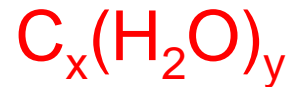
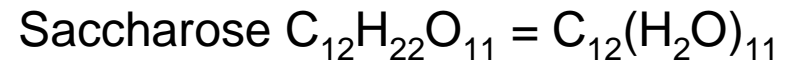
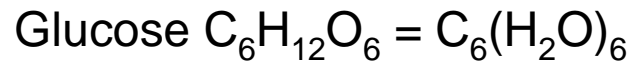


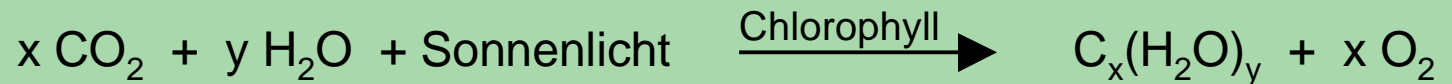
# Kohlenhydrate



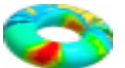
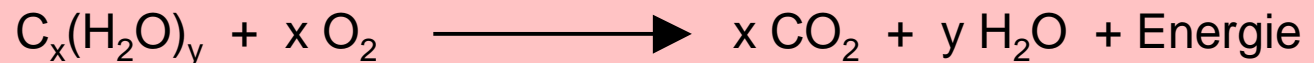
Kohle + Hydrat



Photosynthese:

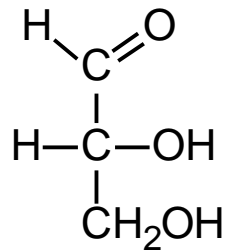


biochemische Verbrennung:

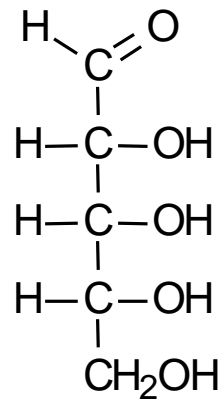


# wichtige Zucker

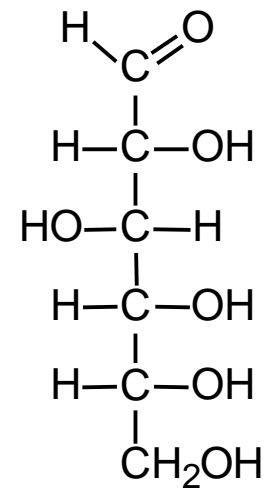
D-Glycerinaldehyd



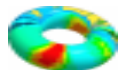
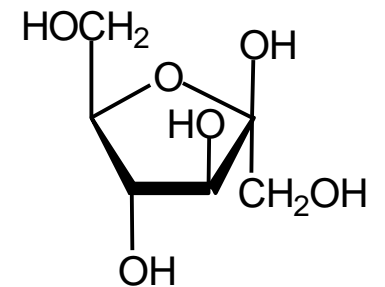
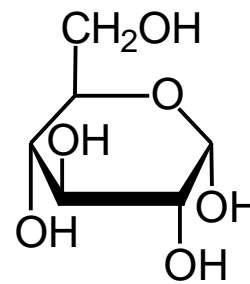
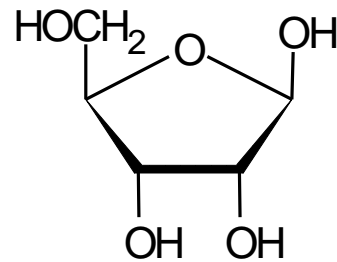
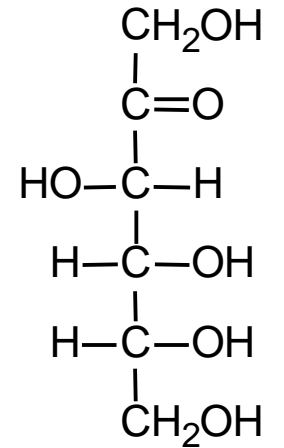
D-Ribose



D-Glucose

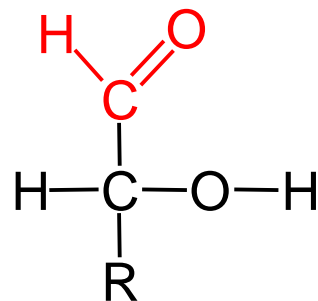


D-Fructose

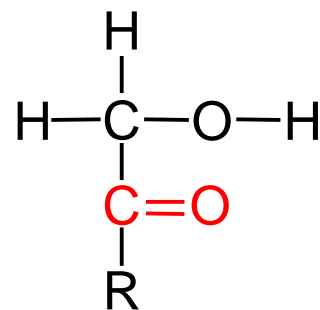


# Konstitution von Kohlenhydraten

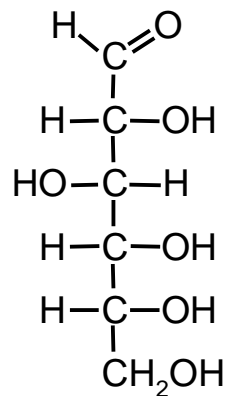
## Aldosen



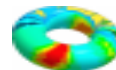
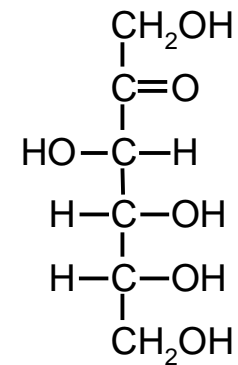
## Ketosen



z.B. Glucose

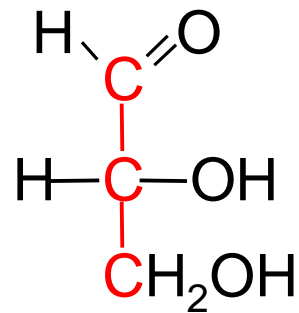


z.B. Fructose

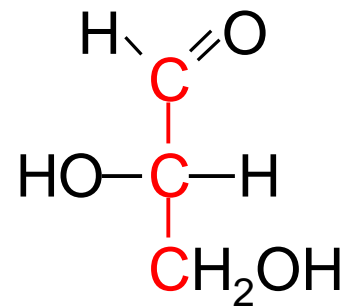


# Triosen

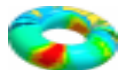
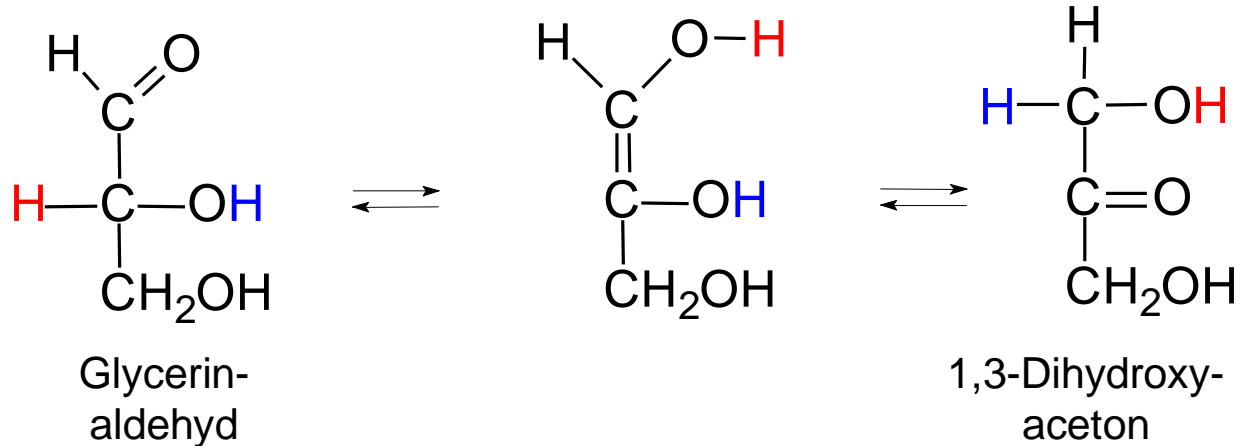
Triosen haben 3 C-Atome, wovon (bei den Aldotriosen) eines chiral ist.



