

Name: _____ Class: _____ Date: _____

Conservation of Mass

Learner Outcomes:

- Observe and describe patterns of chemical change by:
 - o Identifying evidence for conservation of mass in chemical reactions, and demonstrating techniques by which that evidence is gathered.

Key Terms:

Conservation of mass

Open system

Closed system

Background Information: In a chemical reaction, products are formed when the reactants undergo a change. These products usually look very different from the reactants however they still include all of the atoms that were present in the reactant form. Since the law of conservation of mass says that matter cannot be created or destroyed, we would expect the mass of the products to be the same as that of the reactants. In this activity, we will investigate how the total mass is affected by a chemical reaction in both an open and in a closed system.

Research Question: How is the total mass affected by a chemical reaction?

PART A: Mass of Reactants and Products - A Closed System

Hypothesis: _____

Materials:

Sodium carbonate solution NaCO_3 (aq)	Stopper for flask
Calcium chloride solution CaCl_2 (aq)	Graduated Cylinder
250 ml Erlenmeyer flask	Triple Beam Balance
Small test tube	

Procedure:

1. Pour 20 ml of the sodium carbonate - NaCO_3 (aq) solution into an Erlenmeyer flask
2. Pour 10 ml of calcium chloride - CaCl_2 (aq) solution into a test tube. Carefully dry off the outside of the test tube and gently place it into the flask.
3. Seal the flask with a stopper and ensure that the outside of the flask is dry.

This investigation / activity has been adapted from:

Mah K, Martha J, McClelland L, et al. *Science in Action 9*. Toronto, ON: Addison Wesley.

- Record a qualitative description of the reactants and then determine and record the total mass of the reactants and their containers.
- Invert the flask while firmly holding the stopper.
- Observe the reaction and record a qualitative observation of the reactions. Measure and record the mass of the flask and its contents.

Observations:

Before the Reaction		After the Reaction	
Qualitative Description of the Reactants	Mass of Reactants (g)	Qualitative Description of the Reaction and Products	Mass of Products (g)

Analysis:

- What evidence is there that a chemical reaction has occurred?
- What were the reactants in this chemical reaction?
- Using the reactants you listed, write out a **chemical equation** for the reaction you observed.
(*HINT: This is a double replacement reaction - swap the metals (positive charges) to determine the products that formed.*)

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4. From your equation above, write the chemical name for the products and identify which of the two you saw as the precipitate in the lab. Why did you choose the one you did?
5. What happened to the mass after the reactions? Does it agree with your hypothesis?
6. There was another chemical present in both the flask and test tube, but it did not take part in the reaction. What was this other chemical? (*HINT: look at the chemical formulas for each reactant carefully.*)

PART B: Mass of Reactants and Products – An Open System

Problem: How can you explain an apparent difference in mass?

Hypothesis: _____

Materials:

Sodium bicarbonate (baking soda)

- NaHCO_3 (s)

Dilute Hydrochloric acid $\text{HCl}_{(aq)}$

250 ml Beaker

Small test tube

Graduated Cylinder

Balance

This investigation / activity has been adapted from:

Mah K, Martha J, McClelland L, et al. *Science in Action 9*. Toronto, ON: Addison Wesley.

Procedure:

1. Pour 20 ml of the hydrochloric acid - $\text{HCl}_{(\text{aq})}$, into the test tube.
2. Measure 2g sodium bicarbonate - $\text{NaHCO}_3_{(\text{s})}$ and place it in the beaker.
3. Record a qualitative description of the reactants and then determine and record the total mass of the reactants and their containers.
4. Remove the beaker from the balance. *Slowly* pour the acid into the beaker.
5. Observe the reaction and record a qualitative observation of the reactions.
6. Place the test tube back in the beaker and measure and record the mass of the flask and its contents.

Observations:

Before the Reaction		After the Reaction	
Qualitative Description of the Reactants	Mass of Reactants (g)	Qualitative Description of the Reaction and Products	Mass of Products (g)

Analysis:

1. What evidence is there that a chemical reaction has occurred?

2. What were the reactants in this chemical reaction?

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- Using the reactants you listed, write out a **chemical equation** for the reaction you observed .

HINT: This is a double replacement reaction - swap the sodium and the hydrogen to determine the products that formed.

One of the products you'll get is H_2CO_3 - what 2 substances do you think this turns into - think of what was released in the lab.

- What happened to the mass after the reactions? Does it agree with the conservation of mass law? Why or why not?
- If your data does not support the conservation of mass law, how could you modify the experiment to test the theory?

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Conclusion: How do the mass of reactants and products in a chemical reaction compare in an open system versus a closed system?

Extension:

1. Is Earth an open system or a closed system? Explain. How does this influence the types of chemical reactions that happen on earth??

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