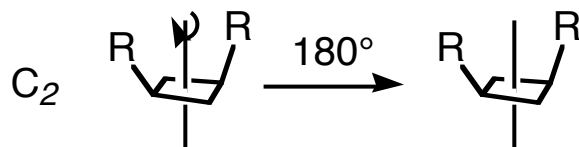


---

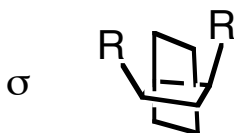
# Stereochemistry Terminology

---

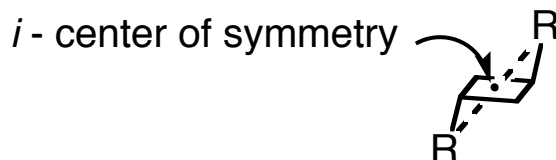
**Axis of symmetry:** When an operation on an axis  $C_n$ , where  $n = 360^\circ/\text{rotation}^\circ$ , leads to a structure indistinguishable from the original.



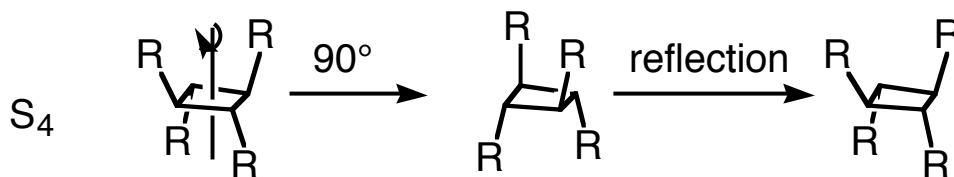
**Plane of symmetry:** ( $\sigma$ ) A plane that divides the molecule into two identical halves. Also visualized as a mirror plane in which one half of the molecule reflects its enantiomeric image.



**Center of symmetry:** a formal point in the center of the molecule, in reference to which each atom present finds its equivalent upon extension of an imaginary line of similar length to that joining it to  $i$ .



**Axis of rotation-reflection:** ( $S_n$ ) present in molecules that can be rotated in such axis by an angle of  $360^\circ/n$  and then reflected through a plane perpendicular to the axis to provide a structure identical to the original.



**Asymmetric molecule:** A molecule that lacks all symmetry elements. Note that molecules can be chiral and have an axis of symmetry - they are not asymmetric - they are dissymmetric.

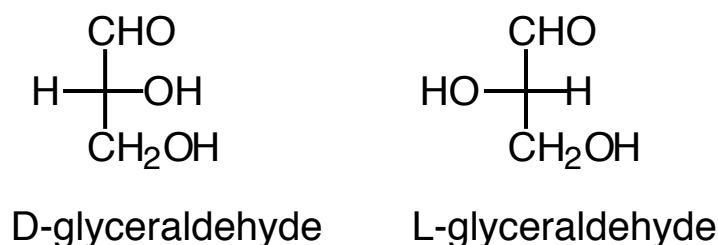
**Absolute configuration:** A description for the absolute orientation of atoms in space about a given stereogenic center.

**Relative configuration:** A description of the orientation of a stereogenic center as it relates to another, rather than by its actual orientation in space.

**Fischer projection:** A format for displaying 3-dimensional structures in two dimensions. The carbon backbone is drawn vertically.. Stereogenic carbons lie in the plane of the paper. The vertical bonds project back into the paper, and horizontal bonds project up away toward the viewer.



**D & L designation:** A system of configuration nomenclature, historically based on glyceraldehyde, stems from the Fischer projection in which the highest oxidation state carbon is placed on the top. The position of the H and non-H groups in the horizontal bonds determines the D or L assignment. If H is left and non-H is right it is D and vice versa for L.

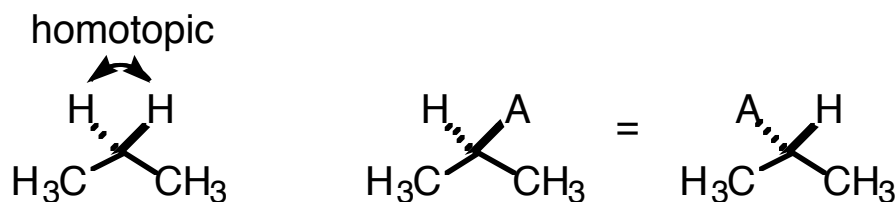


**Cahn-Ingold-Prelog designation:** A system for prioritizing groups and define the absolute configuration with the R and S designation.

