

**DARWIN** 2009  
Exploration is Never Extinct

# Unique Beak Physique

## Lesson Plan grades K-6



**REGENERATIVE MEDICINE**  
THE FUTURE OF HEALTH  
Planetarium shows, movies and  
educational web tools  
[www.sepa.duq.edu](http://www.sepa.duq.edu)

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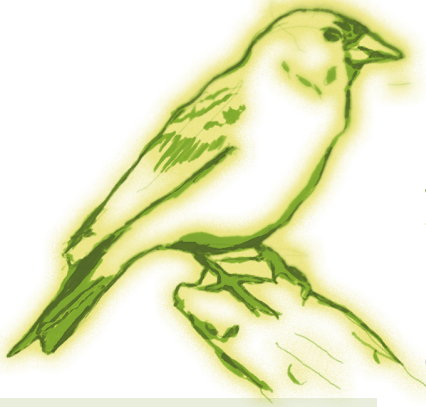
## Darwin 2009: A Pittsburgh Partnership



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Principle funding from  
**Science Education Partnership Award**  
National Center for Research Resources  
National Institutes of Health





# Introduction

## Unique Beak Physique

### Goals

1. To introduce the concepts of natural selection, favorable trait, and adaptation.
2. To use various exhibits at the Aviary to show how these concepts relate to birds.
3. To engage students in hands-on activities to apply their understanding of these concepts.

### Learning Objectives

1. Students will be able to define natural selection.
2. Students will be able to define adaptation.
3. Students will be able to define favorable trait.
4. Students will be able to define divergent evolution.
5. Students will be able to examine how bird beak type relates to bird diet.
6. Students will be able to differentiate which type of bird beak would be best suited for a particular environment.
7. Students will be able to experiment with the environmental influence on natural selection and favorable traits.
8. Students will be able to analyze various birds' beaks and the beaks' correlation with habitat and diet.
9. Students will be able to create a bird based on a given set of environmental conditions.

### Materials, Resources, and Preparation

1. Read the introductory material provided in this packet to learn more about natural selection, adaptation, favorable trait, and divergent/convergent evolution.
2. Make copies of "Battle of the Beaks Chart" (page 13) and "Unique Beak Physique Worksheet" (page 14).
3. Pictures of birds to show during the Pre-Visit Introduction (page 17).
4. Tools for the Pre-Visit Activity - Battle of the Beaks. (See "Materials" on Page 7.)
5. Have groupings of seeds made for the Pre-Visit Activity - Battle of the Beaks. (See "Materials" on Page 7.)

### A few things your students should already know:

Before starting, the students should be familiar with the following terms:  
 - Bird, Environment, Reproduction, Diet

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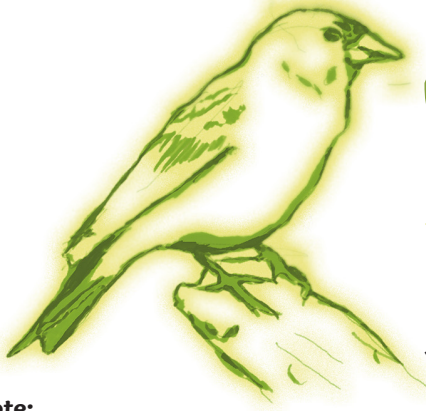
This lesson plan was developed as part of the "Darwin 2009: Exploration is Never Extinct" initiative in Pittsburgh. Darwin2009 includes a suite of lesson plans, multimedia, on-line resources and art. Find all information on-line at: [www.sepa.duq.edu/darwin](http://www.sepa.duq.edu/darwin).

This lesson plan was originally developed for the National Aviary in Pittsburgh, PA.

Special Thanks to Erin Estell, Todd Kazner, Steve Sarro, Caitlin Stone.



