Chapter 7
Stereochemistry

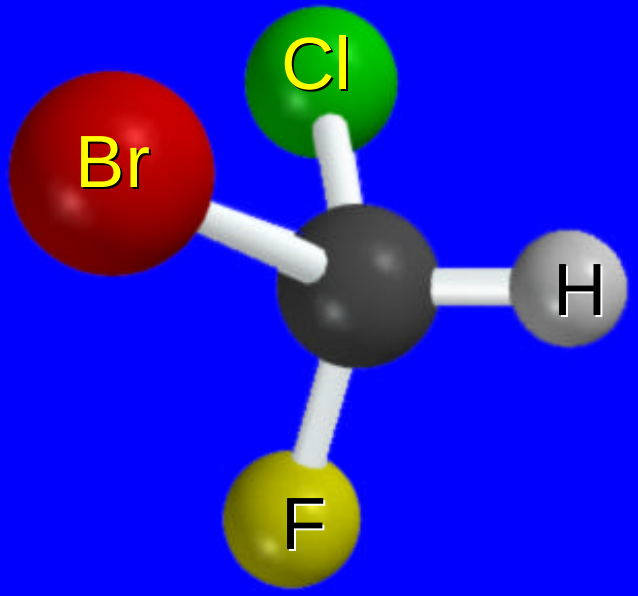
7.1
Molecular Chirality: Enantiomers

Chirality

A molecule is *chiral* if its two mirror image forms are not superposable upon one another.

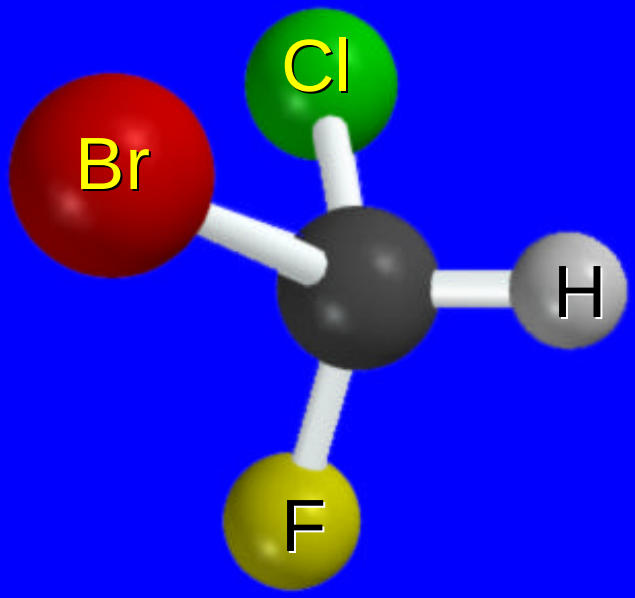
A molecule is *achiral* if its two mirror image forms are superposable.

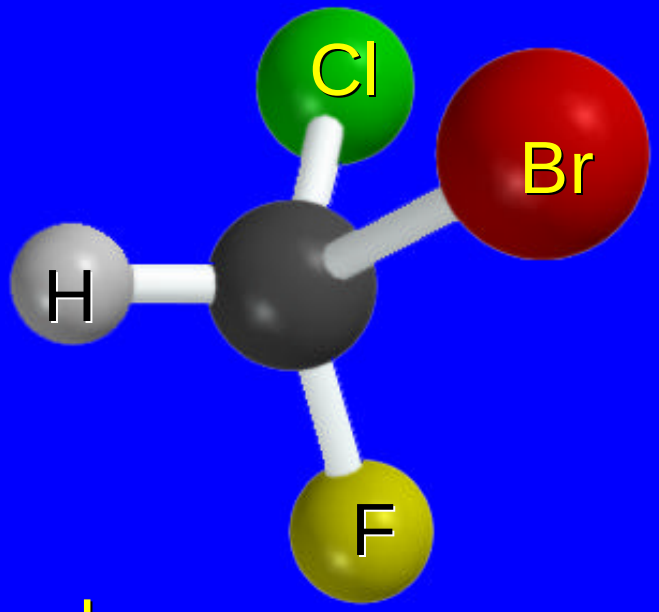
Bromochlorofluoromethane is chiral



It cannot be superposed point for point on its mirror image.

