THE STREAM TEAM

Grade 4

ʻŌhiʻa Project / Exploring the Islands

Essential Questions

- What environmental conditions do stream organisms need in order to survive?
- How are the life cycles of native stream animals dependent upon the sea and the stream?

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—Cycle of Matter and Energy Flow
- Give examples where organisms are reproducing, growing, dying, and decaying.

Key Concepts

- Native Hawaiian stream animals are adapted to various environmental conditions in their habitats.
- Many native Hawaiian stream animals spend the early part of their life cycle as larvae in the ocean, and then return to a stream where they mature and reproduce.

Activity at a Glance

Students make paper "body parts" of native stream animals that illustrate the animals' adaptations for survival. The body parts are used in a game where students role-play the animal's movement from the stream to the sea and back to the stream in their life cycle.

Exploring the Islands Telecast: "Hawaiian Stream Scene"

Students from Mililani Uka Elementary School participate in an exploration of Hawaiian streams. The program "travels" from the edge of the ocean up to the top of waterfalls to learn about the unique freshwater animals of Hawaiʻi, their fascinating life cycles, and some adaptations that allow them to live in unusual habitats. Students learn firsthand how to draw an *ʻoʻopu* (native goby fish) from wildlife artist, Patrick Ching.

Assessment

Students:

- Draw a native stream animal and identify the function of one body structure that helps it adapt to the stream environment.
- Illustrate the life cycle of the stream animal and write a description of the environmental needs in its different habitats.

Time

four–five class periods

Materials/Resources

stream life cards (provided)
life cycle sheets (provided)
game instruction sheet (provided)
3 small boxes
scissors
construction paper
colored markers
masking tape or chalk
3 skeins of yarn, 3 different colors
90 index cards (4 in. x 6 in.)
glue
"Flowing to the Sea" video (optional)

During the *Exploring the Islands* telecast—one per student
drawing paper
pencil and eraser
MindPower Minute sheets 1 and 2 (provided)

Preparation

Locate a large site, preferably outdoors, to play The Stream Team game. Mark off the boundaries with tape or chalk (or use natural features at your site) to approximate the diagram on the game instructions sheet.

Vocabulary

habitat, life cycle, diadromous, larvae, *ʻoʻopu*, *hīhīwai*, *ʻōpae*

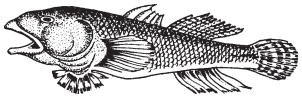
Teacher Background Information

How could freshwater animals survive the oceanic crossing to reach the streams of Hawaiʻi? Understanding the **life cycle** of native stream organisms is the key to understanding how they colonized Hawaiian streams. Scientists believe that the ancestors of our freshwater

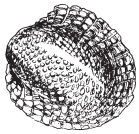
fishes, prawns and snails were probably marine. These marine species evolved to colonize fresh-water streams in the western Pacific, but still spent their larval stage in the sea. The tiny **larvae** of a few species then dispersed through ocean currents and arrived at the mouths of streams in the isolated Hawaiian Islands. Those animals that have not evolved into new species since their arrival are called **indigenous**; those that evolved into new species are **endemic** or unique to Hawai‘i.

Almost all of our large native stream species have **adapted** to the freshwater environment, but they have never lost their dependence on the sea. The larvae of native stream fishes and some invertebrates (snails and prawns) are swept downstream into the sea soon after hatching. The amount of time spent at sea is unknown for most species and may range from three weeks to seven months. But all species return to a stream as young adults. There is no evidence to suggest that these organisms return to the stream of their birth.

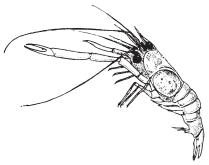
Goby (*‘o‘opu*)—Five species of freshwater gobies or *‘o‘opu* live in Hawaiian streams. Four of these fish are true gobies. They have fused pelvic fins, which they use like a suction cup to cling to rocks and climb up the face of steep waterfalls as they make their way upstream from the sea. The fifth species is a closely related fish that lacks the fused pelvic fin. The most common is the ***‘o‘opu nākea***, which is featured in this activity. Additional information about *‘o‘opu* and the other stream animals is included in the life cycle sheets.



