

# **Epoxides**

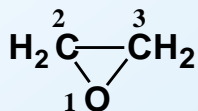
## **Nomenclature**

### **Synthesis and Reactions**

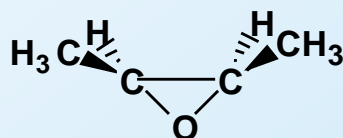
Dr. Sapna Gupta

# Epoxides

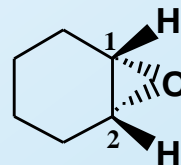
- Epoxide: A cyclic ether in which oxygen is one atom of a three-membered ring.
  - Simple epoxides are named as derivatives of oxirane.
  - Where the epoxide is part of another ring system, it is shown by the prefix epoxy-.
  - Common names are derived from the name of the alkene from which the epoxide is formally derived.



Oxirane  
(Ethylene oxide)



*cis*-2,3-Dimethyloxirane  
(*cis*-2-Butene oxide)

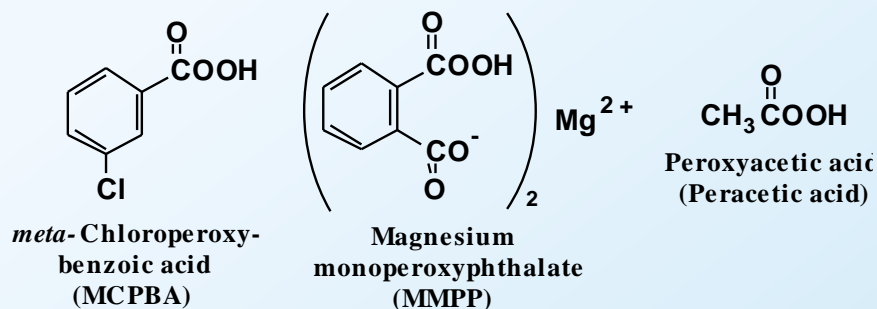


1,2-Epoxycyclohexane  
(Cyclohexene oxide)

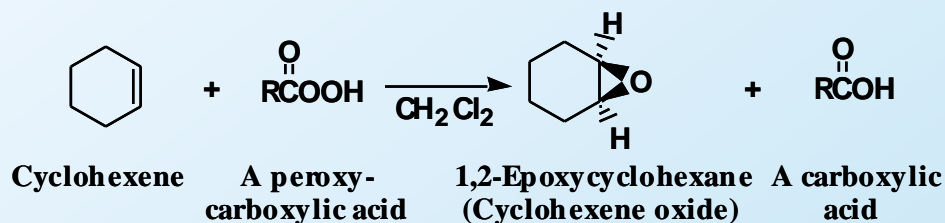
# Synthesis of Epoxides

1) **From Peroxides:** The most common method is oxidation of an alkene using a peroxy-carboxylic acid (a peracid).

