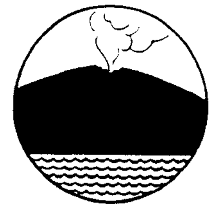
GETTING TO KNOW A VOLCANO



Grade 4

Lesson at a Glance

Students create shield volcano models and play a volcanic vocabulary game that allows them to "erupt" the models.

Key Concepts

The most common forms of lava in Hawai'i are *pāhoehoe* and *'a'ā*. Magma flows to the surface and emerges as lava along rift zones or fractures in the volcano's surface.

Objectives

Students will be able to:

1) Identify the features of a shield volcano.
2) Name two types of lava.
3) Describe where lava emerges from a volcano.

Time

two class periods

Subject Areas

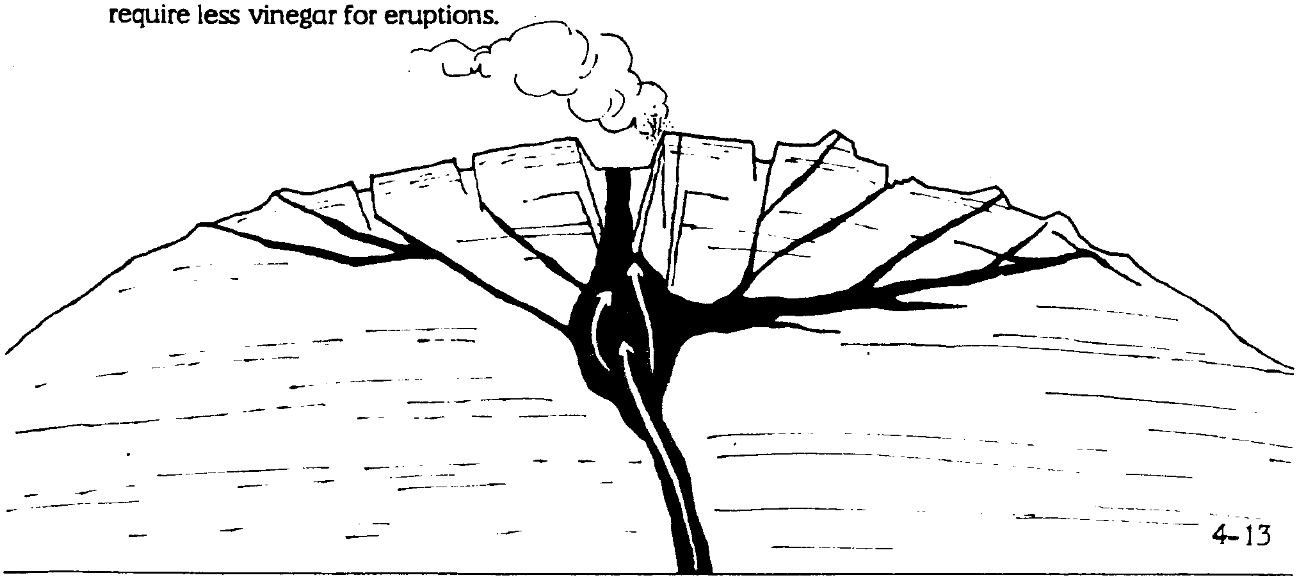
science, Hawaiian studies, language arts, art

Materials

student activity sheet (provided)
lava rock(s) (see Preparation)
1 bottle of soda
baking soda
red food coloring
2 liters (2 qts) vinegar

for each group of students:
- clay or sand (see Preparation)
- 2 118 ml (4 oz) paper cups*
- 2 236 ml (8 oz) paper cups
- teaspoon
- heavy cardboard or cake pan (optional for model base)
- newspaper
- masking tape

*If small paper cups are not available, cut the top half off of larger cups. Smaller cups will require less vinegar for eruptions.



Preparation

Obtain at least one lava rock that has many holes on its surface. If the class will be doing an extended activity, collect or borrow some of the lava rocks illustrated in the Geology Appendix. Refer to the Field Sites Appendix for suggested geology field sites or contact the 'Ōhi'a Project Office for information about lending kits.