D-Glycerinaldehyd

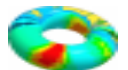
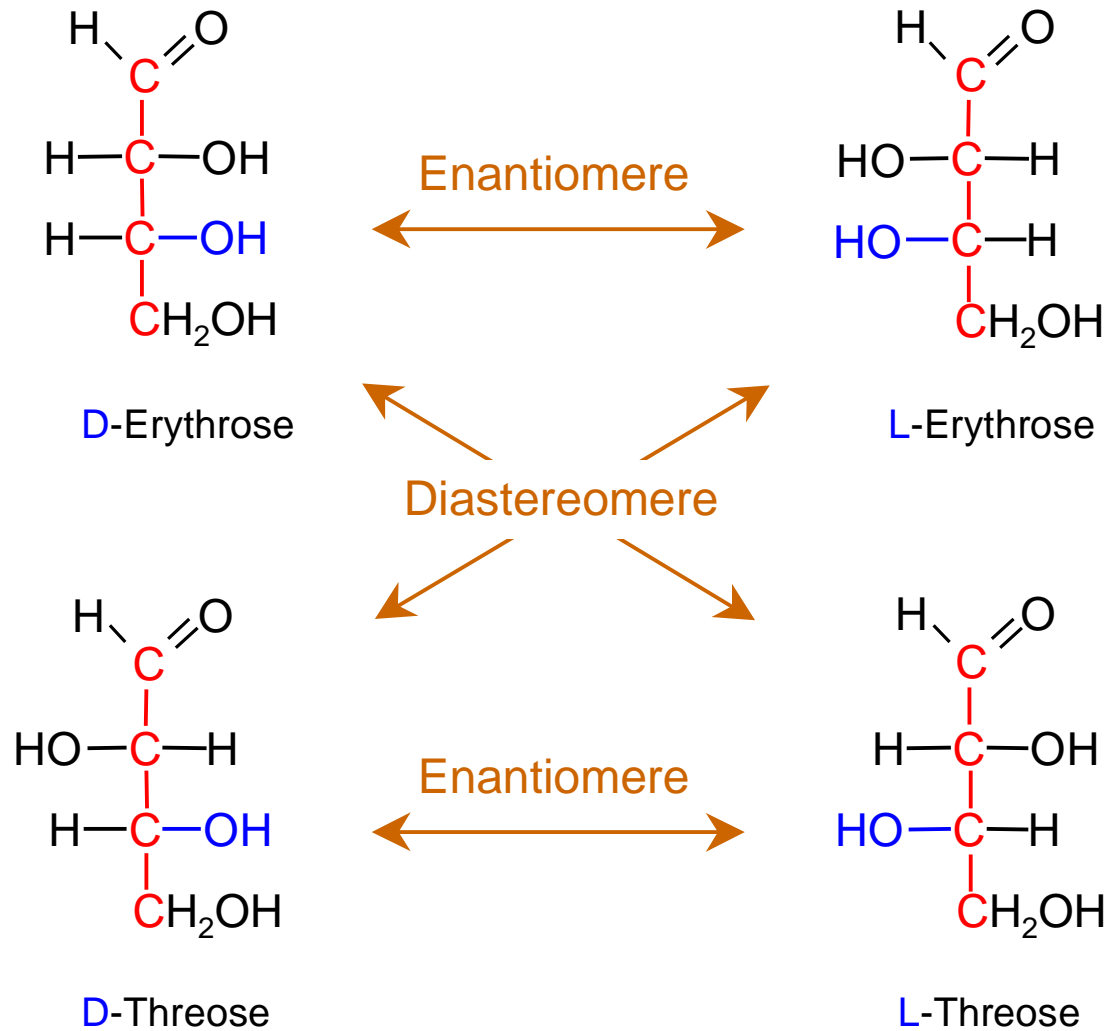


L-Glycerinaldehyd

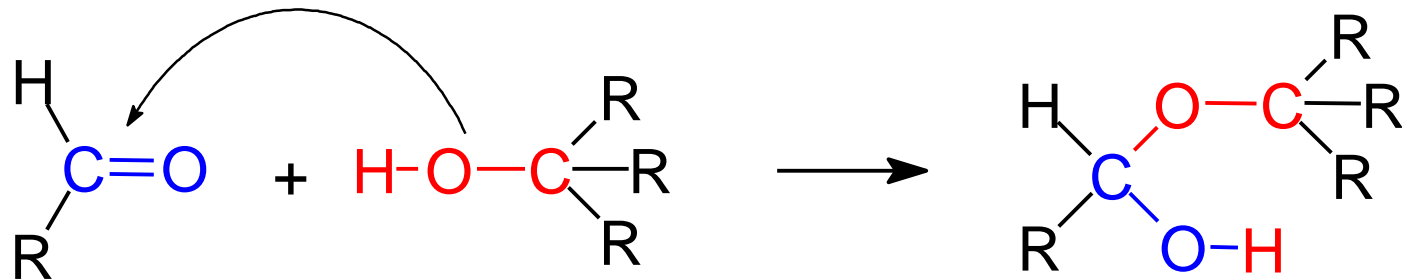


# Tetrosen

Tetrosen haben 4 C-Atome, wovon zwei chiral sind.



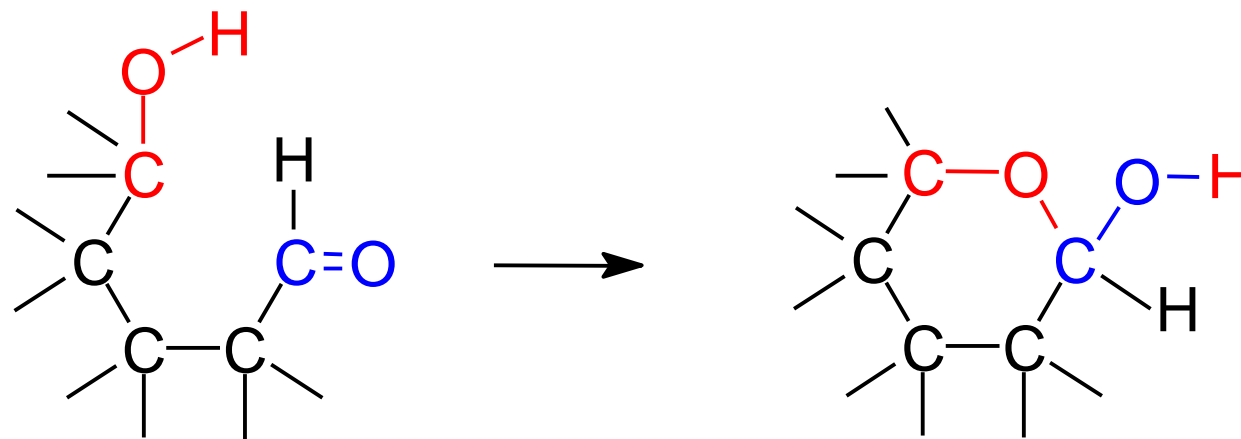
# Halbacetalformen von Zuckern



Aldehyd

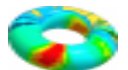
Alkohol

Halbacetal



Aldehyd und Alkoholfunktion  
in einem Molekül

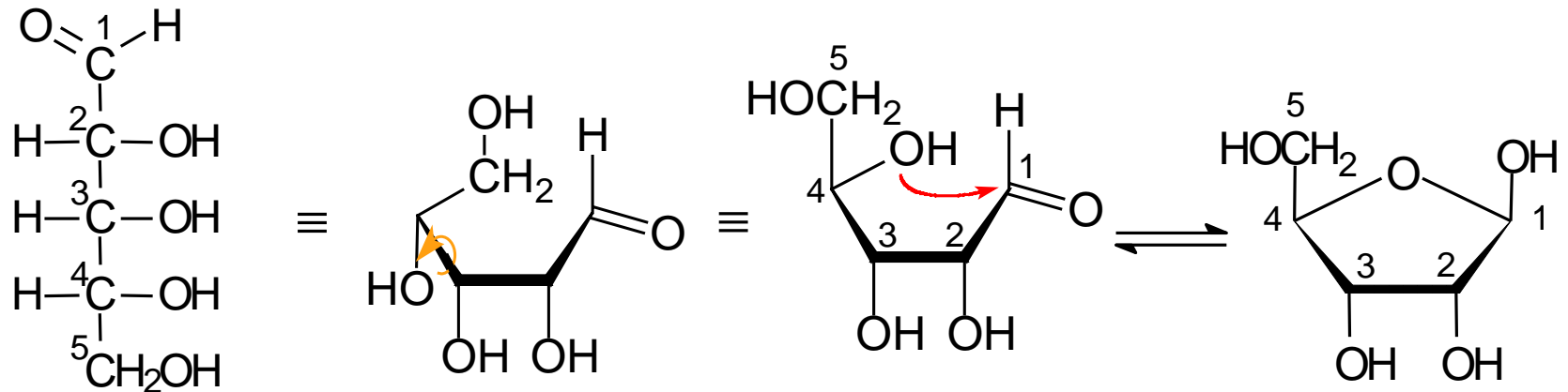
cyclisches Halbacetal



# Pentosen

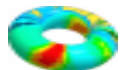
Pentosen haben 5 C-Atome, wovon drei chiral sind.

