Regional Class Research Vessel

Oregon State University

Volcanoes: The Ring of Fire in the Pacific Northwest

Timeframe
1 fifty minute class period

Target Audience
Grades 4th- 8th

Suggested Materials
- Volcanoe profile cards

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Description

In this lesson, students will learn about the geological processes that create volcanoes, about specific volcanoes within the Ring of Fire (including classification, types of volcanoes, formation process, history and characteristics), and about how volcanoes are studied and why. For instance, students will learn about the most active submarine volcano located 300 miles off the coast of Oregon — Axial Seamount. This submarine volcano is home to the first underwater research station called the Cabled Axial Seamount Array, from which researchers stream data and track underwater eruptions via fiber optic cables. Students will learn that researchers also monitor Axial Seamount using research vessels and remote operated vehicles.

Objectives

Students will:

- Synthesize and communicate scientific information about specific volcanoes to fellow students
- Will learn about geological processes that form volcanoes on land and underwater
- Will explore the different methods researchers employ to study volcanoes and related geological activity

Essential Questions

What are the different processes that create volcanoes and how/why do researchers study volcanic activity? How, if at all, do submarine volcanoes differ from volcanoes on land?

Background Information

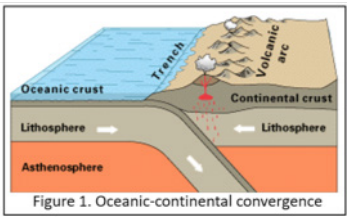

Figure 1. Oceanic-continental convergence

A volcano occurs at a point where material from the inside of the Earth is escaping to the surface. Volcanoes usually occur along the fault lines that separate the tectonic plates that make up the Earth's crust (the outermost layer of the Earth). Typically (though not always), volcanoes occur at one of two types of fault lines. One

is a *convergent* boundary, where one plate slides under another plate. As one plate slides under, it is forced down into the mantle where the pressure and heat are extreme. Under these conditions, the crust melts, forming magma, which is forced up through the crust above it, finally reaching the surface and forming a volcano (see Figure 1). Volcanoes can also form at a divergent boundary, where the plates are moving apart. The plates leave a gap where magma from the mantle can escape to the surface. These faults are usually under oceans and form mid-ocean ridges. Figure 2 shows volcanoes being formed among fault lines, including divergent boundaries. Another place volcanoes form is over hot spots. A hot spot is a location in the mantle at which the temperature is abnormally high. In these places, magma forces its way up to the surface, forming a volcano. A famous hot spot is the one that is forming the Hawaiian Islands chain (see Figure 3). The magma from the hot spot forms a sea mount (undersea mountain) that becomes an island once it is taller than the sea level. As the tectonic plate moves over the fixed hot spot, a series of islands form.

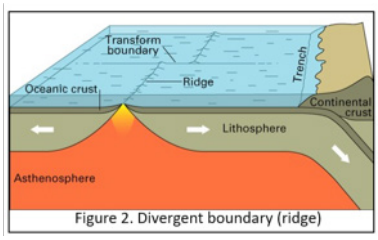

Figure 2. Divergent boundary (ridge)

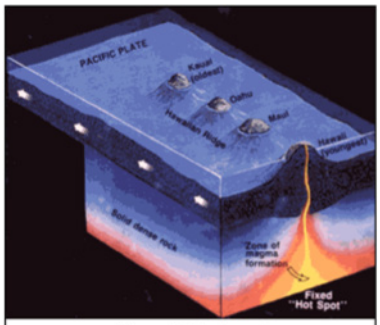

Figure 3. Hot spot

There are different causes of volcanoes, different types of eruptions, as well as different shapes of volcanoes, but a volcano has several basic parts. Under the volcano is a pocket of *molten rock* known as the *magma chamber*. This molten rock, or magma, travels through a crack known as a *vent* from the magma chamber to the surface of the Earth. Magma exits the volcano at the *crater*, becoming lava. If the eruption is violent, then ash and rock are launched into the air. Much of the material ejected from the volcano collects on the sides of the volcano, building it up; these layers are known as *strata*. After many eruptions, enough layers build up to form the recognizable *cone* shape of a volcano.

The three main types of volcanoes are: cinder cone, shield volcano and stratovolcano:

- *Cinder cone*, the most common volcano type, are usually fairly small with steep sides and a bowl-shaped crater. They throw out mostly small pieces of rock from near the vent, and form a small cone from the build-up of cindery (burned rock fragments) lava.

- A *shield volcano* is formed almost entirely from great amounts of liquid lava. The lava flows out of a vent and slides down the side of the volcano, making a wide, gentle-sloping cone. Mauna Loa, in

Next Generation Science Standards

PERFORMANCE EXPECTATIONS:

4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features.

MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

MS-ESS2-3. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.

DISCIPLINARY CORE IDEAS:

ESS2.B.: Plate tectonics and large scale system interactions

SCIENCE AND ENGINEERING PRACTICES:

Analyzing and Interpreting Data

CROSSCUTTING CONCEPTS:

Patterns

Hawaii, is a shield volcano, and the largest volcano in the world!

- *Stratovolcanoes* have a tall conical shape with very steep sides, and look the way most people imagine volcanoes. They form during very violent eruptions of rock and lava. Their shape is made of tephra (ash and rock that was launched into the air) and solidified lava. Mt. St. Helens in Washington is one example.

Many people (scientists, geologists, engineers, naturalists, hobbyists, etc.) study volcanoes. The idea is that if we study them, we can better understand how they form, predict how destructive a future eruption might be, and use that information to prepare for emergency situations. The volcanoes found on land and under the ocean are studied in very similar ways. On land, tilt (slope) and strain meters (shape) measure small changes in the shape of the volcanoes it inflates with magma. Under the ocean, scientists use remote operated vehicles to position tilt (slope) and pressure meter (rise or fall of the seafloor) to also measure the slope and shape of the volcano. Using these instruments, scientists can tell if the volcano is inflating with magma, and even predict when it might erupt next.

