April 10, 2017 Physics 132 Prof. E. F. Redish

- **Theme Music: Van Morisson**
  Wavelength
- **Cartoon: Bob Thaves**
  Frank & Ernest

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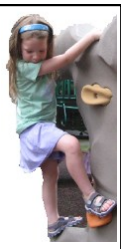
Outline

- Quiz 10
- Recap: Mechanical waves on a string
- Examples
- Sinusoidal waves

Foothold principles: Mechanical waves



- *Key concept*: We have to distinguish the motion of the bits of matter and the motion of the pattern.
- *Pattern speed*: a disturbance moves into a medium with a speed that depends on the properties of the medium (but not on the shape of the disturbance)
- *Matter speed*: the speed of the bits of matter depend on both the size and shape of the pulse and on the pattern speed.
- *Mechanism*: the pulse propagates by each bit of string pulling on the next.

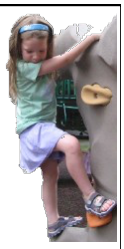
Foothold principles: Waves on a stretched string

- A stretched string can propagate both transverse and longitudinal waves. In both cases the pattern and the matter motions have to be distinguished..
- *Pattern speed*: a disturbance moves on the string with the speed where τ is the tension and μ is the mass density (M/L).

$$v_0 = \sqrt{\frac{\tau}{\mu}}$$

- *Matter speed*: the matter in a transverse wave moves with a velocity that depends on the slope of the wave at that point (dy/dx) times v_0.

Foothold ideas: Sinusoidal waves



- A sinusoidal wave moving in the $+x$ direction look likes

$$y(x,t) = A\sin k(x - v_0 t)$$

Why do we need a "k"

- If we multiply the argument of sin out we get

$$y = A\sin(kx - \omega t) \qquad \omega \equiv kv_0$$

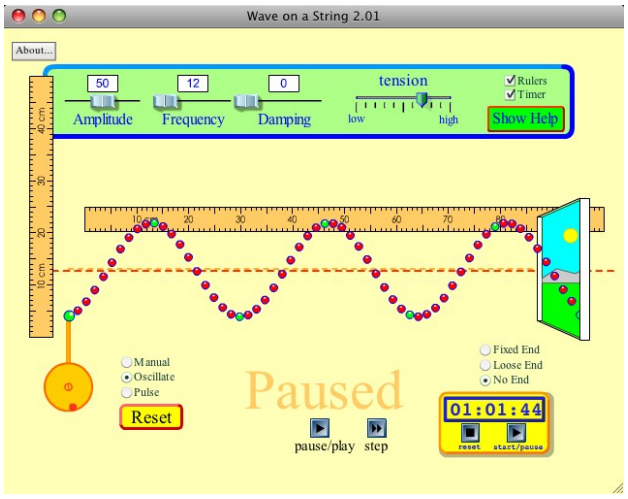
wavelength

Fixed time: $kx : 0 \rightarrow 2\pi$ $\qquad x : 0 \rightarrow \dfrac{2\pi}{k} = \lambda$

Fixed position: $\omega t : 0 \rightarrow 2\pi$ $\qquad t : 0 \rightarrow \dfrac{2\pi}{\omega} = T = \dfrac{1}{f}$

period frequency

Explore with a simulation



http://phet.colorado.edu/simulations/sims.php?sim=Wave_on_a_String