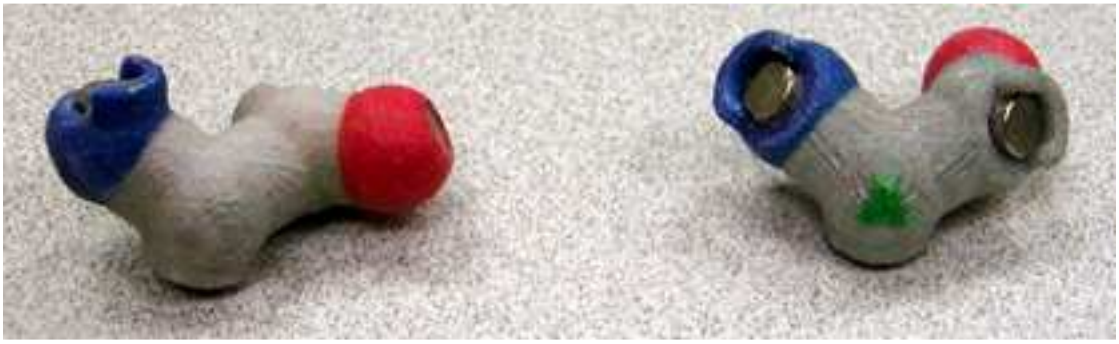
The Structure of Amino Acid Backbones in an α-Helix and a β-Sheet



This kit contains two types of backbone pieces. One type will construct an α-helix and one will construct a β-sheet. The β-sheet backbone pieces have a green "A" on the α-carbon (the "A" symbolizes "anti-parallel"). Each backbone piece has a nitrogen atom (blue), an α-carbon (gray), a carbonyl carbon (gray) and a carbonyl oxygen (red).

Activity

1. Examine each type of backbone piece. What are the similarities and differences between the two backbone pieces?

The backbone pieces are identical in atom composition, but the phi/psi angles are different. The phi refers to the bond between the nitrogen and α-carbon and the psi refers to the bond between the α-carbon and the carbonyl-carbon. In order to adopt the different configurations needed to make an α-helix or a β-sheet, the phi/psi angles will be different. In the construction kit, the backbone pieces have been designed with fixed angles to construct either an α-helix or a β-sheet.

2. Compare your amino acid made from MolyMod® components to the backbone pieces of the construction kits. These are two representations of an amino acid. What are the similarities and differences between the MolyMod® amino acid and the construction kit backbone piece?

The main difference is that the bond rotation capacity is not the same in the MolyMod® representation compared to the amino acid construction kits. In the MolyMod® amino acid, there is free rotation between each atom. As mentioned above, the phi/psi angle of the individual amino acids is fixed in the construction kits to allow for construction of either an α-helix or a β-sheet.

The peptide bond more closely resembles a double bond than a single bond. There is a shorter distance between the nitrogen and the carbon than is typically seen in a single bond. There is no rotation around the peptide bond, in contrast to the bond between the nitrogen and α-carbon. In the construction kit, the peptide bond is represented by a magnet connecting the carbonyl carbon of one amino acid to the nitrogen of the next amino acid.