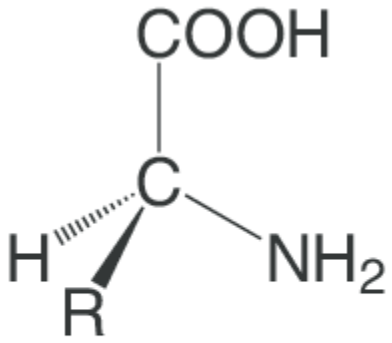
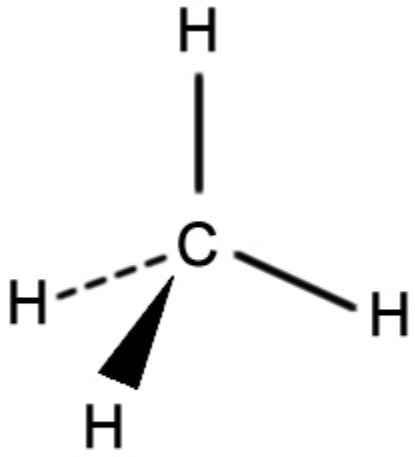
Lec. 1

Stereochemistry

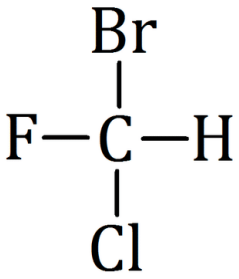
Is the branch of chemistry concerned with the three dimensional aspects of molecules.

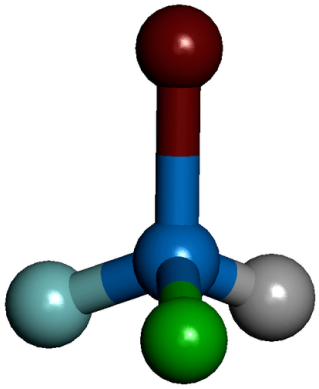


amino acid



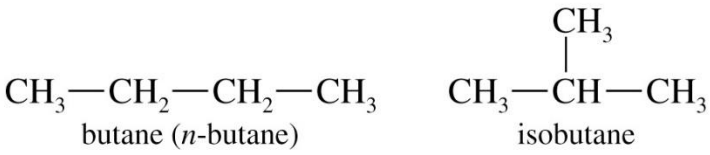
Sketched 3-D Structural Formula of Methane

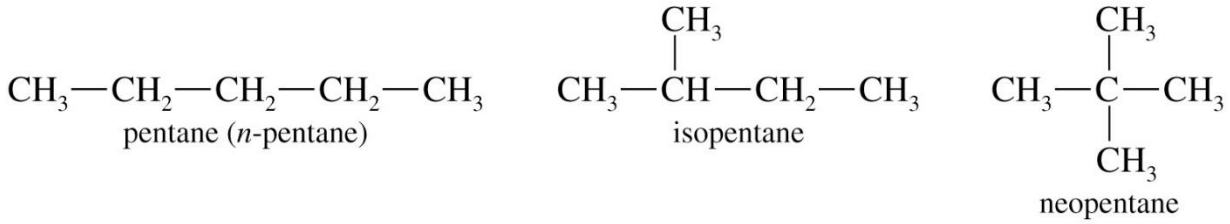


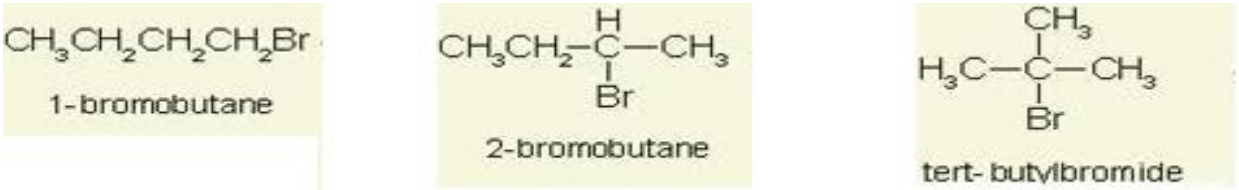


Isomers: different compounds that have the have the same number and kinds of atoms, but they are different in connections.

