



## Feeling Hot, Hot, Hot! Lesson Overview

**GRADE LEVEL:** Grades 9-11

**TIME ALLOTMENT:** Three 45-minute class periods

**OVERVIEW:** Throughout history, volcanic eruptions have been among the most terrifying, catastrophic, and unpredictable natural events. Volcanic eruptions occur when molten rock beneath the Earth's crust erupts through openings in the surface, which can occur either at the boundaries between lithospheric plates or over hot spots. Although scientists know a great deal about the formation of volcanoes, they have yet to develop an effective system for accurately predicting their eruptions. While volcanoes can be devastating to cities and landscapes, they can also create new geographical features such as mountains and island chains.

In this lesson, students will learn about different types of volcanoes, how and why they erupt, and the physical impact of volcanic eruptions. The class will simulate a volcanic eruption by using a model volcano and chemical solution, and compare it to a real eruption in order to understand both the process by which magma is created and the relationship between plate tectonics and volcanism. The lesson also reviews the formation, location, and identity of volcanic islands and other surface features. The class will analyze information gained from video clips and virtual labs to assess the possibility of using knowledge about volcanoes to predict their eruptions.

Student understanding will be assessed through classroom organizers, virtual lab activities, and responses to in-class discussions. Students should have a basic knowledge of plate tectonics prior to completing this lesson.

This lesson can be used following the NATURE lesson, "Stressed Out!"

**SUBJECT MATTER:** Earth Science

### **LEARNING OBJECTIVES:**

Students will be able to:

- Describe the physical effects of volcanic eruptions;
- Describe the four principal types of volcanoes;
- Demonstrate an understanding of the process by which magma is formed;
- Explain the relationship between plate boundaries and zones of volcanism;
- Correlate zones of high occurrence of volcanoes and newly formed mountain ranges/island chains;
- Recognize the geographic areas where volcanoes most frequently occur;
- Compare the positive and negative effects of volcanic eruptions;
- Discuss options for predicting volcanic eruptions.



## STANDARDS AND CURRICULUM ALIGNMENT:

### National Science Education Standards:

<http://www.nsta.org/publications/nses.aspx>

### Earth and Space Science

**CONTENT STANDARD D: As a result of their activities in grades 9-12, all students should develop an understanding of**

- Energy in the earth system
- Geochemical cycles
- Origin and evolution of the earth system
- Origin and evolution of the universe

Fundamental concepts and principles that underlie this standard include:

#### ***ENERGY IN THE EARTH SYSTEM***

- The outward transfer of earth's internal heat drives convection circulation in the mantle that propels the plates comprising earth's surface across the face of the globe.

#### ***THE ORIGIN AND EVOLUTION OF THE EARTH SYSTEM***

- Interactions among the solid earth, the oceans, the atmosphere, and organisms have resulted in the ongoing evolution of the earth system. We can observe some changes such as earthquakes and volcanic eruptions on a human time scale, but many processes such as mountain building and plate movements take place over hundreds of millions of years

### New York State Regents Core Curriculum Alignments

#### Physical Setting: Earth Science Core Curriculum

<http://emsc.nysed.gov/ciai/mst/pub/earthsci.pdf>

**STANDARD 6** - Interconnectedness: Common Themes Patterns of Change:

**Key Idea 5:** Identifying patterns of change is necessary for making predictions about future behavior and conditions.

**STANDARD 4:** Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.



**Key Idea 2:** Many of the phenomena that we observe on Earth involve interactions among components of air, water, and land.

### **Performance Indicator 2.1**

**2.1k** The outward transfer of Earth's internal heat drives convective circulation in the mantle that moves the lithospheric plates comprising Earth's surface.

**2.1l** The lithosphere consists of separate plates that ride on the more fluid asthenosphere and move slowly in relationship to one another, creating convergent, divergent, and transform plate boundaries. These motions indicate Earth is a dynamic geologic system.

These plate boundaries are the sites of most earthquakes, volcanoes, and young mountain ranges.

Compared to continental crust, ocean crust is thinner and denser. New ocean crust continues to form at mid-ocean ridges.

Earthquakes and volcanoes present geologic hazards to humans. Loss of property, personal injury, and loss of life can be reduced by effective emergency preparedness.

**2.1m** Many processes of the rock cycle are consequences of plate dynamics. These include the production of magma (and subsequent igneous rock formation and contact metamorphism) at both subduction and rifting regions, regional metamorphism within subduction zones, and the creation of major depositional basins through down-warping of the crust.

