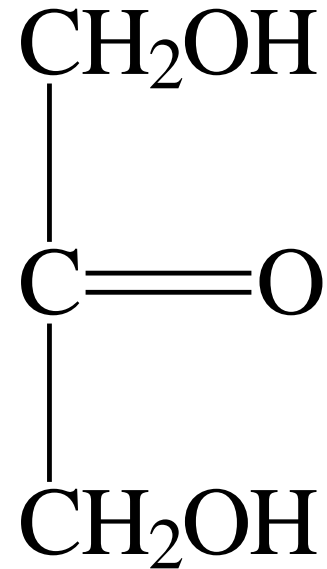
**polisaccaridi**: lunghe catene di unità monosaccaridiche (>20)  
es: cellulosa, glicogeno, amido

# **MONOSACCARIDI**

# TRIOSI



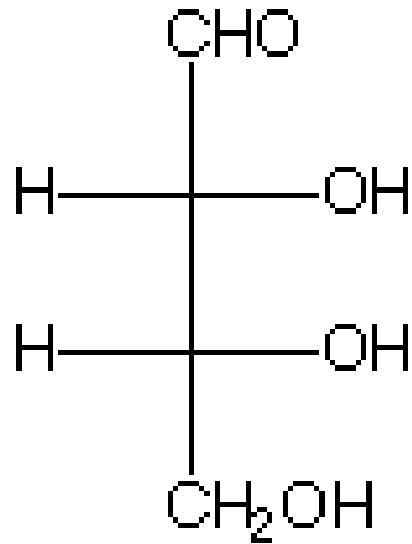
**D-gliceraldeide**



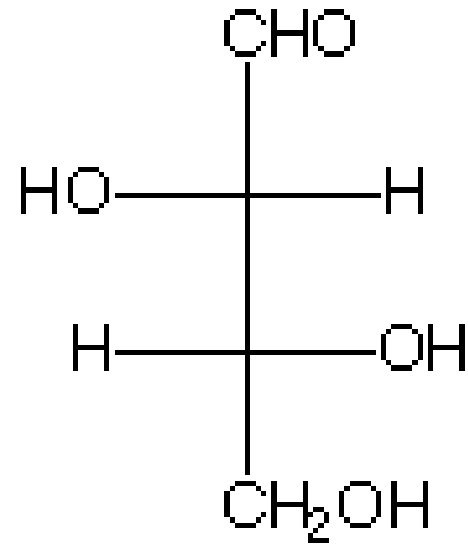
**Di-idrossi acetone**

# SERIE DEI D ALDOSI

## TETROSI



D-Erythrose

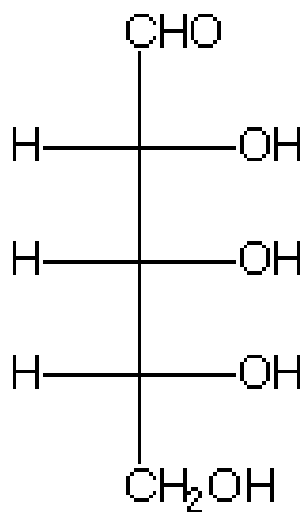


D-Threose

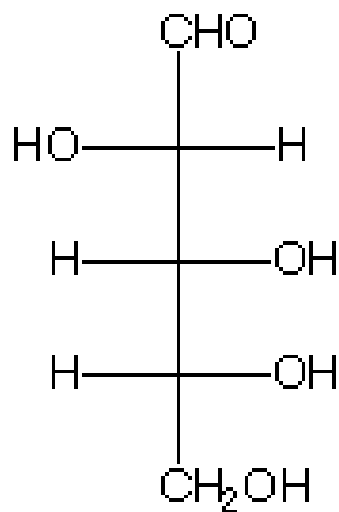


# SERIE DEI D ALDOSI

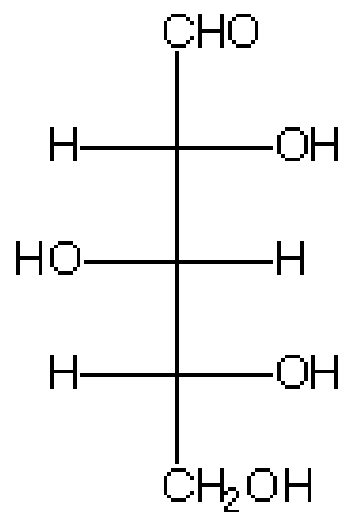
## PENTOSI



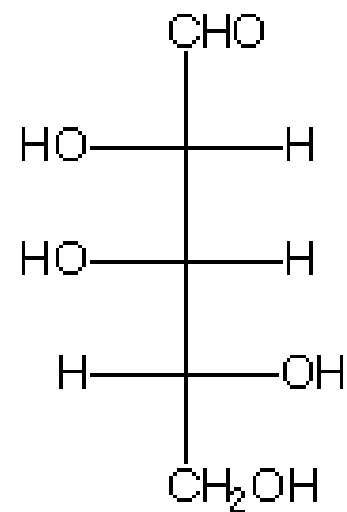
D-Fructose



D-Arabinose



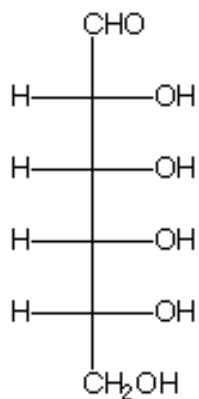
D-Xylose



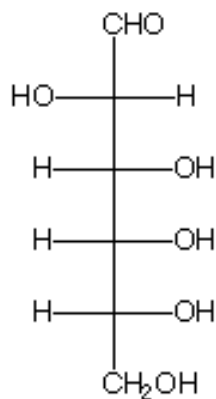
D-Lyxose

# SERIE DEI D ALDOSI

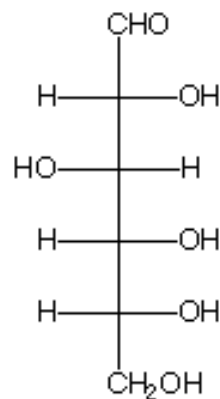
## ESOSI



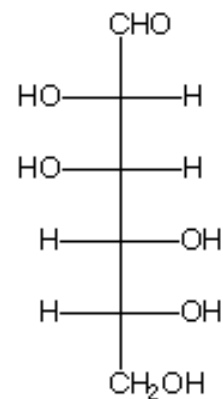
D-Allose



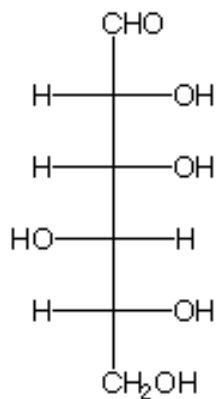
D-Altrose



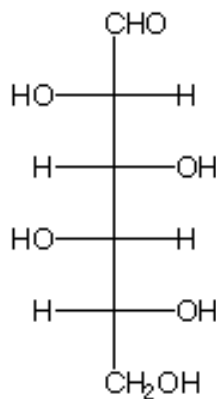
D-Glucose



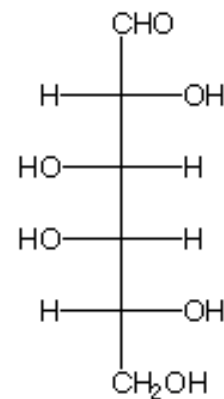
D-Mannose



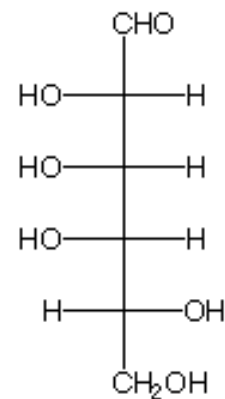
D-Gulose



D-Idose

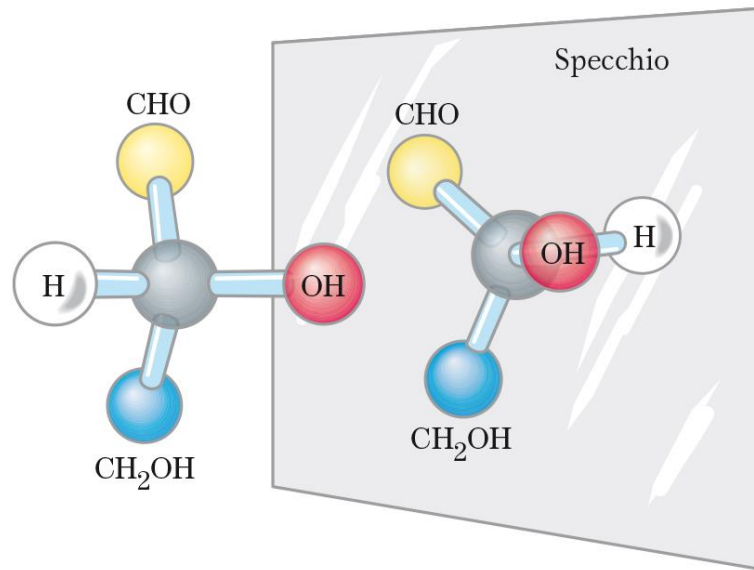


D-Galactose

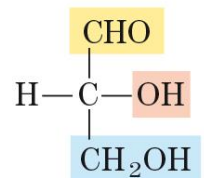


D-Talose

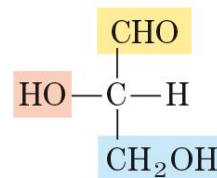
I monosaccaridi hanno centri asimmetrici.



