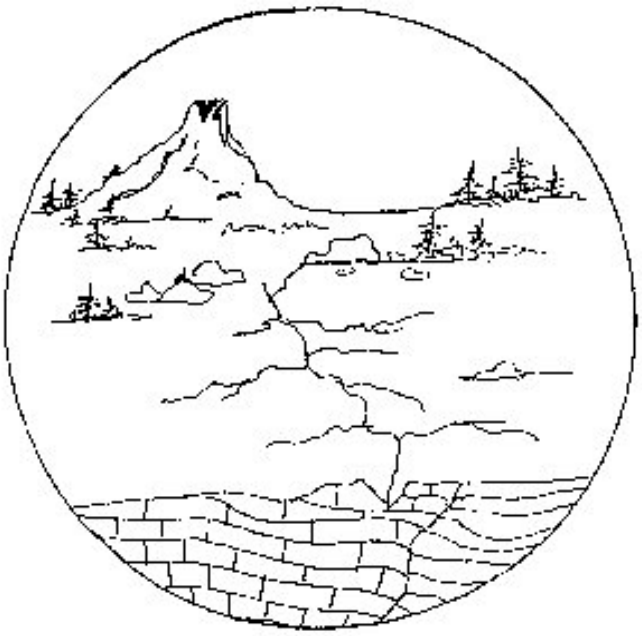
Plate Tectonic Cycle

Earth's Moving Force

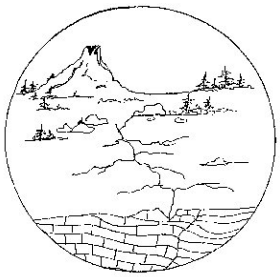
THIRD GRADE

VOLCANOES



1 WEEK
LESSON PLANS AND
ACTIVITIES

PLATE TECTONIC CYCLE
OVERVIEW OF THIRD GRADE



VOLCANOES

WEEK 1.
PRE: *Explaining why there are many types of volcanic rocks.*
LAB: *Comparing rocks from different volcanoes.*
POST: *Learning that volcanoes produce different types of rocks.*

EARTHQUAKES

WEEK 2.
PRE: *Discovering that earthquakes produce energy.*
LAB: Observ*ing different energy experiments.*
POST: *Learning that pressure inside the Earth causes earthquakes.*

PLATE TECTONICS

WEEK 3.
PRE: *Dividing the earth into layers.*
LAB: *Discovering how the earth's crust creates plates.*
POST: *Explaining how plates have moved through time.*

HAZARDS

WEEK 4.
PRE: *Discussing different volcanic hazards.*
LAB: *Exploring different types of volcanoes during an eruption.*
POST: *Learning about historical eruptions.*

PLATE TECTONIC CYCLE - VOLCANOES (3)

PRE LAB

Students look at different volcanic rocks.

OBJECTIVES:

1. Comparing volcanic and plutonic igneous rocks.
2. Explaining why there are many kinds of volcanic rocks.

VOCABULARY:

basalt
granite
igneous
minerals
obsidian
volcano

A lava fountain eruption in Hawaii

MATERIALS:

paper
granite
basalt
obsidian

BACKGROUND:

Volcanoes are structural evidence of plate tectonics. They occur because the Earth's crust is moving, allowing molten rock, or magma, from below to rise through cracks in the crust to the Earth's surface. The reason why magma rises is simple. It is less dense than the surrounding rock, so it moves upward, just like warm air rises toward the ceiling in a room. Magma is molten rock that has not reached the surface of the Earth. "Lava" is molten rock that has reached the surface. When lava cools down it forms volcanic rocks, when magma cools (without reaching the surface) it forms plutonic rocks. Volcanic and plutonic rocks are both types of igneous rocks.

There are many different types of volcanic and plutonic igneous rocks. However, they all have in common that they were once molten, and have since cooled down and become solid. Igneous rocks look different because of two factors: (1) they have cooled at different rates and (2) the "Mother" Magma (original melted rock) was a different composition. Geologists then use these factors to name igneous rocks. For example, magmas cooling at different rates develop different sized crystals. Quick cooling (hours to years) igneous rocks have small crystals. For example, basalt has small crystals that can be seen under a microscope, inferring that basalt cooled quickly. Obsidian (volcanic

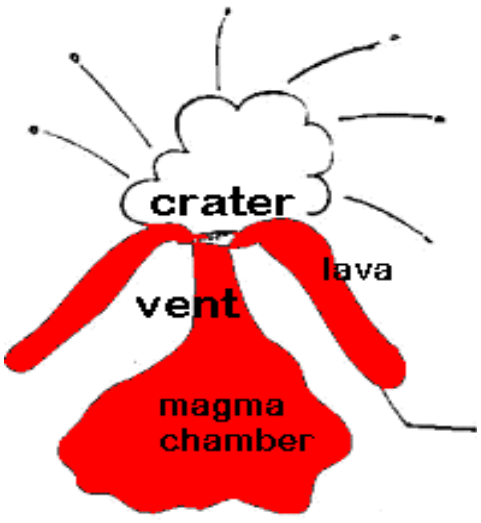
glass) cooled so quickly that has virtually no crystals. Magma that cools slowly (thousands to millions of years) creates rocks with large minerals, like granite.