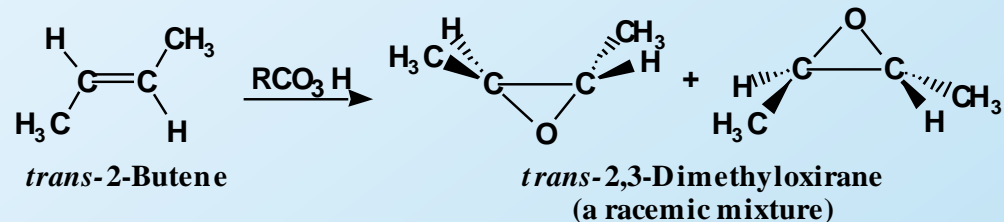
## Reagents



## Example

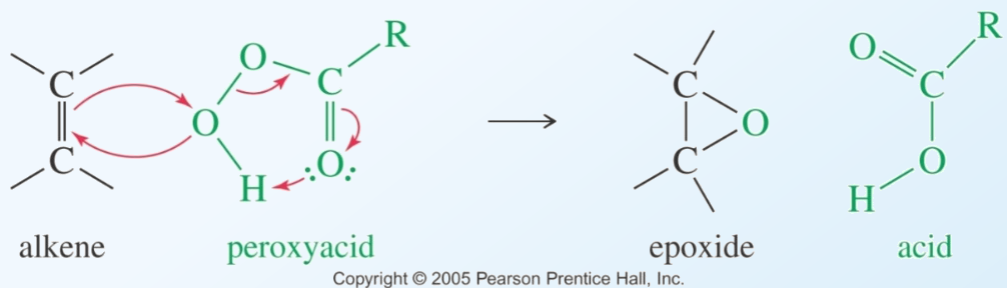


## Stereospecificity

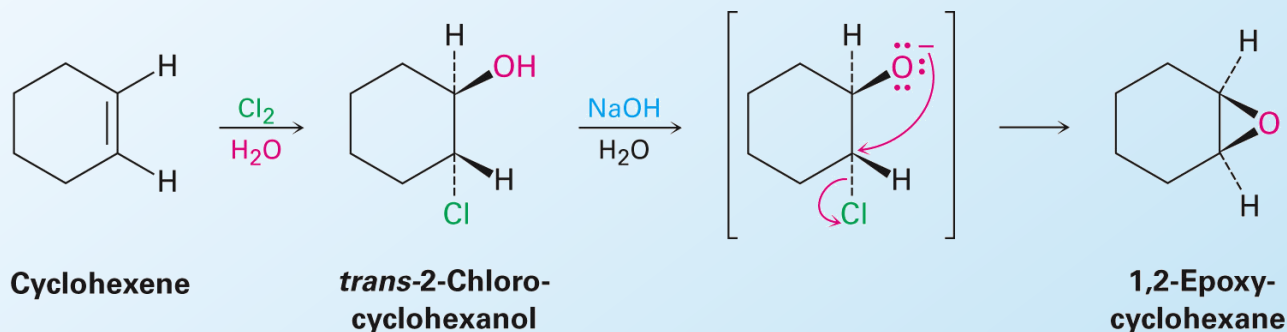


# Synthesis of Epoxides, contd...

## Peroxyacid epoxidation mechanism

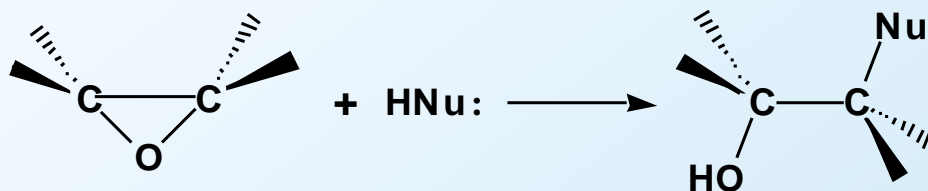


## 2) Cyclization of Halohydrin (intermolecular William synthesis)



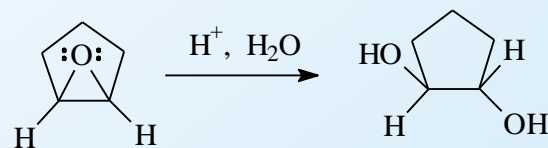
# Reactions of Epoxides

- Ethers are not normally susceptible to attack by nucleophiles.
- Because of the strain associated with the three-membered ring, epoxides readily undergo a variety of ring-opening reactions.

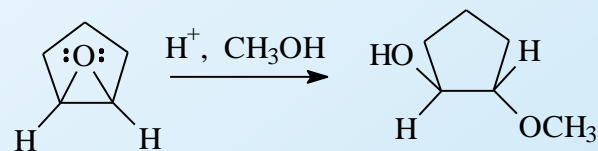


# Reactions - Epoxide Ring Opening in Acid

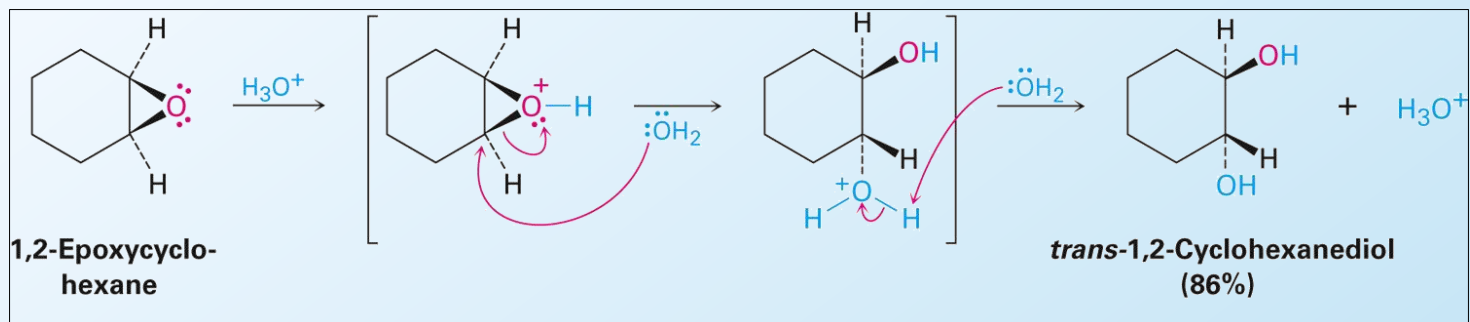
- Trans diol formed in water solvent.



