PhET Tips for Teachers

Wave on a String

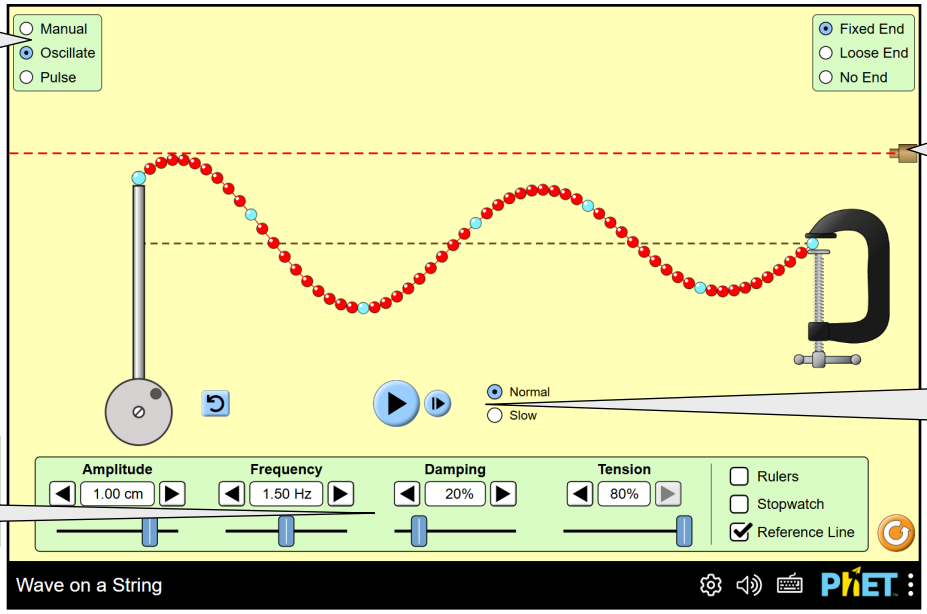
Wave on a String allows students to create their own waves and explore wave concepts such as amplitude, frequency, damping, tension, speed, reflection, and interference.

CREATE a wave with an oscillator or pulse generator, or by moving a wrench

PLACE reference line anywhere

PAUSE and step through the motion of the wave or **VIEW** the wave in slow motion

CONTROL wave properties

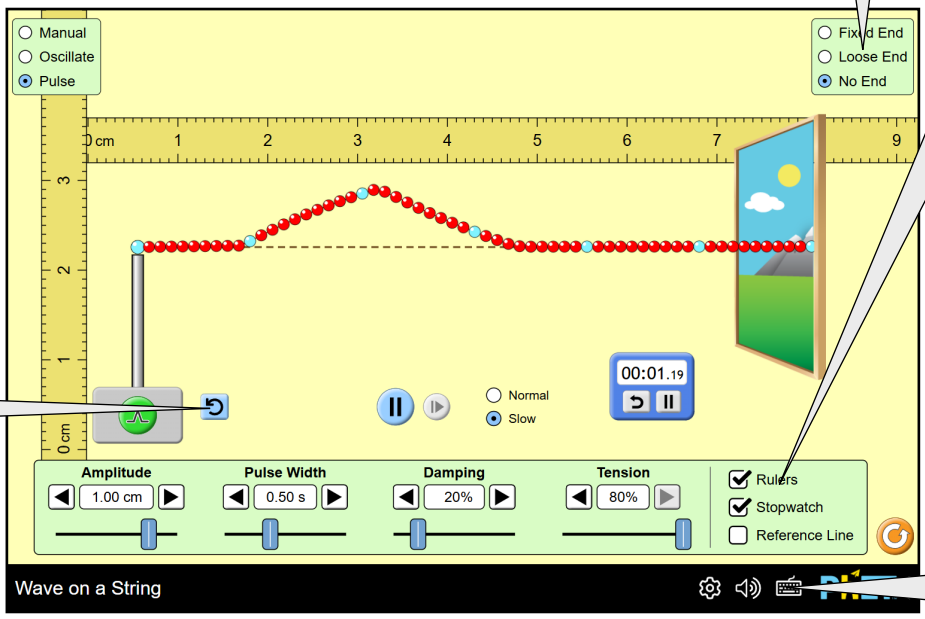


EXPLORE waves with a fixed, loose, or no end point

MEASURE distance or time

RESTART the wave while preserving the other settings in the sim

ACCESS sim controls (sound on/off, keyboard shortcuts) or add features (interactive highlights)



