



The Ever-Changing Landscape

Grade 4

Meet ranger at Kīlauea Visitor Center

9:30-11:30 a.m.

Start hike at Nāhuku—this is a moderate 1 mile round-trip with a descent of 400 feet into Kīlauea Iki

Huli ka lau o ka 'ama'u i uka, nui ka wai o kahawai.

When the wind blows 'ama'u leaves toward the mountain, it also blows clouds inland that produce rain.

INTRODUCTION FOR TEACHERS

In 1959, lava burst from a crack in the crater wall; then multiple vents merged producing a giant fountain of lava that radiated up to 1900 feet, taller than the Empire State Building, and among the highest ever recorded on Kīlauea. The spectacular event lasted five weeks. Molten rock flooded the crater, creating a lake that rose up the crater walls, burying the initial vent. The large cinder and spatter cone now visible before us named Pu'u Pua'i (gushing hill) was created by the cinder from these lava fountains. The winds blew and carried cinder to the edge of Halema'uma'u crater. Many trees were buried under 20 feet of cinder, and leaves of other trees were stripped from their branches leaving them looking like a forest of skeletons. Listen to the forest sounds. What do you hear? Songs of birds, insects buzzing, rustling trees. Imagine the roar of lava blasting skyward! A deep rumble was heard from far away, long before people were close enough to see the lava fountains.

Kīlauea Iki is evidence that our dynamic Earth is very much “alive.”



NPS Photo

SAFETY:

This landscape is the site of constant geologic change. What safety concerns are there on an active volcano? How should we behave when hiking this trail, especially a trail full of pits and along the edge of a 400 foot high cliff? Why should we be respectful of this land? Why is respect important for our safety?

COMMON CORE SC.4.8.2

Forces that Shape the Earth: Describe how fast processes (e.g., volcanoes, earthquakes) sometimes shape and reshape the surface of the Earth.

ESSENTIAL QUESTION:

How do you recognize environmental change on this Volcanic landscape?



OBJECTIVES FOR TODAY'S FIELD TRIP:

Students will be able to see and describe how volcanic eruptions change the landscape and how in time new growth emerges and life becomes abundant again.



PRE-VISIT ACTIVITIES:

Students may practice **Mele Oli Komo** chant in class before coming to the park.

<https://www.nps.gov/media/video/view.htm?id=D36AB8E3-1DD8-B71B-0B60C9ABB53B1703>

Complete two of the following activities in your classroom:

- ◆ Discuss the “Before” and “During” eruption pictures of Kīlauea Iki Crater.
- ◆ View Kīlauea Iki eruption video: https://www.youtube.com/watch?v=H4_zkgZAJ1E
- ◆ Look at the trail map and identify where the vent and **Pu’u Pua’i Cinder Cone** are located.
- ◆ Identify and share how these plants are used by people: **1. ‘ōhi‘a lehua, 2. ‘ama‘u, 3. hāpu‘u,**
- ◆ Use pictures to describe how these volcanic products are produced during an eruption: **Pele’s hair, Pele’s tears, cinder** and **olivine**

MELE OLİ KOMO:

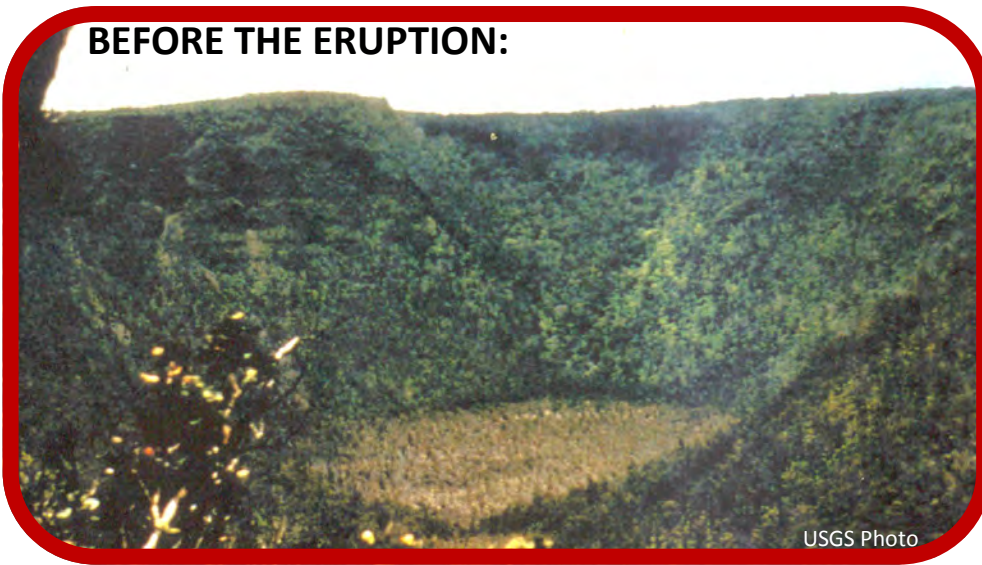
Eia mākou i mua kou alo,
Nā hoa ‘āina ‘imi i ka pono
E a’o mai mākou i ka hana
E ola i ka ‘āina ‘o Kīlauea
E ola mākou a mau loa

Here we are before you,
Friends of the land,
seeking good.

Teach us what is to be
done, That the land of
Kilauea will have life.

Created by Kepā Maly

BEFORE THE ERUPTION:



USGS Photo

Think: What do you think Kīlauea Iki looks like today?

“Pu’u Pua’i means?
(Gushing hill)

Kīlauea Iki means?
(Little Kīlauea)

Kīlauea means?
 (“Spewing”)

DURING THE ERUPTION:

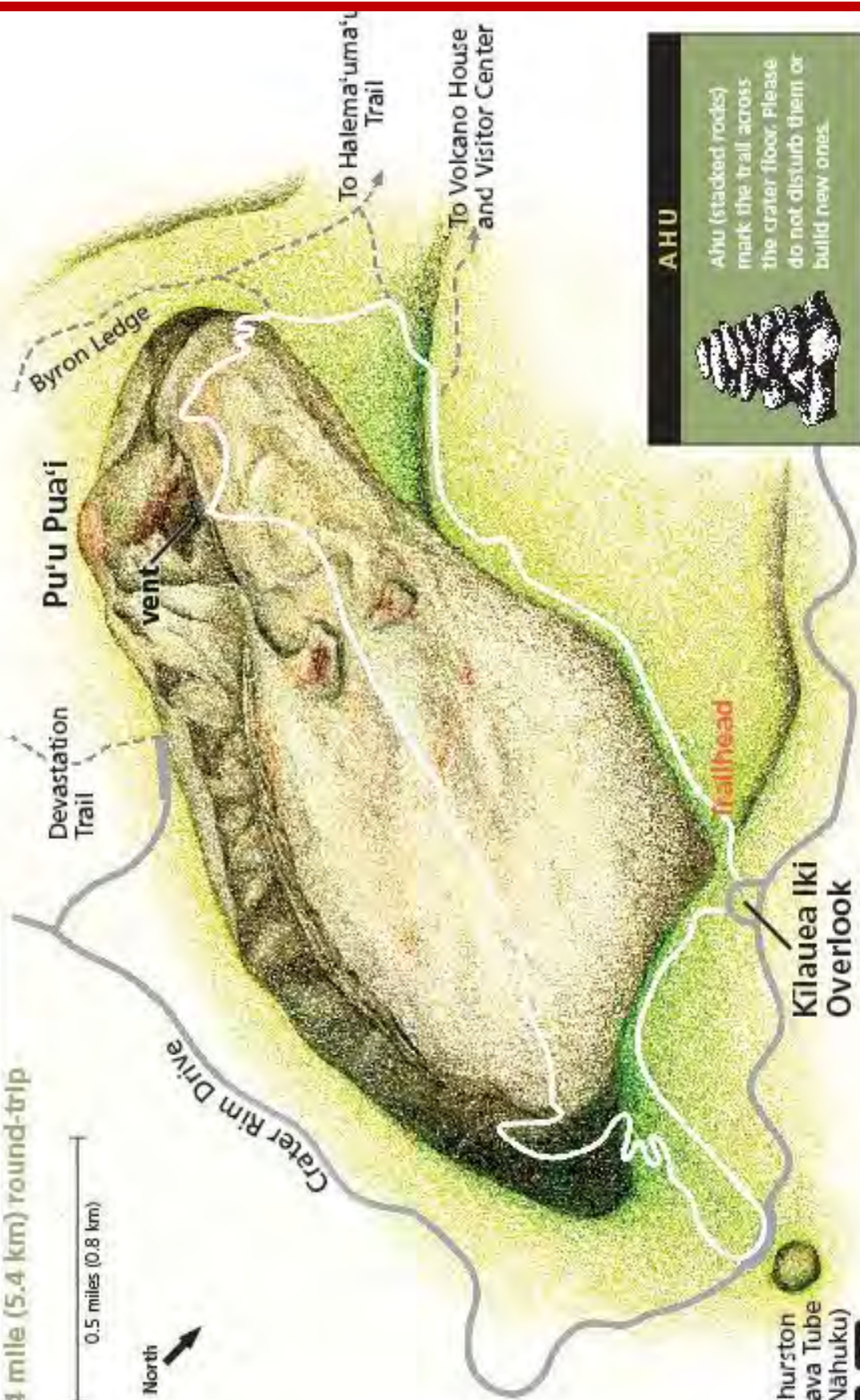


© J.P. Eaton

Kīlauea Iki Crater Trail

4 mile (5.4 km) round-trip

0.5 miles (0.8 km)



AHU



Ahu (stacked rocks) mark the trail across the crater floor. Please do not disturb them or build new ones.



Thurston Lava Tube (Nāhuku)

Kīlauea Iki Overlook



0.5 miles (0.8 km)

THE HAWAIIAN RAINFOREST:

There are many kinds of plants and animals in Hawai'i that are found nowhere else on the entire planet! What in the environment and landscape of Hawai'i caused these **organisms** (living things) to be different? Many of these organisms are now hard to find. Why should we **mālama** (care for) these living things?

PLANT AND ANIMAL SCAVENGER HUNT:

Use the photographs on the following pages to identify three native Hawaiian plants. Divide students into three groups. Assign each group to study one plant, look for and identify their assigned plant while on the Kīlauea Iki field trip. During or after the visit, each group relates their findings to other class members. Remember to only look at and point to each plant without harming it. **E mālama 'āina.**

1. **'Ōhi'a lehua** is a native plant with beautiful red flowers. Often a "pioneer" plant, it is the first to grow on new lava fields. It attracts native birds ('amakihi, 'apapane and others) that feed on 'ōhi'a lehua flowers. Early Hawaiians used the wood as kapa beaters, poi boards, mallets, daggers, idols, spears, clubs, kāhili standards, and in construction. Flowers were used in a concoction to ease childbirth, and leaf buds were used for chronic coughs.



Compare these plants to those where you live. How are they similar or different?



2. **'Ama'u**, a medium-to-large sized fern, is found in diverse habitats ranging from recent lava flows to wet forests. Early Hawaiians used the leaves as garden mulch and roof thatching. Red dye was extracted from young fronds for **kapa**. Sticky sap from fiddleheads was used as glue to weld kapa strips together. The starchy pith was often a famine food, and young shoots were eaten raw or cooked. Young shoots in a mixture were used to drain boils.

3. **Hāpu'u pulu** (7' to 25' tall fern), grows in wet forests from 490 to over 3,900 feet in elevation. It is very slow growing. The average rate of growth of a young hāpu'u fern is about 3 1/2 inches per year. The starchy inner core of the trunk (**pith**) was an important famine food. The **pulu**, or soft woolly material at the base of fronds, was used for dressing wounds and embalming bodies.