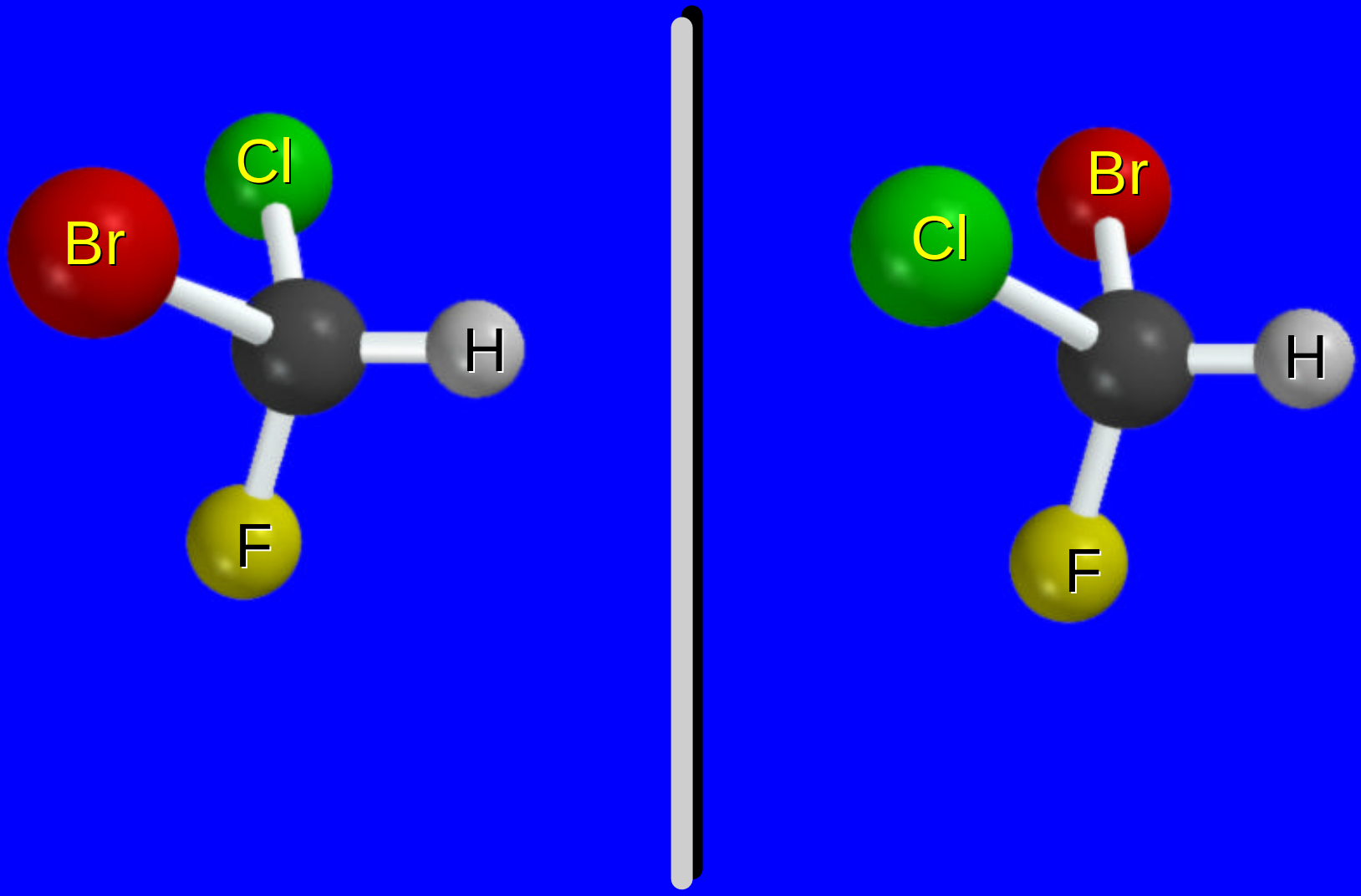
Bromochlorofluoromethane is chiral

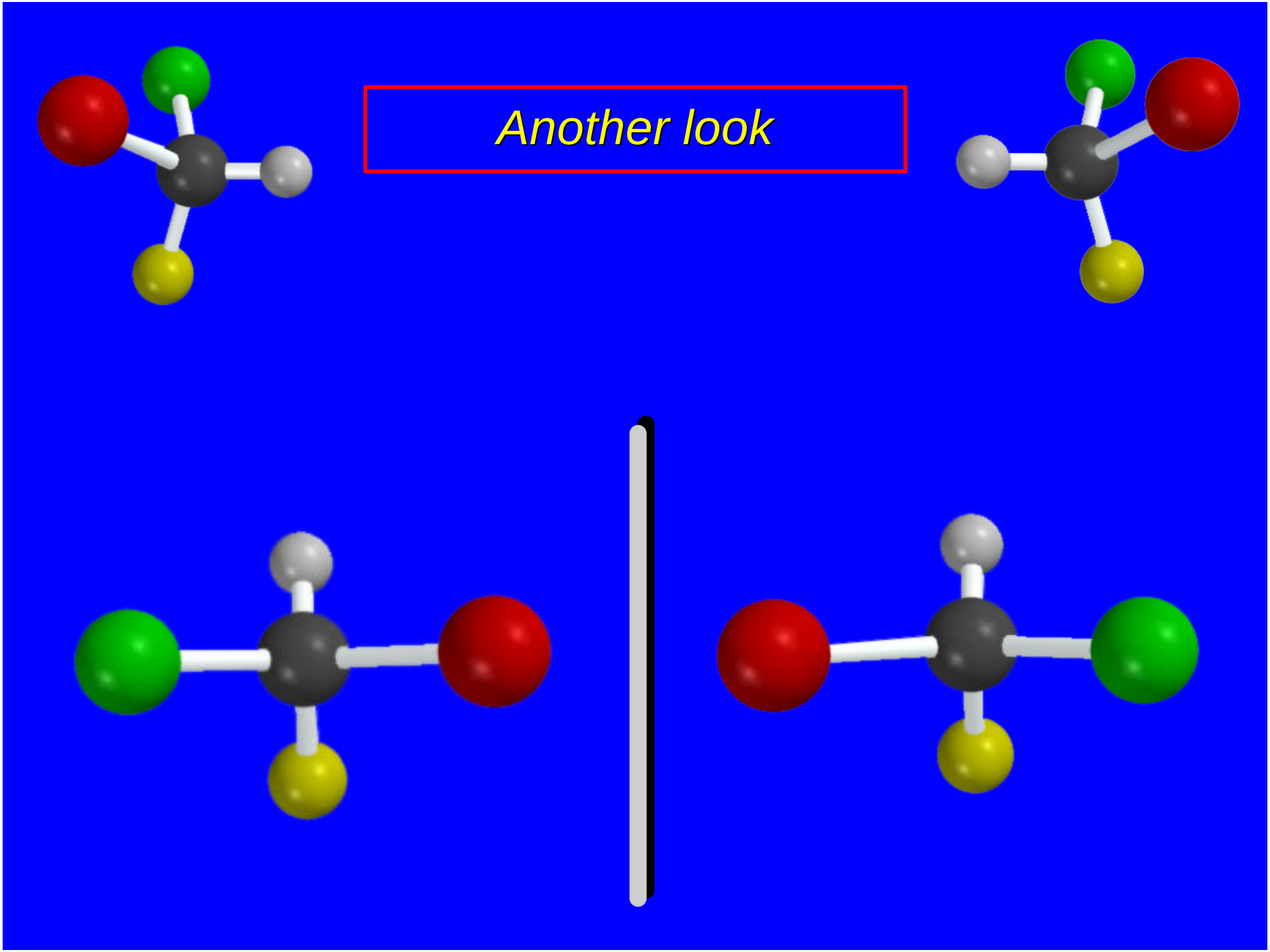




To show nonsuperposability, rotate this model 180° around a vertical axis.