NATIONAL AVIARY



# Teacher Pages

## Unique Beak Physique

### Vocabulary

#### Note:

For an introduction to birds, check out the following web resources:

- Gander Academy's Introduction to Birds ([http://www.stemnet.nf.ca/CITE/owls\\_birds.htm](http://www.stemnet.nf.ca/CITE/owls_birds.htm))
- The K-8 Aeronautics Internet Textbook (<http://wings.avkids.com/Book/Animals/instructor/birds-01.html>)
- About.com: Animals/Wildlife (<http://animals.about.com/od/birdsastudyguide/a/introtobirds.htm>)
- Old and Sold: Antiques Digest (<http://www.oldandsold.com/birds/bd1-1.shtml>)

1. **Natural Selection**- The process by which environmental conditions determine what characteristics of a species are favorable traits for that particular environment. Eventually, the individuals with the favorable traits have a higher rate of reproduction and survival.
2. **Adaptation**- The alteration in an organism's behavior or body resulting from natural selection. This change occurs over an extended period of time. Adaptations are tailored to the organism's environmental niche.
3. **Favorable Trait**- A characteristic that benefits an organism under its environmental conditions. This trait gives an organism an advantage over organisms without it.
4. **Evolution**- The accumulation of changes through inheritance within a population that occurs over a series of generations.
5. **Divergent Evolution**- When a species splits into two or more species due to the accumulation of different traits or adaptations. The adaptations arise due to different or unique environmental pressures placed on the species.
6. **Artificial Selection**- When humans choose specific individuals of a species that have a desired characteristic to reproduce in order to produce offspring with that desired characteristic.
7. **Species**- A group of organisms (plants or animals) that are capable of breeding with other members of the same group but are unable to produce fertile offspring with other organisms.

### Overview

#### *Darwin's Principle of Natural Selection*

Variations within a species are caused by differences in individuals' genes. Random mutations in an individual's DNA can cause new characteristics. These differences arise from several factors explained by the mechanisms of inheritance and genetics. Random mutations in an individual's DNA can introduce a gene variant, which results in new traits. For example, a mutation of the gene that controls the normal coat color of a tiger (light orange) could cause new coat colors (white or dark orange) to arise. Genetic differences are not limited to simply coat color, but can affect almost every aspect of a plant or animal (size, shape, life span, etc.) These random mutations, which cause variations to arise within a species, set the stage for artificial selection.

Darwin was aware that humans had been performing artificial selection for tens of thousands of years. **Artificial selection** is when humans choose from the naturally occurring variations in a species the specific individuals with a desired characteristic to reproduce over others, in order to produce offspring with the desired characteristics. For example, humans choose to breed the fastest horses to produce the fastest offspring.

Darwin wondered if there was a process like artificial selection that could be found in the wild. He saw a wide variety of animals and plants, but could not decipher how some individuals were selected to reproduce more offspring. Suddenly, Darwin saw the answer to his question: *Animals that are more fit to their environment have a higher reproductive and survival rate.*

### **What does it mean to be fit?**

An individual's fitness is described as its ability to produce enough fertile offspring to replace itself. One example of the importance of fitness can be found in the reproduction and evolution of the peppered moths in England.

Peppered moths spend most of their time resting on tree trunks. Hundreds of years ago, the bark of these trees was light colored, and most of these moths were light colored, so they could blend into the bark of the trees in their environment. This camouflage allowed them to hide from predators. In the 1800's, the growth of industry began polluting the air in the moth's environment. The soot from the factories caused all of the tree trunks to turn black. The light colored moths no longer matched the bark of the trees and were, therefore, easily spotted by predators. Because most of the light-colored moths were being eaten, only dark-colored moths were left to reproduce. These dark moths were able to pass on their dark coloring to their offspring through inheritance.

**Because the darker moths were better suited to their environment, they are considered more fit than the lighter colored moths.**

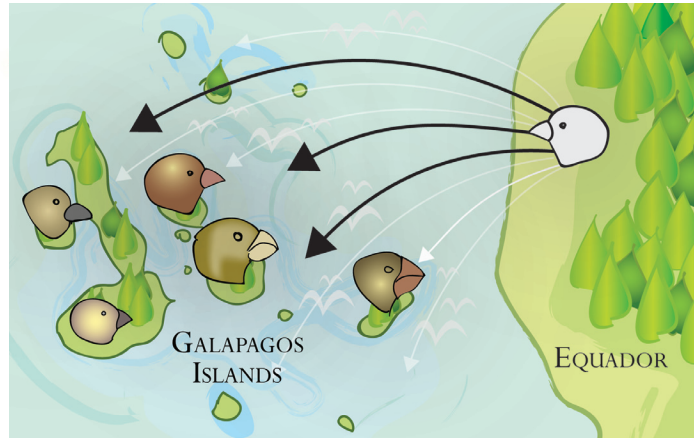
**Natural Selection** is a term coined by Darwin to mean the environmental pressures - like predators or the color of bark - that determine which organisms are most fit.

