UTAH OFFICE OF
ENERGY DEVELOPMENT

Where do the Particles go? A Model of Combustion.

Grade/Subject: 8th-grade Integrated Science

Strand/Standard 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)

Lesson Performance Expectations (description):

- Students will develop a model of combustion showing that mass does not change in the process.

Materials:

- Materials for Glass jar demonstration
  - 1-pint glass jar with lid, no rim needed
  - 1 candle that will fit into the jar
  - 1 piece of clay
  - 1 long-stemmed lighter
  - Scale that measures in 10th of a gram
- Materials for the lab per group of 4 students.
  - 1 wax candle
  - 1 long-stemmed lighter
  - 1 pie plate
  - 1 piece of clay
  - 1 straw
- Video link for conservation of matter. (6.45 min)
- Students will use their phones for slow-motion videoing.

Time: 45 minutes

Teacher Background Information:

- Matter is anything that has mass and takes up space. It includes molecules, atoms, fundamental particles, and any substance these particles make up. Matter can not be created nor destroyed. Matter can change form through physical and chemical changes, but through any of these changes, matter is conserved. The same amount of matter exists before and after the change. This concept is called the Law of Conservation of Mass.

- Boundary, the balancing of equations, will be taught in high school.
- In a physical change, a substance's physical properties may change, but its chemical makeup does not.
- Refer to this article for the jumping flame demonstration
- Wood and paper undergo incomplete combustion when burned.
- Natural Gas undergoes almost complete combustion when burned. The Law of Conservation of Mass applies.

Student Background Knowledge:

- Students should understand that matter is composed of different particles and that gases and particles (solids) are given off when matter is burned.
- Students need to know what the properties of matter are. Properties of matter are the traits or characteristics of a substance. Properties include all the ways you can describe something using your five senses and what the substance can or cannot react with chemically.
- Students should know what a chemical reaction is. A chemical reaction is when atoms in molecules rearrange to create new molecules. Students do not need to know about chemical reactions in detail. Students need to understand what a chemical reaction is and how they work in reactants and products. Combustion is when oxygen reacts with a fuel to produce carbon dioxide and water. When this happens, energy is released.

Teacher Step by Step: A 3-D lesson should insist that students think deeply. Provide time and space for the students to experience the phenomenon and ask questions. The student sheet provided below provides guidance but is only an example of how students might respond.

1. **Introduce *Phenomenon:*** With proper ventilation, burn some paper as a demo or show this video clip of paper burning (:32 sec.).
2. Ask students what questions they have and record them on the student sheet. Give the students time to share some of their questions.
3. Have students draw a model of what they think is happening to the particles of paper as it burns.
4. Show the students the demonstration of a candle in a jar. Place a blob of clay on the bottom of a glass bottle and stand the candle in the clay. Put on the lid. Record the mass of the bottle, candle, and lid.

5. Take the lid off and quickly light the candle, putting the lid back on. After the candle has gone out, record the mass.
6. Ask students what questions they have and record them.
7. Have students draw a model.
8. Show the video Matter Cannot Be Destroyed (6:58 min) or this video on The Law Of Conservation of Mass (4:36). Students will write a statement about the number of particles (atoms) when they go through a chemical change of combustion. Reinforce that this process is called the Conservation of Matter.
9. You can do this next step either as a demonstration or an activity with the students.
    a. For demonstration, read this article and make sure to practice. See step 6 in the student handout sheet.

b. For the activity, challenge students to relight the candle without touching the lighter flame to the candle's wick. Hand out the materials, candle, pie pan, straw, long-stemmed lighter, and clay. Secure the candle to the pie pan with the clay. Light the candle and let it burn for at least one minute. Blow out the candle using a quick puff of air with the straw and try to relight it with the flame at various positions: on the candle wick, to the side of the candle wick, and above the wick. The students will record their results and construct an explanation. See step 7 in the student handout sheet.

10. Students will construct a claim, evidence, and reasoning statement.

Assessment of Student Learning. Students will construct a model and write a statement explaining the Law of Conservation of Matter in their own words.

Standardized Test Preparation:

1. A candle becomes smaller as it burns. Where has the mass gone?
   a. The atoms have been destroyed by burning.
   b. The atoms have changed into new atoms that are smaller.
   c. The atoms have combined with other atoms and left as a gas.*
   d. The atoms have formed a liquid that is less dense than the solid.

2. What does placing a lid on a jar with a burning candle and finding its mass as it burns show?
   a. Mass is neither gained nor lost during burning.*
   b. The heat from a candle can reduce the mass of a jar.
   c. Candles can burn without air.
   d. Vapor from a candle is flammable.

3. A piece of magnesium metal has a mass of 1.3 g. A flame lights the magnesium resulting in bright light and smoke. A white substance is left behind and has a mass of .6 g. Why does this substance weigh less?
   a. The white substance is less dense than the magnesium.
   b. The smoke removed mass from the burning magnesium.*
   c. The magnesium loses mass when heated.
   d. The magnesium shrunk in volume to be half its original size.

4. A candle can be relit after extinguishing it by placing a match above the wick. What substance is catching on fire?
   a. Vaporized candle wax.*
   b. Particles from the wick.
   c. Water vapor from the wax.
   d. Oxygen remains above the wick.

Extension of lesson: Extensions can include other combustion reactions, such as investigating how different fossil fuels burn. A piece of coal takes a very long time to burn, but propane burns very quickly. Students could also create a model using clay, LEGO, or a drawing showing the atoms before and after a combustion reaction.

Career Connections: Have students look up different careers in the Oil and Natural Gas Industry. Oil and Gas Workforce

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Name_____

Phenomenon: Watch as a piece of paper is burned. Ask three questions:

1.

2.

3.

Draw a model of what was happening to the particles of paper—label as needed.

Observe the candle in the jar demonstration.

Mass before lighting the candle.	**Mass after the candle goes out.**

Ask three questions:

1.

2.

3.

Draw a model of what was happening to the particles that helped explain the mass readings. Label as needed.

4. Watch either of these videos Matter Cannot Be Destroyed or The Law Of Conservation of Mass

5. Write a general statement about the number of particles (atoms) when they undergo a chemical change before and after combustion? This idea is called _____

6. (For demonstration) Watch your teacher as they relight the candle from various positions. Predict if you think it will work. Write an explanation as to why this works. Use your knowledge of the Law of Conservation of Matter.

Position of lighter	**Results and explanation**
Lighter touching the wick	
Lighter to the side of the wick	
Lighter above the	

wick	

7. (For class activity) Your challenge is to relight the candle without directly touching the lighter to the wick of the candle. Write your plan and the results on the chart. Use your phone to slow-motion record what is happening. Write an explanation as to why this works or does not work. Use your knowledge of the Law of Conservation of Matter.

Position of lighter	**Results and explanation**
Lighter touching the wick	
Lighter to the side of the wick	
Lighter above the wick	

Summary:

Make a **claim** about the number of particles that go through a chemical reaction.

What **evidence** was convincing to you?

What is your **reasoning**?