

Upper
Elementary

HAWAII
NATURE
CENTER
Iao Valley



Teacher's Resource Guide
Forest Encounters



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Forest Encounters

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Hawai'i Nature Center

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Foreword

This Resource Guide is provided to assist classroom teachers planning to bring their students to the Hawai'i Nature Center's Upper Elementary Program, *Forest Encounters*. It includes an outline of the program's key concepts, goals and objectives, and brief descriptions of the various activities in which students may participate. There are also suggestions for pre-visit preparation and post-visit follow up, scientific and historic background, an annotated reference list, and a sample letter to send home to parents.

Leading early childhood specialists underscore the value of direct experiences for children. Moreover, many noted scientists attest that their commitment to the environment can be traced back to outdoor activities in childhood, and the guidance of an interested adult. We believe that a Hawai'i Nature Center field trip is far more than just child's play, and may be the start of a lifelong connection between students and the natural world.

We are delighted that you have elected to bring your students to visit us, and look forward to a wonderful day in the great, green out-of-doors.

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Program Lessons & Activities

Hawai'i Nature Center
Environmental Education Field Program

Upper
Elementary



PROGRAM OVERVIEW

Key Concepts: Change is a part of nature; people are often forces of change.

Goals: 1) To foster an awareness and appreciation of nature, with emphasis on geological, biological and human-induced change; 2) to expose students to some of the plants and animals found in lowland Hawaiian forest environments; and 3) to introduce factors which influence soil erosion and water runoff in the forest.

Objectives: Students will be able to explain how natural forces shape our islands, interpret one type of change that has occurred in 'īao Valley, and predict how human activity may affect the forest floor and watershed. They will also be able to distinguish between changes that have short-term or local effects and those that have far-reaching ramifications, and suggest changes they could make to create a better future for Hawai'i.



PROGRAM SCHEDULE

9:00 - 9:30	Introduction to Change in Nature
9:30 - 10:45	First Rotation
10:45 - 12:00	Second Rotation
12:00 - 12:30	Lunch
12:30 - 1:00	Summary, clean up, return to school



INTRODUCTION

Key Concepts: Change is a part of the natural world; people are forces of change.

Objectives: Students will be able to describe the basic geologic processes that shaped the Hawaiian Islands, and identify three ways native species initially reached our shores.

<Benchmark SC.4.8.1 Forces that Shape the Earth. Describe how slow processes (e.g. waves, wind, water, ice) sometimes shape and reshape the surface of the Earth.>

<Benchmark SC.4.8.2 Forces that Shape the Earth. Describe how fast processes (e.g. volcanoes, earthquakes) sometimes shape and reshape the Earth.>

<Benchmark SC.4.2.1 Science, Technology, and Society. Describe how the use of technology (e.g. farming, manufacturing, or communication) has influenced the economy, demography, and environment of Hawaii.>

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Activity: Students will gather around a map of the world for a hands-on, participatory review of the geologic formation of the Hawaiian Islands, the dispersal of plants and animals to Hawai'i, and human arrival. We will introduce the concept of change (geologic, biologic, and human-caused) and set the tone for the day's adventure.



ROTATION A: Ranger Hike on a Trail of Changes

Key Concepts: 'Īao Valley has undergone extensive biologic, geologic and human-caused changes. Some of the human-caused changes continue to affect the area, either positively or negatively. The decisions we make today may have positive or negative affects on the area in the future.

Objective: Students will be able to share one example each of geologic, biologic, and human-caused change in the Wailuku area with others.

<Benchmark SC.4.5.1 Unity and Diversity. Describe the roles of various organisms in the same environment.>

<Benchmark SC.4.5.2 Unity and Diversity. Describe how different organisms need specific environmental conditions to survive.>

Activity: The program will begin in a grove of Kukui on the Nature Center trail head. Two by two, the students will proceed up the trail, stopping at Ranger stations along the way to learn short stories about the changes that have taken place in the area. Each pair of students will serve as Rangers, and be responsible for imparting information to their classmates. Two by two, the students will gather at the end of the trail for a review and comparison of the different kinds of changes discovered along the way.



**ROTATION B: Watershed Studies**

Key Concepts: Small animal life on the forest floor and in a stream is one indicator of the ecosystem's health. Factors which affect the forest floor include ground cover, slope, presence of hoofed animals, and land use. People also make major changes to the stream that can be detrimental to not only the stream ecosystem, but also the watershed and ocean below.

Objectives: Students will be able to create and test a hypothesis and be able to suggest how the health of a forest impacts the stream. They will also be able to measure at least two variables at the stream and describe how forest and stream factors are interrelated and can impact the watershed and ocean below.

<Benchmark SC.4.1.1 Scientific Inquiry. Describe a testable hypothesis and an experimental procedure.>

Activities: Students will work in subgroups to create and test a hypothesis about a healthy forest and stream. They will measure variables in and around the stream, such as depth, speed, and temperature. Afterwards, the students will share their data, and consider how issues like land use influence forest and watershed health.

**SUMMARY**

Key Concepts: Changes are on-going in nature. People have accelerated the rate of change in Hawai'i. Changes we make today can affect the future we inherit tomorrow.

Objectives: Students will be able to identify several ways in which human actions have resulted in undesirable changes to the environment, and several actions they can take that may result in long term, positive changes.

