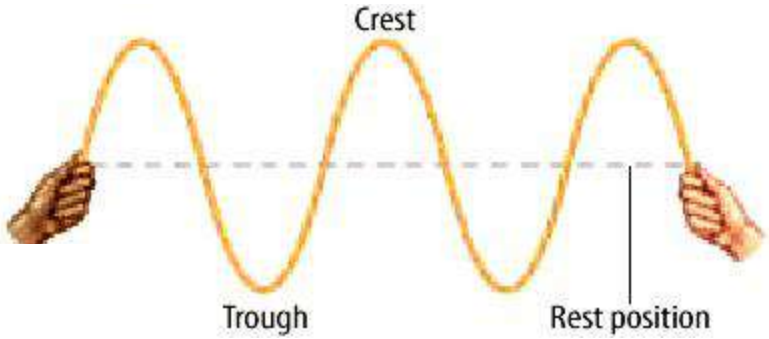
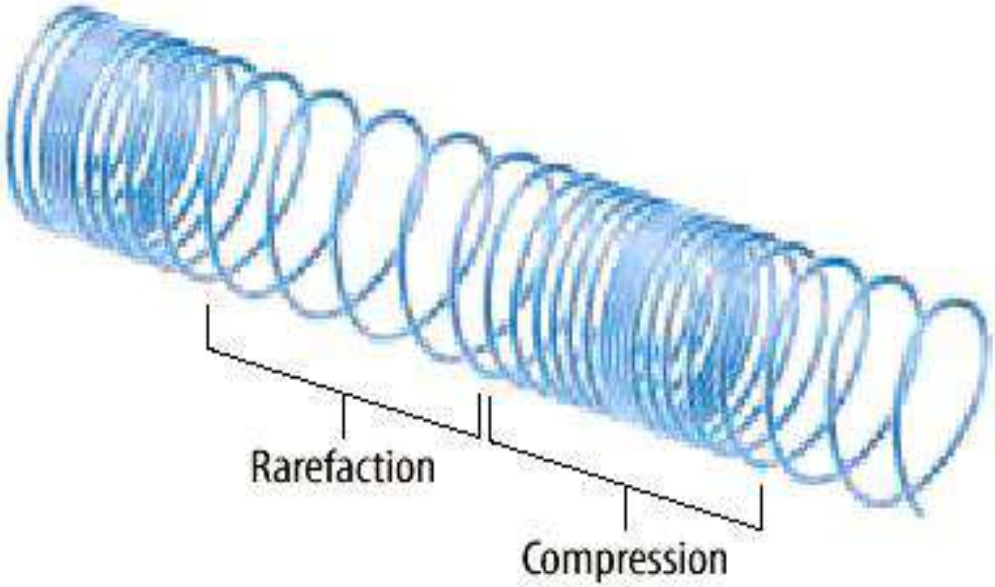
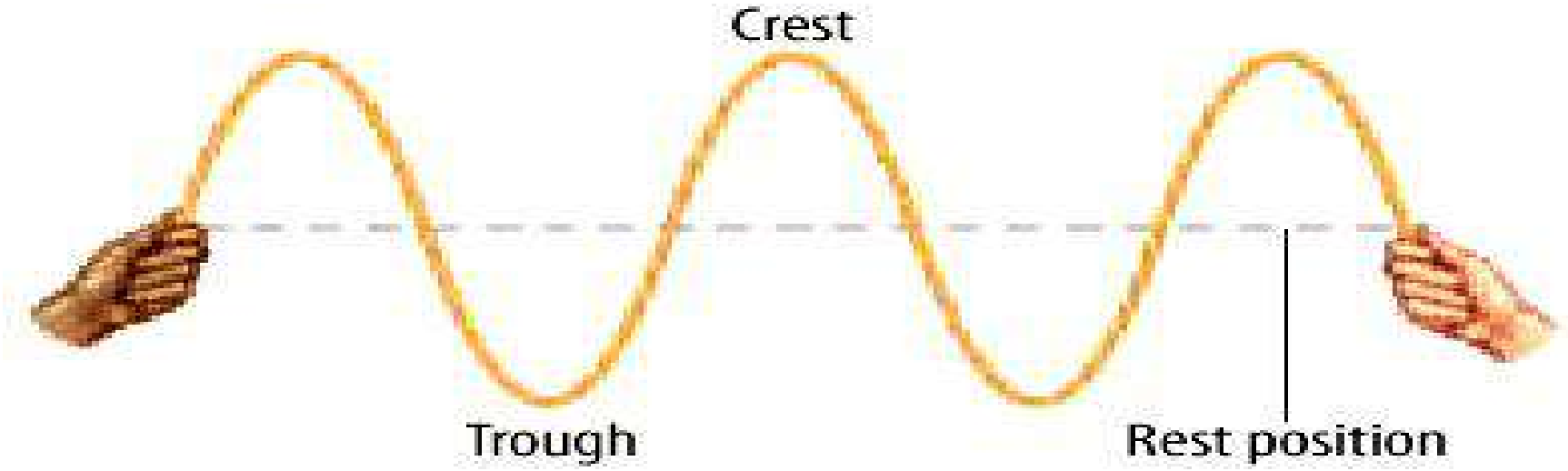
Waves





