



SCIENCE

Oregon's First Geologists

ESSENTIAL UNDERSTANDINGS

- **Since Time Immemorial**
- **History**
- **Lifeways**

LEARNING OUTCOMES

- Students will understand how Native Americans' understanding of geology informed their everyday lives.
- Students will learn Native American ways of knowing and means of understanding the natural world and geologic events, such as volcanoes, earthquakes, and tsunamis.

ESSENTIAL QUESTIONS

How did Native Americans incorporate geologic knowledge into their lifeways and culture?

LOGISTICS

- Where does the activity take place?
Classroom
- How are the students organized?
 - ☑ Whole class ☑ Teams: 3 – 5
 - ☑ Pairs ☑ Individually

TIME REQUIRED

One hour

Overview

In this lesson students will learn how Native American tribes living in what is now Oregon incorporated geologic knowledge into their lifeways and cultures. It will describe tribes' use of stone tools, designation of prominent landforms as significant and meaningful places, and oral traditions they maintained regarding geologic events to help them understand and organize the world they lived in. This lesson assumes students have some familiarity with or prior instruction in earth science concepts such as Oregon landforms, the rock cycle, plate tectonics, and earthquakes and tsunamis.

Background for teachers

The geosphere (solid and molten rock, soil, and sediments) is one of earth's four major systems, along with the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes and make human life possible.

Humans rely on the geosphere to provide a hospitable place to live, nutrients to support plant and animal life we depend on, and useful materials for everyday life. Earthquakes, volcanoes, and landslides have been hazards of human life for millennia, and we continue to seek to understand them,



adapt to them, and minimize their impact on human survival. Striking geologic landforms and landscape features such as the Snake River Canyon, Crater Lake, the Columbia River Gorge, and Mount Hood evoke awe in us and inspire storytelling, art, and a sense of connection to and/or curiosity about forces bigger and more powerful than ourselves. Understanding and appreciating the earth is thus critical to human survival and the ability to flourish. This was as true for the first humans who lived in what is now Oregon as it is for us today.

Native Americans had an intimate knowledge of and reverence for the land on which they lived and sought to understand and use it to support their lives and cultures. They made use of the many plants and animals found in Oregon's wide variety of ecosystems and regions (mountains, inland valleys, the Great Basin, the Pacific Coast, the Columbia Plateau), which had been shaped and influenced by ancient geologic forces.

The Native American tribes in Oregon made use of different types of stone to make household tools and weapons, seeking out or trading among themselves to get access to the best type of stone available. They experienced earthquakes and tsunamis and landslides and sought to find ways to understand them and prepare for them. They navigated by geological landmarks and designated prominent landforms or features as special or significant places. They created both art and forms of communication on rocks.

Native American ways of understanding and adapting to Oregon's geology and other earth systems may seem very different from our own, but this traditional knowledge allowed them to survive and thrive in the region for over 10,000 years, while also leaving

STANDARDS

Oregon science standards

- 4-ESS1 – Earth's Place in the Universe
- 4-ESS2 – Earth's Systems
- 4-ESS3 – Earth and Human Activity

MATERIALS

What materials are needed for students to engage in this activity?

- **PowerPoint presentation** – Load the slides prior to the lesson to ensure they are displaying properly.
- **Classroom writing surface** (i.e., blackboard, whiteboard, chalkboard, chart paper and markers).
- **Audio/visual setup** (for displaying the Geologic Map of Oregon and the tsunami preparedness oral history video; see "Resources" section).
- **Native American Legends and Stories of Geologic History in Oregon** (one copy per student, or one copy per group of three to five students if having students work together for this reading).



the land, air, and waterways healthy and teeming with life. Today, many tribes in Oregon continue to embrace these traditional ways of knowing and living and are combining them with Western scientific methods in ways that will shape the future of our state.