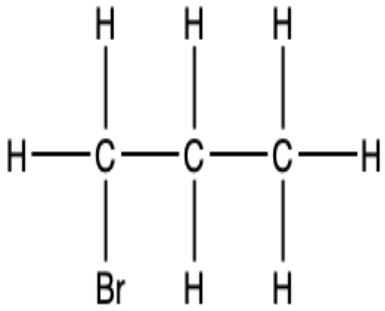
Lec. 1



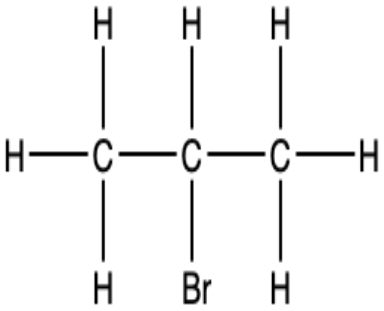




1-bromopropane



2-bromopropane



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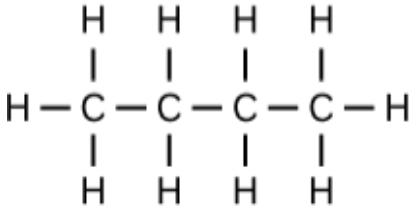
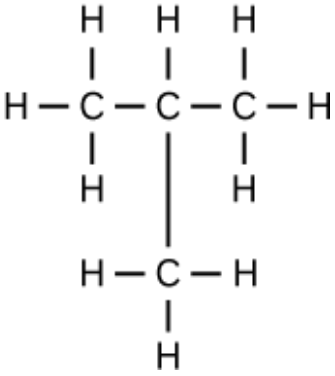
Structural Isomers

