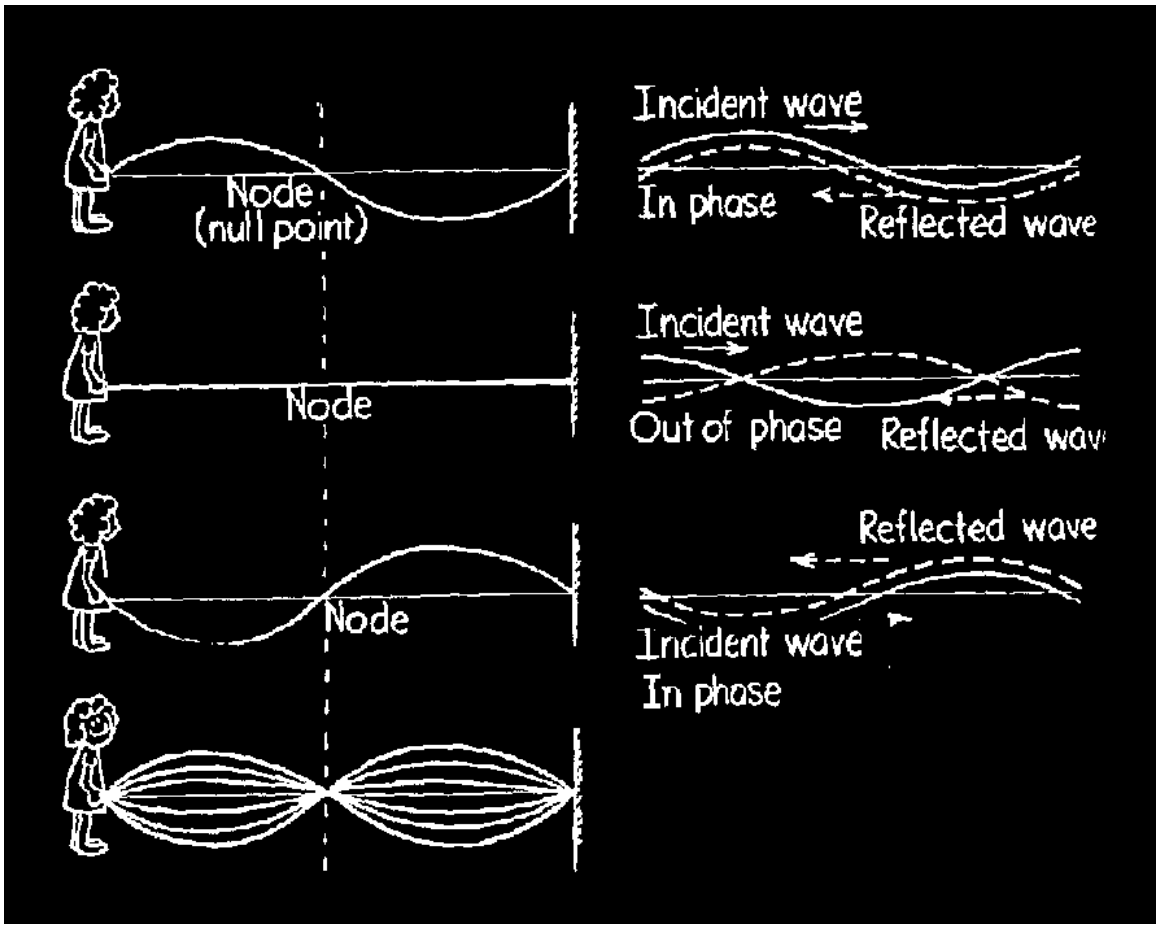
ACTIVITY #9 STANDING WAVE DEMONSTRATOR (TEACHER NOTES)

Standing waves are produced by constructive and destructive interference. A wave reflected from a fixed end reflects back 180° 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.[1]



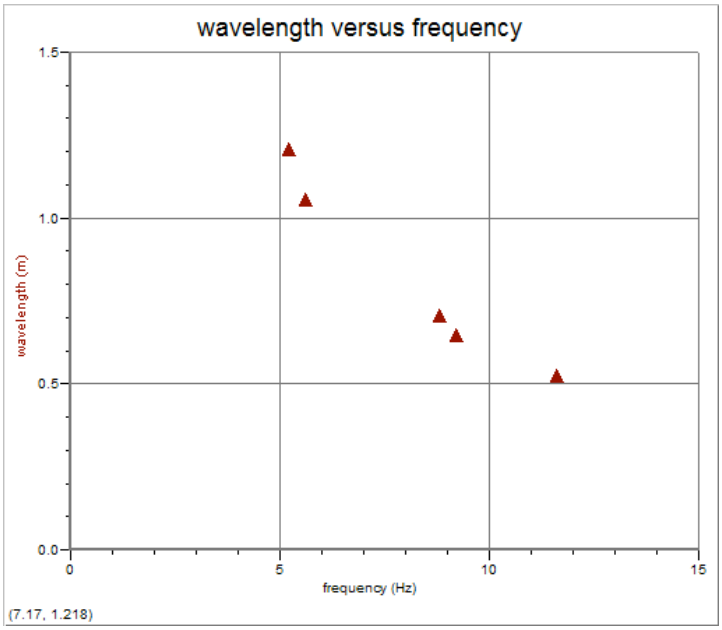
The situation is similar for the Standing Wave Demonstrator. The vibrations of the Demonstrator produce the waves, which are reflected back and forth between the hand and the Demonstrator. When the string length is equal to an integer number of half wavelengths, a node will be established at the hand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

[1] Diagram from clip art Hewitt Drew It ™", Laserpoint, 1328 W. Palo Alto, Fresno, CA 93711

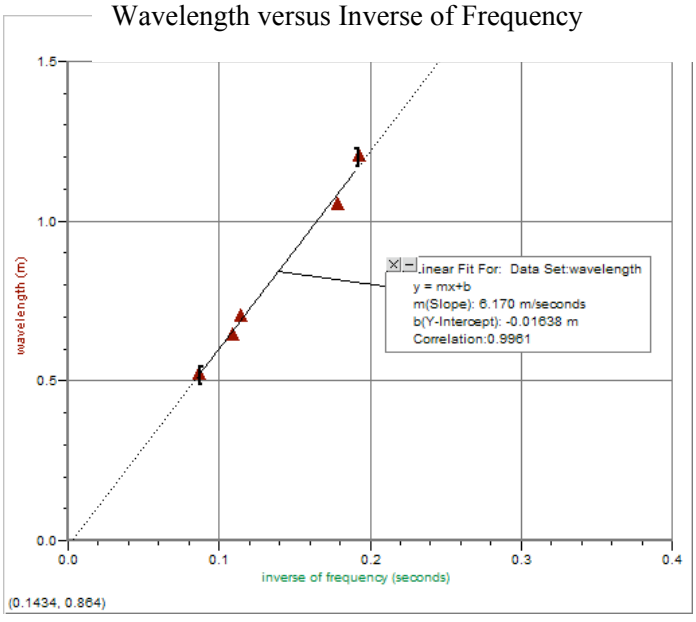
Sample data for a 4 AA battery pack

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



Wavelength versus Inverse of Frequency



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?
   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*