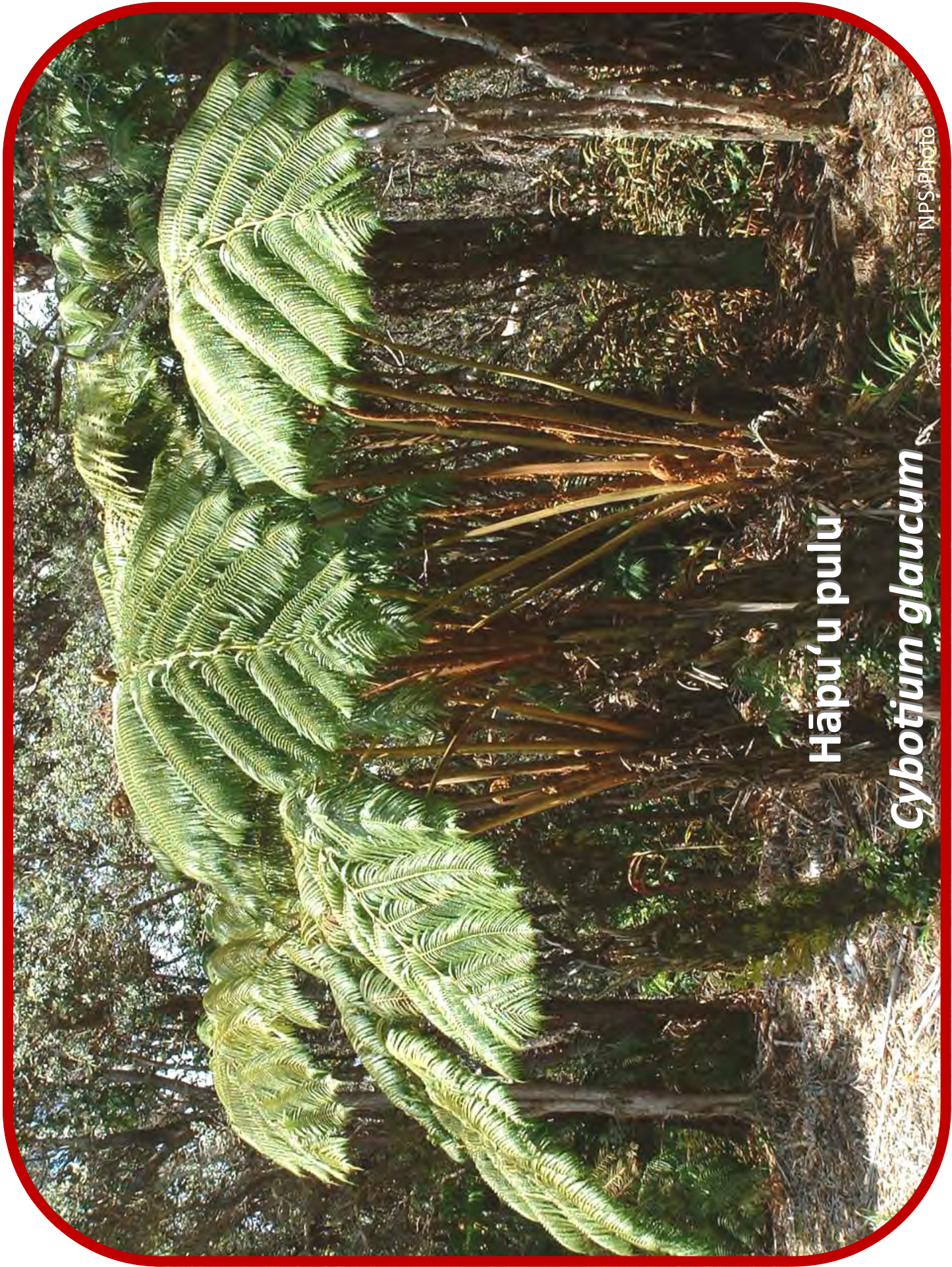
'Ōhi'a Lehua
Metrosideros polymorpha

NPS Photo



NPS Photo

'Ama'u
Sadleria cyatheoides



NPS Photo

Hāpu'u pulu
Cybotium glaucum

IDENTIFY AND LEARN ABOUT THREE NATIVE BIRDS AND HEAR THEIR SONGS

1. **'Apapane** is a native bird with beautiful red, white and black feathers. 'Apapane like to eat bugs and drink the sweet nectar in flowers. They have many beautiful songs and fly long distances in search of nectar in lehua flowers. In the old days, 'apapane were eaten by some Hawaiians. Their feathers were sometimes used in Hawaiian feather 'ahu'ula (capets). Their name may refer to their call and song. 'Apapane can mimic other birds and have a wide variety of songs. What does the 'apapane sound like to you?



2. **'Amakihi** is a native bird that is green or greenish-yellow in color. They have a black mask over their eyes. They are great survivors and have been able to live in places where other native birds are now long extinct (gone forever). 'Amakihi drink the nectar from many flowers and eat arthropods. What kind of habitats do you think 'amakihi like to live in?

Many native birds are now extinct. Why is the 'amakihi still common? In the old days 'amakihi were eaten, but were considered sour and smelly meat. A small person with a grumpy personality was called an 'amakihi 'awa'awa, a "sour 'amakihi". 'Amakihi are curious birds that like to investigate new things in the forest.

Hear their songs, and listen for them on your field trip. Go to:

<http://science.nature.nps.gov/parks/havo/NativeForestBirds.cfm>

Where do you find these birds?

How might these birds be threatened?

3. **'Ōma'ō** is a relatively large dull colored bird with a very loud call. You are far more likely to hear an 'ōma'ō than to see one, since they like to hide in the bushes. One of the favorite foods of the 'ōma'ō are berries and fruits. 'Ōma'ō are extinct in west Hawai'i but can still be found on the east side of the island. This is sad because 'ōma'ō are important birds. What important role do you think the 'ōma'ō plays in a forest?





