

# Geologic Time

Level: MS  
Facilitator Guide

## LESSON DETAILS

**Objective:** Students will construct a model of the geologic time scale to contextualize major events in the geologic history of the Earth, and specifically Nevada.

### Standards

#### NVACSS and NGSS

- **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.
- **MS-ESS2-2:** Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
- **DCI:** The History of Planet Earth; Earth Materials and Systems
- **SEP:** Developing and Using Models; Constructing Explanations; Analyzing and Interpreting Data
- **CCC:** Scale, Proportion, and Quantity; Patterns; Stability and Change

#### Career Readiness

- **1.2.9:** Demonstrate mathematics skills by using mathematical reasoning to accomplish tasks.

### Materials

- receipt paper rolls
- colored markers
- chalk (optional, if working outside for **Explain**)
- scissors
- tape measures or meter sticks
- calculators
- two colors sets of sticky notes
- copies of "Stratigraphic Columns" handout
- copies of "Geologic Timeline Planning" handout
- copies of "Select Major Events on Earth" handout

### Lesson Summary

Students begin by discussing Earth's history and relating it to rock layers visible in outcrops. Students will then correlate stratigraphic columns and discuss significant biological and geological events in terms of Earth's history. Constructing a timeline of Earth's history will help students visualize the relative lengths of the major divisions of geologic time. Students will then focus on Nevada-specific events to learn how the state's landscape was shaped over time. The lesson concludes with students creating and annotating another geologic time visual, and discussing it in small groups.



## Preparation

- Some resources to become familiar with the geologic timeline and events that occurred throughout Earth's history: UC Berkeley's [UCMP Web Time Machine](#), Enchanted Learning's [Geologic Time Scale](#), and National Park Service's [Geologic Time](#).
- For **Explain**, students will create a geologic timeline. Determine if you want students to work outside (potentially using chalk to mark up a sidewalk) or inside (potentially in a hallway marking up receipt paper). Gather supplies students could use to create timelines.

## Engage

1. Facilitate a class discussion around the following questions:
  - ▶ *How do we know what happened on Earth before humans were around to witness and record it?*
  - ▶ *What kinds of clues do geologists use to learn about Earth's history?*
  - ▶ *How could you organize Earth's long history?*
2. Show students a rock outcrop or roadcut with sedimentary layers (potentially from [Random Roadcuts #6: Central Nevada on US-6](#)).
3. Facilitate a discussion as students observe the layers:
  - ▶ *What do you notice about the different layers?*
  - ▶ *How do you think these layers formed?*
  - ▶ *How old do you think these rocks are? What might have been happening on Earth when each layer formed?*

## Explore Stratigraphic Columns

1. Introduce stratigraphic columns by sharing that they are diagrams of rocks, just like the rock outcrops shown in [Engage](#).
2. Distribute copies of "Stratigraphic Columns" handout for students to cut and work with.
  - a. First, point out that the top of each outcrop is labeled with a "T."
  - b. Next, ask them to cut out the segments.
3. As a class, discuss student observations of the columns and answer any initial questions.



- a. Guide students into noticing that certain layers are the same. Share that layers with the same symbols represent the same rock type. In this example, the rock types are sandy shale, sandstone, shale, limestone, and dolomite.
  - b. Discuss the fossils found in these rock layers. Share how fossils can be used to correlate stratigraphic columns and some can even provide a more exact age of the rock layer, otherwise known as index fossils.
4. Ask students to assemble the stratigraphic columns so similar rock types and fossils align, ensuring that each column is oriented with the "T" at the top.
  5. Introduce terms as they relate to the stratigraphic layers: **the law of superposition**, which states that in a sequence of undeformed rock layers the oldest strata are found at the bottom of a sequence, and **the principle of original horizontality**, which states that layers of sediments are deposited horizontally.

## Explore Geologic Events\*

\*Based on "**Demonstrating Geologic Time**" by Polly R. Sturgeon with the Indiana Geological & Water Survey

1. Distribute the "Select Major Events on Earth" handout to the students.
2. Ask them to cut out the event cards and arrange them in the order they think these major events occurred, from oldest to most recent.
3. Have the class work together to come to a consensus of the sequence of events. Discussion should center on their reasoning for how they sequenced the events.
4. When most students are satisfied with the order, share how many are incorrect and allow them to revise the order. Continue until they have determined the correct answer: Continents form, Oceans form, First jellyfish, First fish, First insects, First mammal, First grass, First humans.

