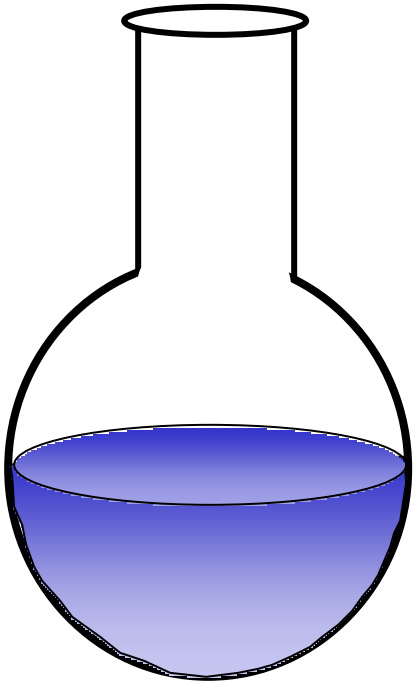
Chemistry in air...!

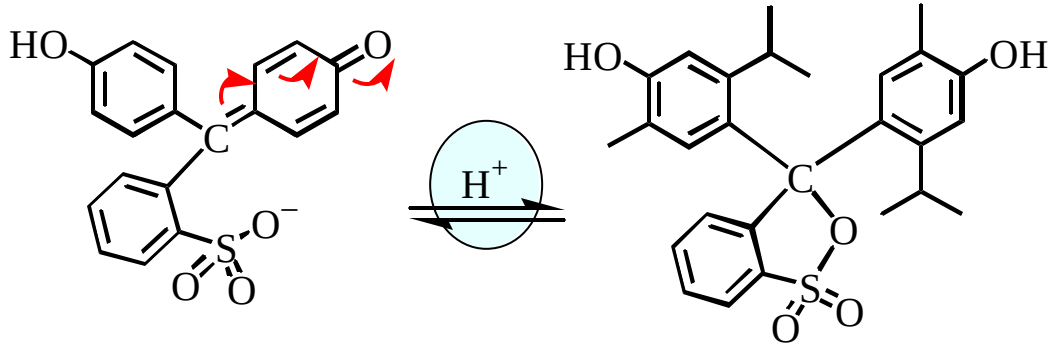
- What is ‘carbon dioxide? What is ‘nitrogen‘?
- When does a gas become a liquid?
- What is ‘ice‘, what is ,‘dry ice‘?

CO_2 = carbon dioxide at a glance...

CO_2 is a gas, but is solid as ‘dry ice‘ when pressurized

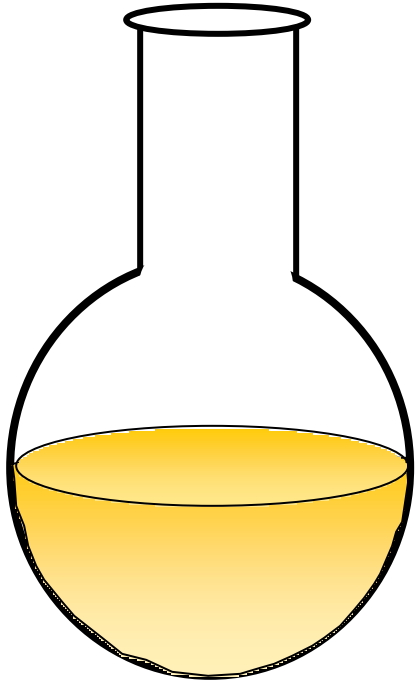
$$CO_2 + H_2O \rightleftharpoons H_2CO_3 \rightleftharpoons HCO_3^- + H^+$$





basic
blue

acidic
yellow



Chemistry in air...!