### Modelli a palle e bastoncini

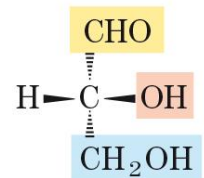


D-Gliceraldeide

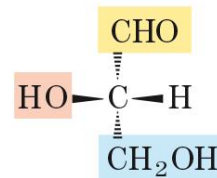


L-Gliceraldeide

### Formule proiettive di Fischer



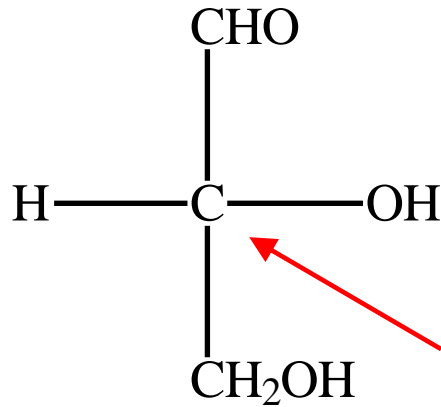
D-Gliceraldeide



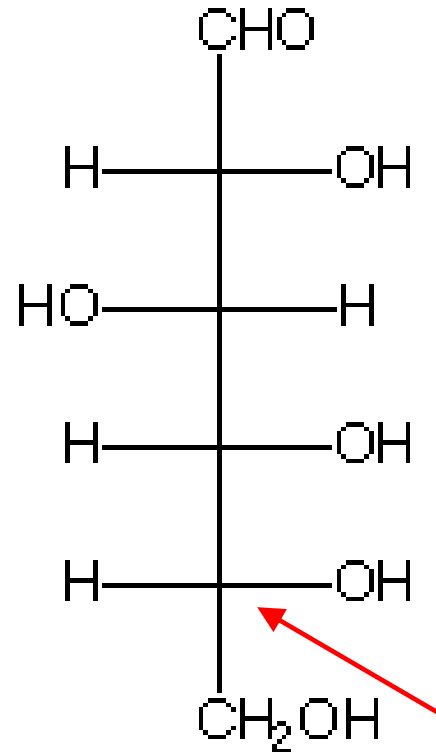
L-Gliceraldeide

### Formule prospettiche

# CENTRI CHIRALI

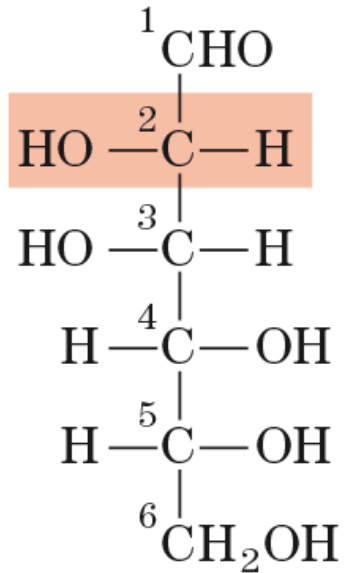


D-gliceraldeide

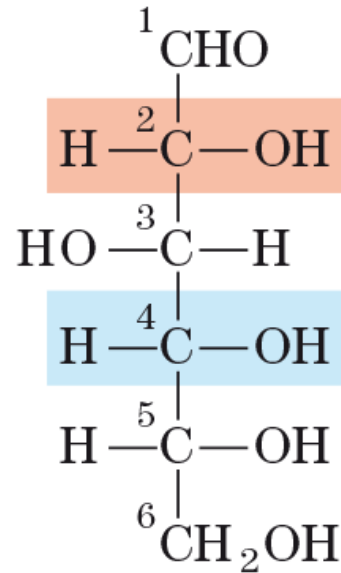


D-Glucosio

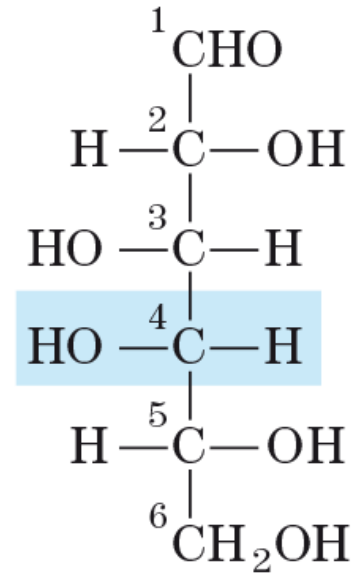
# EPIMERI



D-Mannosio  
(epimero in C-2)

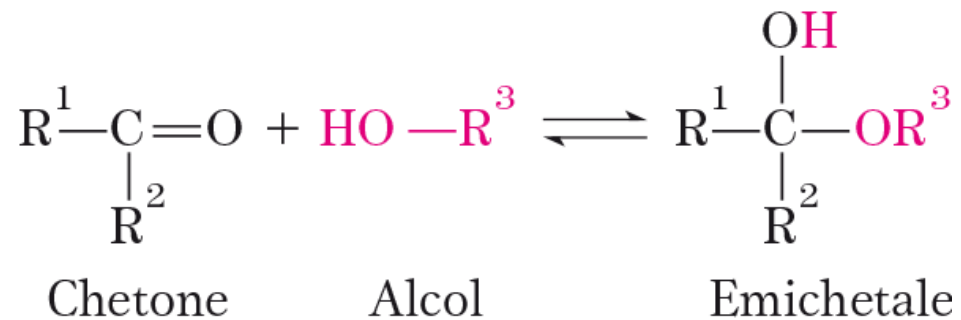
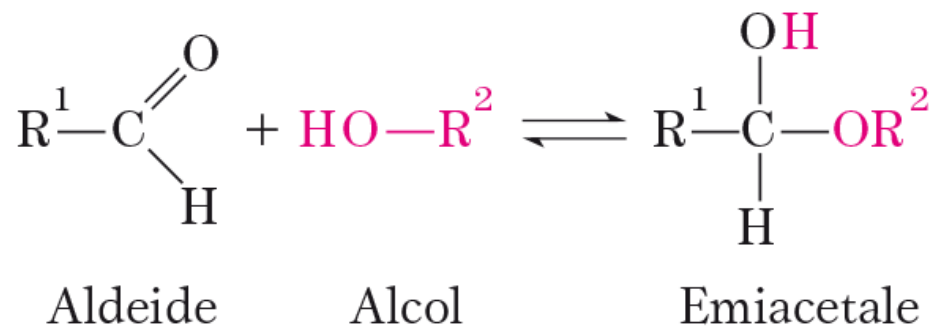


