

VALENTINE'S DAY LAVA LAMP - DENSITY & GAS PRODUCTION STEM INVESTIGATION

Print-and-go STEM
lab where students
learn how to make
a Valentine's Day-
Themed Lava
Lamp through a
hands-on activity.

Homemade Lava Lamp: Density & Gas Production — STEM Investigation

Purpose

Use a hands-on lava lamp challenge to teach experimental design, variables and controls, careful observation, and evidence-based explanations while exploring how **density differences** and **gas production** cause motion in liquids.

Learning Objectives

- Plan and carry out a controlled investigation with clear independent, dependent, and controlled variables
- Observe how liquids of different densities interact
- Investigate how gas production affects movement in fluids
- Identify patterns in cause-and-effect relationships
- Explain results using density, polarity, and chemical reaction concepts

Safety

- Do not eat or taste any materials
- Avoid contact with eyes and wash hands after use
- Clean spills immediately (oil can be slippery)
- Dispose of liquids according to teacher instructions
- Handle glass containers carefully, if used

Materials

- Clear container (plastic bottle or cup)
- Vegetable oil
- Water
- Food coloring
- Effervescent tablets (Alka-Seltzer or similar)
- Measuring cups/spoons
- Timer or stopwatch
- Paper towels
- Data table + pencil

Background Science for the Teacher

This works because of **density differences** and **gas production**. Oil is less dense than water. Oil and water do not mix because water is **polar** and oil is **nonpolar**.

When Alka-Seltzer is added to the water, it reacts to produce **carbon dioxide gas**. Gas bubbles attach to water droplets, making them less dense so they rise through the oil. When the droplets become denser again and sink. This cycle creates the lava lamp effect.



SCROLL
to take a look inside!

NO PREP



HOW THIS LAB WILL HELP YOU



- Print-and-go setup
- Clear Testing Procedure
- Teaches Scientific Method
- Low-cost & common materials

Valentine Lava Lamp STEM Investigation: Density, Gas & “Love Bubbles”

Purpose

Use a Valentine’s Day–themed lava lamp challenge to investigate **density production** while practicing experimental design, variables and controls, evidence-based explanations. Students explore how “love bubbles” (gas Valentine lava lamp).

Learning Objectives

- Plan and carry out a controlled investigation with clear independent variables
- Observe how liquids of different densities interact
- Investigate how gas production affects movement in fluids
- Identify cause-and-effect relationships in physical systems
- Explain results using density, polarity, and chemical reaction

Safety

- Do not eat or taste any materials
- Avoid contact with eyes and wash hands after use
- Clean spills immediately (oil can be slippery)
- Dispose of liquids according to teacher instructions
- Handle glass containers carefully, if used

Materials

- Clear container (plastic bottle or cup)
- Vegetable oil
- Water
- **Red or pink food coloring**
- Effervescent tablets (Alka-Seltzer or similar)
- Measuring cups/spoons
- Timer or stopwatch
- Paper towels
- Data table + pencil

Background Science for the Teacher

This Valentine lava lamp works because of **density differences**: vegetable oil is less dense than water, so it floats on top. Oil and water do not mix because they are immiscible. When an effervescent tablet is added to the water, it reacts to produce carbon dioxide gas bubbles. The gas bubbles attach to colored water droplets, making them less dense than the surrounding oil. When the gas escapes at the surface, the drop repeats the cycle, creating the lava lamp motion.

Homemade Lava Lamp: Density & Gas Production — STEM Investigation

Driving Question

How does adding an effervescent tablet affect the motion of liquids with different densities?

Hypothesis

Write a testable hypothesis predicting how increasing the amount of tablet will affect the amount of bubbles and liquid movement time inside the lava lamp.

Variables – List the variables in the chart below.

Type	Describe for This Experiment
Independent Variable	
Dependent Variable	
Controlled Variables	

Experimental Design

1. Fill the container $\frac{3}{4}$ full with oil.
2. Add water until nearly full.
3. Add food coloring to the water.
4. Allow layers to separate.
5. Add $\frac{1}{4}$ tablet and start timer.
6. Observe liquid movement for 2 minutes and record results for how long the liquid moved for.
7. Repeat with $\frac{1}{2}$ tablet and 1 tablet.

