Why objects sink and float

Buoyancy helps explain why some objects sink and others float. If the buoyant force is greater than its weight, the object floats. In the example above, we would need a buoyant force greater than 2.25 newtons to make our rock float.

If the buoyant force is less than its weight, then the object will sink. Neutral buoyancy occurs when the buoyant force is equal to the weight of the object. When an object is neutrally buoyant, it will stay immersed in the liquid at the level where it was placed. Scuba divers use weights and a buoyancy control device (BCD) to help them maintain neutral buoyancy. When a scuba diver is neutrally buoyant he or she can swim and move underwater without rising to the top or sinking.

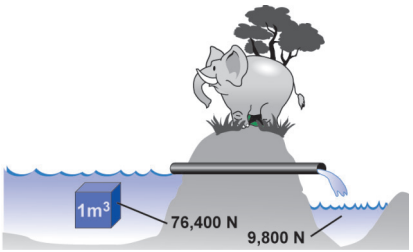

Figure 17.11: *A solid cubic meter of steel weighs 76,400 N. It displaces 9,800 N of water.*

Why does a block of steel sink, but a steel boat float?

Archimedes' principle explains why a substance in one shape will float and in another shape will sink. A cubic meter of steel has a weight of 76,400 newtons. When placed in water, the block would displace one cubic meter of water. The water would have a weight of 9,800 newtons. The weight of the steel block is much greater than the weight of the displaced water. As expected, the block sinks.

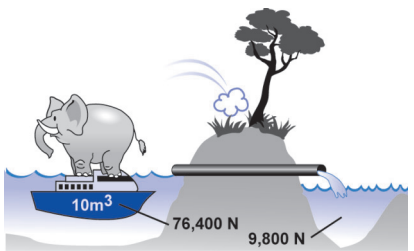

Figure 17.12: *The same amount of steel, shaped into a 10-cubic-meter boat, is held just under the surface by an elephant. Now it displaces 98,000 N of water.*

Why a steel boat floats

Imagine the same block of steel flattened into a thin sheet, its sides bent up into the shape of a boat. That original block of steel, now shaped to be hollow inside, might occupy 10 cubic meters of space instead of one. Ten cubic meters of displaced water has a weight of 98,000 newtons. Now the displaced water weighs *more* than the steel, which still weighs 76,400 newtons.

When placed in the water, your steel boat would settle in the water until it reached a level where it displaced 76,400 newtons of water. Then the upward force exerted by the water would equal the downward force exerted by the boat.

You can try a similar experiment with a stick of clay and a bucket of water. Drop the stick of modeling clay into the bucket and observe what happens. Now mold the clay into a boat shape. Can you make a clay boat float?

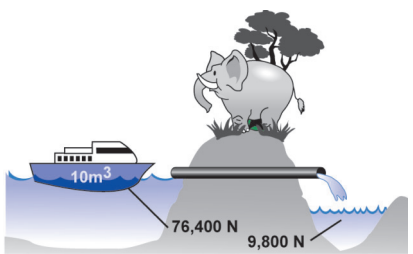

Figure 17.13: *When the boat floats, it displaces 76,400 N of water—which is equal to the boat's own weight.*