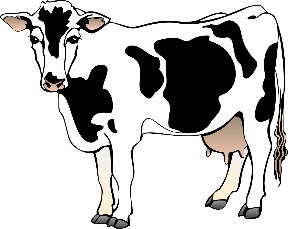
**What do the arrows mean?**

The diagram shows a complete food chain.







grass

humans

cows

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

|  |  |
| --- | --- |
| **A** | The arrows show what eats what. |
| **B** | The arrows mean “eats”. |
| **C** | The arrows mean “is eaten by”. |
| **D** | The arrows show how biomass moves through the food chain. |

*Biology> Big idea BOE: Organisms and their environments > Topic BOE1: Interdependence of organisms > Key concept BOE1.1: Food chains and food webs*

|  |
| --- |
| **Diagnostic question** |
| **What do the arrows mean?** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Feeding relationships within a community of organisms can be modelled using food chain and food web diagrams. |
| Observable learning outcome: | Explain that the arrows in a food chain diagram represent transfers of biomass from producer to consumer, or from prey to predator. |
| Question type: | Simple multiple choice |
| Key words: | food chain, biomass |

**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), and suggests that students interpret the arrow to mean “eats” (Allen, 2014).

In a multinational study of students aged 16-18 (Barman, Griffiths and Okebukola, 1995), the majority of students described a food chain as showing ‘what eats what’ (i.e. feeding relationships). However, most students placed the arrows the wrong way around (e.g. from predator to prey) when asked to assemble a food chain using pre-printed cards, yet when presented with a correct depiction of a food web they did not question the direction of the arrows even though in most cases they contradicted the students’ own constructions.

It has been suggested that children find it easier to correctly identify predator and prey arrangements within food chains when the species are familiar, and particularly when the names are accompanied by pictures (Schollum, 1983).

**Ways to use this question**

Students should complete the question 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 question and answers 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**

**D** – The arrows show how biomass moves through the food chain.

**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).

A number of authors have suggested challenging students to construct their own food chains, including for meals they have eaten themselves, to increase engagement and help develop understanding (Barker and Slingsby, 2011; Grumbine, 2012). Accordingly, the following BEST ‘response activities’ can be used in response to this diagnostic question to help build understanding through model-making and small group discussion:

* Response activity: Build a food chain
* Response activity: Breakfast food chains

**Acknowledgments**

Developed by Alistair Moore (UYSEG).

Images: grass – adapted by UYSEG from pixabay.com/OpenClipart-Vectors (151473); cow – pixabay.com/Clker-Free-Vector-Images (48435); human – pixabay.com/mohamed\_hassan (2791740)

**References**

Allen, M. (2014). *Misconceptions in Primary Science, 2nd* ednBerkshire, UK: Open University Press.

Barker, S. and Slingsby, D. (2011). Ecology. In Reiss, M. (ed.) *ASE Science Practice: Teaching Secondary Biology.* 2nd ed. London, UK: Hodder Education.

Barman, C. R., Griffiths, A. K. and Okebukola, P. A. O. (1995). High school students' concepts regarding food chains and food webs: a multinational study. *International Journal of Science Education,* 17(6)**,** 775-782.

Gallegos, L., Jerezano, M. E. and Flores, F. (1994). Preconceptions and relations used by children in the construction of food chains. *Journal of Research in Science Teaching,* 31(3)**,** 259-272.

Gotwals, A. W. and Songer, N. B. (2010). Reasoning up and down a food chain: using an assessment framework to investigate students' middle knowledge. *Science Education,* 94(2)**,** 259-281.

Grumbine, R. (2012). Can you build it? Using manipulatives to assess student understanding of food-web concepts. *American Biology Teacher,* 74(7)**,** 518-520.

Schollum, B. (1983). Arrows in science diagrams: help or hindrance for pupils? *Research in Science Education,* 13**,** 45-59.