Lab: Investigating Density within Lava Lamps!

FOR THE TEACHER

Summary
In this lab students will make a simple yet spectacular lava lamp while focusing on the density of the components.

Grade Level
Middle School

Objectives
By the end of this lab, students should be able to

- Explain the meaning of *density* and compare components of a mixture based on their density.
- Explain why vegetable oil floats on top of water in relation to their density.
- Describe the meaning of *miscibility* and understand why some substances are *immiscible*.

Chemistry Topics
This lab supports students’ understanding of

- Density
- Solutions
- Mixtures
- Solubility

Time
**Teacher Preparation:** 10 minutes
**Lesson:** 45 minutes

Materials (per group)
- 20oz plastic bottle with lid
- 1 bottle of vegetable oil
- Water
- 1 pack of food coloring
- 2 Alka-Seltzer tablets
- Funnel

Safety
- Always wear safety goggles when handling chemicals in the lab.
- Students should wash their hands thoroughly before leaving the lab.
- When students complete the lab, instruct them how to clean up their materials and dispose of any chemicals.
- Food in the lab should be considered a chemical not for consumption.

Teacher Notes
- Organizing students in small groups of 3-4 is recommended for this lab.

**Background/anticipated results:**
- Vegetable oil and water do not mix. Substances which do not dissolve in each other are *immiscible*.
- Vegetable oil floats on water because it is less dense than water.
- The density of a substance is the relationship between the mass of the substance and how much space it takes up (volume).
Density equals the mass of the substance divided by its volume; \( D = \frac{m}{v} \).

**FOR THE STUDENT**

**Lesson**

**Investigating Density within Lava Lamps!**

**Background**
- Vegetable oil and water do not mix. Substances which do not mix with each other are **immiscible**.
- Vegetable oil floats on water because it is less dense than water.
- The density of a substance is the relationship between the mass of the substance and how much space it takes up (volume).
- Density equals the mass of the substance divided by its volume; \( D = \frac{m}{v} \).

**Pre-lab Questions**
1. Should oil and water mix in this experiment?
2. If oil floats on top of water when they are combined, that means the oil is less dense than the water. If another item is added and also floats on the water, but sinks in the oil, what do you know about its density?
3. A material has a mass of 2.50 grams, and occupies a volume of 3.25 liters. What is the density value for this material? (Hint: Use the formula provide in the background section above!)

**Objective**
You will observe a homemade lava lamp in action, and compare the density of its components based on your observations.

**Materials**
- Plastic bottle with lid
- 1 bottle of vegetable oil
- Water
- Food coloring
- Alka-Seltzer tablets
- Funnel

**Safety**
- Always wear safety goggles when handling chemicals in the lab.
- Students should wash their hands thoroughly before leaving the lab.
- When students complete the lab, instruct them how to clean up their materials and dispose of any chemicals.
- Food in the lab should be considered a chemical not for consumption.

**Procedure**
1. Fill the bottle about 1/3 of the way with water.
2. Use the funnel to carefully add oil about another 1/3 of the way full.
3. Add 2-3 drops of your favorite color of food coloring.
4. Break an Alka-Seltzer tablet into a few small pieces, and drop them in the bottle one at a time.
5. Watch your lava lamp erupt into activity! As the reaction slows down, you can break another tablet and add it to keep the reaction going.
6. Record your observations about the behavior of each component of the lava lamp in
the table below

**Observations**
In the data table make note of what happened to each of the components in the lava lamp during the lab. *Also* make note of what happened to each component after the reaction stopped!

<table>
<thead>
<tr>
<th>Item</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td></td>
</tr>
<tr>
<td>Food Coloring</td>
<td></td>
</tr>
<tr>
<td>Alka-Seltzer Tablets</td>
<td></td>
</tr>
<tr>
<td>Gas Bubbles</td>
<td></td>
</tr>
</tbody>
</table>

**Analysis**
1. When the food coloring was initially added to the bottle, what happened to it? What does this tell you about the density of the food coloring?

2. Which of the following ingredients used in the lava lamp: oil, water, food coloring, or gas formed had the lowest density? How do you know this? Use your observations to support your answer.

3. How did the mixture look at the end of the experiment (after the bubbling stopped)? Can you determine which ingredient is denser, the water or the food-coloring? Explain.

4. Water has a density of 1.0g/ml.
   a. If an object has a volume of 15.0ml and a mass of 40g. What is its density?
   b. Would you expect this object to float or sink in a cup of water? Explain.

**Conclusion**
In a couple sentences describe the meaning of density, and suggest an everyday situation where it would be helpful to know the density of an item.