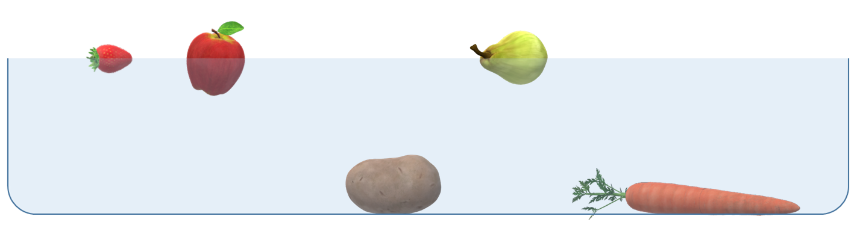
**Fruit and veg**

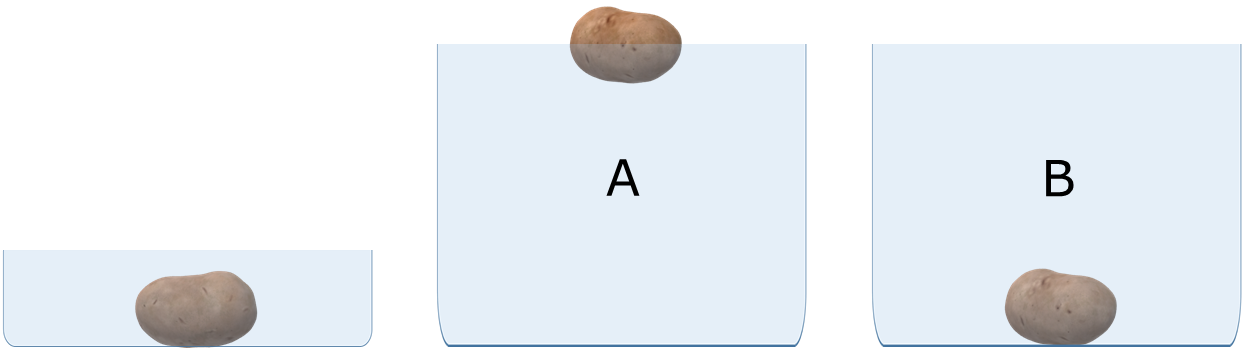
Some fruit and vegetables float on water.

Other fruit and vegetables sink.



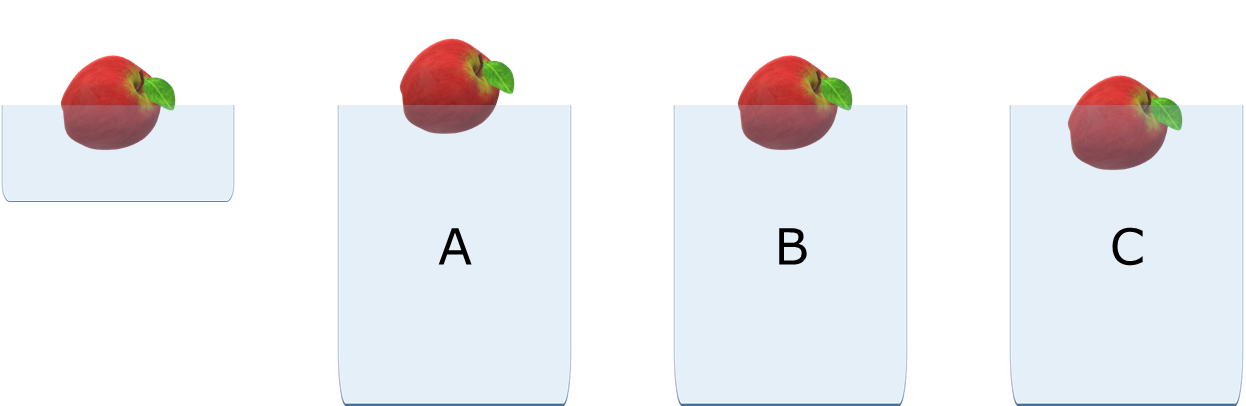
1. A potato sinks in shallow water.

What happens to the potato in deep water?



1. An apple floats in shallow water.

What happens to the apple in deep water?



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

|  |
| --- |
| **Diagnostic question** |
| **Fruit and veg** |

**Overview**

|  |  |
| --- | --- |
| 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. |
| Question type: | Simple multiple choice |
| Key words: | Floating, sinking, weight, volume, density |

**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 question**

Students should complete the question individually. This could be a pencil and paper exercise, or you could use an electronic ‘voting system’ or mini white boards and the PowerPoint presentation.

The answers to the question will show you whether students understood the concept sufficiently well to apply it correctly.

If there is a range of answers, you may choose to respond 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*

You may choose to read the questions to the class, so that everyone can focus on the science. In some situations it may be more appropriate for a teaching assistant to read for one or two students.

**Equipment**

For the class (optional demonstration):

* A potato
* An apple
* Two large beakers of water (1000 ml) – one with just enough water for the apple to float and for the potato to be submerged; and one almost full.

**Expected answers**

1. B – potato will be submerged.

2. B – it floats in the same way.

**How to respond - what next?**

Most students are likely to give the correct answer for question 1. A few may suggest that if there is more water then it will push up harder and may make the potato float.

If students are unsure of how depth affects how well an object floats, they are likely to choose answer A, for the reasons described above. A few may choose answer C: there is a common fear of swimming in deep water, which can translate into the misunderstanding that it is harder to keep afloat in deeper water.

The situation in answer B is identical to the situation in the shallow water, except that in answer B the ‘shallow water’ is supported by the water beneath it, rather than the bottom of the bowl.

If students have misunderstandings about how the depth of water affects how well an object floats, it can help to challenge them with practical examples that show the depth of water does not affect the buoyancy of an object. This can be done by demonstrating this diagnostic question. Careful questioning can elicit the understanding that water in the top section of deep water is identical to the water in a shallow bowl, and that the same piece of fruit or veg interacts with each in the same way.

An extension could be to challenge students to explain why the apple does not float at the same level in a different liquid, for example in salty water.

**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.

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