



Radiometric Dating Lab

By Vicky Jordan

Problem: How long will it take for 100 atoms of the radioactive parent Carbon-14 to completely decay to the stable daughter isotope Nitrogen-14?

Background: **Relative dating** gives an approximate age of something compared to some other event in history. Scientists can tell that the item is “older” or “younger” than certain events in time, but cannot give an exact age of the item. Relative dating is common when comparing layers of rocks in different regions, and figuring out which fossil is older by comparing the rock layers the fossils are in.

Absolute dating gives an actual date in history that the item was formed or died. The most common type of absolute dating for geologic material is _____. A rock containing a radioactive element can be dated by measuring how much of the element remains. Radiometric dating methods give absolute ages ranging from decades to billions of years. Radioactive elements are unstable and decay into other materials at a known, fixed rate through radioactive decay. Different radioactive elements have different rates of decay. Each radioactive isotope has a characteristic, fixed, half-life. The _____ is the amount of time it takes for half of the radioactive element to decay or change into another element. Half-lives of elements can range from microseconds to hundreds of billions of years, depending on the isotope.

Hypothesis: _____

Procedure:

1. Start with 100 pennies. Each penny represents an atom in the radioactive element Carbon-14.
2. Dump out all of the pennies and spread them out on the table.
3. Remove all the coins that show tails to the side. These are atoms that have “decayed” and are no longer radioactive.
4. Record the number of pennies with heads in the table below. These represent atoms that are still radioactive.
5. Put the pennies that had heads up back in the container, mix them, and spread them out on the table and repeat the above process until all the pennies are gone or until you have completed 15 trials.
6. Graph the data in your data chart on the graph provided on the back. Remember graphing rules!
7. Enter your data into the master spreadsheet to chart an all class average.

Checkpoint: Which data is more reliable: your own data or the class average? Explain why with a super sentence. _____

Conclusions:

Look at the scoring guide before you start to answer these questions! Write complete and thorough answers on your own paper, and staple your answers to this sheet.

1. What is the difference between absolute dating and relative dating? Give an example of each.
2. What is the half-life of your 100 atoms of Carbon-14? (How many flips did it take for half of your Carbon-14 to decay?)
3. If each flip represents 5730 years, how many years would it have taken for all of your Carbon-14 pennies to become Nitrogen-14 pennies? Do you accept or reject your hypothesis? (Be sure to restate your hypothesis before you accept or reject it.)
4. Study the chart that shows the half lives of various elements. Most of these elements can be found in rocks all over the Earth. Why would scientists want to use more than one type of element to determine the age of a rock? Why aren't they satisfied with just using one element?
5. Based on radiometric dating, the oldest rocks scientists have found on Earth are 4.6 billion years old, but not ALL rocks are that old. Why might some rocks be 4.6 billion years old, and other rocks are only 2 billion years old, while yet others are only a few thousand years old? (*HINT: Think about the rock cycle and use the names of the different types of rocks in your answer!*)

Level 3 and Honors question:

6. Keeping in mind that scientists continue to gather information about rocks using radiometric dating, why are scientists interested in studying rocks from asteroids, the moon, and other planets?

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Scoring Guide

For each category:

- 4 points = Advanced
- 3 points = Proficient (grade level)
- 2 points = Partially proficient
- 1 point = Unsatisfactory

Part 1- Graph

- 4 points - graph includes all 9 required elements (title, axes labeled, units on axes, numbers spaced at equal intervals along axes, data points plotted correctly, line starts with first point and ends with last point, graph fills the space available and extends more than half-way along each axis, X axis contains the independent variable, Y axis contains the dependent variable)
- 3 points – graph is missing one or two elements, but X and Y axis have the correct variable and are labeled.
- 2 points – graph is missing 3 or 4 elements OR graph is missing one or two elements but X and Y axis are reversed or are not labeled.
- 1 point – graph is missing or has incorrect 5 or more elements
- 0 points – graph is unreadable or missing, or completely flawed

Part 2 – Conclusion Questions

Question 1

- 4 points – super sentence used to answer; both absolute and relative dating are defined, and an example of each is given.
- 3 points – did not use super sentence OR gave definitions of absolute and relative dating but did not give examples of each
- 2 points - gave examples of both, but did not give definitions OR gave a definition of only one
- 1 point - gave an example of one or the other, but did not define either one
- 0 points – information is incorrect

Question 2

- 4 points – super sentence used to answer; number given in the answer matches the data collected
- 3 points – did not use super sentence, but number given in the answer matches the data collected
- 0 points – number given does not match the data, even if written in a super sentence

Question 3

- 4 points - super sentence used to answer; number given in the answer matches the data collected; accept or reject hypothesis matches original hypothesis and data
- 3 points – did not use super sentence, but number given in the answer matches the data collected; accept or reject hypothesis matches original hypothesis and data
- 2 points - only one part of the question is answered completely and correctly
- 1 point - only one part of the question is answered correctly, but not in a super sentence
- 0 points – number given does not match the data, even if written in a super sentence

Question 4

- 4 points- answer includes an explanation of why it's important to verify results and increase reliability of results, and includes an example of how this would be done using information from the chart
- 3 points- answer includes an explanation of why it's important to verify results and increase reliability of results, but no example is given
- 2 points- answer describes the importance of repeating experiments, but lacks detail or explanation
- 0 points- incorrect or unclear explanation

Question 5

- 4 points - answer is more than one sentence that includes an example and includes the names of at least 2 rock types and how they are formed
- 3 points – answer is one sentence that briefly describes how this can be with 2 rock types OR is more than one sentence but does not include at least 2 rock types
- 2 points - answer uses the process of the rock cycle in some way to explain, but is incomplete
- 1 point - answer describes how this can happen, but lacks examples, detail or explanation
- 0 points – incorrect or unclear

Level 3/ Honors question

- 4 points- answer connects back to radiometric dating and gives at least one clear reason why information from a non-Earth source would help describe Earth events
- 3 points- answer connects back to radiometric dating and is well-explained
- 2 points- answer is well-explained, but does not connect to radiometric dating
- 1 point- answer is feasible
- 0 points- incorrect or unclear explanation