This activity uses a PHET simulation: **https://phet.colorado.edu/en/simulation/masses-and-springs**

to let you experiment with different combinations of springs, masses and other parameters. You can specify the properties of the springs (spring constant, length) by means of sliders. In the “energy” and “lab” modes damping can be added. You can even change gravity, moving the experiment to other planets! The format of this worksheet is that you write your responses on the sheet using a different font color, and incorporate any sketches, tables etc. into the file.

1. Choose the PHET simulation’s “Vectors” mode.
   1. Make a table showing where the maximum, minimum, and zero values of velocity, acceleration, and tension occur.
   2. Make a sketch graph to show the phase relationships among these quantities.
2. Choose the PHET simulation’s “Lab” mode. Choose a spring constant and mass, mark and measure the equilibrium position. Make sure that damping is not being applied to the system.
   1. Calculate the spring constant for this system.
   2. Predict the oscillation period.
   3. Now pull the mass down by a measured amount and release it. Use the timer to measure the oscillation period. Stop the simulation. Does it agree with (b)?
   4. For the same system, pull down the mass twice as far as before, release it and user the timer to measure the oscillation period. How does it change?
   5. Change the spring constant to make the spring stiffer. What happens to the period?
3. Choose the PHET simulation’s “Lab” mode.
   1. Come up with and describe a method to discover the masses of the two unlabeled objects provided.
   2. Make the required measurements and calculate the masses.
   3. What changes if you perform the experiment on the Moon, or on Jupiter?
4. Choose the PHET simulation’s “Energy” mode with Damping to model this behavior: A mass on a spring is set in simple harmonic motion, with initial period Po and initial amplitude Ao. In the real world mechanical energy will be gradually lost from the system due to air drag and hysteresis in the spring. As time goes by, how do the following parameters change?
   1. Amplitude
   2. Period
   3. Mechanical Energy
5. Choose the PHET simulation’s “Intro” mode.
   1. Select the option for two springs of different lengths.
   2. Select the option for both springs to have constant THICKNESS.
   3. Arrange for one spring to be twice the length of the other (use the ruler or count the turns). You can think of the longer spring as being two springs identical to the smaller one, attached end-to-end.
   4. Hang a 100g mass on each spring.
   5. What are the oscillation periods of these two systems?
   6. Take a screenshot and include it in your report.

1. Finally use what you learned above to solve this problem: Imagine you are given a set of *N* identical springs and a set of *M* identical masses.
   1. What is the oscillation period for one mass on one spring?
   2. Describe the slowest oscillator that you can build, sketch it, and find its period.
   3. Describe the fastest oscillator you can build, sketch it, and find its period.