



Lesson: Density

Name:

Teacher:

Date:

### Density Rainbow Experiment Article

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### Understanding Density

Density is one of the most fundamental properties of matter. It measures how much **mass** is packed into a given **volume** of a substance. In simpler terms, density tells us whether an object feels heavy or light for its size. The formula to calculate density is:

$$\text{Density (d)} = \frac{\text{Mass (m)}}{\text{Volume (V)}}$$

- **Mass (m):** The amount of matter in an object, measured in grams (g) or kilograms (kg).
- **Volume (V):** The space the object occupies, measured in cubic centimeters (cm<sup>3</sup>) or milliliters (mL).
- **Density (d):** Measured in g/cm<sup>3</sup> for solids and liquids, or kg/m<sup>3</sup> for gases.

#### Example 1 – Solid Object:

A rock with a mass of 50 g and volume of 20 cm<sup>3</sup> has a density of  $50 \div 20 = 2.5 \text{ g/cm}^3$ .

#### Example 2 – Liquid:

Vegetable oil with a mass of 92 g in a volume of 100 mL has a density of  $92 \div 100 = 0.92 \text{ g/mL}$ . Because this is less than water's density (1 g/mL), oil floats on water.

### Why Liquids Form Layers

The **Density Rainbow Experiment** demonstrates how liquids of different densities naturally form layers. Denser liquids sink, while less dense liquids float above them. For example:

Liquid	Approx. Density (g/mL)	Layer Position
Honey / Syrup	1.4	Bottom
Dish Soap	1.06	Above honey
Water	1.0	Middle
Vegetable Oil	0.92	Above water
Rubbing Alcohol	0.79	Top layer



This layering occurs because of **differences in mass per unit volume** and **intermolecular forces** between molecules. Denser liquids have more tightly packed molecules, while lighter liquids have molecules that are more spread out.

### Intermolecular Forces and Mixing

Liquids do not always mix even if they are poured together. **Polarity** and **intermolecular forces** play a crucial role:

- Polar molecules, like water, are attracted to other polar molecules and mix readily.
- Non-polar molecules, like oils, are not attracted to polar molecules and remain separate.

This explains why in the density experiment, oil floats on water and does not blend with it, and why rubbing alcohol can form a distinct top layer.

### Calculating Density in the Experiment

Students can measure the **mass and volume** of small objects and liquids to calculate density, which explains why they float or sink in the liquid layers.

#### Example 3 – Small Object in Liquid Layers:

- A grape with a density of 1.05 g/mL will sink below vegetable oil but float above water, because it is denser than oil but less dense than water.
- A small bead with a density of 0.80 g/mL will float on water and settle in the rubbing alcohol layer.

By observing the relative positions of objects in the layers, students can connect the concept of density to real-world applications.

### Real-World Applications of Density

Understanding density is essential in many areas:

1. **Environmental Science:** Oil spills float on water because oil is less dense, allowing cleanup teams to remove it from the surface.
2. **Cooking:** Salad dressings separate into layers of oil and vinegar due to density differences.
3. **Engineering:** Ships and submarines rely on density calculations for buoyancy and stability.
4. **Material Science:** Scientists classify substances, design materials, and predict interactions based on density.

Density also plays a role in natural phenomena, such as the stratification of lakes, where colder, denser water sinks below warmer, less dense water.



## Observing Physical Properties Through the Density Rainbow

The **Density Rainbow Experiment** provides a clear, visual demonstration of how physical properties influence matter. It highlights:

- How **mass and volume determine density**.
- How **density differences cause layering of liquids**.
- The role of **intermolecular forces** in preventing or allowing mixing.
- How **objects of different densities behave** in a liquid medium.

By engaging in such observations, students not only learn the concept of density but also develop skills in **scientific reasoning, measurement, and analysis**.

## Conclusion

The Density Rainbow Experiment is more than a colorful demonstration—it is a gateway to understanding fundamental physical properties of matter. Through layering liquids and observing floating or sinking objects, students gain hands-on insight into density, mass, volume, and molecular behavior. This experiment bridges classroom learning with real-world phenomena, fostering curiosity and critical thinking in science.

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## References

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