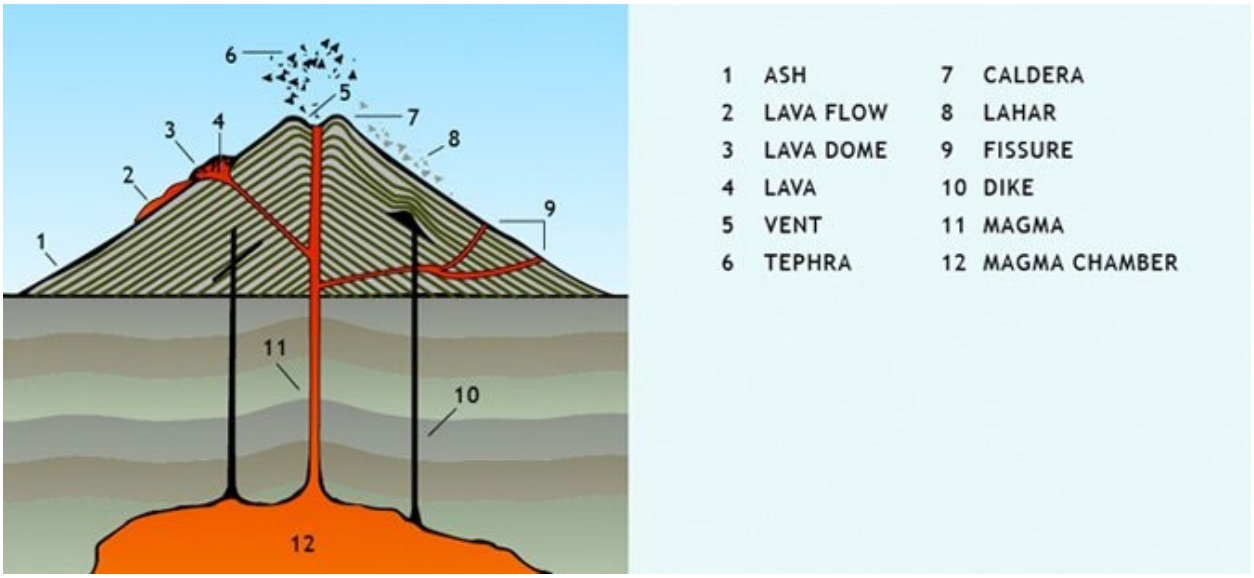
Helping Kids Learn – Post #23 4/8/21 **See also companion lesson Post #21**

STEM: Science – Earth and Space Sciences

Volcanoes have provoked a mixture of awe and fear in people since ancient times. The famous eruption of Mount Vesuvius in 79 C.E. even produced fundamental changes in the way Roman society was organized. What are volcanoes and what should you know about them? Let's find out. This lesson can be adapted for various ages and levels of preparation. See **Lift the Level** for suggestions.

Be a Vulcanologist – The Geoscience of Volcanoes

Vulcanologists (Volcanologists) are scientists who study volcanoes. Even though there are different kinds of volcanoes, there are some common *features* (parts).



Courtesy of https://www.pbs.org/wgbh/nova/article/volcano-parts/

Picture 1

Because the overwhelming majority (95%) of volcanoes form along tectonic plate boundaries (where two plates meet), vulcanologists also study the plates that make up the surface of Earth. See Virtual Learning Post #21.

NOTE: Several investigations are messy and are best done outdoors or in an area that can be washed down afterwards. Younger children should have adult assistance/supervision.

Investigation 1 ***Make a volcano*** You will use your volcano in the other Investigations. You will need a large funnel or stiff paper such as a paper grocery bag or papier mache, a bowl or cup to fit inside the bottom of the volcano, a sheet of cardboard, and tape (package sealing works well if you have it).


Picture 2

A volcano is a mountain usually shaped like a *truncated cone* – an upside-down V without the sharp point at the top. See Picture 1. You can make your volcano out of a large funnel turned upside down (narrow part pointing up), by molding papier mache and letting it dry, or by rolling a sheet of stiff paper into a cone shape with a hole at the top. If you use paper, cut the bottom (wide part) to sit flat. See Picture 2.

