

## Density Paradox Set

DEN-300

Your Density Paradox Set consists of two cylindrical solid objects with attached hooks. This is an awesome discrepant event for your most advanced "density" students! 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 the Density Paradox 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, in about 60 seconds, they mysteriously sink. What's going on here?

One hint is that the first beaker contains hot tap water, while the second beaker holds 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 close to 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 is 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 the object 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.

# Take Your Lesson Further

As science teachers ourselves, we know how much effort goes into preparing lessons. For us, “*Teachers Serving Teachers*” isn’t just a slogan—it’s our promise to you!

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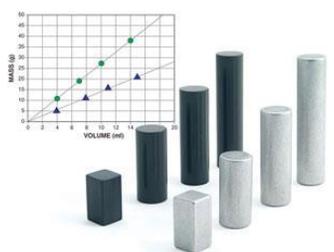
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To extend your lesson, consider these Educational Innovations products:

## Density Sphere Experiment Kit (DEN-10)

This awesome kit is designed to permit students to discover and apply concepts of density and buoyancy. In this kit students make a density gradient from sugar or salt in a plastic column. Students then float five small spheres of different densities in the solution. Each sphere floats at a different level! By manipulating the density gradient, students can change the level at which the spheres float. Kit includes full instructions and write-up as well as spheres made of the following materials: polyethylene, polystyrene, nylon, acrylic, and cellulose acetate. Even unknown plastics are included for student density determination. Great for an elementary science table or as a terrific lab for middle school, high school, or college.



## Density & Slope Set (DEN-40)

Great for showing the difference between accuracy and precision! Students can determine the density of two different materials: aluminum and a gray colored plastic. Plot mass vs. volume. Density is the slope of the line. The set contains four different sized samples of each material for a total of eight specimens. You will need a balance to determine the mass and either a ruler or a graduated cylinder to determine the volume.

## Poly Density Kit (DEN-460)

When the bottle is shaken, blue and white beads mix as expected. However, when allowed to settle, the beads separate, white at the top and blue at the bottom. Then, the two separated colored beads slowly come together in the center of the liquid. How often do you see something floating in the middle of the liquid? Great for illustrating so many concepts: solubility, density, miscibility, the salting out effect...



## Pumice Samples (25 pack) (RM-315)

Your class will erupt with excitement as each student explores and observes the product of an actual volcano. Pumice is a lightweight igneous rock, formed when lava cools quickly above Earth's surface and traps gases before the molten material solidifies. As a result, it contains so many air holes that it floats in water! These are a naturally occurring item. Size and shape are dependent on availability and will vary.

