భారతీయ సాంకేతిక విజ్ఞాన సంస్థ హైదరాబాద్
भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology Hyderabad

Introduction of Bio-nanotechnolgy

BT1110

Lecture 9 : Chirality in Biological systems

Himanshu Joshi 21 November 2023

भारतीय सांकेतिक विज्ञान संस्थ हैदराबाद
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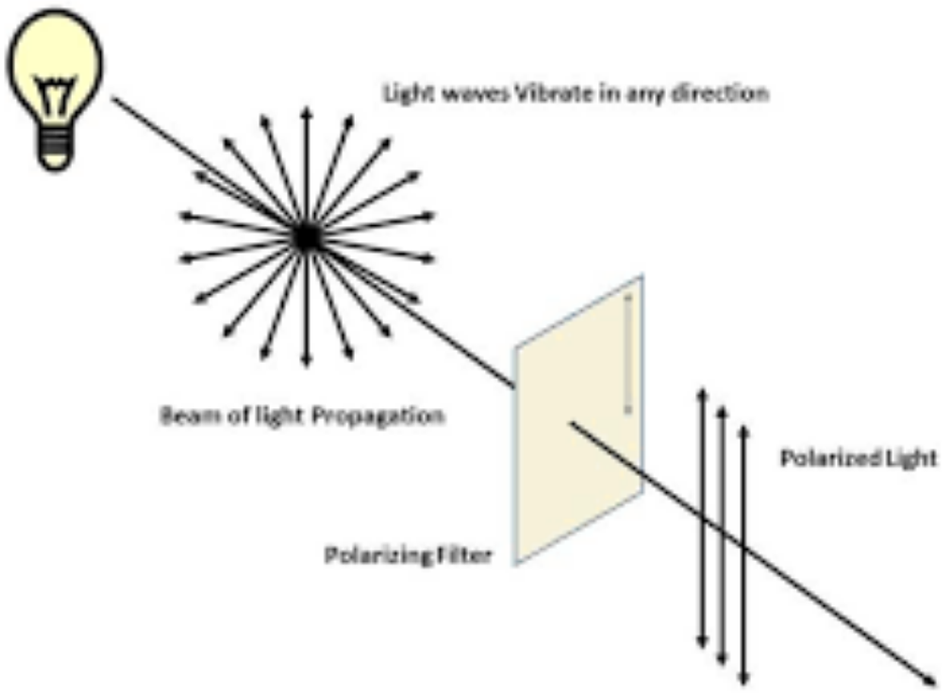
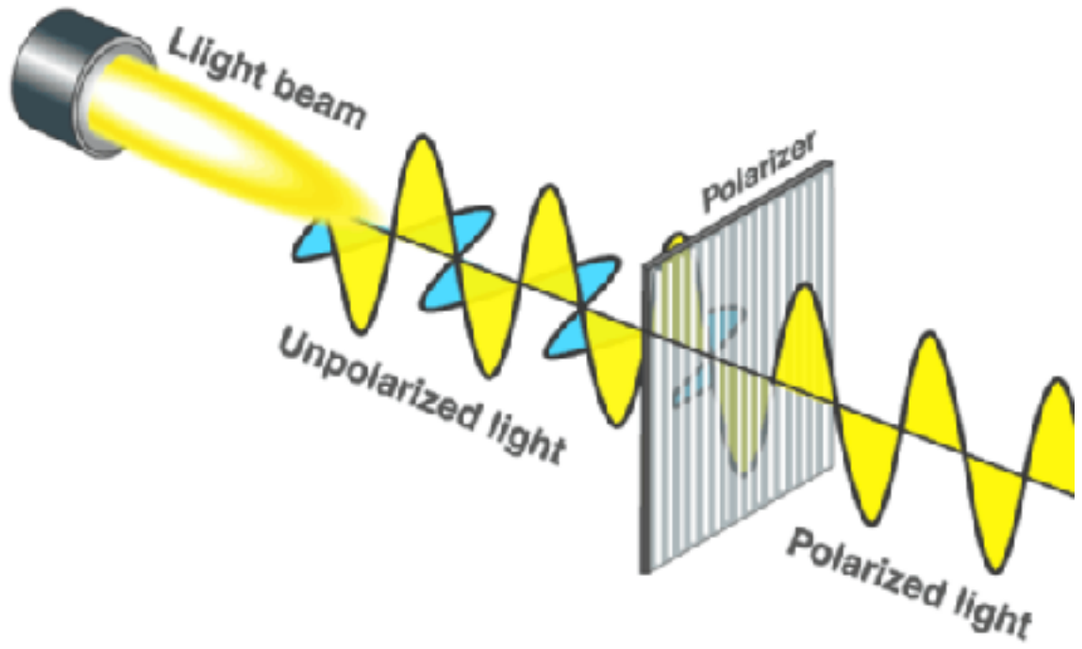
Course contents

