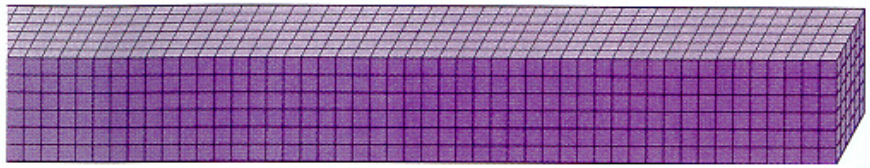
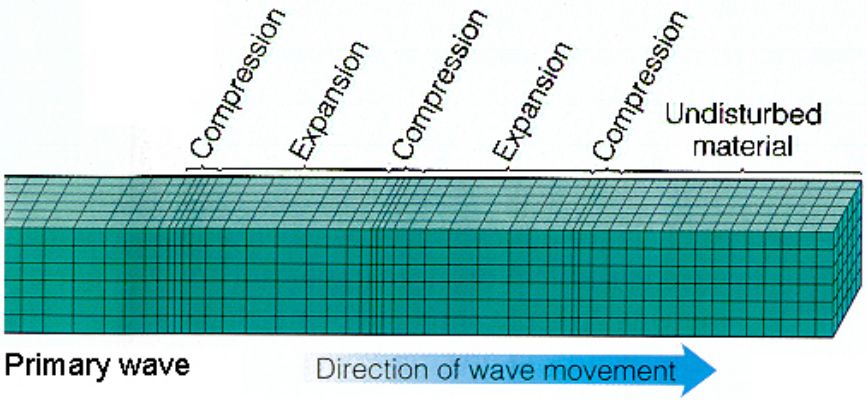
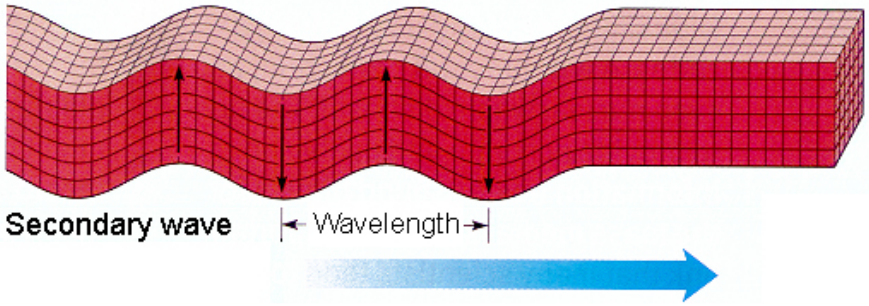


