Cyclohexane → most stable cyclohexane

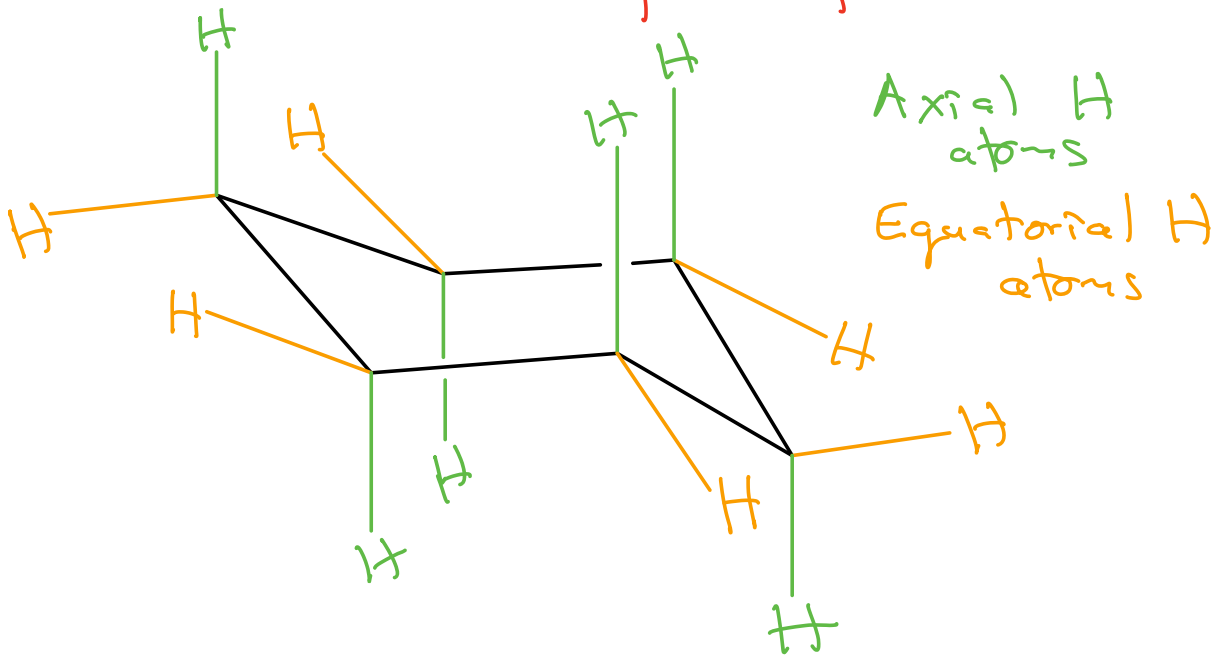
→ Adopts a chair conformation

⇓ Minimal angle strain

⇓ No torsional strain

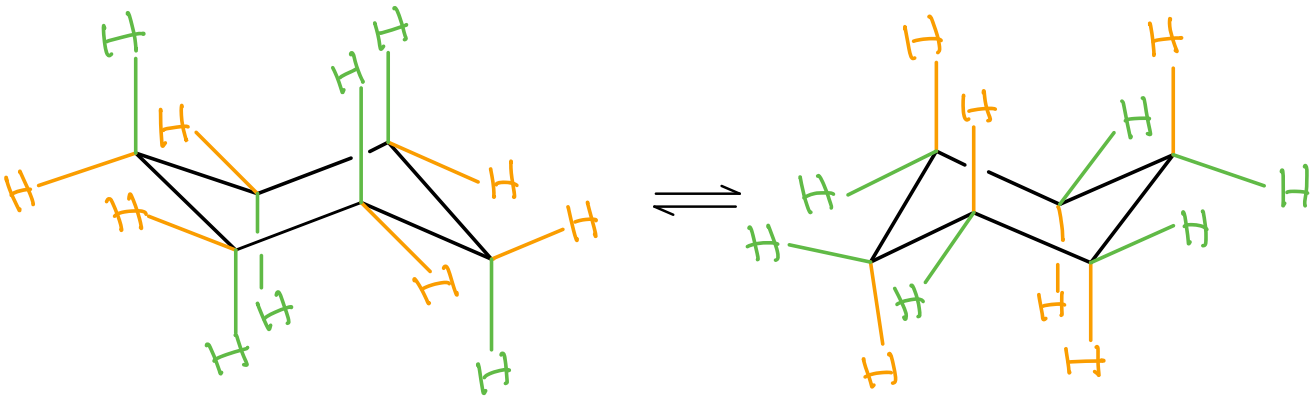
You will need to know how to draw a great chair cyclohexane

