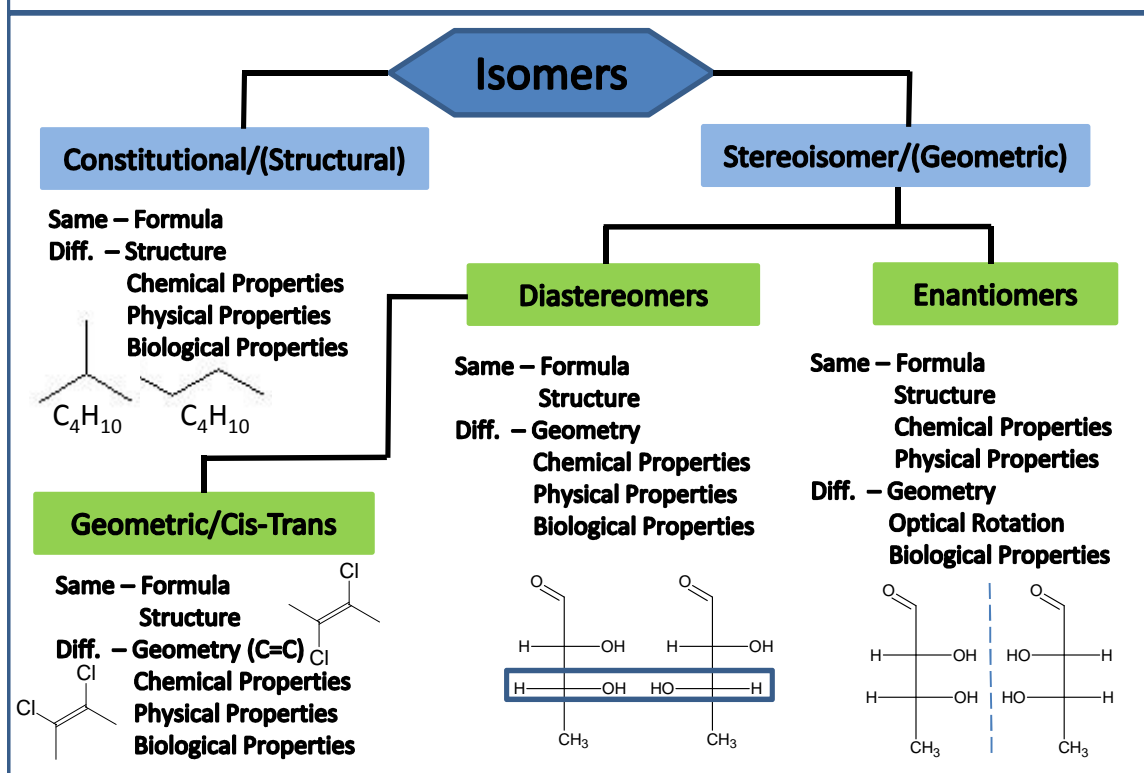


4 Types of Isomers

1. Structural Isomers/(Constitutional)
2. Geometric Isomers/(Cis/Trans)
3. Optical Isomers
 - A. Enantiomers
 - B. Diastereomers

4 Types of Isomers



Structural Isomers

Same

- Chemical Formula

Different

- Structure
- Chemical Properties
- Physical Properties
- Biological Properties

Example

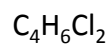
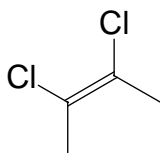


Geometric Isomers

Same

- Chemical Formula
- Structure

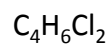
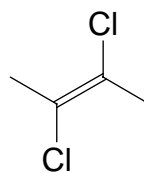
Example



Cis-2,2-dichloro-2-butene

Different

- Geometry (around C=C)
- Chemical Properties
- Physical Properties
- Biological Properties



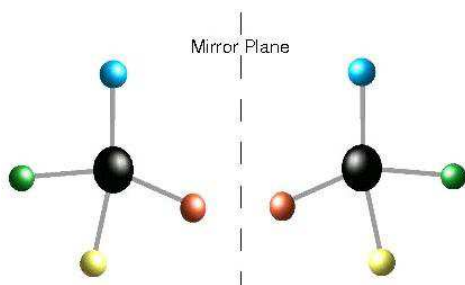
Trans-2,2-dichloro-2-butene

Optical Isomers (Enantiomers)

Definition: Chiral molecules that are mirror images of each other.

