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

|  |
| --- |
| **Response activity** |
| **Match game! Substance-structure-process** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Organisms are made up of one or more cells, which have common structures that carry out life processes. |
| Observable learning outcome: | Use ideas about cell structures and their functions to explain why a cell is a living thing. |
| Activity type: | Discussion |
| Key words: | cell, organelle, nucleus, cell membrane, cytoplasm, mitochondria, chloroplasts, vacuole, cellular respiration, photosynthesis, reproduction, growth, excretion, diffusion |

This activity can help develop students’ understanding by addressing the sticking-points related to whether cells can carry out life processes, and which cell structures or organelles enable cells to do this, as revealed by the following diagnostic question:

* Diagnostic question: A single cell can…

**What does the research say?**

Dreyfus and Jungwirth (1988; 1989) note that most children will never see cells functioning, so the *living* (functional) cell remains an abstract idea even if they have become familiar with the structures of cells through light microscopy and pictures. They found that many 16-year-olds struggled to explain how cells carry out life processes. Many of the students thought that cells contain macroscopic organs such as a digestive tract (e.g. for nutrition) or lungs (e.g. for respiration). Even students who could identify the correct cell organelles could not explain how they carry out their functions, especially how the nucleus ‘controls’ the structure and functions of a cell.

Douvdevany *et al.* (1997) used a game to probe and develop junior high school science teachers’ understanding of the relationships between various substances, structures and life processes in cells. Participants were instructed to select three cards from a pile of cards representing substances, structures and processes, and then asked to describe relationships between the things named on the cards. A number of triangular (truly three-way), chain-like (A-->B-->C) and ‘pair of pairs’ (A-B & B-C, but not A-C) relationships were suggested by the participants, and misunderstandings were revealed and explored during their discussions.

**Ways to use this activity**

The cards on the final page of this document should be printed and cut out. Students should complete this activity in pairs or small groups to pick three cards and reach a consensus, through discussion, on the relationship(s) between them. These could be described to other groups, to the class, or to the teacher.

The students could be instructed to pick one substance card, one structure card and one process card; or for a less structured and more challenging activity they could be told to pick three cards at random from the combined pile.

Giving each group one set of cards between them is helpful for encouraging discussion, but each group member should be able to report back to the class. Listening in to the conversations of each group will provide insights into how the students are thinking.

Students should be encouraged to use the group discussions to help them construct the best explanations as they can about the relationships between the cards they have picked. Class discussion or teacher intervention can help to address any remaining misunderstandings.

**Acknowledgments**

Developed by Alistair Moore (UYSEG), from an instrument reported by Douvdevany *et al.* (1997).

**References**

Douvdevany, O., Dreyfus, A. , Jungwirth, E. (1997). Diagnostic instruments for determining junior high-school science teachers' understanding of functional relationships within the 'living cell'. *International Journal of Science Education,* 19(5)**,** 593-606.

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.

Dreyfus, A. and Jungwirth, E. (1989). The pupil and the living cell: a taxonomy of dysfunctional ideas about an abstract idea. *Journal of Biological Education,* 23(1)**,** 49-55.

**Print and cut out cards for ‘Match game!’ activity**

*Substance cards*

✁

|  |  |  |
| --- | --- | --- |
| Carbon dioxide | Oxygen | Water |
| DNA | Food | Energy |

Note: while energy is not a substance, a helpful approach to developing energy explanations with students aged 11-18 is to regard energy as a quasi-material substance. For further information, see our ‘Approaches’ article ‘*Teaching energy’*, which is available on the homepage at [www.BestEvidenceScienceTeacing.org](http://www.BestEvidenceScienceTeacing.org)

*Cell structure cards*

✁

|  |  |  |
| --- | --- | --- |
| Nucleus | Cell membrane | Cytoplasm |
| Mitochondria | Chloroplasts | Vacuole |

*Process cards*

✁

|  |  |  |
| --- | --- | --- |
| Cellular respiration | Photosynthesis | Reproduction |
| Growth | Excretion | Diffusion |