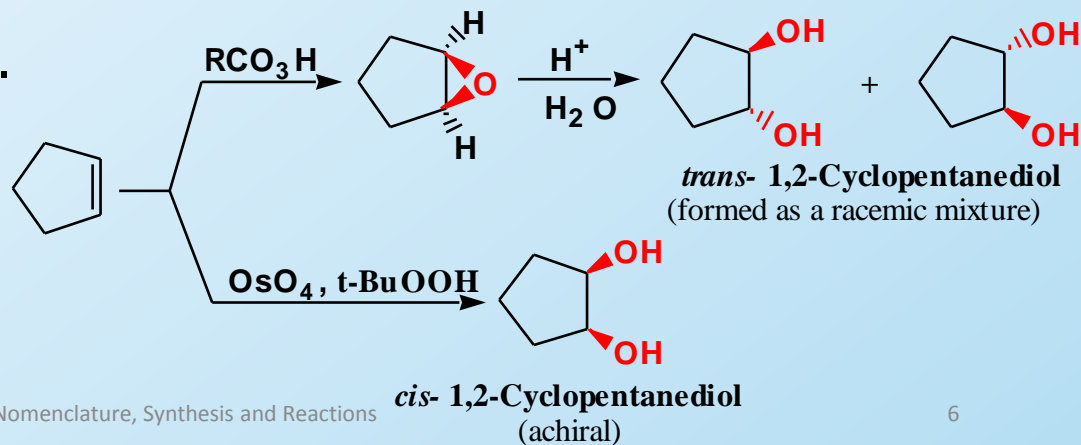
- Alkoxy alcohol formed in alcohol solvent.



- Mechanism

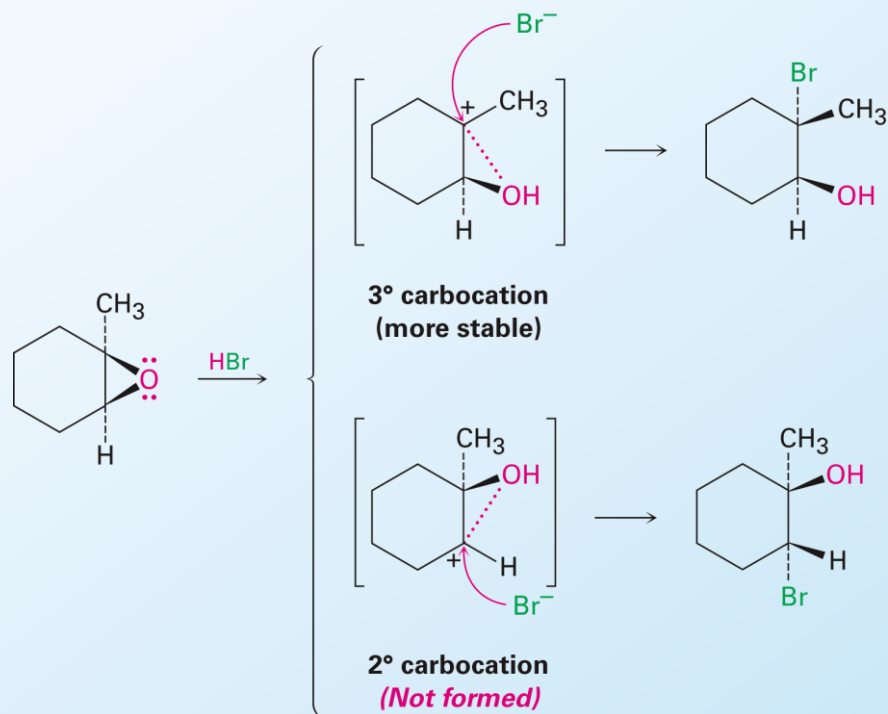


- Stereochemistry of the glycols.



