Wave Speed Lab

In this lab you will determine the speed of a wave in a coiled spring by three different methods.

1. **DIRECT OBSERVATION** - Stretch the spring to a length of 6 meters. Keep this length the same for all trials throughout the rest of the exercise. **Follow** the safety directions given. Produce a pulse in the spring and time how long it takes to travel from one end to the other. Repeat this a number of times. Calculate the average speed from distance divided by the time.

2. **FORMULA METHOD -** Stretch the spring again to 6 meters in length. Attach a spring scale to one end and record the tension force required to keep the spring stretched. Relax the spring, coil it, and then tape it so it does not unravel. Hang the coiled spring from the spring scale and record the mass in kilograms. Determine the wave speed by using the formula: speed equals the square root of the force of tension divided by the mass per unit length.

3. **STANDING WAVE METHOD** - Stretch the spring to 6 meters. Generate a standing wave by having one student act as a generator and the other holding the other end in a fixed position on the floor. Generate wave patterns that cause the spring to vibrate in large loops or antinodes. These vibrating loops will oscillate perpendicular to the line of the spring. The vibrating segments (antinodes) will stay in one place on the spring. Keep in mind that the wave energy is traveling back and forth along the spring. Start with a single antinode standing wave. Keep a steady rhythm to generate the pattern. What is the wavelength of this wave ? Can you visualize a sine wave ? What fraction of a sine wave is represented by the pattern ? This wave is twice the length of the spring. Time ten vibrations of the spring. Calculate the frequency of the vibration. Multiply the frequency by the wavelength to determine the wave speed. Change the frequency of the wave by vibrating the spring faster to produce two antinodes. How does this compare to a sine wave ? What is the wavelength ? Time ten vibrations of this wave and determine the frequency. Calculate the wave speed. Repeat the procedure to produce three, four, and five antinodes, determine their frequencies, and wave speeds. Calculate the average wave speeds for this section.

Compare the wave speeds using all three methods. What do you conclude ? What do you notice abut the frequencies ? Why do you think this is so ?