

Charles Darwin developed the Theory of Natural Selection based on his research of finches in the Galapagos Islands. He postulated that all species of finches on the islands descended from the same original species; however, due to natural occurrences, the finches were eventually isolated on the individual islands. This type of isolation is known as geographic isolation. The isolated finches on each island slowly diverged from the original species and adapted to their specific environment. Each new species of finch took on the characteristics needed for survival in their own unique niche. For example, Darwin noticed that despite a strong resemblance to the original species, each new species of finch had a highly characteristic beak shape, adapted to the specific environments in which these finches were found.

Because of the adaptations they made to their different environments, the finches on each island became reproductively isolated from the finches on the other islands, which in turn led to speciation. Darwin noticed that the birds had only themselves to compete with for food. This competition, called "survival of the fittest" caused the birds, in this struggle, to develop different habits for survival. Birds that developed specialized traits, by evolving, would survive and reproduce, causing different characteristics to emerge, and allowing the birds to fill different niches. For example, through natural selection, the seed-eating finches evolved a thick, bulky, cone-shaped beak for cracking open seeds.

Among each island, however, there was still competition among many birds for the same resource. For example, more than one type of bird was adapted to eating insects. And, more than one type of bird was adapted to feeding on fish. This competition for resources is apparent in all environments. One way in which species reduce this direct competition is by resource partitioning. Resource partitioning is known as the dividing up of resources so that species with similar needs use them at different times, in different ways, or in different places. For example, some birds will feed on insects at night while others will feed during the day. In effect, they evolve traits that allow them to share the wealth.

**DID YOU KNOW?**

A pelican's bill can hold about 3 times as much food as its stomach.

According to Darwin's Theory of Natural Selection, individuals with the best combinations of inherited traits are the most likely to survive and reproduce. This means that over time, populations of animals with specific adaptations to a particular environment are more numerous than populations without these specific adaptations. Animal adaptations can be any body shape, process, or behavior that allows an organism to survive in its environment, and they may change over time to fit the needs of the environment.

Birds can be found throughout the entire world, and they display a wide range of adaptations depending on their environment. Beaks are used for eating, defense, feeding young, gathering nesting materials, building nests, preening, scratching, courting, and attacking. The shape and size of each species' bill is specific for the type of food it gathers. For instance, a pelican has many unique adaptations, including a spoon-like beak, that make it better at catching fish than a woodpecker. In turn, pelicans can be found in aquatic environments where fish are abundant. Woodpeckers, on the other hand, would not be able to survive in an aquatic environment because they are not adapted to that particular environment. The different beak shapes allow easier access to particular food supplies. So, if an environment is altered, organisms within the area will need to change, or adapt, in order to survive. Natural selection is the process by which organisms best suited to the environment survive and reproduce, thereby passing their genes on to the next generation.

PROCEDURE

You and your classmates will represent four different types of birds. Along one of your many journeys, you discover a variety of islands. Upon closer inspection, you notice that each island contains a different type of food for birds. It is up to you to visit each island and compete with various structures of beaks, and then relate their structure to their function. Each test will allow you to see how different bird beaks are adapted to their food source.

1. Your teacher has set up four islands. Each island has a unique environment, and in turn, has a unique food source for birds:
 - Island #1: Aquatic Vegetation
 - Island #2: Worms
 - Island #3: Seeds
 - Island #4: Nectar
2. Your class will be divided into eight groups.
3. Begin with any of the four islands. As a group, note the food present. Record this information in Table 1 in the Analysis section
4. While visiting the first island, hypothesize what a bird would have to do to obtain the particular food source. Record your hypothesis in Table 1.
5. Predict which "beak" on this island will be most effective in obtaining the food. Record your prediction in Table 1.
6. Discuss the reasons why you believe this beak will function most effectively. Record your explanation in Table 1.
7. Repeat steps 3-6 for the other three islands. All of Table 1 must be filled out.

