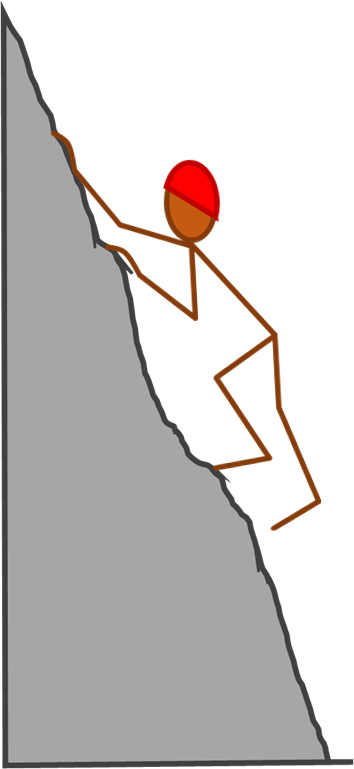
**Climbing**

A rock climber feels the force of gravity.

1. Which way does gravity pull on the climber?



**A**

**B**

**C**

**D**

1. Why did you choose this direction?

Put a tick (✓) in the box next to the best answer.

|  |  |  |
| --- | --- | --- |
| **A** | Gravity pulls the climber towards the ground |  |
|  |  |  |
| **B** | Gravity pulls the climber towards the surface of the Earth |  |
|  |  |  |
| **C** | Gravity pulls the climber towards the centre of the Earth |  |
|  |  |  |
| **D** | Gravity pulls the climber the climber upright |  |

*Physics > Big idea PES: Earth in space > Topic PES1: Solar System and beyond > Key concept PES1.1: Gravity*

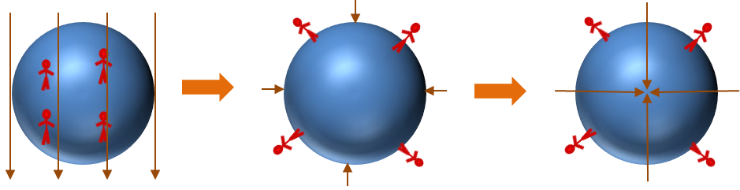
|  |
| --- |
| **Diagnostic question** |
| **Climbing** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Gravity is the force that holds the Solar System together |
| Observable learning outcome: | * Describe how gravity acts towards the centre of the Earth (or other astronomical body) |
| Question type: | Diagnostic, two-tier multiple choice |
| Key words: | Gravity, centre, surface |

**What does the research say?**

At age twelve Nussbaum (1985) found most students hold the idea that there is an absolute ‘down’ that is independent of the Earth. He also found that by age fourteen most students believe gravity pulls towards either the surface of the Earth or towards its centre. At sixteen just 20% of students hold the accepted science view that gravity pulls objects towards the *centre* of the Earth. Most others say gravity acts towards the *surface* (Baxter, 1989).



Children’s notions of the direction of down in relation to the Earth

(Nussbaum, 1985; Driver et al., 1994)

A small minority of students describe gravity as ‘holding us vertical’ (Stead and Osborne, 1980; Driver et al., 1994).

**Ways to use this question**

Students should complete the question individually. This could be a pencil and paper exercise, or you could use an electronic ‘voting system’ or mini white boards and the PowerPoint presentation.

The answers to the question will show you whether students understood the concept sufficiently well to apply it correctly.

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.

*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. B

2. C

**How to respond - what next?**

For question 1 students may think of gravity as acting in the direction of the climbers ‘fall’ (C) or have a literal view that she is attracted to the surface (A). It is likely that most students give answer B, because several different notions of which way down is (see above) could each lead logically to this response.

Question 2 distinguishes whether students who made the correct choice in question 1 did so for the right reason. Answers A or B both describe the most common misunderstanding.

If students have misunderstandings about which way the climber is pulled by gravity, it can help to demonstrate dropping an object, perhaps onto a sloping surface so that students can see that a non-vertical fall is caused by the action of additional force(s).

If students have misunderstandings about *why* the climber is pulled vertically downwards, the following BEST ‘response activity’ could be used to challenge students to think more carefully about their answers:

* Response activity: Caving

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG)

Images: Peter Fairhurst (UYSEG)

**References**

Baxter, J. (1989). Children's understanding of familiar astronomical events. *International Journal of Science Education,* 11 (Special Issue)**,** 502-13.

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

Nussbaum, J. (1985). The Earth as a cosmic body. In Driver, R., Guesne, E. & Tiberghien, A. (eds.) *Children's Ideas In Science.* Milton Keynes: Open University Press.

Stead, K. and Osborne, R. (1980). Gravity. Hamilton, New Zealand: LISP Working Paper 20, Science Education Research Unit, University of Waikato.