You also may want to make a paper *cylinder* (can shape) that fits snug around the bowl and touches the inside top of the volcano. It will help to channel the *tephra* (ash, hot gasses and rocks) and *lava* (melted rocks) to the vent. Put the bowl on a sheet of cardboard and place your volcano over it so it sits flat against the cardboard. Fasten your volcano to the cardboard with package sealing tape, sealing the edges.

Investigation 2 ***Explosive Volcano*** You will need a sheet of waxed or other water-resistant paper, baking soda and vinegar. Protect your eyes with goggles or glasses. **Adults should assist younger children.** In this type of volcano a large cloud of tephra rises through the *vent* (opening), falls on the surrounding land and sometimes drifts large distances.

Tear the waxed paper into tiny bits mix them with 4 tablespoons of baking soda. Pour the mixture carefully through the vent in your volcano into the bowl. Pour about ½ cup of vinegar through the vent into the bowl. **DO NOT look into the vent.**

Investigation 3 ***Non-Explosive Volcano*** You will need baking soda and vinegar. Red food coloring is optional. This is the type of volcano you've probably seen most often on the news or in movies. Pressure in the Earth causes lava to flow out of the vent(s) and down the sides of the volcano.

The bowl inside your volcano should be empty. Pour 4 tablespoons of baking soda through the vent into the bowl. If you want the lava to look red, mix about 10 drops of red food coloring with ½ cup of vinegar. **Ask an adult to help you** pour the vinegar through the vent into the bowl. **DO NOT look into or inhale over the vent.**

Science Vocabulary

Many science/math words are used in this lesson. Some may be new to you; others you may *think* you know but don't really know how scientists use them. Use the Internet or a dictionary to write the *definition* (meaning) of each word – writing them down will help you remember the words and keep them straight.

Feature	Truncated cone	Cylinder
Tectonic plate	Tephra	Lava
Tectonic plate boundary	Vent	Fissure
Simulation/simulate	Erupt/eruption	Vulcan

What's the Science?

Investigation 1 In all of the investigations you are *simulating* (imitating) an actual volcano and its actions. When you combine an acid and a base, a chemical reaction takes place that can, in the right circumstances, be explosive in its power. We suggest baking soda and vinegar because they are readily available. Other combinations of acids and bases could be used.

Investigation 2 An explosive eruption is violent by definition. Explosive eruptions occur when volcanoes contain large amounts of *felsic magma,* which is mainly *silica* (silicon dioxide, SiO_2) and white-to-gray in appearance. Tephra is the silica-rich cloud exploding from the vent. It can rise 10,000 feet or more into the atmosphere making an explosive volcano dramatic to watch – from a safe distance. Tephra clouds can cause severe inflammation in your lungs if you breathe in the dust. This happened during the Mount Vesuvius eruption in 79 C.E. The study of tephra from ancient volcanoes, *tephrachronology,* tells us a lot about the history of the Earth. This is partly because each of the mineral signatures of eruptions is unique.

Picture 3
https://commons.wikimedia.org/w/index.php?curid=2575167
By Michael Ryan, U.S. Geological Survey

Investigation 3 Non-explosive volcanoes are dramatic in a different way. They occur when volcanoes contain lots of iron and magnesium but little silica. Pressure, especially at a plate boundary, causes rock to melt and produce lots of heat. Lava often glows red and burns up everything in its path. The *molten* (melted) rock is heavier than tephra. So the eruption flows rather than exploding. There is often a white cloud with non-explosive eruptions, as there is in explosive volcanoes, but it is steam from water trapped in the Earth and super heated by the lava, not tephra. See Picture 3. Once it cools, lava from non-explosive volcanoes looks dark gray or black.

Lift the Level

You can extend/deepen this lesson by any of the following. **STEM Online** can be helpful in finding answers.