$\Rightarrow 2^3 = 8$  Isomere



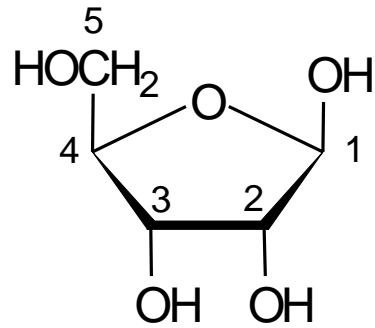
D-Ribose

$\beta$ -D-Ribofuranose

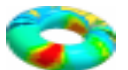
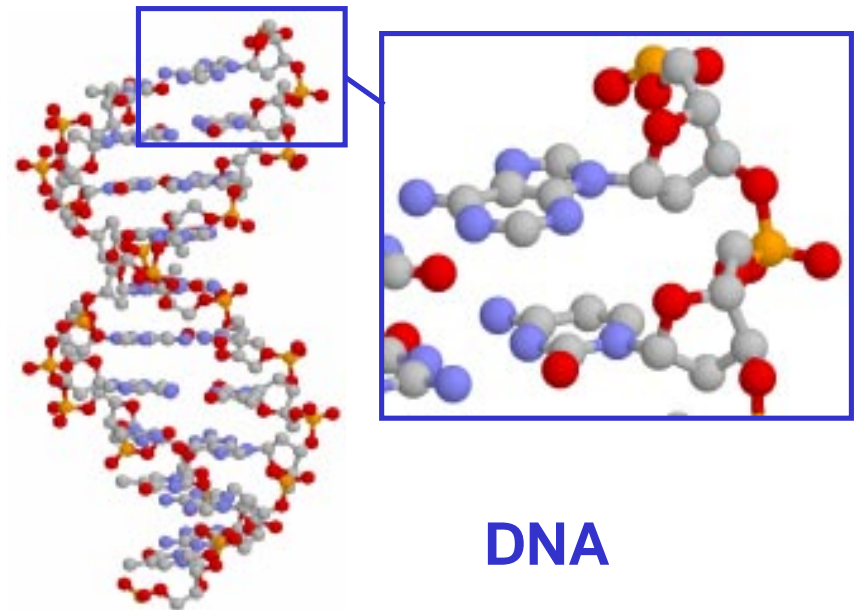
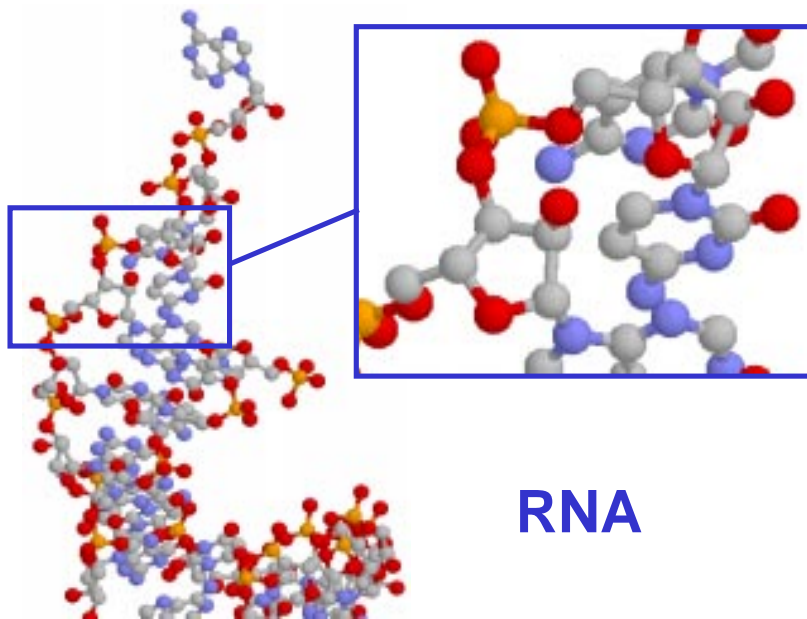
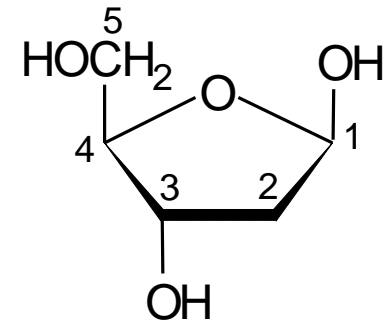


# Pentosen

$\beta$ -D-Ribofuranose



2-Desoxy-D-ribofuranose



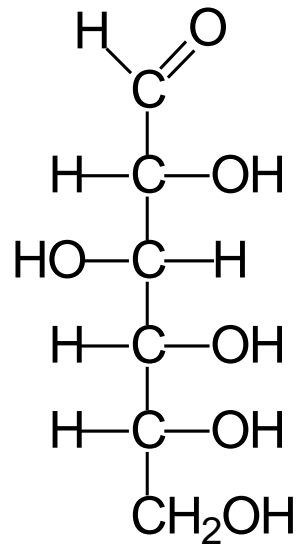
# Hexosen

Hexosen haben 6 C-Atome; bei den Aldosen sind davon vier chiral.

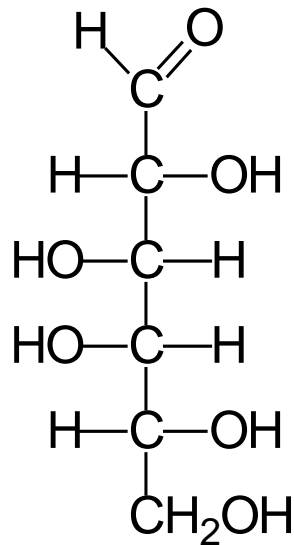
$$\Rightarrow 2^4 = 16 \text{ Isomere}$$

Die Ketosen haben drei chirale C-Atome.  $\Rightarrow 2^3 = 8$  Isomere

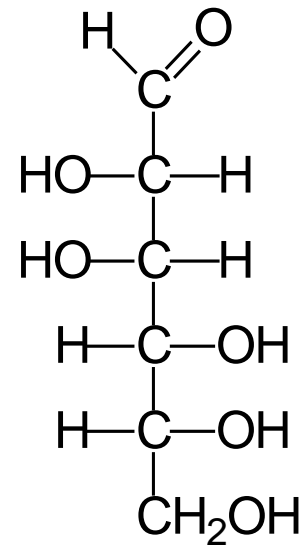
Aldosen:



D-Glucose

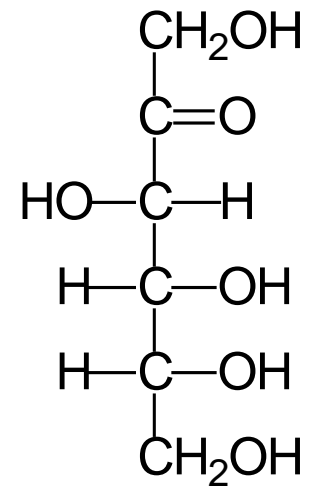


D-Galactose

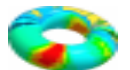


D-Mannose

Ketosen:

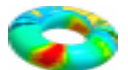
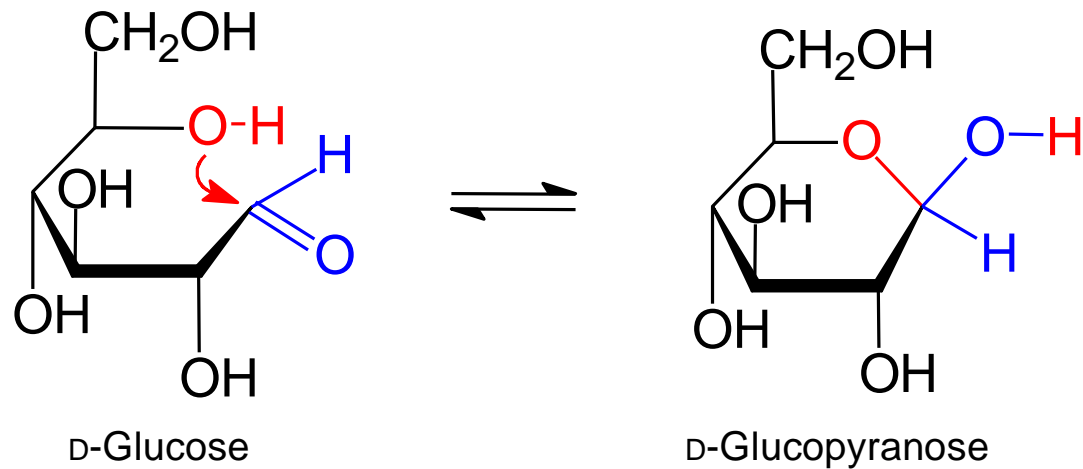
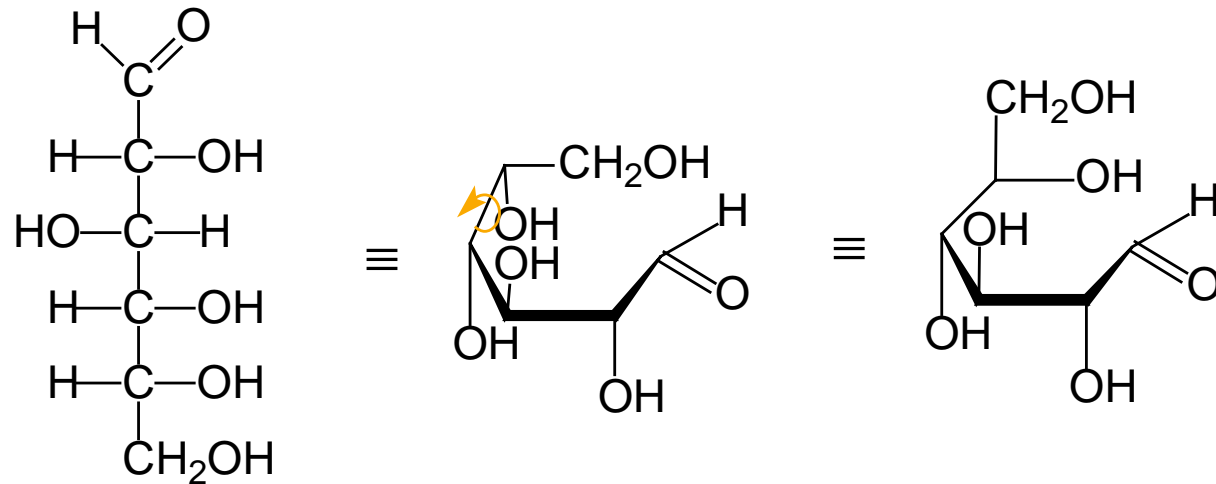


D-Fructose

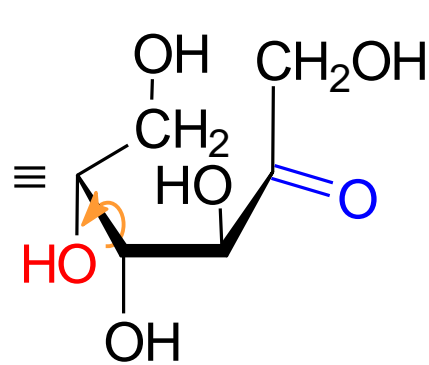
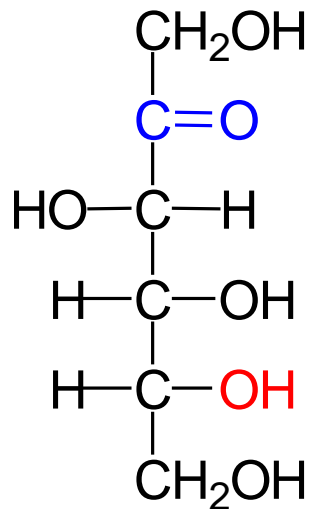


