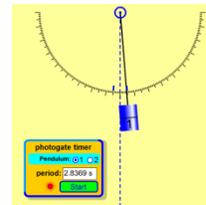


# SIMPLE PENDULUM

## INTRODUCTION

A simple pendulum has a mass  $m$  (bob) hanging from a string of length  $l$  fixed at a pivot point as shown in the diagram at the right. When displaced to a small initial angle and released, the mass will swing back and forth in periodic motion. The period is the time it takes to complete one whole swing while amplitude is the angle of release relative to the vertical.



## OBJECTIVES

- make predictions on the effect of varying amplitude, length and mass of a simple pendulum
- use a spreadsheet software to analyze relationship between the following: amplitude and period, length and period, mass and period

## MATERIALS/EQUIPMENT

PhET Simulation software  
Spreadsheet software

## PREDICTIONS

1. How does the period of the pendulum depend on the amplitude of the swing?

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2. How does the period depend on the length of the pendulum?

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3. How does the period depend on the mass of the pendulum bob?

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4. How does the gravitational acceleration affect the motion of the pendulum?

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## PROCEDURE

How to open the simulation:

- Go to the simulation page <http://phet.colorado.edu/en/simulations/category/new>
- Select "Physics" on the left side of the page and look for "Pendulum Lab" activity.
- Click **Run Now!** to start.

### A. Period and Amplitude

1. Click the lower right button to activate the photogate timer.
2. Set the mass to 1.00 kg, length to 1.00 m and amplitude to  $1^\circ$ .
3. Start the photogate timer. This will automatically stop when it has recorded the time for one complete swing (period).
4. Open spreadsheet software and enter the amplitude and period in two consecutive columns. Label each column with the corresponding units.
5. Continue to take readings for amplitudes  $2^\circ$ ,  $3^\circ$ ,  $4^\circ$  and  $5^\circ$ .
6. Highlight the columns with numerical values on your spreadsheet and insert a scatter plot. Choose a layout that will allow you to add graph title and axes title with complete unit.
7. Observe the shape of the graph.

**Reset**

**Reset before doing another activity.**

### B. Period and Length

1. Keep the amplitude at  $5^\circ$ , the mass at 1.00 kg and gather data for different lengths as follows: 0.50 m, 0.60 m, 0.70 m and 0.80 m.
2. Enter your data on the spreadsheet software, labeling the axes appropriately.
3. Generate a scatter plot and observe the shape of the graph.

**Reset**

**Reset before doing another activity.**

### C. Period and Mass

1. Keep the amplitude at  $5^\circ$ , the length at 1.00 m and gather data for different mass values as follows: 0.50 kg, 1.00 kg, 1.50 kg and 2.00 kg.
2. Enter your data on the spreadsheet software, labeling the axes appropriately.
3. Generate a scatter plot and observe the shape of the graph.

## QUALITATIVE ANALYSIS

1. Analyze each graph and determine the relationship between each variable (amplitude, length and mass) and period of a simple pendulum. Give a brief description of the relationship below.

a) Period and Amplitude

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b) Period and Length

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c) Period and Mass

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2. How does your prediction compare with the results of your experiment?

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3. How does air resistance affect the period of a simple pendulum?

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Verify your answer using the simulation. Move the friction toggle to the right.



4. If the pendulum set-up was transferred to the surface of the moon where the gravitational acceleration is  $1/6$  that of the earth, how does it affect the period of the pendulum?

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Verify your answer using the simulation. Select the "moon" radio button on the right side of the simulation page.

