**Atoms, biological molecules and organelles**

Cell are made up of:

**Organelles**

*Such as:*

Mitochondria

Chloroplasts

Nucleus

Vacuole

**Biological molecules**

*Such as:*

Proteins

Carbohydrates

Fats

**Atoms**

*Such as:*

Carbon

Hydrogen

Oxygen

Nitrogen

Look at the statements in the table. Some are right and some are wrong.

Tick **one** box for each statement.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Statements** | | I am **sure** this is right | I **think** this is right | I **think** this is wrong | I am **sure** this is wrong |
| **1** | Biological molecules, organelles and atoms are all about the same size. |  |  |  |  |
| **2** | Biological molecules are made up of atoms. |  |  |  |  |
| **3** | Biological molecules are made up of organelles. |  |  |  |  |
| **4** | Atoms are much smaller than organelles. |  |  |  |  |

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

|  |
| --- |
| **Diagnostic question** |
| **Atoms, biological molecules and organelles** |

**Overview**

|  |  |
| --- | --- |
| 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: | Confidence grid |
| Key words: | cell, organelle, molecule, atom |

**What does the research say?**

Dreyfus and Jungwirth (1989) acknowledge that the cell is, when first introduced, an abstract concept. 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). Specifically, it has been reported that some children aged 11-16 believe that atoms, molecules and cells are all the same size. This conflation has been dubbed “the molecell” (Arnold, 1983).

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 confidence grid 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 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**

1. Biological molecules, organelles and atoms are all about the same size - **wrong**
2. Biological molecules are made up of atoms - **right**
3. Biological molecules are made up of organelles - **wrong**
4. Atoms are much smaller than organelles - **right**

**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 the relative size and scale of atoms, biological molecules, organelles and cells compared to other structures, it may be helpful to challenge their thinking using online media such as videos and interactive animations. The following BEST ‘response activity’ suggests some online resources that could be used to challenge students’ thinking in this way in follow-up to this diagnostic question:

* Response activity: Zooming in

**Acknowledgments**

Developed by Alistair Moore (UYSEG).

**References**

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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.

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Driver, R., et al. (1994). *Making Sense of Secondary Science: Research into Children's Ideas,* London, UK: Routledge.