

Volcanoes and Earthquakes

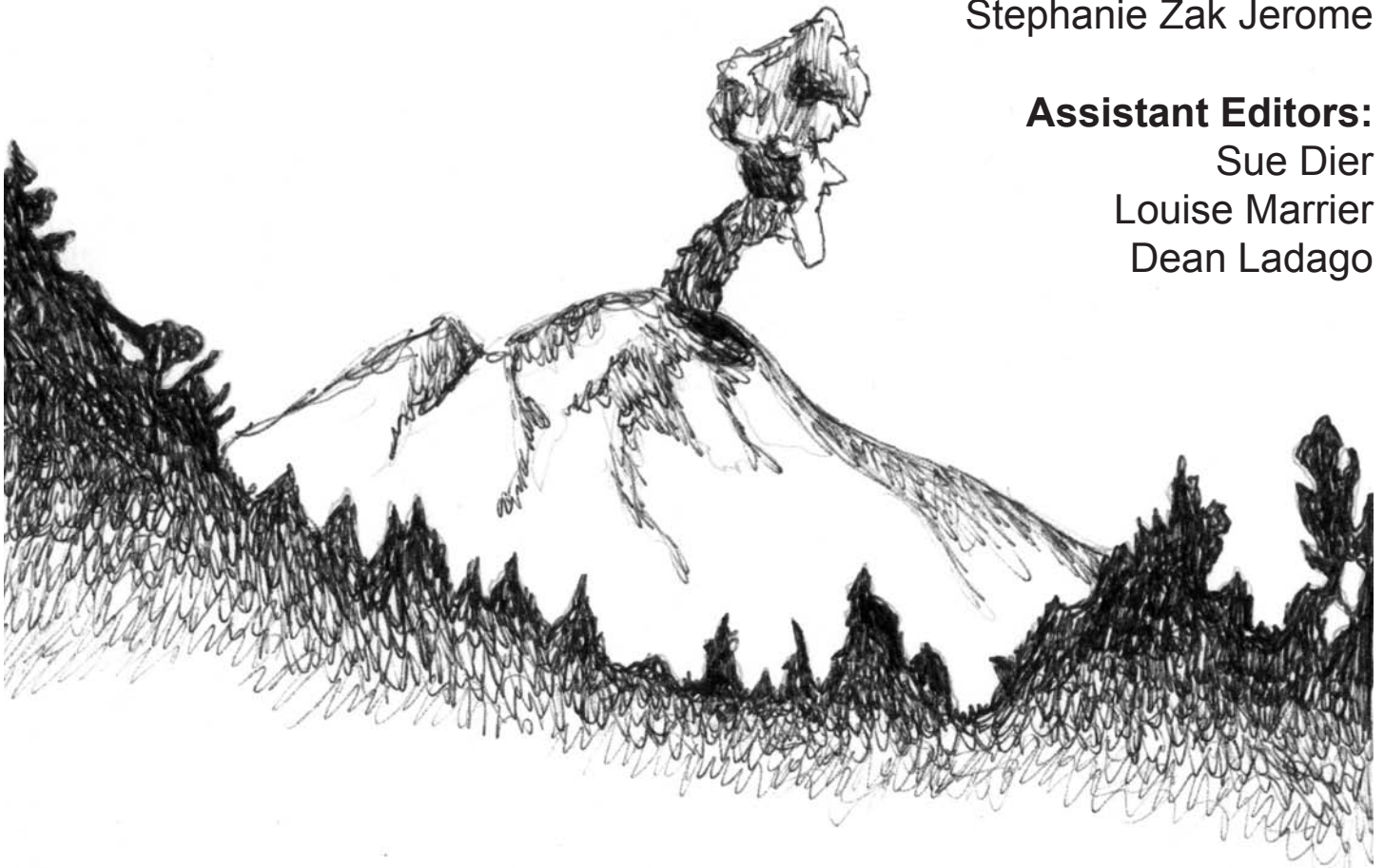
Teacher's Guide Middle School

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A Message from our Company . . .

Dear Educator:

Thank you for your interest in the educational videos produced by the Visual Learning company. We are a Vermont-based, family owned and operated business specializing in the production of quality educational science videos and materials.

We have a long family tradition of education. Our grandmothers graduated from normal school in the 1920's to become teachers. Brian's mother was an elementary teacher and guidance counselor, and his father was a high school teacher and superintendent. This family tradition inspired Brian to become a science teacher, and to earn a Ph.D. in education, and lead Stephanie to work on science educational programs at NASA.

In developing this video, accompanying teacher's guide, and student activities, our goal is to provide educators with the highest quality materials, thus enabling students to be successful. In this era of more demanding standards and assessment requirements, supplementary materials need to be curricular and standards based - this is what we do!

Our videos and accompanying materials focus on the key concepts and vocabulary required by national and state standards and goals. It is our mission to help students meet these goals and standards, while experiencing the joy and thrill of science.

Sincerely,

Brian and Stephanie Jerome



National Standards Correlations

National Science Education Standards

(Content standards: 5-8, National Academy of Sciences, c. 1996)

Earth and Space Science – Content Standard D:

As a result of their activities in grades 5-8, all students should develop an understanding that:

- Lithospheric plates on the scales of continents and oceans constantly move at rates of centimeters per year, in response to movements in the mantle. Major geological events, such as earthquakes, volcanic eruptions, and mountain building result from these plate motions.
- 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.

