Hawaiian Bird Beak Adaptation Lab

Summary
Students will be introduced to the different types of bird beaks that Hawaiian birds have developed as adaptations to the different habitats in which they live. They will use tools that represent different beaks to learn which beak is better adapted to collect different food types in a certain amount of time.

Objectives
- Students will examine the relationship between a bird’s beak and its ability to find food and survive in a particular habitat.
- They will understand that Hawaiian birds have adapted physically to their food sources.
- Students will learn about different Hawaiian birds.
- Students will explore which beaks are more efficient for collecting foods by experimenting with different tools representing different beak types.
- Students will represent their data using bar graphs.
- Students will recognize the importance of multiple trials.

Materials
Plastic cups to represent bird stomach - will need one for each student.

Beak materials:
5-6 sets of chopsticks, 1 turkey baster, 1 nut cracker, 2 pliers, 4 tweezers, 2 medicine droppers, 1 Clothes pin, 2 rulers, 3 plastic spoons, 1 slotted spoon, 1 long snapping hair clip, 1 small hand strainer, and 3-4 straws to hold marshmallows and one straw for nectar

Food Materials:
Gummy worms, sunflower seeds, rice, small berries or sweet tart candies, marshmallows, Swedish gummy fish, oreo/graham cracker cookie crumbs (to represent soil), small twigs, water colored with food dye (can use clear if easier).
Three plastic graduated cylinders
2 Cookie Sheets or pans for sunflower seeds and rice
Plastic container to hold “soil” and worms
Bowls for holding water
Pictures of Birds
Bird Beaks Record Sheet (see below)
Challenge cards for each station (see below)

ADAPTATIONS

Concepts
Endemic Hawaiian birds are unique to Hawaii because they are only found here. Founder species that came to Hawaii were isolated for millions of years, and they had to physically adapt in order to survive in their new environments. Many Hawaiian birds, such as Hawaiian honeycreepers have different beak length and sizes in order to obtain food in their habitats.

HCPS III Benchmarks
SC 7.1.1
SC 7.1.2
SC 7.5.4

Duration
1 hour

Source Material
Adapted from
sciencenetlinks.com
& www.eduref.org
PRISM

Vocabulary
Adaptive radiation
Endemic
Founder species
Hawaiian
Honeycreepers
Making Connections
The students should be able to make connections to personal experiences, such as seeing a bird on the beach or in their backyard that was feeding on lehua nectar. This lesson introduces students to the idea of adaptation using a variety of native bird species. Hopefully, structure, function and adaptation are all concepts students may have also covered in previous years of science class.

Teacher Prep for Activity
• Make challenge cards (cut and paste from list below) to put at each station. If possible, these can be made on card stock and laminated, so they can be used again. The challenge cards state the scenario for each station.
• Xerox “Adaptations” reading and data sheet provided.
• Set up 8 workstations: 1 for each type of food source represented. Place the 3 different types of tools for each station.
  ✓ Station #1: Bird: Aeo
    Food Source: Gummy worms buried in cookie crumbs
    Tools: chopsticks, turkey baster, nutcracker
  ✓ Station #2: Bird: Palila
    Food Source: String beans and sunflower seeds scattered on cookie sheet
    Tools: pliers, chopsticks, tweezers
  ✓ Station #3: Bird: Iiwi
    Food Source: Colored water in a graduated cylinder (one for each student)
    Tools: Medicine dropper, straw (don’t suck up, use finger to stop the liquid), pliers
  ✓ Station #4: Bird: Elepaio
    Food Source: Rice spread out on cookie sheet (to represent insects)
    Tools: Tweezers, clothespin, medicine dropper
  ✓ Station #5: Bird: Nene
    Food Source: Small berries and grass (round sweet tarts work well too)
    Tools: 2 rulers held together, chopsticks, spoon
  ✓ Station #6: Bird: Albatross
    Food Source: Swedish gummy fish
    Tools: Chopsticks, long snapping hair clip, spoon
  ✓ Station #7: Bird: Koloa or Hawaiian Duck
    Food Source: Small twigs in a bowl of water
    Tools: Slotted spoon, tweezers, hand strainer
  ✓ Station #8: Bird: Io or Hawaiian Hawk
    Food Source: Marshmallows (skewered on a straw)
    Tools: Chopsticks, tweezers, spoon
• Place each challenge card and picture of corresponding bird at every station.

