

Geologic Time

 Level: HS
 Facilitator Guide

LESSON DETAILS

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

Standards

NVACSS and NGSS

- **HS-ESS1-5:** Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
- **HS-ESS2-1:** Develop a model to illustrate how Earth’s internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
- **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
- tape measures or meter sticks
- calculators
- post its (optional)
- scissors
- copies of “Stratigraphic Columns” handout
- copies of “Geologic Events” handout

Lesson Summary

Students begin by reviewing major events in Earth’s history and creating a scaled timeline to visualize geologic time, including key events specific to Nevada. Students observe rock outcrops and assemble stratigraphic columns to understand how layers and fossils reveal Earth’s past. Through a jigsaw activity, they explore dating methods and how each is used to interpret Nevada’s geology. Students then research how major mineral deposits in Nevada formed and add these to their timelines. The lesson concludes with students selecting significant geologic events to analyze and explain their impact on Nevada’s landscape and resources.



Preparation

- For **Engage**, decide whether the timeline activity will take place indoors (e.g., hallway or gym) or outdoors (e.g., sidewalk or sports field). Depending on time constraints and students' prior knowledge, you can either create a timeline as a class, or pre-mark the timeline locations according to the appropriate scale and label them with students. Alternatively, if time is limited, consider showing **a video of the activity**, though it is recommended to actively engage students in the activity.
- Football field: **Field of Time**
- 50-foot rope model: **Teaching Time in Large Enrollment Intro Classes: An Active Approach**
- 5-meter, 50-meter, 50-feet, 24-hour timeline: **Timeline Cheat Sheet for Teachers**
- 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**.

Engage

1. Review with students what they remember about **geologic time**.
2. Have students quickly sort the following events in order of when they think they occurred in Earth's history: Continents form, Oceans form, First jellyfish, First fish, First insects, First mammal, First grass, First humans.
3. Review the geologic timescale with students by creating a timeline. Potentially go out onto a football field with flag markers or a long sidewalk with chalk to create a geologic timeline as a class (examples given in **Preparation**).
4. Go through the sequence of the events from step 2 in relation to the timeline you just created as a class.

Explore

1. Show students a rock outcrop or roadcut with sedimentary layers (potentially from **Random Roadcuts #6: Central Nevada on US-6**).
2. 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 evidence might you collect from the rocks to determine their age?*

3. Introduce stratigraphic columns.
4. Distribute copies of the “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.
5. 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 the exact age of the rock layer, otherwise known as index fossils.
6. 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. The correct order of the columns is displayed on the **Suggested Response** at the end of the lesson.
7. Introduce terms as they relate to rock layers and stratigraphic columns: **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.
8. Share a stratigraphic column of Nevada, such as:
 - Figure 2 in **Rapid Oligocene to early Miocene extension along the Grant Range detachment system, Nevada, U.S.A.: insights from multi-part cooling histories of footwall rocks**
 - **The South Grass Vally – Stratigraphic Section** from Nevada Exploration ([Download image here](#))
 - Figure 2 in **Mesozoic tectonics and metamorphism in the Pequop Mountains and Wood Hills region, northeast Nevada: Implications for the architecture and evolution of the Sevier orogen**
9. Have students analyze the column(s) to determine if the layers are all sequenced with the oldest rocks underneath younger rocks.



Explain

1. Have students create their own timelines about Nevada's geologic history, potentially utilizing receipt paper rolls, markers, post its, major events in Earth's history (such as **those listed on page 6 in "Demonstrating Geologic Time"**), and **Table 1. Geologic time scale with major events in Nevada history**. Alternatively, have students create a timeline online.
 - a. Students should consider the length of their model and the scale they want to use as they calculate and mark the different times on their model.
 - b. Students should include both major Earth events and major events in Nevada history.
 - ▶ *Assign student groups different time intervals that they will lead telling about Nevada's history.*
 - ▶ *"Walk through time" with students as a class, having each group share about important events in formed Nevada when it is their turn. The scale of each group's model will likely be different; discuss this as you move between the different timelines.*