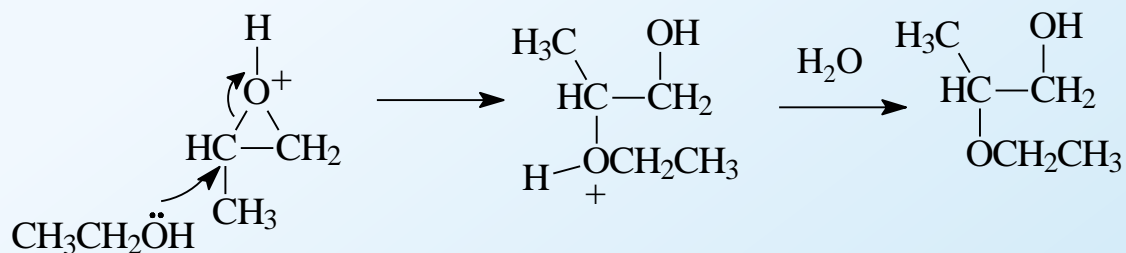
# Regiochemistry of Acid Catalyzed Ring Opening of Epoxides

- Nucleophile preferably adds to more substituted carbon site if primary and secondary C's

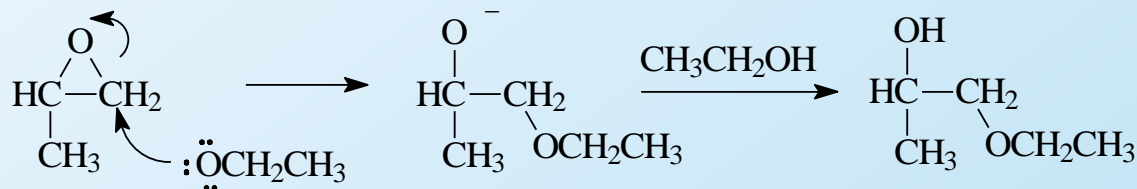


# Reactions - Epoxide Ring Opening: Acids Vs Bases

- In acid, the nucleophile attacks the protonated epoxide at the most substituted carbon



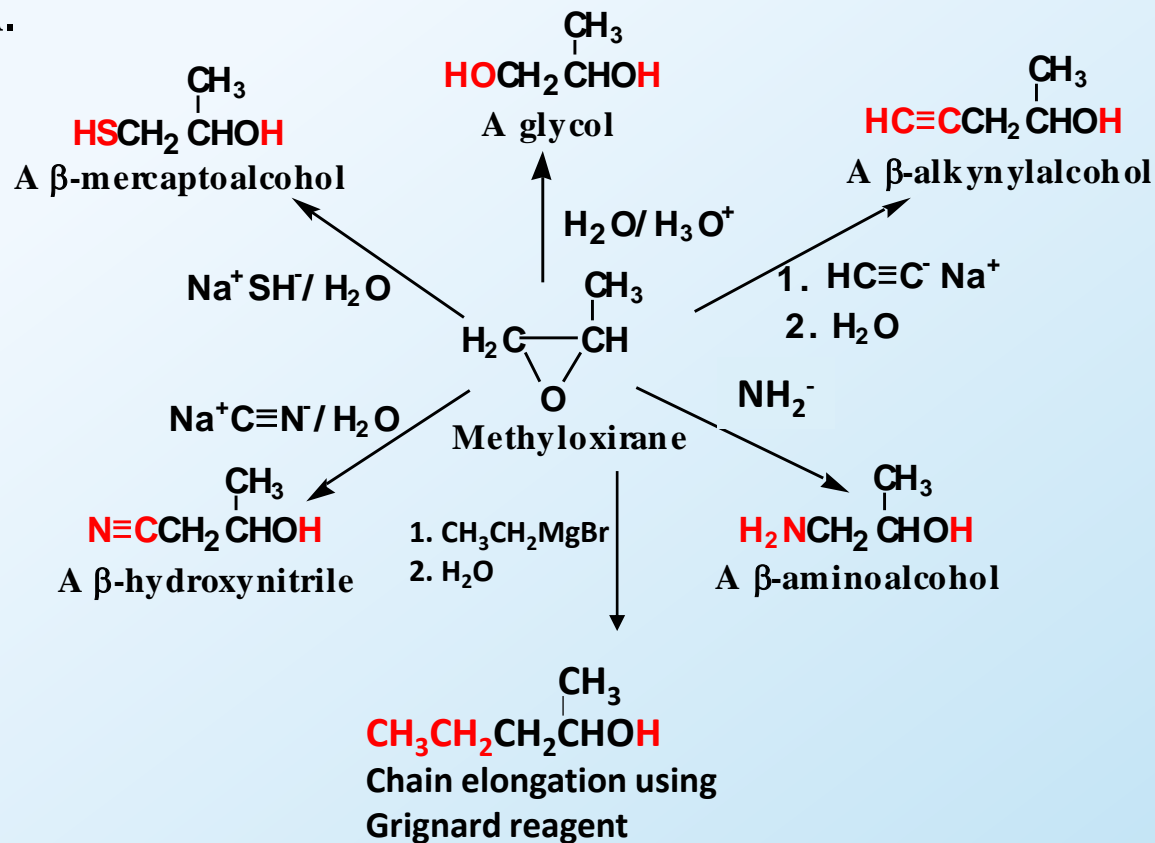
- Base attacks the least hindered carbon.





