

## ***The Race for the Double Helix (1987)***

Name: \_\_\_\_\_

*“Satisfaction comes not from knowing the solution, but from knowing why it’s the solution”*

### **Video Summary**

The film opens in 1951, when the young American biologist James D. Watson (1928- ), attending a conference in Italy, is jolted into active pursuit of the structure of DNA by an X-ray diffraction image of a DNA sample presented by the English biophysicist Maurice Wilkins. Since Wilkins's image reveals the regularity of a crystal, Watson is convinced that DNA might be analyzed by straightforward methods that have previously succeeded in solving the structure of other types of crystals. This conviction carries Watson to England, where the technique of X-ray crystallography is most advanced. However, since various attempts (including an introduction to Watson's sister) have failed to impress Wilkins, Watson does not join Wilkins at King's College, London, but instead goes to Cambridge University, where he teams up with Francis Crick (1916- ), another physicist who has turned his attention to problems in biology. The Cavendish Laboratory at Cambridge, where Watson and Crick work, is headed by Sir Lawrence Bragg (1890-1971), who shared a Nobel Prize in physics with his father in 1915 for their research in X-ray crystallography. The crucial steps in applying the technique of X-ray diffraction to DNA research, however, take place at King's College, London, through the expertise of Rosalind Franklin (1920-1958)-- an expertise she acquired through the study of coal. Although Franklin and Wilkins find it difficult to work together, the possibility of their collaboration heats up the race to discovery, as Watson and Crick see it. They are already worried that the American chemist Linus Pauling (1901-1994) is closing in on a solution.

By the first week of March 1953, Watson and Crick have won the race. In the model they construct that week, DNA (deoxyribonucleic acid) takes the shape of a spiral staircase (a "double helix," in geometrical terms), with the steps composed of pairs of molecules known as bases, and the formed by chains of sugar and phosphate molecules. Because the same types of bases always pair together (adenine with thymine, guanine with cytosine), one half of the DNA staircase (the sequence of bases attached to either sugar-phosphate chain) contains enough information to reproduce the entire structure (the basis for biological reproduction). Moreover, the sequence of bases along the sugar-phosphate chain makes up a code of genetic information. An alphabet of only four letters, A, T, G, C (the initial letters of the names of the bases), produces enough variations in genetic information to account for the great diversity of all living things, including human beings.

Although he did not win the race for the double helix, Linus Pauling won a Nobel Prize in chemistry in 1954 for his work on the nature of chemical bonding. In 1962 (the same year Pauling won the Nobel peace prize for his advocacy of nuclear weapons control), Watson, Crick and Wilkins shared the Nobel Prize in physiology or medicine for their work on the structure of DNA. Rosalind Franklin was not considered for that prize because the rules require that recipients be living at the time of the award, and Franklin had died four years earlier.

### **General Questions**

1. What was James Watson's primary motivation for studying nucleic acids?
2. Watson won a fellowship from the National Foundation for Infantile Paralysis as a result of very promising scholarship while completing a Ph.D at the University of Indiana. To what English university did he go to work after receiving this fellowship?
3. When being interviewed by the director, he decided to have Watson work with one of the older Ph.D. candidates, who was nicknamed the "bright hope". Who was that?
4. What did the director of the lab mean when he said that he hoped Watson's new research partner "would fulfill his early promise before he gets late"?
5. Rosalind Franklin was changing jobs just about the time Watson was meeting his new research partner. At what college did she go to start this new research job?

6. How did Watson get Rosalind Franklin's data on DNA?
7. Why weren't Watson and Crick successful at building the first model?
8. How did the director of Watson's lab view Watson and his partner's research attempt on DNA?
9. One of the critical segments of evidence was obtained when Watson and his partner attended a formal dinner party (*not* the costume party). Who did they meet at the party and what was the evidence that he told them?
10. Why were Watson and Crick in such a hurry to complete the second model?
11. Who was Linus Pauling and what was wrong with his DNA model?
12. A look at one of Franklin's pictures provided the team with the necessary information about the number of bases and the angle of the molecules. Explain how this information was obtained.
13. Crick provided the insight about the direction of travel in each DNA chain. Explain what he said about this.
14. Which member of the team figured out how the bases attach to the deoxyribose sugars?
17. When they had all the pieces of the puzzle, they celebrated by going to a nearby pub. (February 27, 1953) What did they tell the other patrons that they had discovered?
18. It took Watson and Crick about a month to build the second model. The paper was submitted to Nature on April 4, and was published April 23. How much actual lab research had Watson and his teammate done to complete the model?
19. What did Crick mean when he said, about the DNA molecule, "It never dies, Jim" near the end of the film?

20. When was the Nobel Prize awarded? Why wasn't Franklin awarded a share of the Nobel Prize?

21. What did you learn from the movie that you didn't previously know?

## Reflective Write

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Write one to two paragraphs expressing and explaining your thoughts and opinions about the story of the discovery of the structure of DNA as presented in the video. Address ONE of the following questions.

1. Sir Lawrence Bragg, Director of the laboratory in which they were employed, did not want Watson and Crick "fishing in other people's ponds" by working on the structure of DNA.. To what extent is science territorial, and to what extent is such territoriality: beneficial or harmful; necessary or unnecessary; ethical or unethical?
2. Watson and Crick clearly made use of the ideas and results of other scientists in pursuing their goal, including those of Linus Pauling, Erwin Chargaff and Rosalind Franklin. This is, of course, a commonly accepted practice. What was it, then, that leads some to suggest that Franklin had been treated unethically as a result of the use of her findings in the construction of the Watson-Crick DNA model? Were Pauling's and Chargaff's scientific conclusions or predictions also appropriated improperly?
3. Franklin's approach to the DNA problem was painstaking and methodical. She clearly eschewed guesswork. Watson and Crick, on the other hand, did no labor intensive experiments, ventured many guesses about the DNA structure based upon the results of other scientists, and finally triumphed because this informed speculation allowed them to build a model that uniquely conformed to all the known properties of the molecule. Is there anything inherently unethical or of questionable values in the less conventional approach of Watson and Crick?
4. It is clear that in the 1950s Watson held the very chauvanistic and derogatory attitudes toward women that were common among male scientists in that era. Does Watson's attitude result in his devaluing of Franklin's research?
5. To what extent do the social values that Franklin had to confront justify her reluctance to engage in discussions about her research progress with her male colleagues?
6. Credit for a scientific discovery is generally awarded to the person(s) who first publishes the finding. Do you see any ethical problems with this?
7. If you were going to be a scientist, which of these researchers would you choose to be like and why?