FOAMAGEDDON LAB- Elephant Toothpaste

“Where Chemistry Explodes into Learning!”

The Ultimate Elephant Toothpaste STEM Experience



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TABLE OF CONTENTS

Goals and Objectives .....Page 3

Florida Standards .....Page 4

Quick Vocabulary .....Page 5

Course Overview .....Page 6

Lesson Plan and Overview .....Page 7

Reaction Rate Math Worksheet .....Pages 8

Answer Key .....Page 9

Elephant Toothpaste Engineering Log Sheet .....Page 10

Engineering & Innovation Guide .....Page 11

Engineering Design Process .....Page 12

Change Detective Challenge (Physical vs Chemical) .....Page 13

Answer Key .....Page 14

Catalyst Investigation Lab .....Page 15-18

Reflection and Journal .....Page 19

References .....Page 20

Goals and Objectives



The purpose of "Foamageddon Lab" is to help students explore chemical reactions, reaction rates, catalysts, and exothermic energy changes through a high-engagement Elephant Toothpaste experiment.

Students will:

- Investigate how catalysts speed up reactions
- Identify independent, dependent, and constant variables
- Observe evidence of chemical change
- Measure foam height and reaction time
- Analyze how temperature affects reaction rate
- Apply math skills to calculate ratios and compare trials
- Use the Engineering Design Process to improve results

Through this hands-on experience, students integrate:

- **Chemistry** (decomposition reactions, catalysts)
- **Physics** (energy transfer, heat release)
- **Mathematics** (measurement, graphing, rate calculations)

- **Engineering** (designing controlled investigations)

Florida Standards

Science

SC.8. N.1.1 – Plan and conduct investigations

SC.8. P.9.2 – Differentiate physical vs. chemical changes

SC.7. P.11.2 – Investigate energy transformations

SC.6. N.1.4 – Identify variables in experiments

Mathematics

MA.6.AR.1.1 – Apply ratio reasoning

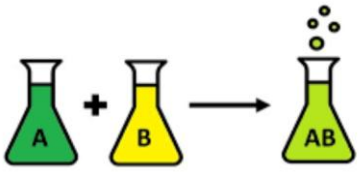
MA.7.AR.1.1 – Analyze proportional relationships

MA.8.AR.2.1 – Graph relationships and interpret slope

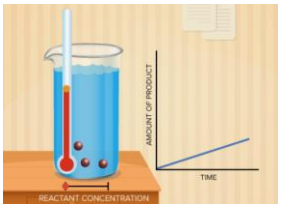
MA.6.DP.1.1 – Interpret data

Quick Vocabulary

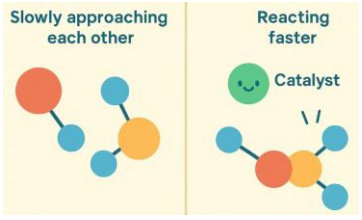
- Chemical reactions- A process where substances mix and change into new substances.



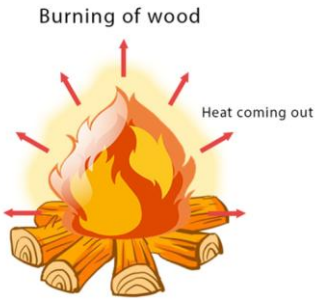
- Reaction rates- How fast or slow a chemical reaction happens.



- Catalyst- A substance that speeds up a reaction without being used up.



- Exothermic- reaction that release energy, usually as heat.



Course Overview – Foamageddon Lab



Students will explore:

Chemical Reactions

Hydrogen peroxide is decomposed into water and oxygen gas.

Catalysts

Yeast speeds up the reaction.

Exothermic Reaction

Students will feel the bottle become warm — energy is released.

Reaction Rate

Students test how:

- Temperature
- Amount of yeast
- Concentration
  affect foam production.

