These notes are posted on my site for the following reasons:

- for students to copy in their own hand-writing
  - in order to complete their class notes
  - if student did not have enough time in class
  - if student was away and missed this section
- for assistants and tutors to follow progress of the concepts taught

Photocopied/printed notes can not be used during the Unit Notebook Check in class.

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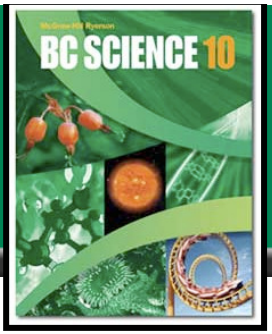
7.2 Half-life

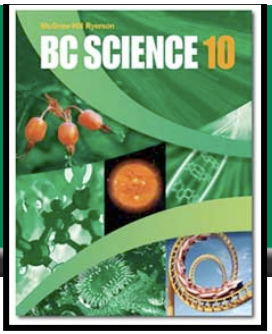


- **It can be difficult to determine the ages of objects by sight alone.**
  - **Radioactivity provides a method to determine age by measuring relative amounts of remaining radioactive material to stable products formed.**
- **Carbon dating measure the ratio of carbon-12 and carbon-14.**
  - **Stable carbon-12 and radioactive carbon-14 exist naturally in a constant ratio.**
    - **In nature, carbon-12 appears 98.9% of the time, while one carbon-14 atom appears for every 1 trillion normal atoms.**
  - **When an organism dies, carbon-14 stops being created and slowly decays.**
    - **Measuring the relative amounts of carbon-12 : carbon-14 is called radiocarbon dating.**
    - **Radiocarbon dating only works for organisms less than 50 000 years old**
      - **The half-life of carbon-14 is 5730 years.**

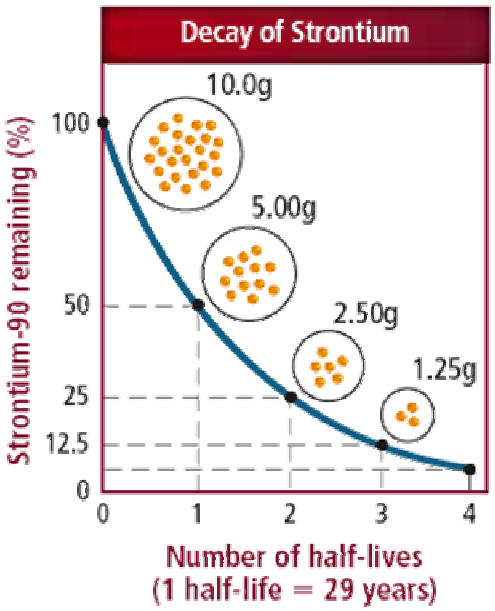
Using radiocarbon dating, these cave paintings of horses, from France, were determined to have been drawn 30 000 years ago.

See pages 302 - 304

The Rate of Radioactive Decay



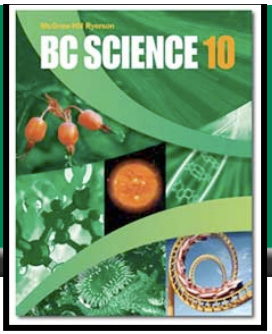
- **Half-life measure the rate of radioactive decay.**
  - **Half-life = time required for half of the radioactive sample to decay.**
  - **The half life for a radioactive element is a constant rate of decay.**
  - **Strontium-90 has a half-life of 29 years. If you have 10 g of strontium-90 today, there will be 5 g remaining in 29 years.**
- **Decay curves show the rate of decay for radioactive elements.**
  - **The curve shows the relationship between half-life and percentage of original substance remaining.**



The decay curve for strontium-90

See pages 305 - 306

Common Isotope Pairs



- There are many radioisotopes that can be used for dating.
  - Parent isotope = the original, radioactive material.
  - Daughter isotope = the stable product of the radioactive decay.
  - The rate of decay remains constant, but some elements require one step to decay, while others decay over many steps before reaching a stable daughter isotope.
    - Carbon-14 decays into nitrogen-14 in one step
    - Uranium-235 decays into lead-207 in fifteen steps.
    - Thorium-235 decays into lead-208 in ten steps.

Table 7.6 Common Isotope Pairs Chart

Isotope		Half-Life of Parent (years)	Effective Dating Range (years)
Parent	Daughter		
carbon-14	nitrogen-14	5730	up to 50 000
uranium-235	lead-207	710 million	> 10 million
potassium-40	argon-40	1.3 billion	10 000 to 3 billion
uranium-238	lead-206	4.5 billion	> 10 million
thorium-235	lead-208	14 billion	> 10 million
rubidium-87	strontium-87	47 billion	> 10 million

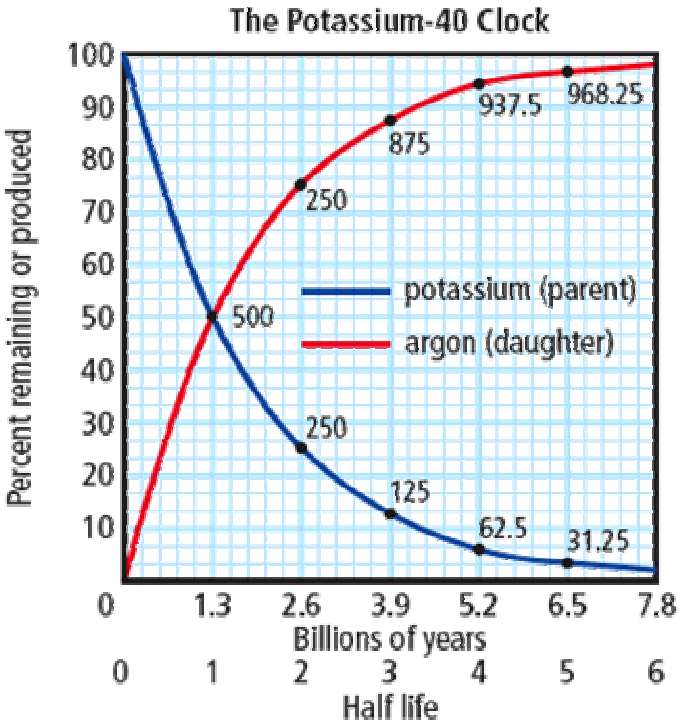
See page 307

The Potassium-40 Clock

- **Radioisotopes with very long half-lives can help determine the age of very old things.**
  - **The potassium-40/argon-40 clock has a half-life of 1.3 billion years.**
  - **Argon-40 produced by the decay of potassium-40 becomes trapped in rock.**
  - **Ratio of potassium-40 : argon-40 shows age of rock.**

Table 7.7 The Decay of Potassium-40

Number of Half-lives	Elapsed Time (billions of years)	Amount of Potassium-40 Present	Amount of Argon-40 Present	Ratio of Argon-40 to Potassium-40
0	0	1000 g	0	0
1	1.3	500 g	500 g	1:1
2	2.6	250 g	750 g	3:1
3	3.9	125 g	875 g	7:1
4	5.2	62.5 g	937.5 g	15:1



See pages 307 - 308

Take the Section 7.2 Quiz