

**Gwen Foster
Catherine Hawkins
Spring, 2005**

Volcanoes

Abstract: This is an introductory lesson on volcanoes. Begin the lesson with a think-write labeled “What I know about volcanoes, what I want to know about volcanoes” followed by a discussion of the student’s answers. To get the students excited about the lesson you will do a quick experiment that simulates pressure buildup inside a volcano. After the experiment the students will view the volcano episode of Bill Nye the Science Guy. They will be given a worksheet that asks them to record specific things they learn from the video. Finally, the students will review their think-writes and record any questions they still have about volcanoes. This information can be used to guide further lessons.

Grade Level: 5th

Utah State Core Curriculum Standards:

Science Benchmark

The Earth’s surface is constantly changing. Some changes happen very slowly over long periods of time, such as weathering, erosion, and uplift. Other changes happen abruptly, such as landslides, volcanic eruptions, and earthquakes. All around us, we see the visible effects of the building up and breaking down of the Earth’s surface.

Standard II

Students will understand that volcanoes, earthquakes, uplift, weathering, and erosion reshape Earth’s surface.

Objective 2:

Explain how volcanoes, earthquakes, and uplift affect Earth’s surface.

Instructional Time: 60 minutes

Materials:

- ◇ Empty film canister with lid
- ◇ Alka-Seltzer tablets
- ◇ Water
- ◇ Large, clear plastic container with lid
- ◇ Bill Nye Volcano Video, *Volcanoes Enhanced Classroom Edition* - Running time 26 minutes, available at: http://dep.disney.go.com/educational/store/detail?product_id=77A25VL00

Terminology:

- ◇ *Volcano:* Any opening in the earth’s surface through which magma erupts
- ◇ *Magma:* Hot melted rock below the earth’s surface
- ◇ *Lava:* Hot melted rock above the earth’s surface
- ◇ *Ash:* Small pieces of hardened lava
- ◇ *Vent:* The opening through which magma reaches the earth’s surface
- ◇ *Shield Volcanoes:* Broad volcanoes with gentle slopes primarily consisting of lava
- ◇ *Cinder Cone Volcanoes:* Tall, narrow volcanoes with steep slopes primarily consisting of ash
- ◇ *Composite Volcanoes (Stratovolcanoes):* Wide volcanoes with fairly steep slopes consisting of alternating layers of lava and ash
- ◇ *Vulcanologist:* Someone who studies volcanoes

Intended Learning Outcomes:

- ◇ Manifest Scientific Attitudes and Interests
- ◇ Understand Science Concepts and Principles

Background Information:

Volcanoes are any hole or *vent* in the earth's surface through which magma erupts. Explosive eruptions occur when volcanic gasses build up and create pressure within magma chambers. Eventually the pressure becomes great enough to break through a weak spot in the earth's crust. When the gas breaks through it can force molten rock and ash thousands of feet into the air.

The three most common types of volcanoes are composite, or stratovolcanoes, shield volcanoes, and cinder cone volcanoes.

Composite volcanoes are steep mountains made up of alternating layers *lava, ash* and other materials.

The layering is caused by violent eruptions that release lots of gas and ash, followed by quieter eruptions that allow a lava layer to form. Mt. Rainier, Mt. St. Helens and Mt. Fuji are composite volcanoes.

Shield volcanoes are broad with gently sloping sides. They are the largest volcanoes, created when thick magma is forced slowly to the surface. Multiple mild eruptions allow the thick lava to form multiple layers. Mauna Loa in Hawaii, the largest active volcano on earth, is a shield volcano.

Cinder Cone volcanoes are the smallest and most abundant volcanoes. They are formed by a violent eruption that spews ash lava and gas into the air. The ash and lava cool quickly, fall to the ground, and form the cone. Because most of the pressure is released in the initial formation of a cinder cone, it is unlikely to erupt again for many years. Sunset Crater in Arizona is a cinder cone volcano.

Most volcanoes form at plate boundaries. When an oceanic plate pushes under a continental plate, the oceanic plate melts forming magma that forces its way up between the plates. Volcanoes, like the Hawaiian Islands, form in the middle of plates, over hot spots in the ocean floor. In these hot spots magma melts through the earth's crust eventually creating an island. As the plate oceanic plate moves over the hot spot new islands are formed.

