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The Double Helix

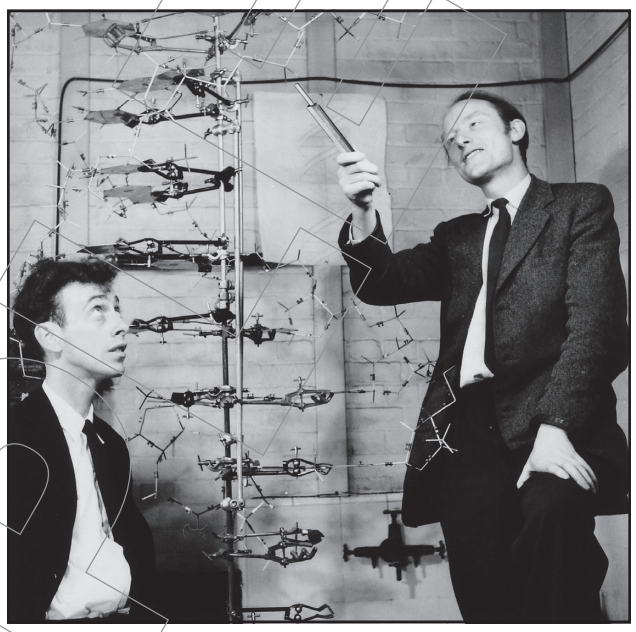
Everyone today is familiar with the three letters DNA. They stand for the stuff of genes, the molecule that contains the code of life on Earth. What is DNA, and how did science discover its importance?

In 1879, scientists first observed the union of animal egg and sperm cells. The roles of female and male in reproduction were finally understood. But where did genes come in? Mendel's experiments had shown there were inherited "factors," or genes. But what were they? How did they work? By the early 1900s, scientists were trying to discover the chemistry behind Mendel's experiments. They guessed that heredity had something to do with chromosomes because of how the structures behave when cells divide.

In 1869, a Swiss physician had discovered nucleic acid in cells. But its connection to genes wasn't then known. By 1915, it was known that genes were lined up on chromosomes. In the 1920s, the basic chemical structure of deoxyribonucleic acid, or DNA, was understood. By 1952, experiments confirmed that the giant DNA molecule carries genetic information. It was also understood that each gene made a specific protein, but the question was how?

The answer came in 1953. James Watson, an American, and Francis Crick, an English scientist, made the discovery. They were helped greatly by the earlier work of their English **colleague,** Rosalind Franklin. DNA turns out to be shaped like a spiral staircase—in terms of geometry, a double helix. Two chains are held together by the "steps," which are made of pairs of chemical compounds called bases.

A gene is a sequence of base pairs in this long chain. Each gene contains instructions to make a particular protein. Each protein has a specific purpose in the organism. There are



only four bases, known by the letters A, T, C, and G, but they are enough to code every life process in every living thing. It's just as the digits 0 through 9 can combine to make all possible numbers.

The entire DNA chain, or genome, is stored in the chromosomes like data in a computer. Its sequence determines whether a living thing is a mushroom or a fly, a pea plant or a person, Jane Smith or Yao Ming.

When cells divide, the double chain unwinds. The bonds connecting the bases break, and the bases on each side link up with bases floating in the cell. A only links with T, and C with G. Linked together, they form a new DNA molecule. It's an exact duplicate of the first. Sex cells (eggs and sperm) contain half of a parent's DNA. When they combine, the new individual has its own genome, half from each parent.

DNA has been called the most important scientific discovery of the last hundred years. What science does with it may be the most important question of the next hundred.

Lesson 19

The Double Helix

DNA—three letters that name one of the most important molecules on Earth. The molecule contains the genetic code for living things, the instructions for creating life. But what exactly is it, and how was its importance discovered? As with most scientific discoveries, it involved many scientists and investigations along the way to solve the puzzle of its structure and function.

