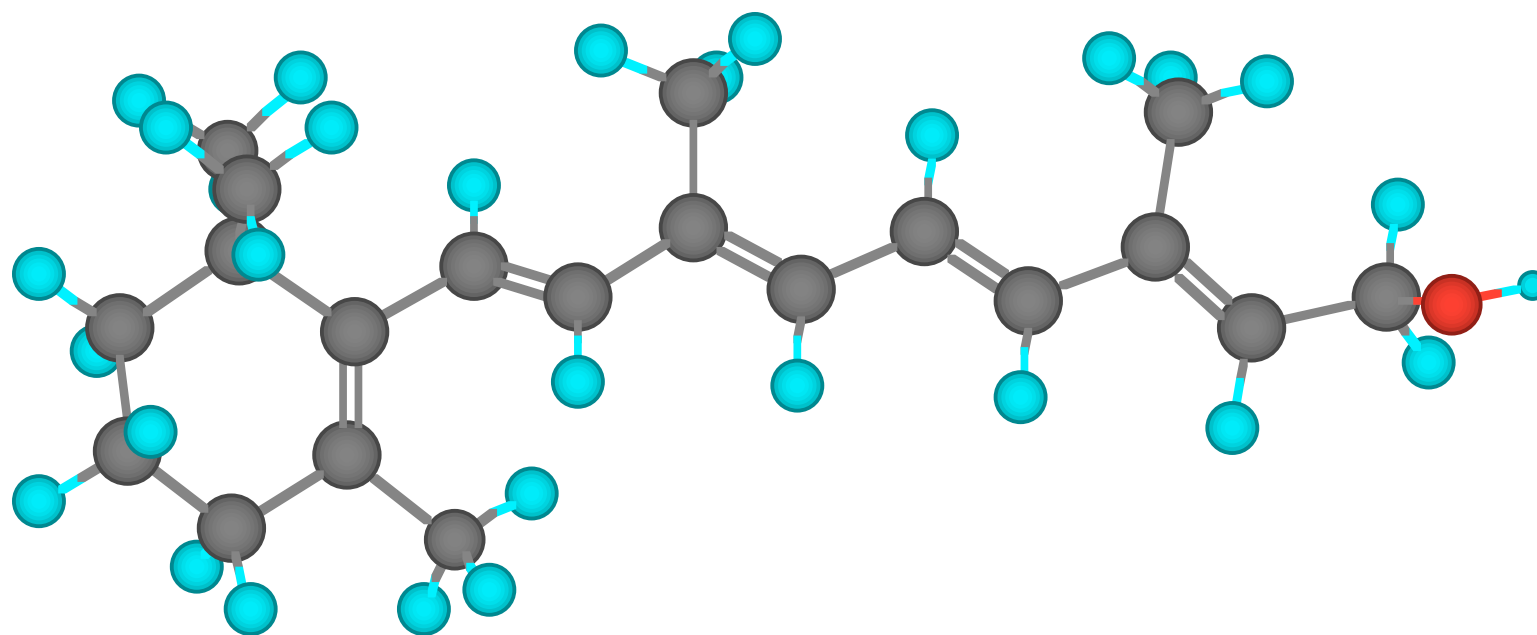
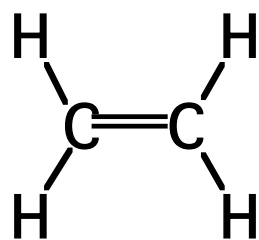

Chapter 6: Alkenes: Structure and Reactivity

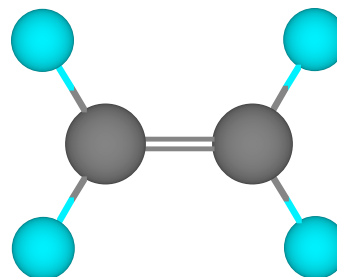


Unsaturated Hydrocarbons

- **Unsaturated hydrocarbon:** contains one or more carbon-carbon double or triple bonds
 - **alkene:** contains a carbon-carbon double bond and has the general formula C_nH_{2n}

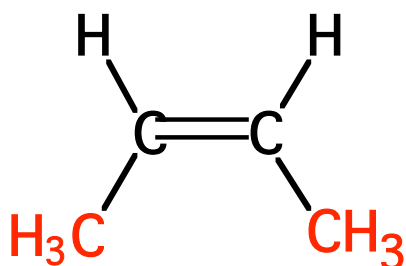


Ethene
(an alkene)

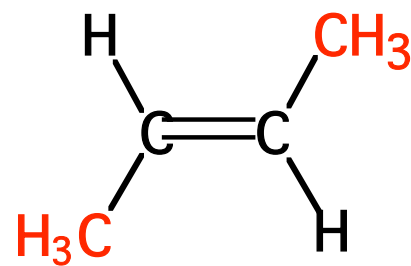


Cis-Trans Isomerism

- Because of **restricted rotation** about a C-C double bond, groups on adjacent carbons are either **cis** or **trans** to each other



