Hands-on

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Tested & Approved STEM Activities

VOLCANOS - GO WITH THE FLOW

Activity Guide

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Science-Technology Activities & Resources For Libraries

A product of the Science-Technology Activities and Resources for Libraries (*STAR_Net*) program.
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Developed by the Lunar and Planetary Institute/Universities Space Research Association
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VOLCANOS - GO WITH THE FLOW

Overview

Children use “eruptions” of baking soda and vinegar to explore how volcanos grow, how later lava flows overlap earlier ones, and how earlier flows influence the paths of subsequent flows. They create layers of “lava flows” using Play-Doh® (and older children map the lava flows on graph paper). They determine their “volcano's” history of eruptions based on the layering of the different Play-Doh flows.

Activity Time

30–45 minutes

Intended Audience

Families or other mixed-age groups, including children as young as 5 years old *with assistance from an older child, teen, or adult*
School-aged children ages 8-9
Tweens up to about age 13

Type of Program

☑Facilitated hands-on experience
☑Station, presented in combination with related activities (although the children may not have enough time to explore all concepts presented here)
☐Passive program
☐Demonstration by facilitator

What’s the Point?

- ☐ By observing the layers of a volcano’s flows, we can look back in history to learn about the way that part of Earth has changed over time.
- ☐ Volcanos may erupt multiple times, creating several volcanic layers. Earlier/older layers influence where more recent/younger lava flows go.
- ☐ The oldest volcanic layers are found under successive flows, with the geologically most recent/youngest volcanic layer being on top.
- ☐ Models — such as the children are using here — can be tools for understanding the natural world.

Facility Needs

- ☐ 2-3 tables

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- ☐ Optional: 15–20 chairs arranged at the table(s) for groups or families to sit together

Materials

For the Facilitator

- ☐ 1 ruler
- ☐ Materials to construct three "volcanos:"
  - ☐ 3 (~2' square) sheets of poster board or cardboard (or trays or box lids) on which to build the volcanos
  - ☐ ~1 cup vinegar
  - ☐ ~1/2 cup baking soda
  - ☐ 9 (3 oz.) cans of Play-Doh, in three or more different colors
  - ☐ 6 small paper cups (4 ounce or smaller)
  - ☐ 3 *clear, colorless* straws, each cut in three 2" sections
- ☐ *Brief Facilitation Outline* (below)
- ☐ *Background Information* (below)

For Each Group of 10-15 Children

- ☐ 3 "volcanos," constructed beforehand using the materials listed above
- ☐ 1 roll of paper towels
- ☐ Scotch tape
- ☐ 3 pencils
- ☐ Optional for older children: 3 sheets of gridded paper AND ☐ Colored pencils or markers

Supporting Media

Consider setting up a digital media player (such as a computer), speakers, and access to the Internet to display websites or multimedia before, during, or after the activity.

Books

Everything Volcanoes and Earthquakes

Kathy Furgang, National Geographic Children's Books, 2013, ISBN: 978-1426313646
Engaging images, informative text, and fun facts will draw children into the science and impacts of volcanos and earthquakes. Appropriate for ages 8 and up.

One Million Things: Planet Earth

John Woodward, DK Children, 2009, ISBN: 978-0756652357
Visually stunning images and clearly written text cover multiple Earth science topics, including volcanos and eruptions. Appropriate for ages 8 and up.

Videos

Yellowstone: Monitoring the Fire Below
American Museum of Natural History, June 2006
http://www.amnh.org/explore/science-bulletins/%28watch%29/earth/documentaries/yellowstone-monitoring-the-fire-below
This episode of *Science Bulletins* features images and animations of the Yellowstone National Park volcano and the work being done by geologists to monitor the active region. Appropriate for ages 11 and up.

Websites

Volcano World: For Kids
http://volcano.oregonstate.edu/kids
Kids can submit their drawings of volcanos to be featured on the site. There are games, puzzles, and simulations to explore! Other areas of the site provide current eruption reports, virtual volcano fieldtrips, interviews with volcanologists, and more. Appropriate for ages 8 and up.

USGS Hawaiian Volcano Observatory (HVO)
http://hvo.wr.usgs.gov
The Hawaiian Volcano Observatory (HVO) provides real-time images of Kilauea and Mauna Loa, the most active volcanoes on the Island of Hawai'i, as well as photo and text updates. Photos and videos appropriate for all ages.

Forces of Nature
http://education.nationalgeographic.com
The National Geographic interactive, "Forces of Nature," covers volcanos in addition to tornadoes, hurricanes, and earthquakes through maps, photos, and 3-D animations. Appropriate for ages 11 and up.

