**What causes variation?**

**Humans**

Humans are all one species (*Homo sapiens*).



There are differences between individual humans.

Differences between members of a species are called variation.

Complete the sentences in the box.

You can only use the words **all**, **some** and **none** to fill the gaps.

|  |
| --- |
| ………………………………… of the variation between humans is caused by differences in their genomes.  ………………………………… of the variation between humans is caused by differences in their lifestyles or environment.  ………………………………… of the variation between humans is inherited from their parents.  ………………………………… of the variation between humans appears because they are created by sexual reproduction. |

**What causes variation?**

**Sunflowers**

The sunflowers in the photograph are all one species (*Helianthus annuus*).



There are differences between the individual sunflowers.

Differences between members of a species are called variation.

Complete the sentences in the box.

You can only use the words **all**, **some** and **none** to fill the gaps.

|  |
| --- |
| ………………………………… of the variation between the sunflowers was caused by differences in their genomes.  ………………………………… of the variation between the sunflowers was caused by differences in their environment.  ………………………………… of the variation appeared because the sunflowers were created by sexual reproduction.  ………………………………… of the sunflowers varied on purpose so that they could absorb more light. |

*Biology> Big idea BVE: Variation, adaptation and evolution > Topic BVE1: Variation > Key concept BVE1.1: Differences within species*

|  |
| --- |
| **Diagnostic question** |
| **What causes variation?** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | There is variation between individuals of the same species, caused by differences in the genomes, lifestyles and environments of the individuals. |
| Observable learning outcome: | Identify sources of variation, including differences in the genomes, lifestyles and environments of individuals. |
| Question type: | Focused cloze |
| Key words: | variation, species, genome, heredity |

**What does the research say?**

Various researchers (e.g. Deadman and Kelly, 1978; Hackling and Treagust, 1982; Gott et al., 1985; Gregory, 2009; Cisterna, Williams and Merritt, 2013; Allen, 2014) have described common misunderstandings about variation and its causes, which can persist in students up to undergraduate level, including that:

* variation is only caused by environmental factors (students are much less likely to suggest sexual reproduction, inheritance or differences in the genome as causes of variation, even when given a scenario in which environmental conditions are said to remain constant);
* teleological arguments such as that variation occurs to satisfy a need, or in order to improve;
* acquired characteristics (variation resulting from interaction with the environment or from learning) can be passed from parents to offspring.

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 (a fundamental requirement for evolution by natural selection, in which the natural variation within populations of a species can cause some individuals to have a survival and therefore reproductive advantage when environmental conditions change).

**Ways to use this question**

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

Make it clear to students that they can only use the words **all**, **some** and **none** to fill the gaps.

*Differentiation*

You may choose to read the sentences 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.

The last two gap-fill sentences on each page could be omitted for some students.

**Expected answers**

*Humans*

**Some** of the variation between humans is caused by differences in their genomes.

**Some** of the variation between humans is caused by differences in their lifestyles or environment.

**Some** of the variation between humans is inherited from their parents.

**Some** of the variation between humans appears because they are created by sexual reproduction.

*Sunflowers*

**Some** of the variation between the sunflowers was caused by differences in their genomes.

**Some** of the variation between the sunflowers was caused by differences in their environment.

**Some** of the variation appeared because the sunflowers were created by sexual reproduction.

**None** of the sunflowers varied on purpose so that they could absorb more light.

**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 the causes of variation, the following BEST ‘response activity’ could be used to build understanding by using real-life examples to challenge students’ thinking in follow-up to this diagnostic question:

* Response activity: Observing and explaining variation

**Acknowledgments**

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Images: humans – pixabay.com/geralt (2944065); sunflowers – pixabay.com/Vijayanarasimha (268015)

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