Stereochemistry- structure in three dimensions

Isomers that have the same constitution but differ in their 3-D arrangement are **stereoisomers**.

cis and trans isomers are one type of stereoisomers.

now look at another type of stereoisomerism …

Every object has a mirror image, but not all objects are superimposable on their mirror image.

Consider a pair of objects … a pair of hands

These objects are not identical; they are mirror images of each other.

The mirror images are not superimposable upon each other.

An object that is not superimposable on its mirror image is **chiral**.

chiral means "handedness"

The opposite of chiral is **achiral**.

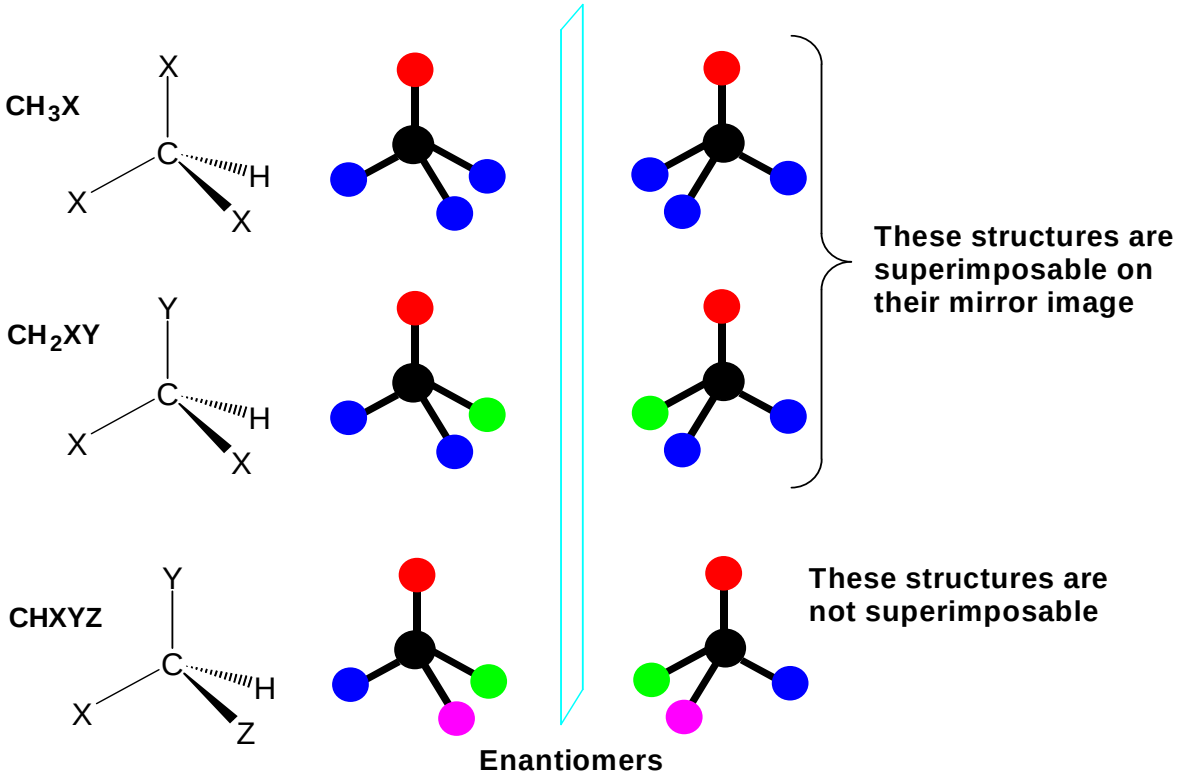
- A sugar cube is achiral because it is superimposable on its mirror image.
- Hands are chiral, gloves are chiral but socks are generally achiral.

Many molecules are chiral.

Chirality most often occurs in molecules that have 4 different groups attached to carbon.

Consider, CWXYZ and its mirror image; they are non superimposable.

Objects (or molecules) that are non superimposable on their mirror image are **enantiomers**.



Molecules with 4 different groups on carbon are chiral.

This type of carbon atom is called a **chirality center**.

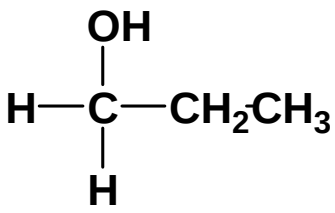
Similar terms: **asymmetric center**, **stereogenic center** or **chiral center**.

