A‘ama and Pipipi Adaptations

Summary
Students will learn more about two ocean grazers, Black Nerite snails (pipipi) and Sally Light-foot crabs (a‘ama). They will focus on the different adaptations (structures and functions) these creatures have evolved for living in their specific ocean ecosystems. Students will use websites to conduct research, view video clips and read newspaper articles.

Objectives
- Students will be able to identify and talk about several structures on each of the ocean grazers discussed.
- Students will be immersed in the concepts of structure and function.

Materials
Pipipi Exploration
Copy of each of the (2) Pipipi worksheets per student

A‘ama Examination
Copy of each per student: A‘ama Weblink Story, A‘ama Worksheet and A‘ama Diagram
At least one computer to watch the Snap! NBC A‘ama video clip (or one computer per two students) for answering worksheet questions

Making Connections
As always, the beginning of any lesson is a great time to recall previous knowledge and review relevant vocabulary words. Open a dialogue with the class by asking, “Have any of you seen an a‘ama crab or pipipi snail?” or “Where can a‘ama crabs be found?”.

Teacher Prep for Activity
There is not too much teacher preparation required for this lesson plan. However, copies need to be made for each of the two activity periods. For the Pipipi Exploration, print one of each the Pipipi Worksheet and make one copy each per student. For the A‘ama Examination, print one of each: (1) A‘ama Diagram, (2) A‘ama worksheet, and (3) A‘ama Story, and make one copy each per student. The A‘ama worksheet and A‘ama Weblink Story can be copied on double-sided sheets of paper.

Concepts
Students will continue to focus on the connection between structure and function and begin to make inferences about creatures they haven’t studied.

HCPS III Benchmarks
SC 3.1.1 SC 3.5.1
SC 3.4.1 LA 3.1.5
SC 3.3.1

Duration
(2) 1-hour activities

Source Material
EnchantedLearning.com
PRISM
NBC13.com Snap!

Vocabulary
Antennae
Cheliped
Eyestalk
Scavenger
Symbiosis
Walking legs
**Background**
Crabs, including the a`ama or Sally Lightfooted crab are brachyurans, or the “true crabs” of the crustaceans. Most marine arthropods are crustaceans, examples of which include lobsters, shrimp, hermit crabs, copepods, mysids, crabs, and cladocerans (water fleas). All crabs have bilateral symmetry (same on one side as they are the other), are composed of segments, and structures/appendages found in pairs. They have a carapace (a shell that covers the head/thorax) and a rostrum (front of carapace with spike-like projection). Their eyes are on stalks and they also have two sets of sensory antennae.

They belong to the Order Decapoda, which means “ten legged.” Crabs are flattened from top to bottom (depressed) like a flounder. Their first pairs of appendages have claws and are called chelipeds. In addition, their last pair of legs are considered walking legs and are one of the main differences between crabs and lobsters. Crabs are slow-growing creatures, and because they live in a hard, fitted exoskeleton they must molt when they grow. To do this, a`ama cling onto the rock with their front legs and back out of their old skeletons, leaving them behind. The red crab-looking bits that are commonly found the on rocky shoreline in Hawai‘i are actually neglected exoskeletons (or molts) of a`ama but not the real-life crab (that is black).

- **FUN FACTS:** Crabs can either grow OR shrink during a molt but can only change by ≤10% of their body size in either direction!
- **FUN FACTS:** It takes about 1 – 2 days for new shells to harden.

