

NAME \_\_\_\_\_

DATE \_\_\_\_\_

1. What are the chemical components of a DNA nucleotide?

- a. a phosphate, a sugar, and a nitrogenous base
- b. a phosphate, a nitrogenous base, and an amino acid
- c. a nitrogenous base, a sugar, and an amino acid
- d. a nitrogenous base, ATP, and a sugar

2. The instructions for the traits of an organism are determined by

- a. the proportions of A,T, C, and G in DNA molecules
- b. the order of nucleotides in DNA molecules
- c. the length of DNA molecules
- d. the way nucleotides are paired in the two strands of a DNA molecule

3. The two strands of a DNA molecule are held together by hydrogen bonds between the

- a. phosphate groups on each strand
- b. nitrogenous bases on each strand
- c. bases and the phosphate-sugar backbone
- d. carbon atoms in the sugars

4. In the diagram below, strands I and II represent the two complementary strands of a portion of a DNA double helix. The sequence of strand I is indicated below. What is the sequence of strand II?

Strand I -----C-T-A-C-----

Strand II -----?-?-?-?-----

- |         |         |
|---------|---------|
| a. AGCA | b. CTAC |
| c. TCGT | d. GATG |

5. In the 1950s when Watson and Crick were working on their model of DNA, many scientists did not think that DNA carried the genetic code.

- a. What was the other type of molecule that some scientists thought might carry genetic information?
- b. Why did this other type of molecule seem like a likely candidate?

6. In 1928, Frederick Griffith conducted an experiment in which he injected mice with different kinds of bacteria. When bacteria that cause disease (pathogenic) were injected in healthy mice, these mice got sick and died. Other types of bacteria (nonpathogenic) did not cause the mice to die. Griffith took the DNA from dead pathogenic bacteria and transferred it into living nonpathogenic bacteria. These altered bacteria were then injected into healthy mice. The mice died of the same disease caused by the pathogenic bacteria. Based on this information, which statement would be a valid conclusion?

- a. When an organism dies, the DNA changes; it no longer provides the same genetic information.
- b. When DNA from one organism is transferred to another organism, the DNA no longer functions.
- c. DNA in different types of bacteria carries exactly the same type of information.
- d. When DNA from one organism is transferred to another organism, it can give new traits to the second organism.

7. The following table is a sample of the data Erwin Chargaff published in 1952.

**Proportions\* of Nitrogenous Bases in the DNA of Different Organisms**

Organism	Tissue	% Adenine	% Guanine	% Cytosine	% Thymine
Yeast		31.3	18.7	17.1	32.9
Sea urchin	Sperm	32.8	17.7	18.4	32.1
Rat	Bone marrow	28.6	21.4	21.5	28.4
Human	Thymus	30.9	19.9	19.8	29.4
Human	Sperm	30.3	19.5	19.9	30.3

(\*Defined as moles of nitrogenous constituents per 100 g of atoms of phosphate.  
Source: E. Chargaff and J. Davidson, Eds. *The Nucleic Acids*. Academic Press, 1955)

a. Which of the following observations can be supported by the data in the table? (Place a check mark in the box next to the correct statement.)

- ☐ All organisms contain about the same amounts of adenine and thymine in their DNA.
- ☐ The proportions of adenine + thymine and guanine + cytosine are the same in all organisms.
- ☐ Larger organisms have greater amounts of each nitrogenous base than smaller organisms have.
- ☐ The total length of DNA molecules in all organisms is about the same.

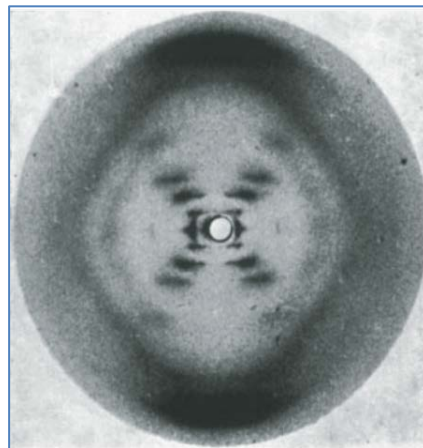
b. In one or two sentences, explain how these observations helped Watson and Crick build their model of DNA.

c. In one or two sentences, explain why the proportions of nitrogenous bases in the DNA of two different human tissues (thymus and sperm) are about the same.

8. The image on the right shows the famous photo B51 taken in May 1952 by Rosalind Franklin and her student Raymond Gosling. This x-ray diffraction pattern provided information about the positions of atoms in a DNA molecule.

a. Identify the clue in this photo that revealed that DNA is a helix.

b. Measurements revealed that the distance between the two strands was always equal. Explain how this information helped Watson and Crick build a successful model of DNA.



c. Was this information consistent with the data obtained by Chargaff (question 7)? Explain your answer.

9. Scientists build models based on what they know from previous research to derive testable hypotheses. Independently, both Watson and Crick and their competitor Linus Pauling constructed an incorrect triple-helix model with the nitrogenous bases arranged so they were on the exterior of the molecule and the phosphate groups on the interior.

a. Although their model was wrong, what assumption made it reasonable to build a model with the bases projecting to the outside?

b. What evidence caused Watson and Crick to revise their model?

10. Even before the structure of DNA was solved, studies indicated that the genetic material must have the following properties:

- be able to store information;
- be faithfully replicated and be passed on from generation to generation; and
- allow for changes, and thus evolution, to occur.

Explain how the structure of the double helix showed that DNA had these properties. Write one or two sentences per point.