**Making gas (Part 2)**



1. Which of the following gasses does a plant make when it’s **dark**?

|  |  |
| --- | --- |
| **A** | Carbon dioxide and oxygen. |
| **B** | Only carbon dioxide. |
| **C** | Only oxygen. |
| **D** | Neither. |

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

|  |  |
| --- | --- |
| **A** | Both cellular respiration and photosynthesis take place all the time in plants. |
| **B** | Only cellular respiration takes place in plants when it’s dark. |
| **C** | Only photosynthesis takes place in plants when it’s dark. |
| **D** | Neither cellular respiration nor photosynthesis take place in plants when it’s dark. |

**Making gas (Part 2)**



1. Which of the following gasses does a plant make when it’s **light**?

|  |  |
| --- | --- |
| **A** | Carbon dioxide and oxygen. |
| **B** | Only carbon dioxide. |
| **C** | Only oxygen. |
| **D** | Neither. |

1. How would you explain your answer to question 3?

|  |  |
| --- | --- |
| **A** | Both cellular respiration and photosynthesis take place all the time in plants. |
| **B** | Both cellular respiration and photosynthesis take place in plants when it’s light. |
| **C** | Only photosynthesis takes place in plants when it’s light. |
| **D** | Neither cellular respiration nor photosynthesis take place in plants when it’s light. |

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

|  |
| --- |
| **Diagnostic question** |
| **Making gas (Part 2)** |

**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 |
| Key words: | cellular respiration, gas exchange |

**What does the research say?**

In a review of numerous research studies published over 20 years, Cañal noted the “frequency and extraordinary persistence” of the misunderstanding that photosynthesis is simply ‘inverse respiration’ in students of all ages from primary school to university level, in countries such as Australia, France, Israel, New Zealand, Spain, the UK and the USA (Cañal, 1999). This misunderstanding 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).

In a study with 13-year-old students by Marmaroti and Galanopoulou (2006), 20% of the students thought cellular respiration only occurs in plants when photosynthesis is not taking place, and a further 20% thought photosynthesis is one of the ways in which plants respire. In a study with 11-16 year-olds by Svandova (2014), one of the most frequent student misunderstandings was that cellular respiration and photosynthesis are the same process in plants, differing only in name and in which part of the day they take place (photosynthesis during daylight and cellular respiration during the night); 77% of the oldest students held this misunderstanding.

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). A number of studies have assessed students’ understanding of cellular respiration by probing their understanding of the gasses taken in and made by animals and plants (e.g. Haslam and Treagust, 1987; Seymour and Longden, 1991; Maeng and Gonczi, 2019). The questions in this activity are adapted from those used by Maeng and Gonczi (2019).

**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**

1. **B** – Only carbon dioxide.
2. **B** – Only cellular respiration takes place in plants when it’s dark.
3. **A** – Carbon dioxide and oxygen.
4. **B** – Both cellular respiration and photosynthesis take place in plants when it’s light.

**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 following BEST ‘response activity’ challenges students to apply their understanding of cellular respiration and which gasses it makes to predict how it will change the composition of an indicator solution, and could be used in follow-up to this diagnostic question:

* Response activity: Respiration indications

Concept maps may help students to understand the relationship between photosynthesis and cellular respiration – specifically that photosynthesis does not directly provide energy for life processes, but provides carbohydrate food that is used as a fuel for cellular respiration in both plants and ultimately consumers such as animals, which does provide energy for life processes. The following BEST ‘response activities’ involve students making concept maps, and could be used or revisited in response to this diagnostic question, with students challenged to explain how the carbohydrate food made by plants (as mentioned in ‘Acorn to oak’) becomes food consumed by animals such as humans (as mentioned in ‘Deep breath’):

* Response activity (from BCL3.1): Acorn to oak
* Response activity (from BCL3.2): Deep breath

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