Bunsen Burner

Teacher Demonstration

Introduction

The purpose of this demonstration is to show the proper technique of lighting and adjusting the Bunsen burner and to understand its operation. Regions of combustion and variations in temperature in the Bunsen burner flame are observed by placing pieces of cardboard, glass tubing, wire, wire gauze, and a match in the flame.

Science Concepts

- Laboratory safety
- Bunsen burners
- Combustion

Materials

Bunsen or Tirrill burner with gas supply (gas outlet)
Matches
Copper or platinum wire, 6–8 cm
Cardboard, approximately 3″ × 3″ squares, 2
Wire gauze squares, 2 (plain wire screen)
Pin
Borosilicate (Pyrex®) glass tubing, 15–20 cm long
Tongs or long forceps

Safety Precautions

Always inspect the Bunsen burner, rubber tubing, and gas valve before using a Bunsen burner. Follow proper procedures for lighting and using a Bunsen burner (see Procedure). Tie back long hair and do not wear loose, long sleeves. Use tongs when holding metal objects in a flame. Have an ABC dry chemical fire extinguisher available. Never leave lit burners unattended. When gas burners are not in use, turn off the main gas supply to the laboratory. Always wear chemical splash goggles whenever chemicals, glassware, or heat are used.

Procedure for Lighting a Bunsen Burner

1. Clear off the lab bench. Remove all flammable and combustible materials from the work area.
2. Connect rubber tubing to the lab burner and gas valve. Check for holes or cracks in the tubing.
3. Close or partially close the air vents on the burner to make it easier to light.
4. Obtain matches, a piezo lighter, or striker (also called a flint lighter). If using matches or a lighter, light it now.
5. Turn on the gas.
6. Bring the lit match (or lighter) alongside the barrel of the burner and raise it slowly over the edge of the barrel from the side. If using a flint lighter, hold it slightly off center of the barrel of the burner and a few inches above the tip. Strike the flint lighter to create a spark over the gas coming out of the burner.
7. Thoroughly extinguish the match with water.
8. A lit Bunsen burner with closed or partially closed air vents gives a yellow safety flame. The soft yellow flame should never be used to heat anything but it is easier to light and observe this flame.
9. Adjust the air supply by turning the metal collar to get a tight, bright, blue, cone-shaped flame. This is a very hot flame.
10. Never leave a lit burner unattended.

Demonstrate the Temperature of a Bunsen Burner Flame

1. Use tongs to hold a piece of cardboard vertically in the flame. As charring occurs, remove the cardboard (extinguish any fire that has started). Show the results to your students (see Figure 1A). Repeat using a new piece of cardboard and holding it horizontally in the flame (see Figure 1B).

Publication No. 10051
061616

2. Using tongs, hold a thin piece of copper or platinum wire and slowly move it up and down in the flame. Note the changes in the glowing of the wire as it passes through different regions of the flame. The wire should glow the brightest in the hottest region of the flame (see Figure 2).
3. Decrease the amount of oxygen to create a cooler flame for this step. Using tongs, hold a 15- to 20-cm long piece of borosilicate glass tubing vertically so that one end is right in the center of the top of the burner barrel. Light the gas coming out of the other end of the glass tubing.
4. Turn off the gas for this step. Place a pin through the stem of a match, slightly below the head of the match. Place the match assembly into the barrel of an unlit burner so that the match head barely shows above the barrel (see Figure 3). Turn on the gas and light the burner. If you're lucky, the match will not light. Turn the flame down until the match does light.
5. Turn off the gas for this step. Using tongs, hold a wire gauze square (a plain wire screen) horizontally about 3 cm above the unlit burner. Turn on the gas and light the gas above the screen. The flame will only be above the screen. Move the screen up and down in the flame and observe.
6. Take a second wire gauze square and hold it horizontally about 3 cm above the unlit burner. This time, light the burner below the screen and wait for a short period of time. Observe.

Background

Methane or propane is used as the source of gas in most laboratories. Check that the burner being used is appropriate for the gas source in your laboratory. Sufficient oxygen is needed for complete combustion. Complete combustion of methane produces a blue, non-luminous flame yielding carbon dioxide and water. When the oxygen supply is insufficient, small carbon particles are produced that, when heated, form a yellow, luminous flame.

Bunsen burners (named after Robert Bunsen, 1811–1899) were designed to generate a combustible gas–air mixture that produces an efficient, hot flame. A properly adjusted burner flame should have three distinct cones: an outer violet oxidizing flame and an inner blue reducing flame with a cone of unburned gas. The tip of the inner blue cone is the hottest part of the flame—reaching 1500 °C. The cool region inside the innermost blue cone may only be 300 °C (see Figure 2).

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Evidence, models, and explanation
Constancy, change, and measurement
Content Standards: Grades 5–8
Content Standard A: Science as Inquiry
Content Standard B: Physical Science, transfer of energy
Content Standards: Grades 9–12
Content Standard A: Science as Inquiry
Content Standard B: Physical Science, conservation of energy and increase in disorder

Answers to Bunsen Burner Activity

1. What is needed for burning to occur?

   A fuel (a flammable material, e.g., liquid or solid), oxygen, and an ignition source such as heat, a spark, or flame.

2. What are the differences between a yellow and blue flame?

   The blue flame is much hotter and a more complete combustion of methane which produces carbon dioxide and water. The yellow flame results from insufficient oxygen and it is a cooler flame. The yellow is due to carbon soot ionizing in the flame.

3. Why does the pattern of charring occur as it does on the cardboard?

   The charing results from the hottest part of the flame. The center of the flame is only 300–350 °C—not hot enough to char paper or cardboard.

4. Where is the flame the hottest? What color is it?

   At the tip of the inner blue cone.

5. Where is the flame the coolest? What color is it?

   Inside the innermost blue cone.

6. How can the match remain unlit in the middle of the flame?

   Just like the charing demo, the innermost cone of the flame is unburned gas and not hot enough to ignite the match.

7. If the wire melts, can you tell anything about the actual temperature of the flame?

   The temperature of the flame is greater than the melting point of the wire.

8. Explain the wire screen observations. How are the burner and screen related to mine safety?

   The flame does not pass through the wire screen. The gas flow passing through the screen prevents the flame from passing back through the screen. Likewise, when the screen is placed above the flame, the flame does not pass through it. The wire mesh reduces the gas temperature and the gas then will not ignite. This concept was first put into practical use by Sir Humphrey Davy (1778–1829), who invented a safety lantern for coal miners. Today, wire mesh screens, called flame arrestors, are used widely in industry.

Acknowledgment

Special thanks to DeWayne Lieneman (now retired), Glenbard South High School, Glen Ellyn, Illinois for providing us with the instructions for this activity.

Materials for the Bunsen Burner—Teacher Demonstration are available from Flinn Scientific, Inc.

Catalog No.	Description
GP6005 GP9010 GP9015	Glass Tubing, Borosilicate Glass, 240 Lengths
AP8350	Wire Gauze Squares, Steel, 40 × 40
C0150	Copper, Wire, Bare, 4 oz

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.

Bunsen Burner Activity

1. What is needed for burning to occur?

2. What are the differences between a yellow and blue flame?

3. Why does the pattern of charring occur as it does on the cardboard?

4. Where is the flame the hottest? What color is it?

5. Where is the flame the coolest? What color is it?

6. How can the match remain unlit in the middle of the flame?

7. If the wire melts, can you tell anything about the actual temperature of the flame?

8. Explain the wire screen observations. How are the burner and screen related to mine safety?