**2.1n** Many of Earth's surface features such as mid-ocean ridges/rifts, trenches/subduction zones/island arcs, mountain ranges (folded, faulted, and volcanic), hot spots, and the magnetic and age patterns in surface bedrock are a consequence of forces associated with plate motion and interaction.

**2.1o** Plate motions have resulted in global changes in geography, climate, and the patterns of organic evolution.

**2.1p** Landforms are the result of the interaction of tectonic forces and the processes of weathering, erosion, and deposition.



## **MEDIA COMPONENTS**

### **Video:**

**NATURE**, *Violent Hawaii*, selected clips

Clip 1, "A Land Born in Fire"

Shows footage of volcanic activity and lava flow in Hawaii.

Clip 2, "How to Build an Island from Scratch"

How the Hawaiian Islands were formed by a geothermal hotspot and related volcanic activity.

Clip 3, "Creating an Island Paradise"

The process by which the next Hawaiian island will be formed.

Access the streaming and downloadable video segments for this lesson at the Video Segments Page (<http://www.pbs.org/wnet/nature/lessons/feeling-hot-hot-hot/video-segments/1533/>).

### **WEB SITES:**

#### **Annenberg Media Exhibits - Volcanoes**

<http://www.learner.org/interactives/volcanoes/entry.html>

This interactive site contains information about the formation and location of volcanoes, as well as information about predicting volcanic eruptions.

#### **Dynamic Earth:**

##### **Plates & Boundaries**

<http://learner.org/interactives/dynamicearth/plate.html>

This section of the interactive shows the different types of plate boundaries and where they are located on the Earth's surface. This page is a good review for students.



## **Slip, Slide, Collide**

<http://learner.org/interactives/dynamicearth/slip2.html>

Starting on the second page of the section, Slip, Slide, Collide shows pictures and animations, accompanied by text descriptions, of the activity at plate boundaries.

## **Active Volcanoes, Plate Tectonics, and the “Ring of Fire”**

[http://vulcan.wr.usgs.gov/lmgs/Gif/PlateTectonics/Maps/map\\_plate\\_tectonics\\_world\\_bw.gif](http://vulcan.wr.usgs.gov/lmgs/Gif/PlateTectonics/Maps/map_plate_tectonics_world_bw.gif)

Map showing plate boundaries and sites of volcanic activity.

## **Virtual Volcano**

<http://dsc.discovery.com/convergence/pompeii/interactive/interactive.html>

This interactive site from the Discovery Channel reviews the composition of volcanoes, the different types of volcanoes, and allows students to adjust conditions create different types of volcanoes and eruptions.

## **USGS Predicting Volcanic Eruptions**

<http://volcanoes.usgs.gov/edu/predict>

This interactive Web site uses data from a series of eruptive episodes of Mt. St. Helens to describe methods of predicting volcanic eruptions. The site includes animations, text, hands-on extension activities, and assessments.

## **Earth Science Reference Table**

<http://emsc32.nysed.gov/osa/reftable/esp1-7.pdf>

Provided by the New York State Regents Board, this reference guide includes useful information for students.

## **MATERIALS**

For each student:

- Earth Science Reference Table, page 5



- Case Study Organizer
- Hawaiian Islands Organizer
- Volcano Types Organizer
- Predicting Volcanic Eruptions Organizer

For each pair/group:

- Computer with Internet access

For the class:

- Computer with Internet access, projector, and screen
- World Map
- Materials for the Volcano Model and Simulated Eruption
  - One 100ml beaker
  - One metric measuring cup
  - One small jar (large enough to hold ingredients)
  - One small dishpan
  - One piece of cardboard, approximately 10 x 20 cm
  - 50g baking powder
  - 180ml white or cider vinegar
  - 60ml dishwashing liquid
  - Red food coloring
  - 120ml water
  - Approximately 0.5kg potting soil
  - Two sticks of modeling clay
- Teacher Answer Keys
  - Case Study Organizer Answer Key
  - Hawaiian Islands Organizer Answer Key
  - Volcano Types Organizer Answer Key
  - Predicting Volcanic Eruptions Organizer Answer Key

## PREP FOR TEACHERS

Prior to teaching this lesson, you will need to:

Preview all of the video clips and Web sites used in the lesson.

