

The Chemistry of -OH and -O-

Substituting a single hydrogen atom to unlock new materials.



Alcohols



Phenols



Ethers



What are alcohols?

The Transformation Equation



Classification

-OH is attached to an sp^3 hybridized carbon atom.

Primary (1°): $-\text{CH}_2-\text{OH}$

Secondary (2°): $>>\text{CH}-\text{OH}$

Tertiary (3°): $>>\text{C}-\text{OH}$

Safety Note: Methanol (CH_3OH)

Highly poisonous. Ingestion of even small quantities can cause blindness; large quantities cause death.

What are phenols?

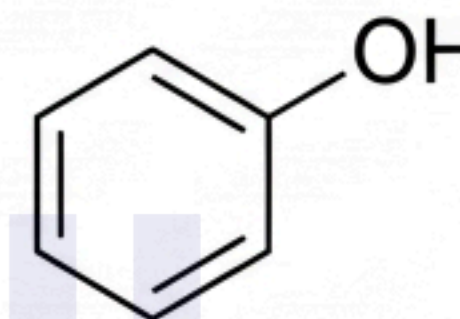
The Transformation Equation

Benzene Ring
(C_6H_6)

Minus H, Plus -OH



Phenol
(Ar-OH)



Core Definition

Contains -OH group(s) directly attached to carbon atom(s) of an aromatic system.

Important Note

The sp^2 Difference

The -OH group is attached to an sp^2 hybridized carbon and conjugates with the aromatic ring. This partial double bond character fundamentally alters its chemical behavior.



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$$E=mc^2$$



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Key Highlights

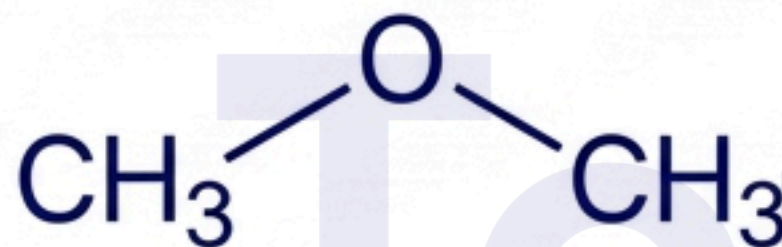
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What are ethers?



The Oxygen Bridge



A hydrocarbon where a hydrogen is replaced by an alkoxy or aryloxy group.

Simple / Symmetrical

Alkyl/aryl groups are identical.

Diethyl ether ($C_2H_5 - O - C_2H_5$)

Mixed / Unsymmetrical

Alkyl/aryl groups are different.

Ethyl methyl ether ($C_2H_5 - O - CH_3$)

Daily-life applications of $-OH$ and $-O-$



Ordinary Spirit

Ethanol (an alcohol) used for polishing wooden furniture.



Sugar

Energy sources packed with multiple $-OH$ groups.



Cotton & Paper

Cellulose fabrics and writing materials rely heavily on long chains of $-OH$ groups.



Fragrances

Synthesized utilizing Ether compounds.



Antiseptics

Historically and currently formulated using Phenol derivatives.

Structural Comparison Matrix

	Alcohols	Phenols	Ethers
Functional Group	-OH (Hydroxyl)	-OH (Hydroxyl)	-O- (Alkoxy/Aryloxy)
Carbon Attachment	sp ³ hybridized aliphatic carbon	sp ² hybridized aromatic carbon	Bridges two alkyl/aryl groups
General Formula	R-OH	Ar-OH	R-O-R'
Example	Methanol (CH ₃ OH)	Phenol (C ₆ H ₅ OH)	Dimethyl ether (CH ₃ OCH ₃)

Key Takeaway

**Substituting just one hydrogen atom
a hydrocarbon with an oxygen-based
group completely rewrites the
molecule's physical properties.**

This single modular change transforms basic hydrocarbons into the active detergents, antiseptics, and fragrances that build our modern world.



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