

WARD'S

Investigating Bird Beak Adaptations Lab Activity Student Study Guide



DID YOU KNOW?

More than 1,900 species are found **ONLY** in the Galapagos islands.

BACKGROUND

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.



DID YOU KNOW?

Though Charles Darwin is often credited with the term "survival of the fittest", it was actually coined in 1852 by Herbert Spencer, a British philosopher.

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.

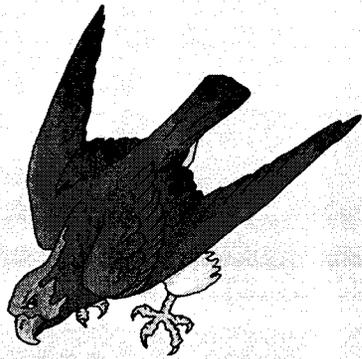
According to Darwin's Theory of Natural Selection, individuals with the best combinations of inherited traits are the most likely to survive and reproduce. This means that over time, populations of animals with specific adaptations to a particular environment are more numerous than populations without 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.

OBJECTIVES

- Comprehend that birds have physically adapted in relation to their food supply
- Deduce what beaks are most efficient for a given food by experimenting with imitation bird beaks and given food sources
- Describe what will happen to a bird population if its environment can no longer support the bird's food source

STUDENT PRE-LAB



DID YOU KNOW?

When "stooping" or diving to catch prey, a peregrine falcon can reach speeds of 200 miles per hour.

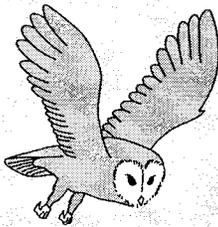
1. Observe the pictures of the birds and their beaks below. Hypothesize as to what each bird eats with its beak and how it uses its beak to eat a particular food.

Sparrow		
Hawk		
Woodpecker		
Hummingbird		
Duck		
Heron		
Warbler		

2. Once you have completed your hypotheses, discuss as a class the hypotheses that were formed. Your teacher may ask you to research each of these birds in order to see if your hypotheses match the actual structure-function relationship displayed by each bird. Or, your teacher may give you the correct answers. Be sure to record the correct answers next to your hypotheses.

PROCEDURE

Scenario



DID YOU KNOW?

Birds have a high metabolic rate and must eat often to survive. Only a few birds such as owls and crows are able to store food for future use.

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.
8. Once you have completed Table 1, you and your teammates are now ready to perform "The Best Beak Competition" on each island. Your teacher will assign your group to an island.

9. Carefully read the following overview of the competition:

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



DID YOU KNOW?

The sword-billed hummingbird of South America has a beak that is longer than its body. It uses this incredible beak to obtain nectar from the long tube-like Datura flower.

⇒ 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 as they desire 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.

- On each island, you may begin with any beak of your choice.
- You may visit the islands in any order. Just make sure to mark the appropriate information for each island in the proper spaces on your Analysis sheet.



Using a timer, your teacher will collectively time each competition on each island.

10. Carefully read the rules below for each island so you know the object of the competition and how to measure the amount of food "consumed".

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.

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 into 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 #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.

11. Once your data is complete, you can determine which beak was best suited for the food on each island. Record your decision in Table 2.
12. Discuss the structural advantage of the best beak on each island and why it was the best, in the appropriate spaces in Table 2.
13. Finally, review the birds and their pictures from the beginning of this activity. Also, think of other birds that you have seen or are aware of. You may use field guides, if available. Decide which of these birds are most likely represented by the best beak on each island. Record your answer in Table 2.
14. Clean up materials according to your teacher’s instructions.



All materials may be disposed of in a wastebasket or poured down the drain. The cork, pipe cleaners, and aluminum pans may be reused if desired.

WARD'S
Investigating Bird Beak
Adaptations Lab Activity

Name: _____
Group: _____
Date: _____

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 the 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							

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.

9. Besides the beak, explain other structures or methods that birds use in order to obtain, or to assist in obtaining, food.

10. 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.

11. 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?

12. 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?