⇒ "Keep it parallel"



There are two kinds of H atoms in chair cyclohexane – axial (Green) and equatorial (orange) – these are different chemical environments

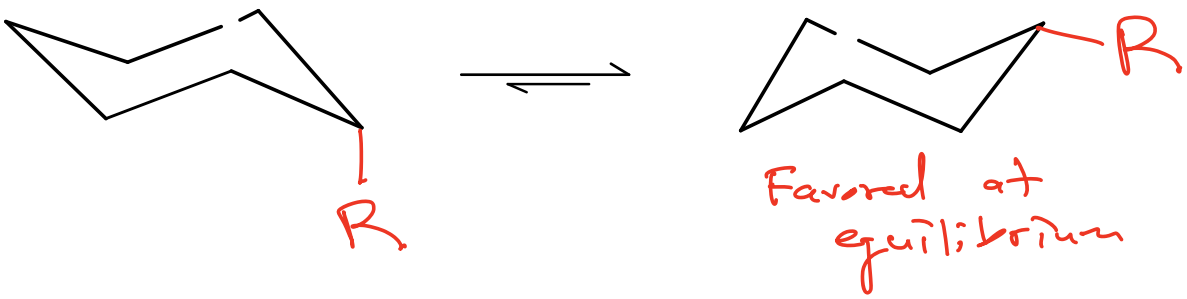
The cyclohexane chair can "flip" at room temperature

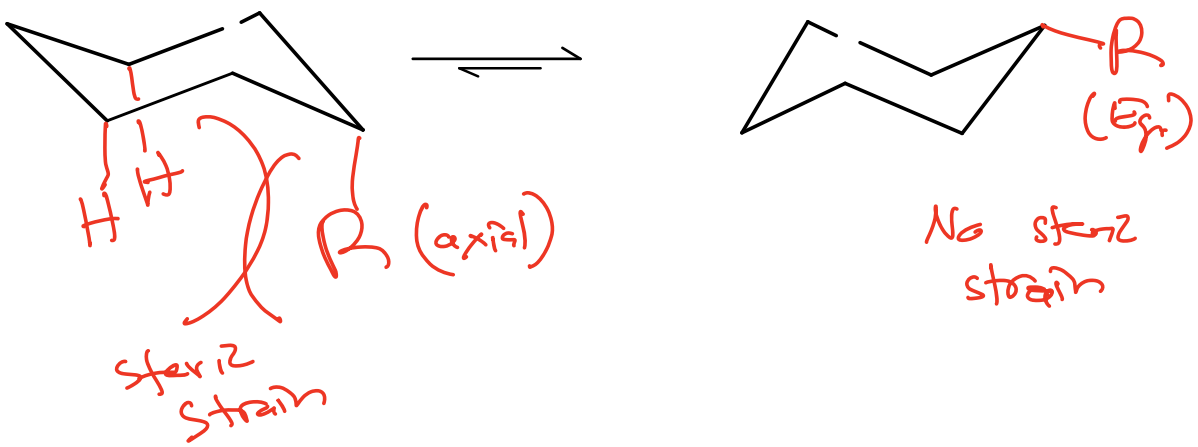


When the chair flips the axial H atoms become equatorial and the equatorial H atoms become axial

As chairs flip, they go through a "boat-like" intermediate conformation

In a cyclohexane chair conformation, any group larger than an H atom will prefer to be equatorial to avoid steric strain ("crunching") → the larger the group (R), the greater the preference for being equatorial