Student Insights

- Some students struggle with damping, which is like internal resistance. Some students may want to understand more and could use Masses and Springs (“Damping” is called “Friction” in this sim) or Resonance sim (the Teacher Tips give a mathematical definition).
- This sim may be helpful for students as an introduction to more difficult concepts like sound, earthquakes, or light.

Model Simplifications

- The waves are modeled as a rope on the ground being oscillated from side to side in the absence of gravitational effects and external friction.
- The rope is modeled as a string of particles, and can appear dissociated under extreme conditions, as the processing increments are not infinitesimally small.
- The tension in the string does not have any specific value in the model, as the appearance of tension is achieved by varying the time step used to animate the wave. The tension slider does not behave linearly — it operates on powers of two (High is 4x larger than Low). The functional relationship between the tension and wave speed can be qualitatively observed if tension is given arbitrary units in increasing powers of two (e.g. 2, 4, 8 or 64, 128, 256).
- See the Model Documentation for more details.

Suggestions for Use

Sample Challenge Prompts

- Predict the pattern of a reflected wave from a fixed or loose end.
- Develop a method to determine the speed of the wave.
- Design an experiment to find the relationship between a the wave speed, wavelength, and frequency.
- Measure the the wave speed and at different levels of tension to determine the relationship between speed and tension.
- Predict how two waves will interfere.
- What effect does damping have on a wave?

Customization Options

Query parameters allow for customization of the simulation, and can be added by appending a '`?`' to the sim URL, and separating each query parameter with a ‘`&`’. The general URL pattern is:
`…html?queryParameter1&queryParameter2&queryParameter3`

For example, in Wave on a String, if you want to mute audio (`audio=muted`) and disable pan and zoom (`supportsPanAndZoom=false`) use:
https://phet.colorado.edu/sims/html/wave-on-a-string/latest/wave-on-a-string_all.html?audio=muted&supportsPanAndZoom=false

To run this in Spanish (`locale=es`), the URL would become:
https://phet.colorado.edu/sims/html/wave-on-a-string/latest/wave-on-a-string_all.html?locale=es&audio=muted&supportsPanAndZoom=false

⚙ Indicates this customization can be accessed from the Preferences menu within the simulation.

Query Parameter and Description	Example Links
⚙ `locale` - specify the language of the simulation using ISO 639-1 codes. Available locales can be found on the simulation page on the Translations tab. Note: this only works if the simulation URL ends in "_all.html".	`locale=es` (Spanish) `locale=it` (Italian)
`audio` - if muted, audio is muted by default. If disabled, all audio is permanently turned off.	`audio=muted` `audio=disabled`
`allowLinks` - when `false`, disables links that take students to an external URL. Default is `true`.	`allowLinks=false`
`supportsPanAndZoom` - when `false`, disables panning and zooming using pinch-to-zoom or browser zoom controls. Default is `true`.	`supportsPanAndZoom=false`

Device and Input Features

Alternative Input and Touchscreen Devices

- Bright pink Interactive Highlights can be enabled for mouse and touch interaction. During demos, Interactive Highlights can draw attention and focus from students. To find and activate Interactive Highlights, open the Preferences menu and look for the Visual tab.
- This sim has custom keyboard shortcuts. See the Keyboard Shortcuts dialog  in the navigation bar for more details.

Auditory Features

Core Description

- This simulation features interactive description to support non-visual access, delivered only while using screen reader software. See the Introduction to Interactive Description video for more info on how to use this feature.
- Teachers can access the A11y View here to decide if this sim's interactive description meets their instructional needs. *Reminder: A11y View is not intended for student use and will not provide a good experience for learners using screen reader software.*

See the simulation page for all supported inclusive features.

See all published activities for Wave on a String here.
For more tips on using PhET sims with your students, see Tips for Using PhET.