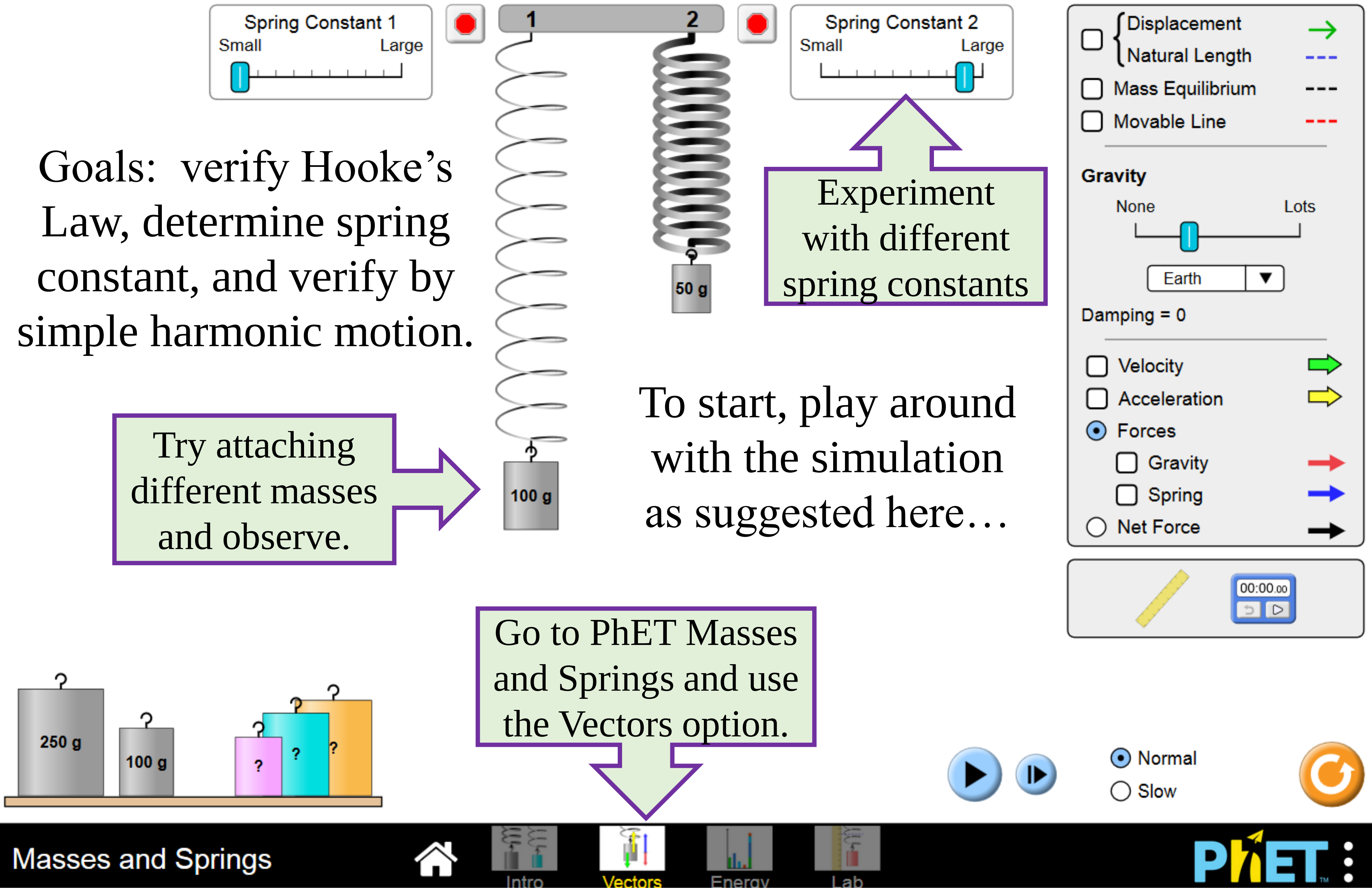
# Virtual Lab – Mass on a Spring, Hooke's Law, Simple Harmonic Motion

Goals: verify Hooke's Law, determine spring constant, and verify by simple harmonic motion.

