# ENERGY AND COMBUSTION: LAB INVESTIGATION

## SAFETY

Home materials can give off smoke even when burning small samples. Please take all the precautions for safety as recommended for middle school lab classrooms. If your classroom does not have the proper equipment or ventilation for testing, please use the UL Xplorlabs video from Investigation 3. The video demonstrates the concepts and allows for students to make predictions and see results.

## PROCEDURE

**Helpful tip for teachers: Watching the entire video before conducting the experiment will be helpful to see the setup of the calorimeter.**

1. Pour 50 mL of water into soda can or beaker.
   - **Note: The data table asks for the mass of water in grams. Hint: 1 mL = 1 g.**
2. Use a paper clip to create a stand for the sample.
3. Record the names of Samples food/material (object burned).

   **Helpful tip for teachers: Consider using the video of Sample 1: plastic as a demonstration model for students if you do not have proper ventilation. After observing and practicing data collection when the plastic sample, they later independently investigate the chips and wood.**

4. Measure its mass and record in the data table.
5. Place the sample on the paper clip securely so that the cork balances and isn't easily knocked over. Place this item in the center of a metal jar lid or on a non- flammable surface in case it is knocked over.
6. Place the can into a ring stand and lower the bottom of the can 1 inch from the sample.
7. Take a starting temperature of the water in the can and record the temperature in Table 1.
8. Be sure there is nothing flammable surrounding the set up and check that sleeves are rolled up and hair tied back.
9. Hold the long reach lighter flame below the sample and ignite
   Helpful tip for teachers: lighting the sample from below produces a better burn.
10. Observe the rate and type of burn including flame spread, smoke, speed of combustion, soot left behind. Record these observations in the last column of Table 1.

    **Helpful tip for teachers: The way these three samples burn are very different. The observations of these samples are an excellent way to do this lab without calculating the equations.**

*By Amy Gilbert, Ph.D., and Megan O'Keeffe, STEM Cobb*

11. Once the sample is completely burned, record the peak temperature reading in degrees Celsius in Table 1. Use caution when removing and disposing of sample! Things will be hot!
12. Measure the burned mass of the object with consideration for the mass of the paper clip.
13. Using lab tongs, empty water from can in sink and add another 50 mL of water OR use a new can with 50 mL of fresh water.
14. Repeat entire procedure with additional samples that represent materials from the case study.
15. Begin data analysis by first calculating the heat absorbed by water (Table 1) and then heat of combustion (Table 2).

**Helpful tip for teachers:** If students are not prepared to make the calculations, you could provide an Excel spreadsheet that calculates H.O.C.

## Table 1: Using Heat Absorbed to determine Heat Released by Sample

Recall: **heat lost or gained** = (specific heat capacity) ● (mass) ● (change in temperature)

| Sample | Starting mass (g) of sample | Mass of water (g) | Starting temperature of water (○C) | Peak temperature of water (○C) | Change in temperature of water (○C) | Final mass (g) of sample | Observations during burn |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

## Table 2: Heat of Combustion

| Sample | Heat Absorbed by water (calorie) $Q = mc\Delta T$ | Beginning mass of sample (g) | Final mass of sample (g) *after burn | Mass lost by sample (g) *mass consumed | Heat of Combustion H.O.C = $\frac{\text{heat released}}{\text{mass consumed}}$ |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |

## CONCLUSION

1. How does the heat of combustion vary with the different materials?

2. What observations did you make about the way each material burned?

3. What can you infer about the difference between how synthetic and natural materials will behave in a fire?

4. Answer the following question using the C.E.R format: *How does the material burned impact a fire?*

*By Amy Gilbert, Ph.D., and Megan O'Keeffe, STEM Cobb*