D-Glucosio

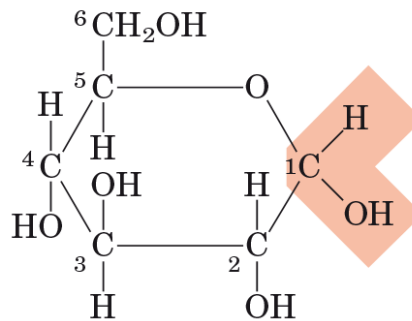
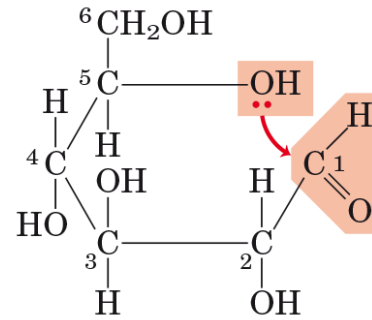
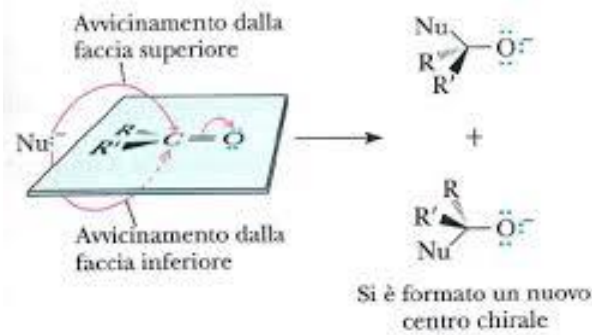
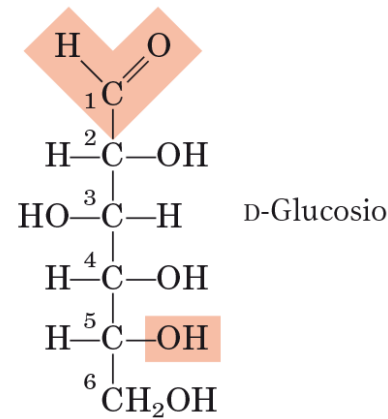


D-Galattosio  
(epimero in C-4)

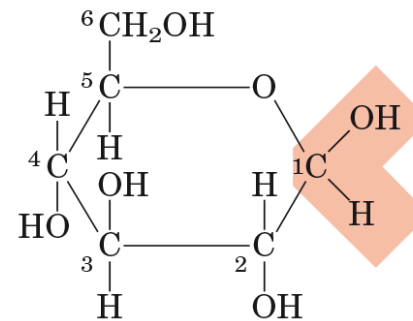
# EMIACETALE E EMICHETALE



I monosaccaridi  
 assumono forme cicliche  
 mediante formazione di  
 emiacetali (o emichetali)

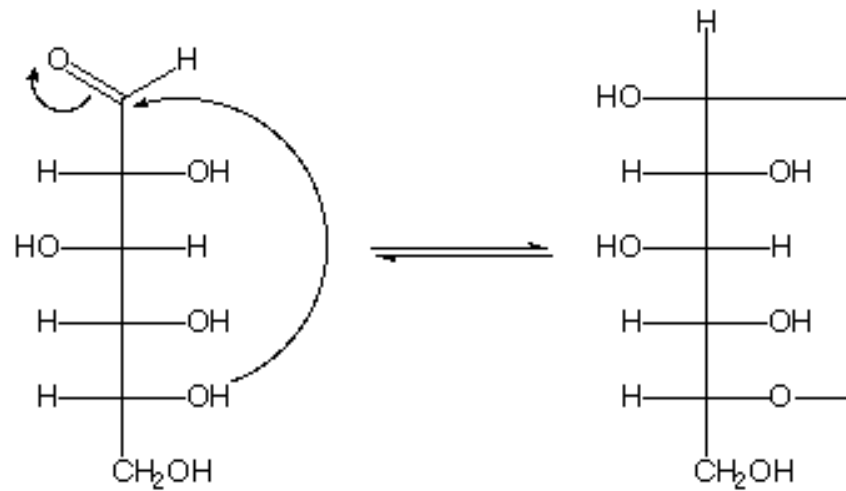


$\alpha$ -D-Glucopiranosio

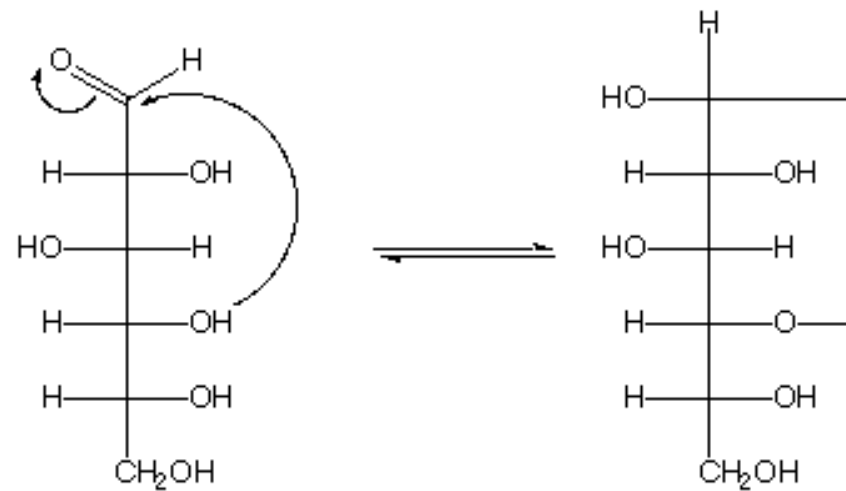


$\beta$ -D-Glucopiranosio

**ANOMERI  $\alpha$  e  $\beta$**

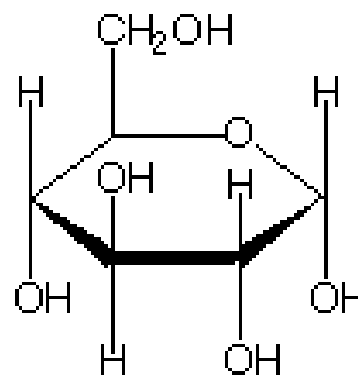
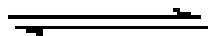
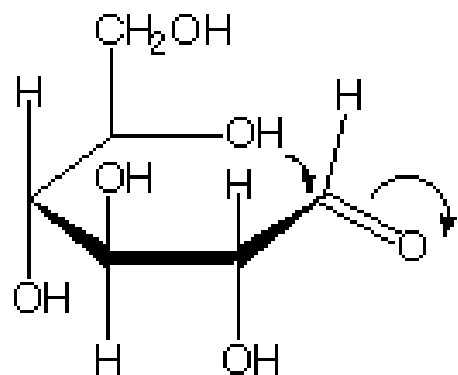


**Ciclo a 6  
termini**

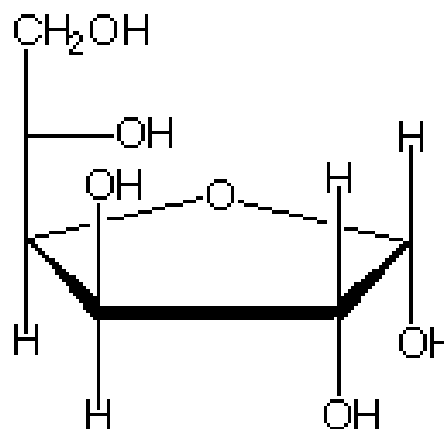
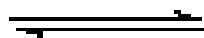
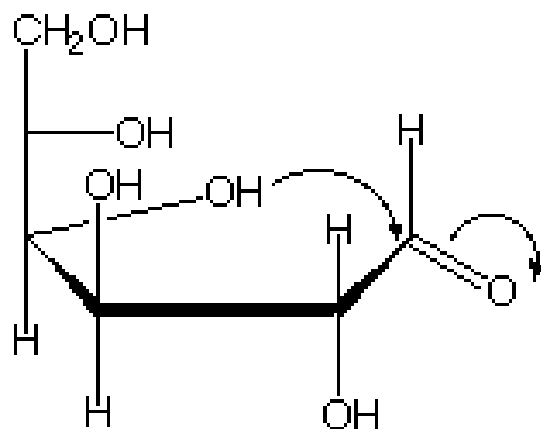


