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Radioactive Decay and the Half-life

Use the half-lives of elements to learn about radioactive dating.

Most elements found in nature are stable; they do not change over time. Some elements, however, are unstable—that is, they change into a different element over time. Elements that go through this process of change are called **radioactive**, and the process of transformation is called **radioactive decay**. Because radioactive decay happens very steadily, scientists can use radioactive elements like clocks to measure the passage of time. By looking at how much of a certain element remains in an object and how much of it has decayed, scientists can determine an approximate age for the object.

So why are scientists interested in learning the ages of objects? By looking at very old things, such as rocks and fossils, and determining when they were formed, scientists learn about the history of the Earth and the plants and animals that have lived here. Radioactive dating makes this history lesson possible! A **half-life** is the time that it takes for half a certain amount of a radioactive material to decay, and it can range from less than a second to billions of years. The chart below lists the half-lives of some radioactive elements.

Table of Half-lives

Element	Half-life
Bismuth-212	60.5 minutes
Carbon-14	5730 years
Chlorine-36	400,000 years
Cobalt-60	5.26 years
Iodine-131	8.07 days

Element	Half-life
Phosphorous-24	14.3 days
Polonium-215	0.0018 seconds
Radium-226	1600 years
Sodium-24	15 hours
Uranium-238	4.5 billion years

1. Use the data in the table above to complete the following chart:

Table of Remaining Radium

Number of years after formation	0	1600	3200	6400	12,800
Percent of radium-226 remaining	100%	50%			

2. If 1 g of sodium-24 has decayed from a sample that was originally 2 g, how old is the sample?

3. What fraction of chlorine-36 remains undecayed after 200,000 years?

Radioactive Decay and the Half-life, continued

4. As uranium-238 decays, it becomes lead-206. After 3.5 g of uranium-238 decays for 1.125×10^9 years, how many grams of the sample will be lead-206?

5. A scientist has a 2.5 g sample of radium-226. How many grams of the sample will decay in 800 years?

6. An archaeologist finds a piece of old bone that she believes may be 2000 years old. The lab technician tells her that the carbon-14 in the bone has completed 25 percent of its first half-life. Does this finding support her belief about the age of the bone? Why or why not?

7. A technician does a test on an unidentified radioactive element and discovers that it has a half-life of 4.5×10^9 years. What element do you think it is, and why?

8. A paleontologist unearths the remains of a *Tyrannosaurus rex*. We know that these dinosaurs became extinct about 65 million years ago. Therefore, would it be reasonable to expect that the carbon-14 in the fossil has completed 15,000 half-lives? Why or why not?
