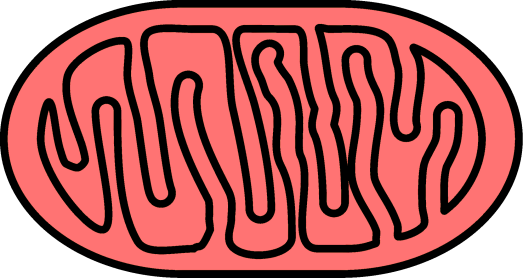
**Plant parts**

**Part 1**



mitochondrion

The diagram shows one of the mitochondria from a plant cell.

1. What could you say about the plant cell that this mitochondrion is from?

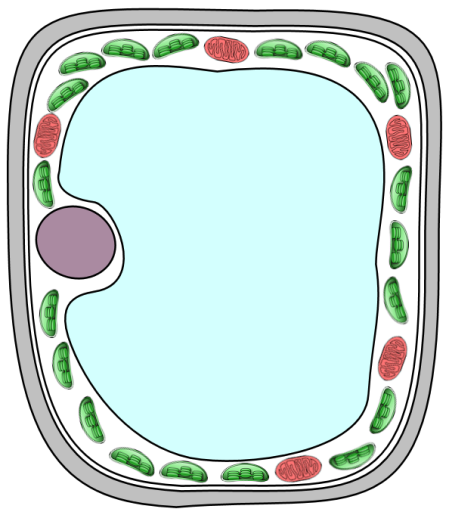
|  |  |
| --- | --- |
| **A** | The cell could be from a leaf or a root. |
| **B** | The cell must be from a leaf. |
| **C** | The cell must be from a root. |

1. How would you explain your answer to question 1?

|  |  |
| --- | --- |
| **A** | Cells in all parts of a plant need mitochondria. |
| **B** | Mitochondria are only found in parts of a plant that can take in light. |
| **C** | Mitochondria are only found in parts of a plant that can take in oxygen. |
| **D** | Mitochondria are not found in parts of a plant that can get energy directly from the Sun. |

**Plant parts**

**Part 2**



nucleus

mitochondria

chloroplasts

cell wall

vacuole

The diagram shows a plant cell.

1. In which part of the cell does aerobic cellular respiration take place, and when?

Connect the correct boxes.

|  |  |  |
| --- | --- | --- |
| cell wall |  |  |
|  |  |  |
| chloroplasts |  | all the time |
|  |  |  |
| mitochondria |  | when it’s dark |
|  |  |  |
| nucleus |  | when it’s light |
|  |  |  |
| vacuole |  |  |

*Biology > Big idea BCL: The cellular basis of life > Topic BCL3: Biochemistry > Key concept BCL3.2: Cellular respiration*

|  |
| --- |
| **Diagnostic question** |
| **Plant cell mitochondria** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Energy for life processes is provided by a chemical process called cellular respiration inside all living cells, which uses glucose (from food) as fuel. |
| Observable learning outcome: | Apply understanding of photosynthesis and cellular respiration to explain when and why they take place in plants. |
| Question type: | Two-tier multiple choice, linking ideas |
| Key words: | mitochondria, cellular respiration |

**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.

Learning about cellular respiration will be most effective if it helps students make connections between concepts with which they are already familiar (Seymour and Longden, 1991). By the time they come to learn in detail about cellular respiration in the later stages of the 11-14 age range, students will have already learnt about mitochondria as part of the animal and plant cell models. They need to be able to link the presence of mitochondria in cells to their role in aerobic cellular respiration – including in plant cells.

The misunderstanding that photosynthesis is simply ‘inverse respiration’ (Cañal, 1999) can lead to incorrect beliefs such as that cellular respiration does not take place at all in plants because they photosynthesise instead (“plants do photosynthesis, animals do respiration”), or that cellular respiration only happens in plants when there is no light for photosynthesis (e.g. during the night) (Haslam and Treagust, 1987; Maeng and Gonczi, 2019).

Svandova (2014) found that, when questioned, most students would select the answer stating that respiration takes place in all living cells (perhaps learned by rote), but would contradict this in a subsequent question by selecting an answer stating that in plants, cellular respiration only takes place in cells in the leaves – a misunderstanding also observed by Haslam and Treagust (1987). This may have been due to an incorrect conceptual link to the presence of light (and students’ confusion with photosynthesis) or to the knowledge that plants take in oxygen through (pores in) their leaves.

Brown and Schwartz (2009) note the student misconception that plant cells do not need mitochondria because “they get their energy directly from the Sun”.

Two-tier multiple choice questions have commonly been used in the research to probe students’ understanding of cellular respiration (e.g. Haslam and Treagust, 1987; Svandova, 2014).

**Ways to use this question**

Students should complete the questions 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 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**

*Part 1*

1. **A** – The cell could be from a leaf or a root.
2. **A** – Cells in all parts of a plant need mitochondria.

*Part 2*

1. mitochondria ––– all the time

**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.

If students have misunderstandings the roles of mitochondria and other cell structures in plant and animal cells, it might be worth revisiting the following BEST key concept, which provides diagnostic questions and response activities to further probe and challenge students’ understanding:

* Key concept: BCL1.2 Cells and cell structures

**Acknowledgments**

Developed by Alistair Moore (UYSEG).

Images: mitochondria – Wikimedia Commons/Nevit (adapted by UYSEG); chloroplasts – pixabay.com/Clker-Free-Vector-Images (35023) (adapted by UYSEG); all other parts – UYSEG

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