ACTIVITY #10 RELATING FREQUENCY, WAVELENGTH AND SPEED USING A STANDING WAVE (Teacher Notes)

This activity addresses the following content standards and benchmarks:¹

- Content Standard 5 8 Physical Science B Transfer of Energy
- Content Standard 9 12 Physical Science B Interaction of Energy and Matter
- Benchmark 6 8 and 9 –12 The Physical Setting 4F Motion

Prior to having students collect data, sketch what is meant by wave segment so that students realize that one segment is half a wavelength and consequently the distance for one segment must be doubled to have the wavelength. Likewise with three segments the distance would be 1.5 wavelengths, four segments two wavelengths, and five segments 2.5 wavelengths. The snakey coil may be more effective than a SlinkyTM for producing sanding waves. *Have students produce waves on the floor as opposed to vertical standing waves.

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Wave segments	Wavelength	Frequency	Wavelength x Frequency
	(m)	(waves/second)	(m/s)
1	8.0	0.7	5.6
2	4.0	1.4	5.6
3	2.7	2.0	5.4
4	2.0	2.8	5.6
5	1.6	3.6	5.8

Data Table (Sample Data)

¹ National Science Education Standards, National Research Council, 1996

Summing Up:

1. Make a graph of frequency versus wavelength. What does the graph seem to indicate about the relationship between frequency and wavelength in a given medium? *Answer: The frequency seems to be inversely related to wavelength.*



2. Make a graph of frequency versus 1/wavelength, 1/wavelength², or wavelength², as needed, to obtain a straight-line graph. Show on the graph how you determined the value of the slope of the line. Write the equation for the straight line using only physics variables in the equation. *Answer: The graph is linear if frequency is graphed versus the reciprocal of wavelength. The equation of the straight line is then,* $f = v/\lambda$.

What does the value of the slope, including its units, represented the speed of the wave.

3. Make does the graph indicate about the relationship between frequency and speed in a given medium? (The medium stays the same.)
<u>Answer: They are independent of each other. The speed would be the same no matter what the wavelength. If the wavelength increases, the frequency must have decreased to maintain a constant speed. The speed versus frequency and speed versus wavelength graphs show that speed is constant for a given medium regardless of the changing frequency and corresponding changing wavelength.</u>



*** (The graph shape is similar for a graph of speed versus wavelength.)

- 4. What does the equation indicate about the relationship between frequency and speed in a given medium? (The medium stays the same.) <u>Answer: They are independent of each other. The speed would be the same no matter what the frequency. If the frequency increases, the wavelength must have decreased to maintain a constant speed.</u>
- 5. If you were to make a graph of speed versus frequency for a wave in a **given medium**, what shape would it be? <u>Answer: It is straight</u>. If your graph were straight, what would the y-intercept represent? <u>Answer: It represents the speed</u>. If your graph were not straight, what would you have to change about the X-axis variable to make the graph straight?