

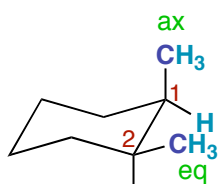
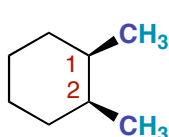
Chapter 4 - Stereochemistry of Alkanes and Cycloalkanes

Conformations of Cyclohexane

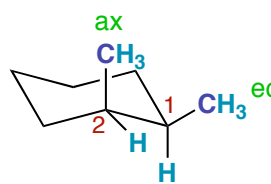
The chair conformations of disubstituted cyclohexanes will have different interactions depending on where on the ring they are substituted and their stereochemistry.

In cis-1,2-dimethylcyclohexane one can draw both chair conformations. In each conformation, one methyl is in an axial position and one is in an equatorial position. Thus, both conformations have identical energy. In the trans stereoisomer, there is a clear difference in the two conformations. One places both methyl groups in the more crowded axial positions and one in the more stable (lower energy) equatorial positions.

cis-1,2-dimethylcyclohexane

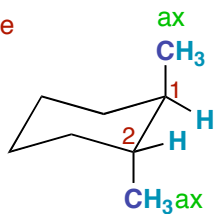
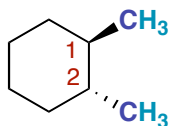


ring flip

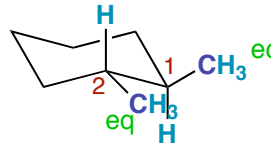


same interactions in both conformations -- equal in energy

trans-1,2-dimethylcyclohexane



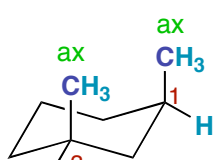
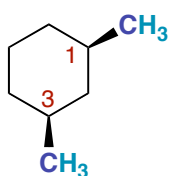
ring flip



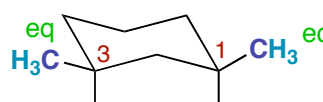
different interactions in both conformations -- NOT equal in energy
lower in energy

In the 1,3-isomers, the opposite is the case. The cis isomer has different energy conformations while the conformations of the trans isomer are equal in energy. Note that on one side of the ring or the other, the axial and equatorial positions alternate from one carbon to the next.

cis-1,3-dimethylcyclohexane

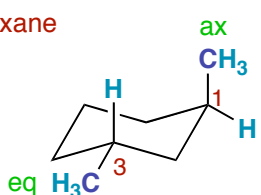
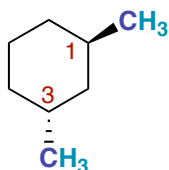


ring flip

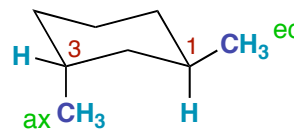


different interactions in both conformations -- NOT equal in energy
lower in energy

trans-1,3-dimethylcyclohexane

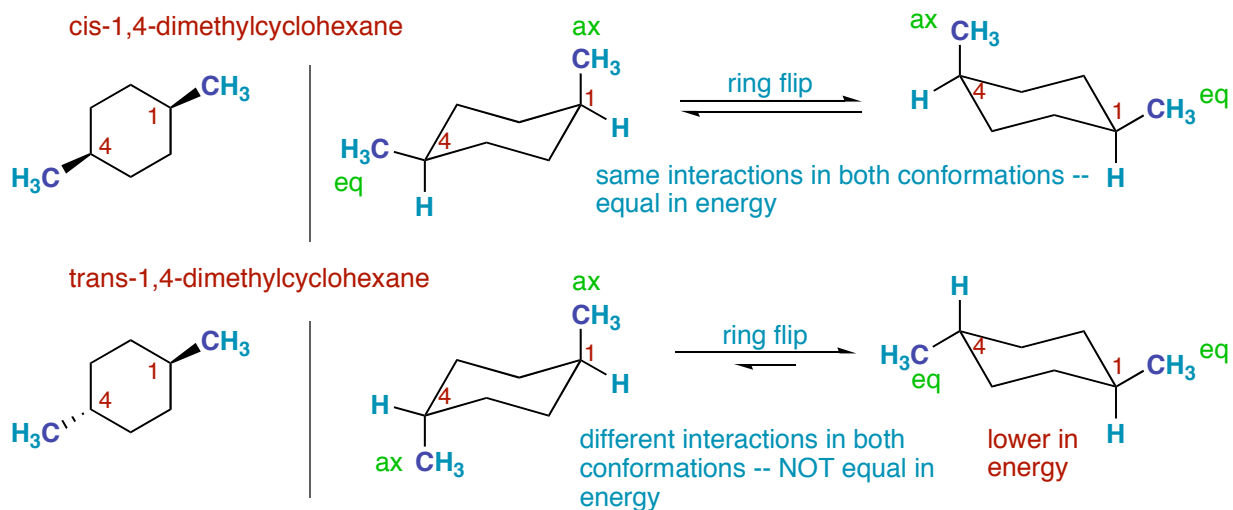


ring flip

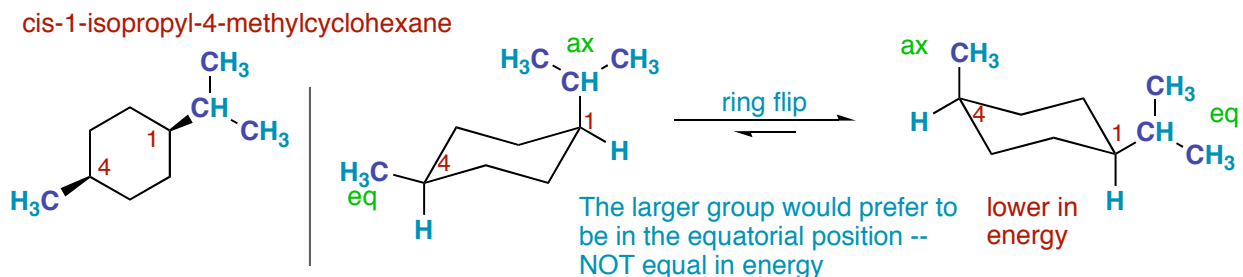


same interactions in both conformations -- equal in energy

The 1,4-isomers have the same issues as the 1,2-isomers. The cis conformation places one group equatorial and one axial in both conformations while the trans isomer has different energy conformations.



The size of the groups can also influence the energy of the different ring flip conformers. For example, if the groups are different and one is bigger than the other, the cis-1,4-isomer favors the one in which the largest group is equatorial. You can find a chart with different substituents and their size effects in your textbook.



Cyclohexane can exist in another higher energy conformation, but this is obviously not preferred. In the Boat conformation, cyclohexane has several additional eclipsing interactions that increase the torsional strain in the molecule.