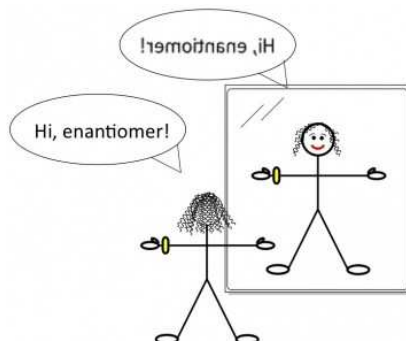
Same

- Chemical Formula
- Structure
- Chemical Properties
- Physical Properties



Different

- Geometry – stereoisomers that are mirror images
- Optical Rotation
- Biological Properties



Optical Isomers (Diastereomers)

Definition:

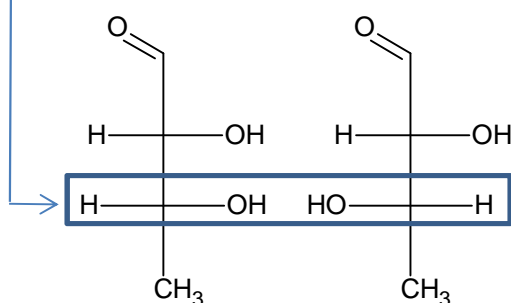
Chiral molecules that are not enantiomers of each other.
Differ in the orientation around one chiral carbon.

Same

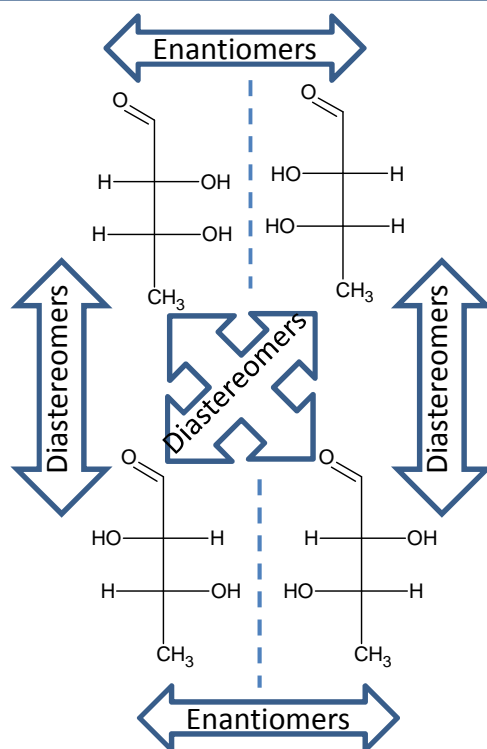
- Chemical Formula
- Structure

Different

- Geometry – stereoisomers that are not enantiomers
- Chemical Properties
- Physical Properties
- Optical Rotation
- Biological Properties