- What is ‘carbon dioxide? What is ‘nitrogen‘?
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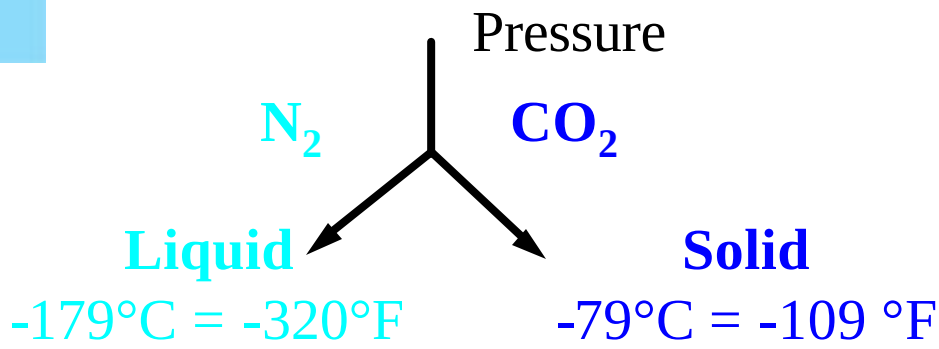
Nitrogen and carbon dioxide at a glance...

Composition of air:

Nitrogen (N_2): 78%

Oxygen (O_2): 21%

Carbon dioxide (CO_2), Ar: ~1%



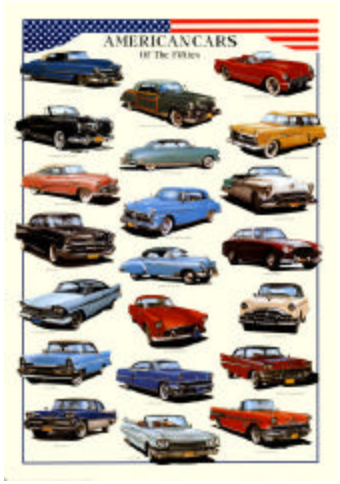
At –320 °F

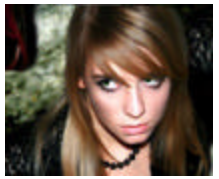
- solids become hard and brittle
- gases shrink

$$\underbrace{CO_2 + H_2O}_{\text{basic}} \rightleftharpoons HCO_3^- + H^+ \quad (\textit{acidic})$$

phenolphthaleine:	**pink (pH > 10)**	colorless (pH < 8)
bromothymol blue:	**blue (pH > 7.6)**	**yellow (pH < 6)**

... Different requirements for dyes for cars, clothes, cosmetics, toys, hair...

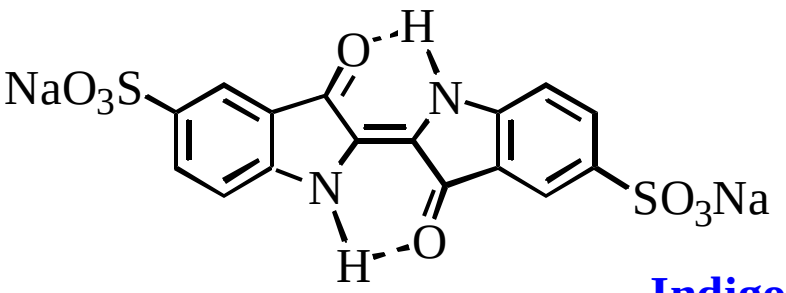




Dyeing jeans with indigo

Dyeing jeans at a glance...

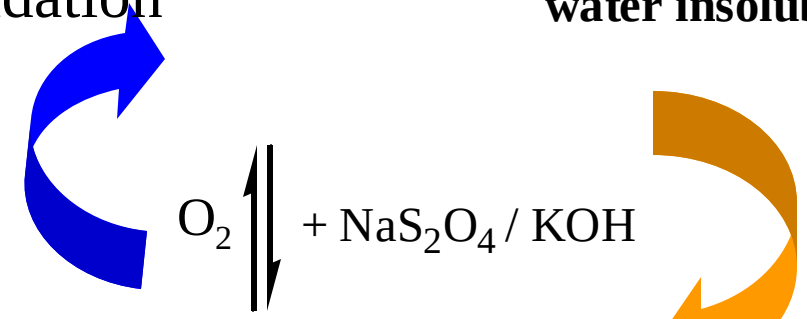
Isatis tinctoria L.



