Week 4

Stereochemistry

4.1 Intro to Chirality and Chiral Compounds

10/26:

- Today:
  1. Stereoisomers / chirality center.
  2. Chirality test.
  3. Keeping track of stereoisomers (R/S system).
  4. Physical properties of enantiomers.
  5. Molecules with multiple chirality centers.
  6. Fischer projections.
  7. Meso compounds.
  8. Chiral molecules with no chirality center.
- **Achiral** (object): An object such that it and its mirror image are identical.
- **Chiral** (object): An object such that it and its mirror are nonidentical (cannot be superimposed).
- Single enantiomer drugs is about a $100 billion industry.
  - Biological molecules are chiral.
- **Stereoisomers**: Same connectivity; different spatial arrangement of groups.
- **Enantiomers**: Non-super-imposable mirror images.
  - E.g., 2-butanol.
- **Diastereomers**: Stereoisomers that are not mirror images of each other.
  - E.g., cis and trans 2-butene.
- **Chirality center**: A tetrahedral carbon that is bonded to four different groups.
- Molecules with one chirality center are chiral and exist as a pair of enantiomers.
- Chirality test: Check for a **plane of symmetry**.
- **Plane of symmetry**: An imaginary plane that bisects the molecule such that the two halves are mirror images of each other.
- Lowest priority group away from you; clockwise 1,2,3 is R; counterclockwise is S.

- Enantiomers have the same boiling and melting point.
  - They are only different when interacting with other chiral substances.
  - They also rotate plane-polarized light different directions.
- **Racemic mixture**: An equimolar mixture of enantiomers.
- **Enantiomeric excess**: The following quantity. *Denoted by* **ee**. *Given by*

$$\frac{(\text{moles enantiomer 1}) - (\text{moles enantiomer 2})}{\text{total moles of both}}$$

  - $ee = 0$ for a racemic mixture; $ee = 100\%$ for an enantiomerically pure mixture.
- How many possible stereoisomers?
  - 2^n possible ones, where n is the number of chirality centers.