© Jack Jeffrey

'Apapane'
Himatione sanguinea



© Jack Jeffrey

'Amakihi
Hemignathus virens virens



© Jack Jeffrey

'Ōma'ō
Myadestes obscurus

IDENTIFY EACH OF THESE VOLCANIC PRODUCTS AND DESCRIBE THEIR CHARACTERISTICS

Pele's tears, Pele's hair, cinder and olivine are different kinds of volcanic products. **Tephra** the general term for volcanic rock fragments exploded or carried airborne during an eruption (including Pele's tears, Pele's hair and cinder. Fragments can range in size from .08 inches to more than 3.2 feet in diameter. The smallest tephra is called volcanic ash; pieces of pulverized rock and volcanic glass the size of sand or silt. So, as tephra is blown farther from the vent, the average size of individual particles becomes smaller and the thickness of the resulting deposit becomes thinner with distance. In this activity we will learn to identify different kinds of volcanic products before our field trip. Later, we will practice our identification skills on our hike. Students will divide into groups and will be assigned to find particular volcanic products. They will meet together to share their findings with other student groups.

ON-SITE ACTIVITIES:

Students will look for samples of **volcanic products**: Pele's tears, Pele's hair, cinder and olivine. They will make observations, then report findings to the group. Remember to put everything back in its place after you examine samples. In national parks it is against the law to remove most natural materials. Moving things such as rocks changes the historic landscape and could potentially harm the environment. **Mālama 'āina** (caring for the land) helps us protect, preserve, honor and respect this special place.

- ◆ **Pele's Tears** are small solidified droplets of volcanic glass from molten lava that cooled rapidly as they fell from high lava fountains.

What shape are they? Why do you think they have this shape?



There used to be more volcanic products found here.