# Bildung cyclischer Halbacetale aus Aldosen

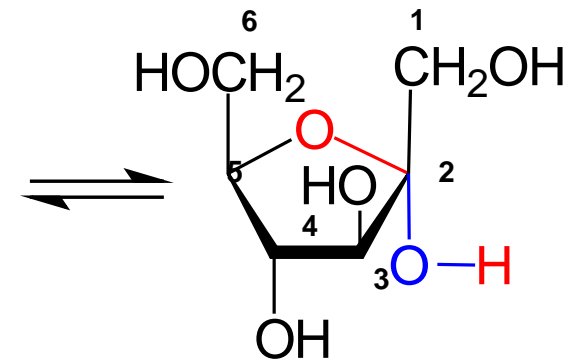
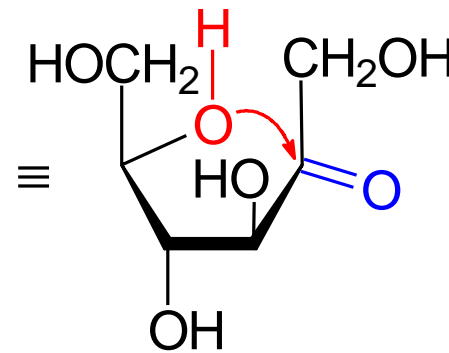
Glucose:



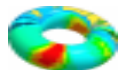
# Bildung cyclischer Halbacetale aus Ketosen



D-Fructose



D-Fructofuranose



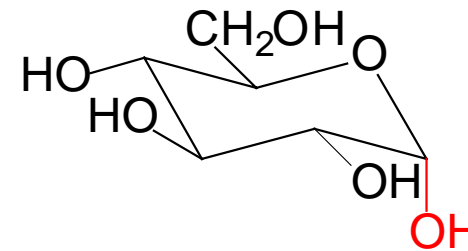
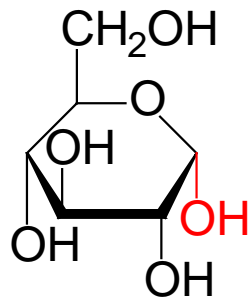
# Stereochemie der Kohlenhydrate

Durch Bildung der cyclischen Halbacetale entsteht ein neues chirales Zentrum.  
Man unterscheidet am **anomeren** Zentrum zwischen  $\alpha$ - und  $\beta$ -Form.

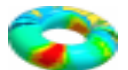
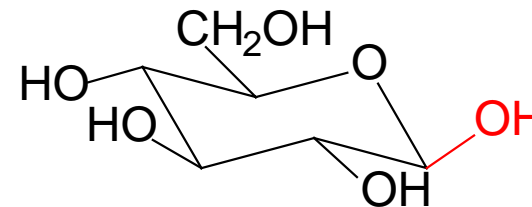
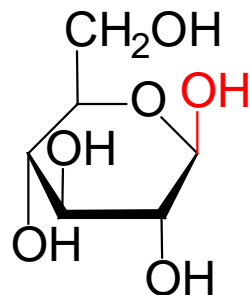
Haworth-Projektion

perspektivische Projektion

$\alpha$

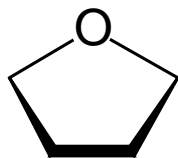


$\beta$

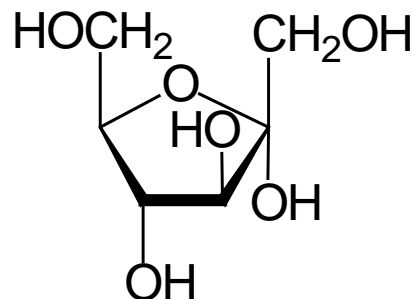


# Bildung cyclischer Halbacetale aus Hexosen

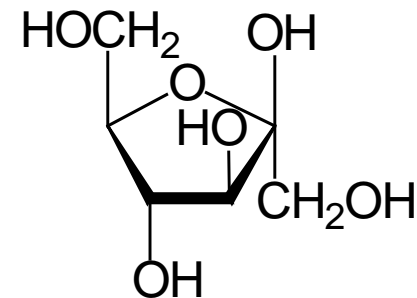
Fünfring:



Tetrahydrofuran

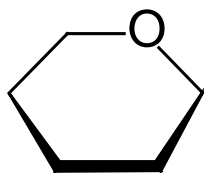


$\alpha$ -D-Fructofuranose

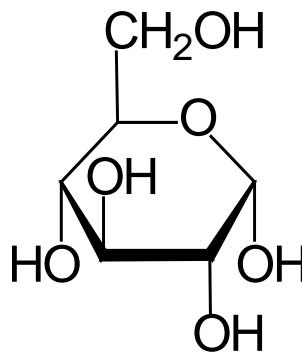


$\beta$ -D-Fructofuranose

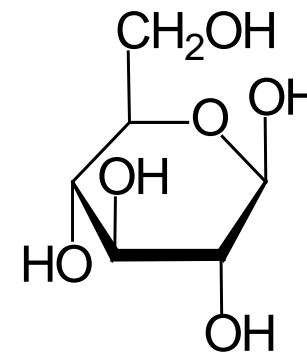
Sechsring:



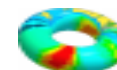
Tetrahydropyran



$\alpha$ -D-Glucopyranose

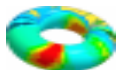
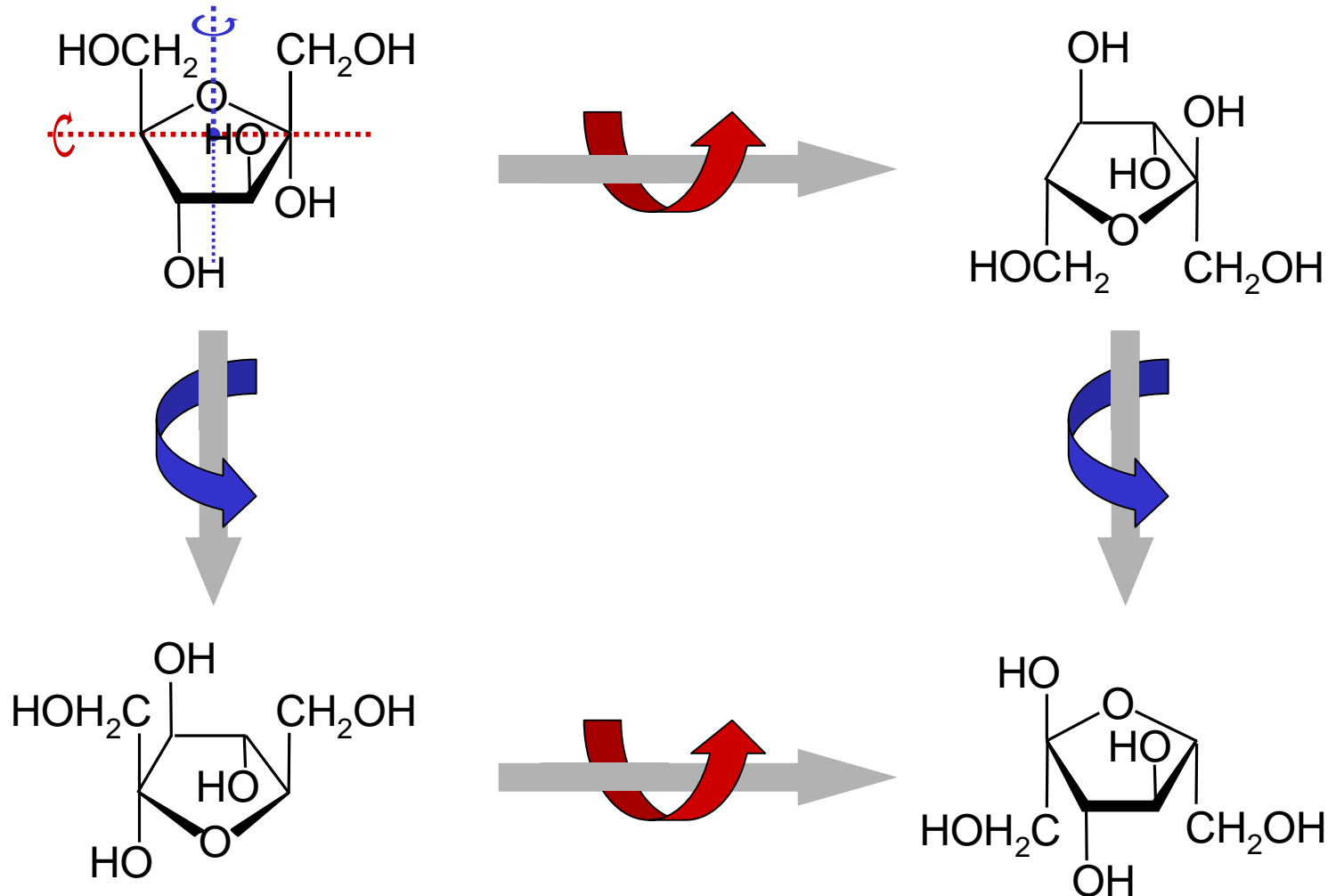


