Work and Energy

Equipment

- LoggerPro v3.3
- Motion Detector and Force Probe
- Cart and track
- Springs, string, masses, pulleys and assorted stands

Objective

Data collection

- Set up appropriate experiment to measure force on and motion of a cart

Data analysis

- Graph potential and kinetic energy of cart
- Determine work and relate to change in energy

Physics Concepts

- Work equals the change in Energy

Conceptual (C-Level)

Draw a picture of a cart that is pushed so it travels up and down an inclined track.

- Draw a schematic diagram with the forces labeled during and after the push
- Draw a diagram indicating the energy of the car
- Find an equation for the change in gravitational energy as a function of the distance the cart has traveled along the track

Basic Lab (B-level)

Incline the track with the motion detector at the top. Setup the cart so that you can push on the force probe to send the cart up the incline.

- Graph the potential, kinetic and total energy of the cart as a function of time.
- Graph the force as a function of distance. Determine the integral of this function while you were pushing on the cart. Compare to the change in energy.

Advanced/Extended Lab Ideas (A-level)

- Setup a pulley system to lift an object with less than ¼ the objects gravitational weight.
  - Find the idealized force to lift a given mass with and without your pulley system
  - Energy required to lift the mass without the pulley system
  - Energy required by pulley system to lift the mass
- Hook your cart to a spring so it oscillates.
  - Graph total energy - is it conserved?
  - Graph Force vs distance and Force vs time for your system
- What might you be curious to investigate?

Using a series of pulleys you can reduce the force needed to lift an object. This might make you think that you can get something for free since clearly you are lifting a massive object (that has a large gravitational weight) with a small applied force. To really figure out what is going on requires us to introduce the concept of energy. There is a saying that "you can not get anything for free in life" you either "pay now or pay later". Philosophically these are just physics principals at work.