Invitation to Learn: Alka-Seltzer activity that demonstrates pressure buildup inside a volcano.

- ◇ The instructor will say, "Most of you know that some volcanoes explode but do you know why? It is because of pressure. Let me show you. This film canister represents a volcano."
- ◇ Fill the film canister with water. While holding an Alka-Seltzer tablet in your hand say, "The water combined with this Alka-Seltzer tablet represents the magma inside a volcano."
- ◇ Drop the tablet into the water. *Instructor:* "The lid represents debris clogging the hole in the top of the volcano." (Quickly put the lid on the canister.)
- ◇ Place the film canister in a large clear-plastic container and watch the top blow off.
- ◇ (The plastic container keeps the mess to a minimum in the classroom.)
- ◇ Explain to the class that the reaction between the Alka-Seltzer and water is a chemical reaction that creates gas and causes pressure to build up. In a volcano extreme heat creates the gas that eventually blows the top off the volcano.
- ◇ Ask Students if they have heard of Mt. Saint Helens. Explain that it is a volcano in Washington that blew up in the 1980's. There are a number of volcanoes throughout the Pacific Northwest that could explode just like Mt. Saint Helens; however, not all volcanoes explode.
- ◇ *Instructor:* "The people who study volcanoes are called vulcanologists. Why do you think they would want to study about volcanoes?"
- ◇ *Instructor:* "For the next few weeks you will all become amateur vulcanologists. I hope you are up for the challenge."

Prior Knowledge Assessment: Think-Write – Ask students to write what they know about volcanoes and what they would like to know about volcanoes?

After watching *Volcanoes Enhanced Classroom Edition*, discuss the items students say they would still like to learn about volcanoes. This can lead to group projects based on interest or simply let you know what information you need to emphasize in future instruction.

Procedures:

Part I – Think-Write

- ◇ Ask the students to fold a paper in half and label one side, “What I know about volcanoes?” Label the other side, “What would I like to know about volcanoes?”
- ◇ Give the students a few minutes to write their answers.
- ◇ Discuss the student’s answers, and make a list of the most common answers to both questions.
- ◇ Be sure to include any vocabulary words the students come up with.
- ◇ Many of the students will probably say that volcanoes explode. Use this to lead into the Alka-Seltzer activity described in the invitation to learn.

Part II – Alka-Seltzer activity (Procedures detailed in Invitation to Learn)

Part III – Bill Nye Volcano Video

- ◇ Hand out the worksheet with a list of terms the students must define while watching the Video.
- ◇ Play the Video.
- ◇ After viewing the video ask the students to review their list of things they would like to learn. Have them underline questions on their list that were answered in the video and put a star next to anything they still have questions about. Give the students a moment to write down any new questions they have. Discuss the revised lists with the class. Be sure to record students’ remaining questions for future lesson planning.
- ◇ Students hand in their worksheets and think-writes.
- ◇ Explain to the class that next class period they will begin building their own volcanoes. They will use the information they learned in today’s class to analyze their volcano and compare it to their classmates volcanoes.

Adaptations and Modifications for Special Learning Needs: Students who are unable to fill in the worksheet during the video will be given a few minutes to work with a partner after the video has stopped.

Assessment: Informal: Classroom discussion, think-write exercise

Formal: Students will fill out a worksheet that includes vocabulary and information introduced in the video.

Sources:

Harcourt Science, Teacher’s Edition. Earth Science Units C and D, Copyright 2000
Printed in the USA C16-C17 Harcourt School Publishers

Glencoe Science Level Green, Glencoe/McGraw Hill, Copyright 2003 Printed in the USA p. 429-433.

http://yahooligans.yahoo.com/Science_and_Nature/The_Earth/Geology/Volcanoes/Volcano_Videos/

<http://www.stevespanglerscience.com/experiment/00000128>

Name: _____

Volcanoes

Use the information from the Bill Nye volcano video answer these questions.

Write a definition for these words-

Volcano:

Magma:

Lava:

Ash:

Vent:

Vulcanologist:

Name at least three different types of volcanoes and their properties:

What happens when a volcano explodes?

How do volcanoes change the surface of the earth?

Gwen Foster
Catherine Hawkins
Spring, 2005

What can you learn from a volcano just by looking at it?