Data Collection

Students measure:

- Foam height (cm)
- Reaction time (seconds)
- Temperature before and after reaction

Lesson Plans and Overview



Pre-Lesson Activities

- Reaction rate demo (Alka-Seltzer in hot vs cold water)
- Variables mini lesson
- Safety briefing

Lesson Plan- Science Component

Students will:

- Identify variables
- Conduct 3 trials
- Record foam height
- Measure temperature change
- Determine if reaction is physical or chemical

Lesson Plan- Math Component

Students will:

- Calculate **reaction rate** (**height ÷ time**)
- Compare proportional increases
- Graph results
- Calculate percent increase

🧪 Reaction Rate Math Worksheet

Name: _____ **Date:** _____

Part A – Measuring Reaction Rate

(Reference: Rate = Height ÷ Time)

1. Trial 1 produced 18 cm of foam in 12 seconds.
   What is the reaction rate?
2. Trial 2 produced 30 cm in 10 seconds.
   What is the rate?
3. Which trial had the faster reaction? Why?

Part B – Catalyst Comparison

Trial A: 1 tbsp yeast → 20 cm foam
Trial B: 2 tbsp yeast → 36 cm foam

4. Did doubling yeast double foam?

5. What does this suggest about reaction rate?

Part C – Temperature Challenge

Cold Trial: 15 cm
Warm Trial: 32 cm

6. How much greater was the warm trial?

7. Why does temperature affect reaction rate?

Answer Key

Part A– Measuring Reaction Rate

1. **18 ÷ 12 = 1.5 cm/sec**
2. **30 ÷ 10 = 3 cm/sec**
3. **Trial 2**

Temperature and catalyst increase reaction rate.

Part B – Catalyst Comparison

4. Did doubling yeast double foam?

No, doubling 20 cm would be 40 cm, but Trial B only produced 36 cm. So, the foam increased, but it did not double.

5. What does this suggest about reaction rate?

It suggests that increasing the amount of catalyst increases the reaction rate, but the relationship is not perfectly proportional.

This happens because:

- **Eventually another reactant (hydrogen peroxide) becomes the limiting factor.**
- **Adding more yeast cannot keep increasing the reaction once peroxide is used up.**

Part C – Temperature Challenge

6. How much greater was the warm trial?

32 cm – 15 cm = 17 cm greater

7. Why does temperature affect reaction rate?

Temperature affects reaction rate because:

- **Warmer temperatures make particles move faster.**
- **Faster particles collide more often.**

- **More collisions increase the chances of a successful reaction.**

This results in:

- **Faster reaction**
- **More foam**
- **Greater energy release**

Elephant Toothpaste Engineering Log Sheet

Name: _____ Date:_____

Team: _____

Independent Variable: _____

Dependent Variable: _____

Constants: _____

Foam Height: _____ cm

Reaction Time: _____ sec

Temperature Before: _____ °C

Temperature After: _____ °C

Engineering & Innovation Guide

STEM/STEAM Lesson Plan Guide to be included in the Engineering Notebook (Grades 6-8)

Define the Problem:

How can we increase foam production safely?

Improve the Design:

What variable did you adjust?

Test and Evaluate:

Did foam height increase? Provide data.

Extend the Investigation:

What would you test next?


FOAMAGEDDON LAB
ENGINEERING DESIGN PROCESS
1 Ask
2 Imagine
3 Plan
4 Create
5 Test
6 Improve

Foamageddon – Change Detective Challenge

Identify: Physical or Chemical Change? Put a check mark and add evidence.

	Physical Change	Chemical Change
1. Yeast added to peroxide → bubbles form		
2.Bottle becomes warm		
3.Soap creates foam		
4. Hydrogen peroxide breaks down		

Students must justify answers using evidence:

- Gas production
- Temperature change
- New substance formation

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Physical vs. Chemical Change – Student Evidence Chart

Name: _____ Date: _____ Period: _____

Directions: Identify whether each example is a Physical or Chemical Change. Justify your answer using evidence (gas production, temperature change, or new substance formation).

Scenario	Physical or Chemical?	Evidence (Check One)	Explanation
Yeast added to peroxide → bubbles form	_____	☐ Gas ☐ Temp Change ☐ New Substance	_____ _____
Bottle becomes warm	_____	☐ Gas ☐ Temp Change ☐ New Substance	_____ _____
Soap creates foam	_____	☐ Gas ☐ Temp Change ☐ New Substance	_____ _____
Hydrogen peroxide breaks down	_____	☐ Gas ☐ Temp Change ☐ New Substance	_____ _____

Answer Sheet

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Physical vs. Chemical Change – Answer Sheet

Scenario	Physical or Chemical?	Evidence	Explanation
Yeast added to peroxide → bubbles form	**Chemical Change**	Gas Production	Oxygen gas is produced when hydrogen peroxide decomposes. Formation of gas is evidence of a new substance forming.
Bottle becomes warm	**Chemical Change**	Temperature Change	The reaction releases heat (exothermic reaction), showing energy change and new substance formation.
Soap creates foam	**Physical Change**	No new substance formed	Soap traps oxygen gas in bubbles, but no new substance is created. It is just a physical mixing process.
Hydrogen peroxide breaks down	**Chemical Change**	New Substance Formation	Hydrogen peroxide decomposes into water (H_2O) and oxygen gas (O_2). New substances are formed.

