

Building a DNA Model

Introduction

DNA, deoxyribonucleic acid, is found in the chromosomes of all living things. The structure of this molecule encodes the genetic information that controls the development of each living thing. When scientists figured out the structure of DNA, they built a model. The structure of this model helped them see how DNA can carry information and be copied to make new DNA molecules. In this investigation you will examine the structure of DNA by building your own DNA model.

Problem

What is the structure of a DNA molecule?

Pre-Lab Discussion

Read the entire investigation. Then, work with a partner to answer the following questions.

1. Which two molecules make up the “sides” of a DNA molecule?

2. When you construct your model of DNA, which materials will you use to represent the sides of a DNA molecule?

3. Which molecules make up the “rungs” of a DNA molecule?

4. When you construct your model of DNA, which materials will you use to represent the rungs of a DNA molecule? What will the toothpicks represent in your model?

5. Which bases usually pair together to form the rungs of a DNA molecule?

Materials (per group)

2 strips of cardboard, 38 cm × 3 cm	metric ruler
toothpicks	crayons
tape	modeling clay
colored gumdrops	

Procedure

1. Study Figure 1. It illustrates the shape of the DNA molecule. DNA is a double helix (a helix is a spiral). The two helices of the DNA molecule form what is often referred to as a “twisted ladder.” The sides of the ladder are made up of alternating sugar molecules and phosphate groups. The sugar is a 5-carbon deoxyribose sugar. Each phosphate group is a phosphate atom with 4 oxygen atoms bonded to it. Each “rung” of the DNA ladder is made up of two nitrogen bases. Together, a sugar, a phosphate group, and a base make up a nucleotide. A nucleotide is the basic unit of DNA.

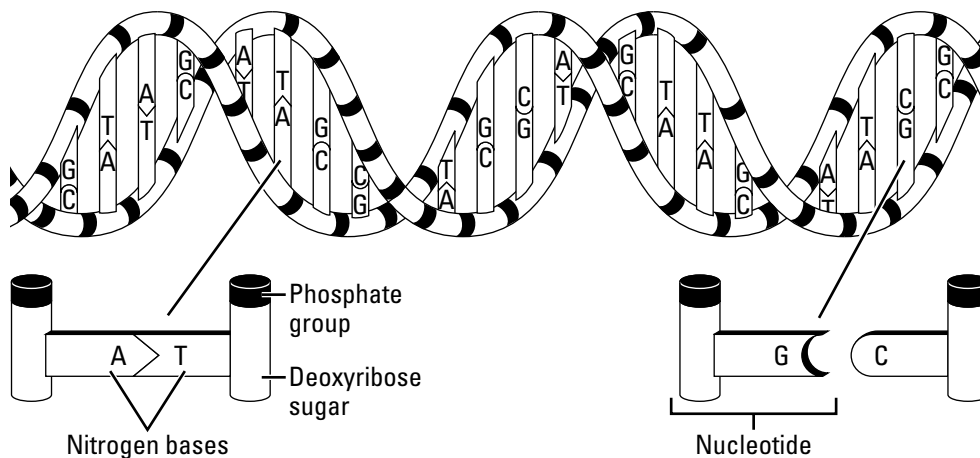


Figure 1

2. Nitrogen bases are grouped into two classes: the purines and the pyrimidines. The purines are adenine (A) and guanine (G). The pyrimidines are cytosine (C) and thymine (T). In a DNA molecule, a purine bonds to a pyrimidine to make up each rung of the ladder. Adenine usually bonds only with thymine. Cytosine usually bonds only with guanine.
3. Now you can make a model of the DNA ladder. Choose two colored crayons and color the cardboard strips with alternating colored boxes. Use one color to represent the sugar molecules and label those boxes S. Use the other color for the phosphate groups. Label those boxes P.
4. To make the rungs of the ladder, choose four different-colored gumdrops. Each color will represent a particular nitrogen base. For example, a green gumdrop might represent an adenine base. A yellow gumdrop might represent a guanine base. Be sure to make a key to explain which color represents which nitrogen base.

5. Stick each gumdrop onto a toothpick. Determine which nitrogen base gumdrops can be bonded together. Then join the correct gumdrops together by placing a toothpick between them.
6. Attach the nitrogen base rungs to the ladder by taping the free toothpick ends to the sugar bases.
7. Continue to add correctly paired nitrogen base gumdrop rungs to the sugar units of the ladder.
8. When your ladder is completed, you might want to stand it up by inserting the two strips into mounds of modeling clay.

Analysis and Conclusions

1. **Predicting** Given the following bases, predict to which base each would be bonded.
A _____ T _____ G _____ C _____

2. **Using Models** How does the model you constructed differ from an actual DNA molecule?

3. **Inferring** If you changed the base on one side of the DNA molecule, what should you do to the base on the other side of the molecule? Explain your answer.

4. **Drawing Conclusions** When DNA is replicated, or copied, the ladder splits as the bases separate. New units are added to each half of the DNA molecule. How does this create two identical molecules of DNA?

Going Further

Consider the following base sequence in one DNA chain. How would you fill in the corresponding portion of the other chain?

GGCATGACGAACTTA