Objectives for Chapter 6 – Stereochemistry

I. Stereoisomers containing C=C

<u>Stereoisomers, constitutional isomers, and conformations</u>

1. Explain what a stereoisomer is, and the difference between constitutional isomers, stereoisomers, and conformations.

2. Correctly label two structures as constitutional isomers, stereoisomers, or conformations.

3. Explain why compounds containing C=C can have stereoisomers.

<u>Determining whether a compound will have stereoisomers or not</u>

4. Describe how to tell if compounds containing C=C will have stereoisomers or not.

5. Determine whether a given C=C compound has a stereoisomer, and if it does, draw it correctly.

<u>Stereocenters</u>

6. Explain what a stereocenter is, and how to determine if a C=C compound contains stereocenters.

7. Correctly label the stereocenters in a compound containing C=C.

<u>Labeling stereoisomers</u>

8. Explain how *cis* and *trans* can be used to identify stereoisomers, and under what circumstances this is appropriate.

9. Explain how *E* and *Z* can be used to identify stereoisomers, when they are required instead of *cis* and *trans*, and how to determine which a compound is.

10. Correctly label stereoisomers of compounds containing C=C as *cis* or *trans*, or *E* or *Z*.

II. Introduction to Chirality

<u>Chirality and enantiomers</u>

1. Explain what it means for an object or a molecule to be chiral or achiral.

2. Explain what enantiomers are.

<u>How to determine if a molecule is chiral</u>

3. Explain what an asymmetric carbon is and what affect this has on chirality, and identify asymmetric carbons in organic molecule.

4. Explain what a plane of symmetry is and what affect this has on chirality, and identify planes of

symmetry in molecules.

5. Correctly label molecules as chiral or achiral using the definition, asymmetric carbons, and/or planes of symmetry.

<u>Stereocenters</u>

6. Explain how to determine which atoms are stereocenters in a chiral compound, and correctly identify stereocenters in chiral compounds.

<u>Labeling enantiomers</u>

7. Explain the rules for determining if an asymmetric carbon is R or S.

8. Determine whether an asymmetric carbon is R or S.

9. Explain why these rules cannot be used if an asymmetric carbon exists, but the orientation of its substituents is not shown.

<u>Including stereochemistry in nomenclature</u>

10. Explain how to incorporate R or S designations into the names of alkanes, and correctly name chiral compounds with asymmetric carbons.

III. Compounds with two or more stereocenters

1. Locate stereocenters in a compound, determine the number of possible stereoisomers, and draw them.

2. Determine the relationship between all possible stereoisomers of a compound, including enantiomers, diastereomers, and identical structures.

3. Explain how to determine if two compounds with multiple stereocenters are enantiomers.

4. Explain what diastereomers are, and how to determine if two compounds are diastereomers.

5. Explain why some compounds have fewer actual stereoisomers from the original prediction of possible stereoisomers.

6. Explain what a meso compound is and how it is different from an achiral compound with no stereocenters, and identify meso compounds.

7. Draw an isomer tree showing the relationships between constitutional isomers, stereoisomers, enantiomers, and diastereomers.

8. Determine whether two structures are identical compounds, meso compounds, enantiomers, diastereomers, or constitutional isomers.

Fischer Projections

1. Describe what a Fischer projection means, make an accurate molecular model based on a Fischer projection, and use it to convert a Fischer projection to a line structure.

2. Explain why Fischer projections can be useful.

3. Give the relationship between two compounds shown as Fischer projections.

4. Label stereocenters in Fischer projections as R or S.

5. Explain how D and L designations are used to identify stereocenters in compounds such as sugars.

6. Label compounds in Fischer projections as D or L.

IV. Physical Properties of Chiral Compounds

Regular physical properties

1. Explain which types of isomers have the same or different physical properties.

2. Explain why enantiomers can have different odors.

Optical Activity

1. Explain why plane polarized light is, and how we can obtain it.

2. Explain what optical activity is, and how it is measured.

3. Explain what factors affect the measurement of optical activity, and how to eliminate the effects of all factors except the structure of the compound.

4. Explain what the specific rotation of a compound is.

5. Write the equation relating observed rotation, specific rotation, concentration, and path length, and perform calculations using this equation.

6. Explain the relationship between optical rotation of enantiomers.

7. Determine whether a given solution is optically active, and explain what a racemic mixture is.

8. Explain what optical purity is, write the equation for optical purity, and perform calculations using this equation.

9. Explain what enantiomeric excess is, write the equation for it, and perform calculations using it.

Separation of enantiomers

1. Give three sources of enantiomerically pure compounds.

2. Explain the principles behind resolution of enantiomers.

Determining stereochemical correlation

1. Explain what stereochemical correlation is and why it must be determined experimentally.

2. Explain the process by which stereochemical correlation can be determined.

3. Explain how the stereochemical correlation of one compound can be used to obtain that of another one.