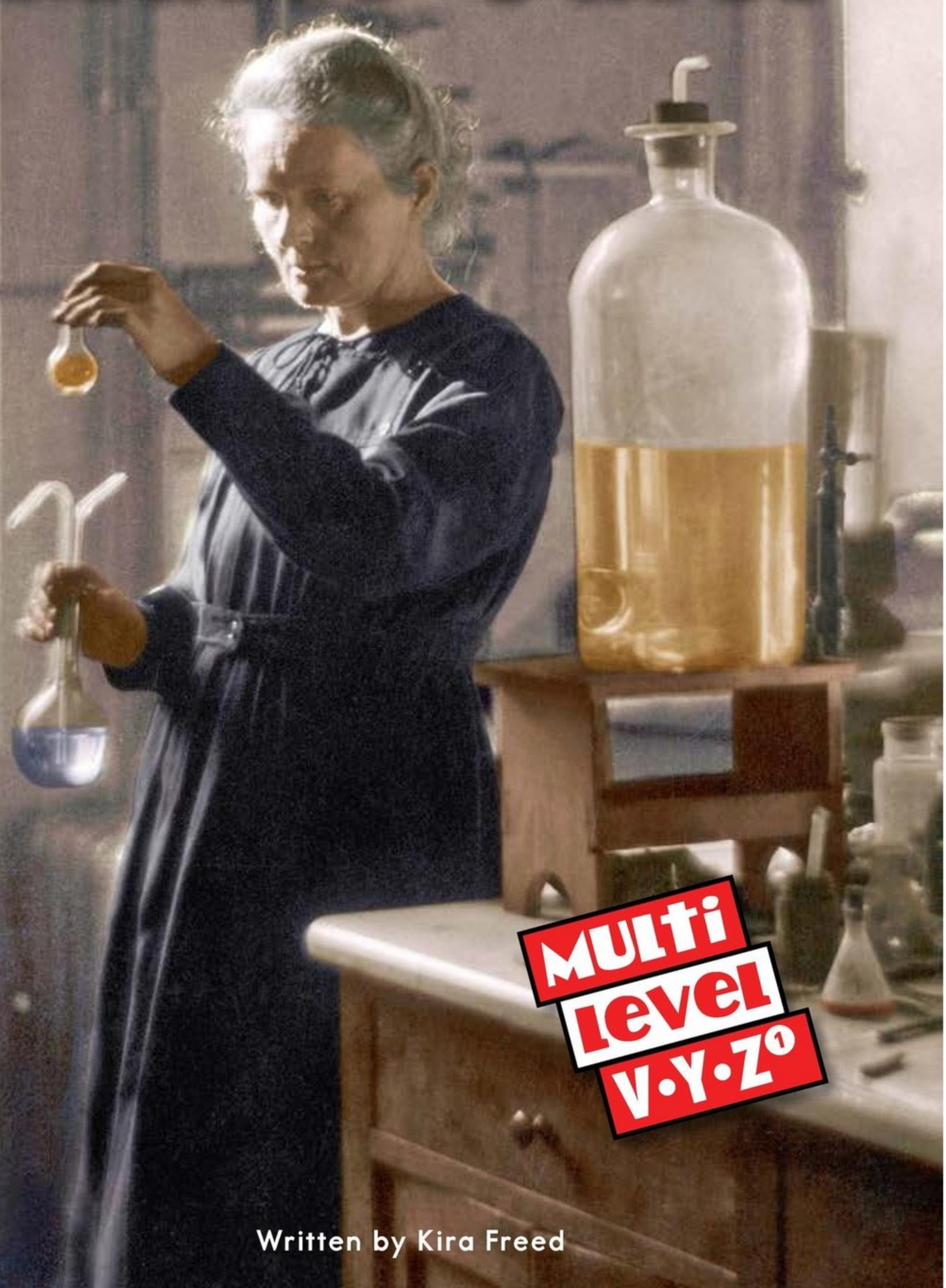


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# Marie Curie



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Written by Kira Freed

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# Marie Curie



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## Focus Question

Who was Marie Curie, and how did she change the world of science?