Download the video clips used in the lesson to your classroom computer, or prepare to watch them using your classroom's Internet connection.

Bookmark the Web sites used in the lesson on each computer in your classroom. Using a social bookmarking tool such as [del.icio.us](http://del.icio.us) or [diigo.com](http://diigo.com) (or an online bookmarking utility such as [portaportal.com](http://portaportal.com)) will allow you to organize all the links in a central location.

Make copies of the [Earth Science Reference Table](#), page 5, (<http://emsc32.nysed.gov/osa/reftable/esp1-7.pdf>) for each student in your class.



Make copies of all Student Organizers for each student in your class.

Prepare the Volcano Model and materials for the Simulated Eruption prior to the lesson, assembling the materials as follows:

1. Put 50g baking soda in a small jar.
2. Cover the sides and part of the top of the jar with modeling clay, forming a cone shape resembling a volcano. Leave an opening at the top.
3. Place the model volcano in a small plastic dishpan.
4. If desired, fill the dishpan with soil, surrounding the volcano. If necessary, use cardboard to hold the soil in place.
5. In a separate container, mix 180ml white or cider vinegar, 60ml dishwashing liquid, 120ml water, and 2-3 drops red food coloring.
6. Set the volcano and vinegar solution aside for the Introductory Activity.

### **INTRODUCTORY ACTIVITY: SETTING THE STAGE**

1. Tell your class that for the next few days they will be learning about volcanoes. Explain that, unlike many other geological processes, volcanic eruptions are sudden and dramatic rather than slow and steady. Give your students some examples of catastrophic volcanic eruptions, such as:

- Mount Tambora, Indonesia: erupted in 1815 and killed approximately 92,000 people
- Mount Pinatuba, the Philippines: erupted June 1991 after being dormant for 635 years
- Mount St. Helens, Washington, USA: erupted violently in May 1980

Ask students if they know anything about these or other volcanic eruptions in history. (*Accept all answers.*)

2. Tell students that they are going to see a demonstration of a volcano. Place the model “volcano” in a central location in the classroom. Ask the students if they have ever seen a demonstration like this before. (Many of them are likely to have seen this demonstration when they were younger.) Ask the students to predict what you will do to make the volcano “erupt.” (*Accept all answers.*) Ask them to pay careful attention to the sights, sounds, and smells of the “eruption” and to record detailed observations in their notebooks.

3. Demonstrate the eruption with the materials prepared prior to the lesson. Slowly pour the vinegar solution into the “volcano.” It will not erupt like a real volcano, but should bubble violently over the top of the jar. Give students a few minutes to record their observations. Ask the students to explain why the volcano “erupted.” (*Chemical reaction of the vinegar solution and baking soda.*) Ask if they think this demonstration accurately simulated the look, feel, and smell of an erupting volcano, as well as the processes that cause real volcanoes to erupt. (*No - a real volcano would produce heat, the lava would*



*be bright, it might smell smoky or like sulfur. The processes would also be MUCH different - instead of a chemical reaction from adding an external solution, real volcanoes erupt because of internal processes in the Earth.)*

4. Tell students they will now watch a video clip of an actual volcanic eruption. Provide students with a FOCUS FOR MEDIA INTERACTION by asking them to observe the characteristics of the eruption and record their observations in their notebooks, alongside or below their observations about the simulated volcano. PLAY Clip 1, “A Land Born in Fire.” (Access the video segments for this lesson at the Video Segments Page, <http://www.pbs.org/wnet/nature/lessons/feeling-hot-hot-hot/video-segments-violent-hawaii/1533/>.) When the clip is finished, give students a few minutes to finish writing their observations.

5. Lead the class in a discussion contrasting the two eruptions, based on the observations they recorded in their notebooks. Some questions to ask are:

A. What differences did you observe between the simulated volcano and the actual volcano in the video? (*Simulation had bubbles instead of lava; there was no heat or pressure involved in the simulation; no blast; consistency of lava was different; lava flow in the simulated volcano did not cool and harden to form surface features; etc.*)

B. Based on what you observed from the video, what do you think you might see, hear, and smell near a real erupting volcano? (*Flowing lava, spewing ash, rumbling, landslides, falling rocks, smoke, ground and buildings shaking*)

C. What are some of the consequences of volcanic eruptions? How might an eruption change the area surrounding the volcano? (*Lava cools and creates new surface features, changes landscape, starts fires, etc.*)

