

GEOS 2900 Sample Instructor Notes

3.3.1 THE HISTORY OF THE EARTH

Things to do before class begins:

1. Place the following daily agenda on the board:
 - a. Announcements
 - b. Go over Activity 3.2.2 (Absolute Age)
 - c. Complete Activity 3.3.1 (Earth History)
 - i. Turn in Outcomes (all)
 - d. Homework
 - i. Read and Reflect 3.3.1
2. Get supplies. Per student group:
 - a. Sheet of blank paper (1 per student)
 - b. Colored pencils
 - c. Index cards (2 per student, helpful if these are different colors)
 - d. Clear tape
 - e. Computer with Internet access
 - f. Geologic time scale (from student course pack)
 - g. Earth events on slips of paper – enough for one event per person.
3. Get supplies for class discussion/demonstration
 - a. Meter stick or measuring tape
4. Prepare slips of paper labeled with important events in Earth's history. Suggested events include (leave off dates for student copies):
 - Formation of the earth (4.6 Ga)
 - First life forms (bacteria; ~3.5 Ga)
 - Oldest rocks (~4 Ga)
 - First multi-cellular organisms (~700 Ma)
 - Formation of oceans & atmosphere (~3.8 Ga)
 - Mass extinction of dinosaurs (~65 Ma)
 - First human ancestors (~3.5 Ma)
 - First modern humans (~35,000 yrs)
 - First dinosaurs (~210 Ma)
 - First land plants (~438 Ma)
 - First reptiles (~320 Ma)
 - First amphibians (~380 Ma)
 - First mammals (~210 Ma)
 - First fish (~520 Ma)
 - Largest mass extinction (end Permian; ~245 Ma)
 - First birds (~210 Ma)
 - Formation of Pangea (~245 Ma)
 - Breakup of Pangea (~65 Ma)
 - Last ice age ended (~15,000 yrs)
 - Formation of Great Lakes (~2 Ma)
 - Oldest rocks in Michigan (~3.5 Ga)
 - Last eruption of Yellowstone caldera (~640,000 yrs)
 - Formation of the Appalachian Mountains (Taconic orogeny; 495-440 Ma)
 - Formation of the Rocky Mountains (late Cretaceous; 140-65 Ma)
 - Man walks on the moon (1969)
 - Largest earthquake in 21st century (December 2004)

5. Place a time line on the upper part of the board to represent 4.5 billion years. The scale is 1 m = 1 billion years. Mark off every 10 cm from 4.5 billion years ago to present, and label every 50 cm.
6. During the activity, when it becomes evident that the cards are crowded toward the more recent end of the timeline, construct a second time line on board below the first one. Scale of the new timeline should be 4 meters = 400 million years. Mark off every 10 cm from 400 million years ago to present, and label every 50 cm.
7. If time permits, a third expanded time scale can be constructed during the activity. Scale of the third timeline should be 4 meters = 4 million years. Mark off every 10 cm from 4 million years ago to presents, and label every 50 cm.

Order of events with approximate times to complete each task:

1. Announcements and go over daily agenda (2-5 minutes)
2. Discuss Activity 3.2.2 (Absolute Age) (10-20 minutes). Important points include:
 - a. Review importance of radioactive decay as a tool for geologists.
 - b. Go over the sequence of events in the rock puzzle diagram, including both relative and absolute ages.
3. If necessary, discuss any question or issues related to Read and Reflect 3.2.2
4. Introduce Activity 3.3.1 (Earth History). Direct students to discuss Before you Begin questions in groups (5 minutes). Discuss responses as a class. (15 minutes)
 - a. How old do you think the earth is? How do you think scientists have determined the age of the earth?
 - i. Most students will know that the earth is 4-5 billion years old.
 - ii. Students will say that scientists use rock layers, fossils, and radioactive dating to determine the age of the earth.
 - b. What do you think are some of the significant events that have happened in earth's history?
 - i. Evolution of life, formation of rocks, Pangea are often mentioned.
5. Direct students to complete Activity 3.3.1 Part 1 on blank sheets of paper (30 minutes). Give students verbal directions for how to complete the activity:
 - a. Each person in the group constructs a timeline based on his/her own criteria. Add events to the timeline and divide the timeline up into at least 4 periods.
 - b. Compare timelines between group members to note similarities and differences.
6. Discuss results of Part 1 as a class (10 minutes).
 - a. Ask students to share how they constructed the timelines.
 - i. Look for examples of scaled timelines (equal spacing between dates) versus event-based timelines
 - ii. Ask what criteria students used to divide the timeline into periods.
 - b. Ask which entries are relative and which are absolute ages.
 - c. Ask which events happened instantaneously (or over very short periods of time) and which were gradual.
7. Direct students to complete Activity 3.3.1 Part 2 (40-50 minutes)
 - a. Have each student pick one earth event and write the name of the event on one index card
 - b. PRIOR to looking up information, invite students to place the index cards in the "best guess" location. Place "guess" cards ABOVE the timeline.
 - c. Students write the same event on the second index card. Then students are to use classroom resources (textbooks, Internet) to look up the "date" when the event occurred. Write this date on the index card.

