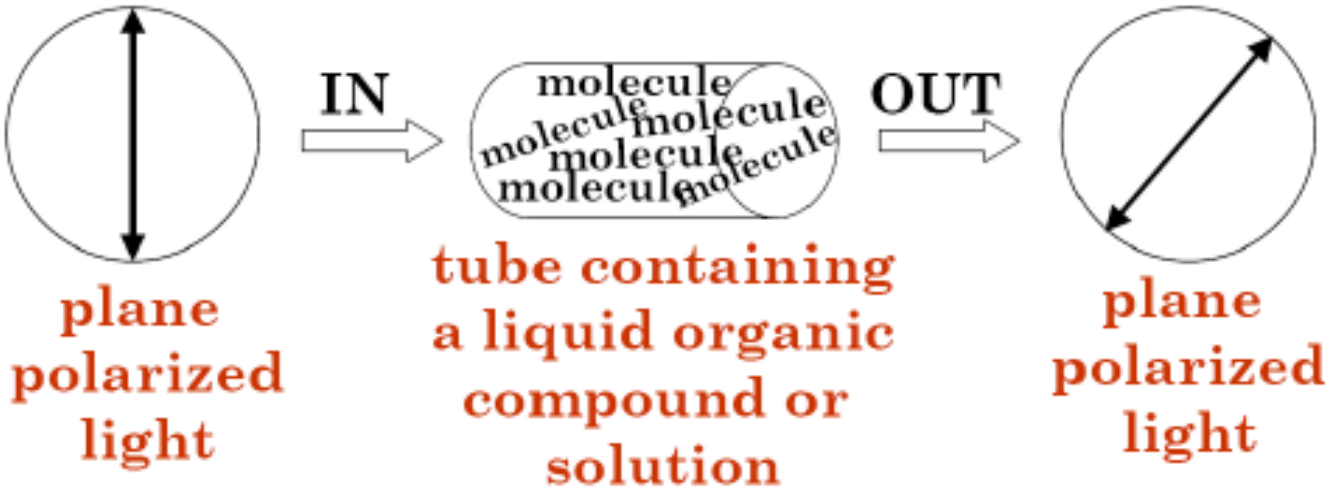
Enantiomers

Chiral Properties: Optical Activity

Chiral molecules rotate plane-polarised monochromatic light either clockwise or counterclockwise. This phenomenon is called optical activity.

This property is inherent in the interaction between light and the individual molecules through which it passes.



Chiral molecules are thus optically active.

Enantiomers

Calculation of Specific Rotation

Specific rotation [α] is a standardized physical constant for the degree that a solution rotates plane-polarized light.

$$\text{specific rotation} = [\alpha] = \frac{\alpha}{l \times c}$$

α = observed rotation (°)
l = length of sample tube (dm)
c = concentration (g/mL)

[dm = decimeter
1 dm = 10 cm]

Specific rotation is the optical rotation observed for 1 g/mL of an analyte in solution in a cell of 10 cm (1 dm) path length using light of the sodium D line of wavelength 589 nm.

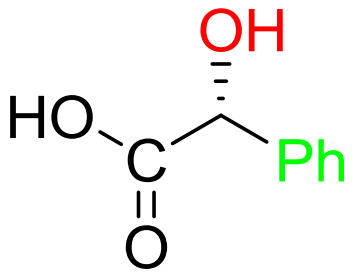
The temperature is maintained at 25 °C

Enantiomers

Chiral Properties: Optical Activity

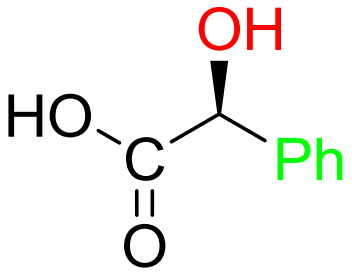
Enantiomers differ only in their properties that are chiral:

- direction of rotation of plane polarized light,
- their rate of reaction with chiral reagents,
- biological activity and taste.



