Animal Adaptations

Summary
Students will review some of the habitats they studied earlier in the curriculum and design an animal that is specially adapted to one of them. In doing so, they must relate particular adaptations to particular stresses in the environment. They will then consider how those adaptations might help or hinder the organism in a different habitat and how, given time, that organism might change to fit the new environment.

Objectives
- Students will be able to identify important environmental stresses and key biological adaptations that help organisms survive.

Materials
Animal Adaptations Worksheet (1 per student)
8 Habitat Summary Sheets (at least 2 sets per classroom)

Making Connections
Having studied different habitats and environmental conditions as well as the variation of body structures, behaviors, and life cycles found in Hawaii’s freshwater animals, the students must in this lab synthesize these topics by designing and evaluating a novel animal.

Teacher Prep for Activity
Copy one Animal Adaptations worksheet for each student. Print out at least 2 classroom sets of the habitat summary sheets. Review the worksheet and Habitat Summary sheets.

Background
No additional background is necessary.

Vocabulary
Stress – Environmental and biological stresses are characteristics of a place that influence what species can live there and how they can do it. For example, the only freshwater fish that can live in the steep streams along the Hamakua coast are those that can climb the waterfalls found along these streams. Similarly, anything living in an anchialine pond must be able to withstand the high water temperature as well as the brackish environment. While these stresses are obvious, many are more subtle. For example, the presence of a predator requires that potential prey have a means of escape.
Adaptation – An adaptation is a biological response to a stress that helps the animal survive. For example, the large waterfalls that are common along the Hamakua coast have driven some species, such as the native ‘o’opu, to develop special adaptations for climbing. Similarly, shallow slow-moving water quickly becomes low in oxygen and the apple snail has adapted to this stress by developing a supplemental lung (in addition to gills) and a snorkel extension to reach the water surface. While many adaptations are physical, some they can also be behavioral. For example, in response to the hot sun beating down on the shallow anchialine ponds, the native ‘opae’ula are behaviorally adapted to escape the heat by hiding in deep cracks in the lava where the water remains cool.

Procedure

Note: This lab is based primarily on the student handout and the students should be fairly independent.

1) Review vocabulary words and key concepts as a class. Both terms have been used before but will be covered in more detail in this lab so should be reviewed.

2) Remind the students of examples of adaptations and differences between species that they’ve seen in previous labs. Good examples are the fused sucker fins of the native ‘o’opu (which enables them to climb waterfalls) and the snorkel-like adaptation of the invasive apple snail (which, along with a simple lung, allows it to breath air in shallow oxygen-depleted water).

3) As a class, discuss some or all of the 8 habitats from the summary sheets with an emphasis of the important environmental factors of each.

4) Pass out a worksheet to each student and give a brief overview of the activity.

5) Have students begin and circulate as needed.

Assessments

Completion of the worksheet
Animal Adaptations

Name: _______________________

Date: _______________________

Period: _____________________

1) Pick a habitat from the list.

   High elevation pristine streams
   Low elevation pristine streams
   Anchialine ponds
   Abandoned water catchments
   Taro Fields
   Brackish river mouths
   Seasonal streams
   Polluted slow flowing streams

What did you choose? ___________________________

2) Describe this location by answering the following questions:

   What is the water temperature?

   Is it rocky or muddy?

   Are there large predators?

   Is it freshwater or brackish?

   Are there floods?

   Are there droughts?

   Is there anything else important about the place?
3) Now design an organism that would be well adapted to this habitat. Draw a picture below and describe the important adaptations. Be creative but keep it realistic.

4) Pick 3 characteristics about the habitat from question 1. Write them below and describe how your organism is specifically well adapted to deal with this stress

1-

2-

3-
Your organism is doing great in its habitat when suddenly a scientist studying adaptation catches it and moves it to a different habitat.

5) Pick a different habitat from the list.

Site: ____________________________

6) Describe this new habitat.

What is the water temperature?

Is it rocky or muddy?

Are there large predators?

Is it freshwater or brackish?

Are there floods?

Are there droughts?

Is there anything else important about the place?

7) How do you think your organism will do in this new place? Discuss the three adaptations that helped your organism in the previous habitat and whether or not they will help here.

Adaptation 1: ____________________________

How did this adaptation help in the original habitat?

Will this adaptation be useful in the new habitat? Why or why not?
Adaptation 2: ______________________

How did this adaptation help in the original habitat?

Will this adaptation be useful in the new habitat? Why or why not?

Adaptation 3: ______________________

How did this adaptation help in the original habitat?

Will this adaptation be useful in the new habitat? Why or why not?

8) Let’s suppose that your organism is able to survive in this new location. How do you think it might adapt over many generations to the different conditions?

9) Pick a real species that is similar in some way with the animal that you’ve created. Do they share any special adaptations? If not, describe how they deal differently with the same problems (escaping or hiding from predators, climbing waterfalls, etc).
High Elevation Pristine Streams

Description:
This is a relatively pristine portion of the stream. At 800 ft above sea level this would be considered middle elevation habitat but there are several large waterfalls below this point so only the best climbers can get here. This stream is prone to extreme flooding during storms and as a result there is very little mud or debris in the streambed. While it is primarily fast flowing even during periods of low flow, there are some slow moving portions.

