

Stereochemistry

3- Two Chiral Centers and Cyclic Structures

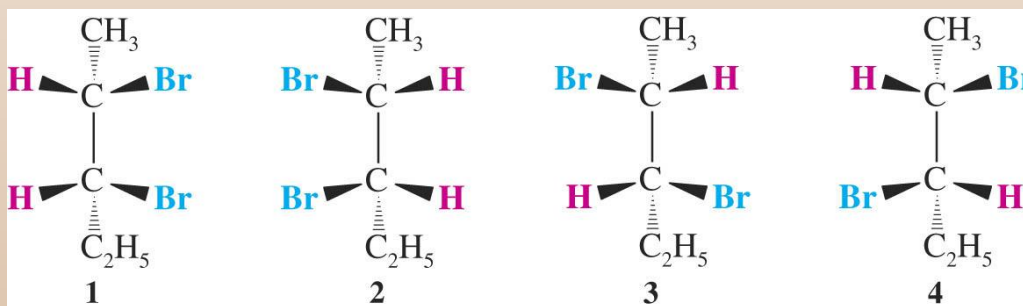
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Two Chiral Centers - Diastereomers

- Molecules that have two or more chiral centers.
- Each of the two chiral centers will have a pair of enantiomers.
- The other stereoisomers are called diastereomers.
- Enantiomers rotate plane polarized in opposite direction.
- Diastereomers have no optical relationship.
- The number of isomers are given by 2^n , where n is the number of chiral centers.
- It is important to understand the concept of symmetry. If a molecule has internal symmetry then it will not be optically active – it will be achiral.

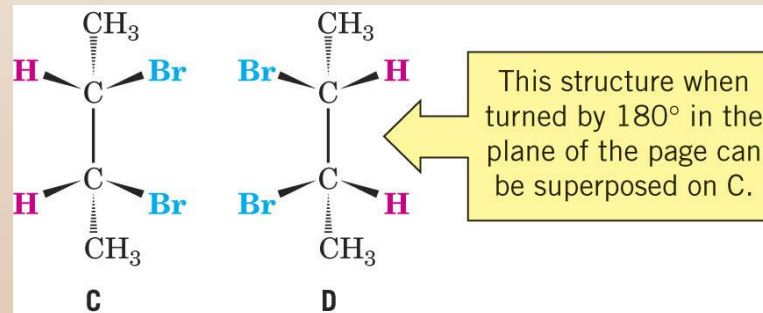
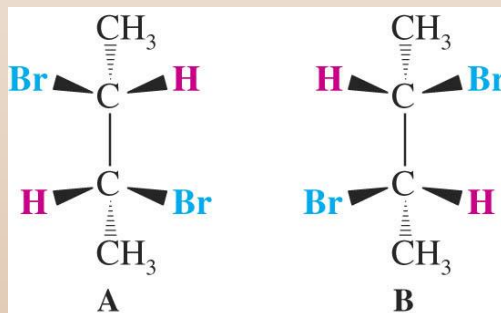
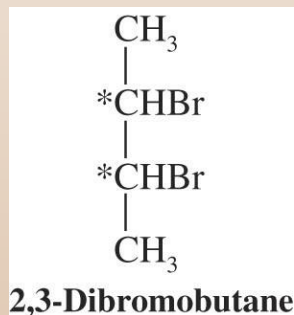
Two Chiral Centers

- There are two pairs of enantiomers (1, 2) and (3,4)
 - Enantiomers are not easily separable so 1 and 2 cannot be separated from each other
- Diastereomers: stereoisomers that are not mirror images of each other
 - For instance 1 and 3 or 1 and 4
 - Have different physical properties and can be separated

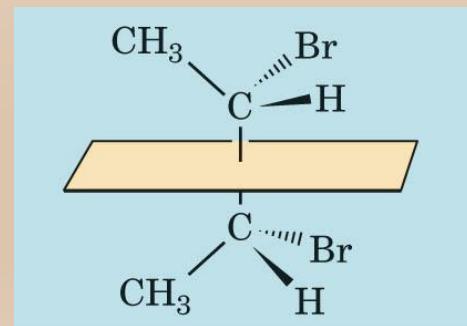


Meso Compounds

- Compounds with two or more chiral centers but not the maximum number of stereoisomers (2^n)
- This is because two enantiomers may be superimposable – i.e. achiral (not optically active)
- This superimposability comes from the molecule having a plane of symmetry.