Resources

Bulman, T. A. & Rice, G. H. (2009). *Student atlas of Oregon: A classroom atlas for elementary and middle schools*. Portland, OR: Portland State University, Center for Geography Education in Oregon. Retrieved from <https://www.pdx.edu/geography-education/table-of-contents-student-atlas-of-oregon-english>

Hunter, D. (January 26, 2016). Thunderbird and the orphan tsunami: Cascadia 1700. *Scientific American*. [Online] Retrieved January 27, 2020, from <https://blogs.scientificamerican.com/rosetta-stones/thunderbird-and-the-orphan-tsunami-cascadia-1700/>

Oregon Department of Geology and Mineral Industries. (n.d.). *Geologic map of Oregon*. [Online] Retrieved January 22, 2020, from <https://gis.dogami.oregon.gov/maps/geologicmap/>

Washington Military Department Emergency Management Division. (2015, January 14). *Tsunami preparedness oral history of the Hoh*. [Online] Retrieved January 22, 2020, from https://www.youtube.com/watch?v=J_sp_oYH0Zc

VOCABULARY

Geology – The study of the earth and what it is made of.

Geologist – A person who studies the Earth, what it is made of, and how it was formed.

Petroglyphs – Rock carvings used for communication, recordkeeping, and/or artistic purposes (rock paintings are called *pictographs*).

Tsunami – A large ocean wave usually caused by an underwater earthquake or a volcanic explosion.

References

- Finkbeiner, A. (September 15, 2015). The great quake and the great drowning. *Slate*. [Online] Retrieved January 27, 2020, from <https://slate.com/technology/2015/09/earthquakes-and-tsunamis-in-the-pacific-northwest-native-american-myths-and-geoscience.html>
- Keyser, J.D. (n.d.) Rock art. *Oregon Encyclopedia*. [Online] Retrieved January 27, 2020, from https://oregonencyclopedia.org/articles/rock_art/#.Xi8rY2hKjct
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- Reano, D., & Ridgway, K.D. (August 2015). Connecting geology and Native American culture on the reservation of Acoma Pueblo, New Mexico, USA. *GSA Today*, 25(8), 26–28.
- Seckel, S. (November 16, 2016). *The earth's terrain through the eyes of Native people*. [Online] Retrieved January 22, 2020, from <https://asunow.asu.edu/20161116-discoveries-earths-terrain-through-eyes-native-people>
- Templeton, A. (August 14, 2016). *Oregon math teacher unearths clue to Native American trade routes*. Oregon Public Broadcasting. [Online] Retrieved January 23, 2020, from <https://www.opb.org/news/article/oregon-native-american-artifacts-obsidian-tools-teacher/>

Considerations for teachers

Assessment

Assessment will depend on how you choose to have students read the selected texts and respond to the accompanying reflection questions. If assigning the readings as individual work, summative assessment can be achieved by having students submit their responses to the reflection questions. If students work in pairs or groups, summative assessment can be achieved by reviewing group responses or by having groups give an oral report in class.

Practices

- The teacher must be prepared to activate engagement strategies and foster pair, small-group, and whole-group discussions.
- Be prepared to provide some context and nuance for the activity in which students will read Native American oral histories regarding important Oregon geologic events such as Crater Lake, the Bridge of the Gods, and earthquakes and tsunamis. Take care to address any student assumptions that these traditional ways of viewing and explaining such events are “primitive” or “unscientific” compared to our current understanding. Tribal oral histories were a means of sense-making and recordkeeping and a way of maintaining tribal identity and passing on knowledge that was essential for survival. These oral traditions were highly valuable and appropriate in their cultural context, and they continue to inform tribal ways of understanding and living in the world today.

Learning targets

- I can explain how Native Americans’ understanding of geology helped them in their daily lives.
- I can describe how Native Americans understood the natural world and geologic events such as volcanoes, earthquakes, and tsunamis.

Options/extensions

- Obtain and bring to class samples of the types of rocks mentioned in the lesson (obsidian, blueschist, chert, and so on) for students to see and feel.
- Have students research whether there are museums, libraries, and history centers in your area exhibiting Native American stone tools or art. Encourage students to visit them with their families and report back, and/or consider organizing (or asking a class parent to organize) a class field trip to view the exhibitions.
- Ask if there are parents/guardians in your class or school community who work or create art in a field in which knowledge of rocks, soils, metals, and minerals is important (e.g., geology, engineering, construction, mining, jewelry making, sculpture). Invite them to join the class for a “show-and-tell” session on why a knowledge of rocks is interesting and important to what they do.
- Have students read the “Thunderbird and the Orphan Tsunami” article (a link is provided in the “Resources” section) and provide a short written summary or reflection on why Native American oral histories were viewed as important evidence by the geologists in the article.