### **Darwin's Finches - How Darwin discovered evolution**

After traveling around the globe on the HMS Beagle, Charles Darwin realized that when variation is combined with a selective pressure, such as natural selection, species evolve and new species can be created. To Darwin, this seemed to be most obviously displayed in the Galapagos finches.

On the Galapagos Islands, Darwin observed many similar finches that lived on different islands. It was not until Darwin returned that he noticed that these finches were actually of separate species. How did these birds become different species? The answer is natural selection! The environment of each island is slightly different so natural selection preferred different traits on each island.

**(Over time, the different groups of finches accumulated different traits and adaptations, and evolved into a different species.)**



Finches from the mainland of Ecuador settled in ecologically different islands off the coast. These birds then evolved into different species over time due to the different selective pressures on each island.

Imagine that on one of the Galapagos Islands, the most common food source was small seeds. This is a selective pressure. From the original population, finches with smaller beaks were better at getting to the seeds. So, having a smaller beak was a favorable trait. These finches were more likely to live longer and reproduce more than the finches with bigger beaks. The finches with smaller beaks were more fit. Since the finches with smaller beaks were more likely to reproduce, the next generation of finches had more individuals with small beaks. This is the process of natural selection. This process continued over time, until all of the finches on this particular island had smaller beaks. Keep in mind that the other Galapagos Islands had different environments where different adaptations evolved - and continue to evolve today!

***How is each bird's beak an example of how the bird has adapted to its environment?***

Each of the birds on the next page lives in a particular environment. Environments are very diverse! Each environment has many specific characteristics, like the kind of food available, how much water there is, what kinds of plants it has, etc. These characteristics act as a pressure on the birds that live there, and the birds that have more adequate traits survive the longest and breed the most. **Over time, these selective pressures help the birds become more adapted to their environment.**

***Did you know, a beak is almost like a bird's hand?***

Birds utilize their beaks to do many things - to eat, to manipulate objects, to kill prey, to probe for food, and to feed their young. Because beaks are such an important everyday tool for birds, they are great examples to help us understand the adaptations of a particular bird.

## Beaks are like Tools

6

### Stop and Think!

Imagine a flamingo trying to sip nectar, or a hummingbird trying to crack open nuts. They couldn't!

EGRET



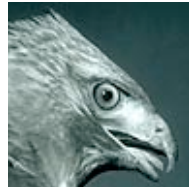
A beak like a knife is good for stabbing at food.

FLAMINGO



A slotted spoon or strainer can filter things out of water.

HAWK



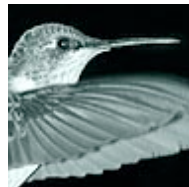
Shears are good for cutting through meat.

HORNBILL



Tongs can grab things that are hard to reach.

HUMMING-BIRD

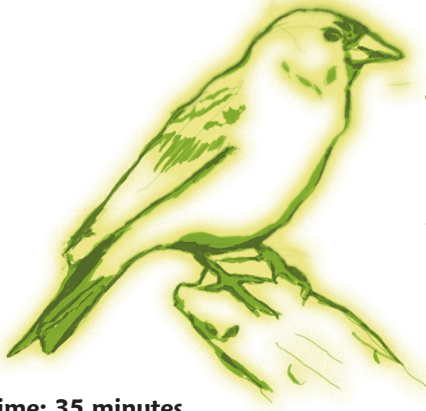


A straw is perfect for sipping.

PARROT



A nutcracker breaks open hard shells.



# Pre-Visit

## Unique Beak Physique

### Lecture

**Time: 35 minutes**

**Materials:**

- For the “Normal Year” have a mix of large and small seeds.
- For the “Forest Fire Year” have just large seeds.
- Make sure that each group of students gets the “Normal Year” seeds and “Forest Fire Year” seeds.
- Instead of using actual seeds, other objects like buttons, coins, marbles, peanuts, pine nuts, etc. could be used as alternatives.