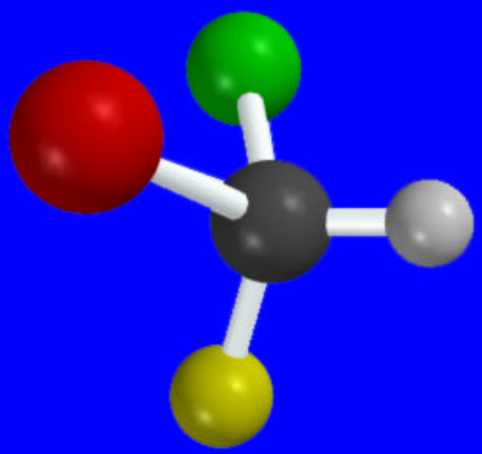
Bromochlorofluoromethane is chiral



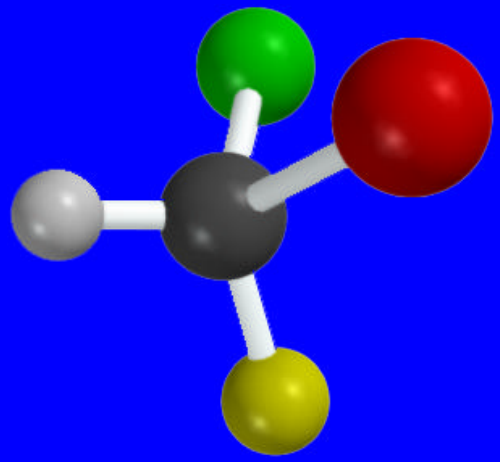

Another look

Enantiomers

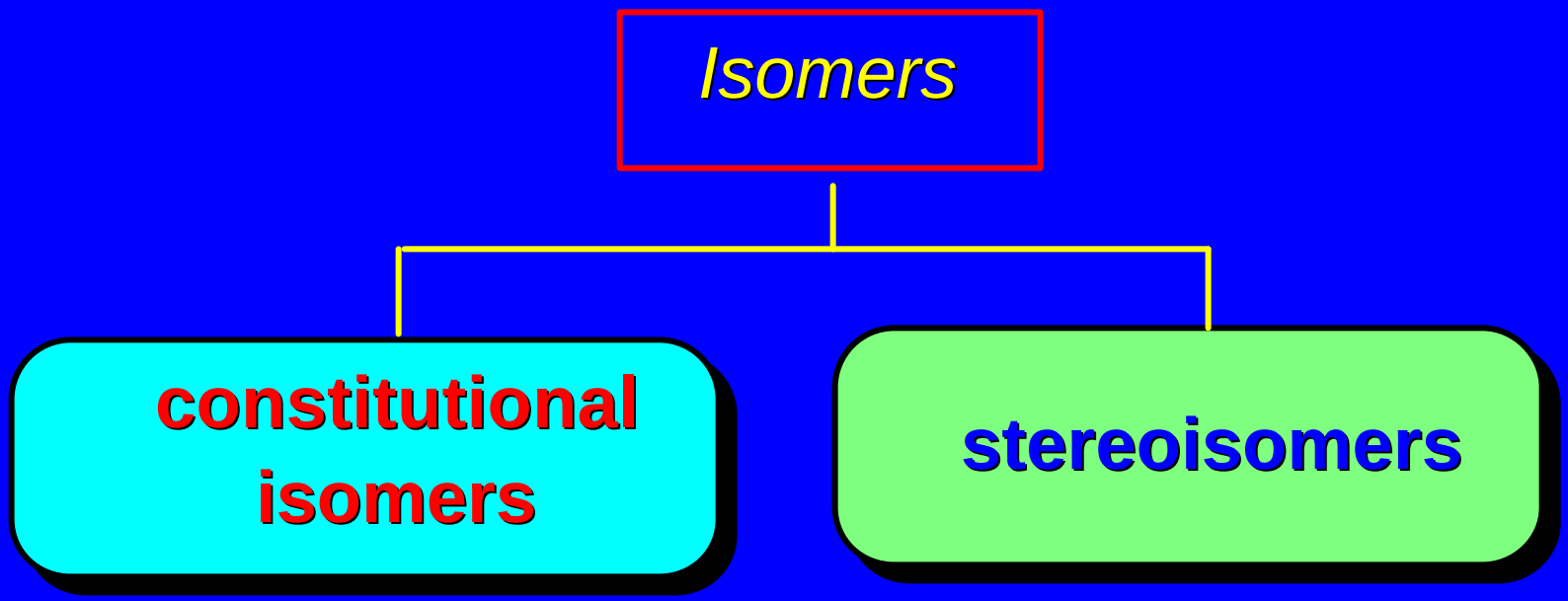
nonsuperposable mirror images are called enantiomers

