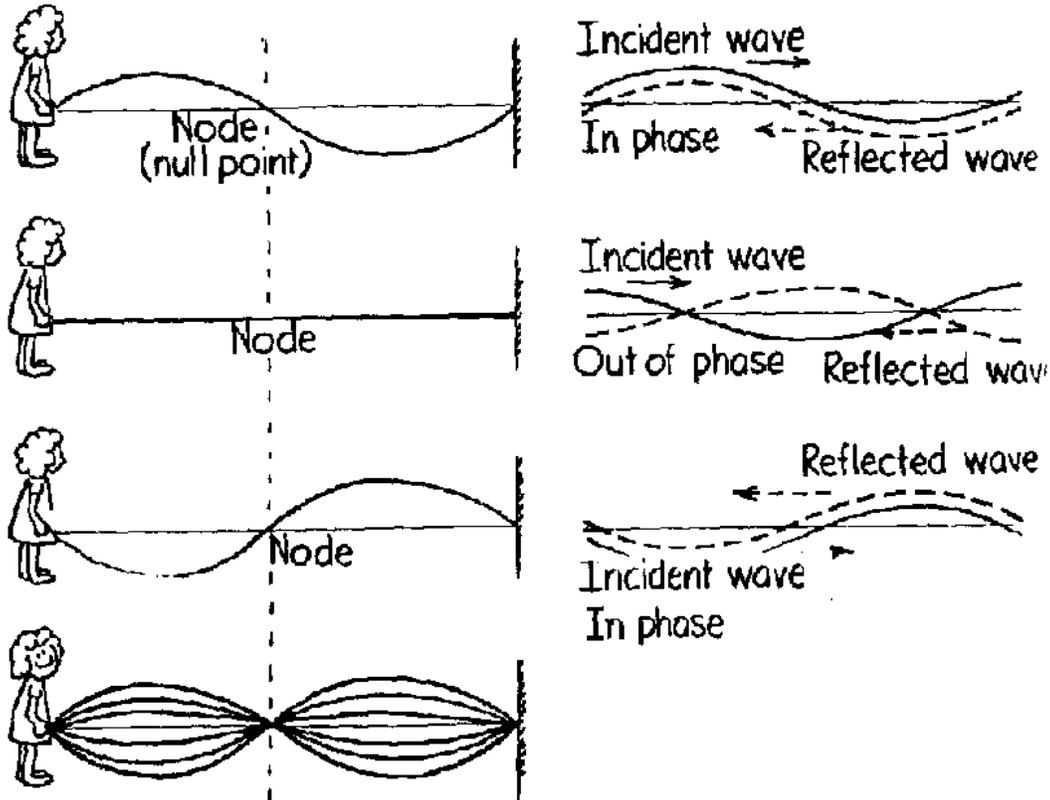


## ACTIVITY #9 STANDING WAVE DEMONSTRATOR (TEACHER'S NOTES)

Standing waves are produced by constructive and destructive interference. A wave reflected from a fixed end reflects back  $180^\circ$  out of phase, but the incident wave and the reflected wave will have equal wavelength and amplitude. When the incident wave and meets the reflected wave, a standing wave will be set up. The diagram below from "Hewitt Drew It" clip art illustrates this point. The girl vibrates the rope producing a standing wave with a node at the wall.<sup>1</sup>



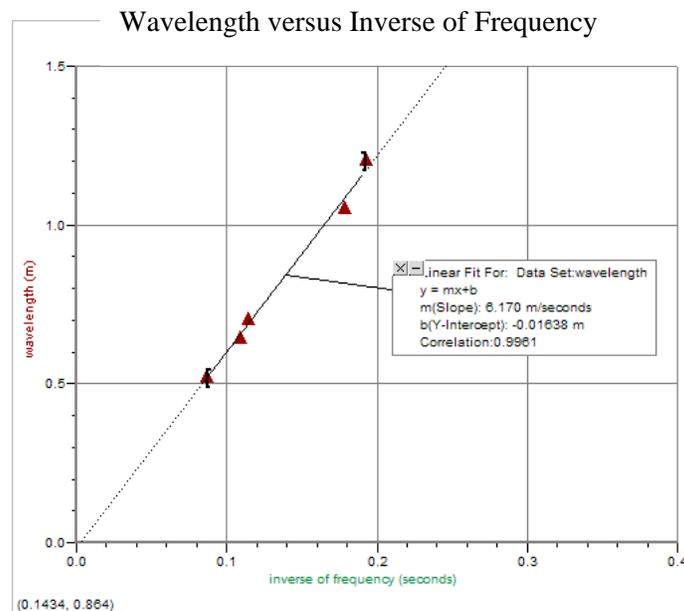
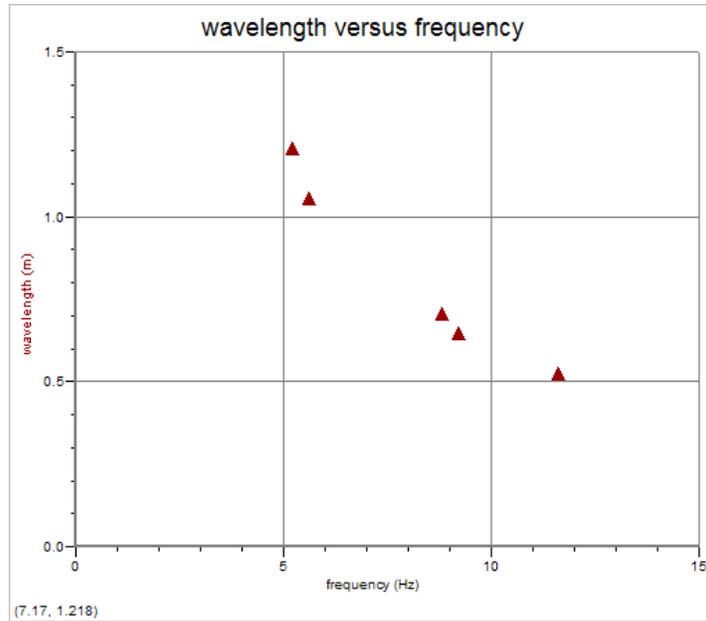
The situation is similar for the Standing Wave Demonstrator. The vibrations of the Demonstrator produce the waves, which are reflected back and forth between the hand and the Demonstrator. When the string length is equal to an integer number of half wavelengths, a node will be established at the hand (and the Demonstrator) resulting in a standing wave. Different lengths of string will work producing different numbers of loops. By letting the string slide through your fingers, you can change the length of the string.

