



Law of Conservation of Matter

Type of Lesson:	<u>Content with Process:</u> Focus on constructing knowledge through active learning.	
IPC Content TEKS:	8C	Investigate and identify the law of conservation of mass.
Learning Goal/ Instructional Goal:	<p>General Objective: Students create their own experiment to prove the Law of Conservation of Mass after conducting a guided practice lab.</p> <p>Instructional Goals:</p> <ol style="list-style-type: none"> 1. Given vinegar and baking soda along with specific directions, students prove the Law of Conservation of Mass. 2. Given Alka-Seltzer and a flask, students design and conduct an experiment to prove the Law of Conservation of Mass. 	
Key Question:	When the substances are combined in a plastic bag, how can the law of conservation of mass be observed?	
Related Process TEKS:	<p>(1) Scientific processes. The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices</p>	<p>The student is expected to:</p> <p>(A) demonstrate safe practices during field and laboratory investigations; and</p> <p>(B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.</p>
	<p>(2) Scientific processes. The student uses scientific methods during field and laboratory investigations.</p>	<p>The student is expected to:</p> <p>(A) plan and implement experimental procedures including asking questions, formulating testable hypotheses, and selecting equipment and technology;</p> <p>(B) collect data and make measurements with precision;</p> <p>(C) organize, analyze, evaluate, make inferences, and predict trends from data; and</p> <p>(D) communicate valid conclusions.</p>
	<p>(3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions.</p>	<p>The student is expected to:</p> <p>(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;</p> <p>(B) draw inferences based on data related to promotional materials for products and services;</p> <p>(C) evaluate the impact of research on scientific thought, society, and the environment;</p> <p>(D) describe connections between physics and chemistry and future careers; and</p> <p>(E) Research and describe the history of physics, chemistry, and contributions</p>

		of scientists.
To the Teacher:	<p>The law of conservation of mass indicates that mass cannot be created nor destroyed. This means the total mass of reactants in a chemical reaction will equal the total mass of the products. If a gas is produced during a reaction, which mass is often forgotten when calculating the final mass because the students are unable to see the gas. For this reason, balloons or zip lock bags may be used to collect the gas and preserve the mass.</p> <p>When balancing chemical equations, the law of conservation of mass is also demonstrated because the total number of atoms that goes into the reaction must be produced. So if 14 atoms are on the reactant side, then 14 atoms must be on the product side. Equations often require balancing to correctly demonstrate the law of conservation of mass.</p> <p>Students work in small cooperative groups to complete a laboratory exercise related to conservation of mass. Using vinegar, baking soda and a sealed plastic bag, students determine the mass of the vinegar and baking soda. Students then seal the vinegar and baking soda in a plastic bag and mix the substances. A gas is formed which will inflate the bag. The mass of the sealed bag will then be determined in order to ascertain if there has been any change in the mass of the reactants and product before and after the reaction took place.</p> <p>In the second activity, students design their own investigation to observe and prove the law of conservation of mass. The first investigation should provide them with the knowledge they need a closed system so the mass of the gas is included. Depending on the restrictions you provide, this activity could use a large number of seltzer tablets. Consider restricting their supply to 2 or 3 tablets, depending on your supplies. Allow students to ask you for additional supplies they might need. Ensure students have a plan in writing before they start testing.</p> <p>We have long known that atoms can be neither created nor destroyed during a chemical reaction. The number of atoms of each element must be the same before and after the chemical reaction.</p> <p>If the number of atoms of each element remains the same, then the mass can never change in a chemical reaction. The total mass of the reactants must equal the total mass of the products. This observation that mass must remain constant in a chemical reaction as known as the <i>law of conservation of mass</i></p>	
Multiple Intelligences:	<i>Logical-Mathematical Intelligence</i> —	Consists of the ability to detect patterns, reason deductively and think logically. This intelligence is most often associated with scientific and mathematical thinking.
	<i>Linguistic Intelligence</i> —	Involves having a mastery of language. This intelligence includes the ability to effectively manipulate language to express oneself rhetorically or poetically. It also allows one to use language as a means to remember information.
	<i>Intrapersonal Intelligence</i> —	Intrapersonal intelligence--the ability to understand one's own feelings and motivations.
	<i>Spatial Intelligence</i> —	Gives one the ability to manipulate and create mental images in order to solve problems. This intelligence is not limited to visual domains--Gardner notes that spatial intelligence is also formed in blind children.

