Carbohydrates

pentose

hexose

Monosaccharides → 5 or 6 carbons and are aldehydes and ketones

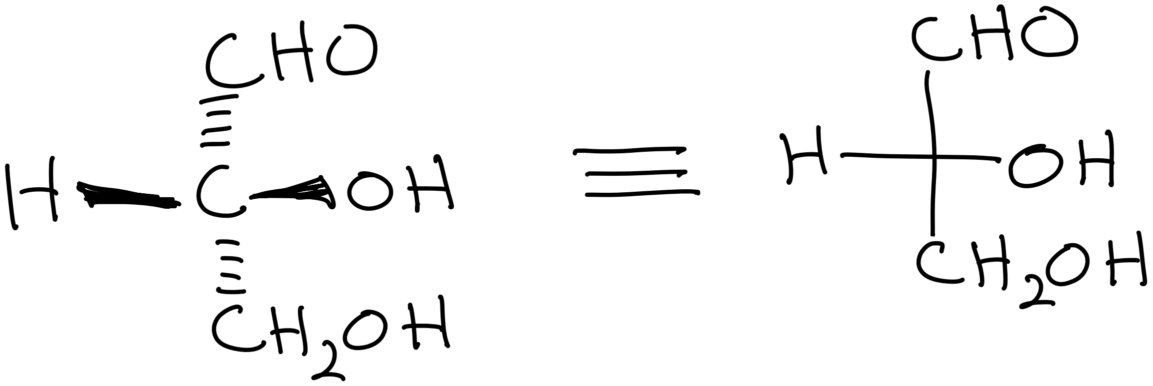
aldose

ketose

Ex.

Glucose is an aldohexose

Stereochemistry



(R)-D-Glyceraldehyde

dextrorotatory (+)

Called Fischer projection

"Like a Teddy Bear giving you a hug"

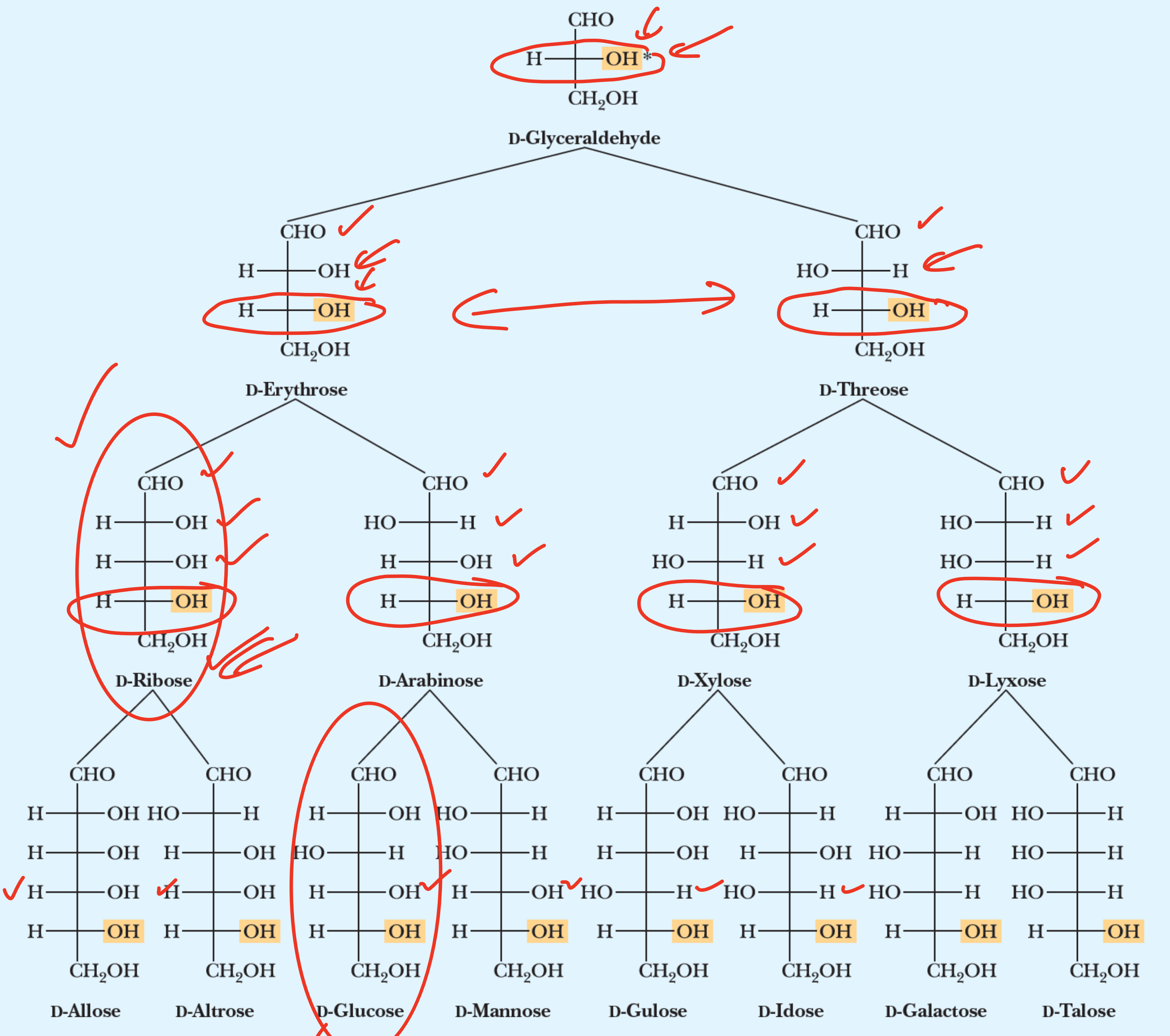

Can I have a hug please?

Stereochemistry defines the different carbohydrates

→ Due to the way carbohydrates are synthesized in cells → the common carbohydrates all have the same stereochemistry as D-glyceraldehyde at the carbon farthest from the carbonyl (aldehyde or ketone)

That is why they are called "D" carbohydrates

Table 25.1 Configurational Relationships Among the Isometric D-Aldotetroses, D-Aldopentoses, and D-Aldohexoses

