

Wave on a String

Classroom worksheet · Interactive simulation: <https://lkforge.com/tools/physics/wave-on-a-string/>

Name: _____ Date: _____

Learning objectives

- Relate wave speed, frequency, and wavelength.
- Describe how tension and linear density affect wave speed.
- Recognize standing waves and their nodes and antinodes.

Variables to change

- Frequency
- Amplitude
- Tension
- Damping

Procedure

1. Drive the string at a steady frequency and measure the wavelength.
2. Double the frequency and measure the wavelength again.
3. Increase the tension and observe the effect on wave speed and wavelength.
4. Tune the frequency until a stable standing wave (fixed nodes) appears.

Observations

Record frequency, wavelength, and computed wave speed ($v = f\lambda$) for each trial.

Questions

1. Write the relationship between wave speed, frequency, and wavelength.

2. When you doubled the frequency at fixed tension, what happened to the wavelength?
3. How does increasing tension change the wave speed?
4. What is a node? An antinode?
5. What conditions produce a standing wave on a fixed string?

Answer key (instructors)

- **1.** $v = f \cdot \lambda$.
- **2.** It halved, because v stays roughly constant so $\lambda = v/f$.
- **3.** Wave speed increases; $v = \sqrt{T/\mu}$, so higher tension means faster waves.
- **4.** A node is a point of zero displacement; an antinode is a point of maximum displacement in a standing wave.
- **5.** When the driving frequency matches a resonant frequency so reflected waves reinforce, forming a stable pattern ($L = n \cdot \lambda/2$).

A wave transfers energy along the string at speed $v = \sqrt{T/\mu}$. Since $v = f\lambda$, raising the frequency shortens the wavelength. At resonant frequencies incident and reflected waves form standing waves with fixed nodes and antinodes.