

Gassy Lava Lamp

Category: Physics, Chemistry

Type: Class Experiment (30 min)

Materials:

1	Clear plastic bottle
1	Bottle of dark food color
1	Bottle of vegetable oil
1	Antacid tablet (like Alka-Seltzer)
	Room temperature water
	Flashlight (optional)

Video: <http://youtu.be/77sPjbDNRxw>

How To:



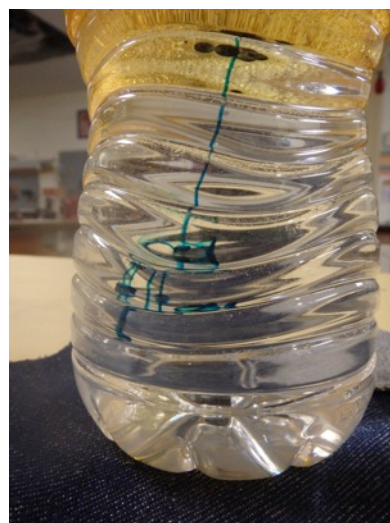
Fill half the bottle with water.



Carefully pour oil on top of the water until the bottle is nearly full.



Add about 5 drops of food coloring to the bottle.



Watch the food coloring move through the bottle.



The food coloring will remain in droplets as it moves through the oil and will spread when it reaches the water.



Break an antacid tablet into pieces that are small enough to fit into the bottle.



Drop them in and watch what happens! Can you tell which are gas droplets and which are water droplets?



Turn off the lights and hold a flashlight to the bottom of the lava lamp.

Fine Points:

→ If you don't have antacid tablets, effervescent tub tablets can also be used.

Objectives:

During this lab, students will learn:

1. That liquids have different densities, and thus some float on others.
2. Liquids have hydrophilic and hydrophobic properties.

Concepts Involved:

- The density of a liquid determines whether it will float above or sink below another liquid.
- A liquid will float if it is less dense than the liquid it is placed in.
- Some liquids will mix together easily, and others will stay separated.

Focus Questions:

1. Will the oil float on the water or sink below, and why do you think it will do that?
2. What will happen when you add the antacid to the bottle? Why do you think this will happen?

3. Would the same thing occur if the antacid was put into only oil?
4. Some of the blobs are water droplets and some are only gas. How can you tell the difference?
5. What happens if the lid is screwed on after the tablet has been added?
6. Do you think the number of tablets added would affect the size and number of the bubbles?

Elaboration:

Liquids, like solids, have a mass and a density; this is determined by the mass of the molecules that make up the liquid and how closely they are packed together. The lava lamp works because the oil floats on top of the water. This happens because the oil is less dense than the water. You can't say it's "lighter than water" because clearly if you had one tiny drop of water and a whole bucket of oil, the oil would be heavier. But still the water would sink to the bottom. So this is about density, not just heaviness. Density depends on mass *and* volume -- it's sometimes easier to think about in terms of solids. We all know that some things like Styrofoam are "light" and fluffy, and other things like metal or rocks are "heavy." The "heavy" things are actually more dense, meaning there is more mass in a given volume.

Oil and water do not mix because they cannot form any chemical bonds with each other. Water is made up of highly charged, 'water loving' molecules (scientifically known as hydrophilic), while oil is made up of long chains of carbon that are 'water hating' (hydrophobic). Oils do not have a charge and are therefore not attracted to the water molecules, causing the separation we see.

When the antacid tablet is added to the bottle, it sinks to the bottom and starts to dissolve and create a gas, carbon dioxide. Antacid is a mix of sodium bicarbonate (also known as baking powder), potassium bicarbonate and anhydrous citric acid (anhydrous means that it contains no water). The bubbling and fizzing of antacid tablets is produced by the baking soda and citric acid reacting with the water to form sodium citrate and carbon dioxide gas. As the gas bubbles rise, they take some of the colored water with them. When the blob of water reaches the top, the carbon dioxide escapes and the colored water falls back down again. When all the gas has escaped, the water and oil separate into two layers again.

Links to k-12 CA Content Standards:

Grades k-8 Standard Set Investigation and Experimentation:

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other strands, students should develop their own questions and perform investigations.

Grades k-12 Mathematical Reasoning:

1.0 Students make decisions about how to approach problems:

- 1.1 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, sequencing and prioritizing information, and observing patterns.
- 1.2 Determine when and how to break a problem into simpler parts.

2.0 Students use strategies, skills, and concepts in finding solutions:

- 1.1 Use estimation to verify the reasonableness of calculated results.
- 1.2 2.2 Apply strategies and results from simpler problems to more complex problems.
- 1.3 Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.
- 2.5 Indicate the relative advantages of exact and approximate solutions to problems

and give answers to a specified degree of accuracy.

3.0 Students move beyond a particular problem by generalizing to other situations:

- 3.1 Evaluate the reasonableness of the solution in the context of the original situation.
- 3.2 Note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems.
- 3.3 Develop generalizations of the results obtained and apply them in other circumstances.

Grade 1 Standard Set 1. Physical Sciences

Materials come in different forms (states), including solids, liquids, and gases. As a basis for understanding this concept:

- 1.a. Students know solids, liquids, and gases have different properties.
- 1.b. Students know the properties of substances can change when the substances are mixed, cooled, or heated.

Grade 3 Standard Set 1. Physical Sciences

Energy and matter have multiple forms and can be changed from one form to another. As a basis for understanding this concept:

- 1.e. Students know matter has three forms: solid, liquid, and gas.
- 1.h. Students know all matter is made of small particles called atoms, too small to see with the naked eye.

Grade 5 Standard Set 1. Physical Sciences

Elements and their combinations account for all the varied types of matter in the world. As a basis for understanding this concept:

- a. Students know that during chemical reactions the atoms in the reactants rearrange to form products with different properties.
- b. Students know all matter is made of atoms, which may combine to form molecules.