ACTIVITY #8 SPRING LABORATORY ACTIVITY (TEACHER NOTES)
My Waves Are Faster Than Your Waves!
Contributed by Mark Kinsey

Part One:

Students will determine the relationship between frequency and wavelength for a fixed tension in the spring. Students will plot a graph of the wavelength versus the period for a given tension. When this graph is plotted and analyzed the result is a straight line through (0,0) with a slope that has units of meters/second. This suggests that the wavelength is proportional to the period. This makes some sense since the faster you vibrated the spring the less time the wave has to move before the pattern is repeated. Also since the slope is constant and has units of meters/second, this suggests a constant speed somewhere in the experiment. The fact that this speed is the speed of the wave along the spring can be checked by the direct measurement of the speed of a pulse along the spring with the stopwatch. Now the student has developed the wave equation, which can be used in part two below.

Wavelength = (Speed of Wave)*(period) OR Speed of Wave = (Wavelength)*(frequency)

This does assume that the student has done an activity to investigate the relationship between period and frequency. See AAPT/PTRA Teaching About Kinematics Manual, Activity #4: Investigation of a Flashing Light.

Part Two:

The now uses the results of Part One (thus a review) to determine the relationship between speed and tension. This can be descriptive (more tension results in faster wave) or more mathematical by plotting the speed (Now we use the wave equation we derived above to calculate speed) versus the tension in the spring. The result looks like it might be an underachiever parabola. To prove this supposition, plot the square of the speed versus the tension and the result is a straight line through (0,0), thus the speed squared is proportional to the tension or stated differently that the speed is proportional to the square root of the tension. In this case the slope is meters/kilogram and that may be more than you want to get into, but it turns out to be the inverse of the mass/length of the spring.

Please note:

It is difficult to obtain a reading for the tension while the spring is vibrating. Hold the end with the spring scale as still (as possible). The other end is the end of the spring that is vibrated.