Major Earth Events, Part Two

Lesson by Lacey Moore

Related Video Titles:

- *Cambrian Explosion*
- *Paleontology: Paleontologists Study Tracks and Traces*

Activity Subject: Cambrian Explosion and other major events in Earth's history

Grade Level: 6-8 grades

Introduction

In this lesson, students explore the Cambrian Explosion and other major Earth events, construct a scale for Earth's history and sequence some of Earth's major events along a timeline. Students consider what evidence exists for these events and then compare Earth's history to schoolyard and personal history.

Assessments Worksheet, Informal Discussions

Time Minimum 80 minutes

Group Size Varies

Materials

- "Major Earth Event Cards"-4 copies
- "Major Earth Event Card Key" to project or hand out to student groups
- Schoolyard Timeline from previous lesson, "Schoolyard Geology" (included on page 4 of this lesson)
- Personal and Earth's Timeline from previous lesson, "Major Earth Events, Part One" worksheet (included on pages 5 and 6 of this lesson)
- Any materials for showing or creating scale of Earth's history (e.g., calculators, 4.6 meter long string, etc.)

NEXT GENERATION SCIENCE STANDARDS

MS-ESS1-4 Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. *[Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of Homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.] [Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.]*

Connections to Nature of Science

Science Investigations Use a Variety of Methods
Scientific investigations use a variety of methods and tools to make measurements and observations.

LEARNING OBJECTIVES

After this lesson, students will be able to:

- Sequence the Cambrian Explosion along a timeline with other major life and physical events in Earth's history.
- Recognize that physical evidence exists that helps scientists reconstruct the history of a place.
- Compare Earth's history to schoolyard and personal history, especially in terms of scale.

Major Earth Events, Part Two-Page 2
Procedure - Teacher's Edition

Preparation

1. Print out four sets of both pages of "Major Earth Event Cards." Use different-colored paper for each set. (Card colors will be used as a grouping strategy later in the lesson.) Cards are organized in life and physical event categories and from most recent at top to oldest the bottom.

2. Cut the cards up before class. You may want to laminate them if you plan to use them with multiple classes. If you don't laminate them, remind students not to write on them so you can reuse them.

3. Organize cards into sets of 10 same-colored cards. The cards can include both life and physical. Each student group will get one set and then later in the lesson, meet up with the other two student groups that have the remaining 20 of the same-colored cards.

4. Review the procedure and decide how you will introduce the scale of Earth's history.

5. The day before this lesson, remind students that they'll need their schoolyard, personal and Earth timelines from previous lessons.

Procedure

1. **INTRODUCE LESSON OBJECTIVE AND ENGAGE PRIOR KNOWLEDGE. (5-10 MIN)**
   Before class, make sure the focus question is projected or on the board: *How do scientists figure out and sequence major events in Earth's history?* When students arrive, remind them that the Cambrian Explosion is one major event. In this lesson, they'll be exploring other major events. Then ask: *What are some of Earth's other major events?* and have them think-pair-share. Once partners have had a chance to discuss this, ask students to share their ideas. As they share, write student ideas on the board or chart paper. (Student ideas may include extinctions, dinosaurs, formation of atmosphere, volcanic eruptions, even events in human history like wars, migrations, etc.) Accept all ideas.

   Note: "Major Earth Event" Cards are based on information gathered in 2018. As new discoveries are made, dates may change more rapidly than this activity is updated. A way around this is to let students' research major Earth events online instead of providing the events and dates and/or periodically googling the events to ensure accuracy.

2. **STUDENTS ANALYZE AND SEQUENCE "MAJOR EARTH EVENT" CARDS. (20-30 MIN)**
   Pass out ten "Major Earth Event" Cards to student groups of three.
   Challenge them to:
   - Compare event cards to student ideas on the board. Are any the same?
   - Identify which are events in the evolution of life on Earth and which are events in the geological or physical history of Earth.
   - Observe relationships between events. Did any cause or contribute to other events?
   - Try to sequence the events from oldest to most recent.
   - Consider what physical evidence may exist that tells the story of the event.

Once most student groups have finished this, have them get together with the other two groups with the same color cards (the cards complete a set of 30 "Major Earth Event" cards) and try to sequence all 30 cards.

3. **SHARE "MAJOR EARTH EVENT" KEY WITH WHOLE CLASS. (10-15 MIN)**
   Project the "Major Earth Event Card Key" for students. Have them compare their sequence to the actual sequence. Then facilitate a class discussion:
   - How easy or hard was it to sequence the events? In small group? In large group?
   - What surprised you?
   - What connections might there be between events (e.g., especially cause and effect)?
   - What physical evidence might exist for each of these events? (e.g., sequence of rock layers, presence of minerals, fossil records, etc.)
   - What kind of categories might these events fall into? Are there any patterns in time periods or kind of event? Any events missing?
   - Do you think all the event cards should be considered major events in Earth's history? Why or why not?

