**Made of cells?**

**Animals**

|  |  |
| --- | --- |
|  |  |
| Humans | Fish |
|  |  |
| Ants | Slugs |

1. Which of these animals are made up of cells?

|  |  |
| --- | --- |
| **A** | All of them. |
| **B** | Only some of them. |
| **C** | Only one of them. |
| **D** | None of them. |

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

**Made of cells?**

**Plants**

|  |  |
| --- | --- |
|  |  |
| Trees | Flowers |
|  |  |
| Vegetables | Grass |

1. Which of these plants are made up of cells?

|  |  |
| --- | --- |
| **A** | All of them. |
| **B** | Only some of them. |
| **C** | Only one of them. |
| **D** | None of them. |

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

**Made of cells?**

**Bacteria**

|  |  |
| --- | --- |
|  |  |
| *Salmonella* | *E. coli* |
|  |  |
| MRSA |  |

1. Which of these bacteria are made of cells?

|  |  |
| --- | --- |
| **A** | All of them. |
| **B** | Only two of them. |
| **C** | Only one of them. |
| **D** | None of them. |

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

**Made of cells?**

**Biological molecules**

|  |  |
| --- | --- |
|  |  |
| Proteins | Carbohydrates |
|  |  |
| DNA |  |

1. Which of these biological molecules are made up of cells?

|  |  |
| --- | --- |
| **A** | All of them. |
| **B** | Only two of them. |
| **C** | Only one of them. |
| **D** | None of them. |

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

*Biology > Big idea BCL: The cellular basis of life > Topic BCL1: Cells > Key concept BCL1.2: Cells and cell structures*

|  |
| --- |
| **Diagnostic question** |
| **Made of cells?** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Organisms are made up of one or more cells, which have common structures that carry out life processes. |
| Observable learning outcome: | Apply the idea that organisms are made up of one or more cells. |
| Question type: | Two-tier multiple choice |
| Key words: | cell |

**What does the research say?**

Research has identified a number of misunderstandings that students have about cells, including:

* that there are only two kinds of cells, namely animal cells and plant cells, and hence that only animals and plants are made up of cells (Clément, 2007)
* the assumption that molecules and cells are all the same size, a conflation that has been dubbed “the molecell” (Arnold, 1983)
* that everything studied in biology lessons, including biological molecules such as proteins and carbohydrates, is made of cells (Dreyfus and Jungwirth, 1988).

**Ways to use this question**

Students should complete the questions 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.

The answers to the questions will show you whether students understand that organisms – including animals, plants and bacteria – are made up of cells, and that molecules such as proteins, carbohydrates and DNA are not.

*Differentiation*

The ‘biological molecules’ group could be omitted for students who may not yet have encountered these terms in lessons, or who would struggle to read the words.

You may choose to read the questions 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**

*Animals*: A – All of them

*Plants*: A – All of them

*Bacteria*: A – All of them

*Biological molecules*: D – None of them

**How to respond - what next?**

Students whose experience of looking at cells using a microscope has been limited to human cheek cells and onion epidermal cells may have the misunderstanding that only the human and the vegetables (deliberately represented here by onions) are made of cells. Such students would benefit from looking at cells from a wider range of tissues and organisms, and hence the following BEST ‘response activity’ could be used in follow-up to this diagnostic question:

* Response activity: What is it made of?

Students who do not think that bacteria are cells may have the misunderstanding that a single cell is not a living thing. These students need to explore through discussion and observation the idea that organisms can be made from just one (or many) cells, and hence the following BEST ‘response activities’ could be used in follow-up to this diagnostic question:

* Response activity: The hungry alien
* Response activity: Life processes in cells

Students who think that some organisms (e.g. ants, grass, slugs) are too small to be made of cells may have misunderstandings about the size and scale of cells. Key concept BCL1.3 *Cell shape and size* provides diagnostic questions to further probe these misunderstandings and response activities to help students overcome them.

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