# GETTING TO KNOW A VOLCANO

Grade 4

*ʻŌhiʻa Project / Exploring the Islands*

## Essential Questions

- What's inside a Hawaiian volcano and how does the volcano work?
- What are the most common forms of lava in Hawaiʻi and what are they made of?

## Hawaiʻi Content Standards and Performance Indicators

Science: Forces That Shape the Earth
- Observe that rock is composed of different combinations of minerals and/or living things.

Social Studies: Physical Systems
- Explain the Earth's physical processes (e.g., lava flows).

## Key Concepts

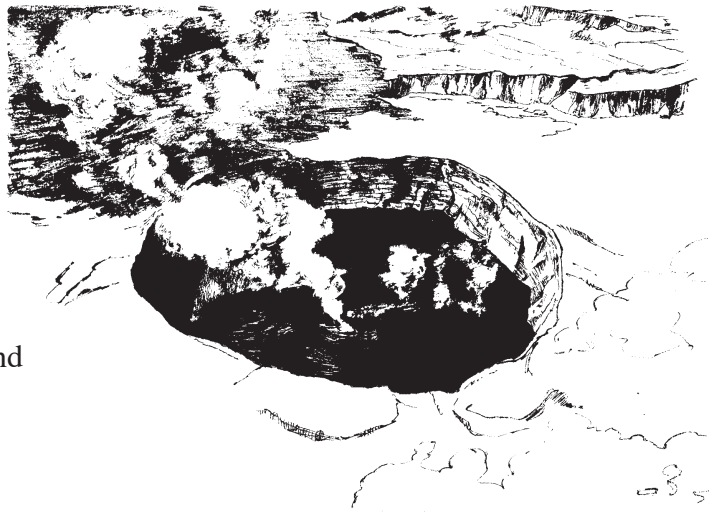
- The most common forms of lava in Hawaiʻi are *pāhoehoe* and *ʻaʻā*, which are composed of basalt. One of the most abundant mineral in Hawaiian rocks is feldspar. The large white crystals in lava are usually plagioclase feldspar; darker minerals in lava are usually olivine or augite.
- Magma flows from beneath the crust to the surface and emerges as lava along rift zones or fractures in the volcano's surface.

## Activity at a Glance

Students go on a rock hunt and create shield volcano models.

## Assessment

- Students create a Hawaiian volcano model or drawing appropriately labeled with the main features of a volcano (magma chamber, caldera, rift zone, and cone).
- Students write a description of their model or drawing that explains the origin of lava flows and the composition of lava rock.



*Halemaʻumaʻu Crater in Kīlauea Caldera*

## *Exploring the Islands* Telecast: "Hawaiian Volcanoes: Inside-Out"

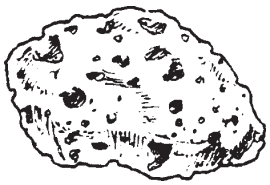
"*Hawaiian Volcanoes: Inside-Out*" features Jim Kauahikaua, geophysicist at Hawaiian Volcanoes Observatory on the Big Island, sharing his knowledge of volcanoes with students from Waiākea Elementary School. During the program, students will complete a diagram to show what happens inside a Hawaiian volcano before a rift zone eruption.

### Time

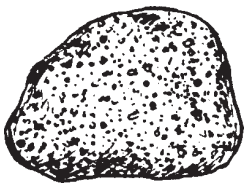
three–four class periods

### Materials/Resources

lava rock
1 bottle of soda
7 sheets of chart paper
markers
"Hawaiian Volcanoes: Inside-Out" activity sheet (provided)
"Hawaiian Volcanoes: Inside-Out" map (provided)
magnifying glasses (optional)



*An eroded piece of* ʻaʻā*, showing irregularly shaped vescicles unevenly spaced over the rock.*



*An eroded piece of* pāhoehoe*, showing round-shaped vescicles evenly spaced over the rock.*

### Preparation

Obtain at least one lava rock that has many holes on its surface. Write each of the vocabulary words on a separate sheet of chart paper. Make a copy of the activity sheet and map for each student.

