

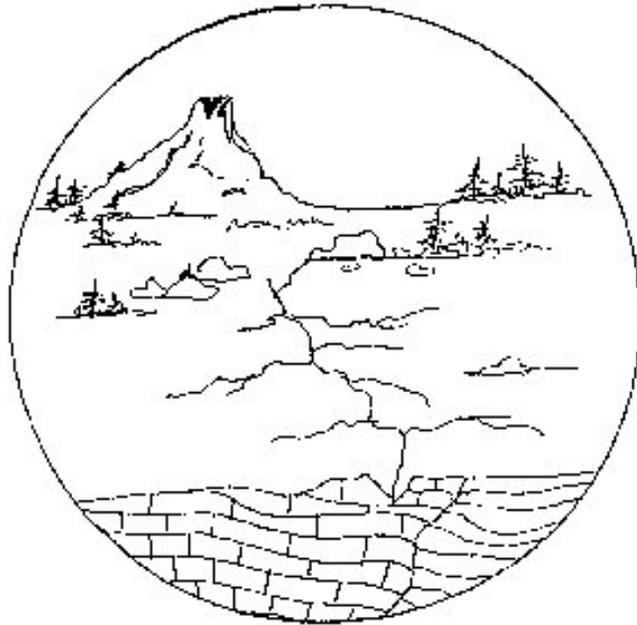


# Plate Tectonic Cycle

Earth's Moving Force

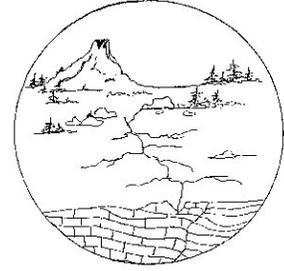


## FOURTH GRADE VOLCANOES



1 WEEK  
LESSON PLANS AND  
ACTIVITIES

## PLATE TECTONIC CYCLE OVERVIEW OF FOURTH GRADE



### VOLCANOES

#### WEEK 1.

PRE: *Comparing different structures of volcanoes.*

LAB: *Modeling three types of volcanoes.*

POST: *Illustrating a volcanic eruption.*

### EARTHQUAKES

#### WEEK 2.

PRE: *Comparing the Richter and Mercalli scales of earthquake measurement.*

LAB: *Testing how different shapes react during an earthquake.*

POST: *Describing a seismogram.*

### PLATE TECTONICS

#### WEEK 3.

PRE: *Distinguishing the different layers of the Earth.*

LAB: *Observing the effects caused by plate movements.*

POST: *Exploring the reason for earthquakes and volcanoes.*

### HAZARDS

#### WEEK 4.

PRE: *Exploring about structural damage caused during an earthquake.*

LAB: *Comparing structural damage caused by earthquakes.*

POST: *Contrasting the Richter and Mercalli scales.*

## PLATE TECTONIC CYCLE - VOLCANOES (4)

### PRE LAB

Students make a paper model of a composite volcano.

### OBJECTIVES:

1. Comparing different structures of volcanoes.
2. Learning that a volcano can be active, sleeping (dormant), or extinct.

### VOCABULARY:

active  
ash  
cinder  
composite  
dormant  
extinct  
lava  
pyroclastic  
shield



A lava fountain eruption in Hawaii

### MATERIALS:

volcano model (U.S. Geological Survey)  
crayons

### BACKGROUND:

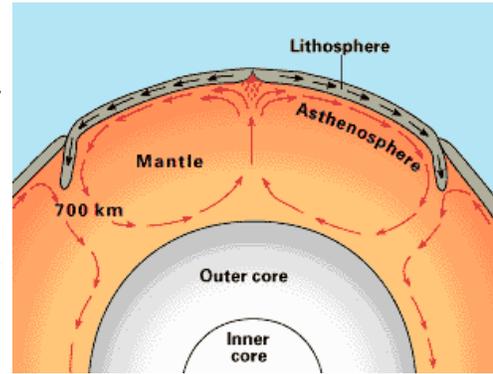
Children are fascinated with the spectacular volcanic eruptions that occur throughout the world. Volcanoes are very important for interpreting what is occurring within the outer portion of the Earth. In addition, as the new Earth developed 4.5 billions years ago, volcanoes released steam, which later became one of the major sources of water on this planet. Volcanoes produce volcanic rocks (igneous rocks) that have built the surface of the Earth. In the theory of Plate Tectonics, most volcanoes are produced where two lithospheric plates (the outer skin of the earth) either diverge (move away from each other) or converge (come together, usually with subduction).

