

Basics of Noise and Its Measurement

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What is Sound?

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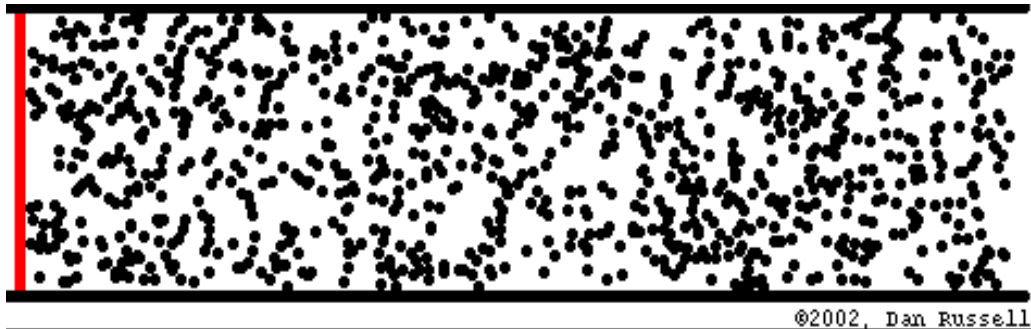
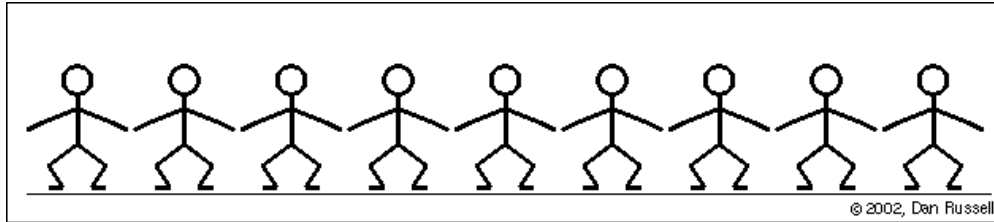
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Breaking a wine glass using resonance

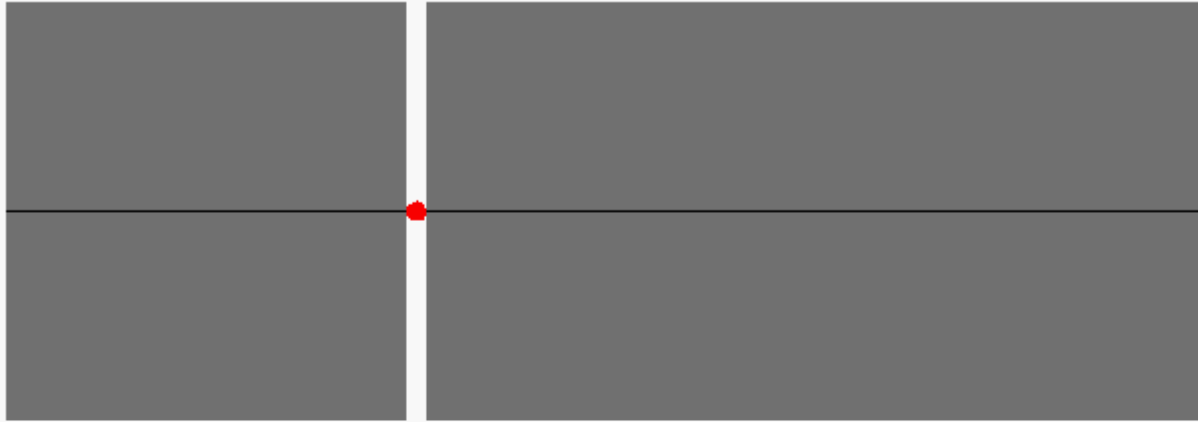
<http://www.youtube.com/watch?v=17tqXgvCN0E>

