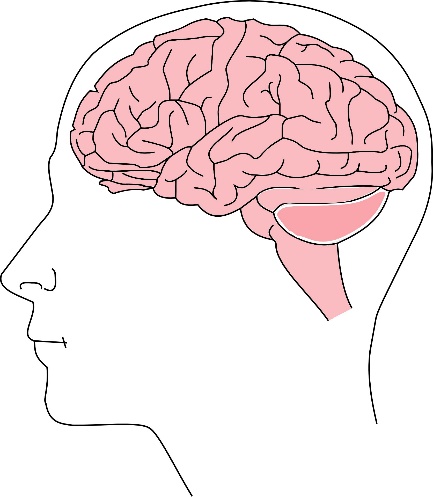
**Brain cell**

**Oxygen**

****

brain

A human brain is made up of billions of cells.

Every cell in the brain needs oxygen to stay alive and function.

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

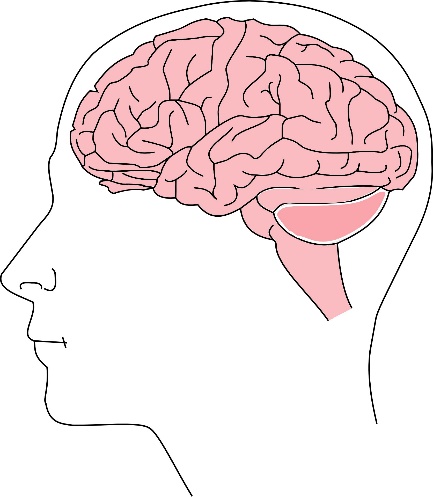
|  |  |
| --- | --- |
| **A** | It makes its own oxygen. |
| **B** | It takes oxygen from the air. |
| **C** | It takes oxygen from the lungs. |
| **D** | It takes oxygen from the blood. |

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. |

**Brain cell**

**Food**

****

brain

A human brain is made up of billions of cells.

Every cell in the brain needs glucose from food to stay alive and function.

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 BCL2: From cells to organ systems > Key concept BCL2.2: Supplying cells – the human circulatory, digestive and gas exchange systems*

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

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Human life depends upon the tissues and organs of the circulatory, digestive and gas exchange systems working together to support the life processes of the cells from which we are made. |
| Observable learning outcome: | Explain how the human circulatory, digestive and gas exchange systems work together to keep cells alive. |
| Question type: | Two-tier multiple choice |
| Key words: | cell, requirements, life, organ systems, circulatory system, digestive system, gas exchange system |

**What does the research say?**

Young children may think of the human body holistically as a single entity, but by age 10 they more commonly understand that it has different functional parts that work together to maintain life (Carey, 1985; Driver et al., 1994).

From age 11, students could begin to explore some basic ideas that introduce a systems view of life (Capra and Luisi, 2014), including the idea that living systems are organised at different levels (molecules, cells, tissues, organs, organs systems and whole organisms) and that life is a property that emerges from the interactions between the parts that make up these different levels (Skinner, 2011).

Researchers have reported the common misunderstanding in children that the bodies of humans and other animals *contain* cells, perhaps floating in a ‘soup’ of body fluids, rather than being *made up of* cells (Clément, 2007). Dreyfus and Jungwirth (1988) found that many 16-year-olds struggled to explain how cells carry out life processes, with many students thinking that cells contain macroscopic organs such as a digestive tract (e.g. for nutrition) or lungs (e.g. for respiration). Cartoon-like depictions of cells with faces, limbs or speech bubbles implying that they are able to speak may introduce or reinforce misunderstandings about the size and scale of cells and organs.

**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**

*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.

*Food*

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 how the human circulatory, digestive and gas exchange systems work together to keep cells alive, the following BEST ‘response activity’ describes a role-play that could be used in follow-up to this diagnostic question to build understanding:

* Response activity: Circulatory system role-play

**Acknowledgments**

Developed by Alistair Moore (UYSEG).

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

**References**

Capra, F. and Luisi, P. L. (2014). *The Systems View of Life,* Cambridge, UK: Cambridge University Press.

Carey, S. (1985). *Conceptual change in childhood,* Cambridge, Massachusetts: Massachusetts Institute of Technology Press.

Clément, P. (2007). Introducing the cell concept with both animal and plant cells: a historical and didactic approach. *Science & Education,* 16(3-5)**,** 423-440.

Dreyfus, A. and Jungwirth, E. (1988). The cell concept of 10th graders: curricular expectations and reality. *International Journal of Science Education,* 10(2)**,** 221-229.

Driver, R., et al. (1994). *Making Sense of Secondary Science: Research into Children's Ideas,* London, UK: Routledge.

Skinner, N. (2011). Cells and life processes. In Reiss, M. (ed.) *ASE Science Practice: Teaching Secondary Biology.* London, UK: Hodder Education.