**Ciclo a 5  
termini**



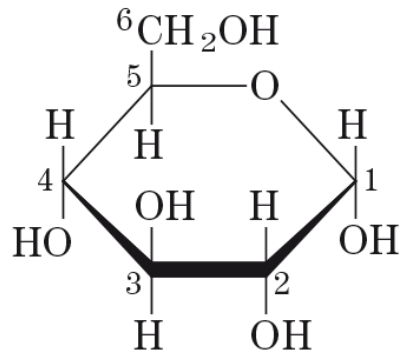


**Proiezione  
di Haworth**

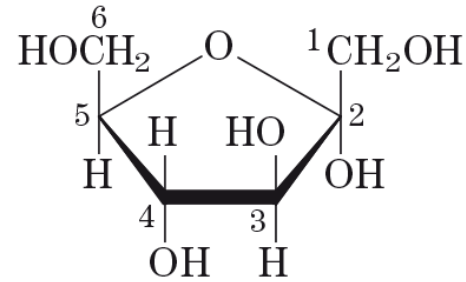


**Proiezione  
di Haworth**

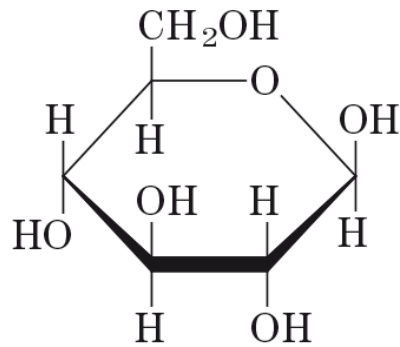
# Forme prospettiche di Haworth



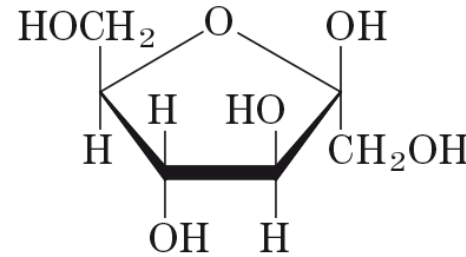
$\alpha$ -D-Glucopiranosio



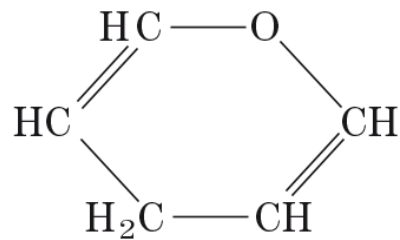
$\alpha$ -D-Fruktofuranosio



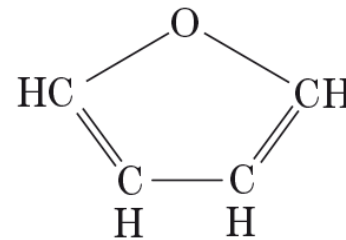
$\beta$ -D-Glucopiranosio



$\beta$ -D-Fruktofuranosio

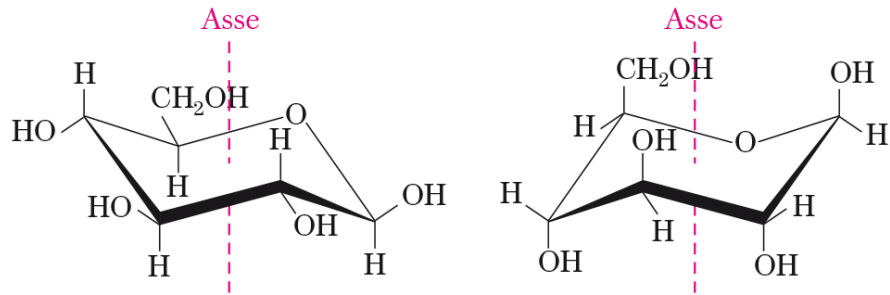


Pirano

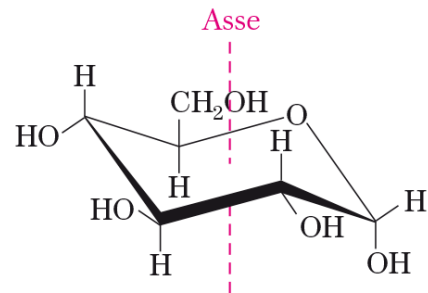


Furano

# FORMULE CONFORMAZIONALI

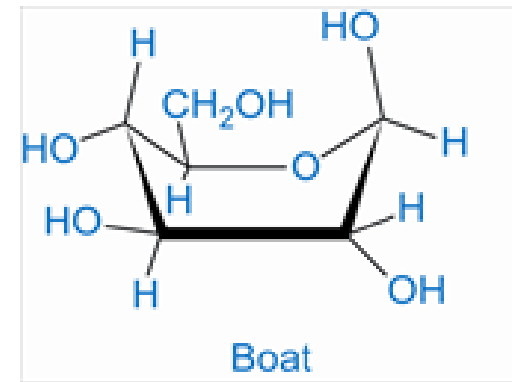


(a)



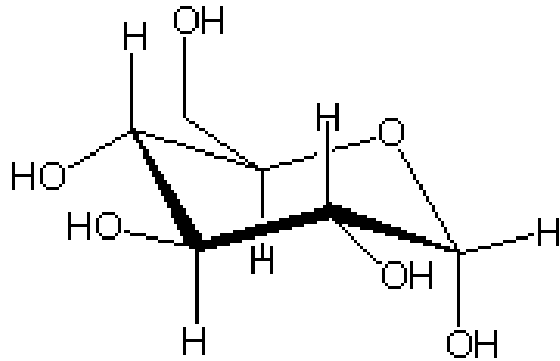
(b)

