UTAH OFFICE OF
ENERGY DEVELOPMENT

# Chemistry of Combustion

***Grade/Subject: 8th Science***

**Strand/Standard 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)

**Lesson Performance Expectations:** Students will be able to explain the concept of combustion-burning of materials

**Materials:**

- Demonstration/investigation materials:
- 1 Magnesium strip or coil
- 1 Bunsen burner and tubing
- 1 tub with soapy water
- Student investigation materials:
- large jar or beaker
- Combustibles: marshmallows, crackers, peanuts, paper, candles, cardboard, etc.
- A lighter or wooden splint (teacher may wish to do the lighting if you do not want students to have lighters)
- Long tweezers, dissecting probes, or another method of holding the burning object
- A tin pie pan to catch or place burning items.
- A tub of water for emergency flame stoppage

**Time:** 1-2 50 minute periods

**Teacher Background Information:**
Chemical reactions with knowledge of reactants and products (bonds are broken and formed)
Combustion reactions-Reactions involve the burning of fossil fuels which releases energy for doing work

**Student Background Knowledge:**
Students do not need to know about chemical reactions in detail. A short introduction will be sufficient. They need to understand what a chemical reaction is and how they work on paper in terms of reactants and products. They will need to be introduced to the concept of combustion-burning fuel to release energy.

**Teacher Step by Step: A 3-d lesson should insist students do the thinking. 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.**

There are two demonstrations with this lesson to show how chemical reactions work with combustion:

Demonstration #1

1. You can do the demo or watch this video of the burning of the magnesium strip.
2. Burn magnesium strips with a bunsen (or alcohol) burner and show students the light and heat energy released.
   Demo Procedure:
   1. To burn the magnesium, you need a fire, a bunsen burner, or an alcohol burner (slower)
   2. Cut a piece of the magnesium strip about one inch long
   3. Turn on the burner and light
   4. Hold the magnesium strip in the flame until it lights. Wear safety goggles. Do not look into the flame
   5. Draw the chemical reaction on the board. $2Mg + O_2 = 2 MgO$

Demonstration #2

1. Wear safety glasses and keep them on throughout experiment
2. Hook up the plastic bunsen burner tubing to the gas nozzle.
3. Run the plastic tubing into a tub of soapy water and turn the nozzle on
4. Blow bubbles into the soapy water until there are many bubbles in a high mound
5. Light a match
6. Drop the match into the bubbles to light on fire

Students design and conduct an experiment:

1. Provide materials for students that will burn in a short amount of time. They need a large jar or beaker and could burn marshmallows, crackers, peanuts, paper, candles, cardboard, etc. Students will need lighter, long tweezers to hold the burning object and a pie plate or other non-flammable pans to place the burnt or burning material. We recommend a tub of water for an emergency flame stoppage.
2. Ask students to design and conduct an experiment to demonstrate combustion as a chemical reaction. Explain that the burning must occur over the metal pan. Students should make observations of all the products of combustion. You can tell students the jar traps the released gases or let them figure that out.
3. Students must wear safety glasses and may only burn small quantities. Encourage different groups to burn different substances.
4. Each group should explain their experiment and findings to the class. Students should see a **pattern** (that all the reactions occurred with similar results).

**Assessment of Student Learning.**

1. What was needed to start the reactions that you witnessed today? *Heat energy*
2. How did substances change during the reactions? *Substances were broken down into carbon and gases (water, carbon dioxide specifically)*
3. What kind of energy was produced in these reactions/demonstrations? *Heat, Light*

**Standardized Test Preparation:**

**Chemistry of Combustion**

1. A strip of magnesium is heated until it begins to burn. Heat and light are released. What evidence does this provide?
   a. The mass has been conserved.
   b. A change of phase has occurred.

c. New atoms have been formed.
d. A chemical change has occurred.*

2. What are the products of this combustion reaction?

$C_3H_8$ + $O_2$ ⟶

Propane Oxygen

a. Propane, oxygen
b. Carbon, water
c. Carbon, hydrogen
d. Carbon dioxide, water*

3. A burning candle goes out when a jar is placed over it. What other substance is necessary for the combustion of the candle?

a. Wax
b. Carbon
c. Water
d. Oxygen*

| **Reactants** | **Products** | **Energy Change** |
|---|---|---|
| Propane + Oxygen | Carbon dioxide, water | Heat is given off |
| Liquid Propane | Solid Propane | Heat removed |
| Propane + water | Propane, water | No energy change |

4. What evidence indicates one of the reactions is a chemical reaction?

a. The propane and oxygen reaction resulted in new products and released energy.*
b. The liquid propane to solid reaction required heat to be removed, changing the propane.
c. The propane and water reaction required no energy, but a new product was formed.

**Extension of lesson:** Extensions can include other combustion reactions like investigating how different fossil fuels burn. A piece of coal takes a very long time to burn, but propane burns very quickly.

**Career Connections:** Potential careers related to this activity are Chemist, Chemical Engineer, and Laboratory Technician

# Chemistry of Combustion

Name _____

**Phenomenon:** Watch as your teacher performs two demonstrations that show combustion.

What questions do you have?

1.

2.

What are three things the demonstrations have in common?

1.

2.

3.

Combustion happens all around us all the time, and we often do not notice it. Where are substances burning to keep your classroom warm or your car running?

Chemical equations help us understand combustion. Many of the substances we burn are carbon compounds that contain hydrogen. Coal, gasoline, natural gas, and propane are all examples of combustible materials that we use every day. The chemical equation looks like this for burning propane:

$C_3H_8 + O_2 \longrightarrow$

Propane Oxygen What products form?

Design your own combustion reaction. Choose from the materials provided and make sure you follow the safety rules (wear your goggles!). You must burn the substance over the metal pan and have a tub of water nearby just in case. What could you use the large glass jar for?

Your task is to show what products form in a combustion reaction. Be ready to explain what and where the products are found.

List your procedures here.

1.

2.

3.

4.

Data: Draw and explain your combustion reaction. You can use words instead of chemical symbols for the substances involved.

Be ready to explain your investigation to the class.

Analysis:

1. What did all the experiments in the class have in common?

2. Which substances were easy to see and describe?

3. Which substances were invisible and escaped?

4. Combustion reactions require energy to get started. Do you think more energy is required to start the reaction or released by the reaction? Why?

Summary

What **claim** can you make about combustion?

What **evidence** do you have?

What **reasoning** did you use?