ANCHIALINE PONDS

Concepts
As good scientists, students will learn more details about their study species, ‘opae ‘ula. They will learn the different stages of the shrimp’s life cycle and be exposed to the process of gradual development. They will also notice the threats and challenges this species faces in order to survive long enough to reproduce.

HCPS III Benchmarks
SC.K.1.2
SC.K.5.1

Duration
1 hour

Source Material
MARE
FOSS
PRISM
Other

Vocabulary
Crustacean
Introduced
Predator
Larvae
Life-cycle

‘Opae Obstacles

Summary

In this lesson, students will act as ‘opae ‘ula at different stages of life. An obstacle course will begin at the egg stage and students will make their way through each step (larvae, post larvae, juvenile, adult). Each stage will use a different mode of locomotion, which students will enact. Props will be used to represent their food resources and eggs.

Objectives

- Students will learn about each stage of the ‘opae ‘ula life cycle.
- Students will enact the developmental stages and the tasks ‘opae ‘ula conduct throughout their life cycle. By the loop set-up of the course, students will realize the cyclic nature of reproduction.

Materials

1 “snack size” plastic bag per student
1 hat or helmet
1 picture or hand puppet to represent a fish predator
1 parachute (if available from Physical Edu. Dept.) or a bedsheet
1 bowl or bucket
1 red cape (piece of red fabric) or jacket to symbolize the new shell
Signs with stakes to label each stage on the course (Eggs, Larve, Post-larve, Juvenile, Adult)
2 balls (soccer-ball size) or use several hacky sacks if available
6 orange cones or markers
1 crawl tunnel or makeshift tunnel
2 hula hoops
1 bag of green dried peas (represents algae)
Several yellow balloons filled with water

Extension Activity (Life Cycle Wheel) materials (per student):

1 Life Cycle Wheel template pages (2 pages)
1 brass fastener
2 pieces of 8.5 x 11” tag board
Glue stick

Making Connections

At this point in the unit, students are familiar with the behavior and anatomy of ‘opae ‘ula. Students will learn more about this unique crustacean and how it reproduces. Knowing the life cycle of a species is crucial to its conservation, and students will talk about the effects of introduced species and loss of habitat on the ‘opae ‘ula life cycle.

Teacher Prep for Activity

Construct the circular obstacle course set up outside prior to class. (See diagram attached of set up). Make sure you have all props and recreational equipment. Gather materials for the extension activity.

Background

Some **crustaceans** including spiny lobsters and crabs have a large number of eggs that are held in the swimmerets beneath the muscular tail. Often the eggs are released to be part of the floating plankton that drifts with the currents. While they produce a very large number of eggs, in nature, relatively few of the hatchlings, or **larvae** survive. In contrast, ‘opae ‘ula have relatively few eggs (10 to 20) but with a high hatch and survival rate. These eggs are brooded for about 38 days under the body of the female, near the swimmerets. Researchers have noticed that these “berried females” typically stay in dark, sheltered places during brooding. Once eggs hatch, free-swimming larvae are produced. These larvae will molt, or shed their shells 4 to 5 times before the megalopal stage (post-larval) of development. After two weeks, the megalopal larvae transform into juveniles, which increase in length until they are full adults. The main differences between juveniles and adults are size and the ability to breed (which comes with age). Adult ‘opae ‘ula females can reproduce more than once per year. Adults are known to live for up to 20 years. This entire process is called the **life-cycle**.

The introduction of non-native (**introduced**) species to anchialine ponds is the largest threat to ‘opae ‘ula. When ponds in Kona were first surveyed in 1971, only 15% of them contained non-native species. Today, over 95% of the ponds contain non-native species. Non-native fish species that prey upon ‘opae ‘ula include tilapia, top minnows, and gobies. Native fish **predators** include aholehole, and mullet. A rare carnivorous shrimp, *Metabetaeus lohena,* also preys upon ‘opae ‘ula. Another large threat to ‘opae ‘ula today is coastal development. Large shoreline resorts and housing developments throughout Hawai‘i have directly bulldozed the ponds for building sites. Other developments have indirectly disrupted pond chemistry by affecting the water table surrounding the ponds, brackish water cannot be maintained at a level that is optimal for ‘opae ‘ula survival. West Hawai‘i contains the most anchialine ponds in the State, and they are constantly threatened by development, invasive species, and groundwater pollutants from golf-course and agricultural fertilizer. Currently, anchialine ponds have no legal protection, although it is much needed for the conservation of this unique and fragile ecosystem.

Procedure

Part 1.

