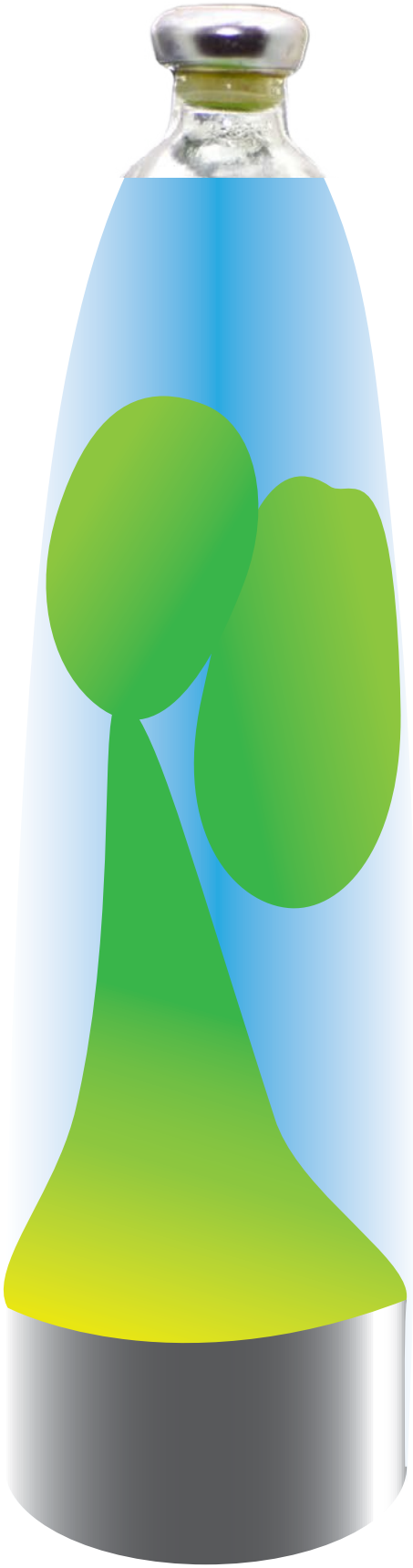


LAVA LAMPS

STEM²D Topic: SCIENCE

Target Population: Students, ages 11-14

Lava Lamps is part of the STEM²D **Student Activities Series** developed by FHI 360 as part of Johnson & Johnson's WiSTEM²D initiative (**W**inning in **S**cience, **T**echnology, **E**ngineering, **M**ath, **M**anufacturing, and **D**esign). The series features interactive and fun, hands-on activities for youth.

Lava Lamp

STEM²D Topic: Science
Target Population: Students, ages 11–14

ACTIVITY DESCRIPTION

Using a Lava Lamp, students will explore density and polarity.

ESTIMATED TIME

This activity is intended to be done at a career fair, science fair, exhibit, or other type of "booth" event. It typically takes **10 to 15 minutes** to complete.

STUDENT DISCOVERIES

Students will:

- Learn about science, density, and polarity.
- Build important STEM²D skills, such as thinking critically, drawing conclusions, and problem solving.
- Realize that STEM²D offers diverse and exciting career opportunities.
- Be inspired to participate in other types of STEM²D experiences.
- Have fun experiencing STEM²D.

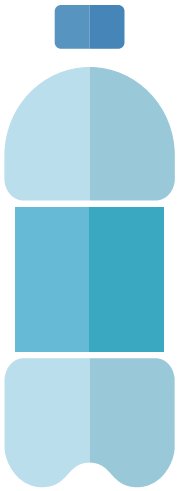
GETTING READY

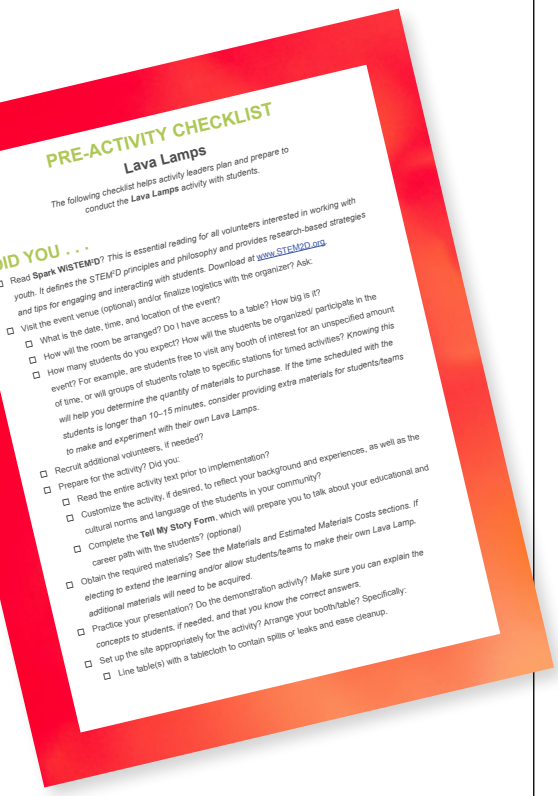
Materials:

- Pre-Activity Checklist
- Tell My Story Form, *optional*
- Hand wipes or paper towels (for cleanup)
- Tablecloths (number required depends on tables being used)
- 1 Alka-Seltzer™ tablet, *1 tablet per demonstration*

STEM²D Skills

- Critical Thinking
- Drawing Conclusions
- Problem Solving




PRE-ACTIVITY CHECKLIST

Lava Lamps

The following checklist helps activity leaders plan and prepare to conduct the **Lava Lamps** activity with students.

DID YOU . . .

- Read **Spark WiSTEM²D**? This is essential reading for all volunteers interested in working with youth. It defines the STEM²D principles and philosophy and provides research-based strategies and tips for engaging and interacting with students. Download at www.STEM2D.org.
- Visit the event venue (optional) and/or finalize logistics with the organizer? Ask:
  - What is the date, time, and location of the event?
  - What is the room be arranged? Do I have access to a table? How big is it?
  - How many students do you expect? How will the students be organized/ participate in the event? For example, are students free to visit any booth of interest for an unspecified amount of time, or will groups of students rotate to specific stations for timed activities? Knowing this will help you determine the quantity of materials to purchase. If the time scheduled with the students is longer than 10–15 minutes, consider providing extra materials for students/teams to make and experiment with their own Lava Lamps.
  - Recruit additional volunteers, if needed?
- Prepare for the activity? Did you:
  - Read the entire activity text prior to implementation?
  - Customize the activity, if desired, to reflect your background and experiences, as well as the cultural norms and language of the students in your community?
  - Complete the **Tell My Story Form**, which will prepare you to talk about your educational and career path with the students? (optional)
  - Obtain the required materials? See the Materials and Estimated Materials Costs sections. If electing to extend the learning and/or allow students/teams to make their own Lava Lamp, additional materials will need to be acquired.
  - Practice your presentation? Do the demonstration activity? Make sure you can explain the concepts to students, if needed, and that you know the correct answers.
  - Set up the site appropriately for the activity? Arrange your booth/table? Specifically:
    - Line table(s) with a tablecloth to contain spills or leaks and ease cleanup.

- Lava Lamp materials, *1 set of the following items:*
  - 1-liter plastic bottle with cap, empty and clean, labels removed
  - ¾ cup (175 ml) water
  - 3 cups (710 ml) oil (vegetable oil or baby oil)
  - 10 drops food coloring
- STEM²D brochures, flyers, or other informational materials, *optional*

Estimated Cost:

Activity leaders can expect to incur less than $15.00 in materials costs when conducting this activity multiple times with student groups.

Activity Leader Preparation

1. Read **Spark WiSTEM²D**. This is essential reading for all volunteers interested in working with youth. It defines the STEM²D principles and philosophy and provides research-based strategies and tips for engaging and interacting with students. Download at www.STEM2D.org.
2. See the **STEM²D Student Activities Overview** for additional information.
3. Review the **Pre-Activity Checklist** (at the end of this document) for details and specific steps for planning, preparing, and implementing this activity.
4. Set up the display. Line the table(s) with a tablecloth and place the partially-assembled Lava Lamp and the Alka-Seltzer™ tablets on the table. If electing to extend the learning and allow students/teams to make their own lava lamps, designate an assembly area or maker station; this optional activity will require additional supplies. See Materials section for a list of required materials and the **Pre-Activity Checklist** with instructions on making the Lava Lamps.

STEP-BY-STEP INSTRUCTIONS: LAVA LAMPS

1. **Welcome & Introductions (1–2 minutes)**
   - Welcome the students as they arrive at the table/booth.
   - Introduce yourself by saying your name, title, and your organization/company.
   - Explain that your career is one of many STEM²D careers. Indicate:
     - **STEM²D** refers to Science, Technology, Engineering, Math, Manufacturing, and Design.
     - Individuals with an interest or degree in these areas are in demand.
   - Ask the other volunteers and students to introduce themselves.
2. **Learning Activity: Exploring Density and Polarity (5–7 minutes)**
   - Show the students the partially-assembled lava lamp *(i.e., a clear, plastic bottle filled with oil, water, and food coloring—the liquids should appear neatly separated; the Alka Seltzer™ tablet will be added shortly). See Pre-Activity Checklist for more details.* Ask:
     - What is density?
     - Which substance, oil or water, is denser? How can you tell?
     - Why don't the two substances combine?
   - State:
     - **Density** is the degree of compactness of a substance, or how much of it fits in a certain amount of space. A denser (or heavier) substance will sink when introduced into a less-dense substance.
     - The display shows the densities of different liquids. The oil is lighter (less dense) than water; it floats to the top. The water molecules are packed more tightly than the oil molecules; the water has more mass (is denser) and it sinks.
     - The two substances (oil and water) do not mix because of **polarity**: the tendency of molecules of the same element to bond or stick together (i.e., water molecules are attracted to other water molecules).