GENERAL OVERVIEW OF "THE BEST BEAK COMPETITION"

- Each type of beak will be tested on each island by each group.
- This will be a competition to see how much of each particular food source can be "consumed" within 15 seconds using each beak.
- Your teacher will be the timer, using a stopwatch to time 15 seconds for each trial.
- Three trials will be performed using each beak, and then an average of the three trials will be calculated in order to determine the average amount of each food consumed.

ROLES

Decide upon a role for you and your group members using the following list:

- => BEAK #1: One group member will use beak #1 to try to obtain food.
- => BEAK #2: One group member will use beak #2 to try to obtain food.
- =>BEAK #3: One group member will use beak #3 to try to obtain food.
- => BEAK #4: One group member will use beak #4 to try to obtain food.
- => REPLENISHER: One group member will empty the cup containing the "consumed" food and replace all materials after each trial.
- => READER: One group member will read the rules at each island and make sure that all group members understand.
- => RECORDER : One group member will record and also make sure that everyone is recording the times in the chart on the observation sheet.

For each trial, group members can rotate in and out of these roles so each group member has a chance to participate. Also, if there are not enough group members to perform all of these roles, some group members can take on more than one role at one time.

Name:

Per:

Objectives:

- Explain physical adaptations birds have due to the available food supply
- Infer what beak type is most efficient for a given food supply
- Describe what will happen to a bird population if it's environment can no longer support bird's food source

Pre-Lab Questions:

1. Read the background and write the meaning of the following terms:








Geographic isolation:

Adaptation:

Resource partitioning:

Natural selection:

2. Consider how the beak of the bird is shaped as well as the type of beak the bird has. For example, the first bird has a beak that is good at cracking and is relatively small. This makes the beak good for eating seeds because it can crack open the seeds and get the nutrients inside. Using the information in the table, hypothesize the type of food the bird will eat and support your answer (i.e. explain why you think this type of food)

Shape	Type	Hypothesis about food source and how bird uses beak
Sparrow 	Cracker	Seed eaters, like sparrows and cardinals, have short, thick, conical bills for cracking seeds.
Hawk 	Shredder	
Woodpecker 	Chisel	
Hummingbird 	Probe	
Duck 	Strainer	
Herron 	Spear	
Warbler 	Tweezer	

ANALYSIS

Table 1
Predictions

Island	Type of Food	What will a bird have to do to obtain this food?	Which "beak" will work the best in obtaining food?	Why?
Island #1				
Island #2				
Island #3				
Island # 4				

Table 2

Observations

Island	Beak Type	Trial 1	Trial 2	Trial 3	Average	Which "beak" worked the best?	Describe the structural advantage	Examples of birds having this beak structure
Island #1: Aquatic Vegetation	Pipet							
	Pliers							
	Tweezers							
	Dip net							
Island #2: Worms	Pipet							
	Pliers							
	Tweezers							
	Dip net							
Island #3: Seeds	Pipet							
	Pliers							
	Tweezers							
	Dip net							
Island #4: Nectar	Pipet							
	Pliers							
	Tweezers							
	Dip net							

ANALYSIS QUESTIONS

1. Define adaptation.
2. You are a scientist who has just returned from a newly-discovered island. While on the island, you discovered many new animals. You would like to share your findings on animal adaptations with the science community. Draw one newly-discovered animal in the space below. Be sure to draw the adaptations that the animal has made to its environment on the island . Write a description of the adaptations that the animal possesses and how they relate to the environment of the island .
3. Describe three ways in which you are adapted to your environment.
4. There are many natural and man-made changes to the environment that can affect different species of birds . Choose two of the following changes to an environment:
 - Deforestation
 - Insecticide application
 - Drought
 - Aquatic oil spill
 - Climatic change (e.g., snowfall in an area where it is atypical)

Describe how each change would impact the everyday lives of the birds in the area. Give an example of an adaptation that would allow the bird to be better suited to its new environment.





5. Choose one island that you visited. Construct a bar graph (histogram) using the averages from each beak that depicts the relative effectiveness of each beak. Make sure to label your graph properly. Explain what the graph is demonstrating in terms of natural selection.

6. Imagine that, after performing this lab, you had a chance to meet Charles Darwin. What three pieces of evidence would you supply to him so he knows that you understand his Theory of Natural Selection?