1. Why are scientists studying volcanoes called *vulcan*ologists? What do you need to learn to become one?
2. Your volcano has only one vent. Volcanoes can also have *fissures* (side vents) on their slopes (see Picture 1). Create a volcano model with side vents and repeat Investigations 2 and 3.
3. You may want to repeat Investigation 2 with actual ash. Or you may want to simulate tephra drift by using a small fan to blow the ash – away from you! **Do not breathe in the ash or get it in your eyes.**
4. As explained in **What's the Science?,** you simulated volcanic actions by combining an acid and a base. Try out other combinations of acids and bases and compare your results for Investigations 2 and 3.
5. Craters in volcanoes are related to **caldera**. Research the similarities and differences and identify several well-known caldera.

6. You may have seen pictures of volcanic mountains with the top covered in ice and snow. When they erupt, ice and magma combine and lightning storms are often produced. Make a model of a *phreatic eruption* and label the parts.
7. Vulcanologists often study in Iceland. An island about the size of the state of Virginia, Iceland has 33 active volcanoes. All volcanic features are found in Iceland. After doing some research, create a map of Iceland showing the 3 volcanic zones and characteristics of the volcanoes there.
8. Volcanoes can erupt under water. Perhaps as many as 80% of volcanic eruptions occur in our oceans. How are deep ocean eruptions the same as and different from land eruptions?
9. Vulcanology is a growing field and the demand for vulcanologists is expected to expand faster than many professions over the next 10 years. Learn more about the field and prepare a tri-fold brochure that you can share with classmates. Include profiles of at least 4 vulcanologists.
10. You can read the landscape for evidence of past volcanic activity. For example, valleys formed by volcanoes have a **V** shape while those formed by glaciers are more **U**-shaped. Research picture online or travel to hills or mountains near you to read the landscape. Make a poster that shows both types of valleys and label appropriately. (A scientist who studies ancient volcanoes is called a **paleovulcanologist.**)
11. Mount Vesuvius is the only volcano in Europe. Its most famous eruption is mentioned in the introduction. Why do vulcanologists continue to study it? Is it still considered active?
12. Volcanoes occur on other planetary bodies. Identify at least two examples, comparing and contrasting with volcanoes on Earth.

STEM Online

These are suggestions only and no endorsement is implied. Although they have been screened for appropriateness before posting, adults should vet the websites children use, as they may change over time.

Caldera https://en.wikipedia.org/wiki/Caldera, https://www.britannica.com/place/Yellowstone-Caldera, https://www.nationalgeographic.org/encyclopedia/calderas/

Mount Vesuvius https://www.history.com/this-day-in-history/vesuvius-erupts, https://www.historyextra.com/period/roman/life-death-pompeii-remains-ancient-rome/, https://vesuviusvolcanoo.weebly.com/ (student report)

Reading the landscape http://www.scienceclarified.com/landforms/Ocean-Basins-to-Volcanoes/Volcano.html, https://www.nps.gov/articles/howglacierchangethelandscape.htm, https://nsidc.org/cryosphere/glaciers/questions/land.html

Vulcanology https://en.wikipedia.org/wiki/Vulcan_(mythology), https://oceantoday.noaa.gov/deepoceanvolcanoes/, https://kids.britannica.com/kids/article/volcano/353902, https://en.wikipedia.org/wiki/Volcanology, https://www.environmentalscience.org/career/volcanologist, https://www.americangeosciences.org/education/k5geosource/careers/volcanologist, https://www.nationalgeographic.com/environment/article/volcanoes (requires email address, no fee)

NJ Student Learning Standards

Science: Physical Science K-PS2-1, K-PS2-2; 3-PS2-1, 3-PS2-2; 5-PS2-1; MS-PS2-1, MS-PS2-4

Earth Science K-ESS2-1; 2-ESS2-1, 2-ESS2-2, 2-ESS2-3; 3-ESS201, 3-ESS2-2; 4-ESS2-1; 5-ESS2-1; MS-ESS1-4; MS-ESS2-2; HS-ESS 1-5, HS-ESS2-2