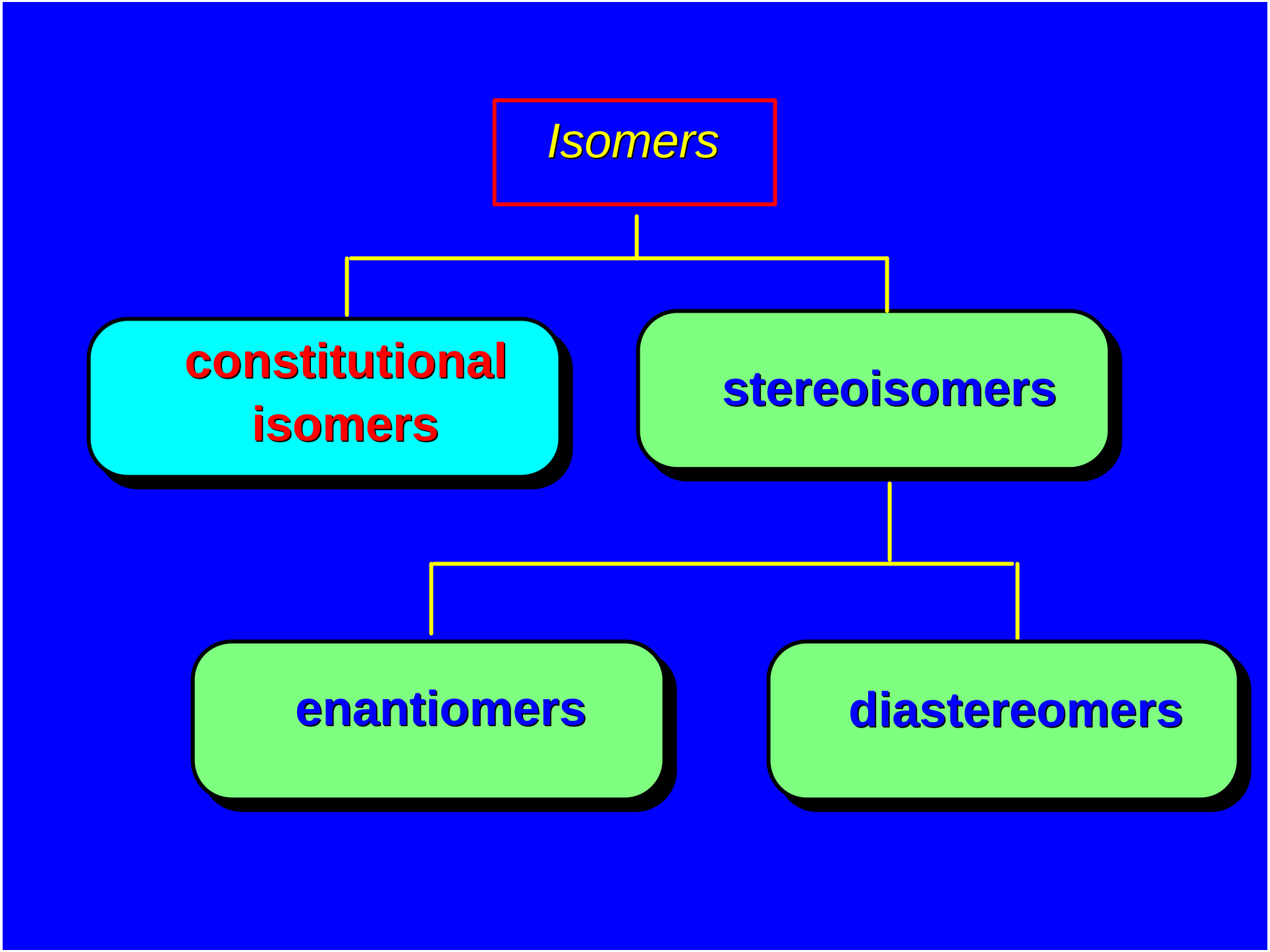


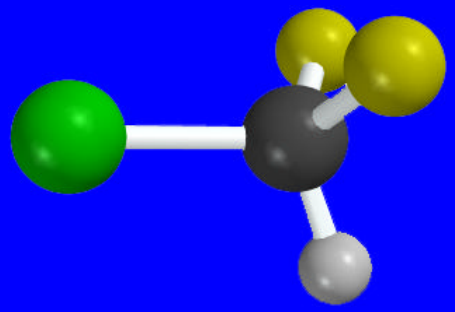
and



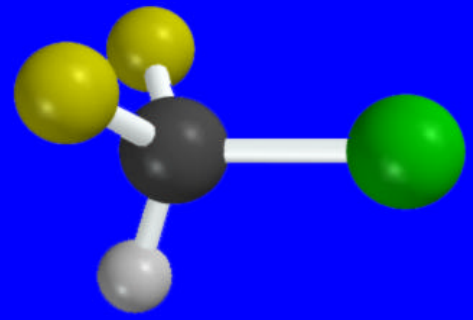
are enantiomers with respect to each other

