Igneous and Metamorphic Rocks

Teacher's Guide
High/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

Standards Correlations

National Science Education Standards

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

Earth and Space - Content Standard D:

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

- Some changes in the solid earth can be described as the "rock cycle." Old rocks at the earth's surface weather, forming sediments that are buried, then compacted, heated and often recrystallized into new rock. Eventually, those new rocks may be brought to the surface by the forces that drive plate motions, and the rock cycle continues.
- Fossils provide important evidence of how life and environmental conditions have changed.

Benchmarks for Science Literacy

(Project 2061 - AAAS, c. 1993)

The Physical Setting - Processes that Shape the Earth

By the end of the 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.
- The slow movement of material within the earth results from heat flowing out from the deep interior of the earth.

Student Learning Objectives

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

- Define the term *molten rocks* and differentiate between magma and lava;
- Describe the source of molten rock, and the role molten rock plays in the formation of igneous rocks;
- Differentiate between intrusive and extrusive igneous rocks, while describing some of the general characteristics of each;
- Identify some common igneous rocks such as basalt, obsidian, pumice, and granite;
- Describe the factors involved in the creation of metamorphic rocks;
- Briefly describe the formation of a metamorphic rock from a sedimentary rock (i.e. slate from shale, or marble from limestone);
- Describe the processes of contact metamorphism and regional metamoprhism; and
- Differentiate between foliated and nonfoliated metamorphic rocks.

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 to your students, read a newspaper clipping of a recent volcanic eruption that occurred in the world. If you cannot find a newspaper article, it is possible to find accounts of recent volcanic eruptions on the Internet website of the United States Geologic Survey (*www.usgs.gov)*. After reading the account to the class, ask students how the eruption affected the everyday lives of people living near the volcano. As a class, discuss how volcanoes may form and the role magma and lava play in a volcanic eruption. Next ask students if they know what kind of rocks may form from lava or magma. Tell them to pay close attention to the video for specific descriptions of rocks that are created by lava or magma, and also rocks that change via heat and pressure.

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:

- Lassen Peak Erupts!
- Making a Volcano
- Identifying Igneous and Metamorphic Rocks
- Sweet Metamorphism
- Vocabulary of *Igneous and Metamorphic Rocks*

Video Script: *Igneous and Metamorphic Rocks*

1. While today this volcano looks calm and peaceful, it was not always that way.
2. On the afternoon of May 22, 1915 Lassen Peak, seen here, erupted in a massive explosion,...
3. … spewing volcanic ash and gas more than 30,000 feet, or over ten thousand meters, into the sky.
4. For days and months molten rock poured out and ash rained down as far as 200 miles away, or 320 kilometers.
5. In Lassen Volcanic National Park, located in northern California, the evidence of the eruption is vividly clear.
6. Deep volcanic ash blankets the landscape,...
7. …huge boulders ejected from the blast dot the countryside,...
8. …and hardened lava flows mark the trails of once flowing, sizzling molten rock.
9. Today hot springs provide evidence that volcanic activity does not loom far below the surface,…
10. …leading scientists to believe this area may erupt again someday.
11. During the next few minutes, we are going to take a look at the rocks produced by magma and lava, called igneous rocks,….
12. ...as well as the characteristics of metaphoric rocks, created by heat and pressure.
13. **Graphic Transition – Igneous Rocks**
14. When this fuse is ignited it has the potential to create an explosion.
15. The words *ignite* and *igneous* are derived from the Latin word *ignis*, meaning fire.
16. In the creation of igneous rocks, heat plays a very important role.
17. Igneous rocks are formed from molten or liquid rock crystallizing inside the earth or on the surface.
18. Igneous rocks are the most common rocks on the surface of the globe.
19. Igneous rocks are used for a wide variety of things. Walls and buildings are made of igneous rocks.
20. Rock climbers, seen here, scale towering cliffs of igneous rock,...
21. …and igneous rocks are even used in barbecue grills to distribute heat.
22. Let's now take a look at the origins of igneous rocks.
23. **Graphic Transition – Magma and Lava**
24. As we just mentioned, igneous rocks form as a result of cooled molten rock.
25. **You Decide!** Where do you think molten rock is formed?
26. Molten rock originates deep within the earth and is called magma.
27. While the surface of the earth is quite solid,...
28. …sixty to two hundred kilometers beneath the surface, rocks can be quite soft and even exist as liquid.
29. Temperatures reaching 1400 degrees Celsius, created by great pressure from overlying rocks, turns hard rock into liquid magma.
30. Magma is less dense than the surrounding surface rock and can be forced upward.
31. In some cases it may reach the surface flowing out of volcanoes.
32. Molten rock on the surface of the earth is called lava.

