**The size and shape of cells**

Some children are talking about cells.

**B**

All cells are the same size, but

not all cells are the same shape.

**A**

All cells are the same size and shape.

**D**

Different cells can have both different sizes and different shapes.

**C**

All cells are the same shape, but

not all cells are the same size.

1. Which person is correct?
2. Can you give examples that prove the other people are wrong?

*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 size and shape of cells** |

**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: | Link the shapes and sizes of different cells to their functions. |
| Question type: | Two-tier multiple choice, talking heads |
| Key words: | cell |

**What does the research say?**

Clément (2007) notes that “the cell concept is generally introduced by two juxtaposed drawings, a plant cell and an animal cell”, and that the plant cell is generally polygonal and adjacent to other cells while the animal cell is more rounded in shape and isolated. Clément has dubbed the common depiction of an animal cell as two concentric circles (cell membrane and nucleus, lacking other organelles or internal structures) the “fried-egg model”, and has shown that it can block subsequent development of understanding (e.g. about cell differentiation).

If students are not presented with a greater variety of images of cells they may come to think that all animals cells and all plants cells have the same shape and structures as these two archetypal depictions; Clément found exactly this misunderstanding persisting in students up to undergraduate level.

Several researchers have reported that children aged 11-16 lack an appreciation of size and scale, manifested in their assumption that atoms, molecules and cells are all the same size. This conflation has been dubbed “the molecell” (Arnold, 1983; 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.

*Differentiation*

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**

1. **D** Different cells can have both different sizes and different shapes.

According to research conducted by the American Association for the Advancement of Science (AAAS), 57% of 11-14 year old students chose the correct response (answer D), while the figure was 63% in 14-18 year olds. In both groups the remaining incorrect responses were approximately equally distributed between answers A, B and C.

1. Students should be able to give examples of cells that show the student is aware there is a variety of sizes and shapes of cells e.g. in terms of size, bacteria are small than animal cells, which are generally smaller than plant cells; and in terms of shape, students may suggest nerve cells, egg and sperm cells, different blood cells, root hair cells, etc.

**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 variety of sizes and shapes of cells that make up organisms, the following BEST ‘response activity’ could be used in follow-up to this diagnostic question:

* Response activity: The right cell for the job

**Acknowledgments**

Adapted by Alistair Moore (UYSEG) from an item developed by the American Association for the Advancement of Science (AAAS Project 2061, item CE053002).

Images: UYSEG

**References**

AAAS Project 2061. *Item CE053002: Different cells can have different sizes and shapes* [Online]. American Association for the Advancement of Science. Available at: <http://assessment.aaas.org/items/1/CE/CE053002#/0>.

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

Clément, P. (2007). Introducing the cell concept with both animal and plant cells: a historical and didactic approach. *Science & Education,* 16(3-5)**,** 423-440.

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.