<Benchmark SC.4.2.1 Science, Technology, and Society. ADVANCED RUBRIC: Explain how the use of technology has influenced the economy, demography, and environment of Hawaii and suggest ways to conserve the environment. >

Activity: The group will gather to discuss the day's activities and review the concepts addressed. Afterwards, students will be asked to choose between several different possible futures, and suggest changes they can make in their own lifestyles to help create the kind of world they want for themselves and their children.



Field Trip Preparation, Reminders & Post-Visit Activities

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IN-CLASS PREPARATION

Before Your Visit: The following activities are suggested to help your class prepare for their Hawai'i Nature Center field trip:

- Locate 'Iao Valley and the Hawai'i Nature Center on a map and see where it lies in relation to your school.
- Also find natural features near your school: streams, forested areas, and beaches. If possible, define your watershed with your class.
- Have a class discussion about good hiking practices: single file, no running, no collecting or throwing objects, be courteous to others and respectful of plants and animals.
- Review the hot spot theory—see the 'Ōhi'a Project (OP) activity *Hot Spot*. To review stages of island building, see *Volcanoes on Stage* (OP, Gr. 4). For more information on plate tectonics, see *The Puzzling Earth* (OP, Gr. 5).
- Review the processes of erosion and weathering. Try *Crumbling, Tumbling, Washing Away*, (included).
- Review soil and common decomposers. See *Soil and Litter Animals*, from the Hawai'i Nature Study Program, Small Animals of the School Neighborhood, (included).
- Include some of these words in vocabulary lessons: erosion, runoff, absorption, pollution, watershed, eruption (primary and secondary), cinder cone, native, introduced, deforestation, reforestation, and/or biodiversity.



ON THE DAY OF THE FIELD TRIP

Important reminders for the day:

- Before leaving school, divide students into two equal subgroups of up to 30 students.
- Bring three adults for each subgroup of students.
- EVERYONE, including teachers and parents, needs a name tag.
- Students should put on mosquito repellent at home before the field trip. Long sleeve shirts and long pants are the best protection. Mosquito repellents without DEET are available at drug stores but if parents want to use DEET, the recommended strength for children is 3 - 18%. Read labels before applying.
- Have students wear clothes and sneakers that can get dirty, and bring rain gear with a hat or hood (optional).
- Bring large garbage bags to take lunch litter back to school.
- Bring lunches in group boxes rather than individual backpacks.
- Students may bring water in small packs or on straps



**EXTENDED ACTIVITIES**

After Your Visit: Before the excitement cools and the memories begin to fade, try some of these activities to reinforce the material presented on your field trip:

- Hold a general review of the day's activities. Write letters and draw pictures pertaining to the lessons and send them to Nature Center staff and volunteers and/or funders.
- Discuss your local geology. Locate your school on a topological map. Which shield volcano is your school on? Is there a secondary cone or exposed coral reef nearby? Where's a good local example of erosion? Create a time line of changes that have taken place in your area over the past year or starting from now into the future.
- The Chinese banyan is only one problem for native koa in Hawaiian forests! Learn more with *Where Have All the Koa Gone?* (OP).
- As a class or school, adopt some place on or near your school grounds that will have a positive effect on the future and the environment. For ideas, see *Adopt a Spot*.
- To learn more about seasonal changes in nature in Hawai'i, see *Seasons of Nature*, (OP).

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(Note: This information is provided to help you answer those difficult questions. Most of it is inappropriate for fourth graders.)



Geology of the Pacific

Scientists believe that the Earth is a layered planet. The fundamental layers are the crust, which is the outer shell of rock forming a thin skin on the Earth's surface, the mantle, made up of molten rock, and the core at the center of the Earth.

The Earth's crust is broken up into many pieces called tectonic plates, which fit together like a puzzle. Currents of liquid rock from deep within the Earth cause the plates to "float" or move around on the mantle. The Pacific Ocean rests on one of these plates, called the Pacific Plate. This plate is moving toward the northwest at the rate of about four inches a year. Around the edge of the Pacific Plate, where it comes in contact with other plates, there is a zone of tectonic activity (earthquakes and volcanoes), known as the Ring of Fire.

Tectonic activity is due to a number of factors. As plates grind past each other, they create earthquakes, such as those that occur along the San Andreas fault. To the north, the Pacific Plate meets the North American Plate head on. Because oceanic plates are denser than continental plates, the Pacific Plate slides under the North American Plate, a phenomenon known as subduction. The crust slides deep within the mantle and melts, causing volcanoes to erupt nearby. This is how the Aleutian islands formed. The same type of activity is occurring in Japan, the Philippines, Australia, Asia, and the western coast of the Americas.

But all this activity around the edge of the Pacific Plate does not explain the existence of the Hawaiian Islands, which are located in the middle of the plate. The Hawaiian Islands sit on what scientists call a *hot spot* which is the result of a mantle plume (an upward convection of magma within the mantle). This hot spot is more or less stationary. Over millions of years, islands are formed over it. Eventually, the Pacific Plate carries the young islands beyond the hot spot, and primary volcanic activity ceases, while a new island begins to form. This accounts for the island "chain" from the youngest, volcanically active island (Hawai'i) out to the older islands to the northwest.