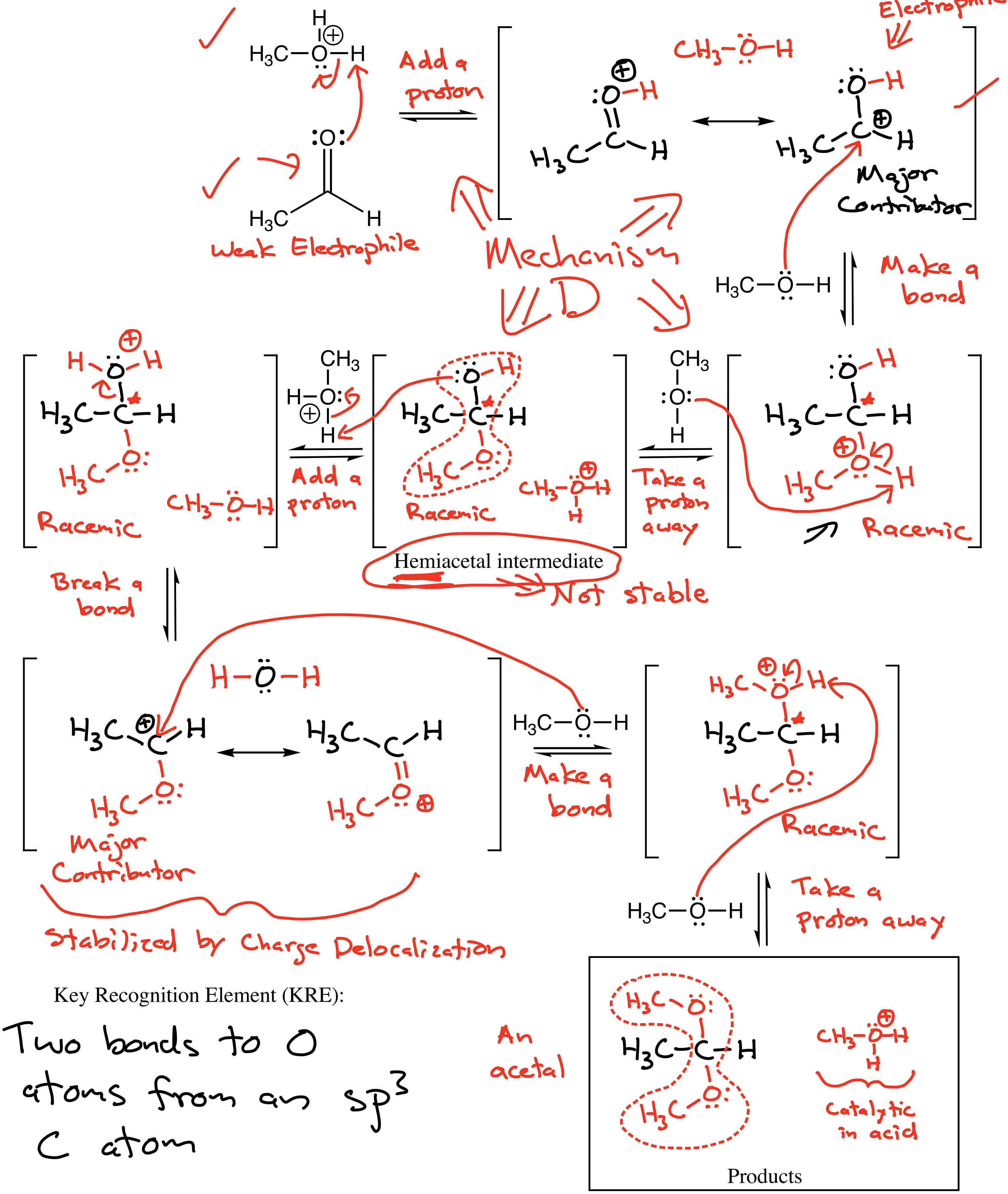



WAYNE'S WORLD

H_2SO_4

“Hey, does that thing have a hemi in it?” “SWEET!” !

Acid Catalyzed Hemiacetal and Acetal Formation From an Aldehyde or Ketone

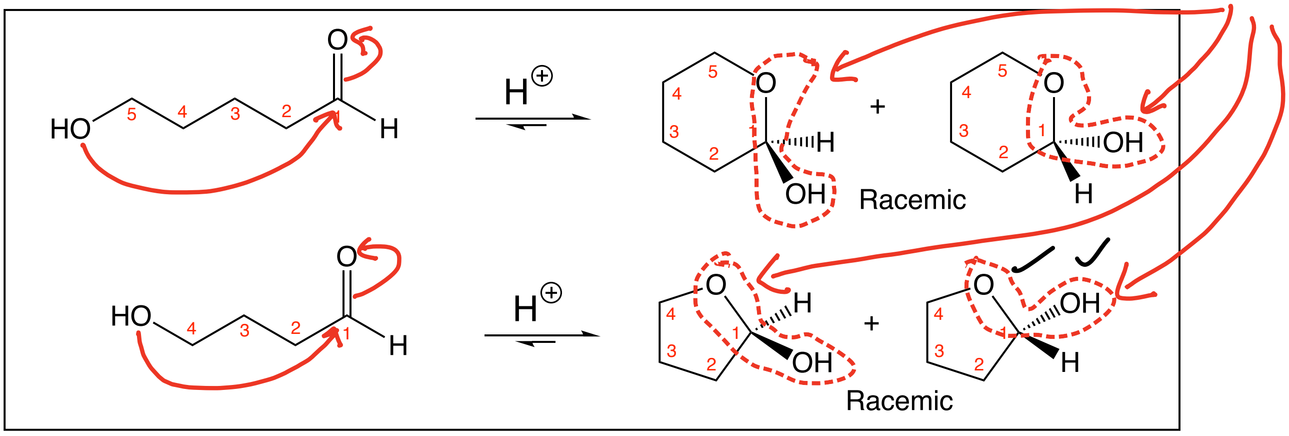


Key Recognition Element (KRE):

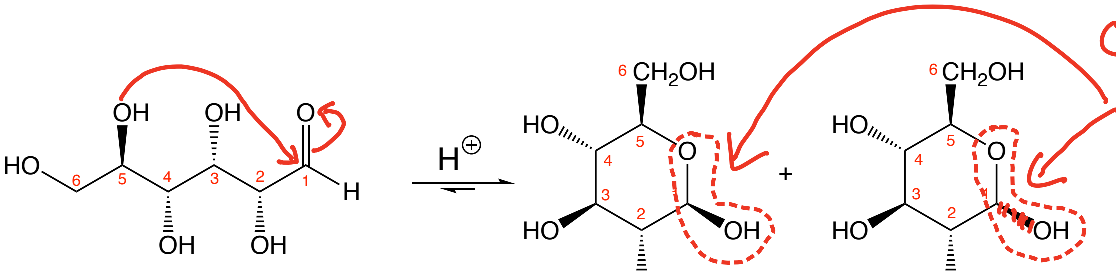
Two bonds to O atoms from an sp^3 C atom

Cyclic Hemiacetals and Carbohydrates

Cyclic hemiacetals



The cyclic form of hemiacetals are stable - "SWEET!"
→ The chelate effect



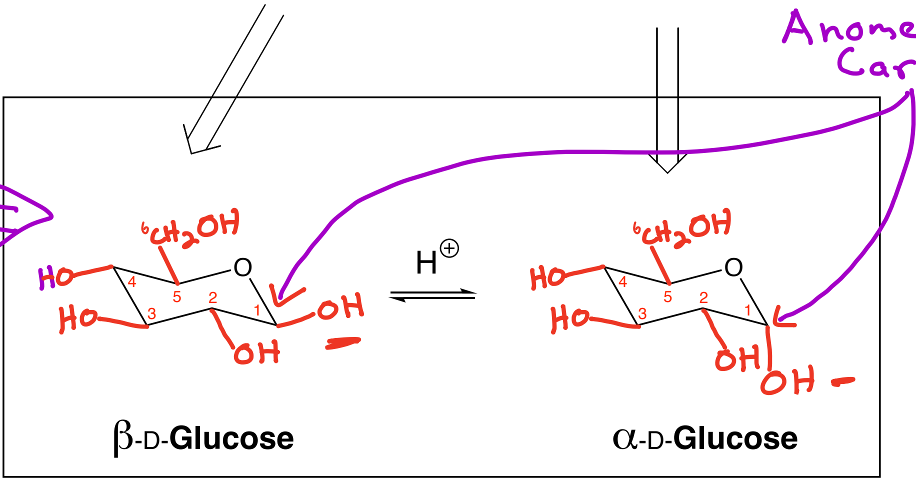
D-Glucose
(open chain form)

Cyclic Hemiacetals

"SWEET!"