Undisturbed material for reference





Waves

http://www.physicsclassroom.com/Class/waves/

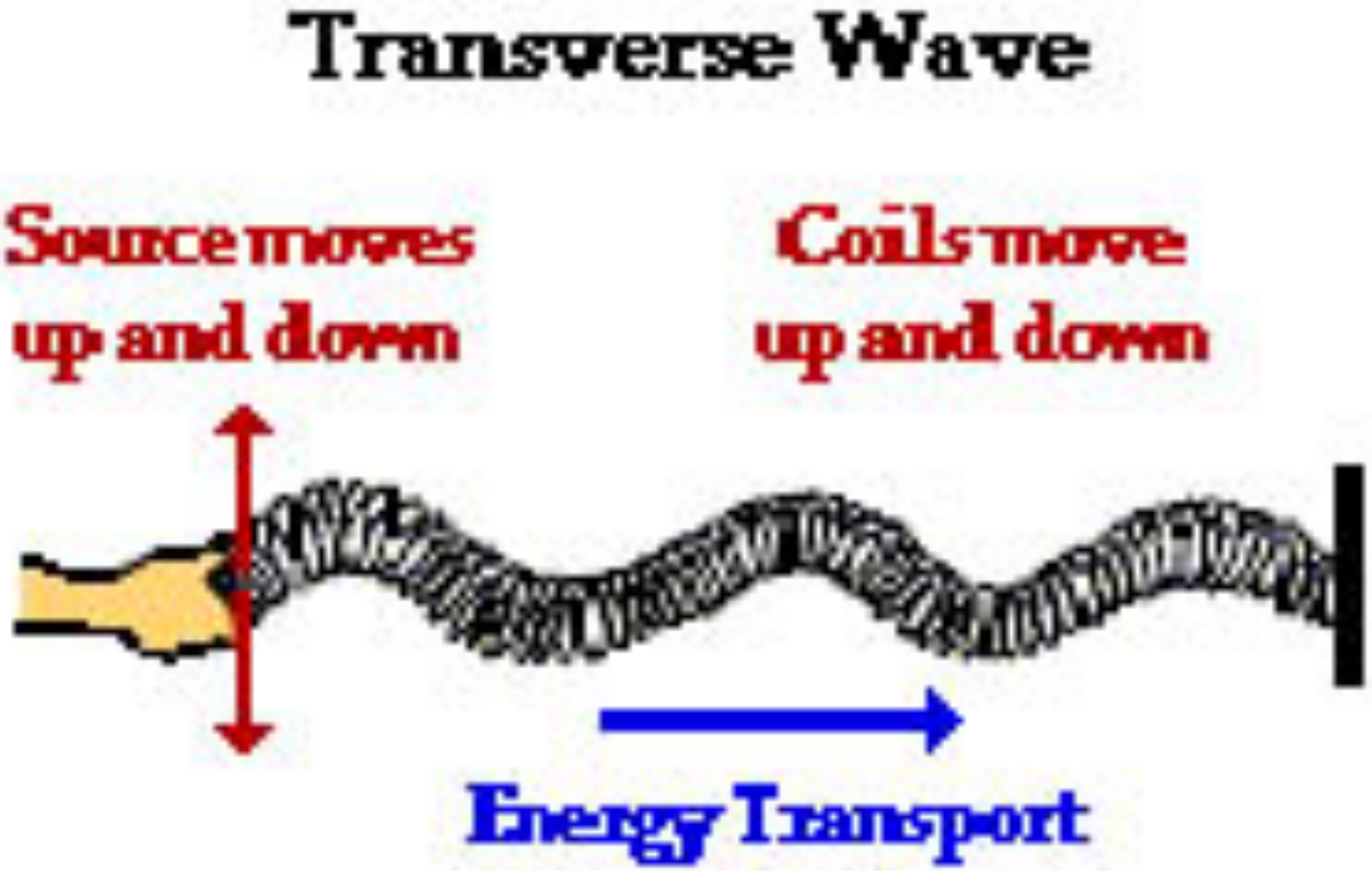
A wave is a transfer of energy through a medium.

