

Unit 4: Proportion and quantity of Atoms and Molecules in Chemical Reactions

Standard(s):

8.1.3 **Plan and conduct an investigation** and then analyze and interpret the data to identify patterns in changes in a substance's properties to determine whether a chemical reaction has occurred. Examples could include changes in properties such as color, density, flammability, odor, solubility, or state. (PS1.A, PS1.B)

8.1.6 **Develop a model** to describe how the total number of atoms does not change in a chemical reaction, indicating that matter is conserved. Emphasize demonstrations of an understanding of the law of conservation of matter. Balancing equations and stoichiometry will be learned at the high school level. (PS1.B)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Students develop physical, conceptual, and other models to represent relationships, explain mechanisms, and predict outcomes.	PS1.A Structure and Properties of Matter PS1.B Chemical Reactions	Scale Proportion and Quantity Students compare the scale, proportions, and quantities of measurements within and between various systems. Patterns Students observe patterns to organize and classify factors that influence relationships.
Big Ideas: Materials can be characterized by their intensive measurable properties. Many substances react chemically with other substances to form new substances with different properties. The total number of each type of atom is conserved (does not change) in any chemical process, and thus mass does not change either.		
Preceding Grade Bands: - Matter can be described and classified by its observable properties (e.g., visual, aural, textural), by its uses, and by whether it occurs naturally or is manufactured. - The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to	Target Grade Bands: - Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. - Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the	Following Grade Bands: The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.

vanish (e.g., sugar in solution, evaporation in a closed container). • Measurements of a variety of properties (e.g., hardness, reflectivity) can be used to identify particular materials. • When two or more different substances are mixed, a new substance with different properties may be formed; such occurrences depend on the substances and the temperature. No matter what reaction or change in properties occurs, the total weight of the substances does not change.	original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. • The total number of each type of atom is conserved, and thus the mass does not change.	• The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.
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Proficiency Scale:

4 Advanced	3 Proficient	2 Approaching Proficiency	1 Beginning Proficiency
I can: Develop a model based on evidence that shows what happens to the <u>quantity</u> (mass) of substances during a chemical reaction. AND Use <u>patterns</u> in data as evidence to support a claim that a chemical reaction did or did not occur between substances. AND Construct an argument based on data to justify claims for why some data are stronger or weaker evidence that a chemical reaction has occurred.	I can: Develop a model based on evidence that shows what happens to the <u>quantity</u> (mass) of substances during a chemical reaction. AND Use <u>patterns</u> in data as evidence to support a claim that a chemical reaction did or did not occur between substances.	I can: Develop a model that shows what happens to the <u>quantity</u> (mass) of substances during a chemical reaction. AND Use data to support a claim that a chemical reaction did or did not occur between substances.	I can: Describe what happens to the mass of substances during a chemical reaction. AND Make a claim about whether or not a chemical reaction occurred between substances.

Anchoring Phenomenon:

[Burning rubbing alcohol](#) - The students weigh the mass of a small amount of rubbing alcohol. They burn the rubbing alcohol and then weigh the mass again. The students make observations about what happened, generate a possible explanation for what they are seeing and record questions that they still have about what is going on.

Essential Question:

What happens when new materials are formed? What stays the same and what changes?

Learning Goals:**Students will be able to:**

- 4A: Plan an investigation to gather evidence to determine whether a chemical reaction has occurred between substances.
- 4B: Develop a model to show what happens to the mass of substances during a chemical reaction.

	Learning Opportunities	Formative Assessments
Engage	Burning Rubbing Alcohol - The students weigh the mass of a small amount of rubbing alcohol. They burn the rubbing alcohol and then weigh the mass again. The students make observations about what happened, generate a possible explanation for what they are seeing and record questions that they still have about what is going on.	<u>Unit 4 Notebook</u> - This document contains all of the activities described below for this unit.
Learning Goal 4A: Plan an investigation to gather evidence to determine whether a chemical reaction has occurred between substances.		
Engage	<u>Activity 1</u> - Mentos and Diet Coke - In this activity the students experience what happens when Mentos mints are added to Diet Coke. They make observations about what happens, come up with a possible explanation and record questions that they have.	Students record observations, explanations and questions in their digital notebook.
Explore	<u>Activity 2</u> - What is a Chemical Reaction? Students are given a piece of paper and asked how many ways it can be changed. As each change is mentioned the students do that change to their paper. When students eventually say that the paper can be burned, the students burn a small piece of paper and then make observations about the changes that happened to the paper when it was burned. The students are asked if each change was a chemical reaction. The class discusses their ideas and generates a definition of what a chemical reaction is and why properties change when a chemical reaction happens. The students then experience several chemical reactions with their group and record the changes in properties that they see happening each time. They look for patterns in the property changes that are occurring.	<u>Learning Ticket 4A.1: Signs of a Chemical Reaction</u>

