GRADES 3–5

TIME
One class period, 40–50 minutes

BUBBLING LAVA LAMP

Science

CHILDREN'S MUSEUM INDIANAPOLIS®

BUBBLING LAVA LAMP

The Children's Museum's lessons are designed to weave classroom experiences and museum education together. All lessons are interdisciplinary and can be used as individual classroom experiences or in combination to create a cohesive unit. Lessons are optimized when used in connection with museum field trips.

Lava lamps hold a special place in pop culture history, but there's a lot of science that we can learn from them, too. Students will discover that when oil and water are combined, they don't mix causing the oil to rise to the surface. When salt is added, the grains attach to the globules of oil making them sink. When the salt **dissolves** in the water, the oil returns to the top. This creates a lively liquid lava-like show. Groovy, baby!

INDIANA ACADEMIC STANDARDS

Science: 5.PS.3, SEPS.1, SEPS.3

OBJECTIVES

Students will:

- Explore density in liquids
- Discover why different types of liquids do not mix
- Conduct an experiment to demonstrate density
- Make a prediction based on an observation

FOCUS QUESTIONS

- What happens when oil and water are combined?
- Why do oil and water not mix together?
- How does adding salt affect the oil?
- What happens when the salt dissolves?

MATERIALS

- Clear jar with a lid
- Vegetable oil
- Food coloring
- Salt
- Water
- Flashlight (optional)

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Create a Lava Lamp Effect

PROCEDURES

1. Explain to students that they will be working with different liquids to create a "lava lamp" effect.
2. Share with students that liquids have unique physical properties, which determine how they interact with other liquids. *(See Description A)*.
3. Once students learn about the different types of liquids, describe that **density** also plays into the experiment. See page 4 for a simple demonstration on density, if students aren't familiar with this concept.
4. Tell students that oil is less dense than water; therefore, oil floats above the water. Because they cannot mix, the oil will stay atop the water despite stirring or shaking. Ask students to try and mix the liquids together. They will see that the oil may form small balls and separate but will return to the top.
5. Ask students to now predict what will happen when they add salt to the oil and water. Students may share from prior experiences that salt will dissolve in water.
6. After the students have made a **prediction**, have them follow the student instructions below.
7. Ask students to describe their observations of how the salt, oil, and water interacted in the jar. Students can share this in a class discussion or in a writing assignment. Using the students' observations, review the science behind the lava lamp reaction. The oil and water do not mix. The oil is less dense than water so it sits on top of the water. When the salt is added to the oil, the salt crystals capture some of the oil. When the salt and oil droplets hit the water, the salt dissolves, releasing the oil. This creates the lava-like reaction.
8. For a more "lava-like" result, put the jar on a flashlight and turn the room lights off.

DESCRIPTION A

Like Dissolves Like

The molecules that make up each type of liquid determine how well it combines with other liquids. This lead scientists to coin the phrase "like dissolves like." This means that liquids that have molecules that are like each other will blend together and liquids that have different molecular structures will not blend together. Oil is made up of fat molecules that are mostly hydrocarbon, which have trouble bonding with water molecules that are rich in hydrogen.

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1 Fill the jar 2/3 full with water.

2 Add 2–3 drops of food coloring to the water

3 Fill the rest of the bottle with oil so it's almost to the top but not overflowing.

4 Add small clumps of salt and **observe** what happens. When the bubbling stops, add more salt.

5 Once the bubbling has completely stopped, screw the lid onto the jar. Tip the bottle back and forth and watch a wave appear. The tiny droplets of liquid join together to make one big lava-like blob.

Explaining Density

Density is the amount of mass in a substance for a unit of volume. To help students understand the concept, complete this simple demonstration in class.

1. Identify a section of the classroom with set boundaries that is at least 6 feet by 6 feet. This can be a rug, an area of the floor that is taped off, or even a sector/zone between desks. Explain to students that this will be the set unit of volume.
2. Ask 2–3 students to stand in the defined area, and have them spread out. Share that the students represent molecules.
3. Invite 4–5 more students to stand in the area, and ask students which model is denser (the second one).
4. Invite 4–5 more students to the area, and have the students notice the difference in the density. There are more students (or molecules in a certain area).

VOCABULARY

- **Density**
- **Dissolve**
- **Observe**
- **Prediction**

REVERSE LAVA LAMP

What did students notice about the direction of the oil droplets in the experiment? As the salt was bonding with the oil, it changed the oils density and weighed it down. Oil droplets then became heavy and dropped to the bottom. Once the salt dissolved, the oil lost its added density and returned to the top. So, the oil traveled from top to bottom and then to top again.

A different way to conduct this experiment is to substitute the salt for an Alka-Selzer tablet. Students will witness the tablet sink to the bottom and begin to release gas (carbon dioxide). The creation of air bubbles will attach to the food coloring and lift them to the top. The air needs to escape, so it will pop and the food coloring will return to the bottom after losing its buoyant air bubble. Students will observe that the density reversal creates a fun discovery about density!

HEAT TRANSFER

A traditional lava lamp must be plugged in to an energy source to work. The lightbulb in the base of the lava lamp creates heat; this is a type of heat called radiation. The lightbulb sends out energy waves to warm the base of the lamp much like the sun sends out waves of energy to warm Earth. There is a metal coil in the bottom of the lava lamp glass. The coil will begin to heat up through the heat transfer method of conduction. Conduction is the reason you do not touch a hot stove! You know that if you do, it will hurt because the heat will transfer directly from the stove to your finger. After the lightbulb heats up, and the coil and glass start to warm, the lava substance also gains heat energy through heat transfer. Now, what makes a lava lamp so mesmerizing to watch is actually due to the heat transfer method called convection. Convection is the rising and sinking movement of a liquid or gas due to changes in density. The density of the lava is affected by the heat. The lava starts out as a cold solid substance at the bottom. As it heats, its molecules spread out and it no longer holds so much of itself in one tiny space of the lamp, causing it to become less dense than the liquid around it. The change in density caused by the heat actually causes the lava to rise! As the lava moves away from the lightbulb and coil at the bottom, the heat once in the lava, transfers to the liquid it is in and the glass around it. When this happens, the lava cools back down. This causes the molecules to move closer together again, raising its density back up higher than the liquid it is in. As a result, the lava sinks back down to the bottom. As the lava gains and loses heat energy, it becomes more and less dense than the surrounding liquid, which causes the cycle of rise and sink that we love to watch in a lava lamp!