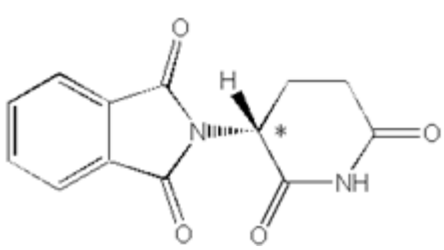
Biological importance of stereochemistry

Stereochemistry may seem like a trivial subject because differences between stereoisomers are usually subtle. In nature, however, and most importantly, in biological systems such as the human body, these subtle differences have sweeping implications. Most drugs for example, are often composed of a single stereoisomer of a compound, and while one stereoisomer may have positive effects on the body, another stereoisomer may be toxic. Because of this, a great deal of work done by synthetic organic chemists today is in devising methods to synthesize compounds that are purely one stereoisomer.

Shown below, for example, is the binding of Ibuprofin, a common pain reliever. While one stereoisomer of the compound has the right three-dimensional shape to bind to the protein receptor, the other does not and can not bind, and is therefore ineffective as a pain reliever.

Shown above: Only one stereoisomer of Ibuprofin has the correct three-dimensional shape to bind to the receptor, so only one isomer actively relieves pain.

Another example of the significance of stereochemistry was demonstrated by Thalidomide (shown below). Thalidomide was a drug used during the 1950s to suppress morning sickness. The drug, unfortunately, was prescribed as a **racemic mixture** -- that is, it contained a 50:50 mixture of its mirror images -- and while one stereoisomer of the drug actively worked on controlling morning sickness, the other stereoisomer caused serious birth defects. Ultimately the drug was pulled from the marketplace.



Thalidomide, a drug once used to surpress morning sickness

The importance of stereochemistry in biological systems extends to more than just drugs: our bodies, for example, can only create and digest carbohydrates and amino acids of a certain stereochemistry. Thus, all of our proteins that make up our hair, skin, organs, brain, and tissues, are composed of a single stereoisomer of amino acids. Additionally, our bodies can make and digest starch (found in potatoes and bread) but not cellulose (found in wood and plant fibers), even though both are just polymers of glucose of different stereochemistry. These are just a few of numerous examples of the important role stereochemistry plays in our everyday lives.