

# Educational Innovations<sup>INC</sup><sup>®</sup>

## DEN-300

### Density Paradox Set

This set consists of two cylindrical solid objects with attached hooks. We have all learned that an object will float if its density is less than the density of the liquid, and sink if its density is greater. Will these objects float or sink?

Dropped into a beaker of water, they immediately sink. And then, a short time later, they bob to the surface and float. Removed and dropped into another beaker, they float. And then sink, after a brief time interval!

What's going on here?

One hint is that the first beaker contained hot tap water, while the second beaker held icy cold water. Cold water is denser than hot water. Does this explain the objects' behavior?

It is only a partial explanation. The objects must have a density near that of water. Their density is less than cold water so they float. Their density is greater than hot water so they sink. At least at first they do. But why does their behavior change after a while?

Dropped into hot water, the objects get hot. Dropped into cold water, the objects get cold. Does their density change as a result. Most solids expand when heated. Does their mass also change? Why or why not? What happens to the density of a solid when it heated? What happens to a solid when it is chilled?

For most solid substances, density changes very little with temperature changes—much less than is the case of liquids. The plastic in these objects is an exception. It expands or contracts much more than most solids as a result of temperature changes, and its density changes more than water.

When the object is dropped into hot water, it sinks because the hot water is less dense. But then with time it heats up and its density becomes even less than the water. So it floats. Similar reasoning explains its behavior in icy water.

#### **Troubles:**

Sometimes bubbles will adhere to the objects. Then they may float when reasoning says they should sink. Make sure there are no bubbles sticking to the objects.

Sometimes surface tension will cause the objects to float when they should sink. But if pushed slightly below the surface they will immediately sink. Problems of surface tension may be greatly reduced by putting a tiny amount of detergent in the water.



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