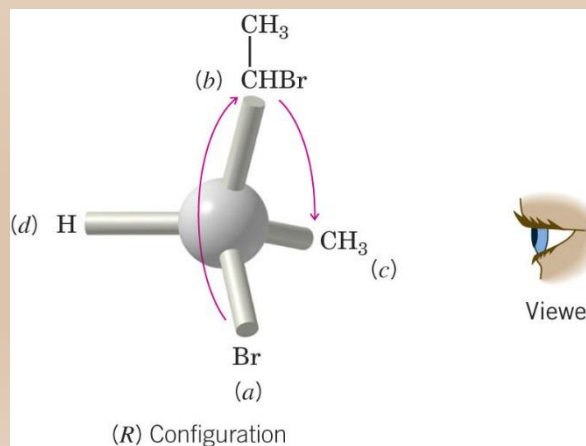
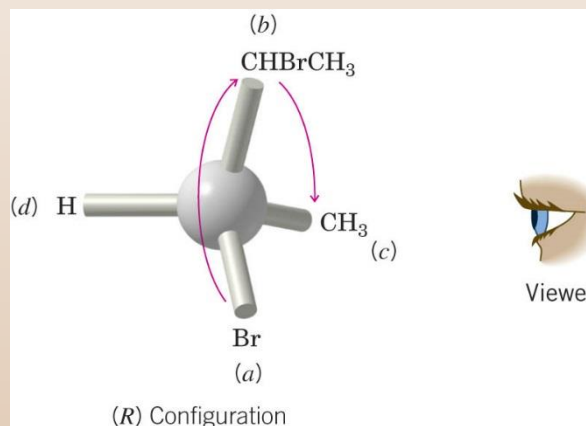
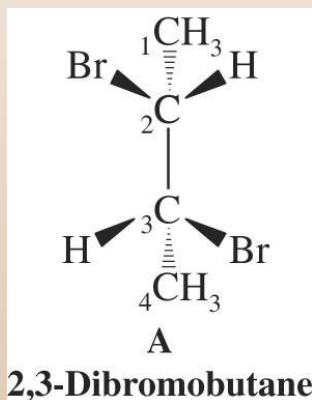


Has a plane of symmetry



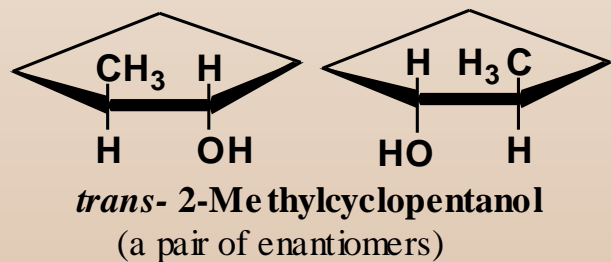
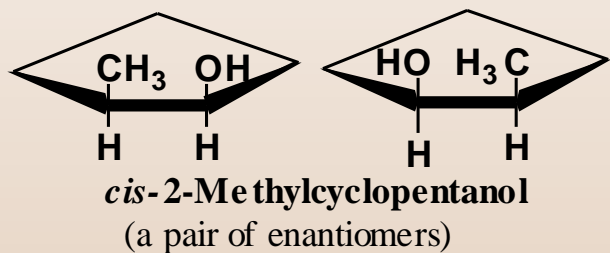
Naming more than one Chiral Center

- The molecule is manipulated to allow assignment of each stereogenic center separately
- This compound is (2*R*, 3*R*)-2,3-dibromobutane



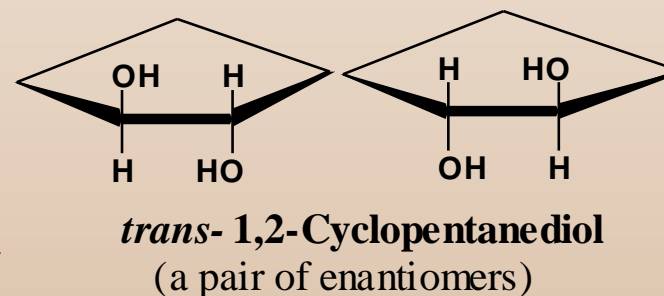
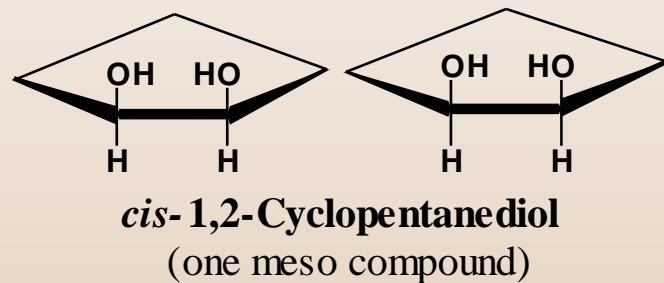
More Examples

