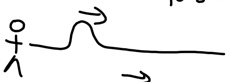
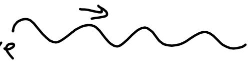
Mechanical Waves (cont.)
- properties of waves
- periodic waves

• Types: transverse / longitudinal / both / torsional

• shape: • pulse


• periodic travelling wave


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• standing wave


pattern appears not to move along.

* Dimensions:
1-D – rope, column of air
2-D – ripples in pond
3-D – light, sound

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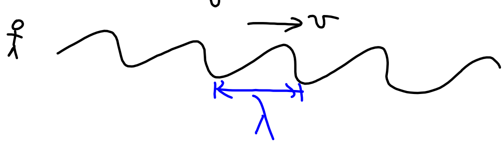
15-2 Periodic waves
- all waves have speed v
- periodic waves have a frequency and wavelength



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- wavelength λ is distance over which wave pattern repeats ("period in space")
- period T (or f or ω) tells the time for one full wavelength to pass by.

periodic wave involves a travelling disturbance.
Each part of the medium oscillates
All have same frequency (f, ω, T)
- same amplitude
- different phases.

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So "easy" to see that

$$\text{speed of wave} = \frac{\text{wavelength}}{\text{period}}$$

true for any periodic wave. $$v = \frac{\lambda}{T} = f\lambda$$

Real physicists use - ω for angular freq. $\omega = 2\pi f = \frac{2\pi}{T}$
- k for angular wave number $k = \frac{2\pi}{\lambda}$

Note: $k = \frac{2\pi}{\lambda}$ is not spring const.

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So real physicists use $v = f\lambda$ (15-1)

$$v = \frac{\omega}{k} \quad (15\text{-}6)$$

15-3 Math. description of waves
Consider any wave in 1 dimension

snapshot of displac of medium at a particular time.

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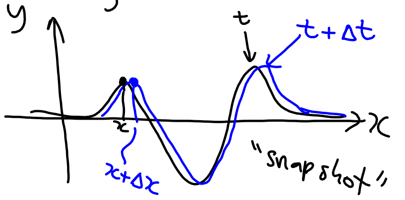
Note $y(x,t)$ is a function of two variables.

y is disp. of medium from equil.



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Easy to see that

$$y(x+\Delta x, t+\Delta t) = y(x,t) \quad -(*)$$

Note $*$ is true for any wave moving in $+x$ direction.

Also note $\Delta x = v\Delta t$

So $(*)$ $y(x,t) = y(x+v\Delta t, t+\Delta t)$

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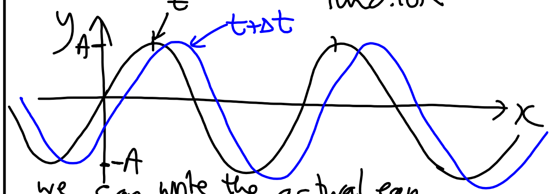
Special case: y is sinusoidal function



we can write the actual eqn

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Not very hard to see

(15-4) $y(x,t) = A\cos\left(\frac{2\pi x}{\lambda} - \frac{2\pi t}{T}\right)$

if add λ to x, then y is unchanged

if add T to t " " "

Note (15-4) describes sinusoidally travelling wave moving in $+x$ direction.

Also write: $\boxed{y(x,t) = A\cos(kx-\omega t)}$ 15-7

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Notes - each point in medium (sock) undergoes SHM with period T freq (ω, f) and ampl. A.

- wave travelling in $-x$ dirn would be

(15-8) $y(x,t) = A\cos(kx+\omega t)$

- Claim H/W both 15-7 and 15-8 satisfy $(*)$

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