

Evidence of Hereditary Material

Background Information

In 1944, Oswald Avery, Colin Macleod, and Maclyn McCarty at the Rockefeller Institute in New York City conducted a series of experiments to determine the origin of inheritance. Their work followed up on an experiment done by a British scientist named Griffith in 1928. The scientists worked with a bacterium called *Pneumococcus*. This bacterium, which causes pneumonia, exists in two forms. The first form is surrounded by a sugar-like compound called a capsule. The other variety has no capsule. Those with a capsule are called smooth while those without are called rough. When cells with a capsule divide, they form other cells with a capsule. Cells without capsules form new cells without capsules.

The following is an abbreviated summary of Avery, Macleod, and McCarty's procedures and results.

Procedure

1. Mouse A was injected with smooth cells, while mouse B was injected with rough cells.

Observation: Mouse A contracted pneumonia and died, while mouse B continued to live.

- a) What conclusion can you draw from the experimental results?
- b) Why might a scientist decide to repeat this experimental procedure on other mice?

2. The smooth pneumonia cells were heated and killed, and then injected into mouse C.

Observation: Mouse C continued to live.

- c) Explain these experimental results.
- d) Predict what would have happened to the mouse if the rough cells had been heated and killed and then injected.

3. The heat-killed smooth cells were mixed with living rough cells. The mixture was grown on a special growth medium. Cells from the culture medium were injected into mouse D.

Observation: Mouse D died. A necropsy indicated that the mouse had died of pneumonia, and smooth bacteria were isolated from the mouse.

- e) Would you have predicted this observation? Explain.
- f) A microscopic examination of the dead and live cell mixture revealed cells with and without capsules. What influence did the heat-killed smooth cells have on the rough cells?
- g) Avery, Macleod, and McCarty hypothesized that a chemical in the dead, heat-treated, smooth cells must have altered the genetic material of the living rough cells. In similar previous experiments, scientists had dubbed this chemical the transforming principle. Griffith also knew about the transforming principle but he was unable to determine if it was DNA, carbohydrates, lipids, or proteins. Avery and his colleagues believed that the transforming principle was DNA. If this were true, what must have happened to the DNA of the smooth cells?
- h) To test whether or not DNA was the transforming principle, Avery and his associates crushed smooth cells to release their contents. The DNA was extracted and added to a culture of R cells. The culture was later found to contain some smooth cells. Did this confirm or disprove their hypothesis? Justify your response.
- i) How did this experiment rule out the possibility that the R cells simply used the capsules of the dead S cells to become pathogenic?