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Catalyst Investigation Lab

How Does the Amount of Yeast Affect Reaction Rate?

Purpose

To investigate how increasing the amount of yeast (catalyst) affects the rate of the Elephant Toothpaste reaction and determine whether the reaction is exothermic.

Background

Hydrogen peroxide (H_2O_2) naturally breaks down into water (H_2O) and oxygen gas (O_2).

Yeast contains an enzyme called **catalase**, which acts as a **catalyst** and speeds up this decomposition reaction.

When oxygen gas is released, dish soap traps the gas, forming foam.

Balanced Reaction (Teacher Reference):
$2H_2O_2 \rightarrow 2H_2O + O_2$

Hypothesis

If the amount of yeast increases, then _____

(Be sure your hypothesis includes a prediction about foam height and/or reaction rate.)

Variables

Independent Variable (What you change): **Amount of yeast**

Dependent Variable (What you measure): **Foam height and temperature change**

Constants (What stays the same):

- **Amount of hydrogen peroxide**
- **Bottle size**
- **Amount of dish soap**
- **Temperature of water used to activate yeast**
- **Room temperature**

Materials

- 3%, 6% or 12% Hydrogen Peroxide
- Dry yeast
- Warm water
- Food coloring
- Dish soap
- Bottle
- Thermometer
- Measuring cup/spoons
- Graduated cylinder
- Ruler
- Tray/pan
- Safety glasses/goggles

Procedure

1. Measure __1/2 cup____ of hydrogen peroxide into the bottle.
2. Add ___5__ mL (or drops) of dish soap. Swirl gently to mix.
3. Measure and record the initial temperature of the peroxide mixture.
4. In a separate cup, activate yeast by mixing:
    - Trial 1: 1 tablespoon yeast + 3 tbsp warm water (Stir for 30 seconds)
    - Trial 2: 2 tablespoons yeast + 3 tbsp warm water (Stir for 30 seconds)
5. Add 2-4 drops of food coloring to the bottle.
6. Pour the activated yeast into the bottle.
7. Immediately start timing the reaction.
8. Measure the maximum foam height (cm).
9. Measure and record the final temperature of the bottle.
10. Repeat for additional trials if needed.

Data Table

Trial	Amount of Yeast	Foam Height (cm)	Time to Peak (sec)	Initial Temp (°C)	Final Temp (°C)
1					
2					

Observations

Before Adding Yeast

Color: _____
Temperature: _____
Any bubbles present? _____

During Reaction

What happened immediately? _____
Was gas produced? _____
Did the bottle feel warm? _____
What happened to the foam? _____

After Reaction

Did the foam continue growing? _____
Did temperature change? _____
Was any solid formed? _____

Analysis Questions

1. Did increasing yeast increase foam height?

---

2. Did increasing yeast affect reaction speed?

---

3. Did the temperature change? By how much?

Conclusion

Was the reaction exothermic?
☐ Yes
☐ No

How do you know?

Evidence should include:
• Temperature increase
• Gas production
• Formation of new substances

Write your complete conclusion below:

Extension Question (Higher Level Thinking)

Why didn’t doubling the yeast exactly double the foam?

(Hint: Think about limiting reactants.)



Reflection & Journal

- What evidence proves this was a chemical reaction?
- How did your data support your hypothesis?
- What surprised you?
- How could this lab connect to real-world science?

References

Discovery Education – Chemical Reactions- https://app.discoveryeducation.com/learn/videos/e63e236f-3c3d-4069-a692-befc66c423e2/

Flinn Scientific – Elephant Toothpaste Demo- https://www.youtube.com/watch?v=e4WeDAzoGBM

Science Buddies- https://www.sciencebuddies.org/stem-activities/elephant-toothpaste