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.*

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