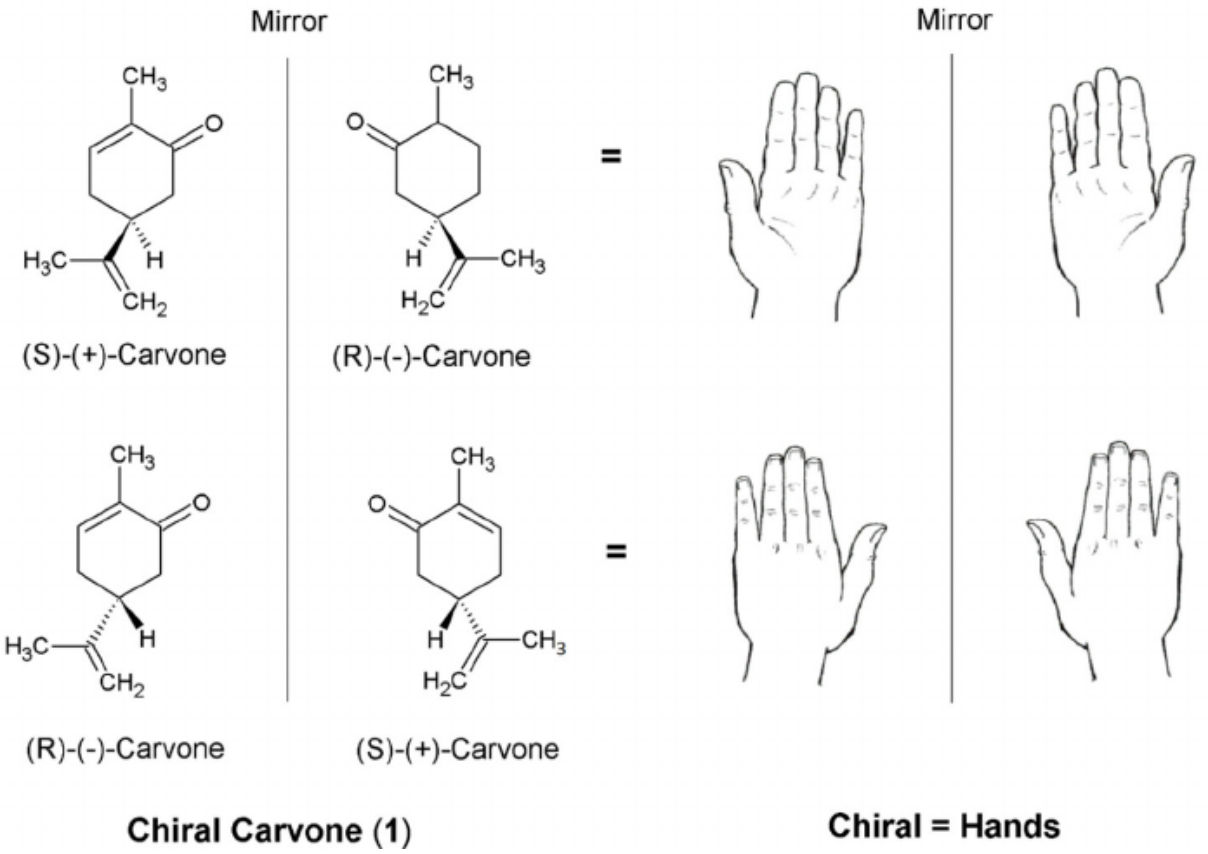
Butane



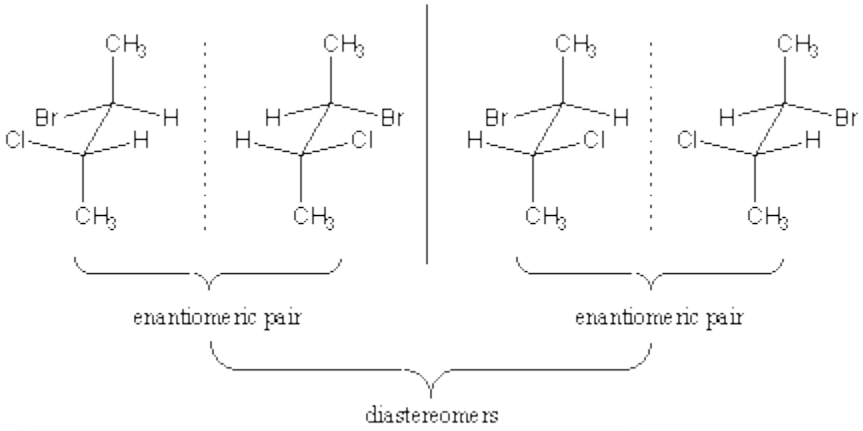
Isobutane

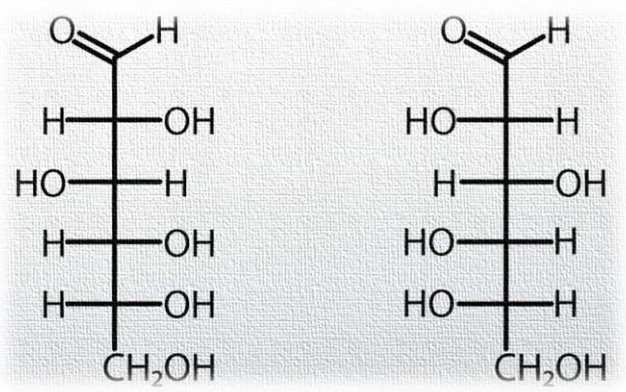


Enantiomers: are stereoisomers that are mirror images but cannot be superimposed.



Lec. 1





Enantiomers have identical physical properties but different in biological activity. One enantiomer of a drug can be considered as a cure for a disease while another could be very toxic.

D-amino acids are biologically not active, while L-amino acids are active.

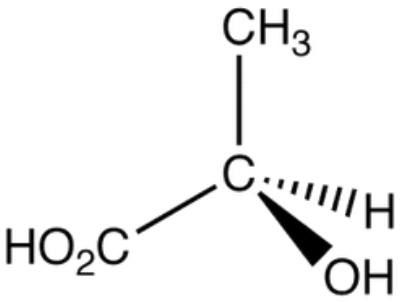
D-sugars are biologically active, while L- sugars are not.

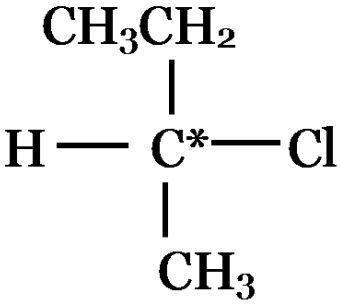
Chiral carbon atom

Tetrahedral carbon atom connected to four different groups is called chiral carbon, it has asymmetrical carbon.