John Steinbeck writes about them (in the *Log from the Sea of Cortez*):
Many people have spoken at length of the Sally Lightfoots. In fact, everyone who has seen them has been delighted with them. The very name they are called by reflects the delight of the name. These little crabs, with brilliant cloisonné carapaces, walk on their tiptoes, They have remarkable eyes and an extremely fast reaction time. In spite of the fact that they swarm on the rocks at the Cape [San Lucas], and to a less degree inside the Gulf [of California], they are exceedingly hard to catch. They seem to be able to run in any of four directions; but more than this, perhaps because of their rapid reaction time, they appear to read the mind of their hunter. They escape the long-handled net, anticipating from what direction it is coming. If you walk slowly, they move slowly ahead of you in droves. If you hurry, they hurry. When you plunge at them, they seem to disappear in a puff of blue smoke—at any rate, they disappear. It is impossible to creep up on them. They are very beautiful, with clear brilliant colors, red and blues and warm browns....Man reacts peculiarly but consistently in his relationship with Sally Lightfoot. His tendency eventually is to scream curses, to hurl himself at them, and to come up foaming with rage and bruised all over his chest. Thus, Tiny, leaping forward, slipped and fell and hurt his arm. He never forgot nor forgave his enemy. From then on he attacked Lightfoots by every foul means he could contrive and a training in Monterey street fighting has equipped him well for this kind of battle. He hurled rocks at them; he smashed at them with boards; and he even considered poisoning them. Eventually we did catch a few Sallys, but we think they were the halt and the blind, the simpletons of their species. With reasonably well-balanced and non-neurotic Lightfoots we stood no chance.


The Black Nerite Snail, or the Hawaiian endemic pipipi snail is one of the most common marine snails in Hawai‘i. Pipipi tend to aggregate in large groups just above the water level,
preferring smooth (pahoehoe) rocks to rough (a‘a) counterparts. They are typically about a centimeter in size. Pipipi may bunch together in groups for “protection in numbers” from their predators (e.g. large carnivorous snails, aquarium collectors). Like all gastropods (including their ‘opihio cousin), they have a muscular foot to move around and stick to their rock substrate, tentacles with eyespots to glean information about the environment they live in, a mouth with a radula (toothed tongue) to scrape algae off the rocks, and a shell to protect their soft insides. However, in addition, marine snails like the pipipi have an operculum or lid-like cover for their shell. This picture of pipipi is available at:

http://www.aecos.com/CPIE/inv_04.html

Vocabulary

**Antennae** – Paired appendages or organs that usually extend from the head of an organism and yield information about its environment via senses such as touch, heat, smell, vibration, and taste (which varies by species); singular → antenna. Crustaceans, such as a’ama crabs, have two pairs of antennae.

**Cheliped** – A curved, pointed appendage, such as the pinching structure of a crab. Literally cheliped means “claw foot.” It is the first pair of thoracic appendages (with pinching claws).

**Eyestalk** – In some organisms, like certain crustaceans like crabs, eyes are extended on stalks and located in between two pairs of sensory antennae.

**Scavenger** – An animal or organism that feeds on dead organic matter.

**Symbiosis** – A relationship between two things that is beneficial for both. A good example of this within our Ocean Grazers curriculum is the algal gardening involving the Pacific Gregory fish and its patch of algae. This territorial fish will guard and “garden” its algae garden such that no other fish can eat it. Therefore, it keeps this resource to itself yet simultaneously allows it to grow more than it would outside this circle of protection.

**Walking legs** – In crabs, the last four pairs of segmented thoracic appendages evolved from swimming legs (as in lobsters) into walking legs with claws in order to grasp the surface they are moving on.

Procedure

**Activity 1. Pipipi Exploration (45 minutes)**

1. Pass out the first Pipipi Worksheet to each of the students.
2. Give them about 15 minutes to complete these drawings.
3. Share with the class – do a gallery walk if time allows.
4. Have a small discussion about pipipi snails and their structures.
5. Compare these to the other gastropod studied (‘opihio).
6. Lead the students, “Like the ‘opihio, pipipi snails have a shell, a mantle, tentacles, and a mouth with a radula … do you think they have a muscular foot?”
7. What would they use a muscular foot for (do they need to cling to rocks like an ‘opihio?) … ? (Yes, like an ‘opihio, pipipi snails need to grasp and cling to the rocks when waves come and threaten to wash them away.)
8. Pass out Pipipi Diagram #2 and have students draw another diagram after they’ve studied the creatures.
9. Allow 15 minutes or however long is necessary. Leave sufficient time for a discussion.