D. What can scientists tell from the lava at different eruption sites? (*Temperature based on color and brightness, how and when the lava was formed, some information about patterns of eruption*)

6. Ask students, based on the class discussion, to make some predictions about the cause(s) for volcanic eruptions.

### LEARNING ACTIVITY 1

1. Tell students that, as they saw in the video clip, volcanoes occur when magma, which is molten rock beneath the Earth’s surface, erupts through openings in the crust. Once the magma has reached the surface, it is called lava. Open the Virtual Volcano Web site (<http://dsc.discovery.com/convergence/pompeii/interactive/interactive.html>) and display on a screen for the class. Click “Enter” to enter the site, and then click the “Inside a volcano” link on the left side navigation menu. Walk students through the different features of the volcano.

2. Explain that while the basic process by which volcanoes erupt is the same for all volcanoes, not all volcanoes are the same. Divide the class into pairs or groups, with



each pair/group at their own computer. Direct pairs/groups to the Virtual Volcano Web site (<http://dsc.discovery.com/convergence/pompeii/interactive/interactive.html>) and ask them to click on the “Volcano types” link in the left side navigation menu. Ask students to read about the three types of volcanoes listed: Stratovolcano, Cinder Cone, and Shield. Give students a FOCUS FOR MEDIA INTERACTION by asking them to note the distinguishing features of each type of volcano, including how they are formed, what they look like, and examples. Distribute the “Volcano Types Organizer” for students to record their observations. Give students 5-10 minutes to complete the activity. When students have finished, check for comprehension by asking students to share their answers with the class (*Answer Keys for all the student organizers are provided in the Materials list on the Overview page*).

3. Ask students, based on the information they now have about volcano types, what factors they think might contribute to creating different types of volcanoes and eruptions? (*Lava consistency/viscosity, lava cooling, force of eruption, location.*) Ask students to click on the “Build your own volcano and watch it erupt” link, and visit that section of the Web site on the class computer as well. Point out that the viscosity and gas levels of magma contribute greatly to the type of volcano that will be formed.

4. Tell students you would now like them to complete the activity and build their own volcanoes. Give students a FOCUS FOR MEDIA INTERACTION by asking them to try and create at least one of each type of volcano by adjusting the viscosity and gas settings. Students should record the settings and type of eruption that results on their organizers. Tell students that there is also a fourth type of volcano that can be created; if they find it, they should fill in its information on the Volcano Types organizer. Give students 5-10 minutes to complete the activity.

5. When students have finished, check for comprehension by reviewing the new answers on the organizer. Ask students how they created the different volcano types. Ask if anyone found the fourth type of volcano, and what it is. (*Lava dome.*) Review the information about lava domes.

## LEARNING ACTIVITY 2

1. Ask students to name the three different types of plate boundaries (*convergent, divergent, transform*). If students need a primer or refresher on plate boundaries, ask them to visit the Plates & Boundaries section of the Dynamic Earth Web interactive (<http://learner.org/interactives/dynamicearth/plate.html>) and read the information on the first page.

2. Explain to students that the movement of the continental and oceanic plates form “zones of volcanism.” The first zone of volcanism occurs at convergent boundaries. Project the Slip, Slide, Collide section of the Dynamic Earth interactive (<http://learner.org/interactives/dynamicearth/slip2.html>) for the whole class. Display the first picture on the Convergent Boundary page. Explain to students that a “subduction zone” is formed when a thinner oceanic plate collides with a thicker, sturdier continental plate. The oceanic crust is then pulled under the continental crust. This process is called subduction. As the oceanic crust is forced deeper into the earth, high heat and pressure



melt the rock and form magma. Scroll to the bottom picture and explain that a Convergent Boundary zone of volcanism can also occur when two continental plates collide. Click through to the next page (<http://learner.org/interactives/dynamicearth/slip3.html>), which focuses on Divergent Boundaries. Play the animation of diverging plates, and explain that as plates move away from each other, volcanoes form from the magma that flows into the rift area. Explain that there is a third zone of volcanism that does not occur at a plate boundary. Hotspots, or intraplate volcanism, occur when a stationary plume of magma breaks through a tectonic plate to form a volcano.

