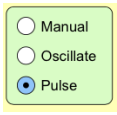
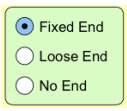
3.3.1 Superposition of waves

When waves meet they add together. This is called superposition.

PhET SIM

Run the following simulation:
https://phet.colorado.edu/sims/html/wave-on-a-string/latest/wave-on-a-string_en.html

Choose 

and 

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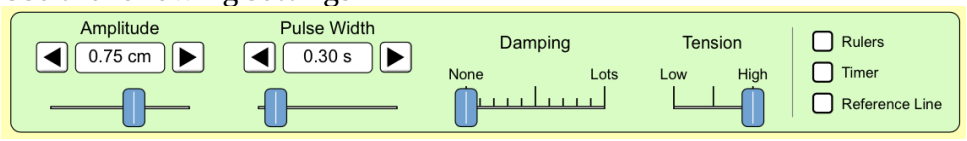
Use the following settings:

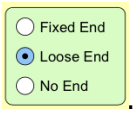


Now send a pulse down the string.

(1) What happens to the pulse at each end?

Press restart. Now send a pulse down the string and a second when the first pulse is on the way back. Choose slow motion and watch what happens when the pulses meet.

(2) Describe what happens.

Press restart. Now choose 

.
Send a pulse down the string.

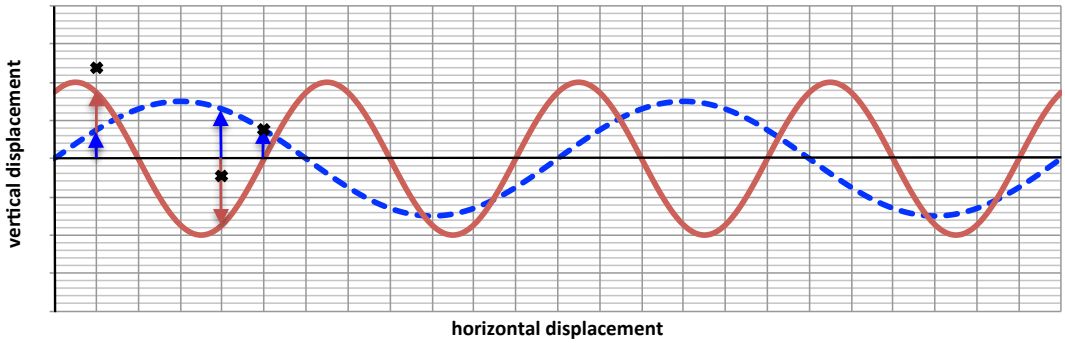
(3) What happens to the pulse at the loose end?

Press restart. Now send a pulse down the string and a second when the first pulse is on the way back. Choose slow motion and watch what happens when the pulses meet.

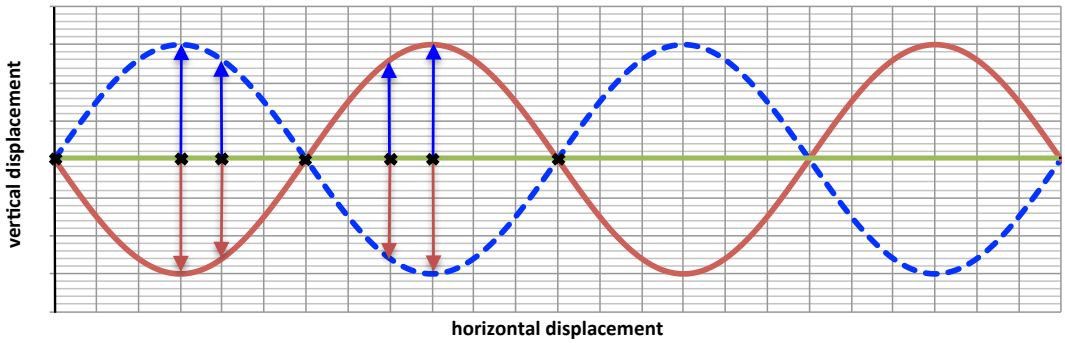
(4) Describe what happens.

When waves combine (superpose), we just sum together the heights of the two waves at every point.

