

Lesson Plan for Lava Lamps

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Introduction & Background Information

Although we cannot see them with our eyes, all things are made up of molecules. Different molecules make up different items. For example, water is made up of water molecules, and oil is made up of oil molecules. Molecules are so small that a single drop of water or oil contains *millions of billions* of molecules – approximately 10,000,000,000,000,000 molecules!

When two different molecules are combined, they may or may not interact, depending on their properties. Molecules like oil and water do not interact with one another (Figure 1). When oil and water are combined, the molecules will always separate from each other no matter how hard you try to mix them together. Other types of molecules do interact with one another. In this lesson plan we will discuss two types of interactions: mixing and reactions.



Figure 1: The site of the Deepwater Horizon oil spill in the Gulf of Mexico, clearly showing that oil and water do not mix.

Mixing is a type of interaction in which molecules do not readily separate from one another when combined. For example, when food coloring is added to water, it mixes with the water to turn it a new color. Similarly, when you dissolve sugar in water, the sugar seems to disappear – this is because the sugar molecules mix (“dissolve”) with the water molecules.

A reaction involves the formation of a brand new molecule (the product) from one or more starting molecules (the reactants). In today’s experiment, the molecules in Alka-Seltzer react with water molecules to form a new product: carbon dioxide. As the reaction progresses, the Alka-Seltzer tablet gets visibly smaller as the Alka-Seltzer molecules react with water molecules to form carbon dioxide gas (visible as small bubbles). Once the Alka-Seltzer tablet completely disappears, the reaction ends.

By taking advantage of the different interactions (or lack thereof) of these molecules, we can use them to make a homemade lava lamp! Because oil and water do not mix, droplets of water can form inside a container filled with oil. Food coloring mixes only with the water droplets, making the water

easier to distinguish from the oil. Finally, adding a bit of Alka-Seltzer tablet starts a molecular reaction with the colored water droplets to produce carbon dioxide gas bubbles. These bubbles rush upwards, carrying some of the water droplets with them to the surface. Once at the surface, the carbon dioxide bubbles burst into the surrounding air, and the water droplets sink to the bottom again. This process is repeated as long as some of the Alka-Seltzer tablet present in the container.

Student Objectives

- Learn that all things are made up of molecules
- Learn that some molecules interact with each other, but others do not
- Learn about two types of molecular interactions: mixing versus reactions

Topics

Molecules: All things are made of extremely small particles called molecules. Molecules are so small that a single drop of water contains around 10,000,000,000,000,000 molecules! Molecules have different properties, which dictate how different types of molecules will or will not interact with one another.

Molecular Interactions: Molecules may or may not interact with each other. Molecules that don't interact (like oil and water) do not like to be around each other. This is why water and oil will separate. Molecules that do interact can do so simply by mixing or through more complex molecular reactions.

Molecular Reactions: Sometimes when two or more molecules interact, they form brand new molecules. In these reactions, the starting molecules are called "reactants" and the new molecule(s) are called the "product(s)". As more and more product forms, the reactants get used up and begin to disappear.

Overview of the Lesson Process (about 1 hour)

- Intro (about 10 minutes) Briefly explain the concept of molecules to the class and the types of interactions that will be observed in this activity. DO NOT tell students what will happen when water, oil, food coloring, or Alka-Seltzer are mixed or how the lava lamps will work!
- Small groups (about 40 minutes) Have each mentor in a small group go through the worksheet (introduction for the students). After completing the worksheet, ask students to predict what will happen when three or four things are added together. Can they figure out what will happen when they build the lava lamp? Next, build the lava lamp and discuss how does the end result compares with the students' predictions. Ask the students to explain how the lava lamp works.
- Remaining group questions and cleanup (about 10 minutes).

Procedures

Introduction for the students (with worksheet)

1. Mix oil and water together in a bottle. Have the students take turns shaking the bottle to mix the oil and water and observe what happens. Ask to students to draw conclusions about water and oil molecules from their observations.

2. Add food coloring to separate bottles/cups of water and oil and observe what (if any) molecular interactions occur. Again, ask students to draw conclusions from their observations.
3. Add Alka-Seltzer to the same water and oil as the previous step and observe what (if any) molecular interactions occur. Ask students to draw conclusions from their observations.
4. Review the types of molecular interactions that the students observed (see worksheet). Based on their observations, ask the students to predict what will happen when three or even all four of these molecules are combined to create lava lamps.

Making the lava lamp¹

1. Fill the bottle $\frac{3}{4}$ full with vegetable oil.
2. Fill the rest of the bottle with water (almost to the top, but not overflowing).
3. Add about 10 drops of food coloring. Be sure to make the water fairly dark in color.
4. Divide the Alka-Seltzer tablet into 8 pieces.
5. Drop one of the tiny pieces of Alka-Seltzer into the oil and water mixture. Watch what happens. Once the bubbling stops, add another chunk of Alka-Seltzer.
6. Try using a flashlight under the bottom of the bottle to simulate a real lava lamp!
7. When you have used up all of the Alka-Seltzer and the bubbling has completely stopped, screw on the soda bottle cap. Tip the bottle back and forth and watch what happens.

Safety Considerations

1. Limit the amount of Alka-Seltzer added to the lava lamps to prevent the bottle from exploding.
2. DO NOT seal the bottles while the Alka-Seltzer reaction is in progress!

Materials

	Qty per group	Estimated Cost (approx. 10 + groups)
Clean plastic 16oz or 20oz drinking bottle w/cap	at least 1	supplied by mentors \$0
Vegetable oil (the cheaper the better)	12-15 fl oz	salad oil (128 fl oz) \$12
Water	4-5 fl oz	\$0
Food coloring	--	one multipack (4 bottles) \$4
Alka-Seltzer*	1-2 tablets	generic brand (36) \$5
Clear plastic cups (for demos instead of bottles)	2	supplied by mentors \$0
Flashlight (optional)	1	supplied by mentors \$0
Paper towels (for cleanup)	--	\$0
		Total \$21

*generic brand is preferred – any *effervescent* antacid

(prices based on shop.safeway.com/superstore)

References/Citations

1. Make Your Own Bubbling Lava Lamp, <http://www.stevespanglerscience.com/experiment/00000035>

Lava Lamps Worksheet

Introduction

All things are made up of *very* small particles called **molecules**. Molecules are so small that a single drop of water has around 10,000,000,000,000,000 single water molecules!

Molecules can have different properties, which determine how different types of molecules will or will not interact. Molecules that do interact may interact by ***mixing*** with each other or by ***reacting*** with each other to create brand new molecules. In this lesson, we will test the interaction between the molecules in water, oil, food coloring, and fizzy tablets. We will then use our new knowledge about molecular interactions to build our very own lava lamps!

As you and your team of scientists test for interactions,
use this worksheet to keep track of your observations:

	Do these molecules interact? (yes or no?)	If yes, which interaction is it? (mixing or reaction?)
water + oil		
water + food coloring		
water + fizzy tablet		
oil + food coloring		
oil + fizzy tablet		

Before making the Lava Lamp

Based on the observations you just made, can you predict what will happen when three of these materials are added together? What do you think will happen if you put *all four* of these items together (water, oil, food coloring, and fizzy tablet)?

After making the Lava Lamp

What happened when the water, oil, food coloring, and fizzy tablet were combined? Explain the interactions that are involved in making the lava lamp work.