Energy Related to Power
The Human Energized Flashlight

http://greenballoon.com/freeplaycompanion.aspx?gclid=CLXJh-SJ55sCFRINDQodpGHy4g

Open the package containing the human-energized flashlight and play with it.

How can you calculate the work done in one revolution? What measurements need to be made, and what instruments will make these measurements possible?

Calculate the work done in one complete revolution:

If you turn the crank *faster* or *slower* do you think you will you do the same amount of work? Explain:

Design an experiment that will test your hypothesis. Outline your procedure, collect data and make observations, and indicate your conclusion.

What other sources of *force* (other than humans) could you employ to keep the crank moving?

Mechanical Power is defined as the time rate of doing work. Mathematically:

$$\text{Power} = \text{work/time (or } P = W/t)$$

Because work and energy are interrelated, mechanical power can also be described as the time rate of expending (or producing) energy. In this experiment, you were asked to determine how *time rate* (faster or slower) affects the flashlight. While the amount of *work* may be held constant, changing the *time rate* changes the power output.

Inserting units of work (or energy) and time into the power equation yields the following possible result:

$$\text{Power} = \text{joules/seconds}$$

A "joule/second" is defined as one "*watt.*" Interestingly, most electrical devices carry ratings of "watts." Conveniently, electrical watts and mechanical watts are identical. So, back to Joule…

$$\text{Energy (in joules)} = \text{Power (in watts)} \times \text{time (in seconds)}$$

Electrical energy in homes can be measured in joules, but most commonly (on electric bills) it is measured in "kilowatt-hours" (or "kWh")

How many *joules* are the equivalent of 1 kWh? How many *calories* of heat energy would that be?

Geoscience Energy Connections:

Commercial electric powerplants convert mechanical energy to electrical energy. The source of mechanical energy is typically created in one of two ways; using mechanical energy to run a turbine (tides, ocean currents, hydroelectric dams, wind energy); or in the heating of water to produce steam. This process uses energy produced from the combustion of coal, biofuels, natural gas, etc. or the conversion of nuclear energy to heat water in a boiler. Solar focusing facilities use concentrated sunlight to boil water.

Each of these processes directly involves topics related to Earth Systems Science.