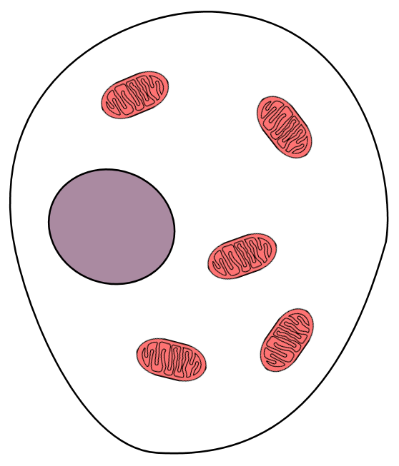
**How many cells?**



1. What is the **smallest** number of cells that a living organism can be made up of?

|  |  |
| --- | --- |
| **A** | One cell |
| **B** | Hundreds of cells |
| **C** | Thousands of cells |
| **D** | Millions of cells |

1. What is the **largest** number of cells that a living organism can be made up of?

|  |  |
| --- | --- |
| **A** | One cell |
| **B** | Hundreds of cells |
| **C** | Thousands of cells |
| **D** | Millions of cells |

*Biology > Big idea BCL: The cellular basis of life > Topic BCL1: Cells > Key concept BCL1.3: Cell shape and size*

|  |
| --- |
| **Diagnostic question** |
| **How many cells?** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Cells are usually too small to be seen without a microscope, but have a range of three-dimensional shapes and sizes. |
| Observable learning outcome: | Estimate the numbers of cells that make up different organisms. |
| Question type: | Simple multiple choice |
| Key words: | cell |

**What does the research say?**

Dreyfus and Jungwirth (1989) acknowledge that the cell is, when first introduced, an abstract concept. A number of researchers have reported that children aged 11-16 lack an appreciation of size and scale, and that this impacts their understanding of the relative sizes of cells and other biological structures (e.g. Arnold, 1983; Dreyfus and Jungwirth, 1988; Driver et al., 1994).

The American Association for the Advancement of Science (AAAS) has reported that in a large sample of students aged 11-18: 37% thought that there are no single-celled organisms, believing instead that the smallest number of cells an organism could be made up of is “about 100”; a further 11% thought that “about 100” is the *largest* number of cells an organism could be made up of, and another 11% thought the maximum to be “about 1000” cells (AAAS Project 2061).

**Ways to use this question**

Students should complete the question 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.

*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**

1. **A** One cell
2. **D** Millions of cells

**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.

If students have misunderstandings about the existence of single-celled organisms it could be helpful to use images and videos of single-celled organisms (including bacteria and unicellular animals such as amoebae) as part of a teacher-led class discussion. In addition, the response activity ‘Match game! Substance-structure-function’ from key concept BCL1.2 *Cells and cell structures* could also be used in response to this diagnostic question, to help reinforce understanding that a single cell is alive.

If students have misunderstandings about the maximum number or cells from which an organism can be made up, it could be helpful to revisit ideas about the relative size and scale of cells compared to other structures using online media such as videos and interactive animations. Exploring how small most cells are in comparison to other more familiar structures may help students to appreciate that larger organisms such as humans must be made up of millions of cells. The following BEST ‘response activity’ suggests some online resources that could be used to challenge students’ thinking in this way in follow-up to this diagnostic question:

* Response activity: Zooming in

**Acknowledgments**

Adapted by Alistair Moore (UYSEG) from an item developed by the American Association for the Advancement of Science (AAAS Project 2061, item CE128001).

Images: mitochondria – Wikimedia Commons/Nevit (adapted by UYSEG); chloroplasts – pixabay.com/Clker-Free-Vector-Images (35023) (adapted by UYSEG); all other drawings – UYSEG

**References**

AAAS Project 2061. *Item CE128001: Different organisms range in the number of cells they have, from only one cell to many millions* [Online]. American Association for the Advancement of Science. Available at: <http://assessment.aaas.org/items/1/CE/281/CE128001#/1>.

Arnold, B. (1983). Beware the molecell! *Biology Newsletter,* 42**,** 2-6.

Dreyfus, A. and Jungwirth, E. (1988). The cell concept of 10th graders: curricular expectations and reality. *International Journal of Science Education,* 10(2)**,** 221-229.

Dreyfus, A. and Jungwirth, E. (1989). The pupil and the living cell: a taxonomy of dysfunctional ideas about an abstract idea. *Journal of Biological Education,* 23(1)**,** 49-55.

Driver, R., et al. (1994). *Making Sense of Secondary Science: Research into Children's Ideas,* London, UK: Routledge.