**Forest dwellers**

**Part 1**



A population of squirrels lives in a forest.

1. The squirrels are in competition with one another for resources such as food.

Which statement about this competition do you think is true?

|  |  |
| --- | --- |
| **A** | The winners will be decided at random. |
| **B** | The winners will **not** be decided at random. |

1. Which statement best explains your answer to question 1?

|  |  |
| --- | --- |
| **A** | All members of a population are the same, so none of them are better or worse at competing for resources. |
| **B** | The biggest and strongest squirrels will always win. |
| **C** | The fastest squirrels will always win. |
| **D** | Some of the squirrels will have inherited features that make them better at competing for resources. |

**Forest dwellers**

**Part 2**



A forest includes a population of trees.

1. Which statement about the trees do you think is true?

|  |  |
| --- | --- |
| **A** | The trees are in competition with one another for resources. |
| **B** | The trees are **not** in competition with one another for resources. |

1. Which statement best explains your answer to question 1?

|  |  |
| --- | --- |
| **A** | Trees cannot fight one another because they cannot move. |
| **B** | Trees make their own food, so they don’t need to compete for it. |
| **C** | Trees compete for limited resources such as water. |
| **D** | Only animals compete for resources. |

*Biology > Big idea BE: Variation, adaptation and evolution > Topic BE3: Evolution > Key concept BE3.1: Explaining evolution*

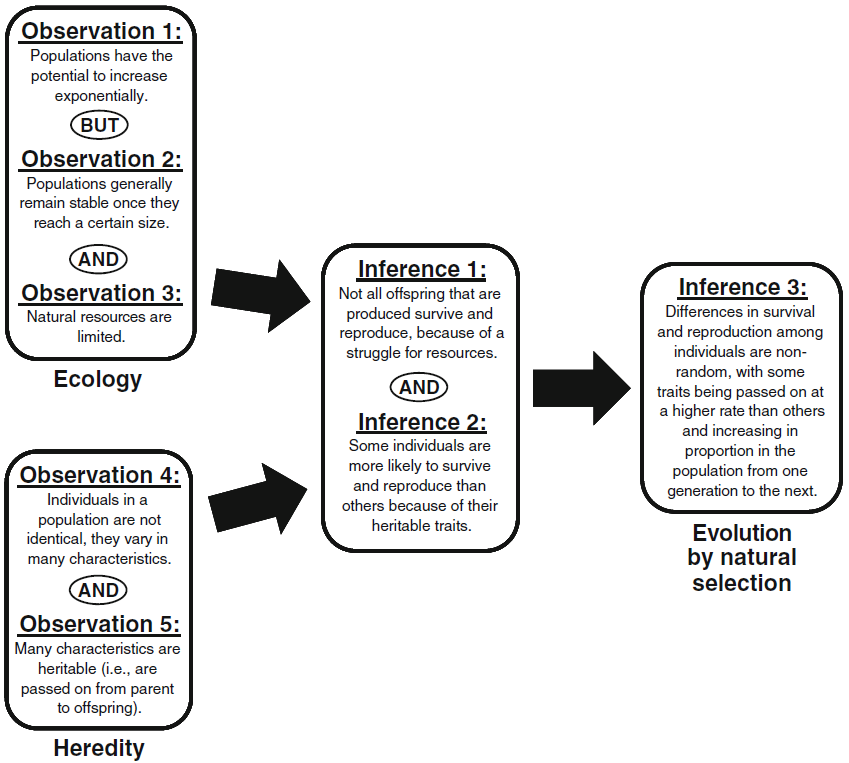
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| --- |
| **Diagnostic question** |
| **Forest dwellers** |

**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: | Recognise that organisms compete for limited resources, and that some individuals have traits that help them compete more successfully than other individuals in the same population. |
| Question type: | Two-tier multiple choice |
| Key words: | competition, population |

**What does the research say?**

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).

**Heredity and variation**

**Ecology**

**Competition and natural selection**

**Evolution**

This activity probes students’ understanding of observation 3 and inferences 1-3.

Gregory (2009) notes that our modern understanding of the process of evolution by natural selection comprises both random and non-random aspects, and describes a two-stage model of the process; a version that could form the basis of understanding at age 16 (and for which the foundations could be laid from age 11) is as follows:

1. Random variation – which arises due to mutations and recombination of alleles during sexual reproduction, both of which are random (non-directed and non-intentional). Most new variations have a neutral effect on competition, some are harmful, and some are advantageous.
2. Non-random selection – in which, due to competition and natural selection, individuals with advantageous variations are more likely to survive to pass their heritable variations to their offspring.

This activity probes students’ understanding of the second, non-random, stage.

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 *essentialism*, which is the incorrect belief that each species has a uniform ‘type’ or a common ‘essence’ and that variation among individual members of a species is an anomalous or unimportant deviation from this norm. Research indicates that it is common for students to believe that while there are differences *between* species there is no variation between individuals of the *same* species (Shtulman, 2006; Gregory, 2009), and numerous studies have found that when students of various ages were asked to explain evolution by natural selection, very few students explicitly included ideas about variation within species (Gregory, 2009).

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).

Students may believe that while animals need to evolve to survive, plants do not (Bizzo, 1994).

**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.

**Expected answers**

1. **B** – The winners will **not** be decided at random.
2. **D** – Some of the squirrels will have inherited features that make them better at competing for resources.

Note: If students select answers 1A (“The winners will be decided at random”) and 2A (“All members of a population are the same, so none of them are better or worse at competing for resources”), this could be evidence of essentialist thinking (see ‘What does the research say’, above). Students who select 2B (“The biggest and strongest squirrels will always win”) or 2C (“The fastest squirrels will always win”) may have heard the term “fittest” in relation to competition (e.g. in the phrase “survival of the fittest”) and may have the common misunderstanding that it refers to the most athletic or strongest individuals rather than to the individuals best adapted to compete and survive in their environment.

1. **A** – The trees are in competition with one another for resources.
2. **C** – Trees compete for limited resources such as water.

Note: If students select 3B (“The trees are **not** in competition with one another for resources.”) and 4A (“Trees cannot fight one another because they cannot move”) or 4D (“Only animals compete for resources”) this may be evidence that they think competition only relates to fighting or racing to win food or mates; this could be related to the common misunderstanding that the term “fittest” (as in “survival of the fittest”) refers to the most athletic or strongest individuals rather than to the individuals best adapted to compete and survive in their environment. If students select 4B (“Trees make their own food, so they don’t need to compete for it”) this may be evidence that they have applied their understanding of photosynthesis; they have selected a statement that is, on its own, true but they need to take into account that plants do compete for other resources that may be limited such as water, light, space, pollinators and seed dispersers.

**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 have misunderstandings about competition, how it operates in populations, and what organisms compete for, the following BEST ‘response activity’ allows them to develop their understanding through small group discussion and concept mapping, and could be used in follow-up to this diagnostic question:

* Response activity: The struggle for existence

**Acknowledgments**

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Images: squirrels – pixabay.com/GeorgeB2 (5733089); forest – pixabay.com/MemoryCatcher (272595)

**References**

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