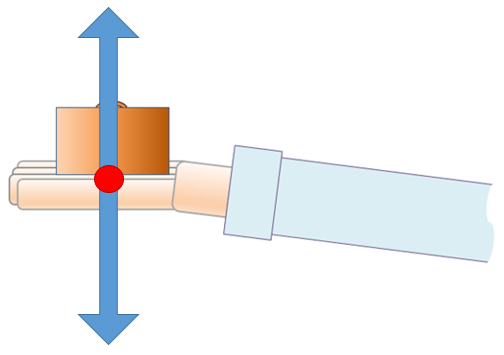
**Adding weight**

This practical activity is about what happens to the forces needed to hold a weight still.

To hold a weight in my hand, I need to push up with a force.

The weight pushes down with a force.

**Equipment**

* Two weights

**Predict**

What do you think will happen to each force when another weight is added?

**Explain**

Explain why you think this will happen.

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| **Hold a weight in your hand, and then double it.** |

**Observe**

Describe what happens to the force you are pushing up with.

**Explain**

Were your prediction and explanation correct?

Try to improve your first explanation to explain this more clearly.

*Physics > Big idea PFM: Forces and motion > Topic PFM1: Forces > Key concept PFM1.2: Describing forces*

|  |
| --- |
| **Response activity** |
| **Adding weight** |

**Overview**

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| Learning focus: | Forces arise when two objects interact; the force on one object is always equal in size, and opposite in direction to the force on the other object; force arrows indicate the size, direction and location of each force. |
| Observable learning outcome: | * Label force arrows to describe the action of the force: ‘force exerted on [object A] by [object B]’. * Describe how forces always arise in pairs and how the force exerted by object A on object B is equal in size and opposite in direction to the force exerted by object B on object A. |
| Activity type: | Response, practical – predict, explain; observe, explain |
| Key words: | Force, weight, Newton, force-arrow |

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

* Diagnostic question: Describing the force?
* Diagnostic question: Describing a pair of forces?

**What does the research say?**

Driver *et al* (1994) stress the importance of paying attention to Newton’s third law in a teaching sequence. They suggest it helps students to appreciate that a force is not a property of an object but forces are characteristic of actions between objects.

Research by Terry *et al* (1985) has shown that expressing it in the form: “for every action (force) there is an equal and opposite reaction” is confusing for students aged 11-16. It is far clearer to describe in full: the force of object A on object B is equal in size, and opposite in direction to the force of object B pushing on object A.

A key problem for students’ understanding of Newton’s third law is the difficulty in recognising a force of reaction. Minstrell (1982) suggests giving students *bridges* between prior ideas and science ideas. In this instance the discussion of adding weights to a hand is an effective way helping students understand the idea that forces always arise in pairs, each of equal size and with opposite direction. Later in their studies students will need to build on this idea to understand the ‘invisible’ reaction force that, for example, holds a weight on a table top.

**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 carry out the practical and 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 each student/pair/group:

* Two equal sized masses that can both be held in one hand.

**Technician notes**

200g masses are heavy enough for students to notice the effect, and not too large to fit in one hand.

Two or three 100g slotted masses could be used instead of a single 200g mass, with the same number being added later.

**Health and safety**

Falling masses may be an issue, and completing the practical whilst seated at a bench reduces this risk.

Practical work should be carried out in accordance with local health and safety requirements, guidance from manufacturers and suppliers, and guidance available from CLEAPSS.

**Expected answers**

When the weight doubles the force of the hand pushing up also doubles. It continues to act upwards.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: UYSEG

**References**

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