Vibration versus Waves

Wave Propagation



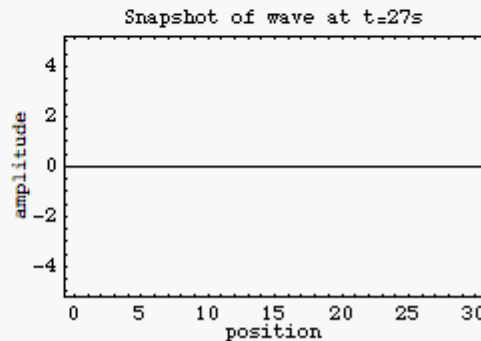
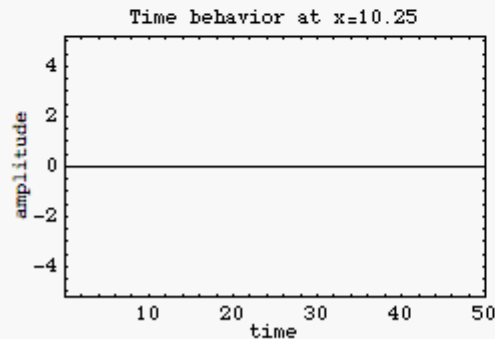
Wave Propagation in Time & Space



Wave function

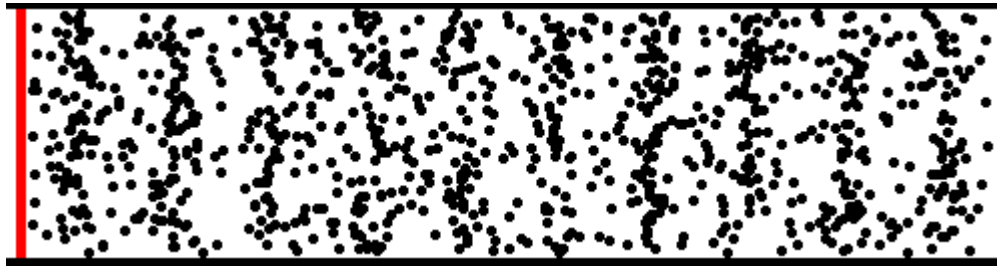
$$\psi(x, t) = A \sin(\omega t \pm kx)$$

A = wave amplitude
 ω = angular frequency
 k = wave number



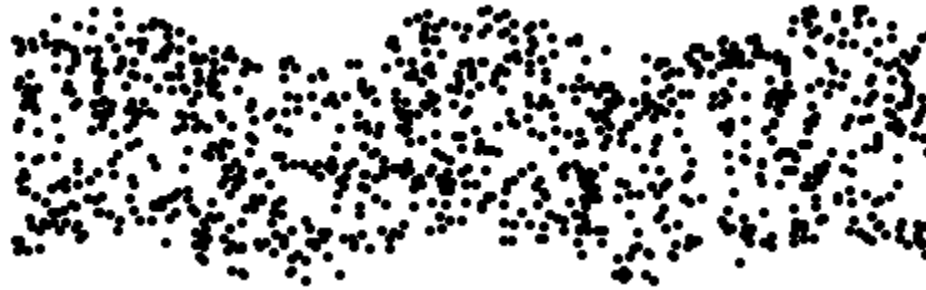
Is particle velocity in a wave same as velocity of wave?

Longitudinal Waves



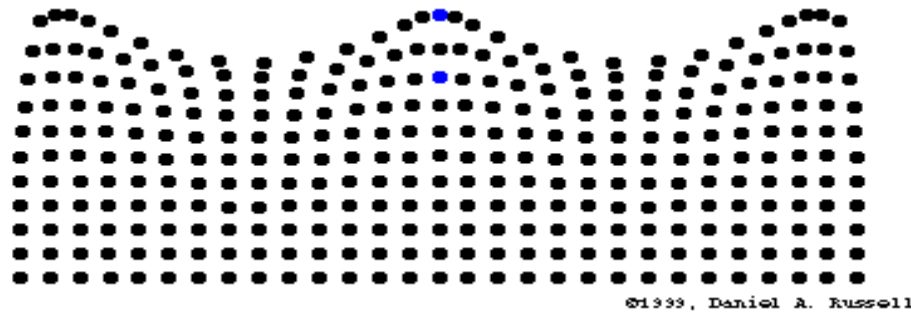
Particles and wave move in the same direction.

Transverse Waves



Particles and wave move in mutually perpendicular directions.

Where do you see such waves?



