

GEOS 2900 Sample Activity

3.3 GEOLOGIC TIME

Introduction: Now that we understand how fossils and rocks are used to interpret past events and to put relative and absolute ages on these events, we can begin to explore the history of the earth. Over its history, the earth has seen both catastrophic and gradual changes. Comets and meteorites have struck the earth, mountains have been built up and gradually worn down, and oceans have risen to cover the continents then receded away. Even the continents themselves have moved and changed shape gradually over time. All of these physical changes accompanied changes in the organisms that inhabited the earth. From tiny one-celled creatures, life has evolved to include the vast number of species that currently inhabit the earth, as well as numerous species that are now extinct.

In this section, we will investigate major events in the history of the earth. We will also understand how the geologic timescale was constructed what information it provides. Materials in this section are designed to meet the following Michigan Elementary/Middle School Content Standards:

- Geosphere (V.1) E3. Describe natural changes in the earth's surface.
- Geosphere (V.1) E4. Explain how rocks and fossils are used to understand the history of the earth.
- Geosphere (V.1) M4. Explain how rocks and fossils are used to understand the age and geological history of the earth.

Materials are also designed to meet the following content areas of the Michigan Test for Teacher Certification in Elementary Science (93):

- Describe processes of structural change in the earth's crust (e.g., mountain building, seafloor spreading, weathering, erosion).
- Identify methods of determining the age of the earth.

Concepts: Earth History

Eon	Era	Period
Epoch	Age	Precambrian
Phanerozoic	Paleozoic	Mesozoic
Cenozoic	Mass extinction	Evolution

3.3.1 THE HISTORY OF THE EARTH

Problem: One of the more difficult ideas for people of all ages to comprehend is the immensity of time over which the Earth has formed and evolved. While most people have some sense that biology has an evolving history, the physical earth has one too, and they are linked together. The earth that we live on today is a result of many, many years of geological activities, some large like earthquakes and volcanic eruptions and some which, day to day, seem small and almost insignificant, like streams moving sand or plates moving a few centimeters per year.

Objective: To create a scale model of major events that occurred in the history of the earth and to understand how the geologic timescale was created.

Before You Begin:

1. How old do you think the earth is? How do you think scientists have determined the age of the earth?
2. What do you think are some of the significant events that have happened in earth's history?
3. Before coming to class, you will need to interview an older adult (preferably a grandparent). Ask this person to describe major events in his or her life (remember to take notes if you are collecting a verbal history). Be sure to include at least 10 major events, and to get dates for at least 5 events. Bring this history with you to class.

Activity Part I – Constructing a Timeline:

Materials:

Paper and colored pencils

Procedure:

1. Use the older adult's personal history to construct a timeline of his or her life. Your finished timeline should include the major life events and dates when some of these events occurred.
2. Once the events are listed, define and name major periods in the person's life based on criteria of your choosing. Define and describe at least 4 major periods.

Outcomes Part I:

1. Explain how you created the timeline and the criteria that you used to divide it up into 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.
3. Which events in your timeline are absolute ages? Which are relative ages? Explain your answer.
4. Which events in your timeline occurred at a single moment in time? Which occurred gradually? Explain your answer.

Activity Part 2 – The Earth’s Timeline:

Materials:

Index cards (8 total, preferably 4 each of 2 different colors)
Measuring stick
Computer with Internet access

Procedure:

1. Each person in the class will be assigned 1 major event in the history of the earth. Write down the event on the first index card, and tape the card to the timeline to mark the point in earth’s history when you think the event occurred.
2. On the second index card, write down your assigned event. Use the Internet and other classroom resources to research how long ago your assigned event occurred.
3. Write down the approximate “date” when your assigned event occurred on the second index card (for example, “formation of the earth – 4.6 billion years ago,” or “4.6 bya”).
4. As a class, we will construct a timescale (scale model) of the earth’s history using the board at the front of the classroom. Tape your card to the appropriate part of the timeline. If the events in the earth’s history become spaced closely together, think about ways in which you might expand this part of the scale.
5. Construct a smaller version of the class’ timescale for your notes.

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?

Activity Part 3 – Geologic Time

Materials:

Computer with Internet access

Procedure:

Use the following website to explore the geologic timescale:
<http://www.ucmp.berkeley.edu/help/timeform.html>.

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?

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?

The Geologic Timescale

Eon		Era		Period		Epoch	Age (millions of years ago)
Phanerozoic	Cenozoic	Quaternary	Neogene	Holocene		Present-0.01	
				Pleistocene		0.01-1.8	
		Tertiary		Pliocene		1.8-5	
				Miocene		5-23	
				Oligocene		23-34	
				Eocene		34-56	
	Paleocene		56-65				
	Mesozoic	Cretaceous		<i>Each period is typically</i>		65-145	
		Jurassic				145-200	
		Triassic				200-251	
	Paleozoic	Permian		<i>divided into Early, Middle, and Late Epochs.</i>		251-300	
		Carboniferous	Pennsylvanian			300-318	
			Mississippian			318-359	
		Devonian				359-416	
Silurian		416-444					
Ordovician		444-488					
Cambrian		488-542					
Precambrian	Proterozoic	Late			542-1000		
		Middle			1000-1600		
		Early			1600-2500		
	Archean	Late			2500-2800		
		Middle			2800-3600		
		Early			3600-4600		

Important events in the history of the earth:

- The earth was formed about 4.6 billion years ago.
- The earth's atmosphere developed during the Archean and was like the modern atmosphere by the end of the Proterozoic.
- The oldest known fossils (single-celled bacteria) are from the Early Archean.
- The first multi-celled organisms evolved during the Late Proterozoic.
- The oldest known fossils of bony fish and shellfish are from the Cambrian.
- Land plants evolved during the Silurian.
- The Devonian is known as the "Age of Fish."
- The Carboniferous is known as the "Age of Insects."
- The Mesozoic is known as the "Age of Dinosaurs."
- During the Mesozoic, all of the continents on earth came together to form a single landmass called Pangea. This super-continent broke up at the end of the Mesozoic when the Atlantic Ocean formed.
- Mammals and birds evolved during the Jurassic.
- The dinosaurs went extinct at the end of the Cretaceous.
- The Cenozoic is known as the "Age of Mammals."
- Human ancestors evolved during the Miocene. Modern humans evolved during the Pleistocene.
- The last Ice Age ended about 15,000 years ago.

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

(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?