**Waves in a Rope – 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 rope

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

Repeat on moderate and High tension

Results:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| String length = | | | | |
| Tension | Time for pulse to travel 5 lengths | Time to travel one length | Distance to travel one length | Speed of wave = distance/ time |
| Low |  |  |  |  |
| Medium |  |  |  |  |
| High |  |  |  |  |

Conclusion:

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

**Experiment 2: 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?

Experiment 3 : Measuring frequency, periods, and wavelength

Instructions: Select ocelate, slow motion, timer, and rulers.

1. Set frequency to .5Hz.
2. Set the amplitude to 1 cm.
3. Pause the simulation when the oscillator at the bottom of it’s cycle.
4. Click play on your timer. It should not start yet.
5. Click unpause. The waves and the timer will start.
6. Click pause when the oscillator is back at the bottom of the cycle. This means you have made one wave.
7. Use the ruler to measure wavelengths.
8. A period is how long it takes to make one wave. Record your data in the table below.
9. Repeat steps 1 - 7 for 1Hz, 2Hz, and 3 Hz.

Demonstration: Measuring the period. <https://www.youtube.com/watch?v=QRzSha78gPc>

Demonstration: Measuring the Wavelength: <https://www.youtube.com/watch?v=P-3PEbpIsww>

|  |  |  |
| --- | --- | --- |
| Frequency | Period | Wavelength |
| .5 |  |  |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |

1. **Based on observations, What is wavelength?**
2. **Based on observations, What is a period?**
3. **Based on observations, what is frequency?**
4. **Based on observations, What is the relationship between frequency in period. (compare and contrast). Give an example to defend your answer.**
5. **Based on observations, what is a question you still have about waves?**