Two basic kinds of waves

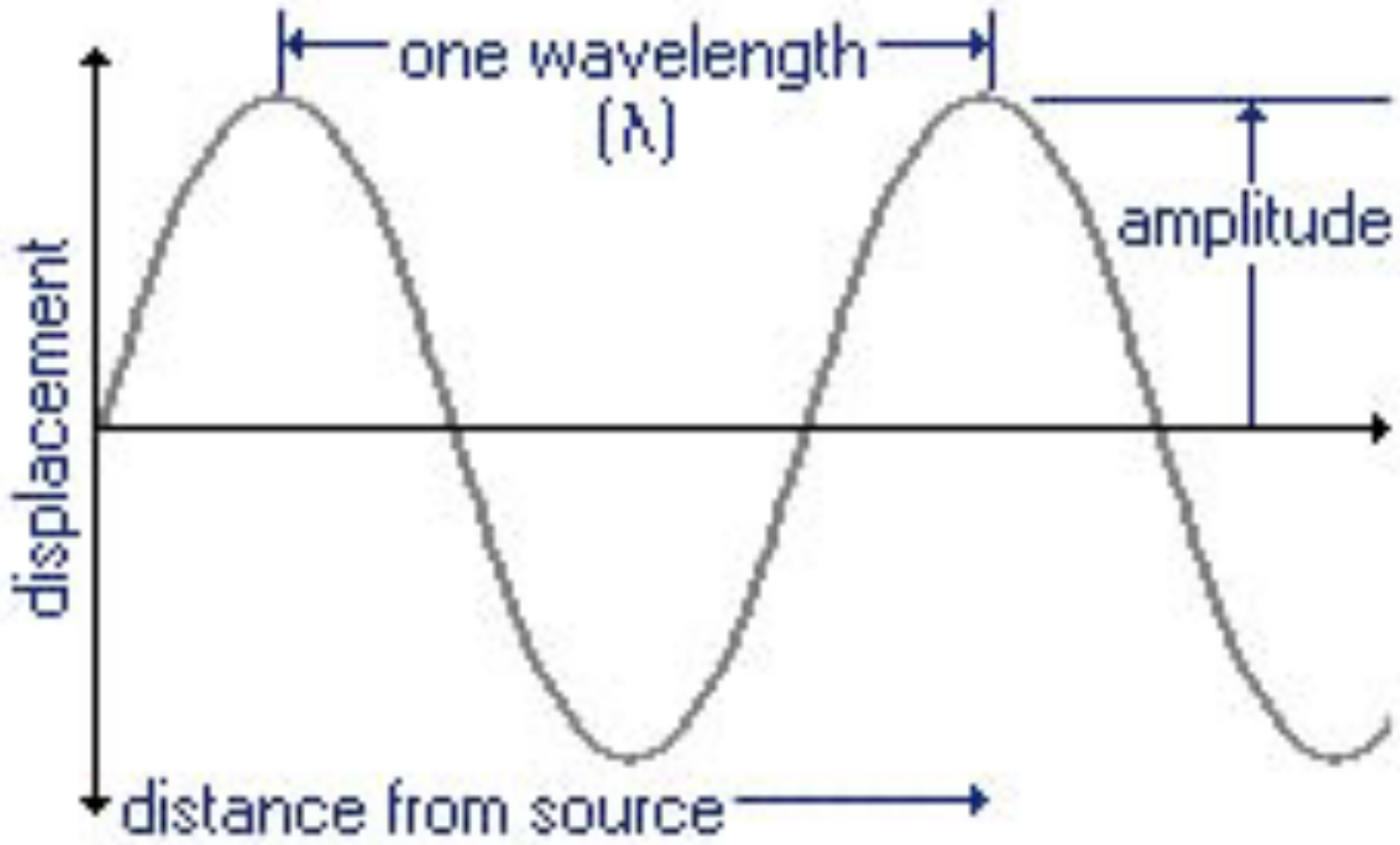
Transverse - displacement perpendicular to the direction of travel.

Longitudinal - displacement parallel to the direction of travel.

