Disubstituted Cyclohexanes

*Cis-trans Isomerism*

Cyclic Stereoisomers

In cyclic structures (rings) *cis* and *trans* notation is used to distinguish between stereoisomers just as in C=C double bonds,

- **Cis**— identical groups are positioned on the SAME side of a ring - drawn as being planar.
- **Trans**— identical groups are positioned on OPPOSITE sides of a ring - drawn as being planar.

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Cycloalkane Stereochemistry

*cis* -trans Isomers

Chair Conformers

cis-1,4-dimethylcyclohexane

Cyclohexane Stereochemistry

*Trans* Isomers

Are the methyl groups axial or equatorial?

What is the actual conformational shape of the cyclohexane ring?
Chair Conformers
trans-1,4-dimethylcyclohexane

Stereochemistry
cis-1,2-disubstituted-cyclohexane

Stereochemistry
trans-1-tert-Butyl-3-Methylcyclohexane

Cyclohexane Stereochemistry
Cis -Trans Isomers

<table>
<thead>
<tr>
<th>Position</th>
<th>cis</th>
<th>trans</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,2</td>
<td>e,a or a,e</td>
<td>e,e or a,a</td>
</tr>
<tr>
<td>1,3</td>
<td>e,e or a,a</td>
<td>a,e or e,a</td>
</tr>
<tr>
<td>1,4</td>
<td>e,a or a,e</td>
<td>e,e or a,a</td>
</tr>
</tbody>
</table>

a = axial; e = equatorial

Question
Indicate the relationship of the pair of molecules shown.

A. same molecules
B. mirror images
C. different molecules
D. constitutional isomers
E. cis and trans isomers

Question
Consider the molecule below. What is the maximum number of methyl groups that can be in the equatorial position at the same time?

A. 0
B. 1
C. 2
D. 3
E. 4
Conformations of Fused Rings

Trans-fused cyclohexane rings are more stable than cis-fused.

Worksheet 7 (Part 2): Ambrox

Many Bicyclic Systems

- There are many important structures that result when one ring is fused to another.

- Camphor, which you smelled the first day of class, and camphene are fragrant natural products isolated from evergreens.

Bicyclic Compounds

Nomenclature

Representing compounds with two fused rings.

To name a bicyclic compound, include the prefix "bicyclo" in front of the total carbon alkane name. For example, the compounds below could both be named, bicycloheptane.

Bicyclic Compounds

Nomenclature

The two molecules are not identical, therefore they cannot have the same name.

Count the number of carbons connecting the bridgeheads.
1. Start numbering at a bridgehead carbon and number the longest carbon chain connectors first.

2. Then give the substituents the lowest numbers possible.
   • Practice with SKILLBUILDER 4.5.

Structure of Steroids

- Fundamental framework of steroids is a tetracyclic carbon framework.

Structure of Cholesterol

Cholesterol is an important steroid endogenously produced in all plants and animals.

- Cholesterol is essential to life. It is the biosynthetic precursor of a large number of important molecules: Sex hormones, Vitamin D, Bile acids, Corticosteroids
There are many biologically important steroids, two related to primary sex traits are:

Hormonal Steroids

Vitamin D$_3$

Insufficient sunlight can lead to a deficiency of vitamin D$_3$, interfering with Ca$^{2+}$ transport and bone development. Rickets may result; as well as very bad moods.

Cholesterol: Biochemical Reactions

Cholic Acid

Cholic acid which is the most abundant of the bile acids.

• What functions are present?

• Is the A/B ring system cis or trans?

• Oxidation in the liver degrades cholesterol to produce Cholic acid.

Cholic Acid

Cortisone

Corticosteroids are involved in maintaining electrolyte levels, in the metabolism of carbohydrates, and in mediating allergic reactions by suppressing the immune system.

• What principal functions are present?
Progesterone

- What principal functions are present?
  - Suppresses ovulation during pregnancy.

Conformations of Multi-fused Rings

- Trans-fused cyclohexane ring is more stable than cis-fused cyclohexane ring. *DIAMOND:*