Three-dimensional Foamboard Volcanoes

Abstract:

This lesson is designed to allow students the opportunity to find an answer to the question, “What can you learn from a volcano just by looking at it?” In part one; students will take time to explore the structure of one volcano of their choice. They will construct a three-dimensional foamboard volcano to get a better understanding of the structure of volcanoes. In part two; students will look for answers to the class question for this project. One way the teacher can facilitate this is to allow students time to examine their volcano in relation to other volcanoes. Through this examination they will be able to see if there are differences in the structure of each volcano. To discover what the student learned, students can create a poster, story or chart. This is a pretty in-depth lesson that requires knowledge of fractions or drawing to scale, ability to follow multi-step directions, and thinking independently. Carefully consider your students and determine if this is the correct activity for your class.

Grade Level: 5th Grade

Utah State Core Curriculum Standards:

Science Benchmark

The Earth’s surface is constantly changing. Some changes happen very slowly over long periods of time, such as weathering, erosion, and uplift. Other changes happen abruptly, such as landslides, volcanic eruptions, and earthquakes. All around us, we see the visible effects of the building up and breaking down of the Earth’s surface.

Standard II: Students will understand that volcanoes, earthquakes, uplift, weathering, and erosion reshape Earth’s surface.

Objective 2: Explain how volcanoes, earthquakes, and uplift affect Earth’s surface. **A:** Identify specific geological features created by volcanoes, earthquakes, and uplift.

Instructional Time:

- ◇ 1 hour to introduce lesson and scaffold the making of a 3-D volcano
- ◇ 30 minutes to choose a volcano
- ◇ 3 hours to create the foamboard volcanoes, this time can be divided up as needed
- ◇ 2 or 3 ten minute sessions during the project to allow students to observe their classmates volcano’s
- ◇ As homework have the students complete their answer to the class question

Materials:

- ◇ Highlighters
- ◇ Foamboard
- ◇ Scissors

- ◇ a photocopy of the topographic map of your favorite volcano
- ◇ tape or spray glue

Terminology:

- ◇ *Topographic maps:* The art of showing in detail on a map the physical features of an area or a region. Maps that show the geographical features, contour lines, and elevation of those features. It takes a three dimensional shape and places it on a one dimensional map.
- ◇ *Three dimensional maps:* A map to scale which shows the topography of the landform, not just the contour lines. You could actually see and feel the landforms, you don't just have to imagine like a normal map.
- ◇ *Contour lines:* A mapping technique to show how the different elevations of the physical features of an area. This is one part of a topographic map.
- ◇ *Scale:* the size of a sample in proportion to the size of the actual object.

Intended Learning Outcomes:

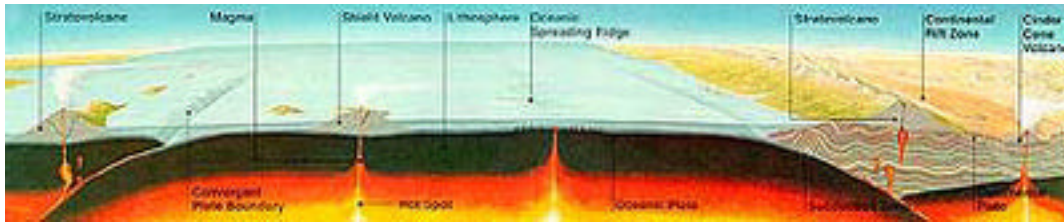
- ◇ Manifest scientific attitudes and interests
- ◇ Understand the nature of science

Background Information:

Due to the open ended nature of this activity a great deal of background information has been included to aid the teacher in answering the variety of inevitable questions that will arise. Information taken from <http://interactive2.usgs.gov/learningweb/teachers/volcanoes.htm>.

