Section 7.2.
Half-Life.

Textbook pages 8 to 33.

Before You Read.

What does the word decay mean to you? As you read about radioactive decay, think about how the common meaning of decay differs from the scientific meaning.

What is radiocarbon dating?

Radiocarbon dating is the process of determining the age of an object by measuring the amount of carbon-fourteen remaining in that object. Carbon's isotopes include carbon-twelve and carbon-fourteen. When an organism is alive, the ratio of carbon-fourteen atoms to carbon-twelve atoms in the organism remains nearly constant. But when an organism dies, its carbon-fourteen atoms decay without being replaced. The ratio of carbon-fourteen to carbon-twelve then decreases with time. By measuring this ratio, the age of an organism's remains can be estimated. Only material from plants and animals that lived within the past fifty thousand years contains enough carbon-fourteen to be measured using radiocarbon dating.

What is a half-life and how is it used in radiocarbon dating?

A half-life is a measure of the rate of radioactive decay for a given isotope. It is equal to the time required for half the nuclei in a sample to decay. Its value is a constant for any radioactive isotope. For example, the half-life of the radioisotope strontium-ninety is twenty nine years. If you have ten grams of strontium-ninety today, twenty nine years from now you will have five grams left. This is because one half-life will have passed (ten grams times one half equals five grams). Fifty eight years from now, two half-lives will have passed and two and a half grams of the sample will remain (ten grams times one half times one half equals two and a half grams). The shorter the half-life is, the faster the decay rate. A **decay curve** is a curved line on a graph that shows the rate at which radioisotopes decay.

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What are parent and daughter isotopes?

A **parent isotope** is an isotope that undergoes radioactive decay. The stable product of this decay is called the **daughter isotope**. The production of a daughter isotope can be a direct reaction or the result of a series of decays.

Each parent isotope can be paired with a specific daughter isotope. For example, carbon-twelve is the daughter isotope of carbon-fourteen (the parent isotope). The chart on page

three hundred and seven of the textbook lists other common isotope pairs. It also shows the half-life of the parent and the effective dating range the isotope can be used for.

How does the potassium-forty clock work?

The potassium-forty clock uses radioisotopes, specifically potassium-forty and argon-forty, to determine Earth's age. Potassium-forty has a half-life of one point three billion years. Its daughter isotope is argon-forty. When rock is produced from lava, all the gases in the molten rock, including argon-forty, are driven out. This process sets the potassium radioisotope clock to zero, because potassium-forty (the parent) is present but no argon-forty (the daughter) is present.

As the molten rock cools over time, it traps gases that form as a result of radioactive decay. When tested, both potassium-forty and argon-forty are now present in the rock. As.

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the mass of the parent isotope drops, the mass of the daughter isotope increases. By measuring this ratio, the age of the rock can be estimated. For example, if analysis showed that there were equal masses of potassium-forty and argon-forty in a rock, the rock would be one point three billion years old, the amount of time it takes half of the potassium-forty to decay into argon-forty.