

INTRODUCTION

This activity explores the research shown in the short film [The Double Helix](#), which tells the story of how DNA's structure was discovered.

PROCEDURE

Use the information in the film to answer the following questions in the spaces provided. You may want to use the film's transcript as a reference.

1. In the 1950s, many scientists thought that proteins, not DNA, carried genetic information.
 - a. Why did proteins seem better suited for storing genetic information?
 - b. Oswald Avery's experiments with bacteria led him and other scientists to propose the following claim: **DNA, not proteins, carries genetic information.** Complete the table below to explain how Avery's experiments supported this claim.

Claim: DNA, not proteins, carries genetic information.
Evidence: <i>(List three pieces of evidence for the claim from Avery's experiments.)</i>
Reasoning: <i>(In full sentences, explain how each piece of evidence supports the claim.)</i>

2. 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
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 complementary sections of DNA. The sequence of Strand I is shown. What is the sequence of Strand II? _____

Strand I -----CTAC-----

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

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

5. 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

6. Watson and Crick first built a triple-helix model of DNA. In this model, the nitrogenous bases were on the outside of the DNA molecule, and the phosphate groups were on the inside.

a. At that time, why did it seem reasonable for the bases to be on the *outside* of the DNA molecule?

b. What evidence caused Watson and Crick to revise this model? Give specific examples from the film.

7. Table 1 contains data that Erwin Chargaff published about the composition of DNA.

Table 1. Proportions of nitrogenous bases in the DNA of different organisms. Data from Chargaff and Davidson (1955).

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

a. Compare the composition of the DNA in the different organisms. Describe any similarities or differences you observe.

b. Based on the data in Table 1, mark the following statements as true (T) or false (F). Justify each answer in one or two sentences.

____ In each organism, there is approximately one adenine for every thymine.

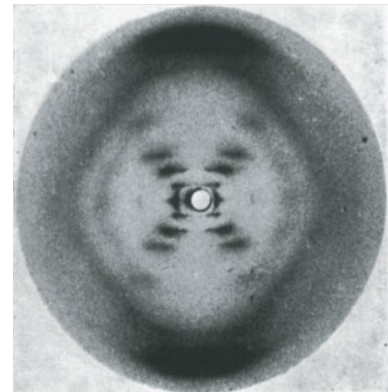
___ In each organism, the proportions of adenine plus thymine equal those of cytosine plus guanine.

___ In each organism, there is approximately one guanine for every thymine.

___ In each organism, there is approximately one guanine for every cytosine.

- c. Why are the proportions of nitrogenous bases in the DNA of the two different human tissues (thymus and sperm) about the same?

8. The image on the right is of *Photo 51*, which was taken in 1952 by Rosalind Franklin and her student Raymond Gosling. It shows the x-ray diffraction pattern of a DNA molecule, which provides information about the positions of atoms in DNA.



- a. Describe the patterns you see in the image.
- b. What conclusions did Watson and Crick reach after seeing this image and reading Franklin's report discussing the symmetry of DNA?

9. Watson and Crick used scientific reasoning, their knowledge of biochemistry, and the research of other scientists to make one of the most important scientific claims of their time: **DNA is a double helix with strands running in opposite directions. Between these strands, A pairs with T, and C pairs with G.**

Complete the table on the following page to explain the evidence that Watson and Crick used to support this claim:

DNA is a double helix with strands running in opposite directions. Between these strands, A pairs with T, and C pairs with G.

Evidence: *(List three pieces of evidence for the claim. Name the scientists who were responsible for each piece.)*

Reasoning: *(In full sentences, explain how each piece of evidence supports the claim.)*

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

- be able to store information
- be consistently replicated between generations
- be able to allow for changes, and thus evolution, to occur

Explain how the structure of DNA gives it these three properties. Write one or two sentences per property.