$\beta$ -D-Glucopyranose



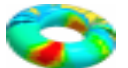
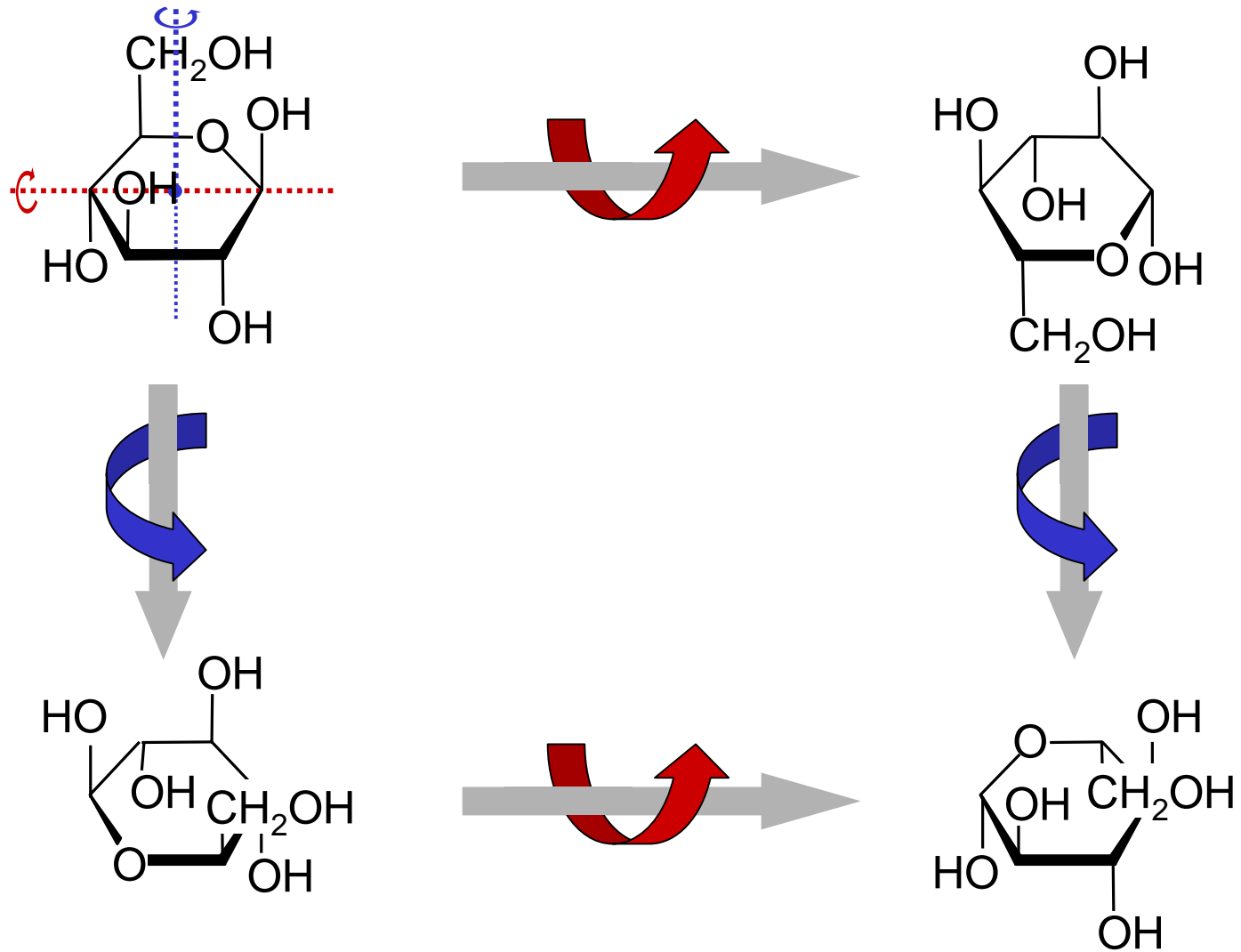
# Haworth-Projektionen: Fructose

$\alpha$ -D-Fructofuranose



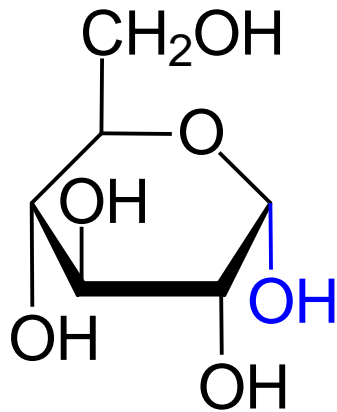
# Haworth-Projektionen: Glucose

$\beta$ -D-Glucopyranose



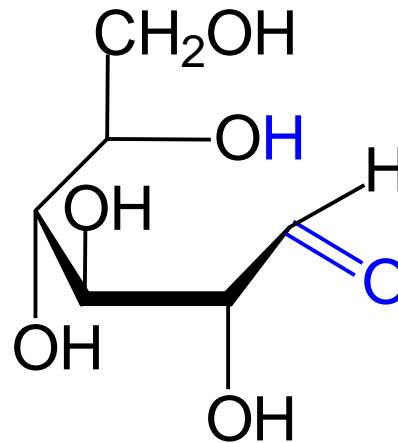
# Mutarotation der Glucose

$\alpha$ -D-Glucopyranose



$$[\alpha]_D = + 112^\circ$$

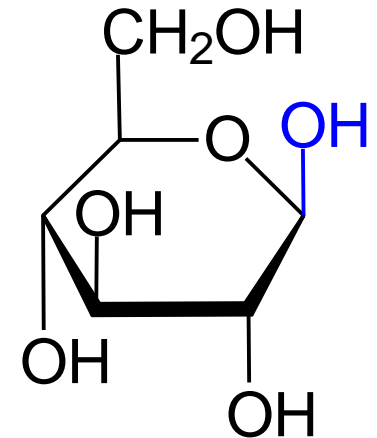
Oxoform



Gleichgewicht:

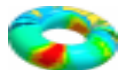
$$[\alpha]_D = + 53^\circ$$

$\beta$ -D-Glucopyranose

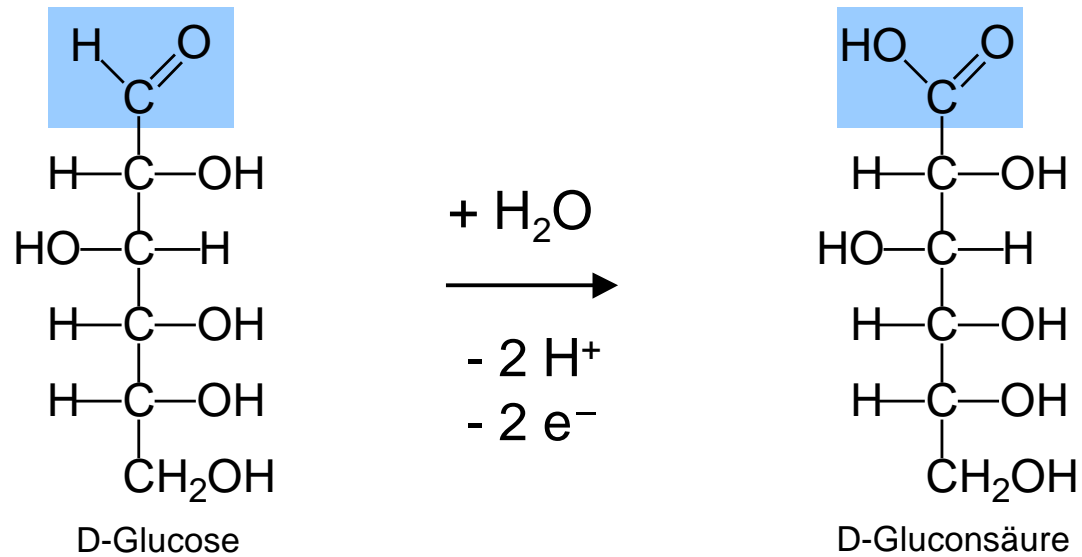


$$[\alpha]_D = + 19^\circ$$

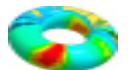
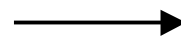
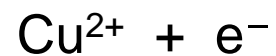
Diastereomere