Data Table:

Tablet Amount	Bubble Activity (Low/Med/High)	Motion Observed	Duration (s)
$\frac{1}{4}$ tablet			
$\frac{1}{2}$ tablet			
1 tablet			

Claim – Evidence – Reasoning

CLAIM

How does the amount of effervescent tablet affect the motion inside the lava lamp?

EVIDENCE

Use observations from at least two trials.

REASONING

Explain your evidence using density and gas production.

★ Teacher Guide: setup, safety, pacing, and background science.

★ Student Packet: clear, step-by-step setup and timing instructions with blank data tables.

★ Data collection tables and marking rubric.

★ Complete answer key with example data tables.

What you get inside

Valentine Lava Lamp STEM Investigation: Density, Gas & “Love Bubbles”

Driving Question
How does adding different amounts of effervescent tablet affect the motion of liquids with different densities in a Valentine lava lamp?

Hypothesis
Write a testable hypothesis predicting how increasing the amount of tablet will affect the number of bubbles and how long the liquid moves.

Variables – List the variables in the chart below.

Type	Describe for This Experiment
Independent Variable	
Dependent Variable	
Controlled Variables	

Experimental Design

1. Fill the container $\frac{3}{4}$ full with oil.
2. Add water until nearly full.
3. Add red or pink food coloring to the water.
4. Allow layers to separate.
5. Add $\frac{1}{2}$ tablet and start timer.
6. Observe liquid movement for 2 minutes and record results for how long it takes to rise and sink.
7. Repeat with $\frac{1}{2}$ tablet and 1 tablet.

Data Table:

Tablet Amount	Bubble Activity (Low/Med/High)	Motion Observed
$\frac{1}{4}$ tablet		
$\frac{1}{2}$ tablet		
1 tablet		

Claim – Evidence – Reasoning
CLAIM
How does the amount of effervescent tablet affect the motion inside the container?

EVIDENCE
Use observations from at least two trials.

REASONING
Explain your evidence using density and gas production.

Teacher Answer Key and Notes

Type	Describe for This Experiment
Independent Variable	Amount of effervescent tablet added
Dependent Variable	Amount and duration of liquid motion (bubble activity)
Controlled Variables	Container type, oil-to-water ratio, tablet brand, temperature, observation time

Expected Results Pattern

- Small tablet amount → limited bubbling and motion
- Larger tablet amount → more gas bubbles and increased motion
- Oil and water remain separated throughout the investigation

Implementation Notes

- Assign roles: **Pourer, Timer, Observer, Recorder**
- Add food coloring to the water **before** adding oil
- Allow layers to fully separate before testing
- Add tablets in equal-sized pieces
- Observe for a fixed amount of time (example: 2 minutes per trial)

Teacher Notes on Common Pitfalls and Fixes

Oil and water mix when shaken → Fix: Emphasize gentle pouring and no shaking.

No bubbling occurs → Fix: Ensure tablets are fresh and added to the water layer.

Too much tablet added at once → Fix: Break tablets into equal pieces and add gradually.

Food coloring spreads in oil → Fix: Add coloring only to water before oil is poured.

Analysis Questions – Teacher Key

1. What happened to the oil and water when they were combined?
The oil floated on top of the water and formed a separate layer. This happened because oil is less dense than water and because oil and water do not mix.
2. How did the tablet affect the movement inside the container?
The tablet reacted with the water and produced gas bubbles. These bubbles caused colored water droplets to rise through the oil. When the gas escaped, the droplets sank again.
3. What pattern did you observe as tablet amount increased?
As the amount of tablet increased, the number of bubbles increased and the motion became stronger and lasted longer.
4. Why do the colored blobs rise and then sink?
Gas bubbles make the water droplets less dense, causing them to rise. When the gas escapes, the droplets become denser again and sink.