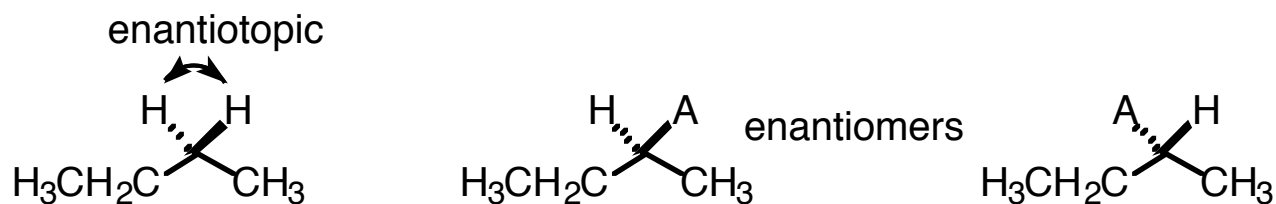
- 1) Look at the atom directly attached to the stereogenic atom. The higher atomic number takes priority.
- 2) If a distinction cannot be made at the 1<sup>st</sup> atom, continue out until you can make a distinction and no further.
- 3) Multiple bonds are equivalent to the same number of single bonds for priority determination.
- 4) Point the lowest group away from you making the other three groups define a circle. If you travel from 1 to 2 to 3 clockwise, the configuration is (*R*), counterclockwise (*S*).

**Prochiral:** A molecule in which a substitution, exchange, or other reaction leads to the formation of a stereogenic center.

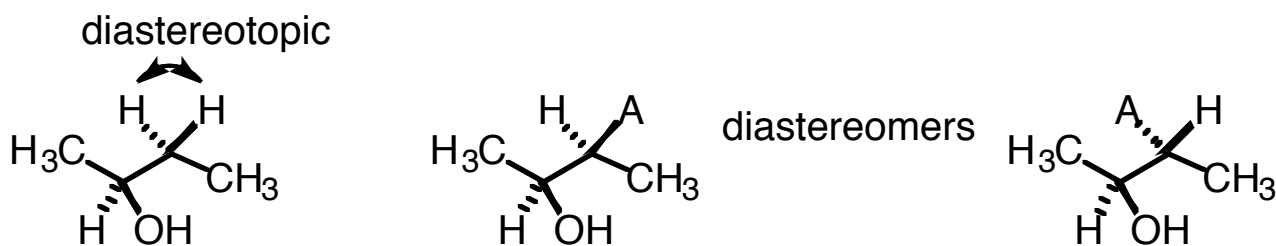
**Homotopic:** A molecule where the substitution of one or the other like groups generates the same molecule.



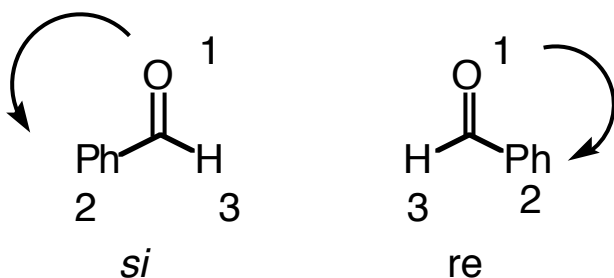
**Enantiotopic:** A molecule where the substitution of one or the other like groups generates enantiomeric molecules.



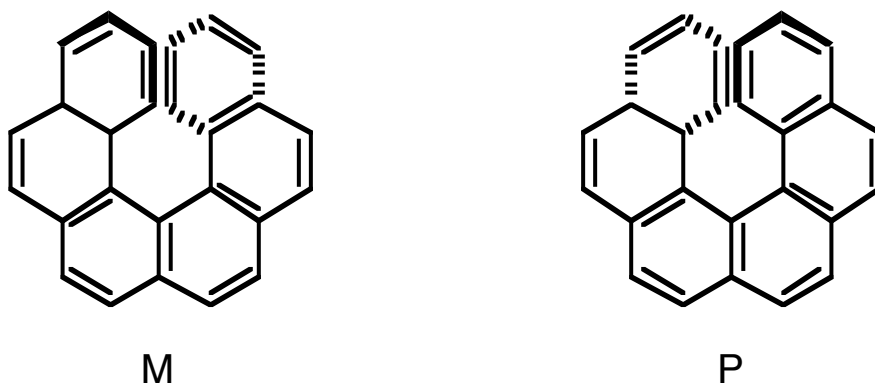
**Diastereotopic:** A molecule where the substitution of one or the other like groups generates diastereomeric molecules.



**Re & Si face designation:** Used to specify the configuration of heterotopic faces - based on the CIP priority rules.



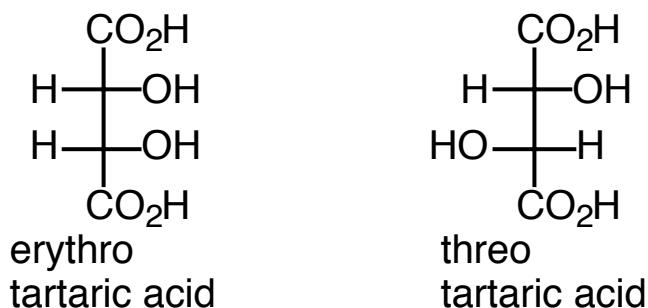
**P & M designation:** Used to specify the configuration of helical chirality. As the helix comes out of the paper toward the viewer, if it is clockwise then the designation is M, likewise P for counterclockwise.