Explain	<u>Activity 3</u> - Is it a Chemical Reaction? After discussing the patterns in the property changes that occurred during the chemical reactions they experienced in Activity 2, the students organize their ideas in a Venn Diagram that they can use as a guide to help them decide whether a change is a chemical reaction or not. They experience several more changes/reactions with the class and use their diagram to determine which were chemical reactions and which were physical changes. <u>Card Sorting</u> - Optional activity in which the students sort cards to practice identifying the signs of a chemical reaction.	• QUIZ 4A Levels 1 and 2 Signs of a Reaction - Google Doc • QUIZ 4A Level 3 Signs of a Reaction - Google Doc • QUIZ 4A Level 4 Signs of a Reaction - Google Doc
Explore	<u>Activity 4</u> - Experimenting with Mentos and Diet Coke In this activity the students design and conduct an experiment to determine whether adding Mentos to Coke is a chemical reaction. They identify the properties of Mentos and Coke before they are combined compared to their properties after they are combined. Based on their results they decide if a chemical reaction has occurred.	Learning Ticket 4A.2 - Important Parts of an Experiment
Explain	<u>Activity 4</u> (Continued)- Experimenting with Mentos and Diet Coke Conclusion Students write a conclusion for their Mentos and Coke experiment, explaining the results of their experiment and why the property changes they experienced show that there was a chemical reaction or not. <u>Revisit the Burning Alcohol Phenomenon</u> - Students use what they have learned in the learning goal to revisit the Burning Alcohol	Conclusion form for their experiment in Activity 4 in the notebook.

	phenomenon, identifying what questions we have answered and what questions we still have.	
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Learning Goal 4B: Develop a model to show what happens to the mass of substances during a chemical reaction.

Explore	<u>Activity 1</u> - Change of Mass in Chemical Reactions Students will compare the masses of the reactants and products of several chemical reactions. They will decide if any mass was lost and if so, what might have happened to it. Students are introduced to the Law of Conservation of Mass (<u>matter</u>). <u>Activity 2</u> - Conservation of Atoms in Chemical Reactions In this activity students will review the Law of Conservation of Mass and learn how to recognize if chemical equations follow this law by looking at the baking soda and vinegar reaction and the rusting reaction. They will review how to write molecular formulas and will learn how to write a full chemical equation, including how to show the number of molecules involved.	<u>Learning Ticket 4B.1: Law of Conservation of Mass</u>
Explain	<u>Activity 2 (Continued)</u> - Conservation of Atoms in Chemical Reactions Rusting Reaction #2 Once the students have learned how to correctly write molecular formulas to show that there is more than one molecule present, they use this knowledge to explain why the rusting reaction chemical equation follows the Law of Conservation of Mass. <u>Revisit the Burning Alcohol Phenomenon</u> - Students use what they have learned in the learning goal to revisit the Burning Alcohol	<u>Learning Ticket 4B.2: Chemical Equations and the Law of Conservation of Mass</u> <u>Learning Ticket 4B.3: Atoms, Molecules, and Reactions</u> • <u>Quiz 4B Levels 1 and 2 Conservation of Mass</u> - Google Doc • <u>Quiz 4B Level 3 Version A</u> - Google Doc

	phenomenon, identifying what questions we have answered and what questions we still have.	• Quiz 4B Level 4 Version B - Google Doc • Quiz 4B Level 3 Version C - Google Doc • Quiz 4B Level 3 Version D - Google Doc • Quiz 4B Level 3 Version with Simpler Molecules - Google Doc • Quiz 4B Level 4 - Google Doc
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Elaborate	<u>Activity 3 (LG 4B Notebook)</u> - Modeling Chemical Reactions In this activity the students will demonstrate their understanding of the Law of Conservation of Matter and of the rules for writing chemical formulas by building a model of the molecules that are the reactants for a chemical equation and rearranging the atoms in these molecules to make the products. They explain how their model demonstrates the Law of Conservation of Matter.	Students create a physical model of the molecules in a chemical reaction to explain how the reaction follows the Law of Conservation of Matter.
Evaluate	Burning Steel Wool https://docs.google.com/document/d/1YQj2_4zG9-C-ky5qsnMyCf-pHldsfAO2kzO3UISa7B4/template/preview	