

Geologic Time

 Level: 3-5
 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

- 4-ESS1-1: Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.
- 5-ESS2-1: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
- **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

- small vials with lids (such as **115 ml plastic test tubes with screw caps**)
- colored sand, or a variety of colored fine-grained materials (e.g., flour, coffee grounds, cocoa powder, crayon shavings, soil, crushed dry leaves, oatmeal)
- small spoons
- funnels (optional)
- receipt paper roll
- colored markers
- tape measures or meter sticks
- scissors
- tape
- copies of “Select Major Events on Earth” handout
- copies of a basic geologic time scale, such as **Geologic Time**

Lesson Summary

Students begin by creating a personal timeline of significant life events, drawing parallels to the concept of time intervals. They then sequence select events in Earth’s history, predicting their order before constructing a geologic timeline using receipt paper to mark major events. Next, students use colored sand and other materials to create layered models representing Earth’s rock layers and examine real-world rock layers in Nevada. The lesson concludes with students either assigning time periods to their layered models or labeling where select events are on a different representation of geologic time.



Preparation

- For **Explain**, become familiar with the geologic timeline and events that occurred throughout Earth's history. Two good resources are UC Berkeley's **UCMP Web Time Machine** and Enchanted Learning's **Geologic Time Scale**.
- For **Elaborate**, prepare trays of materials for students to make models of Earth's layers. Trays should contain plastic vials, colored sand and/or other fine-grained materials in containers, small spoons, and optionally, funnels.
- For **Elaborate**, locate images of local examples of rock outcrops to share along with or in lieu of the two provided in this lesson.

Engage

1. Have students create a timeline of their own life, marking significant events (e.g., birth, starting school, when they lost their first tooth, potentially the birth of new siblings to acquiring a pet).
2. Facilitate a class discussion around their timelines, first highlighting the **sequence** of events, then **numerical time**.
3. Introduce the concept of **time intervals** by asking students to identify how long they have been in school so far on their timeline.
4. Depending on the amount of time you want to spend, you can either:
5. Ask students to mark up their timeline into intervals and facilitate a discussion around why they chose specific times to start and stop an interval.
6. Do a thought experiment as a class that if they were asked to break their timeline up into intervals, how might they do it.
7. End the discussion by introducing the concept that the Earth's history, much like their own, can be broken up into time intervals.



Explore*

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

1. Project a simplified **Geologic Timeline** and introduce how scientists have divided up the history of the Earth. Facilitate a class discussion to orient the students to this type of timeline where younger time periods are at the top and older time periods are at the bottom.
2. Ask students to compare and contrast their timelines from **Engage** to the geologic time scale.
3. Distribute the “Select Major Events on Earth” handout to the students (tell them to ignore the up arrows for now).
 - a. Discuss that these are some examples of major events that mark time intervals in Geologic Time.
 - b. Optionally, discuss why and how biologic events are used to mark time intervals (e.g., that these were significant changes to an Earth system, that they leave fossil (geologic) evidence of their existence).
4. Ask them to cut out the event cards and arrange the major events in the order they think the events occurred, from oldest to most recent.
5. Have the class work together to come to a consensus regarding the sequence of events, sharing their reasoning for why the events should be placed in a specific order.
6. When a majority of students are satisfied with the order of events, share how many are incorrect and allow them to revise the order. Continue until they have determined the correct answer: 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. As a class, make a geologic timeline on a receipt paper roll.
3. Provide students with the scale that fits the desired length of the timeline. For example, using a scale of 1 cm = 25 million years the timeline will be a little less than 2 m long.
4. Have students mark and label the receipt paper roll at designated locations. 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.
5. Have students work as a class or in groups to predict where the Select Major Events on Earth cards would happen on the timeline.
6. Then, walk through the timeline as a class, identifying key organisms, extinctions, or geologic events (as in Table 2 in **On a Roll with Geologic Time** and on page 6 in **Demonstrating Geologic Time**).
7. Revisit the "Select Major Events on Earth" cards:
8. Share the numerical date for each card with students and have students add it to the cards.
9. Move the cards to their correct locations on the timeline, and tape them along the timeline so the arrow is pointing within the correct time interval.
10. Facilitate a class discussion about the timeline, potentially asking students:
 - ▶ *What surprised you about where the "Select Major Events on Earth" cards ended up?*
 - ▶ *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?*

Elaborate

1. Distribute trays of materials for making a layered model of the Earth (described in **Preparation**).
2. Students will add colored sand and other materials to vials, creating layers and noting the sequence and time of deposition. Allow for variation in the layer thickness and texture, just like the real sedimentation process.
3. Optionally, students can add "markers" in the layers (such as crushed dried leaves to represent an ash layer, or sequins or beads to represent fossils)

4. Once filled, students should cap their vials.
5. Have students view each other's vials and make some comparisons between the "histories" told by each vial.
6. Facilitate a group discussion as if students are viewing real rock layers:
 - ▶ *Which layer is oldest? Youngest? How do you know?*
 - ▶ *What caused the layers to be thicker vs. thinner in your model?*
7. Share images of real rock layers in Nevada, such as:
 - An **outcrop at Calico Hills**, Red Rock Canyon
 - A colorful **sandstone cliff west of Colorock Quarry** in the Muddy Mountains



AN OUTCROP IN FALLON, NEVADA: <https://bit.ly/4kNnCVi>

Credit: L. Mossa



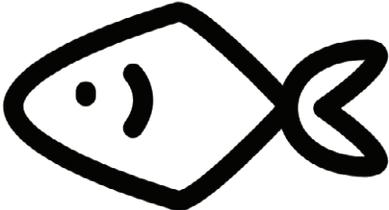
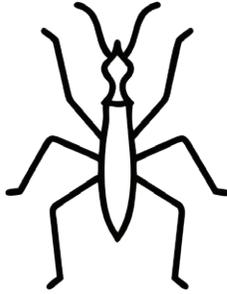
8. Ask students to relate these images to their model, and discuss how rock layers vary in thickness and colors as well. Ask students why they think the rock layers are different.
9. Project an image of the rock layers on a whiteboard, if possible, and mark it up with where boundaries are located and (if possible) the names of the associated geologic time.

Evaluate

1. (want to delete, but numbering is off then)
2. Have students create a detailed sketch of their layered model, clearly showing or noting each layer's color, thickness, and any added fossils or markers.
3. Provide students with a geologic timeline to use as a resource (such as [Geologic Time](#)).
4. Ask students to assign a specific geologic time interval (e.g., period, epoch) to each layer of their model on their sketch.
5. Ask students to write a paragraph explaining why they assigned each layer as they did. The specific time doesn't matter as much as having the explanation correctly match the selected layering (i.e., older layers are at the bottom, thicker layers represent longer time intervals).

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>  

Icons from Noun Project, CC BY 3.0: fish: Yoo Seungyeon; grass: Ishaq_hmad; humans: Edy Susanto; insect: IcoGenixFi; jellyfish: BnB Studio; rodent: Md Moniruzzaman.