Analysis Questions

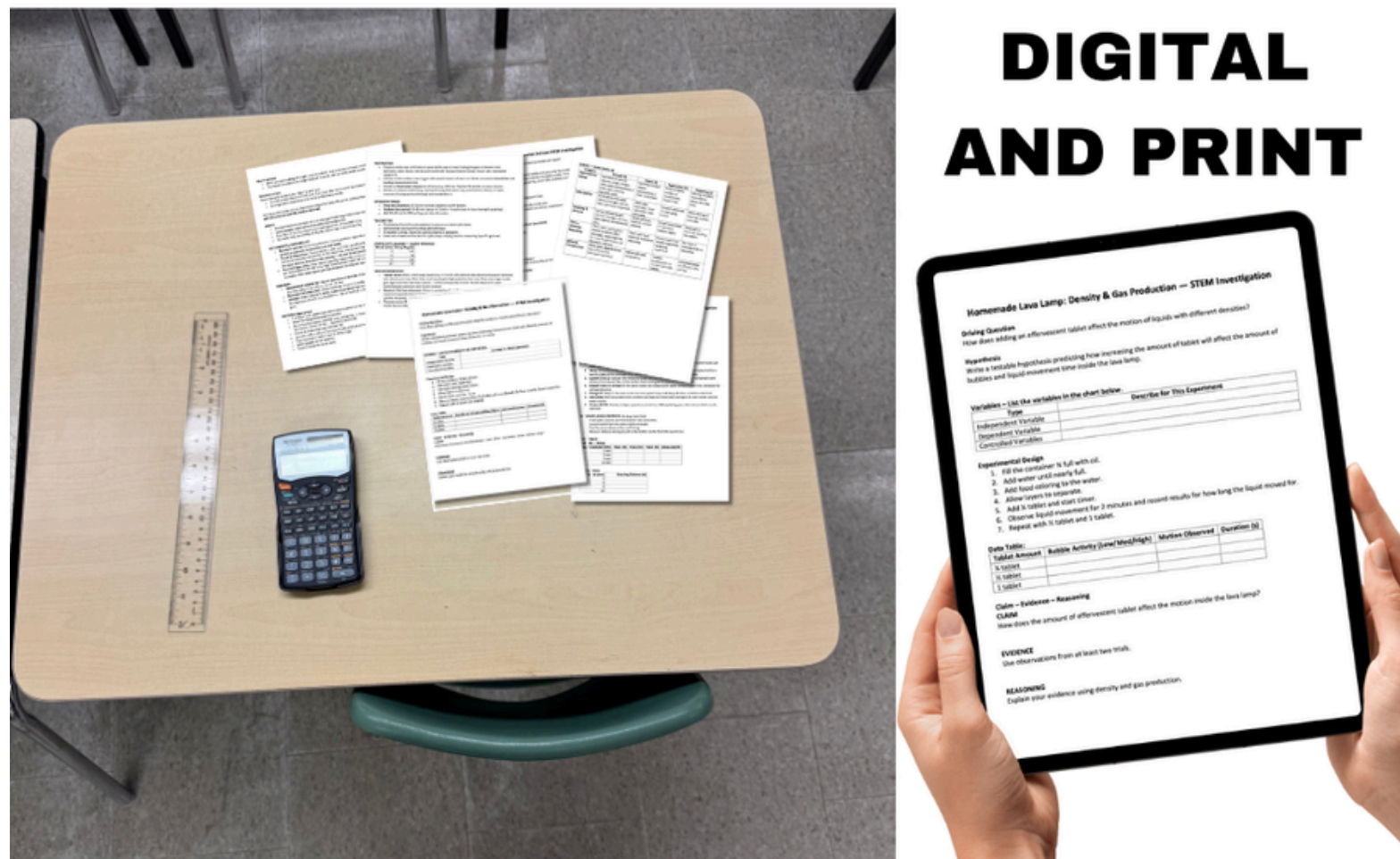
1. What happened to the oil and water?
2. How did the tablet affect movement?
3. What pattern did you observe?
4. Why did blobs rise and sink?
5. Identify two controlled variables.
6. Identify two sources of error.
7. What improvement would you make?

Rubric

Lab Section	Exceeds (4)	Meets (3)
Purpose & Background	Clearly explains purpose using density & gas concepts	States purpose and basic concepts
Hypothesis	Testable, clear, science-based prediction	Testable
Variables & Design	IV, DV, controls all correct; fair test	Variable identified; fair
Procedure & Setup	Follows steps correctly; consistent trials	Minor errors
Data & Observations	Detailed, accurate observations	Mostly observed
Analysis & Patterns	Correctly identifies patterns and cause-effect	Basic identification
Scientific Reasoning	Explains results using density & gas	Basic
CER	Strong claim, evidence, reasoning	Complete
Collaboration	Actively contributes; on task	Partial
Safety	Consistently safe, clean workspace	Minimal

Skills Your Students Will Learn/Improve

FULLY EDITABLE AND READY-TO-GO INVESTIGATION



**GREAT FOR TEACHING THE
SCIENTIFIC METHOD**

- ✓ Carrying out Controlled Experiments
- ✓ Precise Measurement
- ✓ Design and Redesign
- ✓ Analyzing Data
- ✓ Claim–Evidence–Reasoning
- ✓ Analyzing Results

Your Lab

Valentine Lava Lamp STEM Investigation: Density, Gas & “Love Bubbles”

Driving Question

How does adding different amounts of effervescent tablet affect the motion of liquids with different densities in a Valentine lava lamp?

