Consider further aspects of the structure of DNA.

DNA has what is referred to as a secondary structure.

Secondary structure refers to the fact that DNA exists primarily as a double helix composed of two complementary strands of polydeoxyribonucleotides.

By complementary, we mean that where there is an A in one strand there is a T in a corresponding position in the other strand and where there is a G in one strand there is a C in a corresponding position in the other strand as follows-

ATCGTACGT
TAGCATGCA

As noted earlier, the sense of the two strands is opposite, i.e., 5'→3' in one strand and 3'←5' in the second strand.

5' pATCGTACGT 3'
3' TAGCATGCAp 5'

The complementary nature of the two strands results from the use of one strand as a template for the synthesis of the other strand.

This process, called replication, involves the formation of base pairs through H- bonding.

The most favorable formation of base pairs involves A hydrogen bonding to T and G to C as shown in Fig 4.11.

Note that A-T base pairs involve 2 H-bonds while G-C base pairs involve 3 H-bonds.

Other base pairs could be formed, but these are less favorable.

One consequence of such base pairing is that in a DNA molecule the concentration of A will be equal to T and the concentration of G will be equal to C or as expressed in Table 4.1 the ratio of A/T = 1 and of G/C = 1.

There are three recognized double helical forms of DNA called A, B, and Z-DNA.

The three forms correspond to different kinds of helices formed by twisting the two strands around each other with the two strands H-bonded through complementary base pairs.

The characteristics of the 3 helices are indicated in Table 24.3.

Consider what each of these characteristics corresponds to.

Handedness refers to the twist of the helix. Imagine that you can twist two strands of rope around each other in either clockwise or counterclockwise directions.

A right helix corresponds to the curvature of your right hand as one moves along the helix in the direction of your thumb.

A left helix corresponds to the curvature of your left hand as one moves along the helix in the direction of your thumb.

One can see the handedness for the 3 forms of DNA in Fig 4.15. In B-DNA for example, the sugar-phosphate backbone forms a right-handed helix. In Z-DNA the backbone forms a left- handed helix.

The bases per-turn corresponds to the number of nucleotides in the sequence that leads to one turn of the helix.

The rotation per base refers to the angle of rotation of one base pair relative to the neighboring base above or below it in the helix.

The rotation can be visualized by imagining the relative position of steps in a circular staircase. If there are 10 bases (steps) per turn (360°), then the rotation per base pair (step) is 36°.

The rotation is illustrated in a top view of the B-DNA helix shown in Fig 4.12.

The rise per base pair corresponds to the "step" height per nucleotide. In B-DNA the average rise is 0.33 nm (3.3 A°). The rise largely corresponds to the thickness of a purine or pyrimidine ring.

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