Anomeric Carbon

This interconversion is called "mutarotation"



β-D-Gluco$\underbrace{\text{pyranose}}_{\text{means "6-mebered ring"}}$

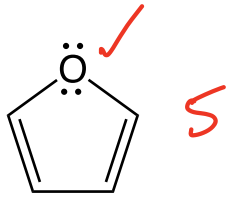
α-D-Glucopyranose

Biochemists call these two forms "anomers"

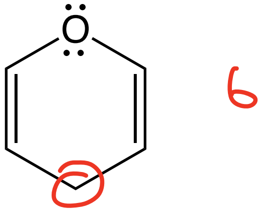
More stable → every group is equatorial!

Less stable → one -OH is axial

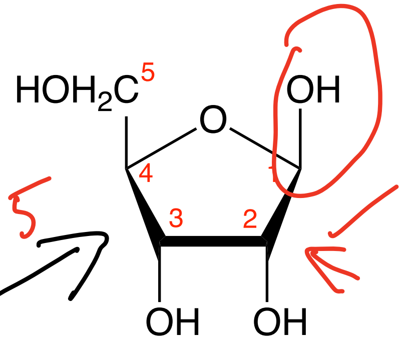
For Glucose:
"α is axial!"



Furan ✓



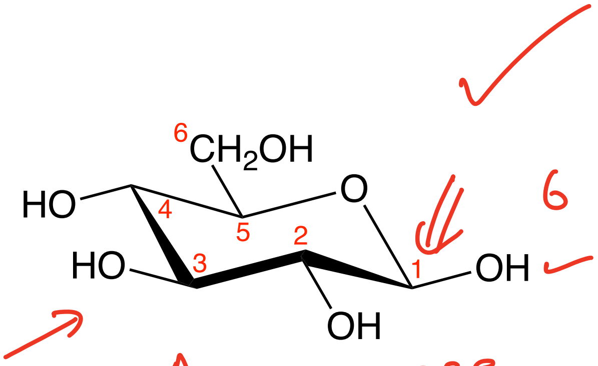
Pyran ✓



A furanose

β-D-Ribose

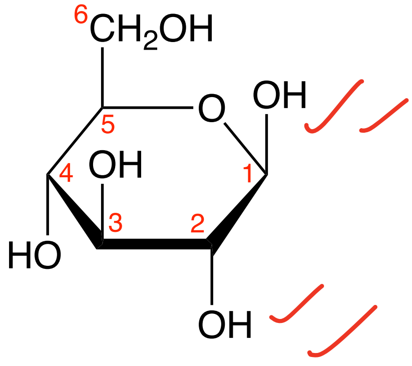
or β-D-Ribofuranose



