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#SeaworthySTEM

Alka-Seltzer Lava Lamp

Grades 6-8

Teacher Guide

Seaworthy STEM™ in a Box Series

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Alka-Seltzer Lava Lamp

Teacher Guide for 6-8

Seaworthy STEM™ in a Box Educator Kit description:

Seaworthy STEM™ in a Box activities are a Navy initiative to provide enhanced Naval-relevant, standards aligned, hands-on activities to K-12 teachers and students. Components of this program include, curated sets of classroom activities that aim to build deep conceptual understanding in Naval-relevant content areas. The kits also includes comprehensive lesson plans, material lists, scientific background information, STEM related literacy books, and student activity sheets. The Seaworthy STEM™ in a Box program is designed to support teachers as they select content, acquire materials, and implement more hands-on STEM activities in their classrooms. Increasing student access to hands-on STEM activities, also increases awareness of STEM career paths, engage students in STEM, and support development of student's abilities in STEM content.

The Seaworthy STEM™ in a Box kits were designed to guide students through the scientific inquiry-based theory and the engineering design process. The content and Naval-relevant activities are aligned with the Next Generation Science Standards. The topics and content covered within the lessons are connected and scaffolded based on distinct grade bands (K-2nd, 3rd-5th, 6th-8th, and 9th-12th).

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Lesson Title: Alka-Seltzer Lava Lamp

Time:

1 class period

Student Objectives:

The students will review the states of matter and how they differ from one another. The students will also understand that despite objects changing states the total mass of the initial system remains the same.

Lesson Overview:

The students will explore density as well as the impact of gases being released within a system that contains different liquids. Additionally, students will conduct an investigation that validates the conservation of mass.

Next Gen Science Standards (NGSS):

MS-PS1-2
MS-PS1-5
MS-PS2-2

Notes

"A cross-disciplinary approach can accommodate diverse learning styles!"

Notes

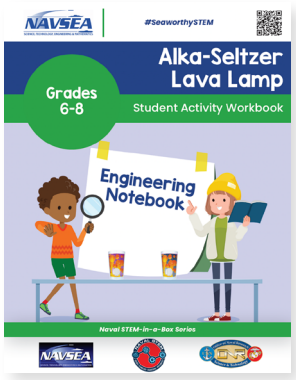
Materials and Equipment List (for each pair of students):

- ☑ Clear plastic cup or jar
- ☑ Approximately 1/3 cup of water with food coloring (teacher may pour from pitcher)
- ☑ Approximately 1/3 cup of vegetable oil
- ☑ 1 or 2 Alka-Seltzer tablets, broken into pieces
- ☑ Writing instruments and activity sheets
- ☑ Optional: Paper plates or aluminum pie pans to catch drips and ease cleanup
- ☑ Beaker
- ☑ Graduated Cylinder
- ☑ Latex glove
- ☑ Pipette
- ☑ Digital Scale

Student Activity Sheets/Handouts:

Guided Observation Worksheet:

Alka-Seltzer Lava Lamps



Technology Tools:

Digital Scale

Sample video: *https://funlearningforkids.com/super-cool-lava-lamp-experiment/*

Procedure:

1. Students working in pairs will assemble a system consisting of colored water and vegetable oil layers in a clear cup or jar.

To make this system:

1. Pour 1/3 cup of water with food coloring into the cup or jar
2. Add 1/3 cup of vegetable oil to the water
3. Stir and let sit until settled

2. Students will then add pieces of Alka-Seltzer tablets to their system and make observations about what happens.

1. Students are to record/brainstorm their observations, inferences, and questions using the student activity worksheet in the engineering notebook.

3. The teacher will monitor students while they experiment, providing materials, instructions, and answers to student questions as needed for all students to complete their observations. The teacher should also listen carefully for preconceptions in student conversations and ask probing questions that encourage students to think more deeply about their observations. Be careful not to give away all "the answers" at this point in the activity.

Helpful Tip:

Watch the Alka-Seltzer drop! When you drop the Alka-Seltzer pieces, they will sink to the bottom. It sinks straight through the oil without any chemical reactions occurring. When it touches the water, however, a chemical reaction occurs that releases carbon dioxide gas bubbles.

Solubility plays an important role in this activity.

Helpful Tip:

Be sure to handle oil carefully as it is messy if spilled and can be slippery if spilled onto the floor.

4 The teacher will now allow the students to explore changes of state as well as the law of conservation of mass.

1. The students will use a digital scale (set to kg) to find the mass of the cup of fluids, 2 unwrapped Alka-Seltzer tablets, and a latex glove. They will record their measurements in their Student Activity Workbook.

2. The students will add the mass of their 2 Alka-Seltzer tablets to the mass of the cup of fluids and record this mass in their Student Activity Workbook.

3. The students will then put the cup of fluid on the scale and then drop the 2 Alka-Seltzer tablets into the cup. After the Alka-Seltzer dissolves in the fluid the students should record the mass in their Student Activity Workbook. *They should notice that the mass has decreased by 1 or 2 kgs due to the release of carbon dioxide.

4. The students are now challenged with how they can dissolve the 2 Alka-Seltzer tablets in the fluids without losing any mass. *After some time, suggest to the student that they may want to use the glove to capture the CO

5. Have the students record the combined masses of the glove, the 2 Alka-Seltzer tablets as well as the cup of fluids in their Student Activity Workbook.

