Title: Lava Lamp STEM Challenge

Estimated Time: 1-2 periods

Core Ideas (GSE Standard and elements):

S5P1. Obtain, evaluate, and communicate information to explain the differences between a physical change and a chemical change.

a. Plan and carry out investigations of physical changes by manipulating, separating and mixing dry and liquid materials.

c. Plan and carry out an investigation to determine if a chemical change occurred based on observable evidence (color, gas, temperature change, odor, new substance produced).

S8P1. Obtain, evaluate, and communicate information about the structure and properties of matter.

b. Develop and use models to describe the movement of particles in solids, liquids, gases, and plasma states when thermal energy is added or removed.

c. Plan and carry out investigations to compare and contrast chemical (i.e., reactivity, combustibility) and physical (i.e., density, melting point, boiling point) properties of matter.

Literacy Connections: Books Pancakes, Pancakes, Eric Carle Awesome Science Experiments for Kids, Crystal Chatterton	**Literacy Connections: Close Reads** Lava Lamps are Groovy Close Read
Science and Engineering Practices: **Asking Questions and Defining Problems:** Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. **Constructing Explanations and Designing Solutions:** Use evidence to construct or support an explanation or design a solution to a problem.	**Crosscutting Concepts:** **Structure and Function:** The way an object is structured/designed determines many of its properties and functions. **Stability and Change:** For designed systems, conditions that affect stability and factors that control rates of change are critical to consider and understand.

STEM Challenge Overview:

In this STEM Challenge, your initial task is to build a mini-lava lamp that uses Alka-Seltzer, rather than a light bulb, to power the motion of the lamp. Once constructed, your design task is to improve the groove of your Lava lamp – find at least one way that you make it hipper than it was before.

Ask	Ask students if they have ever seen a lava lamp in action. If not, you can show a minute or two of this cool lava lamp in action. https://www.youtube.com/watch?v=h_lQ2tMgLVM

	After mentioning their role as psychedelic symbols of the 1960's, ask them to generate some questions that they about these strange fixtures.
Imagine/Brainstorm	Students **brainstorm** ideas for how they could design a miniature lava lamp that could be used to model the unusual motion of the liquids in the lamp. After brainstorming, they should consider the strengths and weaknesses of each idea.
Plan/Design	In order to learn more about these strange fixtures, let students read***, Lava Lamps are Groovy***. After researching the lamps, have students **plan** and **design** a mini-lava lamp that uses Alka-Seltzer, rather than a light bulb, to power the motion of the lamp. Given a basic set of materials, students can decide what combination of oil, water, and Alka-Seltzer work the best for their lamp. Once the lamp is functional, the students' design task is to improve the groove of their Lava lamp – they must find at least one way to make it hipper than it was before. If time permits, have students use the lamp to describe as many key concepts as possible. Turns out, the lamp is loaded with science in motion.
Create/Test	Students follow their plan, and **create** their lava lamp. Once they are created, students **test** their lamp in a measureable way to evaluate their effectiveness. Their results should be recorded, organized, and analyzed.
Improve	After discussing and evaluating their results, students improve their solution, redesign their lamp, and re-test if possible.

Teacher Notes:

It's true, the Lava Lamp is still cool after over half a century. Invented by Edward Craven Walker in 1963, these now famous relics became a 60's symbol of anything mind-altering or psychedelic. Unlike other lamps, these strange fixtures produced little light and they generally appealed to people who liked to hang out and chill in the shadows.

From a science perspective, a lava lamp is a liquid motion lamp that combines two (or more) liquids that are insoluble in one another. For example, oil and water will not dissolve in each other. In other words, oil and water don't mix. In order to make a good lava lamp, you normally need two liquids that are much closer in density than oil and water. As a result, lava lamps usually use water for one liquid and then a mix of mineral oil, paraffin wax, and carbon tetrachloride for the other.

To get the liquids flowing in the lamp in a funky manner, lava lamps apply heat to the bottom of the mixture using an incandescent light bulb. As the heavier liquid absorbs the heat, it expands and becomes less dense. The now lighter liquid rises to the top where it quickly cools, becomes more dense, and sinks back down to the bottom. This mesmerizing cyclical motion repeats continually until the plug is pulled.

In this STEM Challenge, the students' initial task is to build a mini-lava lamp that uses Alka-Seltzer, rather than a light bulb, to power the motion of the lamp. Given a basic set of materials, students decide what combination of oil, water, and Alka-Seltzer works the best for their lamp. Once the lamp is functional, the students' design task is to improve the groove of their Lava lamp – they must find at least one way to make it hipper than it was before.

In addition, close observation of the lamp and its subsequent motion, can lead to a great discussion of a myriad of science concepts. At the start, differences in texture (feel), color, smell and viscosity (thickness) of the substances can be noted as students build their understanding of these important concepts. Identifying each substance as a solid, liquid, or gas can also be helpful as students process the similarities and differences of each state of matter.