Materials:

- 1 zip lock bag
- 2 small plastic cups
- vinegar (acetic acid)
- baking soda (sodium bicarbonate)
- triple beam balance



SAFETY NOTE:



Safety goggles and aprons must be worn.

Students must seal the bag completely in the first experiment so that the chemicals do not spray out during the experiment. During the second part when students design their own experiment, care must be taken to keep the glass flask from breaking due to the pressure of the gas. If the students request a rubber stopper, make sure that it is larger than the opening so that the flask does not crack due to gas exerting pressure.

Engagement:

Drop an Alka-seltzer tablet into a beaker of water. Discuss the Law of Conservation of Mass. Why is it hard to prove the law when a gas is produced? That's your job today in the second part of this lab experiment.

Explore:

1. Fill one cup halfway with vinegar.
2. Fill a second cup halfway with baking soda.
3. Put both cups in the plastic bag. Take care NOT to spill the contents of either cup.
4. Determine the mass of the cups and their contents, and the plastic bag. Write the values in your data table.
5. Seal the plastic bag.
6. Without opening the bag, pour the vinegar into the cup of baking soda.
7. Without opening the bag, record the mass of the contents of the plastic bag. Take care not to break the seal of the plastic bag.

Explain:

<i>Initial Mass (g)</i>	<i>Final Mass (g)</i>	<i>Change in Mass (g)</i>

1. Describe what happens when the vinegar was poured into the cup of baking soda. *Answers may vary, but students should mention release of a gas. This is a typical chemical reaction in which an acid - vinegar, reacts with a base - baking soda, to produce a new chemical - a salt.*
2. What is a chemical reaction? *Chemical reactions occur when two chemicals unite or react to form a compound that is unlike the original substances and cannot be changed back to its original form.*
3. The gas produced in this reaction can put out fires. Can you make an educated guess about its identity? What is the name of the gas? *Carbon dioxide*
4. What is conservation of mass and how does it relate to this exercise? *Conservation of mass says the total mass of the reactants must equal the total mass of the products. As long as the carbon dioxide was not allowed to escape, the change in mass that occurred during the reaction should be zero.*

Elaborate:

Design an investigation to demonstrate the law of conservation of mass using a seltzer tablet and flask. Be specific in your procedures so another person or group could reproduce your investigation and gather the same data and observations. Once the procedures are written, conduct your investigation. Be sure to collect data and observations during each trial. If you change your procedures along the way, make adjustments to your procedures on paper.

Students should ask for balloons or something to put the flask in (large zip lock bag) to create a closed system.



The students will have varying procedures. Hopefully they will create a closed system by placing the seltzer tablet in a balloon on the top of the flask. When the seltzer tablet is dropped in the water, the balloon will capture the gas and the initial mass should equal the final mass.

Evaluate: Design An Investigation

POINTS	Scientific Accuracy	Reasoning	Communication	Collaboration	
4 Excellent	Measurements and answers are very accurate.	Investigation was very well designed and implemented.	Team discussed ideas completely and fully answered all questions with clear and concise answers.	Team members worked very effectively to design their experiment.	
3 Good	Measurements and answers are accurate.	Investigation was well designed and implemented.	Team discussed ideas and fully answered most questions with clear and concise answers.	Team members worked effectively to design their experiment.	
2 Fair	Measurements and answers are fairly accurate.	Investigation was adequately designed and implemented	Team discussed some ideas completely and fully answered some questions with clear and concise answers.	Team members worked in an average way to design their experiment.	
1 Poor	Measurements and answers are not accurate.	Investigation was poorly designed and implemented.	Team discussed few ideas completely and fully answered few questions with clear and concise answers.	Team members worked poorly to design their experiment.	
	Subtotal: ____	Subtotal: ____	Subtotal: ____	Subtotal: ____	TOTAL: ____/16pts

