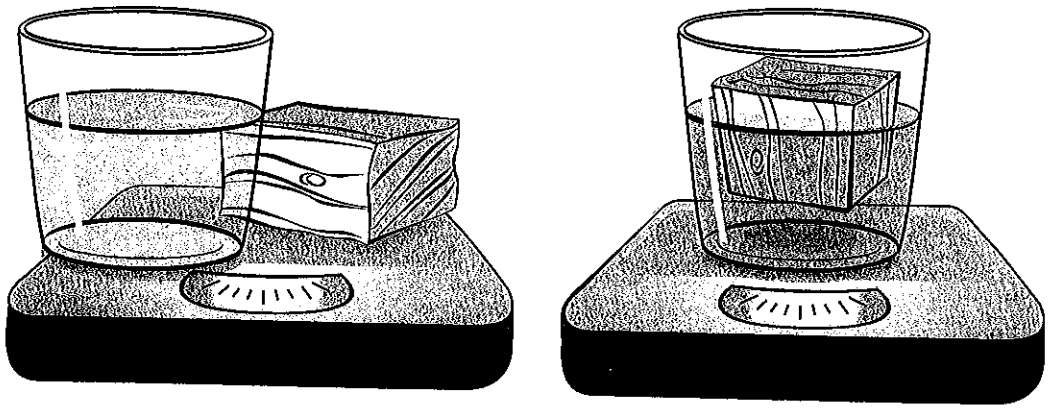
What Will Happen to the Weight?



Devon places a wooden block and a bucket of water side by side on a scale. He records the total weight of the objects. Devon then places the wooden block in the bucket so it floats in the water. What do you think will happen to the total weight of the block plus the bucket of water after the wooden block is placed in the bucket of water? Circle your answer.

A The total weight will increase.

B The total weight will decrease.

C The total weight will stay the same.

Explain your thinking. What rule or reasoning did you use to decide what would happen to the total weight?

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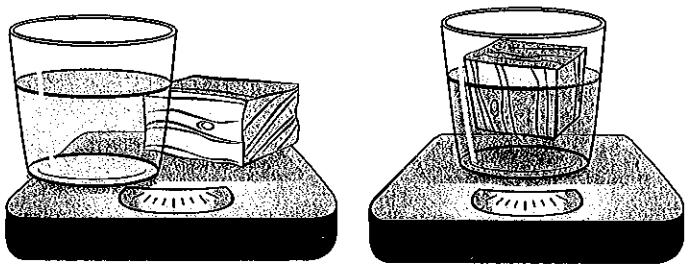
Teacher Notes



Purpose

The purpose of the assessment probe is to elicit students' ideas about weight. The probe is designed to determine whether students recognize that the gravitational force on an object, and thus its weight, is the same whether an object is floating in water or is outside of water.

Related Concepts

buoyant force, floating, gravitational force, weight

Explanation

The best answer is C: The total weight will stay the same. Some students answer the question thinking only about the block (and not the system containing both the block and the water). Students who focus only on the block are correct in thinking that the block *appears* to weigh less in the water (due to the upward buoyant force by the water on the block), but the total weight of the system is the same. The force by the water upward on the block (called the buoyant force) is balanced by the force by the block on the water. Therefore, the fact that the block is floating will have no effect on the total weight of the bucket with the water and the block.

Administering the Probe

This probe is best used with upper elementary, middle school, and high school students. Make sure students understand that the block and the bucket of water are side by side on the scale and that the block is then put into the bucket of water while on the scale.

Related Ideas in *National Science Education Standards* (NRC 1996)

K–4 Properties of Objects and Materials

- Objects have many observable properties, including size, weight, shape, color, temperature, and the ability to react with other

substances. Those properties can be measured using tools, such as rulers, balances, and thermometers.

9–12 Motions and Forces

- Gravitation is a universal force that each mass exerts on any other mass.

Related Ideas in *Benchmarks for Science Literacy* (AAAS 1993, 2009)

K–2 Manipulation and Observation

- Weigh objects using a scale.

3–5 Forces of Nature

- The earth's gravity pulls any object on or near the earth toward it without touching it.

6–8 Forces of Nature

- Every object exerts gravitational force on every other object.

6–8 Manipulation and Observation

- Make accurate measurements of length, volume, weight, elapsed time, rates, and temperature by using appropriate devices.

Related Research

- Stead and Osborne (1980) found that 30% of the 13-year-olds they studied thought there was no force of gravity in water and that explains why things float. Other students suggested that there is less gravity in water or even that there is gravity in water but that it acts upward (Driver et al. 1994).
- The physicist's idea of weight as the force of gravity on an object did not appear to be a firmly held idea in studies of secondary students (Ruggiero et al. 1985).
- A study by Watts (1982) found that secondary students have a very flexible view of gravity—namely, that gravity does not act the same way on all objects. In addition, students thought that gravity did not even act the same way at all times on the same object (Driver et al. 1994).

Suggestions for Instruction and Assessment

- This probe can be used as a P-E-O-E activity (Keeley 2008). Provide students with a container of water and a floating object that can be placed in the container. Have students (a) *predict* what the total weight will be before and after adding the object to the container of water, (b) support their predictions with *explanations,* (c) test their predictions, and (d) if their *observations* do not match their predictions, revisit and revise their *explanations.*
- Students' ideas about weight can be probed in different ways, such as by placing an ice cube next to a glass of water and asking students to predict whether or not the total weight will change when the ice is added to the water. Extend the probe to ask what will happen after the ice is all melted.
- It's important to have consistent definitions for *weight* and *gravity* (Morrison 1999).

References

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