**Ball of energy**

In your group, you are going to play a game with a ball.

**To do – Part 1**

Think of some answers to the question:

**“What do humans need energy for?”**

1. Your teacher will gently throw the ball to somebody in the group.
2. The person who catches the ball must give an answer to the question.
3. That person can then gently throw the ball to somebody else in the group, who must also answer the question, and so on.
4. For each answer, where do you think the energy comes from?

**To do – Part 2**

Think of some answers to the question:

**“What do plants need energy for?”**

1. Your teacher will gently throw the ball to somebody in the group.
2. The person who catches the ball must give an answer to the question.
3. That person can then gently throw the ball to somebody else in the group, who must also answer the question, and so on.
4. For each answer, where do you think the energy comes from?

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

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| **Response activity** |
| **Ball of energy** |

**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. |
| Activity type: | Challenge to thinking |
| Key words: | life processes, living, cellular respiration |

This activity can help develop students’ understanding by addressing the sticking-points revealed by the following diagnostic questions:

* Diagnostic question: Animal life and plant life
* Diagnostic question: Energy for life

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| **P** | **PRIOR UNDERSTANDING**  This activity explores 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, and that it provides energy for other life processes. However, it can be difficult to convince children that all living organisms, particularly plants, demonstrate life processes such as movement. There is evidence that not all students even regard plants as alive: only 30% of children aged 6, and 70-80% of children aged 12-15, regarded plants as alive (Stavy and Wax, 1989).

Research has found that a frequently held and extraordinarily persistent misunderstanding in school students is that cellular respiration does not take place in plants (because students think of it as an animal process, or think that photosynthesis is the plant version of respiration).

Maeng and Gonczi (2019) describe the use of a ball toss activity in which whoever catches the ball must suggest an answer to the question “What do we need energy for?”, as a way of activating students’ prior knowledge and exploring the important of the process that provides the energy for all of their answers – cellular respiration.

**Ways to use this activity**

This teacher-led activity can be completed as a whole-class activity or in several large groups. You may choose to start by having a student throw the ball to you, so that you can give the first answer as an example that might prompt students’ thinking.

It will become more difficult for students to think of novel answers the more the ball is passed around. You may want to ask students to think about which characteristic process of living things (e.g. movement, reproduction, sensitivity, growth, respiration, excretion, nutrition) each answer exemplifies – they may mostly involve movement.

You could issue prompts after every few throws of the ball to challenge students’ thinking, e.g.:

* What about things that don’t involve movement?
* What about things you can’t see because they happen inside the body/inside the plant?

*Differentiation*

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.

**Equipment**

For the class or each group:

* soft ball, or other soft item that can be safely thrown between students

**Expected answers**

There are many answers students may come up with. Maeng and Gonczi (2019) report that common student answers during their use of this type of activity included blinking, catching the ball, breathing, speaking, digesting, smiling, eating, laughing and sitting.

Students are likely to find Part 2 of the game, in which they have to suggest what plants need energy for, more challenging. Research has indicated that the characteristic of life most commonly ascribed to animals was movement (specifically walking), while for plants it was growth (Tamir, Gal-Choppin and Nussinovitz, 1981), suggesting that children do not readily associate movement with plants (perhaps because it is more difficult to observe). Some students struggle to accept that plants are alive, and many find it difficult to believe that they demonstrate all of the characteristic processes of living organisms.

It may be helpful to demonstrate processes such as movement and sensitivity (response to stimuli) in plants, either practically or using videos, which could include rapid movements such as capturing prey or moving leaves in response to touch (thigmonasty), and also slower, growth responses such as growing towards light (phototropism). A good collection of time-lapse videos is provided for free by the ‘Plants-In-Motion’ website; see, for example, their time-lapse video of a climbing vine: <http://plantsinmotion.bio.indiana.edu/plantmotion/movements/nastic/twining/vines.html>

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Images: ball – pixabay.com/Clker-Free-Vector-Images (309050)

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