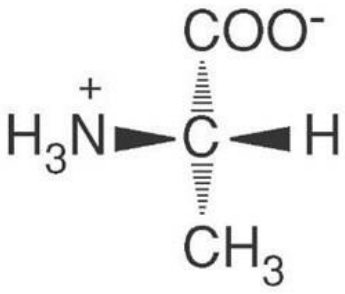
Example

Lec. 1

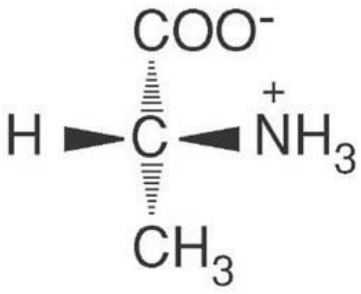




(a) (b)



L-Alanine



D-Alanine

D-alanine called a chiral molecule. It has mirror image and they are superimposed.

Number of isomers (I)=2^n

I=number of isomers

n= number of chiral atoms

In alanine n=1,

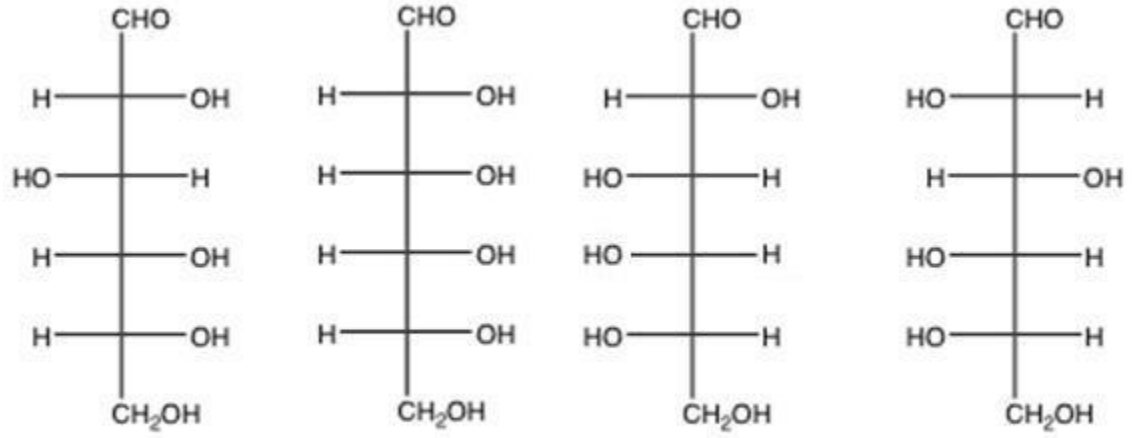
I=2^1 =2

Lec. 1

CH_2OH-CHOH-CHOH-CHOH-CHO

n=2

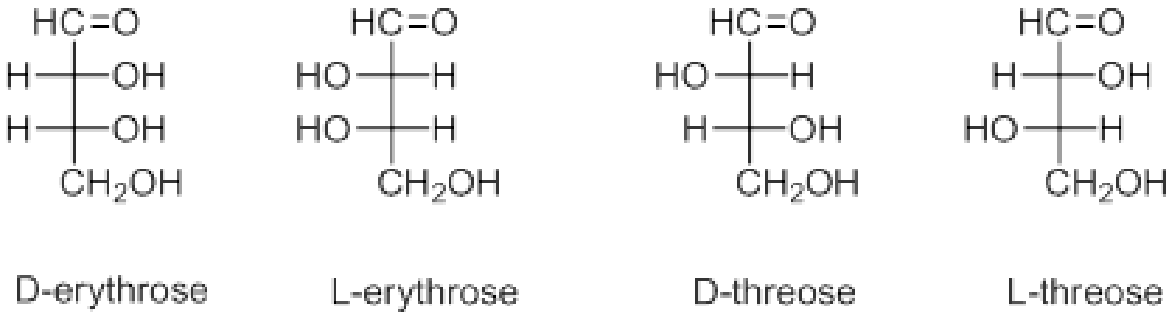
$I=2^2=4$



CH_2OH-CHOH-CHOH- CHO

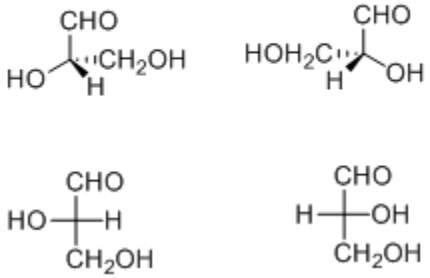
n= 2

$I=2^2=4$



Lec. 1

L-glyceraldehyde D-glyceraldehyde



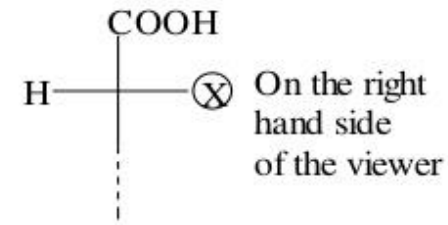