- ◆ **Pele's hair:** Often a thin thread of liquid lava trails behind Pele's tears, which is quickly chilled to form a filament of golden brown glass. Thick mats of Pele's hair can form downwind from high lava fountains.

How do you think Pele's Hair is transported from one place to another?



What do you think happened?

- ◆ **Cinder** is usually dark colored, porous tephra filled with bubble-like cavities (called vesicles) resulting from the sudden chilling of frothy lava from which gases escaped during lava fountaining. During high fountaining episodes (like the 1959 Kilauea Iki eruption) a light fragment filled with bubble-like cavities can be carried many miles downwind from high lava fountains.

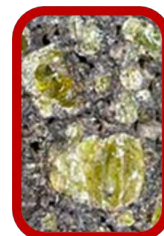
How do you think people make use of cinder?



How do you think people make use of olivine?

- ◆ **Olivine** crystals are formed by very high temperatures during and after an eruption. Olivine crystallizes from magma that is rich in magnesium and low in silica. Olivine can be olive-green, light green, dark green, yellow-green, yellow-brown, and brown.

How were you able to find a sample of olivine?





Pele's Tears



Pepe's Hair



Cinder



Olivine



**What happened in 1959
that changed the
landscape?**

What was this change like?

**Kīlauea Iki was filled with
400 feet of new lava;
enough to fill 6 million
dump trucks!**

**How do you think Pu'u
Pua'i cinder cone was
formed?**



IDENTIFY EVIDENCE OF GEOLOGIC CHANGE



WHAT CAN YOU SEE AT THE BASE OF THE CRATER WALLS?

(Bathtub ring)

The forest downwind from the eruption was buried under 20 feet of cinder. Thousands of visitors per day came to see the spectacle. Visitors held trash can lids, umbrellas and newspapers over their heads to protect themselves from falling, hot cinders.



WHO IS PELE? WHO IS HI'IAKA? WHY ARE THEY IMPORTANT TO THIS LANDSCAPE?



She is known by many names: “Ka wahine ‘ai honua,” “the woman who devours the earth” or “Pelehonuamea” - “Pele of the sacred land.” She is the Hawaiian volcano deity; the goddess who personifies fire and volcanism in all its forms. The volcanic landscape is her handiwork.



Her acts of creation are followed by her sister Hi'ikaikapoliopole, “Hi'ika in the bosom of Pele.” Hi'ikaikapoliopole brings new growth to the land and works together with her sister to sustain life.

Today, the forest is alive with new growth, and visitors whisper in awe, “Ae, aia lā ‘o Pele,” - “Yes, behold Pele!”



HOW DO YOU SEE PROOF OF NEW LIFE AND GROWTH IN THE LANDSCAPE?

Which trees are often first to grow on a new lava flow?

How long do plants take to grow back on new lava fields?

