UNIQUE BEAK PHYSIQUE

Lesson Plan

grades K-6

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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,” “Unique Beak Physique Worksheet,” and “Create a Bird Worksheet.”
3. Pictures of birds to show during the Pre-Visit Introduction.
   (See the Unique Beak Physique Answer Chart or Picture Pages.)
5. Have groupings of seeds made for the Pre-Visit Activity - Battle of the Beaks.

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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Unique Beak Physique

Vocabulary

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**

What is Natural Selection? Natural selection is a term coined by Charles Darwin. It describes the way a species’ environment selects favorable traits. For example, if an environment is very dry, the ability of an organism to use less water is a more favorable trait.

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 specific individuals of a species 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 artificial selection 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.)

**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, the results can be changes in the species, or the creation of a new species. 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 environment of the islands are slightly different so natural selection preferred different traits. (Overtime, the different groups of finches accumulated different traits and adaptations, and evolved into a different species.)
It is believed that finches from the mainland of Equador settled in ecologically different islands off the coast. These birds then evolved 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 - they had the best beak to survive in their environment. 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 were developing.

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 specifics characteristics, like the kind of food available, how much water there is, what kinds of plants it has, etc. These characteristics act as a kind of 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.
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.

HUMMINGBIRD
A straw is perfect for sipping.

PARROT
A nutcracker breaks open hard shells.
Pre-Visit
Unique Beak Physique

Lecture
1. Start a discussion with your students about birds. Ask students if they know what are beaks for.
2. Show students pictures of various birds so that they can observe different beak types. Use the Unique Beak Physique Answer Chart or the Picture Pages 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. Have groupings of seeds already prepared for a “Normal Year;” give each group of students the “Normal Year” seeds.
4. 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.”
5. Tell the students to scatter the seeds on their desk or on a paper plate.
6. 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.
7. Have students record their findings on their chart in the column “Normal Year Trial Actual” for their beaks.
8. 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.
9. Have students record their findings on their chart in the column “Normal Year Actual” for their beaks.
10. Collect all of the seeds from the students.
11. Have groupings of seeds already prepared for the “Forest Fire Year;” give each group of students the “Forest Fire Year” seeds.

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.
12. Explain to students that following the “Normal Year,” there was a forest fire in which only plants that produced large seeds survived.

13. 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.”

14. Tell the students to scatter the seeds on their desk or on a paper plate.

15. 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.

16. Have students record their findings on their chart in the column “Forest Fire Year Actual” for their beaks.

17. Next, have Student B see how many seeds he/she can gather in one minute using the other chosen tool; have the other Student A keep time.

18. Have students record their findings on their chart in the column “Forest Fire Year Actual” for their beaks.

Discussion

1. Ask students questions, such as:
   - Was one kind of seed easier to pick up with your 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/after 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. Now introduce the concepts of natural selection, adaptation, and favorable trait.

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 you 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 would 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
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 13 (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.
5. If time permits, visit one of the Aviary’s suggested classes or daily shows.

Discussion
1. Walk your students to the mural near the rhinoceros hornbills to compare the southeast asian hornbills.
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 just migrate to a new area and stop breeding with the original group.
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. Answer 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.

Time: 60 minutes
Materials:
- Unique Beak Physique Worksheet
- Pencils
- Clipboard

Suggestions:
Additional 1-Hour Aviary Classes:
- What’s For Lunch?
- Amazing Adaptations
- Birds of Prey
- Birds of a Feather

Suggested Daily Aviary Events:
- Feeding Time
- Feed the Lories
- Kitchen Window

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Post-Visit
Unique Beak Physique

Lecture
1. Pass out the 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.
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. Give each student a set of conditions that will be used to create a bird best suited to the 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.
3. The class can also create an individual or a collaborative drawing of the same environment.
4. Photos of various environments are included in the Picture Pages.
5. Give each student drawing paper and coloring utensils.
6. 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.
7. Tell students to think about favorable traits when designing their bird. If there is time, students can color their birds as well.
8. After students are finished, have them present their birds to their classmates and explain why they chose certain features for their bird.
9. 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?
10. Discuss whether students came up with different solutions to the same environmental conditions.
11. Tell students that these different solutions are called adaptations, and that different birds may have adapted differently to their environment.
12. 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.

Time: 40 minutes

Materials:
- Unique Beak Physique Worksheet
- Paper
- Coloring Utensils
## Unique Beak Physique Worksheet

Name: ___________________________

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### 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.

<table>
<thead>
<tr>
<th>Beak Type:</th>
<th>Predict which will be the best tool for the Normal Year (Mark with an X)</th>
<th>Normal Year Actual (Number of seeds picked up)</th>
<th>Predict which will be the best tool for the Forest Fire Year (Mark with an X)</th>
<th>Forest Fire Year Actual (Number of seeds picked up)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beak A.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beak B.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Unique Beak Physique Worksheet

Name: ____________________________________

<table>
<thead>
<tr>
<th>Bird</th>
<th>Type of Beak</th>
<th>Actual Diet</th>
<th>Actual Habitat</th>
<th>Aviary Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>African Pygmy Falcon</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common Nighthawk</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhinoceros Hornbill</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taveta Golden Weaver</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rainbow Lorikeet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steller’s Sea-Eagle</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Hyacinth Macaw</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black-headed Woodpecker</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[Image of bird species and beak types]
## Worksheet
### Unique Beak Physique

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

Flamingo  Bee-eater  Scarlet Ibis

Tropical Rain Forest  Forest