## Words to Know

anemia  
discrimination  
electrometer  
element  
hypothesized  
Nobel Prize

perseverance  
physics  
prestigious  
revolutionized  
Sorbonne  
X-rays

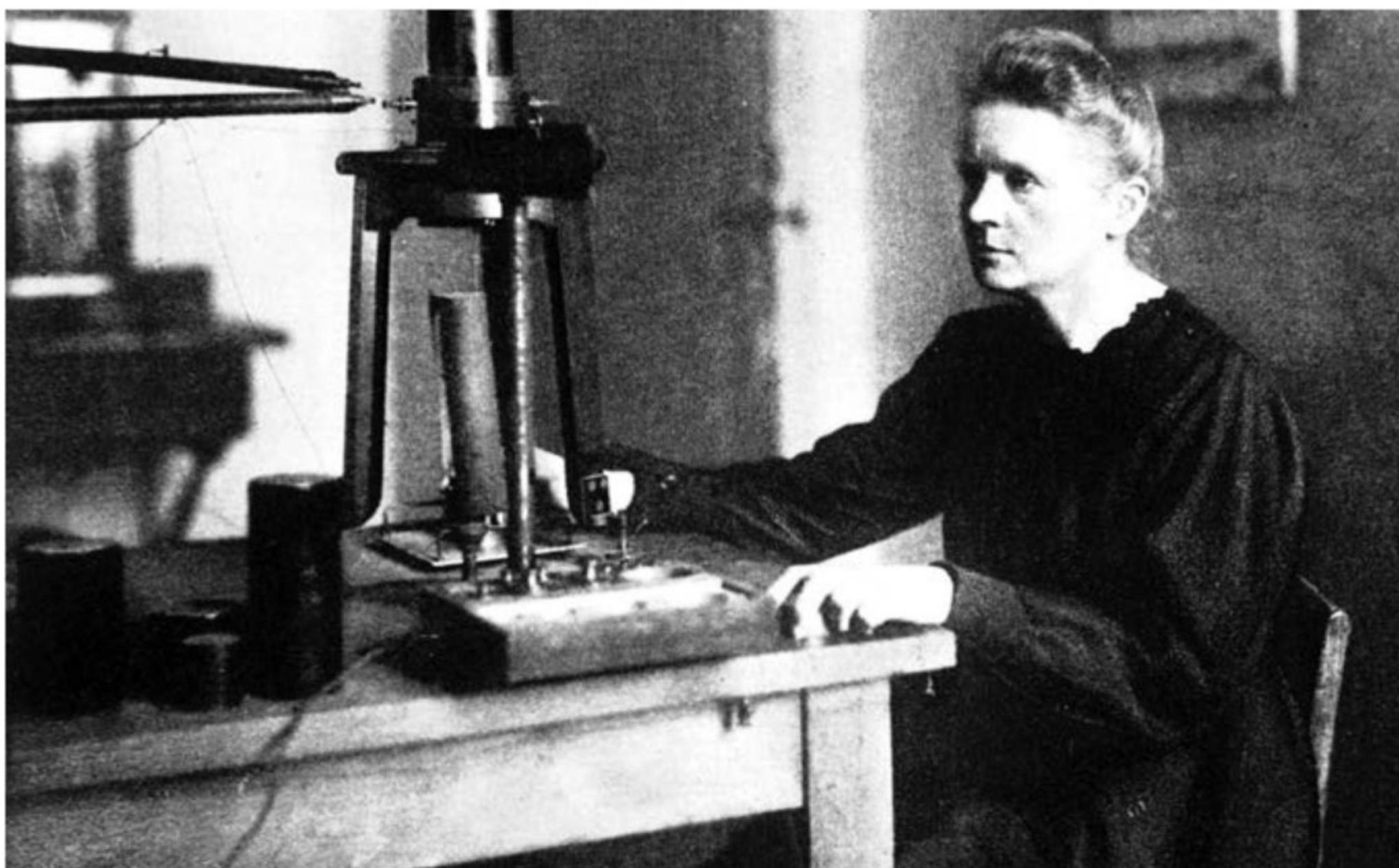
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### Correlation

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Fountas & Pinnell	Y-Z
Reading Recovery	N/A
DRA	70+



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Marie Curie's laboratory was packed with scientific instruments, some of which were invented by her husband, Pierre, and his brother, Jacques.