Visual Aids

USGS Volcano Hazards Program
http://volcanoes.usgs.gov
Find a photoglossary and real-time images of several U.S. volcanos, as well as several image collections, maps, and a volcano FAQ. Site content is appropriate for all ages.

Volcanic Eruption and ***The Hot Zones***
www.pbs.org/wnet/savageearth/volcanoes
As part of its *Savage Earth*, "Out of the Inferno: Volcanoes" collection of resources, two animations feature cross-sections of the interiors of volcanos and the Earth to explore volcanism in detail. Appropriate for ages 11 and up, and for younger children with the assistance of an older child or adult.

Preparation

Six months before the activity

- Prepare and distribute publicity materials for programs based on this activity. If possible, build on the children's knowledge by offering multiple science, technology, engineering,

art, and mathematics (STEAM) programs. See the STAR_Net resources listed at http://community.starnetlibraries.org/resources for ideas.

- For young children, plan to provide assistance with pouring the vinegar and blotting it, then placing thin layers of Play-Doh. Consider allowing extra time for this activity for young children.

The day before the activity

- If you are going to have the older children map the flows, create a grid of lines, spaced one to two inches apart on the poster board (or cardboard, tray, or box lid). Similarly grid the paper the children will use. The scale of the paper and poster board will be different, but the number of grid cells should match.
- Cut the straws into 2" sections.
- On each table, place one set of materials for building a volcano:
  - Cut the top half off one paper cup and tape the cup bottom to the middle of the poster board or tray. Pour the baking soda into the cup.
  - Pour ~¼ cup of vinegar into the second cup.
  - Place three cans of Play-Doh (in a variety of colors), a pencil, a few paper towels, three straw sections, and vinegar near the poster board.

After each “eruption” of vinegar and baking soda, the team will trace around the general outline of the flow, and then blot up as much of the liquid as possible. They will place a thin sheet of Play-Doh on the area where the lava flowed, following the marked lava flow boundary.

Where the flows overlap, there will be overlapping layers of Play-Doh. Another team will use the straw sections to take “core samples” of the layers and try to understand the “volcano's” history of eruptions.

Activity

1. Share ideas and knowledge.

- Introduce yourself and the library. Help the children learn each other's names (if they don't already).
- Frame the activity with the main message: By observing the layers of a volcano's flows, we can look back in history to learn about the way that part of Earth has changed over time.

Lava is molten — or liquid — rock that comes from inside the Earth. When it is inside the Earth, it is called "**magma**." When it flows at the surface, it is called "**lava**."

A **volcano** is the vent through which magma and gases are discharged. Volcanos may erupt multiple times, creating several volcanic layers. Geologists apply the **Law of Superposition** to determine which layers are relatively old and which are young (unless something else — like folding or faulting — has happened). Earlier/older layers influence where more recent/younger lava flows go. The oldest volcanic layers are found under successive flows, with the geologically most recent/youngest volcanic layer being on top. After an eruption, the rock near a volcano's summit can collapse, producing a cauldron-shaped **caldera**.

- Invite the children to talk about what they already know about volcanos, if they have any direct experiences with a volcano or a volcanic eruption, and what they know from school. Use open-ended questions and invite the children to talk with you and each other.

Use discussion to help children start to think about their prior experiences and build new understandings about volcanos and how scientists use them to understand Earth's changes over time. Some conversation-starters are:

- Have you ever visited a volcano?
- Have you ever see lava or ash from a volcanic eruption?
- Where does lava come from?

2. Guide the children in building a model of an erupting volcano to explore how volcanos are created from flowing lava, what factors influence lava flows, and where the oldest and youngest layers of volcanic flows are positioned.

Have the children follow these steps:

a. Pour about ⅓ of the vinegar into the cup – the volcano caldera. After the eruption, trace around the general outline of the flow, and then blot (don't wipe!) up as much of the liquid as possible. Take one color of Play-Doh, flatten it into a thin sheet, and place it on the area where the lava flowed, following the marked lava flow boundary.

You may wish to have children ages 10 to 13 map the different layers. If so, have them create a

map of the flow on their paper that matches where their flow covered the grid on the poster board. Invite them to color the flow and create a key for the map. They will repeat this step for each flow.

b. Repeat the lava flow procedure two more times, using different colors of Play-Doh to mark each flow. It is important to place the Play-Doh exactly where the lava flowed - even if it is on top of another flow!

c. Describe the shape of the volcanos and the positions of the different flows.