### Vocabulary

*ʻaʻā*, caldera, cone, dike, magma chamber, *pāhoehoe*, rift zone, mineral

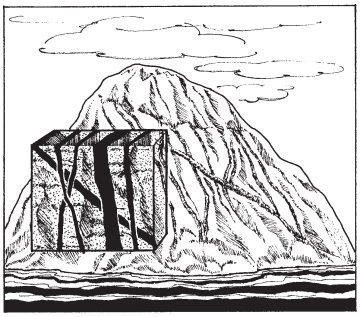
### Teacher Background Information

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 the caldera or **rift zones**—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 ***ʻaʻā***, which is more viscous and has a very rough surface.

Vesicles (holes) in the lava rock are formed when gas bubbles were trapped in the lava when it solidified. Because an ʻaʻā flow has a pasty, dense interior that deforms the shape of the gas bubbles as the flow moves, the vesicles in ʻaʻā are not round, but angular and irregular in size. The vesicles in pāhoehoe are more uniformly shaped due to the fluidity of the lava and the surface tension of the gas bubbles.

Both *ʻaʻā* 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, *ʻaʻā* lava can emerge from the vent. As *pāhoehoe* flows move downslope, they lose gas and may change to *ʻaʻā*, particularly if a flow tumbles over a cliff and the lava gets stirred up. *ʻAʻā* 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 fractures its way from the magma chamber to the vent. Some of the magma stays behind and solidifies in the fracture. This is what we see today as a dike. 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, relatively nonporous rock.



*A three-dimensional view showing sheets of dike rock*

Many of the volcanic **cones** in the rift zone are cinder cones built of vesicle-rich lava cinders or fragments greater than 0.5 cm (0.2 in.) across. Some of these cones are found in the **caldera** at the summit of the volcano. A caldera is a crater usually more than 1.6 km (1 mi) in diameter that forms when the summit of a shield volcano collapses. During the main active shield-building stage, a caldera repeatedly collapses as magma withdraws, and refills as eruptions occur within it. Lava flows may originate from the caldera but more often come from vents along the rift zones.

Minerals in Hawaiian Lava

Hawaiian lava rock is composed of basalt and a variety of **minerals**. The most abundant mineral in Hawaiian rocks is feldspar. The large white crystals are usually plagioclase feldspar, which is a mixture of two chemical compounds—albite and anorthite. The dark colored minerals are generally olivine or augite. The greenish brown color of olivine and its glassy luster make it easy to recognize. Augite is black or very dark green in color and is less widespread than olivine, although it is common on Haleakalā, Mauna Kea and Kuamoʻokāne (Koko Head).

Shield vs. Composite Volcanoes

The fluid lavas of Hawaiian shield volcanoes can flow great distances from their vents, creating the shield-shaped mountains characteristic of our islands. The fluidity of Hawaiian lavas allows gas to readily escape, so volcanic eruptions tend to be less explosive than those of continental, composite volcanoes, such as Mt. Hood. At these more explosive volcanoes the magma is more viscous (and more gas-rich as well) so that bubbles don't escape and instead can sit around coalescing to the point that they have an expansive force greater than the strength of the rocks comprising the volcano. This build-up leads to the explosive eruptions.

## 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 (vesicles) might have formed. Give them a clue that something escaped from the holes and see if they can think of what that might be.

3. Have students observe a bottle of soda and note that there are no gas bubbles visible. 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.) Discuss how this is similar to dissolved gas under pressure in a volcano being released from hot magma when a volcano erupts. The holes in the lava rock were formed when gas escaped from the molten lava.

4. Ask students to go on a rock hunt (individually at home or as a group on the school grounds) and see how many types of rocks they can find. Have them bring their rocks to class.

5. Ask students to work in groups to examine and sort the rocks they have collected. They may choose to sort the rocks by color, shape, texture or other characteristics. Challenge them to distinguish between the two types of lava—*ʻaʻā* and *pāhoehoe*.