Make a volcano model from newspaper with long layers of wet, softened clay placed over it. Directions for making models are on the back of the student activity sheet. Alternatively, models could be made out of mounds of damp sand.

Make a demonstration "magma chamber" with 10 ml (2 tsp) of baking soda in a small paper cup. In a separate cup, mix 30 ml (1 oz) vinegar and a few drops of red food coloring. When you pour the vinegar over the baking soda it will bubble over the surface of the cup and flow down the sides. Prepare a paper cup with 236 ml (8 oz) of the vinegar and food coloring mixture for each team of students. You may also want to prepare a couple of extra cups of the mixture for the game.

Teacher Background

Hawaiian **shield** volcanoes are formed as the Pacific plate moves over a hot spot beneath the Earth's crust. **Magma** originates in the upper mantle and rises through a conduit to a **magma chamber** or reservoir in the Earth's crust. The magma emerges as lava flowing from **rift zones** or fractures in the volcano's surface, extending out from the summit of the volcano. The most common forms of **lava** are ***pāhoehoe***, which moves fluidly and has a smooth or ropy surface, and ***'a'ā***, which is more viscous and has a very rough surface.

Holes or vesicles form in the lava rock by gas escaping from the **molten** lava as it cools. Because an *'a'ā* flow has a pasty, dense interior that deforms the shape of the gas bubbles as the flow moves, the vesicles in *'a'ā* are not round, but angular and irregular in size. The vesicles in *pāhoehoe* are more uniformly shaped because the flow stops moving soon after the gas bubbles appear, so the bubbles maintain their original rounded form.

Pāhoehoe lava is more commonly found on upper slopes of Hawaiian volcanoes and *'a'ā* is more common downslope, although some *pāhoehoe* flows run to the sea. Both *'a'ā* and *pāhoehoe* are of the same chemical composition. Their differences are due to the physical state of the liquid lava and the amount of stirring that takes place. Most lava flows emerge from vents as *pāhoehoe*. However, if an eruption is violent with heavy fountaining, *'a'ā* lava can emerge from the vent. As *pāhoehoe* flows move downslope, they lose gas and may change to *'a'ā*, particularly if a flow tumbles over a cliff and the lava gets stirred up. *'A'ā* flows cannot change to *pāhoehoe*.

The rift zones of a volcano contain a number of volcanic cones and hundreds of **dikes**. Dikes are sheets of rock that form when magma feeding to the surface stops and cools within cracks in a volcano. There are few or no vesicles in dike rock because gases do not escape from the magma as it cools under pressure within the Earth. Wells have been drilled in the sides of the mountains to tap the water that accumulates between sheets of this dense, nonporous rock.

Many of the volcanic cones in the rift zone are **cinder cones** built of lava cinders or fragments greater than .5 cm (.2 in) across. Some of these cones are found in the caldera at the summit of the volcano. A **caldera** is a crater more than 1.6 km (1 mi) in diameter formed by the collapse of the summit of a volcano. Throughout the shield-building stage, the caldera repeatedly settles and fractures as magma withdraws and refills as magma returns. Lava flows may originate from the caldera but more often come from cones along the rift zones.

Teaching Suggestions

1. Hold up a lava rock or pass it around for students to inspect and ask them where they think it came from. Establish that the rock is from a volcano.

2. Ask students to examine the surface of the lava rock and consider how the holes might have formed. Explain that the holes indicate where gas escaped from the molten lava.

3. Shake a bottle of soda and point out the gas bubbles. Open the bottle and ask students to describe what happens. The dissolved gas, under pressure in the bottle of soda, is released when the bottle is opened. When a volcano erupts, pressure is reduced and hot magma releases dissolved gas in a similar way.

4. Describe the differences in *'a'ā* and *pāhoehoe* lava flows and how the holes in the lava rocks are clues to the lava's identity.

