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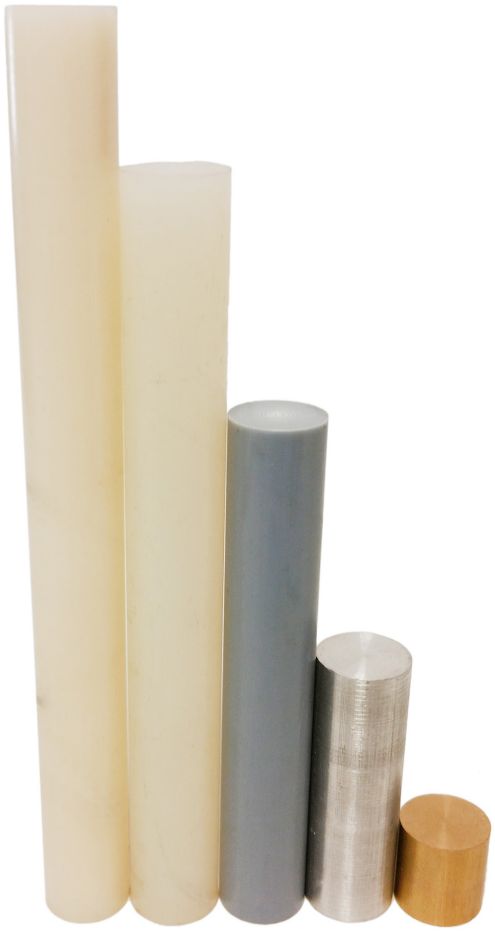
Density Rod Set with Five Equal-Mass Rods of Different Materials #DNRDST-05

Warning:

- **Not a toy; use only in a laboratory or educational setting.**
- **California Proposition 65 Warning: This product can expose you to chemicals including lead, which are known to the State of California to cause cancer, birth defects, or other reproductive harm. For more information go to www.P65Warnings.ca.gov.**



Introduction

All matter in the universe shares at least two properties: mass and volume. **Mass** is the term used to describe just how much matter exists in an object, while the term **volume** is used to describe how much space that mass occupies. Mass should not be confused with weight, which is a measurement of the force of gravity exerted on a given mass. An object's mass is constant, even in zero-gravity conditions, while its weight will fluctuate based on the gravitational force of the planet or body-in-space it is on.

The relationship between mass and volume is talked about in terms of **density.** If mass is referring to how much matter exists in an object, density refers to how tightly its atoms are packed into the space it occupies. For example, if you compare two identically-shaped objects with different masses, you will know that the heavier (*ie.* more massive) object is the denser of the two.

Your Density Rod Set comes with five different rods. Each one is a different material, but they all possess the same mass. In the order pictured on the left, from left to right, your rods are: polyethylene, nylon, PVC, aluminum, and brass. You can use these rods and the knowledge that they all share the same mass to demonstrate the relationship between mass, volume, and density.

In order to fully use your set, you will need a few **additional supplies:**

- A device for measuring your rods' dimensions (*eg.* Ruler, calipers)
- A gram scale with a resolution of 0.01g

You will find instructions on the back of this sheet detailing how to use your rods to investigate these fundamental physical properties.

Finding the Density of Your Rods

As stated on the previous page, density is the relationship between mass and volume. The equation used to find density can be found in the box on the right of this page. You will first confirm that all of your rods are the same mass. After, you will find their volumes, and then calculate the density of each rod. By observing this relationship on your own you will better understand how mass and volume intersect.

Confirming Mass

1. Using a gram scale (not included), measure the mass of any one of your rods. Record this value in grams (g).
2. Repeat this measurement for each of your five rods.
3. Confirm that each rod in your set has the same mass, and observe that they are all different in size.

Measuring Volume

1. Using a ruler with a centimeter (cm) scale or a set of calipers, measure the diameter of one of your rods.
2. Divide this number in half to find the radius of your rod.
3. Measure the height (or length) of the rod in centimeters (cm).
4. Using the formula on the right for the volume of the cylinder, calculate the rod's volume. Record this value in cubic centimeters (cm^3).
5. Repeat these steps for each of your five rods to find their volumes as well.

Calculating Density

1. With the values you found above and the density formula to the right, calculate the density for each rod in your set.
2. Observe that the denser the material of the rod, the more matter it can store in a small amount of physical space.

Density

$$\rho = \frac{M}{V}$$

Volume of a Cylinder

$$V = \pi h r^2$$

Radius

$$r = \frac{d}{2}$$

- ρ = Density (g/cm3)
- M = Mass (g)
- V = Volume (cm^3)
- h = Height (cm)
- r = Radius (cm)
- d = Diameter (cm)