(R)

Mandelic Acid



(S)

-154° Specific Rotation +154°

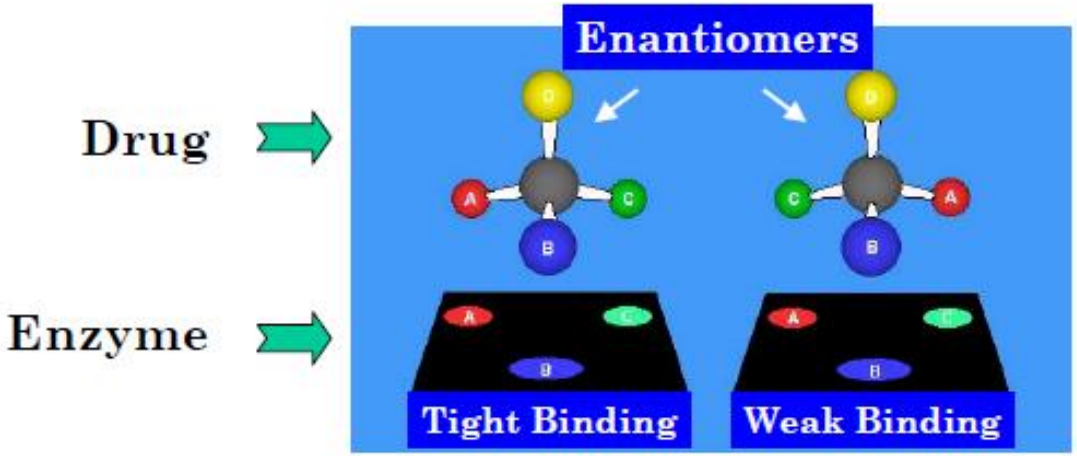
Isolated from Sweet and Bitter almonds

Enantiomers

Chiral Properties: Biological Activity

Stereochemistry is important in biological systems because most body reactions are **stereospecific**. Receptors on cells accept only molecules with specific spatial arrangements. Other configurations of the same chemical may not elicit a favorable response or be toxic.

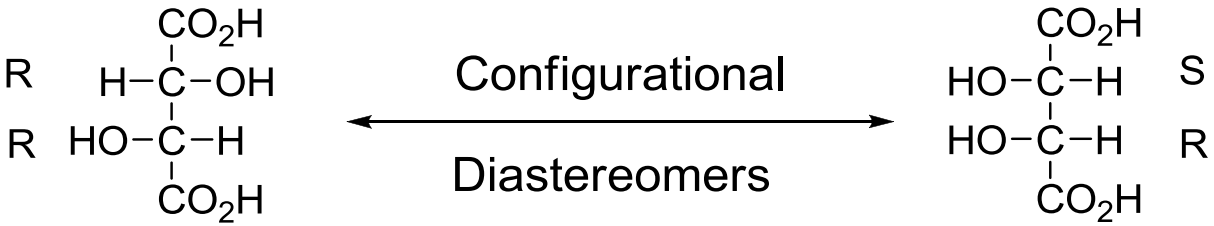
Enantiomers of a chiral drug interact with the biological environment as depicted below.



Diastereomers

Properties of Configurational Diastereomers

Compare the listed properties of the two diastereomers of tartaric acid (dextrotartaric and mesotartaric acid) and note the differences in magnitude.



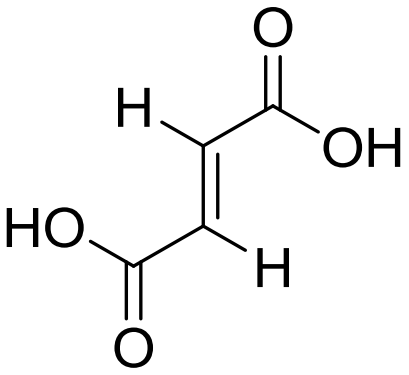
Dextrotartaric acid — Mesotartaric acid

+12.7	$[\alpha]^D$	0 (Achiral)
171-174°C	Melting point	146-148°C
1.76 g/mL	Density	1.66 g/mL
139 g/100 mL	Solubility in water	125 g/100 mL

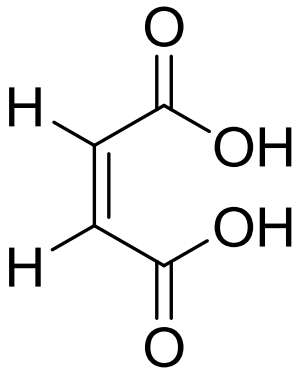
Diastereoisomers

Cis-Trans Diastereomers (Geometric Isomers)

Cis-Trans diastereomers or geometric isomers usually arise when there is restricted rotation in a molecule; commonly at a carbon-carbon double bond.



Fumaric Acid



Maleic acid

Due to the restricted rotation at the double bond, groups attached to it could be positioned on the same or opposite sides of the alkene leading to stereoisomerism.