- Introduction to nanotechnology and bionanotechnology,
- Biological self-assembly
- Biologically inspired nanostructures - introduction to biomimetics
- Nucleic acid nanotechnology
- DNA origami
- Protein engineering
- Lipid nanotechnology
- **Chirality in biological systems**
- Interaction of nanomaterials with biological systems
- Virology: viruses and vaccines

Polarization



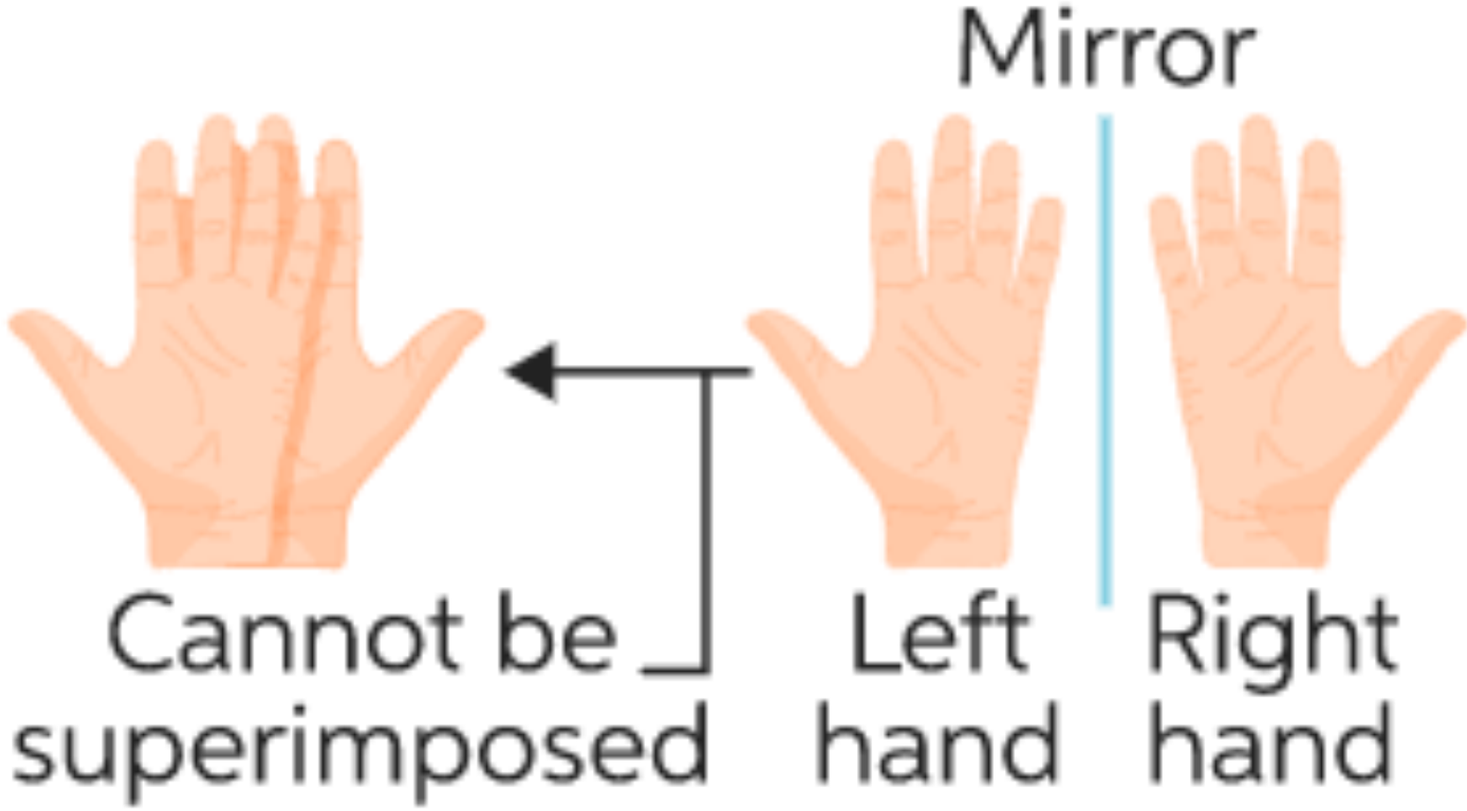


Light is a electromagnetic wave, **E** and **B** fields are perpendicular to each other