Volcanoes have many different shapes, and can be composed of different types of volcanic rock. Throughout the Plate Tectonic Cycle we will use a simplified volcano shape classification based on the types of materials that compose volcano. Other resources may describe other types of classifications. We distinguish three shapes of volcanoes. First, a shield volcano is composed of lava. The name shield describes the low, broad structure of the volcano, like an inverted shield. The Hawaiian volcanoes are shield volcanoes. Second, a cinder cone is a steeper structure and is composed of cinders (or finely

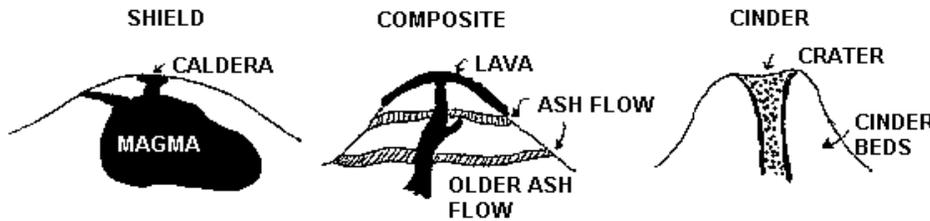
pulverized rock) that were explosively erupted from the volcano. Third, a composite volcano is composed of mixed layers of ash and lava. Composite volcanoes are frequently much higher than shield volcanoes, but not as steep as cinder cones. Mt. Shasta in California, and Mt. Fuji in Japan are examples of composite volcanoes.

**PROCEDURE:**

1. Introduce your students to the Plate Tectonic Cycle, by telling them that the outer part of the Earth, its skin, is composed of lithospheric plates of rock. Explain that these plates move, and it is this movement that causes earthquakes and volcanoes. Tell them that this unit will show students the different kinds of volcanoes.



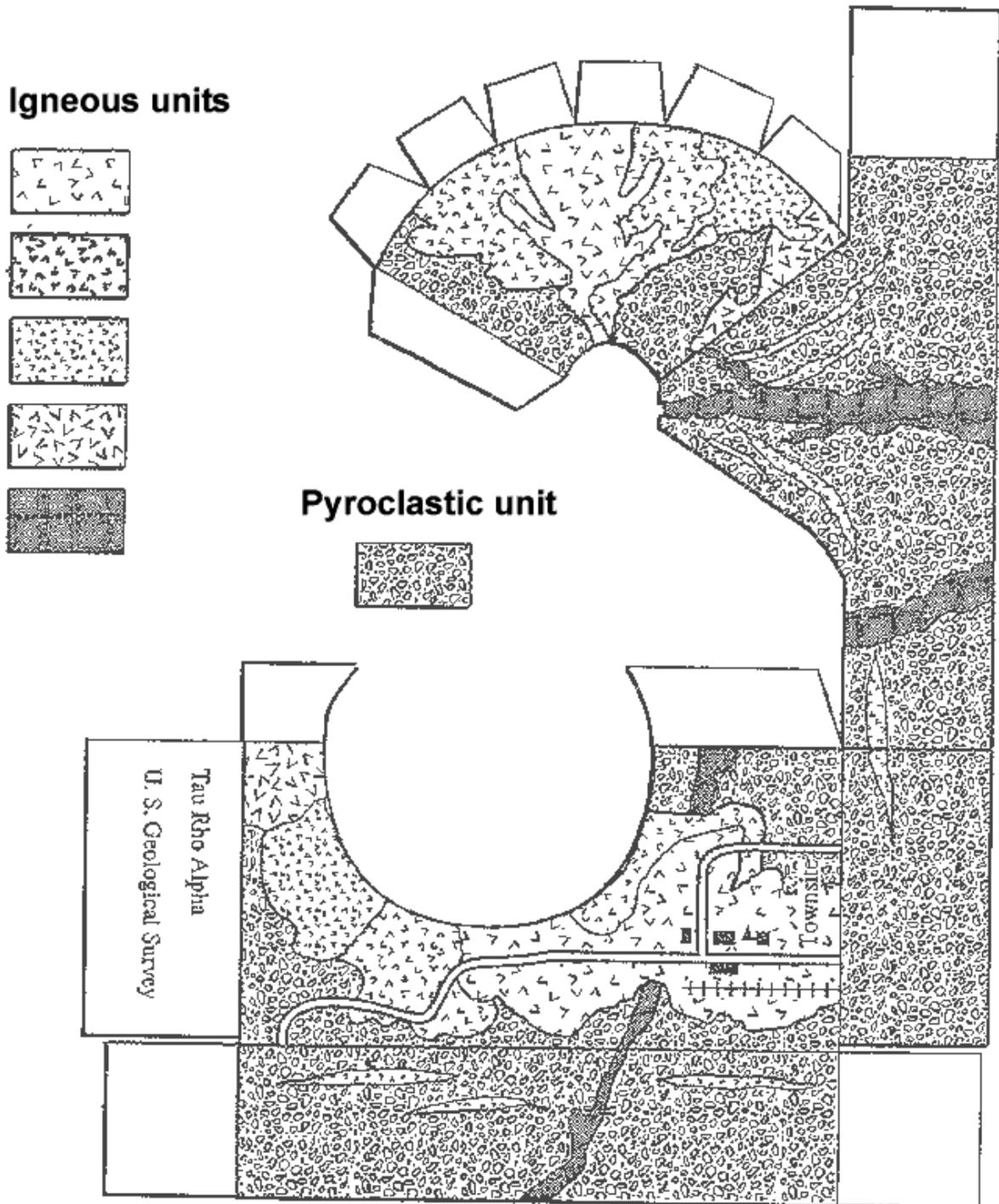
2. Draw the diagrams below on the board. Explain the differences among the three types of volcanoes. Instruct the students decide which type of volcano is shown on their worksheets. The volcano model, produced by the U.S. Geological Survey, is a composite volcano.