sedia

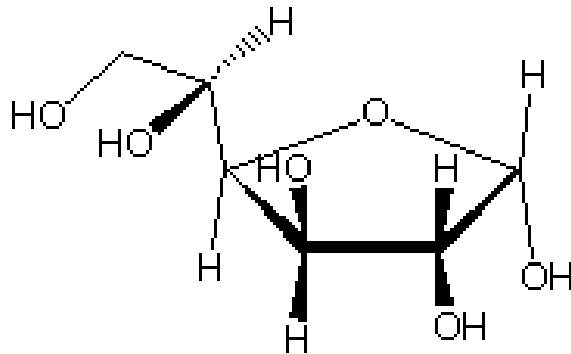


barca

# FORMULE CONFORMAZIONALI



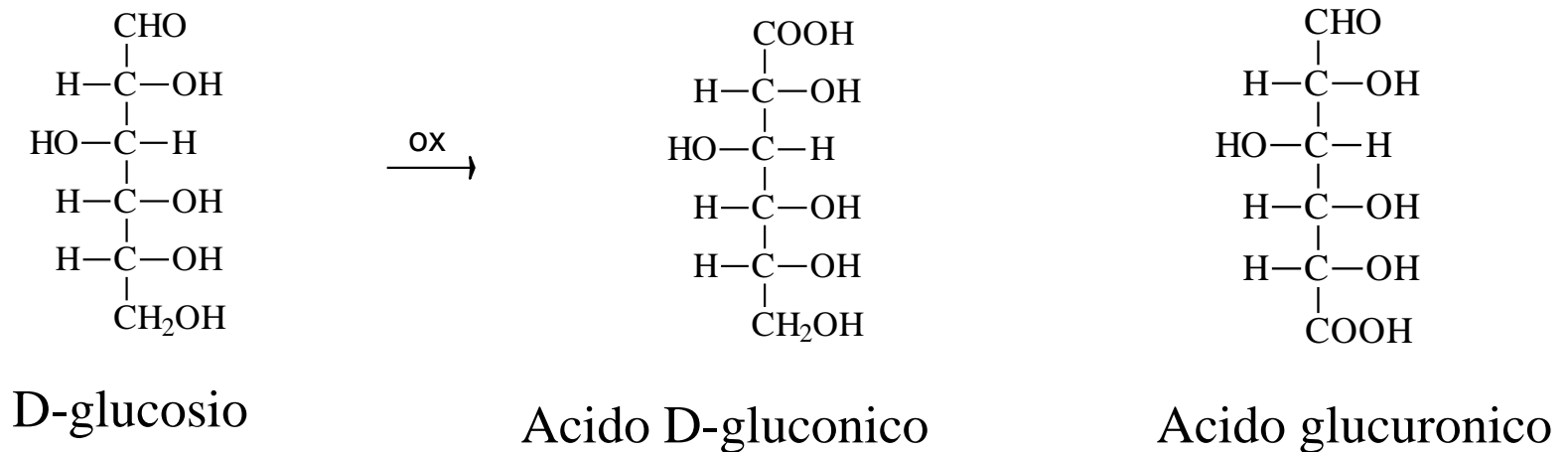
**$\alpha$ -D-glucopiranosio**



**$\alpha$ -D-glucofuranosio**

# OSSIDAZIONE DEL GLUCOSIO

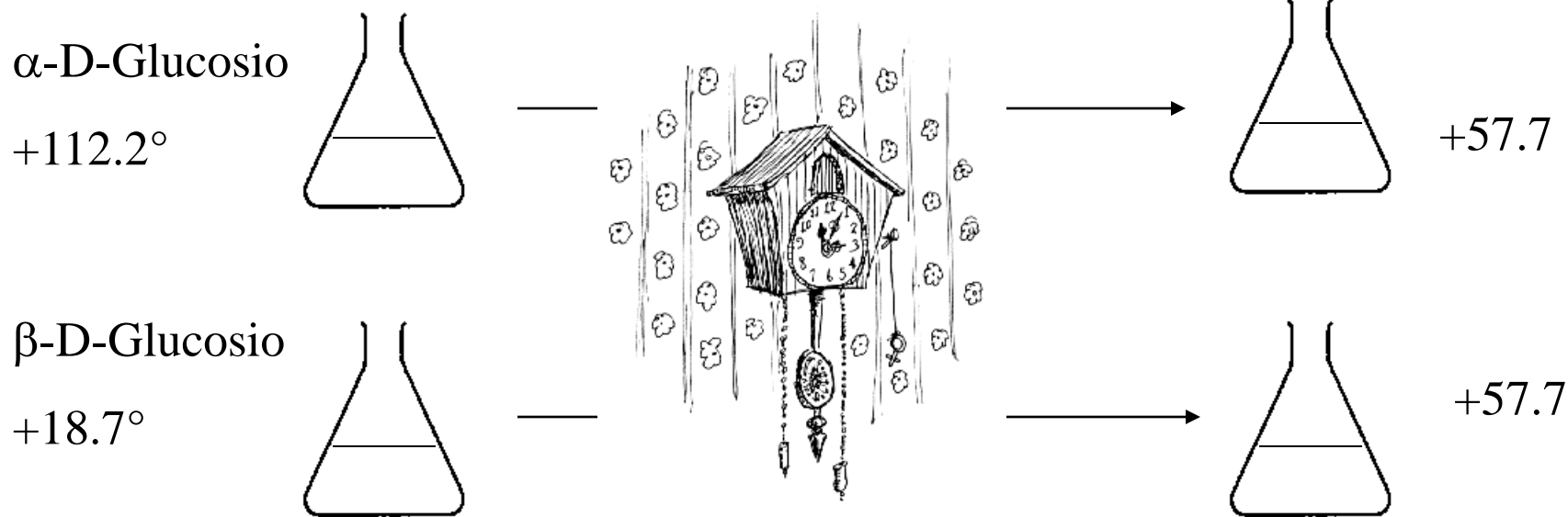
I monosaccaridi riducono facilmente agenti ossidanti. Lo zucchero viene ossidato a livello del carbonile, mentre l'agente ossidante si riduce. Per questo vengono chiamati zuccheri riducenti. Questa proprietà è importante per l'analisi degli zuccheri. Misurando la quantità di agente ossidante che viene ridotto da una soluzione di zucchero, si determina anche la concentrazione dello zucchero.



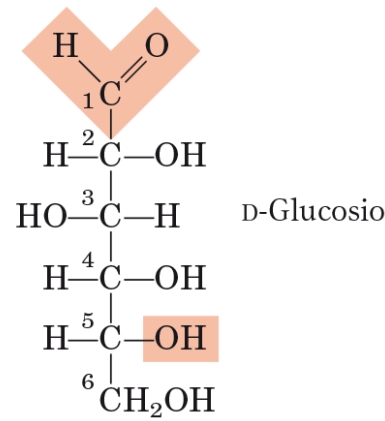
# MUTAROTAZIONE

$\alpha$ -D-Glucosio ha un valore di potere rotatorio specifico,  $[\alpha]_D^{20}$ , di  $+112.2^\circ$ .

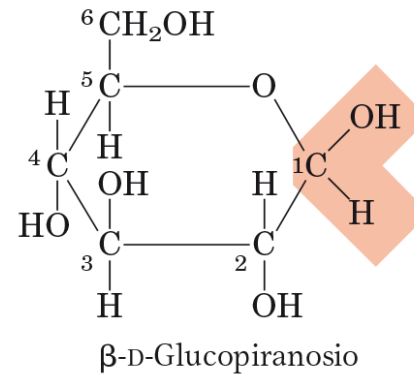
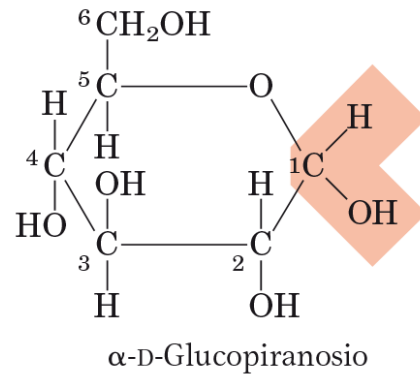
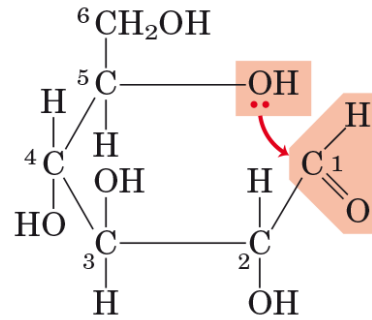
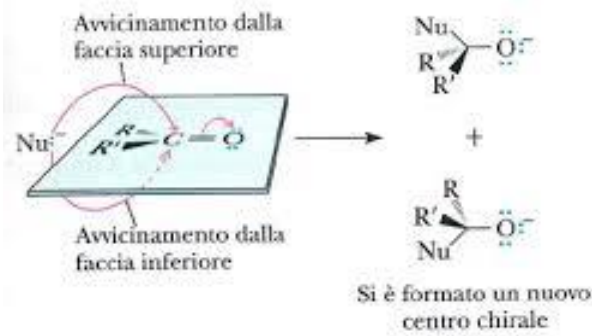
$\beta$ -D-Glucosio ha un valore di potere rotatorio specifico,  $[\alpha]_D^{20}$ , di  $+18.7^\circ$ .



