INCREDIBLE INVERTEBRATES

Grade 4

ʻŌhiʻa Project / Exploring the Islands

Essential Questions

- How do a plant or animal's features and behaviors contribute to its survival in a particular habitat?
- Why does Hawaiʻi have so many unique plant and animal species?

Hawaiʻi DOE Content Standards and Performance Indicators

Science Domain II: Organisms and Development—Unity and Diversity

- Identify environmental needs of different organisms.
- Describe the structure and function in living things.

Science Domain II: Organisms and Development—Interdependence

- Give examples of organisms responding to a changing environment.

Science Domain I: Habits of Mind—Using Unifying Concepts and Themes

- MODEL: Uses geometric figures, number sequences, graphs, diagrams, sketches, number lines, maps, or stories to represent corresponding features of objects, events, and processes in the real world.

Key Concepts

- Descendents of successful plant and animal colonists adapted to the many habitats in the various zones of the Hawaiian Islands.
- The high number of endemic species in Hawaiʻi is due to the islands' isolation, both from afar and from neighboring islands, tradewinds, numerous predators, and the mountainous terrain with its many different habitats in close proximity.

Activity at a Glance

Students match implements to invertebrate mouth parts, complete an activity sheet about the adaptations of incredible Hawaiian invertebrates, and design a species that is adapted to a particular zone in the islands.

Exploring the Islands Telecast: "Forest Treasures"

Students from Na'alehu Elementary School on the island of Hawai'i visit an "enchanted" forest where they unravel the clues as to why there are so many unique plants and animals in Hawai'i.

Assessment

- Design an incredible plant or animal that is adapted to a zone in the Hawaiian Islands. (Use drawing or model.)
- Write a summary that describes:
  - the environmental needs of the plant or animal;
  - the organism's adaptations to its environment; and
  - how the organism could respond or adapt to a change in its environment. (Note that this is not an intellectual response but the survival of a mutation better suited to the change.)
- Present the model or drawing to the class and explain adaptations (structures and function).

Time

four class periods

Materials/Resources

student activity sheet (provided)
student information sheets (provided)
teacher answer sheet (provided)
syringe (available at drug stores)
pliers
sponge
party blower
scissors
" Forest Treasures" CD-ROM (optional, for extended activities)

During the *Exploring the Islands* telecast—one per student
"Forest Treasures" Map (provided)

Prerequisite

"From the Sea to the Mountains," Geography, Grade 4 (introduces vegetation zones covered in this activity)

Vocabulary

invertebrate, native, indigenous, endemic, isolation, predator, habitat, adaptation, microclimate

Teacher Background Information

The "incredible" invertebrates and forest "treasures" that are featured in this activity are a small sample of the fascinating native species that have evolved in Hawai'i. Approximately 99+ percent of native Hawaiian plants and animals are **endemic** or unique to the islands. Why do the Hawaiian Islands have such a high rate of endemism?

- The islands are extremely isolated, which limited the number of colonists and fostered evolution of new forms. The isolation also allowed a lot of time between arrivals.
- There is a predictable year-round climate.
- The high mountains have a number of different habitats in close proximity, which favors the survival of mutations.

Plants and animals that reached Hawai'i without human assistance are referred to as native. Those that evolved to be unique to Hawai'i, such as the happy-face spider, are endemic. Those that still occur in other areas, such as the 'iwa (frigate bird) that nests on the Hawaiian Islands and elsewhere in the Pacific are **indigenous**.

Descendents of native colonizing plants and animals adapted to the variety of ecological opportunities in Hawai'i. The stable Hawaiian climate, combined with a wide range of topography and elevation, creates a variety of vegetation zones including coastal areas, savanna, dry forest, rainforest, subalpine forest, alpine shrubland, and alpine desert. Within each of these zones are a variety of **habitats**, including rocks at the edge of the sea, cracks within barren lava flows, leaf axils in cool rainforests, or snow-covered cinder cones on alpine summits. This variety of habitats provides different **microclimates** within close proximity to one another, which has fostered evolution of new forms.

Scientists studying Hawaiian plants and animals have discovered that descendents of some species that were adapted to one environment gradually shifted to new environments. For example, some insects that were adapted to rainforest conditions were born with mutations such as blindness and loss of coloration. When these insects found suitable food in nearby lava tubes, over time they adapted to the mutations and selection to live only in these lava tubes.

