**Biodiversity and Evolution: Darwin’s Finches – Teachers’ Notes**

Who is it for? 16-18 year olds

How long will it take? The activity is ideal as an hour-long session.

Learning outcomes: Students will discover the importance of biodiversity and will explore how observing variation in the beak shape of Galapagos finches helped Darwin to formulate his theory of natural selection.

What do you need?

* Interactive whiteboard or projector
* Computer to connect to whiteboard or projector
* ARKive’s Biodiversity and Evolution: Darwin’s Finches classroom presentation (PowerPoint)
* Summary data table and data results spreadsheet (Excel)
* Student data tables
* Stopwatch/timer

Activity - for a class of 30 students (10 groups of 3):

* 6 pairs of chopsticks
* 6 small plastic spoons
* 6 toothpicks
* 6 clothes pegs
* 6 tweezers
* 10 paper cups
* 10 plastic boxes (e.g. takeaway boxes) each containing a mixture of rice, large seeds (e.g. pumpkin, sunflower), dried beans and Styrofoam balls (or other similar soft packing material)
* 5 plastic boxes containing rice only
* 5 plastic boxes containing dried beans only

Summary:

This hands-on activity is designed to remind 16-18 year olds about the concepts of biodiversity, evolution and Darwin’s theory of natural selection. By investigating biodiversity and the process of evolution students will learn how traits beneficial for survival are selected for and genetically passed on to successive generations.

Students are reminded how the shape and structure of the beaks of Darwin’s finches affect the type of food that they are able to eat. Students are reminded that birds with beaks that are better adapted to the food available on a particular island have a better rate of survival.

Students are given different implements to use as beaks. They must use these ‘beaks’ to obtain a variety of different types of ‘food’. Students will see which beaks are best adapted for different types of food, and how this can drive survival or extinction, using the finches Darwin observed in the Galapagos Islands as an example.

Preparation guidelines:

1. Read through the teachers’ notes to make sure you understand the session and activity.
2. Download the Biodiversity and Evolution: Darwin’s Finches PowerPoint presentation and accompanying Excel spreadsheet.
3. Print off the student data tables for Rounds 1 and 2 (enough for one set per group)
4. Prepare the plastic containers for Round 1 and Round 2 using the table below. It is useful to label the boxes with the group number, beak type and whether the box is for use in Round 1 or Round 2. You will need 20 small boxes in total.

|  |  |  |  |
| --- | --- | --- | --- |
| **Group** | **Beak** | **Round 1 (Mixed ‘food’)** | **Round 2** |
| 1 | Chopsticks | Rice, large seeds, dried beans, Styrofoam | Rice |
| 2 | Spoons | Rice, large seeds, dried beans, Styrofoam | Rice |
| 3 | Toothpicks | Rice, large seeds, dried beans, Styrofoam | Rice |
| 4 | Pegs | Rice, large seeds, dried beans, Styrofoam | Rice |
| 5 | Tweezers | Rice, large seeds, dried beans, Styrofoam | Rice |
| 6 | Chopsticks | Rice, large seeds, dried beans, Styrofoam | Beans |
| 7 | Spoons | Rice, large seeds, dried beans, Styrofoam | Beans |
| 8 | Toothpicks | Rice, large seeds, dried beans, Styrofoam | Beans |
| 9 | Pegs | Rice, large seeds, dried beans, Styrofoam | Beans |
| 10 | Tweezers | Rice, large seeds, dried beans, Styrofoam | Beans |

How to run the session:

1. Begin by introducing the concepts of biodiversity, evolution and natural selection by working through the Biodiversity and Evolution: Darwin’s Finches PowerPoint presentation. See slide notes on the PowerPoint presentation for further guidance and information.
2. Hand out the Mammalian Diversity worksheet as prompted in the PowerPoint. After providing time for them to complete it, guide the students through the answers.
3. Introduce the Darwin’s Finches activity. Explain that in this activity each student will play the role of a bird with a different beak shape.
4. Organise pupils into ten groups of three and give each group a different type of beak (there should be two groups with chopsticks, two with spoons, two with toothpicks, two with clothes pegs and two with tweezers).

**NOTE:** it is important that the group sizes are equal in order for the calculations later on to work. If you have some groups of two and some groups of three then instruct the students in larger groups that only two of them can take part in each round.

1. For Round 1, give each group the plastic box with the mixed ‘food’ that corresponds to their group number and beak type.
2. Give each student in the group a plastic cup to use as a ‘stomach’.
3. The students must use their ‘beak’ to collect as much ‘food’ from the box as possible in 30 seconds and place it in the cup.

**NOTE:** The students must not touch the container or the food with their hands, or use the beaks in a way other than that in which they are intended (e.g. they cannot use the pegs to scoop the food, or break the toothpicks to create a pair of makeshift chopsticks).

1. Once the ‘food’ has been collected, ask the students to write their data in the data table for Round 1. Get one person from each group to come to the front and enter the total number of each food type collected into the ‘results’ section of the Excel spreadsheet.
2. Collect the Round 1 ‘food’ back into the plastic boxes.
3. For Round 2, explain to the students that the birds have been separated by a storm onto two different islands (with one group of each beak type on each island). There has been a drought and most food types have died out. The food that is available is different on different islands. Give half the groups (one group of each beak type) the boxes that contain rice, and the other half the boxes that contain dried beans.
4. Repeat steps 7, 8 and 9.
5. After the data has been collected discuss:
   1. Were some beak types more successful at feeding than others?
   2. Was there any preference for different food types amongst the different species in Round 1?
   3. Do all birds have the same diet?
   4. Did all birds survive the drought season (Round 2)?
   5. Were the best adapted birds the same on both islands?
   6. What does this show about Darwin’s theory of evolution by natural selection?
6. Entering data into the results tables for Round 1 and Round 2 automatically generates summary graphics in the Excel spreadsheet.
   * Use the ‘food preference’ tab to demonstrate the food ‘preferences’ of the different beak types in Round 1 and to highlight the difference between specialist and generalist species (e.g. toothpicks vs. spoons).
   * Use the ‘total food success’ tab to present the total amount of food eaten by the different beak types in Round 1 and Round 2. The data for Round 2 should clearly demonstrate to the students that the more generalist species (e.g. spoons) survived, while the more specialist species (e.g. toothpicks) died out.

Suggestions for extension activities:

* Explore ARKive to find other examples of island species which have evolved to be different to their mainland counterparts (e.g. Hawaiian honeycreepers).
* Explore the issues surrounding conservation in the Galapagos Islands by downloading ‘ARKive News: Galapagos Conservation’ from our education resources page. Available at: <http://www.arkive.org/education/resources>
* Discuss with students the reasons why Darwin’s theory of natural selection was only gradually accepted, and help them to identify differences between Darwin’s theory and conflicting theories (e.g. Lamarck’s theory of evolution).
* Discuss the evidence supporting the theory of evolution, with reference to fossil, DNA and molecular evidence. Discuss with the students how new evidence from DNA research and the emergence of resistant organisms helps to support Darwin’s theory of evolution through natural selection.
* Get students to discuss the role of the scientific community in validating new evidence (including molecular biology) supporting the accepted scientific theory of evolution (scientific journals, the peer review process, scientific conferences).
* Follow up with a lesson on the three types of natural selection - directional, stabilising and disruptive selection (Darwin’s finches are an example of directional selection - compare to peppered moths and bacterial resistance to antibiotics).