Name _____ Date _____

DNA And RNA

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Deoxyribonucleic acid (DNA) is a complex molecule found in all living organisms. DNA is the chemical of which genes are composed. An understanding of the organization of this molecule has answered many questions. Scientists now know how chromosomes can duplicate during cell division and transfer their genetic information to new chromosomes. Scientists also understand how chromosomes in the cell nucleus can direct the formation of specific proteins outside the nucleus.

In this investigation, you will

(a) learn the names of the molecules which make up DNA.
(b) use models to construct a molecule of DNA and show how it replicates.
(c) learn the names of the molecules which make up RNA.
(d) use models to show how the base sequence code in DNA is transcribed exactly to RNA.

Materials

4 pages of paper models
scissors
NOTE: SAVE ALL MODEL PARTS. THEY WILL BE NEEDED FOR INVESTIGATION 24.

Procedure

Part A. Structure of DNA Nucleotides

Two important molecules which make up DNA are deoxyribose and phosphoric acid. Their models and structural formulas are shown in Figure 1.

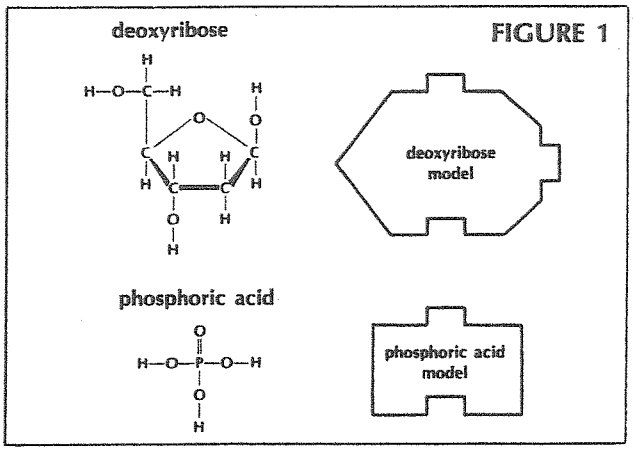


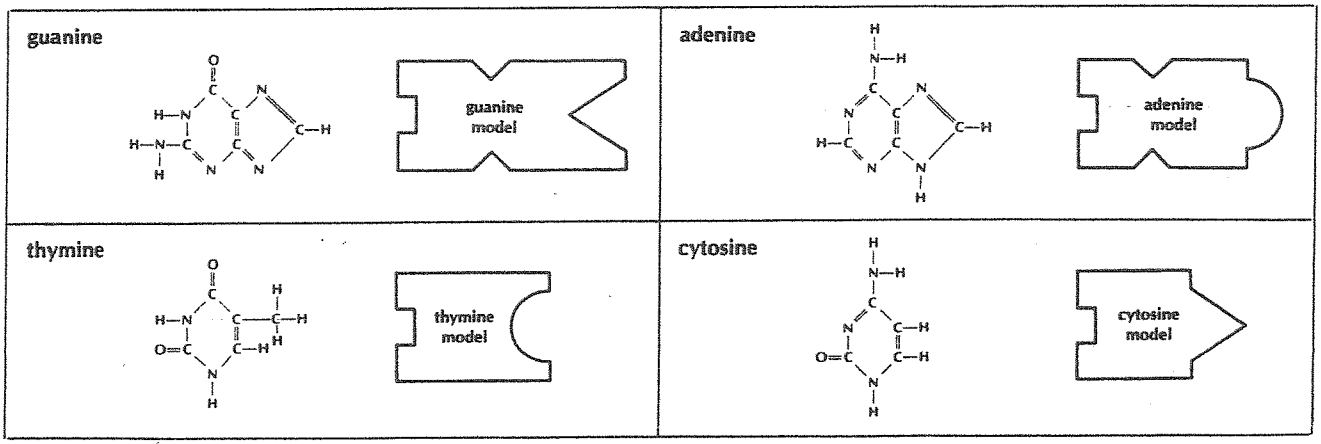
FIGURE 1

1. Give the simple formula for

(a) deoxyribose C__H__O__

(b) phosphoric acid H__P__O__

Deoxyribose is a carbohydrate. Phosphoric acid was studied previously as a molecule in ATP.



