Introduction to Stereoisomers

UCI Chem 51A
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Goals

* After this lesson you should be able to:
  * Distinguish between constitutional isomers and stereoisomers
  * Identify stereocenters in a molecule
  * Determine whether a molecule is chiral (except multiple stereocenters)
  * Recognize pairs of enantiomers
  * Draw the enantiomer of a chiral molecule
Types of Isomers

- **Constitutional Isomers:** Molecules with the same molecular formula whose structures vary by arrangement of atoms & bonds (different connections)

- **Stereoisomers:** Molecules that have the same molecular formula and same connections but vary by spatial arrangement
Types of Stereoisomers

* **Enantiomers**: Isomers that are mirror images of each other but are not superimposable on each other

* **Diastereomers**: Not quite enantiomers, contain multiple stereocenters (we’ll get to these in another lesson)

* **Cis/trans isomers**: Isomers that are not enantiomers or diastereomers but differ in cis/trans (most common with alkenes)
Chirality

A molecule is **chiral** if it IS NOT superimposable on its mirror image.

A molecule is **achiral** if it IS superimposable on its mirror image.
Enantiomers are a pair of isomers that are mirror images of each other and are NOT superimposable on each other.
Stereocenters

* Most (but not all) chiral molecules have at least one stereocenter.

* Stereocenter:
Cyclic Molecules & Stereocenters

* Watch out for symmetry!

H \text{CH}_3

stereocenter?

H \text{CH}_3

stereocenter?
How to Tell If It’s Chiral or Achiral

1. Look for stereocenters.
   - If one stereocenter, chiral.
   - Multiple stereocenters? Maybe chiral.

2. Look for planes of symmetry.
   - Plane of symmetry = achiral
How to Draw the Enantiomer

* Option 1. Literally draw the mirror image.

* Option 2. Switch any two groups.

Option 1

Option 2

mirror plane

red & white switched

rotate
Chiral Without A Stereocenter?! 

- DNA is chiral!
- Helices have a “handedness”
- Hexaphenylnbenzene
- Also a helix
Wrapping Up

- Practice recognizing types of isomers
- Practice identifying stereocenters
- Practice drawing and identifying enantiomers
- Practice looking for planes of symmetry in molecules
- Practice determining whether a molecule is chiral or achiral