**Energy for life**

**Part 1**



Humans use food as fuel to provide the energy they need to stay alive.

In humans, which process uses food as fuel to provide energy?

|  |  |
| --- | --- |
| **A** | breathing |
| **B** | digestion |
| **C** | respiration |
| **D** | photosynthesis |

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**Part 2**



We know that **humans** use food as fuel for a process that provides the energy they need to stay alive.

Which answer do you think is true for other animals?

|  |  |
| --- | --- |
| **A** | Other animals use the **same** process as humans to provide energy to stay alive. |
| **B** | Other animals use a **different** process to provide energy to stay alive. |
| **C** | I don’t know. |

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**Part 3**



We know that **humans** use food as fuel for a process that provides the energy they need to stay alive.

Which answer do you think is true for plants?

|  |  |
| --- | --- |
| **A** | Plants use the **same** process as humans to provide energy to stay alive. |
| **B** | Plants use a **different** process to provide energy to stay alive. |
| **C** | I don’t know. |

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

|  |
| --- |
| **Diagnostic question** |
| **Energy for life** |

**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: | Recall that all living organisms need energy for life processes, which is provided by cellular respiration. |
| Question type: | Simple multiple choice |
| Key words: | cellular respiration, life processes, living |

|  |  |
| --- | --- |
| **P** | **PRIOR UNDERSTANDING**  This diagnostic question probes understanding of ideas that are usually taught at age 5-11, to aid transition from earlier stages of learning. |

**What does the research say?**

Students are likely to have learnt at primary school level that respiration is a characteristic process of living organisms, often as one of a list of processes introduced using the mnemonic MRS (C) GREN (movement, respiration, sensitivity, (control), growth, reproduction, excretion, nutrition).

It can be difficult to convince children that even familiar living organisms, particularly plants, demonstrate all of these characteristics. In a study of 13-16 year-old students’ confusion between breathing and respiration was conducted by Seymour and Longden (1991), some of the students defined respiration in terms of breathing (e.g. “it’s when we inhale and exhale”), and some thought that some animals, particularly invertebrates such as worms, do not respire because there are no visible breathing movements. Many of the students believed that plants do not respire, which may be associated with the perception that they do not visibly breathe in the same way as humans and other animals, but was also linked to the misunderstanding that it’s because they photosynthesise instead.

There is some evidence that while most children regard animals as alive, only 30% of children aged 6, and 70-80% of children aged 12-15, regarded plants as alive (Stavy and Wax, 1989). Students need to understand that plants are living, and that cellular respiration takes places in living plants cells all the time. Researchers have reported that the misunderstanding that cellular respiration does not take place in plants because they photosynthesise instead (“plants do photosynthesis, animals do respiration”) is frequent and extraordinarily persistent in secondary school students (Haslam and Treagust, 1987; Cañal, 1999; Maeng and Gonczi, 2019).

In a study with secondary school students, Maeng and Gonczi (2019) reported that most students thought that in plants a process other than cellular respiration is responsible for providing energy for life processes; some incorrectly thought that plants could not perform cellular respiration (and that only humans could), and some incorrectly believed photosynthesis was the process responsible.

**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. **C – respiration**

Students who pick 1A (“breathing”) may have the common misunderstanding that breathing and respiration are the same thing (Seymour and Longden, 1991). Students who pick 1B (“digestion”) may be focussed on the process that breaks down food before it is absorbed into the blood and circulated to cells, rather than thinking about the process in cells that uses food as fuel to provide energy for other life processes.

1. **A – Other animals use the same process as humans to provide energy to stay alive.**

Students who pick 2B (“Other animals use a different process to provide energy to stay alive”) may think that respiration only takes place in humans, or may have the common misunderstanding that breathing and respiration are the same thing and may think that some animals don’t respire because they don’t display visible breathing movements.

1. **A – Plants use the same process as humans to provide energy to stay alive.**

Students who pick 3B (“Plants use a different process to provide energy to stay alive”) may incorrectly think that plants are not alive, or that respiration only takes place in humans/animals, or that plants don’t respire because they don’t breathe, or that plants photosynthesise (to provide energy for life processes) instead of respiring.

Asking students to explain why they chose the answers they did, for each question, will provide insightful diagnostic information about what they’re thinking.

**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 about the characteristic processes of living organisms, and which organisms display them, it might be worth revisiting key concept BCL1.1 *Living, dead and never been alive* to further probe and consolidate their understanding.

The following BEST ‘response activity’ could be used in follow-up to this diagnostic question to help students to explore some of the things that animals and – crucially – plants (which tend to appear quite static) need energy for:

* Response activity: Ball of energy

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