Burning Calories—Literally!

Student quiz — Answer key

Directions: Circle the best answer for each question below.

1. Which one of the following food item(s) would heat up the water in a calorimeter more if we burned the same amount (mass) of food?

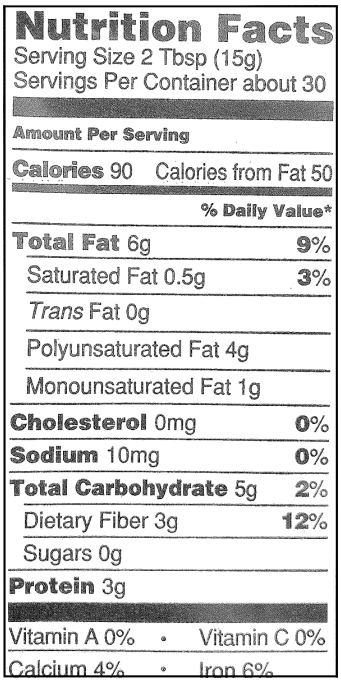
Food Item A



Nutrition Facts
Serving Size 1/2 cup uncooked (40g)
Servings Per Container about 30

Amount Per Serving	
Calories 150	Calories from Fat 25
	% Daily Value*
Total Fat 2.5g	**4%**
Saturated Fat 0g	**0%**
Trans Fat 0g	
Polyunsaturated Fat 1g	
Monounsaturated Fat 1g	
Cholesterol 0mg	**0%**
Sodium 0mg	**0%**
Total Carbohydrate 27g	**9%**
Dietary Fiber 4g	**17%**
Soluble Fiber 2g	
Insoluble Fiber 2g	
Sugars 1g	
Protein 6g	
Vitamin A 0% • Vitamin C 0%	
Calcium 2% • Iron 10%	

Food Item B



Nutrition Facts
Serving Size 2 Tbsp (15g)
Servings Per Container about 30

Amount Per Serving	
Calories 90	Calories from Fat 50
	% Daily Value*
Total Fat 6g	**9%**
Saturated Fat 0.5g	**3%**
Trans Fat 0g	
Polyunsaturated Fat 4g	
Monounsaturated Fat 1g	
Cholesterol 0mg	**0%**
Sodium 10mg	**0%**
Total Carbohydrate 5g	**2%**
Dietary Fiber 3g	**12%**
Sugars 0g	
Protein 3g	
Vitamin A 0% • Vitamin C 0%	
Calcium 4% • Iron 6%	

   a. Food item A will heat up the water more.
   b. Food item B will heat up the water more.
   c. Both will heat the water by the same amount.

2. Which of the following statements is true?
   a. The energy content of food can be expressed in Calories.
   b. If you eat two servings of a food, you need to double the amount of nutrients listed on the nutrition facts label to know how much you consumed of each nutrient.
   c. Both a and b are true.

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Directions: Circle the best answer for the multiple-choice question below. Write your answers for the other questions.

3. Which of the following statements is *not* true?
   a. The amount of Calories your body needs per day depends on your activity level.
   b. Food can be high in Calories and still be good for you.
   c. Food can be low in Calories and still be good for you.
   d. Serving sizes are always equal to about one-half cup of food.

4. In your own words, explain how the calorimeter measures the energy contained in food.

   Answers can contain, but are not limited to, the following: burning food inside the calorimeter releases its energy as heat. By catching the released heat in a reservoir of water and measuring the change in temperature of the water and the change in mass of the food item, you can calculate the energy content or Calorie content of the food.

5. Use the formulas and measurement values listed in the tables on the next page to calculate the energy contained in 1 gram of this food item if the water reservoir contains 150 mL of water. (Note the mass of 1 mL of water is 1 g.)

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Food	Trial #	Food: M_i (g)	Food: M_f (g)	Water: T_i (°C)	Water: T_f (°C)
Food 1	1	1.6	0.5	20	33.3

Formulas	*Variables*
$Q_{water} = m_{water}\, c\, (T_f - T_i)$	Q_{water} : heat captured by the water when heated (Cal) m_{water} : mass of the water that is heated (g) c : specific heat capacity of water (0.001 Cal/(g°C)) T_i : initial temperature of the water (°C) T_f : final temperature of the water (°C) Q_{Food} : energy released when burning the food (Cal) $Q_{Food,1g}$: energy released when burning 1 gram of food (Cal/g) M_i : initial mass of food burned (g) M_f : final mass of food burned (g)
$Q_{water} = Q_{Food}$	
$Q_{Food,1g} = \dfrac{Q_{Food}}{(M_i - M_f)}$	

The answer is 1.81 Cal/g.

The calculation is as follows:

Using the first formula in the table and plugging in

m_{water} = 150 g, c = 0.001 Cal/(g°C), T_f = 33.3°C and T_i = 20°C

we get:

$$Q_{water} = 150\ \text{g} \times 0.001\ \frac{\text{Cal}}{\text{g°C}} \times (33.3°\text{C} - 20°\text{C})$$

Q_{water} = 2.0 *Cal*.

Plugging this value into the second formula, we conclude that: Q_{Food} = 2 Cal

2 Cal were released by burning the food.

Using the last formula and plugging in

Q_{Food} = 2 Cal, M_i = 1.6 g and M_f = 0.5 g

we calculate:

$Q_{Food,1g}$ = 2 Cal/(1.6 g – 0.5 g) = 2 Cal/ 1.1 g = 1.81 Cal/g