611-2105 (30-162) Reverse Density Rod

Warranty and Parts:
We replace all defective or missing parts free of charge. We accept Master Card and Visa, school P.O's. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse, or normal wear and tear.

Introduction:
This brand-new device consists of a PVC cylinder with a nail insert, tested to make sure it performs as described below.

The purpose of the Reverse Density Rod is to get the student to think about the concept of density in a fundamental way. It demonstrates that substances change volume with change of temperature. Water is used as an example at temperatures ranging from room temperature to approximately 10 to 8° C.

If we make the density rod of something which had a volume change greater than water, it would tend to float in hot water and sink in cold water. The Reverse Density Rod calls attention to the fact that we must consider properties of both water and the rod itself.

The Reverse Density Rod exhibits behavior which is exactly opposite the behavior from its cousin, the Density Rod* (which floats in cold water and sinks in hot!) The student knows from prior classroom experiences that water gets less dense as it gets warmer. Why, then, does the Reverse Density Rod float in hot water that is less dense?

The answer is that the density of the rod also changes with temperature and the rod becomes much less dense at higher temperatures. This means that it "wins the race" against the water and so floats. The reverse process happens when the water cools; the rod becomes denser "faster" than the water and so sinks.

* See 611-2100 Density Rod on www.sciencefirst.com

Additional Materials Needed:
• Graduated cylinder or other transparent container
• Water of varying temperatures

How To Use:
1. First place the rod in water at about room temperature. It will float.
2. Next fill a graduated cylinder with cold water adding ice to drop the temperature. Since air bubbles cling to the Reverse Density Rod and cause erratic operation, use de-aerated water if you can. Previously boiled water is good. In about 3 minutes, the rod will begin to sink.
3. If put back in warm water, the rod will begin to float as it warms sufficiently.
4. Please Note: Surface tension may prevent rod from sinking in cold water. A gentle tap on rod should cause it to sink.

Theory:
Why an Object Sinks.
When the buoyant force acting on an object which is submerged in a liquid such as water is less than its actual weight (the actual pull of the earth on the object), the object will sink. In other words, the submerged object apparently loses only part of its actual weight. The volume of the displaced liquid is the same as that of the submerged object, but its weight is less than that of the object. The density (weight per unit volume) of the liquid, therefore, is less than that of the object. The density of any object that sinks in a liquid must be greater than that of the liquid itself.

When the buoyant force acting on a submerged body is just equal to the weight of the body, the body appears to lose all its weight. It will then neither sink or rise of its own accord in the liquid. Its density must be exactly the same as that of the liquid. If you float in water with just your nose out, the average density of your body must be the same as that of the water. This exact balance in density is generally hard to maintain. A fish, for instance, has an air bladder which compresses and expands to change its average density. The air bladder allows the fish to maintain this delicate balance.

Why an Object Floats.
Archimedes' principle, which is defined as: the apparent loss in weight of any object submerged in a liquid is equal to the weight of an equal volume (the displaced volume) of the liquid also applies to objects that float. When the actual weight of an object is less than that of the liquid it displaces, the object is forced upward out of the liquid. It rises above the surface of the liquid and floats with only part of its volume submerged in the liquid. The weight of the volume of liquid displaced by the floating object must just equal the actual weight of the object itself. A floating object must apparently lose all of its weight, but in order to do so, it must be only partly submerged. The average density of a floating body must be less than that of the liquid in which it floats. The less the density of the floating object, the smaller fractional part of its whole volume is under the liquid.

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