1. Start a discussion with your students about birds. Ask students if they know what beaks are for.
2. Show students pictures of various birds so that they can observe different beak types. Use the Unique Beak Physique Answer Chart (page 14) or the Picture Pages (pages 17-18) as a reference.
3. Ask students why they think each beak has a distinctive shape and how each beak got to be that way.
4. Tell students that bird beaks serve a variety of functions:
  - eating, grooming, manipulating objects, killing prey, probing for food, courtship, and feeding their young.
5. Tell students that bird beaks are similar to tools that humans use for a variety of tasks.
6. Show students some of the tools for the Activity - Battle of the Beaks and how they are similar to beak anatomy.

### Activity - Battle of the Beaks

1. Break students into small groups (suggested: two students per group).
2. Give each group of students two tools to use and a chart for them to record their results. Each group does not need to have the same two tools.
3. Give each group of students the “Normal Year” seeds.
4. Tell your students that each tool represents a different beak. The seeds they are receiving represent the food available in their environment. The students will be trying to “feed” using each tool to grab seeds.
5. Before starting, have each group of students hypothesize which tool (out of the two that they have been assigned) is going to be best and have students also predict what kind of seed they think their beak would be best at picking up. Have students record their hypotheses on the “Battle of the Beaks Chart” (page 13).
6. Tell the students to scatter the seeds on their desk or on a paper plate.
7. Have Student A see how many seeds he/she can gather in one minute using one of their chosen tools; have Student B keep time.
8. Have students record their findings on their chart in the column “Normal Year Trial Actual” for their beaks.
9. Next, have Student B see how many seeds he/she can gather in one minute using the other chosen tool; have Student A keep time.

10. Have students record their findings on their chart in the column “Normal Year Actual” for their beaks.
11. Collect all of the seeds from the students.
12. Give each group of students the “Forest Fire Year” seeds.
13. Explain to students that following the “Normal Year,” there was a forest fire in which only plants that produced large seeds survived.
14. Before starting, have each group of students hypothesize which tool (out of the two that they have been assigned) is going to be best. Have students record their hypotheses on the “Battle of the Beaks Chart.”
15. Tell the students to scatter the seeds on their desk or on a paper plate.
16. Have Student A see how many seeds he/she can gather in one minute using one of their chosen tools; have Student B keep time.
17. Have students record their findings on their chart in the column “Forest Fire Year Actual” for their beaks.
18. Next, have Student B see how many seeds he/she can gather in one minute using the other chosen tool; have Student A keep time.
19. Have students record their findings on their chart in the column “Forest Fire Year Actual” for their beaks.

### Discussion

Ask students questions, such as:

- Was one kind of seed easier to pick up with a particular “beak?”
- What beak type/size gathered the most seeds during the “Normal Year?”
- What beak type/size gathered the most seeds during the “Forest Fire Year?”
- Were your predictions correct?
- What kinds of beaks would you expect to find in this forest before the “Forest Fire Year?”
- If there were several years with forest fires, what kinds of beaks would you expect to find in this forest?
- How does a change in environment affect which beak type can gather the most seeds?

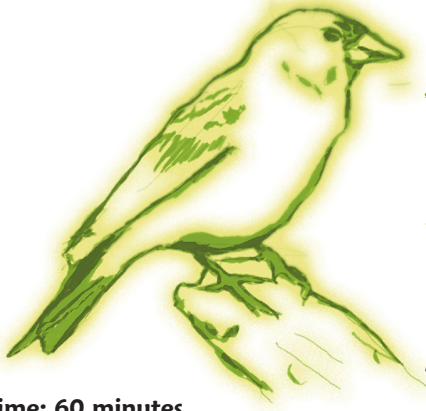
### Reflection

1. Introduce the concepts of natural selection, adaptation, and favorable trait. You can refer to the peppered moth example on page 4.
2. Tell students that in the “Battle of the Beaks” activity, the birds with small beaks were at a disadvantage because the environment changed during the “Forest Fire Year,” leaving only large seeds that the small beaks were unable to pick up.
3. If this type of environment would continue, the birds with small beaks may die off, leaving only birds that can eat the large seeds.
4. Tell students that this process is called **natural selection**. Different



environmental pressures, like having mostly big seeds available, create a situation where certain characteristics, like having a large beak, are more advantageous. These characteristics are called **favorable traits**.