Elaborate Dating Methods

1. Project slide 18 from **Geology of Nevada PowerPoint Presentation**, which displays an outcrop with older rocks on top of younger rocks. Ask students to infer the relative ages of the rock layers.
2. Reveal the ages of the layers on slide 19 and facilitate a discussion with students about how older rocks could end up on top of younger rocks.
3. Refer back to the stratigraphic column(s) from **Explore** step 8. Discuss the stratigraphic column as it relates to the geologic timeline with students. Ask:
 - ▶ *What clues might scientists look for to determine the relative ages of rock layers?*
 - ▶ *How might scientists know the exact (absolute) age of a rock layer?*
 - ▶ *Why is it important to understand both the relative and absolute age of rock layers?*
4. Conduct a jigsaw with student groups to review and/or learn more about dating methods.
 - a. Have each student in a group be assigned to a different rock dating method:
 - Relative Dating
 - Absolute Dating
 - Fossils



- Correlation
 - b. Regroup students so those assigned to the same dating method can work together and discuss their assigned dating technique as needed.
 - c. Have students do a **close read** of their method in **Chapter 7: Geologic Time**.
 - d. Have students return to their original group and share what they learned. Each student should explain the method they read about, how it can be applied, and limitations or challenges of using this method.
5. Share some examples of how the dating methods have been used throughout Nevada:
- **Relative Dating:** In the Pequop Mountains, the relative ages of limestone and shale layers were determined using cross-cutting relationships to understand the timing of faulting events.
 - **Absolute Dating:** Radiometric dating of volcanic ash layers in the Lahontan Basin helped determine the ages of sedimentary deposits formed during the Pleistocene Epoch.
 - **Fossils:** In the Berlin-Ichthyosaur State Park, the presence of ichthyosaur fossils has helped scientists pinpoint the age of Triassic marine deposits.
 - **Correlation:** Stratigraphic correlation of copper deposits near Yerington connects volcanic rocks of the Jurassic period with similar layers found across northern Nevada.

Elaborate Mineral Deposits

1. (if I delete this the numbering below is wrong...)
2. Assign student groups a mineral deposit to focus on:
 - Carlin Gold Deposit
 - Comstock Lode Silver Deposit
 - Robinson Copper Deposit
3. Have students research how the mineral deposit formed and add details to their geologic timeline from **Explain**.
4. Have each group present their findings and discuss how their assigned deposit relates to the overall geologic timeline:
 - ▶ *What geologic processes are common across multiple deposits?*



- ▶ *How does the formation time of the various deposits compare?*
- ▶ *How might ongoing geologic processes in Nevada lead to the formation of new mineral deposits? Where and how might such deposits form?*

Evaluate

1. Have students review their constructed timelines from **Explain** and select 2-3 significant events related to Nevada's geologic history.
2. Ask students to write a brief analysis for each selected event addressing the following questions, researching the events in more detail as needed:
 - ▶ *What geological process(es) led to the event?*
 - ▶ *What evidence is there for the timing of this event?*
 - ▶ *How did this event shape Nevada's landscape and/or resources?*
 - ▶ *What other geologic events or processes are connected to or likely happened in the area around this event?*
3. Discuss the student-selected events and analyses in order of earliest event to most recent event.



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:

