AP Phys 1 Unit 12.1 Notes - Mechanical Waves

12.1 - Mechanical Waves and Properties.

Surf This!!

1. Wave Review!

Draw and label the parts of a wave:

Component Corral

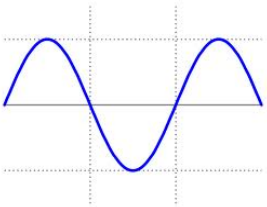
Wavelength λ

Amplitude **+A** **-A**

Displacement

Equilibrium **Trough**

Period **Crest**



Define the following:

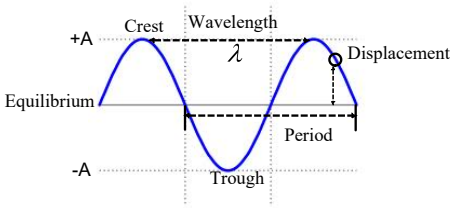
Frequency:

Oscillation:

Sinusoid:

Wave Review Answers:

Amplitude: Maximum displacement of a wave



Frequency: Number of cycles per second

Oscillation: Cyclic (repeated) motion of a system

Sinusoid: The curve an oscillation makes

Mechanical Waves

A wave that propagates as an oscillation of matter, transferring energy (not matter) through a medium.

Waves move over long distances, but transmission medium movement is limited, so oscillating material does not move far from its initial equilibrium position.

Wave Types

Depending on motion, waves can be:

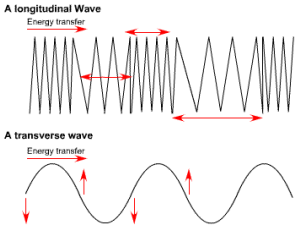
Surface Wave: Travels at the junction of two media.

Transverse wave: a wave with side to side motion: material must have shear strength for this type.

Longitudinal wave: forward and backward motion.

Slinky demo.

Surface Waves



Wave Speed

Waves travel at different velocities, depending on what medium it is moving through and the wave type (surface, transverse, or longitudinal).

Wave Equations:

$\lambda = \frac{v}{f}$ AP Equation	$= v \bullet T$	λ = wavelength (m) v = wave velocity (m/s) f = frequency (Hz or s^{-1}) T = period (s)

Speed and wavelength change as a wave goes into a different medium, BUT frequency is unchanged.

2. Wave Speed Example

An aluminum rod is chimed, and rings with a frequency of 2880 Hz. If the velocity of sound in aluminum is 5100 m/s, what's the wavelength of the vibration in aluminum?

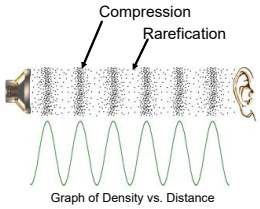
$$v = \lambda f$$

$$\lambda = \frac{v}{f} = \frac{5100\,m/s}{2880\,Hz} = 1.77\,m$$

Sound Waves

Sound we hear is a periodic wave - one from an oscillating source.

Particles disturbed by their neighbors disturb their other neighbors in turn, and a compression wave forms as this disturbance propagates through space.



Human Sound Wave demo. Line up and hit each other!

Earthquakes

Who here has been in an earthquake? Any good stories?

These are caused by movement of the plates in the Earth's crust. Sudden shifts at plate boundaries cause stored energy to be released in the form of ground movement.

Someone's Lucky Day.

Earthquakes

Compressional (longitudinal) waves, called P (primary) waves, travel fastest.

Shear (transverse) waves, called S (secondary) waves, travel slower.

There are more complex waves as well, let's see if the interweb is working today.

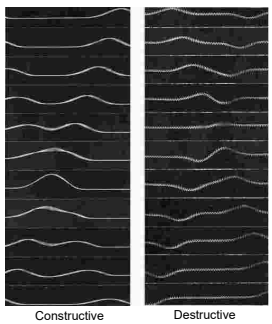
http://www.geometrics.com/what-are-the-different-types-of-seismic-waves/

Superposition

When two or more waves meet, their amplitudes add (or subtract) by the Principle of Superposition.

Constructive Interference: meeting waves build on each other.

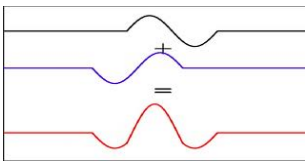
Destructive Interference: meeting waves cancel each other out.



Superposition Energy

What happens to the energy of the waves that have cancelled each other out "destructively?"

It's not destroyed, it's stored in the form of kinetic energy - the medium has some instantaneous velocity that will return to a wave form as soon as the colliding waves pass by.



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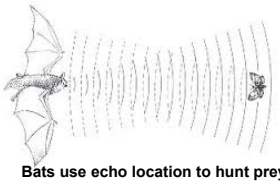
Other Wave Principles

Reflection: A wave will 'bounce' off an object and be redirected.

A common example of this is an echo.

Senior door handrail Demo (if time permits).



Bats use echo location to hunt prey.

The Story of Echo

Who knows the story of Echo?

She was a mountain nymph, who used her voice to distract Hera, Zeus' wife, telling stories while her nymph sisters fooled around with Zeus. Hera figured it out in the end, and took Echo's voice away.

Echo was reduced to mimicking the voices of others in a foolish way for the rest of eternity. Lame!

Echo the Nymph

Painting by Alexandre Cabanel, 1887)

Other Wave Principles

Refraction: A wave alters direction when travelling into a different medium at an oblique angle.

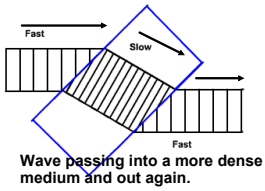
Happens because of changes in wave speed.

Commonly you'll see this with light.

Ever looked at something in water, and thought that it was bent?

Pencil in water demo.

Like getting your car wheels into a soft shoulder.



Wave passing into a more dense medium and out again.

Other Other Principles

Dispersion: Waves of different frequencies are diffracted more than other ones.

Light passing through a prism is an example of this.

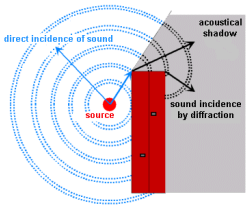
Blue light is refracted more than red light, so as a light beam passes into a prism, these two colors (and all those of the spectrum between) become more separated.

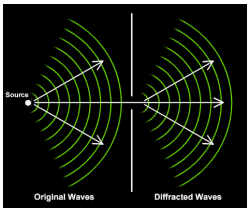
Prism demo.

Other Other Other Principles

Diffraction: Bending of light or sound waves around an edge - not related to refraction.

An example of this is that you can hear people talking around a corner, even though there is no echo.





Homework

12.1 Problems
Due: Next Class.