Benchmarks for Science Literacy

(Project 2061 – AAAS, c. 1993)

The Physical Setting – Processes that Shape the Earth – (4C)

By the end of 8th grade, students should know that:

- The interior of the earth is hot. Heat flow and movement of material within the earth cause earthquakes and volcanic eruptions and create mountains and ocean basins. Gas and dust from large volcanoes can change the atmosphere.
- Some changes in the earth's surface are abrupt (such as earthquakes and volcanic eruptions) while other changes happen very slowly (such as uplift and wearing down of mountains). The earth's surface is shaped in part by the motion of water and wind over very long times, which act to level mountain ranges.



Student Learning Objectives

Upon viewing the video and completing the enclosed student activities, students will be able to do the following:

- Generally describe how earthquakes are created.
- Provide two examples of major earthquake events.
- Differentiate between the following earthquake terms: epicenter and focus.
- Describe seismic waves in relation to earthquakes.
- Classify primary waves, secondary waves and surface waves, and describe the general characteristics of each.
- Describe how the seismograph and Richter scale are used to measure earthquake waves and strength.
- Differentiate between the following terms: lava, magma, vent, crater and caldera.
- Describe some common characteristics of volcanoes and volcanic eruptions.
- Provide two examples of volcanic eruptions.
- Distinguish between the four major types of volcanoes: dome, cinder cone, composite, and shield.
- Construct a diagram of a specific type of volcano.
- Describe how the composition of magma affects volcanic eruptions.



Assessment

Preliminary Test:

The Preliminary Test, provided in the Student Masters section, is an assessment tool designed to gain an understanding of student preexisting knowledge. It can also be used as a benchmark upon which to assess student progress based on the objectives stated on the previous pages.

Video Review:

The Video Review, provided in the Student Masters section, can be used as an assessment tool or as a student activity. There are two main parts. The first part contains questions titled “You Decide” that can be answered during the video. The second series of ten questions consists of a video quiz to be answered at the conclusion of the video.

Post-Test:

The Post-Test, provided in the Student Masters section, can be utilized as an assessment tool following student completion of the video and student activities. The results of the Post-Test can be compared against the results of the Preliminary Test to assess student progress.



Introducing the Video

Before showing the video discuss the occurrence of both earthquakes and volcanoes. Ask the students: What do you think causes earthquakes and volcanoes? Ask students to describe some of the more noteworthy volcanic eruptions they have heard about. Discuss some of the characteristics of these eruptions. Also, ask if a major earthquake were to occur, how would it affect people's lives? Record the student's answers on the board. While viewing the video ask the students to watch closely and discover how earthquakes and volcanoes are formed. Tell them to listen and watch for information on how earthquakes and volcanoes are related.

Video Viewing Suggestions

The student Master "Video Review" is provided for distribution to students. You may choose to have your students complete this Master while viewing the program or to do so upon its conclusion.

The program is approximately 20-minutes in length and includes a ten-question video quiz. Answers are not provided to the Video Quiz on the video, but are included in this teacher's guide. You may choose to grade student quizzes as an assessment tool or to review the answers in class.

The video is content-rich with numerous vocabulary words. For this reason you may want to periodically stop the video to review and discuss new terminology and concepts.



Student Assessments And Activities

Assessment Masters:

- Preliminary Test
- Video Review
- Post-Test

Student Activity Masters:

- Volcano Creations!
- San Francisco Earthquake of 1906
- The Sleeping Giant
- Vocabulary of *Earthquakes and Volcanoes*



Video Script:

Volcanoes and Earthquakes

1. This city by the bay is San Francisco, California ...
2. ... known for the Golden Gate Bridge...
3. ... spacious well manicured parks...
4. ... and quaint neighborhoods, it is regarded as one of the most beautiful cities in North America.
5. But early on the morning of April 18, 1906 this city turned into a disaster zone.
6. A powerful earthquake shook the ground, toppling buildings, and turning them into rubble.
7. Large fires which were ignited as a result of the earthquake raged for three days, burning over 28,000 buildings to the ground, . . .
8. ...the devastation left over 350,000 people homeless.
9. Today the people of San Francisco and the surrounding area regularly feel small earthquakes.
10. Many nervously anticipate a large earthquake referred to as the “Big One”, an earthquake which would be as powerful as the 1906 quake.
11. While scientists predict that a large quake is imminent in the near future, no one knows exactly when the earth will be jolted.
12. How are earthquakes caused? How are they measured?
13. And what do we know about another force in nature, volcanoes? What causes them to erupt, and where are they located?
14. During the next few minutes we are going to investigate these questions and others...
15. ... as we explore some of the most powerful forces on earth.
- 16. Graphic Transition - Earthquakes**
17. You Decide? What is an earthquake?
18. An earthquake is the movement or shaking of the ground resulting from sudden movement between rock masses in the earth’s crust.
19. Strong forces within the earth’s crust may cause rocks to bend and to build up stress and tension over time.
20. When stress exceeds the strength of the rock, the rock breaks or moves along planes called faults.
21. This sudden movement in the earth’s crust generates waves of energy, which travel outward through the ground.
22. It is a process similar to throwing a pebble into water.
23. Notice how small ripples travel outward in all directions.
24. In many cases the amount of energy generated by an earthquake can’t be felt at all.
25. But in some cases the earthquake can be powerful enough to cause intense property damage.



Script (cont.)