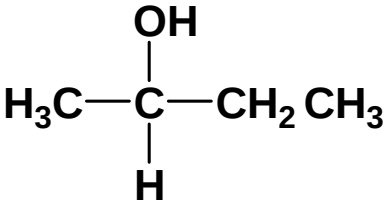
Test for chirality:

Look for 4 different groups attached to carbon

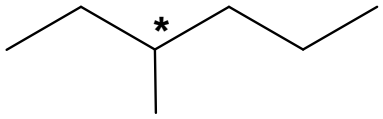
Look at more examples: 4 different groups on carbon

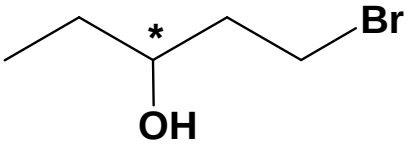
1-propanol (achiral) vs 2-butanol (chiral)

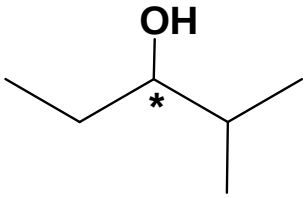


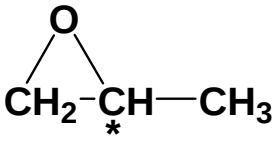


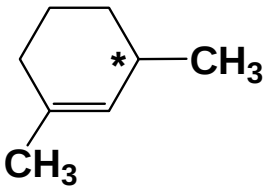
more examples:

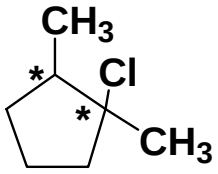








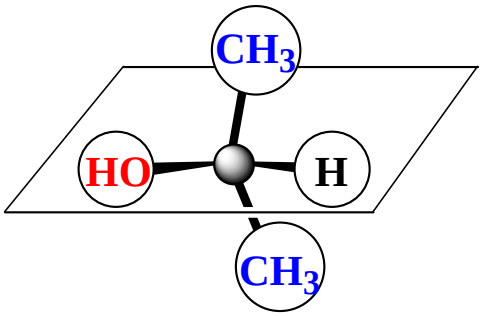




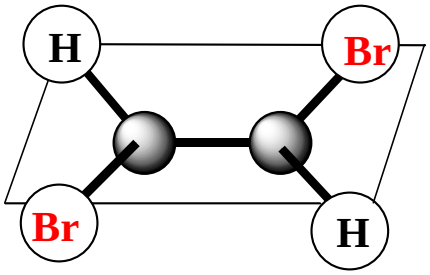
Test for achiral structures:

- Look for a plane of symmetry, also called a σ plane
- Or center of symmetry

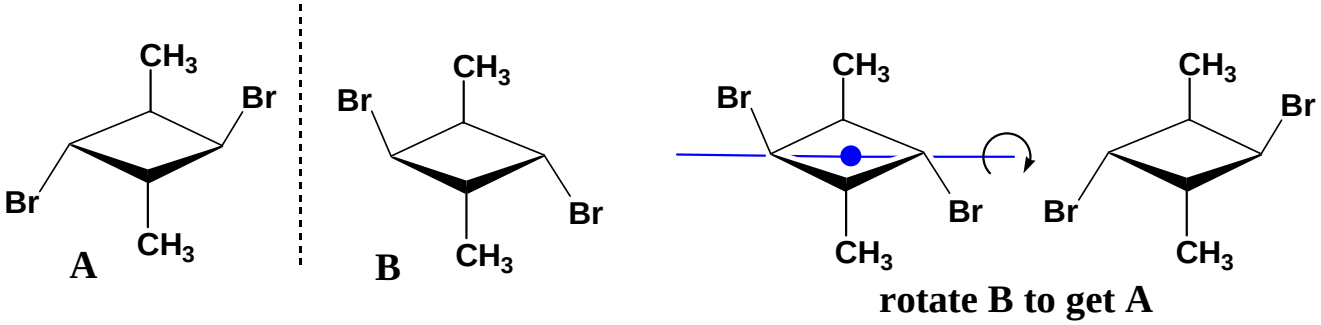
➢ Plane of symmetry



σ plane



➢ Center of symmetry- *Chirality due to this type of situation is not as common as applying the symmetry plane test or identifying 4 different groups on carbon. Students do not need to be able to distinguish centers of symmetry in molecules.*



rotate B to get A