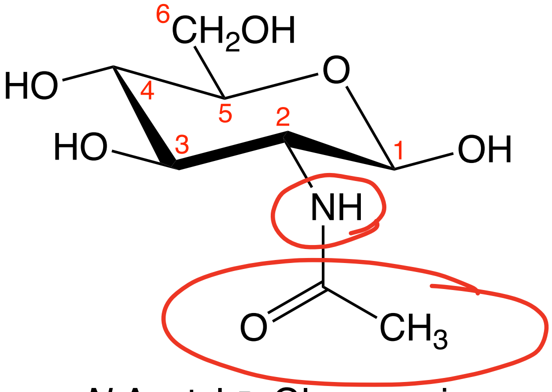
A pyranose

β-D-Glucose

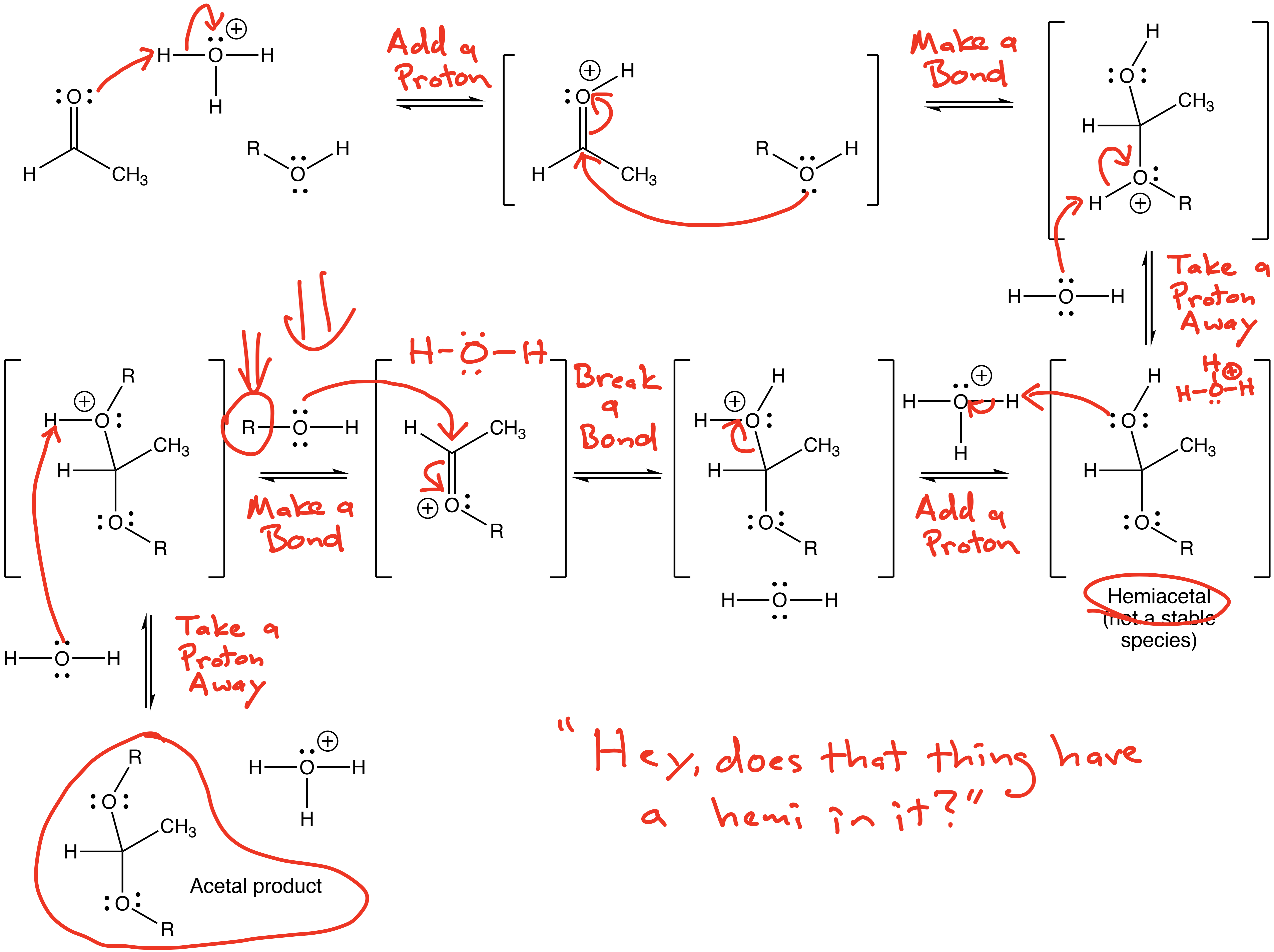
or β-D-Glucopyranose



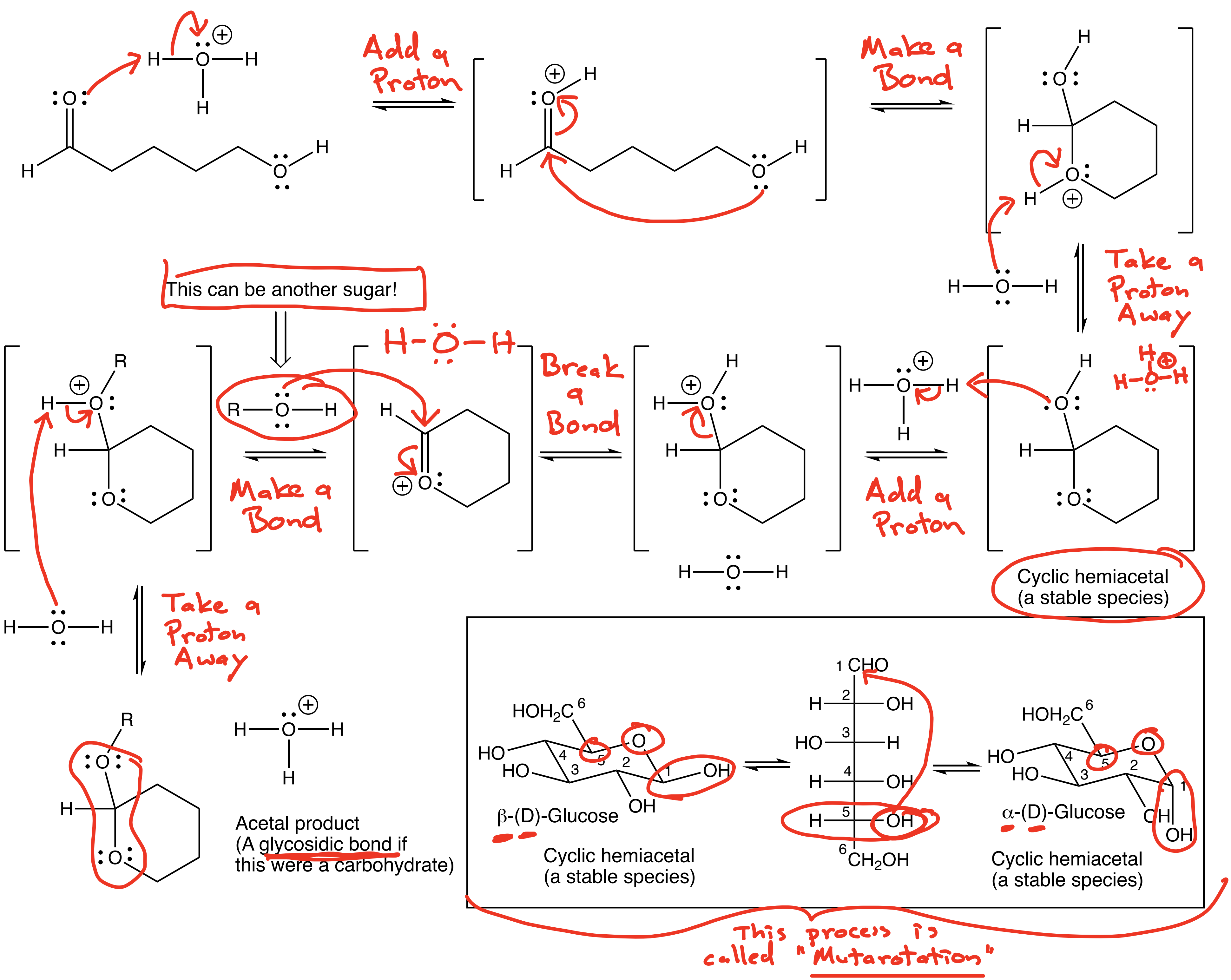
This is called a Haworth projection



N-Acetyl-D-Glucosamine
(GlcNAC) ✓



"Hey, does that thing have a hemi in it?"



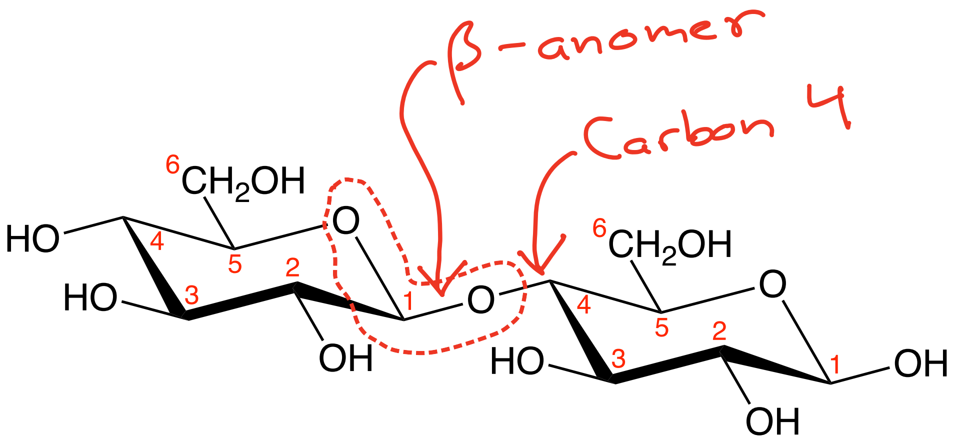
This can be another sugar!

Cyclic hemiacetal
(a stable species)

Acetal product
(A glycosidic bond if
this were a carbohydrate)

Cyclic hemiacetal
(a stable species)

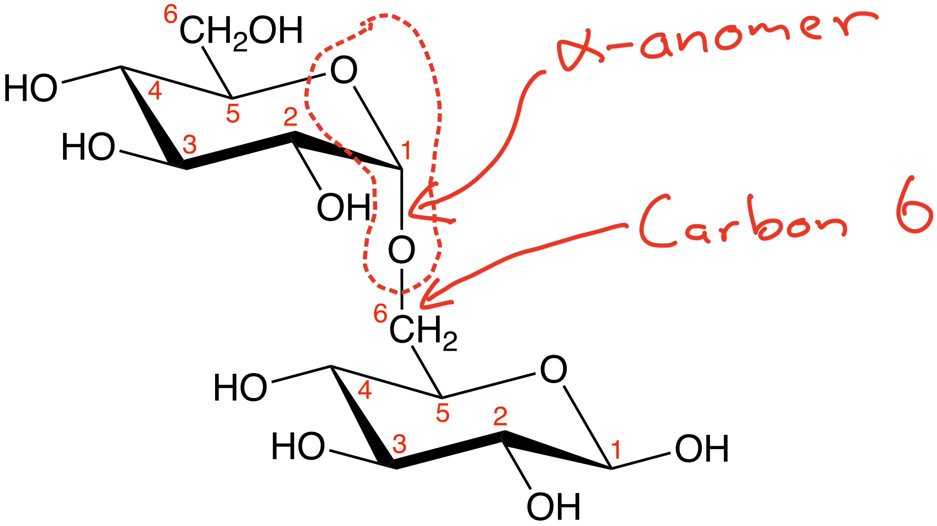
Cyclic hemiacetal
(a stable species)