(Background information: https://www.teachengineering.org/lessons/view/cub_natdis_lesson04)

Procedure (for instructor)

Begin the volcano lessons by showing the two introductory videos of the volcano eruptions (Axial Seamount and Kilauea). Then navigate to the United States Geological Survey (USGS) Volcanoes and Current Activity Alerts website (https://volcanoes.usgs.gov/index.html) and explore up-to-date reportings/monitoring of volcanoes in the region. Begin introducing background information.

• Axial seamount research: https://www.youtube.com/watch?v=ohHiImaS0Ow

• Underwater volcano eruption: https://www.youtube.com/watch?v=hmMlspNoZMs (commentary)

• Underwater volcano eruption: https://video.nationalgeographic.com/video/ng-live/selbe-oceans-lecture-nglive?source=relatedvideo (without commentary)

• Kilauea footage: https://www.youtube.com/watch?v=ao9gUUemaOQ

Select a location that has room for students to move around. Then introduce 'each one teach one' volcano profile activity. The prepared volcano profile cards contain brief facts, statements, diagrams, pictures

of various regional volcanoes as well as some broader concepts. The cards provide cues and structure to students' lessons. Select a location that allows you to keep track of all your students and allows enough space for mingling/rotations. A second adult or leader is helpful. Ideally, this person can continue discussion with students at the starting point until all students are engaged in the activity. This person is also the last "student" to pass through the process and can be a good person to "test" at the end. This person will also manage time to keep the activity moving. Next, explain the steps to the students and emphasize the importance of teaching as a way of learning. Encourage all students to add what they may already know to the information they will be taught.

First Student: Teacher 1 leads Student 1 to just beyond earshot of group, selects a prompt card and gives a 2-minute lecture on the subject. Point to pictures, act out behaviors. Tailor your lesson to that student.

Second Student: After 2 minutes, Student 2 joins Teacher 1 and Student 1. Student 1 leads the lesson for Student 2 with the teacher listening, encouraging and making small suggestions.

Third Student: After 2 minutes, Teacher 1 and Student 2 move a short distance for their private lesson. Student 3 goes to Student 1 for their lesson.

Fourth Student: After 2 minutes, Student 3 joins Teacher 1 and Student 2 for the observed lesson and Student 4 goes to Student 1.

And so on...Teacher 2 stays with the group as it diminishes, becoming the last student. When no new students come, each student moves up the chain until all have arrived at a final point, where Teacher 1 has collected a group of students who have completed the activity. (procedure adapted from: Education and Outreach (https://nmssanctuaries.blob.core.windows.net/sanctuaries-prod/media/archive/management/pdfs/Day10_H8_Eachoneteachone.pdf))

Conclude with a wrap up discussion. Introduce Extension Activities, if applicable.

Vocabulary

cinder cone: A steep and small volcano made from the chunks of volcanic material (cinders) from previous eruptions.
cone: The body of a volcano, in the shape of a cone. The crater is typically located at the top of the cone.
caldera: Formed when a large eruption of magma leaves an empty chamber underground.
crater: A bowl-shaped opening at the top of a volcano. This is typically where tephra and lava escape from the volcano.
detect: To discover or find the existence of something.

eruption: The act of forcing out or releasing something, such as steam or magma, with violence or suddenness.
evacuate: To withdraw from or leave a place or area, especially as a protective measure.
fault: The cracks in the crust of the Earth that mark the boundary between tectonic plates.
lava: Magma that has reached the surface of the Earth.
magma: Molten rock.
magma chamber: A chamber below the Earth's surface that contains a large quantity of magma.
mantle: The layer of the Earth between the crust and the core.
molten: Made liquid by heat; melted.
shield volcano: A volcano with gentle slopes formed by successive liquid lava eruptions.
stratovolcano: A steep-sided volcano composed of many layers of tephra, lava and other volcanic material.
tectonic plate: A piece of the Earth's crust that moves slowly over the mantle.
tephra: Any solid material ejected into the atmosphere from a volcanic eruption.
volcano: An opening in the Earth's crust through which molten lava, ash and gases are ejected.

Extension Activities

Volcano Haiku: Younger students can craft a haiku poem inspired by the volcano lesson. A traditional Japanese poem, a haiku is composed of three lines with seventeen syllables broken down into a 5/7/5 syllable count and commonly centers around themes from nature. Allow students time to compose a haiku in groups, about a volcano described in the volcano profile cards and allow time for sharing. https://www.poets.org/poetsorg/text/haiku-poetic-form

Ready to Erupt!: Older students can engage with an in-class activity that demonstrates key features scientists monitor to predict volcanic eruptions. This activity simulates a tilt meter and survey techniques used to measure swelling of the magma chamber. https://www.teachengineering.org/activities/view/cub_natdis_lesson04_activity1

Volcano Profile Card: Older students can research a volcano of their choice using online resources to compile a profile card of their own. Content would include the volcanoes name, classification, formation, history/description and an image. https://www.teachengineering.org/lessons/view/cub_natdis_lesson04 – https://geology.com/volcanoes/ – https://volcanoes.usgs.gov/index.html

Living on the Edge: Older students will play a game about city planning and budgeting when living next to an active volcano. Students will learn about the primary hazards associated with Cascade volcanoes, keeping

and tracking a budget in response to disasters, and reading topographic maps. https://smile.oregonstate.edu/lesson/living-edge

This project is supported by the Regional Class Research Vessel Program in the College of Earth, Ocean, and Atmospheric Sciences at Oregon State University.