1. Introduce new vocabulary while inside the classroom and add them to the ongoing list. Show pictures of different developmental stages when you introduce the words (e.g. larvae). Encourage discussion about any new behaviors they have observed when looking at their habitat jars. The obstacle course should be set up already (see Obstacle Course diagram below).
2. Have students get in line and go outside to the obstacle course.
3. The first station represents larvae hatching out of the egg. The entire class will make the “mountain” with a parachute. This is when all students are under the parachute and sit on it to hold the perimeter in place, creating a dome. Then they will hatch one at a time and

get in line as larvae. IMPORTANT: Have students go through the course one at a time, so it does not become a race!

4. At the larvae station, the students will need to make a swimming motion while carrying one water balloon (yolk sac) under his/her chin all the way to the post-larvae station where they'll gently place their water balloon down. HINT: Have other students cheer on each student as they swim to the other station. Have students say "Go, larvae go!" to remind them of what stage they are demonstrating.
5. At the post-larvae station, students will put on the antennae hat. This represents the fact that post-larvae is when ʻopae ʻula begin growing their antennae. (Go, post-larve, go!)
6. Next, at the juvenile station, the student will forage on algae by crawling to the rock and pick one bag of green peas from the rock. The student must keep the food bag with them for the rest of the course. They continue crawling until they receive a new red shell (the red cape). Have the student put on the red cape.
7. They have finally become adults! At the adult station, the student will molt its shell and remove the red cape. Then, they will have to walk with a ball or hacky sacks (eggs) in their hands. A predator fish (played by the teacher or assistant using a fish puppet) will come at them, and they must try to keep the ball and the bag of food. The ʻopae ʻula will crawl into the tunnel, but it must always keep the ball or egg in its hands!
8. Once the ʻopae ʻula makes it to the "end" of the tunnel they will notice they're actually at the beginning of the cycle again by the parachute. They have made it around the life cycle!

Part 2.

GROUP DISCUSSION: Have the class sit outside in a circle for the discussion. Here are some discussion-starter questions :

1. Let's name the steps of the life cycle. First we started as…….then……etc. (Start them with leading phrases and point at the obstacle stations to remind them).
2. What parts of the life cycle did you find to be easy?
3. What parts of the life cycle were more challenging? Why?
4. What threats do ʻopae ʻula encounter during their life cycle?

Remind the class that all of the fish predators were introduced to the ponds. Ask the class:

1. Are introduced species good or bad for anchialine ponds?
2. How do you think these animals got into the ponds? (*Some were domesticated species that were placed there, some were introduced for aquaculture or harvesting purposes, and supposedly seabirds have been seen to accidentally drop their tilapia "catches" into anchialine ponds)*
3. Is development near the shore good or bad for the ponds?
4. What can you do to protect anchialine ponds and ʻopae ʻula?

