

Geologic Timeline Student Guide

In this activity you will:

1. Examine temperature, CO₂ concentration, and ice cover data to investigate how climate has changed during the last 715 million years.
2. Understand that long term climate patterns provide evidence for fluctuating CO₂ concentrations.
3. Record and analyze a long-term global climate data set.

In this learning activity, you will use a Web-based Geologic Timeline to understand how the climate has changed in the last 715 million years. Nine distinct time periods are displayed on the timeline ranging from the present day to 715 million years ago. You will examine and interpret global temperature, CO₂ concentration, and ice cover data to infer what the global climate was like during specific time periods and relate this evidence to the current global warming discussion.



Step 1: Download Data

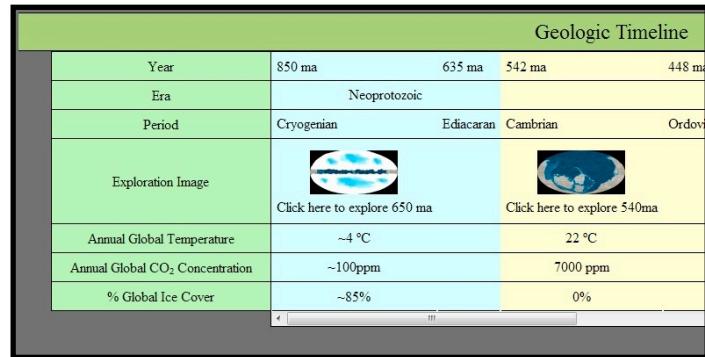
1. Open your Web browser. Go to www.ei.lehigh.edu/learners/cc/.
2. Click **Geologic Timeline**.



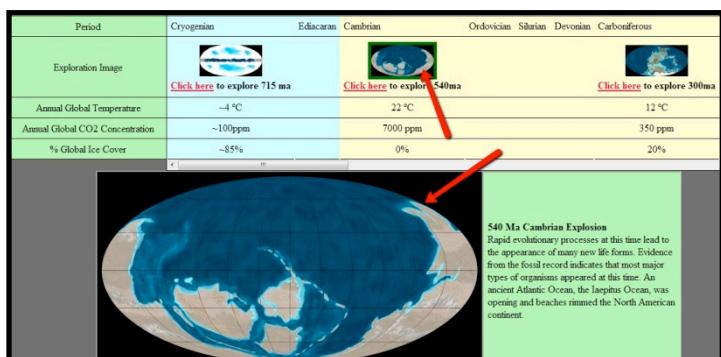
Step 2 : Geologic Timeline Overview

The Geologic Timeline shows the average global temperature, atmospheric CO₂ concentration (ppm), and the percent of global ice cover for nine distinct time periods throughout Earth's history. The pictures associated with each time period depict the location of the continents during that time period. They also show the distribution of ice cover for that time period.

1. The Geologic Timeline opens with a column of row labels on the left hand side and a scrolling timeline that moves to the right.
2. The timeline rows include:
 - a. Year - The years shown encompass the time period of the reconstructions below.
 - b. Era - The geologic name for the broad time interval encompassing the reconstruction.
 - c. Period - The geologic name for the specific time period within the era.
 - d. Exploration Image - A thumbnail picture of the locations of the continents during that time period and the distribution of ice cover.
 - e. Average Global Temperature - The average global temperature for the time period of interest.
 - f. Average Global CO₂ Concentration - The average global CO₂ for the time period of interest.
 - g. % Global Ice Cover - The % global ice cover for the time period of interest.



3. The small thumbnail picture associated with each time period is an "exploration image." When the thumbnail picture is selected, a larger image will appear with a text box at the bottom of the screen. The text box contains additional information about the climate during that time interval.



4. The Geologic Timeline includes the following abbreviations that will be useful to remember:
 - a. CO₂ - carbon dioxide
 - b. ppm - parts per million
 - c. Ma - millions of years ago
 - d. ka - thousands of years ago