Appendix

Materials included in the electronic folder that support this lesson are:

- Slides.ppt
- Materials_Native American Legends and Stories of Geologic History in Oregon.pdf

Activity 1

Activate Prior Knowledge

Time: 20 minutes

Step 1

Confirm that students are familiar with relevant earth science concepts, such as Oregon landforms, the rock cycle, plate tectonics, and earthquakes and tsunamis. Review if necessary. Also review the vocabulary terms provided in the lesson plan and add and define others as you see fit.

Step 2

Review the definition of a geologist with students. Invite them to “put on their geologist hats” for a minute and think about why people study rocks. Invite students to give “popcorn” responses and record those responses on the classroom writing surface. Supply one or more of the following prompts (or others you can think) if students get stuck or are slow to respond.

Possible responses:

- To understand and plan for hazards such as volcanoes, earthquakes, tsunamis, and landslides
- To find useful minerals and metals
- To find the best place to build things
- To find the best place to grow plants and raise animals

Step 3

Display the online geologic map of Oregon: <https://gis.dogami.oregon.gov/maps/geologicmap/> (Also provided in the “Resources” section above.) Pause a few moments to let students take in the entirety of the map, and then navigate on the map to focus or zoom in on the general area where your school is located. Again, have students take in what they see. (Note: The map is highly technical, so you might want to familiarize yourself with it prior to delivering

Activity 1 *(Continued)*

the less. Students are unlikely to understand the terminology and definitions. The purpose of showing it is to highlight the work geologists do to understand the rocks and soils of a particular area.)

Step 4

Ask students to share what they notice or what stands out to them about the map.

Say:

The different shapes and colors represent different types of rocks and soils in Oregon. It represents many years of work by geologists to understand how the land of Oregon came to be as it is today.

Step 5

Click through and discuss with the class slides 2–6, which contain various geology-related maps from the *Student Atlas of Oregon* and a picture that illustrates how geology can be used in daily life—the construction of a commuter train line in the Portland area. For each slide, prompt students to think about and share out loud or with a partner what they think the slide is showing and who might be interested in the information provided.

- The *Farm and Ranch Land* slide shows the distribution of lands in Oregon used for farming and ranching. People interested in or working in farming or ranching might find this information useful, as might local and state farm bureaus, extension agents, and land use planners.
- The *Mineral Deposits* slide shows where deposits of selected minerals have been mined in the past. This information would be of interest to miners, mining companies, and industries that need specific metals to make their products.

Activity 1 *(Continued)*

- The *Natural Hazards: Earthquakes* slide shows earthquakes of different magnitudes that have been recorded in Oregon and the likelihood that Oregonians will feel an earthquake based on where they live. This information would be useful for people who are responsible for planning for natural disasters in cities and towns.
- The *Natural Hazards: Tsunamis* slide shows coastal areas of Oregon that are vulnerable to tsunamis. This information would be useful for emergency planners, as well as people who own land or live in areas susceptible to tsunamis.
- The *Building the MAX Blue Line* slide shows a photograph of a construction project on a commuter train line. This tunnel was part of the construction project that built the MAX Blue Line between Hillsboro and Portland in the 1990s. Understanding the rock and soil of the West Hills area of Portland was important for digging the tunnel. The Washington Park Station is the deepest transit station in North America at 260 feet underground. In many construction projects, geologists and engineers use specialized knowledge and tools to understand how rocks and soils are composed and behave in order to make sure that buildings and other structures can be built and used safely.

Step 6

Summarize and transition to the next segment.

Say:

Understanding the physical structure and materials of the earth is important for human life. This was true for Native Americans living in Oregon thousands of years ago, just as it is true for all Oregonians today. Traditionally, Native people studied the earth in order to discover patterns, locate areas of use or danger, and find things to make life easier or better. Next, we're going to look at some specific ways that Native Americans used their traditional knowledge of geology.

Activity 2

Geologic Knowledge in Traditional Native American Lifeways

Time: 15 minutes

Step 1

As a class, examine and discuss PowerPoint slides 7–9 (described below) to explore how knowledge of rocks and landforms informed traditional Native American lifeways and worldviews.

