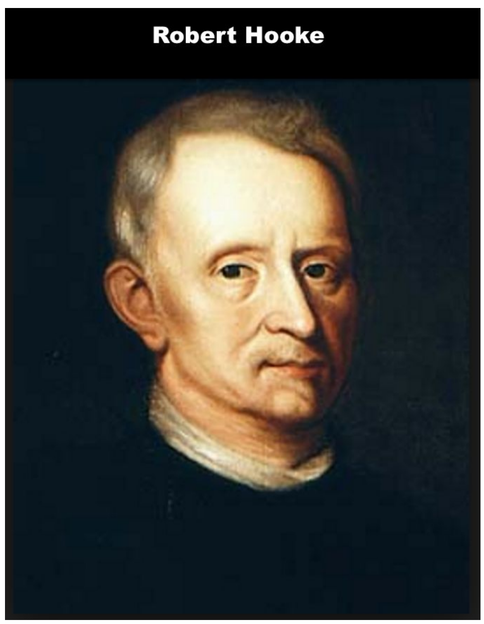
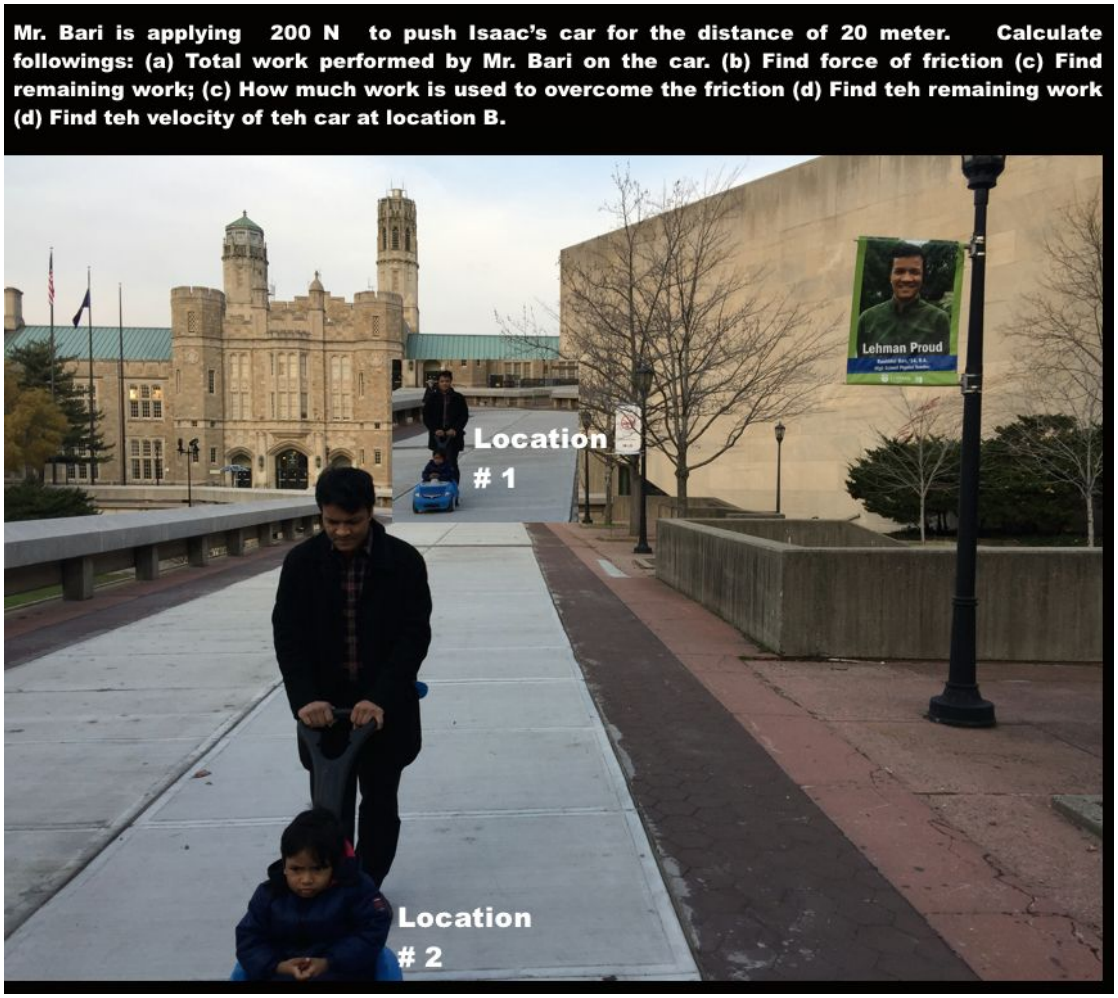
Booklet # 47 || Hooke's Law Lab

