

## Meso Compounds

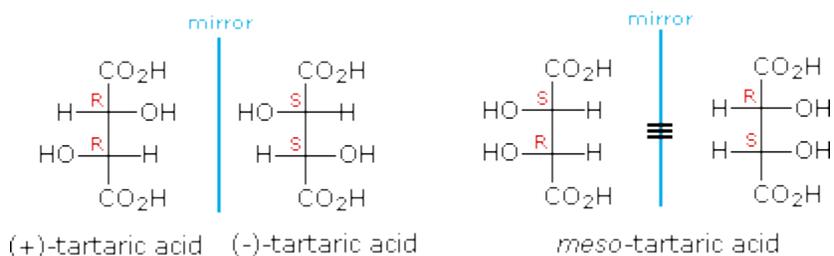
### Achiral Diastereomers (meso-Compounds)

The chiral centers in the preceding examples have all been different, one from another. In the case of 2,3-dihydroxybutanedioic acid, known as tartaric acid, the two chiral centers have the same four substituents and are equivalent. As a result, two of the four possible stereoisomers of this compound are identical due to a plane of symmetry, so there are only three stereoisomeric tartaric acids. Two of these stereoisomers are enantiomers and the third is an achiral diastereomer, called a **meso** compound. Meso compounds are achiral (optically inactive) diastereomers of chiral stereoisomers. Investigations of isomeric tartaric acid salts, carried out by [Louis Pasteur](#) in the mid 19th century, were instrumental in elucidating some of the subtleties of stereochemistry.

Some physical properties of the isomers of tartaric acid are given in the following table.

(+)-tartaric acid:	$[\alpha]_D = +13^\circ$	m.p. 172 °C
(-)-tartaric acid:	$[\alpha]_D = -13^\circ$	m.p. 172 °C
<i>meso</i> -tartaric acid:	$[\alpha]_D = 0^\circ$	m.p. 140 °C

Fischer projection formulas provide a helpful view of the configurational relationships within the structures of these isomers. In the following illustration a mirror line is drawn between formulas that have a mirror-image relationship. In demonstrating the identity of the two meso-compound formulas, remember that a Fischer projection formula may be rotated 180° in the plane.



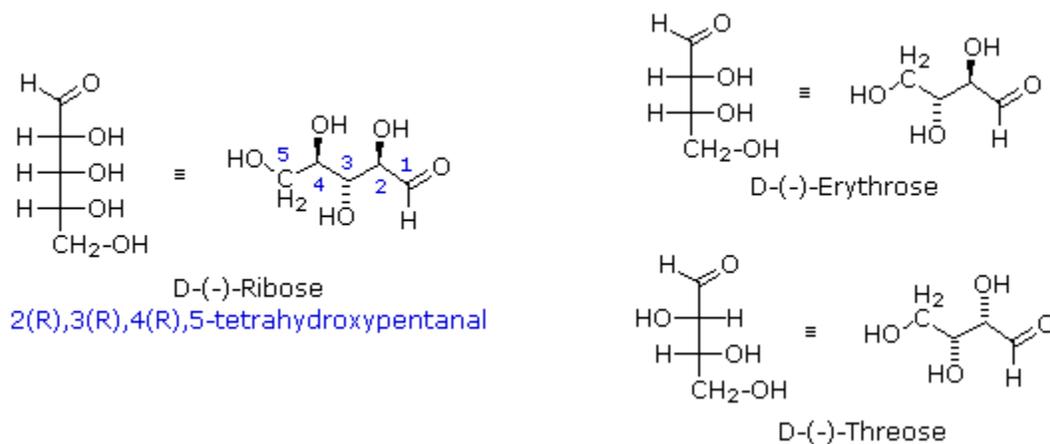
A model of meso-tartaric acid may be examined by

An additional example, consisting of two meso compounds, may be examined by

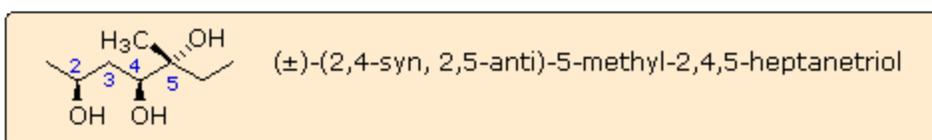
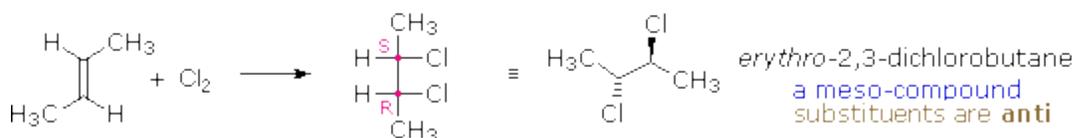
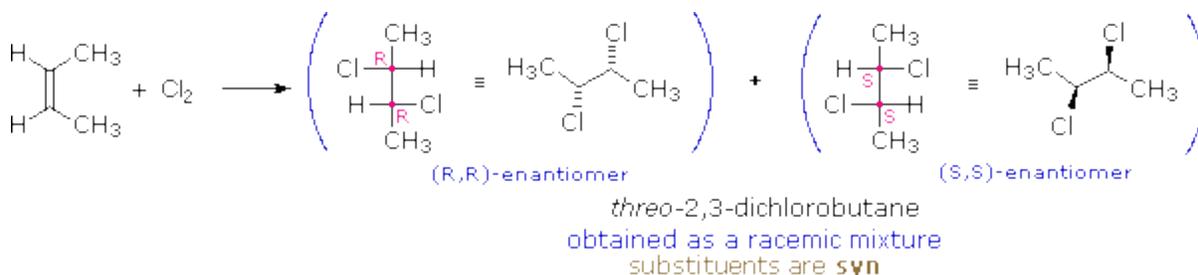
## Other Configuration Notations