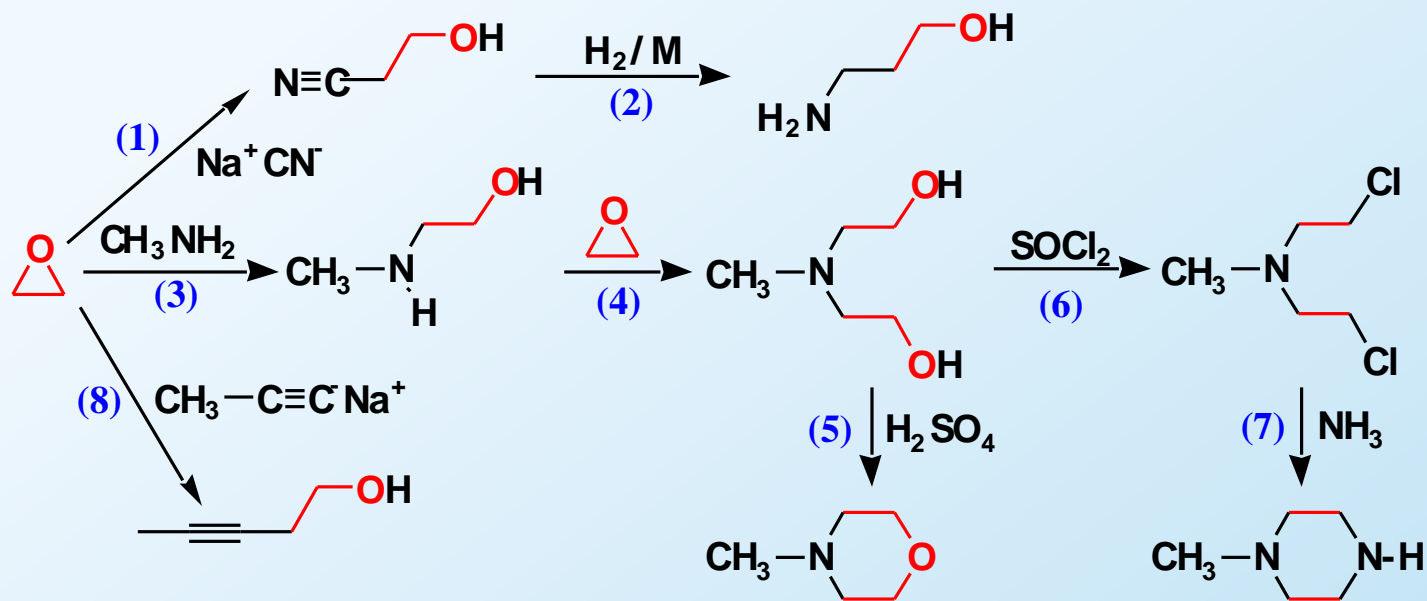
# Reactions of Epoxides, contd...

The value of epoxides is the variety of nucleophiles that will open the ring and the combinations of functional groups that can be prepared from them.



# Ethylene Oxide

Ethylene oxide is a valuable building block for organic synthesis because each of its carbons may be converted to a functional group.



# Applications of Ethers

- Most commonly – for epoxy resins. A polymer used as an adhesive to protect the surface.

Epoxy resin + hardener = polymer

- Cross linking makes the epoxy resin a good coating agent.

# Key Concepts

- Epoxides
- Peracids
- Ring openings
  - Stereospecific