Erosional Processes in Hawai'i

Mauna Loa on the Island of Hawai'i, constitutes the most massive volcano on Earth. Haleakalā is not far behind. In fact, all of the major Hawaiian islands are major geologic features, built up over the centuries of basalt and, later, coral. As scientists (and many fourth graders) now know, these seemingly permanent structures are worn away daily, and will one day drop below sea level.

The terminology to describe this process can be confusing. *Weathering* refers to the weakening of rock and soil; *erosion* occurs when this weakened material is carried away, usually by wind or water. There are two types of weathering: mechanical and chemical. Mechanical weathering involves a physical force, such as roots pushing into rock, or water (at high elevations) freezing and expanding within rock. Chemical weathering involves a chemical reaction within or around rock (or another substance), such as occurs when water mixes with carbon dioxide in the soil and forms a weak carbonic acid. In tropical areas such as the Hawaiian Islands, chemical weathering is far more important than mechanical weathering.



Weakened rock may be eroded in a variety of ways. On a daily basis, streams are the most important erosive force in Hawai'i. Wave action, wind, and rainstorms also contribute to erosion. In addition to this daily erosive activity, scientists have recently discovered a major type of erosion called mass wasting that has occurred on all of the main Hawaiian Islands. Huge submarine rock deposits indicate that large portions of coastlines have broken off and slid into the ocean, possibly touched off by seismic activity. Geologists are still working to learn more about this phenomenon, in hopes of better predicting future catastrophic landslides.

It is the steady erosion created by rainfall that best describes the valley's topography. In Hawai'i, most rain falls at the back of a valley, where steep cliffs are often shrouded in clouds. Rainwater collects into small streams, which flow into other streams and gain size and strength. The water picks up bits of loose soil and rock, and carries it downstream. These bits act like sandpaper, grinding away the stream walls as they go. During heavy rains, the volume, strength and speed of the river may increase dramatically. Giant boulders and tree limbs magnify the stream's erosive force as they tumble downstream.

Wide, flat areas on either side of 'Iao Stream suggest that the water level here has at some time been much higher. There are two possible explanations for this. First, geologic evidence indicates that sea level around the Hawaiian Islands has been higher in the past than it is today. At least one prominent geologist suggests that the flat shelf we see at 'Iao near the Nature Center was carved during a higher stand of the sea. Second, much of the flat area above the current stream level serves as a flood plain, and turns into a river during heavy rains and flash floods.

There is no question that the formation of 'Iao Valley is the natural result of stream flow and erosive forces. It is also likely that human activity on Maui continues to affect the geology of the valley. For example, introduced pigs which have become feral in the mountains root up soil, making it susceptible to erosion. Are increased sediments in the water enhancing the stream's erosive force downstream? Tremendous amounts of water are now being diverted from 'Iao Stream for human and agricultural use. Is the decreased volume reducing the stream's erosive potential? Or is the weakened stream now unable to carry sediment to the sea, leading to stream blockages later, and increasing flood hazard? Some parts of 'Iao Stream have actually been straightened and lined with concrete (channelized)!

'Iao Stream provides an excellent site to examine the interrelationships between human activities and environmental processes in an ever-changing landscape.



Biological Adaptations

Over a hundred years ago, naturalist Charles Darwin first suggested that some plants and animals may be better suited (adapted) for a particular environment than others. In the subsequent decades, scientists around the world have studied and debated the processes involved in biological adaptation and evolution. To our knowledge, plants and animals cannot choose a certain adaptation that will help them survive. Rather, mutations and genetic variations regularly occur in all species; mutations that enable an individual to survive long enough to reproduce are more likely to be passed down through generations. This genetic variation allows different species to thrive in different ecological niches.



Many of the organisms that came to Hawai'i before the arrival of people—that is, native species—became geographically separated from other individuals of their species. Over time, they adapted to the many different types of ecological niches available in Hawai'i. They also tended to lose defensive armaments (such as thorns, poisons, tough bark, or strong wings) against threats that were absent here.

Many native species evolved together (co-evolved). An example of co-evolution often presented is how the curved flowers of the lobelia and the curved beaks of the 'i'iwi (a bird) evolved to suit one another. Some organisms co-evolved to the extent that one could not survive without the other.

When Polynesians first came to Hawai'i about 2,000 years ago, they brought a variety of plants and animals with them. Other people from all corners of the Earth have continued the trend of introducing new species. The *rate* at which new species arrive in the Islands has changed dramatically. Many native species have not survived the onslaught. In fact, in the part of 'Iao Valley that we will visit, only three or four native plant species remain.



A Brief History of 'Iao

Archaeologists have never done a complete field survey in 'Iao Valley. We aren't sure what this area was like before people came. Certainly, there would have been different plants and animals here, such as the beautiful 'ōhi'a and graceful 'ōlapa. The coffee and kukui trees that dominate the valley today did not exist in Hawai'i in ancient times. 'Iao Valley prospered and evolved biologically for hundreds of thousands of years before people ever set foot in it. Historical facts and Hawaiian legend about 'Iao Valley are often intertwined.

Hawaiian oral history is passed on through chants. The valley was sacred to the Hawaiians, and was inaccessible to commoners. Only the mo'i ali'i and ali'i were allowed to enter, except during the annual makahiki festival, when all were welcome to visit. The guardian of the valley lived near a large heiau, located in Wailuku near where Ka'ahumanu Church now stands.