Example

Give me all isomer of ribose $C_5H_{10}O_5$

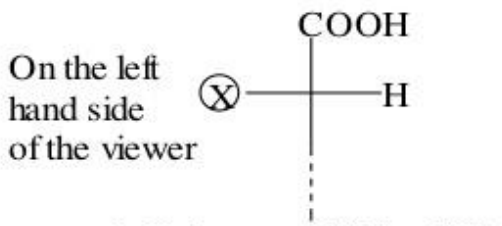
Optical activity

All biological compounds such as sugars, amino acids and drugs with chiral carbon atoms can rotate the polarized light to the right or to the left.

Lec. 1

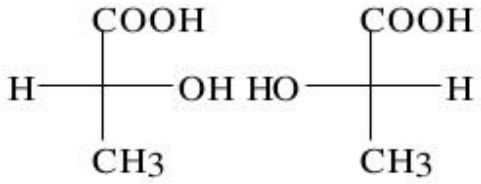


D-Hydroxy acid (X = OH)
D-Amino acid (X = NH_2)

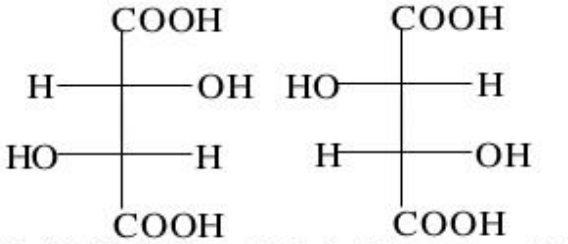


L-Hydroxy acid (X = OH)
L-Amino acid (X = NH_2)

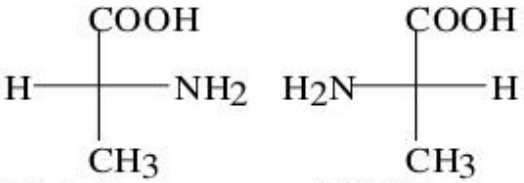
Examples



D-(–)-Lactic acid **L-(+)-Lactic acid**



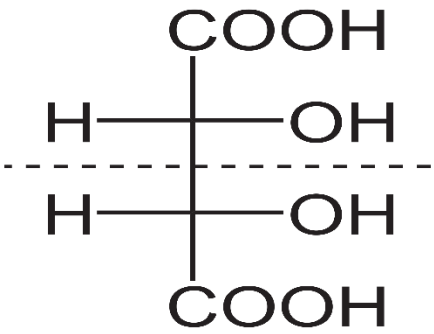
D-(+)-Tartaric acid **L-(–)-Tartaric acid**