<sup>1</sup> Diagram from clip art Hewitt Drew It™, Laserpoint, 1328 W. Palo Alto, Fresno, CA 93711

Sample data for a 4 AA battery pack

**Data Table**

Trial	Wavelength (m)	Frequency (Hz)
1	1.2	5.2
2	1.05	5.6
3	0.70	8.8
4	0.64	9.2
5	0.52	11.6



1. What happen to the number of loops on the string as the frequency is increased?  
As the frequency is increased the wavelength get smaller. Since a loop of a standing wave is half a wavelength the number of loops increases.
2. How are wavelength and frequency in a given medium related? What is the evidence to support your answer?  
The wavelength is inversely proportional to the frequency. This is seem from the graphs of wavelength and frequency and wavelength versus inverse of frequency.
3. How did you plot the data so you get a straight line? What does the slope of this graph represent?  
The slope of the wavelength versus inverse of frequency graph has units of m/s. It is therefore a speed of roughly 6.2 m/s. This is the speed of the wave.
4. What mathematical relationship between frequency and wavelength is represented by this graph and data?  
Answer: Students should be encourage to examine the basic operations of addition, subtraction, Multiplication, and division to see what values are equivalent to the slope of the wavelength of The inverse of frequency graph to develop the concept that the multiplication of frequency and wavelength produce numerical values that are very close to the slope of the linear graph.  $v = f\lambda$

Trial	Wavelength (m)	Frequency (Hz or 1/s)	Addition m+s
1	1.2	5.2	6.4
2	1.05	5.6	6.61
3	0.70	8.8	9.5
4	0.64	9.2	9.84
5	0.52	11.6	12.12
Trial	Wavelength (m)	Frequency (Hz or 1/s)	Subtraction m-s
1	1.2	5.2	-4.0
2	1.05	5.6	-4.55
3	0.70	8.8	-8.1
4	0.64	9.2	-8.56
5	0.52	11.6	-11.08
Trial	Wavelength (m)	Frequency (Hz or 1/s)	Multiplication m/s
1	1.2	5.2	6.24
2	1.05	5.6	5.88
3	0.70	8.8	6.16
4	0.64	9.2	5.89
5	0.52	11.6	6.03
Trial	Wavelength (m)	Frequency (Hz or 1/s)	Division ms
1	1.2	5.2	0.23
2	1.05	5.6	0.19
3	0.70	8.8	0.08
4	0.64	9.2	0.07
5	0.52	11.6	0.04

For a video of a large scale standing wave pattern see  
[http://www.youtube.com/watch?v=WEQrt\\_w7gN4](http://www.youtube.com/watch?v=WEQrt_w7gN4)

Russia Today — May 21, 2010 — Motorists using a bridge in the southern Russian city of Volgograd were given the ride of a lifetime by a powerful gust of wind. The new river crossing started shaking violently and a massive downpour at the same time made conditions worse. Drivers say their cars were literally thrown into the air; many thinking it was an unexpected earthquake. The shaking was so severe it caused vehicles to career into the opposite lane creating chaos. Local authorities claim an earthquake possibly caused the shaking of the bridge. Seismologists, however, say this is highly unlikely. Meanwhile, Russian president Dmitry Medvedev has ordered an investigation into the bridge's safety and construction history.

The bridge across Volga River is 1260 meters long and 32 meters wide. It was opened less than a year ago in October 2009.