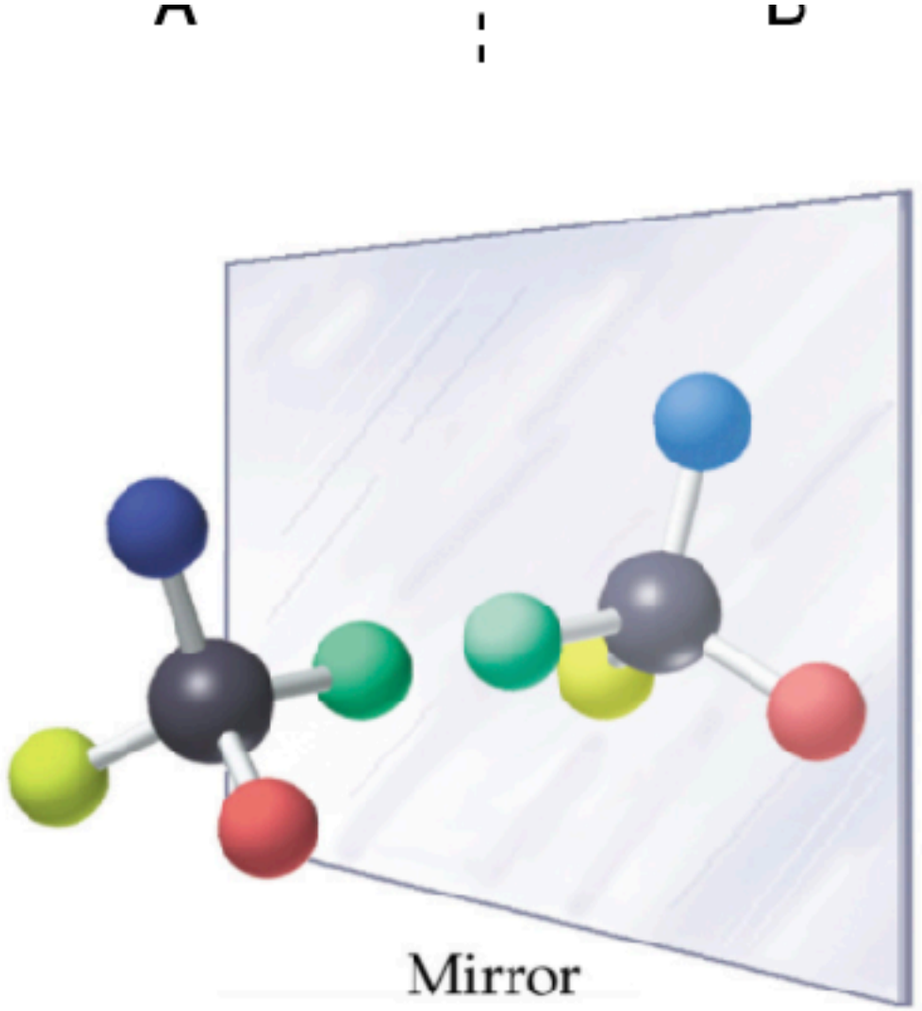
Chirality

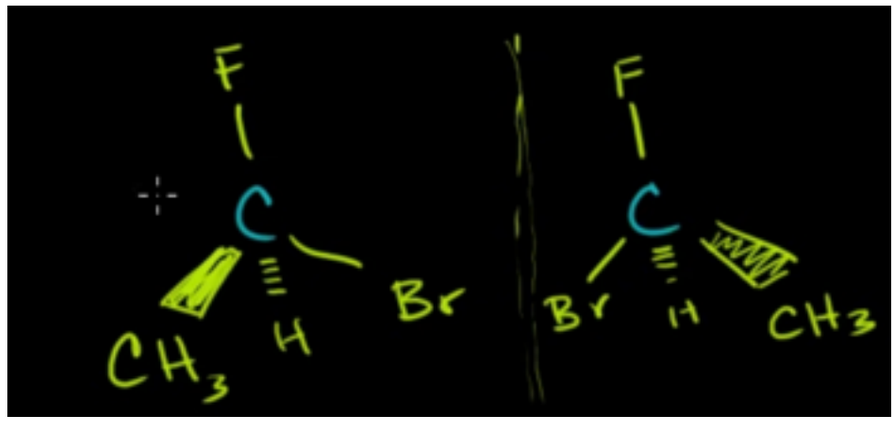
Chirality is the ability of the molecule to exists in two non superimposable ways.

No matter how much I rotate I can not make my right hand, I can not make it superimpose.



