

Visualizing Physics with STELLA: Simple Harmonic Motion

Introduction

This lesson uses “The Pendulum Story” model to explore the concepts behind a simple pendulum. You will be able to explore what effect, if any, string length, initial displacement, and pendulum ball mass have on the amplitude, period, and frequency of the pendulum’s motion. You can also see how the variables of simple harmonic motion are related.

What you need

To complete this activity you will need “The Pendulum Story” sample model and STELLA software. If you don’t own a STELLA license, you can use the free isee Player software.

To download the model, visit:

<http://www.iseesystems.com/community/downloads/EducationDownloads.aspx>

To download the isee Player, visit:

<http://www.iseesystems.com/software/player/iseeplay.aspx>

Instructions

- 1.) Open the model in STELLA or the isee Player.
- 2.) Read the Background and Context section to read more about the model. Return to the Home screen.
- 3.) Go to the Conduct Experiments section, and notice there are three inputs you can control: mass of ball, initial displacement, and string length. Your goal is to determine how each of these variables affects the movement of the pendulum.
- 4.) Click on Instructions to find out how to use the functions of the model. Note that displacement is on the y-axis and time is on the x-axis. The model will display multiple trials on the same graph to make it easier for you to compare trials. If you wish to clear the graph, click on the reset button.

Key Questions – Part I

Use the information you get from conducting experiments to answer the following questions:

- 1.) How does the magnitude of the displacement affect the period, frequency, and amplitude of the pendulum’s motion?
- 2.) What happens when the displacement is a negative value? What is the significance of this in the physical world, i.e. what difference would you observe if you were actually swinging the pendulum?

Key Questions – Part I (cont'd)

- 3.) How does the string's length affect the period, frequency, and amplitude of the pendulum's motion?
- 4.) Grandfather clocks use a pendulum to keep time. If the grandfather clock was running slowly, would you make the pendulum shorter or longer? Why?
- 5.) How does the mass of the ball affect the period, frequency, and amplitude of the pendulum's motion?

Key Questions – Part II

To answer the following questions you should look at page two of the graph which displays velocity vs. displacement. To see page 2, click on the dog ear at the bottom left corner of the graph.

- 1.) What is the displacement when velocity is at its maximum? If you were watching a pendulum, where would the ball be when maximum velocity is achieved?
- 2.) What is the velocity when displacement is at its maximum? Where would the ball be at this point?
- 3.) Why are velocity and displacement sometimes negative?

About STELLA

Using STELLA modeling and simulation software, students can create models and run simulations of systems over time. The results of simulations are displayed with visual representations to support diverse learning styles.

Thousands of educators and researchers have made STELLA the gold standard; using it to study everything from economics to physics, literature to calculus, chemistry to public policy. K-12, college, and research communities have all recognized STELLA's unique ability to stimulate learning.

For more information, contact isee systems, inc.

www.iseesystems.com

Phone: (603) 448-4990

Toll Free: (800) 987-6758

Fax: (603) 448-4992