3. Instruct the students to color the volcano. Have them then cut it out, and fold and paste it together.

**PLATE TECTONIC CYCLE - VOLCANOES (4)  
PRE LAB**

MODEL OF A VOLCANO. CUT, FOLD, AND THEN PASTE THE MODEL TOGETHER.  
WHAT TYPE OF VOLCANO DO YOU HAVE?



## PLATE TECTONIC CYCLE - VOLCANOES (4)

### LAB

Students make models of the different types of volcanoes.

### OBJECTIVES:

1. Modeling three different types of volcanoes.
2. Comparing cross sections of three different types of volcanoes.

### VOCABULARY:

analog  
ash  
cinder cone  
cinders  
composite  
crater  
magma  
shield  
vent



A lava flow on Mt. Etna, Italy

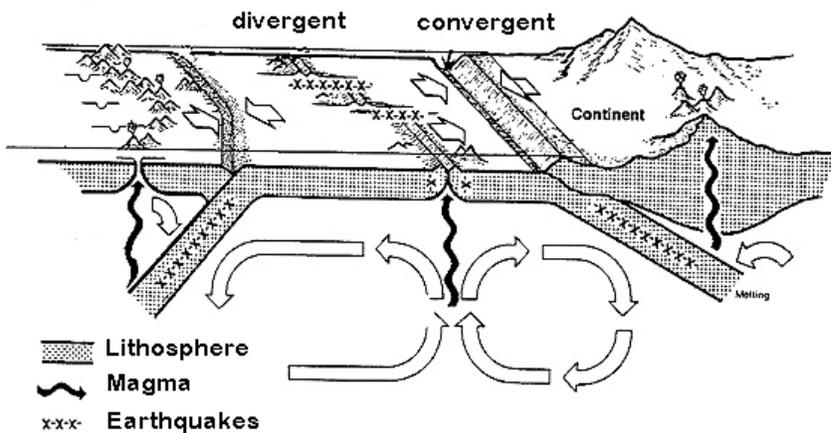
### MATERIALS:

thick string  
two or three different colors of clay (depending on model creating)  
model of composite, shield, and cinder volcanoes (cross sections)

### BACKGROUND:

Volcanoes are mountains which are built by accumulation of their own eruptive products including lava, fragments of former rocks, bombs, and ash. Driven by buoyancy and gas pressure, molten rock, which is lighter than the surrounding solid rock, moves upward and breaks through a weak zone in the Earth's crust. The magma erupts and builds the volcano. Most volcanoes form at convergent or divergent plate boundaries, where much magma is generated.

The parts of a volcano include a reservoir of magma inside the Earth, often called a magma chamber. The magma chamber is connected to the surface of the Earth by a



vent. It breaks through the surface of the Earth at the volcano's crater, and may flow down its side as a flow of lava. Note that magma generally does not form in the magma chamber; it is generated deeper in the Earth, and ascends and collects there.

The growth of a volcano is sometimes difficult for students to

conceptualize. The volcano builds upward as more and more lava and ash are erupted. You may wish to explain this as "growing from the inside out". In this exercise, students will learn about the formation of a volcano by building a clay model.

