Marie Curie

Chemistry, Physics & Radioactivity

Born
November 7, 1867
Warsaw, Poland

Died
July 4, 1934
Savoy, France

By Michelle Feder, adapted by Newsela
In a humble workspace in 1897, Marie Curie began a series of experiments in the science of radioactivity that would 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 France. But she was born in Warsaw, Poland, in 1867, as Maria Skłodowska. 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. But things took a turn for the worse 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. She wanted to continue her education in physics and math, but the University of Warsaw didn’t admit women. Maria knew she would have to leave Poland to further her studies.

Maria 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. There she would have the chance to learn from many of the era’s most brilliant 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. She became the first woman to earn a degree in physics from the Sorbonne.

In France, she met a 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. 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). These rays are electromagnetic radiation and can glow like visible light. They’re released from some chemical materials under certain conditions. Roentgen accidentally discovered X-rays in his lab. One day, he saw X-rays glowing through black cardboard he’d placed around a tube filled with gas. Roentgen’s breakthrough pushed Marie’s own work forward.

Other scientists began experimenting with X-rays. Their ability to pass through solid materials led to the X-ray machine which can see inside the human body. While studying 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, such as gold, uranium, and oxygen, that can’t be broken down into other substances. 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 one or more undiscovered elements 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 at the Sorbonne. 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 separate 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 for this property of matter: “radioactive.”

It took the Curies four hard 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.”

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. The atoms were disintegrating inside the elements and giving off energy. Marie’s findings contradicted the widely held belief that atoms were solid and unchanging. 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 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. For their discovery of radioactivity, the couple won 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 fame. But there was one serious problem. 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 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 Nobel prize came with 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. But on April 19, 1906, this happy 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 work and teaching. The university offered her her husband’s teaching job. 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 was emerging.

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. These were subatomic particles.

The work of Thompson and Curie contributed to the work of British scientist Ernest Rutherford. In 1899, he found that there were two different kinds of particles coming out of radioactive substances. Radioactivity gave off “beta” rays, which traveled nearly at the speed of light and could penetrate thick barriers, and slower, heavier “alpha” rays.

Marie believed radioactivity to be happening inside the atom itself. Rutherford, working with radioactive materials supplied by Marie, researched his “transformation” theory. It claimed that radioactive elements break down. They actually decay into other elements, sending off alpha and beta rays. This theory of decay confirmed Marie’s theory that radioactivity was subatomic.

In 1904, Rutherford came up with the term “half-life.” The term refers to the amount of time it takes an unstable element to decay by one-half of its quantity. This would later prove an important discovery for radiometric dating. Scientists realized they could use “half-lives” of elements to measure the age of materials.

In 1905, a Swiss physicist, Albert Einstein, was also studying unstable elements. His calculations led him to believe that very small amounts of matter were capable of turning into huge amounts of energy. This idea would lead to his General Theory of Relativity a decade later.

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 in part for the discovery of the electron. In 1911, Rutherford made another breakthrough, building upon Thompson’s earlier theory about
Timeline of Curie’s life

1860
- 1867: Born Maria Skłodowska on November 7 in Warsaw, Poland
- 1869: Dmitri Mendeleev devises the periodic table

1870
- 1877: Her mother dies, and the family home becomes a boardinghouse

1880
- 1882: English naturalist Charles Darwin dies
- 1883: Graduates from high school
- 1889: Moves to Paris to study at the Sorbonne

1890
- 1891: Becomes the first woman to earn a physics degree from the Sorbonne
- 1893: Marries Pierre Curie
- 1895: Gives birth to first daughter, Irène; begins her work on radioactivity
- 1896: Shares the Nobel Prize in physics with Pierre Curie and Antoine Henri Becquerel
- 1898: Gives birth to second daughter, Eve
- 1899: Announces discovery of radium and polonium

1900
- 1903: Shares the Nobel Prize in physics with Pierre Curie and Antoine Henri Becquerel
- 1904: Pierre Curie dies
- 1906: Receives second Nobel Prize, this time in chemistry

1910
- 1911: The Nobel Prize is founded by Swedish inventor Alfred Nobel
- 1914: World War I begins
- 1917: Dmitri Mendeleev dies in St. Petersburg, Russia

During the time of Curie
- 1901: The Nobel Prize is founded by Swedish inventor Alfred Nobel
- 1889: The Eiffel Tower is completed
- 1883: Graduates from high school
- 1889: 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: Shares the Nobel Prize in physics with Pierre Curie and Antoine Henri Becquerel
- 1899: Announces discovery of radium and polonium
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- 1906: Pierre Curie dies
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the structure of the atom. He outlined a new model for the atom. He found that it was mostly empty space, with a dense “nucleus” in the center containing “protons.”

Marie’s isolation of radium had provided the key that led to these breakthroughs. 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 as a single mother, professor, and famous researcher. She wanted to learn more about the elements she discovered and figure out where they fit into Mendeleev’s table of the elements, called 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.

A year later, Marie was visited by Einstein. The two scientists had much to discuss: What was the source of this immense energy that came from radioactive elements? To promote the study of radioactivity, Marie established the Radium Institute, a research center in Paris and later in Warsaw.

Marie Curie’s radioactivity research forever changed the field of medicine. Radium became used to treat cancer. During World War I, she designed radiology cars bringing X-ray machines to hospitals for soldiers wounded in battle. 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, which uses radiation to destroy cancerous tumors in the body.
Marie Curie died of leukemia in 1934. 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. Ninety-two were formed in nature. The others have been created artificially in labs.

Marie Curie’s legacy cannot be overstated. Poverty didn’t stop her from pursuing an 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


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