

### Introduction

Environmental conditions act as selecting agents because they select organisms with the most beneficial traits to become the parents of the next generation. Within a species, individuals with variations that make them better adapted to their environment will survive and reproduce in greater numbers than those without such adaptations. Observations have shown that the offspring of better-adapted individuals inherit many of their parents' favorable variations.

Finches are small birds found in many locations throughout the world. Charles Darwin used the numerous finch species found on the Galapagos Islands as evidence of natural selection. The great variety of beak adaptations present on the Galapagos is thought to be due to the isolation of bird populations on the islands with different kinds and amounts of food. Seed eating finches exhibit a great number of differences in beak shapes and sizes. During ongoing competition for resources, some finches are successful and become more numerous, while less successful finches decrease in number.

In this laboratory activity, you will work with different tools that will serve to model finch "beaks." The seeds provided represent finch food on a particular island. You will compete with other "finch" species to see which "beak" is best adapted for obtaining a specific food.

### Objectives

In this laboratory activity, you will:

- learn how structural differences may affect the survival rate of members within a species
- simulate competition for resources among different species of organisms
- see the role of the environment as a selecting agent

### Safety

- You should wear safety goggles for this activity.
- Handle the tools carefully. They may have sharp edges and could cause cuts.
- Be especially careful when two or more of you are reaching for seeds at the same time.

The "beak" being used by one student has the potential to strike another student.

- Do not taste or eat any of the seeds.

### Procedures

1. Examine the different tools ("beaks") and seeds provided. Predict which "beak" will be the *most* successful at picking up small seeds. Give the reasons for your choice.

2. Predict which "beak" will be the *least* successful at picking up small seeds. Give the reasons for your choice.

3. From this point on you and your partner will model a finch feeding. The tool you were assigned will be your "beak" Describe what characteristics it has that make it good for picking up small seeds. In the remaining space or on a separate sheet of paper, draw an outline of your assigned "beak"

4. Both you and your partner should practice transferring the small seeds quickly from the large dish to the small dish before the competition begins. The large dish of small seeds represents the island environment where you live and feed. The small dish represents a finch stomach. You may move only one seed at a time otherwise your bird may choke and you will only get credit for seeds that stay in your "stomach".

*Round One: No Competition, Original Island*

5. When given the "Round One" signal, one member of your team should use the "beak" to pick up small seeds one at a time from the large dish and place them in the small dish. Repeat this for a total of four trials, two trials for each partner. A timekeeper will tell you when to start and stop each trial. Record your results in the Round One: Feeding with No Competition" data table.

Round One: Feeding with No Competition

**Round One: Feeding with No Competition**

		Seeds Collected
Partner #1	Trial #1	
	Trial #2	
Partner #2	Trial #3	
	Trial #4	
	Average	

Calculate the average number of seeds obtained during the four trials. Round off to the nearest seed. In order to "survive," your species needs to collect an average of 13 seeds per trial. If you achieve that goal, you remain healthy and continue to live on the original island and eat small seeds. If your team averaged fewer than 13 small seeds per trial, you and your partner will "migrate" to a new island with a different food supply to avoid starvation. This will be your island for Round Two: Perhaps your "beak" will be better adapted for feeding-success in a new environment.

*Round Two: Competition*

In this round, instead of feeding alone, you will be competing for food with finches that have different kinds of "beaks." To simulate this competition, your

team will feed from the same dish as one other team. If you were successful during Round One, you will be feeding with other finches on small seeds.

If you were not successful, you will be competing for large seeds.

7. In the "Round Two: Feeding with Competition" data table, *check the box that indicates whether you are feeding on the original island (small seeds) or on the new island (large seeds)*. Complete four trials just as you did the first time and record the results of each trial. Again, wait for the time keeper to tell you when to start feeding and when to stop for each trial.

**Round Two: Feeding with Competition**

Original island (small seeds)

New island (large seeds)

		Seeds Collected
Partner #1	Trial #1	
	Trial #2	
Partner #2	Trial #3	
	Trial #4	
Average		

8. Calculate the average number of seeds obtained during the four trials. Round off to the nearest seed. If your team collected an average of 13 seeds or more per trial, you can go on to Round three. If your team collected fewer than 13 seeds per trial, sorry, you and your partner are now eliminated.

**Round Three: Increased Competition**

During this round, you will be competing with all of the other finch species left alive on your island.

In other words, all of the finch teams that were successful at feeding on small seeds will compete at one dish containing small seeds. At the same time, all of the finches successful at feeding on large seeds during Round Two will compete at one dish of large seeds.