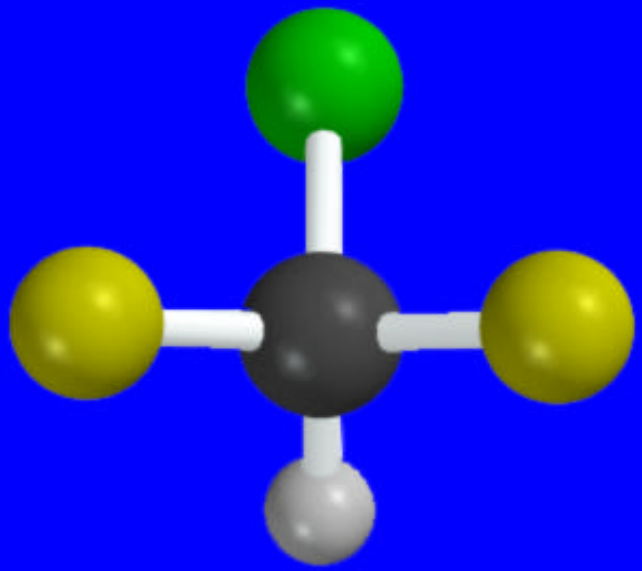

Isomers
constitutional isomers
stereoisomers

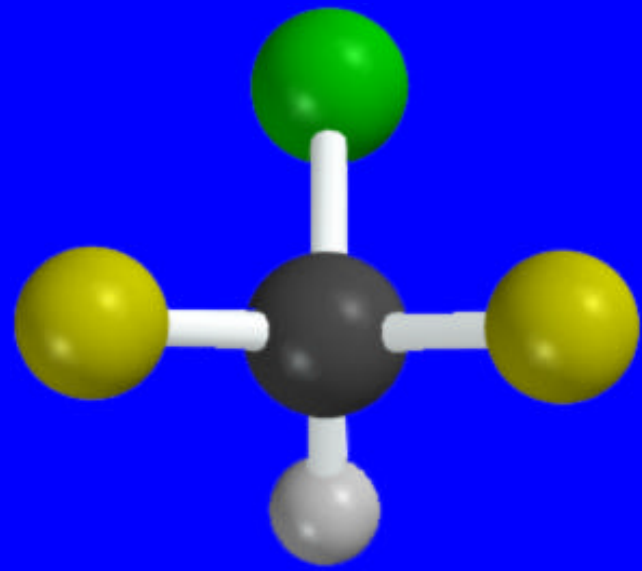

Isomers
constitutional isomers
stereoisomers
enantiomers
diastereomers

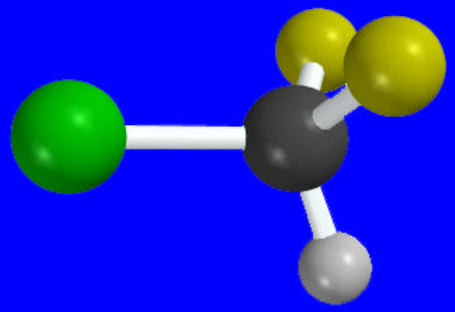


Chlorodifluoromethane is achiral

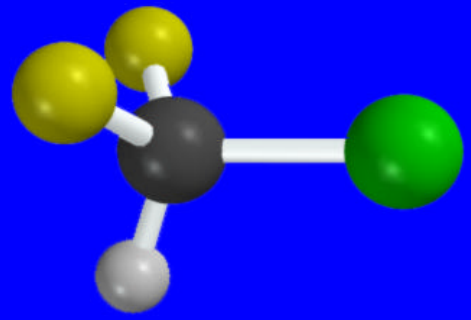


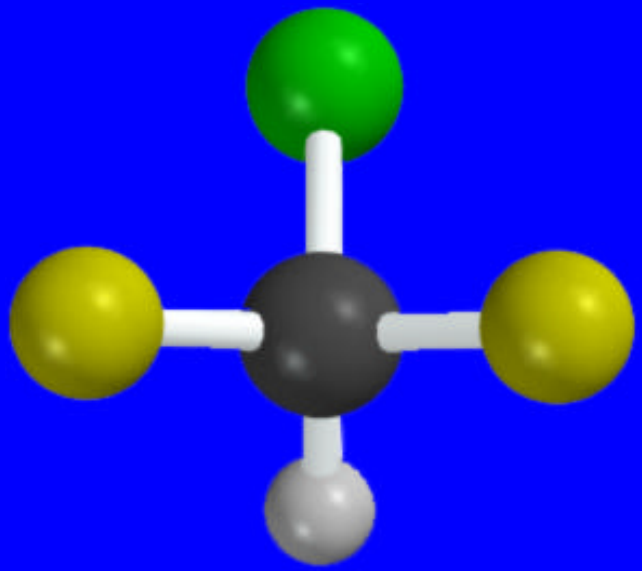






Chlorodifluoromethane is achiral



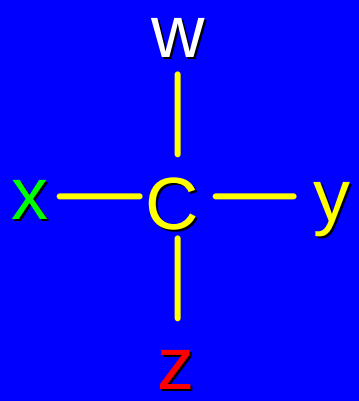


The two structures are mirror images, but are not enantiomers, because they can be superposed on each other.

7.2

The Stereogenic Center

The Stereogenic Center



a carbon atom with four different groups attached to it

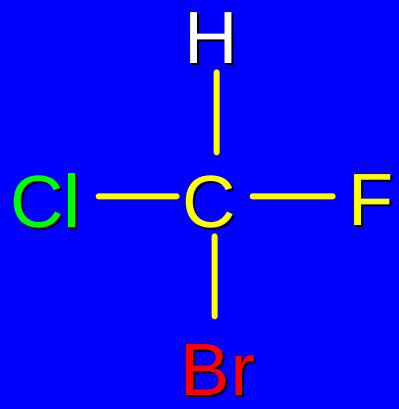
also called:

- chiral center
- asymmetric center
- stereocenter

Chirality and stereogenic centers

A molecule with a single stereogenic center is chiral.

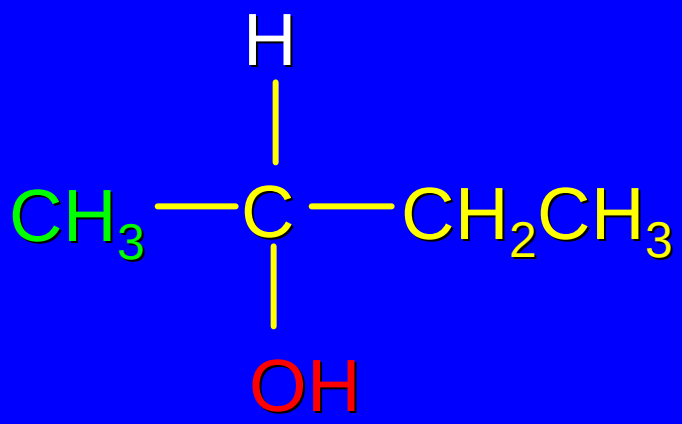
Bromochlorofluoromethane is an example.