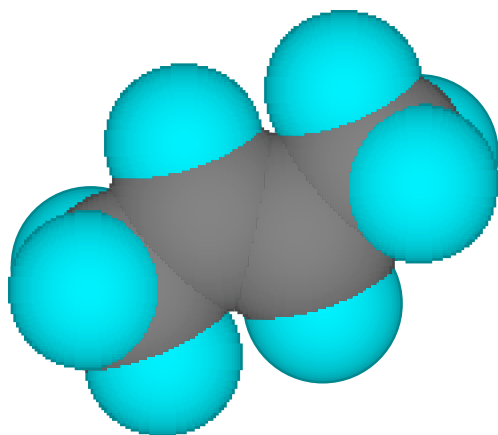
cis-2-Butene
mp -139°C, bp 4°C



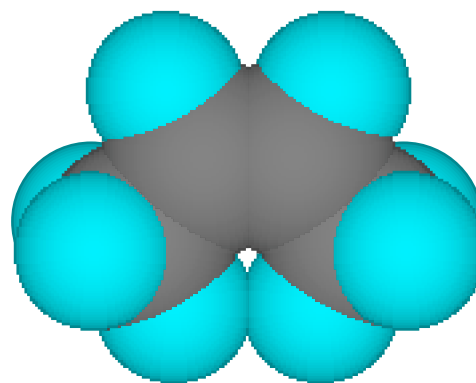
trans-2-Butene
mp -106°C, bp 1°C

Cis-Trans Isomerism

- **trans alkenes are more stable than cis alkenes because of nonbonded interaction strain between alkyl substituents of the same side of the double bond**



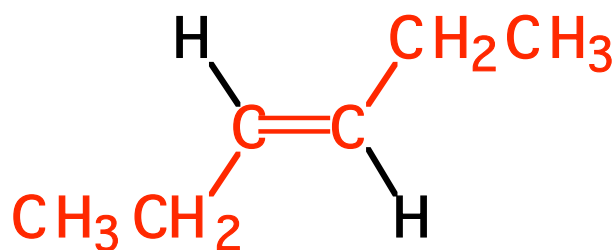
trans-2-Butene



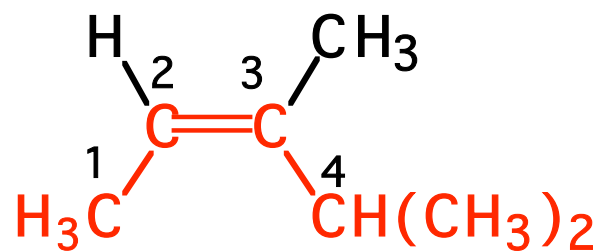
cis-2-Butene

Configuration: Cis-Trans

- **The cis,trans system:** configuration is determined by the orientation of atoms of the main chain



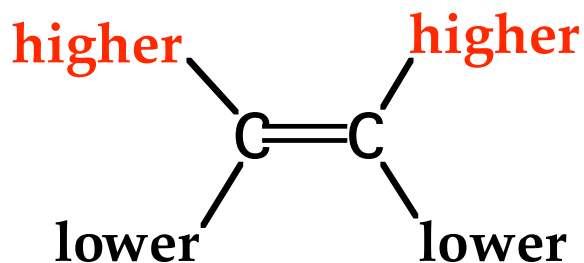
trans-3-Hexene



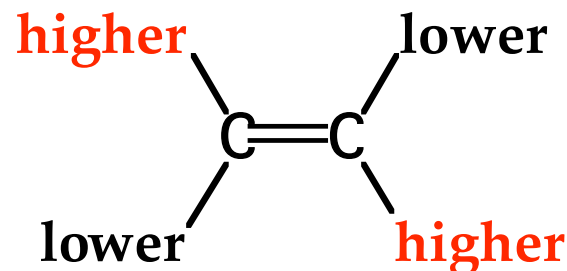
cis-3,4-Dimethyl-2-pentene

Configuration: E,Z

- Assign a priority to the substituents on each carbon of the double bond
 - if the groups of higher priority are on the same side of the double bond, the configuration is **Z** (German: *zusammen*, together)
 - if the groups of higher priority are on opposite sides of the double bond, the configuration is **E** (German: *entgegen*, opposite)



Z (zusammen)

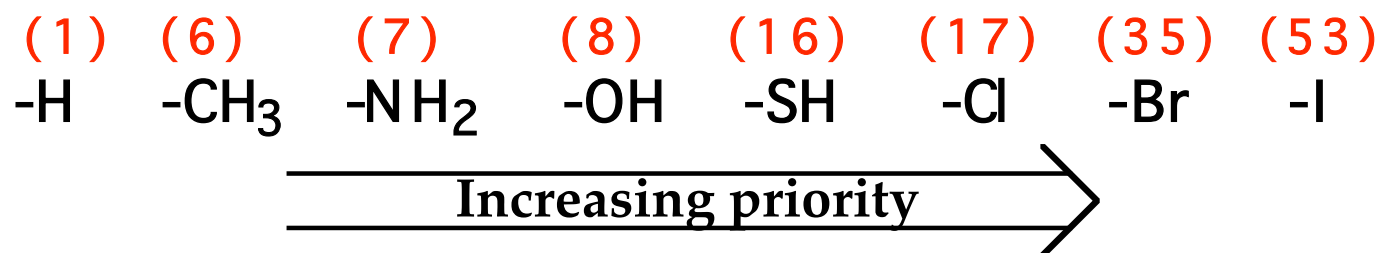


E (entgegen)

