MONDAY MORNING SCIENCE BLAST
Half Left - Earth Science - Age Dating

Although historical time covers centuries, and archeological time covers millennia, geologic time describes the immense span of time - billions of years - revealed in the fossil and rock record of Earth. Geochronology is the science of finding out how old rocks and minerals are. Absolute time and relative time are terms used by geologists to describe the age of rocks and events. Geologists also use radiometric age dating to determine the absolute age, in years, of rocks and minerals.

Every rock and mineral exists in the world as a mixture of elements, and every element exists as a collection of atoms. One element's collection of atoms will not all have the same number of neutrons, so two or more kinds of the same element will have different atomic masses or atomic numbers. These different kinds of the same chemical element are called nuclides of that element. A nuclide of a radioactive element is known as a radionuclide.

The nucleus of every radioactive element spontaneously disintegrates over time. This results in radiation, and is called radioactive decay. Losing high energy particles from their nuclei turns the atoms of a radioactive nuclide into the daughter product of that nuclide, which may or may not be radioactive. If it is, this also decays to form its own daughter product. The last radioactive element in a series of these transformations will decay into a stable element.

There is no way to discern whether an individual atom will decay today or two billion years from today; however, the behavior of large numbers of the same kind of atom is so predictable that certain nuclides of elements are called radioactive clocks. The use of these radioactive clocks to calculate the age of a rock is referred to as radiometric age determination. First, an appropriate radioactive clock must be chosen. The sample must contain measurable quantities of the element to be tested for, and its radioactive clock must tell time for the appropriate interval of geologic time. Next, the amount of each nuclide present in the rock sample must be measured.

The time it takes for half of the parent nuclide to decay into the daughter product is called one half-life. The remaining population of the parent nuclide is halved again, while the population of daughter product is doubled, with the passing of every succeeding half-life. The amount of parent nuclide measured in the sample is plotted on a graph of that radioactive clock's known half-life. Only then can absolute age of the rock, within its margin of error, be read directly from the time axis of the graph.

In this lab your students will use a simple strip of paper as a model to better understand how radiometric decay occurs. To begin, instruct your students to cut a strip of paper 8 cm x 2 cm, thinking of the paper as all of the carbon-14 in an animal when it died. Next have them cut the strip of paper in half and discard one half of the paper (this half represents the decayed material). Instruct your students to record the cut in the Data section by making an “X” in the box for “Cut 1.” Before proceeding to the next step, have them predict how many similar cuts they can make before the remaining piece of paper is too small to cut with scissors and record those predictions in the Data table. Now instruct your students to repeat step 3, again discarding one half of the paper and marking an “X” in the box for “Cut 2". The students are to continue Steps 3 and 4 until their paper is so small that they cannot make another cut, making sure they record each cut they make with an “X” in the Data Section.

Half Left

QUESTION: How are radioisotopes used to determine the age of fossils?

MATERIALS:

paper strip (8 cm x 2 cm)
scissors

PROCEDURE:

1. Cut a strip of paper 8 cm x 2 cm. Think of the paper as all of the carbon-14 in an animal when it died.
2. The idea is to show how to find the age of a rock that contains an animal fossil by using the half-lives of isotopes. Now cut the strip of paper in half.
3. Discard one half of the paper. This half represents the decayed material. Record the cut in the Data section by making an "X" in the box for "Cut 1."
4. Before continuing, predict how many similar cuts you can make before the remaining piece of paper is too small to cut with scissors. Record your prediction in the data table.
5. Now repeat step 3. Again discard one half of the paper and mark an "X" in the box for "Cut 2".
6. Continue Steps 3 and 4 until the paper is so small you cannot make another cut. Be sure to record each cut you make with an "X" in the Data Section.

DATA: See next page

QUESTIONS:

1. Were you able to make more or less cuts than you predicted?

2. What was the total number of times you were able to cut the sample in half?

3. Carbon-14 has a half-life of 5,370 years. What was the total amount of time represented by the number of cuts you were able to make?

4. If a 4 cm x 2 cm piece of paper represents sample rock containing a fossil, about how old would you estimate this fossil to be?

5. The use of radioisotopes helps to provide the absolute age of a fossil. How is the absolute age different from the relative age of a fossil?

6. Could using the half-life of carbon-14 be used to determine when dinosaurs died? Explain.

DATA:

Predicted # of cuts	
Cut 1	
Cut 2	
Cut 3	
Cut 4	
Cut 5	
Cut 6	
Cut 7	
Cut 8	
Cut 9	
Cut 10	
Cut 11	
Cut 12	
Cut 13	
Cut 14	
Cut 15	
Cut 16	
Cut 17	
Cut 18	
Cut 19	
Cut 20	
Cut 21	
Cut 22	
Cut 23	
Cut 24	
Cut 25	
Total Cuts	