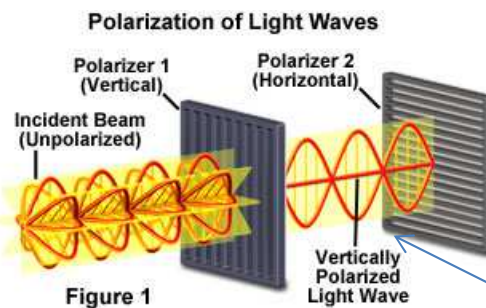


Enantiomers vs. Diastereomers



Plane Polarized Light

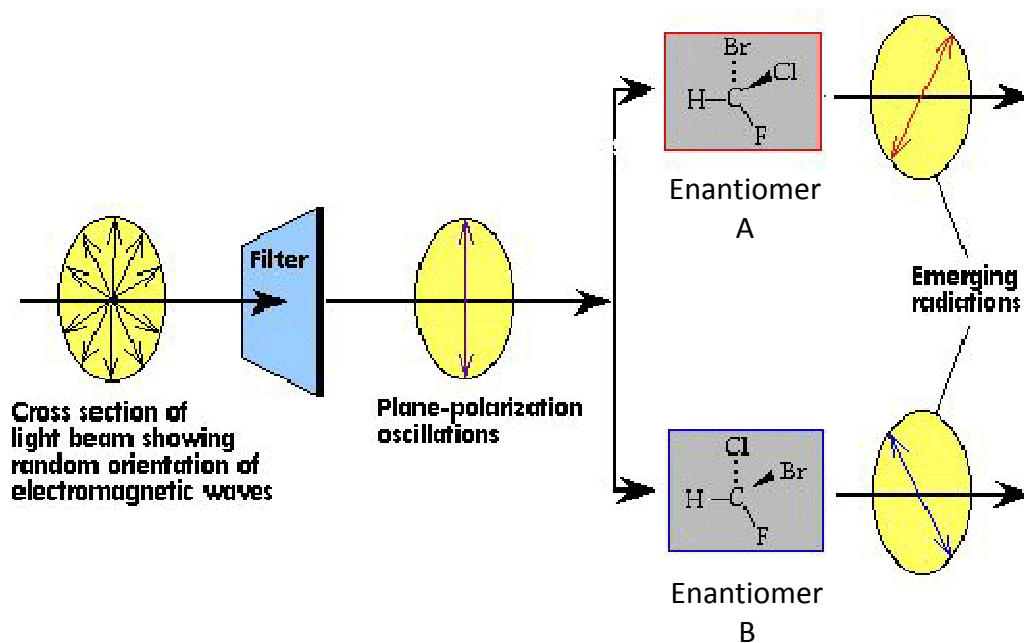
Light normally oscillates/vibrates in every direction:



Plane Polarized Light oscillates/vibrates in only one direction:

Plane Polarized Light can interact with molecules:

Optical Rotation of Plane Polarized Light



Chiral Molecules

Definition:

Molecules that lack a plane of symmetry, and therefore have non-superimposable mirror images. Can rotate plane polarized light.

Requirements:

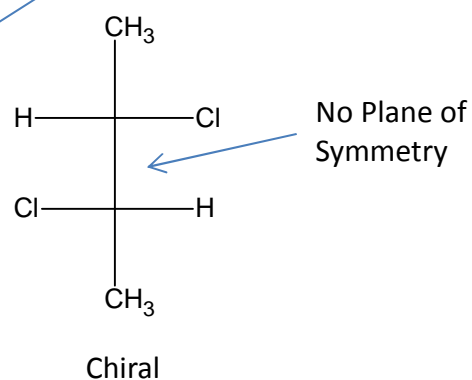
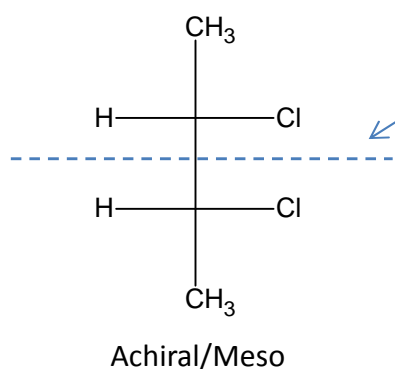
Carbon atoms with 4 bonds to different groups.
No additional plane of symmetry.

Important:

Chiral molecules that are enantiomers have the same physical and chemical properties but different biological properties.

Achiral Molecules

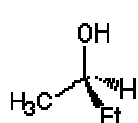
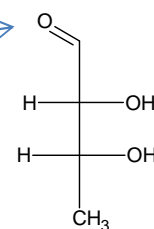
- Molecules that possess chiral carbons but have an additional plane of symmetry
- They do not rotate plane polarized light.
- Meso compounds are achiral.



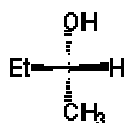
Fischer Projections

Method for drawing chiral molecules in 2D.

