

Effect of Branching and Classification on Alcohol Solubility

Structure	Name	Class	Solubility*
$\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{OH}$	1-Butanol	1°	8
$\begin{array}{c} \text{H}_3\text{C} \\ \\ \text{CH}-\text{CH}_2 \\ \quad \\ \text{H}_3\text{C} \quad \text{OH} \end{array}$	2-Methyl-1-propanol	1°	11
$\begin{array}{c} \text{H}_3\text{C}-\text{CH}-\text{CH}_2-\text{CH}_3 \\ \\ \text{OH} \end{array}$	2-Butanol	2°	12.5
$\begin{array}{c} \text{H}_3\text{C} \quad \text{OH} \\ \diagdown \quad / \\ \text{C} \\ / \quad \diagdown \\ \text{H}_3\text{C} \quad \text{CH}_3 \end{array}$	2,3-dimethylethanol	3°	completely soluble

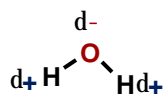
* Solubility in H₂O. Units: g/100ml

Properties of Alcohols

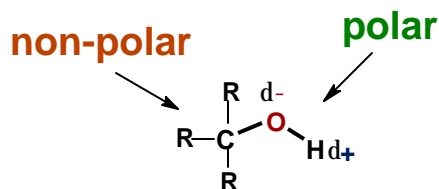
Intermolecular Interactions:

Alcohols are both polar and non-polar molecules

- have ability to H-bond with other alcohol molecules and with water.

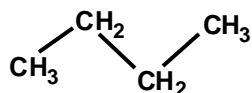


water



alcohol

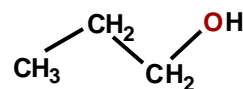
Boiling point:



butane

mw = 58 g/mol

bp = -0.4 °C



1-propanol

mw = 60 g/mol

bp = 97.2 °C

Solubility:

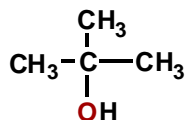
"like dissolves like" **BUT** what is more substantial ~ polar or non-polar part of molecule?

- 1) Mass of non-polar R group(s) ie. methanol more soluble than 1-pentanol

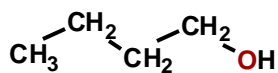
↑ mass, ↓ water solubility

- 2) Branching of molecule

↑ branching, ↑ water solubility



2-methyl-2-propanol
soluble



1-butanol
insoluble

isomers so
same mw

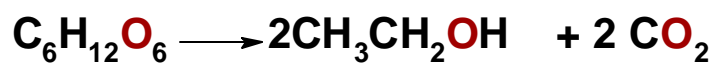
Medicinally Important Alcohols

1) Methanol CH_3OH

- colorless and odorless
- AKA wood alcohol because product of heating wood in absence of air
- fuel for formula racing cars
- causes blindness and death if ingested.

2) Ethanol $\text{CH}_3\text{CH}_2\text{OH}$

- Alcohol in beverages
- produced by fermentation



glucose ethanol

- 12 - 13% alcohol threshold for yeast that produce ethanol

3) 2-propanol (aka isopropyl alcohol) $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$

- rubbing alcohol
- disinfectant
- toxic

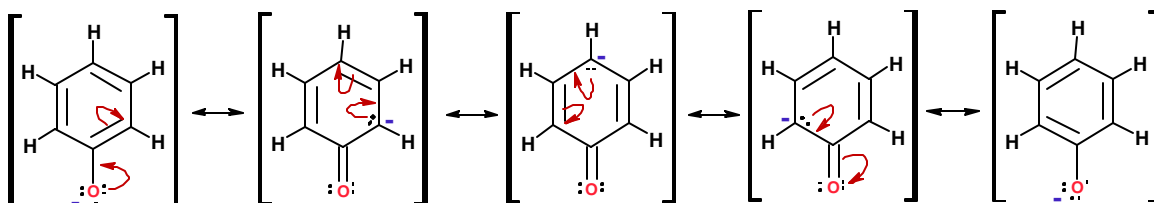
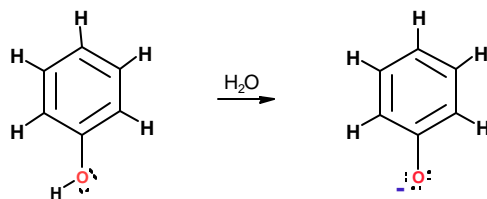
4) 1,2-ethanediol (aka ethyleneglycol) $\text{CH}_2(\text{OH})\text{CH}_2(\text{OH})$

- Antifreeze
 - increases bp and decreases fp of water
- green color is added
- Sweet and toxic

5) 1,2,3-propanetriol (aka glycerol) $\text{CH}_2(\text{OH})\text{CH}(\text{OH})\text{CH}_2(\text{OH})$

- Sweet, viscous liquid
- cosmetics, lubricants and pharmaceuticals

Resonance Structures of Phenolate Ion



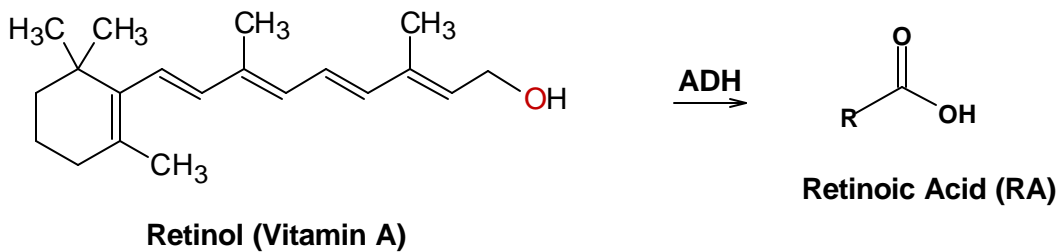
Fetal Alcohol Syndrome

- Leading cause of mental retardation in US
 - Surpassed Down's Syndrome
 - At least 5000 births/year (JAMA)
 - COMPLETELY PREVENTABLE

Symptoms:

- Mental retardation
- Motor effects
- Cranial/facial deformations
- Neurological dysfunction
- Growth retardation

Speculated cause of Cranial/facial deformations



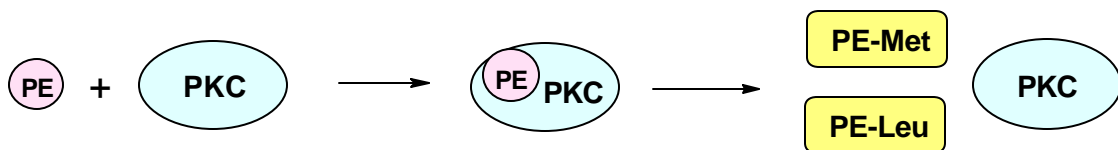
Retinoic acid is CRUCIAL for fetal development!

- Found in limb buds and brain
- Controls differentiation

Speculative cause of mental retardation and neurological damage.

Protein Kinase C (PKC)

- Involved in signal transduction within cells.



Inhibit neuronal proliferation