Hypothesis

Write a testable hypothesis predicting how increasing the amount of tablet will affect the number of bubbles and how long the liquid moves.

Variables – List the variables in the chart below.

Type	Describe for This Experiment
Independent Variable	
Dependent Variable	
Controlled Variables	

Experimental Design

1. Fill the container $\frac{3}{4}$ full with oil.
2. Add water until nearly full.
3. Add red or pink food coloring to the water.
4. Allow layers to separate.
5. Add $\frac{1}{4}$ tablet and start timer.
6. Observe liquid movement for 2 minutes and record results for how long the liquid moved for.
7. Repeat with $\frac{1}{2}$ tablet and 1 tablet.

Data Table:

Tablet Amount	Bubble Activity (Low/Med/High)	Motion Observed	Duration (s)
$\frac{1}{4}$ tablet			
$\frac{1}{2}$ tablet			
1 tablet			

Claim – Evidence – Reasoning

CLAIM

How does the amount of effervescent tablet affect the motion inside the Valentines Day lava lamp?

EVIDENCE

Use observations from at least two trials.

REASONING

Explain your evidence using density and gas production.

All steps are clearly outlined and easy to follow

Students collect data in organized charts

Students analyze their data and draw conclusions

Marking Rubric

Analysis Questions

1. What happened to the oil and water?
2. How did the tablet affect movement?
3. What pattern did you observe?
4. Why did blobs rise and sink?
5. Identify two controlled variables.
6. Identify two sources of error.
7. What improvement would you make?

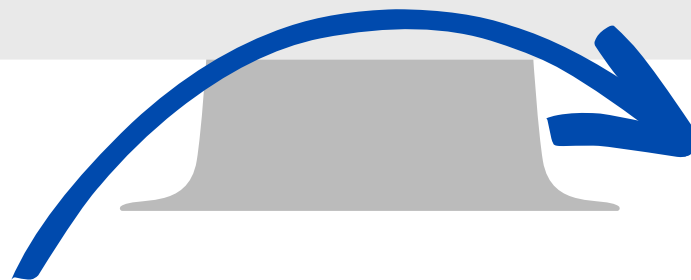
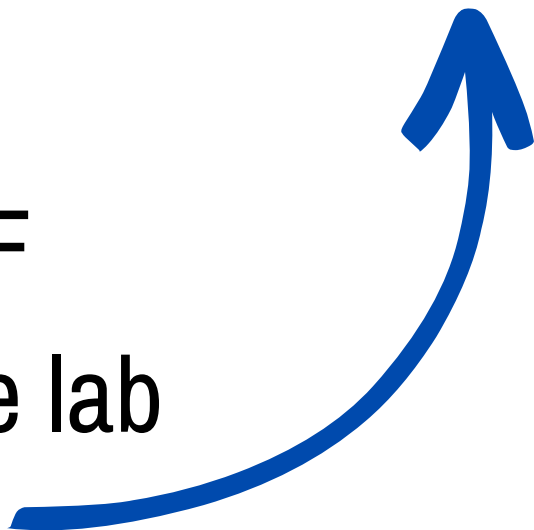
Rubric

Lab Section	Exceeds (4)	Meets (3)	Approaches (2)	Beginning (1)
Purpose & Background	Clearly explains purpose using density & gas concepts	States purpose; basic concept understanding	Partial or unclear purpose	No clear understanding
Hypothesis	Testable, clear, science-based prediction	Testable prediction	Vague or weak prediction	Missing or incorrect
Variables & Design	IV, DV, controls all correct; fair test	Variables identified; mostly fair	Some variables incorrect	No fair test
Procedure & Setup	Follows steps correctly; consistent trials	Minor setup errors	Setup inconsistencies	Setup incorrect
Data & Observations	Detailed, accurate observations	Mostly complete observations	Vague or incomplete	Missing data
Analysis & Patterns	Correctly identifies patterns and cause-effect	Basic pattern identified	Weak or incorrect pattern	No pattern
Scientific Reasoning	Explains results using density & gas	Basic explanation	Limited understanding	Misunderstanding
CER	Strong claim, evidence, reasoning	Complete CER	Weak CER	Missing CER
Collaboration	Actively contributes; on task	Participates	Inconsistent effort	Off-task
Safety	Consistently safe, clean workspace	Minor reminders	Repeated reminders	Unsafe behavior