The tetrahedral carbon

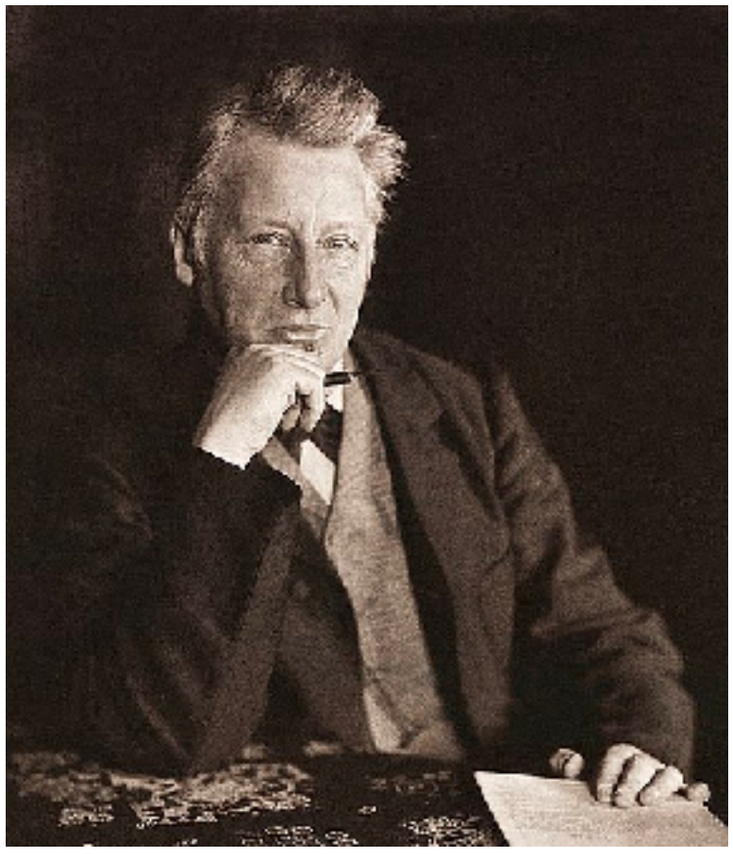




1862 Kekulé first proposed the tetrahedral geometry of carbon
In this Gent laboratory

Orbital hybridization proposed by Pauling (1931).

Optically active compound



Jacobus van 't Hoff
First Nobel prize in chemistry 1901

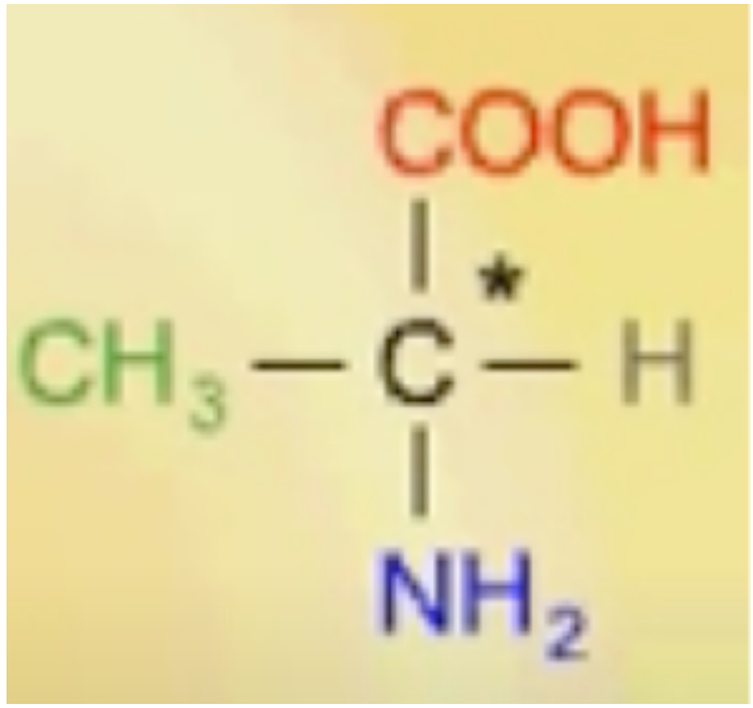
When the plan polarized light passes through some compound, optically active or chiral compound, the plane of polarization gets rotated.

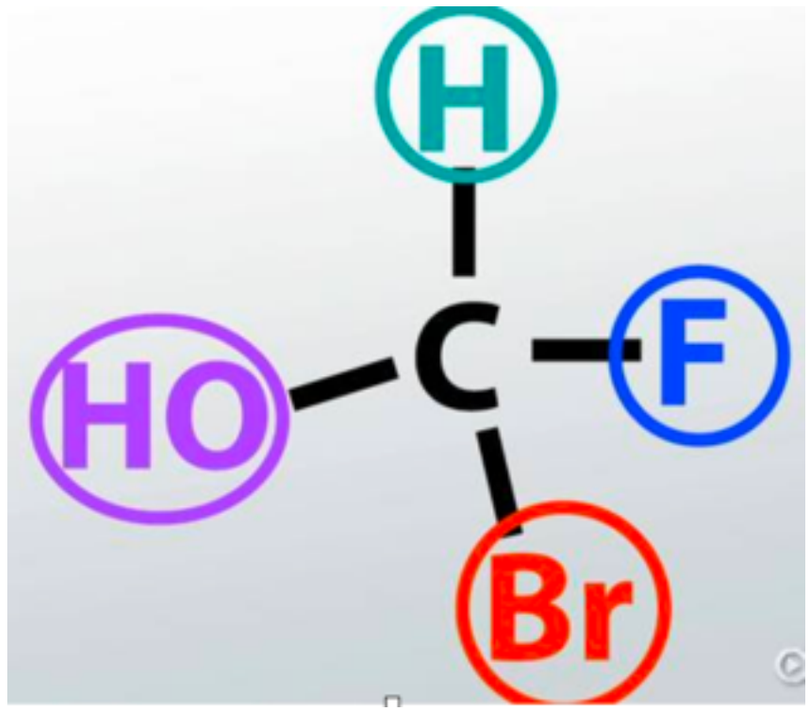
Chiral compound is optical active. **Achiral** compound is optical inactive.