The children's volcanos probably do not look like the steep sided Mount St. Helens that is constructed from lava flows that are thick and explosive. The Play-Doh volcanos actually look more like the low-sloped shapes of the Hawaiian volcanos (and the volcanos on Mars!). These have low slopes because they are constructed from layer after layer of thin, runny lava.

Some of the later/younger flows probably covered the older/earlier flows, making it difficult to determine exactly where each flow went. The second and third volcano flows probably did not go exactly on top of the first flow; earlier flows helped to divert or direct later flows. Some flows had more lava.

d. Exchange volcanos with another team and use the straw sections to collect "core samples" to determine:

- Which flow came first, second, and third;
- Exactly where each of the first, second, and third flows went;
- How many layers are there are;
- Which layers are where; and
- How far a layer may be from the volcano caldera.

How Geologists Look Back in Time

The children have experience with how history is deposited in layers — it's in the laundry piles in their rooms right now! The oldest dirty clothes are on the bottom; the youngest dirty clothes are the ones they put on the pile yesterday. The ages of the volcano layers are similar. The oldest unit is the one on the bottom. It was the lava layer that flowed first. The top unit is the youngest. It is on top of the older units and it represents the lava flow that flowed last.

Geologists collect cores to determine what is below the surface, how thick layers are, and how far layers may extend. In this activity, the children modeled some of the techniques — and challenges — of examining layers to look back in time. Each of their lava flows went into a different area, sometimes over the older flows, and sometimes into new places. Chances are that at least one of the cores was taken in an area that did not contain all three layers. Their core samples provide them with some evidence to determine how far each layer spread from the volcano caldera, but they will need many core samples to create an accurate map.

3. Conclude. Have a group discussion to compare what they determined by taking core samples to what the original team observed as the "volcano" was erupting. If the children mapped the layers, have the team that created the volcano share their map with the team

that is coring the volcano. Encourage the sharing of evidence and conclusions with prompts such as:

- How many layers are there?
- Does each core sample contain the same number of layers? Why or why not?
- Which is the oldest layer? The youngest? How can you tell?
- For older children who created maps: Were the coring team's conclusions correct about which piece of the core sample is the oldest? About where the different pieces of core sample are located?

If you have time, invite the teams to collect more core samples to see if they can map the layers.

Correlation to Standards

National Science Education Standards

Grades K–4

Earth and Space Science **–** Content Standard D

Changes in the Earth and Sky

- The surface of the Earth changes. Some changes are due to slow processes, such as erosion and weathering, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.

Grades 5–8

Science as Inquiry **–** Content Standard A

Abilities Necessary to Do Scientific Inquiry

- Different kinds of questions suggest different kinds of scientific investigations. Some investigations making models.

Earth and Space Science **–** Content Standard D

Structure of the Earth System

- Land forms are the result of a combination of constructive and destructive forces. Constructive forces include crustal deformation, volcanic eruption, and deposition of sediment, while destructive forces include weathering and erosion.

References

Lava Layering, Exploring the Moon: a Teacher's Guide with activities for Earth and Space Sciences, NASA Education Product EG-1997–10–116-HQ by J. Taylor and L. Martel.

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Brief Facilitation Outline

1. Share ideas and knowledge.

- Introduce yourself and the library. Help the children learn each other's names (if they don't already).
- Frame the activity with the main message: By observing the layers of a volcano's flows, we can look back in history to learn about the way that part of Earth has changed over time.
- Invite the children to talk about what they already know about volcanos, if they have any direct experiences with a volcano or a volcanic eruption, and what they know from school. Use open-ended questions and invite the children to talk with you and each other.

2. Guide the children in building a model of an erupting volcano to explore how volcanos are created from flowing lava, what factors influence lava flows, and where the oldest and youngest layers of volcanic flows are positioned. Have the children follow these steps:

a. Pour about ⅓ of the vinegar into the cup – the volcano caldera. After the eruption, trace around the general outline of the flow, and then blot (don't wipe!) up as much of the liquid as possible. Take one color of Play-Doh, flatten it into a thin sheet, and place it on the area where the lava flowed, following the marked lava flow boundary.

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b. Repeat the lava flow procedure two more times, using different colors of Play-Doh to mark each flow. It is important to place the Play-Doh exactly where the lava flowed - even if it is on top of another flow!

c. Describe the shape of the volcanos and the positions of the different flows.

d. Exchange volcanos with another team and use the straw sections to collect "core samples" to determine:

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3. **Conclude.** Have a group discussion to compare what they determined by taking core samples to what the original team observed as the “volcano” was erupting. If the children mapped the layers, have the team that created the volcano share their map with the team that is coring the volcano. Encourage the sharing of evidence and conclusions with prompts such as:

   - How many layers are there?
   - Does each core sample contain the same number of layers? Why or why not?
   - Which is the oldest layer? The youngest? How can you tell?
   - For older children who created maps: Were the coring team's conclusions correct about which piece of the core sample is the oldest? About where the different pieces of core sample are located?

