Radioactive Decay

SECTION 2

Objectives

- Define and relate the terms *radioactive decay* and *nuclear radiation*.
- Describe the different types of radioactive decay and their effects on the nucleus.
- Define the term *half-life*, and explain how it relates to the stability of a nucleus.
- Define and relate the terms *decay series, parent nuclide,* and *daughter nuclide.*
- Explain how artificial radioactive nuclides are made, and discuss their significance.

In 1896, Henri Becquerel was studying the possible connection between light emission of some uranium compounds after exposure to sunlight and X-ray emission. He wrapped a photographic plate in a lightproof covering and placed a uranium compound on top of it. He then placed them in sunlight. The photographic plate was exposed even though it was protected from visible light, suggesting exposure by X rays. When he tried to repeat his experiment, cloudy weather prevented him from placing the experiment in sunlight. To his surprise, the plate was still exposed. This meant that sunlight was not needed to produce the rays that exposed the plate. The rays were produced by radioactive decay. **Radioactive decay** *is the spontaneous disintegration of a nucleus into a slightly lighter nucleus, accompanied by emission of particles, electromagnetic radiation, or both.* The radiation that exposed the plate was **nuclear radiation,** *particles or electromagnetic radiation emitted from the nucleus during radioactive decay.*

Uranium is a **radioactive nuclide,** *an unstable nucleus that undergoes radioactive decay*. Studies by Marie Curie and Pierre Curie found that of the elements known in 1896, only uranium and thorium were radioactive. In 1898, the Curies discovered two new radioactive metallic elements, polonium and radium. Since that time, many other radioactive nuclides have been identified. In fact, all of the nuclides beyond atomic number 83 are unstable and thus radioactive.

Types of Radioactive Decay

A nuclide's type and rate of decay depend on the nucleon content and energy level of the nucleus. Some common types of radioactive nuclide emissions are summarized in **Table 1.**

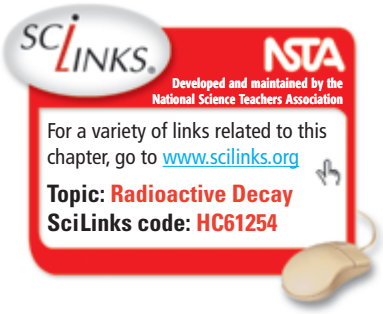

TABLE 1 Radioactive Nuclide Emissions

Type	Symbol	Charge	Mass (amu)
Alpha particle	$^{4}_{2}\mathrm{He}$	2+	4.001 5062
Beta particle	$^{0}_{-1}\beta$	1−	0.000 5486
Positron	$^{0}_{+1}\beta$	1+	0.000 5486
Gamma ray	γ	0	0