



## 14.4 Marie and Pierre Curie

*Marie and Pierre Curie's pioneering studies of radioactivity had a dramatic impact on the development of twentieth-century science. Marie Curie's bold view that uranium rays seemed to be an intrinsic part of uranium atoms encouraged physicists to explore the possibility that atoms might have an internal structure. Out of this idea the field of nuclear physics was born. Together the Curies discovered two radioactive elements, polonium and radium. Through Pierre Curie's study of how living tissue responds to radiation, a new era in cancer treatment was born.*

### The allure of learning



Marya Skłodowska was born on November 7, 1867, in Russian-occupied Warsaw, Poland. She was the youngest of five children of two teachers, her father a teacher of physics and mathematics, her mother also a singer and pianist.

Marya loved school, and especially liked math and science. However, in Poland, as in much of the rest of the world, opportunities for higher education were limited for women. At 17, she and one of her sisters enrolled in an illegal, underground “floating university” in Warsaw.

After these studies, she worked for three years as a governess. Her employer allowed her to teach reading to the children of peasant workers at his beet-sugar factory. This was forbidden under Russian rule. At the same time, she took chemistry lessons from the factory's chemist, mathematics lessons from her father by mail, and studied on her own.

By fall 1891, Skłodowska had saved enough money to enroll at the University of Paris (also called the Sorbonne). She earned two master's degrees, in physics and mathematics.

A Polish friend introduced Marie, as she was called in French, to Pierre Curie, the laboratory chief at the Sorbonne's Physics and Industrial Chemistry Schools.

### The piezoelectric effect



Pierre Curie's early research centered on properties of crystals. He and his brother Jacques discovered the piezoelectric effect, which describes how a crystal will oscillate when electric current is applied. The oscillation of crystals is now used to precisely control

timing in computers and watches and many other devices.

Pierre Curie and Marie Skłodowska found that despite their different nationalities and background, they had the same passion for scientific research and shared the desire to use their discoveries to promote humanitarian causes. They married in 1895.

### Crystals and uranium rays

Pierre continued his pioneering research in crystal structures, while Marie pursued a physics doctorate. She chose uranium rays as her research topic. Uranium rays had been discovered only recently by French physicist Henri Becquerel.

Becquerel's report explained that uranium compounds emitted some sort of ray that fogged photographic plates. Marie Curie decided to research the effect these rays had on the air's ability to conduct electricity. To measure this effect, she adapted a device that Pierre and Jacques Curie had invented 15 years earlier.



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Marie Curie confirmed that the electrical effects of uranium rays were similar to the photographic effects that Becquerel reported—both were present whether the uranium was solid or powdered, pure or in compound, wet or dry, exposed to heat or to light.

She concluded that the emission of rays by uranium was not the product of a chemical reaction, but could be something built into the very structure of uranium atoms.

### Allies behind a revolutionary idea

Marie Curie's idea was revolutionary because atoms were still believed to be tiny, featureless particles. She decided to test every known element to see if any others would, like uranium, improve the air's ability to conduct electricity. She found that the element thorium had this property.

Pierre Curie decided to join Marie after she found that two different uranium ores (raw materials gathered from uranium mines) caused the air to conduct electricity much better than even pure uranium or thorium. They wondered if an undiscovered element might be mixed into each ore.

They worked to separate the chemicals in the ores and found two substances that were responsible for the increased conductivity. They called these elements polonium, in honor of Marie's native country, and radium, from the Greek word for ray.

### A new field of medicine

While Marie Curie searched for ways to extract these pure elements from the ores, Pierre turned his attention to the properties of the rays themselves. He tested the radiation on his own skin and found that it damaged living tissue.

As Pierre published his findings, a whole new field of medicine developed, using targeted rays to destroy cancerous tumors and cure skin diseases. Unfortunately, both Curies became ill from overexposure to radiation.

### Curies share the Nobel Prize

In June 1903, Madame Curie became the first woman in Europe to receive a doctorate in science. In December of that year, the Curies and Becquerel shared the Nobel Prize in physics.

The Curies were honored for their work on the spontaneous radiation that Becquerel had discovered. Marie Curie called spontaneous radiation "radioactivity." She was the first woman to win the Nobel in physics. And in 1904, her second daughter, Eve, was born. The elder daughter, Irene, was seven.

### Tragedy intrudes

In April 1906, Pierre was killed by a horse-drawn wagon in a Paris street accident. A month later, the Sorbonne asked Madame Curie to take over her husband's position there. She agreed, in hopes of creating a state-of-the-art research center in her husband's memory.

Marie Curie threw herself into the busy academic schedule of teaching and conducting research (she was the first woman to lecture, the first to be named professor, and the first to head a laboratory at the Sorbonne), and found time to work on raising money for the new center. The Radium Institute of the University of Paris opened in 1914 and Madame Curie was named director of its Curie Laboratory.

### The scientist-humanitarian

In 1911, Curie received a second Nobel Prize (the first person so honored), this time in chemistry for her work in finding elements and determining the atomic weight of radium.

With the start of World War I in 1914, she turned her attention to the use of radiation to help wounded soldiers. Assisted by her daughter Irene, she created a fleet of 20 mobile x-ray units to help medics quickly determine and then treat injuries in the field. Next, she set up nearly 200 x-ray labs in hospitals and trained 150 women to operate the equipment.

### Legacy continues

After the war, Curie went back to direct the Radium Institute, which grew to two centers, one devoted to research and the other to treatment of cancer. In July 1934, she died at 66 of radiation-induced leukemia. The next year, Irene Joliot-Curie and her husband, Frederic Joliot-Curie, were awarded the Nobel Prize in chemistry for their discovery of artificial radiation.