6. Place the vocabulary chart paper and markers at stations around the room. Have student groups rotate to each station and list what they know about that vocabulary word.

7. Review the charts and discuss students' ideas. Accept all answers and make note of questions that students have.

8. Distribute copies of the "Hawaiian Volcanoes: Inside Out" activity sheet and map, and watch the *Exploring the Islands* telecast. You may want to obtain a tape of the program from the DOE Teleschool office. This will allow you to pause the program during the discussion of different types of lava rocks and give students time to match the rocks they have collected to those shown.

9. After the telecast, distribute magnifying glasses and ask students to look for minerals in their lava rocks. They can access photographs and descriptions of rocks on the MGF web site to help them with this task. See mgf-hawaii.org. Ask students to write a description of one of the rocks they have collected that includes their assessment of the rock's composition.

10. Challenge students to create volcano models or drawings that identify and label the main features of a volcano. The models should feature:

    - the inside of a volcano and show where magma originates in the magma chamber
    - the outside of a volcano showing where the lava erupts from a cone along the rift zone
    - the caldera

11. Ask students to write a paragraph that describes their shield volcano model, explaining how the volcano works, where the lava originates and where it erupts. Be sure they use all of the vocabulary words from this activity.

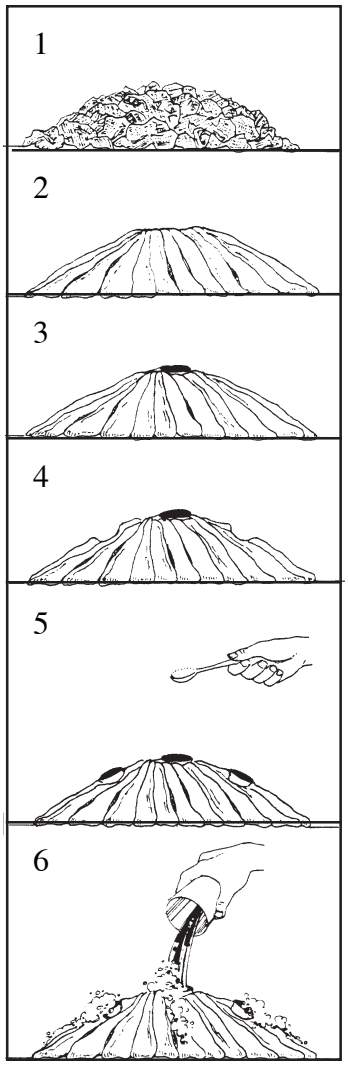
## Extended Activities

- Take students on a rock hunt to collect additional rocks for their collections. Create a rock collection using an oak tag sheet measuring 9 by 12 in. labeled with the types of rocks. Have students glue their rocks to the sheet in the correct category.

- Have groups of students make erupting shield volcano models using newspaper, clay, baking soda, vinegar and red food coloring.

    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 and 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 2 teaspoons of baking soda in each cup.
    6. "Erupt" the volcano by pouring approximately 1 oz. of red-colored vinegar on to the baking soda in each cup.