Certain compound rotated the plane clockwise and others counterclockwise.

The molecules that caused the right handed rotations are called dextrorotatory (d) and those who caused the left handed rotations called levorotatory

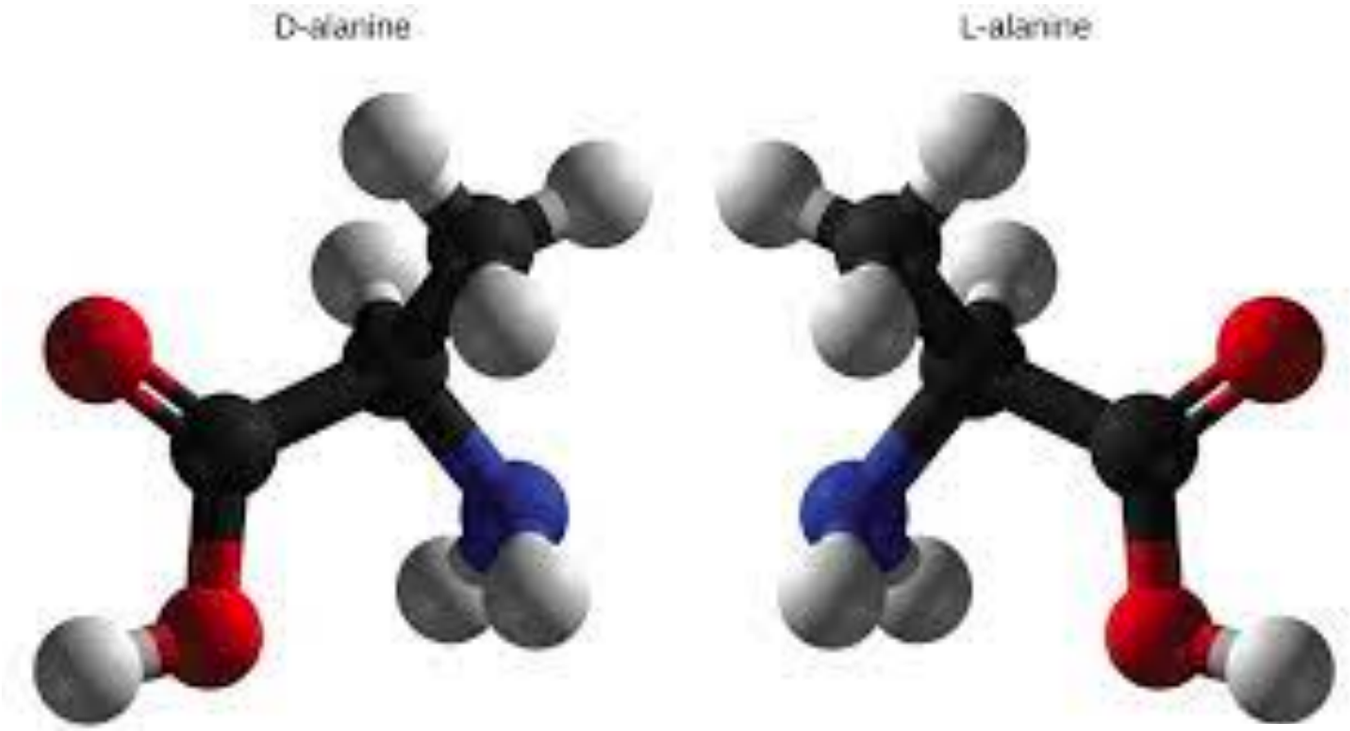
Chirality: Enantiomers

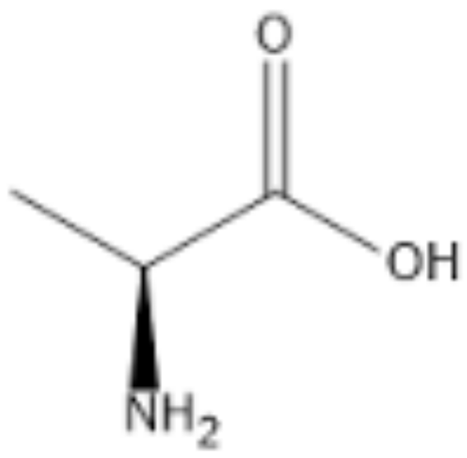




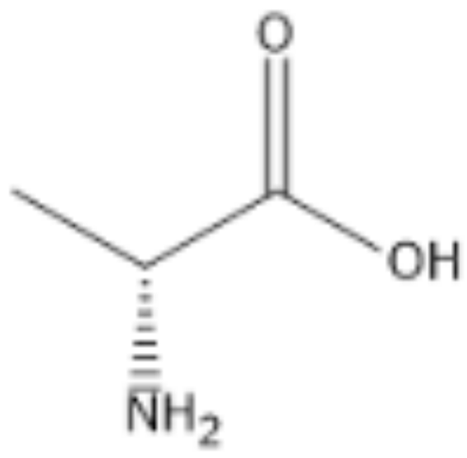
Same mass, density, and other physical properties but rotates the plane polarized wave differently