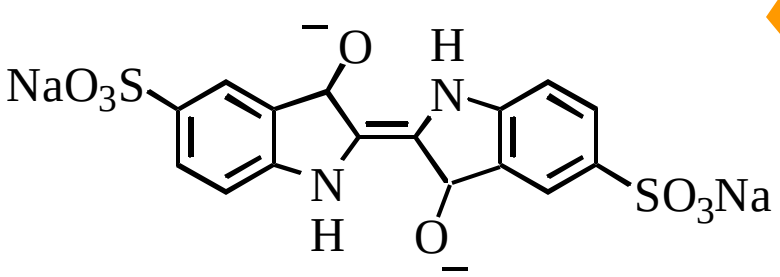
Indigo Carmine

water insoluble

Oxidation



Reduction



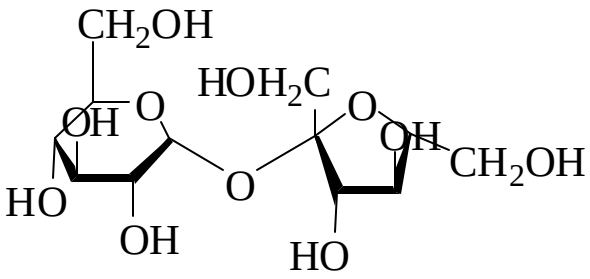
Indigo Carmine leuco form

water soluble

... Drying means removing water...

"Drying" sugar with sulfuric acid (H_2SO_4)..

table sugar



Sucrose

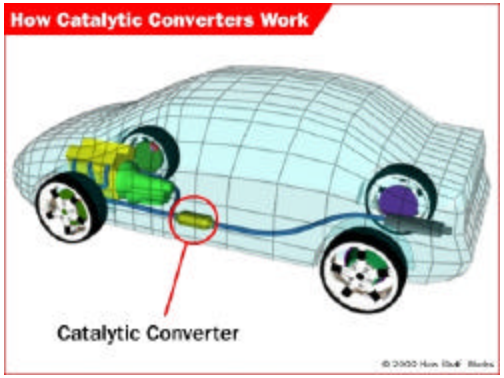
$2C_6H_{12}O_6$ carbo***hydrate***

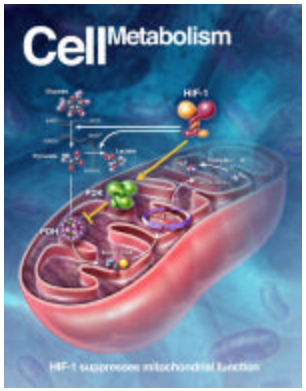
$2C_6(H_2O)_6$ + **H_2SO_4** ⟶ 12 C + $H_2SO_4 \cdot 12\ H_2O$

"hygroscopic" water-binding

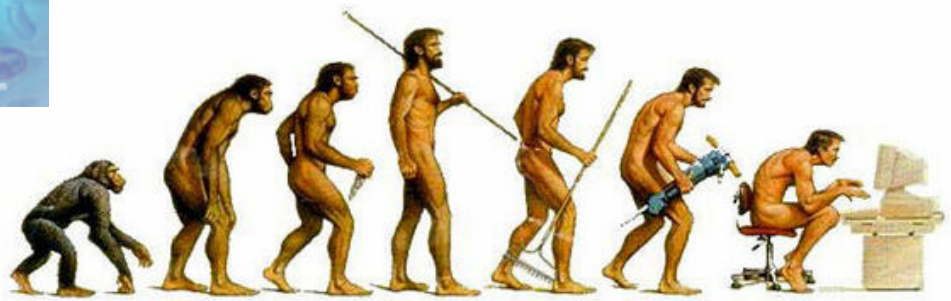
charcoal

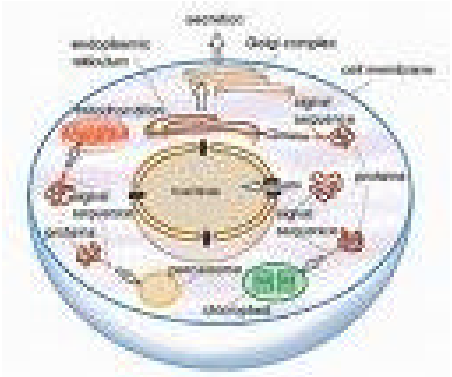
... Chemistry in our body uses catalysts to make reactions run faster





Cell suvival: H_2O_2 decomposition





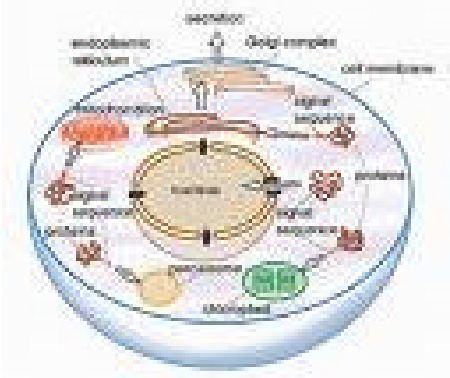
Cell survival at a glance...

