Catch a Wave!

Introduction:

As you begin your investigation you will need to pin down some basic terminology and phenomena that you will encounter along the way. During this laboratory the entire class will be assigned groups composed of three or four students. The purpose is to gain an understanding of basic wave characteristics and their relationships to each other and the medium through which the wave travels.

One of the largest tsunamis (tidal waves) grew from about 0.7m high in open ocean to 35m high when it reached shore.

What Do You Think? Preliminary Questions: Answer these individually

1. How does water move to make a wave?
2. How does a wave travel?
3. What does a water wave carry as it travels?

Materials:

1.5m of bulletin board paper	1 timer
1 double slinky	1 meterstick
1 terms sheet	

1. In an area free of obstacles, stretch out a Slinky® so the turns are a few centimeters apart. Mark the positions of the end of the Slinky by on the paper. Measure the distance between the marks.
   - **Record** the distance between the marks. Label the rest position of the Slinky
2. With the Slinky stretched out to the tape, grab the spring near one end and pull sideways 20 cm and back. Mark the 20 cm displacement on the paper To move it correctly, move your wrist as if snapping a whip. Observe what happens. You have made a transverse pulse.
   - a). In what direction does the spring move as the pulse goes by?
   - b). A dictionary definition of transverse is: “Situated or lying across.” Why is transverse a good name for the wave you observed?
   - c. Measure and record the amplitude of the wave. The distance you disturbed the spring is called the amplitude. The amplitude tells how much the spring is displaced.

Have your teacher approve your data

3. After you have experimented with making pulses, measure the speed of the pulse. You will need to measure the time it takes the pulse to go the length of the spring. Take several measurements and then average the values.
   - a). Record your data
4. Measure the speed of the pulses for two other amplitudes, one larger and one smaller than the value used in **Step 3**.
   - a). Record the results in the data table.
   - b). How does the speed of the pulse depend on the amplitude?

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5. Now make waves! Swing one end back and forth over and over again along the floor. The result is called a periodic wave.
   - a). Describe the appearance of the periodic wave you created.
6. To make these waves look very simple, change the way you swing the end until you see large waves that do not move along the spring. You will also see points where the spring does not move at all. These waves are called standing waves.
7. The distance from one crest (peak) of a wave to the next is called the wavelength. Notice that you can find the wavelength by looking at the points where the spring does not move. The wavelength is twice the distance between these points. Measure the wavelength of your standing wave.

a). **Record** the wavelength of your standing wave

8. You can also measure the wave frequency. The frequency is the number of times the waves moves up and down each second. Measure the frequency of your standing wave. (Hint: Watch the hands of the person shaking the spring. Time a certain number of back-and-forth motions. The frequency is the number of back-and-forth motions of the hand in one second).

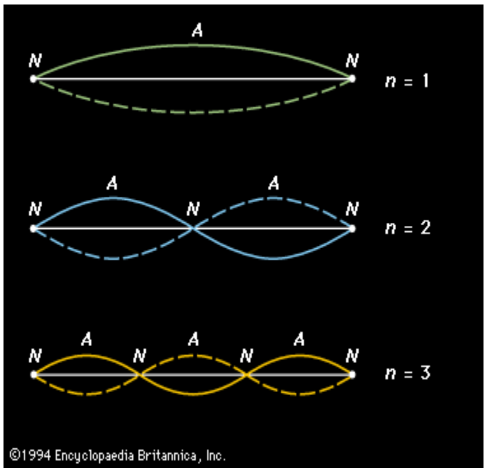
a). **Record** the wave frequency. The unit of frequency is the hertz (Hz).

9. Make several different standing waves by changing the wave frequency. Try to make each standing wave shown in the drawings. Measure the wavelength. Measure the frequency.

a). **Record** both in the data table.

Have your teacher approve your data

b). For each wave, calculate the product of the wavelength and the frequency. Compare these values with the average speed of the pulse you found in **Step 3 and 4 above**.

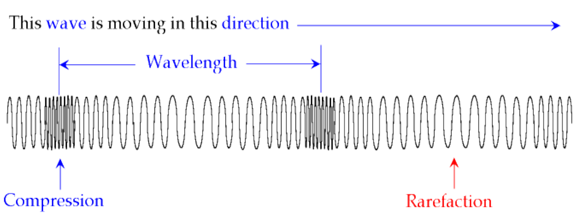


Wavelength = twice Slinky length

Wavelength = Slinky length

Wavelength = 2/3 Slinky length

10. All the waves you have made so far are transverse waves. A different kind of wave is the compressional (or longitudinal) wave. Have the members of your group stretch out the Slinky between the pieces of tape and hold the ends firmly. To make a compressional wave, squeeze part of the spring and let it go. Measure the speed of the compressional wave and compare it with the speed of the transverse wave.



a). Record your results in a table partly like the one after Step 3.
b). In what direction does the Slinky move as the waves goes by?
c). A dictionary definition of compressonal is: "The act or process of compressing. b. "The state of being compressed." A dictionary definition of longitudinal is: "Placed or running lengthwise." Explain why compressional or longitudinal wave is a suitable name for this type of waves.

Have your teacher approve your data

Amplitude	Time for pulse to travel from one end to another	Average Time	Speed = $\frac{\text{lengthofspring}}{\text{averagetime}}$

Wavelength (m/cycles)	Frequency (cycles/s) or Hz)	Speed (m/s) Wavelength x frequency