- Always draw the most oxidized group at the top
- The carbon backbone is drawn top-bottom
- Swaps are allowed only for horizontal atoms
 - Odd number of swaps = diff. molecule
 - Even number of swaps = same molecule



3D View showing tetrahedral shape



2D Representation of a 3D shape

Fischer Projection



Dextrorotatory and Levorotatory

Dextrorotatory

- Rotates light clockwise
- (+)

Levorotatory

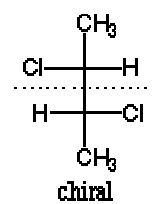
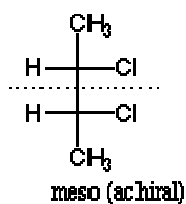
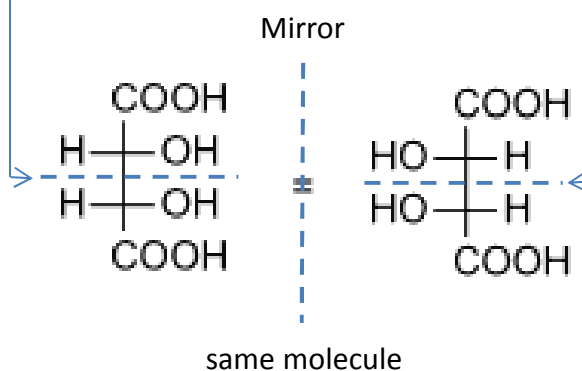
- Rotates light counter clockwise
- (-)

Meso Compounds

Definition:

Meso compounds have 2 (or more) chiral atoms, but do not rotate plane polarized light due to have an extra plane of symmetry

- Extra plane of symmetry
- Mirror image = same molecule
- Does not rotate plane polarized light



Number of Stereoisomer

Maximum number of stereoisomers

$$2^n$$

n = number of chiral carbons

- $2^2 = 4$
- $2^3 = 8$
- $2^4 = 16$
- Meso compounds decrease the number of isomers formed

Racemic Mixtures

Definition:

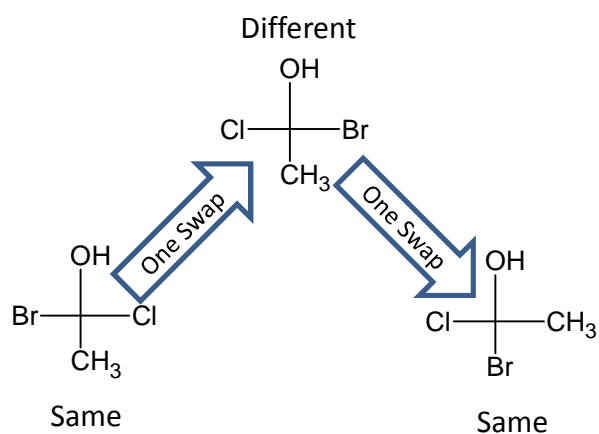
A mixture of equal amounts of two enantiomers

- Does not rotate plane polarized light (the 2 enantiomers cancel each other out)

Same/Different

Two Fischer projections:

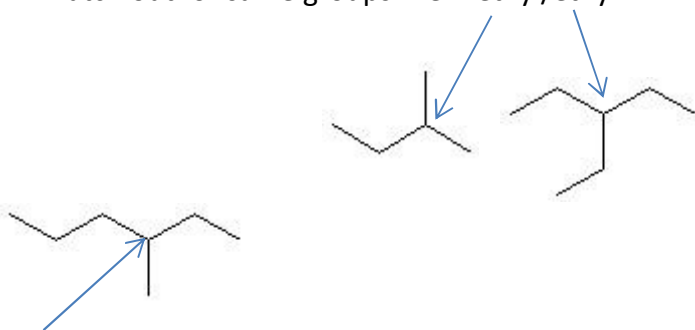
- Even # swaps = same molecule
- Odd # swaps = different molecule



