

Geological Timeline Challenge

Suggested Grade Levels: **8-12**

Description: **Students will create a timeline of Earth history in the classroom and learn about major changes to the Earth and life through time.**

Standards Targeted:

- **ESS1.C: The History of Planet Earth** - *How do people reconstruct and date events in Earth's planetary history?*
- **ESS2.A: Earth Materials and Systems** - *How do the major earth systems interact?*
- **LS4.A: Evidence of Common Ancestry and Diversity** – *What evidence shows that different species are related?*
- **LS4.C: Adaptation** - *How does the environment influence populations of organisms over multiple generations?*
- **ESS2.E: Biogeology** - *How do living organisms alter Earth's processes and structures?*

Skills Targeted: **Conceptualizing time, comprehending inter-relatedness of Earth systems**

Goals:

1. **To provide students with a visual comprehension of the scale of geologic time**
2. **To provide students with an overview of major events in Earth history and how they connect to each other (e.g., evolution of photosynthesis and the rise of atmospheric oxygen).**
3. **To demonstrate to students that processes that occur slowly on human time scales, such as evolution and mountain building, can have dramatic outcomes when played out over geological timescales.**

Objectives—By the end of this activity, students will be able to:

1. **Describe major events in Earth history**
2. **Understand the scale of Earth history in relation to human timescales**

Time Needed: **One 45-60 minute class period; activity can be adjusted for shorter or longer class times.**

Materials:

- **Meter stick or measuring tape**
- **Masking tape**
- **String or yarn (at least 5 meters long)**
- **Event print out (pdf)**
- **Colored printer paper (not required)**



Step-By-Step Instructions:

Before Class: Measure out 4.6 meters in a straight line. Place a piece of tape every half meter from the beginning. Each meter represents 1 billion years of earth's history, each centimeter represents 10 million years, and each millimeter represents 1 million years. Mark the first piece of tape as the present, the next piece as 500 million years ago, the next as 1 billion years ago, and continue on – the last piece of tape will read 4.5 billion years ago, add one extra piece of tape at the end to represent 4.567 billion years ago and the formation of the planet.

20 Minutes: Break students up into small groups (3-5 students is ideal). Each group will get a subset of the 15 event cards (see included PDF "Timeline Cards" – these should be cut up along the black lines). Ideally, each group will get a set of cards printed out on different colored paper, or the sets can be marked with colored markers to distinguish between each group. All groups can place their 'formation of planet Earth' card at the beginning of the timeline. Ask students to work together to place the rest of the event cards in the appropriate place along their timeline. The students do not need any prior knowledge to put their events on the timeline – the idea is for them to work together to figure out their events – let the students know it's OK to be wrong!

10 Minutes: After each group has placed their events on the timeline, start a classroom discussion on where each group placed each event. Did everyone agree? If not, have groups try to justify their decisions.

15 Minutes: After the discussion, work with the students to place the events in their correct location along the timeline. As you re-place each event, engage the students in a brief discussion. If time permits, discuss any events that the students were surprised by. Note that the last two events will be totally indistinguishable from each other and from the end of the timeline – this is key! Events that we think of as being really old, like the extinction of mammoths, are actually very recent when compared to the entire history of the Earth.

Example questions:

- 1) Explain to the students that the evolution of life must logically pre-date the rise of atmospheric oxygen. Ask the students why this must be to get them to think about the link between these two events.
- 2) Engage the students in questions of process. For example, ask students what they think the rate of continental spreading is. The answer is about 2 cm / year. If students guessed much faster, discuss how even though the rate of plate movement is very slow, over many millions of years, it results in a huge ocean.
- 3) Discuss the relationship between plants and animals moving on to land. Why do you think animals came second?



Events:

1. Oceans and continents start to form – 4400 million years ago – 4.4 meters from present day (end of timeline)
2. First evidence of life –3500 million years ago – 3.5 meters from present day
3. Initial of atmospheric oxygen –2400 million years ago – 2.4 meters from present day
4. Evolution of eukaryotic (non-bacterial) life—1800 million years ago – 1.8 meters from present day
5. Cambrian Radiation of Animals—542 million years ago – 54.2 centimeters from present day
6. Plants move on to Land—450 million years ago – 45 centimeters from present day
7. Animals move on to Land—430 million years ago – 43 centimeters from present day
8. Permo-Triassic Mass Extinction – largest known!—251 million years ago – 25.1 centimeters from present day
9. Evolution of Mammals –195 million years ago – 19.5 centimeters from present day
10. Opening of the Atlantic Ocean—160 million years ago - 16 centimeters from present day
11. Extinction of the Dinosaurs—65 million years ago – 6.5 centimeters from present day
12. Rise of the Himalayan Mountains—20 million years ago - 2 centimeters from present day
13. Evolution of our species, *Homo sapiens*—200,000 years ago - 0.2 million years ago – 0.02 centimeters from present day (0.2 mm)
14. Extinction of the Woolly Mammoth—10,000 years ago – 0.01 million years ago – 0.001 centimeters from present day (0.01 mm)