There are different ways to classify volcanoes. In this exercise students are asked to look at cinder cones, composite volcanoes, and shield volcanoes. Cinder cones are simple types of volcanoes. They are usually built by gas-charged lava that breaks into small fragments (or cinders) as it erupts. This material piles up around the volcano, building a cone-like structure. Most cinder cones have a bowl shaped crater at the summit, and are usually smaller volcanoes (less than 350 meters high). Paricutin is a famous cinder cone that erupted in 1943 in a corn field in Mexico. Over a period of 6 years, it destroyed the surrounding area.

Composite volcanos are also referred to as stratovolcanoes. They are usually steep-sided, symmetrical cones of very large dimensions. They are built of alternating layers of ash, cinders, blocks, and bombs. Mount Fuji in Japan, Mount Shasta in California, and Mount St. Helens in Washington are all composite volcanoes.

Shield volcanoes are built almost entirely of lava flows. Flow after flow comes from the crater and fissures along the flank of the volcano which constantly build up the shield. The Hawaiian volcanoes are examples of shield volcanoes.

The growth of a volcano is sometimes difficult for students to conceptualize. The volcano builds upward as more and more lava and ash are erupted. You may wish to explain this as "growing from the inside out". In this exercise, students will learn about the formation of a volcano by building a clay model.

## PROCEDURE:

1. Ask your students "What is a volcano". Write their answers on the board. Explain that volcanoes are mountain-like structures that emit volcanic lava or other types of volcanic rocks, either in the past or present. Emphasize that not all mountains are

volcanoes. Some mountains are pushed upward when plates collide at a convergent plate boundary, or when plates slip by each other at a transform plate boundary.

2. Ask your students to compile a classroom list of what comes out of volcanoes (lava, ash, steam, gases). Go over the 3 different types of volcanoes using the diagrams on the lab sheet. An image of this to project is on a following page.

3. Divide the students into pairs. Assign each pair one of the three different types of volcanoes. Have them make a clay model of their type of volcano. They should include the a magma chamber, vent, and crater. Emphasize to the students that they are to model the volcano as if it is erupting. New lava or magma should be a different color from old lava. Make sure that the students build the volcano as if it had repeatedly "erupted", layer by layer from the bottom up. If they do this exercise right, it will take them some time to "layer" the different parts of the volcano. Remember that a magma chamber would be roughly spherical in three dimensions.

4. After they finish building the model, have them cut it in half, to see a cross section. Each student thus gets a half to take home (if there is sufficient clay). A good way to cut the clay is by using a strong string and dragging it in a downward motion through the model.

5. If the students modeled their volcanoes correctly, the cross sections should resemble the diagrams on the lab sheet. Have the students look at another group's work, so that students view a composite, shield, and cinder volcanoes. Have them complete the lab sheet.

**PLATE TECTONIC CYCLE - VOLCANOES (4)  
LAB**

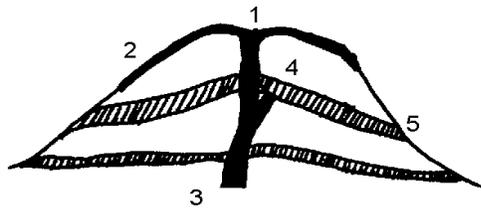
**PROBLEM:** How can you make a model volcano that is an ANALOG of a real volcano?

**PREDICTION:** \_\_\_\_\_

**EXERCISE:**

Using the clay provided, build the model volcano assigned by your teacher. Use the diagrams below to help you create a cross section of a volcano. Use different colors to represent ash, lava, and mud.