Step 3 : Using the Geologic Timeline

<p>1. The Geologic Timeline includes 9 time periods that show a range of climates that occurred during Earth's history. The time periods used in this activity are to the right.</p>	<p>715 million years ago 540 million years ago 300 million years ago 100 million years ago 2 million years ago 50 thousand years ago 10 thousand years ago 1880 2010</p>																																																																								
<p>2. The entire Geologic Timeline can be viewed by using the scroll bar underneath the last row of text. The first few time periods are initially displayed. Scroll to the right in order to access the rest of the time periods.</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="9">Geologic Timeline</th> </tr> <tr> <th>Year</th> <td>850 ma</td> <td>635 ma</td> <td>542 ma</td> <td>448 ma</td> <td>444 ma</td> <td>416 ma</td> <td>359 ma</td> <td>299 ma</td> </tr> <tr> <th>Era</th> <td colspan="4">Neoproterozoic</td> <td colspan="4">Paleozoic</td> </tr> <tr> <th>Period</th> <td>Cryogenian</td> <td>Ediacaran</td> <td>Cambrian</td> <td>Ordovician</td> <td>Silurian</td> <td>Devonian</td> <td>Carboniferous</td> <td>Permian</td> </tr> </thead> <tbody> <tr> <td>Exploration Image</td> <td></td> <td></td> <td></td> <td>Click here to explore 715ma</td> <td>Click here to explore 540ma</td> <td>Click here to explore 300ma</td> <td></td> <td></td> </tr> <tr> <td>Annual Global Temperature</td> <td>-4 °C</td> <td></td> <td>22 °C</td> <td></td> <td>12 °C</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Annual Global CO₂ Concentration</td> <td>-100 ppm</td> <td></td> <td>7000 ppm</td> <td></td> <td>350 ppm</td> <td></td> <td></td> <td></td> </tr> <tr> <td>% Global Ice Cover</td> <td>~85%</td> <td></td> <td>0%</td> <td></td> <td>20%</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Geologic Timeline									Year	850 ma	635 ma	542 ma	448 ma	444 ma	416 ma	359 ma	299 ma	Era	Neoproterozoic				Paleozoic				Period	Cryogenian	Ediacaran	Cambrian	Ordovician	Silurian	Devonian	Carboniferous	Permian	Exploration Image				Click here to explore 715ma	Click here to explore 540ma	Click here to explore 300ma			Annual Global Temperature	-4 °C		22 °C		12 °C				Annual Global CO ₂ Concentration	-100 ppm		7000 ppm		350 ppm				% Global Ice Cover	~85%		0%		20%			
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<p>3. Clicking on the “Exploration Image” associated with each time period will activate a text box below the timeline that contains additional information about that time period.</p>	<p>715 Ma Snowball Earth Earth at this time is often called "Snowball Earth" by scientists. All of the tectonic plates were joined together in one super continent. Glaciers and ice sheets have been found in what was once tropical areas at that time. This provides evidence that Earth was nearly frozen. The high albedo of the ice lead to planetary cooling. The Northern and Southern continents were beginning to separate.</p>																																																																								
<p>4. Observe the “Exploration Image” and locate the Annual Average Global Temperature (#1), Annual Average CO₂ Concentration (#2), and the % Global Ice Cover (#3) for that time period.</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Year</th> <td>542 ma</td> <td>448 ma</td> </tr> <tr> <th>Era</th> <td></td> <td></td> </tr> <tr> <th>Period</th> <td>Cambrian</td> <td>Ordovician</td> </tr> </thead> <tbody> <tr> <td>Exploration Image</td> <td></td> <td>Click here to explore 540ma</td> </tr> <tr> <td>Annual Global Temperature</td> <td>22 °C</td> <td></td> </tr> <tr> <td>Annual Global CO₂ Concentration</td> <td>7000 ppm</td> <td></td> </tr> <tr> <td>% Global Ice Cover</td> <td>0%</td> <td></td> </tr> </tbody> </table>	Year	542 ma	448 ma	Era			Period	Cambrian	Ordovician	Exploration Image		Click here to explore 540ma	Annual Global Temperature	22 °C		Annual Global CO ₂ Concentration	7000 ppm		% Global Ice Cover	0%																																																				
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Step 3 : Geologic Timeline Analysis

1. Beginning with the 715 Ma time period, select the small “**Exploration Image**” icon and read the text in the box that appears.
2. Record the **Annual Average Global Temperature, Annual Average CO₂ Concentration, and the % Global Ice Cover** in the data table provided **for Question #1** on the **Student Exploration Sheet**.
3. After the data has been recorded for the 715 Ma time period, repeat this process and gather data for the eight other time periods. All data should be recorded in the table on the **Student Exploration Sheet**.
4. Following the information provided in Question #2, plot the data from Question #1 onto the graph on the **Student Exploration Sheet**.
5. Answer Analysis Questions #3-8 on the **Student Exploration Sheet**. The questions should be answered in complete sentences.