9. In the "Round Three: Feeding with Increased Competition" data table, indicate whether you are feeding on small or large seeds. Complete four trials as before and record the results of each trial and your average.

**Round Three: Feeding with Increased Competition**

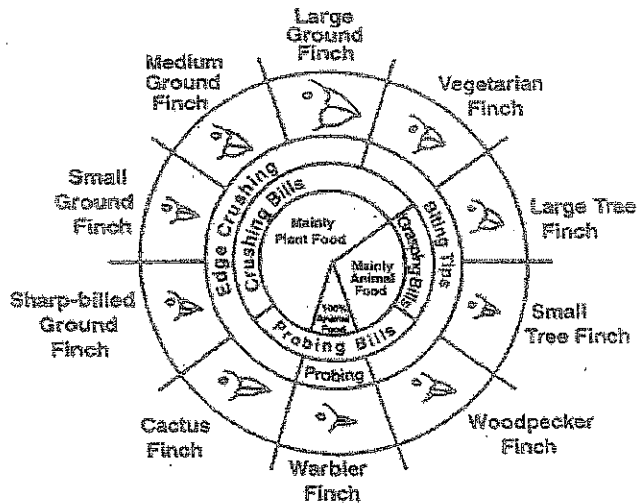
Original island (small seeds)

New island (large seeds)

		Seeds Collected
Partner #1	Trial #1	
	Trial #2	
Partner #2	Trial #3	
	Trial #4	
Average		

## Analysis Questions

1. What characteristics of your "beak" interfered with feeding success on the original island?
2. Name three traits other than beak characteristics that could contribute to the ability of a finch to compete successfully.
3. It is very unlikely that all of the beaks within a species of finch are exactly alike. Random mutations and new gene combinations resulting from sexual reproduction are the source of beak variations. Describe at least three beak variations that could randomly appear and further improve your species' chances of survival when feeding on small seeds.
4. Why did some "beak" types survive on the new island (with large seeds) when they could not survive on the original island?
5. Class Activity: Complete the Class Results data table
6. Did those who were successful in Round One survive equally well when others were competing for food at the same dish during Round Two? Support your answer with an explanation.
7. Why were there fewer survivors at the end of Round Three?
8. At the end of Round Three, were the types of "beaks" that were successful on the new island the same as the types of beaks that were successful on the original island? Support your answer with an explanation.
9. Explain how this activity simulates each of the concepts listed below and their role in natural selection, use specific examples from the lab.
  - variation:*
  - competition:*
  - struggle for survival:*
  - adaptation:*
  - environment:*
  - selecting agent:*



— from *Galapagos: A Natural History Guide*

**Figure 1. Variations in Beaks of Galapagos Islands Finches**

Base your answers to questions 10-12 on Figure 1, which shows various finches found on the Galapagos Islands.

10. Predict which species of finch would be most likely to survive if the weather on the Galapagos Islands gradually changed and the seeds available to the finches became larger with heavier coverings. Support your answer with an explanation.

11. One island is populated by two species—Ground Finches and Small Tree Finches.  
a. What two types of food would you expect to be available on this island? Support your answer with an explanation.

b. Would you expect the two species to compete for food on this island? Support your answer with an explanation.

c. How might the two native finch populations be affected if several dozen Sharp-billed Ground Finches were to migrate to the island and survive? Support your answer with an explanation.

12. a. Explain how an island could support large populations of both Large Ground Finches and Small Ground Finches.

b. How could you use the materials provided in this lab to test your explanation?

13. What happens to animals that cannot compete as well with other animals in the wild?

14. Sometimes animals that are introduced into an area that they never lived in before, out-compete and endanger resident species, why do you think this happens?

15. If only one species is considered the "fittest", why do we still have so many variations among species. Why do some birds have very long pointy beaks, while other birds have short flat beaks?

5. How do you think diseases can affect natural selection?

Data Table for Question #5 of the Analysis Questions

Class Results

Beaks That Were	Number of Beak Types	Characteristics of Beaks (Size and Shape)
Present at the beginning of the activity		
Successful at feeding in Round One on the original island—fed on small seeds, did not need to migrate		
Not successful at feeding in Round One on the original island—fed on small seeds, had to migrate to the new island		
Successful at feeding in Round Two on the original island—fed on small seeds		
Successful at feeding in Round Two on the new island—fed on large seeds		
Not successful at feeding in Round Two on either island—species dies out		
Successful at feeding in Round Three on the original island—fed on small seeds		
Successful at feeding in Round Three on the new island—fed on large seeds		
Not successful at feeding in Round Three on either island—species eliminated		