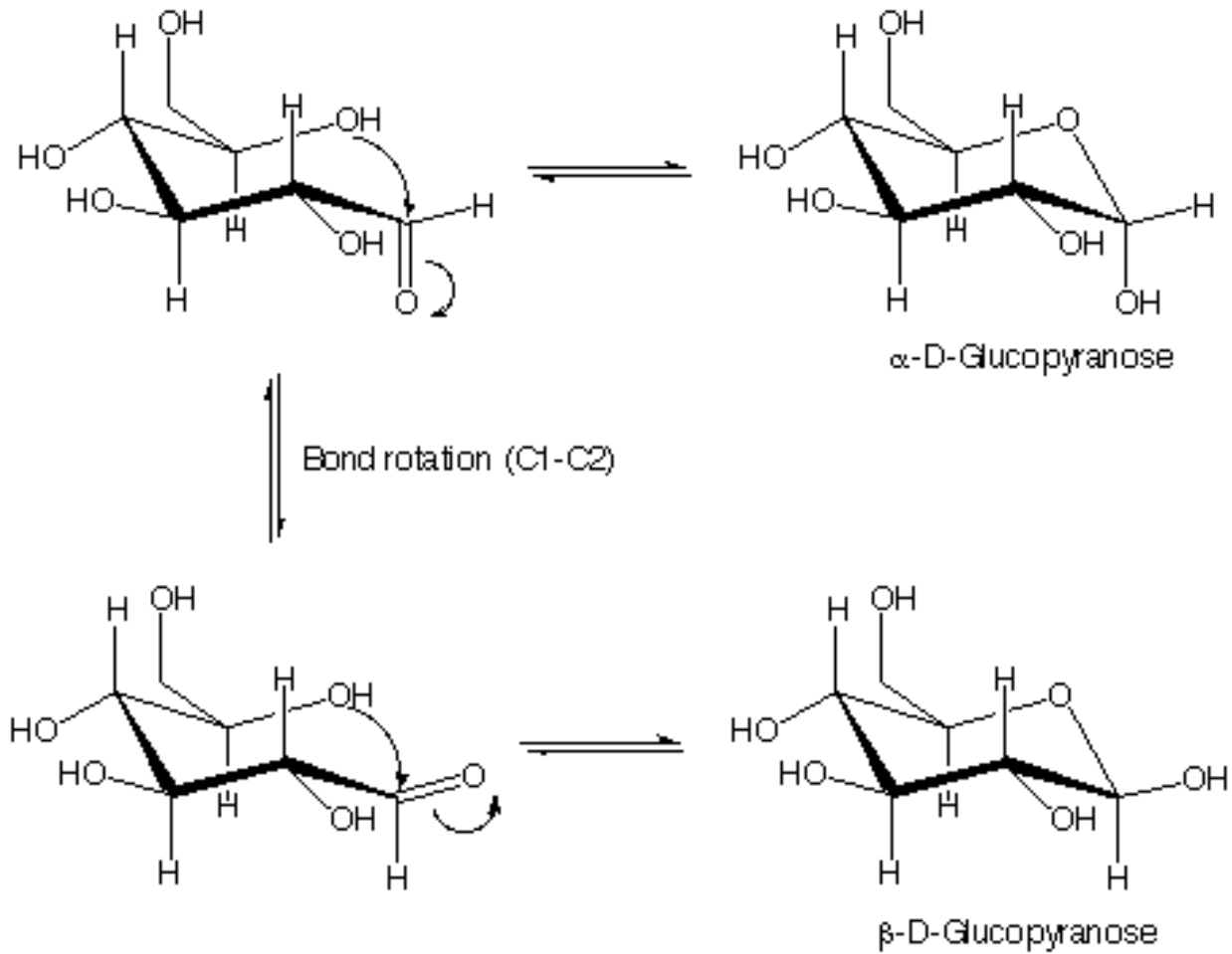
# MUTAROTAZIONE



C1 = carbonio anomero  
anomerico

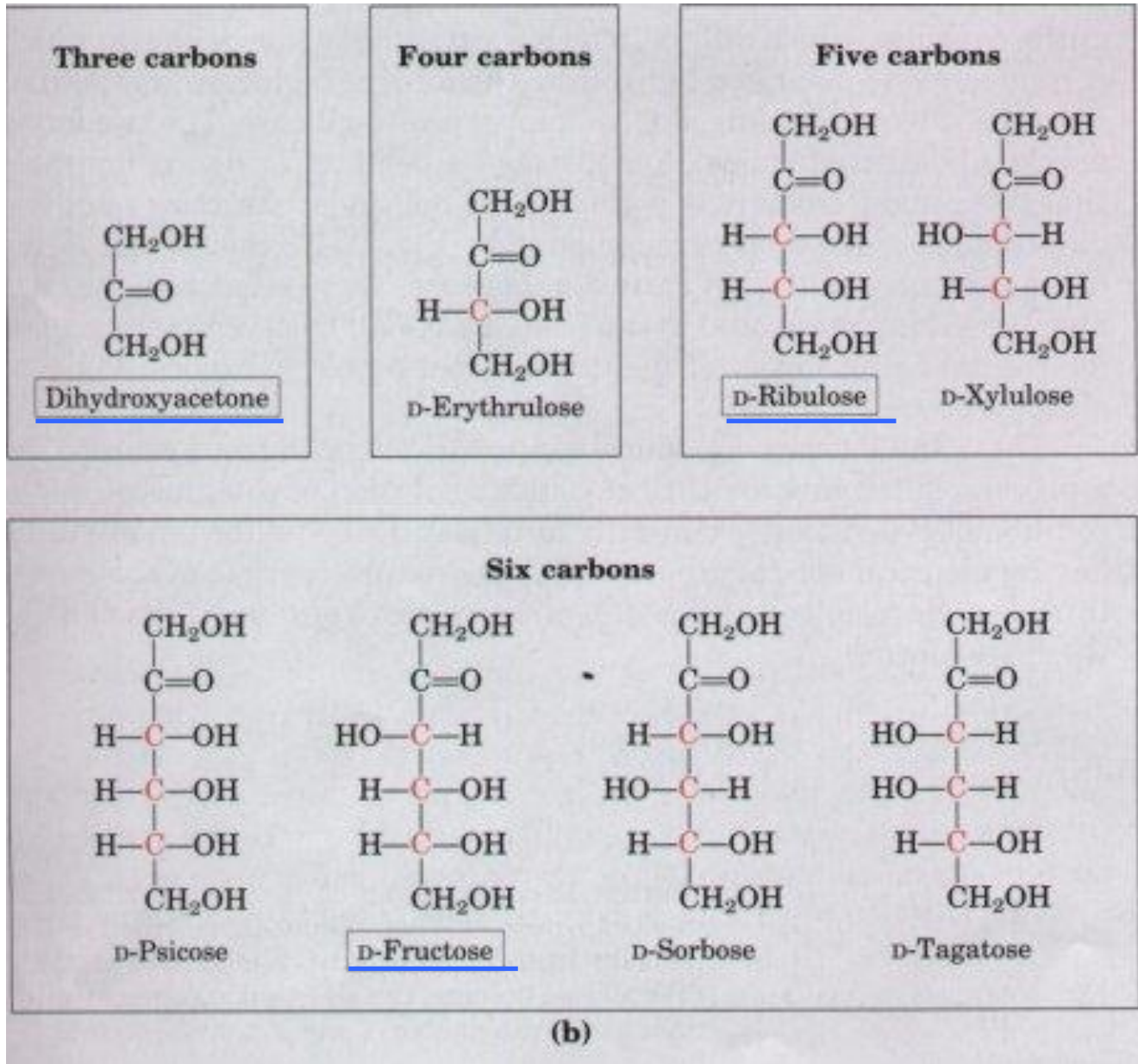


# ANOMERI $\alpha$ e $\beta$

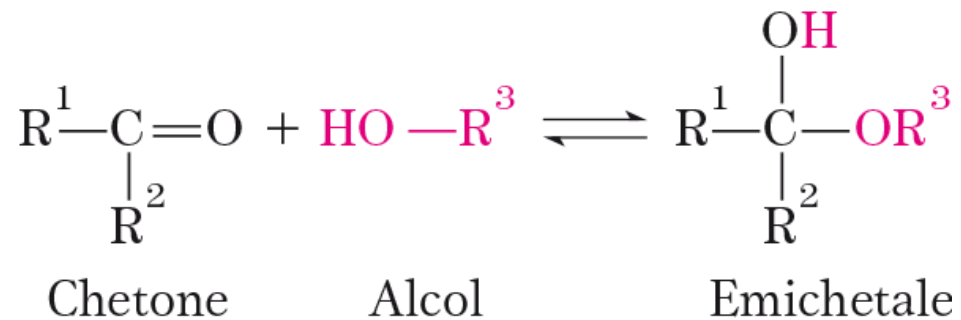
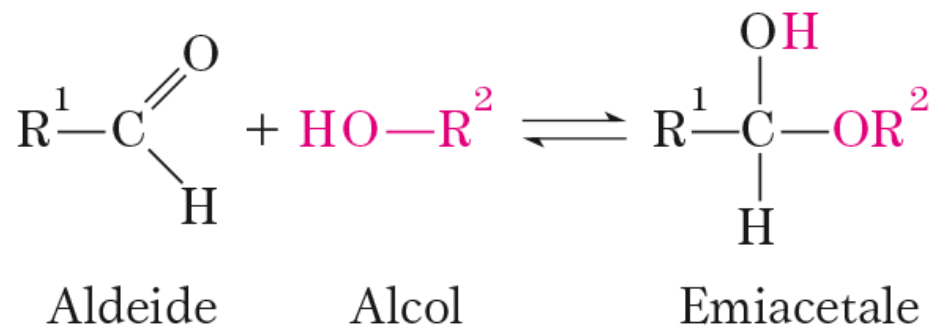