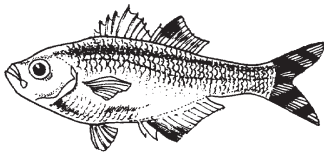
Snail (*hīhīwai*)—The *hīhīwai* is one of two endemic stream snails. It is not related to *‘opihi*, but its rounded black shell rather resembles that of pipipi that lives on rocks in the surf. The other native snail, the hapawai, lives in brackish water near the mouth of streams. Like the *‘o‘opu*, the *hīhīwai* makes its way upstream after developing into a young adult in the sea.



Prawn (*‘ōpae ‘oeha‘a*)—The *‘ōpae ‘oeha‘a* has one large claw. This distinguishes it from the introduced Tahitian prawn that has two claws of equal size. The *‘ōpae ‘oeha‘a* goes through several **molts** in its life cycle and sheds its skin with each molt.

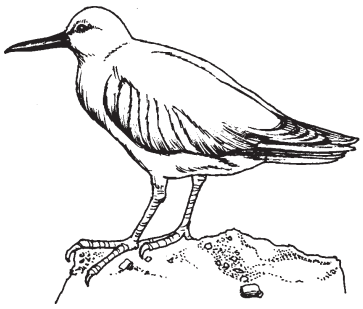


Āholehole—As this endemic fish matures, its habitat is opposite that of native stream animals; as a young fish it is commonly found in streams, as an adult it lives in brackish water or in the ocean.



Wandering Tattler (‘ūlili)—The *‘ūlili* is a migratory bird that spends winters on the main Hawaiian Islands. It feeds on *hīhīwai* by taking the snails to boulders near the stream and piercing their shells with its long beak.

Damselfly (*pinao*)—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 young damselflies have tails and breathing body parts to help them survive on land. Hawaiian damselflies have a 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! Damselflies that lay eggs in forest plants are unique to Hawai‘i.



Dragonfly (*pinao*)—This endemic insect lives in streams and wetlands and a variety of environments. It feeds on spiders, stream or wetland fish, and invertebrates. The Giant Hawaiian Dragonfly has a 15-cm (6-in.) wingspan.

Many Hawaiian streams are channelized, polluted or diverted as stream water is used for human needs. Due to these changes and the introduction of non-native streamlife, many unique Hawaiian stream animals are becoming rare. Conservation of healthy streams is essential to protect native species.

Teaching Suggestions

Introducing Stream Organisms

1. If possible, show the video, “Flowing to the Sea,” which includes footage of all the animals in this lesson. Divide the class into six groups. Give each group some index cards, a set of stream life cards, and information from the reverse side of the cards.

2. Ask students to match each picture with the correct description. Have them color the animal and glue the pictures and information onto index cards. (Save these cards for use in the “Stream Sojourn” activity.)

3. Have students take turns presenting their cards to the class. Assemble the cards into groups of endemic, indigenous and introduced species.

4. Ask students to hypothesize how native (endemic and indigenous) stream animals could have reached Hawai‘i. (Discuss their ideas and clarify that the animals floated to the islands as larvae.)

Life Cycles

5. Introduce the concept of life cycles. Distribute one life cycle sheet to each group of students and ask one student to read the sheet to other group members.

6. Distribute art materials and ask students to create a "body part" for the adult or young adult stage of the animal based on the information presented in the life cycle sheets. The body part should represent an adaptation for the animal's survival, such as a muscular foot or a shell for the snail, a claw or hard shell of the prawn, and a "suction cup" fin for the *ʻoʻopu*.

7. Ask groups of students to present the body parts they have created and see if their classmates can determine how each body part helps the animal to survive. Keep these body parts for later use in the Stream Team game.

8. Distribute the drawing materials and MindPower Minute activity sheets and watch the *Exploring the Islands* telecast.

During the *Exploring the Islands* Telecast
"Hawaiian Stream Scene"

Mystery Minute **Question for this week**

I like fresh water, I like the sea.
in both habitats you'll find me.
On plants I dine.
and animals suit me fine.
Who am I?

MindPower Minute **Questions/Tasks**

- What animals live in lower reaches of streams and what conditions do they need to survive?
- What environmental conditions do animals in middle and upper reaches of streams need to survive?

