

## Discoverers of DNA

1. 8 marks

Scientist	Their work	Their collaboration
<b>James Watson</b> <b>Francis Crick</b>	<ul style="list-style-type: none"> <li>- Gathered all available evidence from research in other laboratories and existing information on DNA</li> <li>- They examined and scrutinised the evidence and questioned the findings of other scientists.                             <ul style="list-style-type: none"> <li>- Todd's findings that the backbone of DNA contained repeating phosphate and deoxyribose groups</li> <li>- Chargaff's rule about the bases of DNA</li> <li>- Used Franklin's x-ray crystallography diffraction pattern to recognise the double helical nature of DNA</li> </ul> </li> <li>- Watson and Crick processed this information, discussed it and manipulated many models.</li> <li>- They discovered the structure of DNA, building a 3D model of the double helical structure consisting of a backbone of phosphate and deoxyribose which were maintained by complementary bases pairs held together by hydrogen bonds.</li> </ul>	<ul style="list-style-type: none"> <li>- They worked to solve the problem and find the structure of DNA together</li> <li>- They communicated well with each other and other scientists</li> </ul>
<b>Maurice Wilkins</b>	<ul style="list-style-type: none"> <li>- Produced crystalline organic molecules by x-ray crystallography</li> <li>- He presented his findings on the x-ray crystallography of DNA at a conference on molecular biology</li> </ul>	<ul style="list-style-type: none"> <li>- Worked alongside Franklin but didn't get along well</li> <li>- Showed Watson and Crick an x-ray crystallography picture which Franklin had produced without her knowledge</li> </ul>
<b>Rosalind Franklin</b>	<ul style="list-style-type: none"> <li>- Performed experiments using the relatively new technique of x-ray crystallography</li> <li>- Took an image of the x-ray diffraction pattern from crystalline DNA from which accurate measurements could be obtained</li> </ul>	<ul style="list-style-type: none"> <li>- Her research followed on from Wilkins' work on DNA while he moved on to work on proteins.</li> </ul>

	- She was able to separate the two different “hydration forms” of DNA which allowed her to produce clear and precise diffraction pictures	- When he took up his work on DNA again, he treated Franklin below him
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**2. What evidence did Rosalind Franklin and Maurice Wilkins provide and how did this contribute to Watson and Crick’s model? 2 marks**

Franklin and Wilkins produced crystalline organic molecules for examination by x-ray crystallography. Wilkins provided Franklin with some of the best DNA samples which allowed her to produce clear x-ray diffraction pictures. X-ray crystallography was used to determine the shape of the DNA molecule. Crick identified the double helical nature of the molecule using Franklin’s photographs.

**3. Adenine (A), thymine (T), guanine (G) and cytosine (C) are bases found in DNA. ‘Chargaff’s rules’ were the result of the researcher Erwin Chargaff noticing that there was a pattern in the amounts of the four bases in DNA. 3 marks**

**a. What pattern did Chargaff notice in the amount of the four bases in DNA?**

Chargaff found that the amount of DNA and its four bases varied from species to species but noticed that the percentages of guanine and cytosine are nearly identical and the percentages of adenine and thymine are likewise almost identical.

**b. How did this information help Watson and Crick?**

Chargaff’s findings caused Watson to realise that the bases came in pairs. Since A and T were present in equal amounts and C and G were present in equal amounts, he figured that they must pair up with each other. If this occurred, he observed that Chargaff’s rules applied and the pairs could be neatly fitted between the backbone of DNA. The pairing of the bases also provided a mechanism for DNA to self replicate.

**4. Discuss the quality of collaboration and communication between Watson, Crick, Franklin and Wilkins. 3 marks**

Watson and Crick worked well together, collecting as much information as they could and working together to discuss and manipulate models of DNA. they communicated well as a team as well as with other scientists to gain as much information as they could.

Franklin and Wilkins worked alongside each other but did not get along well. Wilkins saw himself above Franklin and she was excluded from scientific discussions among the staff at dinners. There was a lack of communication between the two especially because Franklin was a female in the male dominated scientific institute.

After seeing Franklin’s x-ray crystallography photographs, Watson produced his first model with Crick. Franklin told them that they had not interpreted her photographs correctly and continued with her own work alone. Later, Wilkins showed Watson a high quality picture that

Franklin had recently produced without her knowledge or permission. Watson showed Crick and the pair worked together to model the structure of DNA.

Communication between the scientists was strong as they collaborated well together. Franklin however, was excluded from this communication and her work was used without her knowledge to the success of Watson, Crick and Wilkin who won a Nobel prize.

**5. Consider the statement: ‘Watson and Crick could not have unravelled the mysteries of DNA without the contributions of others.’**

**Do you agree or disagree with this statement? Give TWO reasons.** 2 marks

Agree: Watson and Crick would not have discovered the structure of DNA without the contributions of many other scientists. They gathered all available evidence they could from research in other laboratories and existing information on DNA, examining and scrutinising the evidence and questioning the findings of other scientists.

They used Todd’s findings that the backbone of DNA contained repeating phosphate and deoxyribose groups. To determine the positioning and pairing of the bases, they used Chargaff’s rule findings. Franklin’s x-ray crystallography diffraction patterns allowed them to recognise the double helical nature of DNA. Watson and Crick processed this information, discussed it and manipulated many models until they discovered the correct structure of DNA.