β-anomer

Carbon 4

This is a β-1,4-Glycosidic Bond

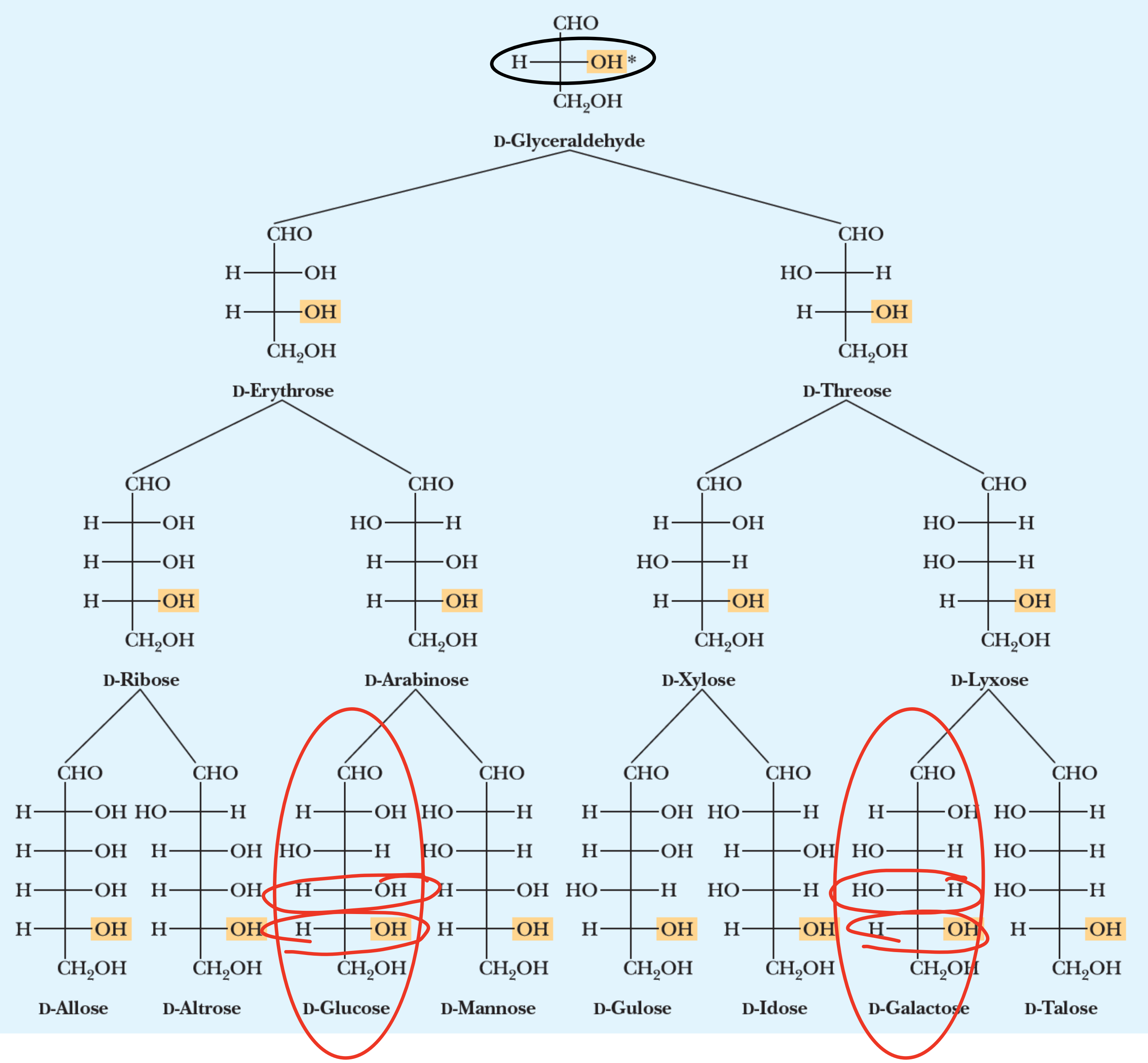


α-anomer

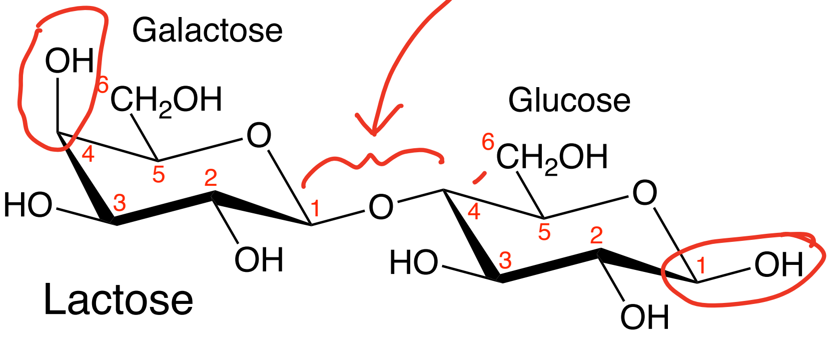
Carbon 6

This is an α-1,6-Glycosidic Bond

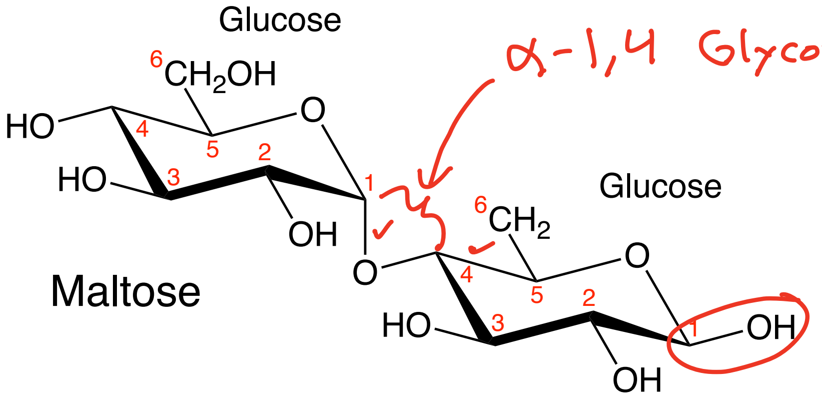
Table 25.1 Configurational Relationships Among the Isometric D-Aldotetroses, D-Aldopentoses, and D-Aldohexoses