26. Graphic Transition – Faults and Earthquakes

27. This aerial image illustrates one of the most famous geologic features in North America – the San Andreas Fault.
28. A fault, as shown by this line, is a break between different areas of rock along which movement has occurred.
29. When sudden movement occurs along a fault, rocks break or slide past each other and energy is released, resulting in an earthquake.
30. These posts show the position of the San Andreas Fault north of San Francisco.
31. And this 1906 photo taken after the San Francisco earthquake in the same location illustrates a large fissure directly over the fault. Notice the person standing directly in the fissure!
32. The San Andreas Fault system is nearly 1000 kilometers in length and runs from southern California through northern California and into the Pacific Ocean.
33. The region east of the fault is moving slowly south, and the region west is slowly moving north.

34. Graphic Transition – Origins of Earthquakes

35. One of the strongest earthquakes ever recorded in North America occurred in Alaska on March 27, 1964.
36. People were just settling down to eat dinner when a massive jolt shook Anchorage and the surrounding region.
37. One woman, running outside to find her children, fell into a crack in the earth facing certain death, only to be thrust upward by the continual shaking of the earth.
38. The earthquake epicenter was located about 130 kilometers southeast of Anchorage.
39. The epicenter is the point on the earth's surface directly above the point underground where the earthquake originated.
40. The point beneath the surface where the quake originates is called the focus.
41. Sometimes earthquakes occur under the ocean.
42. You Decide! What are tsunamis?
43. Tsunamis are large, often fast moving waves which are triggered by earthquakes under the ocean or by underwater landslides.
44. Tsunamis triggered by the 1964 Alaska earthquake caused catastrophic damage, flooding coastal areas and hurling ships far inland.

45. Graphic Transition - Seismology

46. As a result of rocks moving and crumbling, high-energy earthquake waves called seismic waves radiate outwards from the focus or origin of an earthquake.
47. There are three main types of seismic waves.
48. Primary waves, or P waves travel the fastest, penetrating solids, liquids, and even gases.
49. P waves are compression waves. In a compression wave the rock particles are pushed or compressed in the direction of the waves then bounce back.
50. Secondary waves, or S waves do not travel as fast through the Earth as primary waves . . .



Script (cont.)

51. ...and they arrive after P waves.
52. S waves take the form of this moving rope . . .
53. . . and cause rock particles to move at right angles to the direction of the wave.
54. Surface waves are the third major type of seismic waves.
55. Surface waves are also referred to as L waves. They are the slowest moving seismic waves, and travel along the earth's surface.
56. They can wreak havoc with roads, buildings and railroad tracks.
- 57. Graphic Transition – Measuring Earthquakes**
58. Seismic waves produced by earthquakes can be detected and recorded by instruments called seismographs.
59. The zigzag line made by a seismograph called a seismogram, enables scientists to determine the time, epicenter, and focal depth of an earthquake.
60. Generally speaking, the higher the line, the stronger the earthquake.
61. The Richter scale is one method used to calculate the strength of earthquakes.
62. For each increase of 1.0 on the scale, the amplitude of the surface waves is increased ten times.
63. For example, the 1964 Alaska earthquake had an estimated magnitude of 9.0 on the Richter scale . . .
64. ...one hundred times greater than the 1989 Loma Prieta earthquake, which had a magnitude of about 7.
- 65. Graphic Transition – Volcanoes**
66. On the night of January 23, 1973 the people of this small fishing village called Heimaey off the southern coast of Iceland woke to a large volcanic eruption.
67. The people knew the potential dangers of living so close to an active volcano, and within 24 hours . . .
68. ...ships and planes evacuated most of the island's 5,300 residents.
69. A towering wall of blocky lava, seen here behind these houses moved through the town . . .
70. ...engulfing all in its path. This lava-encrusted house still remains today.
71. The entire town was threatened and brave residents had the ingenious idea to turn fire hoses on the lava in an effort to cool and solidify it, forming a lava dam.
72. They succeeded in turning the lava flow seaward, protecting the village, and creating a breakwater for the harbor.
73. After more than five months, the eruption stopped, leaving the village buried deep in ash. The white objects seen here are rooftops of houses . . .
74. . . which took years to dig out.
75. What exactly are volcanoes? What causes them to erupt, and where are they commonly located?
76. During the remaining few minutes we will attempt to answer some of these questions



Script (cont.)

as we explore the powerful forces of volcanoes.

77. Graphic Transition – Magma and Lava

78. When you think of volcanoes, you probably imagine towering plumes of lava.

79. You Decide!

What is lava?

80. Lava is liquid rock, also called molten rock, that makes its way to the surface.

81. Molten rock is formed deep within the earth under great heat and pressure. Molten rock inside the earth is called magma.

82. Magma is constantly moving, and it may work its way to the surface through cracks in rocks.

83. A volcano is the place where molten rock along with other materials including gases reach the earth's surface.

84. Lava flowing across the landscape is capable of burning and destroying everything in its path.

85. The opening through which lava flows is called a vent. Volcanoes may have more than one vent.

86. In many cases a volcanic mountain is formed surrounding a vent.

87. Graphic Transition – Volcanic Eruptions

88. In 1991, in the Philippines, the largest eruption in the twentieth century occurred when Mount Pinatubo blew its top.

89. The massive eruption took a heavy toll with over 42,000 homes destroyed, 100,000 acres of agricultural land buried in ash and mud, and nearly 900 people killed.

