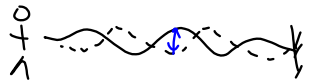
Today - standing transverse waves (cont.)
two & three dimensions
- sound waves

Transverse S.W. in 1-D



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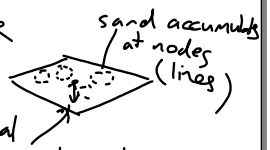
2-D transverse SW

- drum - not resonance
- Chladni plate
resonance



- lots more modes than 1D system
- freqs will not be nice integer multiples

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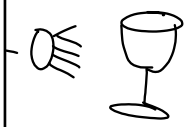
3-D



wine glass

- soap bubbles
- any structure

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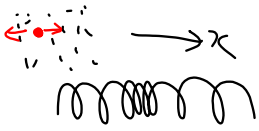
Sound

- longitudinal / compression wave
motion of particles is in same dirn as wave motion

$y(x,t)$
↑
horiz. disp from equil position.



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Turns out that sounds wave also satisfy the wave eqn

$$\frac{\partial^2 y}{\partial x^2} = \frac{1}{v^2}\frac{\partial^2 y}{\partial t^2}$$

key property of medium is how much it resists being compressed.

B "incompressibility" bulk modulus

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Speed of sound

provides restoring force

$$v = \sqrt{\frac{B}{\rho}}$$

B ← bulk modulus
ρ ← mass density $kg\,m^{-3}$
↑ inertia

compare with rope

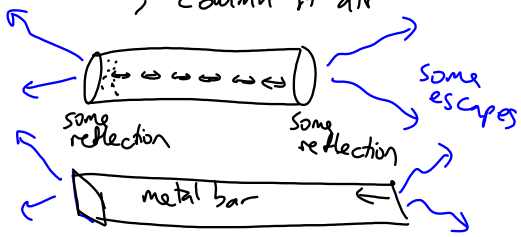
$$v = \sqrt{\frac{F}{\mu}}$$

F ← tension
μ ← linear mass density $kg\,m^{-1}$

May 4-2:22 PM

Standing sound waves

in air, column of air



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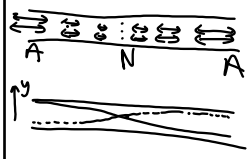
With sound, we also talk about pressure

Example

tube open at both ends

(ends are both antinodes in displacement)

e.g. organ pipe, flute, piccolo recorder



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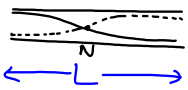
Fully Open pipe

graphs show displacement (sideways!)

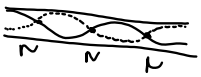
use $v = f\lambda$

Fundamental mode $L = \frac{\lambda_1}{2}$ $f_1 = \frac{v}{2L}$



1st overtone mode $L = \lambda_2$ $f_2 = \frac{v}{L} = 2f_1$ (octave)

2nd overtone $L = \frac{3\lambda_3}{2}$ $f_3 = \frac{3v}{2L} = 3f_1$ etc.



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