## Trailblazer

At a time when few women were scientists, one woman's research and discoveries changed the world. She left her homeland to study science and math at a leading university. She pursued her scientific interests even though the world seemed to put one obstacle after another in front of her. She became the first female **Nobel Prize** recipient and the only person ever awarded Nobel Prizes in two different scientific fields. This groundbreaking scientist was Marie Curie.

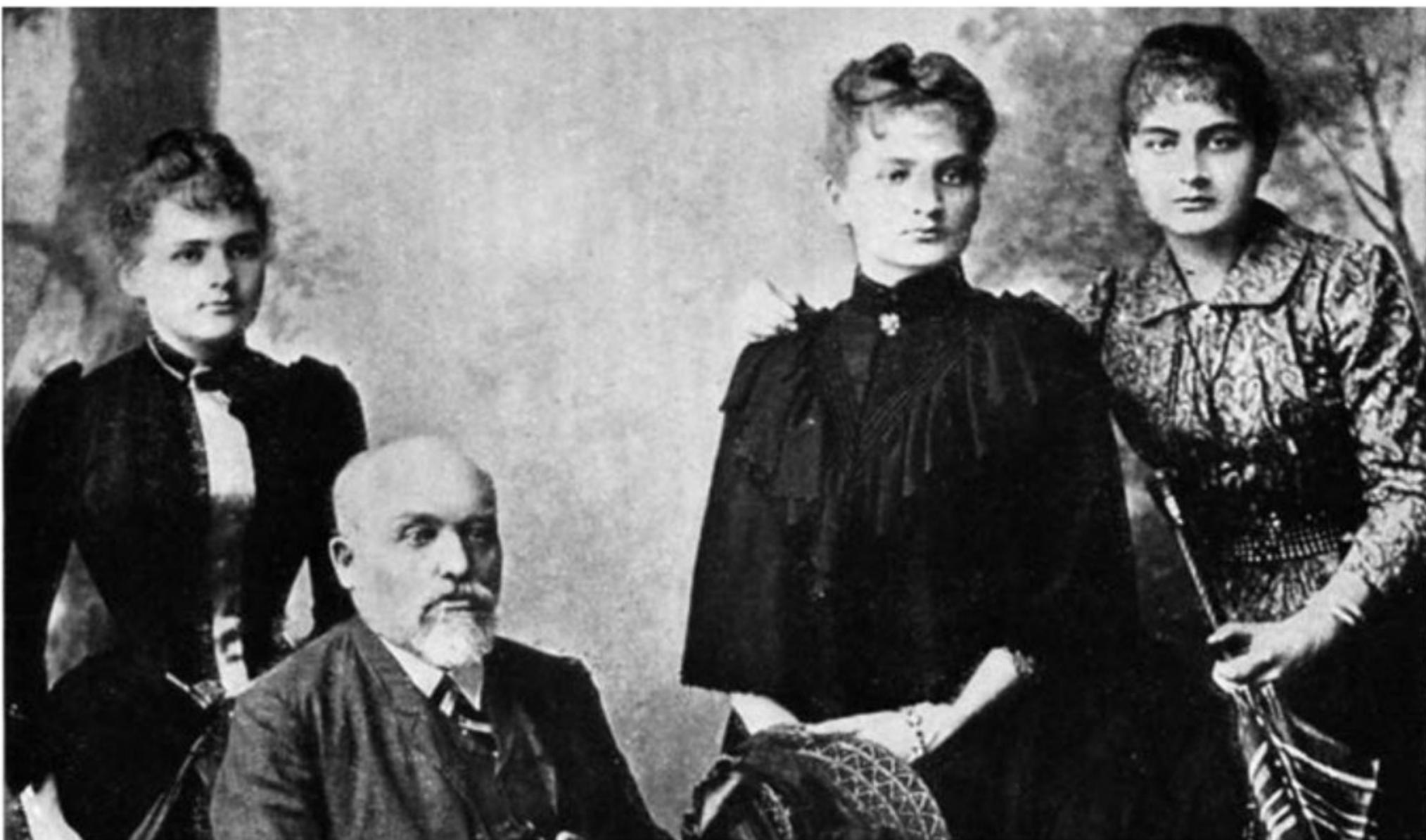


Marie Curie (center) sits for a photograph with her brother and sisters (left to right) Zosia, Hela, Joseph, and Bronya.

## Early Years

Marie Curie was born Maria Skłodowska on November 7, 1867, in Warsaw, Poland. She was called Manya as a child. Manya was the youngest of five children. Their mother had been headmistress of a school but resigned when Manya was born. Their father taught math and **physics** at a boys' high school.

When Manya was born, Poland was not an independent country; it had been divided up in 1815 after several wars, and parts of it belonged to Russia, Prussia, and Austria. The area where Manya's family lived was ruled by the Russian Empire, which attempted to eradicate the Polish national identity. Manya grew up in a climate of fear where showing loyalty to Poland or even simply speaking Polish could put people's lives in jeopardy.



Marie Curie (left) with her father and sisters Bronya and Hela as they appeared in a family photograph from the 1880s.

Manya's father lost his job as a teacher in 1873 because of his support for Polish independence. The family's economic situation declined, and they were eventually forced to take in boarders. In 1876, Manya's oldest sister, Zosia, died of typhus, a deadly bacterial infection. Manya's mother died two years later, when Manya was ten.

Manya's father provided an intellectually and emotionally nurturing environment for his children. He read classic literature to them and taught them about physics using equipment from his former teaching position. Manya was a bright, curious child and an outstanding student who learned physics and math with ease. She was awarded top honors when she graduated from high school at age fifteen in 1883.

## Patience and Preparation

Manya and her sister Bronya wanted to continue their education, but women could not attend the University of Warsaw. They would need to leave Poland but did not have enough money. As a result, the sisters attended Warsaw's "floating university"—free, illegal education offered by Polish teachers and intellectuals that took place in attics and basements around the city. Although the classes were no match for the finest European universities, they kept Manya current on scientific breakthroughs.