90. Not all eruptions of volcanoes are alike.

91. While some eruptions such as Mount Pinatubo can be explosive and violent

92. . . . others are calmer.

93. Several factors affect the nature of an eruption. For example, the relative amount of gas and water vapor within the magma can influence the severity of an eruption.

94. Generally speaking, magma containing large concentrations of gas and water vapor produces explosive eruptions like that of Mount Saint Helen's in the state of Washington in 1980.

95. Just as gas pressure builds up in a soda can, it can also build up within a volcano.

96. There are many different types of magma based on mineral composition. This too can affect volcanic eruptions.

97. For example, the magma here in Hawaii is low in silica, and forms a dark rock called basalt.

98. Volcanoes rich in basalt do not tend to produce violent eruptions.

99. On the other hand, volcanoes containing magma rich in silica tend to produce violent eruptions.

100. Mount Saint Helen's, for example, contained magma rich in silica.

101. These are just a couple of examples of variables involved in determining the nature of



Script (cont.)

volcanic eruptions.

102. Graphic Transition – Types of Volcanoes

103. Different types of volcanoes are formed from different types of volcanic eruptions.
104. For example, this type of volcano in northern California is called a cinder cone.
105. It is made up of small fragments of rock, ash and other particles that form when lava is thrown into the air and cools before hitting the ground.
106. Cinder cone volcanoes tend to be the result of smaller fountain-like eruptions that cause a cone to form.
107. These hikers are scaling this steep 225-meter high cinder cone.
108. And these beautiful volcanic dunes are made from ash rained down from an adjacent cinder cone.
109. Shield volcanoes, such as this one in Hawaii, tend to produce non-explosive eruptions in which relatively thin lava spreads out over a large area.
110. Shield volcanoes, such as Mauna Loa in Hawaii, are gently sloping mountains.
111. Dome volcanoes are another type of volcano.
112. Lassen Peak in northern California is a dome volcano.
113. Dome volcanoes consist of masses of thick molten rock which piles up around a vent forming a dome-shape.
114. You Decide! What is a composite volcano?
115. Composite or strato volcanoes, such as Mount Shasta are another type of volcano. Like Mount Saint Helens, they tend to have a pattern of violent eruptions which produce cinders and ash, which is then followed by lava which spreads over the previous layer of debris.
116. Sometimes a depression called a crater may form on top of a volcano.
117. When the volcano collapses a wider depression may form called a caldera.
118. This caldera in Oregon formed when a large volcano collapsed creating a huge caldera which eventually filled with water to form Crater Lake.
119. Crater Lake is over 1900 meters or around 6000 feet deep,...
120. ... making it one of the deepest caldera lakes in the world.
- ### **121. Graphic Transition- Formation of Volcanoes**
122. Volcanoes commonly occur in places where there is extensive movement in the earth's crust.
123. This movement is related to the movement of the earth's plates which ride over the surface of the planet.
124. Often volcanoes occur where tectonic plates are separating or moving together.
125. For example, this volcano in Iceland is located at a point where the North American plate and the Eurasian plate are moving away from each other.
126. And Mount Shasta in the Cascade Mountains is located where the Juan de Fuca



Script (cont.)

plate is sliding underneath the North American plate.

127. Notice the large concentration of volcanoes circling the Pacific Ocean. This is referred to as the Ring of Fire.

128. Volcanoes do not always occur at plate boundaries, however.

129. Hawaiian volcanoes, for example, are located in the middle of the Pacific plate.

130. These volcanoes form over areas called hotspots. Here, magma makes its way up through the crust from especially hot areas in the upper mantle of the earth.

131. Graphic Transition – Summing Up

132. During the past few minutes, we have taken a look at some of the fascinating features of earthquakes and volcanoes.

133. We discussed how earthquakes are generated and their potential destructiveness.

134. We studied the major types of seismic waves, and explored how seismographs are used to measure and locate earthquakes.

135. We took a look at the powerful forces involved in the creation of volcanoes, and the different types of volcanoes.

136. We also explored some of the factors influencing the nature of volcanic eruptions.

137. So, the next time you hear about an earthquake occurring or . . .

138. . . read about a volcanic eruption, . . .

139. . . think about some of the things we have discussed during the past few minutes.

140. You just might look at these amazing forces a little differently.

Fill in the correct word to complete the sentence. Good luck and let's get started.

1. A _____ is a break between areas of rock where movement occurs.

2. The _____ Fault is a large geologic feature in California.

3. The _____ is the point underground where an earthquake originates.

4. _____ waves are produced by earthquakes.

5. The _____ scale is one method to calculate earthquake strength.

6. _____ is molten rock inside the earth.

7. A _____ is the opening through which lava flows.

8. This type of volcano is called a _____ cone.

9. Shield volcanoes tend to produce relatively _____ eruptions.

10. Hawaiian volcanoes form over a _____ in the mantle.



Answers to Student Assessments

Preliminary Test (pgs. 20-21)

1. earthquake
2. magma
3. volcano
4. epicenter
5. crater
6. seismic
7. shield
8. fault
9. vent
10. tsunamis
11. true
12. false
13. true
14. true
15. false
16. true
17. true
18. true
19. false
20. true

Video Review (pg. 22)

1. An earthquake is the movement or shaking of the ground resulting from a sudden movement between rock masses in the earth's crust.
2. Tsunamis are large waves which may travel at great speeds triggered by earthquakes under the ocean or underwater landslides.
3. Lava is liquid rock, also called molten rock, that makes its way to the surface.
4. A composite volcano tends to have a pattern of violent eruptions that produce cinders and ash, which is then followed by lava which spreads over the previous layer of debris.