D-alanine vs L- alanine



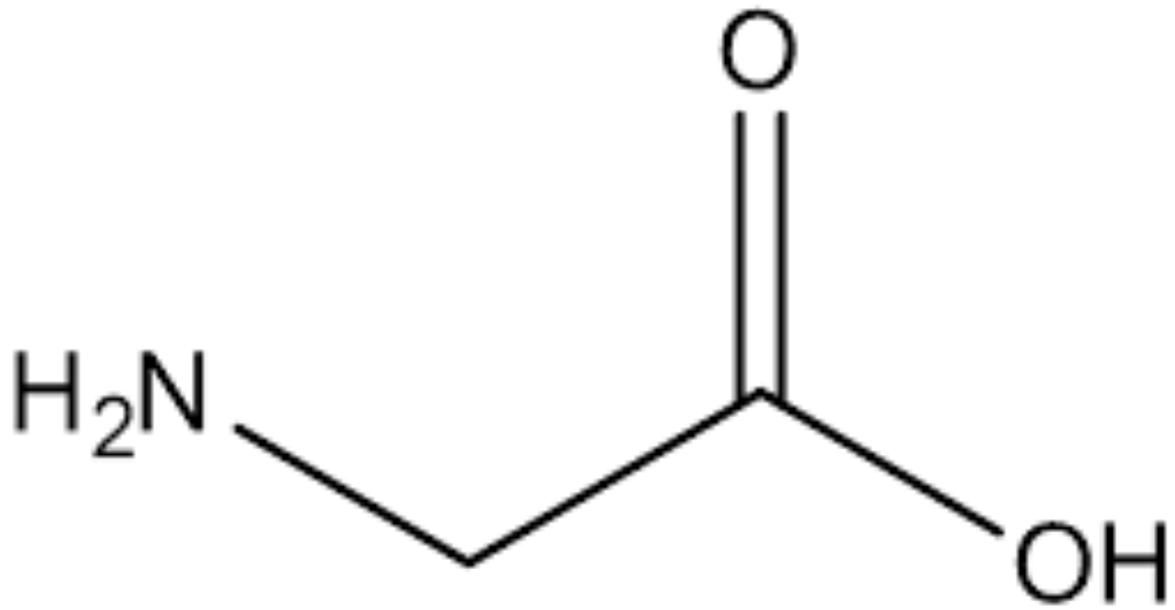


L-alanine



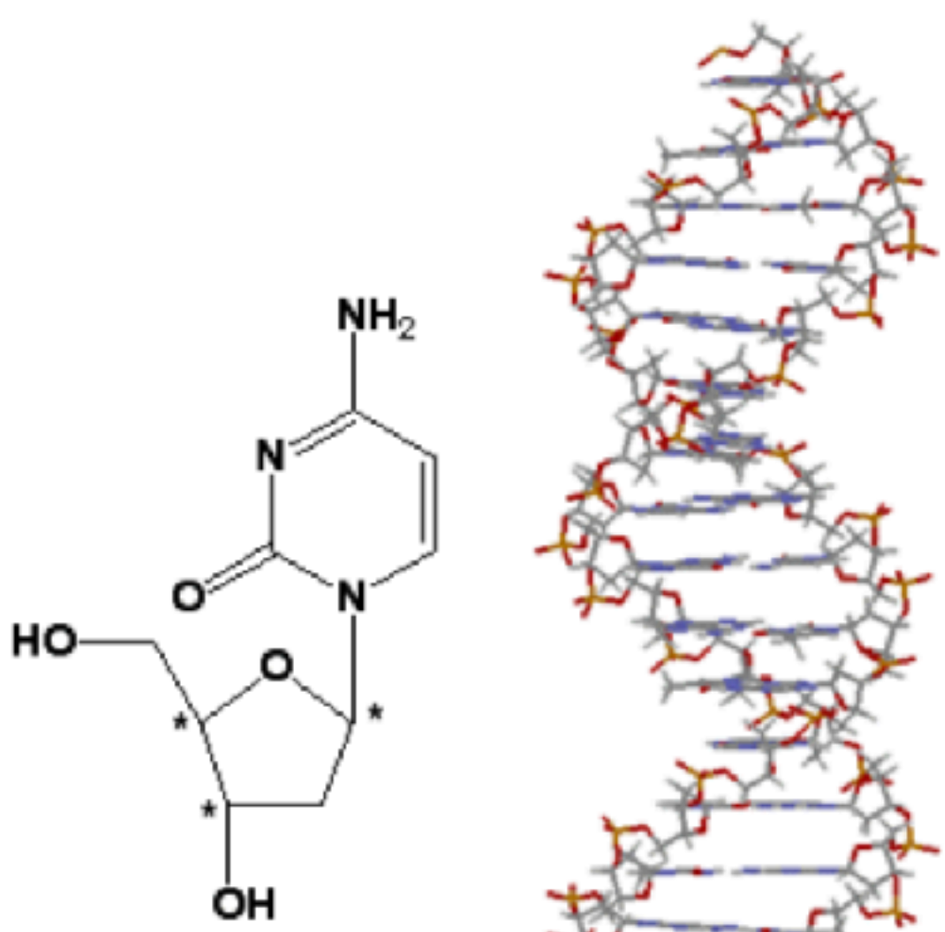
D-alanine

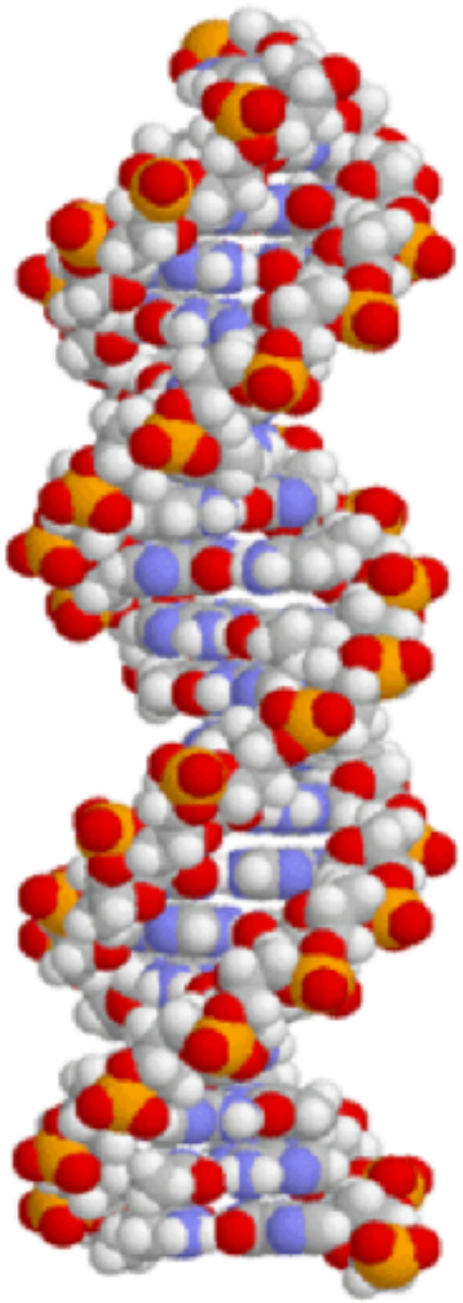
Only achiral amino acid (Glycine)



Glycine

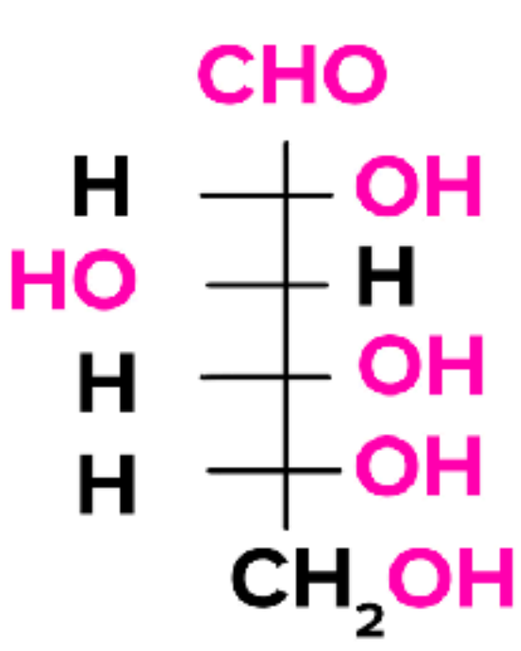
