

Properties of Waves with [Waves-on-a-string](#) simulation

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**Guiding Question: What are amplitude and frequency and how does changing them affect the wavelength of a wave on a string? - (2 day lesson)**

**Students will be able to:**

- Discuss wave properties using common vocabulary.
- Draw arrows to show the amplitude and wavelength on a wave diagram.
- Measure frequency of a pulse or oscillating wave in a system and explain how it can be changed.
- Determine which properties-frequency and/or amplitude- affect wavelength.
- Use a partially filled data table to design an experiment

**Background:**

- Introduce a wave as **a disturbance that transmits energy through matter or space** (Holt Science & Technology – 2001)
- [Anatomy of a Wave](#) partner activity ( or an activity to introduce the general shape of a two dimensional wave with crest and troughs defined)
- \*There is a nice demonstration sim of [Transverse, Longitudinal, and Periodic Waves](#) at NYU. <http://www.physics.nyu.edu/%7Ets2/Animation/waves.htm> The sims are not interactive, just movies.

**Teacher notes:**

	indicates students write a response		indicates students discuss with partner
	Indicates students should check in with teacher before going further		

- This simulation is used to introduce energy moving through matter. I start with defining a wave by opening the simulation [wave on a string](#) to the image of the wrench and the rope in a still position. I introduce the wave-on-a-string system and ask a student to come up and make a “disturbance” in the system.
  - We discuss **the source, receiver** and then the **medium**
  - I ask them what the result of the disturbance was and they tell me “waves”.
  - I also show students that the rulers can be moved anywhere they need them in order to measure.
  - **“Reset” is only a restart.** I will not reset all parameters to the way they were at the beginning. Students need to be sure they have controls set as described.

\*website from *Wave-on-a-string lesson* by Trish Loeblein

- At this time I tell them we will be working with this simulation after completing the pre-lab. I have simplified my lesson to focus on amplitude, frequency and wavelength. I come back to tension of the string and damping when we wrap up the lesson.
- The lessons laid out above are leading to the study of sound energy and light energy. Many PhET simulations provide further insight into these topics and I encourage you to search the sims [PhET Home](#) to find additional materials for labs or demonstrations.
- I continue with longitudinal waves and show how the amplitude and frequency apply. I start with the [wave interference](#) simulation on the **sound tab**- and have them try to draw the wave they see. (this is actually the beginning of my sound unit)
- Wrap-up: Class discussion as noted in the student sheet. I do this in various ways. Sometimes I have two groups join and hand them a question they must discuss and report out to the group. Sometimes I let eager individuals come to the board and use the sim to explain what he/she and partner came up with.
  - I also display the simulation and we look at the tension of the string and damping. We work with various “what ifs” and the goal is to get students to make the connection that damping can “remove” friction in the system. This allows the wave to continue (best out the window) with the amplitude staying the same as the wave travels down the string away from the source. In our investigations, the amplitude decreased as the wave moved away from the source (damping at 50).
- “Frames” are used in many of my activities to help students put their ideas into words. I give students the choice to use them or not, and explain that they may be more helpful or more confusing. As the year progresses, I include them less often.