6.1.5 Clean Smoke Lab Report Template

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Problem

What fuel burns cleaner and hotter

Hypothesis

Based on prior research kerosene will burn hotter and with more particulates. Ethanol will burn cleaner but at a lower temperature.

Materials

Per pair of students:

- LabQuest2
- Temperature sensor
- Forceps
- 2 empty soup cans
- Lighter
- 125ml plastic bottle with lid
- 2 stirring rods
- 2 single hole stoppers
- Ring stand
- 10cm ring
- Utility clamp
- 100ml graduated cylinder
- 2 30ml graduated cups
- Beaker tongs
- Paper towels
- Water

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Per group of four students:

- 60ml burner with kerosene
- 60ml burner with ethanol
- Bromthymol blue (BTB)
- Sodium hydroxide (NaOH)

Per student:

- Safety goggles
- Pencil
- *Agriscience Notebook*
- *Lab Report Template*
- *Lab Report Evaluation Rubric*

Procedures

In this laboratory, you and a partner will investigate the efficiency and environmental impacts of two combustible fuels – kerosene and ethanol. Then you will compare the amount of heat released from combustion, particulate matter produced, and carbon dioxide emitted for each fuel source by collecting qualitative and quantitative data.

Part One – Predictions

In complete sentences on Activity 6.1.5 Student Worksheet, write a prediction of what you believe will occur in terms of heat released, soot production, and carbon dioxide emissions for each fuel source.

Part Two – Preparation

1. Pour 10ml of water into each of the two graduated 30ml cups.

2. Add two drops of bromthymol blue (BTB) to each cup.

3. Swirl each cup to mix the liquids thoroughly.

4. Set cups aside until Part Four.

Part Three – Heat Released

1. Obtain a burner from your teacher. You will conduct three different tests on one fuel source, then exchange burners with the other pair in your group and repeat the tests.

2. Put on your safety goggles and tie back long hair.

3. Prepare the LabQuest2.

    • Connect the temperature sensor to the LabQuest2 and turn the LabQuest2 on.

    • Choose New from the File menu. On the Meter screen, select Rate on the touch screen.

    • Change the data-collection rate to 0.2 samples/second. Set the data collection length to 240 seconds.

4. Set up the apparatus as demonstrated by your teacher. (See Figure 1.)

• Use the graduated cylinder to measure and pour 100ml of cold water into the can.

• Insert a stirring rod through the holes in the top of the can and hold it in place with two one-hole stoppers. Position the can 5cm (~2 inches) above the burner.

• Use a utility clamp to suspend the temperature sensor in the water. The sensor should not touch the bottom or side of the can. Figure 1. Apparatus.

5. Start collecting data.

• Use the lighter to ignite the wick. Position the burner directly below the center of the water-filled can. CAUTION: Always keep hair and clothing away from open flames.

• Tap the green start arrow to begin collecting data.

• A real-time graph of temperature vs. time will be displayed on the LabQuest2 screen during data collection.

• Temperature readings (in °C) can also be monitored to the right of the graph.

6. Stir the water slowly and continuously using a stirring rod until data collection stops.

7. After data collection has stopped, analyze the graph to find maximum and minimum temperature of the water.

    • Choose Statistics from the Analyze menu.

    • Record the Maximum (final) and Minimum (starting) temperature values recorded during data collection in Table 2 of Activity 6.1.5 Student Worksheet.

    • Select OK.

8. Store the data from the first run by selecting the File Cabinet icon.

Part Four – Carbon Dioxide Emissions

1. Pull the burner away from the ring stand.

2. Remove the cap from the plastic bottle.

3. Carefully place the opening of the bottle over the flame.

4. Hold it snugly against the metal casing of the burner until the flame is extinguished.

5. With the bottle still inverted, raise the bottle just enough to screw on the cap.

6. Turn the bottle right side up.

9. Uncap the bottle and quickly pour one graduated cup of the water and BTB mixture into the bottle. Your goal is to let as little oxygen into the bottle as possible.

10. Recap the bottle immediately.

11. Shake the bottle so the solution mixes with the gas.

12. Pour the solution from the bottle back into the graduated cup.

13. Observe the contents and record in Table 1.

14. Add NaOH one drop at a time to the solution while your partner swirls the solution until the blue color returns and is the same as the second cup.

15. Record the number of drops of NaOH required to return the solution to the original color.

Part Five – Clean Up

1. Empty the can of water and place upside down on a paper towel. Use the beaker tongs to move the can as the can and water may still be hot.

2. Dispose of the BTB solutions as instructed by your teacher.

3. Rinse the graduated cups.

Part Six – Comparison Fuel

1. Exchange burners with the other pair in your group to test the fuel source you have not tested.

2. Repeat Part Two, Three, Four, and Five with the second fuel source and a new soup can.

Part Seven – Particulate Matter

1. Locate your two soup cans.

2. Compare the amount and color of particulate matter on the bottom of each can.

3. Record your observations on Table 1 of Activity 6.1.5 Student Worksheet.

4. Clean up as instructed by your teacher.

Part Eight – Compare Quantitative Data

Compare the two samples by viewing both sets of quantitative data on one graph.

- After data collection is complete, select Run 2 on the touch screen and select All Runs. Both runs will now be displayed on the same graph.
- Examine the data points along the displayed curve. To examine the data on the displayed graph, select any data point. As you move the examine line right or left, the temperature values of each data point are displayed to the right of the graph.
- Use the displayed graph to fill in Table 2 and answer the analysis questions on the student worksheet.

Part Nine – Analysis

1. Share your results with your classmates as instructed by your teacher.

2. Record the results of the other groups in Table 3 on Activity 6.1.5 Student Worksheet.

3. Determine the class average for temperature change and drops of NaOH for each fuel.

4. Write a lab report on your findings. Use the Lab Report Template and Lab Report Evaluation Rubric to guide your writing.

Data Collection

Group Data:

	Ethanol	Kerosene
Color of BTB solution with carbonic acid	Light yellow	Brighter stronger yellow
Drops of NaOH required to neutralize	2 drops	2 drops
Particulate matter on can	Little to no residue on can	Heavy residue on the can
Initial Temperature (Celsius)	27.4	27.9
Final Temperature (Celsius)	58.5	51.3
Change in Temperature (Celsius)	31.1	23.4
Notes		We started with a very high flame and the wind would blow it so the heat was being transferred away from the can.

Analysis of Results

Based on the class results the ethanol burns cleaner, but gives less energy. The Kerosene burns hotter, but has more particulate matter. The class average temperature change for Kerosene was 39.83 with an average of 3 for NaOH drops. The class average for temperature change for ethanol was 29.4 and average NaOH drops 2.67.

Conclusions

1. Gasoline is used more than other substance for a common energy source, because it is more readily available.
2. The advantages of biofuels such as ethanol is they burn cleaner, they are easier to neutralize, and they help the economy in the corn belt states. Disadvantages are they do not produce as much energy, they are expensive, and they require a lot of energy to produce.