✔ 5. Distribute the student activity sheets. Describe each feature of the volcano and ask students to label the activity sheet diagram. The volcano should be labeled: a) dike, b) caldera, c) cinder cone, d) magma chamber, and e) rift zone. Discuss where you might find *'a'ā* (lower slopes) and *pāhoehoe* (upper slopes to sea level). The rock illustrations should be labeled f) *pāhoehoe* and g) *'a'ā*.

6. Divide the class into small groups and review the directions for making volcano models (refer to the reverse side of the student activity sheet). Alternatively, to encourage development of problem solving skills, students could be presented with the challenge of making models of their own design.

7. Distribute the materials for making volcano models (except the cups of vinegar mixture for erupting the models). Have students build the models on thick mats of newspaper. If the models will be moved, have them built on heavy cardboard or cake pans. Explain that the models will be erupted as part of a volcanic vocabulary game.

✔ 8. When models are completed, explain how to play the volcanic vocabulary game.

   a. Ask students in each group to count off by number.
   b. Give a definition for one of the words from the word bank on the student activity sheet (see Glossary) and allow 30 seconds for group members to discuss it.
   c. Call a number and challenge the student in each group with that number to write the vocabulary word on a sheet of paper and hold it up.

d. Each team that holds up the correct word is given a cup of vinegar mixture. Instruct teams to make their models erupt by pouring some of the vinegar (approximately 30 ml or 1 oz) in the caldera. They should save most of the vinegar for additional eruptions.
e. The second time teams identify the correct vocabulary word, they can erupt a rift zone cone.
f. After each eruption, the magma sinks back down into the caldera or cone until it erupts with the next correct answer.
g. The team with the most volcanic eruptions scores a volcanic vocabulary victory!

Extended Activities

- Go on a rock hunt around the school. If there are not many rocks in the area, examine stone walls and see if students can distinguish between *'a'ā* and *pāhoehoe*. As students discover rocks, make a list of the many ways that rocks are used in the environment. Collect rocks to bring back to the classroom. See the Geology Appendix for information on identifying rocks.

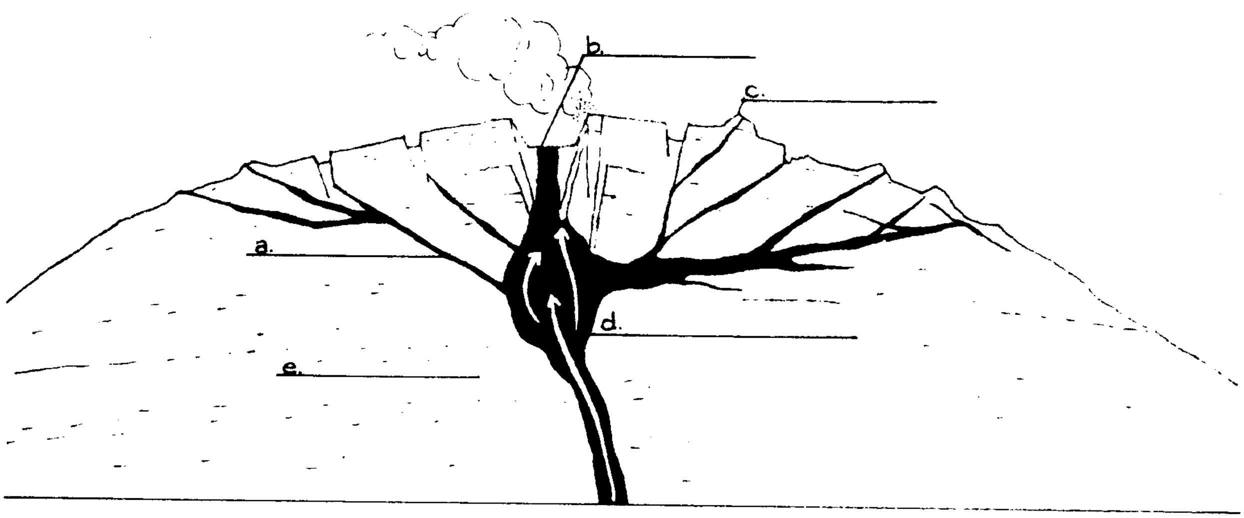
- Divide the class into groups and give each group a rock. Ask students to list five adjectives or descriptive phrases that describe the rock. This will become their rock's label. Collect all of the rocks and place them in the front of the room. Gather students around the rocks and have volunteers read the labels to the class and see if their classmates can match the labels to the rocks.