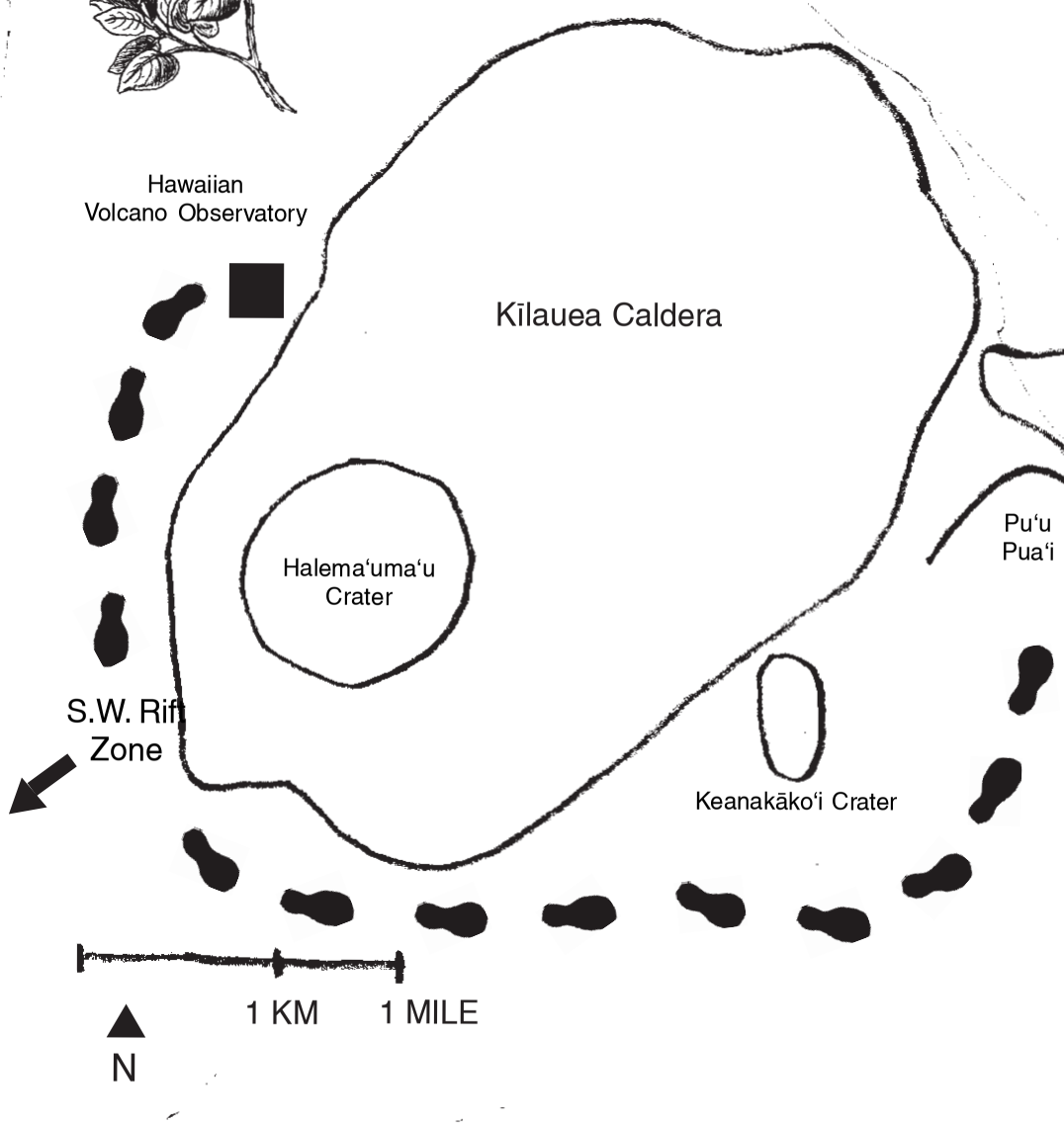
- Use the students' models to play a volcanic vocabulary game. Write the vocabulary words on small slips of paper and place them in a container. Have student groups take turns drawing a word from the container. Give them 20 seconds to come up with a definition. If they are successful, give them some vinegar in a small cup and allow them to erupt their volcano. If they do not come up with a correct definition, another team may try. When all words have been defined, the team with the most volcanic eruptions wins.

