Darwin’s Finches: Investigating Avian Beak Adaptations and Competition

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Scientific Theme(s):

Life Science
* Biodiversity & Natural history
* Adaptations
* Ecological Interactions

Grade Level(s):
* 6-8 (adaptable for 4-5 or 9-12)

Lesson Duration:
Two 1-hour class periods

Overview
One of Charles Darwin’s most famous observations while on his iconic journey aboard the HMS Beagle is the diversity of beak types in the finches found on the Galapagos Islands. He observed different species of finches on these islands and saw that, despite being closely related to each other evolutionarily, they exhibited vast diversity in their beak structures, from robust beaks specialized to eat seeds, to finer, more pointed beaks for eating insects. These birds and their adaptations to eating specific food types were key in the development of his theories of natural selection and evolution. In this lesson, students will model different beak types with household items to observe how a beak may be specialized for a certain type of food or multiple types of food. In addition, students will observe competition both within one species (individuals with the same type beak) and between species (individuals with different types of beaks) to further understand ecological interactions and their effects on populations.

Objectives
- Students will model bird beak adaptations using different household items
- Students will make predictions, record data, interpret results and write conclusions
- Students will investigate interspecific and intraspecific competition using models
- Students will be able to explain the effects of interspecific and intraspecific competitions on populations

Grade Level Expectations (GLEs) Addressed

The student demonstrates an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms by
[3] SC2.1 sorting animals and plants into groups based on appearance and behaviors
[3] SC2.2 observing and comparing external features of plants and of animals that may help them grow, survive, and reproduce
The student demonstrates an understanding of the processes of science by
[7] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating *
[7] SA1.2 collaborating to design and conduct simple repeatable investigations, in order to record, analyze (i.e., range, mean, median, mode), interpret data, and present findings (L)

The student demonstrates an understanding of how science explains changes in life forms over time, including genetics, heredity, the process of natural selection, and biological evolution by
[10] SC1.2 explaining how the processes of natural selection can cause speciation and extinction
[11] SC1.2 researching how the processes of natural selection cause changes in species over time (L)

The student demonstrates an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy by
[9] SC3.3 identifying dynamic factors (e.g., carrying capacity, limiting factors, biodiversity, and productivity) that affect population size
[10] SC3.2 exploring ecological relationships (e.g., competition, niche, feeding relationships, symbiosis) (L)
[11] SC3.2 analyzing the potential impacts of changes (e.g., climate change, habitat loss/gain, cataclysms, human activities) within an ecosystem

Required Background
• Basic knowledge of bird biology (diet, behavior, morphology)

Vocabulary
• Darwin’s finches
• Adaptation
• Natural selection
• Adaptive radiation
• Interspecific competition
• Intraspecific competition

Materials
Supplies:
• Household items to represent “beaks” (tweezers, pliers, wire cutters, straws, spoons, toothpicks, clothespin, etc)
• “Food” items (sunflower seeds, m&m’s, string, water, marshmallows, etc)
• Dixie cups to represent the stomach
• Paper towel
• Paper to keep track of hypotheses, food consumption, observations and conclusions (for younger grades, pre-prepare a worksheet; older students should be able to organize their thoughts with charts and headings without a structured worksheet)

Activity Preparation and Procedure
• Purchase or gather supplies listed above.

Activity for Day 1:
• Show the students the different types of “beaks” available, giving them vocabulary for tools that they might not be familiar with (for example, different types of pliers) so they can refer to them accordingly in their observations. (5 minutes)
• Allow students to choose a beak or assign them. Be sure that there are at least two students with the same beak type for the intraspecific competition portion of the activity.
• Instruct students how to hold their beaks. One hand should be behind their back; the other should hold the “beak” along their cheek. While completing the activity, they should stand and lean over their food bank to best simulate a bird-like stance. For students with straws, instruct them to use their finger to create a vacuum rather than their mouth.
• Start by showing them one food type and having them predict what it may represent as a food that birds consume in nature. (For example, marshmallows represent berries, string represents worms, water represents nectar.)
• Place a food bank of that one food for students in front of them on a piece of paper towel and give them a Dixie cup. Have the students write a prediction for how many of those food items they will be able to place in their stomach (cup) in thirty seconds and explain why their beak may or may not be adapted to eat the food.
• Test the beaks. Allow everyone to prepare his or her bird-stance and then begin—allow 30 seconds of time to pass. (The amount of time is adjustable; 30 seconds keeps the activity fast paced and doesn’t let students whose beaks are maladapted to certain food types become too discouraged.)
• After the 30 seconds have passed, have the students count their food items and record it in their notes or chart. For water or other liquids, have them measure the level in their cup with a ruler. Record how well it matched their hypothesis.
• Repeat for multiple food types. (Each food investigated will take approximately 7 minutes from beginning to writing conclusions.)
• After testing is finished, allow students to share and discuss findings in small groups, where each student has a different beak type. Have students think of birds they know or have seen and discuss what bird best matches their beak model. (10 minutes)
• Students write a conclusion as to why their beak is best adapted to which food type, which food type they struggled the most with and why. (5 minutes)

Activity Day 2:
• Revisit findings from the day before: What foods did we examine? Which beaks were best adapted to each one? Ask for definitions of vocabulary. (5 minutes)
• Have students retrieve their “beaks” from the day before. Ask students to group themselves by which food item they felt their beak was most well adapted to eat. Students will observe that different types of beaks eat the same types of food, and that students with the same model as them will also be in their group. (5 minutes)
• This follows much of the same procedure as day 1, except this time 2-3 students will be sharing a food bank of the one food their beak was most specialized for to simulate competition.
• Model interspecific competition by having two different beak models that the students concluded were most well adapted to eat the same food type share a bank of that food type. Student pairs discuss which one may be the superior competitor beforehand and why. Then give them one minute to get as much food in their cups as possible. Record results and conclusions: was their prediction correct? Why was one a better competitor than the other? What might happen to our poor competitor if the food bank was diminished? Following small group discussion, allow each student to write a conclusion about their findings. (15 minutes)
• Repeat, with model of intraspecific competition (for example, have two needle-nose pliers share the same food bank). Were there any differences between the two beaks that led to one being a better competitor? What happens in this case if the food bank is diminished? Would our species go extinct? Would the population change? Following small group discussion, allow each student to write a conclusion about their findings. (15 minutes)
• Reflect upon the questions that were discussed in small groups as a class. Revisit vocabulary. What are the results of interspecific and intraspecific competition on real populations of birds? (Prompt them with thinking about the model: How would the population of birds in the classroom change as a whole if food supplies were diminished? Which groups would go extinct? Which would thrive?) (10 minutes)

Assessment
Throughout the course of the activity, students are making observations, recording hypotheses and results, and their conclusions. As an “exit ticket” or quiz question, ask students to compare and contrast interspecific and intraspecific competition, including the definitions and their effects on animal populations.

**Complementary Activities and Extension Ideas**

Using the Avian Adaptations education kit from the University of Alaska Museum of the North, students can observe and learn about different beak types of different birds to familiarize themselves with biodiversity and specializations as a whole. They could compare their models to the birds found in the kit and even predict what their beak might most closely model. For information about kit check-out, visit: [http://www.uaf.edu/museum/education/kits/](http://www.uaf.edu/museum/education/kits/)