Density Columns

Recommended Grade Level(s):

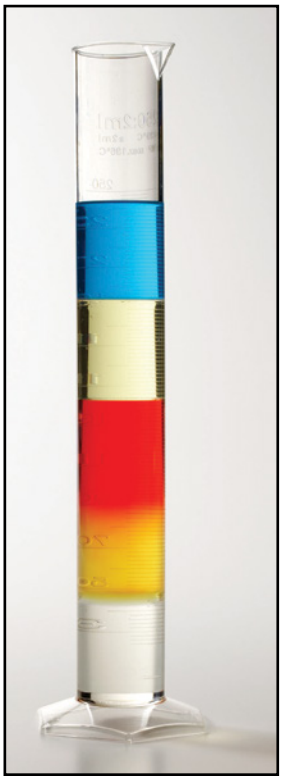
Appropriate for: Middle school and High school

Time Requirements:

Activity Time: 30 minutes

Teaching Topics & Concepts:

- Density, mass, separation methods, solubility, diffusion, immiscibility, hydrophobicity.



Background:

Walking down the salad dressing aisle at the grocery store, you may notice some of the bottles' content looks different from the others. The vinaigrettes have layers of oil and vinegar that just don't mix. As you walk out to the store parking lot, you may spot a few drops of motor oil shimmering on puddles of water. Both examples are real-world observations of the density and mass of substances. These concepts are critical for various fields, including engineering and technology for applications like ships and submarines, oil spills, plumbing, and airplane weight distribution. In this activity, students can demonstrate the concept of density by making a density column that can determine the relative densities of several solid objects.

Materials:

- Syrup (brown) or light corn syrup
- Dishwashing detergent (green)
- Water (colored red with food coloring)
- Vegetable oil (yellow)
- Ethanol (colored blue with food coloring)
- 250 mL glass graduated cylinder
- Small ice cube
- Small cork
- Small piece of chalk

Safety

- Read the SDS sheets for all chemicals before using them.
- Adult supervision required when handling chemicals.
- Wear safety glasses, gloves, and a lab coat.
- Ethanol is highly volatile and flammable. Ensure no open flames are present (candle, Bunsen burner).
- Avoid inhalation of ethanol vapors.

Procedure:

1. Pour 50 mL of syrup into a 250 mL glass graduated cylinder and let the liquid settle.
2. Tilt the graduated cylinder and pour 50 mL of dishwashing detergent slowly down the side of the cylinder. Then, let the liquid settle in the upright position. The detergent should form a layer on top of the syrup.
3. Repeat step 2 for the other liquids: red-colored water, vegetable oil, and blue-colored alcohol.
4. Drop in various items (ice, cork, chalk) and observe the level at which the object sinks or floats.
5. Cover the cylinder in plastic wrap and leave it undisturbed for several days before re-examining.
6. Shake the graduated cylinder and re-examine after several minutes.

Expected Results:

The column is made by pouring the heaviest liquid into the glass first, followed by the next-heaviest liquid, etc. The heaviest liquid has the most mass per unit volume or the highest density. The colored liquids layer in the column (from bottom to top: brown, green, red, yellow, blue).

Follow up/Extension:

1. Why did we use the graduated cylinder? What did that help us measure?
2. Why did we add the objects? How did they impact the total volume?
3. Can liquids have different densities, like solid objects?
4. What differences did you notice between where each object (the ice, chalk, and cork) sank? What explains those differences?
5. How do density and mass help explain your observations?

- Use a triple beam balance for further measurements and investigations.
- Change some of the variables like water temperature, objects used, size of objects, liquids used.
- How do these concepts help explain Earth Science lessons about the density of sedimentary rocks compared to metamorphic rocks?

Teaching notes:

- Except for the oil, the liquids are miscible, so care must be taken when layering them.
- Students could determine the densities of the liquids to generate the order of pouring the liquids.

Disposal/Clean-Up:

Contents of the cylinder can be safely poured down the drain but ensure that solids are strained out or removed from the sink trap and placed in the garbage.