# SERIE DEI D CHETOSI



# EMIACETALE E EMICHETALE



# D FRUTTOSIO

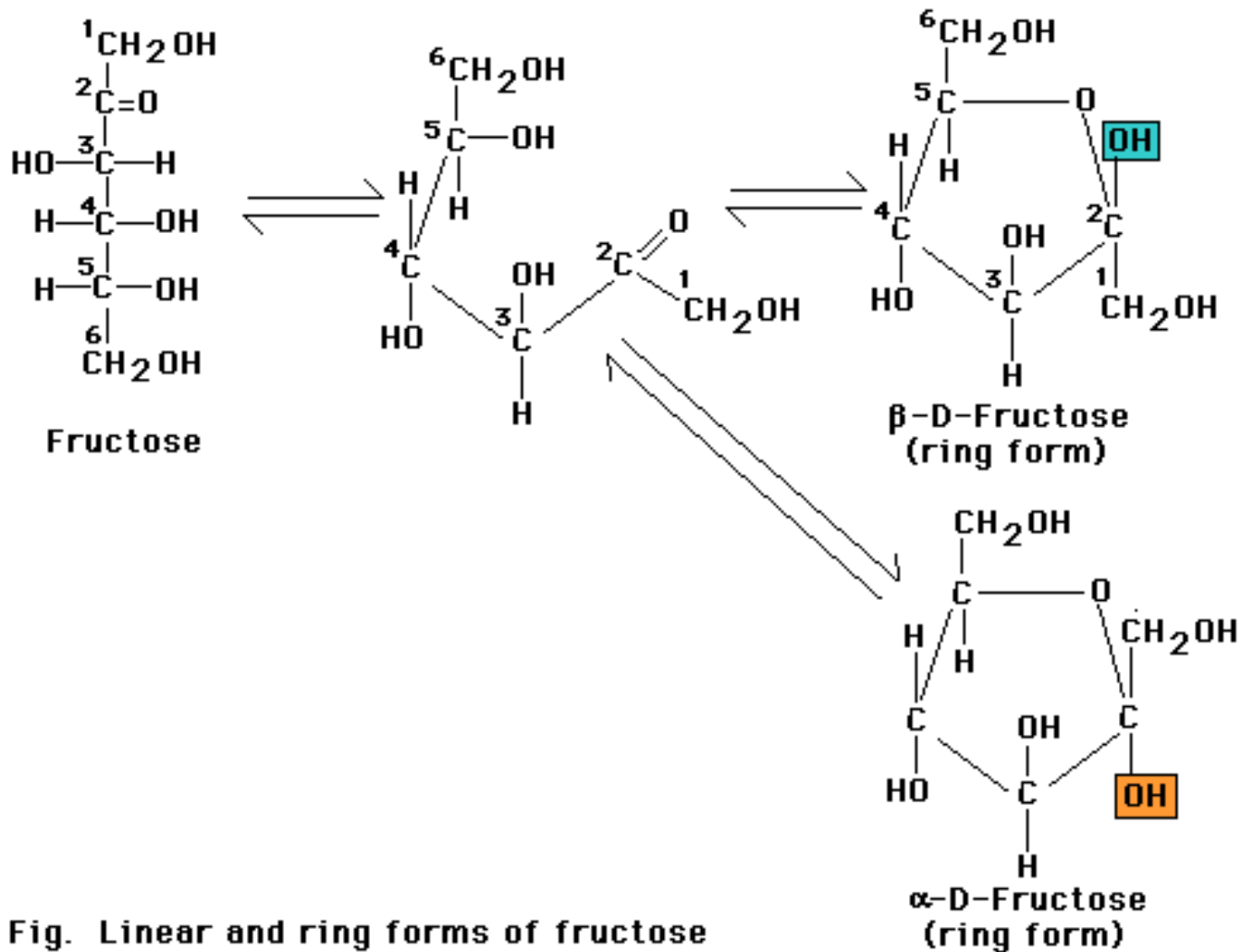
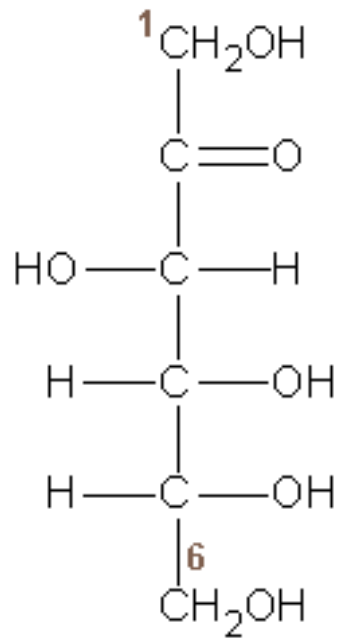
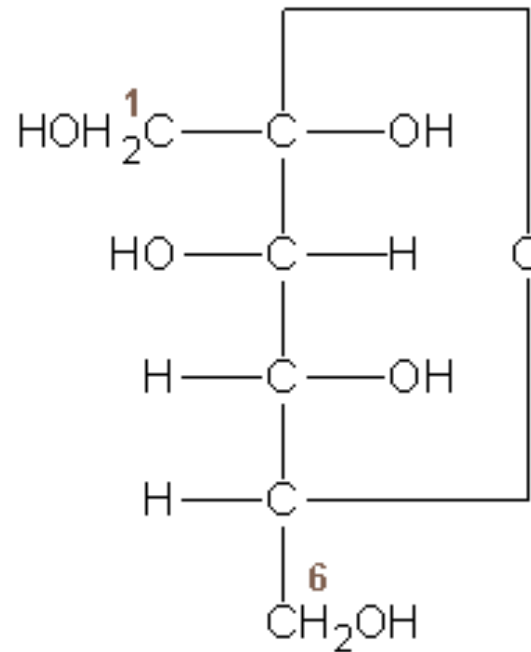
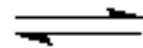


Fig. Linear and ring forms of fructose

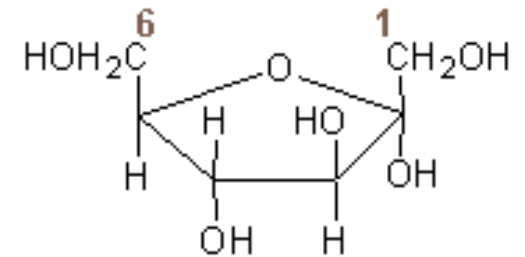
# D FRUTTOSIO



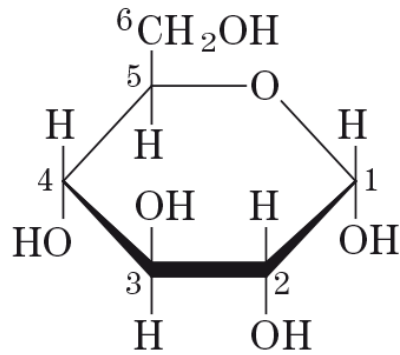
**D-(-)-Fructose  
(Ketoseform)**



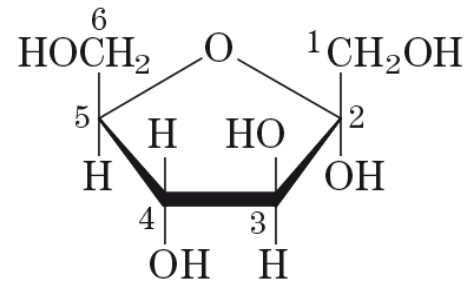
**$\alpha$ -D-(-)-Fructose  
(Furanoseform)**