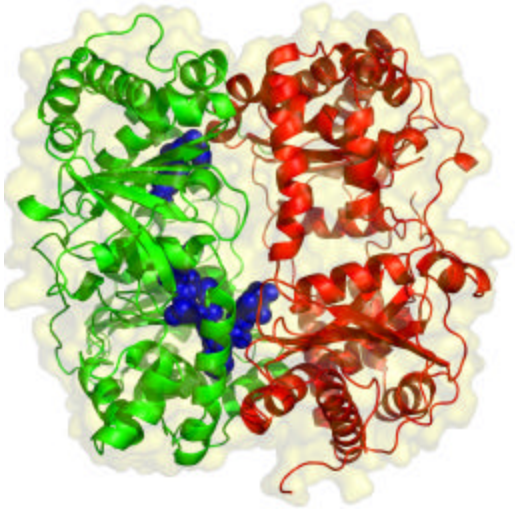
H_2O_2 cytotoxic by-product of cell metabolism

$$2\ H_2O_2 \xrightarrow{\textbf{catalyst}} O_2\uparrow + 2\ H_2O$$

catalysts in Nature: **enzymes**

cell function





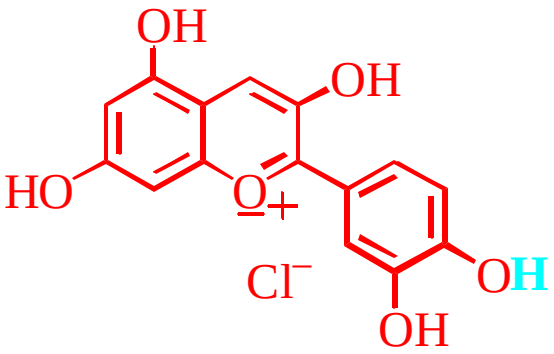
... chemistry brings color in our life...

- color depends on the pH of the soil

Roses in blue?

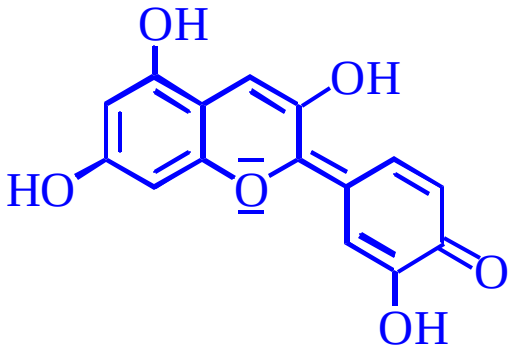
...'blue roses' at a glance...

$NH_3 + H_2O \longrightarrow NH_4^+ + OH^-$



OH^-

$-H_2O$



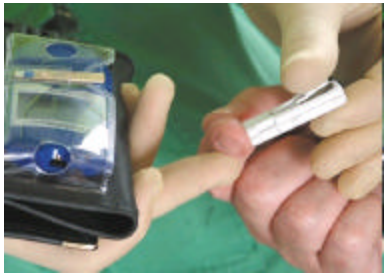
Anthocyanidin chloride (pH < 3)

Anthocyanidin (pH > 11)

...Better and safer drugs: medicinal chemistry...

- monitoring blood glucose

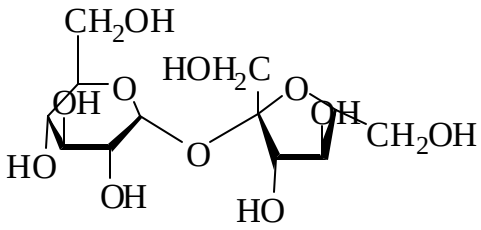
Candy isn‘t candy, sugar isn‘t sugar?