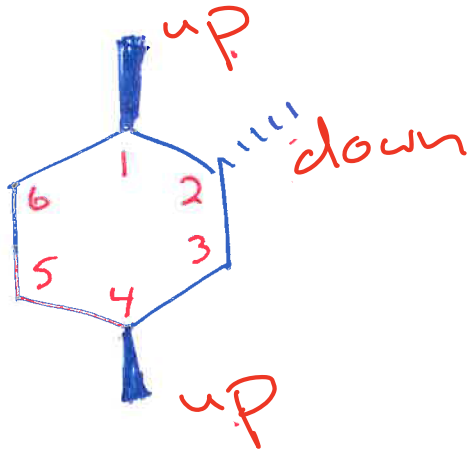
Drawing cyclohexane chairs all of the time can be difficult → so we draw different versions to describe the structures

- "Flat"
- "Haworth Projections"

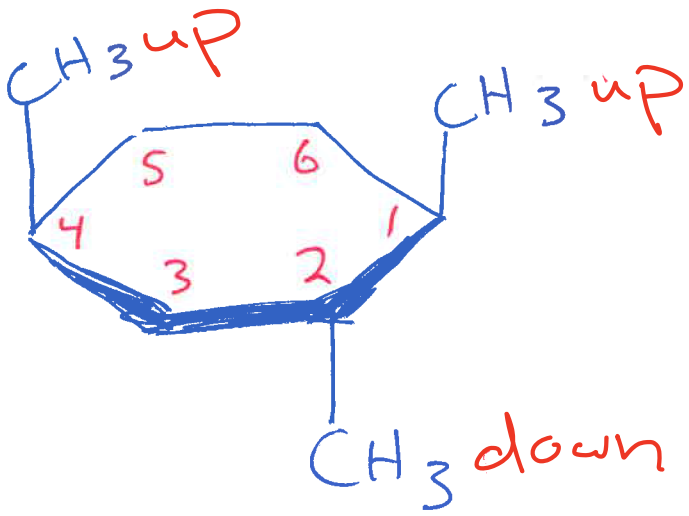
⇒ You will need to be able to convert between flat, Haworth and chairs for cyclohexanes

To do this conversion, remember:

"Up is up and down is down"