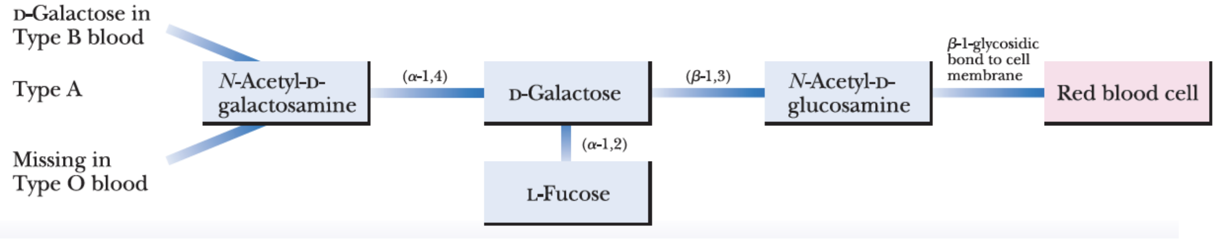
β-1,4 Glycosidic bond



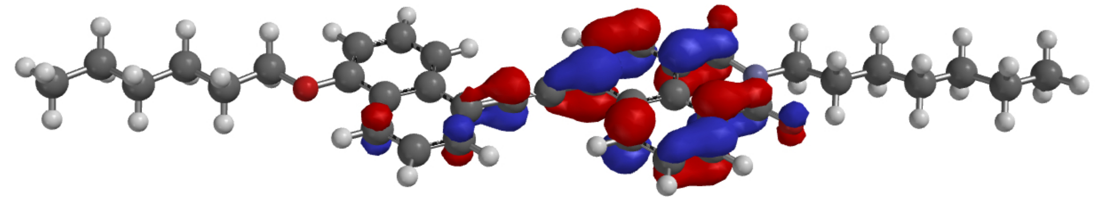
α-1,4 Glycosidic bond



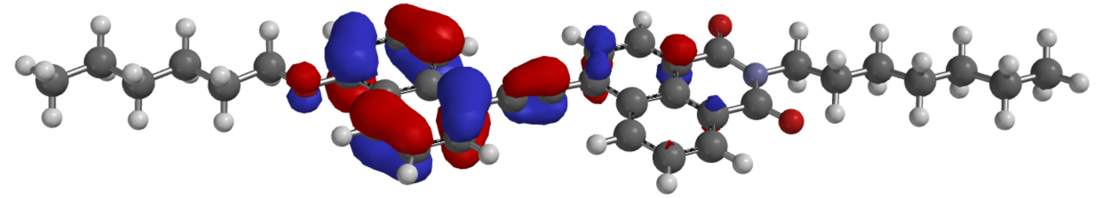
We can link more carbohydrates together, always at Carbon 1, with α or β linkages at carbons 2, 3, 4 or 6

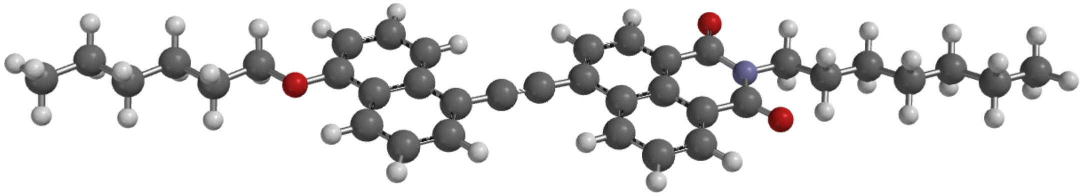


π^*MO



π MO

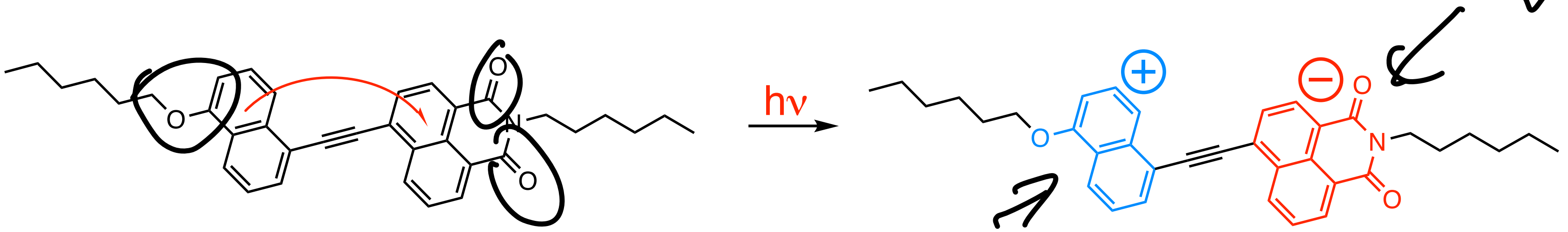


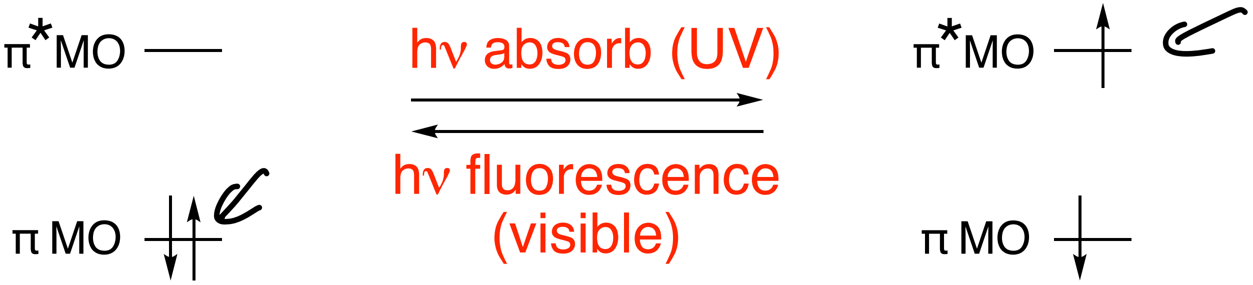


✓

Blue Light = higher energy

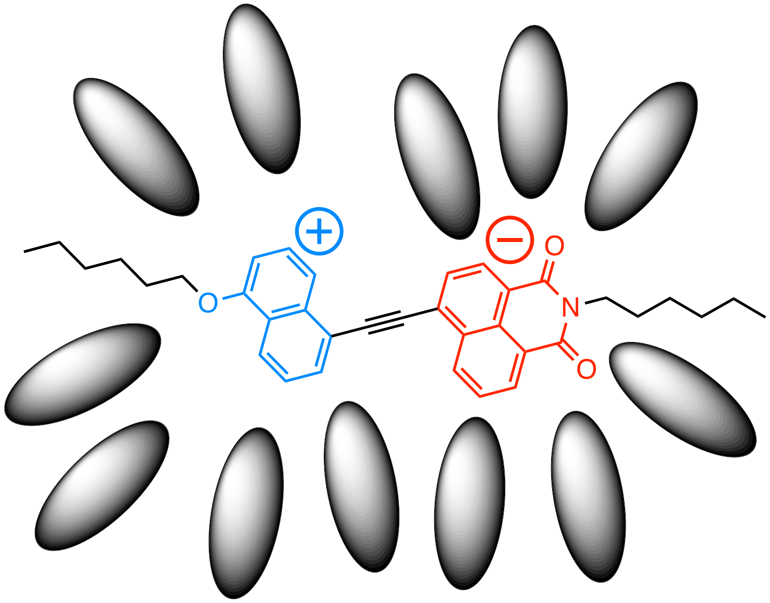
Orange light = lower energy ✓

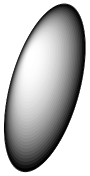




hν absorb (UV)

