

# Damped Oscillation

Damped oscillation is an oscillation that gradually decreases, generally due to friction in the mechanism.

There are three levels of damped oscillation:

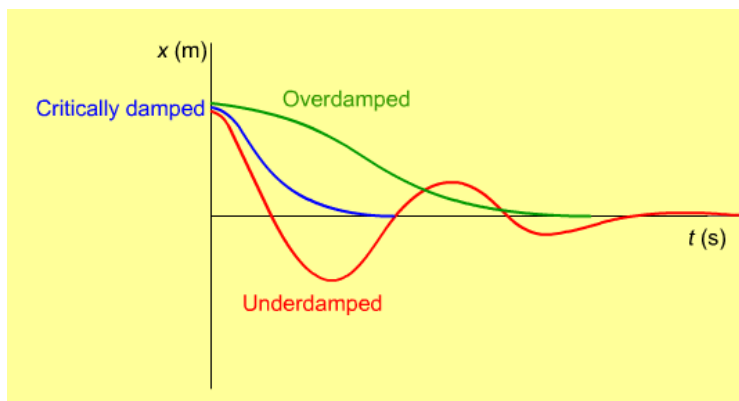
<http://demonstrations.wolfram.com/DampingInRLCCircuits/>



Under Damped: small amount of friction, oscillations happen but the amplitude gradually decreases

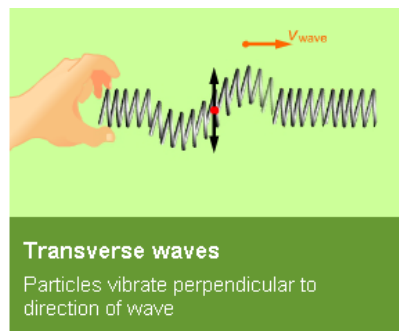
Critically Damped: the perfect amount of friction, object just goes straight to equilibrium but in basically the same way it would if undamped.

Over Damped: Lots of friction, it takes the object much longer to reach equilibrium because it has to fight the friction.

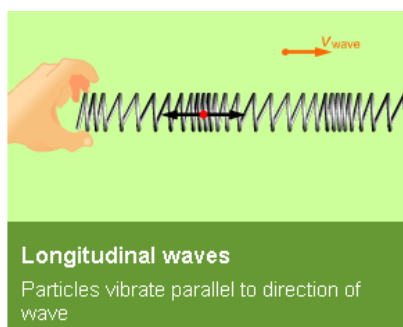


## Transverse vs Longitudinal Waves

Transverse: particles move perpendicular to motion of wave.



Longitudinal: Particles move parallel to motion of wave. (Compression Wave)



## Wave Speed

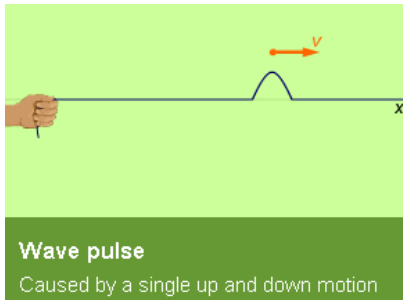
Different waves travel at different speeds depending on the medium they are moving through and what is causing the wave.

