Organic Chemistry

2nd stage

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Lecture 5: Alcohol

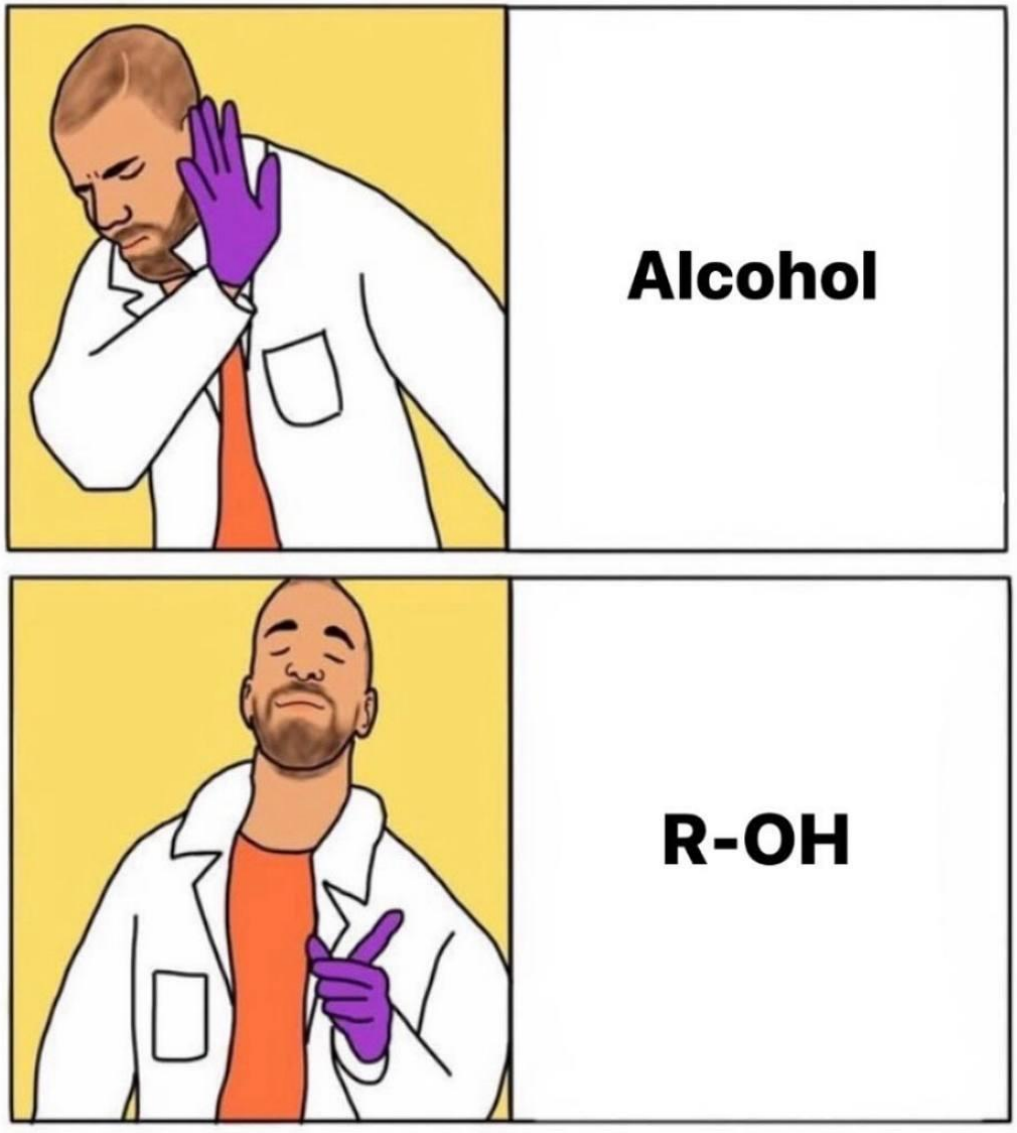
Department of Bio chemistry

Introduction of ALcohol

- **What are Alcohols?**

Organic compounds containing a hydroxyl (-OH) group attached to a carbon atom.

