Be a Scientist!

Refer to a periodic table of the elements to find radium (Ra). Use the table's key or other research to familiarize yourself with how to interpret the numbers in radium's box.

Now build a model of a radium atom. It can be a technical drawing, a three-dimensional model, or some other creative project. Include the correct number of protons, neutrons, and electrons. Use a different color for each type of atomic particle.

Radium is naturally radioactive. How can you change the way you showed radium's atomic structure to make it stable? Either adjust your model or create a second model to represent this change. Explain in writing what you changed and why.

Beyond the Book

Research how radiation can be helpful and how it can be harmful.

Notes

CURIOUS MARIE CURIE

FOCUS Question

How did Marie Curie expand our understanding of atoms and radiation?

Stability and Change

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Radiation All Around

Ah . . . summertime! Swimming has made you chilly, so you let the sunlight warm you from head to toe. The Sun is extremely distant, yet your skin tingles with heat energy. What's the secret? The warmth you feel is due to *radiation.*

Solar radiation creates heat energy, which warms you up. But solar radiation can also harm your skin.

Radiation is the movement of energy from one place to another. Solar radiation is light energy from the Sun, which converts to heat energy when it hits your skin, making you feel warm and tingly. But you don't have to travel into space to find other sources of radiation, because everything on Earth gives off some radiant energy. In fact, some of these sources radiate enough energy to power entire cities.

Notes

Read-Think-Write

Write your answers on separate paper. Use details from the text as evidence.

1. What is *radiation*, and where does it come from?
2. Which sentences in the book explain why Marie Curie's success as a scientist was so unusual for the time?
3. How does the heading on page 5, Atoms and Energy, relate to Marie's "big science news"? What was this news?
4. Look at the diagram on page 7. Explain what makes radium radioactive.
5. What are the dangers of exposure to radiation? Give an example from the book.

FOCUS Question

How did Marie Curie expand our understanding of atoms and radiation? Explain in your own words at least three things she discovered about atoms and radiation. Cite examples from the text.

Nuclear power plants use the radiant energy found in atoms of uranium—a natural element found in the ground. This power is called *nuclear* because the energy comes from the atom's core, or *nucleus*. Uranium has the potential to produce about two million times as much energy as oil or coal.

In 1897, French physicist Antoine Henri Becquerel discovered that uranium releases energy. However, another remarkable scientist, named Marie Curie, figured out *how* it gives off energy. She would completely change our understanding of atoms. She even discovered two new elements along the way.

Antoine Henri Becquerel (1852–1908)

Do You Know?

An atom of uranium can quickly release an enormous amount of energy and radiation. Some countries have used this power to create nuclear weapons.

There are over four hundred nuclear power plants in the world.

Curious Marie

Born in Poland in 1867, Maria Sklodowska loved science. Although most girls were not allowed to attend school at that time, her parents made sure Maria was educated.

Maria (middle) with her siblings

Maria's dream was to study science at Sorbonne University in Paris, France. It took hard work and patience to save enough money to go to France. Maria moved to Paris in 1891, changing her name to Marie to fit in. Even though she didn't speak French when she arrived, she graduated from Sorbonne at the top of her class in 1893. Still eager to learn, she continued her education. In 1903, she became the first woman in Europe to earn a Ph.D.—but her science honors had only just begun.

Marie at Sorbonne University

Sorbonne, one of the oldest universities in the world, dates back to the thirteenth century.

Radium's Legacy

Today we know that large doses of radiation can damage the human body. In clock factories, thousands of "radium girls" used their mouths to shape the tips of paintbrushes covered with radioactive paint. Many later died from bone diseases.

Radium girls were exposed to harmful radiation daily.

Marie Curie herself handled radioactive elements for decades without any protection. She died at age sixty-seven from a bone disease that was probably caused by radiation. It was her life's work, but ultimately she gave her life to her work.

Thanks to Marie Curie, we understand radioactivity. She overcame many challenges to follow her passion and was able to light up the world with the power of knowledge.

Wowser!

Geiger counters detect radioactivity. Scientists used one of these machines to examine the Curies' notebooks. They are still too radioactive to be handled today.

Radium Is All the Rage

Around 1900, nobody knew that radioactivity could harm people. In fact, radium was thought to have healing qualities. This new "wonder" element glowed in the dark and gave off heat.