Early Hawaiians are believed to have buried their navigator, a revered and powerful individual, in a cave in 'Iao Valley. This probably provided a precedence of ali'i-only burials in 'Iao. According to legend, Kapawa, King of Waialua, O'ahu, was buried in the valley some 800 years ago. The practice of ali'i burials continued until 1736.

'Iao Stream was extremely important to the people who lived in Wailuku and Kahului. It was known as "na wai eha," or "one of the four streams" and was the source of a continuous water supply that irrigated taro, sweet potato, and other crops in the valleys below. The Hawaiians used a highly advanced system of temporary water diversion to maintain their fields. They were clearly more in tune with natural cycles than most others in Polynesia at that time.



The Battle of Kepaniwai

In 1790, not long after the arrival of Captain Cook, King Kamehameha defeated Prince Kalanikupule, son of Kahekili, King of Maui, here at the famous Battle of Kepaniwai. King Kamehameha had enlisted the help of the American merchant ship "Fair American" and attacked Prince Kalanikupule with his newly acquired assistants, Isaac Davis and John Young. King Kamehameha had a strong weapons advantage. His ship carried cannons and his soldiers had guns. The King, his soldiers, and cannons moved inland, forcing the people of Maui to flee back into 'Iao Valley. The battle, which ran the course of the river, is called Kepaniwai. Kepaniwai means "the damming of the water;" as the water flow was said to have been choked by slain bodies, and the river to flow red with their blood.





The Rise of Sugar

After the battle, no village life remained. 'Iao was quiet until the 1820s. Throughout the nineteenth century, the taro, sweet potato, and other crops which had thrived in the land below were gradually replaced with sugar cane. The sugar interests were eventually united under Wailuku Sugar Company, which maintained a skeleton crew in 'Iao to work the irrigation ditches

Near the end of the century, the president of Wailuku Sugar Company held a luau for company staff and other dignitaries from Maui. Queen Lili'uokalani was the guest of honor. The festivities lasted for four days! Finally, on the last day, the clouds gathered and it began to rain. It rained so hard that the next day a rope had to be stretched across 'Iao Stream to help the Queen and her companions get out.

In 1906, the village was burned to the ground. Some say the fire was set deliberately to get rid of the rats, which were plaguing the town and carrying disease, but no one knows for sure. Nine grass huts, as well as plum, mango, avocado and coffee trees were destroyed. Ten years later, the valley was swept clean by a tremendous flood.



Changing Landscapes

It is impossible to examine change in the world without considering the role of people. By our very existence, we change the world around us on a daily basis. Change itself is neither good nor bad. Anticipating the long-term ramifications of our actions may help us make better decisions.

Early Hawaiians made many changes in order to survive. One way they changed the landscape was to transform it for agriculture and food production. The following excerpts are from *Alteration of Native Hawaiian Vegetation*, by Linda W. Cuddihy and Charles P. Stone, 1990:

Deforestation and erosion were the natural results of Hawaiian agriculture. There can be no doubt that Hawaiians greatly altered the lowland vegetation of the Hawaiian Islands, particularly during the period of expansion in population and intensification of agriculture between 1100 and 1650 A.D. (Kirch 1985a). Environmental changes associated with deforestation (apart from the simple loss of species) include increase in solar radiation; decrease in soil moisture, permeability, and surface water retention; faster run-off; lower water table and altered micro-climates; and drought (Newman, 1969).

The forests of the irrigated valleys and windward slopes were often replaced completely by the taro ponds, gardens, habitations, and introduced tree species of the Hawaiians. Replacement was accomplished .. by manually pulling the trees and burning vegetation.

Although Maui is the second largest of the Hawaiian Islands, little archaeological work has been carried out there (Kirch 1985a). Many stream valleys and well-watered slopes of West Maui are known to have been settled early (Kirch 1974) and eventually supported large populations and intensive irrigation cultivation (Handy and Handy 1972; Kirch 1985a). Thus vegetation in lowland sites of West Maui was probably replaced early during the Hawaiian period.



In 'Āao Valley, a single change made by people, such as the introduction of kukui trees, altered environmental conditions for other plants and animals. Over time, birds and insects that depended upon the nectar and fruit of the original tree species moved on or died out. The tall kukui trees may have changed understory conditions, such as light availability and temperature. Plants and animals (including decomposers) that better adapted to these new conditions now thrive. Those that could not adapt are no longer in the valley.



'Āao Valley Today

Today, most of the land in 'Āao Valley is zoned for conservation, and is owned by a handful of public and private concerns. Many people still regard 'Āao as sacred.

Most of the plants that dominate lower 'Āao Valley are introduced. Native species still present include 'akia (or the "fish-poison plant" used in catching fish), mamaki, which was probably cultivated for its use in herbal tea and kapa making, and moa, a primitive, fern ally which children played with, and which provided a substance used like talcum powder. Perhaps these species survived because they were useful to the early Hawaiians.

In addition to the kukui trees which now tower high above the forest floor, Hawaiian-introduced plants which have become established in 'Āao include ti, mountain apple ('ai) and banana (mai'a). Most of the other plants we will see were brought to Hawai'i after the arrival of Captain Cook in 1778, and include false kamani, honohono grass, torch ginger, guava, coffee, sword ferns, Java plum, avocado, Surinam cherry, and Christmas berry.