**Activity 2. A’ama Examination (1 hour)**

1. Hand out the A’ama Weblink Story to the students (OR teacher could have students log onto the Susan Scott web address directly).
2. Have the students take turns reading the story aloud to the class.
3. Clarify any obviously unfamiliar words during the reading.
4. Ask the students, “What does the a’ama crab eat?” and “Did you learn anything new?”
5. Give the definition of a scavenger (if it hasn’t already come up in previous discussions):
   Scavenger – An animal or organism that feeds on dead organic matter.
6. What other ocean grazers might be scavengers (opportunistic feeders)? – Answer: sea urchins! Even though both a’ama and sea urchins are primarily herbivorous, they will eat whatever they can find – and yes this does include sporadic dead animal matter.
7. Pass out the A’ama Diagram and A’ama Worksheet to the students.
8. Ask them to start with the A’ama Diagram and have them work individually or in partners to fill in the structure blanks with the word bank.
9. Make sure they discuss their answers with a classmate or two before moving onto the worksheet.
10. Tell them to use previous knowledge, or that from the Weblink Story, or other resources to answer the five questions on Part 3 of the worksheet (this includes the drawing).
11. Alternately, the teacher could give students the worksheet before the diagram so as to get their own renditions of the drawings (otherwise they might just copy the one from the handout!)
12. Discuss answers with the class (i.e., have them discuss their answers with classmates and the teacher). Avoid telling them what the answers should be.

Some additional inquiry-based probing questions to the students might be: What types of limu might an a’ama crab eat? What do the size and shape of their chelipeds tell us about their diet? (The size of their chelipeds fits nicely with their diet that consists primarily of small microfilamentous algae that can fit into their mouths and be grasped with their tiny little claws).

**Assessments**

There are no cumulative assessments in this lesson. The teacher can assess student learning from the A’ama Worksheet and by performing Vocabulary tests and quizzes.

**Resources**

Crabs
- Kamehameha Schools – 8th-grade Interactive Websites

Ocean Watch Article
- [http://susanscott.net/OceanWatch1998/jul06-98.html](http://susanscott.net/OceanWatch1998/jul06-98.html)
Pipipi Snails
- [http://www.fukubonsai.com/M-L1n.html](http://www.fukubonsai.com/M-L1n.html)
- [http://www.wetwebmedia.com/gastropo.htm](http://www.wetwebmedia.com/gastropo.htm)

**Extension Activities**
One fairly easy thing to do would be to bring in some pipipi in a plastic bin (with sea water) to the period for Activity 1 and ask students to complete the initial worksheet before they’ve seen the critters up close and finish Diagram #2 after the fact. ***NOTE*** ***If pipipi were already brought in for the Ocean Grazers lab this is not necessary – however, it is always more fun to have live animals in class.*** Pipipi are fairly hardy creatures and can withstand movement to and from the ocean and classroom better than some of the other grazers. Just be sure to keep pipipi in an aerated container (or change seawater every couple of hours to maintain sufficient dissolved oxygen in the water) and return them to the shoreline as soon as possible. Where feasible, fill the container part-way (a couple of inches) with seawater and include a rock with limu (to emulate natural environment).

**Culture/Art/Math/Literature Connections**
None.
Hawaiian Sea Snail (Pipipi)

Read the following statements and draw a diagram of the pipipi.

- Pipipi can be found in bunches, out of the water in cracks and rocks.
- Pipipi shells are black with spiral lines.
- A pipipi shell is attached to his back.
- Pipipi have tentacles with eyes.
- Pipipi have a radula, muscular foot, and a mantle.
- Pipipi have slimy suction - this type of suction allows them to stick and crawl upside down 😊
Now that you know a little more about pipipi snails, draw another diagram that is a little more detailed than the first...
Name:____________________  Date: ____________

A'ama Crabs

I. Read the article.

II. Answer the following questions about the A'ama Crab. You may use other resources to answer the questions. (Internet, encyclopedias, books, etc.)