Water Type: Fresh
Water Temperature: Cold
Flow Rate: Mostly high, some low flow areas
Substrate: Mostly rock
Large Predators: Some
Pollution Level: Low
Floodling: Common
Droughts: Rare
Connected to Ocean: Yes


Anchialine Ponds

**Description:**

Anchialine ponds are pools of water formed in depressions in lava rock. While they are primarily filled by rainwater and freshwater runoff from upslope, they are also connected to the ocean through cracks in the lava. As a result, the water in these ponds is a mixture of salt and fresh water, which is known as brackish. In may cases the water level, salinity (saltiness), and water temperature change dramatically with the tide and weather patterns. The native organisms that live here are specially adapted to these harsh circumstances and usually not found anywhere else. Only a few species can tolerate these conditions but at least one invasive fish has been introduced to many of these ponds.

**Water Type:** Brackish  
**Water Temperature:** Hot  
**Flow Rate:** None  
**Substrate:** Lava rock  
**Large Predators:** Yes, but only invasive species  
**Pollution Level:** Low  
**Flooding:** None  
**Drought:** Rare  
**Connected to Ocean:** No (except through very small cracks in the lava rock)
Seasonal streams

Description:
Seasonal streams are often completely dry during the summer and the streambed becomes grown over with grass (see picture 1). During the rainy season, however, there can be tremendous flow (see picture 2). There may be water in

**Water Type:** Fresh  
**Water Temperature:** Warm  
**Flow Rate:** Low to High  
**Substrate:** Mud  
**Large Predators:** None  
**Pollution Level:** High  
**Flooding:** Common  
**Drought:** Common  
**Connected to Ocean:** Sometimes

Picture 1

Picture 2
Low elevation Pristine Stream

Description:
This site is at the bottom of Honoli’i stream at about 50ft above sea level. There are no large waterfalls between here and the ocean but there are several small ones. The streambed is rocky due to periods of flooding and the main current is generally strong but more protected sections of water do exist.

Water Type: Fresh
Water Temperature: Cold
Flow Rate: Fast
Substrate: Rock
Large Predators: Yes
Pollution Level: Medium
Flooding: Common
Drought: Rare
Connected to Ocean: Always
Abandoned Water Catchments

Description:
People have been collecting rainwater in artificial water catchments in Hawaii for hundreds of years at least. Many of the early containers were made of wood and have decayed and the modern ones are covered, but others catchments open and can become habitat for freshwater species. These catchments are not connected to any streams and do not have any internal flow.

**Water Type:** Fresh  
**Water Temperature:** Warm  
**Flow Rate:** None  
**Substrate:** Wood, plastic, or metal  
**Large Predators:** None  
**Pollution Level:** Variable  
**Flooding:** None  
**Drought:** Common  
**Connection to Ocean:** Never
**Brackish River Mouths**

**Description:**
While streams and rivers are freshwater, when they meet the ocean (in a region known as the “mouth” of the river) the freshwater mixes with the salt water to create a stretch of brackish water. This area is too salty for most freshwater species and too fresh for most ocean species. However, some animals can handle this salinity and some species are so well adapted to these brackish areas that they don’t live anywhere else. With heavy flooding to carry out all dirt and debris, the streambed of most river mouths is primarily rock.

**Water Type:** Fresh and Brackish  
**Water Temperature:** Cold  
**Flow Rate:** Usually low  
**Substrate:** Rock  
**Large Predators:** Yes  
**Pollution Level:** Medium to High  
**Flooding:** Common  
**Drought:** None  
**Connected to Ocean:** Always
Polluted Slow-flowing Streams

Description:
Most natural streams and rivers in Hawaii are cold, fast flowing, and prone to massive flooding. However, humans have altered many streams so that they now are slow-flowing, which allows mud and silt to collect as well as allowing the water to warm in the sun. These areas are often highly polluted. These conditions are not hospitable to most native species but many invasive species can tolerate and even thrive in this habitat. In some areas the water is brackish due to the proximity of the ocean.

Water Type: Fresh and Brackish
Water Temperature: Warm
Flow Rate: Low
Substrate: Mud
Large Predators: Yes
Pollution Level: High
Flooding: Rare
Drought: None
Connected to Ocean: Always
Taro Fields

Description:
Wetland taro is grown in flooded fields called lo’i. The resulting habitat type is very different from most natural Hawaiian watersheds as fresh water is taken from steep, rocky, fast flowing streams and used to create shallow, muddy, slow-flowing pools.

Water Type: Fresh
Water Temperature: Warm
Flow Rate: Very low
Substrate: Mud
Large Predators: None
Pollution Level: High
Flooding: Very rare
Drought: Uncommon
Connected to Ocean: Yes but poorly