Video Quiz: (pg. 22)

1. fault
2. San Andreas
3. focus
4. seismic
5. Richter
6. magma
7. vent
8. cinder
9. non-explosive
10. hotspots

Post Test (pgs. 23-24)

1. true
2. true
3. true
4. true
5. false
6. false
7. true
8. false
9. true
10. true
11. vent
12. crater
13. magma
14. shield
15. tsunamis
16. earthquake
17. epicenter
18. fault
19. volcano
20. seismic



Answers to Student Activities

Volcano Creations (pg. 25)

1. The toothpaste symbolizes lava.
2. The toothpaste squeezed up through the hole in the cardboard represents a dome volcano
3. Molten or liquid rock inside the earth is called magma. When the molten rock reaches the surface it is called lava. Alternating layers symbolizes a composite volcano.
4. The amount of gas and water vapor can affect the severity of an eruption. Also, the mineral composition of the magma can affect the eruption. Magma rich in granite produces violent eruptions while basaltic magma causes less violent eruptions.
5. Different types of volcanoes are formed by different kinds of volcanic explosions and eruptions.
6. Answers will vary.

San Francisco Earthquake of 1906 (pg. 27)

1. The San Andreas Fault shifted causing a severe earthquake.
2. The earthquake, followed by fires, caused approximately 3,000 deaths, 28,000 buildings were destroyed and 225,000 people lost their homes.
3. People lived in the relief camps because entire neighborhoods were destroyed. People lost their homes and all their belongings. They lived in the camps because they had nowhere to go.

Activities: Answers will vary. The students should try to incorporate factual information in their letters.

Vocabulary (pg. 30)

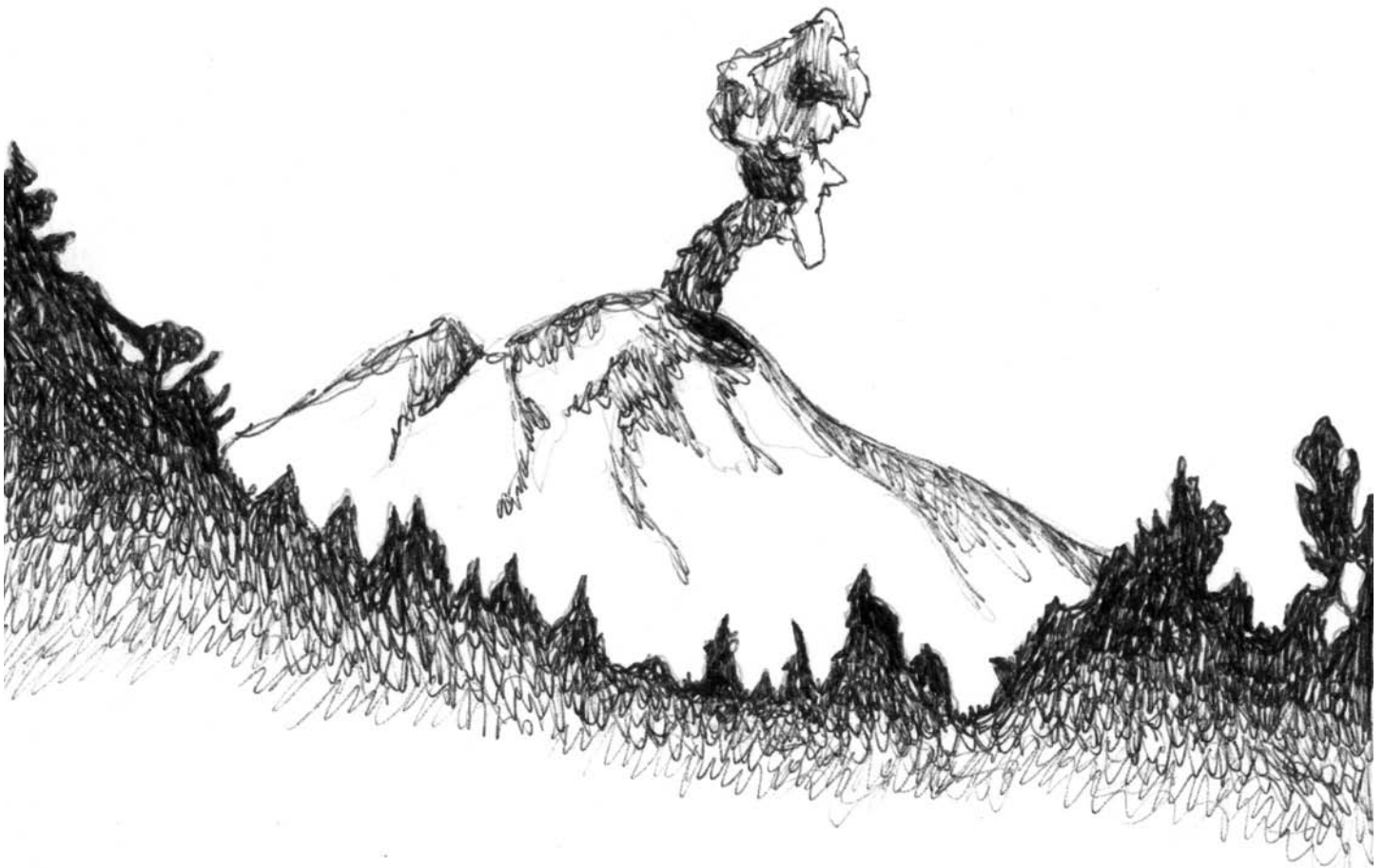
1. seismograph, g
2. volcano, e
3. focus, b
4. lava, c
5. fault, h
6. seismic waves, i
7. Richter scale, f
8. vent, d
9. earthquake, j
10. caldera, a