3. Tell students that this movement of plates and the subsequent volcanic activity often leads to new surface features on the Earth. For example, without the action of volcanoes, many mountains and islands would not exist. Explain that hotspots are responsible for creating many island chains around the globe. Ask students if they can think of an example of this kind of island chain (*Hawaii*). Tell students that there are several hotspot island chains around the world, and point out examples on a world map (*Tahiti, Galapagos, Easter, Pitcairn*). Explain that these island chains are created when a plate moves over a hotspot, and volcanoes are formed in a line that follows the plate's movement.

4. Tell students that they'll be watching two video clips about hotspot island formation in Hawaii. Distribute the "Hawaiian Islands Organizer" to students. Provide students with a FOCUS FOR MEDIA INTERACTION by asking them to look for the factors that contribute to the formation of the new island. Play Clip 2, "How to Build an Island from Scratch" and Clip 3, "Creating and Island Paradise." (Access the video segments for this lesson at the Video Segments Page, <http://www.pbs.org/wnet/nature/lessons/feeling-hot-hot-hot/video-segments-violent-hawaii/1533/>.) Give students a few minutes to record their answers. Replay the clips, if necessary. Check for comprehension by reviewing answers with the class.

### LEARNING ACTIVITY 3

1. Tell students that many of the world's volcanoes are located around the edge of the Pacific Ocean, where many plate boundaries are located, and this region is sometimes called the "Ring of Fire." Ask students to locate the Ring of Fire on a world map.

2. Display this USGS map ([http://vulcan.wr.usgs.gov/Imgs/Gif/PlateTectonics/Maps/map\\_plate\\_tectonics\\_world\\_bw.gif](http://vulcan.wr.usgs.gov/Imgs/Gif/PlateTectonics/Maps/map_plate_tectonics_world_bw.gif)) on a large screen to the entire class, or print copies and distribute to each student. Ask students to name the countries in the Ring of Fire. (*U.S., Canada, Indonesia, Japan, Mexico, Philippines, Russia, New Zealand, Chile, Mariana Islands, Tonga*) Ask students to point out the plate boundaries at which volcanoes most frequently occur, based on the active volcanoes shown on the map. (*Eurasian, Indo-Australian, North American, Cocos, Nazca, Pacific, Arabian, African, South American, Antarctic*) Students may refer to page 5 of the Earth Science Reference Tables (<http://emsc32.nysed.gov/osa/reftable/esp1-7.pdf>) for the names of the plates.



3. Ask students, based on the occurrence of volcanoes on the map, at which type of boundary volcanoes most frequently occur. (*At convergent boundaries.*) Ask students to point out any volcanoes on the map that occur at other boundaries or zones of volcanism. (*many at the Divergent boundary of the Arabian and Indo-Australian plates, hotspots in the middle of the Pacific plate, on the North American Plate, on the Arabian Plate, on the Nazca plate. There is also a hotspot on the Mid-Atlantic Ridge, at the boundary of the North American and Eurasian Plates.*) Students may once again refer to the Earth Science Reference Tables for the types of boundaries between the plates, if necessary.

4. Instruct students to go to the Earth's Plates interactive at the Learner.org Web site (<http://www.learner.org/interactives/volcanoes/activity2/act2main.html>). Divide the class into groups of 3 - 4 students and assign one case study to each group (there will most likely be doubles among the groups). Distribute the "Case Study Organizer" to each student. Provide students with a FOCUS FOR MEDIA INTERACTION by asking students to read the information in their case study and use the information given as well as their knowledge of zones of volcanism to locate their volcano on the map. Ask students to record the details of their case study on the Case Study Organizer. Give students 5-10 minutes to complete the activity. Review answers with the class. As each group presents its findings, encourage other groups to fill in all information for the other Case Studies on their organizer. If desired, the groups can learn more information about the other volcanoes on the map by clicking on the "Read About all the Volcanoes" link, and completing the organizer for the remaining four volcanoes on the list.

### **CULMINATING ACTIVITY**

1. By this time students should be familiar with many causes and effects of volcanic eruptions. Explain that while scientists are working on ways to predict volcanic eruptions, they are not always entirely accurate. Tell the class that they will be looking at a Web site interactive from the U.S. Geological Survey that uses data from eruptive episodes of Mt. St. Helens to demonstrate methods of predicting eruptions. Go to Predicting Volcanic Eruptions (<http://volcanoes.usgs.gov/edu/predict>) and choose the appropriate screen size for your computer.