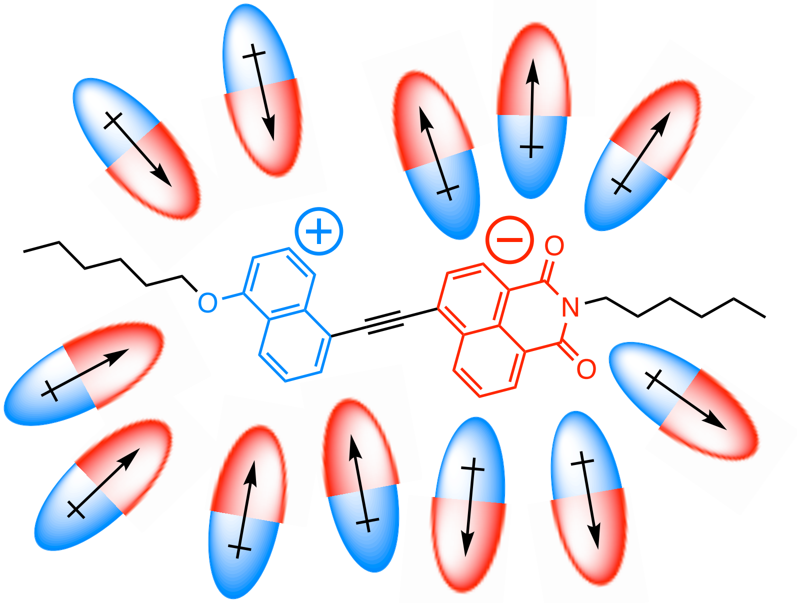
hν fluorescence
(visible)

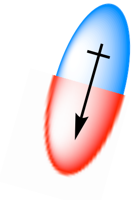




Non-polar Solvent Molecule

No stabilization of the
charged excited state





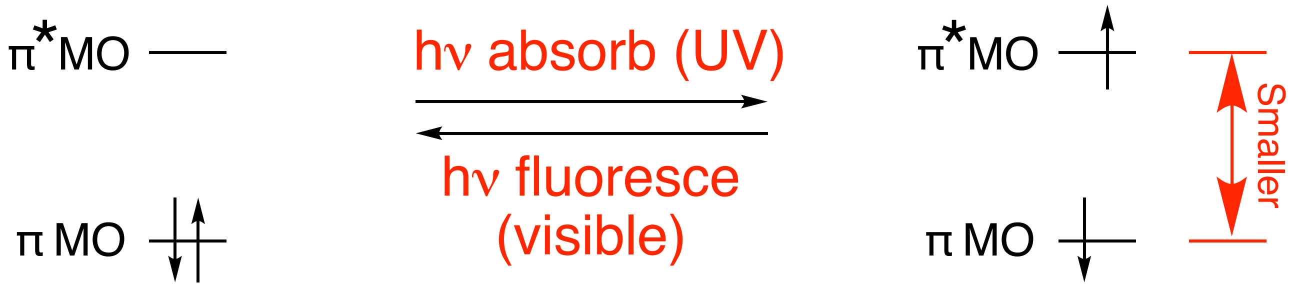
Polar Solvent Molecule

Stabilization of the
charged excited state

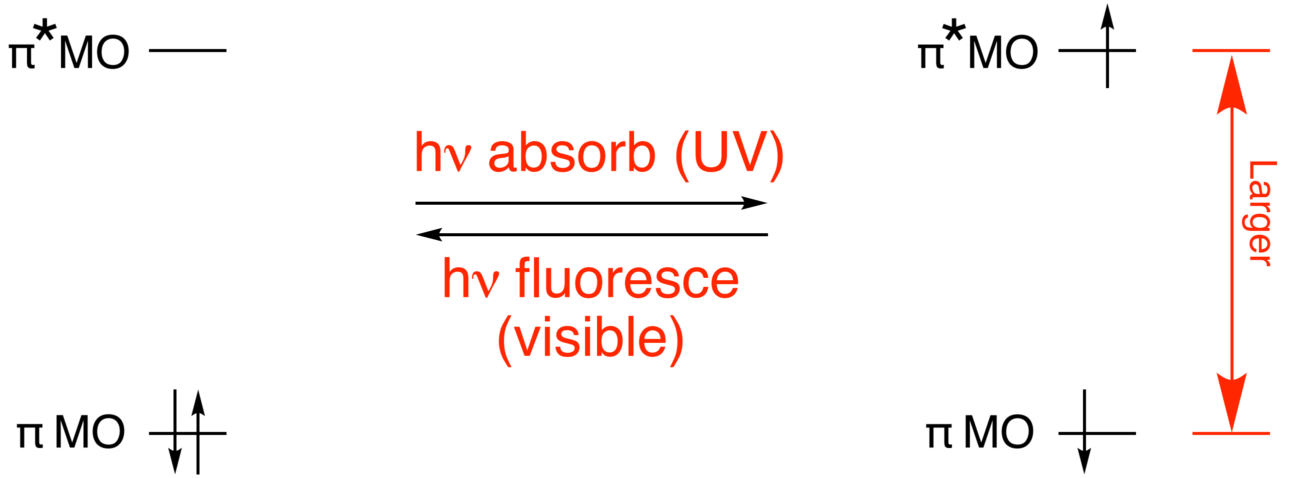
Which is
blue?
Polar or
Non-polar
solvent?

Less Polar Solvents

More Polar Solvents



Polar Solvent - the charged excited state is well solvated because the solvent molecules have a relatively large molecular dipole that interacts favorably with the charges. There is a smaller energy difference between the ground state and excited state, corresponding to orange light

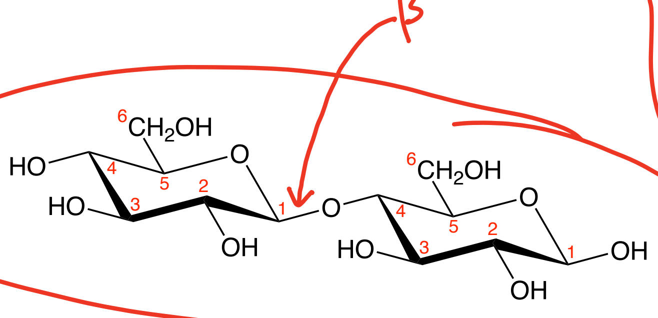


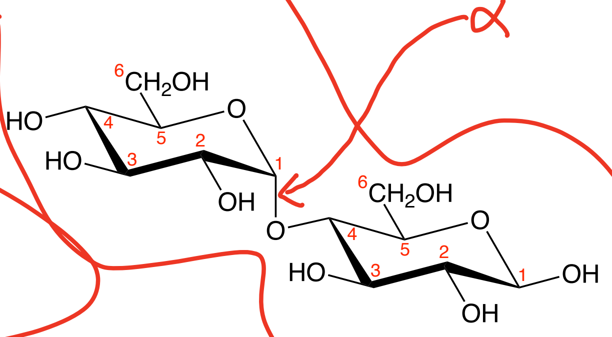
Non-polar Solvent - the charged excited state is disfavored because it is not well-solvated. There is no molecular dipole in the solvent to interact favorably with the charges.This makes the charged excited state higher in energy. There is a larger energy difference between the ground state and excited state, corresponding to blue light

Answer to
pop-quiz
question

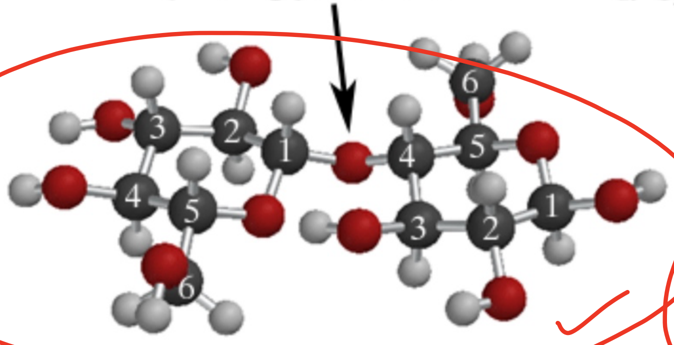
VS.