$$v =$$

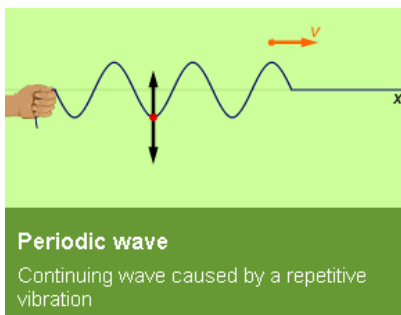
Speed of light:  $3 \times 10^8$  m/s

Speed of sound:  $343$  m/s

## Wave Pulse: A single peak



## Periodic Wave: a continuous oscillation

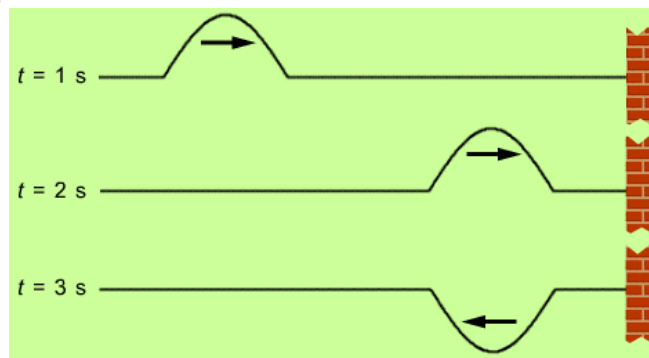


this assumes that the medium continues for ever

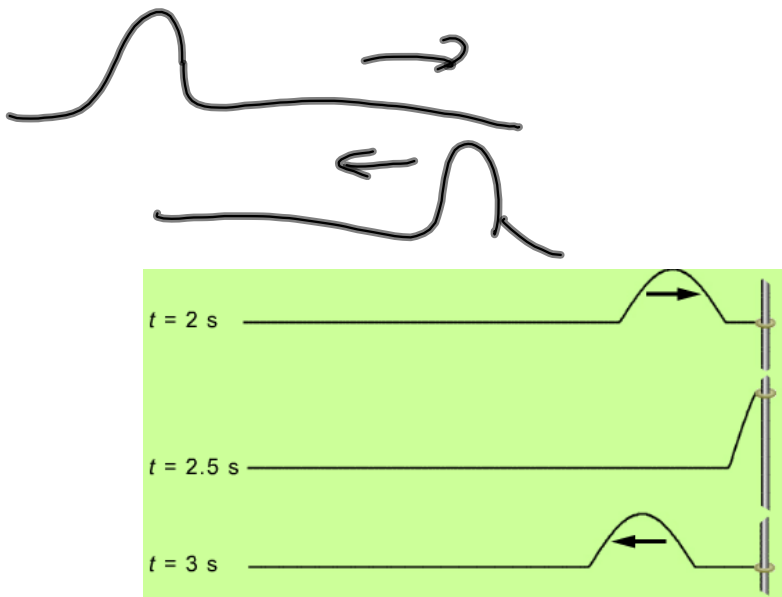
But when the medium ends, interesting things happen and different things happen if the end is fixed or unfixed.

When a wave meets a barrier, things happen

Fixed end:



Un-Fixed End:



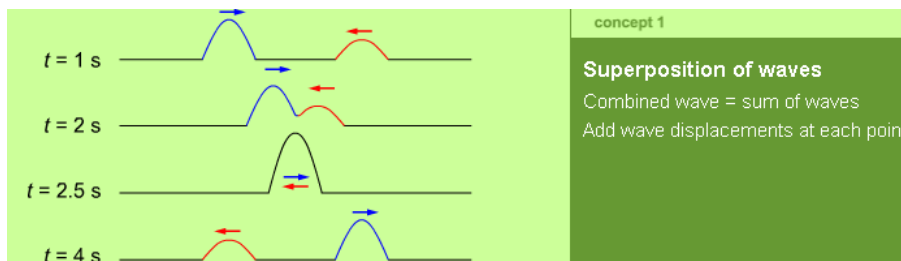
# The Principle of Superposition

When two waves pass by each other they combine, this is called superposition.

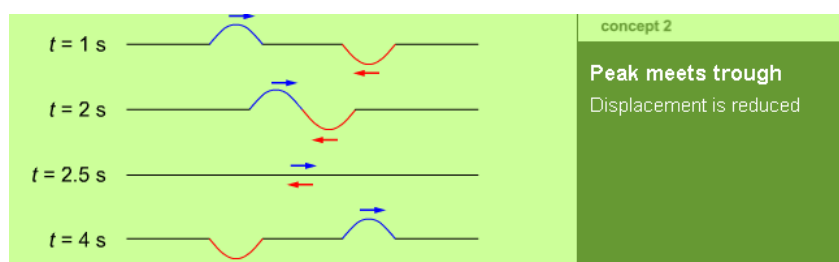
Let's play with this some:  
in the real world and in physicstopia



## Constructive Interference:



## Destructive Interference:



## Standing Waves

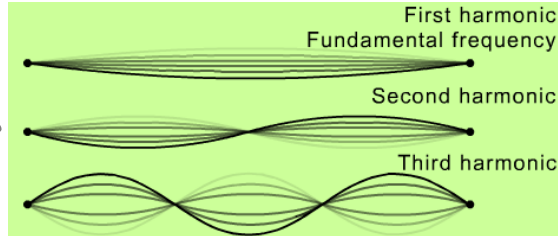
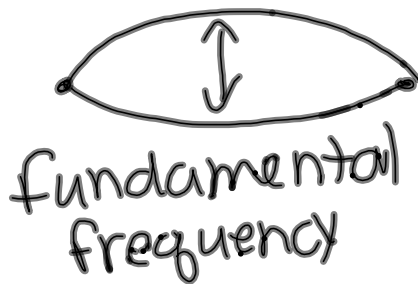
A standing wave is a wave that does not travel

Let's try to make one:  
in the real world and in physicstopia



A standing wave is created by two identical waves traveling in opposite directions.

In a string of fixed length, there are multiple types of standing waves that can be produced



A ← the note A

$$f = 440 \text{ Hz} \quad T = \frac{1}{440} \text{ s}$$

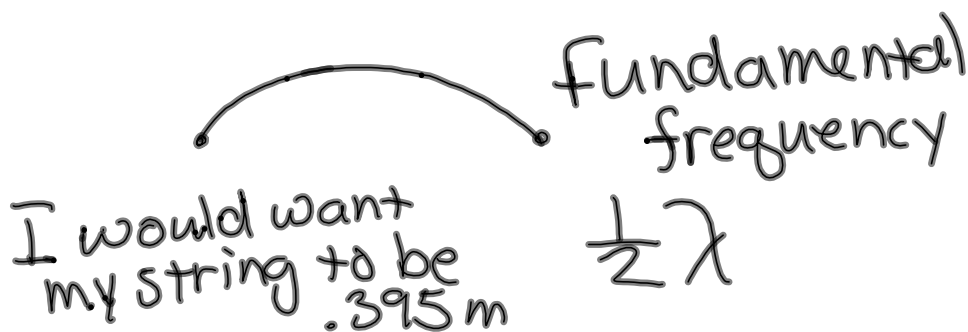
what is the wave length

$$v = f \lambda$$

$$v_{\text{sound}} : 348 \text{ m/s}$$

$$\frac{348 = 440 \lambda}{440}$$

$$\lambda = 0.79 \text{ m}$$



Thicker string: lower pitch

- lower frequency
- longer wavelength