Most of the animals we will see are invertebrates, both native and introduced. We might hear a mejiro, cardinal, myna, or sparrow — all introduced birds. Some of the tiny spiders and insects near the splash zone in the stream are native, but the more common snails and caddis flies are introduced. If we're lucky, we might spot a native goby ('o'opu) or shrimp ('ōpae).

The changes at 'Āao Valley are on-going. The natural processes of erosion continue to wear away the stream, even though stream flow has been reduced. The biological composition of the forest also changes as the old kukui fall and provide openings in the canopy for new plants. Human use of the valley brings its own changes, with improved trails, noxious vine removal, and the introduction (accidental and deliberate) of new species.

What will the Valley be like when today's fourth graders become tomorrow's teachers? Only time will tell, but our actions and decisions will be a factor. We encourage your group to record their memories of the day spent in the valley, and place them in a time capsule to help tomorrow's generation learn about the fascinating history of change in 'Āao Valley.

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Watersheds in Hawai'i

As streams carve valleys out of our shield volcanoes, they create watersheds, or distinct physical areas bounded by ridges, in which all water is eventually channeled to the ocean. Water that begins its journey clean can quickly pick up soil where ground cover has been disturbed, as well as animal wastes, leaf litter, human litter, and anything else not anchored to the ground. Stream water gathers downstream, often in neighborhoods and urban areas, where it picks up motor oil, soap suds, hubcaps, and the daily detritus of human activity. Storm drains feed streams and underground pipes, all of which eventually end up in the ocean.

Leeward areas can actually experience greater runoff and erosion, especially in places where ground cover has been removed or paved over. This is because most rainfall here occurs during a few heavy storms throughout the year; the soil rapidly becomes saturated during these events, causing most of the rainfall to run off.

Topography is another important factor, and can determine how much rainwater drains into the soil, and how much runs off. Topography also influences soil thickness: periodic landslides and regular erosion may prevent soil from becoming very deep on a steep slope, while a flat plain or valley floor may accumulate deep soils both formed on site and washed down from above.

Ground cover and soil structure influence the ease with which soil erodes. Roots and associated fungal mats from lawns, shrubs and trees help to hold soil in place during heavy rains. The layer of vegetation above the soil can also serve to protect the soil surface from heavy bombardment of raindrops. Conversely, unprotected weak, sterile soils are easily washed away.

Ground cover is another factor that should not be overlooked. Plants can affect the acidity of the soil, shade and moisture conditions, soil permeability and structure, organic content of the soil, and the types of decomposers present. Besides the main decomposers, bacteria and fungi, the animal decomposers we are likely to see at Round Top include roaches, beetles, springtails, millipedes, earthworms, and pill bugs. Also there are predators such as spiders and centipedes.

A human-related factor that affects permeability is land use: compacted dirt roads or heavily used trails are practically impermeable compared to the land around them. Human activities also directly influence erosion, ground cover, species composition, and many, many other aspects of the physical landscape.



Forest Encounters



Safety Concerns

While the stream is an exciting place to explore and discover, it does have its hazards. The most common concern is that children will become too rambunctious on the wet rocks and slip and hurt themselves. Our teaching staff will review the rules for stream conduct before we go out. If a child fails to heed safety concerns, s/he will be asked to remain on the bank.

Flash floods are another risk we are aware of. Staff are alert to the danger, and regularly monitor the stream. We will cancel the program if we judge flooding to be a concern. If the stream begins to rise quickly while we are on the bank, an emergency whistle will be used to call students away from the water and up to higher ground.

Leptospirosis is a less visible, but equally serious danger. It is a viral infection carried in the wastes of mammals, including rats, mongooses, and pigs. People can contract the virus through open wounds, eyes, nose and mouth. Early symptoms are flu-like, but the illness can be fatal if left untreated! Children will be asked to inspect their hands for cuts before venturing into the stream. No one, under any circumstances, should drink the water.

Leptospirosis is a small risk when the stream is moving quickly... it is more of a danger when the water is shallow, warm, and stagnant. Muddy soil near the stream can also harbor the virus. It is very important that children do not put their fingers in their mouths, noses, or eyes, and that they wash their hands well before lunch!

Perhaps the most ferocious animals of the forest are centipedes, which often live under rocks or logs. They won't bite unless they are threatened or alarmed. In the nutrient cycle investigations, children inevitably find baby centipedes. Baby centipedes are not great danger to us because of their small size. Therefore, we allow children to carefully collect them in their bug boxes with their other findings. However, children are reminded of the dangers of adult centipedes and we ask that they be left alone! This is a very difficult rule for excited children to follow. It might help if you warn them ahead of time that centipede bites can be very painful, and that collecting adult centipedes is off limits.

The final, predictable danger in the forest is wind. It can appear still and calm on the forest floor, while in the canopy high above, limbs are flailing back and forth. Old or diseased trees can fall with little or no warning to those below! Programs will be canceled on very windy days.

Our staff and volunteers are well trained and are prepared to handle most emergencies with your help. All group leaders will carry a radio and first aid kits. No one on a Hawai'i Nature Center program has ever been bitten by a centipede, carried away by a flash flood, seriously injured, or has contracted leptospirosis. Safety is always our first concern, and the information presented here is included to make you aware of the dangers, and help us create a safe, successful program for your class. Please call our office if you have any additional concerns or suggestions.