6. Have the students place the cup on the scale then insert the 2 Alka-Seltzer tablets followed by putting the glove on top of the cup to collect the CO2.

7. Have the students record the combined masses of the inflated glove and the cup of fluids in their Student Activity Workbook.

5 Clean up the activity. Teacher may want to walk around the room with a large pitcher to collect liquids from each group vs. having students carry them across the room.

Follow-up:

1. After students complete the hands-on activity, the teacher will lead the students in a discussion to elicit their ideas about what they have observed. The teacher should listen carefully to terminology students use in descriptions to see if common misconceptions exist.
2. A brainstorm list should be written on a whiteboard or flip chart. Record all ideas without judgment or correction to encourage all students to contribute their ideas for initial discussions.

> "The chemical reaction in an AlkaSeltzer tablet is between citric acid and sodium bicarbonate (baking soda)"

Teacher Background Information / Notes:

The chemical reaction in an AlkaSeltzer tablet is between citric acid and sodium bicarbonate (baking soda). This acid-carbonate reaction produced carbon dioxide bubbles. The solids in the dry tablet do not react, but once dissolved, the substances are more mobile and can interact.

The oil is less dense than the water, and thus floats on top of the water. As carbon dioxide bubbles form in the water phase, they are surrounded by parcels of water, thus lowering the local density and bringing the gas-water parcel to the top of the system. At the top, the carbon dioxide gas bubbles are released from the water into the air, returning the water to is non-aerated density and allowing it to sink to the bottom again.

Solubility also plays an important role in this activity. Notice that the food coloring is soluble in the water phase, but not in the oil phase. The AlkaSeltzer tablet is not soluble in the oil (and passes through it) but is soluble in the water (which allows the reaction to begin). Also note that oil and water phases are not soluble with each other.

Extension Activity Ideas:

A similar alternative activity that could be used is called "Dancing Raisins" or "Sewer Lice". It involves placing raisins in a container of either clear soda or AlkaSeltzer/

water mixture. Carbon dioxide bubbles will temporarily form on the surface of the raisins, lifting the raisins to the surface. Once at the surface, the bubbles will detach into the air and the raisin will again sink. This activity is commonly used in biology to start a discussion on "living vs. non-living" objects, however, the dynamics of the system are good for density discussions also.

Vocabulary Terms and Mathematical Formulas:

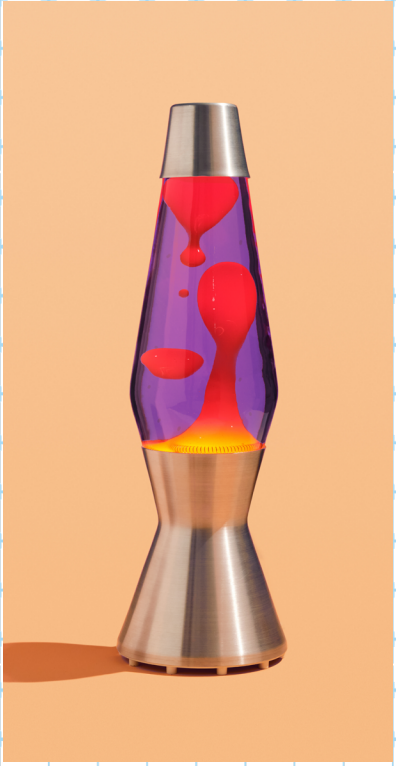
- **Density:** The amount of space an object or substance takes up (its volume) in relation to the amount of matter in that object or substance (its mass) Density = M/V
- **Gas:** A state of matter consisting of particles that have neither a definite volume nor a definite shape
- **Law of Conservation of Mass:** The mass in an isolated system can neither be created nor be destroyed but can be transformed from one form to another
- **Liquid:** A state of matter where particles are free to flow. It has a definite volume, it does not have a definite shape
- **Mass:** The amount of matter in an object
- **Solid:** A state of matter characterized by particles arranged such that their shape and volume are relatively fixed
- **Solubility:** The maximum quantity of a substance that can be dissolved in another.
- **Volume:** The amount of space occupied by an object

STEM Related Careers:

- Chemical Engineer
- Mechanical Engineering

Fun Fact!

The lava lamp was invented in 1948 by an English accountant named Edward Craven Walker. It took Craven Walker 15 years to perfect his design.




Notes

The Seaworthy STEM™ in a Box curricula was developed through collaborative efforts of a team of individuals at the Naval Surface Warfare Center Carderock Division and Albert Einstein Distinguished Educator Fellows via an inter-agency agreement with the U.S. Department of Energy for the Albert Einstein Distinguished Educator Fellowship (AEF) Program. We are grateful to the following Content Specialists who contributed their knowledge and expertise by researching and writing on selected topics: Suzanne Otto, Stephanie Klixbull, and Thomas Jenkins. We'd also like to acknowledge the contributions of AEF participant Ms. Deborah Reynolds, the inaugural AEF Educator at Carderock that helped inspire the design of Seaworthy STEM™ in a Box content. With the help of Albert Einstein Fellow, Melissa Thompson, and Carderock Outreach Specialist, Ashlee Floyd, special additions to the curriculum such as career portfolios, workforce trading cards, and in-house short story publications are included that reflect the diversity of NAVSEA Sites.

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