### Cyclohexane

**What?**

Of all the cycloalkanes, cyclohexane is the only one that can adopt a conformation that has no ring strain (no torsional or angle strain), where each carbon atom is tetrahedral. This conformation is known as the *chair conformation* (the structure resembles a lawn chair), and is cyclohexane’s most stable conformation. There are two types of C-H bonds: *axial* (bonds perpendicular to the plane of the ring) and *equatorial* (bonds somewhat parallel to the plane of the ring). Each cyclohexane molecule has two chair conformations that are constantly interconverting from one to the other, known as *ring flipping*. When one chair conformation flips to the other, all the axial C-H bonds become equatorial C-H bonds, and vice versa.

In a substituted cyclohexane, one chair conformation is usually more stable than the other. Consider bromocyclohexane shown below. Notice how bromine is ‘axial up’ in conformation α, and then ‘equatorial up’ in conformation β. Conformation β is more stable than conformation α since bromine is in the equatorial position.

![Bromocyclohexane](image)

**Why?**

Six-membered rings are part of many organic compounds, and are the most common rings found in natural compounds (such as steroids and carbohydrates). A good understanding of the three-dimensional structure of substituted cyclohexanes helps explain their reactivities toward substitution and elimination reactions (as you will learn in chapter 6).

1. Being able to draw a chair conformation of cyclohexane properly is an important skill. Draw cyclohexane, showing all C-H bonds, as shown below. Notice how the axial bonds alternate between ‘up’ and ‘down’ (as do the equatorial bonds). There’s a simple trick to drawing the equatorial bonds. Draw a line from the carbon that is parallel to the adjacent C-C bond. Let’s see which group can draw the best looking chairs.

![Cyclohexane Conformations](image)

Avoid drawing the infamous ‘bowtie’ chair structure and the distorted chair (shown below).

![Bowtie Chair](image)
2. Your TA will select one of these six structures below for your group to use for this problem. Use it to answer problems 2a-2d. Build your compound using molecular models.

![Structures](image)

a) Give a correct IUPAC name of your cyclohexane derivative.
b) Draw the compound in the chair conformation.
c) Perform a ring flip on your model and draw that conformation.
d) Which of the two chair conformations is the most stable?

3. Alkanes can be prepared from alkenes and alkynes by catalytic hydrogenation.

![Reaction](image)

Consider the following reaction below. Draw all possible structures for the reactant, A. Challenge: see if can you find all six possible structures.

![A](image)

**(Challenge Problem)**

4. Consider the following bicyclic alkane. As you will learn in chapter 5, this bicyclic compound contains 3 chirality centers, leading to a total of 8 different stereoisomers. Draw all 8 stereoisomers in the chair conformation. Using models can be extremely useful. One has already been done for you, shown below in both the planar hexagon form and chair conformation.