DNA is a chiral molecule

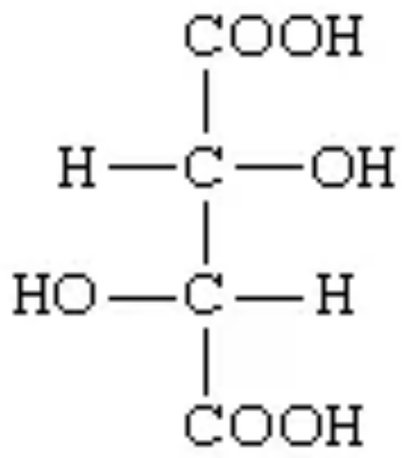




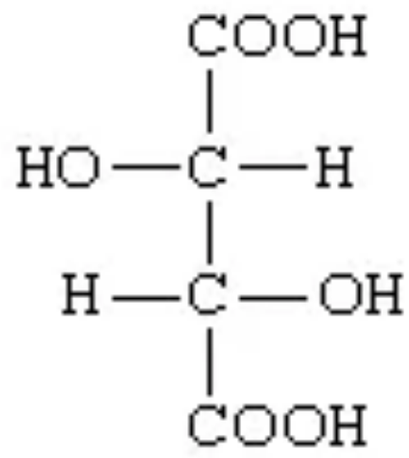
Chiral carbon

A chiral carbon atom is a carbon atom that is attached to four different types of atoms or groups of atoms.