Both sisters wanted to attend the **Sorbonne** in Paris, but they had no money for tuition. They struck a deal: Manya would earn money for Bronya's education, and Bronya would return the favor after earning her degree. Manya worked as a tutor and governess for five years and studied literature, sociology, physics, chemistry, and

math in her free time. Through this work, she knew that math and physics were the right path for her. After helping her sister pay for her schooling, it was Manya's turn to attend.



The Sorbonne was, and still is, one of the finest universities in the world.

## Paris at Last

Manya moved to Paris in 1891 at age twenty-four and enrolled at the Sorbonne. She took the name Marie—the French version of Maria—at that time. After devoting herself to her studies for two years, she graduated first in her class with a master's degree in physics. The following year, she earned a second master's, in math.



Pierre Curie and Marie Skłodowska Curie as they appeared soon after they married.

Before completing her math degree, Marie received a commission to study the magnetic properties of different types of steel. She needed a laboratory because the research involved large equipment. In the spring of 1894, a colleague introduced her to Pierre Curie, a

physics professor who had done groundbreaking research on magnetism. As the laboratory chief at Paris's Municipal School of Industrial Physics and Chemistry, Pierre arranged for Marie to use some lab space.



Marie and Pierre had a simple wedding followed by a bicycle trip for their honeymoon.

Although Marie and Pierre's original connection was simply that of two scientists who respected each other's fine minds, their relationship deepened into love. They married in July 1895.

While Marie was busy with her research, she also earned a teaching certificate so she could teach science to young women. After completing her research, she decided to pursue a doctorate at the Sorbonne.

Marie and Pierre had a daughter, Irene, in 1897. Most mothers at that time were expected to stay home and care for their children, but Marie continued to be dedicated to her scientific pursuits. Pierre's father moved in and cared for Irene so Marie and Pierre could continue their work.