Invertebrates—animals without backbones—have many fascinating **adaptations** to different habitats in the islands. Scientists believe that about 300–400 species of insects and their relatives (arthropods) and 22–24 species of snails originally reached the islands. Over millions of years, scientists estimate that 6,000–10,000 insects and spiders and approximately 1,060 snails have evolved from the original colonizing species. Ninety-nine percent of these terrestrial arthropods and snails are endemic or unique to Hawai'i!

Teaching Suggestions

1. Display the five implements to the class. Ask students to match these implements to mouthparts of some common insects. Introduce some of the uncommon invertebrates that have similar mouthparts.

Implement	Common Invertebrates	Native Invertebrates
syringe	mosquito—females use their needle-like mouths to pierce skin and suck blood.	wēkiu bug—uses needle-like mouthpart to suck body fluids from dead or dying insects stunned by the cold on Mauna Kea. The ʻaʻā bug lives on Mauna Loa.
syringe	spider—has hypodermic needle-like fangs to inject digestive fluids into their prey.	happy face spider—mouthparts typical of spiders.
pliers (held sideways)	crickets—jaws move from side to side as they tear and chew food.	lava crickets—jaws move like normal crickets.
sponge	housefly—soaks up liquids with its sponge-like mouth and then pumps food into its stomach.	pomace fly—soaks up liquids like common housefly.
party blower	butterfly – uses long, thin, coiled tongue to suck up nectar and other liquids.	Pulelehua (Kamehameha butterfly)—has typical butterfly mouthparts.
scissors	damselfly – uses scissor-like mouthparts to cut prey into bite-size pieces.	Pinao ula (native damselfly)—has typical damselfly mouthparts.

2. Conduct a discussion about adaptations and invertebrates.

   Discussion Questions
   - What is the difference between an invertebrate and a vertebrate? (A vertebrates has a backbone; an invertebrate does not.)
   - What are some examples of an invertebrate? A vertebrate?
   - Why do animals have adaptations? (Differences in body form and behavior enable animals to survive in various habitats.)

3. Review the vegetation zones in the Geography lesson, "From the Sea to the Mountains."

Ask students to hypothesize why the vegetation zones from the sea to the mountaintops are important to plants and animals. (They will find out why during the telecast.)

4. Distribute the "Forest Treasures" maps and watch the *Exploring the Islands* telecast.

During the *Exploring the Islands* Telecast "Forest Treasures"

Mystery Minute Question for this week

Ancestors had them when to these islands they came.
Without them their descendents were fair game
To introduced grazers and predators.
What are they?

MindPower Minute Questions/Tasks

- Flightless, stinkless or thornless are we. On isolated islands this came to be. What was missing here—do you see?
- Without mountains we'd be few. Differences in temperature and rainfall too, create conditions each of us need. Who are we?

Student Activities

Complete the "Forest Treasures" map by filling in the clues.

Give the television instructor, Norbert, a makeover, turning him into a super-incredible-Hawaiian invertebrate adapted to a given environment.

Mahalo to…

Na'alehu Elementary School for assisting with *Exploring the Islands*!
Teacher: Doris Boushey
Students: Derek Chevillon, Darin Dennis, Chandi Dockstadie, Karen Estabilio, Allie Holminski

5. Divide the class into small groups and distribute the student activity and information sheets. Ask students to work together and read the descriptions aloud and discuss each animal's adaptations to its environment. Have groups complete the activity sheet. Then review and discuss their answers.

6. Ask students to complete the assessment activities and share their work with the class. Note that this is not an intellectual response but the survival of a mutation better suited to the change.

Extended Activities

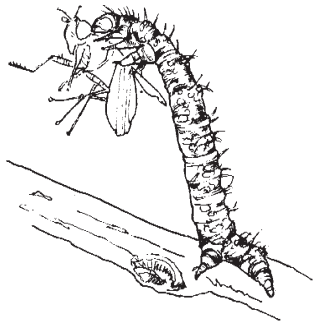
- Provide some clothing and other objects that students could use to "adapt" one of their classmates to a particular zone.

- Encourage students to research other native species to discover unique adaptations to habitats. Students could produce multimedia forest stories about these species using the "Forest Treasures" CD-ROM (see mgf-hawaii.com). The CD features native Hawaiian species and has a Storytelling feature that enables students to use the color photographs, videos, and animal sounds to create their own multimedia stories.