SAMPLE LETTER TO PARENTS

Dear Parent:

On _____ our class will visit the Hawai'i Nature Center in 'Iao Valley on an environmental education field excursion. The students will help build a model of Maui, become Rangers along a mountain trail, interpret the fantastic view from the lookout, and collect and analyze data relating to forest health, watersheds, and land use. It will be a full day of outdoor activity. On the day of the field trip, please send your child to school with the following:

- *A full lunch with beverage
- *A water bottle on a strap or in its own small pack
- *Sneakers that can get muddy
- *Clothes that can get dirty
- *Rain gear with a hat or hood (a tailored plastic garbage bag will do) - optional
- *Sunscreen (optional)
- * Students should put on mosquito repellent at home before the field trip. Long sleeve shirts and long pants are the best protection. Mosquito repellents without DEET are available at drug stores but if parents want to use DEET, the recommended strength for children is 3 - 18%. Read labels before applying.
- *A good night's rest
- *A full stomach from a good breakfast

If you are joining us as a chaperone, you will need the same things as your child. We ask that in addition to looking out for everyone's safety, you help keep students engaged in the exciting process of discovery! Be aware that your attitude toward nature...including mud and mosquitoes, bugs and slugs...provides a role model for students. Please be as positive as you can. Thank you for agreeing to help out on this field trip; we hope it is as fun for you as it is for the keiki!

Hawai'i Nature Center reserves all rights to publish the photographs, video footage or letters of program participants, unless requested otherwise. We hope to have a fun, full day in the outdoors. Please call if you have any questions about the field trip.

