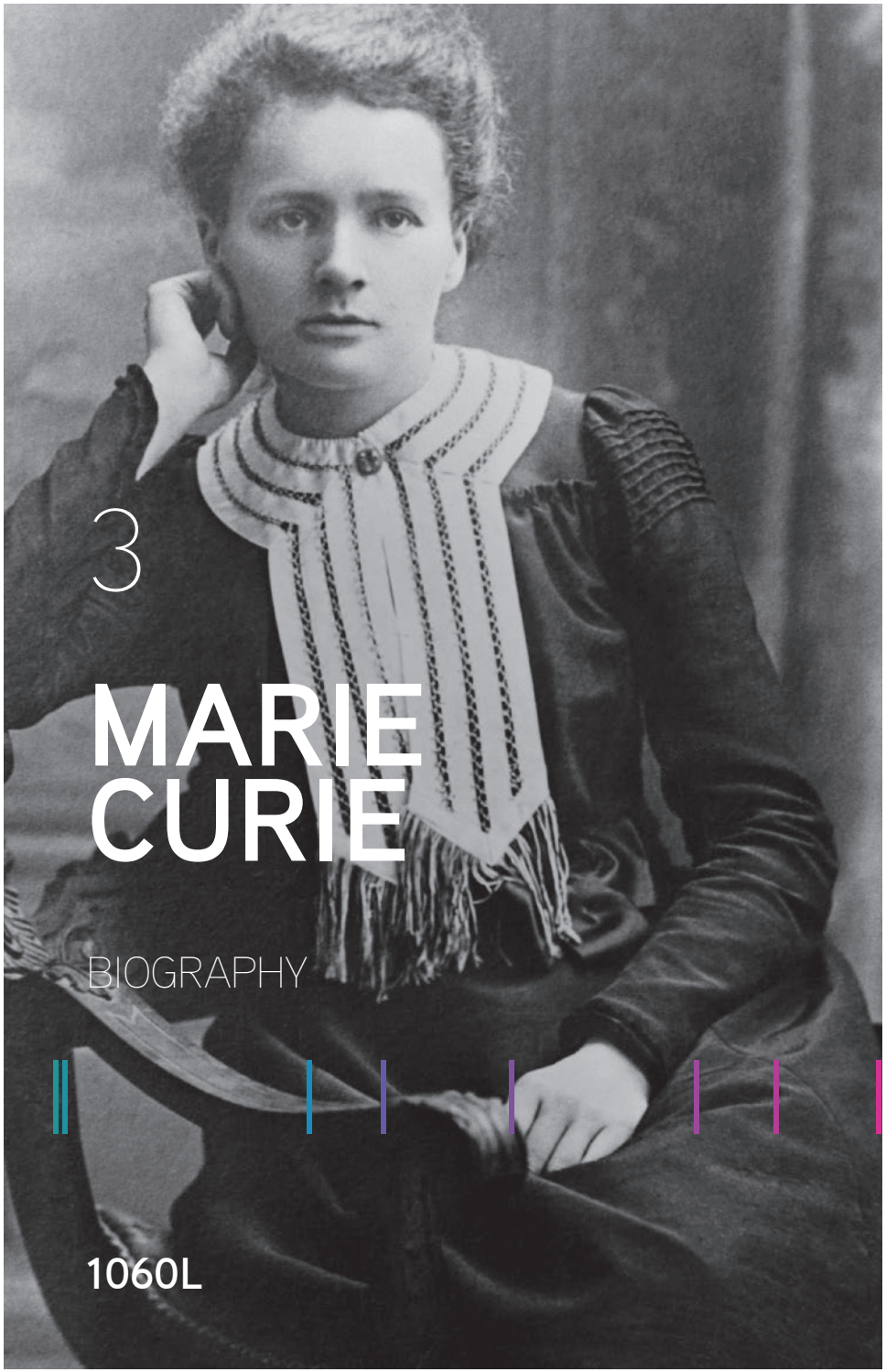


3

MARIE CURIE

BIOGRAPHY

BIG HISTORY PROJECT

1060L

Born
November 7, 1867
Warsaw, Poland

Died
July 4, 1934
Savoy, France

MARIE CURIE

CHEMISTRY, PHYSICS & RADIOACTIVITY

By Michelle Feder

In 1897, using a makeshift workspace, Marie Curie began a series of experiments that would pioneer the science of radioactivity, change the world of medicine, and increase our understanding of the structure of the atom.