The Sleeping Giant (pg. 29)

1. A composite volcano.
2. The volcano formed as volcanic eruptions alternated between violent and quiet eruptions. The violent eruptions produced rock layers made of ash cinders and other debris, while the quiet eruptions formed hardened lava layers.
3. The Mount St. Helens eruption killed people, animals and plants. Forests, lakes, rivers and bridges were damaged or destroyed. Some areas were severely affected by the volcanic ash created by the eruption.
4. The answers will vary.
5. 110,000 acres around the volcanic site have been declared a National Volcanic Monument. Scientists now study this area.

Assessment and Student

Activity Masters





Preliminary Test

Directions: Fill in the blank with the correct word. A list of possible answers is provided at the bottom of the page.

1. An _____ is the shaking of the ground resulting from a sudden movement between rock masses in the earth's crust.
2. Molten rock inside the earth is called _____.
3. A _____ is the place where molten rock along with other materials including gases reach the earth's surface.
4. The _____ is the point on the earth's surface directly above the point underground where an earthquake originates.
5. A depression called a _____ sometimes forms on top of a volcano.
6. Strong energy earthquake waves are called _____ waves.
7. _____ volcanoes tend to produce non-explosive eruptions in which relatively thin lava spreads out over a large area.
8. A _____ is a break between different areas of rock along which movement may occur.
9. The opening through which lava flows is called a _____.
10. Sometimes underwater earthquakes trigger immense sea waves called _____.

vent
earthquake
fault
epicenter
tsunamis
seismic
crater

primary
surface
magma
lava
volcano
shield
composite



Preliminary Test

Directions: Decide whether the answer is True (T) or False (F).

- | | | |
|---|---|---|
| 11. The amount of gas and water vapor in magma affects the severity of a volcanic eruption. | T | F |
| 12. Primary waves are the slowest moving seismic waves. | T | F |
| 13. The Richter Scale measures the strength of an earthquake. | T | F |
| 14. Composite volcanoes tend to have a pattern of violent eruptions. | T | F |
| 15. Volcanoes containing magma rich in basalt tend to produce violent eruptions. | T | F |
| 16. Shield volcanoes tend to have a gradual, flat slope. | T | F |
| 17. Seismic waves produced by earthquakes may be detected and recorded by a seismograph. | T | F |
| 18. The point beneath the surface where an earthquake originates is called the focus. | T | F |
| 19. All volcanic eruptions are explosive and violent. | T | F |
| 20. The volcanic region circling the Pacific Ocean is referred to as the Ring of Fire. | T | F |



Video Review

Directions: During the course of the program, answer the “You Decide” questions as they are presented in the video. Answer the Video Quiz questions at the end of the video.

You Decide:

1. What is an earthquake? Answer _____
2. What are tsunamis? Answer _____
3. What is lava? Answer _____
4. What is a composite volcano? Answer _____

Video Quiz:

1. A _____ is a break between areas of rock where movement occurs.
2. The _____ Fault is a large geologic feature in California.
3. The _____ is the point underground where an earthquake originates.
4. _____ waves are produced by earthquakes.
5. The _____ scale is one method to calculate earthquake strength.
6. _____ is molten rock inside the earth.
7. A _____ is the opening through which lava flows.
8. This type of volcano is called a _____ cone.
9. Shield volcanoes tend to produce relatively _____ eruptions.
10. Hawaiian volcanoes form over a _____ in the mantle.



Post Test

Directions: Decide whether the answer is True (T) or False (F).

- | | | |
|--|---|---|
| 1. The point beneath the surface where an earthquake originates is called the focus. | T | F |
| 2. Composite volcanoes tend to have a pattern of violent eruptions. | T | F |
| 3. The volcanic region circling the Pacific Ocean is referred to as the Ring of Fire. | T | F |
| 4. The amount of gas and water vapor in magma affects the severity of a volcanic eruption. | T | F |
| 5. Volcanoes containing magma rich in basalt tend to produce violent eruptions. | T | F |
| 6. Primary waves are the slowest moving seismic waves. | T | F |
| 7. Shield volcanoes tend to have a gradual, flat slope. | T | F |
| 8. All volcanic eruptions are explosive and violent. | T | F |
| 9. Seismic waves produced by earthquakes may be detected and recorded by a seismograph. | T | F |
| 10. The Richter Scale measures the strength of an earthquake. | T | F |



Post Test

Directions: Fill in the blank with the correct word. Choose from the list of possible answers at the bottom of the page.