KEY WORDS

- **Density**
- **Fluid Mechanics**
- **Physics**
- **Polarity**
- **Science**
- **STEM²D**

TIPS FOR ENGAGING STUDENTS

Involve students in the demonstration:

- Check frequently for understanding by asking open-ended, topic-specific, or process questions.
- Ask students to talk about what they already know.
- Encourage students to ask questions to gain deeper understanding.
- Ask students to predict what will happen before conducting the demonstration.

- Ask
  - Do you think we can alter or temporarily change the density of a substance?
  - How?
- Initiate the demonstration. Drop one Alka-Seltzer™ tablet into the partially-assembled Lava Lamp and place the cap on the 1-liter bottle. *Note: Alka-Seltzer™ contains aspirin; students should not handle medication.*
- Invite students to observe the reaction and reflect on the science. Start a discussion by asking one or more of the following open-ended questions:
  - Which is the densest substance (tablet, oil or water)? How can you tell?
  - Why is the water now floating through the oil? What do you think is happening?
  - What role does polarity play?
  - Why might the Alka-Seltzer™ make water rise even though it is denser than oil?
- Confirm students' thoughts or offer the correct answers to your previous questions:
  - Alka-Seltzer™ is an effervescent product and contains citric acid (antacid) and sodium bicarbonate (baking soda). The acid/baking soda react with the water to produce carbon dioxide gas. The gas attaches to the water to form bubbles. The water/gas combination rises to the top because the water is temporarily less dense than the oil. When the water/gas combination reaches the top of the oil, the gas escapes (the bubbles pop), leaving only water. Because water is denser than oil, it again sinks to the bottom of the bottle.
  - Polarity keeps the water together as it travels with the gas through the oil. Without this force, we would not see the water/gas combo moving through the oil.
  - This movement and popping will continue to occur over and over again until the tablet is completely dissolved.
  - The Alka-Seltzer™ tablet, as a solid, sank directly to the bottom when it was first put in the bottle; this was the densest material of all!

- If time permits, allow the students to predict, test, and observe what happens if some of the variables change:
    - What will happen if we shake the bottle? Tip the bottle?
    - What will happen if we remove the bottle cap?
    - What will happen if we add more Alka-Seltzer™?

3. **Student Reflection (2 minutes)**
    - Wrap up the activity by asking any of the following reflection questions:
        - Can you think of examples of density or polarity you see regularly in your daily life?
        - What kind of careers do you think people with an interest/degree in this area would have?
    - Describe the STEM²D disciplines this activity touches on:
        - **Science:** Observing, studying, and experimenting to better understand the natural world and how it works.
        - Science contains many disciplines. This demonstration is an example of **fluid mechanics**, the branch of **physics** dealing with the properties of fluids in various states and with their reactions to forces acting upon them.
4. **Reset the activity.** If you're repeating this demonstration, simply remove the cap of the 1-liter plastic bottle and allow the gas to escape. The oil and water should resettle in a few moments. When the next student group arrives at the booth, add another Alka-Seltzer™ tablet.

EXTENDED LEARNING

You can extend student learning or expand this activity to a one-hour activity by:

- **Making a Lava Lamp!** If the time scheduled with the students is longer than 10–15 minutes, consider providing materials for students (or teams) to make their own Lava Lamps. Activity Leaders or adult volunteers should always handle the Alka-Seltzer™ tablets.
- **Experimenting with different materials and conditions.** After the demonstration, break the students into teams of 2–3 students per team, and allow teams to experiment with different sets of fluids and conditions to compare different

TIPS ABOUT STEM²D CAREERS

Share with students that there are many different kinds of careers related to STEM²D. Some STEM²D careers related to this activity are:

- Chemist
- Chemical manufacturing
- Experimental Scientist
- Physicist

levels of density and molecular polarity. Be sure to have students formulate and test hypotheses if doing this extended version. Some fluids you could substitute for vegetable oil or water:

- Sodas or juices
- Vinegars of various types
- Different kinds of oil—olive, corn, etc.
- Liquid soaps

Some conditions you could alter:

- Temperature of water or oil
- Size of the bottle
- Lid on or off the bottle
- Size of Alka-Seltzer™ tablet used (portions of tablets vs. full tablets, etc.)