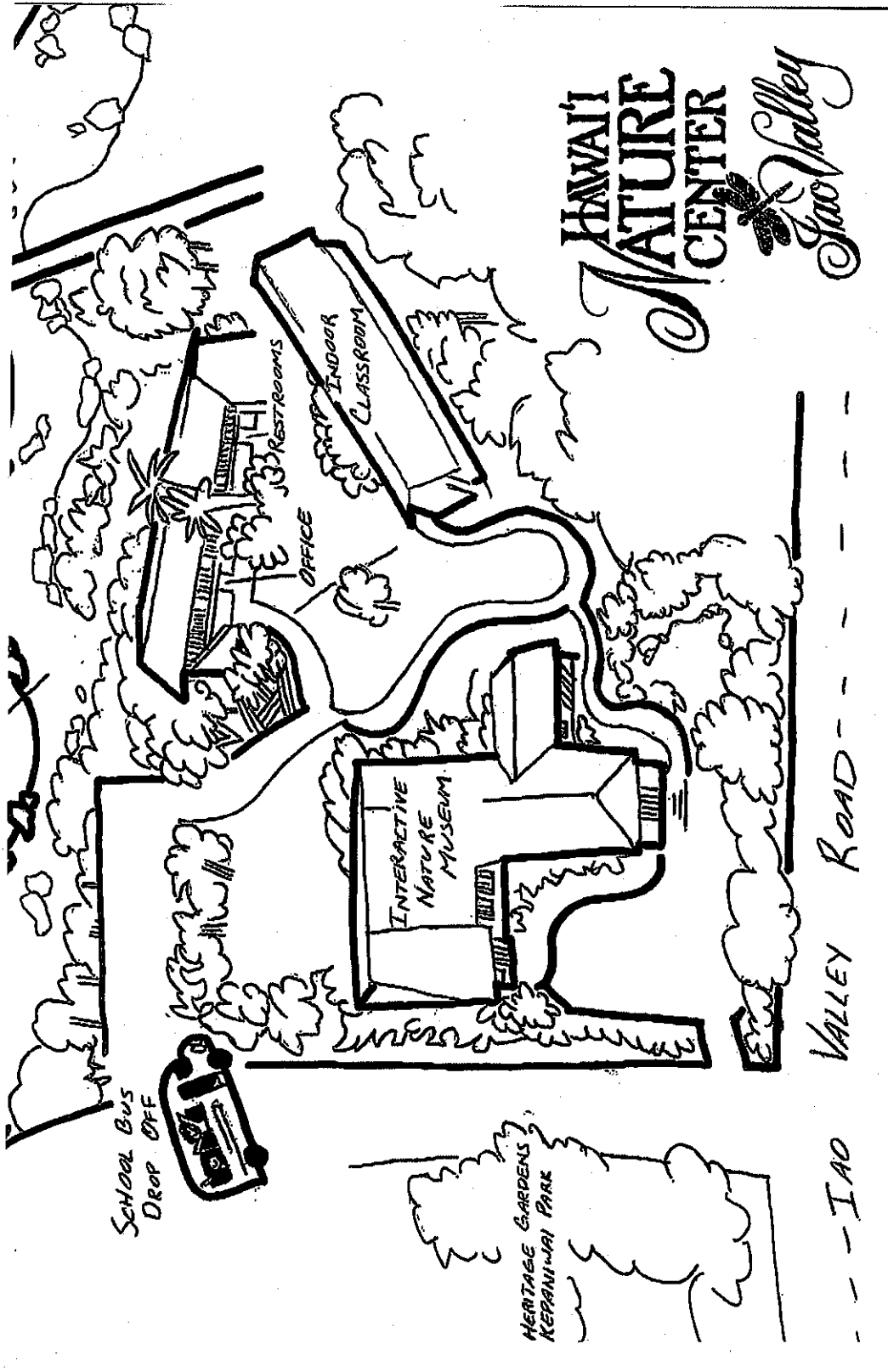
Aloha,

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Map to Field Site

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Recommended References

Hawai'i Nature Center
Environmental Education Field Program

BOOKS AND PUBLICATIONS

- Arrigoni, Ed. *Exploring Nature Safely*. Nature Safety Consultants, 1998. (This reference for educators includes tips on safety and first aid in the outdoors.)
- Blobaum, Cindy. *Geology Rocks: 50 hands-on Activities to Explore the Earth*. William Publishing, 1999. (Activities and questions challenge kids to consider geology in relation to things they use. Useful for teachers.)
- Carlson, Laurie. *Kid's Create*. Charlotte: Williamson Publishing Co., 1990. (Excellent resource of arts and crafts experiences for ages three to nine.)
- Collins, Martin. *Urban Ecology: A Teacher's Resource Book*. Cambridge University Press, 1984. (This terrific resource provides information on hundreds of organisms common in urban environments, including many of those found in the soil in Makiki, as well as school projects, research methods, and further reading suggestions.)
- Cuddihy, Linda W. and Charles P. Stone. *Alteration of Native Hawaiian Vegetation: Effects of Humans, Their Activities and Introductions*. University of Hawaii Press, 1993. (A good reference of how humans have impacted the native vegetation over the years. It also describes how certain human and animal behaviors have further changed the native vegetative habitat.)
- Culliney, John L. *Islands in a Far Sea*. Sierra Club Books, 1980. (This excellent adult reference provides a thorough, well-written account of Hawaiian natural history.)
- Deery, Ruth. *Earthquakes and Volcanoes*. Good Apple, Inc., 1998. (This children's activity book includes interesting comparisons of shield and composite volcanoes.)
- Demancehe, Sr., Edna. *Hawaii Nature Study Program*. (Curriculum Research and Development Group, 1995. Several books are included in this set, which provide background information and activity ideas for children.)
- Diehn, Gwen. *Geology Crafts for Kids*. Sterling Publications, 1998. (Fifty activities to help students learn about plate tectonics, continental drift, minerals, volcanoes, earthquakes and more.)
- Dunford, Betty. *The Hawaiians of Old*. Bess Press, 1987. (This book, which most fourth-graders can read, discusses the natural and cultural history of Hawaii.)
- Hawaii Audubon Society. *Hawaii's Birds*. Hawaii Audubon Society, 1997. (This easy-to-use guide includes color photos and descriptions of most of the birds we are likely to see in Hawaii.)
- Hawaiian Studies Curriculum Guide*. Hawaii State Department of Education, Office of Instructional, 1983. (Includes a wealth of information and activity ideas concerning Hawaiian geology, traditions, and uses of plants.)



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Hayashi, Leslie Ann. *Fables from the Sea*. UH Press, 2000.

Howarth, Francis G. and William Mull. *Hawaiian Insects and Their Kin*. University of Hawaii Press, 1992. (This is a handy teacher resource, filled with spectacular color photos of many native Hawaiian invertebrates.)

Kaopoiki, Stacey. *The Living Treasures of the Hawaiian Islands—The Story of Hawaii's Native Plants and Animals*. (This elementary level book gives a basic introduction to Hawaii native plants and animals, as well as Hawaii's threatened and endangered species.)

Kirch, Patrick V. *Feathered Gods and Fishhooks: An Introduction to Hawaiian Archaeology and Prehistory*. University of Hawaii Press, 1985. (Looks at the evolution of Hawaiian culture as found through archaeological studies.)

Krauss, Beatrice. *Planting a Hawaiian Ethnobotanical Garden*. Lyon Arboretum, 1980. (Provides suggestions for creating a cultivated Hawaiian landscape on the school grounds.)

Krull, Kathleen. *It's My Earth Too: How I Can Help the Earth Stay Alive*. Bantam Doubleday Dell Publishing Group, Inc., 1992. (A great children's book about what the Earth provides us, and how we can help the Earth.)

Lee, Robin. *Legends of the Hawaiian Forest*. Makapuu Press, 1980. (An excellent resource of old Hawaiian forest legends.)

Lee, Robin. *Legends of the Hawaiian Waters*. Makapu'u Press, 1998.

Macdonald, Gordan A., Abbot, Agatin T., and Frank L. Peterson. *Volcanoes in the Sea: The Geology of Hawaii*. University of Hawaii Press, 1983. (A comprehensive look at the geology of the Hawaiian Islands including volcanoes.)

McKenney, Michael P., Lorin T. Gill, David E. Coleman and Douglas A. Jordan. *Index to the Slide Bank of Hawaii's Native Biota*. Moanalua Gardens Foundation, 1989. (This collection of 200 slides of native and introduced plants and animals in Hawaii is available in regional libraries and school district offices. Topics include dispersal, adaptation, and wetlands.)

Mitchell, Donald. *Resource Units in Hawaiian Culture*. The Kamehameha Schools Press, 1982. (See Unit 9 for information about Hawaiian plants and their products.)

Nabham, Gary Paul and Stephen Trimble. *The Geography of Childhood: Why Children Need Wild Places*. Beacon Press, 1994. (This collection of essays written by two fathers and scientists reminds us of the importance of nature in childhood.)