7. The island model in this activity has limitations. For example, it demonstrates competition for only one endless food supply on each island. imagine if this food supply was destroyed. What survival strategies could birds employ if their food source was destroyed?

8. Besides the beak, explain other structures or methods that birds use in order to obtain, or to assist in obtaining, food.
9. Were there any islands in this activity that displayed a healthy competition between some or all of the birds on the island? Were there any islands that had very little competition among the birds? Explain using data collected from this activity.
10. Imagine that you are a hummingbird. You have a very specialized beak that allows you to extract the nectar from flowers. What benefits does your specialized beak provide? What would be the consequences if your food source disappeared through a natural catastrophe?
11. Name two other bird beaks that you are aware of. If you had a chance to design a lab similar to this one, what tools or objects could you use to display the beaks of these birds?


Rules for Island #1: Aquatic Vegetation


-  Using one hand to operate each beak, you have 15 seconds to "consume" as many pieces of aquatic vegetation from the pond as possible. Your teacher will tell you when to begin and when to stop each trial.
-  Place each "consumed" piece of vegetation into the empty cup to be counted after each trial. It is very important that you empty the cup back into the water after each trial.
-  Record your counts and averages in Table 2.
-  Perform three trials using each beak, replacing the vegetation in the pond after each trial.


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-  Record your counts and averages in Table 2.
-  Perform three trials using each beak, replacing the vegetation in the pond after each trial.

Rules for Island #2: Worms


 Using one hand to operate each beak, you have 15 seconds to "consume", ONE AT A TIME, as many worms from the soil as possible. Your teacher will tell you when to begin and when to stop each trial.


 Place each "consumed" worm into the empty cup to be counted after each trial. It is very important that you empty the cup back into the soil after each trial. While placing the worms back in to the soil, make sure that the person with the beak is not looking. It needs to be a random feeding.

 Record your counts and averages in Table 2.


 Perform three trials using each beak, replacing the worms in the soil after each trial.

Rules for Island #2: Worms


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 Record your counts and averages in Table 2.

 Perform three trials using each beak, replacing the worms in the soil after each trial.


Rules for Island #3: Seeds


 Using one hand to operate each beak, you have 15 seconds to CRUSH ("consume"), ONE AT A TIME, as many seeds as possible. Your teacher will tell you when to begin and when to stop each trial.

 Place each "consumed" seed into the empty cup to be counted after each trial. It is very important that you empty the cup into a receptacle after each trial. Do not place crushed seeds back into the pan.

 Record your counts and averages in Table 2.






Rules for Island #3: Seeds

 Using one hand to operate each beak, you have 15 seconds to CRUSH ("consume"), ONE AT A TIME, as many seeds as possible. Your teacher will tell you when to begin and when to stop each trial.






 Place each "consumed" seed into the empty cup to be counted after each trial. It is very important that you empty the cup into a receptacle after each trial. Do not place crushed seeds back into the pan.

 Record your counts and averages in Table 2.

Rules for Island #4: Nectar

-  Using one hand to operate each beak, you have 15 seconds to "consume" as much nectar from the flower as possible. Your teacher will tell you when to begin and when to stop each trial.
-  Make sure that the water is filled to the top line before each trial.
-  Dispense all "consumed" nectar into the empty cup to be disposed of after each trial. It is very important that you empty the cup after each trial.
-  Record your counts (the difference in height in the cylinder in milliliters) and averages in Table 2.
-  Perform three trials using each beak, replenishing the nectar to the top line of each.

Rules for Island #4: Nectar

-  Using one hand to operate each beak, you have 15 seconds to "consume" as much nectar from the flower as possible. Your teacher will tell you when to begin and when to stop each trial.
-  Make sure that the water is filled to the top line before each trial.
-  Dispense all "consumed" nectar into the empty cup to be disposed of after each trial. It is very important that you empty the cup after each trial.
-  Record your counts (the difference in height in the cylinder in milliliters) and averages in Table 2.
-  Perform three trials using each beak, replenishing the nectar to the top line of each.