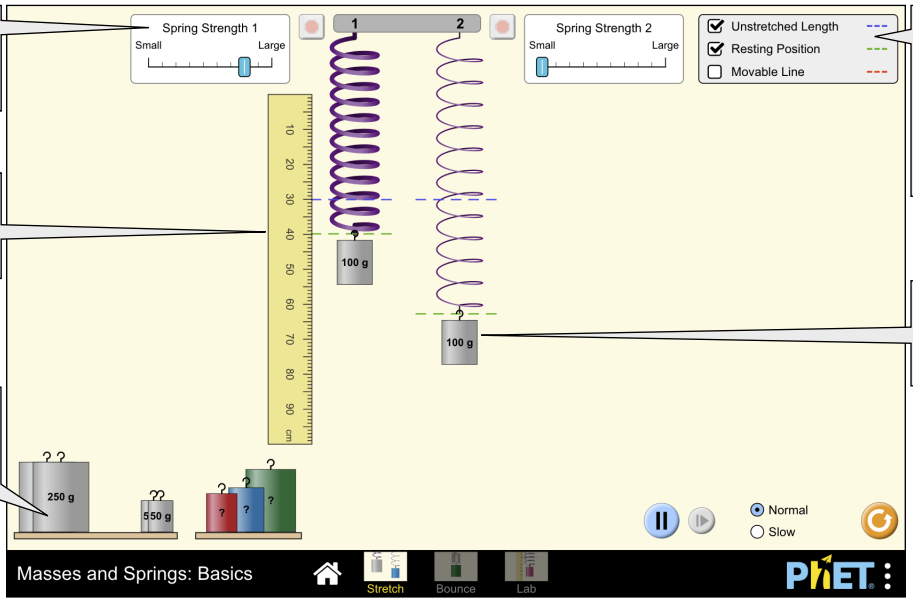
PhET Tips for Teachers

# Masses and Springs: Basics

## Stretch Screen

Play with one or two mass-spring systems and discover the relationship between the mass, spring constant, and displacement.




**ADJUST** the spring constant

**MEASURE** the displacement

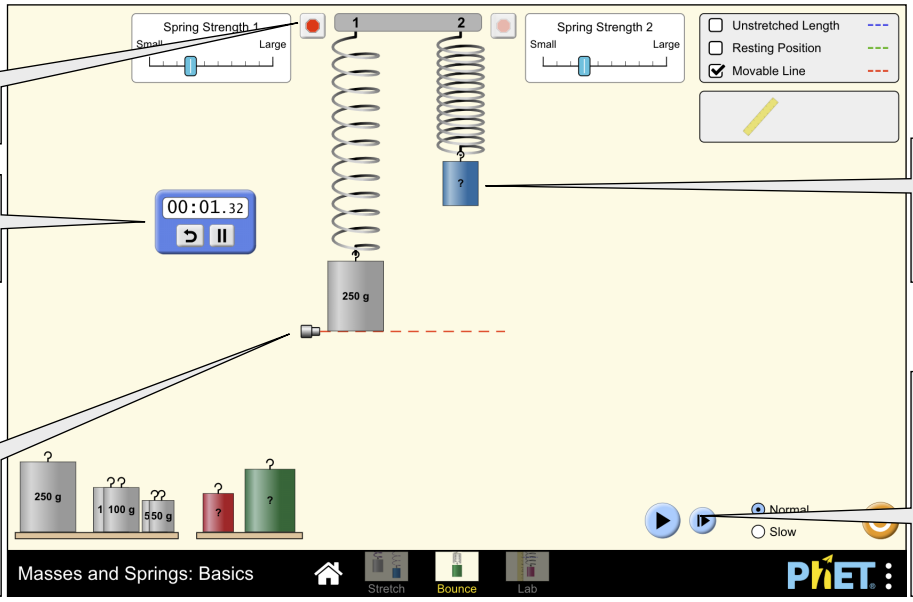
**HANG** masses from springs

**VIEW** natural length and equilibrium position

**COMPARE** two systems

## Bounce Screen

Experiment with an oscillating spring, and determine which variables (such as mass, spring constant, or displacement) affect the period.