The parts of a volcano include a reservoir of magma inside the Earth, called a magma chamber. The magma chamber is connected to the surface of the Earth by a vent. The magma moves upward through the vent because it is less dense than the surrounding rock. It breaks through the surface of the Earth at the volcano's crater, and may flow down its side as a lava flow. Note that magma generally does not form in the magma chamber. This magma is generated deeper in the mantle of the Earth, and ascends and collects in the magma chamber.

There are several stages in the life of a volcano. An volcano is active when lava is being extruded or the magma is moving upward from the magma chamber. An eruption is possible in an active volcano, although it may not have erupted recently. A dormant volcano is "sleeping". It can become active again, when new magma rises upward within it. An extinct volcano has no signs of becoming active. Usually the magma chamber has not been refreshed for thousands to millions of years. Volcanoes may repeatedly move between dormant and active phases.

PROCEDURE:

1. Introduce the Plate Tectonic Cycle to the students. Tell them that the outermost portion of the Earth moves causing stress within the Earth's crust. Preview the unit with them, telling them that in the upcoming weeks they will study rocks from volcanoes, how energy waves cause damage during an earthquake, how stress builds up in the Earth, and how volcanic hazards can harm people.



2. Draw the diagram to the right on the board. Explain the parts of a volcano. Emphasize that plutonic rocks form underground, while volcanic rocks cool on the surface.

3. Show the students samples of basalt, obsidian and granite. Basalt and obsidian are volcanic rocks; granite is plutonic. Ask students how they can determine this. The answer is: plutonic rocks (such as granite) cool slowly in a relatively undisturbed environment permitting the growth of large mineral crystals which can easily be seen by the unaided eye. Volcanic rocks cool quickly, so the minerals do not have as much time to form large crystals, hence you cannot see minerals in a hand specimen of such rocks as basalt. Obsidian is essentially frozen magma; it has cooled so fast that almost no crystals have formed. It thus looks like dark glass. Tell the students that only basalt and obsidian come from a volcano, granite is formed deep within the crust and upper mantle of the Earth.

PLATE TECTONIC CYCLE - VOLCANOES (3)

LAB

Students look at rocks from different volcanoes.

OBJECTIVES:

1. Comparing rocks from different volcanoes.
2. Determining if volcanoes produce different types of rocks.

VOCABULARY:

basalt
composite volcano
obsidian
pumice


Mono Craters

MATERIALS:

Plate Tectonic Cycle - Volcanoes (3)
clay
pictures of volcanoes
paint (optional)

BACKGROUND:

Volcanoes produce different types of volcanic rocks. The creation of volcanic rocks depends on the type of eruption and the source and composition of the magma erupted. The variety of volcanic rocks can range from ash to rocks with small minerals in them. Geologists describe volcanic rocks by their appearance and mineral composition. They examine both hand specimens, and usually make “thin sections”, very thin slices of rock that they can examine under the microscope. They then name rocks based on their observations. For example, basalt (a dark gray to black rock) contains more minerals of olivine and hornblende than andesite (a gray rock). Andesite may contain quartz but basalt will not. A volcanic rock that had gas discharged with the eruption may have “holes” within the rock (called vesicles) while a quiet lava flow would not have such gas bubble holes. Some volcanic rocks start cooling inside the magma chamber, forming some


Mount Shasta on the left, Shastina on the right

Mount Lassen in northern California

Clear Lake near the city of Clearlake

larger minerals. When the volcano erupts, it brings up these larger minerals, as well as other lava which then cools into smaller crystals. In a hand sample of this kind of rock, you would see large minerals embedded in a dark matrix of smaller minerals that would require a microscope to see. Obviously, the naming of igneous rocks is complex. This lab begins to expose students to naming igneous rocks.

Although volcanoes can be close to each other, they may have different types of rocks. In this lab the students look at volcanics from Mt. Lassen, Mt. Shasta, Mono Craters, and Clearlake, which are all located in California.

PROCEDURE:

1. Discuss with students all the different types of volcanic rocks that can form from volcanoes.

2. Locate the following areas where California volcanic rocks can be found: Mt. Lassen, Mt. Shasta, Clearlake, and Mono Lake (all in northern California). Explain that the Mt. Lassen, Mt. Shasta and Mono Craters volcanoes are sleeping (dormant volcanoes), and that the Clearlake volcanics are no longer active (extinct volcano).

3. Instruct students to look at their igneous rock samples and describe them. Tell the students to use words like "black, gray,

heavy, glassy, can see minerals", or any other descriptive terms. All of the specimens form a specific locality may not look exactly the same. The students' descriptions should reflect what they observe in the individual samples. Have them record their descriptions on the worksheet.

