Tracing Inherited Instructions

Three experiments, one question: What carries inherited information?

GEN.1A.2 "Explain the importance of the historical experiments that determined that DNA is the heritable material of the cell (Griffith, 1928; Avery, McCarty & MacLeod, 1944; Hershey & Chase, 1952)."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Read the passage, then underline one key observation in each paragraph and circle the conclusion that observation supports. Number the experiments 1, 2, and 3 in the order they happened.

How Scientists Identified DNA

(1) In 1928, Frederick Griffith worked with two forms of pneumonia-causing bacteria. Smooth, or S, bacteria killed mice, but rough, or R, bacteria did not. Heat-killed S bacteria also failed to kill mice. Yet when Griffith mixed heat-killed S bacteria with living R bacteria, the mice died, and he recovered living S bacteria from them. Something from the dead S cells had changed living R cells into S cells, which could reproduce with that trait. Griffith called this process transformation. His result showed that hereditary information could move between cells, but it did not identify the molecule carrying that information.

(2) A decade later, Oswald Avery, Colin MacLeod, and Maclyn McCarty asked what caused that lasting change. They prepared material from heat-killed S bacteria and treated separate samples with enzymes that destroyed proteins, RNA, or DNA. Each treated sample was mixed with living R bacteria. Destroying protein or RNA did not stop R cells from becoming S cells; destroying DNA did. This result singled out DNA as the substance needed for transformation, rather than protein, a popular candidate. Because the transformed cells could pass on the S trait, the experiment connected DNA to inherited information, not merely a temporary change.

(3) In 1952, Alfred Hershey and Martha Chase tested a different system: viruses called phages that infect bacteria. They made one batch with radioactive phosphorus in phage DNA and another with radioactive sulfur in phage protein. After the phages infected bacteria, a blender shook off the outer phage coats. Most labeled DNA was found with the bacteria, while most labeled protein remained outside. DNA entered the cells and directed the production of new phages. Unlike the earlier experiments, this test followed a virus during infection. Its independent evidence helped settle the dispute over whether DNA or protein carries inherited instructions.

2 ANSWER WITH EVIDENCE

Use the passage

1. Why did Griffith's results matter even though they did not prove that DNA carries inherited information?

2. Why was the result of destroying DNA more important to Avery's team's conclusion than the results of destroying protein or RNA?

3. How did the locations of the two radioactive labels support Hershey and Chase's conclusion about DNA and protein?

4. Why did testing phages strengthen the conclusion from Avery's bacterial experiment?

3 YOUR TURN

Your own words

Write a four-sentence museum label correcting this claim: “Griffith proved DNA carries inherited information, so the later experiments were unnecessary.” Explain what Griffith established, how Avery's team identified DNA, and why the phage test mattered.

ANSWER KEY

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PART 1 · READ AND MARK

Read the passage, then underline one key observation in each paragraph and circle the conclusion that observation supports. Number the experiments 1, 2, and 3 in the order they happened. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Why did Griffith's results matter even though they did not prove that DNA carries inherited information?	**They showed that material from dead S bacteria could give living R bacteria a trait that persisted as the changed cells reproduced, but they did not identify that material.**
2	Why was the result of destroying DNA more important to Avery's team's conclusion than the results of destroying protein or RNA?	**Only destroying DNA stopped transformation. That singled out DNA as necessary for passing on the S trait, while protein and RNA were not necessary in this test.**
3	How did the locations of the two radioactive labels support Hershey and Chase's conclusion about DNA and protein?	**Most labeled DNA was found with the infected bacteria, while most labeled protein remained outside. DNA, rather than protein, entered the cells that produced new phages.**
4	Why did testing phages strengthen the conclusion from Avery's bacterial experiment?	**It supplied evidence from a different system. DNA entered infected bacteria while most phage protein stayed outside, supporting DNA's role in carrying inherited instructions.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Griffith showed that something from dead bacteria could give living bacteria an inherited trait, but he did not identify the substance. Avery's team found that destroying DNA stopped this transformation, while destroying protein or RNA did not. Hershey and Chase then found that phage DNA entered bacteria while most phage protein stayed outside. Their test in a different system added evidence that DNA carries inherited instructions.

Accept explanations that distinguish Griffith's discovery of transformation from the later identification of DNA. For the phage experiment, students should connect the label locations to what entered the bacteria, not just name which label was found where.