Tacoma Narrows

Transverse Wave- Light

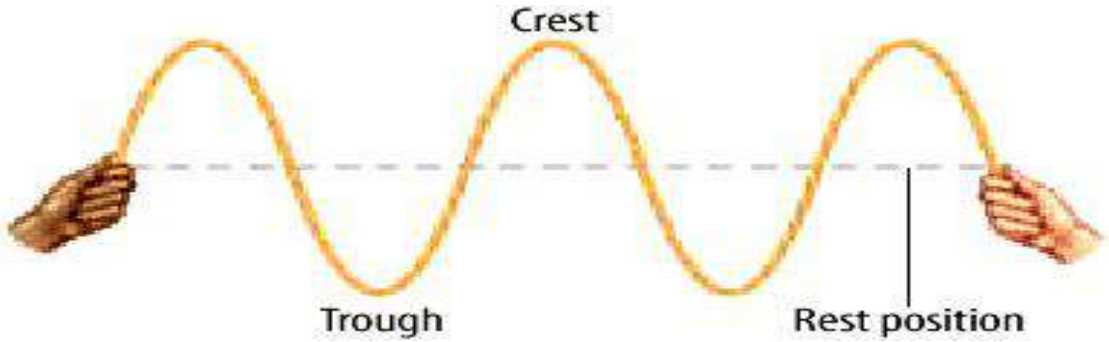


Speed of Light = 3×10^8 m/s

Wave properties:

a. Wavelength – (meters)

Lambda λ



b. Frequency - # of waves that pass per second (Hertz Hz).

Wave behavior:

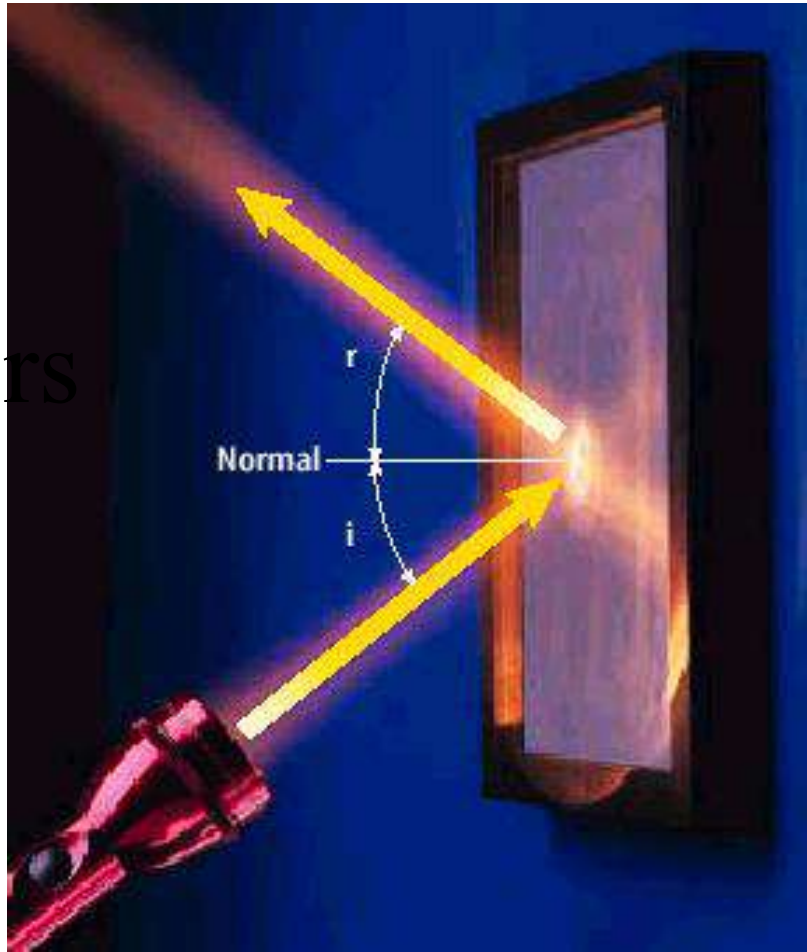
Reflection - the ***bouncing back*** of a wave.

