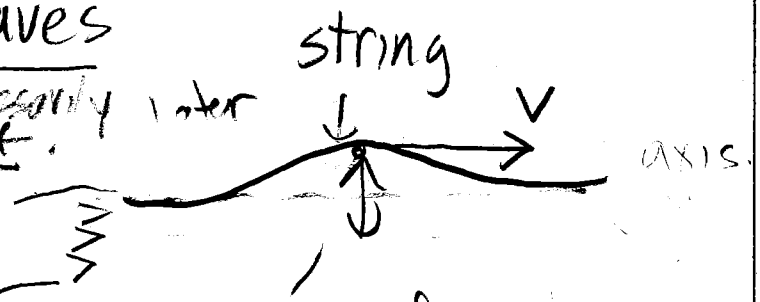
Types of Waves

Transmit energy, not necessarily water shift.

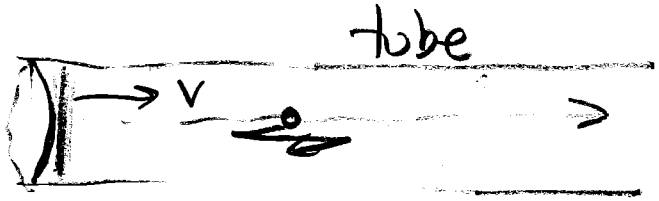
Transverse:



hand

slice of mass moves ⊥ or transverse to axis

Longitudinal (sound)



diaphram (speaker

- pushed in, makes a compression
- drawn back, a "rarefaction.
- slices of mass move ∥, or longitudinal, to axis.

Earthquakes: speed of longitudinal part ("P-wave") faster than transverse ("S-wave").

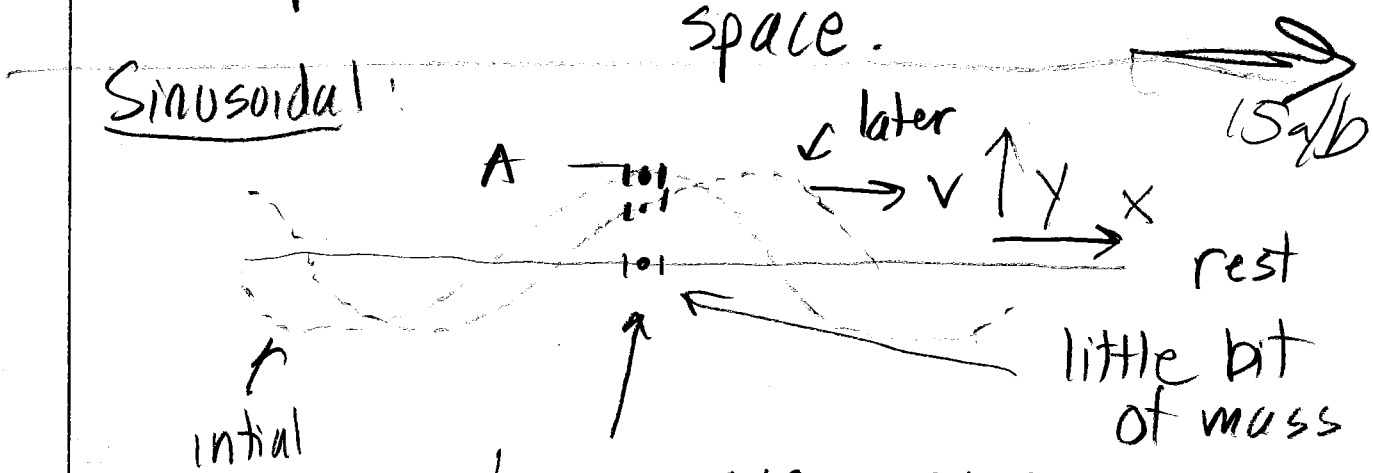
P-wave wakes you, animals up.