4. Make a composite class description of the rocks. The descriptions should reflect a difference between the rock types. For example, samples from Mt. Lassen and Mt. Shasta should be heavier rocks and have many more visible minerals than those from Clear Lake or Mono Craters. The Clear Lake sample is obsidian and Mono Crater sample is a light pumice. Compare the samples as follows:

Clearlake	Mono Craters	Mt. Lassen	Mt. Shasta
black glassy	light color "holey"	gray can see minerals	reddish "holey"

5. Next, have the students make a small model of Mt. Lassen using clay. Mt. Lassen is a composite volcano, composed of lava and ash layers. Use the presentation to help them construct the clay model. The diagram on the lab sheet gives the students clues for making the model. Make sure that they include a crater and a slope which is appropriate for a normal composite volcano. Students will use this model in the **HAZARDS** lab.

PLATE TECTONIC CYCLE - VOLCANOES (3) LAB

PROBLEM: Are all volcanic rocks the same?
PREDICTION: _____
PROCEDURE: Look at the rock from Mt. Lassen in California. Describe it using some of the following words: **black, gray, light, heavy, has visible minerals, glassy, holey, shiny.** You may use your own words. After you look at Mt. Lassen, look at the other 3 rocks and describe the rocks. Use some of the same words as above.

DESCRIPTION

Mt. Lassen, CA

_____

_____

Mt. Shasta, CA

_____

_____

Clearlake, CA

_____

_____

Mono Craters, CA

_____

_____

Mt. Lassen is a composite volcano. It is made of lava and ash. Mt. Lassen erupted in the 1915 but it is now sleeping (dormant). Using clay, make a model of Mt. Lassen. Save the model, it will be used in a later lab.

CONCLUSION: How are volcanic rocks different?

_____
_____

PLATE TECTONIC CYCLE - VOLCANOES (3)

POST LAB

Students complete a worksheet and look at samples.

OBJECTIVES:

1. Discussing that volcanoes erupt on the Earth's crust and produce new rocks.
2. Learning that volcanoes may produce different types of rocks.

VOCABULARY:

ash
basalt
granite
lava
magma
obsidian
pumice
volcano

Mt. Saint Helens erupting in 1980

MATERIALS:

samples from previous lab
granite samples
worksheet

BACKGROUND:

In order for the students to understand igneous rocks, they will need to know two factors that influence what type of rocks a volcano will produce. First, the manner in which lava cools will determine many different aspects of the igneous rock that will be produced. Second, the original chemical composition of the parent magma will play an important role in the formation of the igneous rock. It determines the mineral content of the rock. Remember, minerals make up rocks.

PROCEDURE:

1. Hold up different kinds of igneous rocks for the students to examine. Be sure to use a slow cooled rock (granite) and one or more fast cooling ones (any of the other samples). Ask the students which rock cooled inside the Earth. They should answer granite. Ask them whether the melted rock or magma (inside the crust), produced different rocks. They should answer yes, because the granite looks different, especially in mineral content.

2. Show the students the rock samples that they examined in in the lab. Instruct students to predict which one of the three rocks cooled the fastest. The pumice and obsidian cooled before the basalt. Ask them how they know. The basalt has tiny mineral crystals, the pumice and obsidian do not. Remember that the quicker a lava flow cools the less time there is for minerals to form.

3. Volcanoes are very interesting to students. You may want to have the books or other resources available for students to obtain more information. Here are some recommended websites:

www.meto.umd.edu/~jose/VOLCANOES/volcpage.html

This site has good pictures, including a simulated 3-D column of ash erupted out of a volcano.

http://volcano.und.nodak.edu/vwdocs/current_volcs/current.html

Information on currently erupting volcanoes around the world, with links to each site.

http://www.geo.mtu.edu/volcanoes/

University of Michigan volcano sites around the world.

http://www.usgs.gov

Excellent information on US volcanoes, as well as plate tectonics and geologic hazards. Go to the section on volcanoes.

4. Have the students complete the worksheet. It may also be used as a test.

Answers: (1) lava; (2) magma; (3) volcano; (4) obsidian; (5) pumice; (6) Hawaii; (7) Mt. St. Helens; (8) granite; (9) basalt; (10) ash

PLATE TECTONIC CYCLE - VOLCANOES (3)

POST LAB

WRITE IN THE CORRECT ANSWERS FROM THE FOLLOWING WORDS:

volcano	obsidian
magma	ash
lava	Hawaii
pumice	basalt
granite	Mt. St. Helens

1. _____ is hot, molten, or melted rock which reaches the surface of the Earth.

2. Lava that is still deep inside the earth is called _____.

3. Lava erupts from a _____.

4. _____ is a natural volcanic glass.

5. _____ is a volcanic rock that is very light because it has so many little holes ("preserved" gas bubbles) in it.

6. The state of _____ is a chain of volcanic islands in the Pacific Ocean.

7. _____ is an active volcano in Washington that erupted explosively on May 18, 1980.

8. _____ is an igneous rock that cooled slowly below the earth's surface. It is not produced by a volcano.

9. Most of Hawaii is made of _____ a fine-grained black rock.

10. When Mt. St. Helens erupted, it shot tons of powdery _____ into the atmosphere.