Beak vs. Food
Investigating Bird Beak Adaptations

There are over 10,000 species of birds in the world, with over 50% of them living in the rainforests of Central and South America. The United States is home to over 800 species of birds. The major bird habitats located in the continental United States include oceans, aridlands, grasslands, forests, wetlands and coasts. While there has been a steady increase in wetland bird populations during the last 30 years due to conservation efforts, the populations of the other habitats continue to decline as a result of unplanned urban sprawl, increased agricultural use, unsustainable logging, and global temperature fluctuations. As habitats are destroyed, birds are forced to move to different areas, causing some species to become endangered or extinct. It is especially difficult for birds to survive in a foreign habitat as their plumage color, wing shape, feather type, feet, and beaks have evolved over time to ensure survival in their home habitat. It is important to recognize that these adaptations are the result of evolution and occur over the course of many generations. Individual birds can "adjust" to habitat changes, and those that survive the changes will reproduce, producing offspring that are more likely to share the traits that allowed the parents to "adjust" and survive. Over the course of many generations, the individuals that cannot adjust will die out and those that can survive will continue to pass on the beneficial traits, eventually creating a species adapted to the environment.

The shape of a bird's beak is adapted to allow the bird to eat its preferred food source found in its habitat. The beaks of fish eaters have pouches, spears, or hooks to catch and carry their food. Invertebrate eaters have spatula-like bills for skimming the water or long thin bills for plunging in the mud for worms. Meat eaters have hooked bills to rip prey apart. Nut eaters have heavy bills with thick bases to crack open nuts. Insect eaters have tweezer-like bills to probe for and pick up prey and nectar eaters have long, thin bills with long tongues to collect flower nectar. Some birds, such as gulls, crows, and chickens, do not have a specific beak shape, which allows them to eat a varied diet. These birds are known as generalists and are more likely to survive when a habitat is compromised.

PURPOSE

In this activity you will simulate birds eating in four habitats with five different beak types to demonstrate the connection between beak shape and the ability to access sources of food. You will then investigate how a genetic variation/mutation can help a population adapt to changes in a habitat over time.

MATERIALS

Each lab group will need the following:

cup, 3-oz plastic
pencil

SAFETY ALERT

- Handle pointed utensils with care. Do not consume any of the food items used in this activity.

PROCEDURE

PART I: BEAK DIVERSITY

1. Gather around one feeding station (group of five or less) as assigned by your teacher. Have each group member select one of the beaks. One group member will not use a beak this round and will serve as the timer. You will rotate through all the beak types and the timer position before moving on to the next station.

2. All members of your group will feed at the same time for 30 seconds. Using your beak, pick up one piece of food and place the food item in the small cup serving as your stomach. You must hold your beak in one hand and your stomach in the other. The stomach must be held upright at all times and cannot be used to scoop food. Each beak can only pick up one piece of food at a time. Station specific rules:

    a. At station #3 you cannot put your hands/fingers in the water, only your beak.
    b. At station #5 the graduated cylinder/paper towel roll must remain upright during the feeding session and it cannot be picked up from the table.
    c. At station #6 the popped popcorn should be tossed four at a time into the air by one student without a beak. Those with beaks must catch the food with their beak while it is in the air, food cannot be eaten once it hits the floor. The popcorn cannot be touched, except through a beak, and it cannot be caught directly with the stomach. You will get two opportunities to test your ability with the wooden skewer and tweezers.

3. When all members of the group are ready, the timer will start the stopwatch and everyone will begin feeding. At the end of 30 seconds, immediately stop feeding. Record the number of food items you have in your stomach in Data Table 1 in your student answer pages. Return the food to the feeding station and distribute it evenly in the box top.

4. Repeat the feeding process at your current station until each student in the group has had a chance to use each type of beak. Be sure to record your own data after each 30 second feeding period and return the food to the station. When each member of your group has rotated through each position at the feeding station, wait for directions from your teacher before moving to the next station.

5. After feeding at all six stations, calculate the average number of food items "eaten" with the small binder clips at the two grassland stations (stations 1 and 4) for your group. Be sure to include the total number of food items eaten by all group members in the average. Round the average to the nearest whole number and record the average in Data Table 2 and on the board as directed by your teacher. Complete Data Table 2 using the averages from all groups.

PART II: CHANGE OVER TIME

1. As directed by your teacher, gather around your new feeding station. Only select a beak if directed to do so by your teacher. A small binder clip represents a small beaked Greater Prairie Chicken. A large binder clip represents a Greater Prairie Chicken with a genetic variation resulting in a large beak.