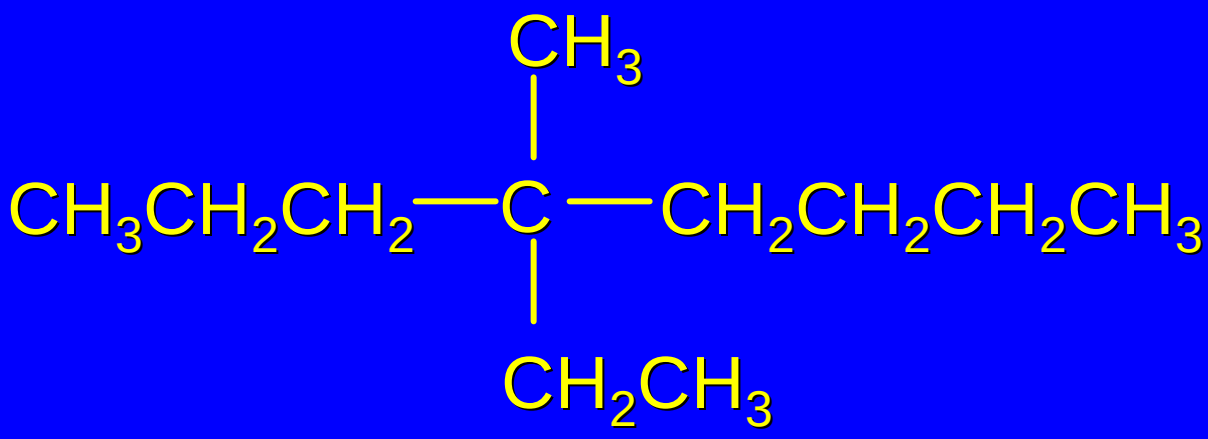
Chirality and stereogenic centers

A molecule with a single stereogenic center is chiral.

2-Butanol is another example.

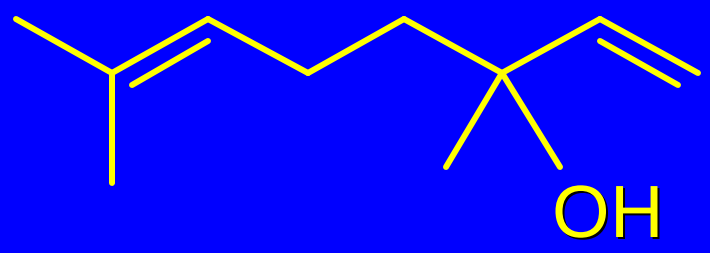


Examples of molecules with 1 stereogenic center



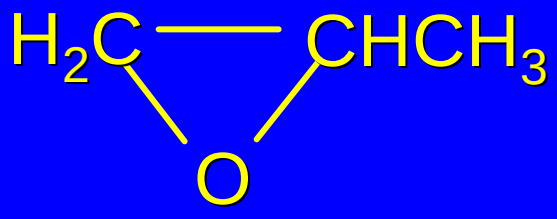
a chiral alkane

Examples of molecules with 1 stereogenic center



Linalool, a naturally occurring chiral alcohol

Examples of molecules with 1 stereogenic center



1,2-Epoxypropane: a stereogenic center can be part of a ring

attached to the stereogenic center are:

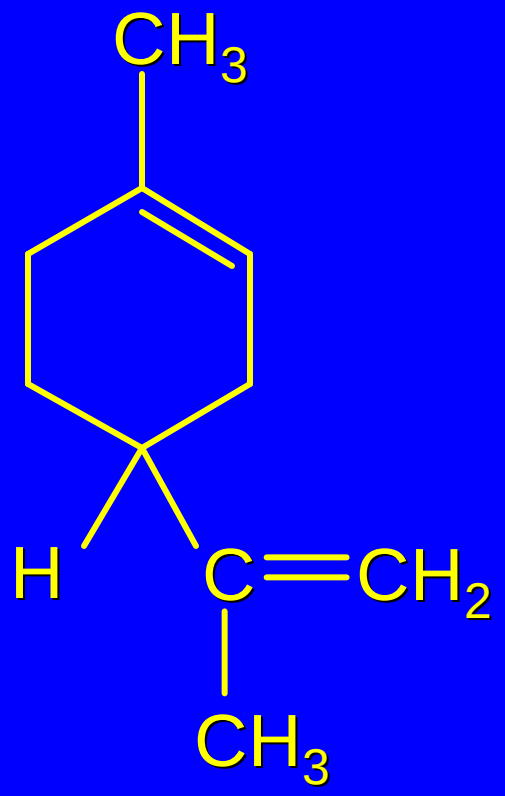
—H

—CH_3

—OCH_2

—CH_2O

Examples of molecules with 1 stereogenic center



Limonene: a stereogenic center can be part of a ring

attached to the stereogenic center are:

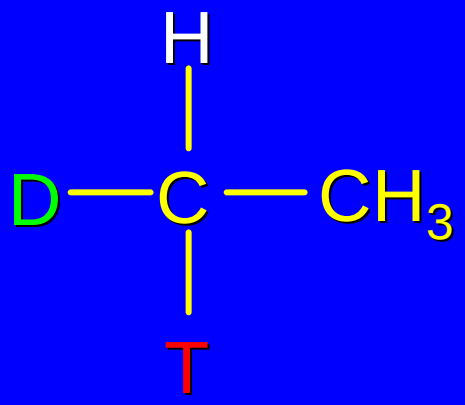
—H

—CH_2CH_2

—CH_2CH=

—C=

Examples of molecules with 1 stereogenic center



Chiral as a result of isotopic substitution

A molecule with a single stereogenic center must be chiral.

