

TEACHER INSTRUCTIONS

Relative vs. Absolute Dating and Gaps in the Rock Record – An Analogy

Developed by Hilary Clement Olson

Standards:

High School TEKS

Earth Systems Science (ESS)

1A	1G	2C	4A
1B	1H	3A	4B
1F	2A	3B	7A
1E	2B	3C	7C

NGSS

K-2-ESS1-1	MS-ESS1-4	HS-ESS1-5
3-LS4-1	MS-ESS2-1	HS-ESS1-6
4-ESS1-1	MS-ESS2-2	HS-ESS2-1
5-ESS2-1	MS-ESS3-1	HS-ESS2-5

Level: K-12, undergraduate, graduate

Objective:

This analog activity presents students with an opportunity to apply relative vs. absolute age-dating techniques to the ages of people. In addition, students will look at the completeness of a record of dates, again by an analogy with date of birth records for people. Large gaps of time between the dates of birth of a line-up of people are an analogy for unconformities in the rock record.

Background Information:

Rocks record geologic time. Geologists speak of time in two different ways: relative time and absolute time. The age of different rock layers or strata can be determined relative to each other within what geologists call a stratigraphic sequence. Geologists invoke established principles of stratigraphy to determine the relative age. For example, the oldest rock layer is at the bottom of a sequence of rocks and, like a layer cake, was deposited first: The Principle of Superposition (see below). Relative dating techniques permit geoscientists to compare two or more entities or events to determine which is older and which is younger. People use similar relative dating techniques on a daily basis when they judge ages of persons based on their physical characteristics.

Most of the early work done in geology involved attempts to establish the relative age of different rock layers. As a result, geologists have developed a system that uses specific terms (e.g., Cretaceous) to refer to different periods of time in Earth history. A geologic time scale will commonly illustrate all the periods of time from the oldest at the bottom to the youngest at the top.

The lengths of time intervals in the geologic record is recorded in absolute numbers on a geologic time scale. Where do these numbers come from? These numbers refer to absolute time, the other way geologists refer to geologic time. These numerical ages in geology are determined by dating the rocks, a method that involves the laboratory analyses of elemental isotopes within the minerals of a rock. People use a similar method of determining the age of persons by asking their date of birth.

Although our understanding of geologic time is fairly complete on Earth, in different parts of the planet, the rock record is not complete, and gaps (called unconformities) exist. For example, in a particular location a rock layer with an absolute age of 10,000 years may be directly overlying a rock layer with an absolute age of 40,000 years. This relationship demonstrates a 30,000-year gap, or unconformity, in the rock record at that particular geographic location. Because the rock record is incomplete at various locations, the construction of the geologic time scale has relied upon the integration of stratigraphic work from many different locations on Earth.

Time 20 – 30 minutes

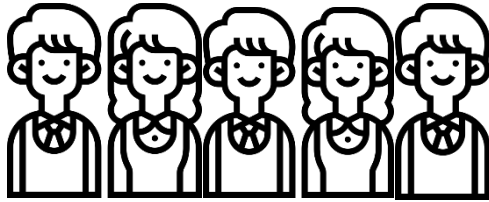
Requirements:

Teacher

Preparation:

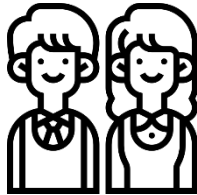
Materials:

1. Five (or so) students from the class up at the front. Depending on the group, the age range may be wide, or it may be narrow. Either will work.



STUDENT VOLUNTEERS

2. Several additional classroom volunteers to be sorters who will 'order' the volunteers from oldest (at left) to youngest (at right).



SORTERS

The class will apply relative vs. absolute age-dating techniques to the 5 volunteers.

Procedure:

Relative Dating

1. The instructor lines five students (#1 above) in a row at the front of the room.
2. The instructor gathers the sorters (#2 above) at the front to collaborate on organizing the group of five by age with oldest on the left and youngest on the right.
 - a. The sorters must consider what principles of observation they will base their order on, for example: grey hair, wrinkles, height or other criteria. The sorters cannot ask any questions of the students. The sorters share their criteria with the class. The instructor asks the class if they are in agreement, or if they could offer additional criteria.
 - b. Based on the final criteria, the sorters now move the students into order by age. The instructor asks the class at large if they are in agreement with this ordering.
3. The instructor discusses how the students used general principles to determine the relative age (which person is younger and which person is older) of the five students.

Absolute Dating

4. The instructor now asks the class at large how they might determine with more precision the absolute ages of the five students to be sure they are in the proper order and to better understand the difference in age between the five students. What data could they ask for or use? (Options include: ask students their birth date or have the students write the date on an index card before the activity and keep it hidden; ask students to see their driver's license.)

5. The five students provide data (a birth date, a driver's license, etc.). The sorters now make any adjustments in the order of the students so they are properly ordered from oldest (left) to youngest (right). Write the order on the board at the front of the room along with the known data (example below).

1. Joe	DOB: 3/1/2015
2. Mary	3/15/2015
3. Pedro	7/15/2015
4. Michelle	9/10/2015
5. Khalid	9/12/2015

Gaps in the Record

6. The instructor now asks the class if there are any significant age gaps between pairs of people. For example, person #1 might be 2 weeks older than person #2. But person #2 might be 4 months older than person #3 (as shown above). Space out the line of 5 people such that the space between people is correlative with the age gaps between individuals. The line now shows representation of more complete age records in the line (closely spaced individuals are close in age) vs. gaps in the age records of the line (further spaced individuals are further apart in age). These gaps in age are analogous to gaps in the rock record (unconformities). In the example record shown above, there are two significant gaps in the age records of the line-up (as shown by the horizontal lines: a four-month gap (unconformity) between Mary and Pedro, and an almost two-month gap (unconformity) between Pedro and Michelle. To think about: Would students have recognized these significant gaps in the age line-up without the absolute age information?
7. Students will now complete their worksheet to answer several reflection questions.

Supporting Documents:

[Teacher Resource Handout](#)

[Student Worksheet](#)

[Slide deck on Review of Rock Cycle and Introduction to Stratigraphy](#)

REFERENCES:

Images of boys and girls: Icon by Eucalyp at www.freepik.com.