**Organic Chemistry – Stereochemistry NOTES**

**- Stereochemistry:**

 - stereoisomers—molecules with the SAME FORMULA and connectivity but

 a DIFFERENT ARRANGEMENT of their atoms in space

 - enantiomer—stereoisomers that are NONSUPERIMPOSABLE mirror

 images of each other

 - chiral—any object that cannot be directly superimposed on its mirror

 image

 - chiral molecules LACK SYMMETRY (does not have an internal plane of

 symmetry!)

- achiral—a compound whose mirror image is identical to itself

- CHIRAL molecules have at least ONE C that has 4 DIFFERENT groups

 bonded to it



Image courtesy of <http://en.wikibooks.org/wiki/Organic_Chemistry/Alkanes/Stereoisomers>



Image courtesy of <http://www.chemguide.co.uk/basicorg/isomerism/optical.html>

- **Naming Stereoisomers:**

 - enantiomers of the same molecule have different properties when they

 interact with light or react with other chiral molecules

 - the **R/S nomenclature system** is used to name chiral molecules

 - “R” stands for the Latin word *rectus* (“right”) and S for the Latin word

 *sinister* (“left”)

 - substituent groups around the stereocenter are ranked and their

 orientation around the stereocenter is determined

 - rank the substituent groups 1 (HIGHEST) 🡪 4 (LOWEST) using the same

 rules as the E/Z isomerism system

 - Draw the molecule (or use a model) so that the LOWEST priority group is

 pointing AWAY from you

 - Draw an arrow from 1 🡪 2 🡪 3 in the molecule

 - If the arrow points CLOCKWISE, the configuration is **“R”**—if the

 configuration points COUNTERCLOCKWISE then the configuration is **“S”**

- name the molecule by putting the letter before the name of the molecule

 in parentheses

1 = OH

2 = COOH

3 = CH3

4 = H

 

Images courtesy of <http://www.dave-cushman.net/bee/lactic.html>

*- Ex. Determine the configuration of the stereocenter shown in the molecule below.*



- **Diastereomers:**

- diastereomers—stereoisomers that are NOT mirror images of one

 another

- diastereomers are common when molecules have more than one

 stereocenter



Image courtesy of <http://chemistry.umeche.maine.edu/CHY251/Exams/F09p2q7.html>



Image courtesy of <http://chemistry.tutorvista.com/organic-chemistry/isomers.html>

 - enantiomers have opposite configurations at ALL stereocenters

 - diastereomers have opposite configurations at SOME stereocenters

- **Meso compounds:**

 - meso compound—has 2 or more stereocenters but ALSO contains a plane

 of symmetry

- meso compounds are ACHIRAL molecules with stereocenters



Image courtesy of <http://www.aceorganicchem.com/blog/2013/05/17/meso-compounds-in-organic-chemistry-surprisingly-not-chiral/>

**- Alkene Stereoisomerism:**

 - Alkenes CANNOT have enantiomers of each other but they CAN have

 diastereomers due to cis-trans isomerism



Image courtesy of <http://2012books.lardbucket.org/books/introduction-to-chemistry-general-organic-and-biological/s16-02-cis-trans-isomers-geometric-is.html>

**- Optical Activity in Chiral Compounds:**

 - enantiomers are optically active (they rotate the plane of polarized light)

 - light behaves as an EMR wave that radiates in all directions

 - a polarizer will only allow light to pass through in ONE particular direction

 - if a CHIRAL molecule is placed in FRONT of a polarizer then the light will

 pass through but it will ROTATE in a particular direction

 - DEXTROROTATORY—chiral compound that rotates light in the

 CLOCKWISE direction and is given the symbol (+) in the prefix

 - LEVOROTATORY—chiral compound that rotates light in the

 COUNTERCLOCKWISE direction and is given the symbol (-) in the prefix

 - (+) and (-) have NOTHING to do with R and S!!!

 - achiral compounds do NOT rotate light at all

 - RACEMIC MIXTURE—has an equal mix of BOTH enantiomers of a chiral

 compound (the mixture is NOT optically active—does NOT rotate light!)



Image courtesy of <http://chemed.chem.purdue.edu/genchem/topicreview/bp/1organic/chirality.html>

- **Physical & Chemical Properties of Stereoisomers:**

- ENANTIOMERS have identical physical properties (boiling point, melting

 point, density, solubility, acidity, etc.) EXCEPT the direction that they

 rotate the plane of polarized light

 - ENANTIOMERS have identical chemical properties when interacting with

 ACHIRAL compounds

 - ENANTIOMERS have different chemical properties when interacting with

 other chiral compounds (IMPORTANT for Biochemistry because most

 molecules in the body are CHIRAL!!)

 - (S)-thalidomide works well as a treatment for morning sickness is

 pregnant women but (R)-thalidomide causes terrible birth defects



Image courtesy of <http://organici.blogspot.com/2013/10/thalidomide-good-or-bad.html>

 - DIASTEREOMERS have completely different chemical and physical

 properties

 - RACEMIC MIXTURES are a 50:50 mixture of enantiomers and are optically

 inactive

 - MESO compounds are optically inactive and achiral