Volcanic eruptions are among the Earth's most powerful and destructive forces. Imagine hearing a volcano erupt thousands of miles away. Imagine looking through binoculars and seeing the top of a mountain collapse. Imagine discovering an ancient Roman city that had been buried in volcanic ash. Volcanoes are also creative forces. The Earth's first oceans and atmosphere formed from the gases given off by volcanoes. In turn, oceans and an atmosphere created the environment that made life possible on our planet. Volcanoes have also shaped the Earth's landscape. Many of our mountains, islands, and plains have been built by volcanic eruptions. Deep within the Earth it is so hot that some rocks slowly melt and become a thick flowing substance called **magma**. Because it is lighter than the solid rock around it, magma rises and collects in magma chambers. Eventually some of the magma pushes through **vents** and **fissures** in the Earth's surface. A volcanic eruption occurs! Magma that has erupted is called **lava**. Some volcanic eruptions are explosive and others are not. How explosive an eruption is depends on how runny or sticky the magma is. If magma is thin and runny, gases can escape easily from it. When this type of magma erupts, it flows out of the volcano. Lava flows rarely kill people, because they move slowly enough for people to get out of their way. Lava flows, however, can cause considerable destruction to buildings in their path. If magma is thick and sticky, gases cannot escape easily. Pressure builds up until the gases escape violently and explode. In this type of eruption, the magma blasts into the air and breaks apart into pieces called **tephra**. Tephra can range in size from tiny particles of **ash** to house-size boulders. Explosive volcanic eruptions can be dangerous and deadly. They can blast out clouds of hot tephra from the side or top of a volcano. These fiery clouds race down mountainsides destroying almost everything in their path. Ash erupted into the sky falls back to Earth like powdery snow, but snow that won't melt. If thick enough, blankets of ash can suffocate plants, animals, and humans. When hot volcanic materials mix with water from streams or melted snow and ice, mudflows form. Mudflows have buried entire communities located near erupting volcanoes. Because there may be hundreds or thousands of years between volcanic eruptions, people may not be aware of a volcano's dangers. When Mount St. Helens in the State of Washington erupted in 1980, it had not erupted for 123 years. Most people thought Mount St. Helens was a beautiful, peaceful mountain and not a dangerous volcano.

Where Do Volcanoes Erupt?



(Top: Poster Fig. 2)

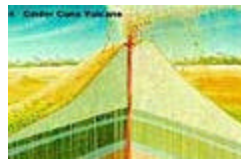
Volcanoes occur because the Earth's **crust** is broken into plates that resemble a jigsaw puzzle. There are 16 major plates. These rigid plates float on a softer layer of rock in the Earth's **mantle**. As the plates move about they push together or pull apart. Most volcanoes occur near the edges of plates. When plates push together, one plate slides beneath the other. This is a **subduction zone**. When the plunging plate gets deep enough inside the **mantle**, some of the rock on the overlying plate melts and forms magma that can move upward and erupt at the Earth's surface. At **rift zones**, plates are moving apart and magma comes to the surface and erupts. Some volcanoes occur in the middle of plates at areas called **hotspots** - places where magma melts through the plate and erupts.

Why Do Volcanoes Grow? Volcanoes grow because of repeated eruptions. There are three main kinds, or shapes, of volcanoes based on the type of materials they erupt.



(Top: Poster Fig. 3)

Stratovolcanoes build from eruptions of lava and tephra that pile up in layers, or strata, much like layers of cake and frosting. These volcanoes form symmetrical cones with steep sides.



(Top: Poster Fig. 4)

Cinder cones build from erupting lava that breaks into small pieces as it blasts into the air. As the lava pieces fall back to the ground, they cool and harden into cinders that pile up around the volcano's vent. Cinder cones are very small cone-shaped volcanoes.



(Top: Poster Fig. 5)

Shield volcanoes form from eruptions of flowing lava. The lava spreads out and builds up volcanoes with broad, gently sloping sides. The shape resembles a warrior's shield.

Invitation to Learn:

Play Eye Spy Game. After a few rounds of the game ask the students how they knew what the correct answer ways. Explain that, just like scientists, we can learn a lot about a subject by observing our environment. Ask the students to tell you something that they have learned about from looking at it.

Prior Knowledge Assessment:

Since this is the second of two lessons in the unit, students have already thought about volcanoes. Draw a volcano on the board. Ask the students to tell you everything they know about volcanoes including what they remember from the first lesson. Write these answers on the board. This discussion can be used to assess how much the students know and will help to lead in the lesson plan. Ask the students if there is something else they want to know? How do they think they can find an answer to this question? The teacher will then explain that for this lesson students are going to recreate a volcano in order to understand if they can find an answer to their question.