2. Round 1 will begin with 2 small beaks and 1 large beak. When you are feeding you may only use one hand and only eat one food item at a time, placing it in your cup before selecting another item.

3. Based on the number of food items eaten at each feeding session there are three possible outcomes: survive, survive and reproduce, not survive.

    a. To *survive* an individual bird must eat 1/3 the class average number of food items (seeds and marbles). Record the number of items that must be eaten to survive above Data Table 3.
    b. To *survive and reproduce* an individual bird must eat more than 1/2 the class average number of food items. Record the number of items that must be eaten to survive and reproduce above Data Table 3.
    c. Those *not surviving* are ones that eat less than 1/3 the class average number of food items. Those not surviving will become the offspring of the reproducing birds and will have the same beak type as their parent.

4. Your group will feed for 30 seconds. Wait for your teacher's instructions on when to begin feeding.

5. After feeding, record in Data Table 3 (small beaks) and Data Table 4 (large beaks) the number of surviving birds and the number of offspring produced for Round 1. The Final Population for Round 1 is the Initial Population of Round 2.

6. Collect extra binder clips from your teacher for new offspring to use in the next round of feeding (remember, offspring have the same beak type as their parent). Those students who were not feeding or do not survive a round will join in during future rounds as offspring. Return binder clips from birds that do not survive to your teacher.

7. All eaten sunflower seeds will not be returned to the station. This represents a change in the available food source. Return all eaten marbles to the feeding station.

8. Complete steps 4–7 for a total of 10 rounds.

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DATA AND OBSERVATIONS

Data Table 1: Individual Student Data					
Feeding Station	**Number of Food Items Consumed with Each "Beak" at Each Feeding Station**				
	Cup	**Short Tweezers**	**Wooden Skewer**	**Salad Tong**	**Small Binder Clip**
1. Grassland (sunflower seeds)			**Timer**		*
2. Aridland (fennel seeds)			**Timer**		
3. Wetland (marble)					**Timer**
4. Grassland (sunflower seeds)			**Timer**		*
5. Forest (marshmallow)					**Timer**
6. Forest (popcorn)			**Popcorn Tosser**		**Timer**

*Use these two numbers for all group members to calculate a group average in Data Table 2

Data Table 2: Class Data	
Group #	**Average Number of Sunflower Seeds Eaten with Small Binder Clips**
1	
2	
3	
4	
5	
6	
Class Average*	
1/3 of the Class Average*	
1/2 of the Class Average*	

*round to nearest whole number

PART II: CHANGE OVER TIME

Amount of food needed to survive round: _____

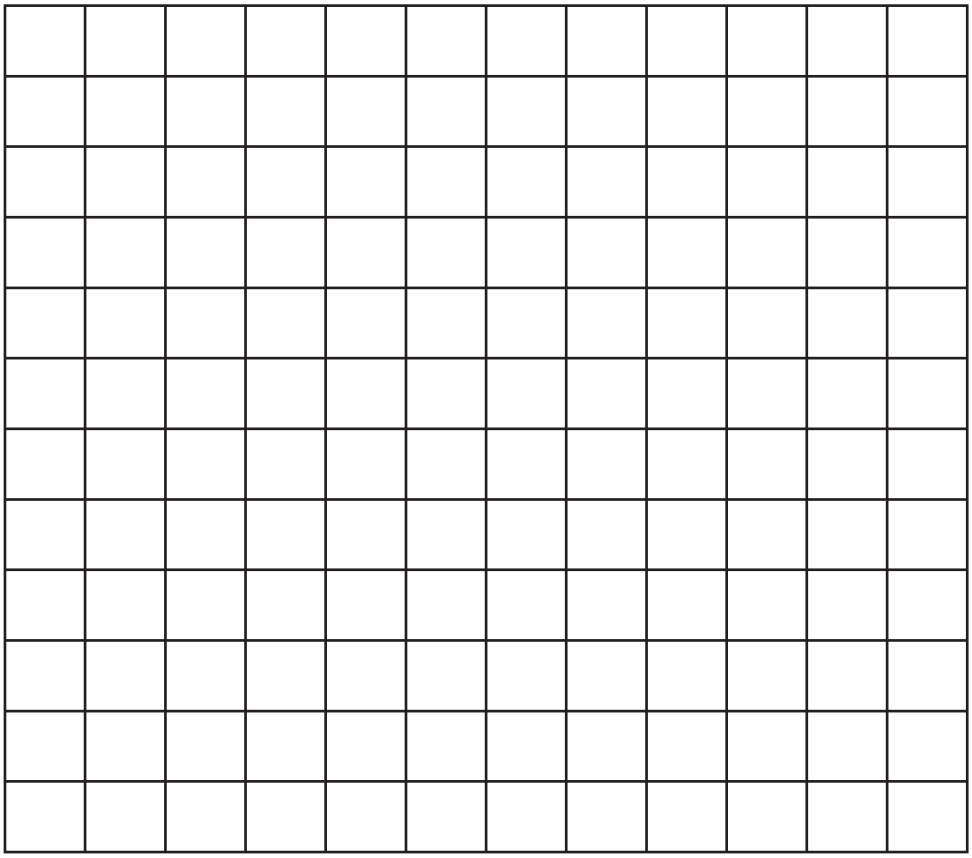
Amount of food needed to survive and reproduce: _____