1) Sound echoes

2) Light images in mirrors

3) Law of reflection

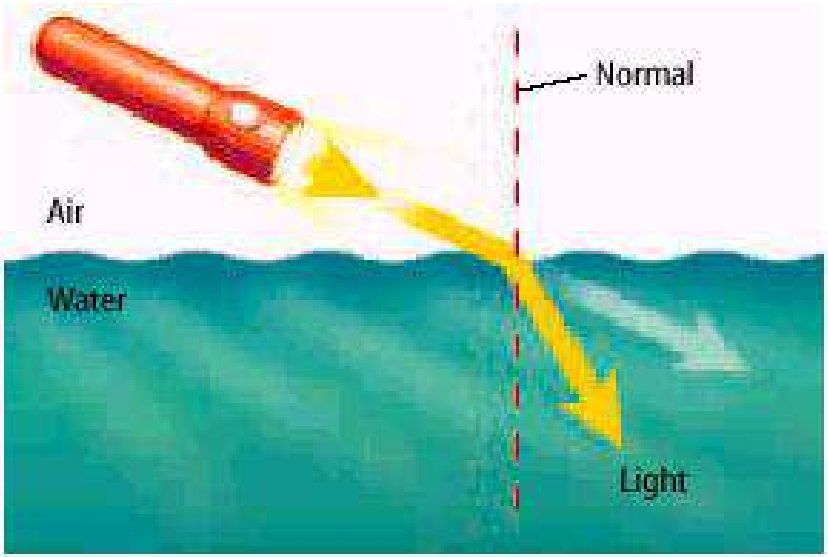
$$i = r$$

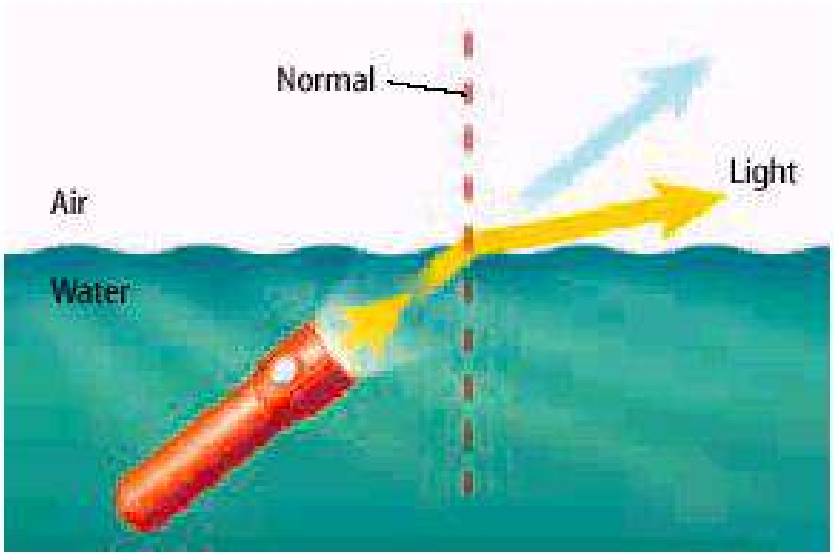


Refraction - the ***bending*** of light due to a change in medium.

(air into water)

Light travels slower in water than in air.





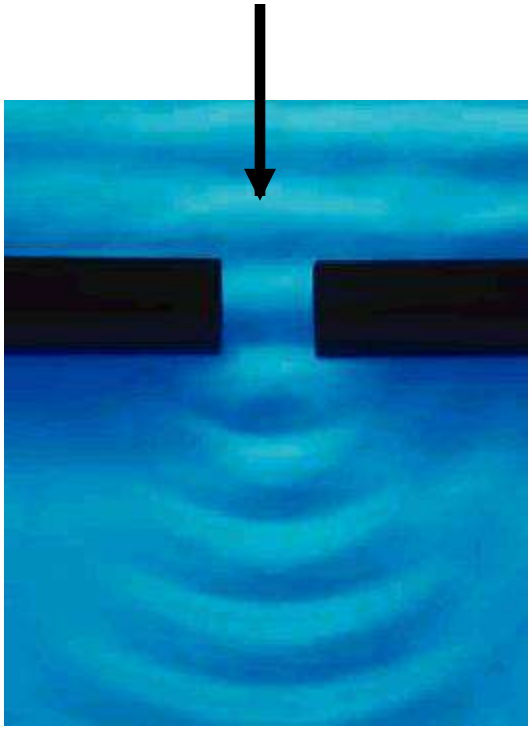
The girl sees the boy's foot closer to the surface than it actually is.

The boy is looking straight down and not at an angle. There is no refraction for him.

Green Laser

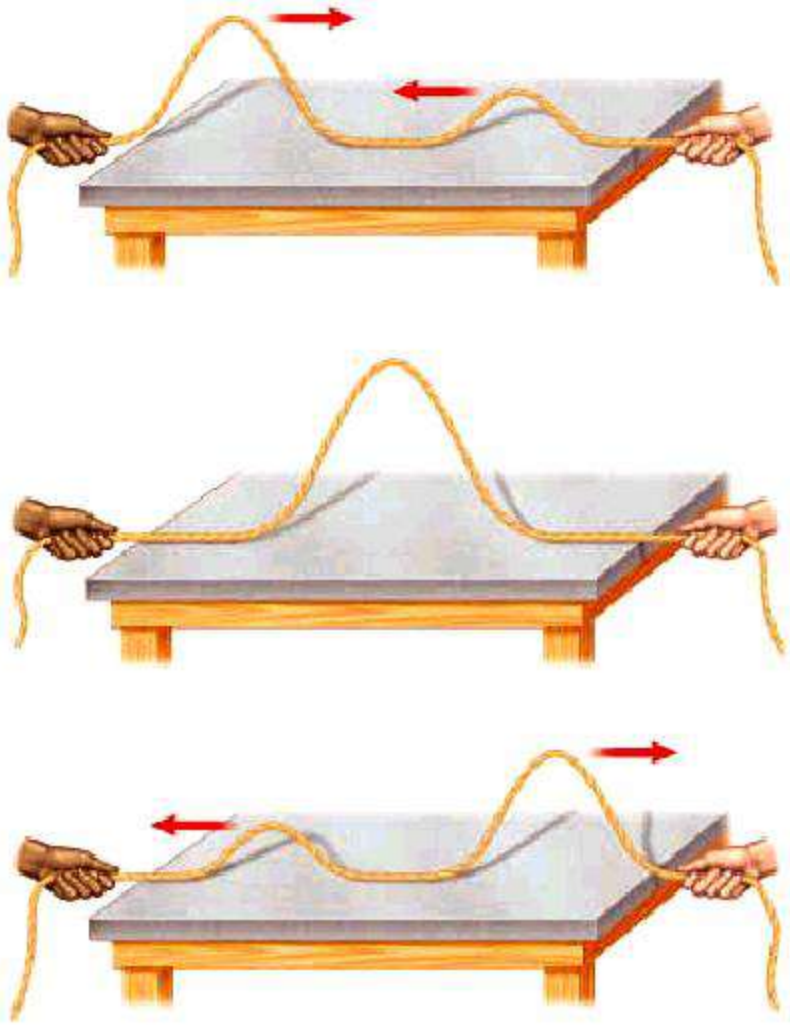
Diffraction - the bending of a wave ***around*** an object.