2-Methylcyclopentanol



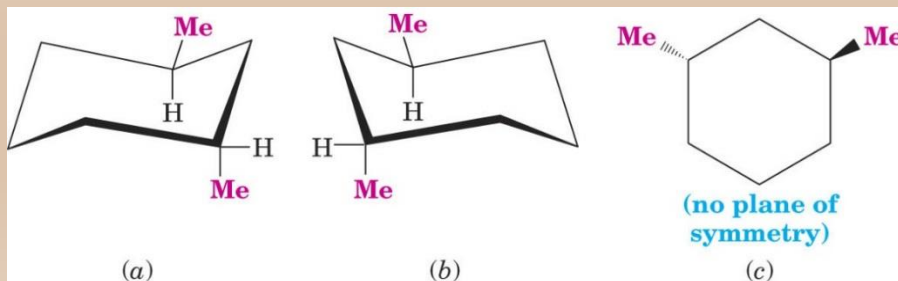
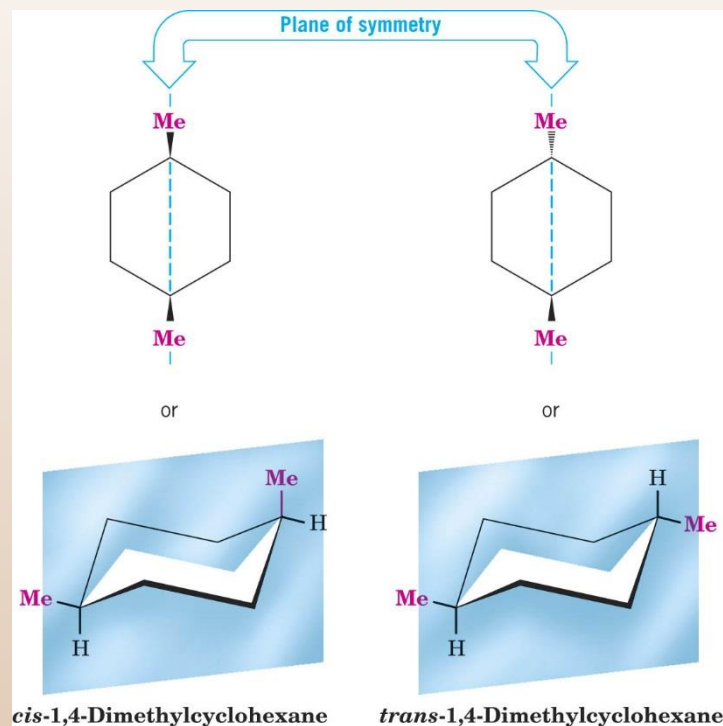
diastereomers

1,2-Cyclopentanediol



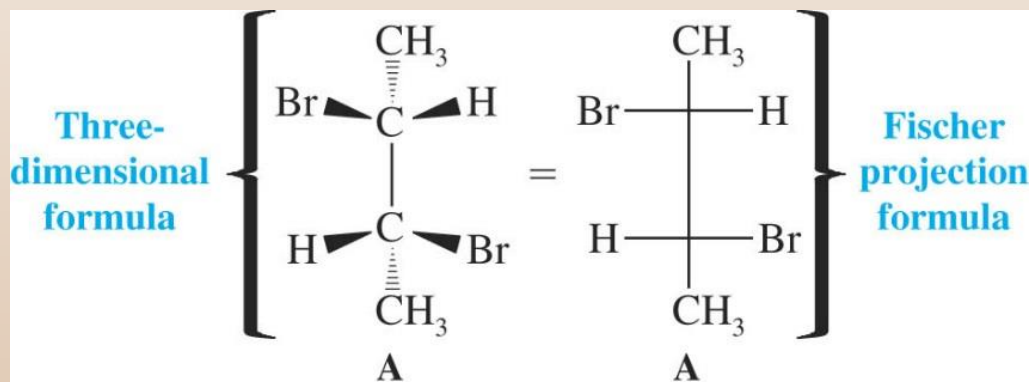
Six Membered Rings

- 1,4-dimethylcyclohexane (shown on the right)
 - Neither the cis nor trans isomers is optically active
 - Each has a plane of symmetry
- 1,3-dimethylcyclohexane
 - The trans and cis compounds each have two stereogenic centers
 - The cis compound has a plane of symmetry and is meso
 - The trans compound exists as a pair of enantiomers



