Imagine you are at a meeting at Cambridge University, it could be in the Eagle pub.

- Which aspects of the nature of science did the scientists follow?
- Did anyone do anything wrong?
- Can we be friends?

Rosalind Franklin

**Introduction:** Rosalind Franklin was an English chemist born in London. After an early career working on porosity in coal, she then learned x-ray crystallography working in Paris. She later worked on the DNA molecule from 1951 until 1953 in Kings College London.

Using x-ray crystallography she took photographs of the B version of the molecule.

**Conflict:** A co-worker of Rosalind Franklin, Maurice Wilkins showed Franklin's photographs of DNA to James Watson, without permission of Franklin.

Watson and his research partner, Francis Crick, were working independently on the structure of DNA, and Watson realized that these photographs were the scientific evidence they needed to prove that the DNA molecule was a double-stranded helix.

**Resolution:** Crick said later that Franklin had been "only two steps away" from the solution to the structure of DNA, herself.

**Nature of Science:** 1.8

The importance of evidence is a fundamental common understanding in science.

Evidence can be obtained by observation or experiment.

It can be gathered by human senses, primarily sight, but much modern science is carried out using instrumentation and sensors that can gather information remotely and automatically in areas that are too small, or too far away, or otherwise beyond human sense perception.

Improved instrumentation and new technology have often been the drivers for new discoveries.

X-ray crystallography was a new method of taking images of biological molecules.

Observations and evidence from Rosalind Franklin’s experiments showed that the DNA molecule was a double helix. (and not a triple helix)
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Francis crick

**Introduction:** was an English molecular biologist, most noted for being a co-discoverer of the structure of the DNA molecule in 1953 with James Watson.

During the period of Crick's study of X-ray diffraction, researchers in the Cambridge lab were attempting to determine the stable helical shape in proteins (the Alpha helix).

Francis Crick, with Watson, and Maurice Wilkins were jointly awarded the 1962 Nobel Prize for Physiology or Medicine "for their discoveries concerning the molecular structure of nucleic acids and its significance for information transfer in living material".

They were helped by Rosalind Franklin's understanding of basic chemistry, which indicated that the hydrophilic phosphate-containing backbones of the nucleotide chains of DNA should be on the outside of the molecule while the hydrophobic bases should be packed into the core.

Franklin shared this chemical knowledge with Watson and Crick when she pointed out to them that their first model (from 1951, with the phosphates inside) was obviously wrong.

**Conflict:**

He knew he would not have achieved the discovery of DNA structure had it not been for the X-ray crystallography work of Rosalind Franklyn.

Crick described what he saw as the failure of Maurice Wilkins and Rosalind Franklin to cooperate and work towards finding a molecular model of DNA as a major reason why he and Watson attempted to do so.

Watson and Crick made use of information from unpublished X-ray diffraction images of Franklin's (shown at meetings and freely shared by Wilkins),

**Resolution:**

In 1990 Crick stated that without the chance to collaborate with Watson, he would not have found the structure of DNA by himself.

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Nature of Science

4.1. Science is highly collaborative and the scientific community is composed of people working in science, engineering and technology.

It is common to work in teams from many disciplines so that different areas of expertise and specializations can contribute to a common goal that is beyond one scientific field.
James Watson
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James Watson

Introduction:

An American molecular biologist, geneticist and zoologist, best known as one of the co-discoverers of the structure of DNA in 1953 with Francis Crick.

In 1952, Watson performed X-ray diffraction on tobacco mosaic virus and found results indicating that it had helical structure

Conflict:

James Watson, with Frances Crick and Maurice Wilkins were jointly awarded the 1962 Nobel Prize for Physiology or Medicine "for their discoveries concerning the molecular structure of nucleic acids (DNA)". Roselyn Franklin had died two years earlier.

They were helped by Rosalind Franklin's understanding of basic chemistry, which indicated that the hydrophilic phosphate-containing backbones of the nucleotide chains of DNA should be on the outside of the molecule

Franklin pointed out that their first model of DNA (from 1951, with the phosphates inside) was obviously wrong.

Resolution:

Watson and Crick had offered co authorship with Kings College who had declined.

It is common practice to share information between scientists in different universities at conferences and in published findings;

- NOS

  4.3. Scientists collaborate and exchange results.

  Scientists often work on a daily basis in collaborative groups on a small and large scale.

  Sometimes they collaborate in laboratories, across organizations and in different countries.

  In the 21st century this is facilitated by modern communications and the internet.

  Examples of large-scale collaboration include:

  - Research into the functioning of memory.
  - The Human Genome Project (HGP), which was an international scientific research project set up to map the human genome.
  - The IPCC (Intergovernmental Panel on Climate Change), they produce reports summarizing the work of many more scientists from all around the world.
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Maurice Wilkins

Introduction:

He was a New Zealand born Physicist and molecular biologist.

He studied the orientation of purine and pyrimidine bases in tobacco mosaic virus and in nucleic acids.

Conflict

He also studied X-ray diffraction studies of DNA and sperm heads at Kinks College London. He might have worked with Rosalind Franklyn had it not been some confusion, which resulted in him being asked to stop working on DNA.

In 1953 Franklin instructed Raymond Gosling to give Wilkins, without condition, a high quality image of "B" form DNA which she had unexpectedly produced months earlier but had “put it aside” to concentrate on other work.

Wilkins later showed James Watson this X-ray photograph of B-DNA without asking Franklyn’s consent. He had been given the photograph by Rosalind Franklin’s Ph.D. student Raymond Gosling.

These x-ray diffraction patterns led to Watson and Crick working out of the molecular structure of DNA.

Resolution:

Wilkins was offered co-authorship of the 1953 paper, but he declined.

He undertook further X-ray studies which established the correctness of the Watson-Crick proposal for DNA structure.

NOS 4.5

There are ethical and political implications of science research.

There are also questions involving intellectual property rights and the free exchange of information that may impact significantly on a society.

Science is undertaken in universities, commercial companies, government organizations, defence agencies and international organizations.

Questions of patents and intellectual property rights arise when work is done in a protected environment or by a private organisation.