- Encourage students who have rocks from continental areas to share them with their classmates. Compare these continental rocks to island rocks.

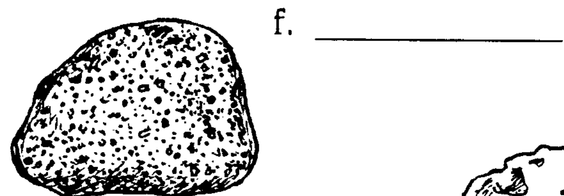
Getting to Know a Volcano — Student Activity Sheet

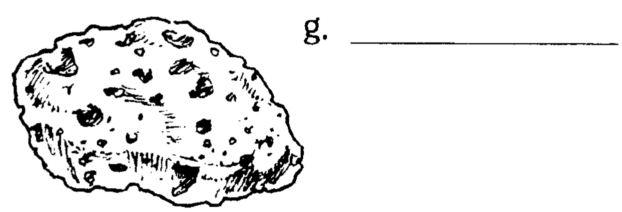
1. Label the rocks and the parts of the shield volcano using words from the word bank.

WORD BANK		
ʻaʻā	cone	magma chamber
caldera	dike	*pāhoehoe*
		rift zone



Shield Volcano

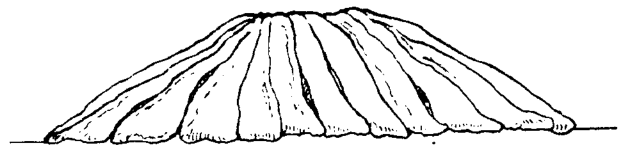




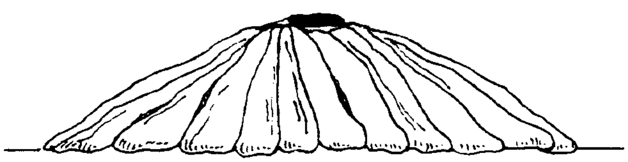
2. Use the reverse side of this sheet to write a paragraph that describes a shield volcano. Use all of the words in the word bank in your description.

Directions for Making a Shield Volcano Model

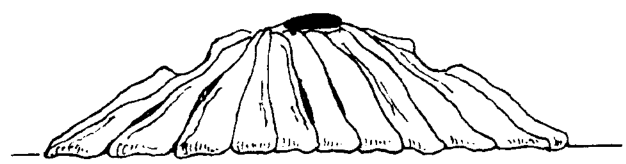
1. Crumple some pieces of newspaper and mound them into a shield volcano shape. Tape them together.



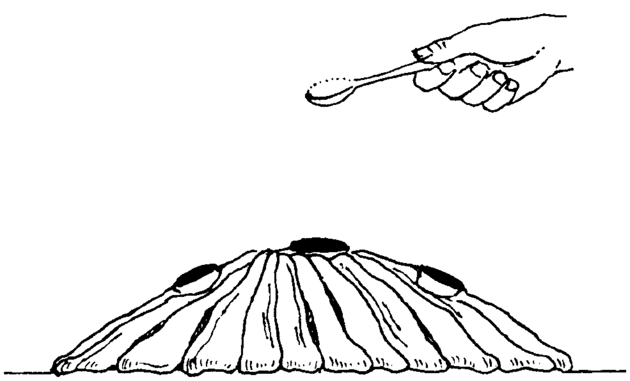
2. Soak some pieces of clay in water to soften them. Then cover the newspaper with the layers of clay. Let them dry.



3. Carve out a caldera and place a large cup inside it.



4. Build some small cones on the rift zone and carve craters in them.



5. Place a small cup in each of the small craters. Place 10 ml (2 tsp) of baking soda in each cup.

6. Erupt your volcano by pouring approximately 30 ml (1 oz) of red-colored vinegar on to the baking soda in each cup.