### Formulas Using Other Configurational Notations

Fischer projection formulas are particularly useful for comparing configurational isomers within a family of related chiral compounds, such as the carbohydrates. However, the eclipsed conformations implied by these representations are unrealistic. When describing acyclic compounds incorporating two or more chiral centers, many chemists prefer to write zig-zag line formulas for the primary carbon chain. Here, the zig-zag carbon chain lies in a plane and the absolute or relative configurations at the chiral centers are then designated by wedge or hatched bonds to substituent groups. This is illustrated for D-(-)-ribose and the diastereoisomeric D-tetroses erythrose and threose in the following diagram.



These compounds are all chiral and only one enantiomer is drawn (the D-family member). Many times, however, we must refer to and name diastereoisomers that are racemic or achiral. For example, addition of chlorine to *cis*-2-butene yields a stereoisomer of 2,3-dichlorobutane different from the one obtained by chlorine addition to *trans*-2-butene. In cases having two adjacent chiral centers, such as this, the prefixes **erythro** and **threo** may be used to designate the **relative configuration** of the centers. These prefixes, taken from the names of the tetroses erythrose and threose (above), may be applied to racemic compounds, as well as pure enantiomers and meso compounds, as shown in the following diagram. In the commonly used zig-zag drawings substituents may lie on the same side of the carbon chain, a **syn** orientation, or on opposite sides, an **anti** orientation. For adjacent (vicinal) substituents this is opposite to their location in a Fischer formula. Thus, the substituents in the erythro isomer have an anti orientation, but are syn in the threo isomer.



The syn-anti nomenclature may be applied to acyclic compounds having more than two chiral centers, as illustrated by the example in the colored box. The stereogenic center nearest carbon #1 serves as a reference. At sites having two substituents, such as carbon #5, the terms refer to the relative orientation of the highest order substituent, as determined by the [C.I.P. sequence rules](#).

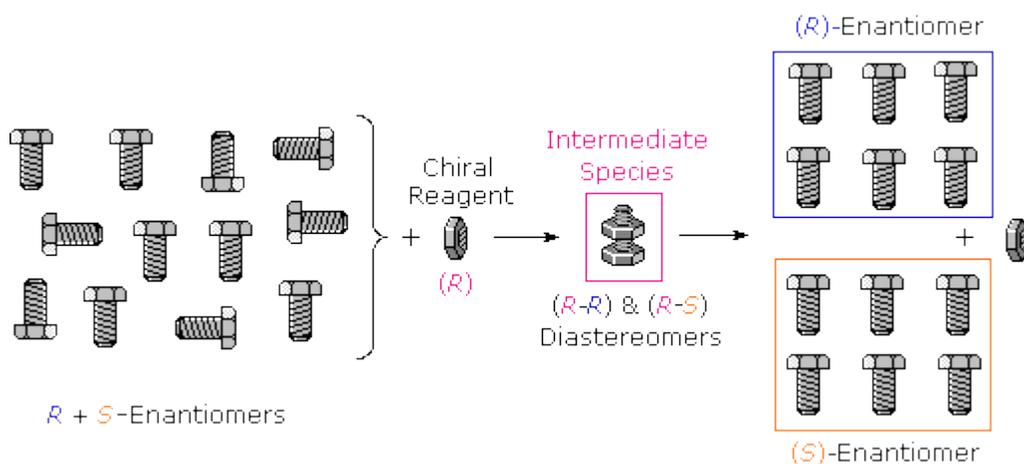
## Resolution

### Resolution of Racemates

As noted earlier, chiral compounds synthesized from achiral starting materials and reagents are generally racemic (i.e. a 50:50 mixture of enantiomers). Separation of racemates into their component enantiomers is a process called **resolution**. Since enantiomers have identical physical properties, such as solubility and melting point, resolution is extremely difficult. Diastereomers, on the other hand, have different physical properties, and this fact is used to achieve resolution of racemates. Reaction of a racemate with an enantiomerically pure chiral reagent gives a mixture of diastereomers, which can be separated. Reversing the first reaction then leads to the separated enantiomers plus the recovered reagent.

Many kinds of chemical and physical reactions, including salt formation, may be used to achieve the diastereomeric intermediates needed for separation. The following diagram illustrates this general principle by showing how a nut having a right-handed thread (R) could serve as a "reagent" to discriminate and separate a mixture of right- and left-handed bolts of identical size and weight. Only the two right-handed partners can interact to give a fully-threaded intermediate, so separation is fairly simple. The resolving moiety, i.e. the nut,

is then removed, leaving the bolts separated into their right and left-handed forms. Chemical reactions of enantiomers are normally not so dramatically different, but a practical distinction is nevertheless possible.



Source : <http://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/sterism3.htm#isom13>