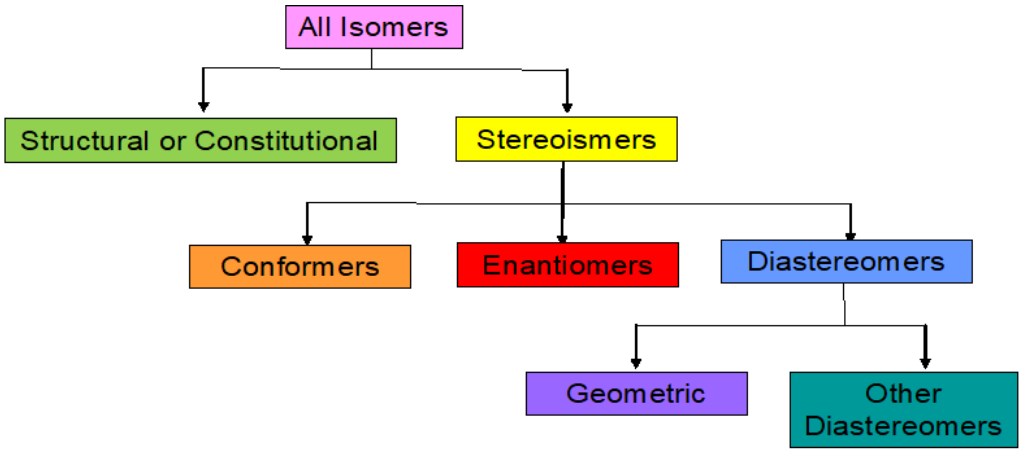
6.6: ISOMERISM SUMMARY DIAGRAM

Learning Objective

- distinguish and discern the structural and chemical relationships between isomeric compounds

The various types of isomers have been introduced and explored over several chapters. It can be helpful to review, compare, and contrast all of the forms of isomerism to build our skills of discernment. A brief review of each type of isomerism follows the summary diagram. See the respective chapter for a complete explanation.

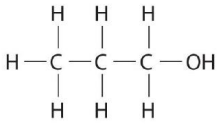


CONFORMATIONAL ISOMERS

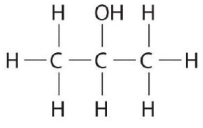
The rotation of C–C single bonds both carbon chains creates conformers (the same compound shown in different rotations). Consequently, many different arrangements of the atoms are possible, each corresponding to different degrees of rotation. Differences in three-dimensional structure resulting from rotation about a σ bond are called differences in conformation, and each different arrangement is called a conformational isomer (or conformer). While complete rotation of C-C single bonds is not possible in rings. The freedom of bond movement does allow the rings to assume different conformations, such as the chair and boat for 6-membered rings.

STRUCTURAL (CONSTITUTIONAL) ISOMERS

Unlike conformational isomers, structural isomers differ in connectivity, as illustrated below for 1-propanol and 2-propanol. Although these two alcohols have the same molecular formula C_3H_8O, the position of the –OH group differs creating a unique compounds with differences in their physical and chemical properties.

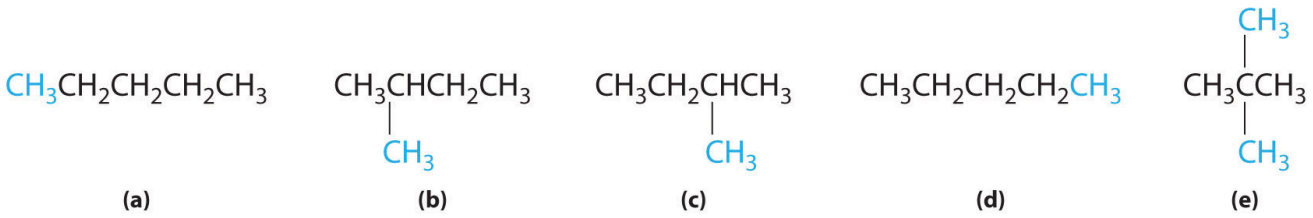


1-Propanol (*n*-propanol)



2-Propanol (isopropanol)

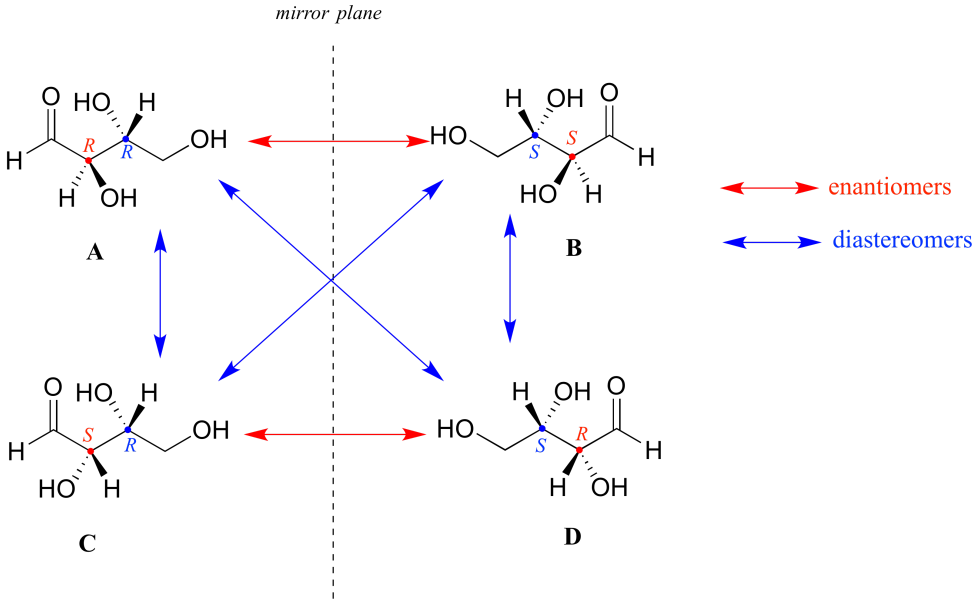
Consider, for example, the following five structures represented by the formula C_5H_{12}. In the conversion of one structural isomer to another, at least one bond must be broken and reformed at a different position in the molecule.



Structures (a) and (d) above represent the same compound, n-pentane. Structures (b) and (c) represent the same compound, 2-methylbutane. No bonds need to be broken and reformed to convert between (a) and (d) or between (b) and (c). The molecules are simply rotated 180° about a vertical axis. Structure (e) is named 2,2-dimethylpropane. There are only three structural isomers possible with the chemical formula C_5H_{12}: n-pentane, 2-methylbutane, and 2,2-dimethylpropane. Structural isomers have distinct physical and chemical properties.

STEREOISOMERS

Enantiomers are pairs of compounds that are non-superimposable images. When there are two or more chiral centers in a compounds, the diatereomers can exist. Diastereomers are stereoisomers that are NOT enantiomers. Enatiomers share all physical properties except for their interaction with plane polarized light. Diastereomers have different physical properties (melting points and boiling points and densities).



Exercise

1. What kind of isomers are the following pairs? Note: It can be difficult to answer this question directly from the names. It can be helpful to draw the structures.

a. (R)-5-chlorohexene and 6-chlorohexene
b. (2R,3R)-dibromohexane and (2R,3S)-dibromohexane

Answer

1.

a. Structural Isomers

b. Diastereomers

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