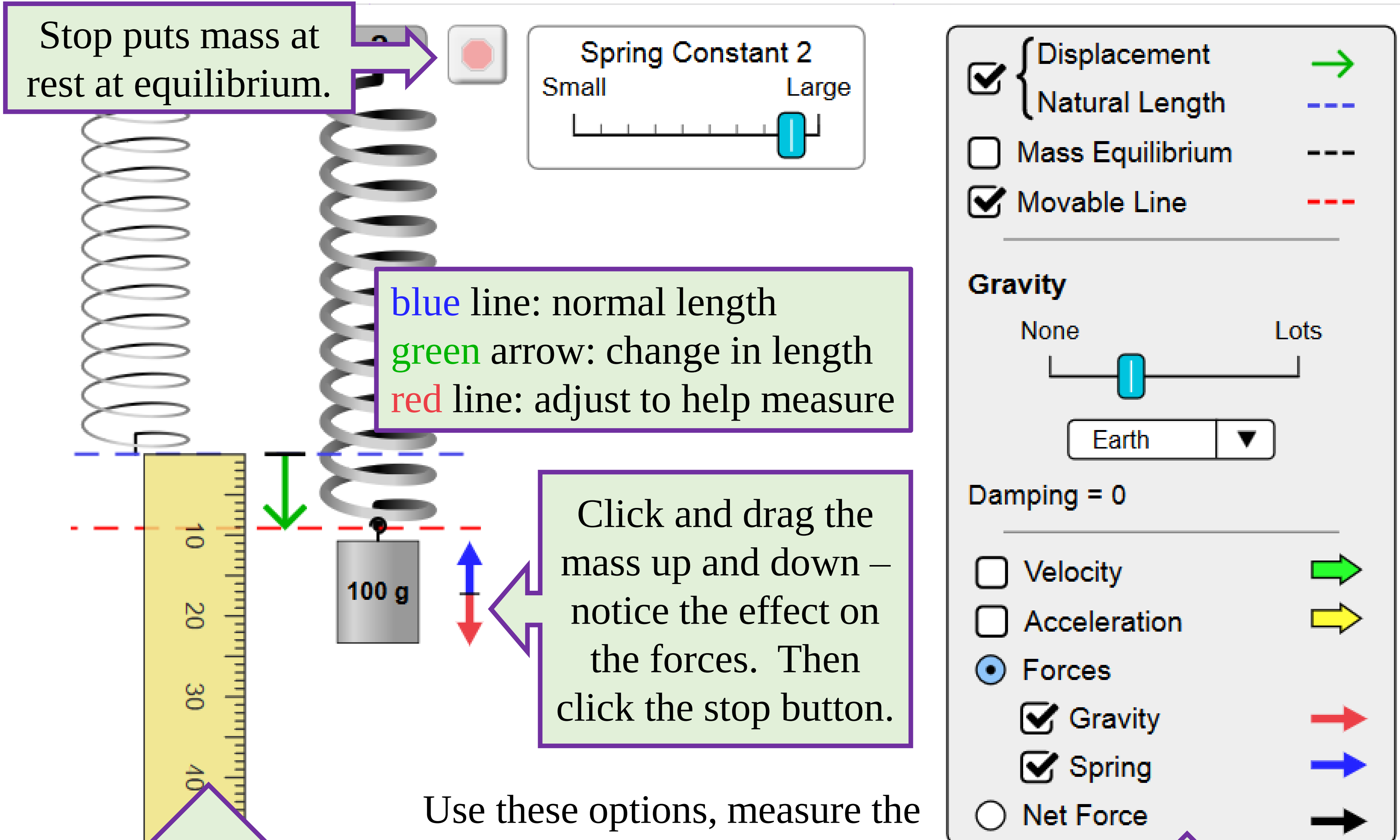



Experiment with different spring constants

Try attaching different masses and observe.