Early life and overcoming obstacles

Marie Curie became famous for the work she did in Paris. But she was born in Warsaw, Poland, in 1867, as Maria Sklodowska. She was the youngest of five children, and both of her parents were educators: Her father taught math and physics, and her mother was headmistress of a private school for girls. Circumstances changed for Maria's family the year she turned 10. Her mother died, and her father lost his job. Her father rented bedrooms to boarders, and Maria had to sleep on the floor.

Even as a young girl, Maria was interested in science. Her father kept scientific instruments at home in a glass cabinet, and she was fascinated by them. Maria proved herself early as an exceptional student. At that time, Russia ruled Poland, and children had to speak Russian at school; indeed, it was against the law to teach Polish history or the Polish language. Nevertheless, Maria graduated from high school when she was 15 with top grades. She wanted to continue her education in physics and math, but it would be decades before the University of Warsaw admitted women. Maria knew she would have to leave Poland to further her studies, and she would have to earn money to make the move.

Maria's sister Bronya, meanwhile, wanted to study medicine. Together, they made a deal: Maria would work to help pay for Bronya's medical studies. Then, when Bronya was a doctor, she would help pay for Maria's education. When Maria's turn came, she did not want to leave her family or country, but knew it was necessary. She chose Paris because she wanted to attend the great university there: the University of Paris — the Sorbonne — where she would have the chance to learn from many of the era's leading thinkers.

In Paris

When Maria registered at the Sorbonne, she signed her name as "Marie," and worked hard to learn French. Of 1,800 students there, only 23 were women. Many people still believed that women should not be studying science, but Marie was a dedicated student. She rented a small space in an attic and often studied late into the night. In 1893, Marie took an exam to get her degree in physics, a branch of science that studies natural laws, and passed, with the highest marks in her class. She was the first woman to earn a degree in physics from the Sorbonne.

Marie thought seriously about returning to Poland and getting a job as a teacher there. But she met a French scientist named Pierre Curie, and on July 26, 1895, they were married. They rented a small apartment in Paris, where Pierre earned a modest living as a college professor, and Marie continued her studies at the Sorbonne. In September 1897, Marie gave birth to a daughter, Irène.

Meanwhile, scientists all over the world were making dramatic discoveries. The year the Curies were married, a German scientist named Wilhelm Roentgen discovered what he called "X-radiation" (X-rays), the electromagnetic radiation released from some chemical materials under certain conditions. This breakthrough served as a catalyst for Marie's own work.

Other scientists began experimenting with X-rays, which could pass through solid materials. While researching the source of X-rays, French physicist Antoine Henri Becquerel found that uranium gave off an entirely new form of invisible ray, a narrow beam of energy. Marie Curie wanted to know why. One of her greatest achievements was solving this mystery.

Radiant discoveries

Marie Curie, and other scientists of her time, knew that everything in nature is made up of elements. Elements are materials that can't be broken down into other substances, such as gold, uranium, and oxygen. When Marie was born, there were only 63 known elements. (Today 118 elements have been identified.) At the time she began her work, scientists thought they had found all the elements that existed. But they were wrong.

Marie began testing various kinds of natural materials. One substance was a mineral called "pitchblende." Scientists believed it was made up mainly of oxygen and uranium. But Marie's tests showed that pitchblende produced

much stronger X-rays than those two elements did alone. She began to think there must be an undiscovered element in pitchblende that made it so powerful.

To prove it, she needed loads of pitchblende to run tests on the material and a lab to test it in. Pierre helped her find an unused shed behind the Sorbonne's School of Physics and Chemistry. There, Marie put the pitchblende in huge pots, stirred and cooked it, and ground it into powder. She added chemicals to the substance and tried to isolate all the elements in it. Every day she mixed a boiling mass with a heavy iron rod nearly as large as herself.

After months of this tiring work, Marie and Pierre found what they were looking for. In 1898, Marie discovered a new element that was 400 times more radioactive than any other. They named it "polonium," after her native country. Later that year, the Curies announced the existence of another element they called "radium," from the Latin word for "ray." It gave off 900 times more radiation than polonium. Marie also came up with a new term to define this property of matter: "radioactive."

