**Deep breath**



Amber goes swimming after lunch.

She wants to find out how long she can stay underwater at the bottom of the swimming pool.

She knows she won’t be able to breathe underwater, so she takes a deep breath first!

Amber’s deep breath and her lunch will both help her body to keep working underwater.

**To do in your pair or group**

1. Look at the cards you have been given.
2. Talk about how they could be used to complete the **concept map** on the next page.
3. When it is complete, the concept map should explain how Amber’s deep breath and her lunch will both help her body to keep working underwater.
4. Place the cards on the concept map.



**A deep breath provides**

**Lunch**

**provides**

AIR

FOOD

which is taken into the body

by the process of

which is taken into the body

by the process of

which

fills the

and is broken down by the process of

and

provides

which

provides

for the process of gas exchange, during which it moves into the

which is absorbed

into the

which

carries it

to the

where it is used as a fuel for

which

provides

ENERGY



**for life processes that keep the body working underwater!**

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

|  |
| --- |
| **Response activity** |
| **Deep breath** |

**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: | Distinguish between cellular respiration and breathing, including the nature of the processes and where they take place.  Link living animals’ and plants’ need for oxygen and the presence of mitochondria in their cells to aerobic respiration. |
| Activity type: | Concept map, discussion |
| Key words: | cellular respiration, breathing |

This activity can help develop students’ understanding of the differences between, and relationship between, cellular respiration and processes such as breathing and digestion, and where they take place. It can be used in response to the following diagnostic questions:

* Diagnostic question: Respiration
* Diagnostic question: Respiration and 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; 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”).

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.But they point out that simply telling students this may not change their existing conceptions unless it helps to build connections between what they already know. For example, linking the roles of breathing and the gas exchange system, and of eating and the digestive system, in humans to the provision of substances that are transported by the circulatory system to cells, where they are used as fuels for cellular respiration to provide energy for other life processes.

Linking concepts in this way may be challenging for students, as they often lack experience in establishing meaningful connections between concepts – particularly at different levels of biological organisation, such as cellular explanations for phenomena observed at the organism level (Songer and Mintzes, 1994; Ummels et al., 2015).

Concept maps have been used with students of all ages to probe and develop their understanding of cellular respiration (e.g. Al khawaldeh and Al Olaimat, 2010; Wierdsma et al., 2016; Bergan-Roller et al., 2020). Songer and Mintzes (1994) used concept maps in the context of a swimmer taking a deep breath to challenge students to explore their ideas about how breathing and other processes support cellular respiration.

**Ways to use this activity**

Students should complete this activity in pairs or small groups. The focus of the activity should be on group discussion to decide how to assemble the concept map.

It is through the discussions that students can check their understanding and develop their explanations. Listening in to the conversations of each pair/group will often give you insights into how your students are thinking. The quality of the discussions can be improved with a careful selection of pairs/groups, or by allocating specific roles to students in each pair/group. For example, you may choose to select a student with strong prior knowledge as a scribe, and forbid them from contributing any of their own answers; they may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

After their discussions, each pair/group should be prepared to report the key points of their discussion to another pair/group, or to the class.

*Differentiation*

If appropriate, students could be encouraged to develop their own concept map from scratch (no template), with or without the cards provided. Others could use the template provided (optionally with some boxes already filled in) with or without the cards.

You may choose to read the instructions 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.

Some students could be challenged to expand the concept map by adding their own arrows, boxes and explanatory text to show how the circulatory and gas exchange systems further support cellular respiration by removing the carbon dioxide that cellular respiration makes as a waste product.

**Equipment**

For each pair/group:

* cards, printed and cut out from the end of this document (optional)
* concept map template, from the second page of this document (optional)

**Acknowledgments**

Developed by Alistair Moore (UYSEG), from an idea by Songer and Mintzes (1994).

Images: girl underwater – pixabay.com/OpenClipart-Vectors (1296326); girl taking a deep breath – adapted by UYSEG from pixabay.com/Westfrisco (2340272); sandwich – from pixabay.com/Prawny (1104188); goggles – adapted by UYSEG from pixabay.com/OpenClipart-Vectors (1296326)

**References**

Al khawaldeh, S. A. and Al Olaimat, A. M. (2010). The contribution of conceptual change texts accompanied by concept mapping to eleventh-grade students understanding of cellular respiration concepts. *Journal of Science Education and Technology,* 19(2)**,** 115-125.

Bergan-Roller, H. E., et al. (2020). Using concept maps to characterise cellular respiration knowledge in undergraduate students. *Journal of Biological Education,* 54(1)**,** 33-46.

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.

Ummels, M. H. J., et al. (2015). Designing and evaluating a context-based lesson sequence promoting conceptual coherence in biology. *Journal of Biological Education,* 49(1)**,** 38-52.

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.

**Expected answers**

AIR

LUNGS

BREATHING

OXYGEN

BLOOD

BODY CELLS

ENERGY

CELLULAR RESPIRATION

and

provides

for the process of gas exchange during which it moves into the

which is absorbed

into the

**A deep breath provides**

**Lunch**

**provides**

which

carries it

to the

where it is used as a fuel for

which

provides

which is taken into the body

by the process of

which

fills the

FOOD

DIGESTION

EATING

GLUCOSE

which

provides

which is taken into the body

by the process of

and is broken down by the process of

**for life processes that keep the body working underwater!**

**Print and cut out cards for card-sort activity**

✁

|  |  |  |  |
| --- | --- | --- | --- |
| BREATHING | LUNGS | OXYGEN | EATING |
| DIGESTION | GLUCOSE | BLOOD | BODY CELLS |
| CELLULAR RESPIRATION |  |  |  |

✁

|  |  |  |  |
| --- | --- | --- | --- |
| BREATHING | LUNGS | OXYGEN | EATING |
| DIGESTION | GLUCOSE | BLOOD | BODY CELLS |
| CELLULAR RESPIRATION |  |  |  |

✁

|  |  |  |  |
| --- | --- | --- | --- |
| BREATHING | LUNGS | OXYGEN | EATING |
| DIGESTION | GLUCOSE | BLOOD | BODY CELLS |
| CELLULAR RESPIRATION |  |  |  |

✁

|  |  |  |  |
| --- | --- | --- | --- |
| BREATHING | LUNGS | OXYGEN | EATING |
| DIGESTION | GLUCOSE | BLOOD | BODY CELLS |
| CELLULAR RESPIRATION |  |  |  |