



## ***The Origin of Species: The Beak of the Finch***

# **NATURAL SELECTION AND THE EVOLUTION OF DARWIN'S FINCHES**

## **INTRODUCTION**

There are 13 different species of finch on the Galápagos Islands off the coast of Ecuador. On one of the islands, Daphne Major, biologists Peter and Rosemary Grant have devoted many years to studying four of these bird species. The Grants have studied the effects of drought and periods of plenty on the finches, and the results of their experiments have had an enormous impact on evolutionary science.

For this lesson, you will first analyze the characteristics of the 13 species of finch found on the Galápagos Islands. Then you will watch a short film about the research conducted by the Grants. Based on the information presented in the film ([The Origin of Species: The Beak of the Finch](http://www.hhmi.org/biointeractive/origin-species-beak-finch), at <http://www.hhmi.org/biointeractive/origin-species-beak-finch>) and your own observations, you will construct an argument and make predictions about the role of natural selection on the evolution of finch populations.

## **MATERIALS**

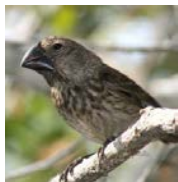
- Finch cards (13 cards per student team)
- Large, white poster board or butcher paper
- Blue painter's tape for attaching cards to poster board or butcher paper
- Access to a camera (optional)
- Sticky notes or index cards
- Graph paper
- Science notebooks or paper for writing
- Different-colored pens (optional)

## **PROCEDURE**

Break into teams as instructed by your teacher. Each team will receive 13 cards of different finch species. Follow the instructions below, recording observations and answers to questions in your science notebook or on a sheet of paper.

### **PART 1: What Do You Already Know?**

1. Working with others on your team, examine the cards of the Galápagos finches and arrange the species into groups based on their characteristics. Grouping species according to shared characteristics can provide clues to how they have evolved.
2. On a large piece of poster board or butcher paper, use the tape to attach the cards according to the groups your team has created (or you can display the groups on your table). Give each group an informative name and write that name down next to each group. On sticky notes or index cards, list the evidence for each grouping.



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3. Pause for a gallery walk. Walk around the class and examine the displays by the other teams, paying attention to the following:

- How were other teams' groupings similar to your team's? How were they different?
- What evidence did your classmates use to justify their groupings?
- How does the evidence they provided support their groupings?

On your own, write two questions about each team's presentation on sticky notes or index cards. Initial your feedback.

4. Based on what you observed during your gallery walk, does your team want to make any changes to its own groupings? What additional evidence would you need to better justify your team's groupings?

Make your changes and write down in your notebook or on a sheet of paper your rationale for revising (or not revising) your groupings. Write additional evidence on your poster.

### **PART 2: Sorting Finch Groups**

5. Watch the first segment of the film [The Origin of Species: Beak of the Finch](http://www.hhmi.org/biointeractive/origin-species-beak-finch)

(<http://www.hhmi.org/biointeractive/origin-species-beak-finch>), from the beginning to 5:36 minutes. As you watch, listen for answers to the following questions:

- What do the different beaks tell us about the different finch species?
- What evidence did scientists use to determine that the 13 species of finches on the Galápagos arose from a single common ancestor?
  - What was an alternative explanation, and how did the scientists discount it?
  - Why was the scientific conclusion of common ancestry important for understanding the effects of natural selection on these bird species?

6. *Pause* for class discussion.

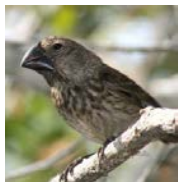
7. Return to your finch groupings from Part 1. Work with others on your team and, if necessary, rearrange the bird groupings based on what you heard in the film. Then use the information from the film to revise the names and evidence. Answer the following questions in your notebook or on a sheet of paper.

- a. What did you change?
- b. What evidence from the film convinced you to make the change?
- c. What do the different groups of finches that you created represent?

### **PART 3: Examining Finch Beaks**

8. Watch the second segment of [The Beak of the Finch](http://www.hhmi.org/biointeractive/origin-species-beak-finch) (<http://www.hhmi.org/biointeractive/origin-species-beak-finch>), from time stamp 5:36 minutes to 9:00 minutes. As you watch, listen for evidence to help you answer the following questions.

- a. Describe the beak sizes of the medium ground finch population (species 12 in the finch cards).
- b. How did the population of medium ground finches on the island of Daphne Major change as a result of environmental changes?



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9. Make a prediction. After watching the segment, create a bar graph on your own that shows the beak sizes of the population of medium ground finches before and after the drought. Your graph should indicate the number of medium ground finches with each of four different beak sizes (from smallest to largest) before and after the drought. (Hint: You will create two bars for each category of beak size, one representing the populations before the drought, and one representing the populations after the drought.) Include the following categories of beak sizes in your graph:
- Medium ground finches with much smaller beaks
  - Medium ground finches with smaller beaks
  - Medium ground finches with larger beaks
  - Medium ground finches with much larger beaks
10. Share your graph with others on your team and provide feedback by asking your team members two or more questions about their graphs. Be ready to explain your own graph.
11. Watch the third segment of *The Beak of the Finch* (<http://www.hhmi.org/biointeractive/origin-species-beak-finch>), from time stamp 9:00 minutes to 11:12 minutes. After watching the film, answer the following questions.
- a. How did your graph compare to the graph in the film? Did anyone on your team have a graph that was similar?
  - b. If no one on your team had a graph that was similar, what evidence did you not consider?
  - c. If your graph was close to the one in the film, what part of your thinking was the same as that of the scientists in the film?
  - d. Why did the drought have such an impact on the medium ground finch population?
12. Class prediction: What was the response of Peter and Rosemary Grant to the dramatic change in the distribution of beak sizes in just one generation of birds? If the drought had continued longer, what would you expect your beak graph to look like?

