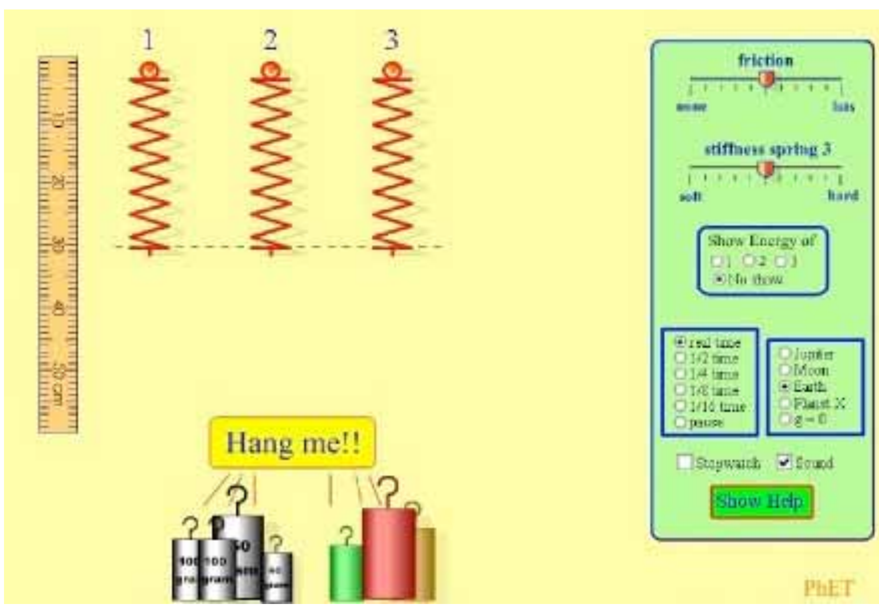
The online mass-spring lab

The University of Colorado PhET group has produced a nice on-line simulation that lets you explore the force law and period of oscillation for a mass hung from a spring as well as how the energy is distributed. In this problem, you will explore some of the aspects the the mass-on-a-spring system. The mass-spring-lab is available online.

First explore the interface. It is shown at the right. Notice that you can:



- click and drag a mass to the bottom of a spring and it will hook onto the spring,
- click and drag the horizontal (dotted) line wherever you like,
- click and drag the vertical ruler anywhere you like,
- slow down the pace at which things happen by choosing a time fraction in the "time box" in the green control panel,
- turn on a stopwatch by clicking on the stopwatch box in

the control panel,

- turn on a display of the components of the energy of one (and only one) of the mass/spring systems.

When adding and removing the masses, you might find it useful to pause the simulation by clicking on the "pause" radio button in the time box. You can start it up again by clicking on one of the "time" buttons.

A. The sliders for the friction and spring stiffness have no numbers marked on them. Determine what they mean by changing them and seeing how the motion of a hanging mass changes. Does the "0" marker (the leftmost mark on the slider) correspond to the value "0" for friction? for spring stiffness (k)? Explain how you decided.

B. Set the slider for "stiffness of spring 3" in the middle (at the "5" mark). When it is set this way, do all three springs have the same spring constant? Explain how you decided. Can you find the spring constants of each of the springs? If you can, find them. If you can't, explain why you can't. When you change the slide for "stiffness of the spring 3" to a different value, do all the springs change together? Explain how you d ecided.

C. There are three masses on the right of the mass collection colored red, gold, and green. These are not labeled as to their mass. Can you find their masses? If you can, do it. If you can't, explain why you can't.

D. Turn on the display of the energy of 3. Determine where on the screen for what configurations of the mass and spring it defines the zero of the gravitational potential energy and for what configurations of the mass and spring it defines the zero of the elastic (spring) potential energy.

E. For this part of the problem, you are to watch the pattern of the energies change as the mass and spring oscillates. First, set a mass on one of the springs. Turn on maximum friction and let the mass come to rest. Move the dotted line to show where the equilibrium point is. Now turn off friction and move the mass to another spring at just the equilibrium point so it remains almost at rest. (This will restart the energy calculation.) Turn on the view of energy for your system. You should have some elastic PE and some gravitational PE.

- Predict what you think will happen to the two potential energies and the total energy if you grab the mass and pull it down slowly. Then do it and see what happens. If it agrees with your prediction, explain the basis of your prediction. If it disagrees, explain what went wrong.
- Now set the timing so that the mass is oscillating slowly and you can watch what happens to the energies. Pull the mass down and release it. Use the stopwatch to find an approximate time between the maximum values of each of the kinetic and the two potential energies. Is time between two maxima of the KE the same as between the two potential energies? If so, explain why. If not, explain why not.

Not finding what you wanted? Check the Site Map for more information.

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