Chemical reaction of glucose
D-Glucose-4-Sulfate

D-Glucosamine

6-Deoxy-D-Glucose

Replace OH with sulfate

Replace OH with NH₂

Reduction of the C-6 Position

Oxidation of the C-1 aldehyde to a carboxylic acid

D-Gluconic Acid (An Aldonic Acid)

D-Glucose-6-Phosphate

Sorbitol (An Alditol, Polyol)

Oxidation of the C-6 Position

Reduction of the anomeric Carbon

D-Glucuronic Acid (A Uronic Acid)

Look! this too can be drawn in a Haworth projection.
Oxidation

Bromino water

\[
\text{Gluconic acid} \rightarrow \text{Glucose} \rightarrow \text{Glucaric acid}
\]
Reduction

- Carbonyl groups can be reduced to alcohols (catalytic hydrogenation)

\[
\begin{align*}
\text{H} & \quad \text{O} \\
\text{R} & \quad \rightarrow \\
\text{H} & \quad \text{OH}
\end{align*}
\]

- Sweet but slowly absorbed
- Glucose is reduced to sorbitol (glucitol)
- Xylose can be reduced to xylitol
- Once reduced – less reactive; not absorbed
Reduction.

- Aldehyde sugars (reducing sugars) are readily oxidized and will react with Benedict’s reagent.

\[
\begin{align*}
\text{H} & \quad \text{C}=\text{O} \\
\text{H-CH}_2\text{OH} & \quad + \ 2 \ \text{Cu}^{2+} + 5 \ \text{OH}^- \\
\text{CH}_2\text{OH} & \quad \rightarrow \quad \text{H} \quad \text{C}=\text{O} \\
& \quad \text{CH}_2\text{OH} + 2 \ \text{Cu}_2\text{O} + 3\text{H}_2\text{O}
\end{align*}
\]

- This provides a good test for presence of glucose in urine - forms a red precipitate.

- **Other tests** - Tollen’s or Fehling’s solutions.
Benedict’s reagent

Benedict's Reagent

0.5% 2%

glucose
Glycoside formation

- α or β -OH group of cyclic monosaccharide can form link with another one (or more).

- glycosidic bond

- sugar -O- sugar

- oxygen bridge

+ H_2O
Glycosidic bonds

Type is based on the position of the C-1 OH

\[ \alpha \text{ glycosidic bond} \]
- linkage between a C-1 \( \alpha \) OH and a C-4 OH

\[ \beta \text{ glycosidic bond} \]
- linkage between a C-1 \( \beta \) OH and a C-4 OH

C-4 end can be either up or down depending on the orientation of the monosaccharide.
The replacement of a hydroxyl group on a carbohydrate results in an amino sugar.

- β-D-glucose
- β-D-2-aminoglucose (glucosamine)
Amino derivatives

- Uses for amino sugars.
- Structural components of bacterial cell walls.
- A major structural unit of chondroitin sulfate - a component of cartilage.
- Component of glycoprotein and glycolipids.
Osazone formation

D-glucose + 2 C₆H₅NHNH₂ → NH₃ + C₆H₅NH₂ + C≡NNHC₆H₅ + (CHOH)₄CH₂OH → D-Clucosazone
Dehydration

Glucose + H₂SO₄ -------- hydroxyl methyl furfural + 3H₂O
Xylose + HCl -------- furfural + 3H₂O
Furfural + α naphthol ------- violette ring
hydroxyl methyl furfural + α naphthol ------- violette ring
Furfural + orcinol ------- green ppt (Bial test)
hydroxyl methyl furfural + Resorcinol ------- red ppt (salwanoffe test)
THANK YOU