

Section 6.2: DNA Structure and Function: A History

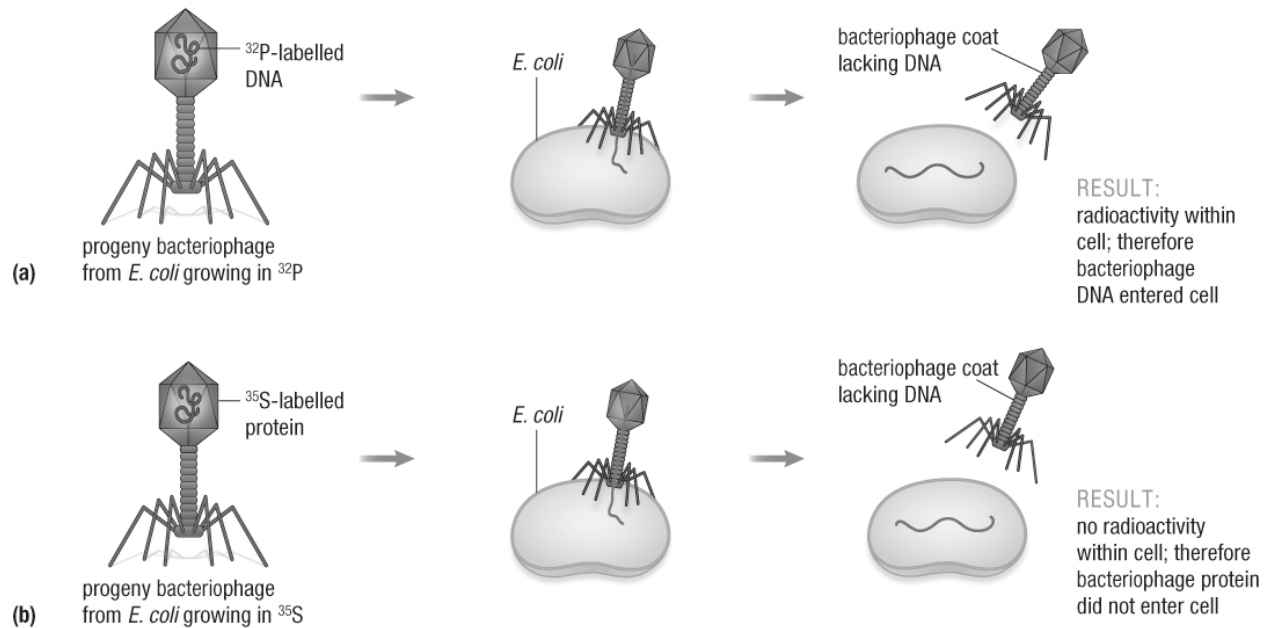
Research This: The Collaborative Nature of Science, page 278

A. Answers may vary. Sample answer: Hershey and Chase made their discovery in 1952. The experiment they conducted was to find out if the protein coat or the DNA core was responsible for the pathogenicity of a bacteriophage. The experiments took place at the Department of Genetics, Carnegie Institution of Washington, Cold Spring Harbor, Long Island, New York. Hershey and Chase found that the virulence factor in bacteriophages was the DNA. They published their findings in the *Journal of Genetic Physiology* on April 9, 1952.

1 Infected *E. coli* were grown in the presence of radioactive ^{32}P or ^{35}S with bacteriophages. The progeny bacteriophages became labelled either with ^{32}P in their DNA or with ^{35}S in their protein.

2 Fresh *E. coli* cells were infected with the radioactively labelled bacteriophages.

3 After the bacteria became infected, they were mixed in a blender to remove the bacteriophage coats from the cell surface. The bacteria were analyzed for radioactivity.



B. Watson and Crick used the information that DNA was acting as a hereditary molecule to help rationalize the structure of the double helix design.