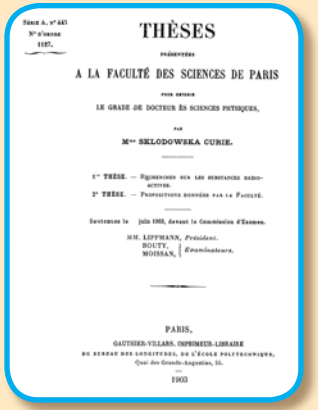
Toothpaste, drink mixes, and even chocolate containing radium were produced until the mid-1900s. Popular products emerged with names like Radium Brand Creamery Butter and Tho-Radia. There was even a dance called the Radium Dance. Because radium paint glowed in the dark, companies applied it to airplane dials, clocks, and wristwatches. The numbers glowed in the dark! But a much darker side of radium would soon be discovered.

Drinks made with radium and wristwatches with glowing radium numbers were popular until the mid-1900s.

Atoms and Energy

Marie began working with a physicist named Pierre Curie. They fell in love and married in 1895. Two years later, Becquerel discovered that uranium emits energy. Marie decided to figure out the mystery of how uranium worked.

Uranium is found in *ore*—natural minerals in the ground. Marie learned that when greater amounts of uranium were present, an ore sample radiated more energy. Marie suggested that the energy must come from inside the uranium atoms themselves. If so, this would mean that atoms must have smaller parts inside that somehow *emit*, or give off, energy. No one had thought of this before, so her hypothesis alone was big science news!


THÈSES

A LA FACULTÉ DES SCIENCES DE PARIS

LE GRADE DE DOCTEUR ÈS SCIENCES PHYSIQUES,

Mme SKLODOWSKA CURIE.

PARIS,

1903

In this report from 1903, Marie announced a key discovery.

Marie and Pierre Curie in their laboratory

New Elements

Next, Curie separated the uranium from the ore. Surprisingly, she noticed that the ore was still releasing energy. She suggested that new elements within the ore could also radiate energy.

Marie and Pierre used several tons of ore to collect enough of the new elements to study them. After four years of hard work, Marie named two new elements, radium and polonium. Both elements emit far more energy than uranium. Radium is one million times more active than uranium! Marie named this newfound form of energy *radioactivity.*

Marie and Pierre shared the 1903 Nobel Prize for their study of radiation. Marie also won the 1911 Nobel Prize for her discovery of radium and polonium.

Do You Know?

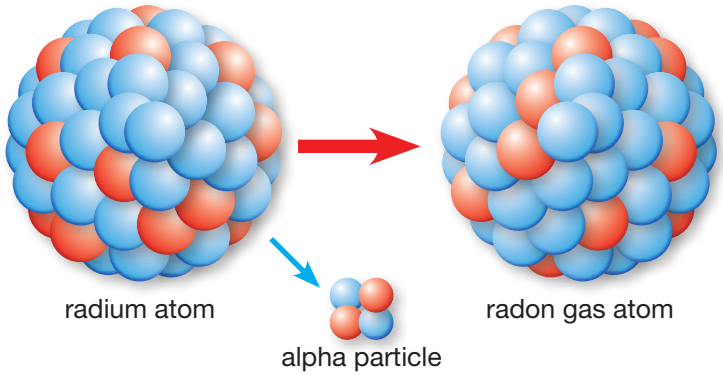
A woman winning a Nobel Prize was unheard of in 1903. In fact, Pierre Curie alone was first offered the Nobel, but he refused to accept if he could not share the prize with Marie. Still, only Pierre was allowed to deliver the acceptance speech.

Unstable Atoms

How do uranium, radium, and polonium give off energy? Like all elements, these three are made of atoms. Each atom has a central nucleus made of particles called *protons* and *neutrons.* A radium nucleus has many more neutrons than protons, making it unbalanced, or unstable. To become more balanced, or more stable, it sheds some of the protons and neutrons. Through this process, the atom radiates energy. This is *nuclear radiation.*

When an element changes its number of protons and releases energy, it becomes a completely different element. This is called *radioactive decay.* In the case of radium, it becomes radon, a gas.

RADIOACTIVE DECAY OF A RADIUM ATOM



An alpha particle has two protons and two neutrons. When a radium atom decays, it gives off an alpha particle and becomes radon gas.