Script (cont.)

33. Below the surface, magma may come in contact with water which becomes superheated.
34. This superheated water has the ability to rise to the surface, forming geysers and hot springs.
35. Graphic Transition – Formation of Igneous Rocks
36. The line of light colored rock was originally formed deep underground from magma, which later hardened.
37. Magma oozed itself between rock layers, and then cooled to form igneous rock.
38. Notice the light colored lines in this cliff. These were formed when magma intruded into this rock when it was buried beneath the surface.
39. Magma that hardens inside the earth forms a type of rock called intrusive rock.
40. When magma cools, crystals called mineral grains form.
41. Generally, molten rock that cools inside the earth cools slower than on the surface.
42. Slow cooling allows larger crystals to form.
43. This igneous rock formed inside the earth, called pegmatite, possesses large crystals.
44. Extrusive rock forms when molten rock or lava on the earth's surface cools.
45. Because the air on the earth's surface is cooler, igneous rocks tend to cool and solidify quickly
46. This quick hardening does not allow time for large crystals to form.
47. Therefore, extrusive igneous rocks, such as this rhyolite seen here, tend to have smaller crystals.
48. This piece of obsidian cooled so quickly that there are no visible crystals, making it appear almost glass-like.
49. In some extrusive rocks, such as pumice and scoria, air and other gasses become trapped inside them as they cool,...
50. ...creating holes and air pockets.
51. This enables some rocks, such as the pumice, to float!
52. Graphic Transition – Identifying Igneous Rocks
53. You Decide! From what substance is this red candle formed?
54. This candle was formed from red, liquid wax that cooled.
55. Similarly, igneous rocks are created from different types of magma or lava.
56. From what type of lava do you think scoria is formed?
57. Scoria is formed from basaltic magma, a type of dark magma.
58. The major minerals in igneous rock play an important role in their appearance.
59. Light colored igneous rocks, such as this rhyolite, contain a great deal of silica, a glass like mineral,...
60 …whereas dark mineral rocks, such as basalt, are formed from magma which has high concentrations of magnesium and iron.
61. The environment in which igneous rocks are formed also has an impact on them.
62. For instance, you can often tell if a rock was formed inside the earth or...
63. ...outside the earth's surface...

Script (cont.)

64. …by the rock's texture.
65. Fine-grained rocks, such as this andesite, are believed to have formed on or close to the surface of the earth.
66. You Decide! This igneous rock called gabbro is large grained. Where do you think it formed?
67. Gabbro is formed from the cooling of magma deep within the earth.
68. As you can see, the characteristics of igneous rocks can tell us a lot about the environment in which they were created.
69. For example, this dark rock called basalt has small crystals and therefore cooled quickly.
70. Basalt is the most common rock on earth, covering the majority of the ocean floor.
71. Graphic Transition- Granite
72. Yosemite National Park, located in the Sierra Nevada Mountains, is one of the world's most…
73. …vivid examples of granite.
74. Granite is an igneous rock which is mined from quarries, such as this, so that it may be…
75. …used in making road curbing…
76. …and buildings.
77. Granite is commonly made of a number of minerals including feldspar, quartz, mica, and hornblende.
78. The granite, seen here on Half Dome in Yosemite, was formed deep underground where the magma hardened.
79. Over many years the granite was folded, uplifted and eventually exposed as a result of erosion and glacial movement.
80. Today we see sheer walls of granite …
81. …with spectacular thousand foot waterfalls.
82. Graphic Transition – Metamorphism
83. You Decide!
84. What will happen to these small beads of clay if you squeeze and heat them in your hand?
85. As you can see, they all turn into a single piece of clay.
86. A similar process takes place deep underground.
87. Existing rocks, buried deep within the earth, can be exposed to tremendous heat and pressure.
88. This heat and pressure, along with chemical reactions, can change rocks dramatically.
89. Metamorphism is the process of changing one kind of rock into another kind of rock via heat, pressure or chemical reactions.
90. To get an idea of how intense the heat and pressure created within the earth is,...
91. …try stacking books on top of your hand. As more books are added you feel the pressure increasing.
92. Imagine the pressure created by layers of rock thousands of feet thick.
93. Graphic Transition – Metamorphism in Action
94. This is a marble quarry.
95. Marble is a beautiful metamorphic rock used in making buildings,...
96. …walls,...