5. Tell students that we might find that the birds that survived all had big beaks. We might also find that some of the species that originally had smaller beaks seem now to have bigger beaks! What do the students think happened?
6. Tell students that **the beaks did not grow!** However, the birds with larger beaks in each generation were more likely to find food, survive longer and create more progeny. The birds with larger beaks were more fit! Because the birds with larger beaks in each generation are more likely to have more offspring, over long periods of time, smaller beaks will become less common in the birds and could even disappear. In other words, **species of birds with smaller beaks could evolve larger beaks.**
7. Charles Darwin was one of the first scientists to realize that this process occurred, and he called it the principle of evolution. His great “eureka moment” came from observing different species of birds in the Galapagos Islands. Darwin observed 12 different species of finches that lived on different islands. The similarities between the different species led him to realize that the birds he was observing may have descended from a **common ancestor**. They all looked slightly different, and had different adaptations because the environments were different on each island.
8. Tell students that they will observe bird beaks at the Aviary. They will be taking notes about the beaks that they find, and the environment they are in, and will try to explain how and why the different beak types developed over time.



# Visit

## Unique Beak Physique

### Activity

**Time: 60 minutes**

**Materials:**

- Unique Beak Physique Worksheet
- pencils
- clipboard

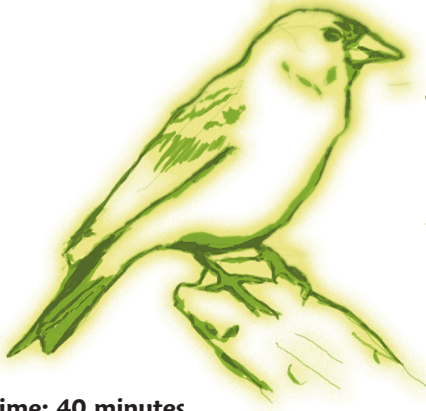
**If you can't go to the Aviary, bring the Aviary to your own classroom!**

- Assign each student one of the birds listed in the worksheet's charts on pages 13 and 14.
- Bring in books for your students, spend a day at the library, and/or allow them to use the Internet to find information about their bird. They should write a brief report about their bird (They can write an essay or the text for an exhibit sign!) and include an illustration (They can print a picture or draw one!) of their bird.
- Hang the students' reports and illustrations around the classroom.
- During the Aviary Visit (as described to the right), the students will rotate around the room to each "exhibit." Each student should briefly present their report when they arrive at their "exhibit." The students will fill out their worksheets based on their classmates' reports, drawings, and presentations.

1. Give students the "Unique Beak Physique Worksheet," which includes a chart for students to fill in as well as a diagram of beak shapes.
2. Tell students that they will be observing birds at the Aviary.
3. Visit the birds listed on page 14 (Unique Beak Physique chart) and have students fill in the beak type, diet, and habitat for each bird listed.
4. After worksheets are completed, collect them for the post-visit activity.

### Discussion

1. The hornbills are a great example of a species that diverged into multiple species. If your Aviary has Rhinoceros hornbills and Southeast Asian hornbills, take your students to one of these exhibits. If not, bring photographs of these birds on your trip.
2. Remind students of Darwin's experience with the finches. (See "Lecture" in the Pre-visit.)
3. Tell students that like with the finches in the Galapagos, the Southeast Asian Hornbills look similar because they all came from a common ancestor. Various external forces can separate a group of birds; for instance, sometimes a group of them will migrate to a new area.
4. Tell students the groups of birds that settled in a new area can be subjected to different environmental pressures than the original group.
5. Ask students if they can name some different environmental conditions.
6. Answers may include: more bodies of water, more rain, more fires, less water (droughts), bigger/smaller seeds, colder or hotter temperatures/climates, more or less predators, etc.
7. Ask students what are some adaptations that birds may develop in response to these environmental conditions.
8. Answers may include: longer or thicker feathers, different beaks, more camouflage, feet adaptations for swimming, etc.



