**Evolution in the garden**



*Parus major* is a species of bird.

In the UK, this species of bird often gets its food from bird feeders in people’s gardens.

Scientists have made an observation:

* longer beaks are becoming more common in the *Parus major* population in the UK.

**To talk about in your pair or group**

How could you explain the scientists’ observation?

In your explanation you should include ideas about:

* variation
* advantage
* competition
* natural selection.

*Biology > Big idea BVE: Variation, adaptation and evolution > Topic BVE3: Evolution > Key concept BVE3.1: Explaining evolution*

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| **Response activity** |
| **Evolution in the garden** |

**Overview**

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| Learning focus: | The characteristics of a species can change over generations as advantageous adaptations become more common; this is evolution, and can be explained by a process of natural selection. |
| Observable learning outcome: | Use ideas about heritable variation, competition, fitness and natural selection to explain why an advantageous trait became more common in a population over a number of generations.  Apply the idea that evolution by natural selection occurs within populations, over generations and without foresight. |
| Activity type: | Discussion |
| Key words: | evolution, variation, competition, fitness, natural selection |

This activity uses small group discussion to help develop students’ ability to use the ideas of variation, competition, fitness and natural selection to explain why an advantageous trait became more common in a population over a number of generations. It can be used in response to the following diagnostic questions:

* Diagnostic question: The changing faces of evolution
* Diagnostic question: Is it evolution?
* Diagnostic question: Silence on the island

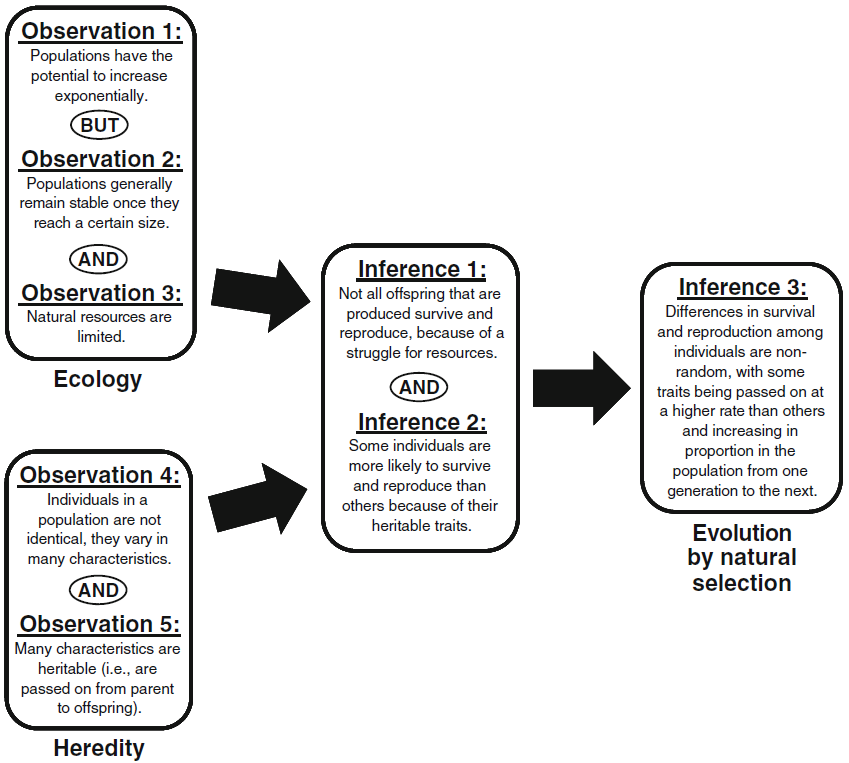
**What does the research say?**

Biologists explain evolution by combining ideas about heritable variation, competition, fitness and natural selection to explain why advantageous traits become more common in populations over generations.

To help students to become secure in doing this, it is helpful to allow them to practice with plentiful examples from the real world.

This activity uses a familiar, everyday context – that of birds in domestic gardens, and a selection pressure applied by the use of bird feeders – to remind students that evolution by natural selection is not something that happens only to species that are remote from us in distance or time (e.g. finches on the Galápagos Islands), but is happening right now all around us.

The explanation for evolution developed by Charles Darwin, Alfred Russel Wallace and others, and described by Darwin in his book *On the Origin of Species by Means of Natural Selection* in 1859, have been summarised by Mayr (1982) and others into five observations (or facts) and three inferences.



A summary of Darwin’s theory of evolution by natural selection; adapted from Mayr (1982) by Gregory (2009).