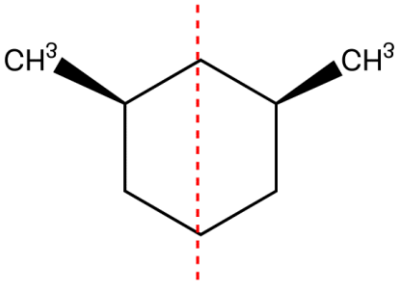


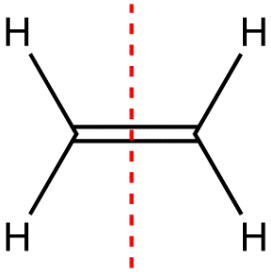
D-(–)-Alanine **L(+)-Alanine**

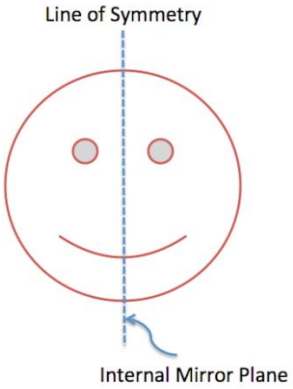
Mesocompound: A molecule that contains chiral centers but optically inactive. It contains internal plane of symmetry:

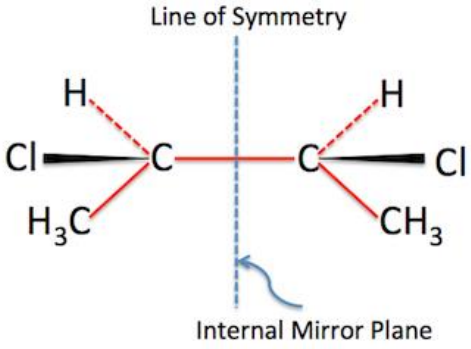
Lec. 1





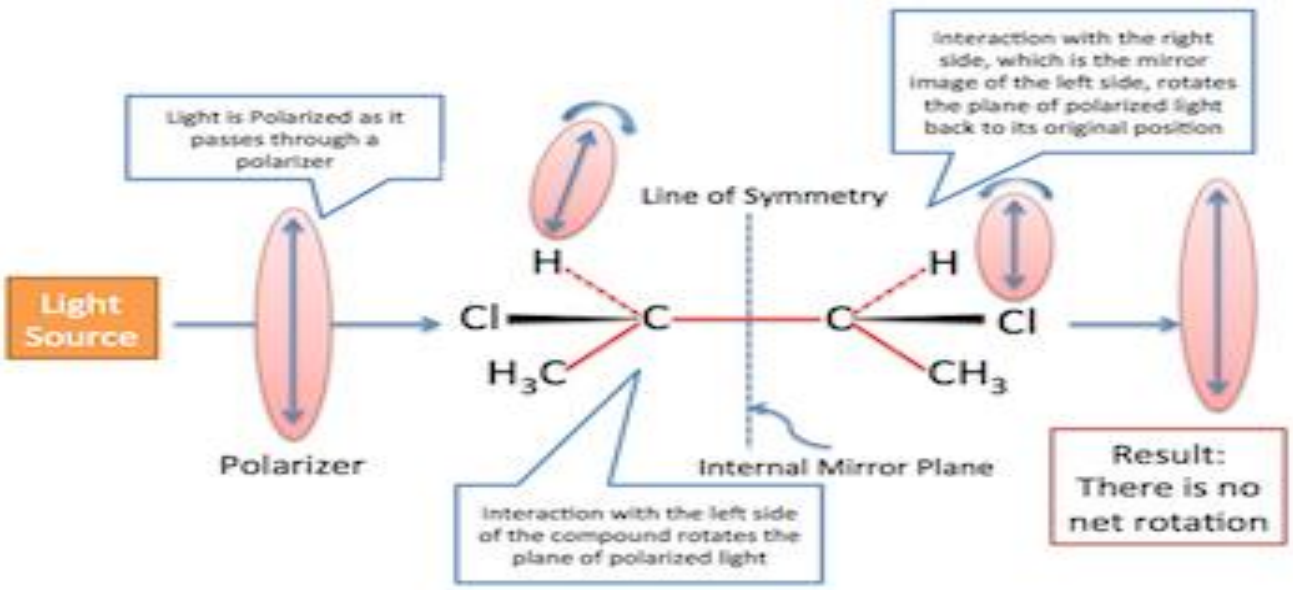






Smiley face has an internal mirror plane of symmetry

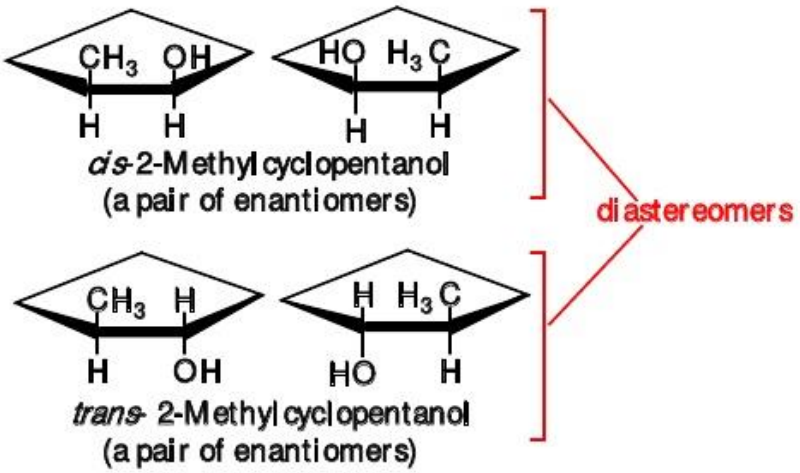
Lec. 1



Example for cyclic enantiomers and diastereomers**.**

