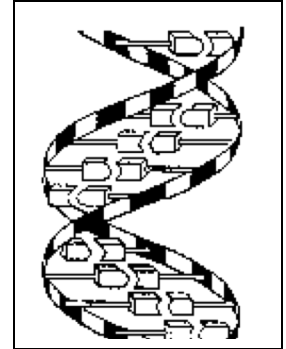


## DNA Structure and Replication

### Introduction:

Deoxyribonucleic acid (DNA) is a complex molecule found in all living organisms. It is the molecule of which genes and chromosomes are composed. An understanding of the organization of this molecule has answered many questions, such as how chromosomes can duplicate during mitosis and transfer their genetic information to new chromosomes.



### Objectives:

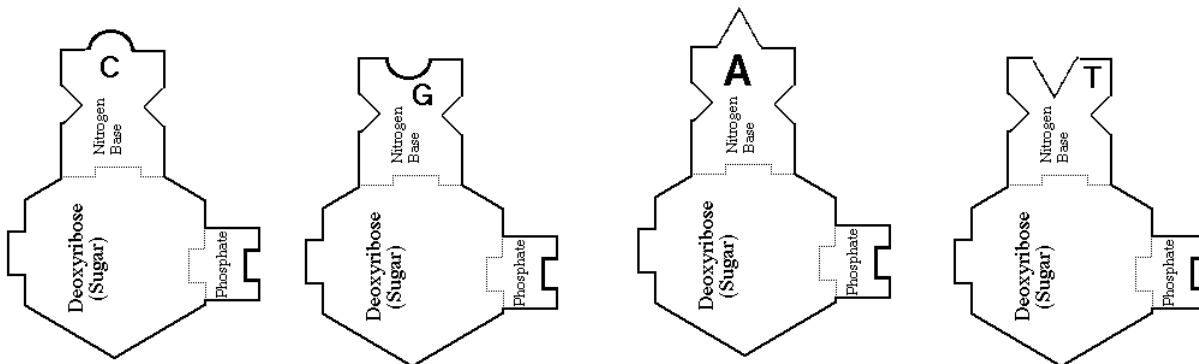
In this lab, you will...

- Learn the names of the parts which make up DNA
- Demonstrate how the nitrogen bases pair in DNA
- Use models to construct a molecule of DNA and show how it replicates
- 

**Materials:** scissors, DNA nucleotide sheet

### PART A: STRUCTURE OF DNA NUCLEOTIDES

Two important molecules which make up DNA are deoxyribose (sugar) and phosphoric acid. In addition, there are four different parts called nitrogen bases. Their models are shown below.



A deoxyribose joins with a phosphoric acid and any one of the four nitrogen bases to form a chemical compound called a **nucleotide**.

### PART B: STRUCTURE OF A DNA MOLECULE

A DNA molecule has the shape of a “spiral staircase” or “twisted ladder”. Oftentimes, when discussed on paper, the “twisted ladder” is flattened out to better understand its structure and function.

Deoxyribose and phosphoric acid join alternately to form the sides or uprights of the ladder. Nitrogen bases join together from the deoxyribose to form the rungs of the ladder.

- Cut out the nucleotide models. BE SURE TO CUT ONLY ALONG THE SOLID LINES!
- Fit six nucleotides together in a puzzle-like fashion to form a row in the following sequence from top to bottom:

Cytosine nucleotide  
 Thymine nucleotide  
 Guanine nucleotide  
 Adenine nucleotide  
 Guanine nucleotide  
 Cytosine nucleotide



Let this sequence represent the left half of your the left side of your ladder. This should consist of one side or upright plus six half rungs.

2.) Name two molecules which make up the upright (or side) portion of a DNA molecule

\_\_\_\_\_ & \_\_\_\_\_

3.) What specific molecule is each nitrogen base attached to? \_\_\_\_\_

4.) What parts of the nucleotide form the half rungs of the ladder? \_\_\_\_\_

Complete the right side of the DNA ladder by matching the bases of other nucleotides to form complete rungs. Turn the nucleotides upside down in order to join certain base combinations.

**NOTE:** The ends of each base will show only a specifically shaped matching base to fit exactly.

Your completed model should look like a ladder with matched bases as the rungs. Besides being shaped like a ladder, remember a DNA molecule is twisted, resembling a spiral staircase. Furthermore, remember that a DNA molecule consists of a sequence of many thousands of nucleotides, not just 6 like we have here.

5.) What are two ways that an actual DNA molecule is different from the model of DNA that you have just constructed? \_\_\_\_\_ & \_\_\_\_\_

6.) Is the order of half-rung bases exactly the same from top to bottom on each side of your molecule?

7.) Only two combinations of base pairings are possible for the rungs. Name these two pairs.

\_\_\_\_\_ & \_\_\_\_\_

8.) If four guanine bases appear in a DNA molecule, how many cytosine bases should there be? \_\_\_\_\_

9.) If four guanine bases appear in a DNA molecule, how many adenine bases should there be? \_\_\_\_\_

10.) The following lists the order of bases found on the left side of a hypothetical DNA molecule. Under each base, list the base that would make up the right side of the DNA molecule.

T    A    G    G    C    T    C    A    T    T    G    A    T    C

The two strands of DNA are said to be **complementary**; that is each base of a DNA nucleotide can pair with only one other specific base. Adenine (A) can only pair with thymine(T), and guanine(G) can only pair with cytosine(C).

### **PART C. REPLICATION OF A DNA MOLECULE**

Chromosome is made up of DNA. Your DNA model represents only a short length of the DNA portion of a chromosome. Remember, an entire chromosome made up of a DNA molecule has thousands of rungs rather than only six. Although your model is only a small part of a chromosome, its replication is the same as that of an entire chromosome.

11.) What two cell processes require chromosomes to replicate? \_\_\_\_\_ & \_\_\_\_\_

- Open your DNA model along the point of attachment between base pairs (rungs) and separate the two ladder halves. This is similar to how a chromosome of DNA untwists from its spiral staircase form and “unzips” prior to replication. See the figure at the right as a guide.
- Using the left half of your model as a pattern, add new nucleotides to form a new right side.
- Build a second DNA model by adding new nucleotides to the right half of the original model.

12.) Do the two new molecules contain the same number of rungs? \_\_\_\_\_

13.) Is the order from top to bottom of base pairs (rungs) different or the same for each new DNA molecule?

14.) How many pairs of adenine and thymine are in each DNA molecule? \_\_\_\_\_

15.) Are the two DNA molecules exact copies of each other? \_\_\_\_\_

16.) How does DNA replication make it possible to produce two identical daughter cells from one parent cell in mitosis?

17.) How does the specific base pairing of adenine with thymine and cytosine with guanine contribute to the information of an exact copy of DNA being formed in replication?

The specific order of bases in DNA serves as a code or language. When a chromosome replicates, the code (the order in which the bases occur) is carried over to the new chromosomes.

# DNA Nucleotides

Color the nucleotides using the following key:

Deoxyribose = red    Phosphate = black

A (Adenine) = gold    C (Cytosine) = blue

G (Guanine) = green    T (Thymine) = yellow

Cut out your nucleotides.

