How Much Energy Is That Anyway? Student Sheet

Objective:

- Students will determine how much energy a snack food provides to their body and how much physical activity (work) can be performed when that food is consumed.
- Students will convert between Calories, calories and joules

Essential Questions:

- How does your body get energy that is different from your car?
- How does the amount of energy used by your body compare to that used by your car?
- How does your body process its fuel differently than your car?
- How do scientists determine the energy in food and fuel?

Materials: Table of Calories Burned During Exercise
Snack candy, cookies or crackers (1 per group)

Background:
The human body requires energy in order to function. The chemical reactions that take place in the cell require energy, which is obtained by the oxidation of glucose. Glucose is the end product of carbohydrate (contained in the food we consume) metabolism. With the aid of enzymes, all foods undergo a chemical reaction during digestion and energy is a product of that chemical reaction.

Glucose + oxygen → carbon dioxide + water + energy

Energy is measured in units of calories (cal) or joules (J). The dietary Calorie (Cal) is equal to 1000 calories (cal) or 1 kilocalorie (kcal).

1 Calorie = 1000 calories = 1 kilocalorie

In addition, 1 calories = 4.184 joules

The nutrition label below shows that one serving of the product will provide 120 Calories of energy. Using the following dimensional analysis you can convert Calories to calories and joules.

Nutrition Facts

Serving Size: 1 tbsp (14g)

Amount Per Serving		
Calories 120	Calories from Fat 117	
		% Daily Value*
Total Fat 13.6 g		**21%**
Saturated Fat 8.91 g		**45%**
Trans Fat		
Cholesterol 0 mg		**0%**
Sodium 0 mg		**0%**
Potassium 0 mg		**0%**
Total Carbohydrate 0 g		**0%**
Dietary Fiber 0 g		**0%**
Sugars 0 g		
Sugar Alcohols 0 g		
Protein 0 g		
Vitamin A 0 IU		0%
Vitamin C 0 mg		0%
Calcium 0 mg		0%
Iron 0 mg		0%

Dimensional analysis to convert these 120 Cal (dietary calories) to calories and also joules

$$\frac{120\,Cal}{1} \times \frac{1000\ cal}{1\ Cal} = 120000\ cal$$

$$\frac{120\,Cal}{1} \times \frac{1000\ cal}{1\ Cal} \times \frac{4.184\ J}{1\ cal} =$$

Procedure:

1. Each person will select an activity from Table A. Write the name of the activity in Data Table 1.

2. Each person will record the weight that is closest to their body weight in Data Table 1.

3. Record the name of the snack food provided to your lab group in Data Table 1.

4. Look at the nutrition label and record the Calories/ serving in Data Table 1.

5. Calculate the number of Calories consumed if you ate the entire snack and record the results in the data table. Please show all work where indicated on your results sheet.

6. Calculate how long you would need to perform the activity you selected in step 1 in order to burn all the Calories consumed in step 5 and record the results in Data Table 1. Please show all work where indicated on results sheet.

7. Using the answer from step 5 determine the number of calories and joules in the snack you were given. Record the answers in Data Table 1. Show all work where indicated on results sheet.

8. Find 4 different people in your class and share the results of your findings. Record this information in Data Table 2: Class Results.

Table A: Calories Burned During Exercise

Activity	Calories burned per hour per body weight (Cal/lb)			
	75 lb	100 lb	150 lb	200 lb
Bicycling (6 mph)	135	160	240	320
Bicycling (12 mph)	225	270	410	540
Running (5.5 mph)	365	440	660	880
Running (7 mph)	510	610	920	1220
Running (10 mph)	710	850	1280	1700
Jumping rope	415	500	750	1000
Swimming (25 yd/min)	155	185	275	370
Swimming (50 yd/min)	270	325	500	650
Tennis (singles)	220	265	400	530
Walking (2 mph)	125	160	240	320
Walking (3 mph)	175	210	320	420
Walking (4.5 mph)	245	295	440	590

Data provided by Encarta http://encarta.msn.com/media_461520244/calories_burned_during_exercise.html

Data Table 1: Individual Results

Activity Chosen	Weight (lb)	Snack Name	Calories / Serving (Cal)	Calorie in entire snack (Cal)	Time of activity (min)	# calories snack (cal)	# joules in snack (J)

Data Table 2: Class Results

Snack Chosen	Body Weight (lb)	Activity Chosen	Time (min)

Calculations: Show all work!

Number of Calories in the entire snack

Activity time required to use all Calories in the snack

Number of calories in the entire snack

Number of joules in the entire snack

Conclusions:

1. It is recommended that a teenage girls consume 2200 Calories and a teenage boy consume 2800 Calories per day. Based on the data above and your daily activity level, is this number logical for you? Please explain using specific examples from your day to justify your answer.

2. List any assumptions that were made in this activity that may not hold true and explain why.

3a. If you travel 10 miles to school each day and your car gets 24 miles per gallon of gas, how many gallons of gas did you burn in order to get to school?

b. Based on the current price of gas, how much did it cost you to get to school today?

c. Now let's determine how many joules of energy your car consumed in order to get you to school today. The combustion of gasoline produces 47 MJ/Kg of fuel. If a gallon of gasoline has a mass of 6.073 lb. and 454 g = 1 lb.

d. How does this amount of energy compare to that provided by your snack above?

4. What additional questions do you have about dietary Calories?