It took the Curies four laborious years to separate a small amount of radium from the pitchblende. In 1902, the Curies finally could see what they had discovered. Inside the dusty shed, the Curies watched its silvery-blue-green glow. Marie later remembered this vividly: "One of our pleasures was to enter our workshop at night. Then, all around us, we would see the luminous silhouettes of the beakers and capsules that contained our products." (Santella, 2001)

Marie presented her findings to her professors. She suggested that the powerful rays, or energy, the polonium and radium gave off were actually particles from tiny atoms that were disintegrating inside the elements. Marie's findings contradicted the widely held belief that atoms were solid and unchanging. Originally, scientists thought the most significant learning about radioactivity was in detecting new types of atoms. But the Curies' research showed that the rays weren't just energy released from a material's surface, but from deep within the atoms. This discovery was an important step along the path to understanding the structure of the atom.

A woman of distinction

In 1903, Marie received her doctorate degree in physics, which was the first PhD awarded to a woman in France. In November of the same year, Pierre was nominated for the Nobel Prize, but without Marie. He sent a letter to the nominating committee expressing a wish to be considered together with her. For their discovery of radioactivity, the couple, along with Henri Becquerel, shared the Nobel Prize in physics. Marie Curie was the first woman to receive a Nobel Prize.

After many years of hard work and struggle, the Curies had achieved great renown. But there was one serious problem. The Curies were unable to travel to Sweden to accept the Nobel Prize because they were sick. Both of them suffered from what later was recognized as radiation sickness. Marie coughed and lost weight; they both had severe burns on their hands and tired very quickly. All of this came from handling radioactive material. At the time, scientists didn't know the dangers of radioactivity.

The Nobel (accepted on the Curies' behalf by a French official in Stockholm) contributed to a better life for the couple: Pierre became a professor at the Sorbonne, and Marie became a teacher at a women's college. The Sorbonne still did not allow women professors. The prize itself included a sum of money, some of which Marie used to help support poor students from Poland.

In 1904, Marie gave birth to Eve, the couple's second daughter. Around that time, the Sorbonne gave the Curies a new laboratory to work in. But on April 19, 1906, this period came to a tragic end. On a busy street, Pierre Curie was hit by a horse-drawn carriage. He died instantly. Only 39 years old when she was widowed, Marie lost her partner in work and life.

Marie struggled to recover from the death of her husband, and to continue his laboratory work and teaching. Though the university did not offer her his teaching job immediately, it soon realized she was the only one who could take her husband's place. On November 5, 1906, as the first female professor in the Sorbonne's history, Marie Curie stepped up to the podium and picked up where Pierre had left off. Around her, a new age of science had emerged.

A chemistry of the invisible

An atom is the smallest particle of an element that still has all the properties of the element. Periodic table creator Dmitri Mendeleev and other scientists had insisted that the atom was the smallest unit in matter, but the English physicist J. J. Thompson, responding to X-ray research, concluded that certain rays were made up of particles even smaller than atoms. The work of Thompson and Curie contributed to the work of New Zealand–born British scientist Ernest Rutherford, a Thompson protégé who, in 1899, distinguished two different kinds of particles emanating from radioactive substances: "beta" rays, which traveled nearly at the speed of light and could penetrate thick barriers, and the slower, heavier "alpha" rays.

Marie considered radioactivity an atomic property, linked to something happening inside the atom itself. Rutherford, working with radioactive materials generously supplied by Marie, researched his "transformation" theory, which claimed that radioactive elements break down and actually decay into other elements, sending off alpha and beta rays. The Curies had resisted the decay theory at first but eventually came around to Rutherford's perspective. It confirmed Marie's theory that radioactivity was a subatomic property.

In 1904, Rutherford came up with the term "half-life," which refers to the amount of time it takes one-half of an unstable element to change into another element or a different form of itself. This would later prove an important discovery for radiometric dating when scientists realized they could use "half-lives" of certain elements to measure the age of certain materials.

In 1905, an amateur Swiss physicist, Albert Einstein, was also studying unstable elements. According to his calculation, very small amounts of matter were capable of turning into huge amounts of energy, a premise that would lead to his General Theory of Relativity a decade later. In 1906, Marie voiced her acceptance of Rutherford's decay theory.

