DNA in Action

Name _____

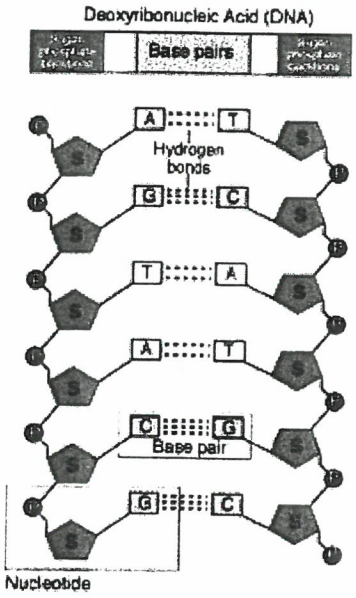
Introduction

DNA, deoxyribonucleic acid, is the genetic instructions used in the development and functioning of every living organism. Knowledge of its structure and functions is key to an understanding of molecular biology.

Background

Less than fifty years ago the nature of the genetic code still eluded scientists. In the fifty years since the structure of DNA was first hypothesized, it has become the most significant biological topic of the century. Understanding the structure of DNA helps to explain many life processes and why we are who we are. In this activity, the major processes of DNA will be modeled. Each step of the procedure will simulate a key DNA structure or process.

A simplified diagram of a short section of DNA is shown to the right. The diagram contains six base pairs. A real chromosome may contain a single DNA molecule with as many as 100 million base pairs or even more! Since the base pairs represent the genetic code, the chromosomes can store a lot of messages!



Materials

Blue pop beads	**thymine**
Green pop beads	**guanine**
Orange pop beads	**cytosine**
Pink pop beads	**uracil**
Yellow pop beads	**adenine**
Red pop beads	**phosphate**
White pop beads	**deoxyribose**
Plastic connectors	**Hydrogen bonds**

Procedure:

Part A: Structure of the DNA molecule

1. Using the color code for the pop beads shown above, make a DNA molecule using the following base pair pattern:

TTC CCC ACA TAG GCT
AAG GGG TGT ATC CGA

Remember that the base pairs must be paired via hydrogen bonds with their complement, that is, adenine with thymine and guanine with cytosine. Connect the two strings of base pairs using the plastic connectors to represent the hydrogen bonds.

2. Twist your molecular model 360 degrees from the top rung of the ladder to the bottom rung. DNA is often called a ẗwiste"ladder. A complete 360 degree rotation actually occurs every 11 steps (base pairs) of the ladder.

3. When all groups have constructed their DNA model, a longer segment can be visualized by laying them all on one table at the same time.

Analysis

1. What base does adenine pair with?

2. What base does guanine pair with?

3. Describe the shape of the DNA molecule. Draw a picture if it helps!

4. How many nucleotides are in your model?

Connections:

5. In what organelle is DNA located?

6. What are the three components of a nucleotide?

7. What is the name of the sugar molecule in the DNA helix?

8. Suppose you know that the sequence of bases on one DNA strand (one side of the DNA ladder) is AGCTCAG. What is the sequence of the bases on the opposite strand?

9. Assume that a 100-bair pair DNA double helix contains 45 cytosines. How many adenines are there?

10. What is the monomer of nucleic acids?

Part B: DNA Replication

DNA is a self-replicating molecule (it can create an exact copy of itself). This is very important when cells divide. The replicated molecules (with their genetic code) are directed into each new cell during mitosis.

1. Separate an end base pair by pulling the hydrogen bond (plastic connector) apart.

2. Find a complementary base pair for each of the separated bases and connect each to its complement using new pop beads and plastic connectors.

3. Disconnect the nexxt base pair and find the complementary base pairs.

4. Continue to ""unzip" the DNA molecule and all complementary base pairs. As each pair is complete, connect the pair to the DNA backbone chain by adding the appropriate replacement phosphates and deoxyribose sugars to complete each new DNA strand.

5. Complete this process for the entire length of the DNA strand.

Analysis

1.What is the final result after the complete "unzipping" and synthesis process?

2.How does each strand compare to the original strand?

3.Replicate the following piece of DNA:

TAC CCG ATT TAT GAG CAT GCG ATC