   Note: The learning objective is not to have them memorize major events and times in Earth's history but rather get a sense of life and earth processes over time (e.g., evolution of life, landscape changing processes like volcanoes, mountain building, etc.) and glimpse the vast scale of Earth's history.

   Have students pull out their Earth's timeline from the previous lesson (included in this lesson). Ask students to choose 5-10 of the Earth events they feel are the most significant in Earth's history and add them. (All answers are acceptable here.)

4. **EMPHASIZE THE VAST SCALE OF EARTH'S HISTORY USING AN ANALOGY. (VARY)**
   To help students visualize the scale of Earth's 4.6 billion-year history, have them either calculate a scale or show them one. Here are some resources:

   a. The Cambrian Explosion on Shape of Life's website walks students through how to calculate the time of each Earth event using a clock analogy. (One hour equals 190,000,000 years. The middle of the Cambrian explosion would be at 9:06 p.m. and Homo sapiens appear at 11:59:56 p.m.) Here is the math (model it and leave it on the board for students):

   1 hour=190,000,000 years
   x hours=550,000,000 years
   550,000,000/190,000,000=2.9=2 hours, 54 minutes
   12 a.m.- 2 hours, 54 minutes=9:06 p.m.

   b. Another analogy is hanging a 4.6-meter long string in the classroom. If Earth's formation is at one end and present time at the other end, then the Cambrian explosion would be 4.05 meters from Earth's formation and 55 centimeters from present time. (One centimeter equals 10 million years.) It's a startling visual showing how recent life and its evolution is.

c. The CA NGSS Framework (Chapter 5, page 223) uses the analogy of a calendar year (Earth formed January 1, first modern humans 11:33 p.m. on December 31st.)

d. Another analogy uses a football field. See NPR's Skunk Bear's Earth History video.

5. **ADD EVENTS TO EARTH'S TIMELINE AND COMPARE SCALE TO SCHOOLYARD AND PERSONAL HISTORY TIMELINES. (15-20 MIN)**
   After students get a sense of the immense scale of Earth's history, have them pull out all of their timelines-schoolyard, personal and Earth. In pairs, ask students to compare their timelines and discuss questions like the following (project or write on board):
   - How do the major events on each timeline compare?
   - How does the time frame and scale compare?
   - What are the similarities and differences in how we uncover or identify these major events?
   - What limitations might our timelines include? Why?
   - What might the schoolyard's future, your future and the Earth's future look like? Why do you think that?
   - Any other comments or questions?

6. **WHOLE CLASS DEBRIEF (5-10 MIN)**
   Bring students back to the idea of *How do scientists figure out and sequence major events in Earth's history?* Have them jot down their ideas answering this question on the back of the Earth's timeline page.

Extensions

If you want a more kinesthetic version of this activity print out a class set of "Major Earth Event" Cards and give one to each student. Challenge the class to get in order of event occurrence, from oldest to most recent. Then show the key and compare to how they did. (If you have more than 30 students, replicate a few of the cards or find other Earth events to add.)

Resources

Earth Science Week Geologic Time Scale Analogy: http://www.earthsciweek.org/classroom-activities/geologic-time-scale-analogy

Evolution, PBS (note this is 2001 resource):
http://www.pbs.org/wgbh/evolution/change/deeptime/

A Journey Through Climate History, ABC:
http://www.abc.net.au/innovation/environment/cc_timeline.html

CA NGSS Framework, Grade Six-Eight-Integrated Course Model, p.223 of PDF:
https://www.cde.ca.gov/ci/sc/cf/scifwprepubversion.asp

Shape of Life
The Story of the Animal Kingdom

Major Earth Event Cards: Life-Page 1
Student's Edition

Intergovernmental Panel on Climate Change (IPCC) report Strongly links humans to climate change	First Earth Day Held to encourage environmental awareness.	First Modern Humans
"Lucy" Australopithecus afarensis, an early human relative	Non-avian Dinosaur Extinction	Early Flowering Plants
Archaeopteryx (first bird)	Early Mammals	Early Dinosaurs
"The Great Dying" Permian Extinction The largest of the five known extinction events. Over 90% of species went extinct.	Time of the Burgess Shale	Middle of the Cambrian Explosion
First Modern Cell	Photosynthesis Evidence of bacteria that produces its own food and energy	First Evidence of Life

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Major Earth Event Cards: Physical-Page 2
Student's Edition

