**Respiration and breathing**

What do you know about respiration and breathing?

Complete the sentences in the box.

You should only write **respiration** or **breathing** in each gap.

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| --- |
| Moving air into and out of your lungs is called ……………………………………………. .  Using food as fuel to provide energy is called ……………………………………………. .  ……………………………………………. happens in **all** living things.  ……………………………………………. only happens in **some** living things.  ……………………………………………. does not happen in plants.  ……………………………………………. provides living things with oxygen for ……………………………………………. . |

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

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| --- |
| **Diagnostic question** |
| **Respiration and breathing** |

**Overview**

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| --- | --- |
| 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: | Focused cloze |
| Key words: | cellular respiration, breathing |

**What does the research say?**

Wierdsma et al. (2016) note that some concepts – such as respiration – have different meanings in different contexts, and that in science lessons students have to learn to recontextualise them. In everyday life, the word ‘respiration’ is often used to refer to breathing; in biology, ‘respiration’ refers to the chemical process that takes place in cells, while ‘breathing’ (or strictly, ventilation) refers to the movement of air into and out of the lungs. Yet another term – ‘gas exchange’ or ‘gaseous exchange’ – refers to the diffusion of molecules of gasses across an exchange surface, such as the lining of the alveoli between the blood and the air in the lungs.

Many studies have noted that secondary school students incorrectly think breathing and (cellular) respiration are the same thing (e.g. Haslam and Treagust, 1987; Seymour and Longden, 1991; Songer and Mintzes, 1994; Wierdsma et al., 2016).

An in-depth analysis was conducted by Seymour and Longden (1991) with 13-16 year-olds. 32% of the students incorrectly thought that respiration and breathing are the same thing; and 57% thought that respiration took place (only) in the lungs. 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. When asked how they thought you could tell if an organism was respiring, a typical response was that you would be able to see 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.

Seymour and Longden (1991) note that in order to fully understand the difference between breathing and respiration, students must accept that respiration is a biochemical process that takes place inside cells.

**Ways to use this question**

Students should complete the cloze exercise 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 sentences 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.

For lower ability students, the final sentence in the cloze activity could be omitted, or the word “oxygen” could be changed to “air” (however, care must be taken not to perpetuate the common misunderstanding that air and oxygen are the same thing, perhaps via some guided discussion after the activity has been completed).

**Expected answers**

Moving air into and out of your lungs is called [**breathing**].

Using food as fuel to provide energy is called [**respiration**].

[**Respiration**] happens in all living things.

[**Breathing**] only happens in some living things.

[**Breathing**] does not happen in plants.

[**Breathing**] provides living things with oxygen for [**respiration**].

**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 differences, and relationship, between breathing and respiration, the following BEST concept mapping ‘response activity’ could be used in follow-up to this diagnostic question:

* Response activity: Deep breath

**Acknowledgments**

Developed by Alistair Moore (UYSEG).

Images: girl taking a deep breath – adapted by UYSEG from pixabay.com/Westfrisco (2340272)

**References**

Haslam, F. and Treagust, D. F. (1987). Diagnosing secondary students' misconceptions of photosynthesis and respiration in plants using a two-tier multiple choice instrument. *Journal of Biological Education,* 21(3)**,** 203-211.

Seymour, J. and Longden, B. (1991). Respiration - that's breathing isn't it? *Journal of Biological Education,* 25(3)**,** 177-183.

Songer, C. J. and Mintzes, J. J. (1994). Understanding cellular respiration: an analysis of conceptual change in college biology. *Journal of Research in Science Teaching,* 31(6)**,** 621-637.

Wierdsma, M., et al. (2016). Recontextualising cellular respiration in upper secondary biology education. Characteristics and practicability of a learning and teaching strategy. *Journal of Biological Education,* 50(3)**,** 239-250.