



Basic Molecular Biology: Basic Science

DNA Structure

Deoxyribonucleic Acid or DNA is a complex molecule that consists of many components. Let's break down the components into four groups: basic elements, nucleosides, nucleotides, and nucleic acids. Each of these four groups builds upon the other to form the familiar structure of DNA.

The basic elements that compose DNA are five atoms: carbon, nitrogen, oxygen, phosphorous, and hydrogen. A nucleoside is the combination of these atoms into two structures, a fivecarbon sugar molecule called deoxyribose, which is responsible for the name of DNA, and a phosphate group. Together, these two structures form the supporting backbone of DNA. A nucleotide consists of the previous nucleoside and one of four nitrogen bases.

The four types of nitrogen bases found in nucleotides are: adenine, thymine, guanine, and cytosine. When nucleotides form chains they are referred to as nucleic acids, thus DNA is a type of nucleic acid. In the living cell, DNA is not produced as a single strand, but on a template formed by a preexisting DNA strand. This creates a second or double strand of nucleotides. The nitrogen bases protruding from the existing strand bind to bases of the strand being synthesized according to the base pairing rules: Adenine binds to Thymine, and Cytosine binds to Guanine.

Note that the second strand is arranged in the opposite orientation or upside-down relative to the existing strand. For orientation purposes, the carbon atoms in the nucleotide sugar are numbered one through five. The phosphate group is attached at carbon five and is appropriately called the five prime end. The next nucleotide in the chain attaches at the third carbon and is called the three prime end.

This means that one strand's nucleotide chain runs in the 5 prime to 3 prime direction, whereas the other runs in the 3 prime to 5 prime direction. This naming convention is important because nucleic acids can only be synthesized in vivo in the in the 5 prime to 3 prime direction

Link to video job aid: [Basic Molecular Biology: Basic Science – DNA Structure | OneLab REACH \(cdc.gov\)](https://www.cdc.gov/one-lab-reach/basic-molecular-biology-basic-science-dna-structure)