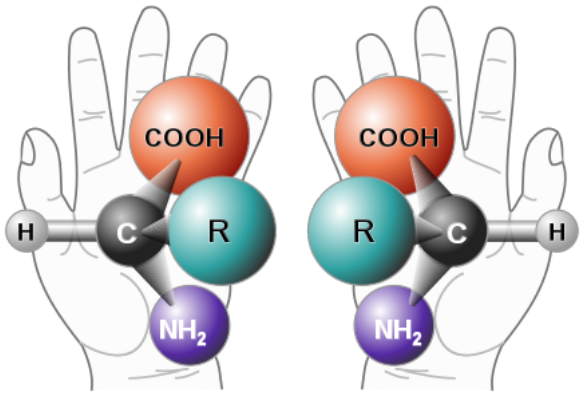
Stereocenter

In a molecule, a **stereocenter** is a particular instance of a stereogenic element that is geometrically a point. A stereocenter or **stereogenic center** is any point in a molecule, though not necessarily an atom, bearing different substituents, such that interchanging any two substituents leads to a stereoisomer.[1] The term stereocenter was introduced in 1984 by Kurt Mislow and Jay Siegel.[2] A **chirality center** is a stereocenter consisting of an atom holding a set of ligands (atoms or groups of atoms) in a spatial arrangement which is not superimposable on its mirror image. The concept of a chirality center generalizes the concept of an asymmetric carbon atom (a carbon atom bonded to four different entities) such that an interchanging of any two groups gives rise to an enantiomer.[3] In organic chemistry, a chirality center usually refers to a carbon, phosphorus, or sulfur atom, though it is also possible for other atoms to be chirality centers, especially in areas of organometallic and inorganic chemistry.



Two enantiomers of a generic amino acid at the stereocenter

Contents

Possible number of stereoisomers

A molecule can have multiple stereocenters, giving it many stereoisomers. In compounds whose stereoisomerism is due to tetrahedral stereogenic centers, the total number of hypothetically possible stereoisomers will not exceed 2^n, where n is the number of tetrahedral stereocenters. However, this is an upper bound because molecules with symmetry frequently have fewer stereoisomers. Having two chirality centers may give a meso compound which is achiral. Certain configurations may not exist due to steric reasons. Cyclic compounds with chiral centers may not exhibit chirality due to the presence of a two-fold rotation axis. Planar chirality may also provide for chirality without having an actual chiral center present.

Stereogenic on carbon

The carbon which has four different groups or atoms attached to it is called a chiral carbon.

Stereogenic on other atoms

Chirality is not limited to carbon atoms, though carbon atoms are often centers of chirality due to their ubiquity in organic chemistry. Nitrogen and phosphorus atoms can also form bonds in a tetrahedral configuration. A nitrogen in an amine may be a stereocenter if all three groups attached are different because the electron pair of the amine functions as a fourth group.[4] However, nitrogen inversion, a form of pyramidal inversion, causes racemization which means that both epimers at that nitrogen are present under normal circumstances.[4] Racemization by nitrogen inversion may be restricted (such as quaternary ammonium or phosphonium cations), or slow, which allows the existence of chirality.[4]

Metal atoms with tetrahedral or octahedral geometries may also be chiral due to having different ligands. For the octahedral case, several chiralities are possible. Having three ligands of two types, the ligands may be lined up along the meridian, giving the *mer*-isomer, or forming a face—the *fac* isomer. Having three bidentate ligands of only one type gives a propeller-type structure, with two different enantiomers denoted Λ and Δ.

See also

- Chirality_(chemistry)#Stereogenic_centers
- Cahn–Ingold–Prelog priority rules for nomenclature

References

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3. "chiral (chirality) center" (http://goldbook.iupac.org/C01060.html). *IUPAC.org*.
4. Smith, Janice Gorzynski (2011). "Chapter 25 Amines". *Organic chemistry* (http://highered.mheducation.com/sites/007340277x/student_view0/index.html) (Book) (3rd ed.). New York, NY: McGraw-Hill. pp. 949–993. ISBN 978-0-07-337562-5.