CHE 141 Lab Week 3 Molecular Modeling

Enantiomers, Meso Compounds, Diastereomers, Fischer Projections

1. To a tetrahedral carbon attach 4 groups. Use three different colored balls representing three different groups. Let the fourth ball be the same color as one of the other three balls. The model should now have three different substituents attached to the carbon. Is there a plane of symmetry (a cutting plane that divides the object into two equivalent halves; the elements on one side of the plane are the exact reflection of the elements on the other side.)? Passing the cutting plane through the model, what colored elements does it cut in half? What is on the left and right half of the cutting plane? Construct its mirror image. Are the two models superimposable on each other? Are they different or identical molecules? Molecules with a plane of symmetry are achiral.

2. Make a model of a tetrahedral carbon center with four different atoms attached (red, white, blue, green). Does this model have a *plane of symmetry*? Molecules without a plane of symmetry are *chiral*. The tetrahedral carbon is the chiral center. A simple test for a *chiral center* is to look for a carbon with four different atoms or groups attached.

3. Place the model you constructed in #2 in front of a mirror (real or imagined). Construct the model of the image projected in the mirror. Are both chiral? Try to superimpose one model onto the other. *Enantiomers* are two molecules that are related to each other such that they are *nonsuperimposable mirror images of each other*.

4. Construct a pair of enantiomers. From each, remove the same common element (e.g., the white component) and the connecting links (bonds). Reconnect the two central carbons by a bond. This is a *meso* form of a molecule.
    - Has a plane of symmetry
    - 2 chiral centers but mirror images are superimposable (identical)

5. Using one of the models from #4, exchange any two colored groups. This molecule:
    - Has no plane of symmetry
    - It is chiral (2 chiral centers)
    - It is not superimposable on the meso form (compare to other model from #4).
    - They are not mirror images
    - They are different, and are called *diastereomers*.

6. Fischer Projections