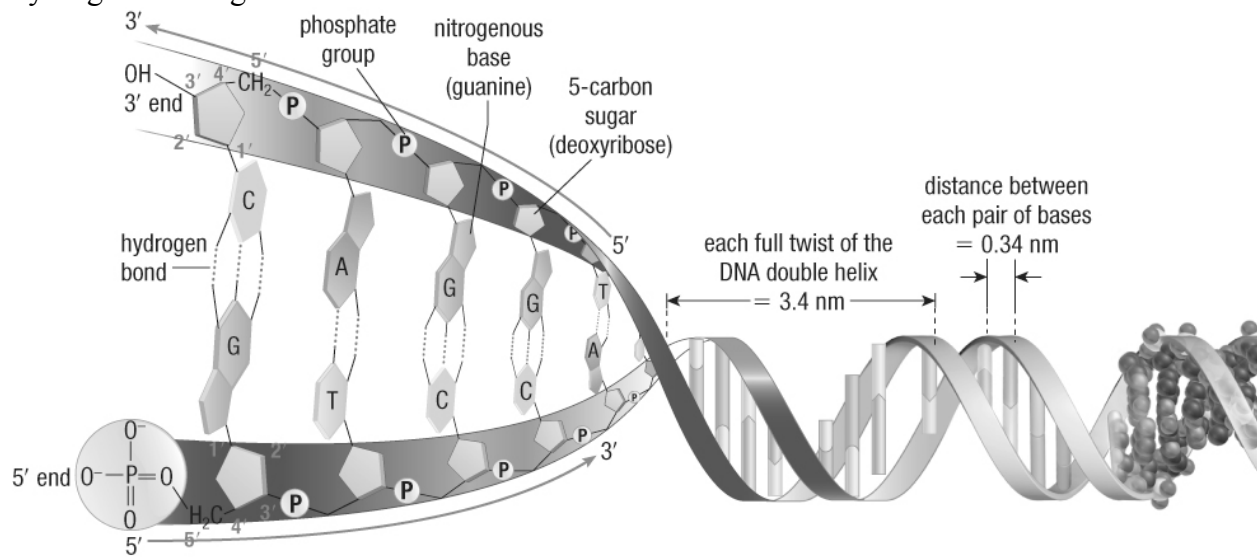
C. Answers may vary. Sample answer: Science is collaborative. Watson and Crick helped critique their peers' model for DNA and had access to unpublished data from Franklin and Wilkins that proved invaluable for revealing the size and shape of the molecule.

D. Answers may vary. Sample answer: Journals enhance the collaboration between scientists by allowing them to share data and discoveries.

E. Answers may vary. Sample answer: It is important for scientists to collaborate so knowledge can be developed faster and become more refined by others who are working in similar fields.

Section 6.2 Questions, page 279

1. If Hershey and Chase had found radioactive sulfur instead of phosphorus in infected bacteria cells they would have concluded that the protein coat of the bacteriophage was involved in the transformation of the *E. coli*.
2. The sample of DNA will contain 32 % thymine, 18 % guanine, and 18 % cytosine.
3. DNA is a polymer composed of a nucleotide monomer unit. Each nucleotide contains a phosphate group, a deoxyribose sugar, and a nitrogenous base. The phosphate group bonds to the neighbouring nucleotide's ribose sugar, and together they form the backbone of DNA. There are four nitrogenous bases in DNA. Two strands of DNA interact using hydrogen bonding between the nitrogenous bases such that adenine (A) pairs with thymine (T) and cytosine (C) pairs with guanine (G). DNA forms a double helix when two complementary strands combine with hydrogen bonding interactions.



4. The complementary strand for GTGACTAACAGTGGCCAT is CACTGATTGTCACCGGTA.
5. 1928: Griffith described transformation in bacteria.
1944: Avery, McLeod, and McCarty identified DNA as the most probable molecule of heredity.
1950: Chargaff discovered that bases always occurred in definite ratios, A:T and C:G.
1952: Hershey and Chase confirmed DNA as the molecule of heredity.
1952: Franklin and Wilkins used X-ray crystallography to show the shape of DNA.
1952: Watson and Crick determined the structure of DNA.
6. (a) Nitrogenous bases are ringed group of hydrocarbons that contain nitrogen. Nucleotides are the monomeric unit of DNA and contain a phosphate group, a deoxyribose sugar, and a nitrogenous base.
(b) Purines are a class of nitrogenous bases with a double ring structure; adenine and guanine are purines. Pyrimidines are a class of nitrogenous bases with a single ring structure; thymine and cytosine are pyrimidines.
(c) Bacteria are prokaryotic single-celled organisms. Bacteriophages are viruses that can infect and kill bacteria.
7. The bacteriophages require a host to reproduce. This allowed Hershey and Chase to culture bacteriophages that contained radioactive markers. The radioactive markers were used to observe the transformation process that occurs during bacteriophage infection.

8. (a) Avery, McLeod, and McCarty were hesitant to report their findings because at that time it was commonly believed that proteins acted as genetic material.

(b) Answers may vary. Sample answer: It is important for scientists to report their findings so that other scientists can build on the findings, create new ideas, and speed up scientific progress using the new knowledge.

9. Answers may vary. Sample answer: Watson and Crick can be considered scientists even though they did not actually conduct any experiments with DNA. They generated a new theoretical framework for DNA that advanced human knowledge.