Enantiomers & Diastereomers

- 2-Methylcyclopentanol

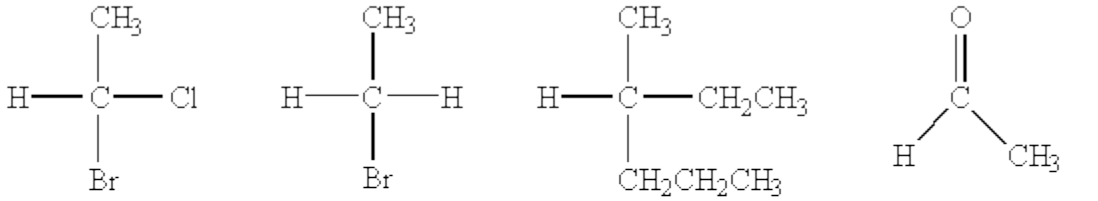


Lec. 1

Stereoisomers of carbon compounds

Configuration: The arrangement in space of the atoms of a molecule.

Chiral carbon atom: a carbon atom bonded to for different atom or groups.



chiral

Has 4 different atoms bonded to the carbon

achiral

Does not have 4 different atoms or groups bonded to the carbon (2 hydrogens)

chiral

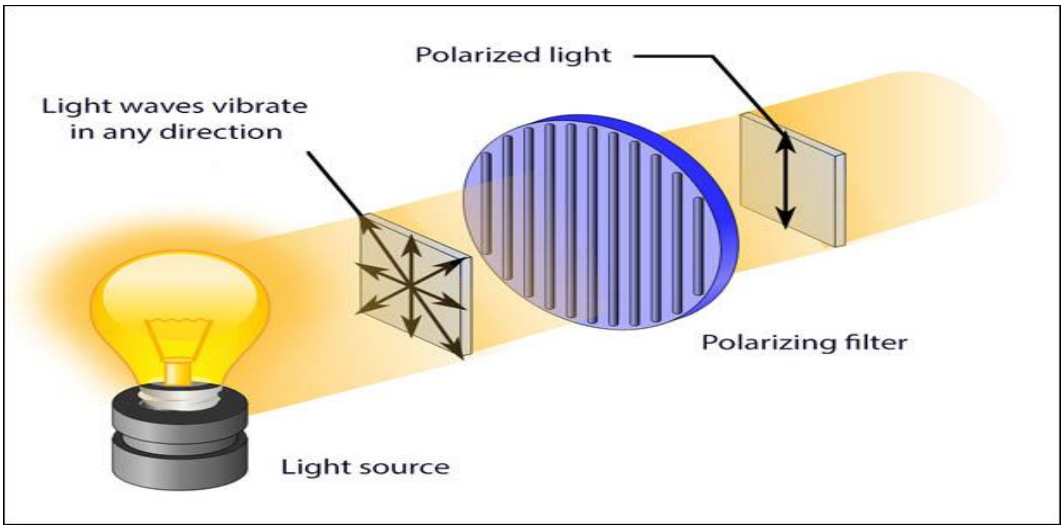
Has 4 different groups bonded to the carbon

