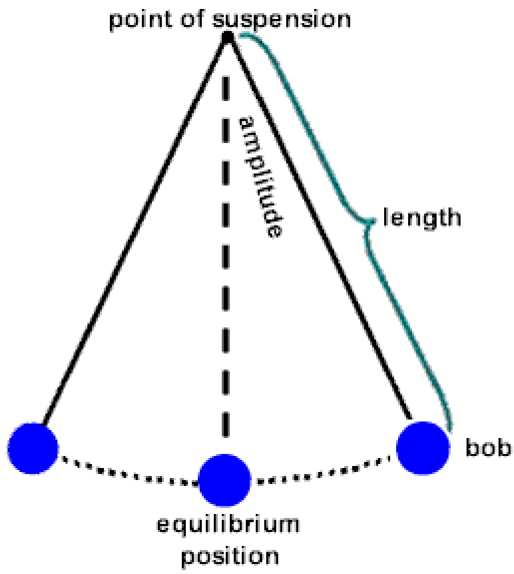
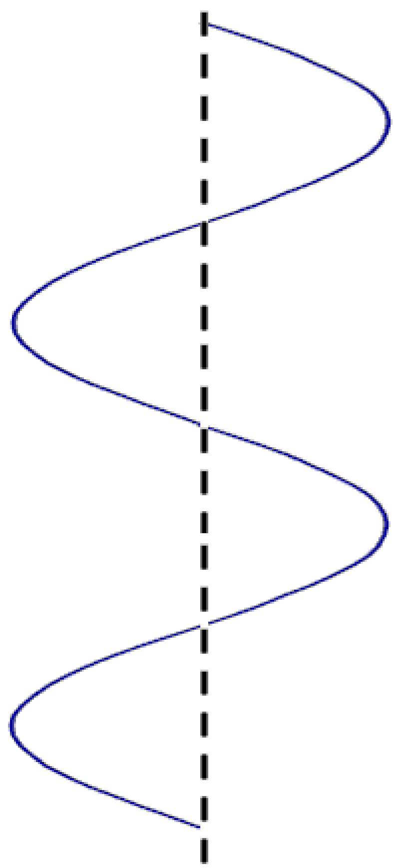
A **simple pendulum** consists of a string, cord, or wire that allows a suspended mass to swing back and forth. The categorization of "simple" comes from the fact that all of the mass of the pendulum is concentrated in its "**bob**" - or suspended mass.




As seen in this diagram, the **length** of the pendulum is measured from the pendulum's point of suspension to the center of mass of its bob. Its **amplitude** is the string's angular displacement from its vertical or its **equilibrium position**. If a pendulum is pulled to the right side and released to swing back and forth, its path traces our a sine curve as shown below.



The time required for one complete vibration, for example, from one crest to the next crest, is called the pendulum's **period** and is measured in seconds.

The formula to calculate this quantity is

$$T = 2\pi\sqrt{\frac{L}{g}}$$

where

- **L** is the length of the pendulum in meters
- **g** is the gravitational field strength, or acceleration due to gravity

This quantity at sea level is 9.81 m/sec$^2$ and can be calculated as

$$g = G\frac{M_{Earth}}{{R_{Earth}}^2}$$

where

- **G** = 6.67 x $10^{-11}$ nt m$^2$/kg$^2$
- **M** $_{\text{Earth}}$ is the mass of the earth (6.02 x $10^{24}$ kg)
- **R** $_{\text{Earth}}$ is the average radius of the earth (6.4 x $10^6$ meters)

Notice in the formula that the mass of a simple pendulum's bob does not affect the pendulum's period; it will however affect the tension in the pendulum's string.

In this related lesson, you will find a derivation of this formula for the period of a simple pendulum that will help you understand the restrictions on its use. It will also explain to you why a simple pendulum is NOT a true representation of simple harmonic motion, SHM. Take a few moments and use this physlet to investigate how the period of a pendulum is impacted by its length and its initial displacement.

The **frequency** of a pendulum represents the number of vibrations per second. This quantity is measured in hertz (hz) and is the reciprocal of the pendulum's period.

$$f = \frac{1}{T}$$

**Let's practice a few problems with these formulas.**

What would be the period of a pendulum located at sea level if it is 1.5 meters long?

If the pendulum's length were to be shortened to one-fourth its original value, what would be its new period?

How many complete vibrations would this shorter pendulum trace out in one minute if it were to be released with a small initial amplitude?

At sea level, how long would a pendulum be if it has a frequency of 2 hz?

The timing mechanism in a grandfather's clock is based on the principles of a simple pendulum. If your clock is gaining time, should you shorten or lengthen its pendulum?

Would a grandfather clock keep time on the moon?