Data Table 3: Small Beak Data				
Round	**Initial Population**	**Number Surviving**	**Offspring Produced**	**Final Population**
1	2			
2				
3				
4				
5				
6				
7				
8				
9				
10				

Data Table 3: Large Beak Data				
Round	**Initial Population**	**Number Surviving**	**Offspring Produced**	**Final Population**
1	1			
2				
3				
4				
5				
6				
7				
8				
9				
10				

ANALYSIS

Create a graph of Final Population vs. Round Number with both the Small Beak and Large Beak data. Include the Initial Population from Round 1 in your graph as well.



1. Based on your graph, what is happening to the small beak bird population? Explain.

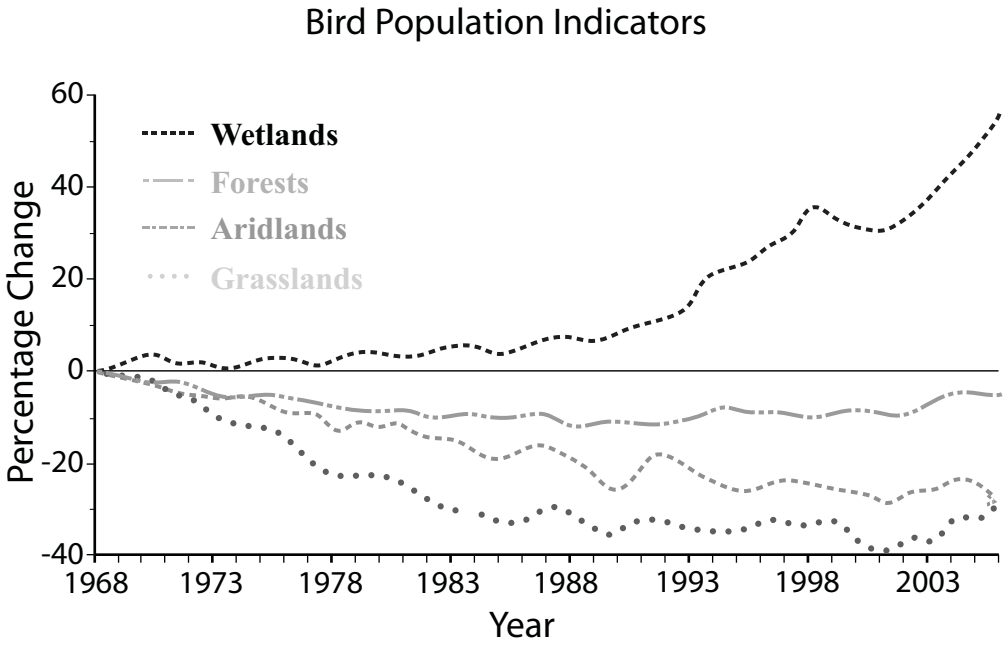
2. Based on your graph, what is happening to the large beak bird population? Explain.

3. Circle the area on the graph where the large beak bird population has reached carrying capacity. Define carrying capacity and explain why it is occurring with the large beak population.

CONCLUSION QUESTIONS

1. Using the data collected from the Part I feeding stations, how do you explain the difference between the amounts of food "eaten" at each station and the various "beak" types?

2. What is a possible explanation for the existence of an initially limited number of large beaks in the Part II bird population?



3. Based on the graph above, how might you explain the change in wetland bird populations compared to the other habitats?

4. What impact might increasing global temperatures have on the wetland bird populations? Give examples of possible beneficial adjustments that could lead to adaptation over time, ensuring the survival of the wetland bird populations if faced with a dramatic increase in global temperatures.