Lesson Plans on Dating Rocks

Grade level: Grades 3-5
Standards: SC.D.1.2.4, SC.D.1.2.5
Background knowledge necessary for students:
Students should have content knowledge of rock types and of the rock cycle.

Objective: The students will gain knowledge on how to determine the age of a rock.

Content knowledge: One of the oldest methods of dating individual fossils in geologic time is studying how deeply a fossil is buried. Sedimentary rock layers (strata) are formed episodically as earth is deposited horizontally over time. Newer layers are formed on top of older layers, pressurizing them into rocks. Generally, deeper rocks and fossils are older than those found above them. The following 2 lessons deal with this concept known as stratigraphy.

Lesson 1: "Relative" dating or time:

A. Use the cards in Set A: a set of nonsense syllables (copy provided which are used to introduce the students to the concept of sequencing. The cards should be duplicated, laminated, and cut into sets and randomly mixed when given to the students.
B. Spread the cards with the nonsense syllables out and determine the correct sequence of the eight cards by comparing letters that are common to individual cards and, therefore, overlap. The first card, "Card 1, Set A", represents the bottom of the sequence. The remaining cards should be arranged vertically. If the letters T and C represent fossils in the oldest rock layer, they are the oldest fossils, or the first fossils formed in the past for this sequence of rock layers.
C. Look for a card that has either a T or C written on it. Since this card has a common letter with the first card, it must go on top of the TC card. The fossils represented by the letters on the card are "younger" than the T or C fossils on the TC card.
D. Sequence the remaining cards by using the same process. When you finish, you should have a vertical stack of cards with the top card

representing the youngest fossils of this rock sequence and the TC card at the bottom of the stack representing the oldest fossils.

E. The correct sequence from youngest to oldest rock strata is MDXONBUAGCT. Remind the students that the letters represent fossils in a rock layer and that one fossil next to another within a rock layer implies no particular rock layer (as in MD).

F. Discussion and questioning should follow.

Lesson 2: "Relative" dating of fossils.

A. Examine the second set of cards that have sketches of fossils on them. Each card represents a particular rock layer with a collection of fossils that are found in that particular rock stratum. All of the fossils would be found in sedimentary rocks of marine origin. (To enhance this activity, have students match the fossil sketches to real fossils. One suggested kit is the John Hanley Fossil Teaching Set from the Geology Museum at the Colorado School of Mines (303) 273-3815.)

B. The oldest rock layer is marked with the letter M in the lower left-hand corner. The other letters have no significance at this time. Find a rock layer that has at least one of the fossils you found in the oldest rock layer. This rock layer would be younger as indicated by the appearance of new fossils in the rock stratum. Remember extinction is forever. Once an organism disappears from the sequence it cannot reappear later. Use this information to sequence the cards in a vertical stack of fossils in rock strata. Arrange them from oldest to youngest with the oldest layer on the bottom and the youngest on top.

C. Using the letters printed in the lower left-hand corner of each card, write the sequence of letters from the youngest layer to the oldest layers. See Figure 2-B for key. In what kinds of rocks might you find the fossils from this activity? Marine sedimentary rocks such as limestone, shale, and sandstone might contain fossils similar to this activity.

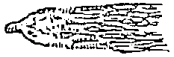
These two lessons were taken from
www.ucmp.berkeley.edu/fosrec/BarBar.html

TC	CGA
AU	UBN
BN	NO
OXD	DM

Card 1

NAME: Foraminifera
(microscopic type)
PHYLUM: Protozoa
(Sarcodina)
DESCRIPTION:
Shelled, amoeba-like
organism

NAME: Gastropod
PHYLUM: Mollusca
DESCRIPTION:
Snails and relatives;
many living species



NAME: Crinoid

NAME: Pelecypod

PHYLUM: Mollusca
DESCRIPTION:
Clams and oysters;
many living species

G

NAME: Icthyosaur

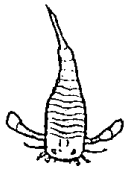
PHYLUM: Vertebrata
DESCRIPTION:
Carnivore; air-
breathing aquatic
animal; extinct

NAME: Shark's tooth
PHYLUM: Vertebrata
DESCRIPTION:
Cartilage fish; many
living species

NAME: Pelecypod

PHYLUM: Mollusca
DESCRIPTION:
Clams and oysters;
many living species

O



NAME: Eurypterid

NAME: Brachiopod

NAME: Graptolite
PHYLUM: Chordata
DESCRIPTION:
Primitive form of
chordate; floating form
with branched stalks;
extinct