2. Go to the "Ground Deformation" section of the interactive by clicking the link on the left menu bar. Give students a FOCUS FOR MEDIA INTERACTION by asking them to notice the three factors considered by USGS scientists in predicting volcanic eruptions. Read or call on students to read each of the three paragraphs on the first page of the Ground Deformation section. Once the paragraphs have been read, check for comprehension by asking students to name the three factors. (*New faults or thrust faults, ground tilt, and earthquakes*). If desired, roll over the pictures to give students more information and a better understanding of the factors leading up to eruption.

3. Divide the class into pairs or groups, with each pair or group using their own computer. Distribute the "Predicting Volcanic Eruptions Organizer" to each student. Instruct pairs/groups to read and watch the animations on the remaining pages of the Ground Deformation section. Provide students with a FOCUS FOR MEDIA INTERACTION by asking them to observe how the data found is analyzed by scientists.



Students can record their answers on the organizer. Give pairs/groups 10-15 minutes to complete the interactive and fill in their answers. Review answers with the class.

4. Tell the pairs/groups that they will now have the chance to analyze the data surrounding volcanic eruptions themselves. Direct students to click on the “Exercise” link in the left toolbar. Give students a FOCUS FOR MEDIA INTERACTION by asking them to carefully read and review the information presented on pages 1-3, and then use that information to make predictions and choose their actions on pages 4-6.

5. For a related homework assignment, students can visit either the Kilauea or Mt. St. Helens section of the interactive and view the data surrounding the eruptions. Students can use this information to write a short (1-2 page) paper describing the factors that indicated that these volcanoes were going to erupt.

## **CROSS-CURRICULAR EXTENSIONS**

### *Social Studies*

Yellowstone National Park sits atop a caldera and is one of the world’s largest supervolcanoes. Research the effects of volcanic activity on the area and the emergency procedures that are in place should the volcano erupt.

Volcanic eruptions can be damaging at best and devastating at worst. Research and discuss specific strategies in place for town and city planning or building structures near volcanoes. Discuss ideas students might have for “volcano-proofing” towns.

## **COMMUNITY CONNECTIONS**

Ask students to develop a disaster plan for their community, taking into account the relevant natural threats to the area (earthquake, volcanic eruption, flood, tornado, hurricane, etc.)



NAME: \_\_\_\_\_

DATE: \_\_\_\_\_

**Case Study Organizer**

	Location	Type	Volcanic Zone	Date & Type of Eruption (s)
Case Study #1: <b>Kilauea</b>				
Case Study #2: <b>Popocatepetl</b>				
Case Study #3: <b>Santorini</b>				
Case Study #4: <b>Surtsey</b>				



NAME: \_\_\_\_\_

DATE: \_\_\_\_\_

### Hawaiian Islands Organizer

1. What is the name of the plate on which Hawaii sits? \_\_\_\_\_

2. In which direction does this plate move? \_\_\_\_\_

3. What is the name of the new volcano? \_\_\_\_\_

4. When will the new volcano break the surface of the ocean? \_\_\_\_\_

\_\_\_\_\_

5. What will the volcano look like when it emerges? \_\_\_\_\_

6. What will the area surrounding the volcano look like in one hundred years?

\_\_\_\_\_

\_\_\_\_\_

7. Why? \_\_\_\_\_

\_\_\_\_\_



NAME: \_\_\_\_\_

DATE: \_\_\_\_\_

### Volcano Types Organizer

	Formation	Shape	Examples	Levels	Eruption
Stratovolcano					
Cinder Cone					
Shield					
_____					



NAME: \_\_\_\_\_

DATE: \_\_\_\_\_

### Predicting Volcanic Eruptions Organizer

Page 2:

Describe two changes that occurred on the surface of the dome as the magma moved upward?

1. \_\_\_\_\_

2. \_\_\_\_\_

Page 3:

In the weeks and days before the eruptions, what happened to the distance between the metal stakes?

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How did the observations described in the previous question affect the scientists' predictions?

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Page 4:

What happened to the crater floor just before eruption?

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Page 5:

Describe one method scientists use to analyze earthquake data.

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What happens to earthquakes before an eruption?