Script (cont.)

97. …steps,...
98. …and is even used in toothpaste.
99. But this marble did not always exist as a metaphoric rock.
100. The marble seen here in New England was formed from sedimentary rock called limestone.
101. The limestone was formed underwater when shallow seas covered the landscape,...
102. …depositing shells, crustaceans and other ocean life, which eventually solidified into limestone.
103. Under heat and pressure the limestone compressed to form much denser and smoother marble.
104. So when you walk across a marble floor,...
105. …you are actually stepping on the altered remains of once living sea creatures.
106. Graphic Transition – Contact Metamorphism
107. You probably do not like to eat raw eggs,...
108. … so you cook them.
109. Heat from the frying pan causes the egg to change chemically. Its color and texture changes to one you are used to eating.
110. Notice that the portion of the egg closest to the heat becomes white.
111. During a process called contact metamorphism, rocks go through a similar process.
112. Contact metamorphism occurs when magma inside the earth goes into or intrudes existing rock.
113. The rock that is in contact with the magma becomes superheated and new types of rock are formed.
114. Graphic Transition – Regional Metamorphism
115. Regional metamorphism can affect huge areas of rocks.
116. Regional metamorphism tends to occur at the boundaries of plates,...
117. …where large areas of rock are deeply buried.
118. Pressure and heat created by the thick layers, as well as possible contact with magma, gives rise to the creation of large areas of metamorphic rocks.
119. This rock, called schis,t was most likely created as the result of regional metamorphism.
120. **Graphic Transition – Foliated and Non-Foliated Metamorphic Rocks**
121. You Decide!
122. From what metamorphic rock is this roof made?
123. If you said slate, you are right. Slate has been used for centuries as roofing on buildings.
124. Slate is a metamorphic rock that is derived from a sedimentary rock called shale. Shale is made of fine-grained sediments.
125. Slate is easily split into flat leaves, which make it ideal for laying on roofs.
126. This is because its grains are arranged in parallel bands. This is referred to as foliation.
127. Slate becomes foliated when the grains in shale flatten under heat and pressure. The grains are typically compressed so that water cannot pass through them.
128. This schist is another common metamorphic rock and is also foliated.
129. Metamorphic rocks tend to be either foliated or non-foliated.
130. Watch what happens when this piece of marble is broken.

Script (cont.)

131. It does not break along flat, even bands like slate.
132. In non-foliated rocks, such as marble, banding does not occur, causing the rock to break in uneven, random fragments.
133. Graphic Transition- Summing Up
134. During the past few minutes we have taken a look at some of the characteristics of igneous rocks.
135. We have taken a look at how magma forms rocks, such as granite, deep within the earth,...
136. ...and how lava forms rocks such as basalt…
137. …and pumice on the surface of the earth.
138. We explored how the characteristics of different types of igneous rocks can tell us a great deal about the environment in which they were formed.
139. We also studied metamorphic rocks - rocks changed by heat and pressure from other preexisting rocks.
140. We investigated how metamorphic rocks are created either via contact metamorphism…
141. …or via regional metamorphism in large areas.
142. Finally we took a look at differences between foliated and non-foliated metamorphic rocks.
143. So the next time you walk across a marble floor,…
144. …use a barbecue,…
145. …or look at a slate roof, think about some of the characteristics of metamorphic…
146. …and igneous rocks. You just might look at your world a little differently.

Fill in the correct word when you hear this tone ____. Good luck and let's begin.

1. _____ rocks are formed from molten rock.
2. Molten rock on the surface of the earth is called ____.
3. _____ rock is formed inside the earth.
4. Igneous rocks with large crystals cool _____.
5. _____ rocks are created via heat and pressure from existing rocks.
6. Metamorphic rocks that break along flat, even bands are _____ rocks.
7. _____ is an igneous rock which is mined from quarries such as this.
8. Igneous rocks on the earth's surface cool _____.
9. Under heat and pressure, limestone may form _____.
10. _____ metamorphism occurs over large areas.