TAKS-like Items:

- The Law of Conservation of Mass states that mass is neither created nor destroyed in an ordinary chemical reaction. When an iron nail rusts, it seems to get heavier in mass. Does the iron nail follow the Law of Conservation of Mass?
 - No, rusting is an exception to the Law of Conservation of Mass.
 - No, since rusting is a chemical change it does not follow the Law of Conservation of Mass.
 - Yes, the iron rearranges its protons so that the masses are the same before and after the reaction and rusting follows the Law of Conservation of Mass.
 - Yes, iron chemically combines with the oxygen in the air so if you add the oxygen into the mass of the chemicals before the reaction, the mass after the reaction is the same.
- When wood burns, a small amount of ashes is made. Why is the mass of the wood before the fire not equal to the mass of the ashes after the reaction?
 - The mass of the wood has been destroyed.
 - The mass of the wood and the oxygen that allowed it to burn will equal the mass of the ashes and the gas given off during the burning.



- C The mass of the wood and the ashes equals the mass of the oxygen and the smoke given off during the time that the wood burned.
- D The wood has holes in it so it is actually lighter in mass than it appears. The mass of just the wood will equal the mass of just the ashes after the burning.

3. How does the Law of Conservation of Mass apply to a burning candle?

- A The amount of wax before the reaction equals the amount of energy afterwards.
- B The mass of the wick before the reaction equals the mass of the smoke afterwards.
- C The mass of the wick, wax that burned and the oxygen that helped the flame before the reaction equals the mass of the smoke and the gases released after the reaction.
- D The mass of the molecules of the candle before the reaction equals the mass of the candle and burned wick after the reaction.

4. Which of the following reactions best illustrates the Law of Conservation of Mass?

- A $\text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{O} + \text{O}_2$
- B $\text{Na} + \text{CuS} \rightarrow \text{Na}_2\text{S} + 2 \text{Cu}$
- C $\text{K} + \text{AgCl} \rightarrow \text{KCl} + \text{Ag}$
- D $\text{NaOH} + 2 \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$

5. When sodium chloride reacts with calcium oxide to form sodium oxide plus calcium chloride, which of the following equations best illustrates the Law of Conservation of Mass?

- A. $\text{NaCl} + \text{CaO} \rightarrow \text{Na}_2\text{O} + \text{CaCl}_2$
- B. $4 \text{NaCl} + \text{CaO} \rightarrow 2 \text{Na}_2\text{O} + \text{CaCl}_2$
- C. $2 \text{NaCl} + \text{CaO} \rightarrow \text{Na}_2\text{O} + \text{CaCl}_2$
- D. $3 \text{NaCl} + 2 \text{CaO} \rightarrow \text{Na}_2\text{O} + 3 \text{CaCl}_2$

6. **In the following reaction: 2NaN_3 decomposes to form $2\text{Na} + 3\text{N}_2$.** If 500 grams of NaN_3 decomposes to form 323.20 grams of N_2 . How much Na is produced?

- A 100 grams
- B 176.80 grams
- C 323.20 grams
- D 500 grams

10. Which chemical equation best illustrates the Law of Conservation of Mass?

- A $2 \text{H}_2\text{O} \rightarrow \text{H}_2 + \text{O}_2$
- B $\text{Zn} + \text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$
- C $\text{Al}_4\text{C}_3 + 3\text{H}_2\text{O} \rightarrow \text{CH}_4 + 4 \text{Al}(\text{OH})_3$
- D $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$

References/Resources/Websites: (Keep in bulleted format)

- <http://dbhs.wvusd.k12.ca.us/Equations/Conserv-of-Mass.html>
- <http://www.coe.ttu.edu/me/dpj/thermo/Mass/Mass.htm>