Student Activities

- Complete student activity sheets.
- Draw an *ʻoʻopu* (goby fish) along with wildlife artist Patrick Ching.

Mahalo to…

Mililani Uka Elementary School for assisting with *Exploring the Islands!*
Teachers: Pat Arakawa, Kathy Sproles
Students: Mariah Chao, Aaron Ibnao, Asia Mescan, Noah Ogata

9. Conduct a discussion to review what students have learned about stream animals.

Discussion Questions

What are some adaptations of stream animals that enable them to live in freshwater streams?
- What is a life cycle?
- What is unique about the life cycles of native stream animals?

10. Play the Stream Team Game. See Game Instructions included with this activity.

11. After playing the game generate a class discussion.

Discussion Questions

- How did these native stream animals reach Hawai‘i?
- What could keep native stream animals from making their way back upstream?
- How would your animal's body part help it to make its way upstream?
- Why do you think the eyes of the *‘o‘opu* are near the top of its head?
- How might your animal be affected if there was a drought and the streams no longer flowed to the sea?
- How do you think tiny stream animals in the ocean find streams?

12. Ask students to demonstrate what they have learned by completing the assessment activity.

Extended Activities

- Visit a natural healthy stream and have students observe and record the animals' adaptations for survival, such as claws, coloration and shells. Refer to the "Stream Sojourn" activity in this unit.

- Have students write captions for the *‘o‘opu* drawings they have created and display their work for others in the school to see.

- Investigate how human actions are affecting the life cycles of native stream animals. See "Swimming Upstream," in this unit. Have students search for articles in newspapers or magazines that describe these changes. Ask students to summarize the articles and describe their reactions to human impacts.

- Combine the stream life cards with plant and animals cards in "Dispersal Bingo" and have students practice grouping the cards into categories of endemic, indigenous, and introduced species.

Objectives

- *āholehole*: to tag as many stream larvae as possible
- *ʻūlili*: to tag as many *āholehole* and stream larvae as possible
- larvae: to enter the sea, obtain an adult body part and return to the stream without being caught.

Players

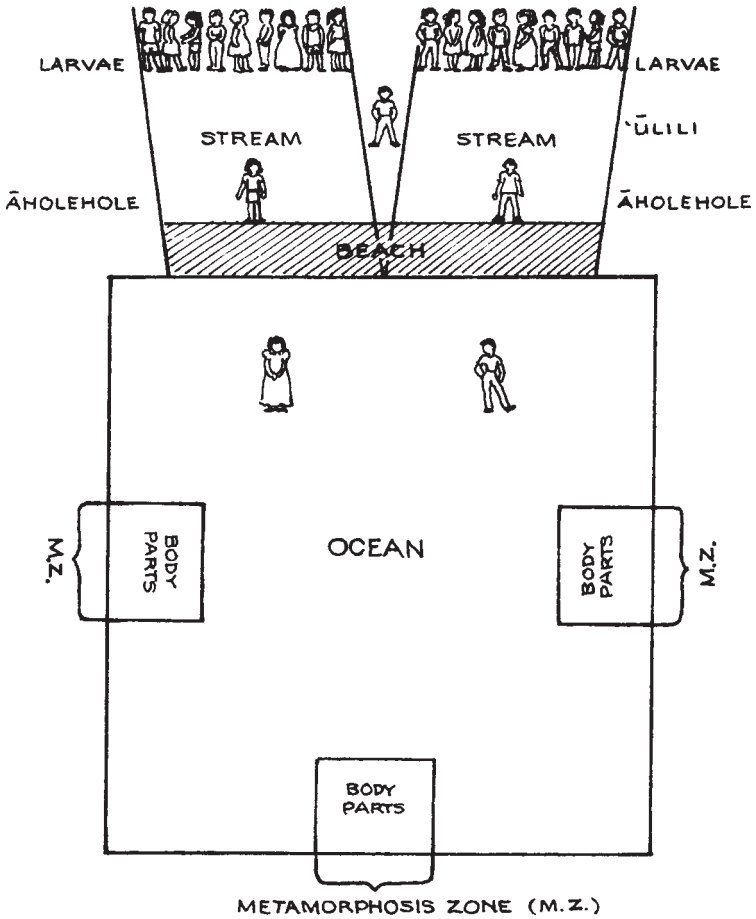
larvae (prey): 7 snails
7 prawns
7 gobies

predators: 2 *āholehole* (fish in stream)
1 *ʻūlili* (bird)
2 *āholehole* (fish in the ocean)

If there are more than 26 students in your class, add more prey to the game.