### **PART 4: Understanding Speciation**

13. Watch the final segment of *The Beak of the Finch* (<http://www.hhmi.org/biointeractive/origin-species-beak-finch>), from time stamp 11:12 minutes to 15:45 minutes. As you watch the film, listen for an answer to the following:
- How did one ancestral finch population give rise to 13 species, each with different characteristics?
14. With your team, create a graphic representation of the *process* that led to 13 different finch species. You may use the cards with the finches to construct your graphic. Prepare your representation like a museum exhibit, so it will stand alone without your needing to explain it. However, you can include a written caption, as museum exhibits do.
15. Pause for a gallery walk. During the gallery walk, offer written feedback in the form of questions to at least three other teams' exhibits. Initial your feedback.
16. After the gallery walk, you may want to revise your presentation. What do you need to add? What do you need to take out? Make sure your representation can stand up to peer review.



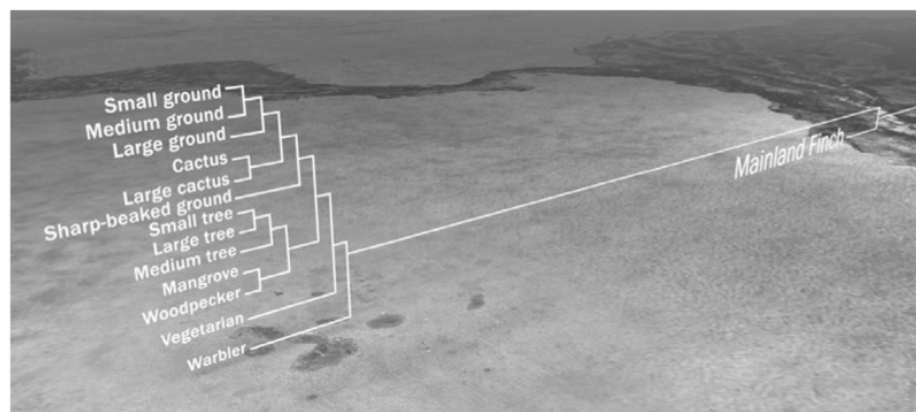
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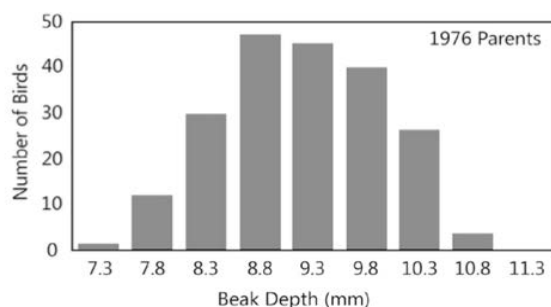
Student Worksheet

### PART 5: Summary Activities

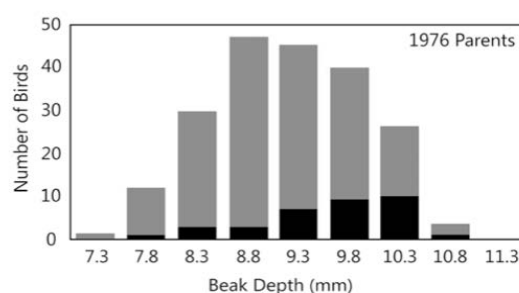
**17.** Construct an explanation based on the evidence. Write an explanation for how the process of evolution primarily results from competition for limited resources (such as water, shelter, and mates) and differences in the abilities of individuals in a population to survive and reproduce in that environment. Write your explanation in a notebook or on a piece of paper using the evidence in Figures 1–4 and information from the HHMI film.



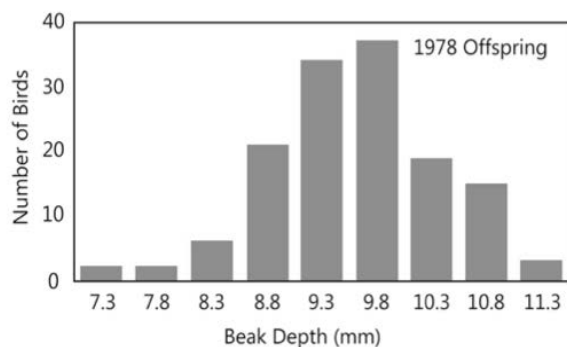
**Figure 1. Phylogenetic Tree Showing Relationships among Galápagos Finches.**



**Figure 2. Beak Sizes of a Sample of 200 Medium Ground Finches Living on Daphne Major in 1976.**



**Figure 3. Beak Sizes of Medium Ground Finches Living on Daphne Major in 1976 (gray bars) and Finches That Survived the Drought of 1977 (black bars).**



**Figure 4. Beak Sizes of Offspring of Medium Ground Finches That Survived the Drought of 1977.**



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**18.** Apply the same reasoning to a different scenario.

*You are a scientist studying birds on Daphne Major. You have been recording many of the birds' physical traits, including the length of both wings. You observe that for 80 percent of the individuals measured, the length of the left wing is not significantly different from the length of the right wing (in other words, they are symmetrical). But for about 20 percent of the birds measured, the wing lengths are asymmetrical. This distribution is true from generation to generation. Suddenly, a rare, five-day windstorm takes over the island. After the storm, you spend the next several days netting each bird on the island that survived the storm. You discover that 85 percent of the birds with symmetrical wings survived the storm, whereas only 5 percent of the birds with asymmetrical wings did.*

Construct three graphs showing the proportion of birds with symmetrical and asymmetrical wings in the population of birds before and after the windstorm and in their offspring. Explain your reasoning.