**Ecology**

**Heredity and variation**

**Competition and natural selection**

**Evolution**

This activity probes students’ understanding of observations 4 and 5, and inferences 2 and 3.

Gregory (2009) summarises numerous studies in which it was found that when students of various ages were asked to explain evolution by natural selection, very few explicitly included ideas about variation within species.

Research reported by a number of authors suggests that children up to age 11 have numerous misunderstandings about the inheritance of characteristics from one generation to the next, including that acquired characteristics (e.g. variation resulting from interaction with the environment) can be passed from parents to offspring (Cisterna, Williams and Merritt, 2013). In order to correctly explain evolution using ideas about natural selection, students must appreciate that only genetic variation can be inherited.

Evolution-related terminology can be associated with misunderstandings (Andersson and Wallin, 2006). The phrase “survival of the fittest” is often used without (or in order to avoid having to demonstrate) understanding of the mechanisms involved, and many students incorrectly think “fittest” refers to the most athletic or strongest individuals rather than to the individuals best adapted to compete and survive to reproduce in their environment (Gregory, 2009).

Common misunderstandings about natural selection and evolution arise from naïve, everyday ways of thinking that – whilst intuitive and therefore difficult to overcome – do not align with the accepted scientific explanations (Gregory, 2009; Smith, 2010). These naïve ways of thinking include **teleology**, **anthropomorphism** and **Lamarckism**.

**Ways to use this activity**

The common name for *Parus major* is the great tit. You can decide whether or not you want to use the term ‘great tits’ with your students when you introduce the activity! The student sheet avoids it, to retain the focus on the science.

Students should complete this activity in pairs or small groups. The focus of the activity should be on group discussion to what to include in their explanation and how to sequence it.

It is through the discussions that students can check their understanding and develop their explanations. Listening in to the conversations of each pair/group will often give you insights into how your students are thinking. The quality of the discussions can be improved with a careful selection of pairs/groups, or by allocating specific roles to students in each pair/group. For example, you may choose to select a student with strong prior knowledge as a scribe, and forbid them from contributing any of their own answers; they may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

After their discussions, each pair/group should be prepared to report the key points of their discussion to another pair/group, or to the class.

*Differentiation*

You may choose to read the instructions to the class, so that everyone can focus on the science. In some situations it may be more appropriate for a teaching assistant to read for one or two students.

To increase the challenge for more able students, you could omit the prompt for students to include ideas about variation, advantage, competition and natural selection in their explanation.

**Expected answers**

Students should use ideas about heritable variation, advantage/fitness, competition and natural selection to explain why longer beaks are becoming more common in the *Parus major* population in the UK.

The main points of students’ explanation should include:

* There was (genetic) variation in the *Parus major* population (which arose at random). Some of the birds had shorter beaks and some had longer beaks.
* Individual birds with longer beaks had an advantage in the competition for food, as they were better adapted to reach food inside the bird feeder. These individuals were more likely to survive to reproduce – this is natural selection – and were therefore more likely to pass on (the gene/mutation that causes) the longer beak shape.
* As the birds reproduced, over a number of generations (the gene/mutation that causes) the longer beak shape became more common in the population.

Be on the lookout for evidence of incorrect ways of thinking in students’ explanations, such as:

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|  | **Incorrect way of thinking** | **Example** |
| **Teleology** | Ascribing a goal, intention or purpose to a natural process such as evolution, including implying that adaptations arise by design or in order to fulfil a need (Alters and Nelson, 2002; Kelemen, 2012). | Suggesting that the birds’ beaks got longer so that they could reach more food, or got longer to help them survive. |
| **Anthropomorphism** | Evoking human emotions and motivations to explain a natural process such as evolution (Tamir and Zohar, 1991; Legare, Lane and Evans, 2013). | Suggesting that the birds wanted or chose to evolve longer beaks. |
| **Lamarckism** | Belief in the inheritance of acquired characteristics, whereby evolution proceeds because organisms pass on characteristics they have acquired through use or disuse during their lifetime (Engel Clough and Wood-Robinson, 1985; Alters and Nelson, 2002). | Suggesting that the birds’ beaks got longer because they were stretching to reach inside the feeders, or because the feeders provided plenty of food to help the birds and their beaks grow big and strong, and that the birds’ offspring then inherited these longer beaks. |

**Acknowledgments**

Developed by Alistair Moore (UYSEG).

Images: pixabay.com/fietzfotos (5159874)

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