

LAB 2 Laboratory Activity

Thermal Energy from Foods

You use food as fuel for your body. Food contains the stored energy you need to be active, both mentally and physically. To keep your body processes going, your body must release the energy stored in food by digesting the food.

You cannot directly measure the energy contained in food. However, you can determine the amount of thermal energy released as a sample of food is burned by determining the thermal energy absorbed by water heated by the burning sample. By measuring the temperature change of a given mass of water, you can calculate the energy released from the food sample. Raising the temperature of 1 kg of water by 1 Celsius degree requires 4,190 joules of energy. This information can be expressed as the specific heat (C) of water, which is $4,190\text{J/kg} \cdot ^\circ\text{C}$. You can use the following equation to determine the heat (Q) released when a food sample is burned.

$$\begin{aligned} \text{energy released} &= \text{energy absorbed} \\ \text{energy absorbed} &= \text{temperature change of} \\ &\text{water} \times \text{mass of water} \times \text{specific heat of water} \\ Q &= (T_f - T_i) \times m \times C \end{aligned}$$

Strategy

You will calculate a change in thermal energy.

You will account for the difference between energy released and energy absorbed.

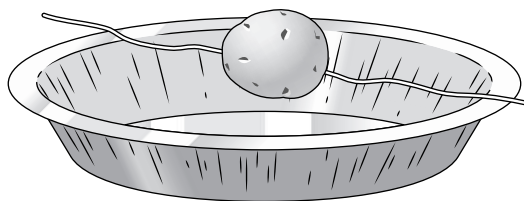
Materials

large paper clip or long pin	water	thermometer
food sample	100-mL flask	wood splint
aluminum potpie pan	utility clamp	matches
metric balance	ring stand	watch or clock
100-mL graduated cylinder		

Procedure

1. Wear a laboratory apron and safety goggles throughout this experiment. Straighten the paper clip and insert it through the food sample. Position the paper clip on the edges of the aluminum potpie pan as shown in Figure 1. Use the balance to determine the mass of the pan, paper clip, and food sample. Record the mass in Table 1 as m_1 .
2. Use the graduated cylinder to add 50 mL of water to the flask. Clamp the flask on the ring stand about 5 cm above the tabletop. Use the thermometer to measure the temperature of the water. Record this value in Table 1 as T_i .
3. Ignite the wood splint with a match. **CAUTION: Always use care with fire.** Use the burning splint to ignite the food sample. Once the food sample is burning, safely extinguish the splint. Position the aluminum pan under the flask. The water in the flask should absorb most of the energy released by the burning food.

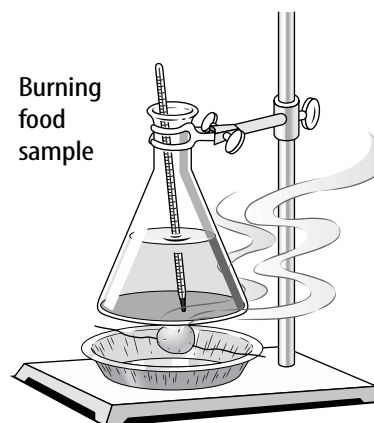
Figure 1



Laboratory Activity 2 (continued)

- Stir the water with the thermometer and closely observe the temperature rise.
- Blow out the flame of the burning food after about 2 minutes. Record the highest temperature of the water during the 2 minutes in Table 1 as T_f .
- Allow the aluminum pan and its contents to cool. Determine the mass of the pan and contents after the release of energy. Record this value in Table 1 as m_2 .

Figure 2



Data and Observations

Table 1

Food sample	Mass (kg)		Temperature ($^{\circ}\text{C}$)	
	m_1	m_2	T_i	T_f

$$T_f - T_i = \underline{\hspace{2cm}}$$

$$m \text{ (mass of 50 mL of water)} = \underline{\hspace{2cm}}$$

$$(m_2 - m_1) = \underline{\hspace{2cm}}$$

$$Q = \underline{\hspace{2cm}}$$

$$\text{Heat absorbed per gram of food burned} = \underline{\hspace{2cm}}$$

- Calculate the rise in the water temperature by subtracting T_i from T_f . Record this value.
- Use the equation given in the introduction to calculate the energy absorbed by the water when the food sample was burned. Be sure to use the mass of the water for m . Record this value.
- Calculate the heat absorbed per gram of food by dividing the energy absorbed by the water by the mass of food burned ($m_2 - m_1$). Record this value.
- Your teacher will make a data table of food samples and energy absorbed by the water in the flask. Record your data in this table.

Laboratory Activity 2 (continued)**Questions and Conclusions**

1. In order to calculate the amount of energy released or absorbed by a substance, what information do you need?

2. How do you know that energy was transferred in this experiment?

3. Did you measure the energy released by the food sample or the energy gained by the water?

4. Most of the energy of the burning food was absorbed by the water. What do you think happened to the small amount of energy that was not absorbed by the water?

5. Look at the data table of different food samples tested by your class. Which food sample released the most energy? Which food sample released the least energy?

6. Suppose 20.0g of your food sample is burned completely. Use a proportion to calculate the value of energy released.

Strategy Check

_____ Can you calculate a change in thermal energy?

_____ Can you determine whether energy is released or absorbed?