At School or at Home



Word and PDF
versions of the lab



Fully digital and editable - can be
done in class or through distance
education/homeschool



Ways to Use this Resource



Introduce the Scientific Method



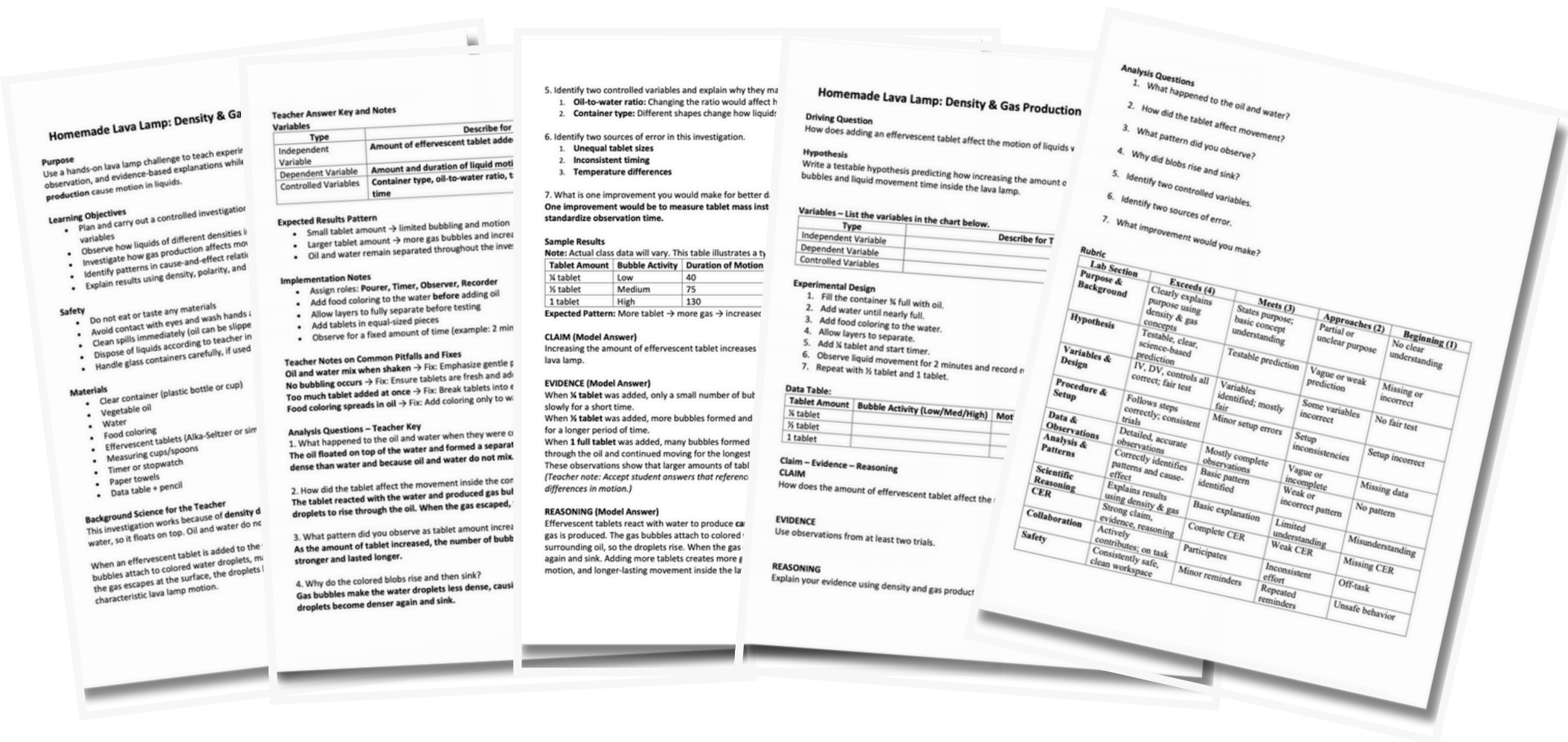
Teach data analysis and graphing



Reinforce key ideas



Formative or Summative Assessment



Download my Angle of Attack STEM Lab FREE
CLICK HERE

Paper Airplane Angle of Attack STEM Lab

Scientific Method • Variables • Data & Graphing

✓ Classroom-Ready

✓ Data tables + bar graph templates included



✓ Teacher guide with setup, safety, background science, pacing

✓ Step-by-step procedure for testing

✓ Analysis questions with model answers and Rubric



Paper Airplane: Angle of Attack STEM Investigation: Scientific Method Activity

Teachers Reference:

Angle of Attack Explained - <https://youtu.be/D1J1oUP-aKA?si=vsnb9a72PajoWnZs>



Purpose

Use a high-engagement paper-airplane challenge to teach experimental design, variables and controls, proportional reasoning, data analysis, and communication of results.

Learning Objectives

- Plan and carry out a controlled investigation with clear independent, dependent, and controlled variables.
- Collect sufficient data (replicates) and compare results across angle conditions.
- Graph distance data to analyze trends and construct evidence-based claims.
- Explain the physical principles (lift, drag, stall) that affect flight distance.

only airplanes; no paper clips or sharp nose cones.
a clear launch lane; stand behind the throw line; throw parallel to the floor.
ing area clear; retrieve planes only after all throws in a round are complete.

- Use a standard 8.5x11 in. paper (identical for all planes)
- Use a standard template (optional, one standard design for all teams)
- Use a protractor (or angle guides) to set release angle relative to horizontal
- Tape for a throw line and distance marks; measuring tape or meter tape
- Data sheets (included), clipboards, pencils

Background Science for the Teacher

Lift vs Angle of Attack (AoA): Lift generally increases with AoA up to a point. Beyond a critical AoA, airflow separates (stall), causing lift to drop and drag to rise, shortening distance.

Drag and Energy: Higher AoA increases frontal area and induced drag; too much drag slows the plane quickly. Moderate AoA balances adequate lift with manageable drag for a longer glide.

