Structure, symmetry, asymmetry, dissymmetry, axial versus point dissymmetry, asymmetry.

- When presented with any two similar organic molecules we can ask a series of questions to categorize the relationship between the two molecules.

  - **isomers**: the atoms have identical connections
    - **constitutional isomers**
    - **diastereomers**
      - 0 interconverted by bond rotation
    - **enantiomers**
      - 0 interconverted by bond rotation

- **stereo isomers**: the structures are mirror images
  - **diastereomers**
  - **enantiomers**
    - **atropisomers**

- **Examples**
  - **constitutional isomers**: EtOH and Me-O-Me
    
  - **configurational diastereomer**:

  - **conformational diastereomers**:
**enantiomers:**
- these molecules can be designated (1S,2S) and (1R,2R) respectively.

**conformational enantiomers:**

**atropoisomers:**
- I am guessing that these molecules would be atropoisomers.
- That is that they would be isolable at room temperature under normal laboratory conditions.
- The activation barrier of the equilibrium needs to be greater than ~23 kcal/mol.

**Dissymmetric versus asymmetric.**
- Asymmetric: lacking symmetry, $C_1$ point group.
- Dissymmetric: lacking some particular symmetry element. This term might be used with respect to the particular symmetry element. One might say the object is dissymmetric with respect to a $\sigma_v$.

- Think about the symmetric versus the dissymmetric signals sent by these faces.
- Apparently there is more than one way to feel ambiguous.

**All objects/ molecules that are asymmetric are chiral.**

**All objects/ molecules that are dissymmetric with respect to Sn are chiral.**
- The chiral point groups are $C_1$ (asymmetric), $C_n$, and $D_n$ (dissymmetric).
Principles of Organic Chemistry

At this point the instructor plays with a flexible cube to demonstrate this the ideas above.

Some Stereochemistry verbiage:
- I will discuss the following terms and what they mean.
- The table below was copied from C&EN 1984, June 11, p. 21. and the ideas of Prof. Kurt Mislow.

<table>
<thead>
<tr>
<th>Stereogenic</th>
<th>Chirotopic</th>
<th>Achirotopic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stereogenic</td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
<tr>
<td>Nonstereogenic</td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
</tbody>
</table>

- The absolute configuration of the product is just a name! It depended in this case on the priority (nomenclature, not chemistry) of the nucleophile.
  - Names are arbitrary.
- Review the Cahn, Ingold Prelog rules in an Organic Chemistry Textbook if you think this is necessary.
- Other designators
  - Axial versus point chirality:
    - 2,3-pentadiene has axial chirality
    - R,S designation can be applied, but it is not so convenient.
      - Instructor demonstrates.
    - The simplest axial chirality can be found in a helix or a spiral.
      - Identical ends
• What is the point group of a simple helix?
  o Only symmetric with respect to $C_2$ so $C_2$.
  o Right handed helix . . . use the right hand rule **along the dissymmetric axis**. Why dissymmetric and not asymmetric here?
    • Instructor demonstrates with a helix drawn on the board.
    • Instructor demonstrates with 2,3-pentadiene on the board.
  o Instructor talks about molecules in terms of M versus P designations
    • Instructor compares these to left versus right handed helical designations and finds that they are map into one another.
    • $M =$ Right handed helix.
    • $P =$ Left handed helix.