Name(s) _____

Purpose

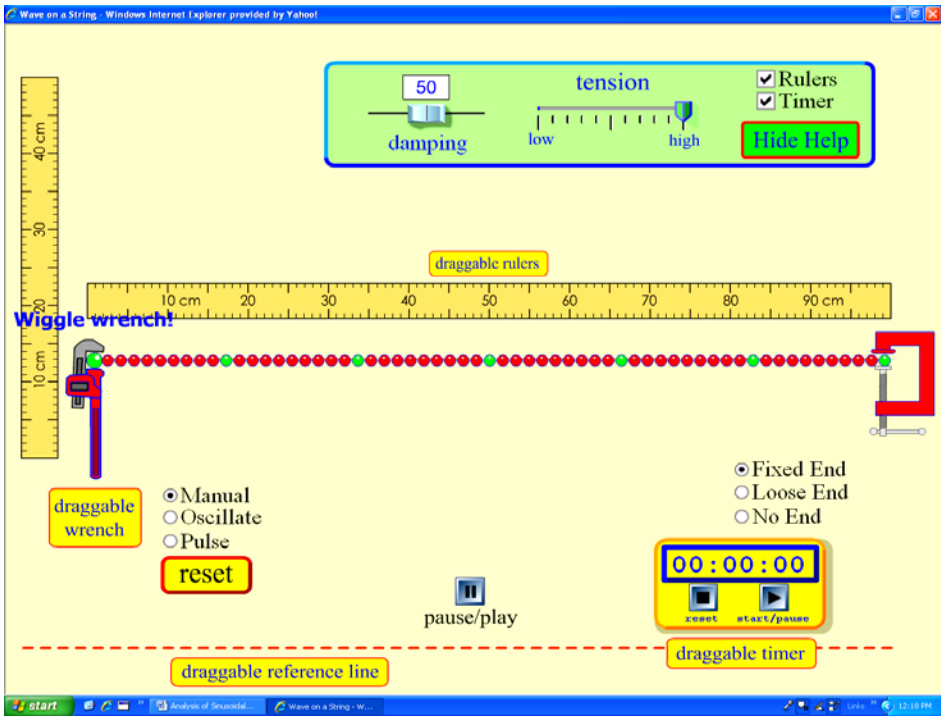
In this computer based activity you will apply the properties of sinusoidal function to model the movement of energy on the sting. While working on this activity, you will practice the applications of the following trigonometric concepts:

- Amplitude of sinusoidal function
- Period of sinusoidal function and its relation to frequency
- Wavelength
- Vertical transformation of a sinusoidal function
- Horizontal compression.

Getting Familiar with the Simulation

- Open the simulation Wave on a String
  http://phet.colorado.edu/new/simulations/sims.php?sim=Wave_on_a_String

- On the left upper corner press on Rulers and Time and Show Help



- There are two rulers shown on the screen; one horizontal, one vertical. Using respective ruler measure the distance between two consecutive green sections of the string _____
- Align the **draggable reference** line with the string.
- Adjust the **vertical ruler** so that its zero is aligned with initial section of the string.
- Wiggle the wrench so that the initial amplitude of the wave is 25 cm.
- Does the amplitude of the wave remain constant and the energy is moving along the string? _____

Part 1. Purpose: Finding the equation of a wave with prearranged components.

Set up the controlled variables of the experiment as follow:

- **Mode** of generating the wave to **Oscillate**
- **Amplitude** of the wave to **15 cm.** Note **15cm = 81 units** on the screen scale
- **Damping factor** that determines the loss of transmitted energy per wave to **0**
- **Tension** that represents the properties of the medium in which the wave moves to **high**
- **The medium** at the end of the right side of the string; **No End.** This factor assures no change in medium at the end of the string.
- Adjust the **frequency** factor so that only **one wave** is shown on the string.
- Using the **timer** provided on the screen or a stopwatch, measure the time for the **oscillator** to make one full revolution. Repeat the measurements 4 times and find the average value.

Trial	1	2	3	4
Time (in sec)				

Average time **T (period)** =_____

- What quantity, from the listed below, is represented by the measured time, seconds?