Background
Over time, animals change in order to fit the needs of their environment. The Hawaiian Islands are the most isolated archipelago on the planet, and due to millions of years of isolation, only a small amount of animals and plants have arrived here. Species arrived on the islands by only
three modes of transportation: wind, waves, and wings (the “three Ws”). All plant and animal species that are native or endemic to Hawaii descended from a small community of founder species. Hawaiian rain forests are home to several endemic species, such as Hawaiian birds and these species are unique to the islands. Most endemic forest birds belong to a group of birds known as Hawaiian honeycreepers. Scientists think all the honeycreepers evolved from a single finch species that colonized the islands 15 million years ago. Hawaiian endemic birds evolved and radiated into new species after they arrived to the islands from somewhere else. This is a process called adaptive radiation, which has resulted in many different honeycreepers adapted to various environments. One characteristic that can distinguish Hawaiian honeycreepers apart is their diverse bill shapes and lengths. There are also non-honeycreepers, such as a species of Flycatcher (the Elepaio) and a species of Hawk (the ‘Io) that are also endemic to Hawaii.

All birds have different beak shapes and sizes depending on what the bird eats and where that food is found. A bird’s beak is basically a lightweight, bony extension of the skull. Bird beaks are multi-functional tools used to gather and capture food, build nests, groom feathers and attack competitors.

**Procedure**

1) First have students read background information about Adaptations (Information follows)-this can be done in class or have students read the information for homework or the instructor can lecture on the material.

2) After students have completed the readings, ask the students what they know about adaptations. Explain that Hawaii is the most isolated archipelago in the world and how animal and plant species arrived here. Be sure the students understand species, such as Hawaiian honeycreepers filled different niches throughout Hawaii and adapted to their specialized habitats. Have them explain what it means if a species is endemic or indigenous. Pick at least three concepts that you will want the students to really remember such as: *What is adaptive radiation? What will happen if a species will not adapt to environment? What will happen if a habitat changes?*

3) Divide students into groups of three (one tool per student). If there are more students, add another station, or divide groups into four and have one of the students be responsible for timing the other students and writing down data. Have the students repeat what they did, but have the student who was the scorekeeper trade out with another student. Also, each student will keep the same beak throughout the lab. They should improve as they go along.

4) Have students go to their assigned station and have them read their challenge card.

5) Pass out record sheet.

6) Have each student write down a prediction on the worksheet provided.

7) Each student will be given 20 seconds to gather as much food as they can with the “beak” (tool) they have. They will put the food into their “stomach” (cup).

8) When the teacher says “Stop”, students empty their stomachs and count the number of items they collected. Record this amount on the Bird Beaks Record Sheet.

9) Repeat the trial 3 times and be sure students empty their stomachs after each round and record amount on their worksheet.

10) Students calculate the average amounts for each beak type and have each group construct a bar graph of their averages for each station. The three different bird beaks should be on the X-
axis and the average amount of food collected should be on the Y-axis. See sample bar graph below:

![Sample bar graph](image)

**Teacher Resources for this activity**

**Challenge Cards:**

Challenge #1 - You have been given gummy worms (to represent worms) as your food source. You have also been given sample beaks: 1) Chopsticks, 2) Turkey Baster, and 3) Nut cracker. Your challenge is to obtain as many gummy worms as you can that are buried in the soil within 20 seconds. Put your food in your stomach (cup). Repeat each trial 3 times and record the amount of food after each trial on your worksheet.

Challenge #2 - You have been given sunflower seeds (to represent seeds) as your food source. You have also been given sample beaks: 1) Pliers, 2) Chopsticks, and 3) Tweezers. Your challenge is to use each beak to crack the seed and remove the seed inside within 20 seconds. Put your food in your stomach (cup). Repeat each trial 3 times and record the amount of food after each trial on your worksheet.

Challenge #3 - You have been given colored water (to represent nectar) in a graduated cylinder. You have also been given sample beaks: 1) Medicine dropper, 2) Straw, and 3) Pliers. Your challenge is to use each beak to see how much water you can transfer to your stomach in 20 seconds. Repeat each trial 3 times and record the amount of food after each trial on your worksheet.

Challenge #4 - You have been given rice (to represent insects) as your food source. You have also been given sample beaks: 1) Tweezers, 2) Clothes Pin, and 3) Medicine Dropper. Your challenge is to use each beak and transfer as many pieces of rice to your stomach in 20 seconds. Repeat each trial 3 times and record the amount of food after each trial on your worksheet.