## Two Types of Rays

Marie needed to find a topic for her doctoral research. Two important discoveries had recently been made in the world of physics. In late 1895, Wilhelm Roentgen, a German physicist, discovered **X-rays**. Early the following year, French physicist Henri Becquerel discovered that the chemical **element** uranium also emitted rays, which were weaker than X-rays. Scientists were fascinated with X-rays and began studying them in depth. Marie decided to instead study uranium rays.

Marie was interested in studying the effect of uranium rays on air. Using a device known as an **electrometer**, she measured barely perceptible electric currents in air that had been blasted with uranium rays. Marie verified Becquerel's observations that uranium in any form emitted electricity and that more uranium emitted more intense rays. In addition, she **hypothesized**—and later proved—that the rays were an inherent property of uranium's structure rather than a product of its physical or chemical state.

Marie then became curious about whether uranium was the only element that made air conduct electricity better, so she tested every known element.

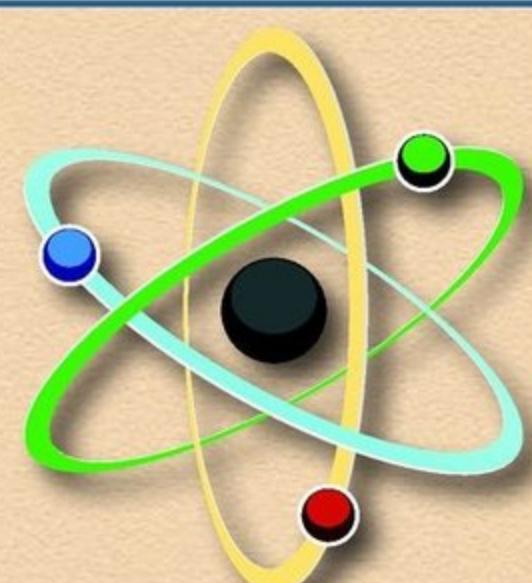
She discovered that thorium also emitted rays, and she coined the word *radioactivity* to refer to the emission of rays from an atom's nucleus, or center.

Marie continued to test various materials to see which ones emitted rays. When she tested a mineral called pitchblende, which contains uranium, she found that it gave off more rays than its uranium could account for. She concluded that pitchblende must contain a second radioactive element—one that was unknown.

Up to this point, Pierre Curie had been involved in his own research on crystals. In 1898, as Marie's work progressed, he set aside his research to assist her in studying radioactivity. The search for a new element was compelling for both of them. After extensive research, they discovered two new elements: polonium (named for Marie's homeland) and radium (from the Latin word for "ray").

## The Birth of Atomic Physics

Marie's discovery about uranium rays sparked a profound shift in scientific understanding that became the foundation of atomic physics. Scientists at the time thought that atoms could not be broken down into smaller units. Someone else discovered electrons at about the same time, but it was Marie who discovered that atoms store an immense amount of energy.





Marie Curie's research led to the invention of devices such as this linear accelerator, which uses a radioactive beam of energy to kill cancer cells.

Industrialists were fascinated by the Curies' discoveries. Radium gave out both light and heat, and it seemed to foretell the possibility of new inventions as well as scientific breakthroughs. In addition, Pierre demonstrated that radium's radioactivity could harm living flesh, which opened the doors to treatments for cancer and other illnesses. Industrial companies offered them lab space as well as raw materials and staff. Radioactive materials were extracted and used for medical and other purposes. Scientists conducted experiments on atoms and confirmed Marie's suspicion that atoms contained powerful energy.

## Health Concerns

Marie and Pierre were often ill while doing their research. It wasn't clear whether the cause was working too hard or radiation. Marie did not accept the idea that radiation was to blame, but today we know that it can cause illness and death.



Marie and Pierre worked closely together for many years.

## Achievements and Recognition

Marie earned her Doctor of Science in June 1903. She was the first woman in France to be awarded a doctorate and the first woman in all of Europe to be awarded a doctorate in science.

Despite Marie's leading role in the groundbreaking physics research she and Pierre conducted, she was almost bypassed for the Nobel Prize, one of the world's most **prestigious** awards, because she was a woman. Pierre Curie and Henri Becquerel were originally nominated for the 1903 Nobel Prize in Physics. A mathematician on the nominating committee who was a champion of female scientists notified Pierre of the situation. Pierre responded that it would be a grave injustice for Marie to be excluded from the award.

Marie's name was then added to the list of nominees, and she and Pierre won jointly, along with Becquerel, in December 1903. The award, which recognized their pioneering work on radiation, was the first Nobel Prize awarded to a woman.



The Curies instantly became internationally famous. Pierre received a promotion to professor at the Sorbonne, and Marie received a salary and became chief of laboratory. She was energized by the attention and new responsibilities. In addition to her research and a teaching position,

she enjoyed explaining her discoveries to the public.

The Curies had a second daughter, Eve, in 1904. Around the same time, the Sorbonne gave the Curies a new laboratory to work in.



The Curies finally moved to a laboratory with more space in 1904.

## Dark Times and More Acclaim

The Curies were riding high on their successes when tragedy struck. In 1906, Pierre was run over by a horse-drawn wagon while crossing a street and killed instantly. News of his death spread around the world. Marie was completely numb with shock but eventually found the will to go on.

Marie was offered Pierre's teaching position as Professor of General Physics at the Sorbonne. She was the first woman to become a Sorbonne professor. She hoped to honor Pierre's memory by creating a state-of-the-art lab.

Marie's textbook *A Treatise on Radioactivity* was published in 1910. She established an international standard for radium emissions, and the international scientific community recognized her contributions by naming the unit the Curie.

## Timeline of Marie Curie's Life

1867	Born in Warsaw, Poland, November 7	1903	Earns doctorate in physics; awarded Nobel Prize in Physics
1883	Graduates high school	1904	Daughter Eve is born
1891	Moves to Paris	1906	Pierre dies; becomes Sorbonne's first female professor
1893	Earns master's degree in physics	1911	Awarded Nobel Prize in Chemistry
1894	Earns master's degree in math	1914	Uses portable X-ray machines in World War I
1895	Marries Pierre Curie	1918	World War I ends; opens Radium Institute
1897	Studies Becquerel rays; daughter Irene is born	1934	Dies on July 4
1898	Discovers polonium and radium		

In late 1910, Marie offered herself as a candidate for a vacant physicist seat in the French Academy of Sciences. Her only serious competition was Edouard Branly, who had made scientific contributions to wireless telegraphy. Branly's supporters spread false rumors about Marie to lessen her chances of being chosen. Even though others defended her, Branly won the seat.

Marie was awarded a second Nobel Prize, this time in chemistry, in 1911 for her work in radioactivity and her discovery of radium and polonium. She was the first scientist to be awarded two Nobel Prizes and, to this day, is the only person to be awarded prizes in two different areas of science.



French soldiers gather around one of the mobile X-ray trucks using Marie Curie's equipment on October 31, 1914. The machines undoubtedly saved the lives of many wounded soldiers during World War I.

## On the Battlefield

World War I broke out in late July 1914, and Germany invaded France just a few days later. Most of Marie's staff left to fight in the war, and resources for scientific research were lacking. Marie looked for ways to put her science to work to help the war effort. She took up the cause of making portable X-ray machines available in the field for treating wounded soldiers. Throwing herself into her new project, Marie convinced wealthy people to donate their cars. She set up twenty mobile X-ray stations and two hundred fixed installations. Not content to just coordinate assistance, Marie learned how to use X-ray equipment and taught herself to drive so she could operate the portable X-ray machines herself.



Marie Curie (center) traveled by ship to New York to tour the United States with her daughters Irene and Eve in 1921.

## Later Life

After World War I ended, Marie worked tirelessly and successfully to turn the Sorbonne's Radium Institute into a world-class center for research on radioactivity.

Marie's daughter Irene and her husband were awarded the Nobel Prize in Chemistry in 1935. Sadly, Marie didn't live long enough to celebrate that achievement. We now know that radioactive substances are extremely dangerous, but that was not known during Marie's life. She died at age sixty-six on July 4, 1934, from a type of **anemia** that is often caused by prolonged radiation exposure. Marie was buried next to Pierre. In 1995, their remains were moved to the Panthéon in Paris, where France's most brilliant citizens are buried. Marie was the first and only woman to be buried there for her own achievements.

## Gifts to the World

Marie Curie's work **revolutionized** scientific understanding of the nature of atoms and opened up new frontiers in medicine. It also led to the discovery of radiocarbon dating, a way

to determine the age of ancient organic material. Marie showed that careful, purposeful scientific investigation can yield extraordinary breakthroughs.



As remarkable as Marie Curie's scientific contributions were, her legacy went beyond them. In the face of persistent **discrimination**, her

clear-sighted certainty about her purpose gave her an unwavering determination and gave the world an inspiring model. In her words: "Life is not easy for any of us. But what of that? We must have **perseverance** and above all confidence in ourselves. We must believe that we are gifted for something and that this thing must be attained."

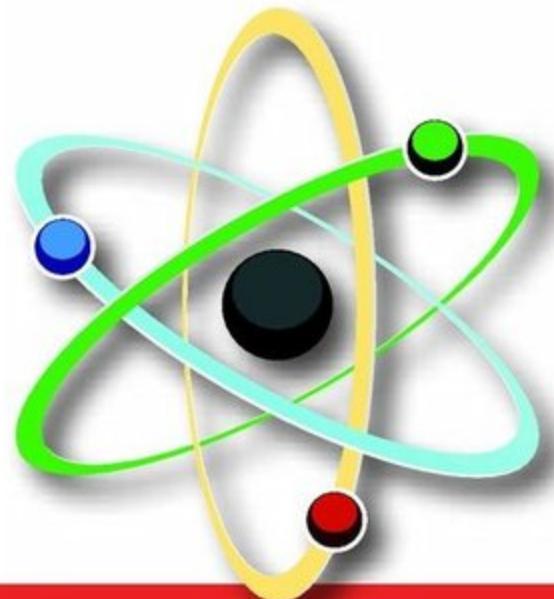
## Glossary

<b>anemia</b> ( <i>n.</i> )	a blood condition in which there are too few red blood cells (p. 18)
<b>discrimination</b> ( <i>n.</i> )	the unfair treatment of a person or group based on gender, race, age, religion, or other differences (p. 19)
<b>electrometer</b> ( <i>n.</i> )	a device used to detect differences in electric currents (p. 10)
<b>element</b> ( <i>n.</i> )	a substance that cannot be broken down into simpler substances and is made up of only one kind of atom (p. 10)
<b>hypothesized</b> ( <i>v.</i> )	formed a hypothesis; made an informed guess (p. 10)
<b>Nobel Prize</b> ( <i>n.</i> )	one of six prizes awarded each year for work in chemistry, economics, literature, medicine, or physics, or for advancing the cause of world peace (p. 4)
<b>perseverance</b> ( <i>n.</i> )	the quality of staying determined and committed despite challenge or delay (p. 19)
<b>physics</b> ( <i>n.</i> )	the scientific study of matter, motion, and energy (p. 5)
<b>prestigious</b> ( <i>adj.</i> )	honored, respected, or held in high standing (p. 13)
<b>revolutionized</b> ( <i>v.</i> )	made enormous changes (p. 19)
<b>Sorbonne</b> ( <i>n.</i> )	a university in Paris, France (p. 7)
<b>X-rays</b> ( <i>n.</i> )	invisible energy that can go through many solid substances (p. 10)

# Marie Curie

A Reading A-Z Level Z1 Leveled Book

Word Count: 1,969



## Connections

### Writing

How would our world be different without the work of Marie Curie? Write an essay highlighting her achievements and their impact on our world today.

### Social Studies

Research another woman who has won a Nobel Prize in science. Create a poster for your class, including biographical information about the scientist and her impact on science.

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