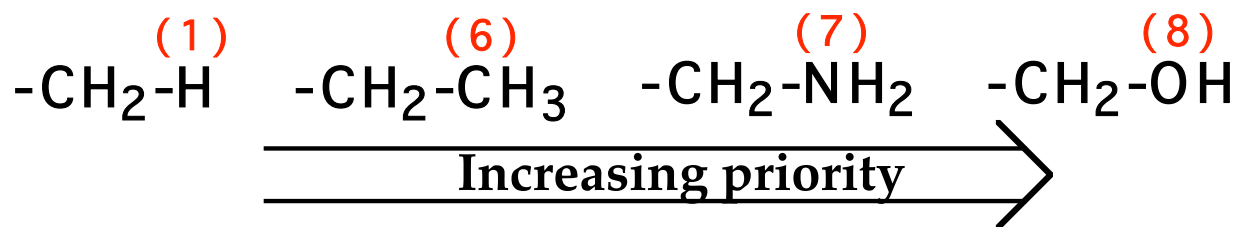
Configuration: E,Z

- **Priority rules**

1. **Priority is based on atomic number; the higher the atomic number, the higher the priority**

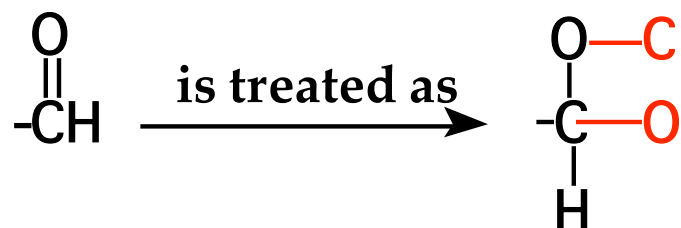


2. **If priority cannot be assigned on the basis of the atoms bonded directly to the double bond, look to the next set of atoms; priority is assigned at the first point of difference**



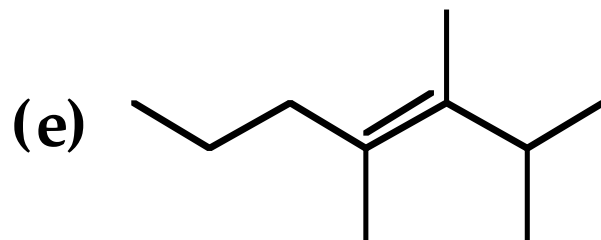
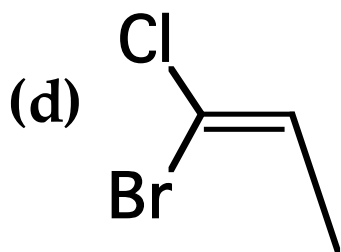
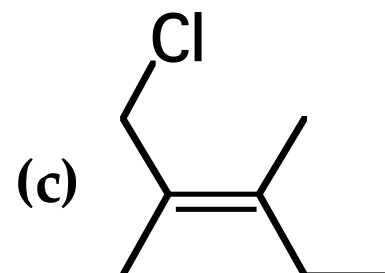
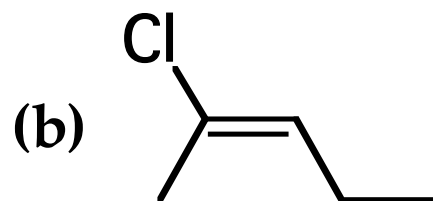
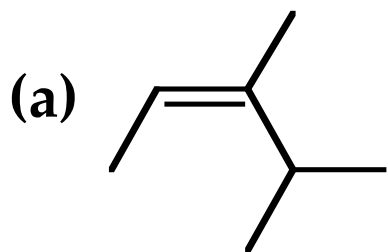
Configuration - E,Z

3. Atoms participating in a double or triple bond are considered to be bonded to an equivalent number of similar atoms by single bonds



Configuration - E,Z

- Example:** name each alkene and specify its configuration by the E,Z system



Cis-Trans Isomerism

- **Dienes, trienes, and polyenes**
 - for an alkene with n carbon-carbon double bonds, each of which can show cis-trans isomerism, 2^n cis-trans isomers are possible
 - consider 2,4-heptadiene; it has four cis-trans isomers, two of which are drawn here

Double bond	
C ₂ -C ₃	C ₄ -C ₅
trans	trans
trans	cis
cis	trans
cis	cis