## Explain

1. Introduce the **Geologic Time Scale** and how it organizes Earth's history into eons, eras, periods, and epochs.
2. Have students work in groups to brainstorm ways to create a physical model of the geologic time scale.
  - Share the available materials with the class, and narrow down the model choices or modify previous suggestions to utilize the available materials.



- The rest of this section is written for creating a model geologic timescale on a receipt paper roll.
3. Distribute the “Geologic Timeline Planning” handout and have students record their plan.
    - a. Have students determine the scale for their timeline, knowing it needs to go back at least 4.6 billion years and considering the available space for their model. You can share the maximum length with students, or for a more challenging version of the activity, let students select their desired length (which would result in many different scale and length possibilities). See Table 1: Geologic Time Broken into Relative Units from [On a Roll with Geologic Time](#) for measurements using the scale 1 cm = 25 million years for ~2m timeline.
    - b. Have students use their scale to calculate the measurements for each time on the handout.
    - c. Optionally, ask students to check in with you before continuing on with constructing their model.
  4. Students will measure a portion of receipt paper for their model and mark it with each time period following their calculations.
  5. Revisit the “Select Major Events on Earth” handout.
    - a. Ask students to guess when those events took place, and where they would fit on the timeline.
    - b. Share the occurrence of each event, and have students calculate where it would be placed on the timeline.
  6. “Walk through time” with students on one of the timelines from the beginning to the present. Highlight key organisms, extinctions, and geologic events.
  7. Facilitate a class discussion about the timeline, potentially asking students:
    - ▶ *Which parts of Earth's history take up the most space on our timeline? Why do you think that is, and what does it tell us about Earth's early history?*
    - ▶ *Looking at the timeline, do you notice any patterns in the occurrence of major extinctions or geologic events?*
    - ▶ *How much of Earth's history have humans been a part of?*
    - ▶ *If we were to add another billion years to the timeline, what changes or patterns might we expect to see in Earth's systems or life forms?*
- Optionally, watch a 12-minute video from PBS Learning Media, [A Brief History of Geologic Time](#).



## Elaborate

8. Ask students to share what they notice about the land and rocks in Nevada (e.g., red sandstone).
9. Introduce that the land we call Nevada has been forming throughout Earth's history. Use BioInteractive's **EarthViewer** to visualize the dynamic evolution of Earth's surface over time. Emphasize that global processes have shaped the regional geology of Nevada.
10. Focus in on Nevada's history by discussing each event listed in **Table 1. Geologic time scale with major events in Nevada history** from **Geology of Nevada** by Jonathan G. Price. Highlight key events such as volcanic activity, formation of mountain ranges, and the deposition of valuable mineral resources.
11. Have students return to their timelines. Using the scale they established, calculate the placement of each significant event that helped shaped Nevada's landscapes and mark the locations of these events with a different color of sticky notes along the opposite side of the timeline.
12. Have students make comparisons between significant events in Earth's history with those specific to forming Nevada.
  - ▶ *What patterns do you notice between Nevada's geologic timeline and the overall geologic time scale?*
  - ▶ *How do regional events in Nevada connect with broader events in Earth's history?*
13. Project a stratigraphic column from northeast Nevada in Figure 2 of **Mesozoic tectonics and metamorphism in the Pequop Mountains and Wood Hills region, northeast Nevada: Implications for the architecture and evolution of the Sevier orogen**.
  - a. Allow time for students to make observations of the figure.
  - b. Ask students to identify connections between specific rock layers in the stratigraphic column and corresponding events on their timeline.
14. Facilitate a class discussion to synthesize how rock layers can provide evidence for major geological events in Earth's history.
15. Optionally, share images of outcrops or physical rock samples that represent key periods in Nevada's geologic history. For each sample or image, prompt students to determine where that time interval appears on their geologic timelines.
  - **Precambrian Metamorphic Rocks** (2,500–1,700 million years ago): Gneiss or schist from the East Humboldt Range or southern Nevada represent some of the oldest rocks in Nevada.
  - **Cambrian Limestone and Sandstone** (543–490 million years ago): Cambrian limestone with marine fossils illustrate a time when Nevada was submerged under a shallow sea.



