



The Chemical Structure of DNA

This is a 3D model of a DNA molecule. It is made up of two strands that form a double helix. If we unwind the helix, we can see that each strand is a chain of building blocks called nucleotides.

Let's pull out these five pairs of nucleotides to take a closer look at their parts. These diagrams show the chemical structures of the nucleotides. The nucleotides are linked together. They are linked one way on one strand and in the opposite way on the other strand. Because the strands are arranged in opposite but parallel ways, they are called "antiparallel."

All nucleotides in DNA are made of the same basic parts. They include deoxyribose sugar molecules, which form the backbone of each DNA strand, and nitrogenous bases, which have four different types in DNA.

Nucleotides are linked by chemical bonds called phosphodiester bonds between their sugar molecules and phosphate groups. The phosphate groups are shown as the circles highlighted on this diagram. Here is the chemical structure of a phosphate group, which has a negative charge.

This is the chemical structure of a deoxyribose sugar. The carbon atoms at the 5' and 3' positions of the deoxyribose sugar form bonds with the phosphate groups. The 5' and 3' positions are used to show the orientation, or direction, of a DNA strand. During DNA replication, enzymes build DNA strands by adding nucleotides in the 5' to 3' direction.

DNA has two kinds of nitrogenous bases. The first kind are the purines: adenine and guanine. The second kind are the pyrimidines: thymine and cytosine.

The bases on one strand of DNA bind to bases on the other strand through chemical bonds called hydrogen bonds. The bases bind in specific ways. Cytosine binds with guanine. And adenine binds with thymine. Bases that bind to each other are called complementary, meaning "matching."

If you know the sequence of nucleotides on one strand, you can figure out the sequence of the other strand by knowing which bases are complementary. For example, this top strand has the sequence ACGTT when read in the 5' to 3' direction and the bottom strand has the sequence AACGT when read in the 5' to 3' direction. The bottom sequence is made of bases complementary to those in the top sequence, but in the reverse order.

The five pairs of nucleotides we looked at are only a small part of this DNA molecule. But the components and relationships are true for all DNA.