# Post-Visit

## Unique Beak Physique

**Time: 40 minutes**

**Materials:**

- Unique Beak Physique Worksheet
- paper
- coloring utensils

**Lecture**

1. Pass out the filled-out Unique Beak Physique Worksheets to the students.
2. Discuss the findings from the Aviary.
3. Ask students how they think beak type correlates with diet, habitat, etc.
4. Ask students about specific birds and why they think these birds had particular beak types. What form did natural selection take in this case?
5. Reiterate the concept of natural selection and ask students how the birds' beaks that they observed at the Aviary were well-suited to their diet/habitat.

**Activity - Create a Bird**

1. Tell your students that they will be detailing environments and then creating birds that would be fit to a particular environment.
2. Ask the students what environments they saw at the Aviary. Have a class discussion that helps the class create a detailed description of each environment. For example, encourage students to think of the different kinds of food available (fish, flowers, seeds on the ground, seeds in fruit). For your reference, there are photos of various environments included in the Picture Pages (pages 17-18).
3. The class can also create an individual or a collaborative drawing of the same environment.
4. Give each student drawing paper and coloring utensils.
5. Tell students that they will use what they have learned about natural selection and adaptations to create a bird that would be suited to the environment of the students' choice.
6. Tell students to think about favorable traits when designing their bird. If there is time, students can color their birds as well.
7. After students are finished, have them present their birds to their classmates and explain why they chose certain features for their bird.
8. Ask questions that relate to the environmental conditions, such as:
  - Why did you choose those feet?
  - With that particular beak, would your bird be able to find food?
  - How does your bird suit your environment?
9. Discuss whether students came up with different solutions to the same environmental conditions.
10. Tell students that these different solutions are called adaptations,



## Unique Beak Physique

and that different birds may have adapted differently to their environment.

11. Afterwards, revisit the concept of natural selection to show students how nature can “select” favorable traits, just like the students selected the traits their birds would have to best fit the environment.



# Worksheet

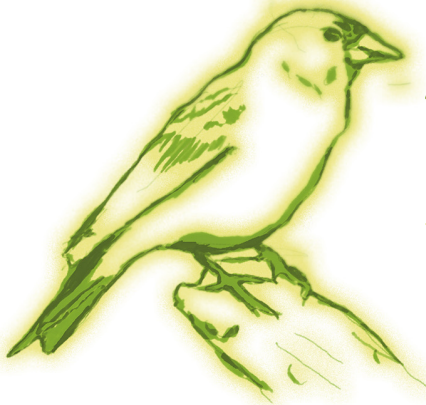
## Unique Beak Physique

Name: \_\_\_\_\_

### Battle of the Beaks

Directions: Before starting, hypothesize what beak types you think would be best for gathering the most seeds. Then record your predictions and later findings on the chart.

Beak Type:	Predict which will be the best tool for the Normal Year (Mark with an X)	Normal Year Actual (Number of seeds picked up)	Predict which will be the best tool for the Forest Fire Year (Mark with an X)	Forest Fire Year Actual (Number of seeds picked up)
Beak A				
Beak B				



# Worksheet

## Unique Beak Physique

Name: \_\_\_\_\_

### Battle of the Beaks



Generalist



Insect catching



Fruit eating



Grain eating



Nectar feeding



Chiseling



Meat Eating



Nut Cracking



Dip netting



Probing



Filter feeding

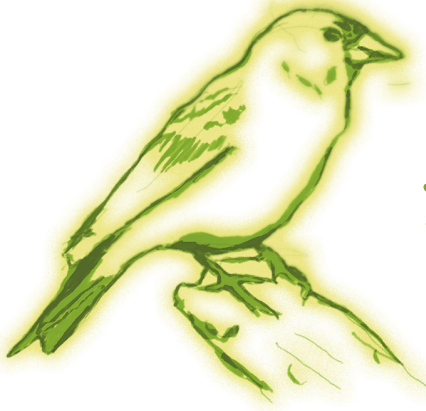
Bird	Type of Beak	Actual Diet	Actual Habitat
African Pygmy Falcon			
Common Nighthawk			
Rhinoceros Hornbill			
Taveta Golden Weaver			
Rainbow Lorikeet			
Steller's Sea-Eagle			
Hyacinth Macaw			
Black-headed Woodpecker			



