

The Simple Pendulum Challenge

A STEM Activity from Teamwork & Teamplay

For this investigation, equip your audience with the following supplies: 6 feet of string, 6 metal washers, duct or masking tape, a stopwatch. The ideal place to conduct your investigation pendulum motion is an interior doorway or any location where the pendulum pivot can be created and the pendulum can swing freely without contacting anything.

The Task: Challenge your audience to create a pendulum (by trial and error) that has a period (one complete oscillation, forward and back) of exactly 2 seconds, using the resources provided.

After 10 minutes of experimentation, introduce your group to the fundamental equation for simple pendulums, at small angles. In this equation T is the period (measured in seconds), $\pi = 3.1415827$, L = the length in inches of the string, measured from the pivot point (taped to the doorframe), to the center of mass of the washers. Notice that the weight of the washers does not enter into this equation (i.e. the period of the pendulum does not depend on the amount of weight used, it only depends on the the ratio of length/gravity).

Pendulum Motion

The motion of a [simple pendulum](#) is like [simple harmonic motion](#) in that the equation for the angular displacement is

$$\theta = \theta_{\max} \sin \sqrt{\frac{g}{L}} t \quad \text{Show}$$

which is the same form as the motion of a mass on a spring:


$$y = A \sin \sqrt{\frac{k}{m}} t$$

The angular frequency of the motion is then given by $\omega = \sqrt{\frac{g}{L}}$

compared to $\omega = \sqrt{\frac{k}{m}}$ for a mass on a spring.

The frequency of the pendulum in Hz is given by $f = \frac{1}{2\pi} \sqrt{\frac{g}{L}}$

and the period of motion is then $T = 2\pi \sqrt{\frac{L}{g}}$



$$T = 2 * \pi * \sqrt{(L/386.088)}$$

Or, to calculate the exact length of the pendulum to produce a period of exactly two seconds, use the following equation:

$$\text{Length (inches)} = T^2 * g / (4 * \pi^2) = 4 * 386.088 / (4 * 9.8696) = 39.119 \text{ inches}$$

Ask your audience to compare the length they found by experimentation with the length they calculated using the equation above.