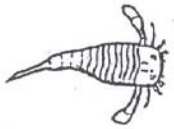
NAME: Trilobite

S

NAME: Brachiopod
PHYLUM:
Brachiopoda
DESCRIPTION:
"Lampshells";
exclusively marine
organisms with soft
bodies and bivalve
shells; many living
species

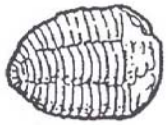
NAME: Trilobite
PHYLUM: Arthropoda
DESCRIPTION:
Three-lobed body;
burrowing, crawling,
and swimming forms;
extinct

M



NAME: Eurypterid
PHYLUM: Arthropoda
DESCRIPTION: Many were large (a few rare species were 5 feet in length); crawling and swimming forms; extinct

NAME: Horn coral
PHYLUM: Coelenterata (Cnidaria)
DESCRIPTION: Jellyfish relative with stony (Cnidaria) (calcareous) exoskeleton found in reef environments; extinct



NAME: Trilobite
PHYLUM: Arthropoda
DESCRIPTION: Three-lobed body; burrowing, crawling, and swimming forms; extinct

I

NAME: Foraminifera (microscopic type)
PHYLUM: Protozoa (Sarcodina)
DESCRIPTION: Shelled, amoeba-like organism

NAME: Pelecypod
PHYLUM: Mollusca
DESCRIPTION: Clams and oysters; many living species

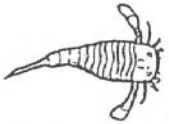
NAME: Ammonite
PHYLUM: Mollusca
DESCRIPTION: Squid-like animal with coiled, chambered shell; related to modern-day Nautilus

R

NAME: Placoderm
PHYLUM: Vertebrata
DESCRIPTION: Primitive armored fish; extinct

NAME: Horn coral
PHYLUM: Coelenterata (Cnidaria)
DESCRIPTION: Jellyfish relative with stony (Cnidaria) (calcareous) exoskeleton found in reef environments; extinct

NAME: Crinoid
PHYLUM: Echinodermata
DESCRIPTION: Multibranched relative of starfish; lives attached to the ocean bottom; some living species ("sea lilies")



NAME: Eurypterid

N

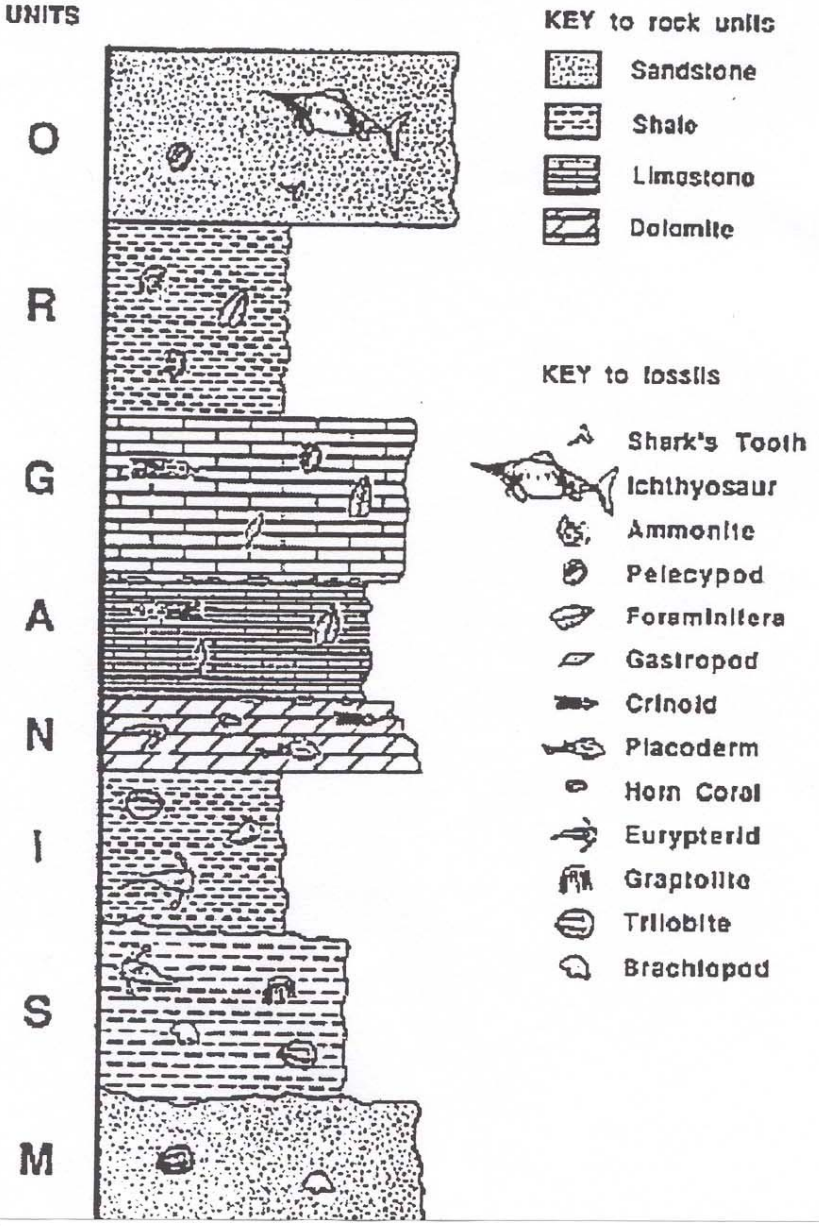
NAME: Foraminifera (microscopic type)
PHYLUM: Protozoa (Sarcodina)
DESCRIPTION: Shelled, amoeba-like organism

