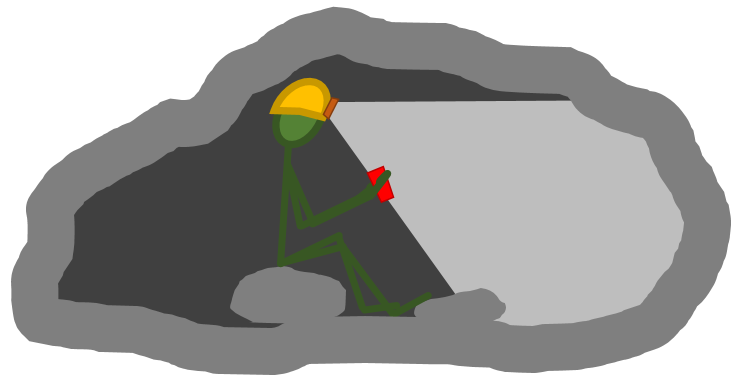
**Caving**

Some people like to crawl around in caves.

The posh name for this hobby is speleology.

Three students are thinking about being in a cave. They wonder what the gravity is like.



**Ruby:** Gravity pulls you down towards the centre of the Earth.

**Sophie:** Gravity pulls you up towards the surface.

**Thomas:** Gravity pulls you to every surface.

I think you float.

**To answer:**

1. Who do you think is right about gravity in a cave?
2. Why do you think the other students’ answers are silly?

*What would you say to them to help them to understand?*

|  |  |
| --- | --- |
| Caving cards | **Ruby:** Gravity pulls you down towards the centre of the Earth. |
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*Physics > Big idea PES: Earth in space > Topic PES1: Solar System and beyond > Key concept PES1.1: Gravity*

|  |
| --- |
| **Response activity** |
| **Caving** |

**Overview**

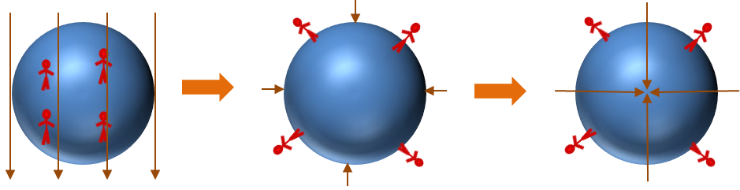
|  |  |
| --- | --- |
| Learning focus: | Gravity is the force that holds the Solar System together |
| Observable learning outcome: | * Describe how gravity acts towards the centre of the Earth (or other astronomical body) |
| Activity type: | Response, talking heads |
| Key words: | Gravity, centre, surface |

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

* Diagnostic question: Climbing

**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)

This activity gives students the opportunity to think through the consequences of the two common misunderstandings of gravity that are illustrated above.

**Ways to use this activity**

Students should complete this activity in pairs or small groups, and the focus should be on the discussions. The statements are also provided as cut-out cards for students to physically organise.

Students should work together to follow the instructions on either the worksheet or the PowerPoint. Giving each group one worksheet to complete between them is helpful for encouraging discussion, but each member should be able to report back to the class. Listening in to the conversations of each group will often give you insights into how your students are thinking.

If there is disagreement when you take feedback, a good way to progress might be 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*

The quality of the discussions can be improved with a careful selection of groups; or by allocating specific roles to students in the each group. For example, you may choose to select a student with strong prior knowledge as a scribe, and forbid them from contributing any of their own answers. They may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

**Expected answers**

Ruby is correct.

Sophie is clearly wrong, but this is the natural consequence of saying that gravity pulls you towards the surface. The question here is ‘which surface?’ If it is always the surface that is down, what is it that makes gravity act in that direction? It is because this is the direction towards the centre of the Earth.

Thomas is clearly wrong as well. By taking the idea to its logical conclusion he has reached a very strange conclusion. Here the question is ‘what is the difference between the different surfaces?’ The answer is that the bottom surface is in the direction of the centre of the Earth – which is the direction in which the force of gravity acts.

**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.

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