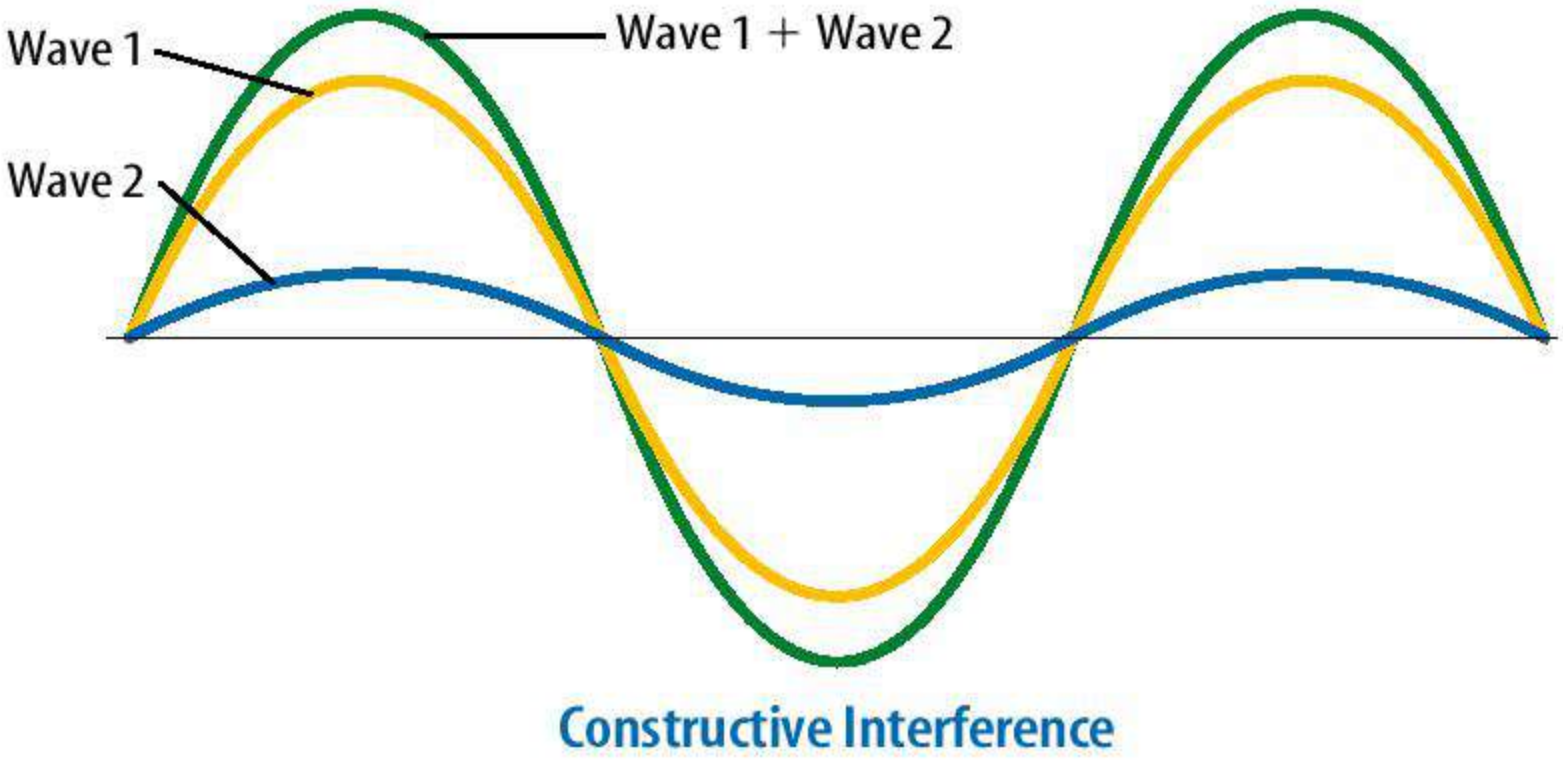
1) Water waves bending around islands



2) Water waves passing through a slit and spreading out

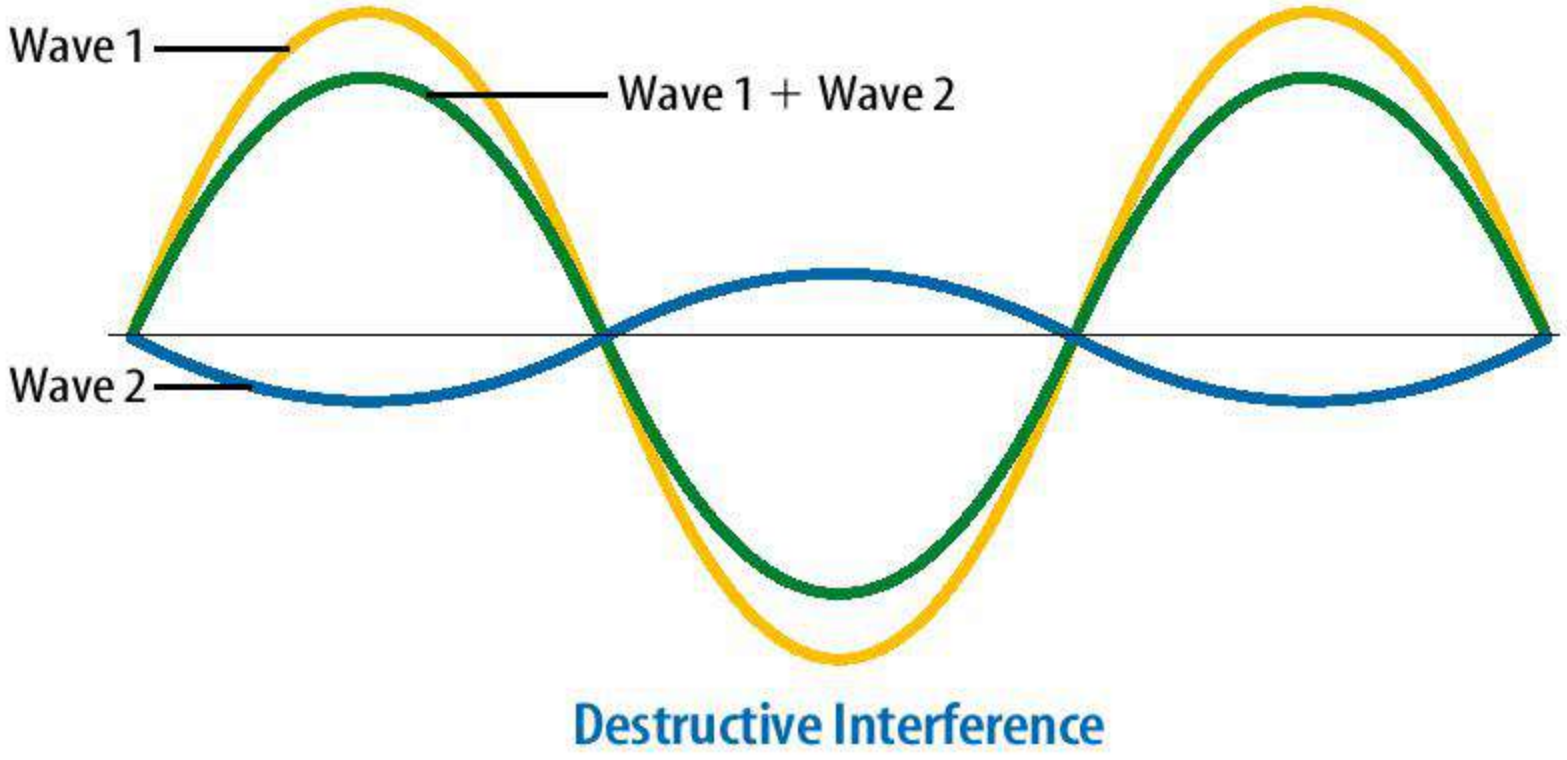