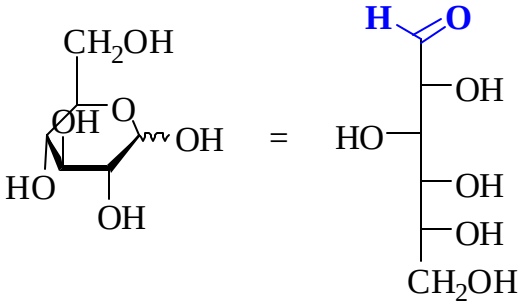


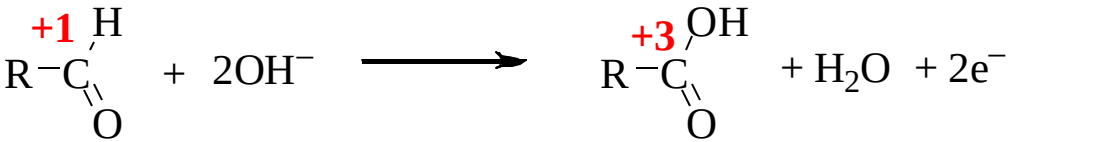
The Fehling reaction at a glance...

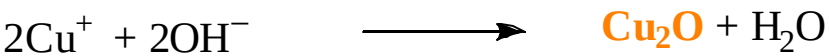
Table sugar

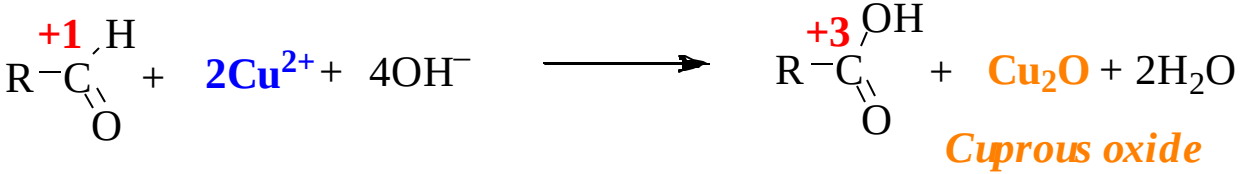
Dextrose







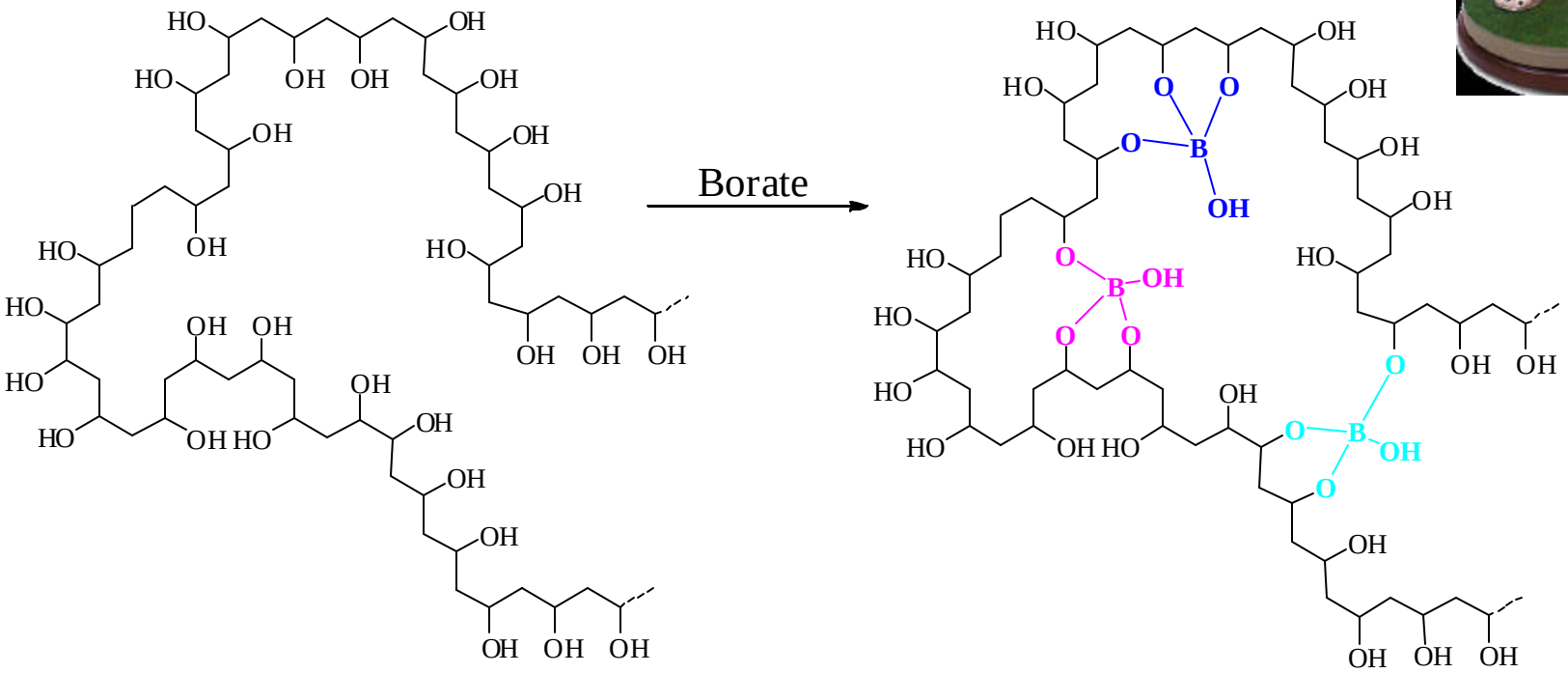




... Convenience and comfort: polymer chemistry

Make a polymer,
make your own gak !

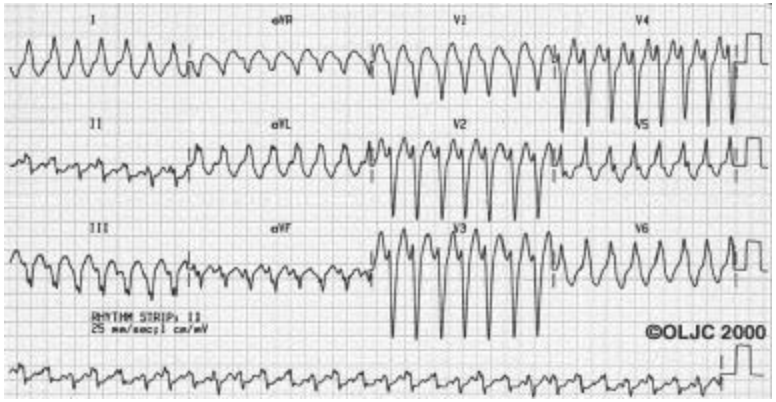
Cross-linking of polyvinyl alcohol



water-soluble, linear

not water-soluble, cross-linked

