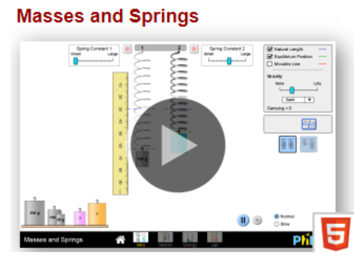
Masses and Springs

https://phet.colorado.edu/en/simulation/mass-spring-lab

LAB REPORT: Type or hand write the answers to the observations and questions in this lab report in a separate document. Convert your final document to a PDF and submit into your Google Drive Physics Shared Folder.

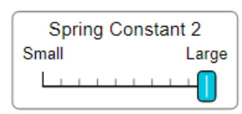
- Include the number of the question and then the answer, calculations, Data Table, etc.
- If you type, for drawing, calculations, graphs, etc., scan images of these into your document. Save your final work as a PDF and save it to your Google Drive Physics Shared Folder.
- If you hand write, scan your work as a PDF and submit into your Google Drive Physics Shared Folder.



TO BEGIN: Click the link above or go to the PhET site (http://phet.colorado.edu) and launch *Masses and Springs*

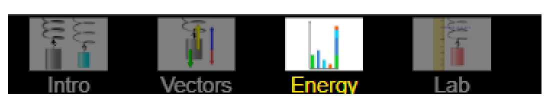
PART A: INVESTIGATING DIFFERENT SPRINGS

- Select INTRO
- Put a 100 g mass on the first and the second springs. They should hang at the same level and move similarly. **Always carefully place the mass on the spring, NEVER PUSH UP OR STRETCH**
- Remove the mass from spring 2
- Increase the **SPRING CONSTANT 2** (make large, aka make the spring stiffer)
- Put the 100 g mass back on the second spring



1. What happens when the stiffness (constant) of spring 2 is increased?
2. Remove the second mass, make the value small for Spring Constant 2, and place the mass back on. What happens when the stiffness (constant) is decreased?

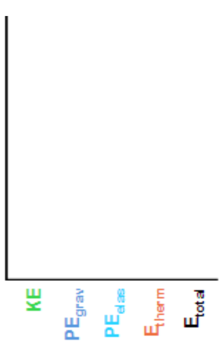
PART B: ON THE BOTTOM, SELECT ENERGY



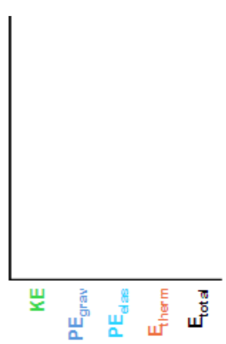
- Set the DAMPING to NONE

3. Draw the ENERGY BAR GRAPH diagrams when the mass is at the identified positions

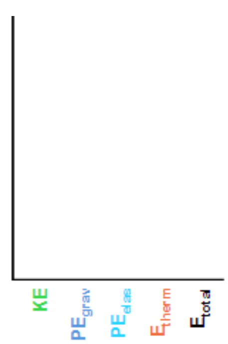
Energies at HIGHEST point (no stretch)



Energies at MID point



Energies at LOWEST point (full stretch)



4. When you put the 100 g mass on the spring, describe what happens to the
   a. KE as the spring bounces:
   b. PE_{grav} as the spring bounces:
   c. PE_{elas} as the spring bounces:
   d. E_{total} as the spring bounces:

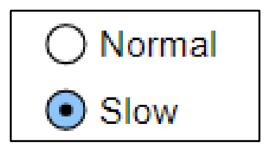
   **Note we are ignoring E_{therm} for now*

5. Remove the mass, make the **SPRING CONSTANT 1 <u>Small</u>** and place the mass back on.
   a. What changes about the springs motion?
   b. What changes about the springs energy bars?

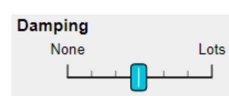
6. Remove the mass, make the **SPRING CONSTANT 1 <u>Large</u>** and place the mass back on.
   a. What changes about the springs motion?
   b. What changes about the springs energy bars?

<u>PART C:</u> INVESTIGATING ENERGY

- RESET
- Set Damping (friction) to Zero.
- Add the 100 g mass to the Spring, it should bounce or osculate up and down.
- Slow down the time - this will help you measure!

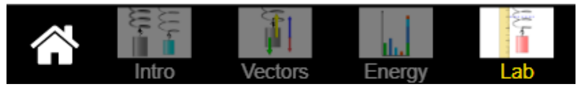


7. Where does the spring have maximum gravitational potential energy?
8. Where is the gravitational potential energy the least?
9. Where is the kinetic energy zero (*may be MORE than one point*)?
10. Where is the kinetic energy the highest (at its maximum)?
11. Where is the elastic potential energy zero?
12. Where is the spring when elastic potential energy is at its maximum?
13. While bouncing does the total energy ever change?

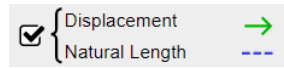


14. SET Friction (**Damping)** to the middle and return time to NORMAL:
    a. What changes about the springs motion when Friction is on?
    b. What changes about the energy bars when Friction (damping) is on?

PART D: FINDING A SPRING CONSTANT

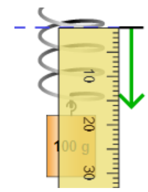


- Select LAB
- Place the RULER so that ZERO is lined up with the bottom of the spring.
- Set DAMPING to LOTS
- Select DISPLACEMENT NATURAL LENGTH



- To change MASS, use the sliding bar at the top. Change the mass prior to placing the mass on the spring.

- Place the mass on the end of spring **being careful not to also push up or down when ready to start** *(this can result in lots of error!!)*
- To measure, use ruler to measure from the zero on ruler to the bottom of the spring (not the mass)



15. Solve for the spring constant using the steps below
    a) Select a mass value *(convert to kg!)* and calculate the force of gravity. Record both in a Data Table.
    b) Hang the mass carefully and measure displacement *(convert to meters!)*. Record results in a Data Table.
    c) Solve for Spring constant (**k**) and repeat this process with new masses. Show your calculations and include results in your Data Table.
    d) REPEAT 5 times and average your spring constant values. Include data for all trails and your average in your Data Table

16. Construct a graph showing the relationship between force and displacement *(Pay attention to which is the independent and which is the dependent variable!)*
    a) What is the value of the slope of your line?
    b) How does this value compare to the spring constant value from your calculations? Explain.

PART E: SOLVING FOR UNKNOWNS

17. Using the spring constant (**k**) you found above, find the mass of the mystery masses.
    a) Carefully place the BLUE mystery mass on the spring and measure the displacement. Record both in a new Data Table.
    b) Using the spring constant (**k**) and displacement find the Force using Hooke's Law. Show your calculations and include results in your Data Table.
    c) Determine the mass in kg and g. Record both in your Data Table.
    d) Repeat the steps above for the RED unknown mass. Show your calculations and include results for the second mass in your Data Table.
    e) Verify your answer by sliding the mass bar to your calculated value and measure the displacement. Record the actual mass of both in your Data Table.
    f) Calculate your percent error. Show this information in your Data Table.
    g) If you have more than 10% error, go back and correct your work or experimental methodology.

    Note: a most common mistake is PUSHING UP or PULLING down with either your mystery mass or the known mass. Redo the measurement carefully, if you have more than 10% error, then repeat the lab.