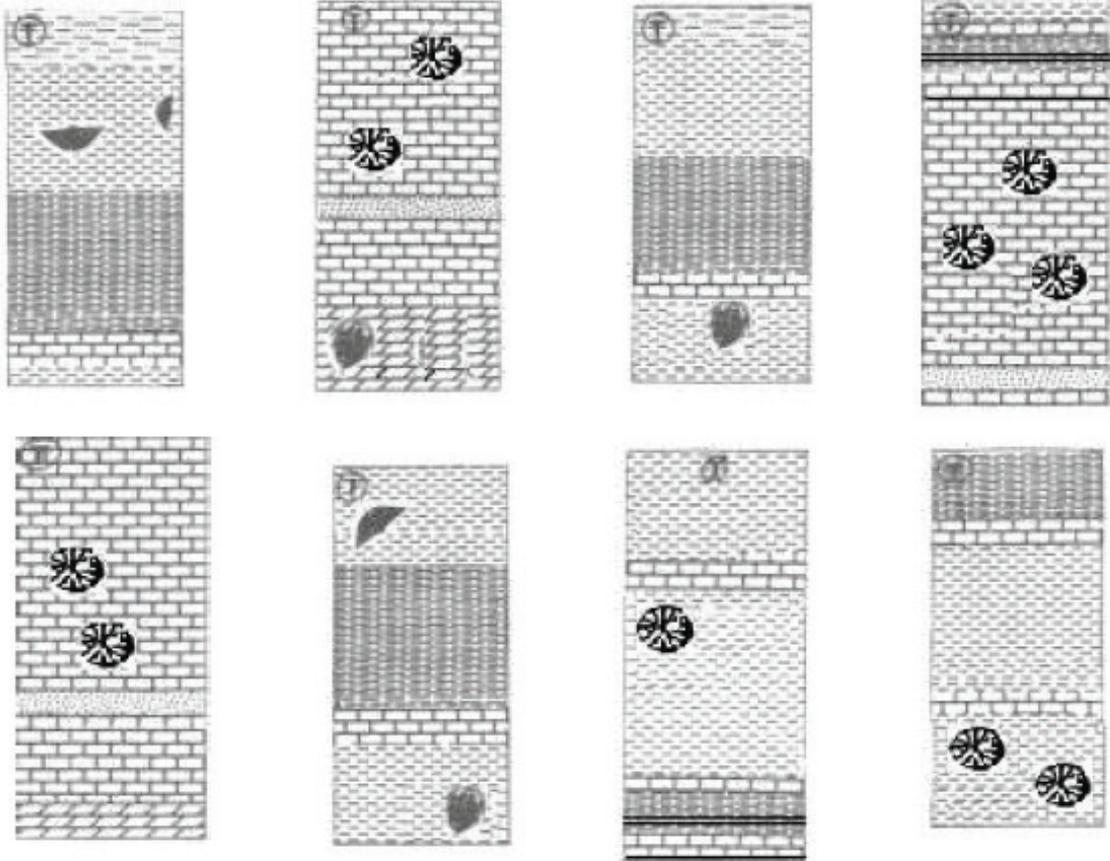
- **Triassic Marine Reptile Fossils** (251–208 million years ago): Image of ichthyosaur bones to communicate the presence of large marine reptiles during the Triassic and to highlight Nevada’s role as a marine environment.
- **Jurassic Sandstone and Copper Deposits** (208–144 million years ago): Sandstone from Valley of Fire State Park to speak to the arid, desert-like conditions or copper samples/deposits from Yerington to speak to mineral formation during this time of tectonic activity.
- **Cretaceous Granite and Ore Deposits** (144–65 million years ago): Granite from the Sierra Nevada or ore samples containing copper, molybdenum, and/or tungsten from Ruth, Ely, or Tonopah to represent a time of major igneous activity.
- **Tertiary Volcanic Rocks and Gold Deposits** (65–1.6 million years ago): Ash-flow tuffs or epithermal gold quartz veins from northern Nevada, to highlight more volcanic activity.
- **Quaternary Basin and Range Features** (1.6 million years ago – Present): Alluvial deposits from valley floors or glacial moraines in mountain ranges to illustrate how the basin and range area continues to evolve.