- **General formula:** R-OH (where R is an alkyl or aryl group).


Alcohol
R-OH

Alkyl Group

- alkyl group is a chemical group derived from alkanes by removing one hydrogen atom. It is hydrophobic and nonpolar, typically represented by the symbol R-.

General Formula of Alkyl Groups:

- If the parent alkane has the formula C_nH_{2n+2},
- alkyl group will have the formula C_nH_{2n+1} after the removal of one hydrogen atom.

- Examples of Common Alkyl Groups:

- Alkane Name Derived Alkyl Group Chemical Formula
- Methane (CH_4) Methyl -CH_3
- Ethane (C_2H_6) Ethyl -C_2H_5
- Propane (C_3H_8) Propyl -C_3H_7

Aryl Group

- aryl group is a group derived from arenes (aromatic compounds) by removing one hydrogen atom from the aromatic ring, allowing it to bond with other molecules. It is typically represented by the symbol Ar-.

- Examples of Common Aryl Groups:

- Aromatic Compound Derived Aryl Group Chemical Formula
- Benzene (C_6H_6) Phenyl -C_6H_5
- Toluene ($C_6H_5CH_3$) Benzyl -$C_6H_5CH_2$

Alkyl Groups

—CH_3 , Methyl, Me—

—C_2H_5, Ethyl, Et—

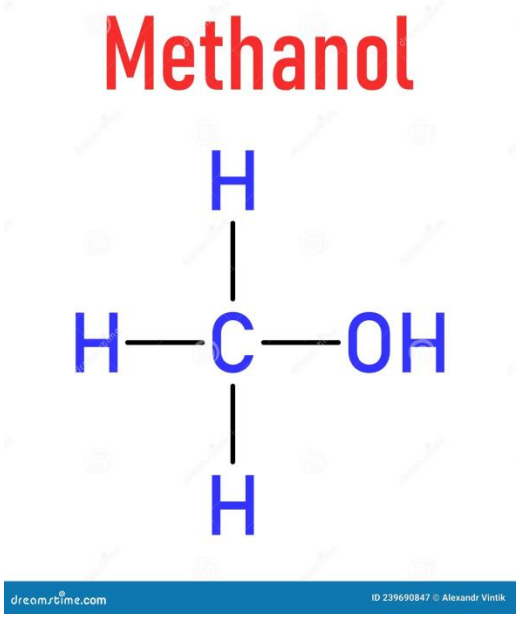
—C_3H_7, Propyl, Pr—

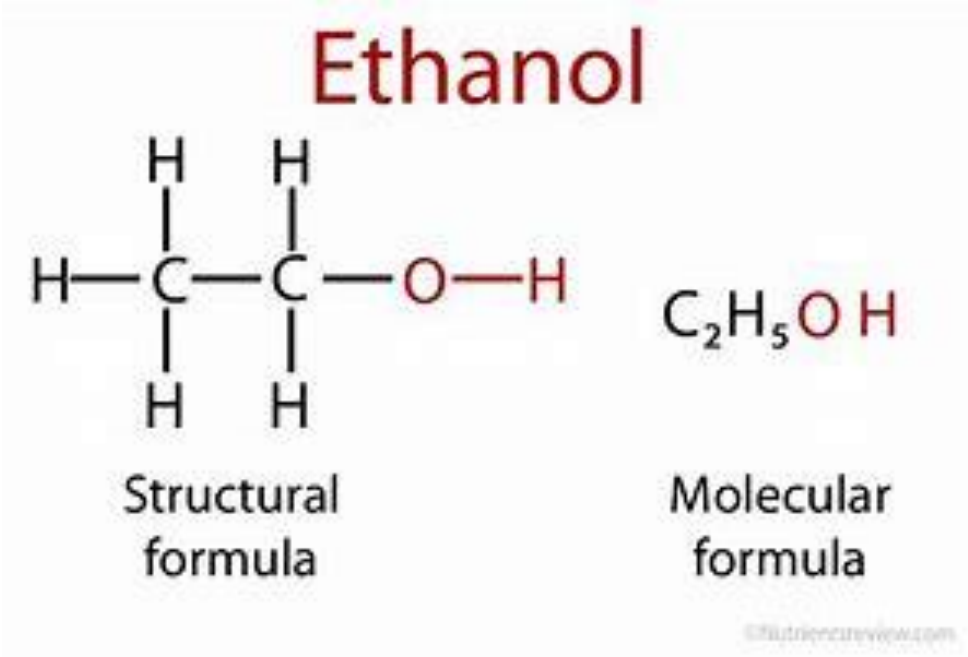