Nagata, Kenneth. *How to Plant a Native Hawaiian Garden*. Hawaii State Office of Environmental Quality Control, 1992. (This publication, which outlines preparation, species selection, and propagation methods, is now available in all school libraries.)



- Nishida, Gordon M. and Joann M. Tenorio. *What Bit Me?* University of Hawaii Press, 1993. (Good reference on spiders, centipedes, roaches, mosquitoes, ants and many other invertebrates common in Hawaii.)
- O'Conner, Maura. *Call of Kolea*. Moanalua Gardens Foundation, 1992. (This story for students presents the marvels of various Hawaiian habitats, and includes a complete translation in Hawaiian! Complements the video "In the Middle of the Sea.")
- Ohia Project Grades 4-6*. B.P. Bishop Museum and Moanalua Gardens Foundation, 1990. (Hands-on activities addressing our unique Hawaiian environment are combined with extensive background information in this easy-to-use volume.)
- Orr, Katherine and David Boynton. *Discover Hawaii: Natural Forests*. Island Heritage, 2000. (This book discusses how plants, animals, and insects got here, and where they are established in the forest.)
- Orr, Katherine and Mauiola Cook. *Discover Hawaii: Birth by Fire Volcanoes*. Island Heritage, 2000. (This book provides a good overview of the geologic formation of Hawaii, island erosion, and how plants and animals arrived.)
- Parker, Steve. *The Random House Book of How Nature Works*. Grisewood and Dempsey Limited, 1993. (The subtitle of this book—an illustrated guide to the inner workings of plants and animals and how they struggle to survive on earth—sums up the aim of this colorful, easy to read reference.)
- Pomerantz, Charlotte. *The Day They Parachuted Cats on Borneo*. Young Scott Books, 1971. (This children's book—written as a play—is based on a true story, and brings home the ecological impact of introducing new species to an ecosystem.)
- Selsam, Millicent E. *Birth of an Island*. Harper and Row, 1959. (This children's story brings the formation of a Hawaiian island to life!)
- Siy, Alexandra. *Hawaiian Islands*. Dillon Press, 1991. (This excellent reference for children includes information about Hawaiian geology, geography, plants and animals.)
- Williams, Julie Stewart. *From the Mountains to the Sea*. Kamehameha Shoals Press, 1997. (A book about the early Hawaiian life.)

**WORLD WIDE WEB**

- City and County of Honolulu Recycling. www.opala.org (Provides information and guidelines for taking care of garbage and recycling.)
- EPA Global Warming Website. www.epa.gov/globalwarming (Includes global warming impact statements for Hawaii.)
- Groundwater Foundation. www.groundwater.org (Kids Corner has information about groundwater for children.)



Hawaiian Volcano Observatory. www.hvo.wr.usgs.gov (Includes history as well as daily updated information on Kilauea and Mauna Loa volcanoes.)

The Nature Conservancy of Hawaii. www.tnc-hawaii.org (Has general information of the natural history of Hawaii.)

Hawaii's Quality Extension Program. www2.ctahr.hawaii.edu/wq (Water quality extension programs in Hawaii, including the HAPPI project.)

Water Science for Schools. www.ga.usgs.gov/edu (An informational website on many aspects of water, along with pictures, data, maps, and an interactive center to give opinions and test water knowledge.)

Hawaii Department of Land and Natural Resources. www.state.hi.us/dlnr/Welcome.html (News and information about environmental issues in Hawaii.)

Moanalua Gardens Foundation. www.mgf-hawaii.com (Resources about natural Hawaiian history.)

Waikiki Aquarium. www.mic.hawaii.edu/aquarium (Information and links about marine life.)



VIDEOS

After the Warming. Maryland Public Television, two videos. (Episode I discusses how life on Earth has historically been affected by changing weather patterns. Episode II traces various ways humans could respond to global warming, deforestation and changing)

Hawaii: Strangers in Paradise. National Geographic, 1991. (This made-for-television video portrays the magnificence of the Hawaiian environment along with all the environmental challenges we face. Adults are the intended audience, but the spectacular footage makes it valuable for children as well.)

Hawaiian Wilderness. Time-Life films, 1981. (A beautiful presentation of animals, especially birds and insects, found in Hawaii. Explains how Hawaii was formed from molten lava rocks.)

Inside Hawaiian Volcanoes. Smithsonian Institution, 25 min., 1989. (Very thorough look at volcano research and how the Hawaiian Islands came to be.)

It's Everybody's Business. Board of Water Supply, 1985. (Explains why we must value fresh water in Hawaii and includes background on water systems in the islands. Available through the Hawaii State Library System)

Listen to the Fores. Eddie and Myrna Kamae, 1991. (Explores Hawaiian natural history from the perspective of Hawaiian cultural attitudes toward the forest. Includes excellent bird footage.)



Na Keiki o ka 'Aina. Na Maka o ka 'Aina, 28 min., 1994. (Actual footage of school children at Makaha Elementary School learning the value of malama 'aina, caring for the land that feeds them.)

Special Report: You Can Make a Difference. National Wildlife Federation, 1990. (This production for the Discovery Channel brings global issues to a personal perspective, addressing actions each of us can take to protect the environment.)

ETV, *Na Ki'i Hana No'eau Hawai'i*, No. 10. *Ke Kalo: The Taro*. Hawaii State Department of Education. (Looks at the role of taro in Hawaii, and the importance of freshwater to sustain it.)



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