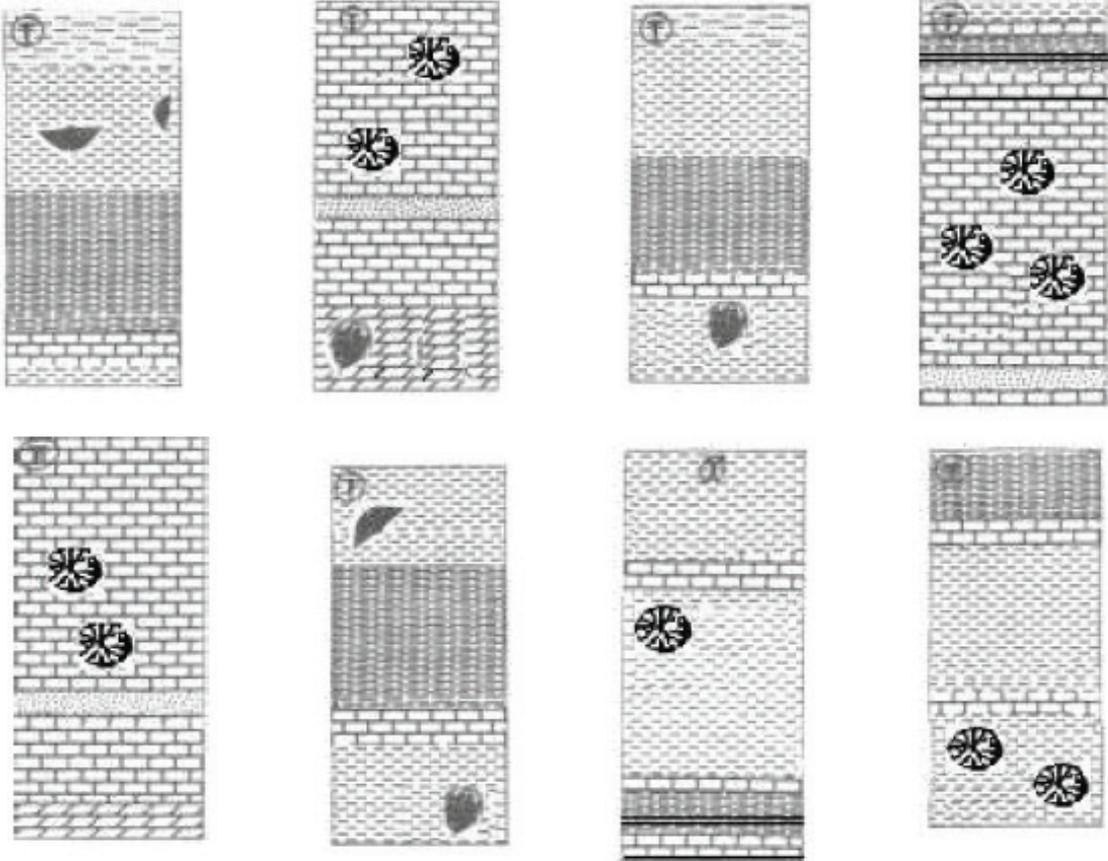
Unit	Name	Start (million years before present)	Scale
Eons	Phanerozoic	542	
	Proterozoic	2500	
	Archean	3800	
	Hadean	4570	
Eras	Cenozoic	65	
	Mesozoic	251	
	Paleozoic	542	
	Neo-Proterozoic	850	
	Meso-Proterozoic	1600	
	Paleo-Proterozoic	2500	
	Neo-Archean	2800	
	Meso-Archean	3200	
	Paleo-Archean	3600	
	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	

HANDOUT

Stratigraphic Columns



The diagram shows eight vertical stratigraphic columns, each representing a different geological sequence. The columns are arranged in two rows of four. Each column contains various rock layers, some of which contain fossils. The fossils are represented by symbols: a semi-circle for Brachiopods, a star-like shape for Corals, and a trilobite shape for Trilobites. The columns illustrate different patterns of fossil distribution and rock layering, such as fossils appearing in specific layers or across multiple layers.

- Column 1: Brachiopods in the upper layer, Corals in the middle layer, Trilobites in the lower layer.
- Column 2: Brachiopods in the upper layer, Corals in the middle layer, Trilobites in the lower layer.
- Column 3: Brachiopods in the upper layer, Corals in the middle layer, Trilobites in the lower layer.
- Column 4: Brachiopods in the upper layer, Corals in the middle layer, Trilobites in the lower layer.
- Column 5: Brachiopods in the upper layer, Corals in the middle layer, Trilobites in the lower layer.
- Column 6: Brachiopods in the upper layer, Corals in the middle layer, Trilobites in the lower layer.
- Column 7: Brachiopods in the upper layer, Corals in the middle layer, Trilobites in the lower layer.
- Column 8: Brachiopods in the upper layer, Corals in the middle layer, Trilobites in the lower layer.

 Brachiopods

 Corals

 Trilobites

SUGGESTED RESPONSE

Stratigraphic Columns