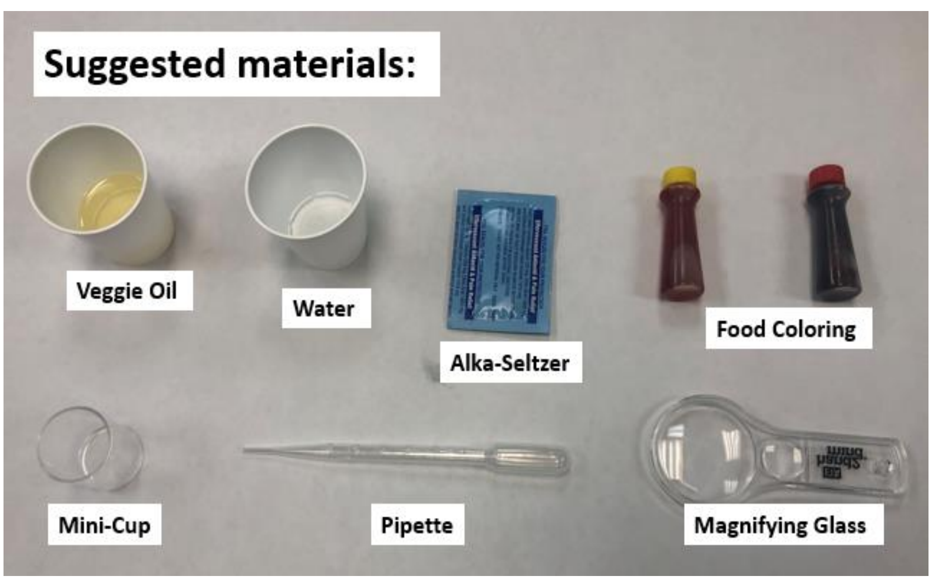
After pouring one liquid on top of the other, the fact that one liquid is heavier than the other is obvious and this can be used to discuss density differences (mass per unit volume) if your students are ready. In addition, the observation that the liquids are insoluble in each other, and hence will not mix, can lead to some excellent discussions in with respect to mixing, dissolving, and dispersing.

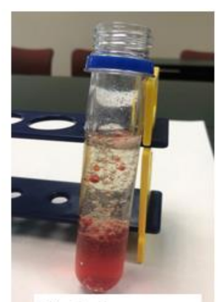
As tiny pieces of Alka-seltzer are added, the system is quickly propelled into a fast moving and quickly changing arena. Close observation is very important at this point, and it provides an excellent opportunity for students to use their observation skills to develop an explanation (hypothesis) that describes the up and down motion of some of the fluids. A drop of food coloring also adds to the excitement.

As students observe the robust production of gas bubbles, they may infer this as a sign of a chemical reaction (especially since no heat is added). In this case, a chemical reaction between substances in the tablet (citric acid and baking soda), causes the production of carbon dioxide gas and sodium citrate (new substances). The carbon dioxide gas bubbles attach to water droplets making them less dense and giving them plenty of lift to rise to the top. Once the bubbles escape, the heavier water droplets sink back to the bottom and cyclical motion commences. In this case, one cool chemical reaction is used to power one groovy lava lamp.

Suggested materials for students to use: (per group)

Small cups, vegetable oil, water, Alka-Seltzer tablet, food coloring, mini-cup, pipette, magnifying glass.





Test tube can also be used.

Works Well with Larger Cup Too

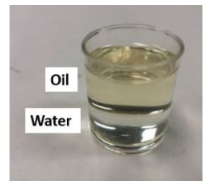
Vocabulary Cards:

mixture

a blend of things

insoluble

does not dissolve
in each other



liquid

a material that can flow

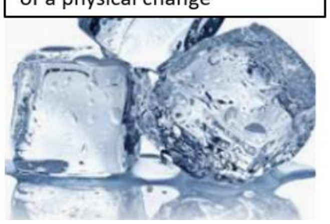
chemical change

a change where new
substances are produced

physical change

change in form of a substance
but not its composition

Ice cube melting is an example
of a physical change



engineer

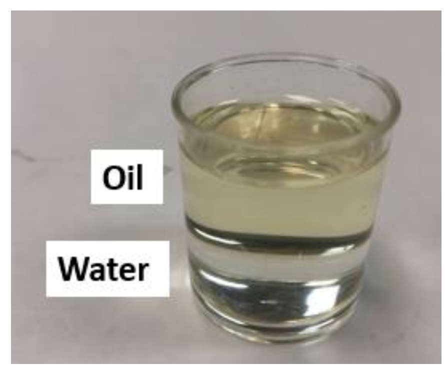
to design, build, and
improve things

Lava Lamp STEM Challenge:

Can you design and build a mini-lava lamp that uses Alka-Seltzer, rather than a light bulb, to power the motion of the lamp.

Designing and constructing your pliers:

1. After learning about lava lamps, **plan** and **design** a lamps that uses Alka-Seltzer, rather than a light bulb, to power the motion of the lamp.
2. Observe the properties of each substance that will be used to construct your lava lamp including the oil, water, and Alka-Seltzer. Describe each substance using appropriate terms.
3. Using the materials provided and your plan, **construct** your lamp. Your lamp should include oil, water, pieces of Alka-Seltzer, and a drop or two of food coloring.
4. Using a pipette, add water to your mini-cup. Using another pipette, add oil to your mini-cup until it is about ¾ full. Observe the oil and water interacting together.
5. Add a small piece or two of Alka-seltzer to the cup. Observe closely.
6. Add a drop or two of food coloring and observe.
7. Use you observation skills to develop an explanation (hypothesis) that describes the up and down motion of the fluids.
8. Use your observations and evidence gathered to infer whether or not the changes that are occurring are primarily chemical or physical in nature.
9. Extra credit: Use the lamp to describe at least 5 key concepts that we have covered this year.



Evaluating and Improving:

As a group, **evaluate** the effectiveness of your design and discuss how you would change your design moving forward to **improve** the moving groove your lamp. If time permits, make these improvements and re-test.