



Make a DNA Model: What Is the Molecular Structure of DNA?

DNA is the acronym for deoxyribonucleic acid, the molecule that carries all the genetic information required for the reproduction, development, and functioning of all organisms and numerous viruses. The DNA molecule is composed of phosphate groups, ribose molecules, and four different nitrogenous bases—adenine, cytosine, guanine, and thymine. The phosphate groups bind to the ribose sugars to form the molecular backbone of the DNA structure. A nitrogenous base binds each ribose molecule, and a second nitrogenous base attached to a complementary DNA strand. Nitrogenous bases in DNA are bound by hydrogen bonds, which hold together the two complementary DNA strands.

Watch Video 1

Observe Part 1

Predict: What mistakes were made when building the third DNA sequence? Would these mistakes affect the structure of a real DNA sequence?

The first mistake was putting two phosphate groups (represented by pony beads) in sequence on each DNA strand. The next two errors were to pair up adenine and guanine, and thymine with cytosine. These errors would be problematic because the entire structure of DNA depends on having only complementary bases bound to each other.

Watch Video 2

Observe Part 2

Explain: Were you able to identify all the mistakes made when building the third DNA sequence in **Video 1**? How would you fix the mistakes?

I was able to identify the pairing of bases that were not complementary. I missed the use of two phosphate groups on each strand. The mistakes are easy to fix; only one phosphate group is attached in between base-pairs on each DNA strands; and only complementary bases must be paired up in the DNA structure, that is adenine pairs with thymine, and cytosine pairs with guanine.

Identify an Experimental Design Flaw

What molecular component of DNA is not included in the models shown in **Video 1** and **Video 2**? How would you add this molecule to your own model?



The ribose molecules are not included in any of the DNA sequences shown in the videos. Using tape of a color not previously used, one could cut pieces in the shape of pentagons to represent the pentagonal structure of ribose. There would be one ribose molecule per phosphate group. The ribose is the bride between a phosphate group and a nitrogenous base.

Refine/Expand the Experiment

What else would you change or add to the DNA model to make it more accurate?

The model should show the correct termination for each DNA strand that is part of a double-strand structure. Also, it would be ideal to twist the DNA model into a helical shape that better resembles the double helix structure of DNA.

Practice Scientific Reasoning

What would happen if two nitrogenous bases that are not a complementary find each other aligned in the same base-pair location of a DNA double helix? Explain.

This would result into a DNA base-pair mismatch. The pairing of nitrogenous bases in DNA is very strict because it determines the overall structure and twisting of the DNA sequence into a double helix. A mismatch in base-pairs would lead to structural defects in the DNA structure, making it less stable. The synthesis of proteins depends on the sequence of base pairs in DNA; this process would likely be affected by a DNA base-pair mismatch.

Connect to Your World

Do an online search about the Human Genome Project. What is the Human Genome Project? What was its outcome and impact?

The Human Genome Project (HGP) had the goal of obtaining a complete map and understanding of all the genes of human beings. The HGP revealed that there are probably 20,500 human genes. The HGP has given us detailed information about the structure, organization, and function of the entire set of human genes. Scientists working on the HGP determined the sequence of all the bases in our genome's DNA; developed maps that show the locations of genes for major sections of all our chromosomes; and produced linkage maps, through which inherited traits can be tracked over generations.

Learn More by Exploring These Links

Make a DNA Model <https://www.flinnsci.com/make-a-dna-model/dc10649/>

Gene Expression Essentials <https://phet.colorado.edu/en/simulation/gene-expression-basics>



At-Home Extension

You may use the instructions provided in **Video 1** to build your own DNA model at home. If you do not have access to chenille wires, stiff electrical wire coated with plastic would work well. You could also use colored tape to cut small pentagons that would represent the ribose molecules.

In School

For an introduction to DNA forensics, we recommend the following kit:

360Science™: DNA Forensics <https://www.flinnsci.com/360-science-dna-forensics/>