Identifying Chiral Carbons

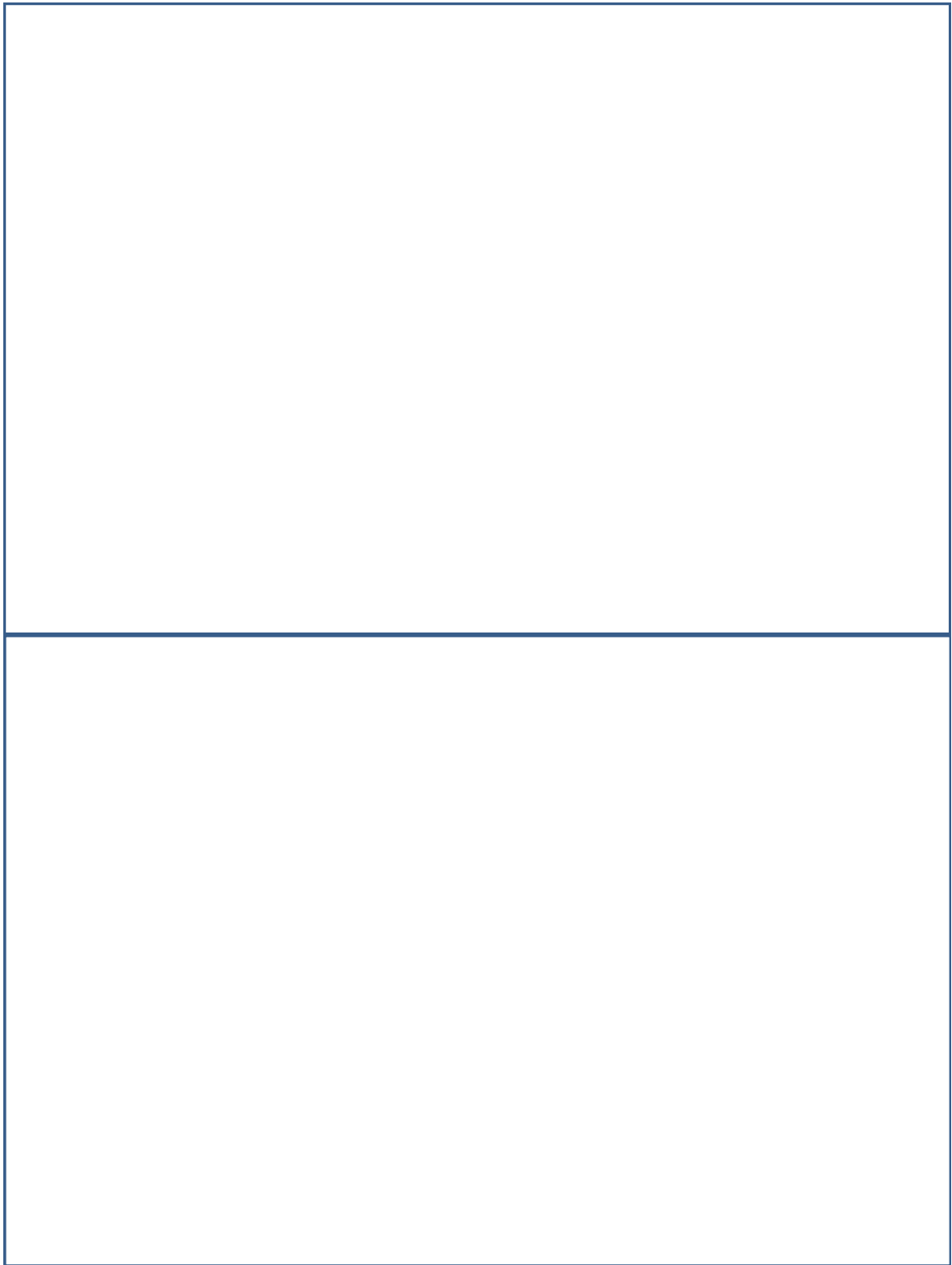
Definition: Chiral carbons are bonded to 4 different groups of atoms