What is the difference —
They are both polymers
of D-Glucose



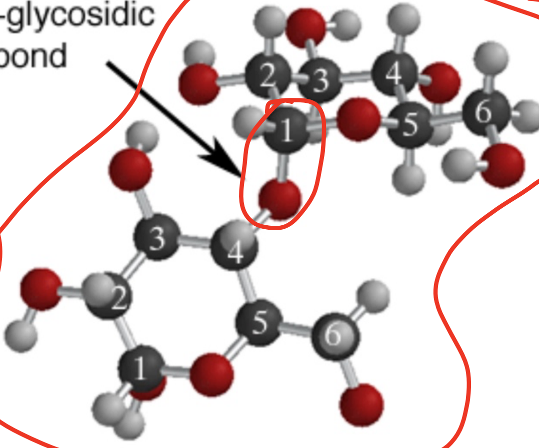


β–1,4–glycosidic bond



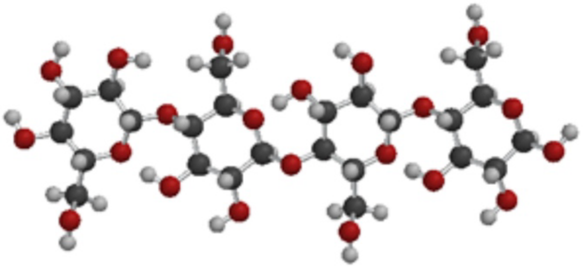
β-1,4-D-glucose

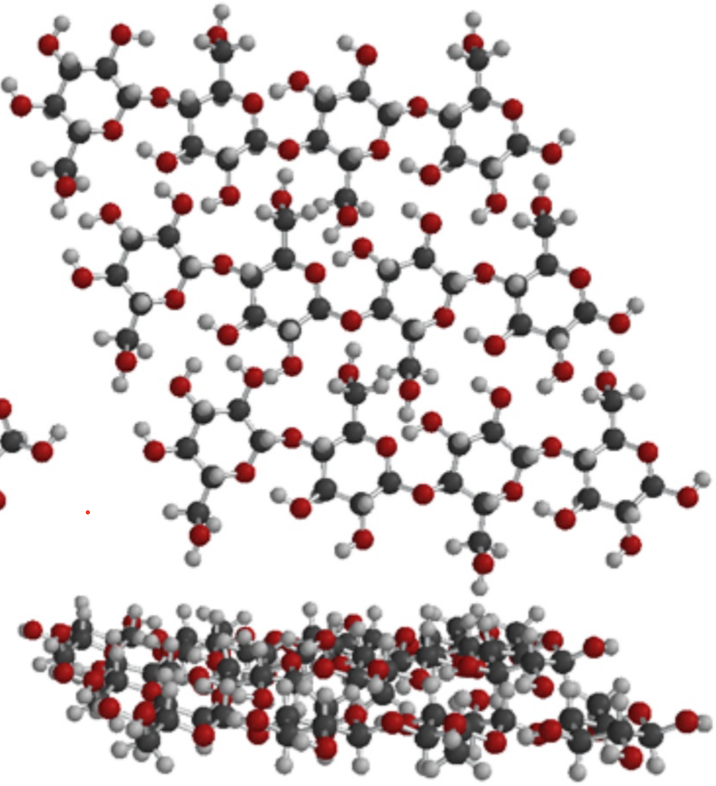
α–1,4–glycosidic bond



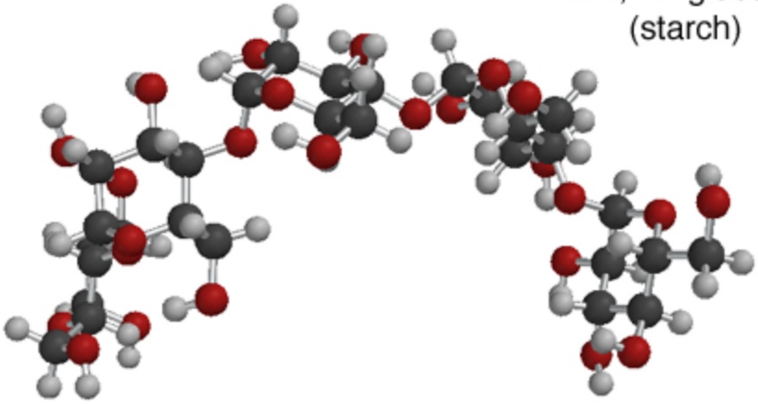
α-1,4-D-glucose

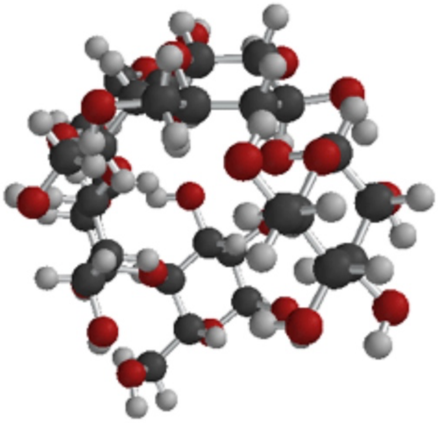
β-1,4-D-glucose
(cellulose)



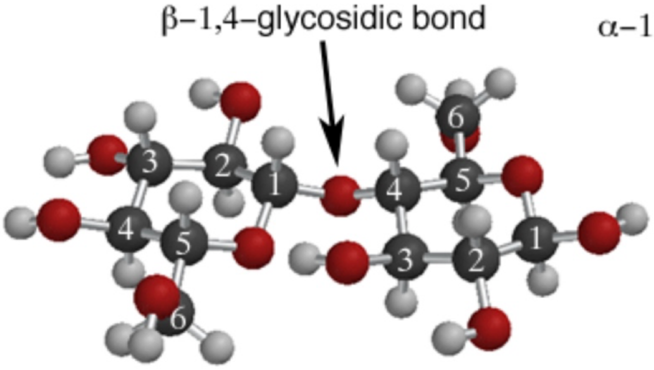


α-1,4-D-glucose
(starch)

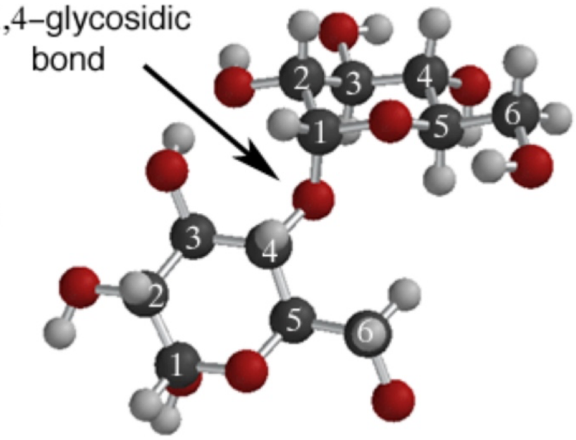




vs.



β-1,4-D-glucose



α-1,4-D-glucose