DNA: Deoxyribonucleic Acid

Every single instruction for all of the traits that you have inherited and all of the life processes that occur in your cells is contained in your DNA. It is no wonder then that DNA molecules are the largest molecules found in cells. Living organisms vary widely in the size and number of DNA molecules in their cells. Some bacterial cells contain only 1 DNA molecule, while human cells contain 46 relatively large DNA molecules. Each human cell contains about 2 m of DNA, which is divided and packed into the cell's 46 *chromosomes*. An average cell is only about 6 μm in diameter and contains many organelles and structures. To fit in a cell, DNA must undergo extensive twisting, coiling, folding, and wrapping.

The Swedish scientist Friedrich Miescher first extracted DNA from cells in 1868, but its three-dimensional structure was not discovered until 1953. Using the X-ray data of Maurice Wilkins and Rosalind Franklin, James Watson of the United States and Francis Crick of England proposed that DNA was a double helix. In this structure, which has been confirmed by numerous methods, two strands of the sugar-phosphate backbone are wound around each other, and the nitrogenous bases point inward, as shown in **Figure 21.** The sequence of these nitrogenous bases along the phosphate-sugar backbone in DNA forms the code responsible for transferring genetic information. The three-dimensional DNA molecule is similar to a twisted ladder. The sides of the ladder are the sugar-phosphate backbone, and the rungs are base pairs of A–T (adenine-thymine) or G–C (guanine-cytosine) bases extending between the two backbones. Hydrogen bonding between these pairs of nitrogenous bases holds the rungs of the ladder together.

FIGURE 21 Hydrogen bonding between base pairs makes the three-dimensional structure of DNA stable. Base pairing occurs between adenine and thymine or guanine and cytosine, keeping the distance between the strands constant.