- Take students on an invertebrate hunt in the schoolyard. Look for invertebrates under stones and logs, in shrubs, and in leaf litter. Where are the most invertebrates found? Have students determine how each animal's size and coloration are adaptations to individual habitats.

- Have students research Hawaiian proverbs, *ʻōlelo noʻeau*, that they could relate to invertebrates and the study of their mouth parts. For example, *Waha koʻu* (*lit.* clucking mouth, refers to one who talks too much).

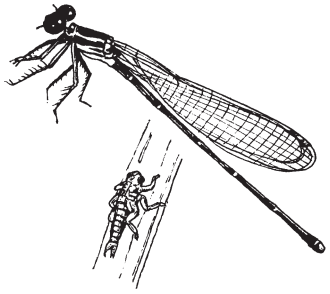
Carnivorous Caterpillar



There are more than 100,000 different kinds of caterpillars in the world. Almost all eat plant leaves. There are very few meat-eating caterpillars (carnivores) in the world. The only caterpillars that actually ambush their prey live in the Hawaiian Islands. The carnivorous caterpillar perches on a leaf, twig, or trunk in forests and shrublands and waits for food. Its powerful rear "legs" help it hold on. When an insect touches the hairs or skin on the rear of the caterpillar, the caterpillar swings the top of its body around and in 1/10 of a second grabs the insect. A second set of forceful claws attack the intruder. Hopefully, whatever is caught will be a tasty meal, such as a native fly or spider.

So great is this caterpillar's strength that it often seizes prey greater than its own weight. The caterpillar eats the prey as it struggles to escape! Don't think you can fool a carnivorous caterpillar by offering it a dead bug. The caterpillar will not touch it. Only a live meal will do!

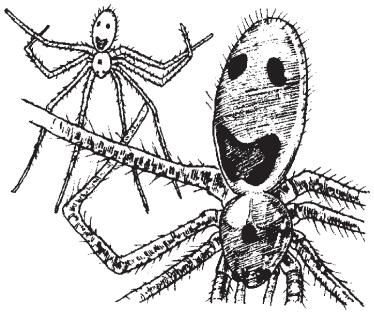
Damselfly



Most young damselflies (naiads) in the world live and grow in streams and ponds. In Hawai'i many damselflies live on land, in axils of rainforest plants, wet rocks, or in streams or ponds. The adults of some lay their eggs in the moist litter that collects between leaves and stems of native plants, or in slits in a leaf. The young damselflies have tails and breathing body parts to help them survive on land. Hawaiian damselflies have another rare adaptation. They play possum! That is, they will pretend they are dead when threatened, just like an opossum will. When a shadow passes over a damselfly, it will fold its wings and drop to the ground as if it were dead. Scientists believe this may prevent birds from eating the damselfly!

The adult damselfly catches its food in midair. It holds its front feet together to form an insect-catching basket. The naiad's lower jaw is hinged to open wide for a tasty meal. Damselflies that lay eggs in forest plants are unique to Hawai'i.

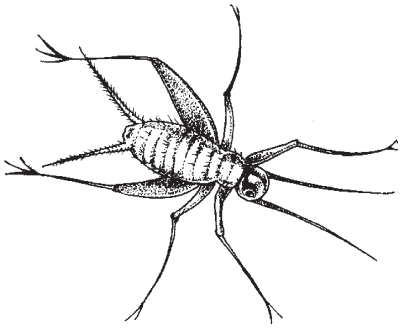
Happy-Face Spider



Happy-face spiders live under leaves in the rainforest. When the sun shines through their green leaf "roofs," their yellow color and their happy-face markings make them nearly invisible to predators. These marks vary on different spiders. One spider can look as if it is grinning and its neighbor can look like it is surprised. But these marks are not on the spider's face, they're on the back of its abdomen. The variety of marks probably fools birds and other predators that can't learn to recognize the happy-face spiders.

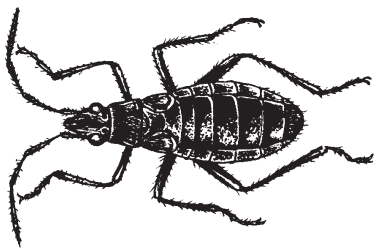
Female happy-face spiders are among the few spiders in the world that care for their young. After her eggs hatch, the mother spider feeds and cares for her children for several months. When she detects a small fly moving on her flimsy cobweb, the mother spider creeps close enough to throw more web to catch the fly. Scientists believe new kinds of happy-face spiders may develop one day.

