***Archaeopteryx***

Photograph 1 shows a famous fossil of an animal called *Archaeopteryx*. Photograph 2 shows an artist’s idea of what *Archaeopteryx* looked like, based on fossil evidence.

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| --- | --- |
| **Photograph 1** | **Photograph 2** |
|  |  |

*Archaeopteryx* is extinct. Only twelve *Archaeopteryx* fossils have ever been found.

Why might the artist’s idea not look exactly like a real *Archaeopteryx*?

Tick **one** box for each answer.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Answers** | | I am **sure** this is right | I **think** this is right | I **think** this is wrong | I am **sure** this is wrong |
| **1** | There are no living *Archaeopteryx* to look at. |  |  |  |  |
| **2** | Fossils are often incomplete organisms. |  |  |  |  |
| **3** | There would be variation between individual *Archaeopteryx.* |  |  |  |  |
| **4** | The artist had to use imagination. |  |  |  |  |
| **5** | Fossils cannot show us what colour an organism was. |  |  |  |  |

*Biology> Big idea BVE: Variation, adaptation and evolution > Topic BVE1: Variation > Key concept BVE1.2: Changes in species over time – fossil evidence*

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| --- |
| **Diagnostic question** |
| ***Archaeopteryx*** |

**Overview**

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| Learning focus: | The fossil record provides evidence that species change over time, but it is incomplete and there are limitations to the conclusions that can be drawn from it. |
| Observable learning outcome: | Explain why there are limitations to the conclusions and explanations that can be made from fossil evidence. |
| Question type: | Confidence grid |
| Key words: | fossils, evolution |

**What does the research say?**

Numerous authors have recognised that young children find fossils interesting and thus that fossils can be used to increase student engagement in learning about evolution (e.g. Earland, 2004; Borgerding and Raven, 2018; Hunter et al., 2018).

Some authors have also noted that fossils provide a useful context for leaning about the nature of science, e.g. collecting evidence, making observations, and making inferences from evidence (e.g. Gift and Krasny, 2003; Balmer, 2015). Hence, fossils could be used as a context in which to explore ideas about the limitations of the conclusions and explanations that can be made from evidence.

**Ways to use this question**

Students should complete the confidence grid 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 question and answers 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. There are no living *Archaeopteryx* to look at – **right**
2. Fossils are often incomplete organisms – **right**
3. There would be variation between individual *Archaeopteryx* – **right**
4. The artist had to use imagination – **right**
5. Fossils cannot show us what colour an organism was – **wrong** (students may be surprised by this, but evidence about the colour of feathers, fur and skin can be obtained from fossils; scientists studying *Archaeopteryx* fossils have found preserved microscopic structures that make the pigments found in feathers)

**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.

It has been reported that experience of examining real fossils in the classroom and in the field can increase engagement and learning of key concepts about fossils (e.g. Clary and Wandersee, 2009; Teske and Pittman, 2016); if students have misunderstandings about what kinds of inferences can be made from fossils, and the limitations of these inferences, it could be helpful to provide some fossil specimens for them to examine in pairs or small groups, with an emphasis on discussion of what you could conclude about the original organisms from observing their fossils.

The following BEST ‘response activity’ presents a case study from a young scientist working at the Natural History Museum in London, UK, for students to discuss, and could be used in follow-up to this diagnostic question:

* Response activity: *Stegosaurus*

**Acknowledgments**

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Images: *Archaeopteryx* fossil – pixabay.com/fill (911017); artist’s impression – pixabay.com/Raw2daBon3 (1645455)

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