Manifest Density

Estimated Time: 30 minutes

SUMMARY

Remember the scene from the Polar Express? The children are at the North Pole, rushing to return to the train. Billy spots his gift among the massive pile, but fears how large the package is. How was he able to pick up such a massive box? The package, though large, was not *dense*. Density is dependent on the mass and volume of matter; this derived function describes an object's compactness. Although a kilogram of bricks and a kilogram of feathers have the same *mass*, they take up much different *volumes*. Bricks are much denser than feathers. In this activity, students will learn how to measure density by calculating mass and volume.

WHAT YOU'LL LEARN

- How to measure density, including mass and volume
- Data collection methods
- International System of Units (SI measurements)
- Important applications of density

Materials Used

- Liquid measuring cup
- Food scale or other scale that measures grams
- A collection of small items to measure (think rocks, coins, water-proof toys, ice cubes, etc., that fit in the measuring cup)
- Tap water
- Calculator
- Writing utensil and scratch paper (to record measurements and calculate density)

WHAT TO DO

1. Create a data table and review the methods for calculating density.
2. Determine several different objects to measure for the activity. Keep in mind that this activity will use water displacement to measure volume, so it is important to choose water-safe objects.
3. Discuss density, a measure of compactness, or the amount of matter that takes up a given space. The student can predict which objects will be densest; for instance, a rock will be much denser than a sponge.
4. Begin by weighing each object on the scale. Record the masses in your data table.
5. To find the volume of each object, fill the liquid measuring cup about 2/3 of the way full. It should have enough water to submerge the item, but not so much that the cup will overflow or exceed the cup's measurement capacity when the object placed in the water. Record the volume before adding an object. Place one object at a time in the water, recording the volume after the addition.

6. Before calculating density, you must find the change in volume before and after adding an object to the water. This is done by subtracting the volume of plain water from the volume after adding the object.
7. Density is calculated by dividing the mass over the change in volume. Record the calculated densities of each object. Were any of the results surprising? Why was something much denser or less dense than you expected?
8. Also discuss if objects floated on the water or sunk. Can your student explain this? Prompt a conversation about floating and sinking; objects that are denser than water will sink, while objects less dense than water will float. Why is this important? It means that ice stays on the surface of ponds and lakes in the winter, leaving an insulated liquid environment below for aquatic life. It also means that most animals can swim. And engineers can design products that won't be lost in the bottom of the ocean as easily.

TIPS

- Realistically, density is just the measurement of mass divided by volume. If your family does not have a scale that measures in grams or a liquid measuring cup with metric units, this activity can still be educational! Although the SI unit for density is kg/m^3 or g/cm^3, try the activity with lbs/fluid oz.
- It is important to understand the equivalent conversions of the measurements in this activity. A cubic centimeter is equivalent to a milliliter (ever heard a doctor call for 10 cc's of a fluid? That's the same as saying 10 mL).