**Billions of years**

The Earth was formed approximately 4.5 billion years ago.



The oldest fossils are of organisms that lived approximately 3.5 billion years ago.

How long is a billion years?

|  |  |
| --- | --- |
| **A** | Ten million (10000000) years. |
| **B** | One hundred million (100000000) years. |
| **C** | One thousand million (1000000000) years. |
| **D** | One million million (1000000000000) years. |

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

|  |
| --- |
| **Diagnostic question** |
| **Billions of years** |

**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: | Recall that fossils are between ten thousand and billions of years old. |
| Question type: | Simple multiple choice |
| Key words: | fossils |

**What does the research say?**

Learning about fossils and evolution requires students to appreciate the timescales involved. At the time of writing, the oldest fossils ever discovered are thought to be around 3.5 billion years old (Tyrrell, 2017).

Studies have found that children understand relative time (including the concepts of ‘before’ and ‘after’) long before they understand absolute time (e.g. historical dates) (Ault, 1982; Barton and Levstik, 1996).

Research has suggested that children at age 10-11 find it difficult to appreciate the absolute ages of fossils and the species they relate to; for example, one study found that when children of this age were asked to estimate when dinosaurs lived, answers ranged from “1000 years ago” to “millions of years ago”, and this could be down to guessing due to the children’s limited understanding of large numbers (Trend, 1998).

Note: Historically, a billion was defined using the ‘long scale’ in British English as one million million   
(1000000000000, or 1012), while American English has always used the ‘short scale’ definition of one thousand million (1000000000, or 109). The UK government has used the ‘short scale’ definition since 1974, and it is this definition that is used here.

**Ways to use this question**

Students should complete the question 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 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**

C – One thousand million (1 000 000 000) years.

**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 conceptualise a billion, a simple challenge to their thinking may be helpful. For example, ask students to think about a *thousand* seconds, a *million* seconds and a *billion* seconds in other units of time. A thousand seconds is just under 17 minutes; a million seconds is 11.5 days; a billion seconds is almost 32 years.

If students have misunderstandings about the relative ages of fossils and the organisms from which they are formed, the following BEST ‘response activity’ describes a small-group discussion task in which students assemble a timeline using relative and absolute ages. It could be used in follow-up to this diagnostic question:

* Response activity: The year of life

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Images: NASA

**References**

Ault, C. J. (1982). Time in geological explanations as perceived by elementary-school students. *Journal of Geological Education,* 30**,** 304-309.

Barton, K. C. and Levstik, L. S. (1996). “Back when God was around and everything”: Elementary children's understanding of historical time. *American Educational Research Journal,* 33**,** 419-454.

Trend, R. (1998). An investigation into understanding of geological time among 10- and 11-year-old children. *International Journal of Science Education,* 20**,** 973–988.

Tyrrell, K. A. (2017). *Oldest fossils ever found show life on Earth began before 3.5 billion years ago* [Online]. University of Wisconsin–Madison, WI. Available at: <https://news.wisc.edu/oldest-fossils-found-show-life-began-before-3-5-billion-years-ago/>.