Consistency: A single plane design, constant throw force/height, and a clear angle-setting method are key to fair comparisons.

Expected Results Pattern

- Distances typically peak at a moderate AoA (around 10°–15° for a simple dart design).
- Very low AoA (0°–5°) may dive or fail to generate a strong glide; very high AoA (20°+) often stalls or climbs then falls rapidly.
- As throw technique becomes consistent, variation decreases and the distance curve vs angle becomes clearer.

Implementation Notes

- Use one standard airplane design per class for consistency (provide a template or model).
- Assign roles: Thrower, Angle Setter/Checker, Measurer, Recorder. Rotate roles between angles.
- Mark the throw line and measure angle at release using a protractor or an angle card taped to the forearm or launcher guide.

Answer Key and Sample Results

Note: Actual class data will vary. The sample below models typical trends and acceptable analysis quality.

Sample Summary Data

Angle (°)	Average Distance (m)
0	7.8
5	10.6
10	12.9
15	12.1
20	8.9

Interpretation

- Greatest average distance at 10° (=12.9 m) with a close second at 15° (=12.1 m).
- Very low angle (0°) underperformed (dives/low lift). Very high angle (20°) lost distance (near-stall and higher drag).
- The trend supports a moderate-angle optimum due to balance of lift and drag.

Model Responses to Analysis Questions

- Best angle: 10° with an average of ~12.9 m (our class graph shows a peak around 10–15°).
- Consistency: Results were reasonably consistent after the practice round; using the same thrower and angle card reduced variation.
- Controls that mattered most: Plane design and paper type, release height and throw force, indoor/no-draft room, and measuring to first contact.
- Follow-up: Test nose mass with paper clips at the best angle. Hypothesis: Adding a small nose mass (1–2 clips) will increase distance by improving stability without greatly increasing drag.

STEM INVESTIGATION BUNDLE

Build a high-engagement, low-prep STEM program.

- This Bundle includes my best STEM investigations—each one built around true engineering design, fair testing, repeated trials, data tables, graphing, and CER writing.
- STEM develops crucial skills like critical thinking and creativity and prepares students for a changing world and future opportunities.



Tell me and I forget. Teach me and I remember. Involve me and I learn. - Benjamin Franklin



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