<u>Pulse</u>: one segment

<u>Periodic</u>: keep doing it (Sound)

<u>Complication</u>: both time <u>and</u> space.

<u>Sinusoidal</u>:



when wave moves left, little bit of mass does not move left, but <u>down</u>. (Transverse)

<u>Mass</u>: $y(t) = A\cos(\omega t)$

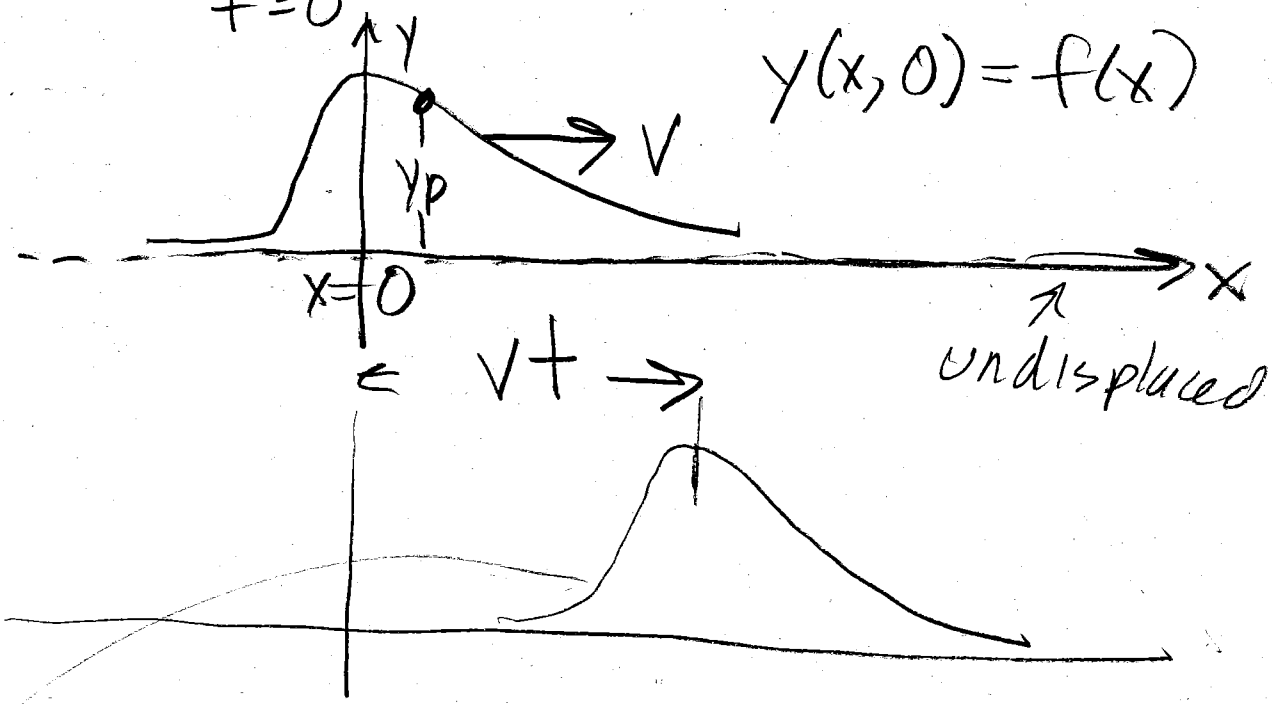
what will that ω turn out to be.

→ will be related to the wavelength, and the speed v.

On a string ....

→ ideal, <u>non-dispersive</u>

$t=0$



$y(x,0)=f(x)$

later... displaced in x by...

vt, <u>SAME SHAPE</u> (non dispersive)

$y(x,t)=f(x-vt)$

THINK.. $t=0$

$f(x)$

$t>0$ ...

$x-vt=$ constant 0, PEAK.