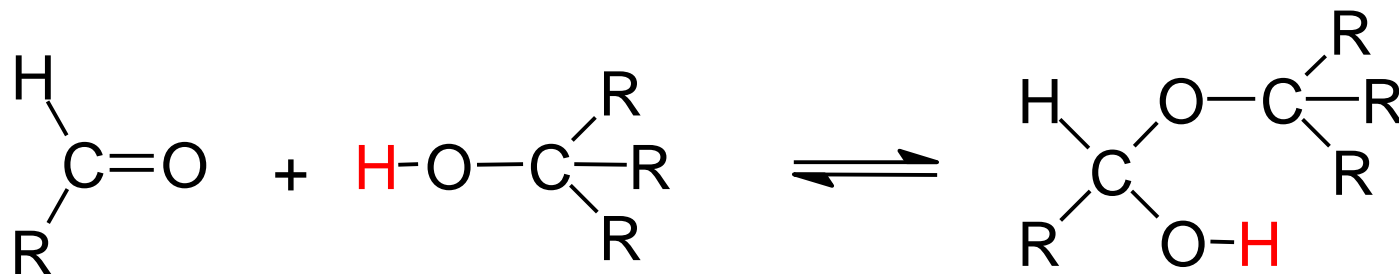
# Reduzierende Wirkung von Aldosen



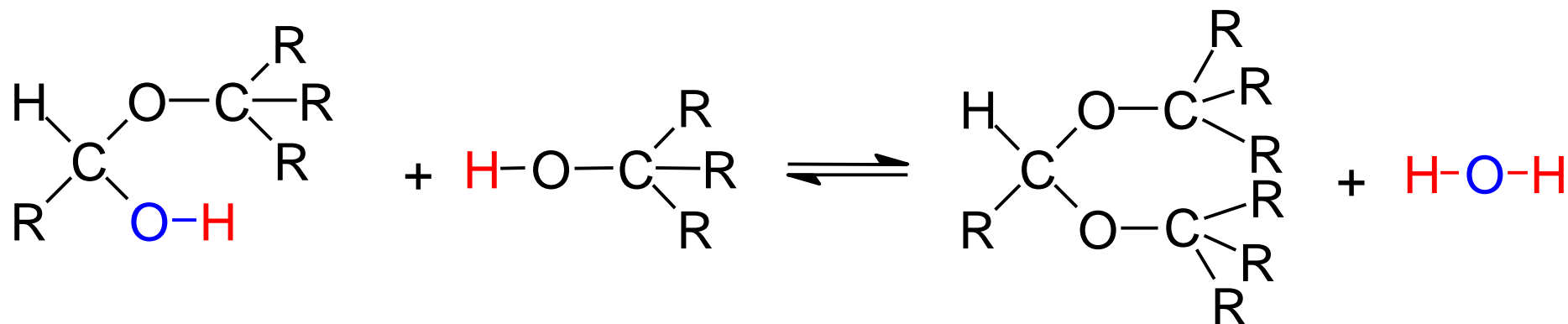
*Fehlingsche Lösung:*



## Reduzierende Wirkung von Aldosen

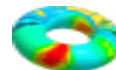


- Halbacetalbildung und -spaltung sowohl **sauer** als auch **basisch** katalysiert möglich



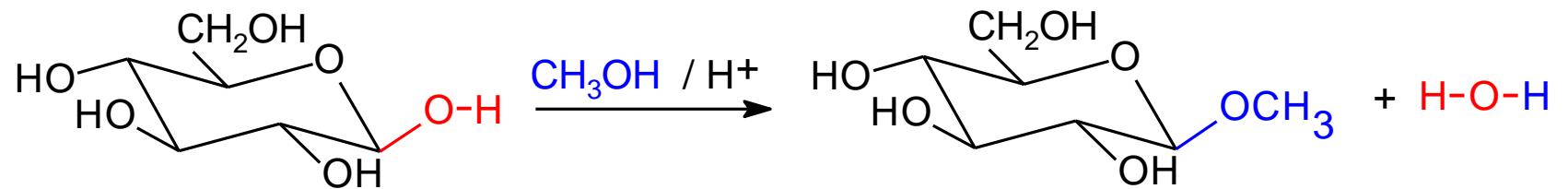
- Acetalbildung und -spaltung *nur* **sauer** katalysiert möglich

⇒ im basischen Medium kann nur aus einem Halbacetal ein reduzierender Aldehyd gebildet werden, nicht aus einem Acetal.

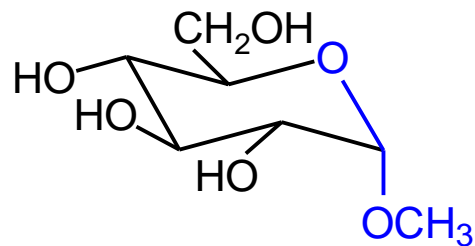


# Die glykosidische Bindung

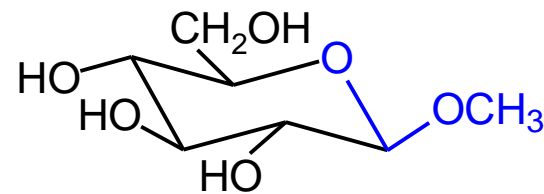
Durch Reaktion des anomeren Zentrums mit Alkoholen entstehen Acetale, die Glykoside.



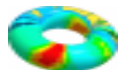
Man unterscheidet zwischen  $\alpha$ - und  $\beta$ -Glykosiden:



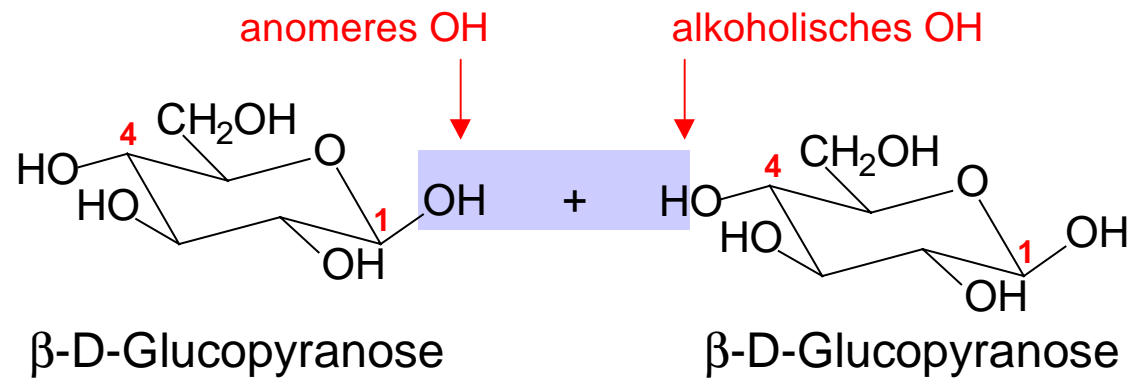
Methyl- $\alpha$ -D-glucopyranosid



Methyl- $\beta$ -D-glucopyranosid



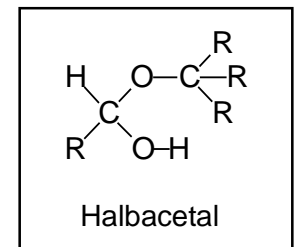
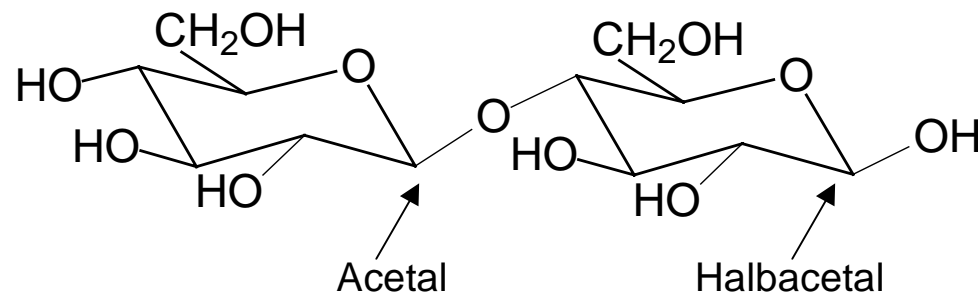
# Disaccharide



$\beta$ -1,4-glykosidische Verknüpfung

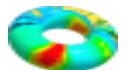
- H<sub>2</sub>O

Cellobiose:

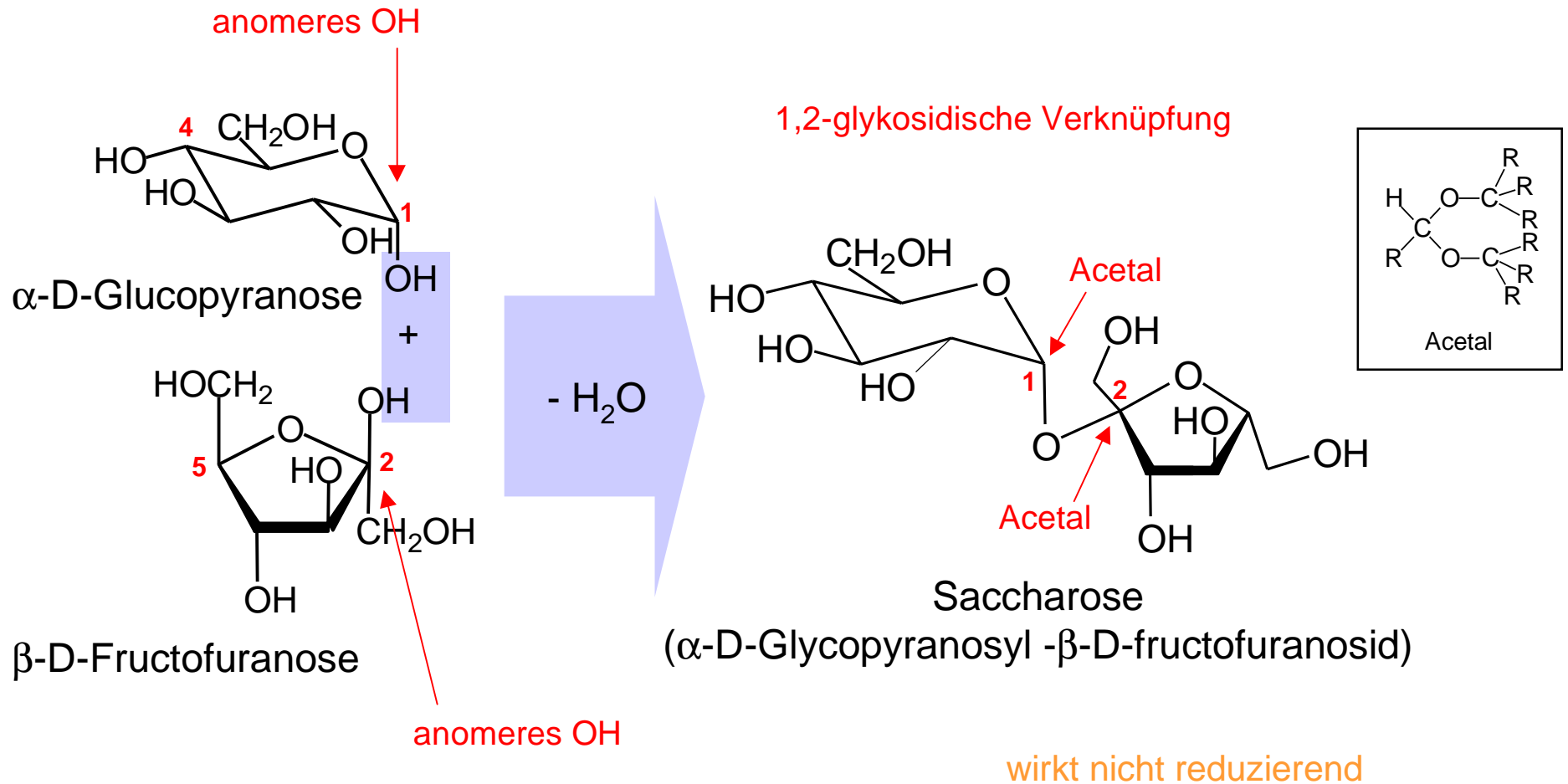


wirkt reduzierend

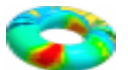
z. B. gegenüber Fehlingsche Lösung, Tollens Reagens (basisches Medium)