- d. Tape the second index card to the board BELOW timeline. Watch student placement of events (students with events <100 million years ago have trouble placing the cards).
 - e. Draw attention to the placement of cards along the time scale. Ask students how we can better show the events that have occurred in the past 400 million years. Students will suggest expanding that part of the timescale.
 - f. Have student place the cards for events in the last 400 million years on the new (expanded) time scale.
 - g. Tour the events when all cards are placed. General order of events is of interest but not exact dates.
8. Complete activity 2.3.1 Part 3 (20 minutes)
- a. Instruct students to use the website given in the course pack to explore the geologic timescale.
 - b. With student assistance, add names of eons and eras to timescale on the front board. Discuss long versus shorter spans of time.
 - c. Discuss what events are used to divide up the earth's history into eons and eras (Cambrian explosion, end Permian mass extinction, end Cretaceous mass extinction, etc.).
 - d. Draw analogies between the personal timeline and the timeline of the earth (how divided up, more dates recent vs. long ago, gradual vs. instantaneous events, absolute vs. relative ages, etc.)

Scoring guide for Outcome questions (20 points):

Outcomes Part I:

1. Explain how you created the timeline and the criteria that you used to divide it up into periods.

(2 points) Responses vary, but should describe the timeline for each person in the group, and that person's criteria for determining periods.

2. What similarities do you notice between timelines among your group members? What major differences do you notice? In your response, consider the type of events in the timeline as well as how the timeline was constructed and divided up.

(2 points) Answers vary but may include: contain personal and/or political events, contain similar events (graduations, marriage, births, deaths), contain absolute and relative ages, etc.

3. Which events in your timeline are absolute ages? Which are relative ages? Explain your answer.

(2 points) Answers vary, may include: absolute – births, deaths, marriage; relative – moving, starting job. Absolute ages happen at a given point in time. Relative ages are placed in relationship to other events.

4. Which events in your timeline occurred at a single moment in time? Which occurred gradually? Explain your answer.

(2 points) Answers vary, may include: single moment – birth, death, graduation; gradual – working, building house, going to school. Instantaneous events can be placed at a single point on the timeline, gradual events span segments of time.

Outcomes Part 2:

1. Summarize what this activity has shown you.
 - a. What observations can you make about the history of life on Earth based on the timeline?
 - b. Which events happened instantaneously or very quickly?
 - c. Which events happened gradually over long periods of time?

(2 points each)

- a. *Observations of the history of life – most events occurred in the last 500 million years (“explosion” of life), oldest fossils show the sequence of evolution (single celled organisms, multicellular organisms, invertebrates, fish, etc.), man is very young in comparison to other organisms.*
- b. *Instantaneous events – mass extinctions, volcanic eruptions.*
- c. *Gradual events – evolution, Pangea forming and breaking apart, mountains forming, Ice ages.*

Outcomes Part 3:

1. Superimpose the eras and eons of the geologic timescale onto the timescale of the earth’s history that we created as a class.
 - a. What eon or era represents the largest portion of geologic time?
 - b. What eon or era represents the shortest portion of geologic time?
 - c. In which eon or era did life on earth largely evolve?
 - d. What does this show us about the history of human beings as residents of our planet?

(1 point each)

- a. *Precambrian*
- b. *Cenozoic*
- c. *Phanerozoic*
- d. *Humans have a short residency on the planet.*

2. How does the timeline you created for an older adult compare to the timescale of the earth’s history? What similarities and differences did you notice?

(2 points) Responses vary. Earth’s history is divided into periods based on events that occurred, which is similar to how many of the students divide up their timelines; earth’s history contains both gradual and instantaneous events, similar to student timelines. Earth’s history is on a much larger scale (whole planet and its life) and over a much longer span of time (billions of years).

3.3.1 READ AND REFLECT: EARTH HISTORY

Reading Assignments:

Constructing the Geologic Timescale

The Age and Early Evolution of the Earth

Reflection Questions:

1. How were fossils and relative age-dating techniques used to create the geologic timescale?

A unique assemblage (group) of fossil organisms characterizes each interval of geologic history, so the timescale was first developed in the 1800's based on the appearance and disappearance of different organisms in the fossil record. Matching up fossil assemblages from different sedimentary rocks around the world allowed geologists to develop the geologic timescale. Igneous and metamorphic rocks were placed in the timescale based on their relative positions to the sedimentary rocks, because the technique of radiometric dating had not yet been discovered.

2. Why do the absolute ages listed on the geologic timescale change slightly, while the names of periods of time do not?

New data are constantly being collected to determine the exact age of the boundaries between the different periods of geologic time. The time period names and fossil assemblages that characterize each time period are agreed upon by international convention, and do not change.

3. Place the events leading to the formation of the earth in the correct order:

- A. The solar nebula formed as gas and dust were compressed by gravity
- B. The earth became hot enough to melt; heavy elements such as iron and nickel moved downward to form the core, and light elements "floated" on the surface
- C. The earth cooled, forming a primitive crust
- D. The impact of debris caused temperatures to rise in the early planets
- E. The sun and early planets formed as dust and debris were heated and condensed

- a. A, E, D, B, C
- b. E, A, D, C, B
- c. E, A, D, B, C
- d. A, E, D, C, B

4. What did the Earth's surface look like when it first formed?

- a. One large continent surrounded by water
- b. All water and no land
- c. Similar to today
- d. Rocks and molten rock, and no water

5. The oldest mineral found on earth has been dated at about 4.2 billion years old. The oldest fossils are only around 3.6 billion years old. However, scientists believe that the earth formed 4.6 billion years ago. How is the age of the earth determined?

The earth likely formed at the same time as other objects in the solar system. Samples of other objects (the moon, meteorites) where tectonic activity has not obliterated early rocks are dated to 4.5-4.6 billion years old, so the earth is estimated to have the same age.

(Discussion question) Young children are often not ready to understand the immense amounts of time that make up the earth's history. How would you address this issue in your teaching? What problems or misconceptions do you think you might encounter?

2 discussion points for substantive contribution.