In addition, there are four different molecules called bases. Their structural formulas and models are shown on page 91.

2. Of the four bases, which other base does

   (a) adenine most resemble in shape? _____

   (b) thymine most resemble in shape? _____

A molecule of deoxyribose joins with phosphoric acid and any one of the four bases to form a chemical compound called a nucleotide. A nucleotide is named for the base that joins with the deoxyribose. For example, if thymine attaches to deoxyribose, the molecule is called a thymine nucleotide.

• Use the pages of nucleotide models to answer questions 3 and 4.

3. List the four different nucleotides. _____

_____

4. (a) How is each nucleotide alike? _____

_____

   (b) How does each nucleotide differ? _____

_____

_____

Part B. Structure of a DNA Molecule

A DNA molecule is "ladderlike" in shape. Deoxyribose and phosphoric acid molecules join to form the sides or uprights of the ladder. Base molecules join to form the rungs of the ladder.

• Cut out the 24 nucleotide models provided by your teacher. *Cut only on solid lines.* **CAUTION:** *Always be careful when using scissors.*

• Fit six nucleotides together in puzzlelike 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 arrangement represent the left half of a ladder molecule. It should consist of one side or upright plus six half rungs.

5. If DNA is "ladderlike," which two molecules of a nucleotide form the sides, or upright portion of the ladder? _____

6. To which molecule does each base attach?

_____

7. Name the molecules of each nucleotide that form part of the ladder's rungs. _____

• Complete the right side of the DNA ladder by matching the bases of other nucleotides to form complete rungs. It may be necessary to turn molecules upside down in order to join certain base combinations. NOTE: The ends of each base will allow only a specifically shaped matching new base to fit exactly.

Your completed model should look like a ladder with matched bases as the rungs. Besides being shaped like a ladder, a DNA molecule is twisted. It looks like a spiral staircase. However, your paper model cannot show this shape.

8. Is the order of half-rung bases exactly the same from top to bottom of each side of your model?

_____

9. Only two combinations of base pairings are possible for the rungs. Name these molecule combinations or pairs. _____

_____

10. If four guanine bases appear in a DNA model, how many cytosine bases should there be?

_____

11. Your DNA model has four guanine bases.
   (a) Does the number of cytosine bases in your model agree with your prediction? _____
   (b) The following are the bases on the left side of a DNA molecule. List the bases that would make up the right side of a DNA molecule.

Thymine _____

Adenine _____

Guanine _____

Guanine _____

Cytosine _____

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Part E. RNA Transcription

- Cut out the six RNA nucleotide models. *Cut only along solid lines.*

- Open or unzip one of the DNA chromosomes along the base pair points of attachment and separate the two halves.

- Using the left side of your DNA model as a pattern, match RNA nucleotides with the proper nucleotides of the DNA half.

20. Do the RNA half-rung bases pair exactly as they would if this were DNA replication?

_____

- Remove the RNA nucleotide series from the DNA pattern.

- Close the DNA molecule back up with its original right side. (DNA molecules "unzip" temporarily during RNA production.)

RNA is a single-stranded (or ½ ladder) molecule. Thus, the series of RNA nucleotides formed from DNA represents an RNA molecule. After its formation, this RNA leaves the nucleus of the cell and goes to the ribosomes. It carries the DNA message of base sequences in the exact same order. Therefore, the formation of this series of RNA nucleotides is called transcription.

Analysis

1. Complete Table 1 by using check marks to indicate to which molecule each characteristic applies.

TABLE 1. SIMILARITIES AND DIFFERENCES BETWEEN DNA AND RNA

	DNA	RNA
Deoxyribonucleic acid		
Ribonucleic acid		
Ribose present		
Deoxyribose present		
Phosphoric acid present		
Adenine present		
Thymine present		
Uracil present		
Guanine present		
Cytosine present		
Formed from nucleotides		
Double stranded		
Single stranded		
Remains in nucleus		
Moves out of nucleus		
Contains a chemical message or code		

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