Carbon Dioxide Level is 368.5 Parts Per Million As measured in the air at Mauna Loa Observatory	Ocean pH is 8.09 decreased nearly .10% in 120 years which represents 30% increase in acidity	Carbon Dioxide Level is 279 Parts Per Million As measured in Antarctic ice cores (from 1510 to 1900 the recorded change was 13.1 ppm)
Beginning of Most Recent Global Ice Age Scientists think we are in the fourth major ice age (yet in an interglacial period that began approximately 12,000 years ago)	Modern Continents Form	Siberian Traps Volcanic Eruptions Scientists think these eruptions lasted for around 900,000 years.
Carboniferous Period The trapped carbon from huge trees and swamps dying was transformed into fossil fuels, now used to power our cars and heat our houses.	Oxygen Levels Near Present Day	Great Mountain Ranges Form Two of Rodinia's former land blocks collide creating rocky formations (earliest parts of the Appalachian mountain range).
Ozone Layer in Place Except for bacteria, life has been in the oceans where risk of UV radiation is reduced. But now oxygen levels are high enough to form this protective layer.	First Snowball Earth In this period, there are thought to have been two ice ages (out of four total) resulting in ice covering the entire planet.	First Supercontinent Forms (Rodinia) Landmasses collide and break up over a billion years in three cycles. This is the oldest (Pannotia and Pangaea more recent).
Breathable Air	Ocean Forms As Earth cooled, water vapor escaped from the new surface crust. The resulting storms are thought to have flooded the Earth.	Formation of Earth

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Major Earth Event Card Key-Page 3
Student's Edition

Note: These are approximations as of 2018. Per the nature of science, dates may change as new discoveries are made (and more quickly than this lesson is updated).

YEARS AGO	EVENT
Carbon dioxide level is 385.5 parts per million	X years ago (measurement from 2009)
IPCC report links human to climate change	X years ago (published in 2007)
Ocean pH is 8.09	X years ago (measurement from 2000)
First Earth Day	X years ago (1970)
Carbon dioxide level is 279 parts per million	Over 250 years ago (1750)
First modern humans	200,000 years ago
"Lucy"	3,200,000 years ago
Beginning of most recent ice age	2.6 million years ago
Non-avian dinosaur extinction	66 million years ago
Early flowering plants	120 million years ago
Archaeopteryx (first bird)	140 million years ago
Modern continents form	175 million years ago
Early mammals	210 million years ago
Early dinosaurs	247 million years ago
"The Great Dying"-Permian extinction event	251 million years ago
Siberian Traps volcanic eruptions	252 million years ago
Carboniferous Period	354 million years ago
Oxygen level near present	400 million years ago
Great mountain ranges form	425 million years ago
Time of the Burgess Shale	508 million years ago
Middle of the Cambrian explosion	550 million years ago
Protective ozone layer in place	600 million years ago
First snowball Earth	635-800 million years ago
First supercontinent-Rodinia	1.1 billion years ago
First breathable air	2.4 billion years ago
First modern cell	2 billion years ago
Evidence of photosynthesis	3.7 billion years ago
First evidence of life	3.8-4.2 billion years ago
Oceans form	4.2 billion years ago
Formation of Earth	4.6 billion years ago

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Name_____ Period/Class_____ Date_____

Major Earth Events, Part Two-Page 4

Student's Edition

Note: You will be using this timeline throughout the next few lessons.

Timeline of Schoolyard History

1. Create a timeline of your schoolyard below.
   - Draw a vertical line below or on a separate sheet of paper. Title it "Schoolyard Timeline."
   - The top of the timeline represents present time. Decide what the bottom of your schoolyard represents (development of schoolyard site, construction of school, existence of ecosystem/site before school) and label it. Record the date or guess at the age of that time.
   - Based on your observations and inferences in the schoolyard, add major events and/or features in the schoolyard's history in chronological order on the timeline. *Remember oldest events are closer to the bottom. Recent events are closest to the top.*

Name_____ Period/Class_____ Date_____

Major Earth Events, Part Two-Page 5

Student's Edition

How do scientists figure out and sequence major events in Earth's history?

Note: You will be using the following timelines throughout the next few lessons.

Personal Timeline

2. Create a personal timeline below.
   - Use a metric ruler to draw a vertical line below or on a separate sheet of paper that is as many centimeters as you are old.
   - Think of three to five major life events (things that have happened in your life that have shaped who you are). Label them along the timeline at the appropriate measurement. *The bottom of the timeline represents when you were born so oldest events should be at the bottom.*

Name_____ Period/Class_____ Date_____

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Earth's Timeline

2. Create a timeline representing Earth's history below or on a separate sheet of paper.
   - Title the top of the page "Earth's timeline." Draw a vertical line the length of the page.
   - The top of the timeline represents present time. The bottom of the timeline represents Earth's formation. Label both and record a numeric guess of how old the Earth is. Add the Cambrian Explosion to where you think it belongs.
   - In the next lesson, you'll look at other major Earth event and add them to the timeline. *Remember oldest events should be at the bottom.*