ASSESSMENT & EVALUATION

Try the pre- and post-tests (a 10-item multiple choice quiz provided), or create your own.

EXTENSIONS & VARIATIONS

1. Consider using other items to replace the bean and popcorn seeds. Beans can break. The original version used peanuts in their shells (Peanutium) and M&Ms (Emenemium) in large Ziplock bags. Also consider permanently sealing each set in its plastic bag, if you have such a device.

2. If you have a fair number of math-literate students, consider providing a number of bags ("rock samples") with ratios other than precise half-life proportions, and have class create a half-life curve and figure out the age of their particular samples according to where they fit on the curve.

3. Encourage (or even facilitate) students to do the online **Virtual Age Dating** tutorial, using a high speed internet connection, with the prospect of earning their official "Certificates of Completion as a Virtual Geochronologist".

4. Consider taking your students on a simulated journey back in time in our **Time Machine**. It's an experience they'll never forget (well, maybe in time…)

5. Be sure to display a scaled geological time in your room throughout the year, something you can use repeatedly, helping your students to internalize the relative timing for events occurring in geological history. See the **Time Machine** lesson for specifics.

ATTRIBUTIONS

The original version (using peanuts and M&Ms) was done at the San Francisco Exploratorium by its Biology Education Director Karen Kalumuck in her Evolution Teaching Workshop, 11/23/2002. This ENSI adaptation was developed by Larry Flammer, and successfully tested on classes of Earth Science students.

DATE A ROCK

Beanium → Cornium

Half Life = 100 million years

SAMPLE	SAMPLE	Be	Co	Half-Lives	Age: Mil. Yrs
J	A	128	0		
K	B	64	64		
L	C	32	96		
M	D	16	112		
N	E	8	120		
O	F	4	124		
P	G	2	126		
Q	H	1	127		
R	I	0	128		

If possible, find or make a box with at least 10 shelves, about 30 cm (12") tall X 16 cm (6") square, and the shelves about 1.5 cm (1") apart. Decorate the sides with uneven layers of different colors, simulating layers of sediment (showing some as sandstone, some as shale, some as conglomerate, etc.). Insert on one or two of the shelves a small fossil or two (in Ziplock sandwich bags). Place the Ziplock bags on the shelves according to their ages (youngest, e.g. sample A, on top shelf, oldest, e.g. sample I on bottom shelf). To simulate "getting rock samples from the ground, from different levels, pull the bags out of the box as you give them to students.

Have available the following items:

Overhead transparencies of: the **Date a Rock** data table; the **Deep Time** isotopes sequence sheet (optional)

A few recognizable fossils, of known (or approximately known) age. Good sources: a local university geology department, or your science supply house.

A colorful geological map, preferably of your area (on wall, or as an overhead color transparency). Good sources: the USGS online, or your science supply house.

The Deep Time activity envelopes (one for each team of two, with isotope strips in them) (optional)

The Deep Time handouts: 6-page packets, and the worksheets (*optional*)

The pre- and post-test quizzes, ready to hand out (*optional*)

A scaled time-line for the solar system around the classroom, if possible (see our **Time Machine** lesson).

PROCEDURE

PRESENTATION OUTLINE (See **Script** of a sample dialogue for this lesson)

1. ENGAGE: Show geological maps, timelines, and/or fossils, pointing out ages in millions of years, asking "How do we know these ages? How sure are we about these ages? How do we measure the ages of rocks?"
2. EXPLORE:
   a. Count "atoms" in simulated rock samples of different "ages". Students relate half-lives of radioisotopes to the application of dating rocks.
   b. Sequence all known radioisotopes with half-lives greater than 1 million years; look for pattern, showing that all longer-lived isotopes are still with us, and the shorter-lived ones are not, indicating a finite age of our solar system, and that its age must be in the millions or billions of years.
3. EXPLAIN: Do the Deep Time lesson, which emphasizes why we are so confident of geological age dates.
4. ELABORATE: Do the Virtual Age Dating Tutorial (online), for further reinforcing of half-life concept and how this is applied to dating rocks. This is especially helpful in explaining how isochrons work, and why they are so compelling.
5. EVALUATE: Pre/Post test to sample understanding of material.

Date a Rock!

An Age-Dating Simulation

by Karen Kalumuck
Biology Education Director at the San Francisco Exploratorium
Variation and Adaptation for ENSIWEB by Larry Flammer

SYNOPSIS

Students get simulated "rock samples" which show a "highly magnified" selection of 128 atoms, each sample with a different proportion of the atoms of two different elements: a parent radioisotope, and its daughter product. By counting the parent radioactive atoms and knowing the "half-life" of those atoms, students can figure the number of half-lives since the sample solidified, and therefore the "age" of the sample.

CONCEPTS

1. Age-dating rocks involves counting atoms and comparing the counts.
2. Radioisotope half-lives provide a reliable measure for age-dating rocks.

ASSESSABLE OBJECTIVES (Students will…)

1. recognize what is measured in determining elapsed time in geological samples.
2. know that half-life is a measure of the rate of decay of radioisotopes.
3. know that radioactive decay involves atoms changing to different atoms.

MATERIALS

Ziplock bags containing various ratios of two different items (e.g. beans and popcorn seeds)
Overhead: blank table showing samples and spaces for entering counts, half-lives, and ages of samples
Overhead showing those different ratios identified for each bag, and the half-life and age for each "bag"
Geological map (colored, on wall or overhead)
Some fossils, with known (or estimated) ages

TIME

One 45 minute class period

TEACHING STRATEGY & PREPARATION

CONTEXT/BACKGROUND

This lesson would fit well into any Earth Science or Geology class. It would also be useful in any science class in which radioactivity and/or geological age-dating, time-scales or fossils are encountered (Physical Science, Physics, Chemistry, or Biology). This lesson would probably fit best whenever the ages of fossils or rocks have been encountered, enabling students to readily understand the essentials for how they are dated. Although it could just be a stand-alone lesson, it was intended to introduce our **Deep Time** lesson, laying the background for doing the isotope sequencing activity (#15) in that lesson, then the Deep Time packet and worksheet which can be finished as a homework assignment.

PREPARATION

18 Ziplock bags (sandwich size)
bag of small beans, e.g. pinto beans
bag of popcorn kernels (not popped!)

Set up a set of 9 bags, labeled with marker pen "A – I", and 9 more labeled the same (or "J –R")
Place the numbers of beans (Be) and popcorn seeds (Co) into each bag as shown below:
(TIP: count out 50 popcorn seeds into a 50 ml graduated cylinder, note the "volume" (~22ml), and simply fill to volume to get approximate multiples of the larger popcorn numbers; much easier than counting!)