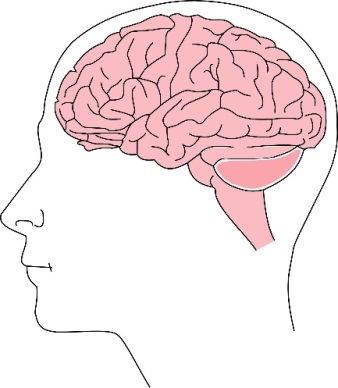
**Busy brain cell**

**Part 1: Brain cell needs**

brain

A human brain is made up of billions of cells.

Every brain cell is busy all the time. They work hard just to stay alive, even when you’re not thinking about anything!

The cells of humans and other animals need particular things to stay alive.

Draw straight lines to join the boxes to explain what animal cells need and what they do with it.

**What animal cells do with it**

**What animal cells need**

Glucose

Oxygen

Water

Use it as a fuel

in cellular respiration

to provide energy.

Use it to

breathe.

Use it to

make food.

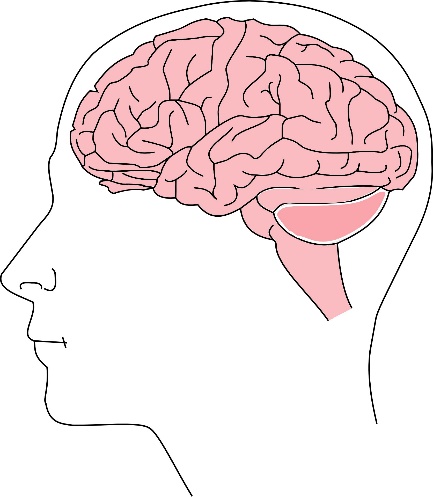
Use it to

store and transport

dissolved substances.

**Busy brain cell**

**Part 2: Getting oxygen**

****

brain

Every cell in the brain needs **oxygen** for aerobic cellular respiration.

1. How does a cell in the brain get oxygen?

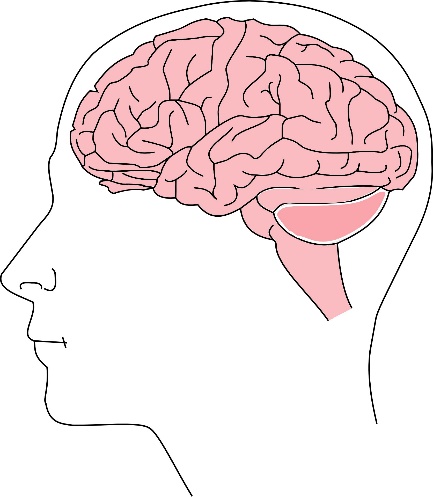
|  |  |
| --- | --- |
| **A** | It makes its own oxygen. |
| **B** | It takes oxygen from the air. |
| **C** | It takes oxygen from the lungs. |
| **D** | It takes oxygen from the blood. |

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

|  |  |
| --- | --- |
| **A** | The lungs absorb oxygen from air we breathe in. |
| **B** | The circulatory system carries oxygen from air in the lungs to all cells in the body. |
| **C** | Oxygen is made by cellular respiration. |
| **D** | Oxygen from air diffuses through the body to all of its cells. |

**Busy brain cell**

**Part 3: Getting glucose**

****

brain

Every cell in the brain needs **glucose** for aerobic cellular respiration.

1. How does a cell in the brain get glucose?

|  |  |
| --- | --- |
| **A** | It takes glucose from food in the mouth. |
| **B** | It takes glucose from the stomach and intestines. |
| **C** | It takes glucose from the blood. |
| **D** | It makes its own glucose. |

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

|  |  |
| --- | --- |
| **A** | Glucose is made by cellular respiration. |
| **B** | The digestive system absorbs glucose from digested food. |
| **C** | The circulatory system carries glucose from digested food to all cells in the body. |
| **D** | Glucose from digested food diffuses through the body to all of its cells. |

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

|  |
| --- |
| **Diagnostic question** |
| **Brain cell** |

**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: | Link living animals’ and plants’ need for oxygen and the presence of mitochondria in their cells to aerobic respiration. |
| Question type: | Linking ideas; two-tier multiple choice |
| Key words: | cell, requirements, life, living, cellular respiration |

**What does the research say?**

At age 5-11 children are likely to learn that living things depend on their environment to survive, including that animals need a plentiful supply of air, water, and nutrients from food to keep them alive (Department for Education, 2013).

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), for example to explain why cells (and therefore organisms) need oxygen from air and glucose from food, and how they get these fuels.

However, 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). A study by Anderson and Sheldon (1990) found that even university students in the US did not connect food, oxygen, carbon dioxide and energy in a coherent conception of cellular respiration.

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 PowerPoint 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 – Brain cell needs*

Glucose

Oxygen

Water

Use it as a fuel in cellular respiration to provide energy.

Use it to breathe.

Use it to make food.

Use it to store and transport dissolved substances.

*Part 2: Oxygen*

1. D - It takes oxygen from the blood.
2. B - The circulatory system carries oxygen from air in the lungs to all cells in the body.

*Part 3: Getting glucose*

1. C - It takes glucose from the blood.
2. C - The circulatory system carries glucose from digested food to all cells in the body.

**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 through dialogue.

If students have misunderstandings about what cells must be supplied with and how they use it, the following BEST ‘response activity’ provides a small group discussion and card sort task that could help to build understanding in response to this diagnostic question:

* Response activity: What do cells need?

If students struggle to explain the connection between processes such as gas exchange, digestion, circulation and cellular respiration, the following BEST concept mapping ‘response activity’ could be used in follow-up to this diagnostic question:

* Response activity: Deep breath

If students are unsure about how tissues, organs and organ systems work together to keep the cells alive, key concept BCL2.2 *Supplying cells – the human circulatory, digestive and gas exchange systems* provides diagnostic questions and response activities to further probe and develop understanding.

**Acknowledgments**

Developed by Alistair Moore (UYSEG).

Images: adapted by UYSEG from pixabay.com/OpenClipart-Vectors (153550)

**References**

Anderson, C. W. and Sheldon, T. H. (1990). The effects of instruction of college non-majors' conceptions of respiration and photosynthesis. *Journal of Research in Science Teaching,* 27(6).

Department for Education (2013). Science programmes of study: key stages 1 and 2 - National curriculum in England ( DFE-00182-2013 ).

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.

Svandova, K. (2014). Secondary school students' misconceptions about photosynthesis and plant respiration: preliminary results. *EURASIA Journal of Mathematics, Science & Technology Education,* 10(1)**,** 59-67.

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.