

LAB: The Simple Harmonic Oscillator with Friction

Background: We have spent a lot of time studying the mass-spring oscillator. We looked at it using energy and we discussed the forces acting on it, but because the spring force changes as the spring stretches/compresses (Hooke's Law: $F = -kx$), we were not able to actually derive the equations for oscillation period. In this simulation, we will take the opportunity to re-examine this system. We will even go so far as to analyze it under the effects of friction.

Initial Program Code: Download the program link here: [SimpleHarmonicOscillator](#)

Objectives: Modify the Simple Harmonic Oscillator program to conduct two controlled investigations to complete the following objectives. You should graph your results in Logger Pro and make claims regarding each objective based on your experimental data.

- **Objective 1:** Find the relationship between *EITHER* mass or spring constant (ind variable) and oscillation period (dep variable). Note: your results will hopefully allow you to verify the equation you've seen before ($T = 2\pi m/k$).
- **Objective 2:** Modify this code to assume that the mass is moving across a tabletop and experiencing frictional force. Use your modified version of this simulation to conduct a controlled investigation between two variables of your choice (make sure to get your choice approved by me!)

Here are some ideas of what you could choose to study:

- How does the "lifetime" of oscillation relate to the coefficient of friction?
 - How does the energy of the system change over time?
 - How does the coefficient friction affect the period of oscillation?
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Methods: You must clearly explain the methods used to accomplish both objectives 1 and 2. You must write out your methods such that your work is replicable (this means one of your peers should be able to repeat your work by reading what you have written.)

Tip: I suggest running your code multiple times and altering the initial conditions each time to modify your independent variable. Set the program up to print out the dependent variable at the desired instant. You can graph your data using Logger Pro.

Graphs and Evidence-Based Claims:

- Include labeled graphs for both objectives these should be printed from Logger Pro. Also, include data tables showing independent and dependent variables from both experiments.
- **Objective 1:** Describe whether your data supports or refutes the equation we expect this system to follow. You should fit the correct type function and describe the physical significance of the coefficient. This means you should relate it to physical values you held constant in the simulation. How close is this coefficient to what the equation predicts it should be?
- **Objective 2:** Do not attempt to fit a function onto your graph for objective 2, unless you have a good justification for a particular type of function. Use your data to make a claim regarding the relationship between the variables you chose to study for this objective.