**Cell division**

New cells are made from existing cells. This requires cell division.

Which diagram best represents cell division?

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| --- | --- | --- | --- | --- |
| **A** |  |  |  |  |
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| **B** |  |  |  |  |
|  |  |  |  |  |
| **C** |  |  |  |  |
|  |  |  |  |  |
| **D** |  |  |  |  |

*Biology > Big idea BHL: Heredity and life cycles > Topic BHL2: Changes within an organism’s lifetime > Key concept BHL2.1: Growth*

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| **Diagnostic question** |
| **Cell division** |

**Overview**

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| Learning focus: | The process of growth takes place in all living multicellular organisms when existing cells divide to make new cells. |
| Observable learning outcome: | Apply the idea that cell structures (such as the genome and organelles) must be copied to make genetically identical cells during cell division. |
| Question type: | Simple multiple choice |
| Key words: | growth , cell division, nucleus, genetic material, genome |

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| **B** | **BRIDGING**  This diagnostic question probes understanding of ideas that are usually taught at age 14-16, to build a bridge to later stages of learning. |

**What does the research say?**

Research conducted by Riemeier and Gropengießer (2008) identified aspects of learning about growth and cell division that students can find difficult, including a lack of clarity about what would happen to genetic material during cell division (including the misunderstanding that it would be shared, rather than copied, which would lead to a decrease in the number of chromosomes). When cell division is introduced students do not appreciate that cell enlargement must occur and the genome must be copied if the cells resulting from division are to be copies of the original cell.

From their reanalysis of investigations conducted by Lewis & Wood-Robinson (2000), Riemeier and Gropengießer noted “some students imagined cell division as a division of the cell into two halves, thereby reducing the number of chromosomes as well”. Replication of chromosomes had therefore not been considered. Lewis & Wood-Robinson, in their study looking at school students aged 14 -16 and their understanding of the processes of cell division, found that although there was an awareness of the general functions of mitosis (growth and repair) and some understanding of the purpose of cell division in terms of transfer of genetic information, there appeared to be little understanding of the processes by which these functions are achieved.

**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**

The expected answer is C, in which the new cells that have been formed are the same size as the original cell and each other, and both have a complete copy of the genome (stored in the nucleus).

If students choose option A this may suggest that their understanding of cell division has not yet progressed to include the role of cell enlargement prior to division, which ensures that the new cells are the same size as the original cell (such that the cells do not become smaller with each division).

Students who choose option B may not appreciate that each new cell that is made requires a complete copy of the genome (stored in the nucleus) to enable it to function, and therefore that the genome must be copied during cell division. Similarly, students who choose option D may have the misunderstanding that the genome is shared during cell division.

**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.

The responses given by students will allow you to determine whether students are aware that during cell division the genome (genetic material) located in the nucleus is copied, and that the new cells that are made will each have a complete copy of the genome (to enable them to function) and will be identical to the cell they arose from (and each other). The size of the nucleus in this activity is important as it allows you to assess if students think the genome is halved during cell division.

If students have misunderstandings about the copying of the genome during cell division the following BEST ‘response activities’ could be used in follow-up to this diagnostic question:

* Response activity: Cupcake bakery
* Response activity: A carbon copy

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Images: UYSEG

**References**

Lewis, J. and Wood-Robinson, C. (2000). Genes, chromosomes, cell division and inheritance - do students see any relationship? *International Journal of Science Education*, 22, 177-195.

Riemeier, T. and Gropengießer, H. (2008). On the roots of difficulties in learning about cell division: process-based analysis of students' conceptual development in teaching experiments. *International Journal of Science Education*, 30(7), 923-939.