   If you have time, invite the teams to collect more core samples to see if they can map the layers.

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Background Information

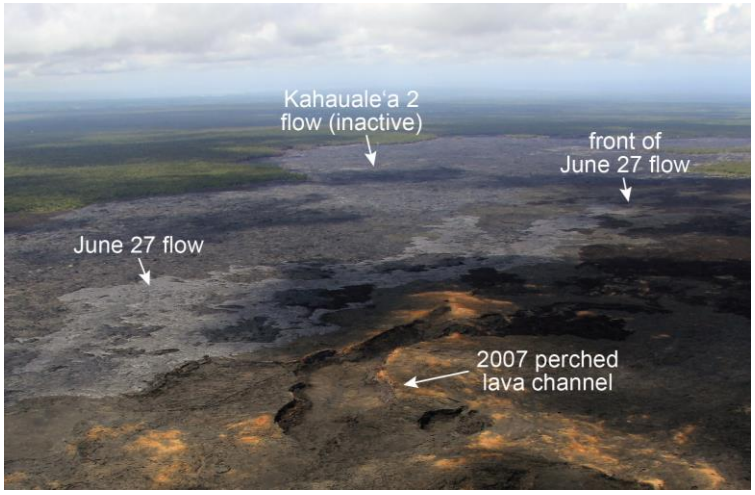
Volcanic Eruptions!

Volcanism is the eruption of molten rock (magma) onto the surface of a planet. A volcano is the vent through which magma and gases are discharged. After an eruption, the rock near a volcano's summit can collapse, producing a cauldron-shaped caldera. Smaller circular depressions — volcanic craters — form when rock is explosively excavated during an eruption. Magma that reaches the surface is called "lava." Volcanos may erupt multiple times, creating several volcanic layers.

Geologists apply the Law of Superposition to determine which layers are relatively old and which are young (unless something else — like folding or faulting — has happened). Earlier/older layers influence where more recent/younger lava flows go. The oldest volcanic layers are found under successive flows, with the geologically most recent/youngest volcanic layer being on top. Geologists collect cores to determine what is below the surface, how thick layers are, and how far layers may extend.

Lava erupts from Pu`u `O`o spatter and cinder cone at Kilauea Volcano, Hawai`i to form a series of channels and flows.

Image Credit: J.D. Griggs , U.S. Geological Survey, http://volcanoes.usgs.gov



Geologists are documenting the flows of the Kīlauea Volcano, Hawai`i. The flow front from June 27, 2014 flow front, seen in this view toward the northeast from the Pu'u 'Ō'ō crater, has run up against the slopes of an older flow from 2007 and become narrower.

Image Credit: U.S. Geological Survey, http://volcanoes.usgs.gov

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Volcanos that have erupted recently, or even within historic times, are considered “active” volcanos. These include Mount St. Helens, Pinatubo in the Philippines, and even Mount Vesuvius in Italy. Volcanos that still have the potential to erupt but haven’t erupted within historic time are “dormant.” Because volcanos may have lifespans of millions of years, this can include volcanos that haven’t erupted many thousands of years. Volcanos that are unlikely to erupt again are “extinct,” but this can be difficult to determine; the Yellowstone caldera is at least 2 million years old and hasn’t erupted for 70,000 years, but is considered active because of its frequent earthquakes, geothermal system, and rapid rates of ground uplift.

Volcanos are named for Vulcan — the Roman god of fire!

Volcanos Are Windows into a Planet’s Interior

Volcanism is the result of a planet losing its internal heat. Volcanos can form where rock near the surface becomes hot enough to melt. On Earth, this often happens in association with plate boundaries. Where two plates move apart, such as at mid-ocean volcanic ridges, material from Earth's interior slowly rises up, melts when it reaches lower pressures, and fills in the gap. Where one plate is being subducted under another, chambers of magma may form. These magma bodies feed the volcanic islands that mark subduction zones. The pattern of distribution of volcanos on Earth gives us a clue that Earth's outer surface is divided into plates; the chains of volcanos associated with mid-ocean ridges and subduction zones mark the plate edges. Although most volcanic activity takes place at plate boundaries, volcanism also can occur within the plate interiors at hotspots (for instance, Hawaii).