NAME: Gastropod
PHYLUM: Mollusca
DESCRIPTION: Snails and relatives; many living species

NAME: Crinoid
PHYLUM: Echinodermata
DESCRIPTION: Multibranched relative of starfish; lives attached to the ocean bottom; some living species ("sea lilies")

A

Figure 2-B. Stratigraphic Section for Set B



Lesson 3: Absolute dating:

Background information: This is also known as Radiometric Dating. Naturally-occurring radioactive materials break down into other materials at known rates. This is known as radioactive decay. Radioactive parent elements decay to stable daughter elements. Many radioactive elements can be used as geologic clocks. Each radioactive element decays at it own nearly constant rate. Once this rate is known, geologists can estimate the length of time over which decay has been occurring by measuring the amount of radioactive parent element and the amount of stable daughter elements.

Objective:
Model what happens in a nuclear reaction for the students, so they can obtain a better understanding of radiometric dating.

1. Set up stations with 4-5 students. Put 32 marbles, each with attached lump of clay, into large beakers. Marbles with clay represent unstable atoms.
2. During a 45-sec. period remove 16 marbles and pull off the clay. Place clay into a pile and marbles into another beaker. Marbles without clay represent stable atoms. Clay is the by-products or waste of the reaction (smaller atoms that may still be capable of giving off additional energy).
3. Repeat this procedure 4 more times, each time removing half the marbles remaining in the original.

Background information for further concept development:
Half-life is the time required for half of the atoms in any given quantity of a radioactive element to disintegrate. If the half-life of a radium isotope is 1600 years, therefore, in 1600 years ½ of Ra will disintegrate into another element. In a 2nd 1600 years, ½ of the remaining element will disintegrate, so ¼ of the original will remain after 3200 years.

Objective:
Demonstrate radiometric dating and half-life using manipulatives.

Lesson 1:

1. Prepare a bag of 20 M&M's for each student. Each student should shake their bag and dump them out. Roll them out and remove all the candies with the M&M showing. Record number left.

2. Continue the process until only 10 are left. Count how many times you had to remove. That number would represent the half-life of the element.

Lesson 2:

1. Have each student begin with a bag of 20 manipulatives.
2. This 20 will represent 20 grams of the parent element. It is determined that the half-life of the original is 15 hours. Our problem is to determine how much of the element is remaining after 30 hours.
3. Demonstrate by removing objects: after 15 hours, 10 would remain. Then after 30 hours, 5 would remain.

Station Activity: Plan for 5 stations with 3 students in each group.

a. Station #1: Card with half-live = 2 years. Bag A (original)= 48 grams; Bag B would contain 24 grams after 2 years; Bag C would contain 12 grams after 4 years. How many grams would remain after 6 years? Count and record answer.
b. Station #2: Card with half-live=3 years. Bag A (original)=48 grams; bag B =24 grams after 3 years; bag C= 12 grams after 6 years. How many would remain after 18 years? Count and record answer.
c. Station #3: Card with half-life=5 years. Bag A (original)= 50 grams; Bag B=25 grams after 5 years. How many grams would remain after 20 years. (This requires development of ½ and ¼ of the original amount.)
d. Station #4: Card with half-life = 100 years. Bag A (original)=80grams; Bag B=40grams after 100 years. How many grams would remain after 300 years.
e. Station #5: Card with half-life = 8 days. Bag A (original) = 40 grams. Count and label bags after 16 days and 32 days.

Follow up with checking answers and discussion.
Submitted by: Patricia Wagner