Game Setup

Place a box with body parts for each kind of animal in each of the three metamorphosis zones. Tie a different colored piece of yarn around the arms of students to identify larvae, āholehole and *ʻūlili*.



How to Play

Larvae

1. Larvae must make their way downstream, stay in the stream boundaries and avoid being eaten (tagged) by the *āholehole* in the stream. The larvae must make their way through the surf zone (beach) and into the ocean.

2. Once in the ocean, the larvae must change into their young adult form by finding an appropriate body part in one of the metamorphosis zones. These are safety zones where larvae cannot be eaten.

3. If a larva cannot find the appropriate body part, it must try another zone. A larva needs only one body part before making its way back upstream.

4. Once a larva has obtained a new body part, it may stay in the metamorphosis zone for only ten more seconds and it cannot return to these zones.

5. Once an animal is eaten it goes to one of the metamorphosis zones and helps monitor how long larvae stay in these zones.

6. After they have their new body parts, the animals make their way up into either of the streams. On their way upstream, the animals are large enough to be seen by the ʻūlili bird. The ʻūlili can catch them in the surf zone or in the stream. The larvae must also try to avoid the āholehole if it is still in the stream.

Āholehole

7. The *āholehole* stream predators live in the downstream area and must not leave the stream as they try to tag larvae.

8. The *āholehole* in the sea can come up into the surf zone as they try to catch larvae, but they risk being eaten by *ʻūlili* birds when they are in the surf.

ʻŪlili

9. The *ʻūlili* must hop on one foot as it moves from one stream to another and into the surf zone to catch *āholehole*.

10. *ʻŪlili* cannot see the tiny larvae coming downstream and will not eat them. It cannot go beyond the surf zone.

11. The *ʻūlili* may eat the prawn, snail or goby while they are holding their body parts and are in the surf zone or coming back upstream.

To End the Game

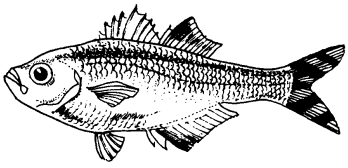
Larvae that return to the starting point in the stream with the correct body parts will become adults. The game ends when all larvae have been tagged or have become adults.

Variations

- The teacher can halt the game and announce that one of the streams has been diverted to water sugarcane, so all larvae must return to the other stream.
- The number of predators could be increased to equal the number of larvae.
- Lack of rain could cause the connection between the streams and the sea to become dry, so that no larvae can make their way upstream. These larvae would then die.

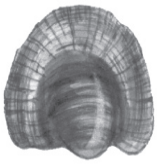
MINDPOWER MINUTE #1

In the Lower Reaches of Hawaiian Streams

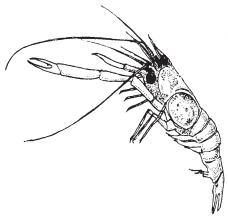


āholehole

ʻoʻopu ʻakupa



hapawai



ʻōpae ʻoehaʻa

ʻoʻopu naniha

ENVIRONMENTAL CONDITIONS: What conditions do animals in the lower reaches of Hawaiian streams need to survive?

The Hawaiian Stream Scene

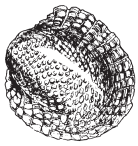
MINDPOWER MINUTE #2

In the Middle and Upper Reaches of Hawaiian Streams

ʻoʻopu alamoʻo

ʻōpaekalaʻole

ʻoʻopu nākea



hīhīwai

ʻoʻopu nōpili

ADAPTATIONS: Circle the three strongest climbers.
What adaptations enable stream animals to climb to high elevation pools?

ENVIRONMENTAL CONDITIONS: What environmental conditions do animals in middle and upper reaches of streams need to survive?