Timeline of Curie's life

1867
Born Maria Sklowdowska on November 7 in Warsaw, Poland

1877
Her mother dies, and the family home becomes a boardinghouse

1883
Graduates from high school

1891
Moves to Paris to study at the Sorbonne

1893
Becomes the first woman to earn a physics degree from the Sorbonne

1895
Marries Pierre Curie

1897
Gives birth to first daughter, Irène; begins her work on radioactivity

1898
Announces discovery of radium and polonium

1903
Shares the Nobel Prize in physics with Pierre Curie and Antoine Henri Becquerel

1904
Gives birth to second daughter, Eve

1906
Pierre Curie dies

1911
Receives second Nobel Prize, this time in chemistry

1860 | 1870 | 1880 | 1890 | 1900 | 1910

During the time of Curie

1869
Dmitri Mendeleev devises the periodic table

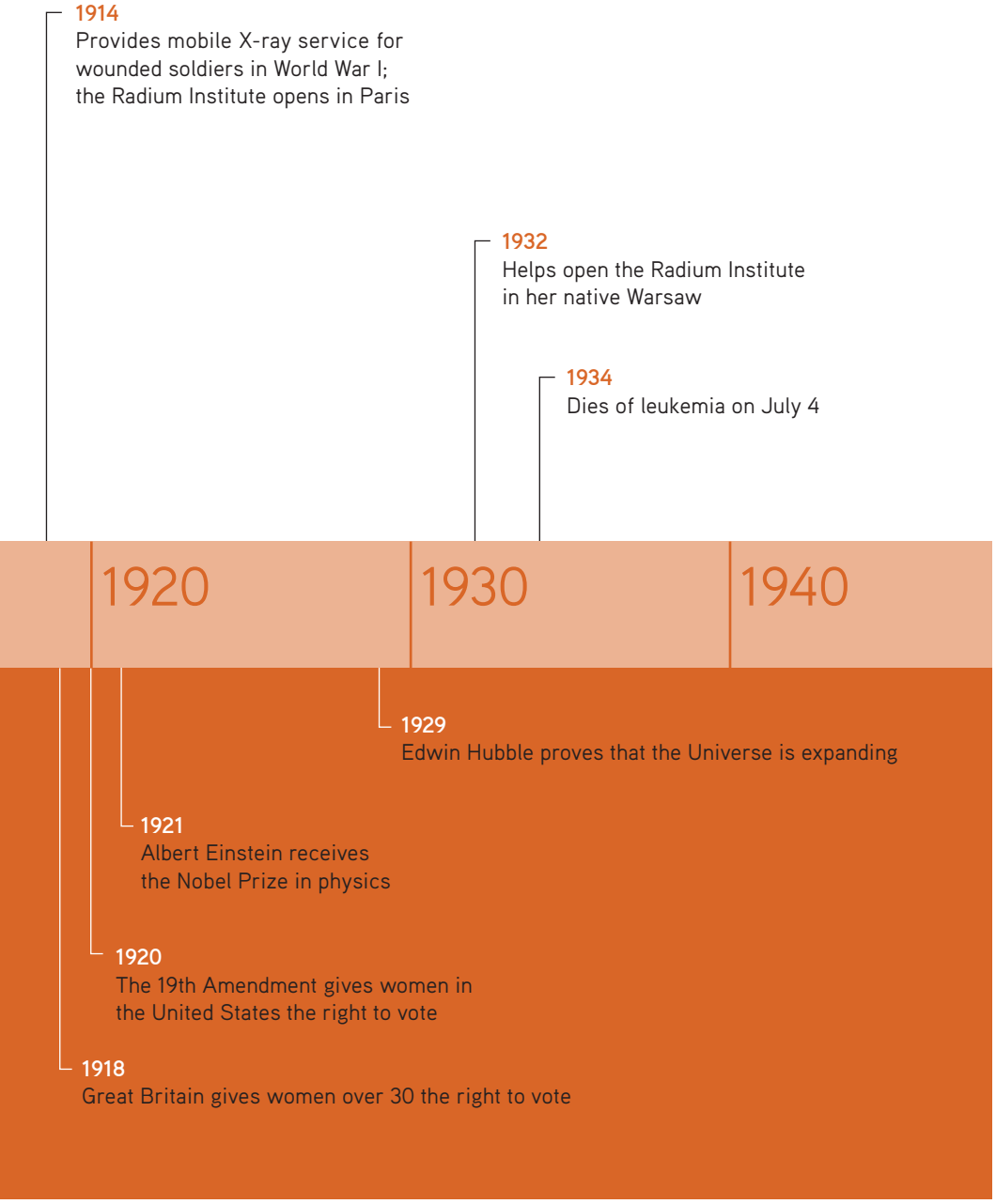
1882
English naturalist Charles Darwin dies

1889
The Eiffel Tower is completed

1901
The Nobel Prize is founded by Swedish inventor Alfred Nobel

1907
Dmitri Mendeleev dies in St. Petersburg, Russia

1914
World War I begins



By then, Thompson was calling the particles smaller than atoms "electrons," the first subatomic particles to be identified. Thompson was awarded the 1906 Nobel Prize in Physics for the discovery of the electron and for his work on the conduction of electricity in gases. In 1911, Rutherford made another breakthrough, building upon Thompson's earlier theory about the structure of the atom. He outlined a new model for the atom: mostly empty space, with a dense "nucleus" in the center containing "protons."

