



Experiment

Cargo Overboard

In answer to a question about what would happen when an ice cube with a piece of cork in it melts, Ramón Hernandez suggested another exploration.

In a small and closed pond there is a boat loaded with steel beams.

The crane operator picking up the beams makes a mistake and the beams fall to the bottom of the pond. Will the water level rise, fall, or stay the same?

Keep curious,
—Ramón

Experiment

To do this you need the following:

- A glass of water
- A small plastic cup
- Coins
- Colored tape

Since we don't have a barge full of steel beams or a nearby pond, we decided to scale down the problem. A glass of water stands in for the pond. Our barge was a small plastic cup. Instead of steel beams, we used some coins.

We put our cargo of coins in the cup and set the cup floating in a glass of water. We marked the water level with a piece of blue tape.

Then we dumped the coins overboard. They quickly sank to the bottom. The cup remained floating. What happened to the water level?

Try this for yourself. Then check our results below.



Results

The water level went down. Why?

Archimedes had the answer. He observed that when an object is partly or fully submerged in water, it displaces, or pushes aside, the water. There are two possible situations:

1. The object is less dense than water and it floats.
2. The object is denser than water and it sinks.

A floating object displaces an amount of water that weighs the same as the object. If it sinks, it displaces an amount of water equal to its size.



Before we look at our barge, imagine a block of wood floating in water. Since wood is less dense than water, it floats, partly above the waterline and partly below. The part below has displaced an amount of water that weighs the same as the whole block of wood.

Imagine a rock that is denser than water. It sinks. It displaces an amount of water equal to its size.

Our cup of coins floats even though the coins are much denser than water. This is because of the boatlike shape of the cup. You can see that when the cup of coins is floating, there is a considerable amount of air below the waterline. The boat as a whole displaces an amount of water that equals its weight: cup, coins, and air.

What happens when we dump the coins overboard? The coins are no longer displacing a volume of water that equals their weight, but much less. We don't know exactly what metals the coins are made of, but it is probably some combination of copper, nickel, and zinc. The densities of these three metals are as follows:

- Copper: 9.0 grams per cubic centimeter (g/cc)
- Nickel: 8.9 g/cc
- Zinc: 7.0 g/cc

The density of water is 1.0 g/cc.

One cc of copper sitting in the cup displaces 9 ccs of water. This is because 1 cc of copper weighs the same as 9 cc of water. When that same piece of copper is out of the cup and sitting at the bottom of the glass, it displaces only 1 cc of water.

To learn more about floating and sinking, try the [Buoyancy Explorer](#).

For a fun look at calculating displacement, try the [Float and Sink](#) math puzzle.

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The cup still floats, but without the weight of the coins, it rides much higher in the water.

So the answer to the question posed by Ramón is that the water level in the pond will fall when the beams are dropped in.

But what would happen if the barge was in the ocean rather than in a small pond? Would the sea level fall as well? Think about it, then read on for our answer.

Answer

The ocean level would fall, but by an immeasurably tiny amount. This is because the volume of water is so much greater than that of the beams. Try the coin-and-cup experiment with a large glass bowl instead of a drinking glass to get an idea of how this works.