Answers to Student Assessments

Preliminary Test

1. pumice
2. shale
3. magma
4. geyser
5. extrusive
6. crystals
7. metamorphism
8. molten
9. foliation
10. igneous
11. false
12. true
13. false
14. true
15. true
16. false
17. false
18. true
19. false
20. true

Video Review

You Decide:

A. Molten rock originates deep within the earth and is called magma.
B. The candle is formed from red, liquid wax which has been cooled.
C. Gabbro is formed from the cooling of magma deep within the earth.
D. The clay beads will turn into a single piece of clay.
E. The roof is made from slate.

Video Quiz:

1. igneous
2. lava
3. intrusive
4. slowly
5. metamorphic
6. foliated
7. basalt
8. quickly
9. marble
10. regional

Post Test

1. false
2. true
3. false
4. true
5. false
6. true
7. true
8. true
9. false
10. false
11. extrusive
12. crystals
13. foliation
14. pumice
15. molten
16. magma
17. igneous
18. shale
19. geyser
20. metamorphism

Answers to Student Activities

Lassen Peak

1. A pyroclastic flow is an avalanche containing hot ash pumice, rock fragments and very hot gases which are produced by certain volcanic eruptions.
2. A lahar can be a result of a volcanic eruption, which produces a flow primarily of mud and water.
3. The continued close association of heat, water, and pressure deeper within the earth causes steam vents, hot springs, and mud pots to persist after an eruption.
4. In the worst conditions, the sky might be nearly dark as night, the air would be full of ash, and the ash might be several inches deep on the ground. The ash could be so dense that automobile and airplane engines could be damaged if they were run. If the ash-fall were severe enough, it could destroy trees, fill rivers and ponds, and make the environment unable to support life.
5. This term refers to the numerous volcanoes that surround the Pacific ocean. The frequent eruptions that occur in North America, Alaska, South America, Asia, and Japan are all part of this collection of very active volcanoes. These volcanoes and associated frequent earthquakes are the result of geologic instability in the earth's crust.

Making a Volcano

1. When the vinegar and baking soda reacted, the mixture bubbled and rose.
2. Volcanoes are similar in that gases expand and rise to the surface, releasing pressure, sometimes in the form of a violent eruption.
3. The model volcano is different in that the reactants are not the same as in an actual volcano. In an actual volcano magma originates from inside the earth.

Identifying Igneous and Metamorphic Rocks

Answers will vary. Students should be able to complete the data table on their own. However, students will need assistance in specifically identifying the rocks.

Sweet Metamorphism

Part I: Recrystallization

1. The individual pieces are becoming indistinguishable as they melt together.
2. The gummi pieces stick together because the crystals have melted at the edges.
3. If microwaved, the individual pieces would become one piece. This would resemble an igneous rock.

Part II: Foliation

1. The toothpicks should have flattened into layers.
2. The pressure from the weight of the book flattened the toothpicks into layers.
3. The weight of the book symbolizes the weight of the earth's crust (rock layers).
4. Sketches will vary.

Vocabulary

1. metamorphic rocks, e
2. basalt, c
3. foliation, h
4. intrusive, f
5. igneous rocks, d
6. magma, a
7. metamorphism, j
8. lava, b
9. extrusive, h
10. granite, i

Assessment and Student Activity Masters

 Name_____

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. The holes in _____ are caused by air trapped inside the rock as it forms.

2. Slate is derived from a sedimentary rock called _____.

3. Molten rock within the earth is called _____.

4. When water comes in contact with superheated rocks inside earth, the water may rise to the surface forming a spray of water known as a _____.

5. Igneous rocks that form on the earth's surface are called _____ rocks.

6. When magma cools, _____ are formed.

7. _____ occurs when rocks under the earth's surface change into a new form due to large amounts of heat and pressure.

8. Igneous rocks are formed from _____ or liquid rock.

9. _____ is a characteristic of some metamorphic rocks that exhibit parallel bands.