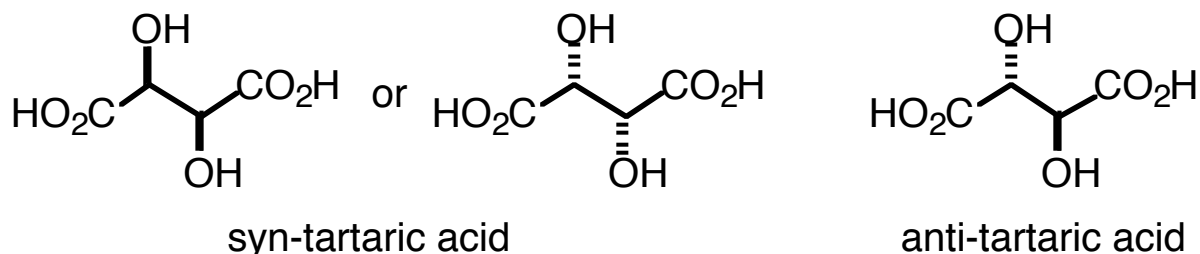
**Cis & trans designation:** Used to designate like groups on the same side (cis) or opposite sides (trans) of a double bond or ring.

**E & Z designation:** Used to designate the highest priority groups being in a cis (Z) arrangement or a trans (E) arrangement.

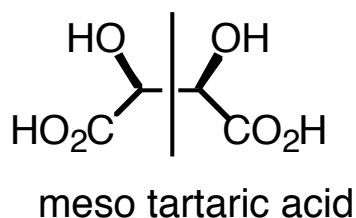
**Erythro & threo diastereomers:** Used to designate the relative configuration of two stereogenic centers with identical groups where a Fisher projection being the frame of reference. Erythro has the groups on the same side, while threo has the groups on opposite sides.



**Syn & anti diastereomers:** Used to designate the relative configuration of two stereogenic centers comparing the groups being on the same side (syn) or opposite sides (anti) where the fully extended staggered carbon chain is used as the frame of reference.



**Meso:** A molecule which contains stereogenic centers, but is achiral. A meso compound has a plane of symmetry.



**$\alpha$  &  $\beta$  designation:** Historically used in steroid compounds -  $\alpha$  being a down orientation and  $\beta$  being an up orientation.

**Stereoselective reaction:** A reaction in which one stereoisomer is preferentially formed over another.

**Stereospecific reaction:** A reaction is termed stereospecific if, in such a reaction, starting materials differing only in their configuration are converted to stereoisomerically distinct products.

---

**Asymmetric induction:** Any factor contributing to the selective formation of a new stereogenic center.

**Internal asymmetric induction:** The formation of a new stereogenic center with respect to the simultaneous formation of another.

**Relative asymmetric induction:** The presence of an existing stereogenic center dictating the selectivity for the formation of a new stereogenic center.

**Syn & anti addition:** Used to describe an addition reaction where two partners react on the same face (syn) or opposite face (anti) of a reactant.

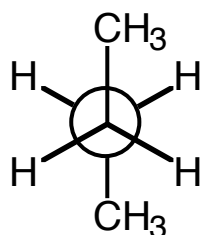
**Antiperiplanar:** An orientation of two groups on adjacent atoms that are in the same plane, but  $180^\circ$  apart.

**Kinetic resolution:** A process by which two stereoisomers are formed at different rates in a reaction. Often referring to the formation of one enantiomer over another.

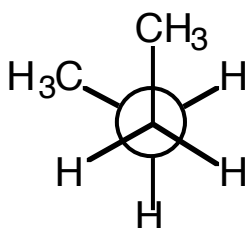
**Racemization:** A process which converts one enantiomer into the other.

**Epimerization:** A process which inverts the configuration of one stereogenic center in a molecule and not other.

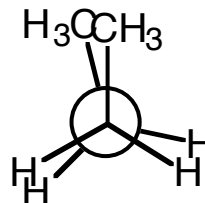
**Gauche, eclipsed, and anti conformations:** The orientation of groups based on the rotation about a bond.



anti-butane



gauche-butane



eclipsed-butane

**Ring strain:** The extra strain associated with the constraints of ring compounds. Made up of torsional strain, angle strain, and steric strain.

**Allylic strain:** The strain associated with the constraints of a double bond in the 1,3-relationships.



**Anomeric effect:** The stereoelectronic stabilization found when an electron withdrawing group is placed in the axial position of an anomeric carbon. Due to filled pi orbital on oxygen overlapping with unfilled sigma\* orbital of the electron withdrawing group.

