20.12: Polypeptide Chains

The backbone of any protein molecule is a polypeptide chain obtained by the condensation of a large number of amino acids with the elimination of water. You will recall that the amino acids are bifunctional organic nitrogen compounds containing an acid group, —COOH, and an amine group, —NH_2. The amine group is attached to the carbon atom adjacent to the —COOH (the **α carbon atom**). The three simplest amino acids are

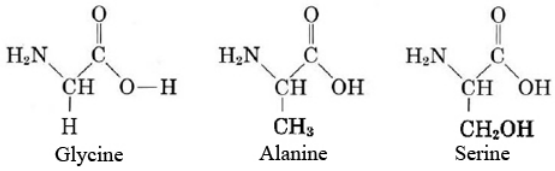


Figure 20.12.1 Rotatable Jmol representations for three amino acids.

In practice, though, these acids are usually in the form of their zwitterions, and we should write them

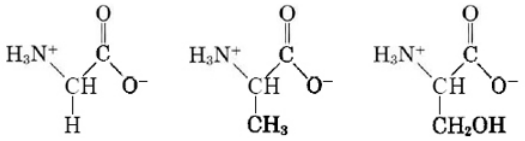


Figure 20.12.2 Zwitterionic forms of 3 amino acids.

If these three amino acids are now condensed, water is eliminated and a simple polypeptide containing three amino acids is obtained:

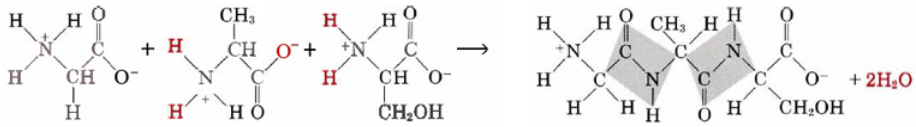


Figure 20.12.3

The two CO—NH bonds produced by this reaction are called **peptide bonds**. Notice that the peptide bond is an amide linkage. An important feature of such a peptide bond is that it is planar. This is because of the existence of two resonance structures

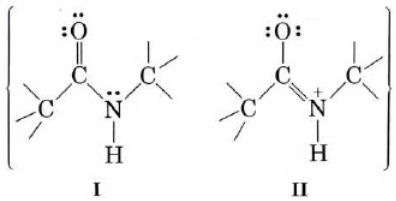
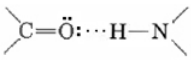


Figure 20.12.3 can twist relative to one another, but they must remain planar. This limitation offers important constraints which can greatly aid analysis of protein structure and of the conformations available for different polypeptide chains.

Another important aspect of the peptide bond is the opportunity it provides for hydrogen bonding. The oxygen on the  carbonyl group can bond to the hydrogen on an  group further along the chain:



Such a bond is somewhat stronger than a normal hydrogen bond because of the partially negative character of the oxygen atom and the partially positive character of the nitrogen atom conferred by resonance structure II.