10. _____ rocks are formed from different types of magma.

shale	igneous
foliation	pumice
metamorphism	molten
wax	magma
geyser	crystals
silicates	extrusive

 Name_____

Preliminary Test

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

11. Slow cooling of magma forms small crystals. T F

12. Marble is a metamorphic rock that can be formed from the sedimentary rock limestone. T F

13. Regional metamorphism affects small areas of rock. T F

14. Igneous rocks are formed from magma or lava. T F

15. Molten rock originates deep inside the earth. T F

16. Intrusive rocks form on the surface of the earth. T F

17. Granite is a sedimentary rock formed underground. T F

18. Heat and pressure are the main factors involved in the process of metamorphism. T F

19. Basalt is a rock made from solidified ocean life. T F

20. The characteristics of a rock provide clues about the type of environment in which the rock was formed. T F

 Name_____

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:

A. Where do you think molten rock is formed?

Answer _____

Answer _____

B. From what substance is this red candle formed?

Answer _____

C. This igneous rock called gabbro is large grained. Where do you think it formed?

Answer _____

D. What will happen to these small beads of clay if you squeeze and heat them in your hand?

Answer _____

E. From what metamorphic rock is this roof made?

Video Quiz:

1. _____ rocks are formed from molten rock.
2. Molten rock on the surface of the earth is called _____.
3. _____ rock is formed inside the earth.
4. Igneous rocks with large crystals cool _____.
5. _____ rocks are created via heat and pressure from existing rocks.
6. Metamorphic rocks that break along flat, even bands are _____ .
7. _____ is an igneous rock which is mined from quarries such as this.
8. Igneous rocks on the earth's surface cool _____.
9. Under heat and pressure, limestones may form _____.
10. _____ metamorphism occurs over large areas.

 Name_____

Post Test

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

1. Granite is a sedimentary rock formed underground. T F
2. Igneous rocks are formed from magma or lava. T F
3. Slow cooling of magma forms small crystals. T F
4. Heat and pressure are the main factors involved in the process of metamorphism. T F
5. Basalt is a rock made from solidified ocean life. T F
6. Marble is a metamorphic rock that can be formed from the sedimentary rock limestone. T F
7. Molten rock originates deep inside the earth. T F
8. The characteristics of a rock provide clues about the type of environment in which the rock was formed. T F
9. Intrusive rocks form on the surface of the earth. T F
10. Regional metamorphism affects small areas of rock. 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. Igneous rocks that form on the earth's surface are called _____ rocks.

12. When magma cools, _____ are formed.

13. _____ is a characteristic of some metamorphic rocks that exhibit parallel bands.

14. The holes in _____ are caused by air trapped inside the rock as it forms.

15. Igneous rocks are formed from _____ or liquid rock.

16. Molten rock within the earth is called _____.

17. _____ rocks are formed from different types of magma.

18. Slate is derived from a sedimentary rock called _____.

19. When water comes in contact with superheated rocks inside earth, the water may rise to the surface forming a spray of water known as a _____.

20. _____ occurs when rocks under the earth's surface change into a new form due to large amounts of heat and pressure.

shale	igneous
foliation	pumice
metamorphism	molten
wax	magma
geysers	crystals
silicates	extrusive

 Name_____

Lassen Peak Erupts!

On May 22, 1915, an explosive eruption at Lassen Peak, California, the southernmost active volcano in the Cascade Range, devastated a 3-square-mile area. This event rained volcanic ash as far away as Winnemucca, Nevada, 200 miles (over 320 km.) to the east. This explosion was the most powerful in a three-year series of eruptions in the Cascades.

Beginning on the evening of May 19, 1915, a large steam explosion blasted out a new crater at the volcano summit. This created an avalanche of hot lava blocks, volcanic debris, and snow. As the snow melted from the heat, a huge mudflow of volcanic materials, called a lahar, was generated. The lahar rushed 7 miles (11.2 km.) down the river valley, releasing huge volumes of water. The avalanche, lahars, and floods produced by this explosion uprooted and carried away 100-foot-tall (30 meters) trees with ease. For two days, new lava welled up into and filled the crater created by the steam explosion.

On May 22, Lassen Peak exploded again. This powerful eruption blasted rock fragments and pumice into the air, generating a column of volcanic ash and gas that reached more than 30,000 feet (about 9,000 meters). Another high speed avalanche, this time composed of hot ash, pumice, rock fragments, and gas, called a pyroclastic flow, swept down the side of the volcano. In turn, more mudflows appeared on all flanks of Lassen Peak. A layer of volcanic ash and pumice rained 25 miles (40 km.) to the northeast.