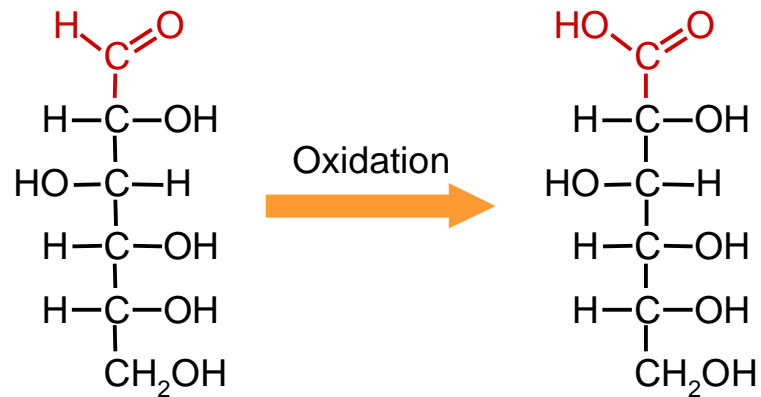
# Disaccharide



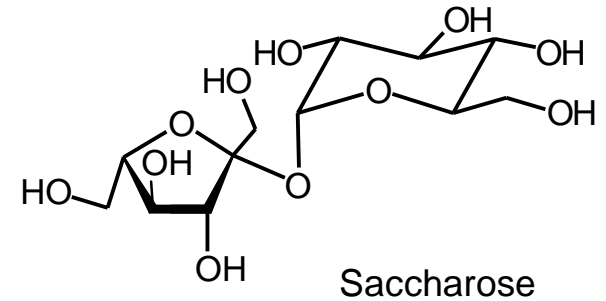
z. B. gegenüber Fehlingsche Lösung, Tollens Reagens (basisches Medium)



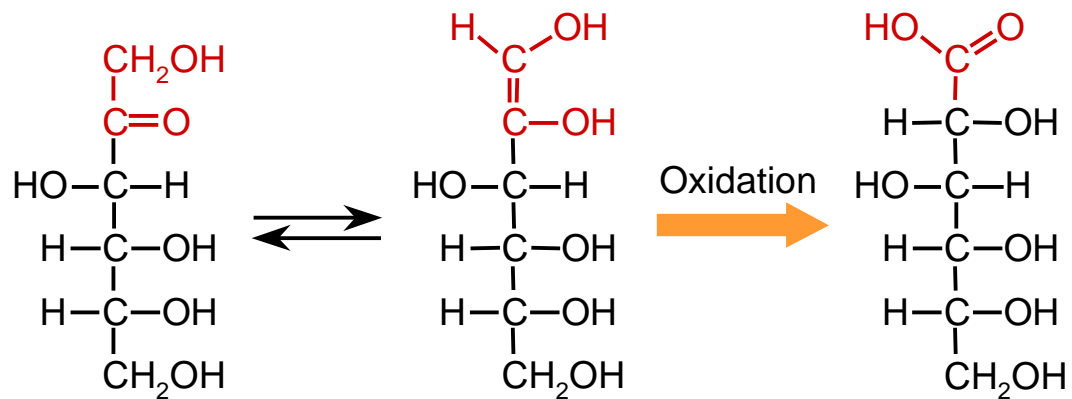
# Praktikumsversuch: Oxidation von Zuckern



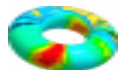
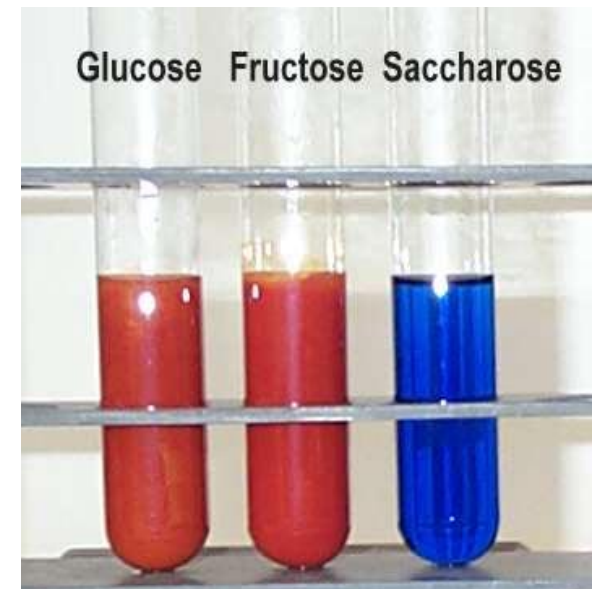
Glucose



## Fehling-Reaktion

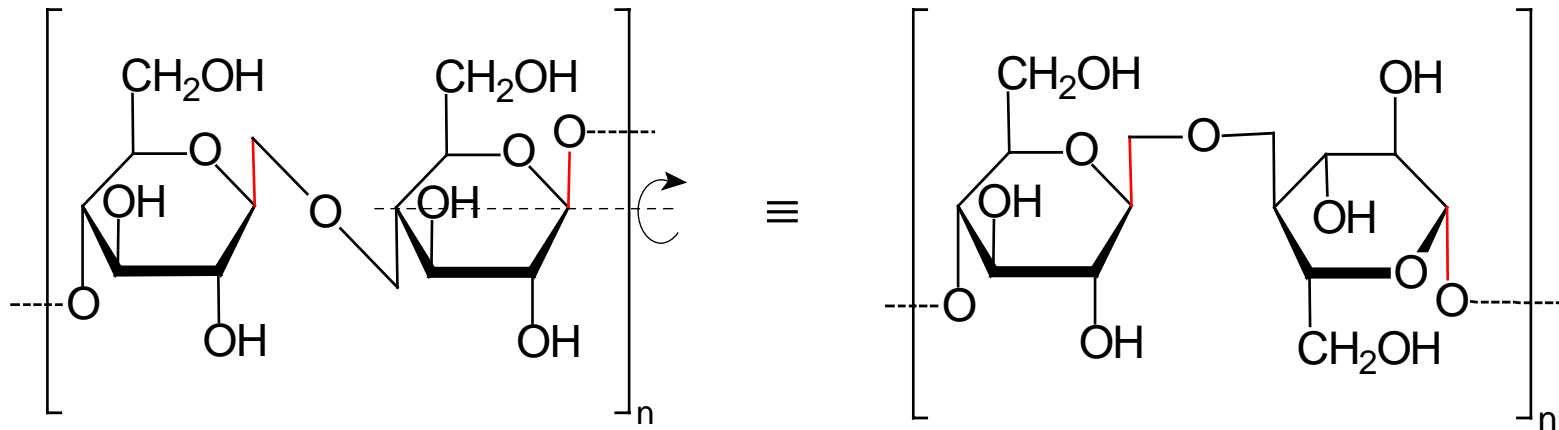


Fructose



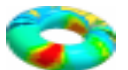
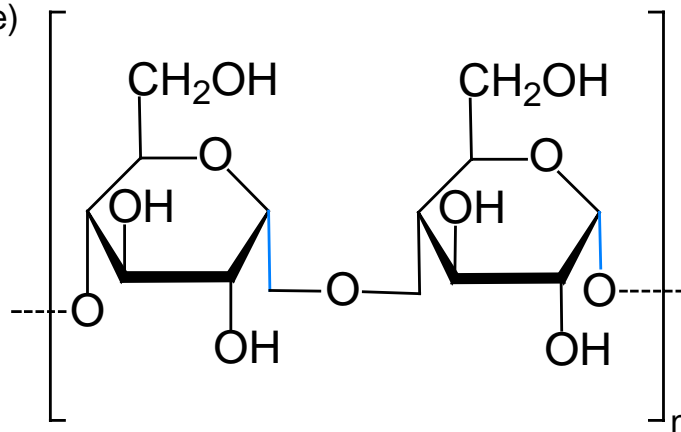
# 1,4-Verknüpfungen