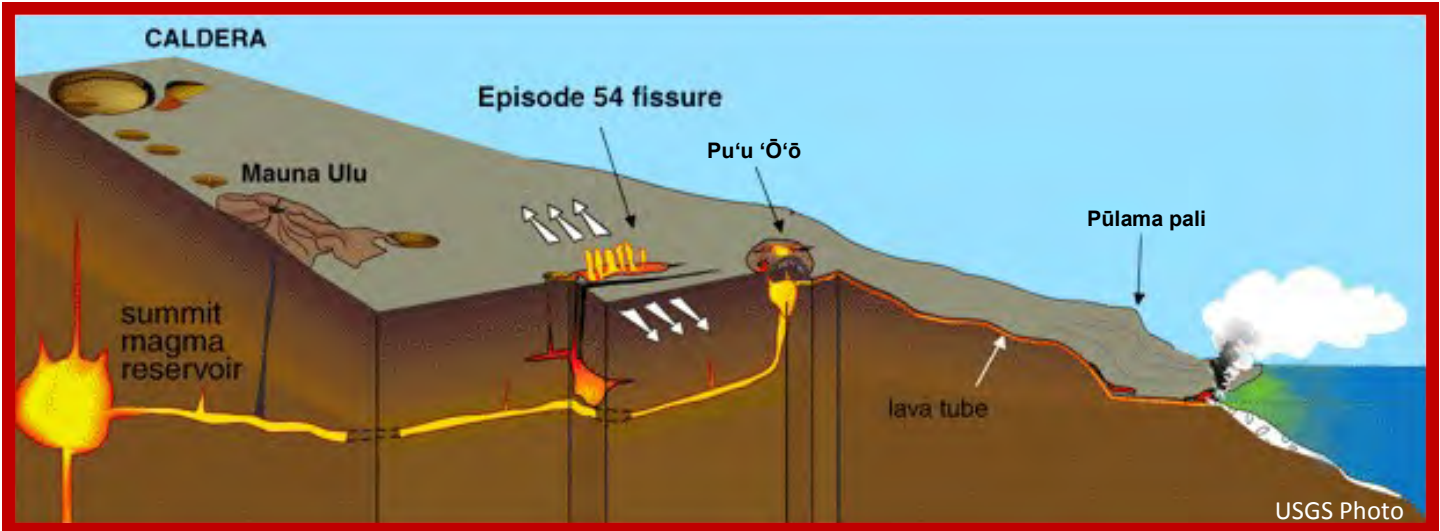
Why should we study this unique, natural site?

What kinds of life do you see in this area?



POST-SITE ACTIVITIES:

Ask students to share, draw or teach other students about one new thing that they learned or saw that interested them. Reflect and review activities, places and sites. Ask the questions below after viewing this section drawing of Kīlauea Caldera, Halema'uma'u, Kīlauea Iki, Mauna Ulu and Pu'u 'Ō'ō:



Deep within the Earth, the temperature is so hot that some mantle rocks slowly melt to form magma. Because magma is less dense (lighter) than the solid rock around it, magma rises and collects in magma storage chambers within the earth's crust. Under the right conditions, this magma can erupt on to the Earth's surface through vents and fissures, which is what happened in 1959 at Kīlauea Iki in 1959.

IMPORTANT NAMES AND PLACES:

What is the name for hot molten rock before it reaches the surface? (**Magma**)

Smooth or "ropey" lava is called _____? (**Pāhoehoe**)

_____ is the name for rough lava. (**'A'ā**)

Name the two places that are erupting on Kīlauea? (**Pu'u 'Ō'ō and Halema'uma'u**)

Describe two ways that the Earth is "alive."

Where is the oldest volcano on Hawai'i island? (**Kohala**) Why?

Tell where the youngest volcano is located on the island of Hawai'i? (**Kīlauea**) Why?

How could you learn more about why our 'āina (land) is alive?

CONCLUSION:

Despite our tendency to consider Earth as static, it is actually a dynamic, ever-changing planet. Wind, water, and ice erode and shape the land. Volcanic activity and earthquakes alter the landscape in a dramatic and often violent manner. And on a much longer timescale, the movement of Earth's plates slowly reconfigures oceans and continents.

THE CLIMATE CHANGE CONNECTION:

Climate is the normal weather in a certain place over time.

What is the climate like where you live?

Right now the climate of the Earth is changing. The temperature is getting warmer. Why? Even though volcanoes are powerful and can affect climate, human activities affect the climate more in one year than all of the volcanoes in the world combined. In 2010, human activity produced 270 times more carbon dioxide than volcanoes!

Carbon dioxide is created from all kinds of things that we do. Using electricity, driving cars, burning fires, and many other things that we do create carbon dioxide. Too much carbon dioxide and other **green house gases** can make the climate warmer. This is scary because a warmer climate means extreme weather, dry land disappearing under the ocean, more disease, and all kinds of other problems.

DISCUSS:

How does climate change affect plants and animals?

What activities do you do that create carbon dioxide or green house gases?

Can you think of ways to produce less carbon dioxide?

Our every day decisions, no matter how small, have an effect on the Earth. Do your part and stop the climate change!