Procedures:

Lesson adapted from http://volcano.und.nodak.edu/vwdocs/volc_models/three_d.html

1. Introduction

- a. Teacher will explain that the class has spent time talking about volcanoes and what can be learned by observation with their eyes.
- b. Ask the students how these two concepts can be added together?
- c. Ask “What do you think you can learn about volcanoes from observation?”
- d. Teacher will list these ideas on the board.
- e. Teacher will have students write down one or two questions that think they might want to discover through observation.

2. Chose a volcano

- a. Have a pile of topographic maps, books and pictures of volcanoes that are available for students to look through.
 - i. Introduce vocabulary: Topographic map, and three dimensional maps.
- b. Take some time to look in depth at different maps. Explain what a **topographic map** is and what it tells scientists and students. Once again ask students to tell you what they can learn about the volcano from looking at these maps.

3. Pattern

- a. On the chosen map highlight the contour lines
 - i. Introduce vocabulary: Contour lines and scale
 - ii. The contour lines chosen to be highlighted should all be equally apart and to scale.
 - iii. Students will need to determine the fraction on which they are going to highlight
 - iv. Students may need help determining which lines to use for the simple topographic map so be sure to scaffold this choice as much as possible.
- b. The number of layers (pieces of foamboard) on your volcano depends on the **scale** (contour interval)
- c. Cut out the map along the contour lines that were highlighted.
- d. Place a layer of the cut out map on a piece of foam board.
- e. Cut out the foamboard using the map as the template.
- f. Place the layers of the foamboard as if you were looking down on the volcano. The largest pieces will be on the bottom. Once all the layers are in the right order, glue them together.

4. Discovery

- a. Refer back to the list that the class made at the beginning of the lesson and the questions the students wanted to discover
- b. Remind students that the question they are trying to answer is “What can you learn from a volcano just by looking at it?”
- c. Tell students that now that they have had time to discover what makes one volcano unique they still need to answer the class question
- d. Since this is a level three inquiry lesson – allow students to choose the additional resources they may need to answer the question and how the answer will be presented.

Assessment:

Assessment of this project will be done in two steps. First, evaluate the foamboard volcano for accuracy based on the topographic map of the volcano that students choose. A fun way to do this would be to have all the topographic maps posted and all the students’ volcanoes displayed to see if students are able to match the two together. If most of the students are able to match the volcano to the map then the student did a successful job. If most students are not able to match the two then the student was not as successful as others in the class.

Second, evaluate the students' answers to the question, "What can you learn from a volcano just by looking at it? Some other possible questions to ask to get to this information are: what does the shape of the volcano tell you, what do you think causes the similarities in shape and size, does the type of eruption determine what the volcano will look like after the eruption, in other words is the type of eruption an indicator of what it will look like when its done? Answers to these questions can all be found in the background information so please refer back to that for further clarification. To evaluate the students answers look for evidence that students wrestled with what they can learn from observation, that they started thinking like scientists, and that they learned something new about volcanoes.

Adaptation and Modifications for Special Learning Needs:

Some students may not have the fine motor skills to cut a foamboard volcano. These students could draw their volcano or write a story about their volcano.

Other students may need to have more guidance during this project. Create smaller goals that each student can accomplish each session to help the student progress through the project and successfully complete it.

Depending on the specific needs of the students, it is always possible to adapt the lesson to allow for pairs of students to work together.

To help the students progress through the steps, give an instruction sheet to each student to use as a checklist.

Student Instructions

1. Making the volcano :

- a. Choose a volcano to study
- b. Get a copy of the topographic map of your volcano
- c. Decide what scale you are going to use
- d. Highlight the layers/contour lines according to your scale
- e. Cut out your map along the contour lines
- f. Use the cut out map to cut out your foamboard
- g. Glue your foamboard pieces together

2. Examine other students volcanoes:

- a. Take time to look at other volcanoes
- b. What is different between your volcano and your classmates'
- c. What is the same between your volcano and your classmates'

3. Answer this question:

- a. What can you learn from a volcano just by looking at it?
- b. Choose a method to tell/share what you learned about volcanoes. You could make a poster or write story or use other methods – be creative.

Here are some pictures to help clarify some of the step outlines above.



Mount St. Helens. Photograph courtesy of U.S. Geological Survey. A cardboard representation of this volcano.