To start, play around with the simulation as suggested here…

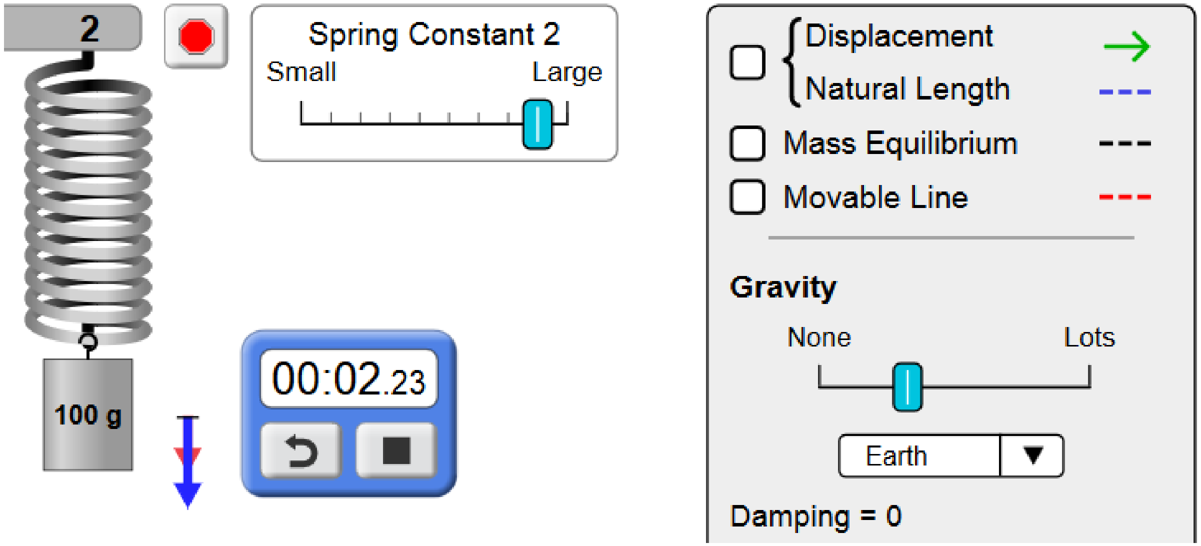
Go to PhET Masses and Springs and use the Vectors option.




Use the ruler tool to measure the spring's elongation – 9.0 cm in this example.

Use these options, measure the elongation for three different masses. Calculate the value of the spring constant ($k = F/x = mg/x$) and find the mean. The result should be in the range: $2\text{ N/m} < k < 12\text{ N/m}$