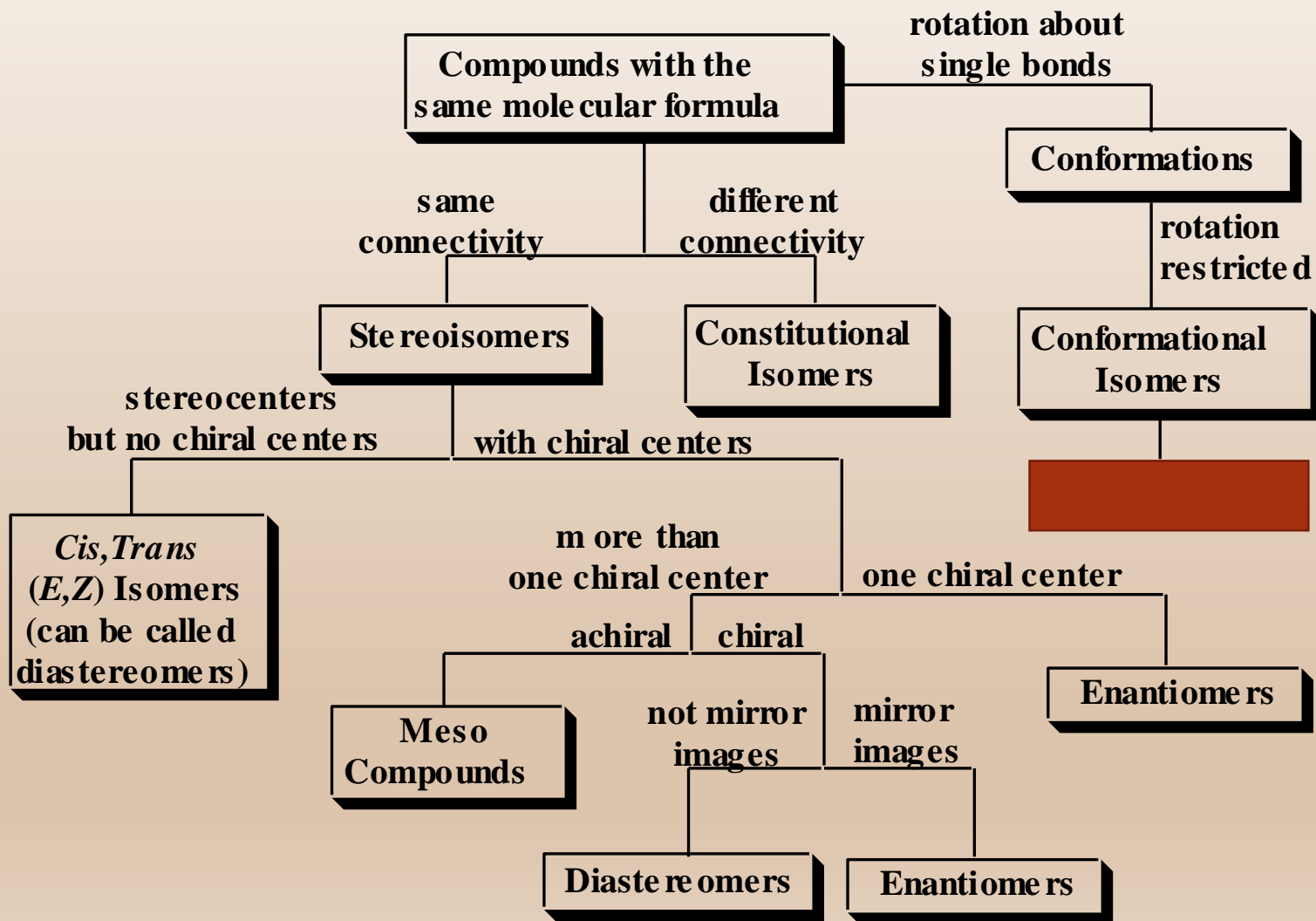
Fisher Projections

- A 2-dimensional representation of chiral molecules
 - Vertical lines represent bonds that project behind the plane of the paper
 - Horizontal lines represent bonds that project out of the plane of the paper