Resources:

http://www.complex-life.org/timeline_events

More detailed information on some of the timeline events.

This website, Time Scale Creator, enables you to explore and create charts of any portion of the geologic time scale from an extensive suite of global and regional events in Earth History.

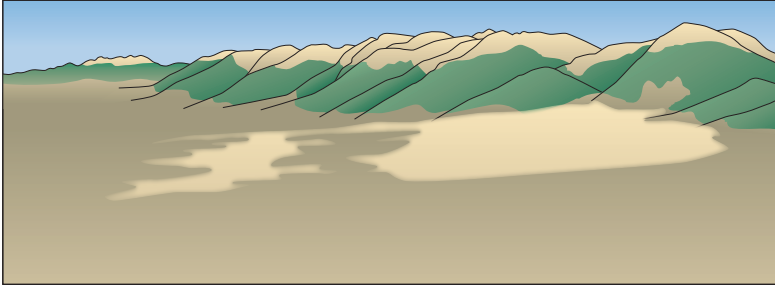
<https://engineering.purdue.edu/Stratigraphy/tscreator/index/index.php>

This site, Understanding Evolution for Teachers, provides comprehensive teaching resources on this topic.

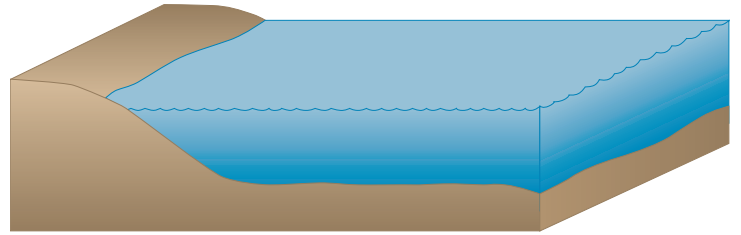
<http://evolution.berkeley.edu/evosite/evohome.html>



Rise of the Himalayan Mountains



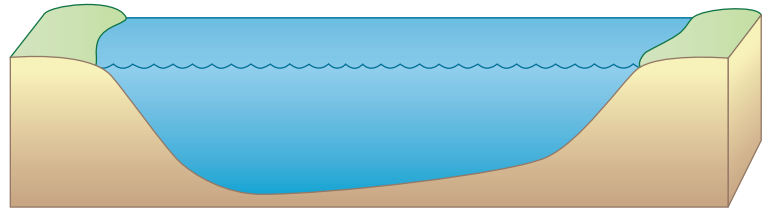
First Oceans & Continents



Animals Move onto Land



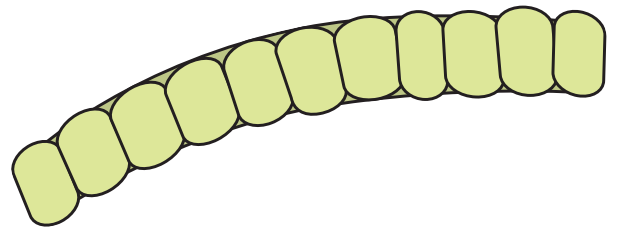
Opening of the Atlantic Ocean



First Animals



First Evidence of Life



First Mammal



Rise of Atmospheric Oxygen



Extinction of Woolly Mammoths



First Land Plant



Extinction of Dinosaurs



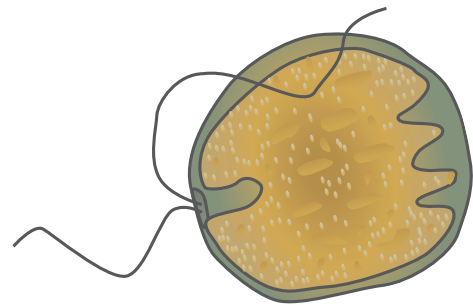
First Human



Formation of Planet Earth



First Eukaryote



Permo-Triassic Mass Extinction