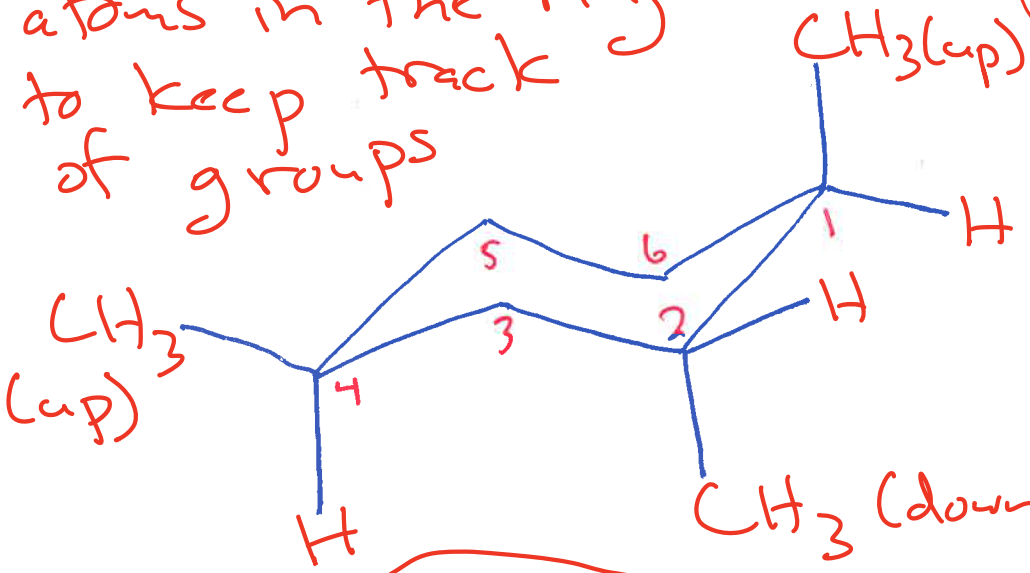
Drawn Flat



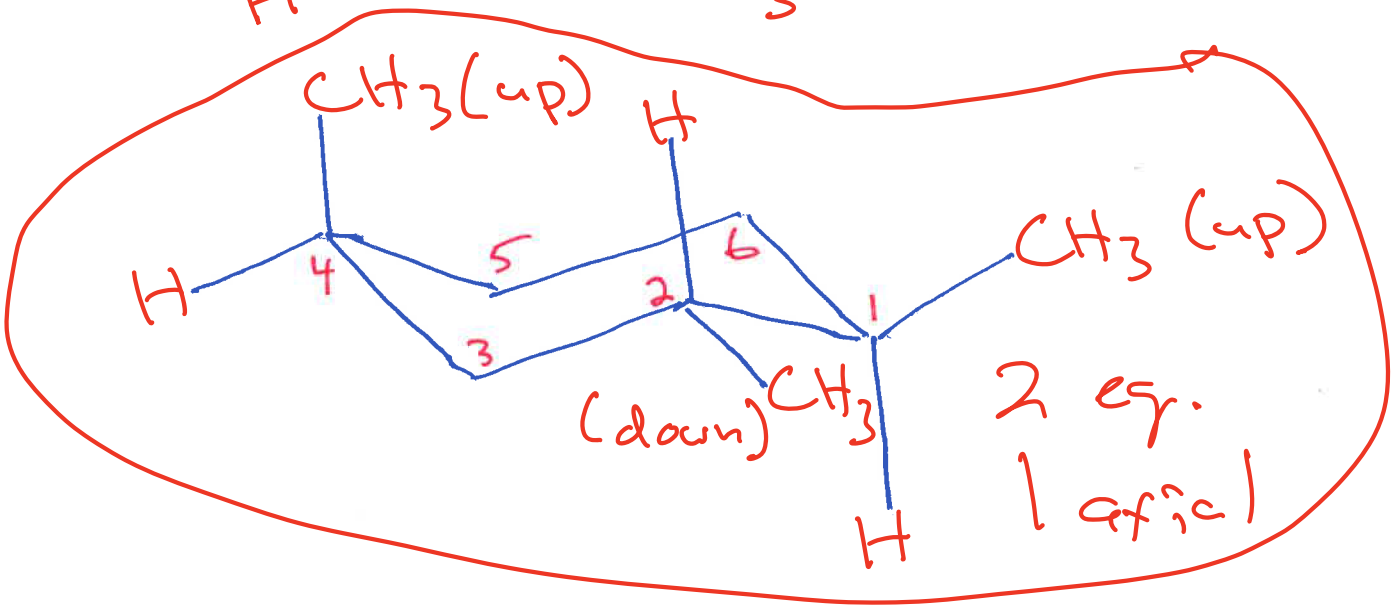
Haworth Projection

Pro tip: Always number the carbon atoms in the ring to keep track of groups

⇒ Number consistently so clockwise stays clockwise



2 axial
1 eq.