Interference - two waves combine to form a new wave.





1) Constructive (in phase)

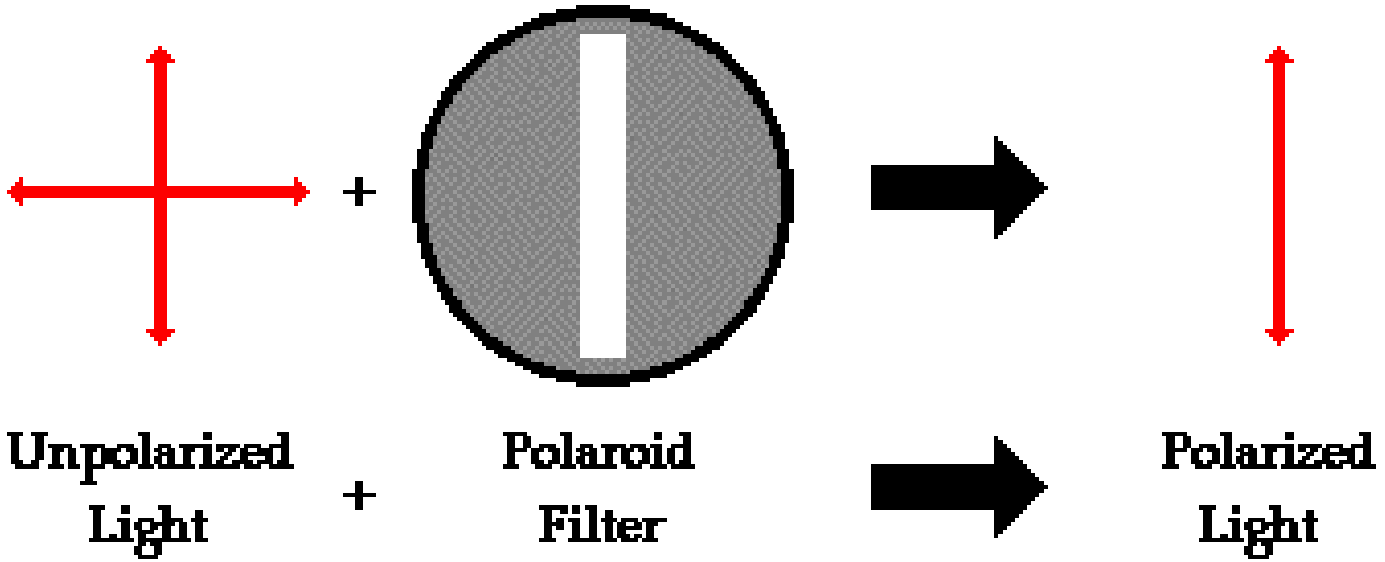
Sound waves that constructively interfere are louder



