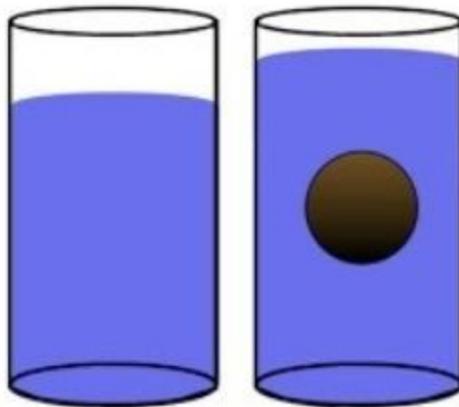


# Why Do Boats Float and Rocks Sink?

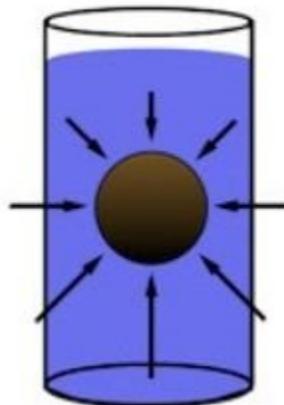
by Dr. Hany Farid

When an object is placed in water, there are two primary forces acting on it. The force of gravity yields a downward force and a buoyancy force yields an upward force. The gravitational force is determined by the object's weight, and the buoyancy force is determined by the weight of the water displaced by the object when it is placed in water. If the gravitational force is less than the buoyancy force then the object floats (a boat), otherwise it sinks (a rock). That is, if an object weighs less than the amount of water it displaces then it floats otherwise it sinks. Read on for a more detailed explanation.

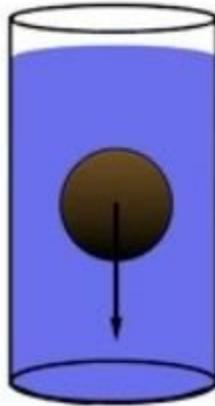
**Fact 1.** When an object is placed in water, it will displace water to "make room" for the object (e.g., when you get into a bath, the level of the water rises).



**Fact 2.** When an object is submerged in water, the surrounding water exerts a force (buoyancy force) on the object. This force increases with the depth of the water, so that for any submerged object, there is a net force upwards.



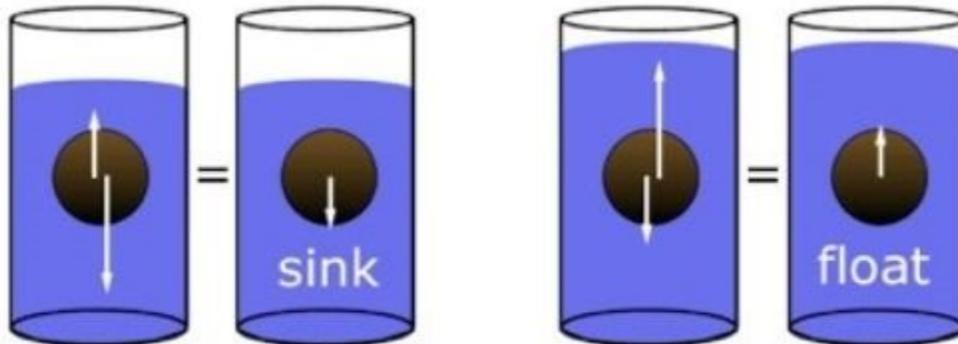
**Fact 3.** Any object is attracted downward due to gravity. This force increases with the mass of the object.



There are two primary forces acting on an object placed in water:

1. a gravitational force acts in the downward direction causing the object to sink. The strength of this force depends on the object's mass (weight) -- the more massive an object the stronger the downward gravitational force will be.
2. a buoyancy force acts in all directions, but has a net upwards direction, causing the object to float. The strength of this force depends on how much water the object displaces -- the more water that is displaced the stronger the upward buoyancy force.

If the downward gravitational force is less than the upward buoyancy force then the object floats, otherwise it sinks. That is, if an object weighs less than the amount of water it displaces then it floats otherwise it sinks. A boat floats because it displaces water that weighs more than its own weight.



Name: \_\_\_\_\_ Date: \_\_\_\_\_

1. When an object is placed in water, how many primary forces are acting on it?

- A. two
- B. four
- C. three
- D. one

2. Placing an object in water can be thought of as a cause. What is an effect of placing an object in water?

- A. Water is displaced to "make room" for the object.
- B. The upward buoyancy force on the object decreases.
- C. The amount of water decreases to "make room" for the object.
- D. The downward force of gravity on the object increases.

3. Read these sentences from the text.

If the downward gravitational force is weaker than the upward buoyancy force, then the object floats; otherwise, it sinks. That is, if an object weighs less than the water it displaces, then it floats; otherwise, it sinks. [...] the more water that is displaced, the heavier [the water's] weight, and the stronger the upward buoyancy force.

Based on this evidence, what conclusion can you draw about weight?

- A. The lighter the weight of an object, the more likely it is to sink.
- B. The weight of an object depends on the amount of water it displaces.
- C. The strength of the upward buoyancy force on an object is related to the weight of the object.
- D. The strength of the downward gravitational force on an object is related to the weight of the object.

4. Why do rocks sink when placed in water?

- A. because rocks weigh more than the water that they displace
- B. because rocks weigh less than the water that they displace
- C. because water does not exert a buoyancy force on rocks
- D. because rocks do not displace water

5. What is the main idea of this text?

- A. When an object is placed in water, the force of gravity and a buoyancy force both act on the object.
- B. If the gravitational force on an object in water is less than the buoyancy force, then the object floats; otherwise, it sinks.
- C. Any object is attracted downward due to the force of gravity, which increases with the mass of the object.
- D. When an object is submerged in water, the surrounding water exerts a force (buoyancy force) on the object.

6. Why might the author have included the diagram at the end of the text?

- A. to introduce new information to the text
- B. to persuade the reader to agree with the author
- C. to illustrate the main idea of the text
- D. to give evidence to support a claim made by the author

7. Choose the answer that best completes the sentence.

If an object weighs less than the water it displaces, then it floats; otherwise it sinks. \_\_\_\_\_, a boat floats because it displaces water that weighs more than its own weight.

- A. In contrast
- B. For example
- C. However
- D. Meanwhile

8. If an object in water weighs less than the water that it displaces, what does it do?
9. Explain why a boat floats. Support your answer with evidence from the text.
10. Imagine that you are looking at two boats on land. One is a very small boat made out of heavy material, and the other is a large boat made out of light material. Explain which boat would be more likely to float. Support your answer with evidence from the text.