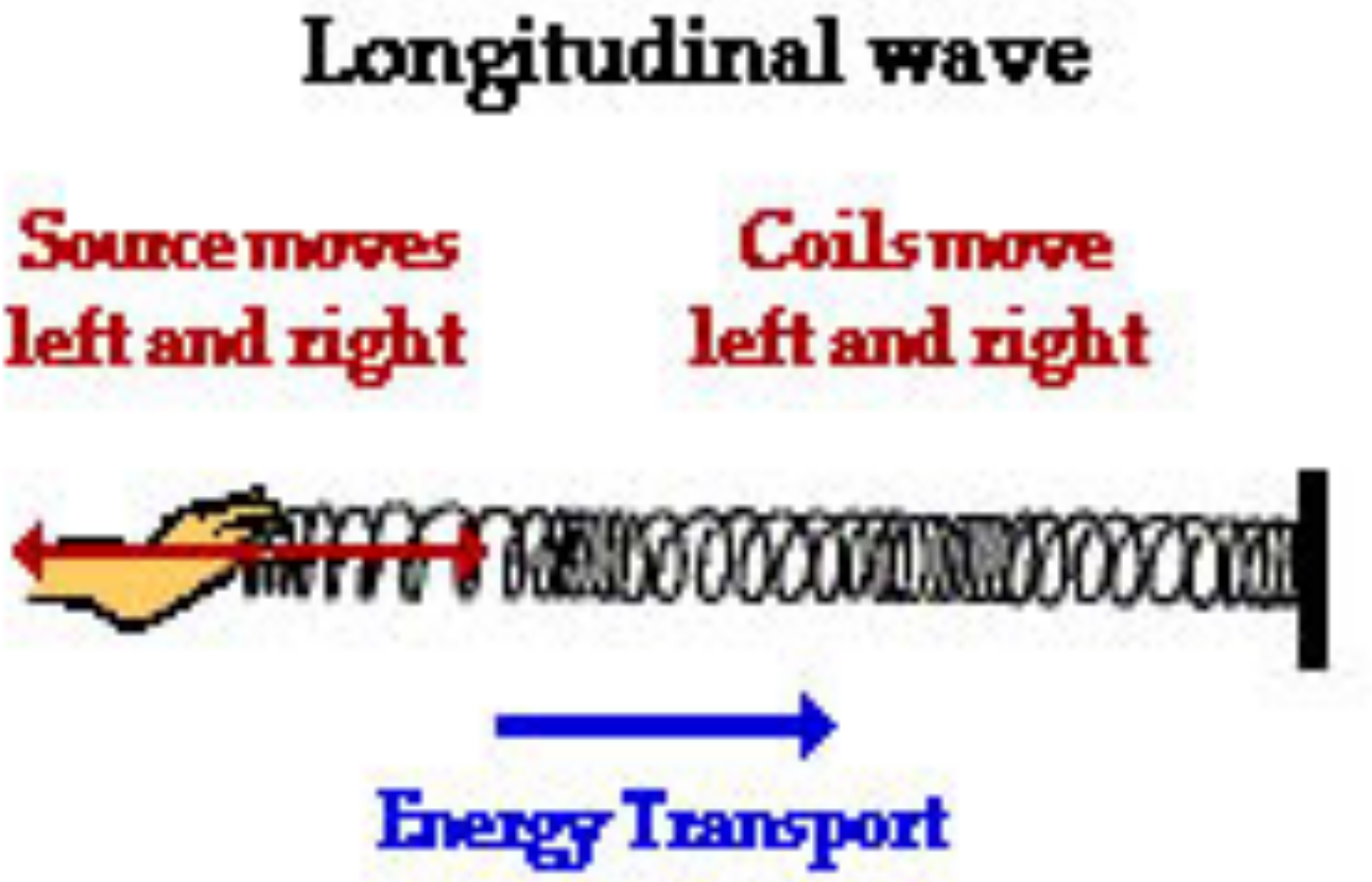
Transverse Wave



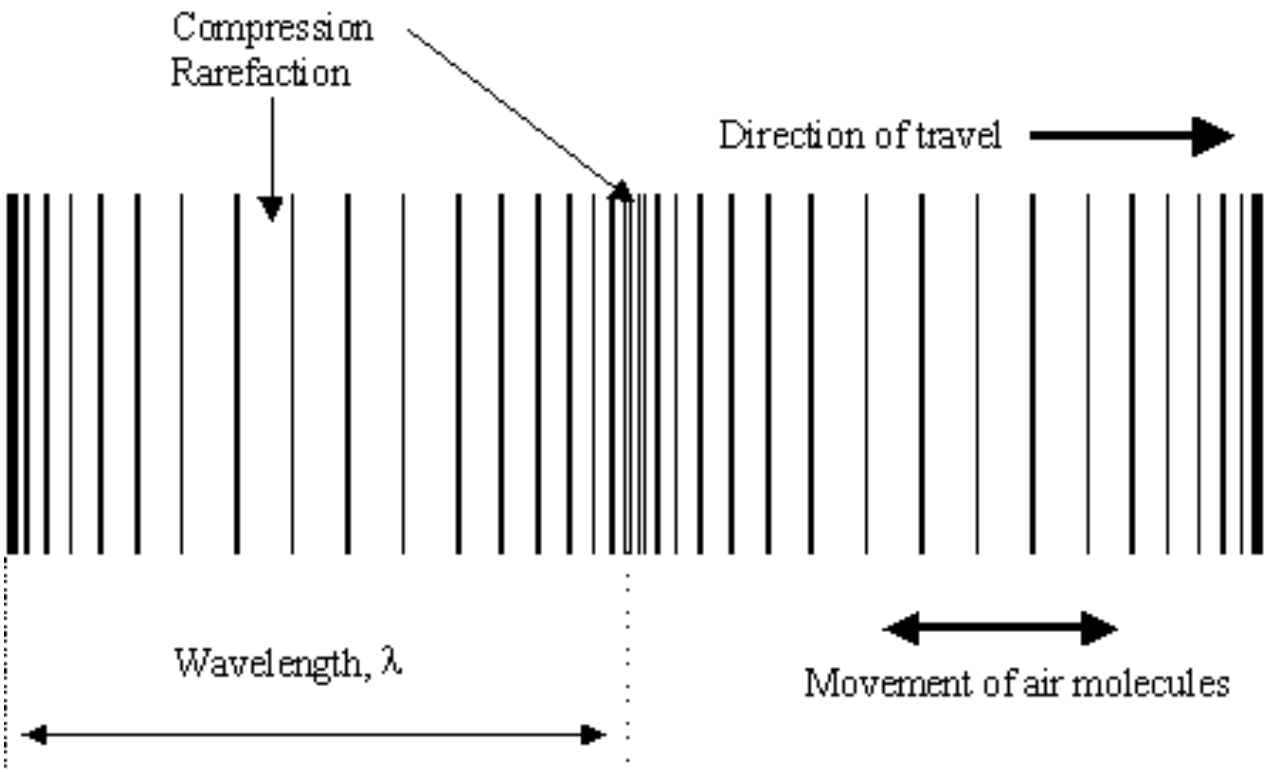
Transverse Wave



Longitudinal Wave



Longitudinal Wave



Simulation of a longitudinal wave

Waves In Motion

Simulated Waves

Crash Movie

Tachoma Narrows

Dog on the Bridge

Tachoma 2

Tachoma 3

Tachoma 4

Interference

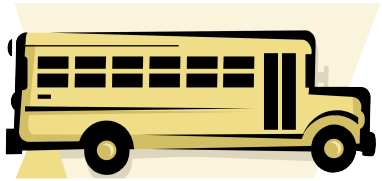
Constructive interference happens when two waves meet and the amplitude is increased.

Destructive interference happens when two waves meet and the amplitude is decreased.

