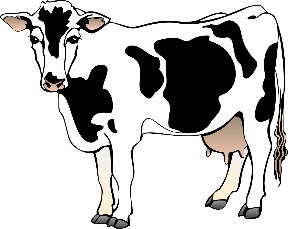
**Along the food chain**

The diagram shows a complete food chain.







grass

humans

cows

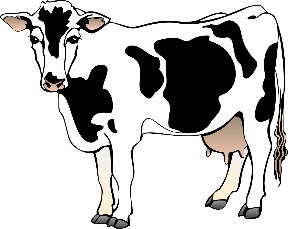
1. Which statement **best** explains what is shown by the arrows in the food chain?

|  |  |
| --- | --- |
| **A** | The arrows mean “eats”. |
| **B** | The arrows mean “is eaten by”. |
| **C** | The arrows show which way biomass is passed along the food chain. |

**Along the food chain**

The diagram shows a complete food chain.







grass

humans

cows

1. How do humans and cows get energy for life processes such as movement?

Connect the correct boxes.

They get energy directly from the Sun…

They use some of the biomass they have eaten as fuel…

They make their own food…

…to warm them up.

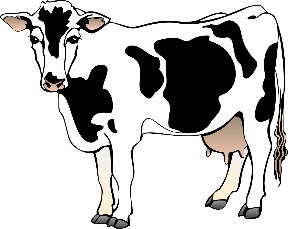
…in cellular respiration.

…in photosynthesis.

**Along the food chain**

The diagram shows a complete food chain.







grass

humans

cows

1. How does grass get energy for life processes?

Connect the correct boxes.

It gets energy directly from the Sun…

It uses some of the food it has made as fuel…

It makes its own food…

…to warm it up.

…in cellular respiration.

…in photosynthesis.

`

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

|  |
| --- |
| **Diagnostic question** |
| **Along the food chain** |

**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: | Recognise that biomass is transferred through food chains, and energy for life processes is made available when some of this biomass is used as fuel for cellular respiration. |
| Question type: | Simple multiple choice; linking ideas |
| Key words: | food chain, biomass, cellular respiration |

**What does the research say?**

Confusion about the direction and meaning of the arrows in a food chain is a commonly reported misunderstanding (Gallegos, Jerezano and Flores, 1994; Gotwals and Songer, 2010; Barman, Griffiths and Okebukola, 1995), and suggests that students commonly interpret the arrows to mean “eats” (Allen, 2014).

A focus only on the biochemistry of cellular respiration and the role of mitochondria could lead to compartmentalised learning, in which students miss the significance of cellular respiration in the wider ecosystem beyond an individual and its cells (Brown and Schwartz, 2009). It will provide a useful foundation for progression if by age 14 students have developed the understanding that photosynthesis makes food, which is turned into *biomass* that is passed along food chains and used by both producers and consumers as a fuel for cellular respiration to provide energy for life processes; this is consistent with the reality that *matter* (not energy) is what is transferred to an organism when it eats another (Ross, 2013; Needham, 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**

1. C – The arrows show how biomass moves through the food chain.
2. They use some of the biomass they have eaten as fuel… – …in cellular respiration.
3. It uses some of the food it has made as fuel… – …in cellular 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 direction and meaning of the arrows in a food chain, it may be helpful for them to use the “arrow’s mouth trick” (Gotwals and Songer, 2010) or “Pac-Man rule” (Allen, 2014) as an aide-mémoire.

prey

predator

*“Pac-Man rule”, adapted from Allen (2014)*

A more scientifically correct explanation for the direction of the arrows is that they show the direction in which matter, specifically biomass, moves through the food chain (from producers to consumers, and from prey to predators).

If students’ struggle with food chains, it might be worth revisiting the following BEST key concept, which provides diagnostic questions and response activities to further probe and challenge students’ understanding:

* Key concept: BOE1.1 Food chains and food webs

Concept maps may help students to understand the relationship between photosynthesis and cellular respiration – specifically that photosynthesis does not directly provide energy for life processes, but provides carbohydrate food that is used as a fuel for cellular respiration in both plants and ultimately consumers such as animals, which does provide energy for life processes. The following BEST ‘response activities’ involve students making concept maps, and could be used or revisited in response to this diagnostic question, with students challenged to explain how the carbohydrate food made by plants (as mentioned in ‘Acorn to oak’) becomes food consumed by animals such as humans (as mentioned in ‘Deep breath’):

* Response activity (from BCL3.1): Acorn to oak
* Response activity (from BCL3.2): Deep breath

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