**Laboratory 3:** Period of a Mass on a Spring

In class, we have discussed the mass-on-a-spring system as the prototype example of Simple Harmonic Motion. In particular, we said that

- The strength of the spring, **k**, is the *restoring* term,
- The mass on the spring, **m**, is the *inertial* term,
- The timing of the oscillation should be independent of its amplitude,
- The frequency and period should be determined by:

$$f^2 = \frac{\text{Restoring}}{\text{Inertia}} = \frac{k}{m} \quad \& \quad T^2 = \frac{\text{Inertia}}{\text{Restoring}} = \frac{m}{k} .$$

We will test all of these experimentally today.

| **Experimental advice: hang enough mass on the spring to make sure it is actually stretched a bit and bouncing freely.** |
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## A. Your Reference Clock

We have set up a spring in the back of the room. It is a good match to one of your two springs, although you have grown correctly suspicious that any two things will behave *exactly the same*. Our reference "green" spring has 1000 g hanging on it, and that one will give the oscillations that you time by. That defines our **boing** unit today.

## B. Independence from Amplitude

Using either spring with 1000 g hanging on it. Take three oscillations with amplitudes *small, medium, large*. Compare the periods of the three cases.
Is our claim that the period is independent of the amplitude justified?

## C. Spring Period as a Function of Restoring

Put the same amount of mass on your green spring and on your blue spring.
Determine which is stronger or weaker by seeing which one stretches farther.
Then, let each spring bounce and time the period.
Does the stiffer spring have a higher frequency as we expected?

## D. Spring Period as a Function of Inertia

Now, for one of your springs (we will have half of you do each color),
sequentially set up 6 different masses, in the range: 700 – 1800 g.
Record the time for 10 cycles and find the periods.

## E. Analyzing the Data, Building an Explanatory Model

We will talk you through the graphical analysis of these data, with an eye toward testing our theoretical model of Simple Harmonic Motion.

- Similarly to the pendulum, we will graph $T^2$ *vs.* the inertia (mass in this case),
- If we get a good fit line, we have confidence that our model of how period depends on inertia is pretty good,
- By comparing results from the blue and green springs, we can make a case for our model of how period depends on restoring ($T^2 \sim 1/\text{Restoring}$).