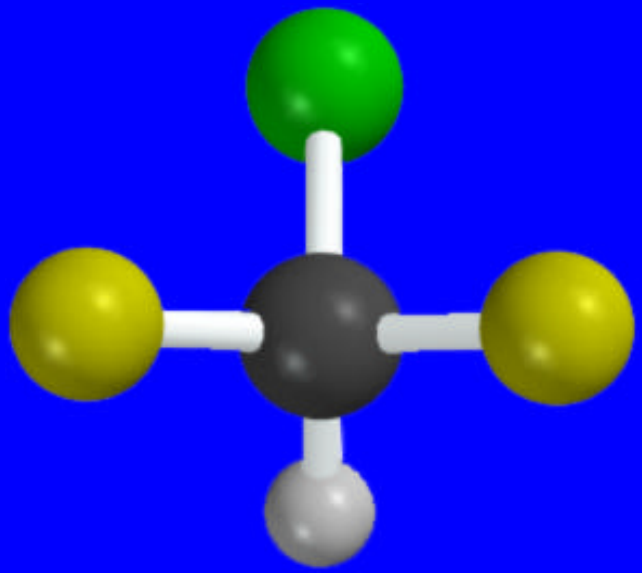
But, a molecule with two or more stereogenic centers may be chiral or it may not (Sections 7.10-7.13).

7.3
Symmetry in Achiral Structures

Symmetry tests for achiral structures

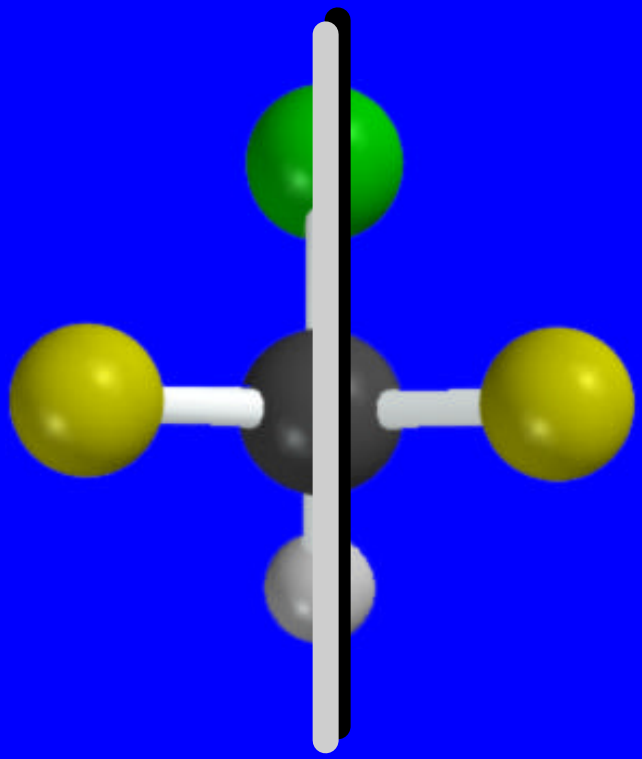
Any molecule with a plane of symmetry
or a center of symmetry must be achiral.

Plane of symmetry



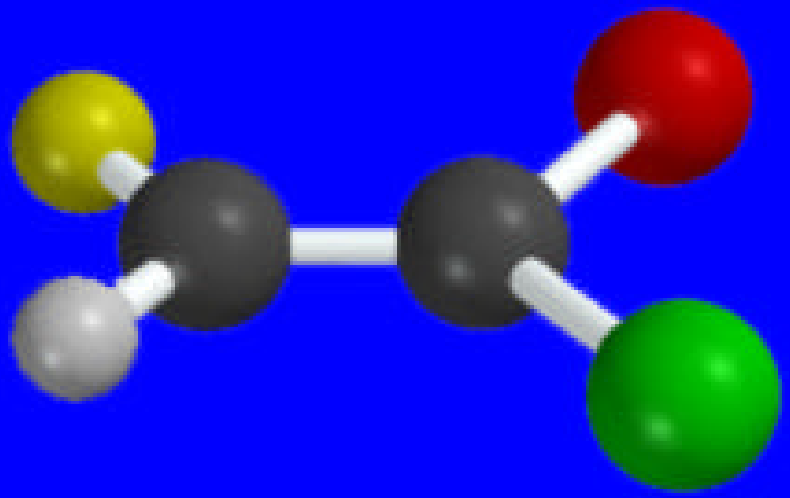
A plane of symmetry bisects a molecule into two mirror image halves. Chlorodifluoromethane has a plane of symmetry.

Plane of symmetry



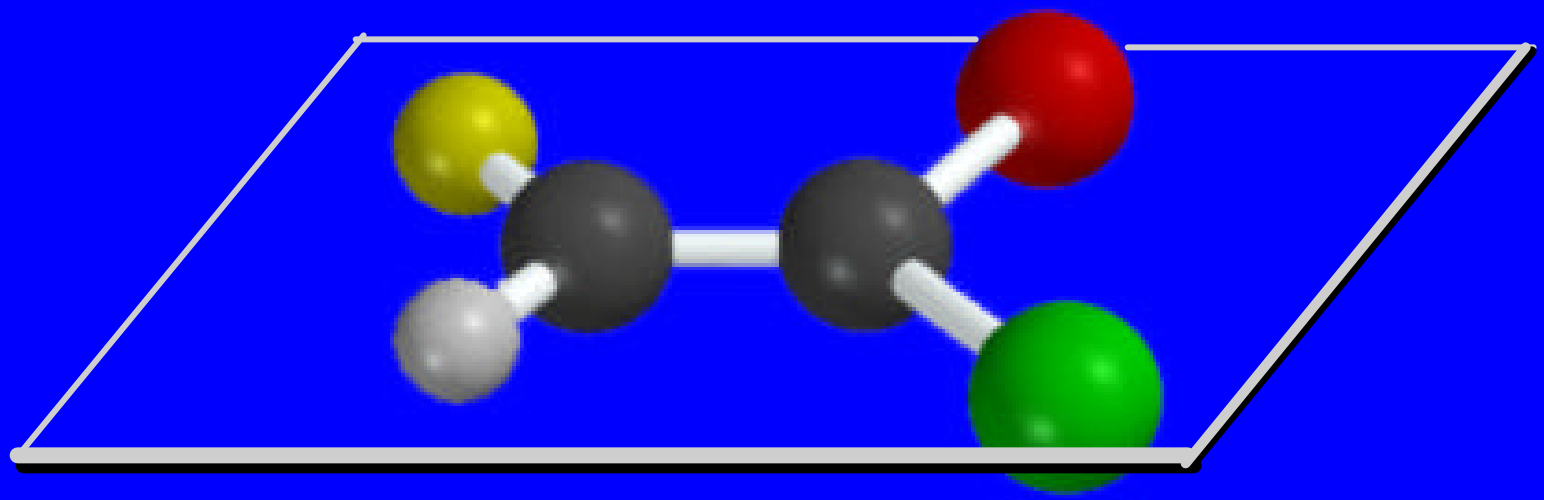
A plane of symmetry bisects a molecule into two mirror image halves. Chlorodifluoromethane has a plane of symmetry.