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<td>1. Environment: Where are a'ama crabs found?</td>
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<td>2. Eating Habits: What do a'ama crabs eat? What animal eats it?</td>
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<td>3. Description: Describe what an a'ama crab looks like...</td>
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<td>4. History: Tell me about the history of an a'ama crab.</td>
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5. Draw a picture of an a'ama crab and label its structures.

Q: What is each structure’s function? Take a guess...

- Gills
- Cheliped
- Eyestalk
- Mouth
- Antennae
- Flattened last pair of legs
Ocean Watch (by Susan Scott)


Hawaii’s a‘ama crabs help keep its shorelines clean

While boarding my sailboat in the Ala Wai Boat Harbor recently, I spotted a baby bird floating dead in the water. It was sad seeing that downy little body there in the ocean, but I shrugged it off to natural selection and went about my business.

A while later, when I was leaving the boat, I noticed some commotion at the water's edge. To my surprise, a rock crab, or a‘ama, was dragging the dead bird to a ledge near the waterline. No bigger than the bird itself, that crab tugged and hauled with amazing efficiency.

I watched for a while, then checked back a few hours later. The crab was gone and there wasn't a trace of the bird left. The little a‘ama had performed its recycling chores perfectly.

These little scavengers do a fine job of cleaning up Hawai‘i’s shorelines, but they have other uses too.

Not long after I moved here, a friend invited me to a baby luau. When I arrived at the party, I was shocked to see a row of spidery, black legs sticking out of the mouths of several children.

"They're eating a‘ama," a friend told me. "Good with salt, yeah? Try one."

"You eat the shell?"

He pried the back off a dead crab and sprinkled some coarse salt onto the crab's innards. "Like this," he said, popping the creature into his mouth.

I'm not one to turn up my nose at unusual foods, but slurping raw crab guts was where I drew the line. I didn't do it. However, I did enjoy watching the kids do it. They sucked on those crabs like they were lollipops.

Over the years, as I prowled Hawai‘i's beaches and shorelines, I found a‘ama nearly everywhere. These fast-running crabs are often at the top of the tideline on rocky shores, scavenging for just about anything they can find to eat, plant or animal, alive or dead.

In some places, it's common to find lovely crimson versions of Hawai‘i's a‘ama. These look like red,
dead crabs but they aren't. They're the molted shells of growing a'ama.

Examine one of these molts and you will find a paper-thin shell with a slit at the back. After reabsorbing much of the calcium from the old shell, the crab backs out and abandons it. The roomy new shell hardens soon after.

Their flat bodies and long legs are perfectly suited for life on Hawai‘i’s wave-battered shorelines. When a wave approaches, the crab grips its rock with the spines on its legs, then hunkers down for the onslaught.

Once, I spent an afternoon at a rocky beach in Lanai watching several big a'ama nibble a dead, wedged fish while being absolutely pounded by waves. The crabs held their ground just fine.

A'ama have some interesting predators. Once, near my boat slip, I saw a puffer fish lunge from the water and grab an a'ama that was basking near the edge. Another time, I watched a man catching the crabs with a simple tool that snags a'ama by the eyes.

In ancient Hawai‘i, a’ama was a sacred food for priests, but the crab had to be whole with no legs missing. Hawaiians also used a’ama to treat illnesses, and as sacrificial animals to persuade the gods to answer a request. Today, people use the crabs for both bait and food.

I love seeing the busy little a'ama scurrying around the rocks near my boat, but not everyone appreciates them. Once, while I fumbled with my gate key, a mainland friend gripped my arm. "Hurry," she said.

"Why?"

She looked down at the rocks and made a face.

"The rock crabs? They can't hurt you."

"Crabs?"

"They're called a'ama," I told her, as their dark bodies scurried over the rocks.

"Thank god," she breathed. "I thought they were tarantulas."
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A‘ama crab
(Grapsus tenuicrustatus)

Scientific Name: Grapsus tenuicrustatus

Common Names: Rock crab, Light-footed crab

Word Bank:
- Gills
- Carapace
- Cheliped
- Eyestalk
- Antennae
- Walking legs
- Mouth

Under carapace: