**Block work**

This demonstration challenges students understanding of how both mass (or weight) and volume contribute to determining how well an object floats.

Increasing mass

**Safety**

Water spillages may cause slipping.

Dropping metal blocks into a glass trough may break it – they need to be lowered in gently. This is especially important if students are assisting. Consider placing a cushioning cloth on the bottom.

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

**Apparatus and materials**

* Set of density blocks – including a large and small wooden block that float, and two metal blocks, one heavier than the large wooden block and one lighter than it.
* Glass trough filled with water.
* Balance – with capacity to measure the mass of the heaviest block.

**Procedure**

1. Measure the mass of each block and arrange them in order of mass.
2. Challenge students to predict which ones will float and which will sink, discussing their explanations in pairs or small groups.
3. Ask students to feedback their answers and use these to derive some general principles, which will be along the lines of:
   * Bigger mass makes a block more likely to sink.
   * Bigger volume makes a block more likely to float.
   * A block that is heavy for its size sinks.
   * An object that is light for its size floats.
4. Test the blocks to check answers.
5. Define what we mean by density and challenge students to write their own definitions using everyday language.

*Physics > Big idea: PMA Matter > Topic PMA2: Floating and sinking > Key concept PMA2.1: Floating, sinking and density*

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| **Response activity** |
| **Block work** |

**Overview**

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| Learning focus: | An object that is surrounded by a fluid (liquid and/or gas) floats if its overall density is less than the density of the fluid. |
| Observable learning outcome: | Describe how the mass and volume of an object affect how well it floats. |
| Activity type: | Clarifying - demonstration |
| Key words: | Floating, sinking, weight, volume, density |

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

* Diagnostic question: Building bricks

**What does the research say?**

In a study of 13-14 year olds (n=120), Ȕnal and Coştu (2005) found that about half of students thought that the main factor influencing whether an object floated or not was its weight or mass. It is quite common for young children to think all light objects float, and all heavy objects sink (Allen, 2014). In Ȕnal and Coştu’s study many students identified the volume of an object as also playing a part in whether or not an object floated, but approximately 40% had difficulties in describing density and in comparing the densities of different objects. A surprising finding was that over half of students thought that increasing the volume of liquid in a container would make objects float more easily. Biddulph and Osborne (1984) found that up to 35% of 11- to 12-year-olds held this view.

Paik et al. (2017) describe a learning progression for buoyancy that begins with the basic concepts of weight and volume, before starting to develop the scientific concepts of density and buoyancy. In their progression, the density of an object is introduced as the object being *heavy (or light) for its size*. This working definition of density allows students to develop understanding of how volume and weight combine to give an object its buoyancy, and provides descriptive tools that help explain why boat-shaped objects (that are filled with air) are more buoyant than other more compact shapes. This idea is also linked to the understanding that buoyancy increases as the volume of liquid (or gas) displaced increases. Buoyancy is defined as the resultant upward force of the liquid (or gas) around an object, on the object.

**Ways to use this activity**

This demonstration gives you the opportunity to re-teach a challenging concept, and show your students how it builds up from simpler ideas, using a structured teacher-led discussion.

You should use carefully selected questions to check your students’ understanding of each step, before progressing onto the next one.

The steps you follow in this demonstration are described in the demonstration notes.

*Differentiation*

You could challenge different individuals by asking them follow-up questions to clarify or to extend their original answer. If a student is having difficulty with a particular question, it is often helpful to break it into smaller *chunks*, to lead them to a fuller answer. This technique models more thorough answers, and can be used to support an open classroom culture in which students are encouraged to ‘have a go’.

**Equipment**

For the demonstration:

* Set of density blocks
* Glass trough filled with water
* Balance – with capacity to measure the mass of the heaviest block

**Technician notes**

As a minimum a large and small wooden density block are needed, together with metal blocks, one which has a smaller mass than the large wooden block, and one with a bigger mass than the large wooden block.

A glass trough is necessary so that students can observe each block clearly.

**Health and safety**

Water spillages may cause slipping.

Dropping metal blocks into a glass trough may break it – they need to be lowered in gently. This is especially important if students are assisting. Consider placing a cushioning cloth on the bottom.

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**

Both metal blocks sink, and the wooden ones float.

Density measures how heavy an object is for its size.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: Peter Fairhurst (UYSEG).

**References**

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Biddulph, F. and Osborne, R. (1984). Pupils' ideas about floating and sinking. *Australian Science Education Research Association Conference.* Melbourne.

Paik, S.-H., et al. (2017). Developing a Four-level Learning Progression and Assessment for the Concept of Buoyancy. *Eurasia journal of mathematics, science and technology education,* 13(8)**,** 4965-4986.

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