- The *Tools* slide provides images of selected Native American tools made of—or incorporating—stone. Native Americans sought out specific types of rock based on their “toughness” (resistance to fracture) and their malleability (how easily they can be chiseled or reshaped) when making tools. For example, the chisel from the Coquille Indian Tribe on the slide is made from blueschist, a particularly hard stone, which made it useful for carving canoes out of cedar logs. Native Americans also used obsidian, chert, and jasper. For thousands of years, Native Americans traveled to special quarries in the Cascade Mountains to locate obsidian needed to make tools.
- The *Special Places* slide shows rock formations in Oregon that were landmarks and special places for Native Americans. Grandmother Rock, a significant landmark, was a blueschist outcrop on the Oregon Coast near present-day Bandon that was ultimately blasted to pieces by white settlers to build the current-day Bandon jetty. Neahkahnie Mountain in Tillamook County gets its name from a Tillamook word thought to mean “place of the creator.” It features in Tillamook oral histories. Steens Mountain in Harney County is a special place for the Burns Paiute Tribe.
- The *Art* slide shows a group of petroglyphs (rock carvings) in Lake County, Oregon. (Note: The carvings have been chalked to make them more visible. This is no longer considered appropriate and is, in fact, illegal to do on public lands.) Such rock art marked important places or trails, staked out territorial borders, warded off evil spirits, and recorded important stories or events.

Activity 2 (Continued)

Step 6

Summarize and transition to the next segment.

Say:

There are many reasons that geologists want to know how the earth behaves. One of these is to keep us safe from natural disasters such as earthquakes, volcanic eruptions, landslides, and tsunamis. Just as we do today, Native Americans in the Pacific Northwest have always looked for ways to explain geological events, identify patterns, and keep their people safe.

Activity 3

Native American Understanding of Geologic Events

Time: 20 minutes

Step 1

Display the Geologic Events slide (slide 10) and distribute the Native American Legends and Stories of Geologic History in Oregon reading packet to students (if you have not already).

Step 2

Provide an overview and specific instructions for the reading activity.

Say:

Now we're going to read three passages that describe how Native Americans experienced major geologic events in Oregon's past. The first is the formation of Crater Lake from a volcanic eruption 7,000 years ago. The second is a land bridge across the Columbia River near The Dalles that became known as the "Bridge of the Gods." The third describes a flood experienced by members of the Coos people on the Oregon coast that may have been caused by an earthquake and tsunami.

Step 3

Depending on available time; your sense of your students' abilities; and your preference for students working with the material individually or together in pairs, small groups, or as a whole class, provide instructions and scaffolding to help students read the packet. (For example, have individuals, pairs, or groups read all three passages or divide them up and have students work on them separately and report back.) Answer any questions that arise during the reading activity.

Activity 3 (Continued)

Step 4

After students have had sufficient time to complete the readings, use the following prompts (and/or others of your choosing) to encourage student reflection. You can ask students to reflect and respond either individually, in pairs, or in small groups. (You could also assign the prompts as an individual writing exercise.)

1. *What did you notice about the stories? What do you remember the most? What was most interesting?*
2. *What can we learn from these stories about how Native Americans made sense of their world?*

Step 5

If time permits, play the video on the tsunami preparedness oral history of the Hoh people: https://www.youtube.com/watch?v=J_sp_oYH0Zc (Also provided in the "Resources" section of the lesson plan.) In this video, a Hoh tribal Elder describes experiencing a tsunami resulting from an earthquake in Chile and the tribal knowledge passed down from previous generations to head to high ground when the coastal waters recede dramatically and unexpectedly.

Activity 4

Closure/Reflection

Time: 5 minutes

Step 1

Review the learning objectives with students and discuss as needed to confirm understanding and to answer any final questions.

Step 2

Provide a brief statement to summarize and close the lesson. Consider using or adapting the following.

Say:

As we can see, humans study the earth for many different reasons, from finding useful materials to understanding patterns in natural phenomena to planning for natural disasters like earthquakes and tsunamis. This is true for us today, and it was also true for the first people to live in this region. Just like us, Native Americans revered and studied the earth to find things they could use in everyday life and to understand why it behaved the way it did. While their geologic knowledge and the way they used it may have differed from ours, they passed it down through many generations to help their cultures survive and thrive for thousands of years.