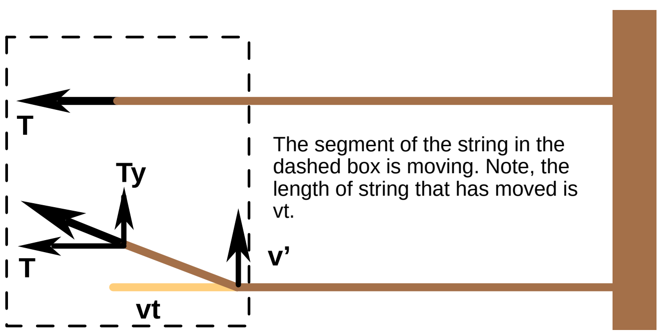
Transverse Waves
transversewaves.swf

Transverse waves consist of particles vibrating up and down, *thus* creating a wave in the left-right direction. The wave is essentially formed by a continuum of vibrating particles, each moving in simple harmonic motion. (You can think of the resultant left-right wave as being caused by a chain-effect of up and down particles affecting their neighbor's motion, as shown in the Flash movie above.)

0.1 Transverse Wave Velocity

While the individual particles propagate at rapidly changing velocities, the wave (*formed by all the particles*) propagates at a velocity dependent on the tension (T) in the string and the mass density (μ). This formula applies for small amplitude waves, which is valid for most practical applications.

$$v = \sqrt{\frac{T}{\mu}} \tag{1}$$



The diagram illuminates the similar triangles involved, where v' is the vibrational velocity and v is the wave velocity.

$$\frac{T}{T_y} = \frac{vt}{v't} \tag{2}$$

$$\frac{Tt}{(\mu vt)v'} = \frac{v}{v'} \tag{3}$$

$$\frac{T}{\mu vv'} = \frac{v}{v'} \tag{4}$$

$$v^2 = \sqrt{\frac{T}{\mu}} \tag{5}$$

The second lines follows from impulse-momentum, noting that $T_y t = \Delta p = (\mu vt)v'$. Note that: $\mu = \frac{m}{l} \Rightarrow m = \mu vt$. The length ($l$) of the string of mass (m) is the distance propagated by the wave.

Of course, the usual formula relating wavelength (λ) and frequency ($f = 1/T$) for waves applies to transverse waves:

$$v = \sqrt{\frac{T}{\mu}} = \lambda/T = \lambda f \tag{6}$$