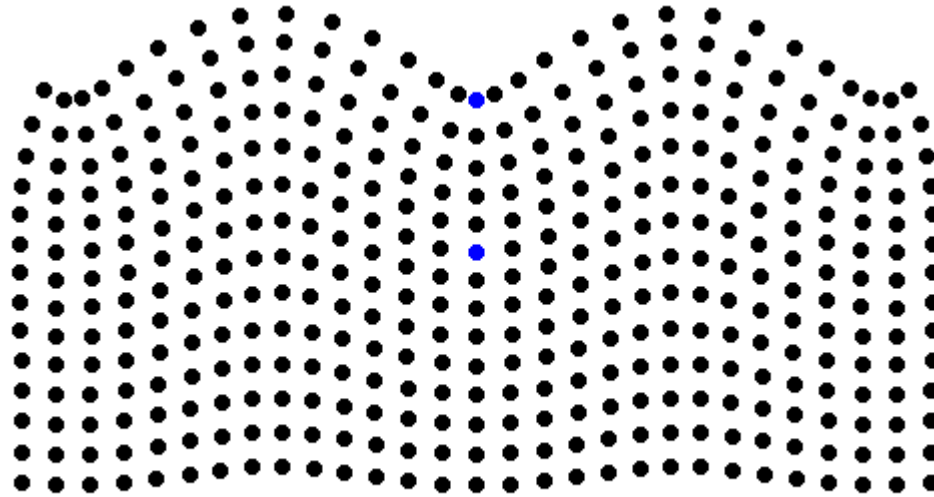
Particles move in longitudinal and transverse directions.

Wave travels in longitudinal direction.

Particle motion is more on top than at bottom.

Here, **blue-dots** move in clockwise direction.

Rayleigh Waves



©1999, Daniel A. Russell

Particles move in longitudinal and transverse directions.
Particle motion is anti-clockwise on top.
Particle motion is clockwise below.

Animation courtesy of Dr. Dan
Russell, Kettering University

Nature of Sound Wave

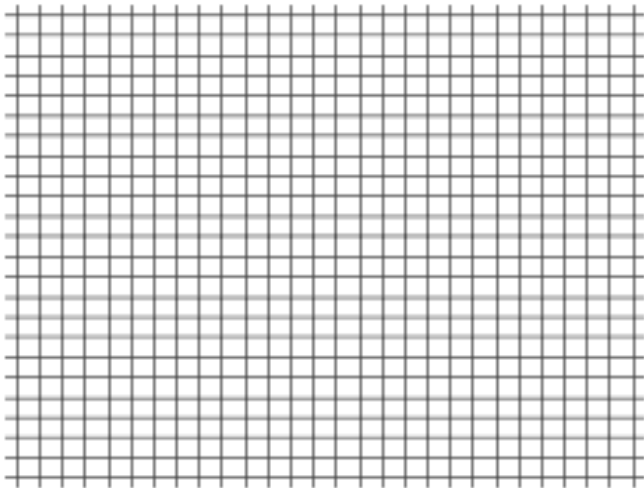
A small disturbance in fluid (acoustical) medium

- Pressure, density, displacement, velocity, temperature

Longitudinal waves

- velocity (c) = 343.2 m/s at 20 °C in air

Sound pressure is measured by microphones or pressure transducers



Source: Wikipedia

Nature of Sound

$$P_{total} = P_0 + p$$

$$P_0 = 1,01,325 \text{ Pa}$$

Acoustic Waves (Sound)

- Pressure wave
- Speeds in various media

Medium	Speed (m/s)
Air @ 21 C	344
Alcohol	1213
Hydrogen @ 0 C	2169
Water (fresh)	1480
Water (saline - 3.5%)	1520
Human body	1558
Wood	3350
Concrete	3400
Mild steel	5150
Glass	5200

References

- Acoustics, Beranek Leo L., Acoustical Society of America, 1993.
- Introduction to Acoustics, Finch Robert D., Pearson Prentice Hall, 2005.
- Fundamentals of Acoustics, Kinsler Lawrence E., et al, 4th ed., John Wiley & Sons, 2005.
- Sound and Structural Vibration, Fahy Frank, et al, 2nd ed., Academic Press 2007.