**A carbon copy**

When multicellular organisms grow, new cells are made from existing cells. This requires cell division.

After each division the cells that are made are identical to the cell they came from.

**To do**

Below is a drawing of a cell. It has two chromosomes in the nucleus, and three mitochondria in the cytoplasm.

After the first division there will be two cells. After the second division there will be four cells.

Draw the cells that will be produced after each division in the spaces provided.

|  |  |
| --- | --- |
| **Cell that will divide** | **After first division - Two cells** |
| **After second division - Four cells** | |

**To talk about in your pair**

1. Compare your drawings with your partner. Do your drawings look the same? If there are differences what are they?
2. Are the cells that have been drawn all the same size?
3. Who has drawn the cells correctly?

*Biology> Big idea BHL: Heredity and life cycles > Topic BHL2: Changes within an organism’s lifetime > Key concept BHL2.21: Growth*

|  |
| --- |
| **Response activity** |
| **A carbon copy** |

**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. |
| Activity type: | Drawing, discussion |
| Key words: | cell division, genetic material, mitochondria, cytoplasm |

This activity can help develop students’ understanding by addressing the sticking-points revealed by the following diagnostic question:

* Diagnostic question: Cell division

|  |  |
| --- | --- |
| **B** | **BRIDGING**  This activity explores 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.

Researchers have found that formative assessment coupled with constructivist approaches such as drawing and group discussions can help students to explore explanations and develop understanding, and has been found to enhance participation (e.g. Backett-Milburn and McKie, 1999; Chin and Teou, 2010). The drawing aspect in particular enables children to convey personal preferences and concepts that may be beyond their current vocabulary.

**Ways to use this activity**

Students should complete the first part of this activity individually and the second part either in pairs. The focus of the discussion should be to determine if the cells that individuals have drawn are correct, in that they are replicas of the original cell, contain the same components and the cells are the same size. The activity will allow students to compare their drawings and through discussion determine whether their drawings are correct. In turn this will allow you to determine whether students have understood the idea that enlargement and copying of the genome and organelles are essential for cell division.

It is through the discussions that students can check their understanding and develop their explanations. Listening in to the conversations of each pair will often give you insights into how your students are thinking. The quality of the discussions can be improved with a careful selection of pairs, or by allocating specific roles to students in each pair. For example, you may choose to select a student with strong prior knowledge as a scribe, and forbid them from contributing any of their own answers; they may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

After their discussions, each pair should be prepared to report the key points of their discussion to another pair, or to the class.

**Expected answers**

Students should draw exact copies of the cells in the boxes provided. Each cell should have the same number of chromosomes and mitochondria as the original cell, and should be the same size as the original cell.

*Note*

This activity presents cell division in the context of growth, so it is assumed that the two rounds of cell division are both mitosis to produce identical body cells (rather than the two divisions of meiosis, which would reduce the chromosome number and produce gametes).

**Acknowledgments**

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Images: UYSEG

**References**

Backett-Milburn, K. and McKie, L. (1999). A critical appraisal of the draw and write technique. *Health Education Research,* 14(3)**,** 387-398.

Chin, C. and Teou, L.-Y. (2010). Formative assessment: using concept cartoon, pupil's drawings, and group discussions to tackle children's ideas about biological inheritance. *Journal of Biological Education,* 44(3)**,** 108-115.

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.