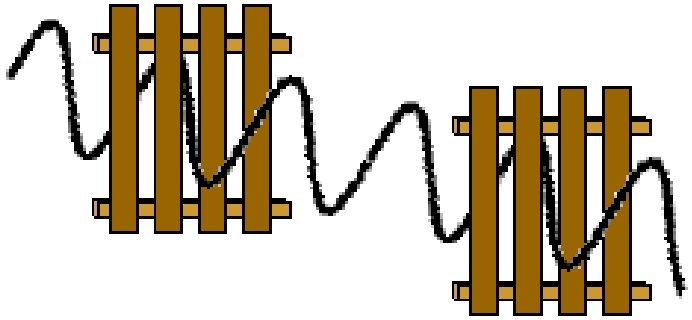
2) Destructive (out of phase)

Sound waves that destructively interfere are not as loud

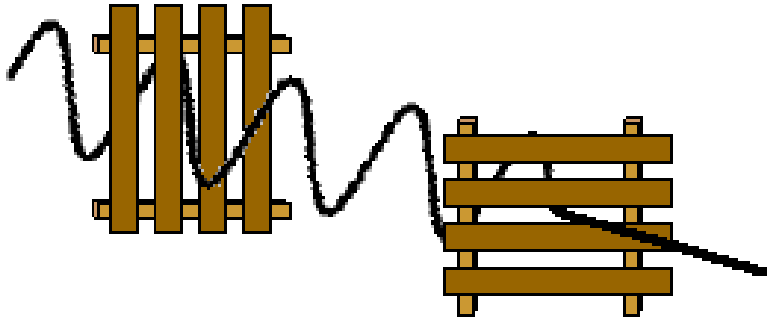
Polarization – *filtering* of light into a single plane



The Picket Fence Analogy



When the pickets of both fences are aligned in the vertical direction, a vertical vibration can make it through both fences.



When the pickets of the second fence are horizontal, vertical vibrations which make it through the first fence will be blocked.

Teacher

Teacher seen through two Polaroids

Axes aligned parallel to each other

Teacher seen through two Polaroids

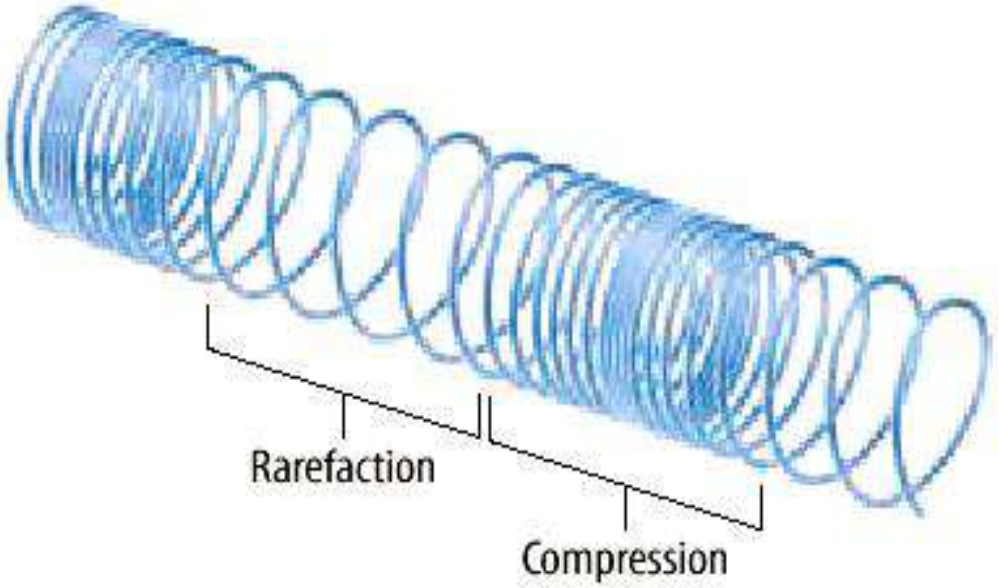
Axes aligned perpendicular to each other

Polarized Lenses

Sound

Mario Bros.

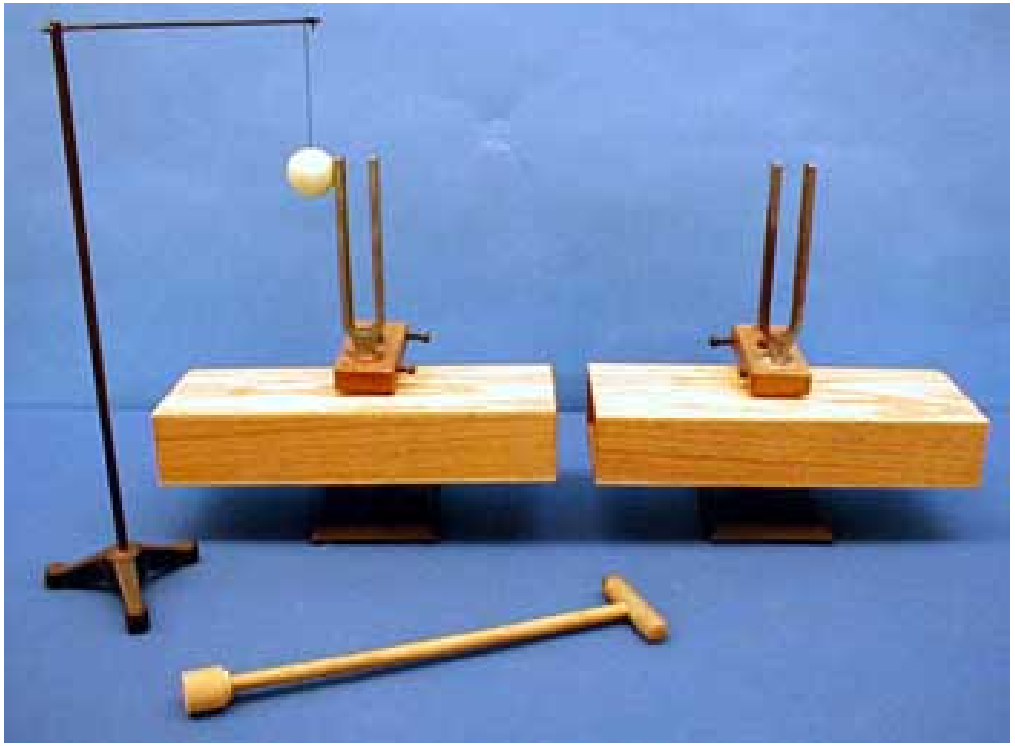
Compressional - Sound
v = 343 m/s
Must have a medium!! (air)