For several years following the May 22, 1915 eruption, spring snowmelt percolating down into Lassen Peak triggered steam explosions. This indicated that rocks beneath the volcano's surface remained hot. A particularly vigorous steam explosions in May 1917 blasted out the second of the two craters now seen near the volcano's summit.

Since the volcano has quieted, scientists have been studying the devastated area surrounding Lassen Peak. The slow but steady return of plants and trees now serves as a model which helps us understand how landscapes recover from volcanic episodes. Now Lassen Peak sleeps again, but active steam vents, hot springs, and bubbling pools of hot mud are still found in Lassen Volcanic National Park. No one can say when, but it is almost certain that the Lassen area will erupt again.

Directions:
Answer the following questions:

1. What is a pyroclastic flow? Describe the contents.
2. What is a lahar?
3. What causes steam vents, hot springs, and hot mud to persist after an eruption?
4. Describe what the outdoor conditions would be like after an eruption such as Mt. St. Helens, if you lived 50 miles (80 km.) away in the direction of the air flow.
5. Look up the term, "ring of fire". What does it mean? Where is it?

 Name_____

Making a Volcano

Objective: Students will simulate the flow of lava and bubbly gases erupting from a volcano.

Materials:
Safety eyeglasses or goggles
Small glass or plastic bottle with a narrow neck, clean, lid removed
Small plastic "Rubbermaid" box
Modeling clay
Piece of construction paper to roll into a funnel
Baking soda (about 1/4 cup, more or less depending on the size of bottle)
1/2 cup of white vinegar
Measuring cup with spout or a small pitcher
Red food coloring
Spoon

Procedure:
1) Stand the bottle in the middle of the box. (You may use any surface that may get wet, like an empty bathtub or an outdoor area.)
2) Use flat slabs of clay to build the shape of a volcano around the bottle. Be very careful to leave the mouth of the bottle open.
3) Use the paper "funnel" to pour the baking soda into the mouth of the bottle. The amount you use will depend on how big the bottle is. Fill the bottle about halfway.
4) Place the vinegar into the measuring cup or pitcher. Add a few drops of red food coloring and stir to mix it.
5) Before pouring in the vinegar, **put on protective eye glasses**.
6) Slowly pour the colored vinegar into the opening at the top of the volcano model. The colored vinegar now represents magma inside the volcano.
7) As the mixture emerges from the volcano, it symbolizes lava.

Discussion: Answer the following questions in your lab notebook.
1. Describe what happened after the vinegar reacted with the baking soda in the volcano.
2. How is this like the eruption of a real volcano?
3. In what ways is it different?

 Name_____

Identifying Igneous and Metamorphic Rocks

Objective: Students will practice the diagnostic process used to identify rock specimens.

Background:
Examine a rock closely. What do you see? Do you see specks of similar material? Or are there individual large particles of material that look quite different? Feel their surfaces. Are they smooth or rough and grainy? Are some heavier than others?

Rocks are naturally formed aggregates (combinations) of minerals. Because each rock is made of a specific combination of minerals, you can identify a rock by determining the minerals that are present within it. Many times, however, minerals in rocks are not visible without the assistance of high-powered microscopes or complex chemical testing.

To help identify rocks "in the field," geologists use the following characteristics to describe each rock specimen:

- color
- texture (how the rock feels)
- visible layers
- other identifiable properties, such as weight and the presence of specific minerals

Before you begin the activity, create a data table which has 6 columns and 6 rows. At the top of each column write the following labels: **Sample Number, Color, Texture, Visible Layers, Other, Class & Name**. When the chart is complete, you can compare the characteristics of each specimen with the lists of rock properties found in your school's reference books. This will help identify these igneous and metamorphic rocks.

 Name_____

Igneous and Metamorphic Rocks (cont).

Materials:
5 rock samples—all samples will be either igneous or metamorphic
Worksheet chart
Hand lens or magnifying glass

Procedure:
1) Record the specimen's color. If there is more than one color, record them all (pink and gray, for example). List the most abundant color first and the least abundant color last.

