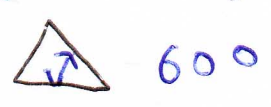
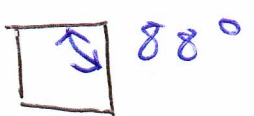


Angle strain  
Chair + boat forms of cyclohexane  
Cis + trans  
axial vs equatorial  
ring flips

highly - strained

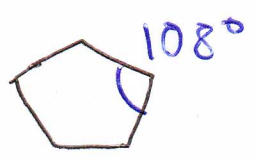


Cyclopropane

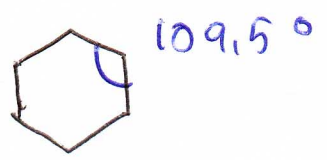


Cyclobutane

Angle strain - higher potential caused by distortion of bonds caused by deviation of molecular geometry from ideal bond angles



cyclopentane

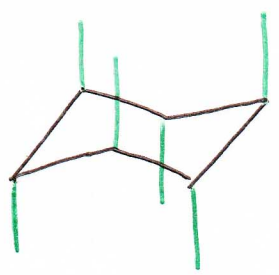
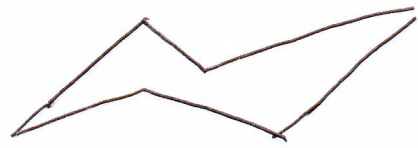


cyclohexane

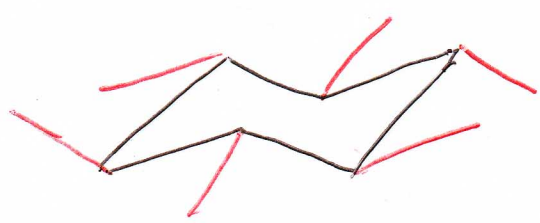
little or no angle strain

- Rings with 7-11 carbons have a very small amount of strain; Past 11, rings again have no strain.

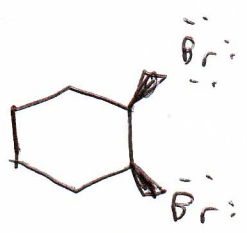
Cyclohexane  
Chair form



axial substituents



equatorial substituents



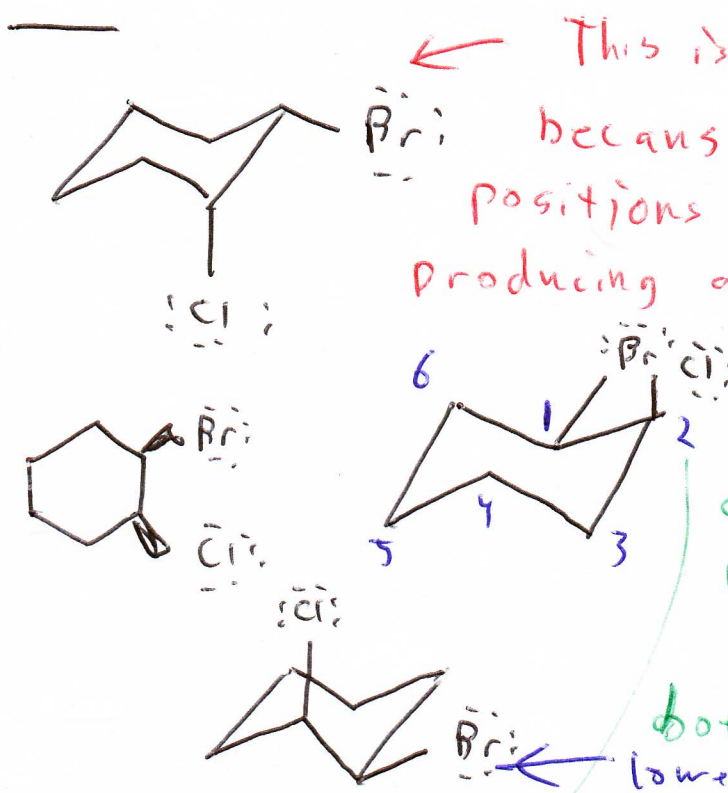
vicinal dihalide

cis - both substituents pointed the same way

vicinal - neighboring positions  
geminal - double substitution at one position

For vicinal cis-substituted cyclohexane rings, #3  
 one substituent must always be axial, the other equatorial.

ring flip - an inversion of a cyclohexane ring in which the axial substituents become equatorial and vice versa.



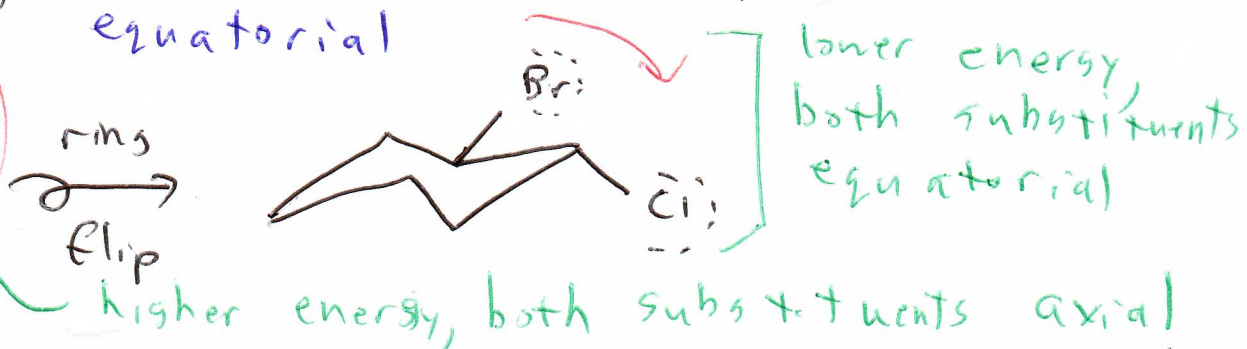
← This is an improper ring flip because the axial + equatorial positions were simply exchanged, producing a mirror image molecule.

This is a proper ring flip because the relative geometry (up vs down) was maintained.

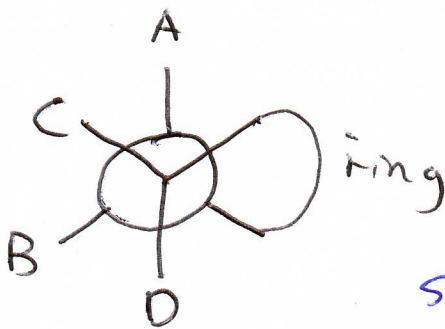
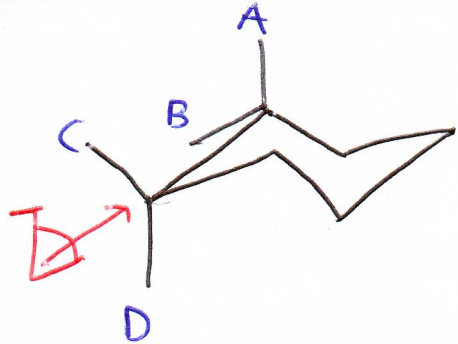
both acceptable lower energy since larger group is equatorial



ways  
 trans-substituents are pointed opposite  
 For vicinal trans-substituted cyclohexanes, both substituents must be axial or equatorial



In cyclohexane rings, substitution at an axial position causes steric hindrance due to diaxial interactions, thus, when possible, a substituent would prefer to be @ an equatorial position.



All bonds in a chair form of cyclohexane are staggered (gauche) #3

