

## Chapter 4 - Stereochemistry of Alkanes and Cycloalkanes

### Conformations of Ethane, Propane and Butane

Please see the media files on-line for more details about the conformations of alkanes.

### Conformations of Cycloalkanes

Cyclic compounds contain something we call Ring Strain. There are three things that contribute to ring strain. Torsional strain (electron repulsion in eclipsing bonds), steric strain (atoms bumping into each other) and angle strain.

**Angle Strain:** the strain due to bond angles being forced to expand or contract from their ideal.  $sp^3$  hybridized atoms want to have bond angles of  $109.5^\circ$ . However, if the rings are very small or very large, there is no way to accommodate this angle. Thus, this increases the energy of the molecule.

**Heat of Combustion:** the amount of heat (energy) released when a molecule burns completely with oxygen. By comparing the heat of combustion of different sized cycloalkanes, their relative energies can be obtained. The fact that the size of the ring has an influence on the total energy of the molecule indicates that there is some degree of instability associated with constraining the rings. This added energy (in addition to what would be expected from carbon and hydrogen combustion per mole) can be attributed to ring strain.

Below is a plot of the amount of ring strain energy versus the size of a cycloalkane ring. Notice that a six membered ring has the lowest amount of ring strain and rings a little bit larger have more. This eventually tapers off when the rings get to be at least 14 carbons.

