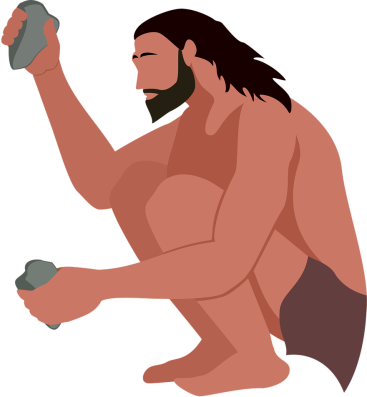
**The changing faces of evolution**



Would you recognise the face of a human from 4 million years ago?

Fossils show that humans with thicker and stronger face bones became more common as the human species evolved.

**Part 1**

1. Fossils of a population of early humans show that:

* some of the individuals had weak face bones
* some of the individuals had stronger face bones.

What is this an example of?

|  |  |
| --- | --- |
| **A** | competition |
| **B** | natural selection |
| **C** | variation |

1. The individuals in the population of early humans fought each other for food and mates.

What is this an example of?

|  |  |
| --- | --- |
| **A** | competition |
| **B** | natural selection |
| **C** | variation |

1. Individuals with stronger face bones were more likely to survive the fights and could then reproduce, passing on their features to the next generation.

What is this an example of?

|  |  |
| --- | --- |
| **A** | competition |
| **B** | natural selection |
| **C** | variation |

**Part 2**

1. When individuals with stronger face bones reproduced, their offspring also had stronger face bones.

This means that the stronger face bones must have been caused by…

|  |  |
| --- | --- |
| **A** | …differences in the individuals’ environments. |
| **B** | …information stored in the individuals’ genomes. |
| **C** | …the diet that the individuals were eating. |

1. Why would scientists describe the individuals with stronger face bones as ‘fitter’?

|  |  |
| --- | --- |
| **A** | Those individuals were better adapted to survive. |
| **B** | Those individuals were more athletic. |
| **C** | Those individuals were more attractive. |

1. Why is the story of the changing face bones an example of evolution?

|  |  |
| --- | --- |
| **A** | Humans used natural selection to evolve stronger face bones. |
| **B** | Natural selection caused stronger face bones to appear in humans for the first time. |
| **C** | Natural selection caused stronger face bones to become more common in the population over generations. |

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

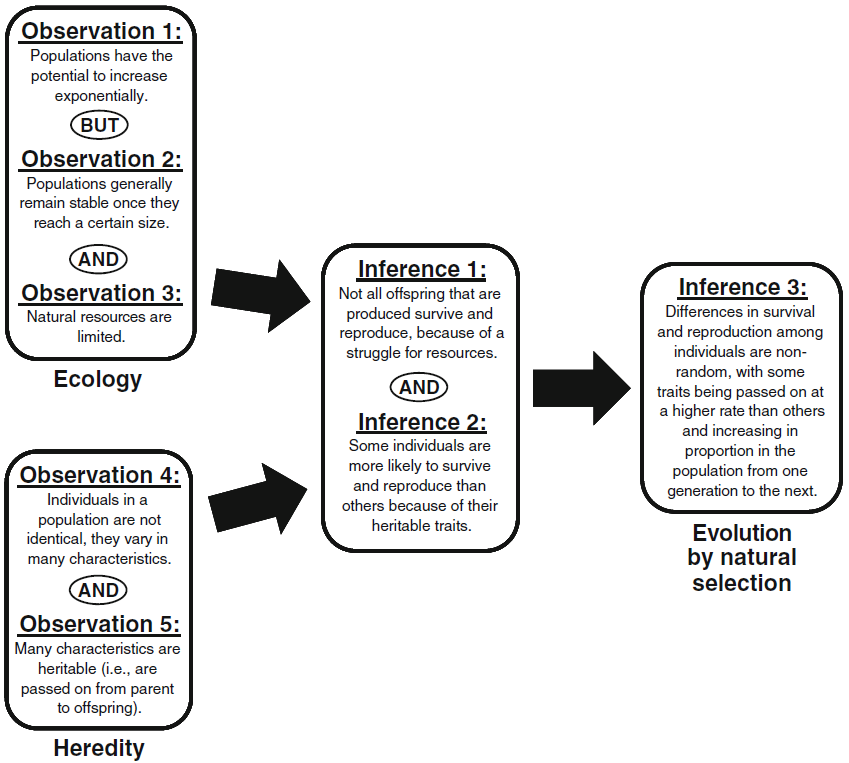
|  |
| --- |
| **Diagnostic question** |
| **The changing faces of evolution** |

**Overview**

|  |  |
| --- | --- |
| 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. |
| Question type: | Simple multiple choice |
| Key words: | evolution, variation, competition, fitness, natural selection |

**What does the research say?**

Fossils and other evidence show that the characteristics of species change over generations, and this change is called evolution. 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.



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**

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.

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).

**Ways to use this question**

Students should complete the questions individually. This could be a pencil and paper exercise, or you could use the presentation with an electronic voting system or mini white boards.

*Differentiation*

You may choose to read the questions 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.

*Extension*

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**. This is incorrectly ascribing a goal, intention or purpose to a natural process. In the case of evolution by natural selection, it is common and intuitive – but incorrect – for students to think and use language that implies that adaptations arise by design or in order to fulfil a need (Alters and Nelson, 2002; Kelemen, 2012).

More able or older students could be challenged through group discussion of a piece of text in which incorrect teleological explanations appear. Teleological explanations are common in popular media reports. This activity is based upon a piece of scientific research that was reported on the BBC News website (Webb, 2014), which contains some statements that could be read as teleological – for example: “our male ancestors evolved beefy facial features as a defence against fist fights”. Even the scientific paper describing the original research (Carrier and Morgan, 2015) includes statements that could be read as teleological, e.g. “we suggest that many of the facial features that characterize early hominins evolved to protect the face from injury during fighting with fists”.

Students could be challenged to re-write these statements to avoid teleology, e.g.: “fist fights caused strong facial bones to become more common during human evolution” or “fist fights caused the natural selection of individuals with strong facial bones during human evolution”.

**Expected answers**

*Part 1*

1. **C** – variation
2. **A** – competition
3. **B** – natural selection

*Part 2*

1. **B** – …differences in the individuals’ genomes.
2. **A** – Those individuals were better adapted to survive.
3. **C** – Natural selection caused stronger face bones to become more common in the population over generations.

**How to respond - what next?**

If there is a range of answers, you may choose to respond through structured class discussion. Ask one student to explain why they gave the answer they did; ask another student to explain why they agree with them; ask another to explain why they disagree, and so on. This sort of discussion gives students the opportunity to explore their thinking and for you to really understand their learning needs. Responses often work best when the activities involve paired or small group discussions, which encourage social construction of new ideas (meaning making) through dialogue.

If students struggle 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, the following BEST ‘response activity’ allows them to develop their understanding through small group discussion, and could be used in follow-up to this diagnostic question:

* Response activity: Evolution in the garden

**Acknowledgments**

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Images: pixabay.com/UnifiArt (4462628)

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