# Substitution and Elimination
# Learning Objectives

**Here are the skills you should have for most chapters on alcohols, ethers, and epoxides:**

**1)** Know the reactions from previous chapters for synthesizing alcohols and epoxides:
   1) hydration of alkenes (via $H^+/H_2O$ or oxymercuration-demercuration)
   2) hydroboration of alkenes
   3) halohydrin formation from alkenes=
   4) substitution rxns using NaOR or NaOH as nucleophile (note: these reactions may compete with elimination and thus give lower yields of the desired alcohol or ether product)
   5) epoxidation of alkenes using $RCO_3H$

**2)** Be able to compare the physical properties (b.p., m.p., density) of alcohols and ethers with that of other functional groups.

**3)** Be able to compare the acidity of alcohols with other acids, both organic and inorganic (see Table)

**4)** Understand the processes of oxidation and reduction as they apply to organic compounds & reactions.

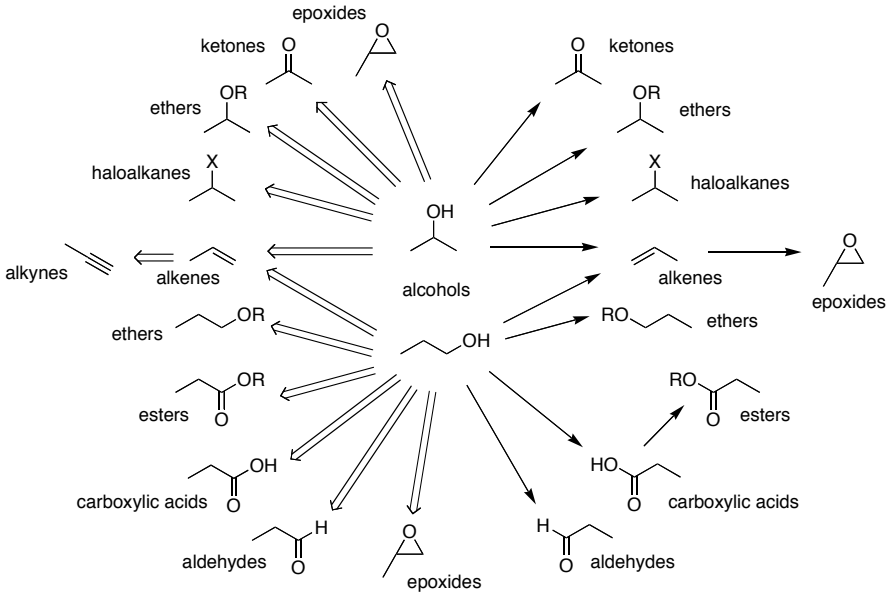
**5)** Understand the reactivity (i.e. the lack thereof) of ethers.

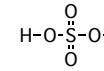
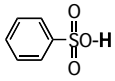
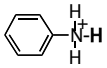
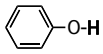
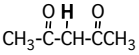
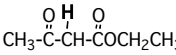
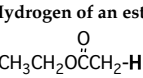
**6)** Understand the utility of epoxides and be able to recognize when one is needed in a synthesis.

**7)** Recognize when a carbon atom of an organic compound can act as an electrophile.

**8)** Recognize when a carbon atom of an organic compound can act as a nucleophile.

**9)** Understand that alcohols are key intermediates and starting materials in many important syntheses.
   a. They can be made regioselectively
   b. They can be made stereoselectively
   c. They are the products of many C-C bond forming reactions
   d. They can be protected




| Class and Example | Typical p$K_a$ |
|---|---|
| **Hydrogen halide** H–I , H–Br , H–Cl | -11, -9, -8 |
| **Sulfuric acid**  | -3 (2nd = 1.99) |
| **Hydronium** $H_3O^+$ | -1.7 |
| **Sulfonic acid**  | 0-1 |
| **Carboxylic acid**  | 3-5 |
| **Arylammonium ion**  | 4-5 |
| **Hydrogen cyanide** HCN | 9.2 |
| **Thiol** $CH_3CH_2S$-H | 8-12 |
| **Phenol**  | 9-10 |
| **β-Diketone**  | 10 |
| **Alkylammonium ion** $(CH_3CH_2)_3\overset{+}{N}$-H | 10-12 |
| **β-ketoester**  | 11 |
| **Water** HO-H | 15.7 |
| **Alcohol** $CH_3CH_2O$-H | 16-19 |
| **α-Hydrogen of an aldehyde or ketone**  | 18-20 |
| **α-Hydrogen of an ester**  | 23-25 |
| **Terminal Alkyne** R–C≡C–H | 25 |
| **Amine**  | 35-38 |
| **Alkene**  | 45 |
| **Alkane** R–H | >50 |