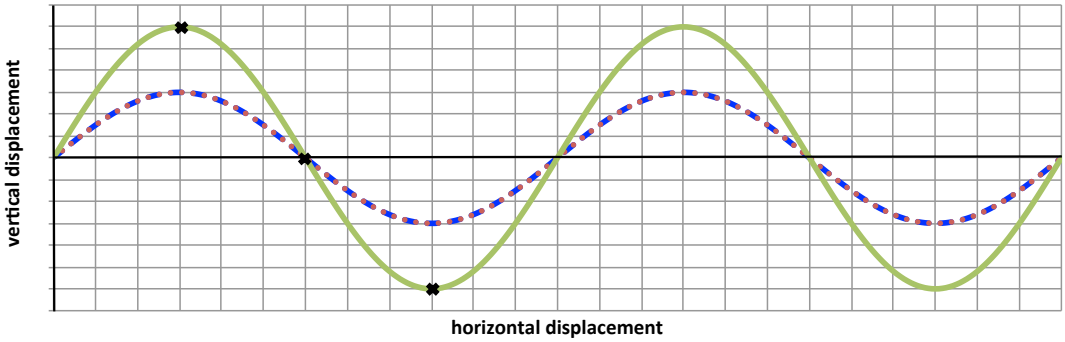
(5) Add together the following two waves, and plot the resultant wave on the same graph. All you have to do is add the height of the two waves at any point – 3 example points are shown.



When waves with the same frequency (and wavelength) and similar amplitude superpose, they can combine in the following ways:



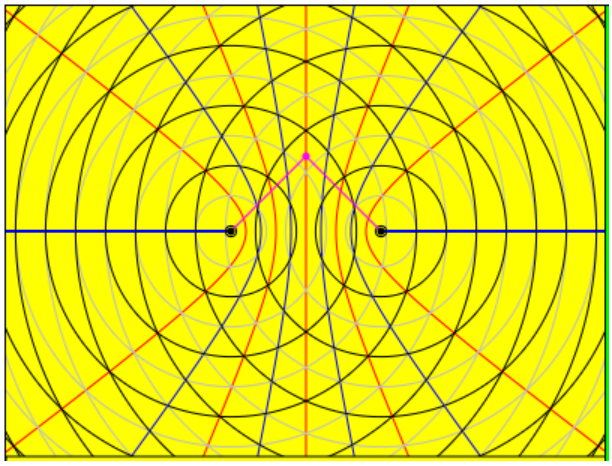
The waves are antiphase (180° phase difference). At every point the two waves cancel to produce a resultant wave with zero amplitude everywhere. This is known as destructive interference.



If we superpose two waves that are in phase (0° phase difference), then they combine to produce a wave which is twice as big. This is known as constructive interference.

Take a look at the following simulation:
http://www.walter-fendt.de/html5/phen/interference_en.htm

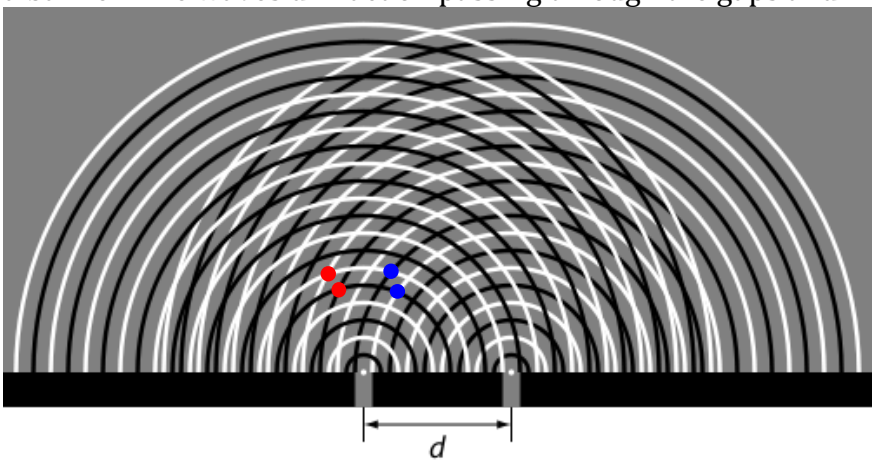
This simulation shows two sources of circular waves spreading from two point sources. The waves from these two sources overlap and superpose.



The black lines show 'wavefronts'. These are parts of the wave that are in phase. You can imagine the wavefronts as peaks of the wave. The red lines show areas where the waves from the two sources always meet in phase and combine constructively. The blue lines show where waves always meet in antiphase (180° phase difference) and so combine destructively.

The pattern that is observed is called an interference pattern.

A similar interference pattern can be observed for waves passing through gaps in a barrier. The waves diffract on passing through the gaps and interfere.



The dark lines show wave peaks and the pale lines show wave troughs.

Use a red pen and mark dots where waves meet in phase (i.e. peak-peak or trough-trough). An example is done for you. Connect up your dots.

Use a blue pen and mark dots where waves meet in antiphase (i.e. peak-trough). An example is done for you. Connect up your dots.