### What?

**Alcohols** are compounds whose molecules have a hydroxyl group attached to a **saturated** carbon atom. Compounds that have a hydroxyl group attached directly to a benzene ring are called **phenols**. Ethers differ from alcohols in that the oxygen atom of an ether is bonded to two carbon atoms.

### Why?

Nature is an abundant source of alcohols and ethers.

Menthol, found in peppermint oil, is an alcohol used both for flavoring and medicinal purposes. Ethanol, the alcohol produced by fermentation, is often used in alcoholic beverages and a promising alternative fuel. And eucalyptol, which shares the ending of its name with other alcohols but is actually an ether, comes from eucalyptus leaves and is used as a flavoring, scent, and medical agent.

1. **Methyl tert-butyl ether (MTBE)** was commonly used as an anti-knocking agent in gasoline. Below are shown two different syntheses. One pathway is much more efficient than the other.
   
   a. Give a mechanism for each synthesis.
   
   b. Determine which pathway is more efficient.

   ![MeTHOle synthesis](image)

2. Using reactants and reagents containing four carbon atoms or less, propose a synthesis of the following ether.

   ![Ether structure]
3. Predict and draw the structures of compounds A - D. All four compounds are made as racemic mixtures.

Challenge Problem

4. Propose a synthesis of the following compound starting from cyclopentane and any other reagent necessary. HINT: you may need to use CH₃Li somehow to add that methyl group.