- no C=C or C≡C
- watch out for same groups like methyl/ethyl

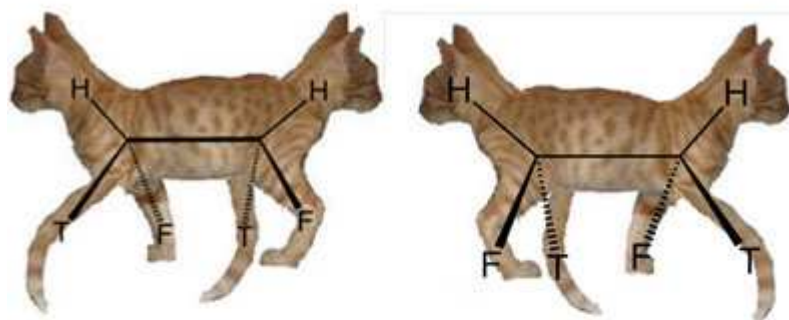


chiral 4 different groups

- H
- methyl
- ethyl
- propyl

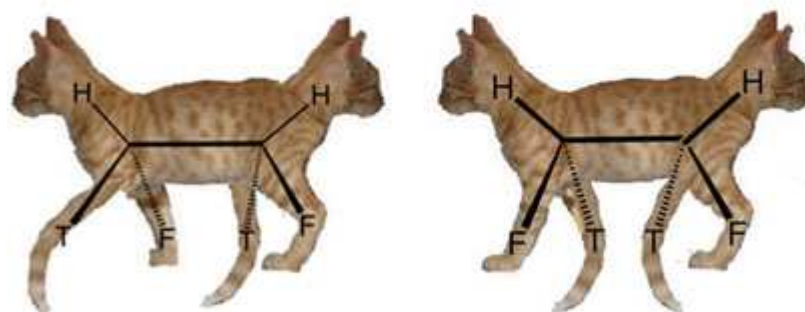


Two types of stereoisocats



Enantiocats

- The configuration is the same (same connectivity)
- Differ in orientation of limbs in space
- Non-superimposable mirror images
- We call this relationship "enantiomeric"

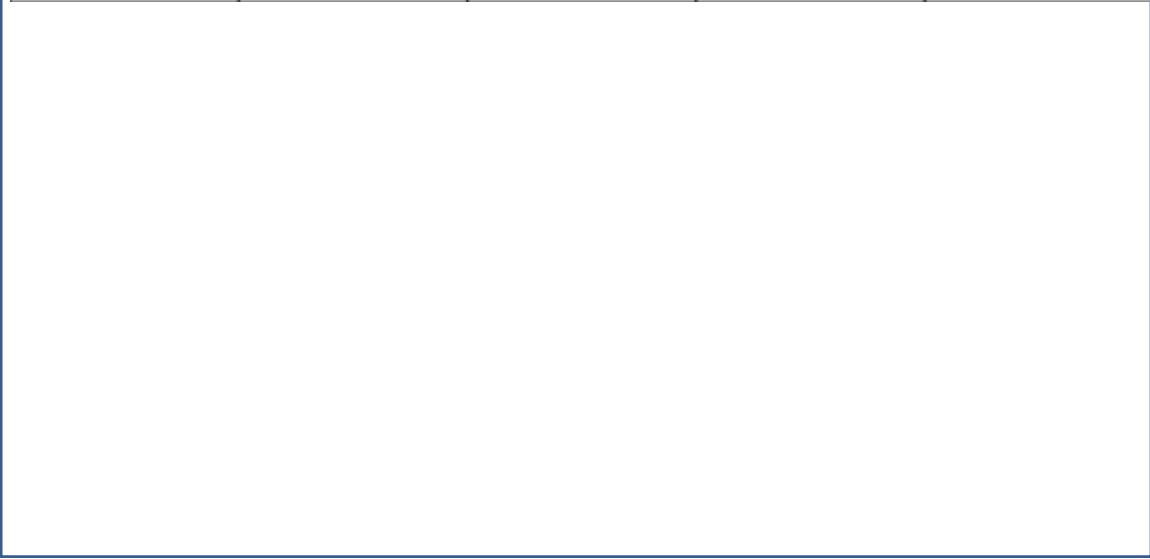
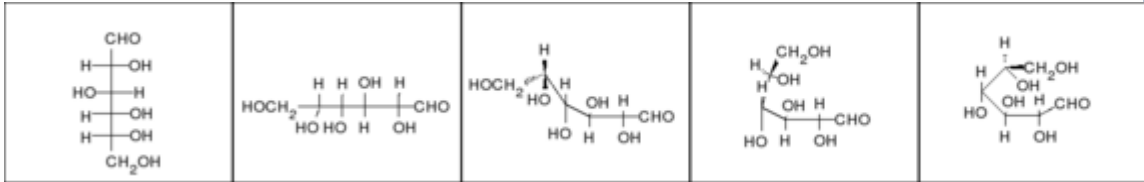


Diastereocats

- The configuration is the same (same connectivity)
- Differ in orientation of limbs in space
- NOT mirror images
- We call this relationship "diastereomeric"



Constitutional Isocats



Enantiomers

Definition:

Chiral molecules that are non-superimposable mirror images of each other.

Same chemical and physical properties

Different optical activity and biological properties