Challenge #5 - You have been given small berries or sweet tart candies that look like berries as your food source. You have also been given sample beaks: 1) 2 rulers held together, 2) Chopsticks, and 3) Spoon. Your challenge is to use each beak and transfer as many berries to your stomach in 20 seconds. Repeat each trial 3 times and record the amount of food after each trial on your worksheet.

Challenge #6 - You have been given Swedish gummy fish (to represent fish) as your food source. You have also been given sample beaks: 1) Chopsticks, 2) Long snapping hair clip, and 3)
spoon. Your challenge is to use each beak and transfer as many fish to your stomach in 20 seconds. Repeat each trial 3 times and record the amount of food after each trial on your worksheet.

Challenge #7 - You have been given small twigs (to represent small invertebrates) in water as your food source. You have also been given sample beaks: 1) Slotted spoon, 2) Tweezers, and 3) Small hand strainer. Your challenge is to use each beak and transfer as many twigs to your stomach in 20 seconds. Repeat each trial 3 times and record the amount of food after each trial on your worksheet.

Challenge #8 - You have been given Marshmallows on a straw (to represent small mammal) as your food source. You have also been given sample beaks: 1) Chopsticks, 2) Tweezers, and 3) Spoon. Your challenge is break apart the marshmallows and transfer as many marshmallows to your stomach in 20 seconds. Repeat each trial 3 times and record the amount of food after each trial on your worksheet.

Assessments
Journal writing
Bird Beak Data Sheet
Build a Hawaiian Bird Lesson

Resources
http://www.eduref.org/cgi-bin/printlessons.cgi/Virtual/Lessons/Science/Animals/ANM0016.html
www.sciencenetlinks.com/pdfs/birdbeaks_actsheet.pdf
http://www.hear.org/hoike/
Foss-Populations and Ecosystems

For ideas about forest habitats, the following website is a good start (pgs 7-11):
http://www.state.hi.us/dlnr/dofaw/kids/teach/forest%20activity%20guide.pdf
They can still use field guides and come up with questions that would be suitable for field research.

Great field guides to use as references on bird watching and plant identification are:
A pocket guide to Hawaii’s birds, H.D. Pratt and J. Jeffrey (~$9.00)
A pocket guide to Hawaii’s trees and shrubs, H.D. Pratt (~$10.00)

Extension Activities
If time prevails, students can switch stations after the first 3 trials and learn about different beak adaptations. If this is the case, then the worksheet should be extended to add more columns.

Also, take students on a field trip to different habitats where native birds might be found. For example, students could visit a rain forest such as Volcanoes National Park to see native birds such as the ‘Omao, Apapane and Hawaii Amakihi. Students could also visit a mesic forest like Pu‘u Wa‘a Wa‘a Forest Bird Sanctuary and observe birds like Akepa and Elepaio and in the Dry Land Forest of Pu‘u Wa‘a Wa‘a students may see Nene. If time prevails, take students on another field trip to a habitat that is completely different from the first one they visited.
A second field trip could be to the coastline, such as Kaloko-Honokohau National Historical Park for example. Students may see Ae’o and the Hawaiian Coot. It would be ideal if students had binoculars and field guides to see the birds up close. Discuss with students why birds live in different habitats (be sure to notice different food sources within each habitat). Ask what adaptations the birds have in order to survive in each of the habitats. This would be a good time to get the students thinking about what types of questions they could ask in order to conduct a scientific investigation in the field. For example, “How many invertebrates does an Ae’o collect in a certain amount of time”? How would they set that experiment up and how would they conduct it? They can write about it in a journal entry.

If a field trip is not possible, create a class simulation of a field trip. Before the students come to class, transform your classroom into a natural habitat. Get pictures of birds and plants that represent a particular habitat and hang on wall or an area of your choice. When the students come to class, explain to them which habitat they just encountered and have them walk around to see the different bird and plant pictures. Audio with bird songs could help improve this simulation.

**Culture/Art/Math/Literature Connections**

None.
Honeycreeper Poster
Bird Beak Lab Pictures

Hawaiian Black-necked Stilt

Photo: commons.wikimedia.org/wiki/Category:Ae

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Hawaiian Bird Beaks Lab

Photo: J. Jeffrey
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Hawaiian Bird Beaks Lab

Photo: P. Latourrette
Moli

Laysan Albatross

Photo: www.pbase.com/jpkin/image/54126096
Hawaiian Duck
Hawaiian Goose

Photo: www.aol.com/nationalgeographic.com
Partnerships for Reform through Investigative Science and Math

Hawaiian Bird Beaks Lab
Division of Forestry and Wildlife Bird Posters