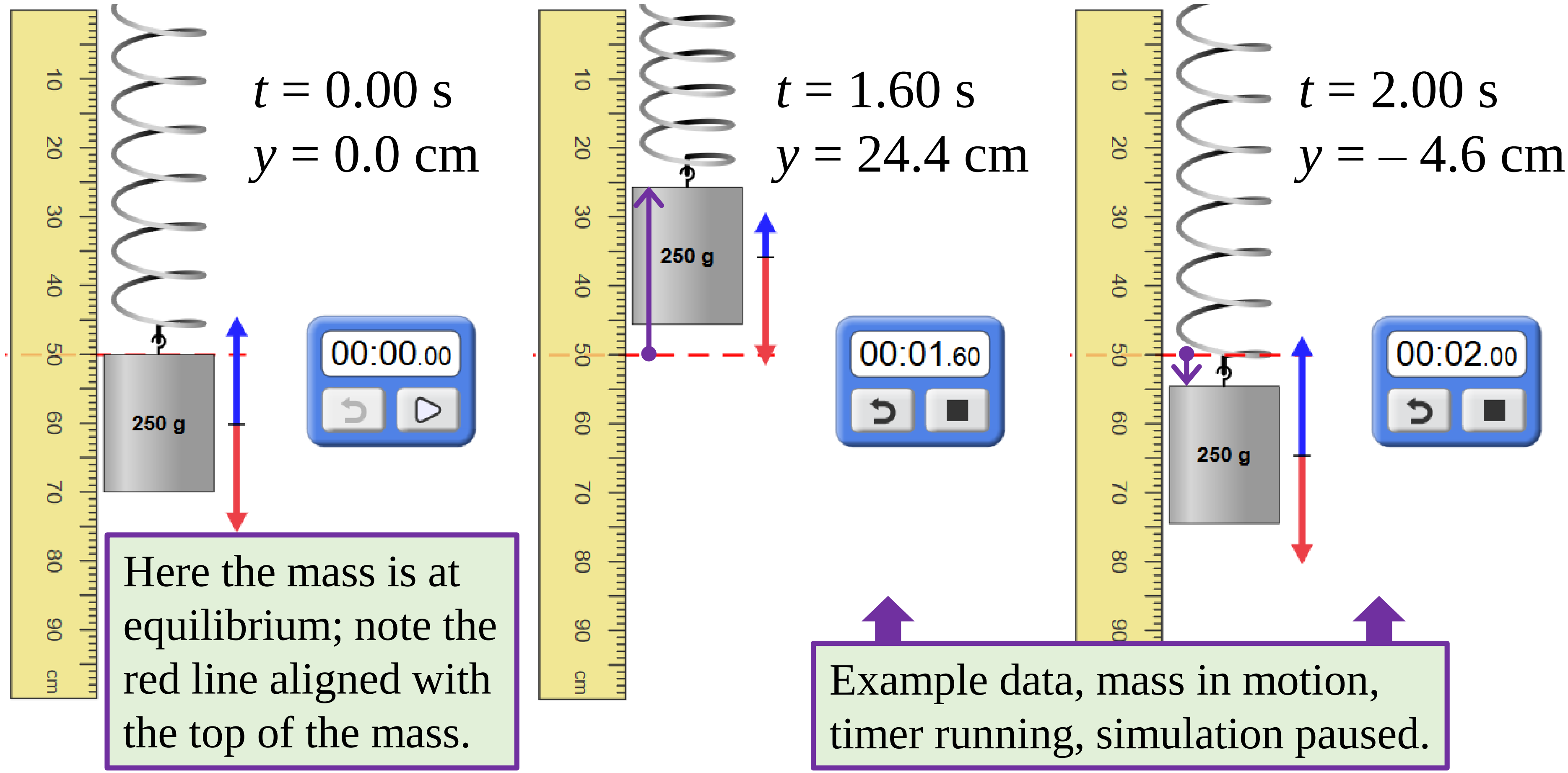
Select the 4 options shown.




Now using the *same spring*, experiment with a mass oscillating up and down. Measure the period using the stopwatch tool – measure the time for 10 oscillations and divide the total time by 10. (Or you can pause and step through the animation.)

Determine $k$ based on values of $m$ and $T$ using the equation: $T = 2\pi\sqrt{\frac{m}{k}}$
If all goes well it should match the previously determined value!
Does it? You must allow for error in measurement.

Other things to try:
Repeat all or part of the experiment using gravity of a different world. If you choose the "Custom" setting you can also try zero gravity.
Determine one of the unknown masses by timing the period and solving for $m$ and/or by measuring the elongation it causes and using $F = kx$. Check yourself by doing both!




Optional challenge: Use a setup similar to this to collect data needed to create a position vs time graph. You can pause and "step through" the simulation, recording the time and position at increments of 0.10 s. Then do a sinusoidal curve fit of this data using an equation of the form $y = A \sin(Bt + C)$. Determine the spring constant $k$ using the coefficient $B$ and the mass of the object, compare to previous results.