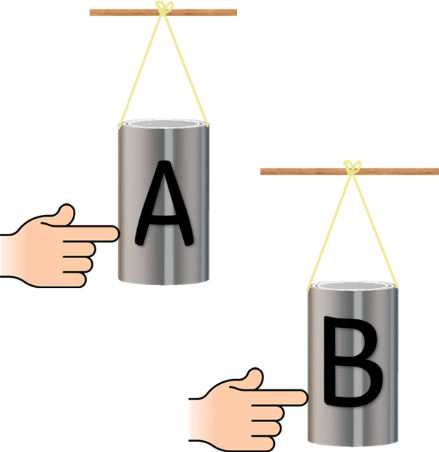
**Mass cans**

Two cans are hanging on a stand.

The cans look the same.

One can has more mass than the other one.

**Predict**

****What will happen if you push each can with the tip of your finger?

What will you feel?

**Explain**

Why do you think you will feel this?

|  |
| --- |
| **Push each with the tip of your finger.**  **Push sideways.** |

**Observe**

Describe what you feel when you push each can.

**Explain**

Were your prediction and explanation correct?

Try to improve your first explanation to explain what happens more clearly.

*Physics > Big idea PFM: Forces and motion > Topic PFM3: More about force > Key concept PFM3.1: Mass and weight*

|  |
| --- |
| **Response activity** |
| **Mass cans** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Mass is a measure of the amount of matter an object or substance is comprised of and weight is the force needed to support the object or substance. |
| Observable learning outcome: | Describe mass as a measure of the amount of matter in an object or substance. |
| Activity type: | Predict, explain; observe, explain (PEOE) |
| Key words: | mass, material, matter |

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

* Diagnostic question: The biggest mass

**What does the research say?**

From an early age children develop a notion of the heaviness of an object by feeling how much it appears to ‘press down’. ‘Felt weight’ is typically conceived as a characteristic property of an object. The object’s mass is often associated with ‘massive’ because the words are similar. Ideas about mass can then be conflated with size or volume and some students will judge mass based on the size of an object (Mullet and Gervais, 1990; Driver et al., 1994; Galili and Bar, 1997; Stein, Galili and Schur, 2015).

A mass of one kilogram is properly defined by Newton’s second law, as the mass one Newton of force will cause to accelerate at the rate of one metre per second squared. At this stage it is sufficient to define mass of an object or substance as the amount of matter it contains, and to reinforce the understanding that mass does not change unless material is added or taken away from the object.

Students often confuse the terms weight and mass, which is understandable as teachers are often advised not to distinguish between weight and mass in presecondary teaching (e.g. National Academy of Sciences, 2012)

This practical activity shows how the amount of matter in an object (mass) affects how hard it is to change its motion.

**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 (very quick) practical. For this practical it is possibly easiest to have about four pairs of cans set up around the room so that all students can have a go for themselves, without the need for lots of equipment.

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 tin cans hanging, with string, from a clamp and stand.

**Technician notes**

Two cans with lids are needed, or two plastic bottles that have been covered so that the contents cannot be seen. One can contains a little sand and the other can a lot of sand.

Some sand is needed in each can so that neither moves in air currents.

This practical can be completed either as a demonstration with one pair of cans, or perhaps with several pairs so that every student can have a go. One set per pair is not necessary.

**Health and safety**

Depending on how this experiment is organised, students may be moving around the lab.

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**

The can with more mass is harder to move. It is harder to change its motion from still to moving.

It is also harder to stop the can with more mass moving.

The can with more mass has more stuff in it so it takes more force to change its motion. This also means it has more momentum when it is moving so it takes more force to stop it, or to change its direction.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: Peter Fairhurst (UYSEG); hand: <https://pixabay.com/vectors/pointer-pointing-index-finger-hand-152868/>.

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