Aryl Groups

—C_6H_5,Phenyl, Ph—

- **Examples:**

1. Methanol (CH_3OH)
2. Ethanol (C_2H_5OH)



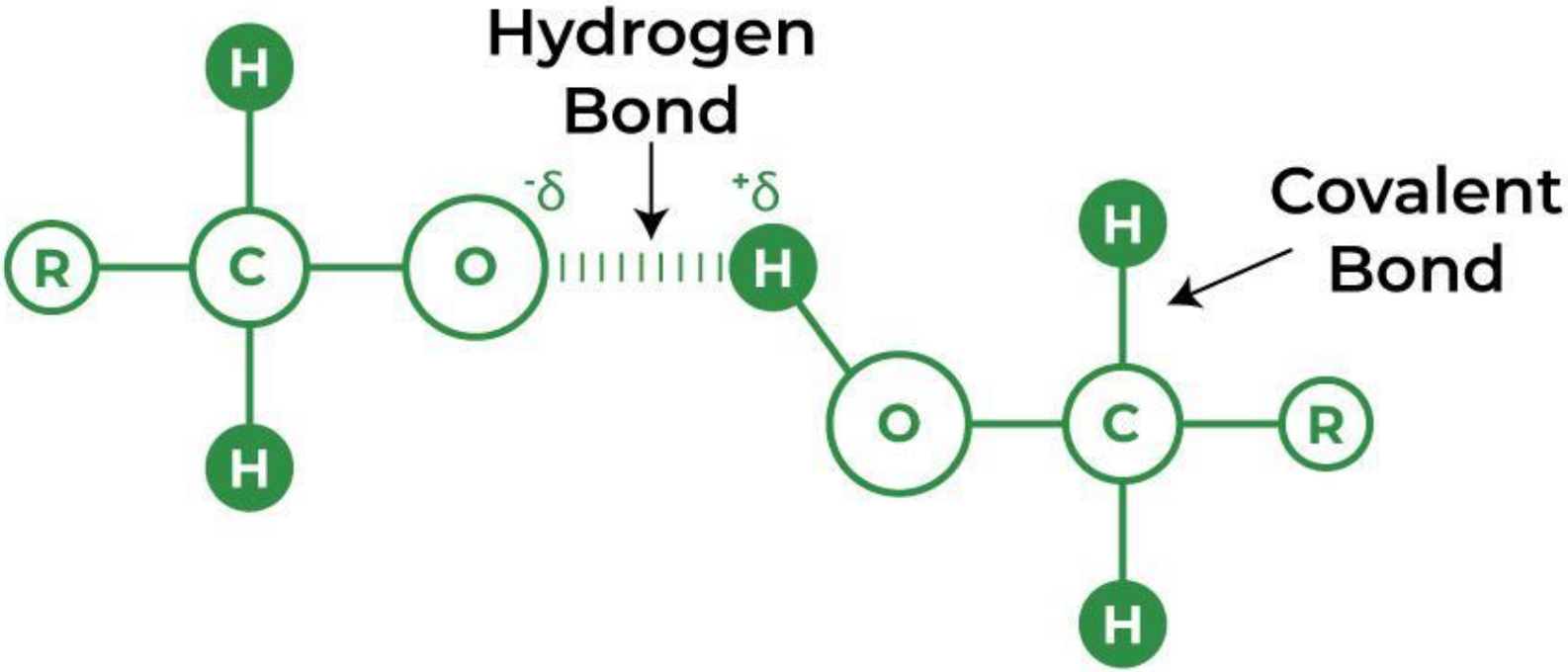


Structure of Alcohols

- The **-OH** group is polar

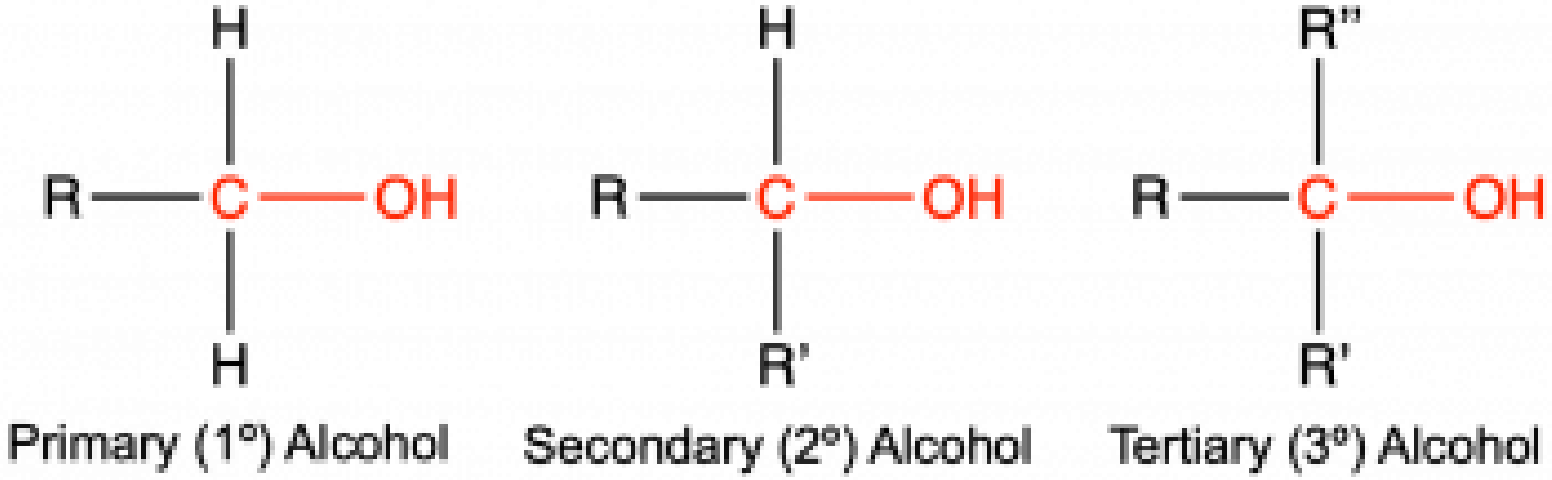
due to the electronegativity difference between oxygen and hydrogen.

- The carbon attached to -OH is sp^3 hybridized.



Hydrogen Bonding in Alcohols

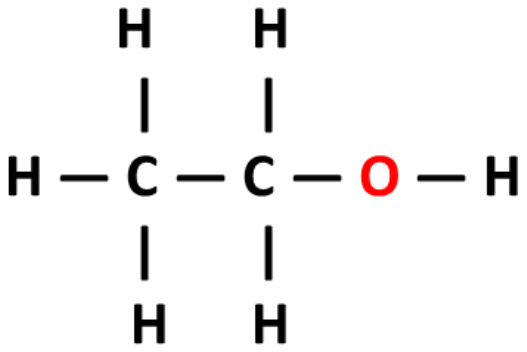
Classification of Alcohols



Primary (1°) Alcohols:

The -OH group is attached to a carbon bonded to only one other carbon.