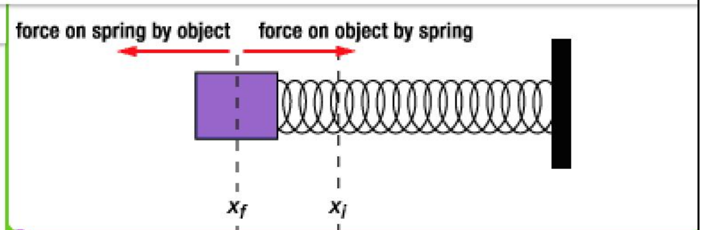


Unit: Work & Energy || Topic: Hooke's Law Lab
Date: Dec 16, 2015 || Name:

Do now: Solve the problem below?



$$W_{spring} = \int_{x_i}^{x_f} -kx \, dx = -\left(\frac{kx_f^2}{2} - \frac{kx_i^2}{2}\right)$$



Q If you stretch a spring, how much work is the spring doing on you?

$W_{spring} = \int_{x_i}^{x_f} -kx \, dx$ $\qquad$ $W_{spring} = \int_{x_i}^{x_f} F_{spring} dx$

	Lab Activity
	Take out a laptop Go to Bari Science Lab Click on Work & Energy Find Hook's LAw Simulation Click on it

	Lab Activity

Hooke's Law Lab

Lab Write-up
Purpose
Procedure
Data
Calculations/Graph
Questions

Name ____________________

Hour ______

Purpose:

1. To investigate Hooke's Law (The relation between **force** and **stretch** for a spring) $F = -kx$

2. To re-visit Newton's 3^{rd} Law of Motion.

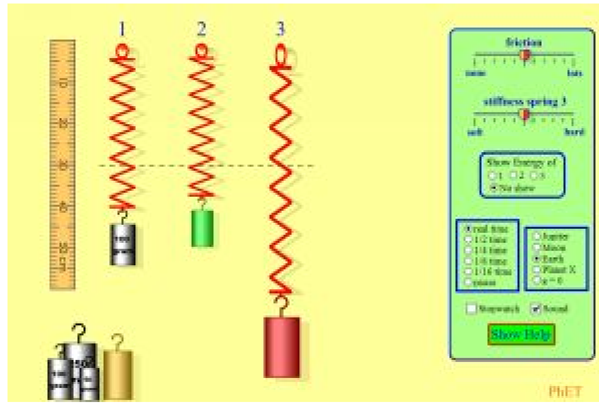
Discussion:

Everybody knows that when you apply a force to a spring or a rubber band, it stretches. A scientist would ask, "How is the force that you apply related to the amount of stretch?" This question was answered by Robert Hooke, a contemporary of Newton, and the answer has come to be called Hooke's Law.

Hooke's Law, believe it or not, is a very important and widely-used law in physics and engineering. Its applications go far beyond springs and rubber bands. You can investigate Hooke's Law by measuring how much known forces stretch a spring. A convenient way to apply a precisely-known force is to let the weight of a known mass be the force used to stretch the spring. The force can be calculated from $W = mg$. The stretch of the spring can be measured by noting the position of the end of the spring before and during the application of the force.

Equipment:

Simulation “Springs and Masses” from
http://www.bari-science-lab.com/work-energy-and-momentum



Procedure:

1. Go to PhET web address and run Springs and Masses.

2. Construct a data table in lab book. You will need to record the mass that you hang from the spring and the change in position of the end of the spring before and after the mass is added.

Trial	mass (g)	mass (kg)	Displacement (cm) (stretch)
1			
2			
3			

3. From this, you will calculate the force applied to the spring. You will do three trials using Spring #3, set to the default setting for stiffness of the spring. Place each of the masses from the spring and record you data (A sample data table is shown above.)

4. For each trial, record the mass, the starting position of the spring (before hanging the mass) and the ending position of the spring (while it is being stretched) and record the change in position as displacement.

5. Repeat the process using spring #3 but set the stiffness to hard.

Mass (kg)	Weight (Newtons)	x (meters)	$\Delta x = x - x_i$
0	0		0

Calculations:

1. Calculate the force applied to the springs in each trial (W = mg) Use g = 9.803 m/s^2. Mass must be in kg when converting to N
2. Draw graphs (you may use Graphical Analysis) of **force versus stretch for the spring and the spring set to hard**. You may be able to put both graphs on the same sheet of graph paper, depending on the data. Find the slope of each line on graph.

Initial position of weight hanger:

Calculation of the Slope of the Line of Best Fit:

Find a point on your graphed line that is as far to the right and towards the top of your graph as you can. Then the slope, which equals the spring constant of your spring, is:

$$slope = \frac{mass}{distance} =$$

gm/cm

Typically, spring constant are reported in Newtons/meter (N/m). To convert to this value, simply multiply by 0.98.
Thus, your **spring constant k =** N/m.

% Error Calculation:

$$\% \ Error = \frac{|Observed\ Value - Accepted\ Value|}{Accepted\ Value} * 100\%$$

=