Screaming Chickens

- Pitch depends on Frequency
- Energy depends on Amplitude

Resonance - When an object vibrates at it's ***natural frequency***.



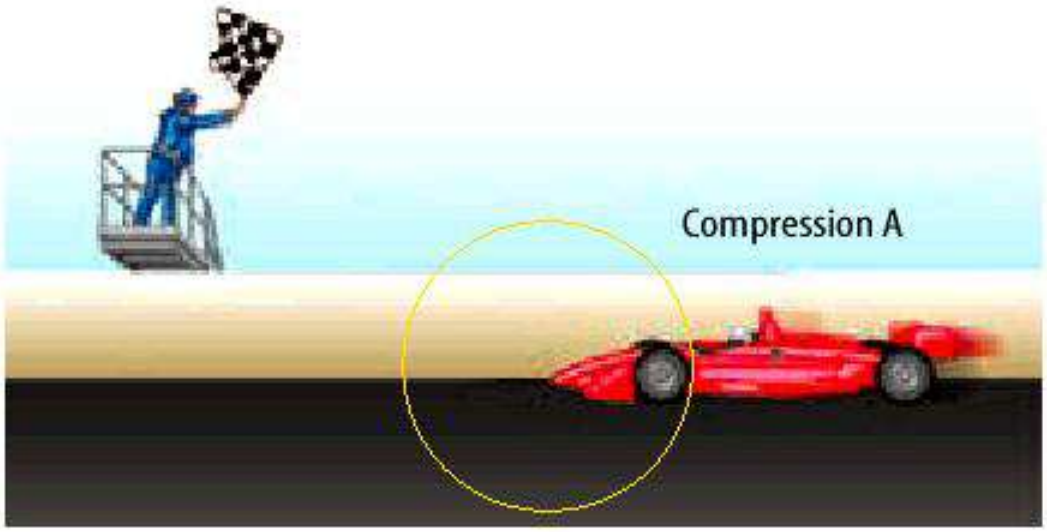
Salt on Speaker

Ruben’s Tube

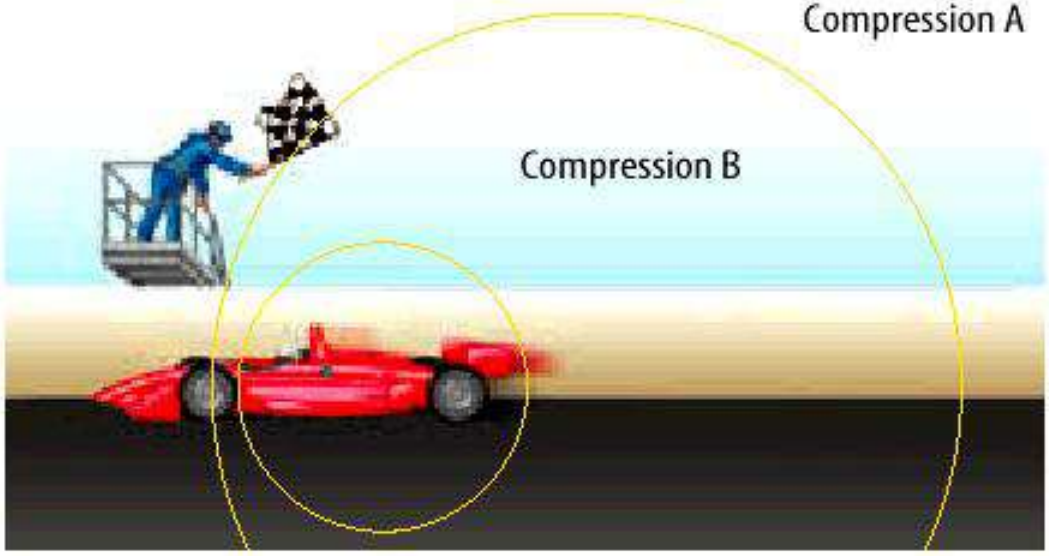
The Doppler Effect

– the change in pitch due to a ***moving wave source***.

The Doppler effect occurs when the source of a sound wave is moving relative to a listener.