11. The opening through which lava flows is called a _____.
12. A depression called a _____ sometimes forms on top of a volcano.
13. Molten rock inside the earth is called _____.
14. _____ volcanoes tend to produce non-explosive eruptions in which relatively thin lava spreads out over a large area.
15. Sometimes underwater earthquakes trigger immense sea waves called _____.
16. An _____ is the shaking of the ground resulting from a sudden movement between rock masses in the earth's crust.
17. The _____ is the point on the earth's surface directly above the point underground where an earthquake originates.
18. A _____ is a break between different areas of rock along which movement may occur.
19. A _____ is the place where molten rock along with other materials including gases reach the earth's surface.
20. Strong energy earthquake waves are called _____ waves.

vent
volcano
seismic
earthquake
shield
primary
fault

epicenter
surface
composite
tsunamis
magma
lava
crater



Volcano Creations!

Objectives: The students will differentiate between the following types of volcanoes: dome, cinder cone, composite and shield volcanoes. The student will construct a model of a specific type of volcano.

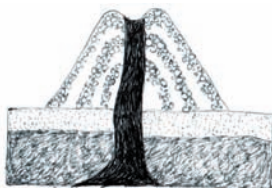
Background: A volcano is the place where molten rock, along with other materials including gases reaches the earth's surface. Molten or liquid rock inside the earth is called magma. When molten rock reaches the surface it is called lava. Not all eruptions of volcanoes are alike. Several factors affect the nature of an eruption. The amount of gas and water vapor within the magma can influence the severity of an eruption. Also, the mineral composition of the magma can affect the eruption. For example, volcanoes containing magma rich in granite tend to produce violent eruptions while volcanoes containing basaltic magma cause less violent eruptions. Different types of volcanoes are formed by different types of volcanic eruptions. Shield, composite, dome, and cinder cone are four types of volcanoes.

A cinder cone volcano is made up of small fragments of rock, ash and other rock particles that form when lava is thrown into the air and cools before hitting the ground. Cinder cone volcanoes are the result of explosive eruptions, forming a cone with a narrow base and steep sides.

Shield volcanoes tend to have non-explosive, quiet eruptions in which relatively thin lava spreads out over a large area. A gentle, sloping, dome shaped mountain forms after several relatively quiet lava eruptions.

Composite volcanoes, also referred to as strato volcanoes, are made up of alternating layers of lava and pieces of volcanic rock. Composite volcanoes frequently produce violent eruptions consisting mainly of ash and cinders. Quieter eruptions often produce lava. Over many years of alternating eruptions a large cone eventually forms.

Lastly, dome volcanoes are formed when lava piles up around a vent forming a dome-shaped mountain.



Cinder



Shield



Composite



Dome



Volcano Creations!

Activity:

1. Divide the students into groups.
2. Each group will construct one type of volcano.
3. Students may use some or all the materials to create a specific type of volcano.
4. Students may experiment with the materials to create the volcano with details specific to the type of volcano.

Upon completion of the volcanoes, students should present their volcano to the class, describe its construction, and state the type of volcano it models.

Materials: cardboard pieces for base, paper tubes, plastic cups, masking tape or duct tape, glue, paint, toothpaste, sand, salt dough, food coloring (for dough), wood pieces, and any other materials that might be useful.

Suggestions for using the materials to create volcanoes:

Toothpaste - Make a hole in the center of the cardboard. Squeeze the toothpaste up through the hole until a layer forms around the opening. Gently pull the tube out.

Dough - Tape or glue a paper tube section to a cardboard base. Mold the dough around the tube to form a volcano. Different colored dough can be used to form layers.

Questions for Volcano Creations:

1. What does the toothpaste symbolize?
2. What type of volcano does the toothpaste represent?
3. What is the difference between lava and magma? What type of volcano is formed by alternating layers?
4. What causes the intensity of volcanic eruptions to differ?
5. What causes volcanoes to be different sizes and shapes?
6. If you lived by a volcano, what type would you want it to be? Why?

Extensions:

1. Students can research a specific volcano to coincide with their model. For instance, Surtsey in Iceland is a shield volcano.
2. Build a town around the volcano.

Recipe for Salt Dough**Ingredients**

1 cup flour
1/2 cup salt
1 t. alum
1/3 to 1/2 cup water
food coloring (a few drops)

Directions: 1. Mix the flour, salt, and alum in a bowl. 2. Stir water into flour a little at a time. Too much water will make the dough sticky; add a little more flour if the dough gets sticky. 3. Knead the dough until smooth (you can add food coloring at this time). 4. Construct your model. 5. Let the model dry two to three days.

Notes: You can double this recipe to make more dough. You can store the dough in an airtight container to keep for a period of time.



San Francisco Earthquake of 1906

Objective: The students will describe the following terms: earthquake and fault. The students will describe the effects of the 1906 San Francisco earthquake.

Background: An earthquake is the movement or shaking of the ground resulting from a sudden movement between rock masses in the earth's crust. The most common cause of earthquakes is movement within the earth along fault lines. Faults are breaks between different areas of rock along which movement may occur. When sudden movement occurs along a fault, rocks break or slide past each other and energy is released, resulting in an earthquake. It is estimated that over one million earthquakes occur world wide each year. However, the majority of these earthquakes are so minor that the earth's surface barely moves. The earthquakes that do move the earth's surface can cause significant damage to buildings and other structures. One such earthquake occurred in San Francisco along the San Andreas Fault on the coast of California.