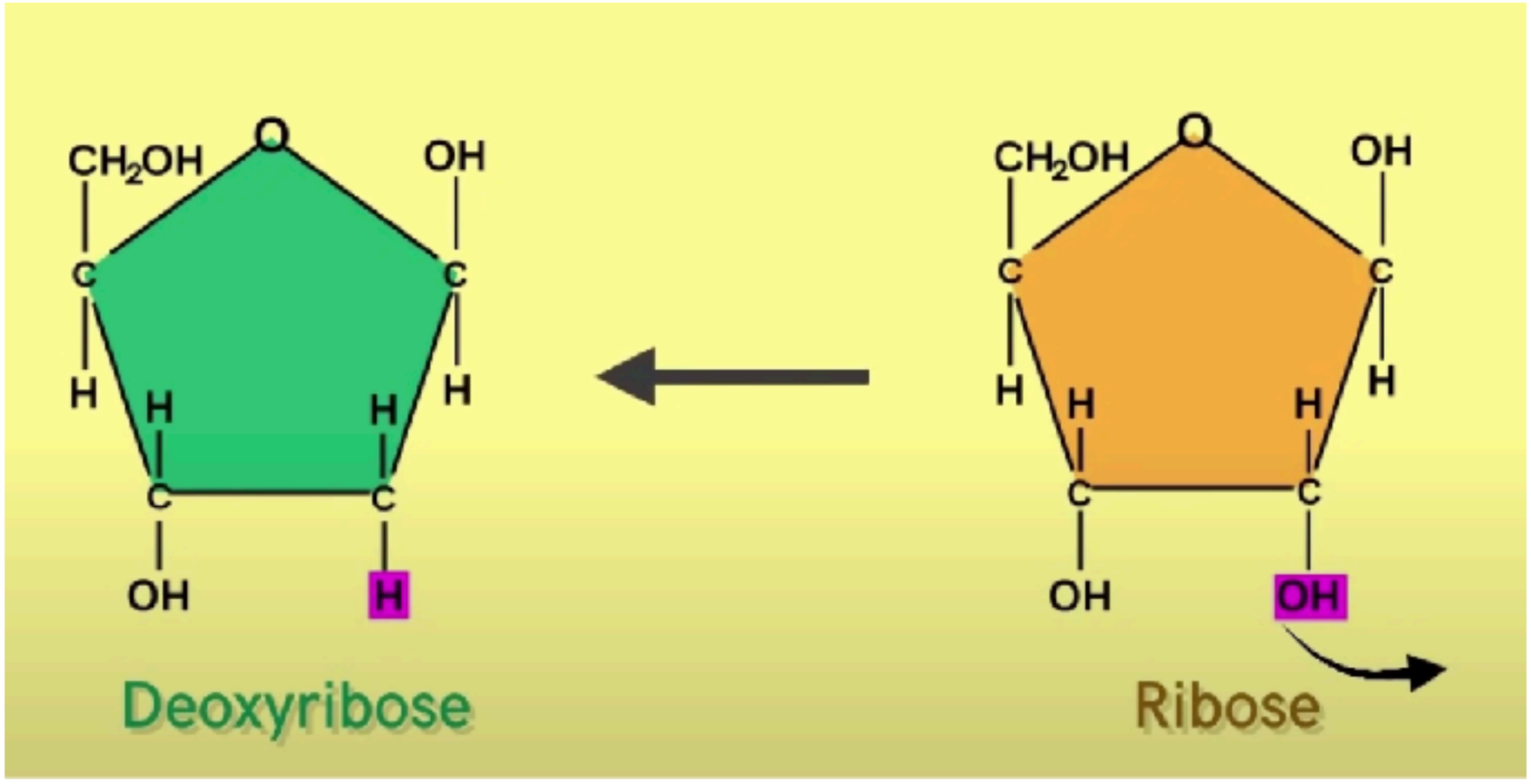
d-tartaric acid



l-tartaric acid

4 chiral carbon

DNA vs RNA


CH2OH
O
OH
C
C
H
H
H
C
C
OH
H
Deoxyribose
CH2OH
O
OH
C
C
H
H
H
C
C
OH
OH
Ribose

Chemistry and Biochemistry: The difference

Biological molecules are much larger than the conventional molecules study in chemistry.

Most of the biomolecules are chiral