Lab 1: Conservation of Mass (Closed System)

Name: _____ Partner(s): _____

Date: _____ Period: _____

Purpose: *Verify that mass is conserved during a chemical reaction in a closed system.*

Standards: *HS-PS1-2, HS-PS1-3*

• Sodium bicarbonate (NaH_2CO_3), ~5.00 g; household vinegar (~0.8–1.0 M), 30.0 mL

• 250 mL Erlenmeyer flask; small balloon; funnel; weigh boat; electronic balance (±0.01 g)

• 50 mL graduated cylinder; paper towels; marker

Procedure:

1. Measure 30.0 mL vinegar; pour into a dry, labeled 250 mL Erlenmeyer flask; dry exterior.
2. Tare balance with weigh boat; measure 5.00 g NaH_2CO_3.
3. Transfer NaH_2CO_3 into an empty balloon using a dry funnel; tap to settle.
4. Stretch balloon over Erlenmeyer flask mouth (do not mix yet); ensure airtight seal.
5. Record *initial total mass* of the closed system.
6. Dump NaH_2CO_3 into vinegar; allow CO_2 to inflate balloon; wait until bubbling stops.
7. Swirl gently; dry exterior; record *final total mass*.
8. Repeat twice with fresh reagents.

Data & Observations:

Keep system closed while weighing to prevent gas loss.

Trial	Initial Mass (g)	Final Mass (g)	Δm (g)	% Error
1				
2				
3				

Analysis Questions:

1. Compute Δm and % error for each trial. What does Δm ≈ 0 indicate about your system?
2. Explain, using a particle model, why mass is conserved in a closed system that produces a gas.
3. If Δm was negative, identify the most likely error source and its effect; propose a procedural fix.

Conclusion (CER):

1. **Claim**: State whether your results support the Law of Conservation of Mass in this experiment.

2. **Evidence**: Cite specific values from your table (initial/final mass, Δm, % error).

3. **Reasoning**: Explain why your evidence supports (or does not support) mass conservation using the particle model and the closed-system setup.

4. **Error/Improvement**: Identify at least one likely source of error and describe how it would change Δm; propose a concrete procedural improvement.

Lab 1: Conservation of Mass (Closed System) — Rubric

Weights: Only Analysis & Conclusion are weighted ×2.

Criterion	1	2	3	4	5
Preparation & Safety	Arrives without materials; disregards safety; multiple reminders required.	Partial setup; inconsistent safety practices; repeated reminders.	Arrives prepared; follows core safety rules; needs few reminders.	Proactive setup; models safe technique; assists peers appropriately.	Exemplary safety leadership; anticipates hazards; mitigates independently.
Data & Observations	Missing/incorrect data; no units; disorganized records.	Some data present; frequent omissions or unit errors; limited organization.	Complete data with units; legible organization; minor omissions only.	Detailed, well-structured tables; includes replicates; notes on uncertainty.	High-precision records; trends annotated; clear rationale for repeated trials.
Analysis & Explanations (×2)	Incorrect or irrelevant reasoning; calculations absent/incorrect.	Partially correct calculations; superficial reasoning; little linkage to model.	Correct calculations; reasoning generally sound; connects to model at a basic level.	Accurate calculations; strong quantitative reasoning; addresses error sources explicitly.	Insightful quantitative analysis; clear model-based explanation; error impacts quantified.
Conclusion (×2)	No claim or claim contradicts data; no justification.	Vague claim; minimal or generic evidence provided.	Clear claim; cites at least one quantitative result as support.	Well-supported claim; multiple quantitative references; coherent logic.	Compelling claim; precise quantitative evidence; reasoning generalizes beyond this lab.