

Stereochemistry and Molecular Models Pre-Lab

1013-435

Stereochemistry is the field of chemistry that deals with the 3-D structure of molecules and is integral in many areas of chemistry including: **organic**, **inorganic**, **biological**, **physical** and **supramolecular chemistry**.

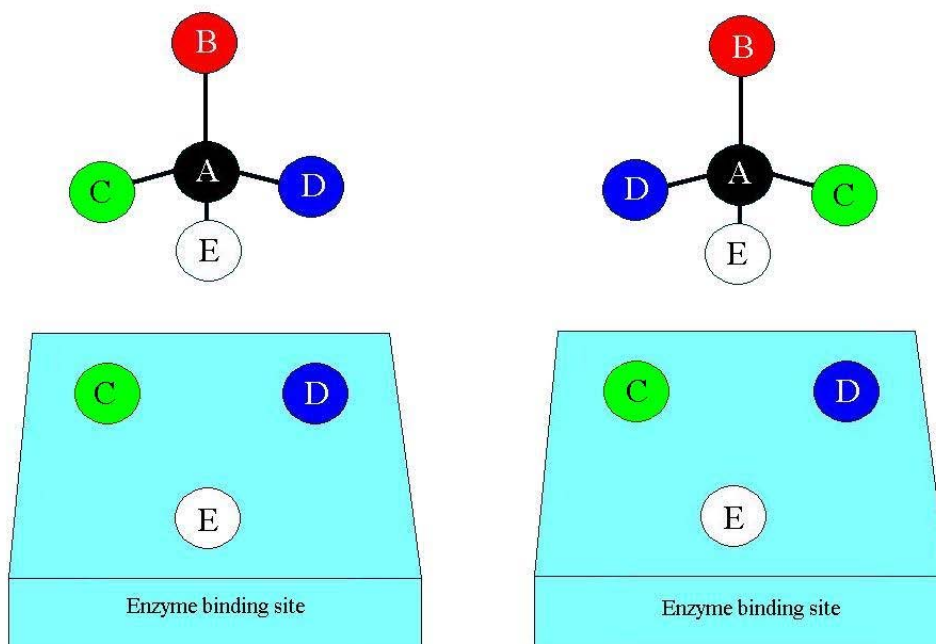
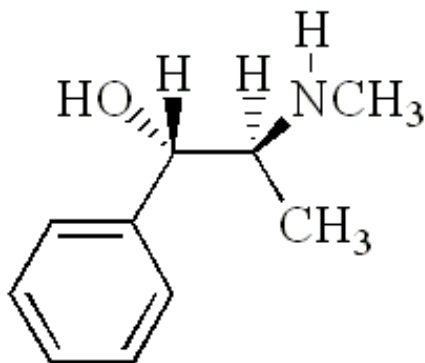


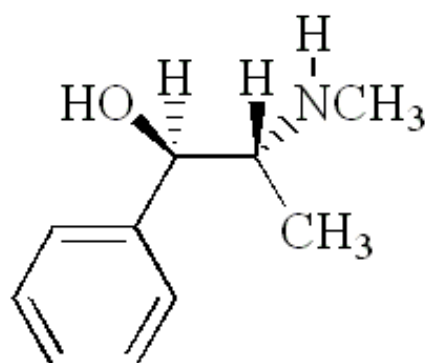
Figure 1. The two molecules are enantiomers, that is, non-super-imposable mirror images. The molecule on the left fits tightly into the binding site while its enantiomer on the right doesn't fit so it cannot bind.

One important aspect of stereochemistry is the molecular interactions in biological systems. **Enzymes** catalyze reactions in biological systems by very selectively binding to a particular molecule based on its 3-D structure. Nature evolved enzymes to be very specific. Mankind has also designed tools based on stereochemistry, a pair of scissors, for example is a tool based on **chirality**. Chirality is the difference between your right and left hands. Left and right hands are made up of all the same parts, but have you ever tried to use left handed scissors in your right hand or right handed scissors in your left? Think of your hand as an enzyme and the scissors as a molecule.

Chiral molecules bind differently in very specific binding sites. For example, (-)-ephedrine is a decongestant (active in the human body) whereas its enantiomer, (+)-ephedrine, is not biologically active in the human body.



(-)-ephedrine



(+)-ephedrine

The most abundant and easily generated representations of molecules are the two-dimensional drawings on paper. Although the 2-D drawings are the most common they often don't accurately represent the 3-D nature of the molecule being represented. The objective of this lab is to explore the 3-D nature of organic molecules using computer generated 3-D molecules and molecular modeling kits (plastic hand held models). This lab will be made up of 4 parts, part one, the pre-lab, you are reading now. Part 2 will be an exploration of the 3-D nature of organic molecules and familiarization with terminology. During part 2 you will make drawings and notes in your lab notebook to be turned into your instructor. Part 3 will consist of exercises dealing with stereochemistry in which you will fill out a worksheet to be collected by your instructor. Part 4 is a quiz to assess your understanding of stereochemistry.

Glossary

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Binding Site: In biochemistry, a binding site is a region on a protein, DNA, or RNA to which specific other molecules and ions form a chemical bond.

Biological Chemistry: The scientific study of the chemical composition of living matter and of the chemical processes that go on in living organisms.

Chiral Molecule: A molecule that is not super-imposable on its mirror image.

Chirality: The characteristic of a structure (usually a molecule) that makes it impossible to super-impose it on its mirror image. Also called handedness.

Enantiomer: Either of a pair of crystals, molecules, or compounds that are mirror images of each other but are not identical, and that rotate the plane of polarized light equally, but in opposite directions.

Enzymes: Any of numerous proteins or conjugated proteins produced by living organisms and functioning as biochemical catalysts.

Inorganic Chemistry: The branch of chemistry that deals with inorganic compounds.

Organic Chemistry: The branch of chemistry that deals with carbon and organic compounds, especially hydrocarbons.

Physical Chemistry: The branch of chemistry that is concerned with the physical structure of chemical compounds, the amount of energy they have, the way they react with other compounds, and the bonds that hold their atoms together.

Stereochemistry: The branch of chemistry that deals with the spatial arrangements of atoms in molecules and with the chemical and physical effects of these arrangements.

Supramolecular Chemistry: refers to the area of chemistry that focuses on the non-covalent bonding interactions of molecules