BATTLE OF THE BEAKS

Biology Practical—Beak adaptation

INSTRUCTIONS FOR TEACHERS

It is expected that the practical part of this task can be completed in 45–60 minutes. The activity is intended for the whole class, but students should work individually within the group. Practical work may be carried out in a classroom or laboratory. Discussion and further research will depend on the time available. Extension activities could also be completed individually as homework exercises.

The following items are required for a class of 28 students.

APPARATUS

- 7 pairs of scissors
- 7 teaspoons
- 7 pairs of tweezers
- 7 clothes pegs
- 28 plastic beakers or cups

MATERIALS

- large paperclips
- large rubber bands
- toothpicks
- macaroni (or other small pasta)
- marbles
- mini-marshmallows
- peas

Students will simulate bird feeding by using a beak to collect food and place it into a stomach. There are four different beak types and a range of different food types to choose from.

This activity will allow students to explore the wide variety of beak shapes that can be seen within the bird population, as well as developing an understanding of the way in which beak shape is related to the available food sources within an environment.

If you wish to expand the learning experience for your students, you could provide them with some background information and perhaps a hypothesis, then ask them to develop their own experimental protocol to test their theories. This is a good way to help students get to grips with using the scientific method as well as developing analytical skills.

If your students are particularly able and you have sufficient time, you could use the full class data set to carry out some statistical analysis, such as a one-way ANOVA test. This will develop students scientific IT skills and also allow them to identify whether their data is statistically significant or purely due to chance.
In any habitat, food is limited and the types of foods available can vary. Animals with variations allowing them to take advantage of available foods will be more likely to survive. We call beneficial inherited variations adaptations. Animals with the most helpful adaptations will be the most likely to live long enough to pass their genes on to the next generation.

Many birds have evolved specialised beak shapes that are well suited to the available food sources in their environment. The image to the left shows a variety of these specialised beaks, as well as the food source they are most suited to. Students should be encouraged to study the beak shapes and form their own conclusions as to why each shape is best for each food. This can also be used as a reminder of generalist versus specialist feeding strategies.

Although this experiment only examines beak adaptations, students should be urged to think about other variations which may help animals adapt to their environment. These could include feet, wings and colouration in birds, and a whole host of other features in animals. Ask students to research animal adaptations which are unusual—these could be physical or behavioural. Suggest that they stay away from the common examples of polar bears, cacti, penguins, camels etc.

During the experiment, encourage the students to discuss their observations. Ask questions such as:

- What did you notice about your feeding abilities?
- Did everyone with your beak type have the same success rate with the same food? Why or why not?
- What did you notice about your behaviour and the behaviour of others?

After the final feeding stage, where all food types are available, ask students:

- What were your strategies this time?
- Was this different from the other feeding stages?
- If you were to repeat this stage would you change your strategy?
- What would you do differently if each food had a different nutritional value?
Practical activity

Students should select one of either a spoon, tweezers, binder clip or scissors plus a plastic cup, then sit quietly in a large circle. Explain to the students that they are now birds. Their chosen implement is their beak, and the plastic cup is their stomach. The beak must be held in one hand and the stomach should be on the floor. The stomach must remain upright at all times, and students can only put food into it using their beak.

Explain that some food items (paperclips, rubber bands, toothpicks and macaroni) will be placed in the feeding area, and spread out evenly among the students. When you say ‘go’ they are to use their beak to collect as much food as they can, and place it in their stomach. They have until you say ‘stop’. At this point they should stop feeding and count the items in their stomach, return the items to you, and record the total on their student sheet.

Note: Depending on your students you may need to caution them as to proper behaviour. As this is essentially a competitive environment, students may get carried away and become more aggressive as the activity progresses. (For safety you could replace scissors with chopsticks.) If you feel that some students are not responsible enough, they could be naturalists, observing and making notes on the feeding strategies of the other birds.

Take one of the food items, paperclips for example, and distribute evenly in the feeding area. Allow students 1–2 minutes to feed, or until all of the food is gone. Allow the students a few moments to count their stomach contents and fill in their worksheets. Then distribute a different food type, and repeat the experiment. Once the students have tried all of the available food groups, they should collate their individual results into a class data set.

For the final feeding activity, all types of food should be made available. Students should feed for 2–3 minutes. Students do not need to record data for this round, but should make behavioural observations. It may be best to do this activity in two groups if you have a large class, with one group observing and then swapping roles.

Discussion:

In this experiment what is the dependent variable? What is the independent variable?

Why is it better to use data from the entire class averaged together when assessing results and creating a graph, rather than using only your own data? For this experiment is it better to use a bar graph or a line graph to display the data? Create the appropriate graph from your class data set.

What did you notice about your behaviour and the behaviour of the other ‘birds’? Is this analogous to the behaviour of birds in the wild? Obviously most habitats have more than one food type available. This was simulated by the final feeding round in the activity. What was your strategy when all food items were available? How did this differ from your strategies in the previous scenarios?

What if the paper clips were high-protein beetles that were four times more nutritious than any of the other food items? Would your feeding strategy change?

What would happen if all of the birds simulated here flew to an island where no birds had been before, and the only available food was raisins. Which birds would be most successful? Which would be least successful? If we came back to the same island in 50 years, what would you expect to see?
Extension activities

Research the life of Charles Darwin and his voyage on *HMS Beagle*. Work as a group to develop a timeline of Darwin’s work on the theory of evolution, until he published his book *On the Origin of Species*. Make sure to mention other prominent scientists who were involved, including Alfred Russel Wallace, Charles Lyell and Joseph Dalton Hooker.

Visit a local park or woodland area and observe the birds that you find there. Make notes on their appearance, paying special attention to features that differ widely between species (such as beak shape). Take photographs or produce sketches of the birds you observe. Once you are back in the classroom, use ornithology books or the internet to identify the species of birds you have seen. Try to find out about the feeding habits of these birds—can you formulate a theory as to why the birds have the specific features you have noticed?

You will be allocated a beak type (a peg, pair of tweezers or a plastic spoon). In pairs, collect a beaker containing 30 peas, your beak implements and a stopwatch. You have 15 seconds to compete with your partner for the food in your beaker. You can only use your beak to pick up food, and you cannot pick up another food item until the previous one is safely in your hand. If you drop any, you will need to use your beak to pick them up before you can continue. After 15 seconds count how many food items you have. The winner is the one with the most, and at this point the losing bird ‘dies’—it has been outcompeted. The winning bird ‘reproduces’—in our simulation the losing bird will swap their beak type to that of the winner. (Make sure you have plenty of each type!) Keep swapping partners and repeat the competition until you have done it three times. After three competitions record the frequency of beak types in your population. Now complete another three competitions before stopping and recording the frequency of beak types again. Explain what happened to the bird populations as the experiment progressed and why. Do you think this is an accurate representation of population dynamics in a real-life ecosystem?

In your experiment above, the losing birds died at the end of each round of the experiment. Eventually, the weakest species will die out altogether. This is a natural and essential part of the evolutionary process, but in some cases the extinction of species has been hastened by human intervention. Visit the IUCN Red List website (www.iucnredlist.org) and research some species which are critically endangered. Have these species been naturally outcompeted, or have humans played a role? Write a report on your findings. Be sure to mention a variety of species—not just the cute and cuddly!