**The unit of life**

The diagrams show an atom, a biological molecule and a cell. They are not drawn to the same scale.

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| --- | --- | --- |
|  |  |  |
| An atom | A biological molecule | A cell |

1. What is the **smallest** structure that can be alive?

|  |  |
| --- | --- |
| **A** | An atom |
| **B** | Many atoms arranged to make a biological molecule |
| **C** | Many biological molecules arranged to make a single cell |
| **D** | Many cells arranged to make an organism |

1. How would you explain your answer to question 1?

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

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| **Diagnostic question** |
| **The unit of life** |

**Overview**

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| 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: | Describe the interacting levels of organisation within a cell (atoms, molecules, subcellular structures and whole cells) that make life possible. |
| Question type: | Two-tier multiple choice |
| Key words: | cell, life, living |

**What does the research say?**

A single cell can carry out all the processes of life. An organism may be made up of a single cell or many cells working together. This is why scientists think of cells as the basic units of life.

Researchers have acknowledged that the cell is, when first introduced, an abstract concept, and that children may never see cells functioning, so the *living* (functional) cell remains an abstract idea even if they have become familiar with the structures of cells through light microscopy and pictures (Dreyfus and Jungwirth, 1988; 1989).

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). A related misunderstanding is that everything studied in biology lessons, including biological molecules such as proteins and carbohydrates, is made of cells and is alive; some children would only apply the term “molecule” to things they had studied in chemistry and physics (Dreyfus and Jungwirth, 1988).

**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.

The answers to the question will show you whether students understand that cells carry out life processes and that a single cell is the smallest thing that can be alive, and will reveal the presence of common misunderstandings.

*Differentiation*

You may choose to read the statements 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** – Many biological molecules arranged to make a single cell

To explain their answer, student should use the idea that a single cells is the smallest structure that can carry out all of the characteristic processes of living things.

**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 through dialogue.

If students have misunderstandings about whether cells can carry out life processes, or about which cell structures or organelles enable it to do this, 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 struggle with the idea that a single cell is functional and active, and therefore alive, it may be helpful to challenge their thinking using videos that show living cells growing, dividing and moving. Some freely-accessible videos are available on the *Cell Image Library* website at:

* Cell division: <http://www.cellimagelibrary.org/browse/cellprocess/Cell%20Division?refresh_video=true>
* Cell movement: <http://www.cellimagelibrary.org/browse/cellprocess/Cell%20Migration%20&%20Motility?refresh_video=true>

**Acknowledgments**

Developed by Alistair Moore (UYSEG).

Images: atom – Wikimedia Commons/AG Caesar; protein (myoglobin) – Wikimedia Commons/AzaToth; mitochondria – Wikimedia Commons/Nevit (adapted by UYSEG); all other drawings – UYSEG

**References**

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