USGS Photo

Pre/Post visit additional teaching materials



The Earth's layers, showing the Crust, Mantle, Outer Core and Inner Core.

Discoverymagazine.com Photo



WHAT ALLOWS 'ŌHI'A TO SURVIVE AND THRIVE IN HAWAI'I?

Taking a tumble on the rough, glassy lava surface can leave a sharp, lasting impression. Yet within a few years, a recent lava flow can host a community of plants that includes 'ōhi'a lehua (*Metrosideros polymorpha*)—one of the most common trees in Hawai'i and the first native tree to colonize young lava. From its humble beginnings on a barren flow, 'ōhi'a lehua, or 'ōhi'a, becomes the dominant tree of the Hawaiian rain forest. This **keystone species**, upon which many other organisms rely to survive, evolved in complete isolation, and occurs nowhere else in the world. They can grow efficiently in cracks and fissures, taking advantage of residual moisture after rainfall. 'Ōhi'a also have the capability to close their **stomata**, or breathing pores, so the trees can "hold their breath" when toxic volcanic gases are blown their way. 'Ōhi'a is a tree with immense cultural significance, symbolizing strength, beauty, and sanctity. It is considered a physical manifestation of Kū, one of the four principal Hawaiian deities. Different aspects of Kū are involved in many things - healing, war, and very often the forest itself and the various human occupations that take place in the forest such as canoe making, bird catching, and the gathering of herbs.

Today, there is a new menace threatening this important tree: a fungus, *Ceratocystis fimbriata*, that is causing a lethal disease in 'ōhi'a. This rapidly spreading disease is commonly known as "'Ōhi'a Wilt," or "Rapid 'Ōhi'a Death" (ROD). A diseased tree exhibits rapid browning of the leaves on a single limb and/or in the entire tree **crown** and typically dies within a matter of weeks. Researchers report that nearly all of the trees in an affected stand can succumb to the disease within two to three years. This has the potential to radically change ecosystems in Hawai'i, putting our unique Hawaiian birds, invertebrates, plant communities and potentially entire **watersheds** at risk. Currently the disease is confined to the island of Hawai'i. However, this menace has the potential to spread to forests state-wide.

How would the destruction of our 'ōhi'a forests be harmful?

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VOCABULARY

Biodiversity: the variety of life in a particular place.

Carbon Dioxide: a colorless, odorless, gas found in our atmosphere. CO₂, 1 carbon atom bound to 2 oxygen atoms.

Cinder: Rough particles of hardened lava, formed when gas-charged lava erupts from a vent under pressure blows violently into the air.

Climate: the normal weather conditions of a place.

Crown: The branches and leaves of a tree or plant.

Ecosystem: a community of interacting organisms and their environment.

Extinction: when a particular kind of living thing no longer exists.

Greenhouse gasses: various gasses that trap heat in the atmosphere, when there are too many of these gasses in the atmosphere they can make the Earth's climate warmer.

Kapa: traditional Hawaiian fabric made from pounding bark from certain kinds of trees.

Keystone Species: a species in an ecosystem that many other species depend upon to survive. If this species were to disappear, the ecosystem could possibly collapse.

Magma: molten rock.

Mālama: to take care of someone or something.

Mālama 'āina: to take care of the land.

Mele Oli Komo: a chant requesting entrance.

Organism: a general term for any kind of living thing, plants, animals, bacteria, fungi, etc.

Pith: the spongy tissue in the stems of many plants.

Pulu: silky hair-like fibers that cover young Hapu'u tree fern fiddleheads.

Spatter cone: a steep-sided volcanic cone built up of volcanic rock materials ejected from a fissure or vent.

Stomata: (plural of stoma) the tiny pores in the leaves of plants which allow them to "breathe".

Tephra: solid matter ejected by erupting volcanoes.

Vent: an outlet of a volcano that allows magma to flow out.

Vesicles: a tiny sac or cavity containing fluid or gas.

Watershed: An area of land that is the water source for streams, rivers, and other fresh water bodies.