## Evaluate

1. Have students review their completed geologic time scale and design a one-page visual (e.g., pie chart, bar graph, spiral timeline) that shows the relative lengths of each interval.
2. Have students annotate their visual to include at least five significant or intriguing events.
3. Ask students to reflect on both representations:
  - a. Which intervals occupy the greatest share of Earth’s history?
  - b. Where do humans fall on both visuals?
  - c. How did you select which events to include? Why did you consider each significant?
4. Have students share visuals in small groups, comparing and contrasting the different models while using accurate geologic vocabulary.

# HANDOUT

## Stratigraphic Columns

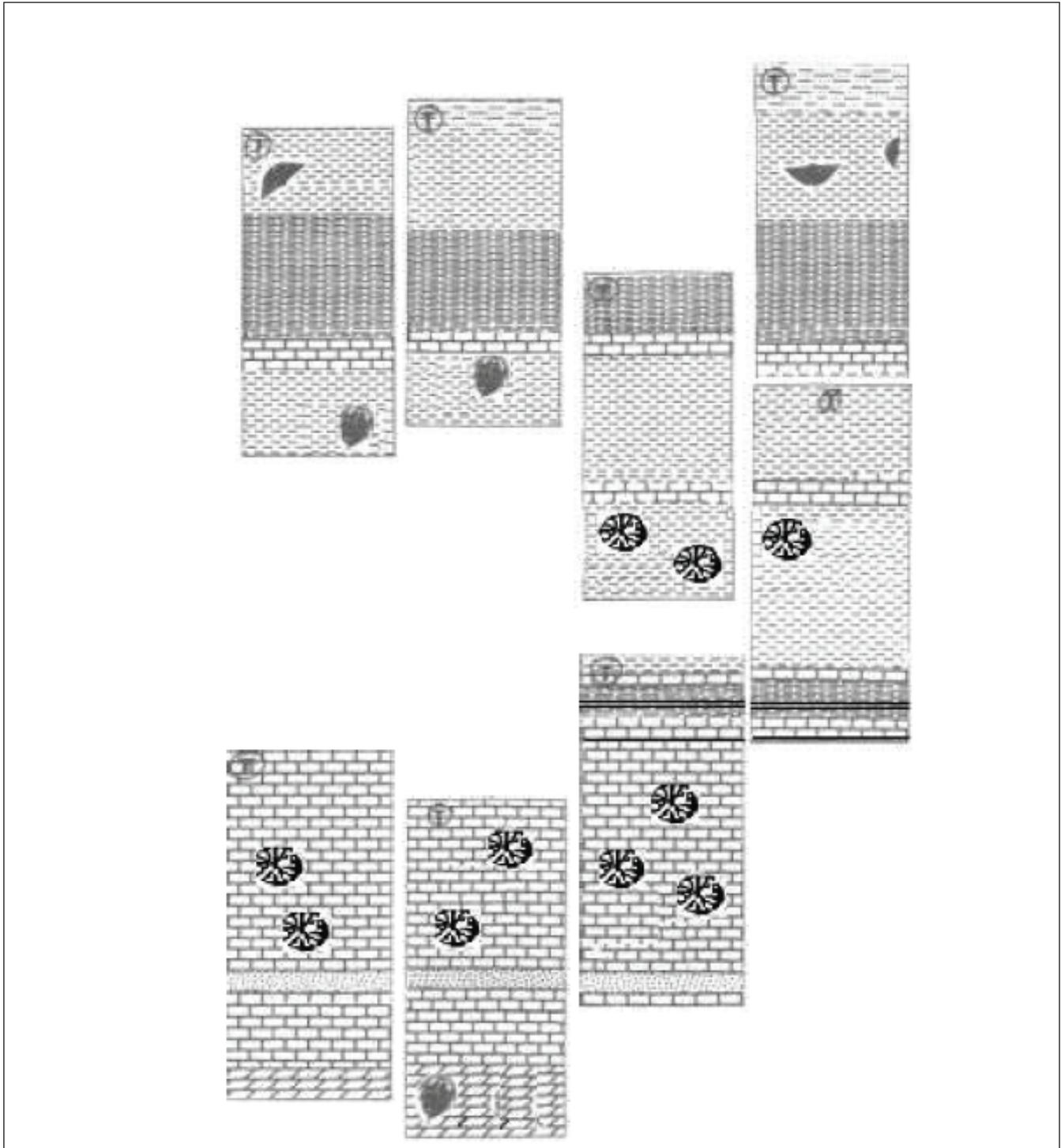


The image displays eight vertical stratigraphic columns, each representing a different geological sequence. Each column is composed of various rock layers, some of which contain fossils. The fossils are represented by symbols: a shell for brachiopods, a star-like shape for corals, and a trilobite for trilobites. The columns are arranged in two rows of four. The top row shows columns with varying fossil distributions and rock layer patterns. The bottom row shows columns with different fossil distributions and rock layer patterns. A legend at the bottom left identifies the symbols: a shell for Brachiopods, a star-like shape for Corals, and a trilobite for Trilobites.

-  Brachiopods
-  Corals
-  Trilobites

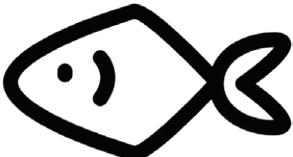
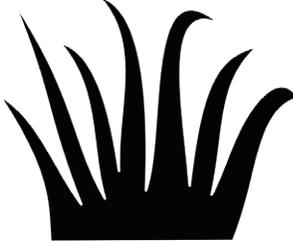
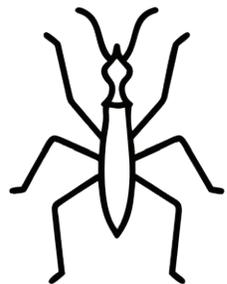