2) How does the rock specimen feel in your hand? If it seems smooth and you cannot see individual particles in it, record the texture as ***fine grained***. If it feels somewhat rough and sandy and you can see some individual particles, call it ***coarse grained***. If it is very rough and particles are easily visible, the texture is ***extremely coarse grained***.

3) Does the rock sample contain visible layers? Do they appear as layers that might be separated or are they simply bands of minerals? Describe the layers in your chart. Be as specific as possible. In foliated metamorphic rocks you may see banded layers containing different minerals.

4) Record any other characteristics or properties you can observe or identify. Some of these might be:
- *Weight* - If it is light, does it float in water? Pumice floats because of the air cavities it contains.
- *Appearances* - Does it look like some other material? Obsidian looks like glass.
- *Minerals* - Can you identify individual minerals in it? List them if you can.

These characteristics or properties do not necessarily have to be specific, but they should be something you can identify or observe in the specimen.

5) Record the specimen's classification (igneous or metamorphic). State why you think so. Make an educated guess if you are unsure. Go further and give the rock a name using reference books and field guides provided by your teacher.

 Name_____

Sweet Metamorphism

Objective: Students will simulate two of the effects of metamorphism, *recrystallization* and *foliation*.

Part I: Recrystallization

Background:
Metamorphic rocks are formed when existing rocks are changed by heat, pressure, and/or chemical reactions. The effects of metamorphism range from simple compaction to a total remake of the rock. In this experiment we will simulate the effect of heat and pressure on "crystals" that result in an altered "rock".

Materials:
5 gummi bears—variety of colors
Scissors
Wax paper

Procedure:
1. Cut each gummi bear into 5 pieces. Clean scissors with soap and water when done.
2. Arrange pieces on wax paper in a pile. These pieces represent unmetamorphosed rock material and crystals.
3. Place all pieces in your hand and knead them into a ball for 5 minutes (Like you would with clay).
4. Record the time at which your hands first became hot. Keep going.
5. After 5 minutes stop and record observations. What has happened to the individual gummi pieces?
6. Continue for 5 more minutes, then record observations. Sketch the metamorphosed rock, paying close attention to the edges of each "crystal". Gently try to pull apart one of the gummi pieces. What happens? Have the crystals "melted" slightly at the edges?
7. What would happen if you stuck your metamorphic rock into the microwave for 8 seconds? What type of rock would this resemble?

 Name_____

Sweet Metamorphism (cont.)

Part II: Foliation

Background:
As we saw in Part I, the crystal structure of a metamorphic rock can be altered by tremendous pressure and heat. Often the crystals line up in bands. When the different minerals in metamorphic rocks separate into parallel layers, the rocks are *foliated*. This experiment will simulate the *foliation*, or alignment of "mineral crystals."

Materials:
20 flat toothpicks
Book
Foliated metamorphic rock samples

Procedure:
1. Snap the toothpicks in half but leave them connected.
2. Pile the toothpicks on a table. These toothpicks represent the 3-dimensional arrangements of minerals in a rock.
3. Place the book on top of the toothpick pile and press down.
4. Carefully remove the book without disturbing the toothpicks.

Discussion: Answer the following questions:
1. Did the toothpicks flatten into layers? Sketch the arrangement of toothpicks in your lab journal. Pay careful attention to the direction and layering of toothpicks.

2. What caused this change to occur?

3. What in nature is represented by the weight of the book pressing down on the toothpicks?

4. Sketch one of the foliated rock samples. Pay careful attention to the direction of the parallel bands and layers. Describe what you see in your lab journal.

 Name_____

Vocabulary of *Igneous and Metamorphic Rocks*

___ 1. otmimpehrac orskc

___ 2. sabatl

___ 3. ltiioofna

___ 4. iisvnrteu

___ 5. giosneu okrsc

___ 6. gaamm

___ 7. mmmhieptaors

___ 8. aavl

___ 9. uteeirsvx

___ 10. iraengt

a. molten rock deep within the earth

b. molten rock on the surface of the earth

c. a dark colored igneous rock from the ocean floor

d. formed from molten or liquid rock

e. created by heat and pressure

f. cooled inside the earth

h. cooled on the surface

i. an igneous rock commonly used in buildings

j. the process of changing one kind of rock into another via heat, pressure or chemical reactions

h. arrangement of minerals into parallel bands; a result of metamorphism