Marie's isolation of radium had provided the key that opened the door to this area of knowledge. She had created what she called "a chemistry of the invisible." The age of nuclear physics had begun.

A second Nobel Prize

In the years after Pierre's death, Marie juggled her responsibilities and roles as a single mother, professor, and esteemed researcher. She wanted to learn more about the elements she discovered and figure out where they fit into Mendeleev's table of the elements, now referred to as the "periodic table." Elements on the table are arranged by weight. To determine the locations for polonium and radium, she needed to figure out their molecular weight. Her research showed that polonium should be number 84 and radium should be 88.

In 1911, Marie was awarded the Nobel Prize for Chemistry, becoming the first person to win two Nobel Prizes. This time, she traveled to accept the award in Sweden, along with her daughters. Marie was recognized for her work isolating pure radium, which she had done through chemical processes.

A year later, Marie was visited by Einstein and his family. The two scientists had much to discuss: What was the source of this immense energy that came from radioactive elements? To promote continued research on radioactivity, Marie established the Radium Institute, a leading research center in Paris and later in Warsaw, with Marie serving as director from 1914 until her death in 1934.

Marie Curie's radioactivity research indelibly influenced the field of medicine. In 1904, the first textbook that described radium treatments for cancer patients was published. During World War I, she designed radiology cars bringing X-ray machines to hospitals for soldiers wounded in battle. She also equipped and staffed 200 permanent radiology posts in hospitals. Marie trained women as well as men to be radiologists. In the last two years of the war, more than a million soldiers were X-rayed and many were saved. Her research laid the foundation for the field of radiotherapy (not to be confused with chemotherapy), which uses ionizing radiation to destroy cancerous tumors in the body.

Marie Curie died of a type of leukemia, and we now know that radioactivity caused many of her health problems. In the 1920s scientists became aware of the dangers of radiation exposure: The energy of the rays speeds through the skin, slams into the molecules of cells, and can harm or even destroy them.

A place in the periodic table

In 1944, scientists at the University of California–Berkeley discovered a new element, 96, and named it "curium," in honor of Marie and Pierre. Today we recognize 118 elements, 92 formed in nature and the others created artificially in labs.

Marie Curie's legacy cannot be overstated. Poverty didn't stop her from pursuing an advanced education. Marriage enhanced her life and career, and motherhood didn't limit her life's work. At a time when men dominated science and women didn't have the right to vote, Marie Curie proved herself a pioneering scientist in chemistry and physics.

Sources

Cobb, Vicki. *Marie Curie*. New York: DK Publishing, 2008.

Fox, Karen. *The Chain Reaction: Pioneers of Nuclear Science*, Milwaukee, WI: Franklin Watts, 1998.

Krull, Kathleen. *Marie Curie.* Series: Giants of Science. New York: Viking Penguin, 2007.

Santella, Andrew. *Marie Curie*. Series: Trailblazers of the Modern World. Milwaukee, WI: World Almanac Library, 2001.

Venezia, Mike. *Marie Curie: Scientist Who Made Glowing Discoveries*. New York: Scholastic, 2009.

Image credits

Marie Curie in 1898
© Bettmann/CORBIS

Marie Curie in her laboratory
© Hulton-Deutsch Collection/CORBIS

Marie Curie in her laboratory in 1905
© Bettmann/CORBIS

NEWSELA

Articles leveled by Newsela have been adjusted along several dimensions of text complexity including sentence structure, vocabulary and organization. The number followed by L indicates the Lexile measure of the article. For more information on Lexile measures and how they correspond to grade levels: http://www.lexile.com/about-lexile/lexile-overview/

To learn more about Newsela, visit www.newsela.com/about.

The Lexile® Framework for Reading
The Lexile® Framework for Reading evaluates reading ability and text complexity on the same developmental scale. Unlike other measurement systems, the Lexile Framework determines reading ability based on actual assessments, rather than generalized age or grade levels. Recognized as the standard for matching readers with texts, tens of millions of students worldwide receive a Lexile measure that helps them find targeted readings from the more than 100 million articles, books and websites that have been measured. Lexile measures connect learners of all ages with resources at the right level of challenge and monitors their progress toward state and national proficiency standards. More information about the Lexile® Framework can be found at www.Lexile.com.