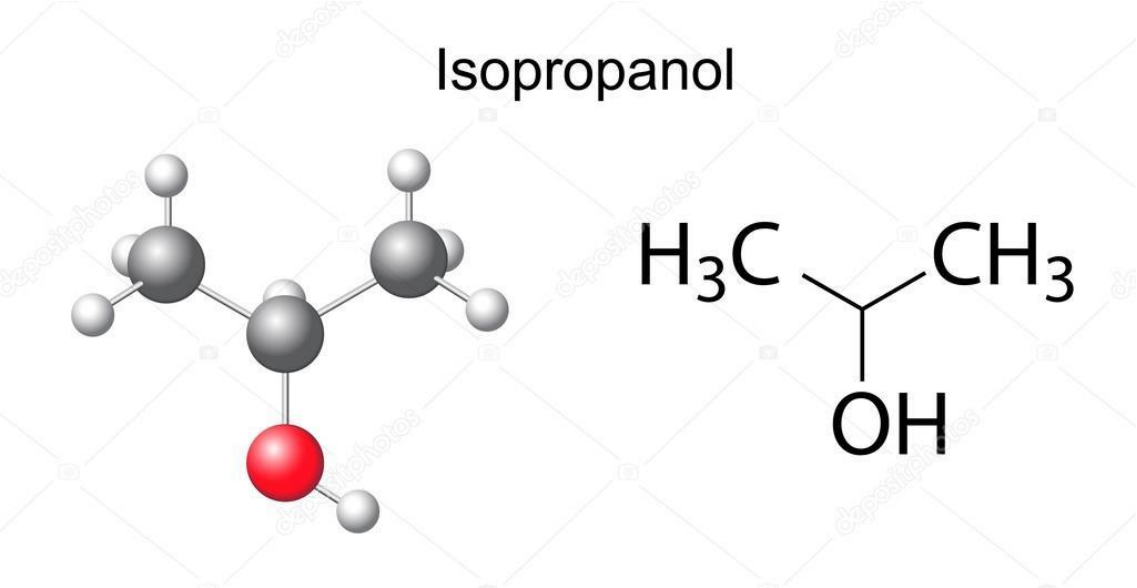
Example: Ethanol (CH_3CH_2OH).



2- Secondary (2°) Alcohols:

- The -OH group is attached to a carbon bonded to two other carbons.

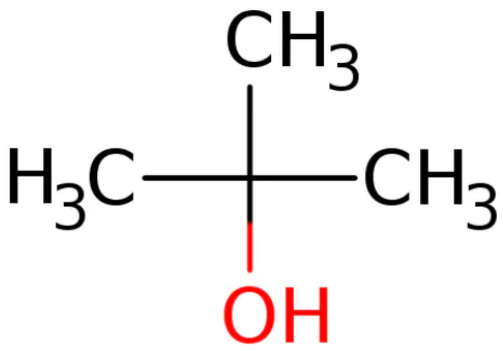
Example: **Isopropanol ($CH_3CHOHCH_3$).**



3- Tertiary (3°) Alcohols:

The -OH group is attached to a carbon bonded to three other carbons.

Example: **tert-Butanol [$(CH_3)_3COH$].**



Physical Properties of Alcohols

1. **Boiling Points:**

Higher than alkanes due to hydrogen bonding.

2. **Solubility:**

Small alcohols (e.g., methanol, ethanol) are soluble in water.

Solubility decreases as the carbon chain length increases.

Uses of Alcohols

1- Industrial Uses:

- Solvents, fuels, antifreeze, and disinfectants.

2- Biological Importance:

- Ethanol in medicine methanol in labs.

Toxicity of Alcohols

1. Methanol:

Highly toxic; can cause blindness or death.

2. Ethanol:

Safe in small amounts but toxic in large quantities.