Cellulose:  $\beta$ -1,4-glykosidische Bindungen zwischen Glucose-Einheiten



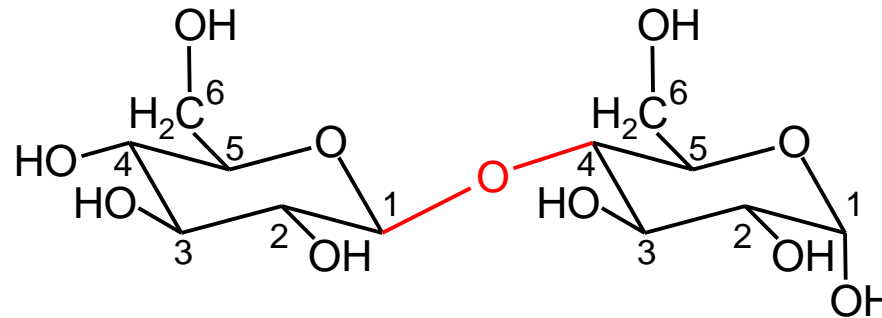
Amylose:  $\alpha$ -1,4-glykosidische Bindungen zwischen Glucose-Einheiten

(unverzweigter Bestandteil der Stärke)

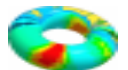
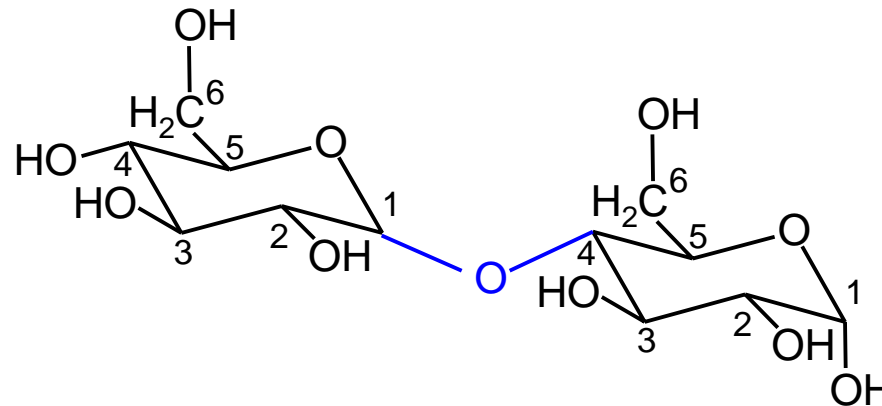


# 1,4-Verknüpfungen

Cellulose:  $\beta$ -1,4-glykosidische Bindungen zwischen Glucose-Einheiten

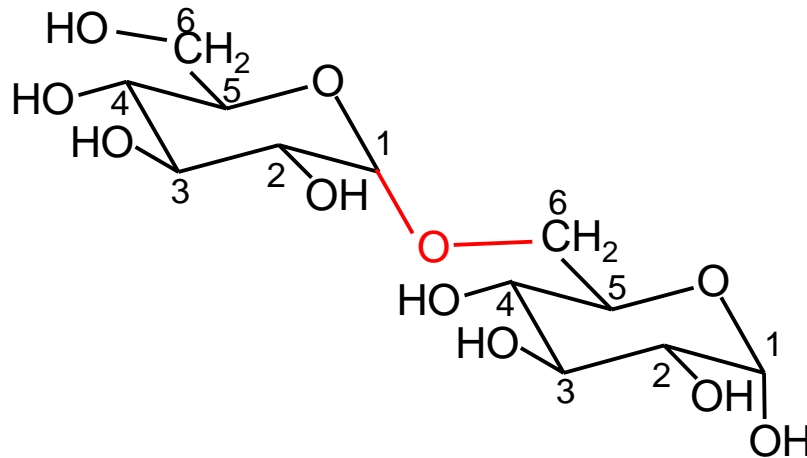


Amylose:  $\alpha$ -1,4-glykosidische Bindungen zwischen Glucose-Einheiten



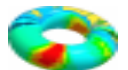
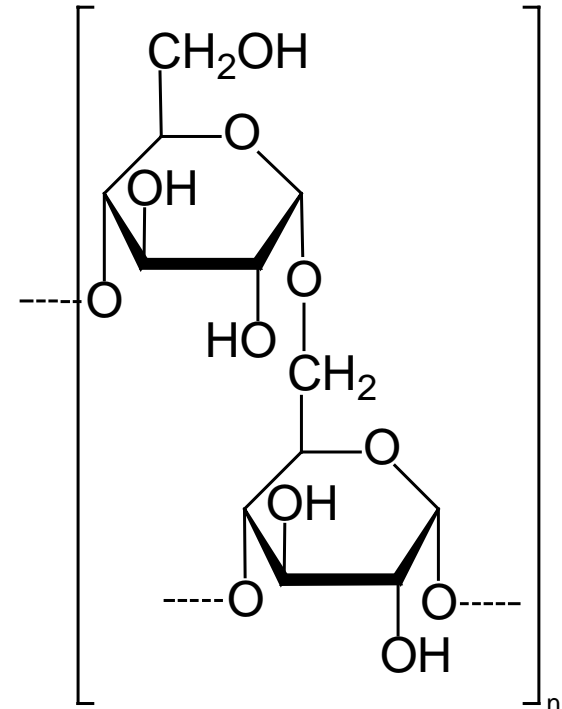
# 1,6-Verknüpfungen

Amylopektin: zusätzlich zu den  $\alpha$ -1,4-glykosidische Bindungen noch  **$\alpha$ -1,6-glykosidische Bindungen** zwischen den Glucose-Einheiten (verzweigter Teil der Stärke)



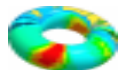
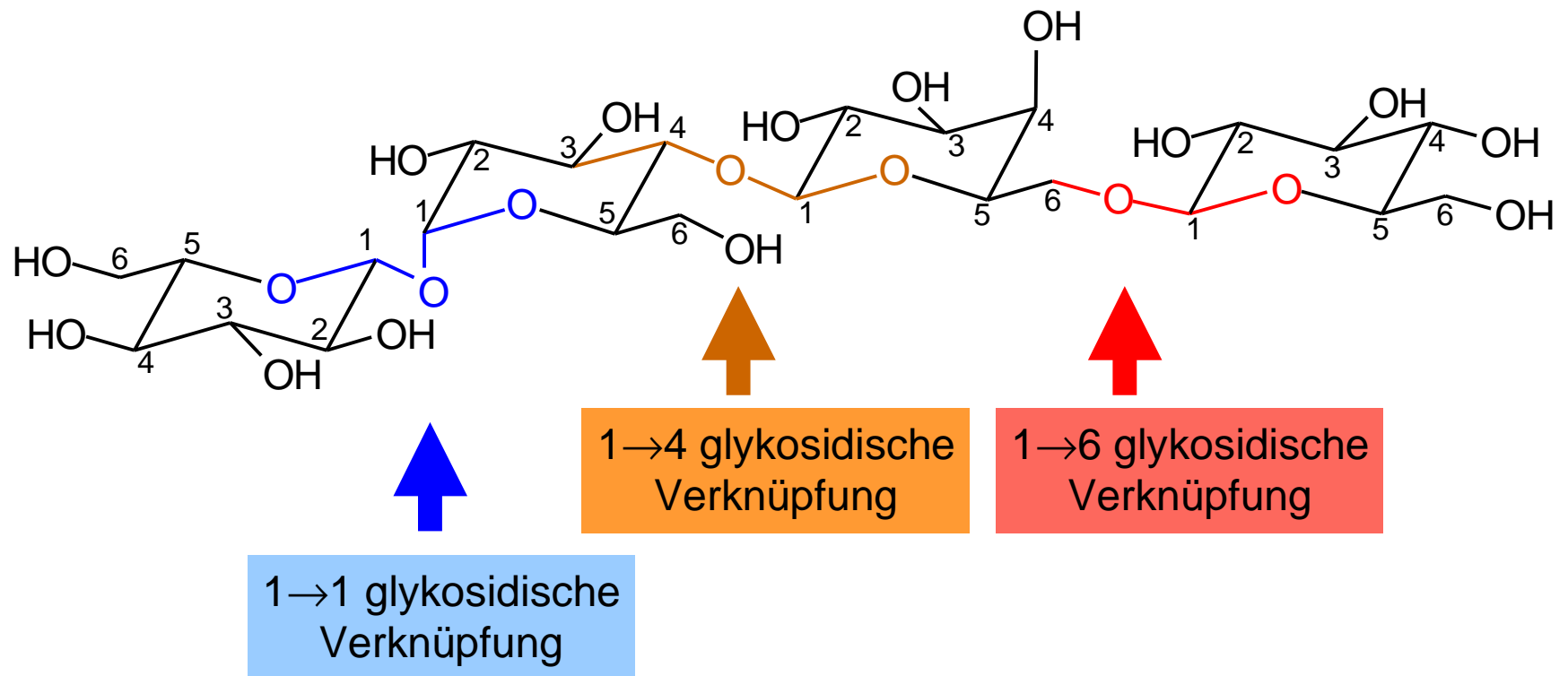
Glykogen: Reservestoff in der Leber

ebenfalls  $\alpha$ -1,4- und  $\alpha$ -1,6-glykosidische Bindungen zwischen den Glucose-Einheiten, aber stärker verzweigt als Stärke



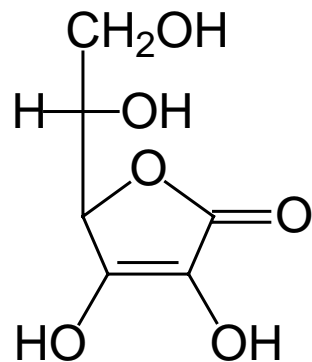
# Saccharide

Glykosidische Bindungen zu Alkoholgruppen anderer Kohlenhydrate ergeben Di-, Oligo- oder Polysaccharide.



# Wichtige Derivate

L-Ascorbinsäure  
(Vitamin C)



Adenosin  
(in der RNA)

