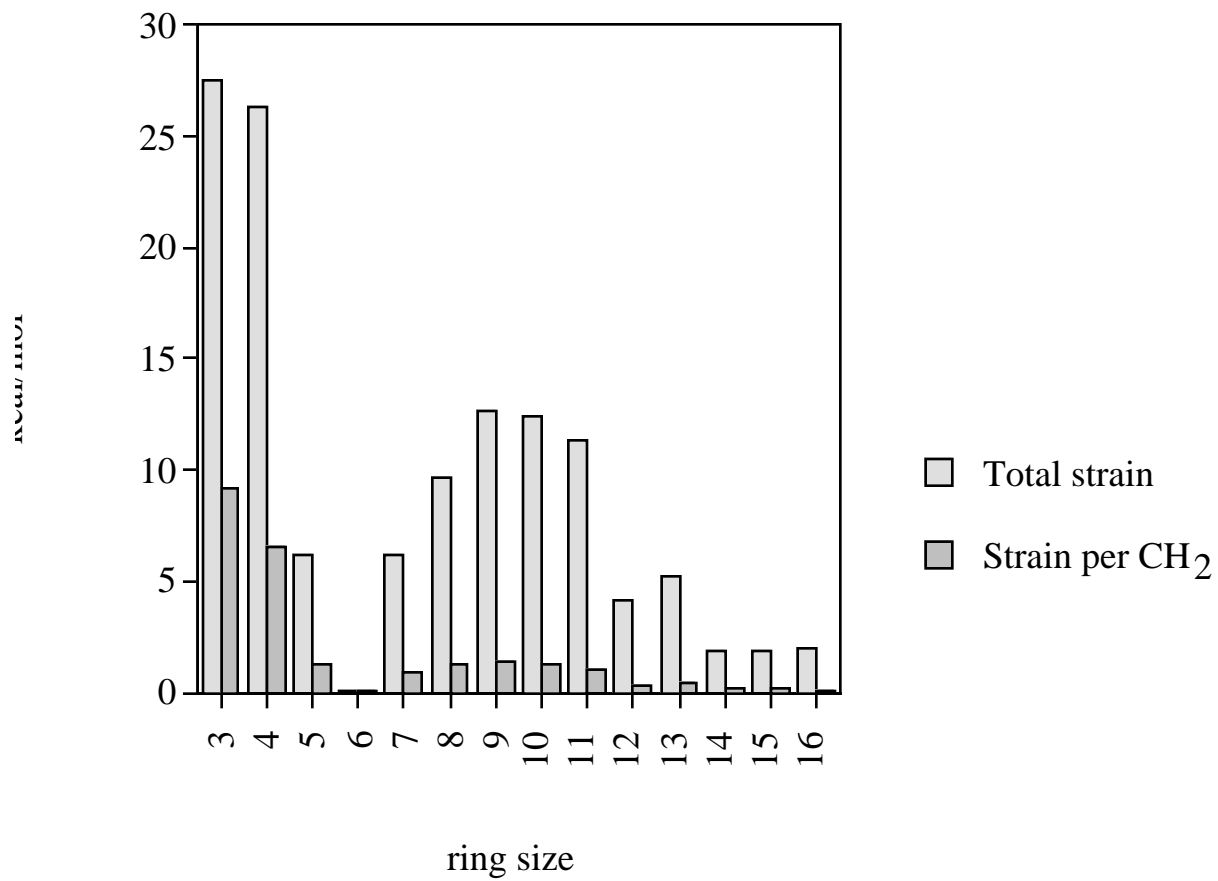


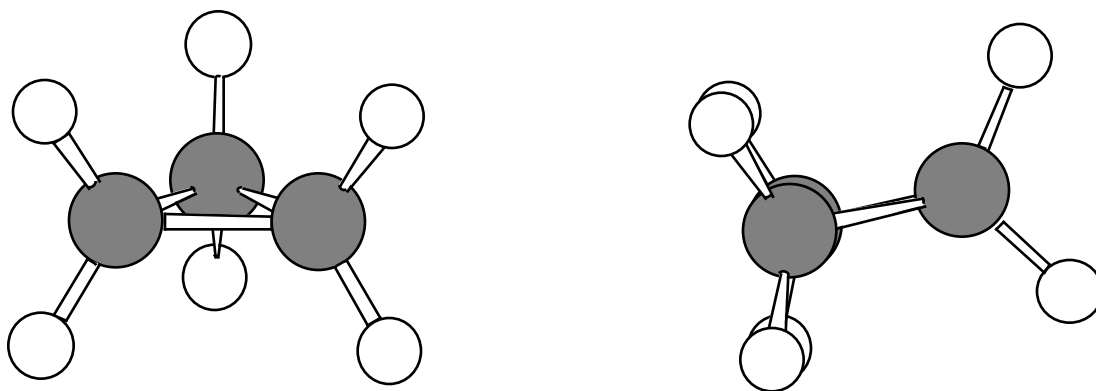
# Cycloalkane Ring Strain



## Conformers of Cyclopropane and Cyclobutane

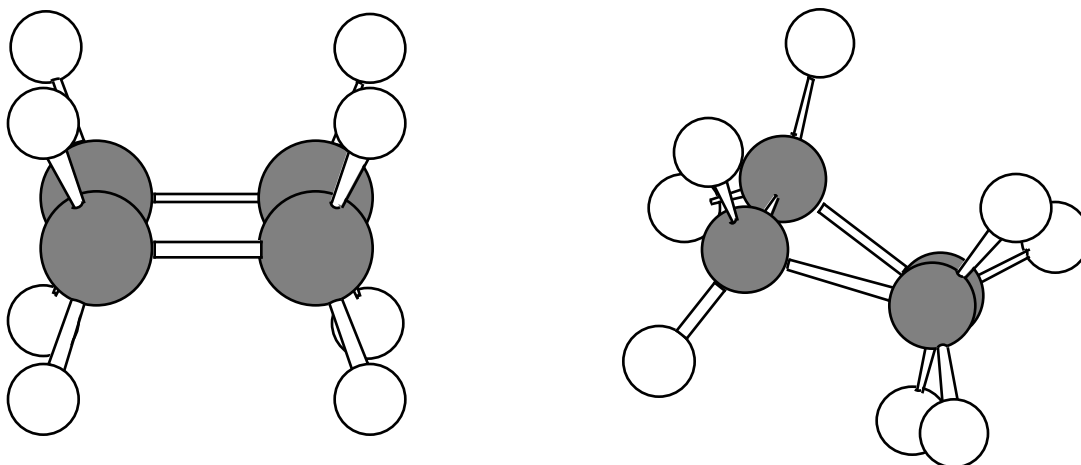
**Cyclopropane ( $C_3H_6$ ) is planar** (three points define a plane)

- angle strain ( $C-C-C = 60^\circ$ )
- torsional strain (all  $C-H$  bonds eclipsed)



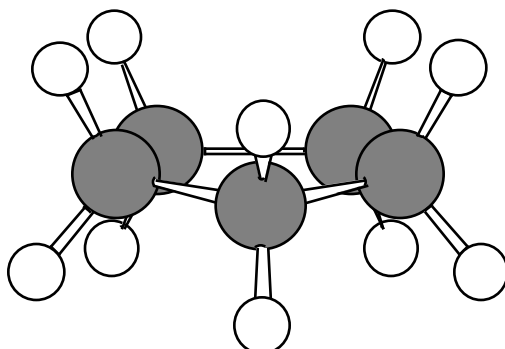
**Cyclobutane is puckered**

- planar cyclobutane has all  $C-H$  bonds eclipsed (not a minimum)
- puckered cyclobutane trades increased angle strain for decreased torsional strain



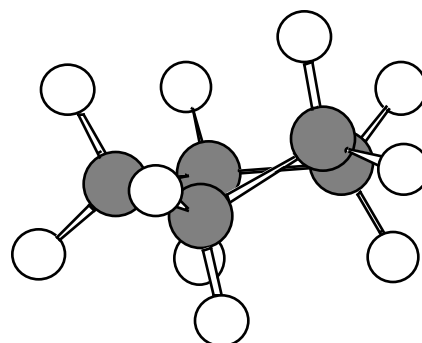
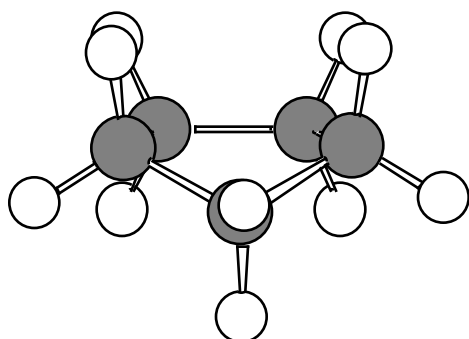
## Conformers of Cyclopentane

**Planar Cyclopentane ( $C_5H_{10}$ )** has almost no angle strain ( $108^\circ$ )  
but all C–H bonds are eclipsed; *not a minimum*



**Cyclopentane has two conformers of similar energy**

- envelope (4 atoms in a plane, 1 out)
- twist (3 atoms in a plane, 1 above, 1 below)



## Conformers of Cyclohexane

**Planar Cyclohexane (C<sub>6</sub>H<sub>12</sub>)** has angle strain (120°)  
*and* all C–H bonds are eclipsed; *not a minimum*

**Cyclohexane has one low energy conformer**

- chair shape with "axial" and "equatorial" H's
- "flipping" the chair exchanges all "a" and "e" H's
- other conformers will be introduced later