2 eq.
1 axial

The lower structure is more stable than the upper structure

Upper Structure → 2 axial and 1 equatorial methyl group

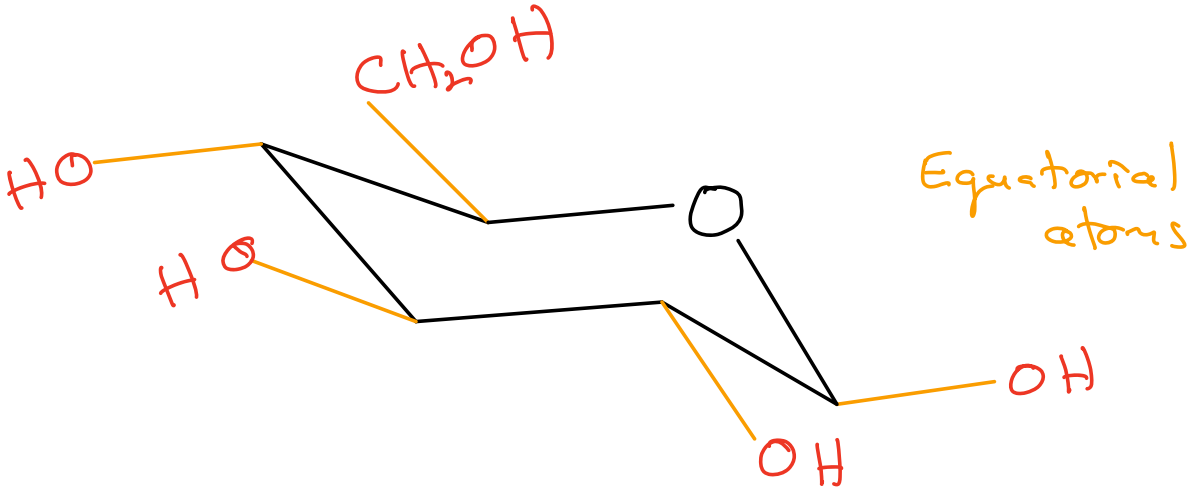
More axial so more steric strain

Lower Structure → 1 axial and 2 equatorial methyl group

Less steric strain so more stable

Why do we care so much about chairs anyway?

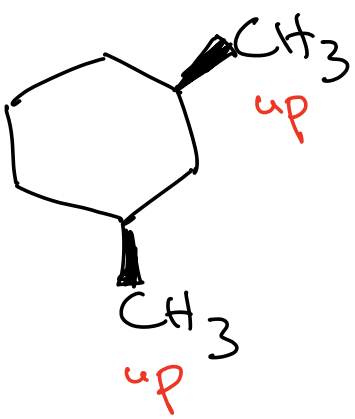
Most common molecule in the biosphere:



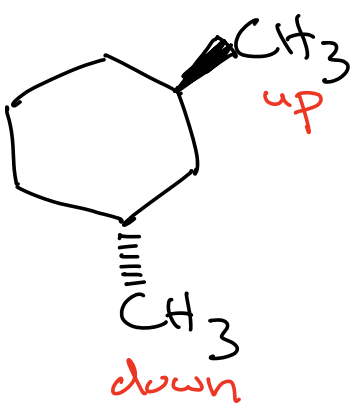
β-D-Glucose

Stable because all of the groups are equatorial!!

Stereoisomers →
two molecules with the same connectivity of atoms, but different orientations of groups in three-dimensional space

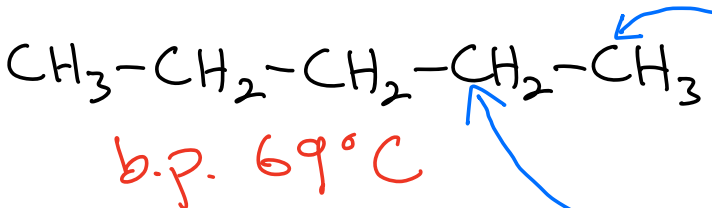


cis
"same side"



trans
"opposite side"

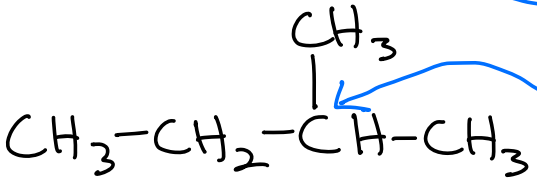
Classification of carbon atoms



b.p. 69°C

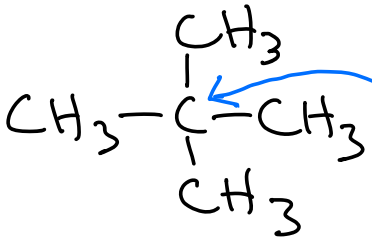
1° (primary) bonded to 1C, 3H

2° (secondary) bonded to 2C, 2H



b.p. 63°C

3° (tertiary) bonded to 3C, 1H



b.p. 49°C

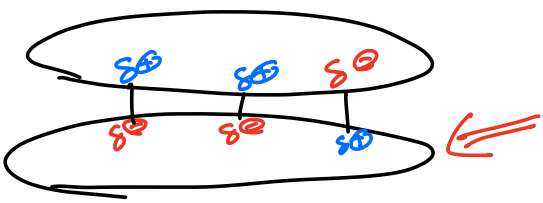
4° (quarternary) bonded to 4C, 0H

Boiling points (b.p.) of alkanes → More surface area of contact between molecules increases boiling point