Early on the morning of April 18, 1906, the men, women and children of San Francisco were awakened suddenly with an abrupt jolt. The San Andreas Fault had shifted causing a severe earthquake. The violent shaking lasted approximately a minute. The earthquake extended over approximately 290 miles along the fault. Buildings were toppled, streets moved, and thousands of people were injured or killed. Seven to eight hundred people died as a direct result of the earthquake. Intense damage and injuries were also caused by the fires that followed the earthquake. The earthquake caused water mains in the city to break, leaving firefighters no water to suppress raging fires. Fires burned for three days and nights. Approximately 3,000 deaths were directly or indirectly attributed to the earthquake and its aftermath.

Businesses, hotels, social clubs, municipal buildings, homes and even whole neighborhoods were destroyed by the earthquake and fires that followed. Approximately 28,000 wood and brick buildings were destroyed. The property damage attributed to the earthquake and fires amounted to a 1906 monetary value of \$400,000,000, which today would equate to much, much more.



San Francisco Earthquake of 1906

In a city with a population of 400,000, over 225,000 were left homeless. People lost their homes along with all their worldly possessions. Relief camps were established, consisting of rows and rows of tents. During the confusion of the earthquake and fires, some children and even babies were separated from their parents. The Salvation Army set up a rescue home for these children to reunite them with their lost families. Following the earthquake and fires, San Francisco began the long, arduous task of rebuilding the city.

Questions:

1. What caused the earthquake on April 18, 1906 in San Francisco?
2. What damage did the fires and earthquake cause?
3. Why did people live in the relief camps?

Activities:

1. Imagine you are a 13 year old boy or girl living in a relief camp. Write a letter to a friend describing why you are at the camp and what it is like to live there.
2. Pretend you are the mayor of San Francisco. Write a letter to the editor of the city's newspaper detailing your steps to rebuild the city.

References and Suggested Reading:

Camp for Stray Children. (1906, April). San Francisco Chronicle.
Harris, H. L. (1998). Agents of Chaos. Missoula: Mountain Press Publishing Company.
London, J. (1906, May). The Story of an Eyewitness. Collier's The National Weekly.



The Sleeping Giant

Objectives: The students will describe some of the effects of the volcanic eruption of Mount St. Helens on May 18, 1980.

Background: Mount St. Helens, a volcanic mountain, lay sleeping in a dormant state for over a hundred years. Dormancy refers to an inactive state which resembles sleep. But, in 1980, Mount St. Helens awoke in a violent eruption. Mount St. Helens is located in the state of Washington and is part of the volcanic Cascade Mountain Range.

Mount St. Helens is a composite volcano. Composite volcanoes are comprised of varying layers that build up over time to form very tall volcanic mountains. Layers develop as the volcanic eruptions alternate between violent, explosive eruptions and nonexplosive, quiet eruptions. Hardened lava layers are formed by the quiet eruptions, while rock layers made of ash, cinders, and other debris develop from the violent explosions.

Mount St. Helens began to awake from its slumber in March of 1980. Earthquakes began to occur around Mount St. Helens and small volcanic explosions followed. On May 18, 1980 Mount St. Helens woke up with a bang! The explosion blew over 1,000 feet of the mountain's top off. The eruption sent ash, clouds of gas and rocks high into the air.

Authorities had issued evacuation warnings to hikers and residents of the area. One elderly man, Harry Truman, refused to leave his home. He was killed along with 22 people minutes after the explosion. A scientist studying the eruptions was also killed by the explosion.

Animals, plants, forests and lakes were destroyed by the eruption. High winds, flying rocks, extensive heat, ash, and mudslides wiped out everything for miles. The high temperatures melted mountainous snow and ice which carried mud and debris down the mountain, clogging up waterways, destroying homes and damaging bridges.

Volcanic ash traveled for miles, darkening the sky, causing the most damage in Yakima, Washington. Ash rained on the city covering houses, streets and playgrounds. Residents wore surgical masks while they swept, shoveled and removed the ash from their city.

In 1982, the area around Mount St. Helens was declared a National Volcanic Monument by Congress. Scientists now study this undisturbed 110,000 acres to examine the effects of the eruption and the process of life returning to the area.

Questions:

1. What type of volcano is Mount St. Helens?
2. How did this volcano form?
3. What damage did Mount St. Helens cause?
4. Why do you think Harry Truman ignored the evacuation order?
5. What is the Mount St. Helens National Volcanic Monument?



Vocabulary of Volcanoes and Earthquakes

Directions: Unscramble the vocabulary words in the first column. Match the words to the definitions in the second column.

- | | |
|---------------------------------|---|
| ____ 1) grhssmoaeip _____ | a. the depression that forms at the top of a volcano when it collapses. |
| ____ 2) onaoclv _____ | b. the point beneath the surface where the earthquake originates. |
| ____ 3) sufco _____ | c. liquid or molten rock that makes its way to the surface. |
| ____ 4) alva _____ | d. the opening in a volcano through which lava, steam, smoke and ash are released. |
| ____ 5) ultfa _____ | e. the place where molten rock along with other materials including gases reach the earth's surface. |
| ____ 6) sscimeia
awevs _____ | f. a method used to calculate the strength of an earthquake. |
| ____ 7) ichterr
cales _____ | g. an instrument used to measure seismic waves produced by earthquakes. |
| ____ 8) entv _____ | h. a break between masses of rock along which movement occurs. |
| ____ 9) kethraauqe _____ | i. strong energy waves produced by earthquakes which travel outward from the earthquake's focus. |
| ____ 10) deraalc _____ | j. the sudden movement of the ground resulting from the movement of rock masses in the earth's crust. |