Plane of symmetry



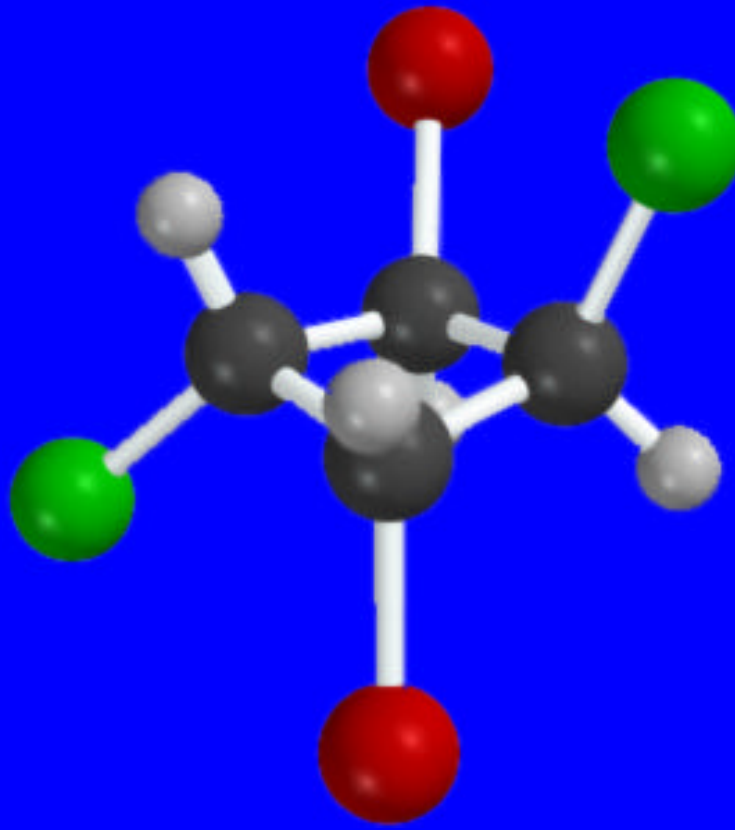
A plane of symmetry bisects a molecule into two mirror image halves.
1-Bromo-1-chloro-2-fluoroethene has a plane of symmetry.

Plane of symmetry



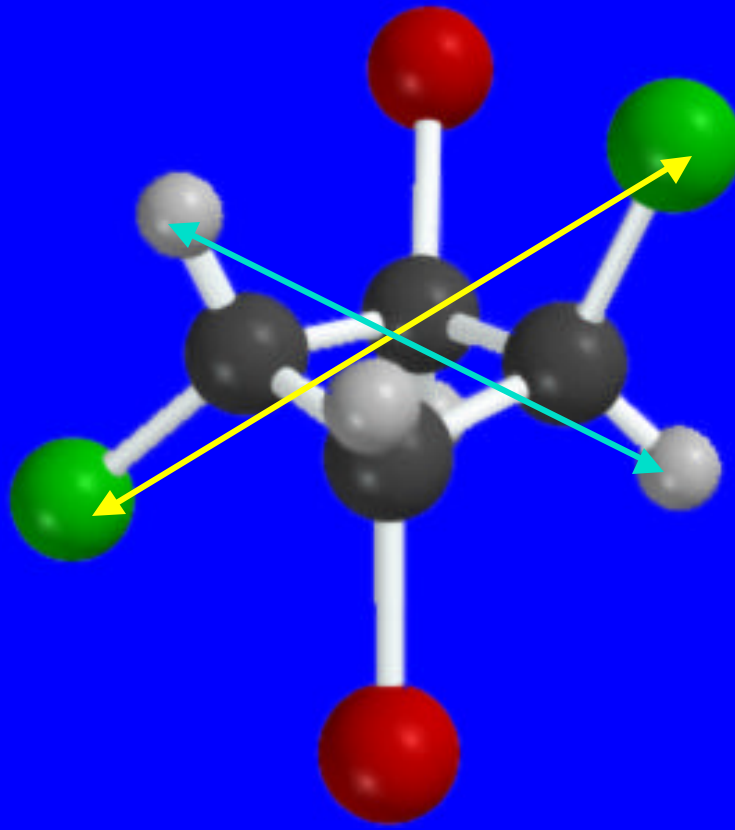
A plane of symmetry bisects a molecule into two mirror image halves.
1-Bromo-1-chloro-2-fluoroethene has a plane of symmetry.

Center of symmetry



A point in the center of the molecule is a center of symmetry if a line drawn from it to some element, when extended an equal distance in the opposite direction, encounters an identical element.

Center of symmetry



A point in the center of the molecule is a center of symmetry if a line drawn from it to any element, when extended an equal distance in the opposite direction, encounters an identical element.