→ Branching of alkanes decreases boiling points be decreasing surface area of contact

Reason → Dispersion forces → attraction between temporary partial charges on adjacent molecules

Dispersion forces → molecules have small, fluctuating and temporary partial charges



opposite small partial charges are induced in adjacent molecules

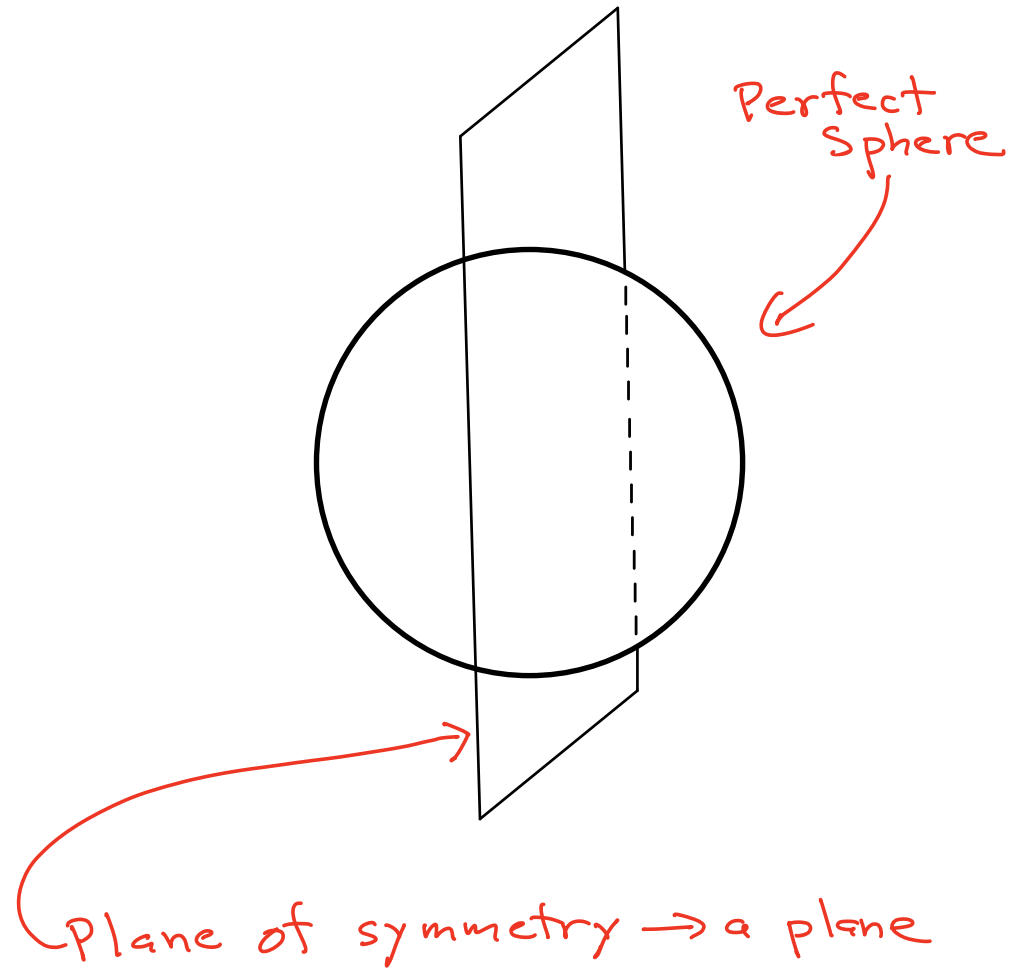
These opposite small partial charges on adjacent molecules attract each other ⇒ enough to provide small attraction between molecules that is proportional to the surface area of contact between molecules

Stereochemistry

Chiral Object Chiral Molecule

1) Not identical to its mirror image

2) Does not contain a symmetry element such as a plane of symmetry or a point of symmetry



Plane of symmetry → a plane cutting through an object such that one half is the direct reflection of the other half

Stereoisomers ⟶ molecules with the same connectivity of atoms, but different orientations of groups in three-dimensional space