Wave on a String

Your Name:
Date:
Class:

Answer the following questions using the simulator found at this page: https://phet.colorado.edu/en/simulation/wave-on-a-string. You will see the words "Wave on a String" with a box underneath. Press the Play button on that box to open the simulator. Play with the simulator for a few minutes and then set it up with the following settings:

1. Set it to "Oscillate" (green box in the upper-left corner).
2. Set it to "No End" (green box in the upper-right corner).
3. Set "Amplitude" to 1.0 cm (bottom control panel).
4. Set "Damping" to None (bottom control panel).
5. Set "Tension" to the middle setting (bottom control panel).
6. Turn on the "Rules" and the "Timer" (bottom control panel).

Note the "Slow Motion" and "Pause" buttons, which will help you as you try to answer the following questions.

1. What is a wavelength? Draw a wave in the space below and mark off one wavelength.

2. What does frequency mean? Set the Frequency setting to 1.0 Hz. Set the simulator to Slow Motion and use the timer to help you to write your own definition of the frequency of a wave. As you consider this question observe **both** the *oscillator device* and the *moving string*.

3. What is the definition of the frequency unit, which is hertz (Hz)?

4. What is the amplitude of a wave? Play with the Amplitude setting in the simulator to find the answer. Include a drawing in your response to this question.

5. What is the speed of a wave? Measure the speed of the wave using the settings as they are. Pause the simulator, start the timer, set it for slow motion, unpause and let the wave move a specific number of centimeters. Calculate speed in cm/s. Measure the speed three times using different lengths and times and report those three values along with the average.

6. Now you will determine how wavelength and frequency are related. To do so, fill in the following table. Make all measurements using the settings already given. You will vary the frequency to see how that affects the wavelength. Give wavelength measurements to the nearest tenth of a centimeter. For a very long wavelength, measure half a wave and multiply by two.

Frequency (Hz)	Wavelength (cm)
3.0 Hz	
2.0 Hz	
1.5 Hz	
1.0 Hz	
0.5 Hz	

7. Sketch a graph of your data on the grid below:
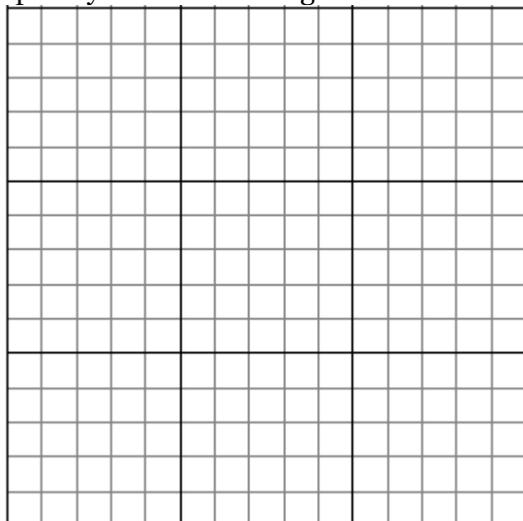
8. What happens to the wavelength of a wave when the frequency is doubled? That is, by how much does it have to be multiplied to get the new wavelength? (The answer may be a fraction).

9. What happens to the wavelength of a wave when the frequency is multiplied by four? That is, by how much does it have to be multiplied to get the new wavelength? (The answer may be a fraction).

10. What happens to the wavelength of a wave when the frequency is cut to one third? That is, by how much does it have to be multiplied to get the new wavelength?

11. What kind of proportion exists between the wavelength and frequency of a wave, inverse or direct? Justify your answer with repsect to the pattern in the data table *and* by reference to your graph.

12. Frequency is given in units of hertz (Hz) which stands for 'per second' or 1/sec (1/s). When multiplied by wavelength in centimeters the units combine as follows: (cm) × (1/s) = cm/s. The unit (cm/s) is a unit of speed. Mutiply your wavelengths by your frequencies for each of the rows in your data table above and record the answers next to the table.

13. What pattern do you notice in the speeds you calculated by multiplying wavelength times frequency? How does this result compare to your answer to the question at the beginning of this activity about the measured speed of the wave?

14. Write an equation relating wavelength, frequency, and speed for a wave using what you have learned in this activity. Use the symbol λ for wavelength, f for frequency, and s for speed.