

6 *A Feeling for the Organism*

The Life and Work of Barbara McClintock

—*Evelyn Fox Keller*

Synopsis

A Feeling for the Organism is the biography of Barbara McClintock, a Nobel Prize-winning geneticist. She lived a secluded, independent, eccentric life, and because of her unique personality and style, she had a brilliant and productive career.

At a time when few women even went to college, McClintock received her Ph.D. in botany from Cornell University in 1927. Following her formal education, she became a research scientist, exploring genetics by working with maize.

Scientific research was making tremendous progress in the field of genetics and McClintock's research led her to the understanding of transposition of genetic elements. However, she was ahead of her time and her thorough presentation of the concept was not well received by the scientific community in the 1950s. Many of her colleagues found her ideas and explanations too elusive to grasp until more specific gene-programming work was done by other scientists in the area of molecular biology.

Throughout her career, she encountered opposition as a woman and as an individual thinker in science. Her scientific style, an extension of her personality, produced a body of research that reflected her "feeling for the organism." The Nobel Prize, research grants, and public recognition came late in her career. Despite the early lack of such tangible rewards, she never wavered from the absorption, or identification, that she felt for her genetic research material.

Student Focus

Reading this biography will help you understand Barbara McClintock as a person and as a scientist. The genetic findings of McClintock and her colleagues were far ahead of McClintock's time and beyond the understanding of her fellow scientists. How did this affect McClintock personally? How did McClintock's scientific style and methodology affect her work?

Correlation to Subject Matter

Genetics, Cytology, Molecular Biology, Embryology, and Evolution

Analyzing the Book

Identifying Facts

1. What organism did Barbara McClintock use to conduct her genetics investigations? What was her methodology?

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2. Describe the problem that McClintock suggested Harriet Creighton solve. How did her findings correspond to what was discovered with *Drosophila*?

[illegible]

A Feeling for the Organism Date _____ Class _____

3. In the early 1930s, what similarities did McClintock and her colleagues find in the genes of plants and animals?

4. X rays produce mutagenic effects. What did X rays allow McClintock to determine about the chromosomes of maize?

5. Describe the relationship between embryology and genetics. Why was it important for scientists in the 1930s to integrate the two fields?

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6. To what did McClintock equate the gene? How did her view differ from the views of other scientists?

7. What impact did World War II have on scientific research? How did the war affect McClintock's work?

8. Transposition is controlled breakage, or dissociation, in the chromosome. What was McClintock's initial conclusion about transposition? What did she still need to determine?

9. What was the scientific community's reaction to McClintock's findings about transposition? What were some reasons for this reaction?

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Date _____

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10. What advantage did *Drosophila* have over maize in gene studies? What advantage did bacteria have over both *Drosophila* and maize in gene studies? What were the limitations to using bacteria?

11. Watson and Crick's discovery of the molecular structure of DNA was a revolution for genetics. What answers did it provide?

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- 12.** How did the attitude and methodology of molecular biologists change the study of genetics and cytology?

- 13.** How did McClintock's individual methodology differ from that of other molecular biologists? What effect did this have on her ability to communicate the findings of her research?

- 14.** What genetic rearrangements did molecular biologists identify that corresponded to the rearrangements McClintock had identified as a consequence of transposition in maize?

- 15.** How did McClintock's experiences as a child and as a college student affect her lifelong work?

**Interpreting
Meanings**

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Date _____ Class _____

- 16.** Three major research areas of 20th-century biology are heredity, development, and evolution. How did the relationship between these areas change?

- 17.** How did scientists reconcile genetics and evolution?

- 18.** What did McClintock mean by “understanding” the entire organism and her “feeling for the organism”?

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- 19.** Why did McClintock's thorough research techniques complement her "feeling for the organism"?

- 20.** Describe the correlation between McClintock's scientific work and the work of an artist.

- 21.** The central dogma, as put forth by Francis Crick, stated that "once [genetic] 'information' has passed into protein, it cannot get out again." What modifications did Jacques Monod and François Jacob make to the central dogma to account for protein variability?

- 22.** Describe the process by which DNA dictates the construction of a particular protein.

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23. Why was McClintock opposed to the use of models as scientific methodology?

24. Why did McClintock's "feeling for the organism" make it possible for her to achieve success in her scientific research?

Applying Meanings

25. Explain how genetic elements, known as transposons, jumping genes, or insertion elements, affect organisms.

Writing About the Book

On a separate sheet of paper, write the answers to each of the following.

Extending the Story

1. McClintock was convinced that there are valid ways of "knowing" other than those conventionally advocated by science. Imagine that you are a scientist 50 years from now and that applied science has taken McClintock's approach. Write a short narrative that describes McClintock's historical contribution to science.

Thinking About Assumptions

2. Once McClintock had arrived at her understanding and conclusions about transposition, she was frustrated by her colleagues' seeming lack of knowledge, which she attributed to "tacit assumptions." Explain how tacit assumptions impede scientific understanding and progress.

Responding to a Social Attitude

3. Barbara McClintock was frequently confronted with difficulties caused by the social attitude toward women in science that prevailed during her lifetime. Write an essay in which you react to this issue. Do you think she handled her circumstances well? Was there anything she could or should have done differently? Use references to support your answer.

Evaluating Characters

4. *Brilliant*, *remarkable*, and *genius* are just some of the words that have been used to describe Barbara McClintock. At times, some of her colleagues also described her as *eccentric*, *crazy*, and *mad*. Explain how all of these descriptions apply to McClintock. Why did her personality make her such a great scientist?

Writing a Letter

5. Imagine that you are Barbara McClintock and that you have just presented your work at Cold Spring Harbor for the third time. Write a letter to a trusted colleague and friend. Explain why you are certain your methodology and results are accurate and important, and describe how you feel.

Analyzing Scientific Methodology

6. Compare and contrast McClintock's methodology with that of traditional scientists. If you were Barbara McClintock, would you attempt to explain your methodology to your colleagues?

Testing on the Book

On a separate sheet of paper, write the answers to each of the following.

Critical Thinking and Writing

1. The early part of McClintock's career was marked by success in her findings and presentations concerning maize chromosomes. Cite examples of her success.
2. Transposition explains the elements that control or regulate rearrangement of genes. Describe McClintock's initial process for concluding that "jumping genes" and exhibited mutations were correlated.
3. During McClintock's lifetime, the study of genetics changed dramatically. Write an overview or outline of genetics in the 20th century.
4. Molecular biology ultimately provided the information that corroborated and explained McClintock's findings. Explain why this was so. Why was McClintock unable to achieve this on her own?
5. McClintock's unique approach to observation and gaining a "feeling for the organism" contributed to her research success. Cite specific examples of her personal and scientific style that aided her scientific study.