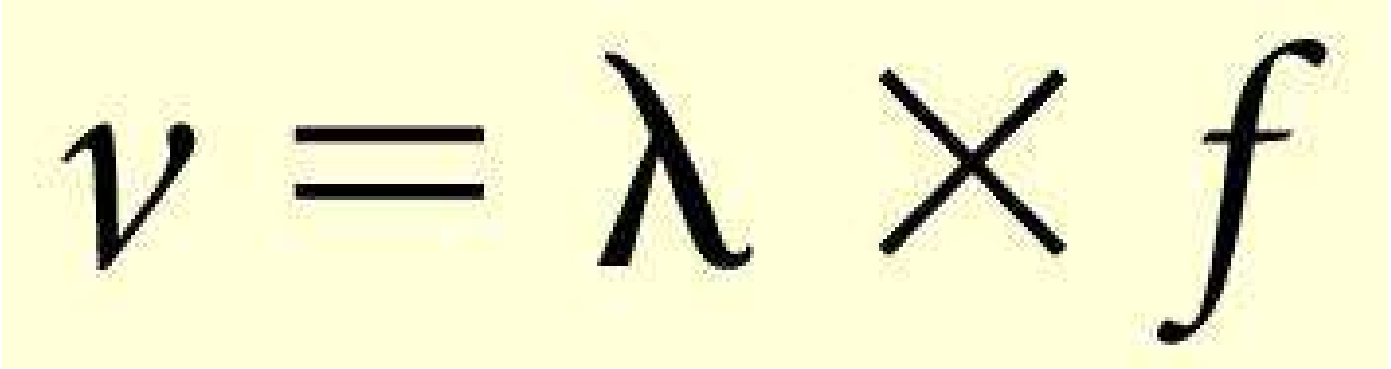
A The race car creates compression A.



B The car is closer to the flagger when it creates compression B. Compressions A and B are closer together in front of the car, so the flagger hears a higher-pitched sound.

Doppler Effect Horn

Doppler Effect – Big Bang



Velocity = wavelength x frequency

A wave is traveling at a speed of 18 m/s and its wavelength is 3 m. Calculate the wave frequency.

1. **What do you know?**

   $v = 18\ m/s$; $\lambda = 3m$

2. **Formula**

   $f = v/\lambda$

3. **Plug it in**

   $f = 18(m/s) / 3\ m$

4. **Solve**

   $f = 6\ Hz$

Uses of sound waves

a. Acoustics – the study of sound.

Soft materials dampen sound; hard materials reflect it (echoes and reverberations).

b. SONAR – Sound Navigation and Ranging (echolocation).

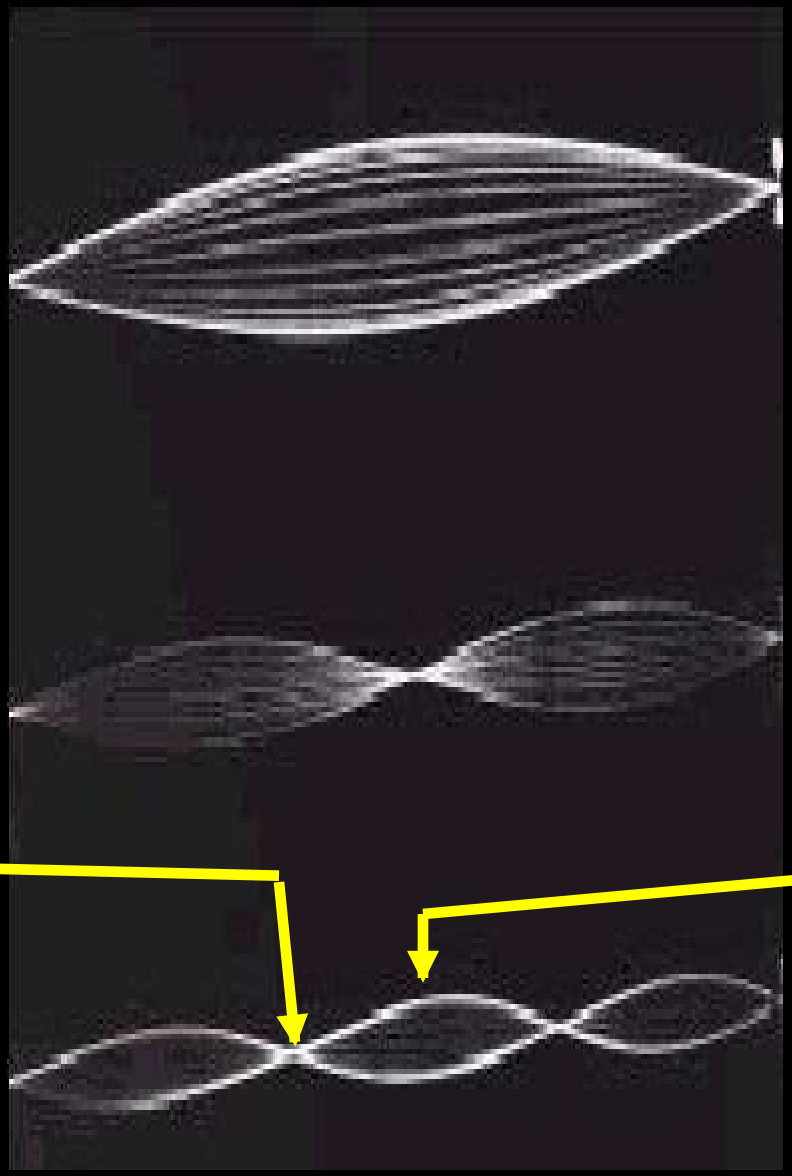
c. Ultrasound imaging

d. Kidney stones & gallstones.

Christmas Boomwhackers

Swinging Pendulum

e. Standing wave



Disappearing Beaker