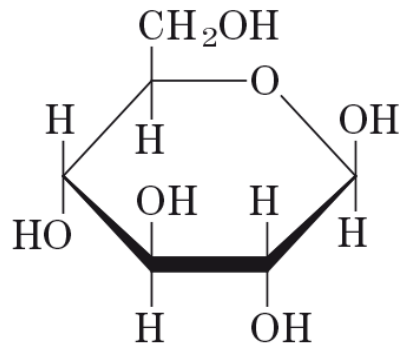
Forme  
prospettiche  
di Haworth



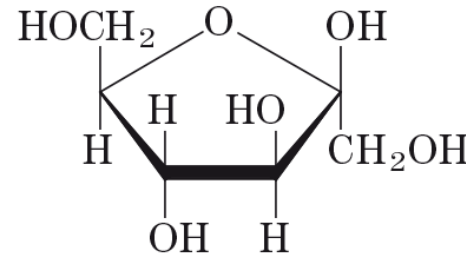
$\alpha$ -D-Glucopiranosio



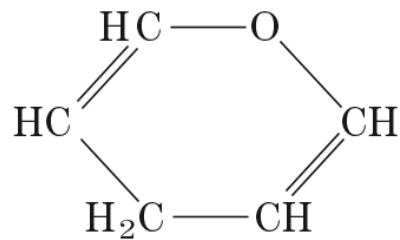
$\alpha$ -D-Fruktofuranosio



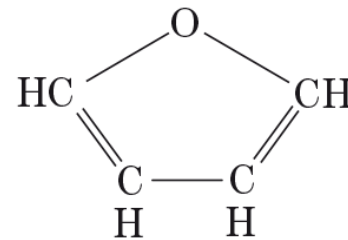
$\beta$ -D-Glucopiranosio



$\beta$ -D-Fruktofuranosio

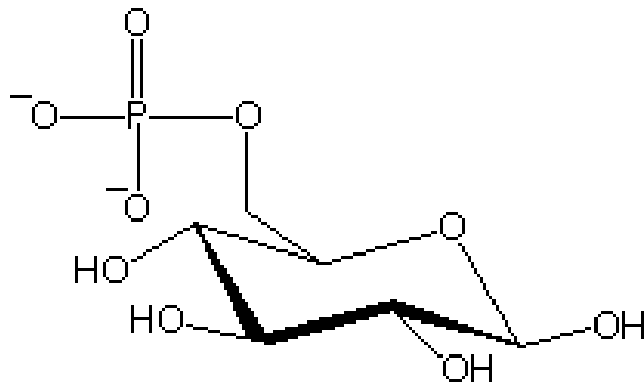


Pirano

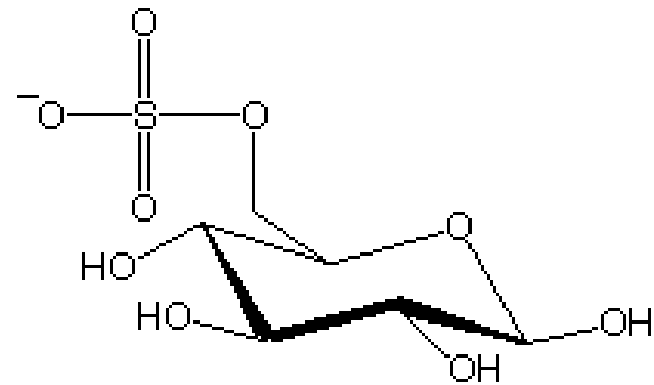


Furano

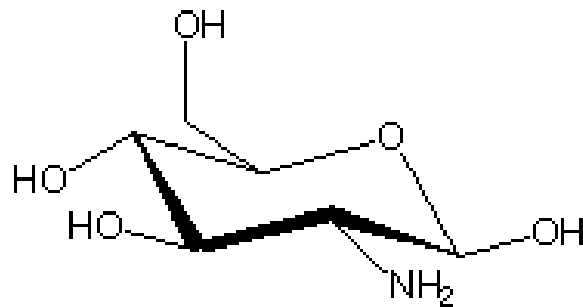
## DERIVATI DEL GLUCOSIO



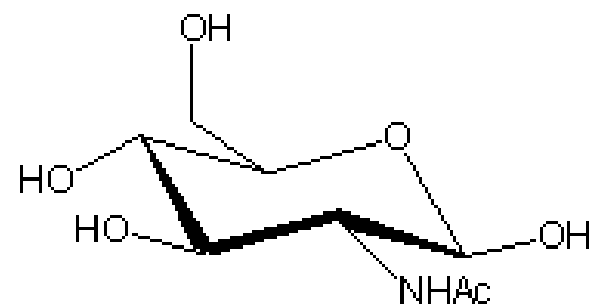
$\beta$ -D-glucopyranose-6-phosphate



$\beta$ -D-glucopyranose-6-sulfate

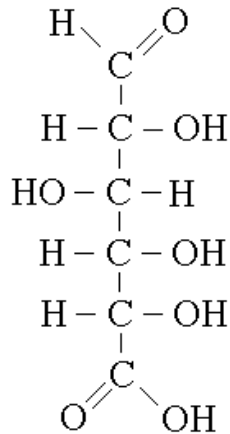


$\beta$ -D-glucopyranose-2-amine  
(glucosamine)

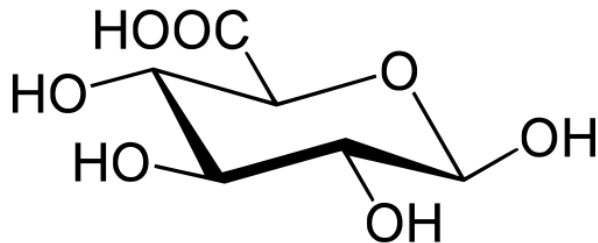


N-Acetyl- $\beta$ -D-glucopyranose-2-amine  
(N-acetylglucosamine)

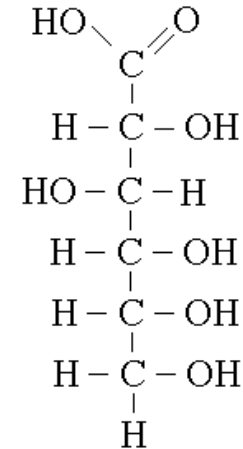
## DERIVATI DEL GLUCOSIO



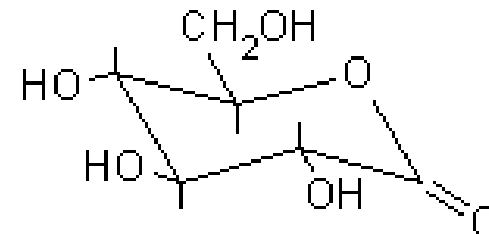
**Acido D-Glucuronico**



**Acido  $\beta$ -D-Glucuronico**



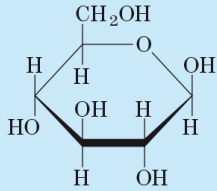
**Acido D-Gluconico**



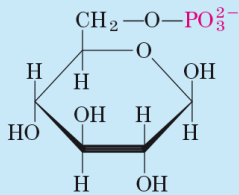
**D-Glucono lattone**

# DERIVATI DEGLI ESOSI

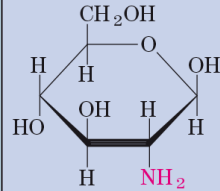
## Famiglia del glucosio



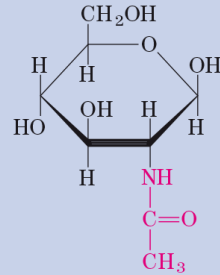
$\beta$ -D-Glucosio



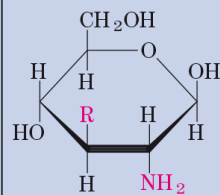
$\beta$ -D-Glucosio 6-fosfato



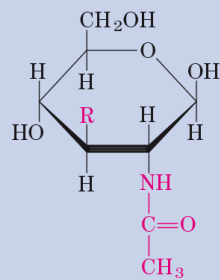
$\beta$ -D-Glucosammina



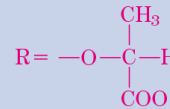
*N*-Acetil- $\beta$ -D-glucosammina



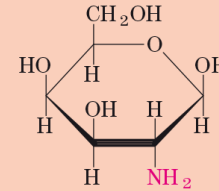
Acido muramico



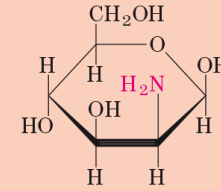
Acido *N*-acetilmuramico



## Amminozuccheri

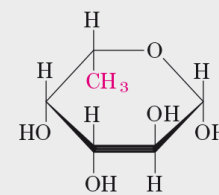


$\beta$ -D-Galattosammina

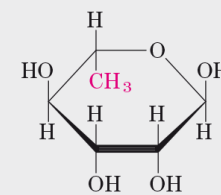


$\beta$ -D-Mannosammina

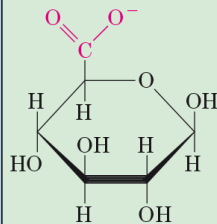
## Deossizuccheri



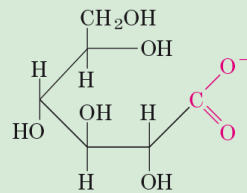
$\beta$ -L-Fucosio



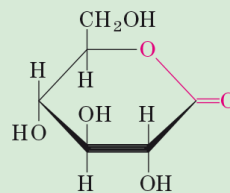
$\alpha$ -L-Ramnosio



$\beta$ -D-Glucuronato

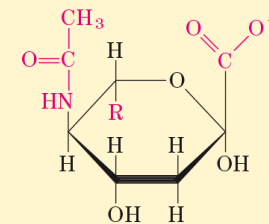


D-Gluconato



D-Glucono- $\delta$ -lattone

## Zuccheri acidi



Acido *N*-acetilneuramminico  
(acido sialico)