**COMPOSITE VOLCANO**

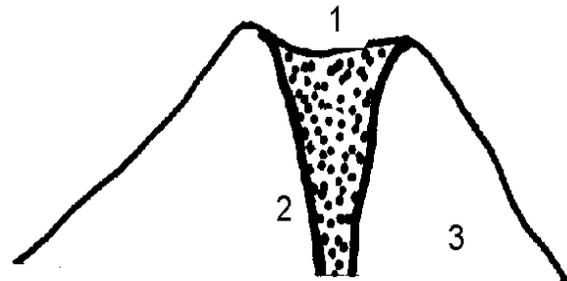


1. CRATER
2. NEW LAVA FLOW
3. CINDER BEDS
4. OLDER LAVA FLOW
5. ASH BEDS

1. What makes this model different from a cinder and a shield volcano? \_\_\_\_\_

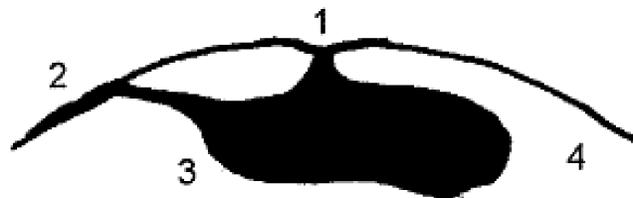
**CINDER CONE**

1. CRATER
2. VENT
3. CINDER BEDS



2. What makes this model different from a composite and a shield volcano?  
\_\_\_\_\_

**SHIELD VOLCANO**



1. SUMMIT
2. NEW LAVA FLOW
3. MAGMA
4. OLD LAVA FLOWS

3. What makes this model different from a cinder and a composite volcano?  
\_\_\_\_\_  
\_\_\_\_\_

**CONCLUSION:** How can you make a model volcano that correctly mirrors a real volcano?  
\_\_\_\_\_  
\_\_\_\_\_

## PLATE TECTONIC CYCLE - VOLCANOES (4)

### POST LAB

Students look and interpret a video tape of the Hawaiian

### OBJECTIVES:

1. Illustrating a volcanic eruption.
2. Learning how to define words using pictures.

### VOCABULARY:

see list under PROCEDURE below

### MATERIALS:

Kilauea Eruption video tape

### BACKGROUND:

The Hawaiian Islands are composed of a chain of shield volcanoes including Kilauea and Mauna Loa on the island of Hawaii, which are two of the world's most active volcanoes. As you go northeast from the island of Hawaii, the volcanoes become inactive, and the islands grow older and older. The Hawaiian Islands are one of the few volcanic sites that are not associated with plate boundaries. Instead, the volcanism in Hawaii is caused by a hot spot, a stationary plume of magma that originates below the plates in the Earth's lower mantle. This plume has melted its way through the plate, erupting lava to make the islands.

The floor of the ocean is more than 5000 meters deep off shore from the islands. Mauna Loa itself is almost 4200 meters high. This combined height makes Mauna Loa the "tallest" mountain on Earth.

The eruptive style of the Hawaiian volcanoes is mainly quiet. Basaltic lava pours out from long fissures instead of central vents, and floods the surrounding area with lava. The video tape will provide more information on the background of Kilauea.



Lava flow from Hawaii.

### PROCEDURE:

1. Show either the entire or part of the video presentation of the 1959-60 Kilauea eruption. You can make the film interactive by stopping the video when one of the questions can be answered on the lab sheet. Note that the vocabulary is very difficult if the students do not learn to take clues from the video. Every time the video says a new word they usually have a picture as an example. Some students need to be taught to recognize this. Ask them questions, stop the video and by the end of the tape, they will

be able to figure out the new words. If you have another appropriate video you can develop your own vocabulary list.

2. Discuss the following questions and the vocabulary words they present with the class. They are given below in their order of presentation in the film. You do not have to stop at every word; treat this as a list of words that may be confusing. Use the list to develop questions for your students. The answers are presented clearly within the context of the film.

1. What is a caldera?
2. What is a lava lake?
3. What is a flank eruption?
4. What does subside mean?
5. What is a seismograph?
6. What is lava fountain? Braided lava?
7. What is sparkling light?
8. What is a lobe?
9. Does the word tholeiitic basalt have any meaning to a K-6 student? (no)
10. How can gas cause splashing of lava?
11. What is a trough?
12. What is a cascade of spatter rampart?
13. What is the seismograph showing?
14. What are the geologists doing near the volcano?
15. What do you observe as the lava is flowing?
16. What is a viscous fluid?
17. What does incandescence mean?
18. What is a levee?
19. Where is Niagara Falls? (NY)
20. What is pumice?
21. What does lull mean?
22. What are cubic yards of lava?
23. Is Kilauea a violent eruption?
24. What is a vent?
25. Can these people get hurt?
26. What is a spatter?
27. Spatter as large as bathtubs, how large is that?
28. What is an ocean surf?
29. How hot is 1200 degrees centigrade?
30. What is the color in lava caused by ? (Gas)
31. How does lava move?
32. What happens when the lava meets a tree?
33. What is a cinder cone?
34. What does drain downward to the vent mean?
35. What is a whirlpool? Backflow?
36. Where is downwind? What are these sticks? (trees)
37. How long will the lava lake take to cool?
38. Why was the town evacuated?

39. Where is the graben in the village?
40. What is a flank eruption?
41. What are basaltic dikes?
42. What are the geologists doing?
43. What is a conduit?
44. Which is steam, which is lava?
45. Where is the steam coming from?
46. Why does lava go to the oceans?
47. Why is there a steam cloud when lava hits water?
48. What is an aa flow? Pahoehoe flow?
49. Why are the Papyrus leaves stripped?
50. What is slowly consumed?
51. How can lava be extruded?
52. Where is the Washington monument?
53. Did the volcano make land?
54. How long does it take to recuperate from a volcanic eruption?