# Worksheet

## Unique Beak Physique

Bird	Type of Beak	Actual Diet	Actual Habitat
Blue-bellied Roller			
Brown Pelican			
Flamingo			
Guira Cuckoo			
Roseate Spoonbill			
Scarlet Ibis			

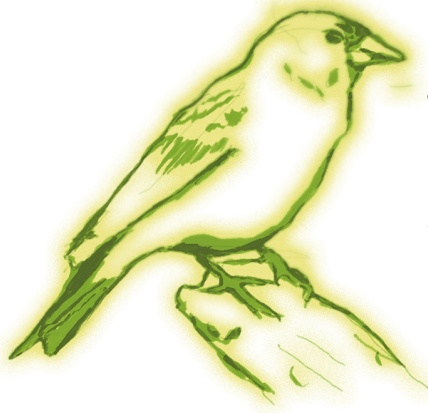


# Answer Chart

## Unique Beak Physique

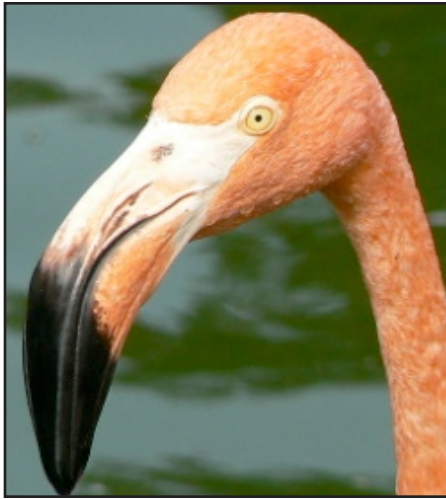
Bird	Type of Beak	Actual Diet	Actual Habitat
African Pygmy Falcon	Hunting/Tearing	small rodents, reptiles, birds, large insects	dry deciduous forests bordering savannah
Common Nighthawk	Insect Catching	moths and other large flying insects	open habitats, including cities and suburbs
Rhinoceros Hornbill	Fruit Eating	fruits, small reptiles, mammals, insects	lowland rainforest
Taveta Golden Weaver	Grain Eating	small seeds, insects	African grasslands bordering water
Rainbow Lorikeet	Fruit Eating/ Nectar Feeding	nectar, pollen, fruits	rainforest, coastal bush, woodlands, urban parks
Steller's Sea-Eagle	Hunting/Tearing	fish, crabs, mollusks, birds, mammals, carrion	sea coasts, large rivers, tree lines, rocky cliff ledges
Hyacinth Macaw	Nut Cracking	palm nuts, fruits, seeds	palm savannahs, semi-open woodland, rainforest edges
Black-headed Woodpecker	Chiseling	insects, acorns, nuts, fruits	wooded areas and forests all over the world (except Australia)
Blue-bellied Roller	Insect Catching	grasshoppers, beetles, lizards	woodlands, savannah
Brown Pelican	Dip Netting/ Scooping	fish, amphibians	along coasts and bays
Flamingo	Filter Feeding	shrimp, algae	wetlands
Guira Cuckoo	Generalist	insects, small mammals, reptiles, carrion, fruit, seeds	open woodlands and arid scrub forests
Roseate Spoonbill	Probing (not a true filter feeder)	insects, aquatic invertebrates, small fish	wetlands
Scarlet Ibis	Probing	insects, fish, amphibians, reptiles	mud flats, shorelines, and shallow bays



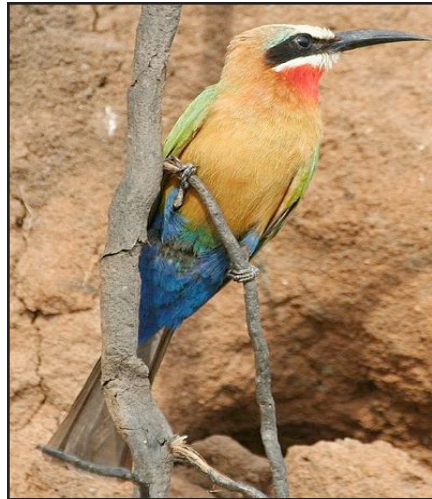


# Picture Pages

## Unique Beak Physique



Flamingo



Bee-eater



Scarlet Ibis



Tropical Rain Forest



Forest



Wooded Area



Wetlands



Desert