Energy Applied to Heating Water:
Calorimetry

http://hyperphysics.phy-astr.gsu.edu/Hbase/thermo/calor.html

Light a cheese puff (attach the cheese puff to a partially opened paper clip). Observe:

How much *heat* (in joules and in calories) is produced by a burning cheese puff? Design an experiment to measure/calculate this amount of energy. Create a procedure, including the materials required and the measurements you'll need to make:

What *limitations* do you anticipate in performing your experiment? What can be done to minimize these limitations?

Assume that a measured mass (m, in grams) of water contained in an aluminum soda can is heated, and the change in temperature (Δt, in ^{o}C) is calculated, the "heat" absorbed by the water can be calculated, in either *joules* or *calories:*

$$H = m\ c\ \Delta t \quad (c \text{ for water is } 1.0 \text{ cal/g } ^{o}C \text{ or } 4.184 \text{ J/g } ^{o}C)$$

In this equation, "H" is frequently replaced (especially among chemists) as "Q" because H is the mathematical symbol (again, especially among chemists) used for "enthalpy" which can be defined as "*a quantity associated with a thermodynamic system, expressed as the internal energy of a system plus the product of the pressure and volume of the system, having the property that during an isobaric process, the change in the quantity is equal to the heat transferred during the process*. Symbol: *H*"

Okay, so:

$$Q = m\ c\ \Delta t \quad (c \text{ for water is } 1.0 \text{ cal/g } ^{o}C \text{ or } 4.184 \text{ J/g } ^{o}C)$$

There are some potential limitations in this experimental approach. First, the aluminum can *itself* will absorb some of the heat from the burning cheese puff. While this amount can be approximated (using the mass of the empty can and its specific heat capacity and assuming that the heat is dissipated uniformly throughout the aluminum), this will account for only a portion of the heat released that never makes it to the water. Because the burning takes place in air, heat is also released to the surrounding area.

The specific heat capacity (c) for aluminum is 0.215 cal/g ^{o}C or 0.900 J/g ^{o}C)
http://hyperphysics.phy-astr.gsu.edu/Hbase/tables/sphtt.html

Finally, then, complete the experiment for the burning of one cheese puff, minimizing the limitations, and complete the following calculation to determine both Joules and calories of heat released:

$$Q = [m\ c\ \Delta t\ ]_{water} + [\ m\ c\ \Delta t\ ]_{aluminum\ can}$$

For fun:

You've approximated how many joules (and calories) of heat are produced by burning 1 cheese puff. How many joules and calories would be produced by burning one serving of cheese puffs? How about for one bag of cheese puffs?

How many steps in the Harvard step test would you have to complete to produce the equivalent of mechanical energy (Joules) as the heat energy liberated by burning 1 bag of cheese puffs?

Why are the "Calories per serving" not even close to the heat equivalent (in calories) of burning one serving of cheese puffs?