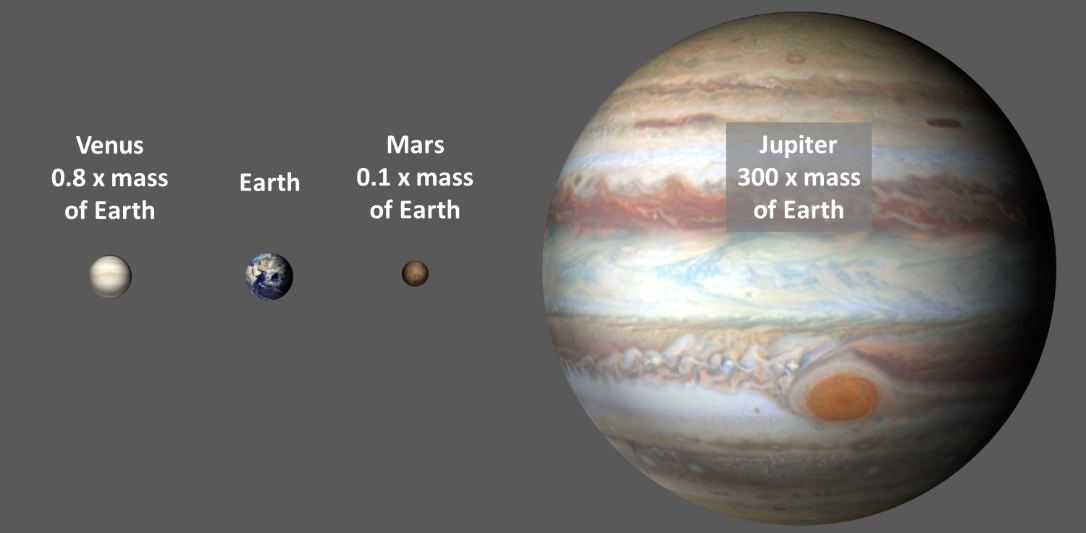
**Different weight?**

What do things weigh on different planets?



**Predict**

Identical bottles are put on each planet.

How do you think the weight of each bottle will compare?

**Explain**

Why do you think this will happen?

|  |
| --- |
| **Now compare the weight of each bottle** |

**Observe**

Record what you find out.

**Explain**

Were your prediction and explanation correct?

If not, can you explain what you observed?

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

|  |
| --- |
| **Response activity** |
| **Different weight?** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Gravity is the force that holds the Solar System together |
| Observable learning outcome: | * Describe how gravity increases with the mass of a planet (or other astronomical body) |
| Activity type: | Response; predict, explain, observe, explain – whole class practical |
| Key words: | Gravity, weight |

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

* Diagnostic question: ‘On the Moon’

**What does the research say?**

A widespread view of gravity amongst 11-to-17-year-olds, is that it is a ‘holding’ force rather than a pulling force. This thinking is bound up with the idea that gravity is linked to the atmosphere, and with air pressing down to stop things floating away (Stead and Osborne, 1980; Driver et al., 1994). This can lead to the misunderstanding that there must be air for there to be gravity. This has implications for thinking about gravity acting in space, on other planets and on the Moon.

In a study Stead and Osborne (1980) found that it is common for eleven-year-olds to think that gravity only relates to the Earth. At age thirteen (n=258) 44% do not think there is gravity on the Moon, and they commonly think that not all planets have gravity. 81% of 13-year-olds and 75% of 14-year-olds in the study do not think there is gravity in space (Stead and Osborne, 1980; Driver et al., 1994).

In reviewing the diagnostic question: ‘On the moon’ students should have discussed that there is gravity on the Moon because it has mass, and that the gravity on the Earth is bigger because it has a greater mass than the Moon. This activity gives students the opportunity to apply this understanding in the context of four planets, each with a different mass.

**Ways to use this activity**

Students should complete this activity in pairs or small groups, and the focus should be on the discussions. It is through the discussions that students can check their understanding and rehearse their explanations.

To begin, each group should discuss the activity and use their scientific understanding, firstly to predict *what* they think will happen, and then to explain *why* they think they are going to be right. If students in any group cannot agree, you may be able to direct them with some careful questioning.

Students now take part in a whole class teacher led practical.

After the practical each group should be given the opportunity to change, or improve their explanation. A good way to review your students’ thinking might be through a structured class discussion. You could ask several groups for their *explanations* and put these on the whiteboard. Then ask other groups to suggest which explanation is the most accurate and the most clearly expressed, and through careful questioning work up a clear ‘class explanation’.

A useful follow up is for individual students to then write down explanations in their own words – without reference to the class explanation on the board (i.e. cover it up).

*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.

**Equipment**

For the class:

* A set of four ‘identical’ bottles

**Practical procedure**

The four bottles look identical, but weigh what they would on the planet indicated by the label.

A few students could be invited to arrange the bottles in order of weight, and this order subsequently confirmed (or not) by one or two other students.

The agreed order can be compared to the masses of the planets shown on the PowerPoint to spot a pattern.

**Technician notes**

The bottles are filled with sand so that they weigh the same as they would on each of the planets.

* Four empty and identically shaped 500 ml plastic soft drink bottles are needed. These should be painted so that they each look identical and their contents cannot be seen. Each is labelled with the name of a different planet: Mars, Venus, Earth and Jupiter.
* The bottles should be filled with dry sand to give the following masses and then sealed:
  + Venus = 270 g
  + Earth = 300 g
  + Mars = 120 g
  + Jupiter = 780 g

**Expected answers**

The greater the mass of the planet, the heavier the bottle on that planet.

NB Gravity on Jupiter is not 300 times greater than on Earth because Jupiter is a lot bigger. As the bottle moves away from the centre of a planet the force of gravity reduces. This effect has been ignored to avoid confusion and because it does not alter the qualitative results.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG), based on ‘Teaching Approach 03: Tin of beans’, Supporting Physics Teaching website, Institute of Physics <http://supportingphysicsteaching.net/EsHome.html>

Images: Peter Fairhurst (UYSEG), photographs from NASA / Goddard Space Flight Center Scientific Visualisation Studio

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