**STOP** oscillation

**MEASURE** the period

**SET** reference point with Movable Line

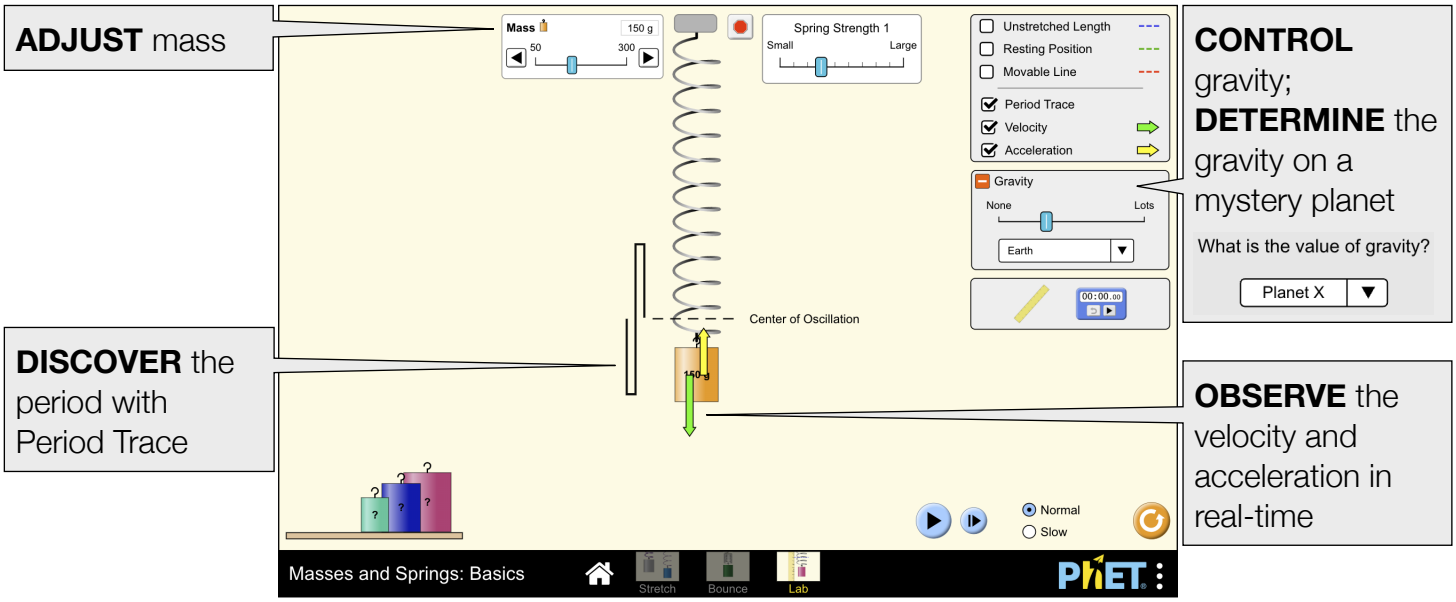
**EXPERIMENT** with mystery masses

**PAUSE** the sim to set up an experiment; **JUMP** forward by 0.01 seconds

Rouinfar, November 2022

## Lab Screen

Collect data and determine the value of the mystery mass or g on Planet X.




## Model Simplifications

- The thickness of the spring is used to indicate the spring constant. The spring constant range is 3-12 N/m, with tick mark intervals of 1 N/m.
- The gravity values for the planets/moon match those used in the original Masses and Springs simulation. (Earth = 9.8 m/s$^2$, Moon = 1.6 m/s$^2$, Jupiter = 24.8 m/s$^2$)
- The vocabulary in this simulation is designed for younger learners who many not have been formally introduced a mass-spring system or simple harmonic oscillation.
    - Spring Strength: spring constant
    - Unstretched Length: natural length
    - Resting Position: equilibrium position
- On the Stretch Screen, the springs are heavily damped to minimize oscillation. This is to better support learning goals related to Hooke's Law. However, the springs on the Bounce and Lab screens are undamped. To support learning goals around damping, please use Masses and Springs.
- On the Lab screen, turning on the Period Trace, Velocity, or Acceleration will reveal the "Center of Oscillation" line, which represents the location of the center of mass at equilibrium. The Period Trace, Velocity, and Acceleration are drawn with respect to the center of mass, so the Center of Oscillation is a more appropriate reference than the Resting Position (equilibrium position).
- The Period Trace draws the path of one full oscillation about the equilibrium position of the center of mass. The path will begin drawing when the center of mass crosses the Center of Oscillation line.
- If a parameter (e.g. gravity, mass) is changed mid-oscillation, the instantaneous displacement, mass, spring constant, gravity, and velocity will be used as the new initial conditions for the equation of motion. Frequent mid-oscillation changes can lead to hard-to-interpret (though technically still accurate) behavior, so we recommend stopping the mass between experiments.

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## Suggestions for Use

### Sample Challenge Prompts

- Describe the Unstretched Length and Resting Position in your own words.
- Identify all the ways to increase the displacement at equilibrium.
- Determine the relationship between the applied force and displacement.
- Explain what the period represents, and determine a method to measure it.
- Design a controlled experiment to (qualitatively or qualitatively) determine how a variable — such as mass, gravity, spring constant, or displacement — affects the period.
- Determine a way to give a heavier mass a shorter period than a lighter mass.
- Determine the mass of the mystery masses or the value of g on Planet X (qualitatively or quantitatively), and explain your method(s).

See all published activities for Masses and Springs: Basics here.
For more tips on using PhET sims with your students, see Tips for Using PhET.