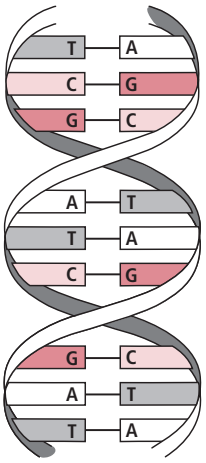
When scientists first observed the union of animal egg and sperm cells in 1879, they finally understood the roles of female and male in reproduction. But what part did Gregor Mendel's inherited "factors," or genes, play? His pea plant experiments had stimulated interest in genetics, and by the early 1900s, scientists were working to decipher the chemistry of heredity. They guessed that heredity was related to chromosomes, because of how the structures behave when cells divide.

Scientists in many different countries worked on this problem for years. In Switzerland in 1869, a physician had discovered nucleic acid. It was later found to be part of deoxyribonucleic acid, or DNA. But no one guessed that it was involved in genes. By 1915, scientists knew that genes were lined up on chromosomes. In the 1920s, the chemical components of DNA were deciphered. But it took until 1952 to demonstrate the connection between DNA and genetic information. Scientists now knew that DNA was made up of genes and also that each gene made a specific protein, but the question remained how this happened.

In 1953, James Watson and Francis Crick, building on the earlier work of their English **colleague,** Rosalind Franklin, made a discovery about DNA's structure that answered this question. It turned out that DNA was shaped like a spiral staircase. In geometry, this shape is known a double helix. Two chains are held together by the "steps," which are made of pairs of chemical compounds called bases.

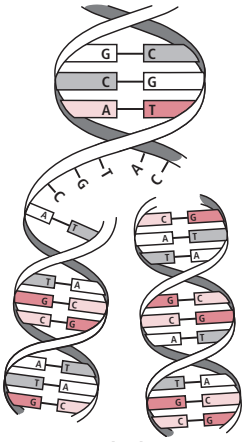
A gene is a sequence of base pairs in this long chain. Each gene contains instructions to make a particular protein, which has a specific purpose. There are only four bases, known by the letters A, T, C, and G, but they are enough to code every life process in every living thing. That's a lot like how we can use the digits 0 through 9 to represent all possible numbers.

The entire DNA chain, or genome, is a blueprint for building a living thing. It is stored in the chromosomes somewhat like data is stored in a computer. Its sequence determines whether a living thing is a mushroom or an octopus, a pea plant or a human being.



DNA molecule

During cell division, the double chain unwinds and the bonds connecting the bases break. The bases on each side link up with bases floating in the cell. A only links with T, and C with G. Linked together, they form a new DNA molecule. It's an exact duplicate of the first. Sex cells (eggs and sperm) contain half of a parent's DNA. They combine to create a new individual with its own genome, half from each parent.


DNA duplicating during cell division

DNA has been called the most important scientific discovery of the last hundred years. What science does with it may be the most important question of the next hundred.

Read each question. Circle the letter of the best answer.

1 Which of these scientists was not involved in the discovery of DNA?

A Gregor Mendel
B James Watson
C Francis Crick
D Rosalind Franklin

2 Which of these sentences expresses the main idea of the article?

A DNA is the molecule that contains the code of life on Earth.
B What is DNA and how did science discover its importance?
C DNA has been called the most important scientific discovery of the last hundred years.
D A gene is a sequence of bases in this long, twisted chain.

3 You can conclude that the "double helix" shape is important because ____.

A it explains how DNA can duplicate itself
B it's found in the chromosomes of cells
C it's found only in human beings
D it can't be seen through a microscope

4 Which of these events happened *first?*

A DNA was found to be a double helix.
B Genes were connected to chromosomes.
C DNA was known to carry genetic information.
D Nucleic acid was discovered in cells.

5 Which of these statements is an opinion?

A A Swiss physician discovered nucleic acid in cells.
B A gene is a sequence of bases that code a cell to make a particular protein.
C What a cell divides, a DNA molecule creates an exact duplicate of itself.
D DNA is the most important scientific discovery of the last hundred years.

6 Because each base links only with one other base, the sequence of base pairs ____.

A always break apart the same way
B is different every time it is made
C is made of free-floating bases
D is duplicated exactly

7 The word **colleague** means someone who ____.

A comes from the same country

B does the same kind of work

C has graduated from college

D copies one's work

Write your answer to each question on the lines.

8 Why is DNA considered such an important discovery?

9 Many scientists from many countries and over many years contributed to this important discovery. What aspect of the scientific method was instrumental in making this possible?