achiral

Only has 3 atoms bonded to the carbon

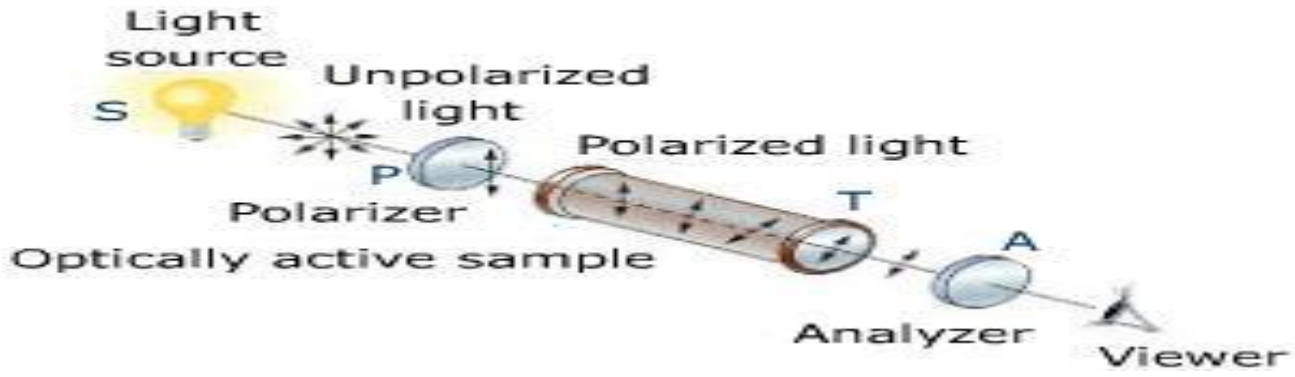
Optical activity: all chiral molecules have the ability to rotate plane-polarized light.

Polarized light: light in which all rays vibrate in a single plane.



Lec. 1

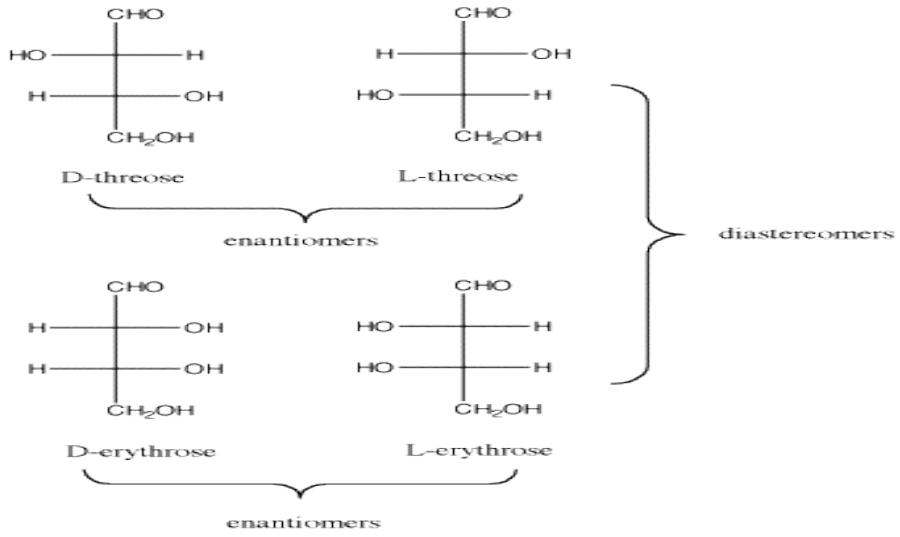
Any substance that will rotate plane polarized light is said to be optically active.



A compound that rotates plane-polarized light to the right is called **dextrorotatory.** If the rotation is to the left, the compound is called **levorotatory.**These compound are called optical isomers.

A mixture of equal amounts of the two enantiomers is called a racemic mixture. Such a mixture is optically inactive.

Diastereomers: Stereoisomers that are optically active but are not mirror images.



Lec. 1

Meso stereoisomers:

A molecule that contains chiral centers but is optically inactive.