## SUGGESTED RESPONSE

### Stratigraphic Columns



# HANDOUT

## Select Major Events on Earth

<p>First fish</p>  	<p>First grass</p>  
<p>First humans</p>  	<p>First insects</p>  
<p>First jellyfish</p>  	<p>First mammal</p>  
<p>Continents form</p>  	<p>Oceans form</p>  

Icons from Noun Project, CC BY 3.0: fish: Yoo Seungyeon; grass: Ishaq\_hmad; humans: Edy Susanto; insect: IcoGenix; jellyfish: BnB Studio; rodent: Md Moniruzzaman; volcano: Eklip Studio; ocean: Vectorstall.



# HANDOUT

## Geologic Timeline Planning

Describe where and how you place to create your geologic timeline.

What is the maximum length you want your timeline to be? \_\_\_\_\_

What will be your scale for the timeline? \_\_\_\_\_ years = \_\_\_\_\_

Using your scale, calculate the measurement for each of the geologic time periods:

Unit	Name	Start (million years before present)	Scale
Eons	Phanerozoic	542	
	Proterozoic	2500	
	Archean	3800	
	Hadean	4570	
Eras	Cenozoic	65	
	Mesozoic	251	
	Paleozoic	542	
	Neo-Proterozoic	850	
	Meso-Proterozoic	1600	
	Paleo-Proterozoic	2500	
	Neo-Archean	2800	
	Meso-Archean	3200	
	Paleo-Archean	3600	
	Eoarchean	3800	
	Lower Imbrian	c. 3850	
	Nectarian	c. 3920	
	Basin Groups	c. 4150	
	Cryptic	c. 4570	



Periods	Neogene	23	
	Paleogene	65	
	Cretaceous	145	
	Jurassic	199	
	Triassic	251	
	Permian	299	
	Carboniferous (Pennsylvanian)	318	
	Carboniferous (Mississippian)	359	
	Devonian	416	
	Silurian	443	
	Ordovician	488	
	Cambrian	542	
	Ediacaran	630	
	Cryogenian	850	
	Tonian	1000	
	Stenian	1200	
	Ecstasian	1400	
	Calyymmian	1600	
	Statherian	1800	
	Orosirian	2050	
Rhyacian	2300		
Siderian	2500		
Epochs	Holocene	0.011	
	Pleistocene	1.8	
	Pliocene	5.3	
	Miocene	23	
	Oligocene	34	
	Eocene	56	
	Paleocene	65	