LESSON MAKER PRO

Snack Heat Lab

Use water temperature to estimate energy from burning food.

HIGH SCHOOL · PHS.8.4

PHS.8.4 "Enrichment: Use an engineering design process to construct a simulation of heat energy transfer between systems. Calculate the calories/joules of energy generated by burning food products..."

NAME _____ DATE _____

MODEL THE HEAT TRANSFER

In this simple simulation, assume all heat released by burning food goes into the water unless a problem says otherwise. Heat gained by water in small calories equals water mass in grams × (final temperature − starting temperature), and 1 small cal ≈ 4.2 J. One food Cal equals 1,000 small cal.

WORKED EXAMPLE

A food sample burns beneath 35 g of water. The water warms from 16°C to 22°C. Estimate the energy released in small calories and joules.

1. Temperature rise = 22°C − 16°C = 6°C.
2. Heat gained = 35 × 6 = 210 small cal.
3. Energy in joules ≈ 210 × 4.2 = 882 J.

Answer: 210 small cal, or approximately 882 J

PRACTICE 6 problems

1 In an ideal simulation, burning a food sample warms 40 g of water from 21°C to 24°C. Estimate the energy released in small calories.

ANSWER _____

2 Use the simulation data to estimate the energy released in joules.

FOOD-BURN SIMULATION

Water mass	Starting temperature	Final temperature
50 g	11°C	15°C

ANSWER _____

3 A food sample transfers 300 small cal to 60 g of water. How many degrees Celsius does the water temperature rise?

ANSWER _____

4 A simulation reports 360 small cal transferred to water that warms from 19°C to 28°C. What mass of water was used?

ANSWER _____

5 In an ideal simulation, a food sample warms 200 g of water from 10°C to 20°C. Estimate the energy released in food Cal.

ANSWER _____

6 Use the simulation data to estimate the energy released in both small calories and joules.

FOOD-BURN SIMULATION

Water mass	Starting temperature	Final temperature
75 g	17°C	25°C

ANSWER _____

_____

APPLY IT Show your work

1 For a field-trip snack test, you burn a food sample beneath 90 g of water. The water warms from 14°C to 19°C. Under the ideal model, how many small calories and joules did the sample release?

WORK SPACE

ANSWER _____

2 You test equal masses of two trail snacks. Each sample burns beneath 100 g of water. Which snack transfers more energy to the water, and by how many joules?

TRAIL SNACK TESTS

Snack	Starting temperature	Final temperature
A	20°C	27°C
B	20°C	29°C

ANSWER _____

CHALLENGE One step up

You propose adding a heat shield to improve the simulation. The same snack releases 1,000 small cal in each trial. Use the results to find the joules that reach the water in each trial. Does the shield improve energy capture? Support your conclusion with the results.

HEAT-SHIELD SIMULATION

Setup	Heat reaching water
Without shield	600 small cal
With shield	800 small cal

WORK SPACE AND ANSWER

ANSWER KEY

Snack Heat Lab

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	In an ideal simulation, burning a food sample warms 40 g of water from 21°C to 24°C. Estimate the energy released in small calories.	**120 small cal**
2	Use the simulation data to estimate the energy released in joules.	**Approximately 840 J**
3	A food sample transfers 300 small cal to 60 g of water. How many degrees Celsius does the water temperature rise?	**5°C**
4	A simulation reports 360 small cal transferred to water that warms from 19°C to 28°C. What mass of water was used?	**40 g**
5	In an ideal simulation, a food sample warms 200 g of water from 10°C to 20°C. Estimate the energy released in food Cal.	**2 food Cal**
6	Use the simulation data to estimate the energy released in both small calories and joules.	**600 small cal, or approximately 2,520 J**

PART 2 · APPLY IT

1. **450 small cal, or approximately 1,890 J** The water rises 5°C, so it gains 90 × 5 = 450 small cal. Multiply by 4.2 to get approximately 1,890 J.
2. **Snack B, by approximately 840 J** Snack A transfers 100 × 7 = 700 small cal, while B transfers 100 × 9 = 900 small cal. The difference is 200 small cal, or approximately 840 J.

CHALLENGE

Without the shield, approximately 2,520 J reaches the water. With the shield, approximately 3,360 J reaches the water. The shield improves energy capture by approximately 840 J, bringing the measured heat closer to the snack's 1,000 small cal release.

Joule values use the rounded conversion 1 small cal ≈ 4.2 J. Accept equivalent units and calculations that show the same results.