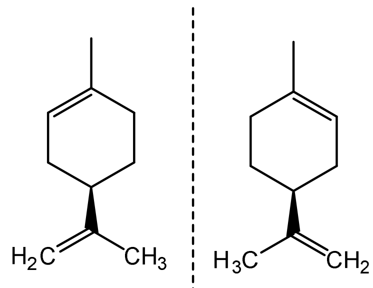
TC8 – Introduction to Optical Isomerism

TERMINOLOGY

Optical isomerism is a kind of **stereoisomerism**. It occurs when two molecules have the same molecular formula but exist as mirror images of each other. Limonene is an example of an **enantiomer** (an optical isomer) with a **non-superimposable mirror image**, this means that if one enantiomer was placed on top of the other, they wouldn't look the same. Your hands are an example of this. Placing your upturned right hand below your upturned left hand shows that, since they are mirror images, all your fingers are in the opposite order.



R-Limonene S-Limonene

Optical isomers are **optically active**. Optically active substances can rotate the **plane of polarised light**. This means that, if a beam of electromagnetic radiation (light) vibrates in only one plane e.g. a vertical plane (up and down), then an optically active substance can **rotate** this beam clockwise or anti-clockwise. The enantiomer which rotates the beam clockwise is known as the 'D' isomer and the enantiomer which rotates the beam anticlockwise is known as the 'L' isomer. The terms **D/L-** can be used to differentiate molecules. The terms **R/S-** are also used.

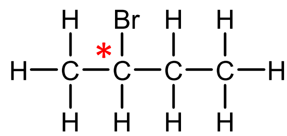
Plane of polarisation (vertical) Rotation (clockwise)

DIFFERENTIATING ENANTIOMERS BIOLOGICALLY

Although identical in molecular formula, the differences in 3D structure can have a significant effect on the function and properties of a molecule. This is because many **receptors** can differentiate between two different enantiomers. For example, the scent receptors in the nose can differentiate the two enantiomers of limonene. This means that R-limonene smells of citrus, whereas S-limonene smells of pine, even though they have the same molecular formula.

CHIRALITY

Molecules that are non-superimposable on their mirror images are called **chiral molecules**. Carbon atoms bonded to four different groups are known as **chiral centres**, as these are the positions which give the molecule chirality. For example, the chiral carbon in 2-bromobutane is connected to a methyl group, a bromine atom, a hydrogen atom, and an ethyl group. The chiral carbon is often identified with an asterisk, as shown in the diagram. A molecule can have more than one chiral centre and if so will have more than two optical isomers.



All 20 naturally occurring amino acids exhibit optical isomerism, with the exception of glycine. Glycine is achiral, since it can be superimposed on its mirror image, however alanine is chiral – it cannot be superimposed onto its mirror image.

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