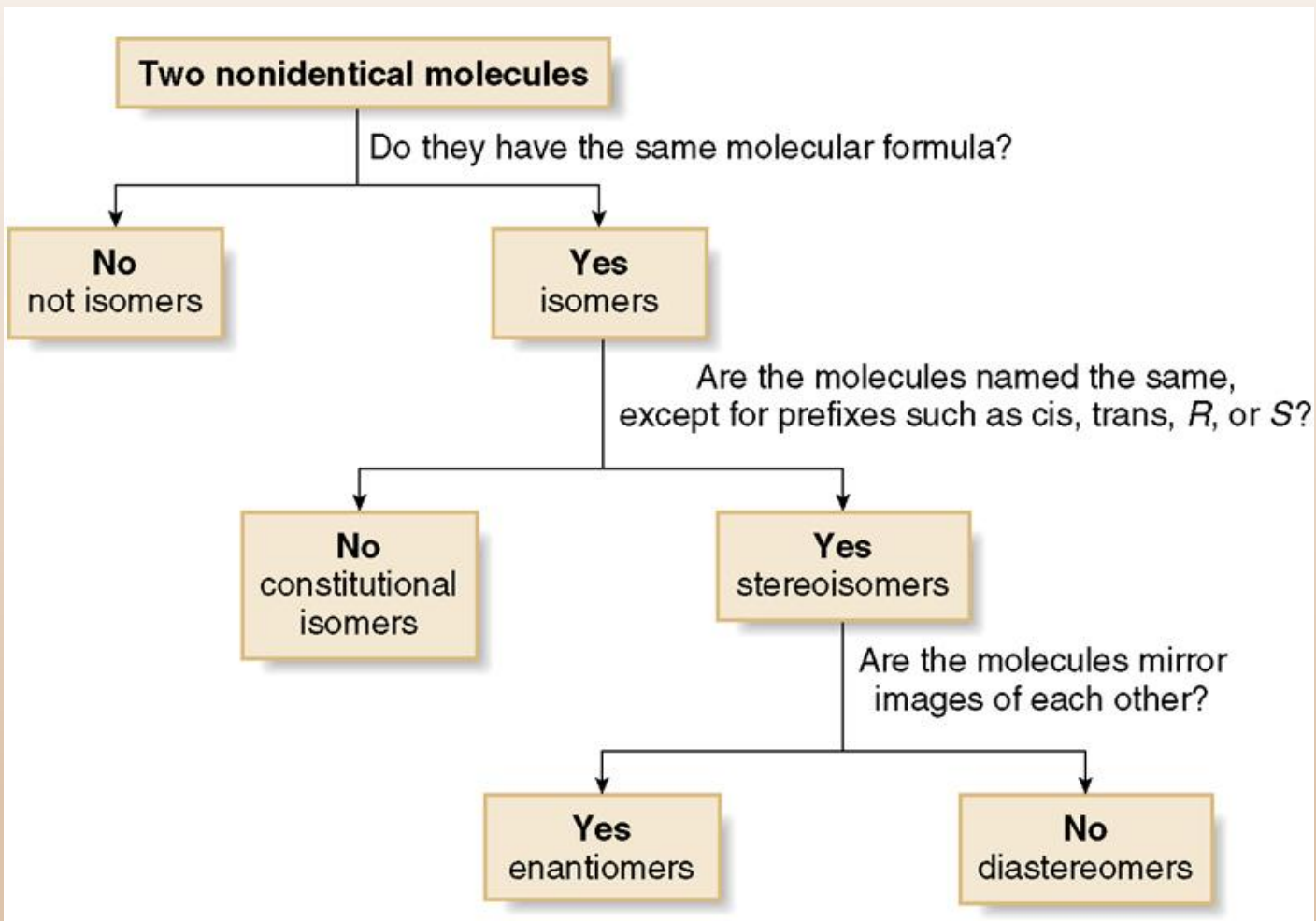


Review of all Isomers

- Here is a flowchart of all isomers we have done so far.



Determining Stereochemistry



Key Words/Concepts

- Stereoisomers
- Chiral Center
- Chirality
- Enantiomer
- Plane polarized light
- Dextrorotatory (d)
- Laevorotatory (l)
- Diastereomers
- Meso compounds
- Cahn Ingold and Prelog nomenclature
- Configurations (R and S)
- Racemic mixtures
- Fisher projections
- Enantiomeric excess
- Absolute configuration