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NAME: \_\_\_\_\_

DATE: \_\_\_\_\_

**Case Study Organizer ANSWERS**

	Location	Type	Volcanic Zone	Date & Type of Eruption (s)
Case Study #1: <b>Kilauea</b>	Hawaiian Islands	Shield	Hotspot	Every 2-3 years, not explosive
Case Study #2: <b>Popocatépetl</b>	Mexico (55 km from Mexico City)	Stratovolcano or composite	Convergent boundary	12/21/1994, some explosive eruptions
Case Study #3: <b>Santorini</b>	Greece	Stratovolcano or composite	Convergent boundary	1640 BC, large and explosive
Case Study #4: <b>Surtsey</b>	Off the coast of Iceland	Not specified	Divergent boundary	November 1963, explosive
Bezymianny	Russia	Stratovolcano or composite	Convergent	
Katmai	Alaska	Stratovolcano or composite	Convergent	
Pelee	Martinique	Stratovolcano or composite	Convergent	
Vesuvius	Italy	Stratovolcano or composite	Convergent	



NAME: \_\_\_\_\_

DATE: \_\_\_\_\_

### Hawaiian Islands Organizer ANSWERS

1. What is the name of the plate on which Hawaii sits? \_\_\_Pacific\_\_\_\_\_
2. In which direction does this plate move? \_\_\_Northwest\_\_\_\_\_
3. What is the name of the new volcano? \_\_\_Lo'ihi\_\_\_\_\_
4. When will the new volcano break the surface of the ocean? \_\_\_\_\_  
\_\_\_thousands of years from now\_\_\_\_\_
5. What will the volcano look like when it emerges? \_\_barren\_\_\_\_\_
6. What will the area surrounding the volcano look like in one hundred years? \_\_\_\_\_a  
lush garden\_\_\_\_\_
7. Why? \_\_\_\_\_spores and seeds blown by wind will grow in the rock, erosion turns the  
lava into fertile soil \_\_\_\_\_



NAME: \_\_\_\_\_

DATE: \_\_\_\_\_

**Volcano Types Organizer ANSWERS**

	Formation	Shape	Examples	Levels	Eruption
Stratovolcano	Layers of mostly viscous magma	Steep sides, can reach great heights	Mt. Vesuvius, Mt. St. Helens	Med. high and high viscosity, high gas	Vulcanian. Many cannon-like bursts/explosions. Some lava flow.
Cinder Cone	Built from piles of ejected rock fragments	Small, steep sides, cylindrical	Stromboli, Parícutin	Med. low viscosity, low or high gas	Minor. Lava sprays with little force. Dense blobs of magma are ejected.
Shield	Layer upon layer of fluid, runny lava cools to form the volcano. Often builds from the sea floor	Massive with broad, sloping sides	Many islands – Mauna Loa in Hawaii	Low viscosity, low or high gas	Calm, effusive/ "Hawaiian." Steady stream of running lava, some of which moves very slowly
<u>Lava Dome</u>	Lava pushes up from the earth through the sides or top of a stratovolcano, or in a collapsed crater. Lava piles up to form the dome.	Small dome.		Med. high viscosity, low or high gas	Minor and uncommon. The lava doesn't move easily and flows in pancake-like shapes.



NAME: \_\_\_\_\_

DATE: \_\_\_\_\_

### Predicting Volcanic Eruptions Organizer Answers

Page 2:

Describe two changes that occurred on the surface of the dome as the magma moved upward?

1. \_\_\_movement of thrust fault increased\_\_\_\_\_

2. \_\_\_tilt increased\_\_\_\_\_

Page 3:

In the weeks and days before the eruptions, what happened to the distance between the metal stakes?

\_\_\_\_\_the distance between the stakes grew shorter as thrust faults moved\_\_\_\_\_

\_\_\_\_\_the stakes moved more quickly\_\_\_\_\_

How did the observations described in the previous question affect the scientists' predictions?

\_\_\_\_\_this indicated to scientists that there was a pattern to which actions occurred before an eruption\_\_\_\_\_

Page 4:

What happened to the crater floor just before eruption? \_\_\_\_\_the angle of the ground changed. The crater floor tilted outward away from the dome.\_\_\_\_\_

Page 5:

Describe one method scientists use to analyze earthquake data.

\_\_\_\_\_one way to analyze the data is to plot the number of earthquakes that occur beneath a volcano every day\_\_\_\_\_

What happens to earthquakes before an eruption? \_\_\_\_\_the number of earthquakes\_

\_\_\_\_\_increases right before an eruption, but not the size of the earthquakes\_\_\_\_\_