Interference

Wave Velocity

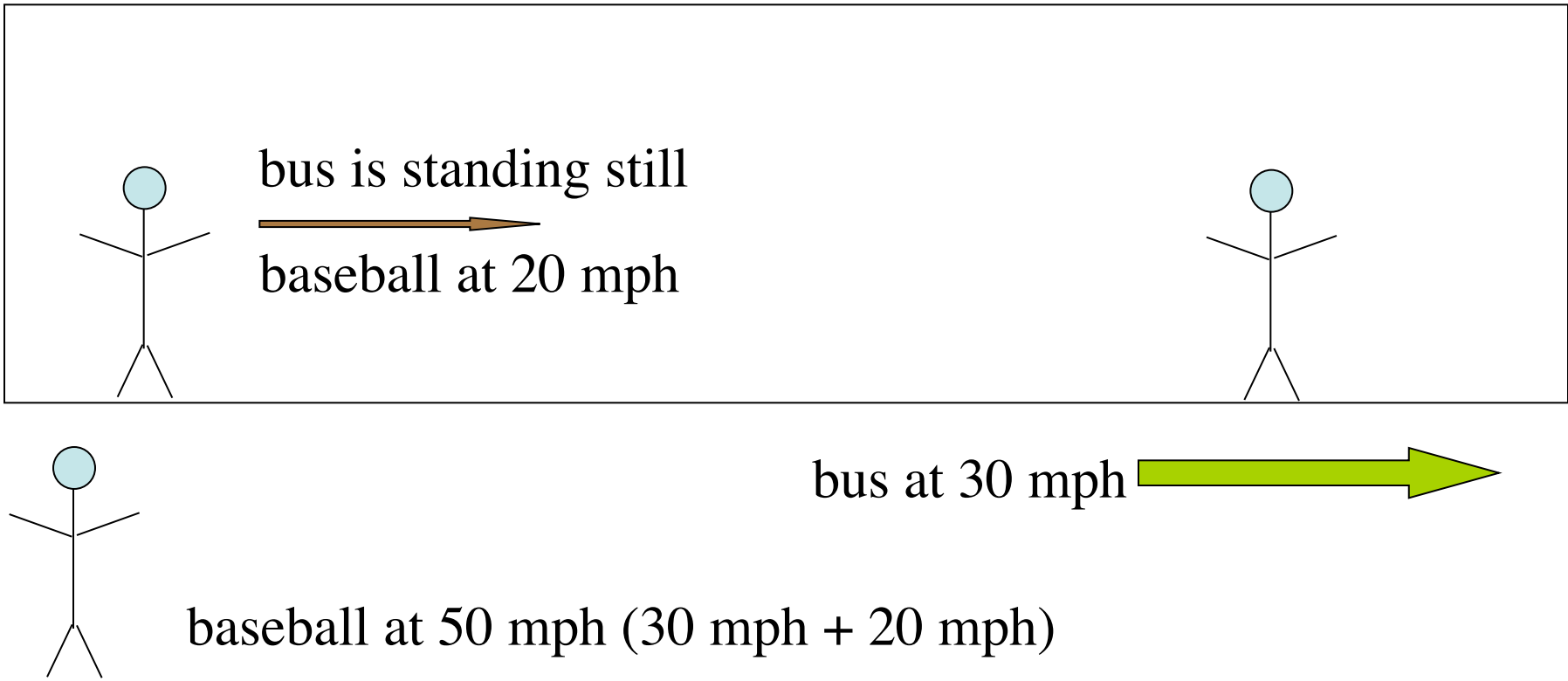
The velocity (speed) of a wave depends ONLY on the kind of wave and the medium it travels through.



This is not true of particles in motion.