Key Words

Density: The degree of compactness of a substance (i.e., how much mass is packed into a certain amount of space). A denser (or heavier) substance will sink when introduced into a less-dense substance.

Fluid Mechanics: The branch of physics dealing with the properties of fluids in various states and with their reactions to forces acting upon them.

Physics: The branch of science concerned with the nature and properties of matter and energy. The subject matter of physics, distinguished from that of chemistry and biology, includes mechanics, heat, light and other radiation, sound, electricity, magnetism, and the structure of atoms.

Polarity: The tendency of molecules of the same element to bond or stick together. Molecular polarity is the reason the water and oil separate so cleanly.

Science: Observing, studying, and experimenting to better understand the natural world and how it works.

STEM²D: An acronym referring to the Science, Technology, Engineering, Math, Manufacturing, and Design disciplines.

Resources and References

Activity concepts and real-life connections adapted from:

- “Blobs in a Bottle.” Science Bob. Accessed 13 November 2018. https://sciencebob.com/blobs-in-a-bottle-2/
- “Hudson, Laura. “STEAM Lava Lamps.” Education Closet, 1 September 2017. Accessed 13 November 2018. https://educationcloset.com/2017/09/01/steam-lava-lamps/
- “New Zealand Students Study Density with Blobs in a Bottle.” Science Bob. Accessed 13 November 2018. https://sciencebob.com/students-in-new-zealand-explore-blobs-in-a-bottle/

PRE-ACTIVITY CHECKLIST

Lava Lamps

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- ☐ Visit the event venue (optional) and/or finalize logistics with the organizer? Ask:
  - ☐ What is the date, time, and location of the event?
  - ☐ How will the room be arranged? Do I have access to a table? How big is it?
  - ☐ How many students do you expect? How will the students be organized/participate in the event? For example, are students free to visit any booth of interest for an unspecified amount of time, or will groups of students rotate to specific stations for timed activities? *Knowing this will help you determine the quantity of materials to purchase. If the time scheduled with the students is longer than 10–15 minutes, consider providing extra materials for students/teams to make and experiment with their own Lava Lamps.*
- ☐ Recruit additional volunteers, if needed?
- ☐ Prepare for the activity? Did you:
  - ☐ Read the entire activity text prior to implementation?
  - ☐ Customize the activity, if desired, to reflect your background and experiences, as well as the cultural norms and language of the students in your community?
  - ☐ Complete the **Tell My Story Form**, which will prepare you to talk about your educational and career path with the students? *(optional)*
- ☐ Obtain the required materials? *See the Materials and Estimated Materials Costs sections. If electing to extend the learning and/or allow students/teams to make their own Lava Lamp, additional materials will need to be acquired.*
- ☐ Practice your presentation? Do the demonstration activity? *Make sure you can explain the concepts to students, if needed, and that you know the correct answers.*
- ☐ Set up the site appropriately for the activity? Arrange your booth/table? Specifically:
  - ☐ Line table(s) with a tablecloth to contain spills or leaks and ease cleanup.

- ☐ Partially assemble one Lava Lamp. *Prior to the first demonstration, pour ¾ cup (175 ml) water into the 1-liter plastic bottle (clean, labels removed; reserve cap). Add 3 cups (710 ml) vegetable or baby oil and 10 drops food coloring. Reserve Alka-Seltzer™ tablets for each demonstration.*
- ☐ Place the Lava Lamp and the Alka-Seltzer™ tablets on the table.

☐ Bring a camera, if desired, to take photographs?

☐ Obtain and collect permission slips and photo release forms for conducting the activity, if applicable?

☐ **Have fun!**

Tell My Story Form

This form will help activity leaders and other volunteers prepare to talk about their STEM²D interests, education, and career path.

ABOUT YOU

Name: _____

Job Title: _____

_____

Company: _____

When/Why did you become interested in STEM²D? _____

_____

_____

What do you hope young people will get out of this activity?_____

_____

FUN FACT:

Share a little about your background. Ideas:

- Share a memory from childhood when you first had your "spark" or "interest" in STEM²D.
- Detail your journey, highlighting what you have tried, what you learned, steps to success, etc.
- Failures or set backs are also great to talk about—difficulties, and/or challenges, and how you overcame them.

EDUCATION AND CAREER PATH

What classes/courses did you take in secondary school and in college that helped or interested you most? _____

_____

How did you know you wanted to pursue a STEM²D career? _____

_____

What was your postsecondary path, including the institution you attended and your degree? *If you switched disciplines, make sure you explain why.* _____

_____

What your current position entails. *Be sure to include how you use STEM²D during a typical work day.* _____

_____

This activity was written by Johnson & Johnson's Bridge to Employment (BTE)
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Emily Rodriquez, BTE–Trenton, New Jersey.
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