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Phet: Waves On a String

**Waves on a String – Simulation**

Aim: to observe relationships between frequency, wavelength, speed of waves in a rope, and observe how these change with changing tension in the rope.

Method: Use the pHet app “Wave on a string”

<https://phet.colorado.edu/sims/html/wave-on-a-string/latest/wave-on-a-string_en.html>

**Experiment 1 – Speed of wave and tension**

Set to “Pulse”; “Fixed End”; Damping = None; Normal; Tension = Low

Turn the Ruler and Timer on

Use the ruler to measure the length of the piece of string. Record

Click the button on the pulse generator to send a pulse through the string

Use the timer to measure how long it takes for the pulse to travel back and forth 5 times.

Repeat on moderate and High tension

Results:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| String length = | | | | |
| Tension | Time for pulse to travel 5 round trips | Time to travel one round trip | Length of one round trip | Speed of wave = length / time |
| Low |  |  |  |  |
| Medium |  |  |  |  |
| High |  |  |  |  |

Conclusion:

How does tension affect the speed of a wave in a rope?

**Experiment 2 – Generating Standing Waves of Different Harmonics**

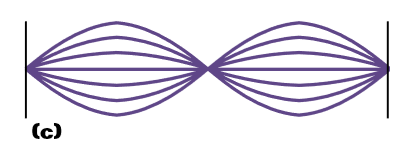
Set to “Oscillate”; “Fixed End”; Damping = None; Normal; Tension = Medium, Amplitude = 0.20 cm

Turn the Ruler and Timer on

Use the ruler to measure the length of the piece of string. Record it here:

Use the results of Experiment 1 to determine the speed of the wave when the rope is set to medium tension. Record here:

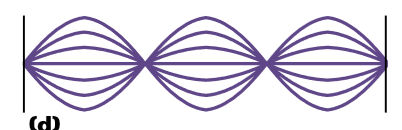
Analysis:

1) Determine the wavelength that will generate a second harmonic standing wave. Record it here:

Use v = λ \* f to calculate the frequency of this wave.

Record it here:

Input this frequency into the simulator and press restart. If it works, show your teacher and get it checked off:

2) Determine the wavelength that will generate a third harmonic standing wave. Record it here:

Use v = λ \* f to calculate the frequency of this wave.

Record it here:

Input this frequency into the simulator and press restart. If it works, show your teacher and get it checked off:

3) Draw a picture of a fifth harmonic standing wave:

Determine the wavelength that will generate a fifth

harmonic standing wave.

and Record it here:

Use v = λ \* f to calculate the frequency of this wave.

Record it here:

Input this frequency into the simulator and press restart. If it works, show your teacher and get it checked off:

**Experiment 3: Relationship between wavelength and frequency**

Set to “Oscillate” and “No End”

Keep the ruler and timer on

Set the frequency to 1 and tension to low

Measure the time it takes for a wave to travel the length of the string

Measure the length of a single wave length.

Do the same measurements at Frequency = 2 and 3

Repeat the experiment at moderate and high tension

Results:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tension | Frequency | Time to travel the length of the string | Wavelength | Speed =  Length/time | Frequency X wavelength |
| Low | 1 |  |  |  |  |
| Low | 2 |  |  |  |  |
| Low | 3 |  |  |  |  |
| Moderate | 1 |  |  |  |  |
| Moderate | 2 |  |  |  |  |
| Moderate | 3 |  |  |  |  |
| High | 1 |  |  |  |  |
| High | 2 |  |  |  |  |
| High | 3 |  |  |  |  |

Conclusion:

1. If the tension remains constant and the frequency increases, what happens to the wavelength?
2. Is there any pattern in the last two columns of the table (speed and Frequency X wavelength)?
3. What is the relationship between frequency, wavelength and speed of a wave?