Lava Cricket



Lava crickets live on fresh lava flows. They have adapted from life among wet rocks at the beach (their cousin is the beach cricket) to the hot rocks of fresh lava flows. They drink only fresh water. Lava crickets move onto smooth pāhoehoe lava flows within a month after an eruption! They abandon an area within 20–100 years, when the barren lava flow becomes covered with plants. They spend their days in the cracks of lava flows and gather their food at night. The strong winds that blow over the lava bring them insects and other small creatures to eat. Food and water get trapped in holes in lava rocks. A tasty meal to a lava cricket is one that has been cooked by the heat of a warm lava flow! Unlike many other types of crickets, lava crickets are wingless and they do not "sing."

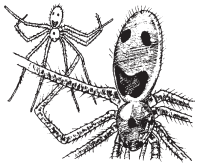
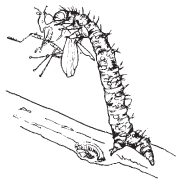
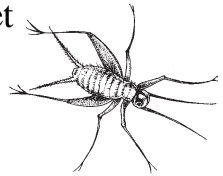
Wēkiu Bug



How can an insect possibly survive on an extremely cold, frozen and windy mountain top in the alpine desert? The wēkiu bug does! Its black body absorbs the warmth of the sun and also blocks out the sun's harsh rays. The wēkiu bug also has an anti-freeze chemical in its body. It has long black legs to hold it off the cold ground and it takes advantage of warm places. Unlike its close relatives, which have wings and can fly, the wēkiu bug is wingless and flightless. The closest relatives of the wēkiu bug are seed eaters, but the wēkiu are predators. Wēkiu bugs are adapted to sipping the body fluids of dead and nearly dead insects that are blown up the barren slops of Mauna Kea. When these windblown insects reach the cold mountaintops, they freeze. Wēkiu bugs are most active during the summer months when the mountain snows are melting. They go to the wet rock zones of melting snow to get water. A close relative, the ʻaʻā bug, lives in a similar manner on Mauna Loa.

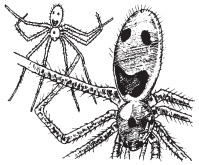
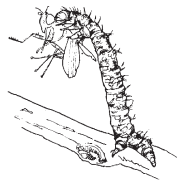
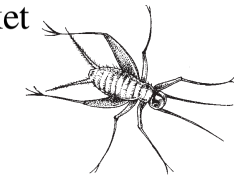
Incredible Invertebrates — Student Activity Sheet

After reading the information about our incredible Hawaiian invertebrates, fill in the boxes below to describe where the animal lives and how it is adapted to live there. On a separate page, design an incredible plant or animal that is adapted to an island zone.

	ZONE	HABITAT	ADAPTATIONS
Wēkiu Bug 			
Happy-face Spider 			
Damselfy Naiad 			
Carnivorous Caterpillar 			
Lava Cricket 			

Incredible Invertebrates — Teacher Answer Sheet

After reading the information about our incredible Hawaiian invertebrates, fill in the boxes below to describe where the animal lives and how it is adapted to live there. On a separate page, design an incredible plant or animal that is adapted to an island zone.

	ZONE	HABITAT	ADAPTATIONS
Wēkiu Bug 	Alpine desert	Rocks near snow (freezing conditions)	Black body to absorb heat and stay warm, long legs, wingless, and anti-freeze chemical in body
Happy-face Spider 	Rainforest	Under leaves	Coloration/variety of body patterns as camouflage, throws web to catch food
Damselfy Naiad 	Rainforest	Moist leaf litter in leaf axils (base of leaves)	Adapted to breathe in water, ability to breathe in air, play possom to fool birds, naiad uses hinged jaw and adult uses legs to catch prey
Carnivorous Caterpillar 	Moist to dry forests and shrubland	Leaves and twigs	Camouflaged to look like twigs or leaves, powerful, big claws for catching and holding prey, scissors-like jaws for cutting prey
Lava Cricket 	Barren lava flows in a variety of zones	Cracks in barren lava flows	Nocturnal so it won't overheat or lose water, small to fit in cracks in lava, black color for camouflage