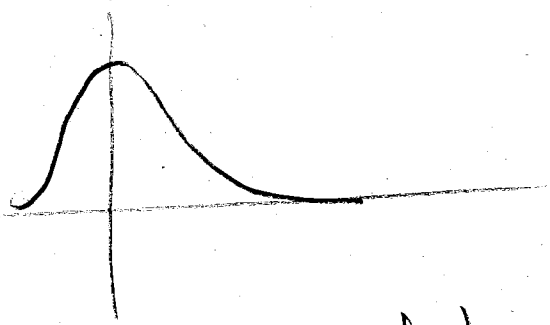
$\frac{dx}{dt}-v=0$, $\frac{dx}{dt}=v$

Generally,

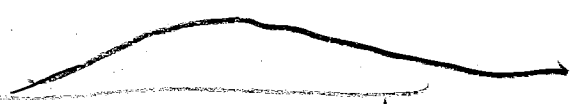
$f(x+vt)$ would work too! HOW DIFFERENT?

$\Rightarrow$ generally, wave equations give... v^2 ... for speed.

Dispersive.



later...



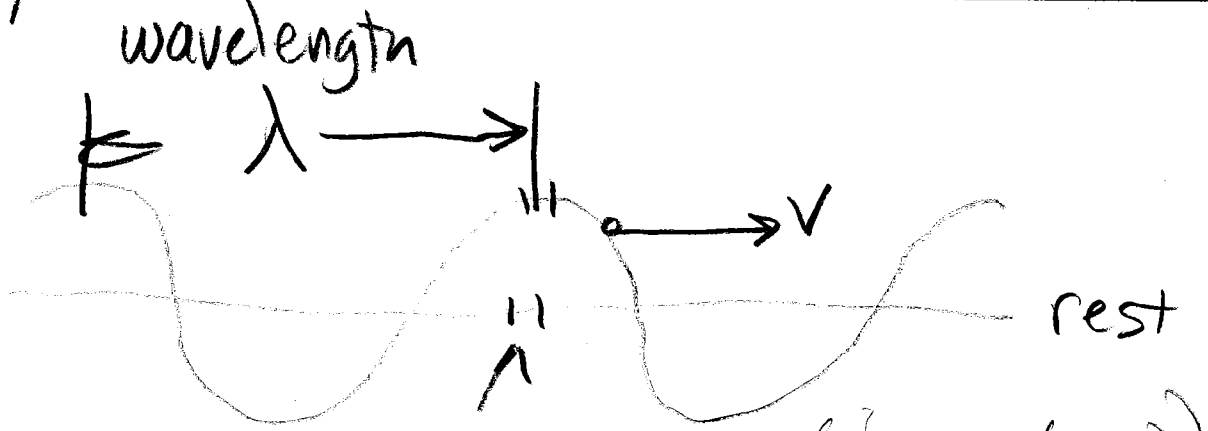
"sussy"

NON-IDEAL!

$\downarrow$

speed of propagation depends on frequency

LIGHT!



$A\cos(\omega t)$ (or $\cos(-\omega t)$)

period $T = \dfrac{2\pi}{\omega}$

$\cos(\omega T) = \cos(2\pi) = 1$
$= \cos(0)$

T is also time it takes for the next crest to go distance λ:

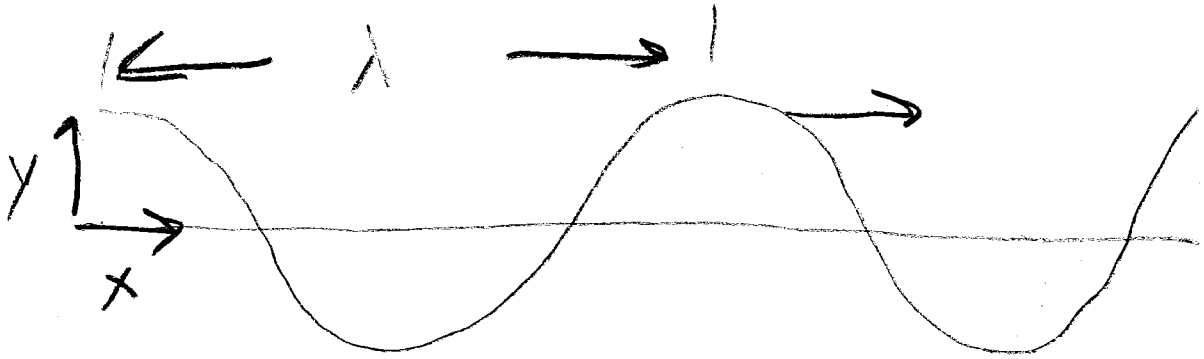
$$V \cdot T = \lambda$$

$$V \cdot \frac{2\pi}{\omega} = \lambda$$

$$\boxed{V = \lambda \cdot \frac{\omega}{2\pi} = \lambda \cdot f}$$

ω in $\dfrac{\text{radians}}{\text{sec.}}$ | length | $\dfrac{1}{\text{time}}$

<u>Wave function</u>: $y(x,t)$



snapshot at $t=0$.

$$y(x,t=0) = A\cos\left(\pm\frac{2\pi x}{\lambda}\right)$$

why?

study particular x

$$y(x=0,t) = A\cos(\pm\omega t)$$

<u>Combine</u>

$$y(x,t) = A\cos\left(\pm\left(\frac{2\pi x}{\lambda} \pm \omega t\right)\right)$$

irrelevant

not irrelevant

"constant phase"

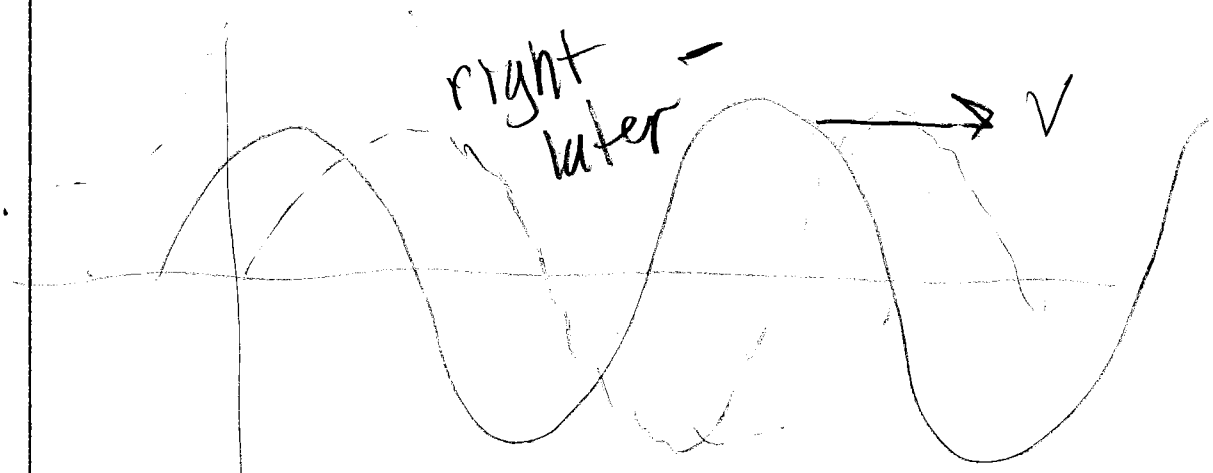
$$\frac{2\pi x}{\lambda} \pm \omega t = \text{constant}$$

$$x = \underbrace{\mp \frac{\omega\lambda}{2\pi}}_{v\,!} t + \text{constant}$$

$$x = \mp v t + \text{constant}$$

$$A\cos\left(\frac{2\pi x}{\lambda} + \omega t\right) \rightarrow \text{left moving wave}$$

$$A\cos\left(\frac{2\pi x}{\lambda} - \omega t\right) \rightarrow \text{right moving wave}$$



<u>often</u>: $\frac{2\pi}{\lambda} = k$ wave vector

$$v = \frac{\omega}{k}$$