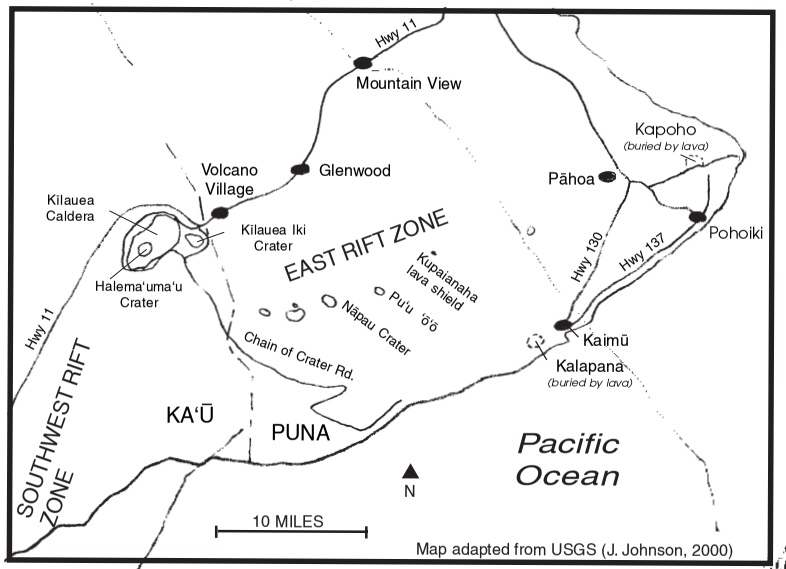


# Hawaiian Volcanoes Inside-Out

## Kīlauea Volcano

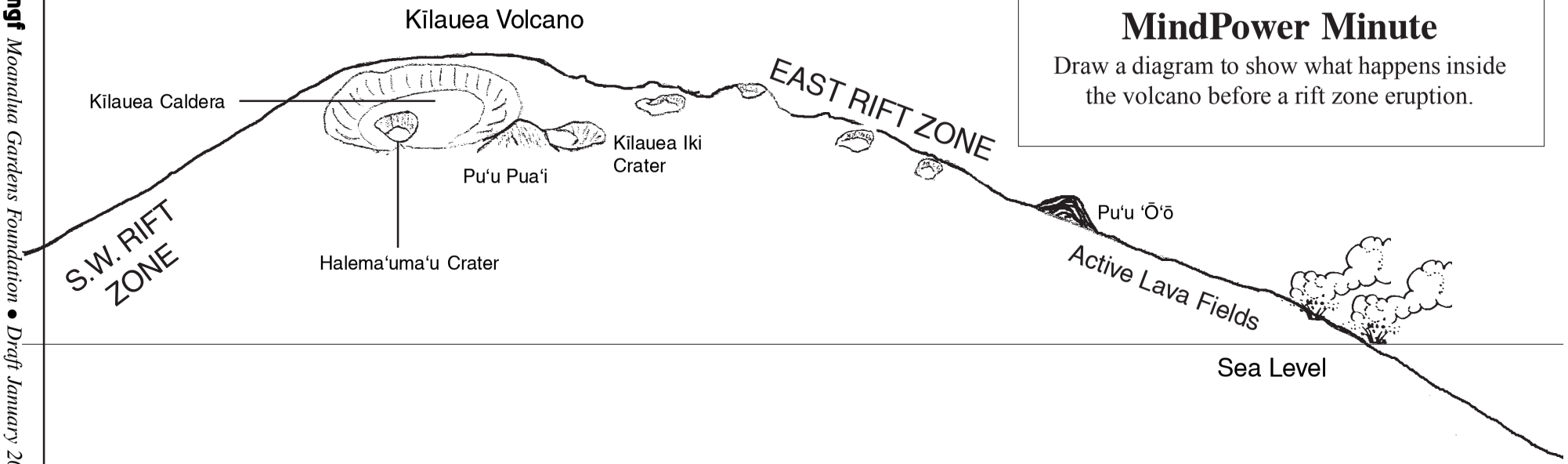
### Island of Hawai'i



# Hawaiian Volcanoes: Inside-Out

# Student Activity Sheet




## MindPower Minute

Draw a diagram to show what happens inside the volcano before a rift zone eruption.

Ocean Floor (Crust)
(about 10 km deep)

Upper Mantle

Hot Spot
(Deep Source)

**Color the caldera orange, the rift zone red, and the cones blue.**