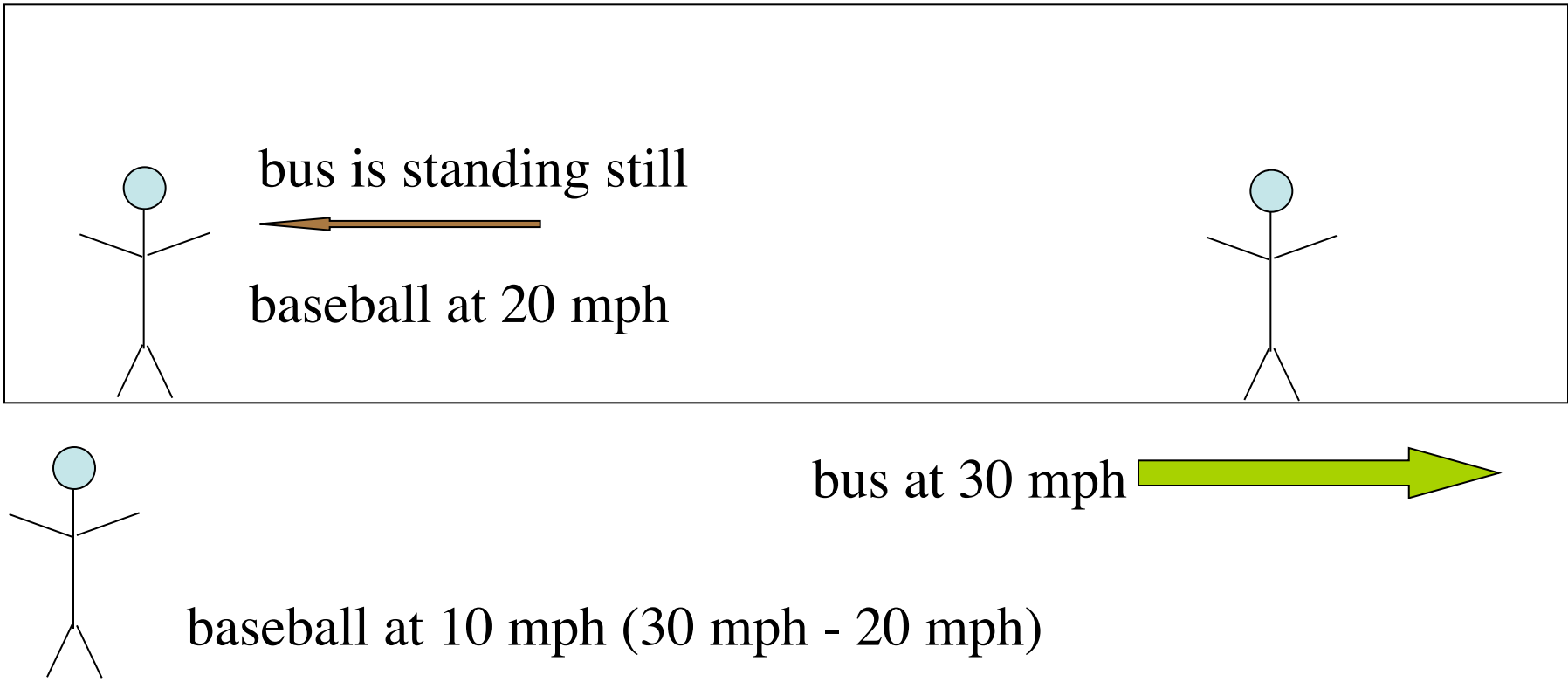
Imagine a person watching a bus drive by at 30 mph. Imagine two people in the bus playing catch with a baseball. The baseball is moving differently for the people on the bus than for the person at the side of the road.

Relative Motion



The people on the bus see the ball moving right at 20 mph, the person on the side of the road sees the baseball moving at 50 mph

Relative Motion



The people on the bus see the ball moving right at 20 mph, the person on the side of the road sees the baseball moving at 10 mph

Relative Motion

Doppler Effect

Relative motion doesn't happen with waves because one wave doesn't change another wave. The velocity of the wave depends only on the kind of wave and the kind of material it is traveling through.

But waves from moving sources have to travel differently from waves produced by sources that are not moving.

Doppler Effect

Doppler Effect 2

http://www.acs.psu.edu/drussell/demos/doppler/doppler.html

Doppler Effect of Sound

Moving Car Horn

If the material the wave is traveling through is also moving (like wind - moving air) the equation becomes a little more complicated - we won't take the time to consider that situation.

$$f_o = f_s \frac{v}{v \pm v_s}$$

Sonic

A **sonic boom** happens when a moving object goes at or faster than the speed of sound.

Objects traveling slower than the speed of sound are **subsonic.**

Objects traveling faster than the speed of sound are **supersonic.**

An **echo** happens when sound **reflects** from a barrier.

Reverberation happens when there are multiple reflections.

Speed of Sound

- The speed of sound depends on the kind of material it is traveling through.
  - for dry air at 0°C it is 331.5 m/s and increases by $\frac{0.6\text{m/s}}{\text{°C}}$
- The speed of sound depends on the material
  - sound in water is about 4 times that of sound in air
  - sound in steel is about 15 times that of sound in air