... Reactions in cycles: oscillating reactions...!



heart beat

Start all over again, and again, and again....

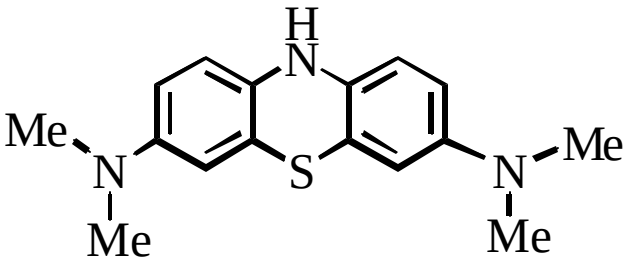
The blue bottle experiment

Reversible reduction and oxidation ...

oxidation:

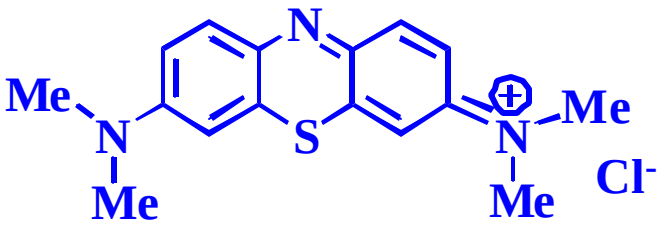
$$2\ \text{R-CHO} + 4\ \text{OH}^- \longrightarrow 2\ \text{R-COO}^- + 4\ \text{H}_2\text{O} + 4\ \text{e}^-$$

glucose — *gluconic acid*



reduced form

$H^+, 2e^-$



oxidized form

reduction:

$$O_2\ (aq) + 4e^- + 2H^+ \longrightarrow 2OH^-$$