A. Frequency B. Wavelength C. Period D. Circumference

A general form of a sinusoidal function is following

$y = A\sin\left(\frac{2\pi}{T}\right)t$ or $y = A\sin(2\pi f)t$, where:

A is the amplitude of the function, expressed in the units of length,
T is the period of oscillation, expressed in the units of time (s)
f is the frequency of wave production, expressed in the units of hertz
t represents a general independent variable (time) of the function

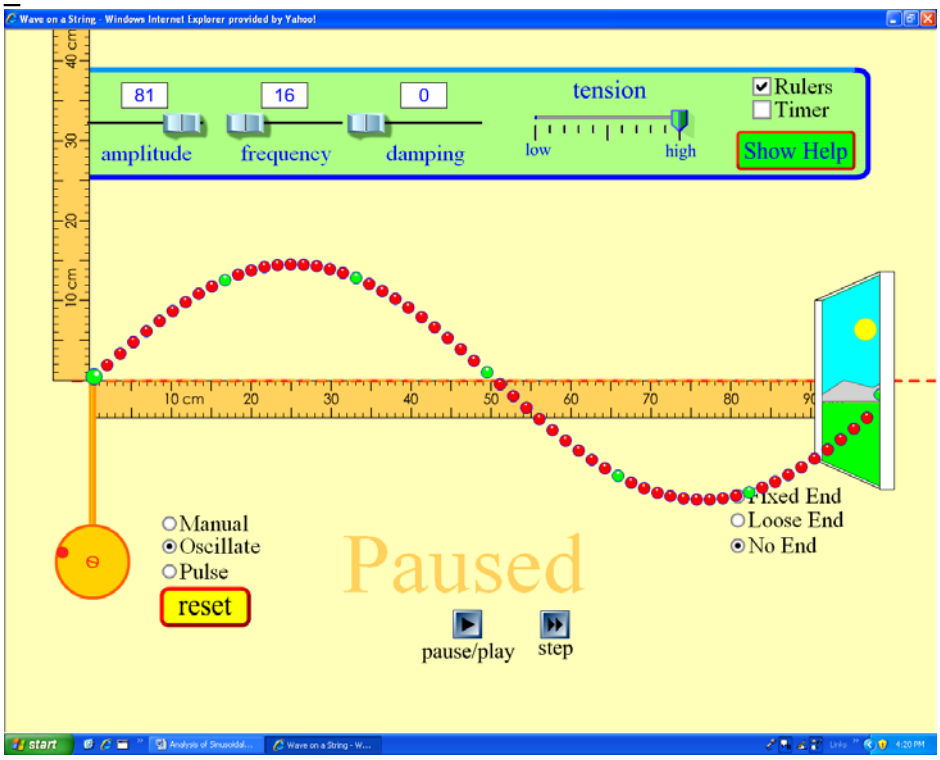
Substitutes indicated quantities to the general form and write the 2- function equations (in terms of T and f) for the motion of the energy on the string.

_____

Part 2. Analysis of the wavelength and the speed of the wave.

- Using the settings from the part 1, measure the wavelength of the wave.

- Using a general equation for speed of the front of the wave that is $\text{Speed} = \frac{\text{Distance}}{\text{Time Elapsed}} = \frac{\text{Wavelength}}{\text{Period}}$ calculate the speed of the wave on the string:



- Will the speed of the wave change if the amplitude changes?

- Will the speed of the wave change if the frequency changes?

Part 3. Modifying controlled variables

For each scenario given below construct a respective sinusoidal function, and then verify, using simulations, how the parameters affect the physical appearance of the wave.
As the reference equation, refer to form constructed in Part 1.

1. Suppose that the x-axis; the draggable reference line, is moved 30 cm below the string. Identify the parameter that changes from the listed below and then construct the function.
A. Vertical Transformation B. Wavelength C. Period D. Horizontal Compression

_____

2. Suppose that the period of the wave decreased by 50%.

_____

3. Suppose that the amplitude of the wave increased by 4 cm.

_____

Part 4. In this part you will investigate the influence of the tension factor on the wave components.

1. Change the tension of the string to 7/10 of the high value. What parameters of the wave changed? Circle the one(s) that apply.

A. Speed B. Horizontal Compression C. Period D. Wavelength

2. Calculate the speed the speed of the new wave?

_____

3. Will increase of frequency of the oscillator produce more waves? Write the answer and then check your predictions using the simulation.

_____

4. Does the wavelength of the wave depend on the frequency or on the medium represented here by the tension?

_____