Assessments

Class discussion after the game and listing of the stages

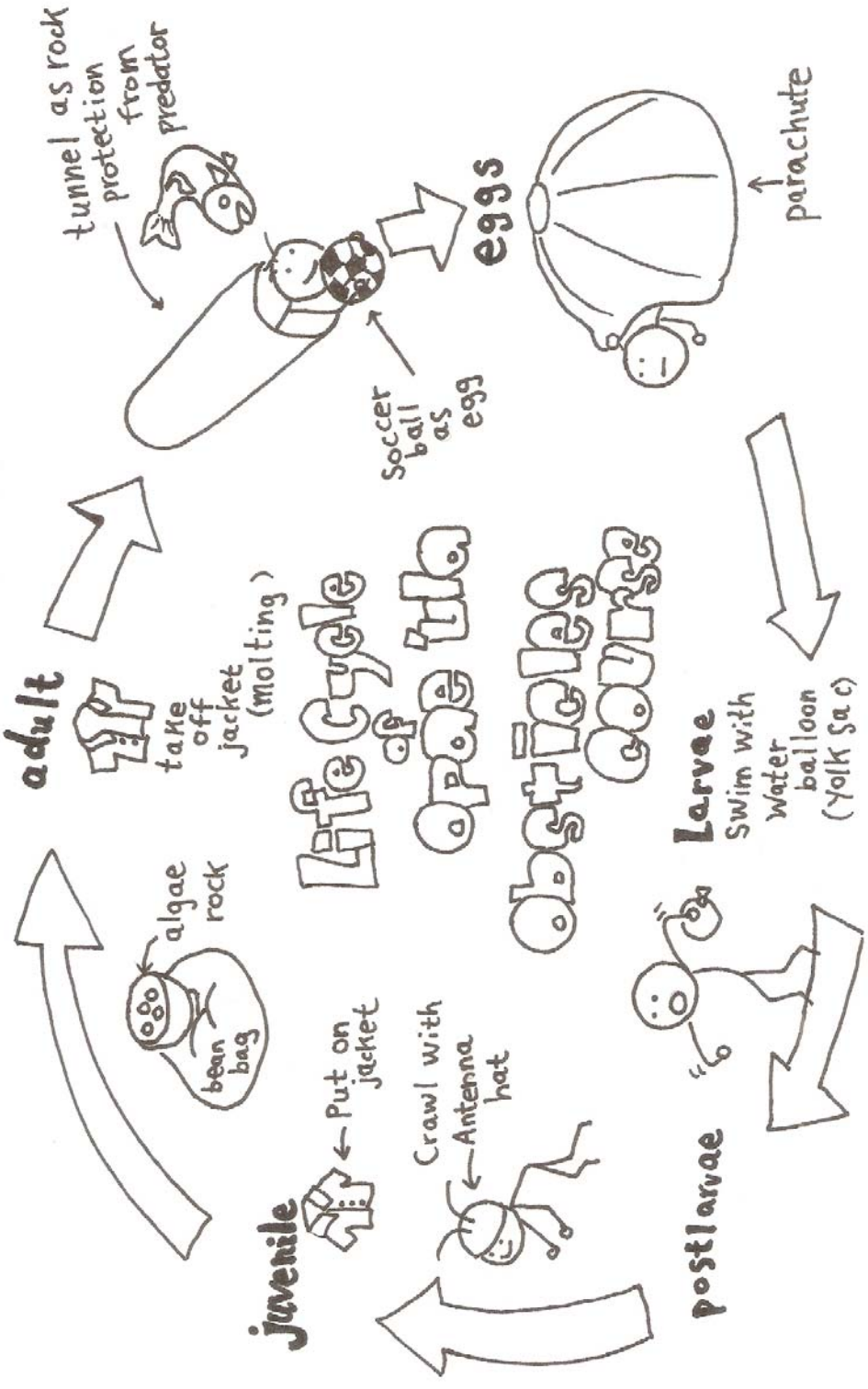
Resources

Project Aquatic Wild (Hawaii supplement)
Sandy Shores Curriculum (PRISM)
http://www.fukubonsai.com/M-L2c1.html

Extension Activity: Art Connection

Students may color in the ‘opae ‘ula stages on the life cycle wheel (see page 2 of “ ‘Opae ‘ula Life Cycle Wheel” document). They will cut out the colored life cycle and glue it to construction paper or tag board (thicker paper). Then, students will cut out the wheel cover (see page 3 of “Opae ‘ula Life Cycle Wheel” document) and the teacher will help students place a round-headed brass fastener in the middle. This creates a life cycle wheel that rotates to reveal one stage of the ‘opae ‘ula life cycle at a time. This activity will reinforce what the students enacted in the life cycle obstacle course and they can use it as a reference to recall the stages in the near future.

Obstacle Course Diagram:



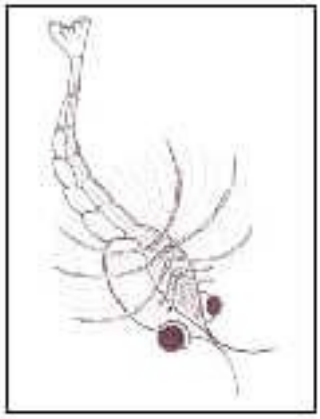
Supplemental materials:

‘OPAE ‘ULA LIFE CYCLE

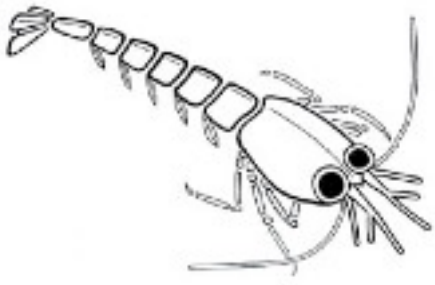
1. Molting. After molting an adult female is able to receive the sperm from males.

2. Eggs. A “berried female” ‘opae ‘ula with everal eggs. She will brood for 30-38 days before larvae hatch.

3. **Larvae.** The larvae are only about 1/8” long. They do not have developed appendages and survive on yolk sac. This stage lasts about 13-15 days.



4. **Post-Larvae.** This stage is also called the megalopal stage. Larvae develop swimming legs and begin feeding on algae.



5. **Juvenile.** Antennae are still growing at this stage and feeding is very important in order to grow to adult length. After 7 weeks, juveniles usually become adults.

6. **Adult.** Once adult, ‘opae ‘ula are about ½” in length. They are viable for reproduction and females can reproduce more than one time per year. Adults can live up to 20 years if a proper habitat is available.

All photos from Fukubonsai.com: http://www.fukubonsai.com/M-L2c1.html

LIFE CYCLE DIAGRAM: