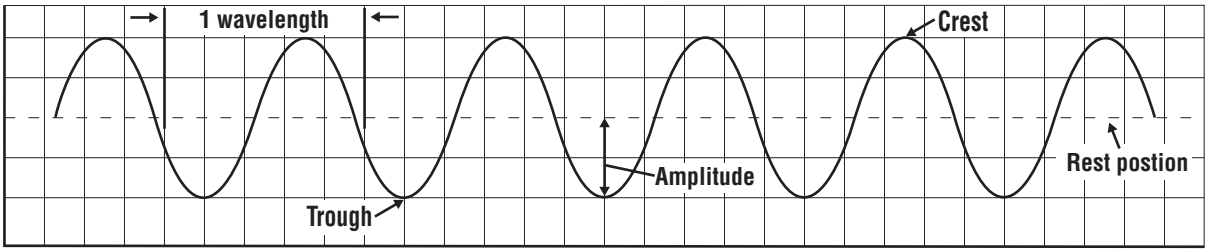
LAB 1 Laboratory Activity

Velocity of a Wave

Energy can move as waves through material such as ropes, springs, air, and water. Waves that need a material to pass through are called mechanical waves. Ripples in flags and sound waves are examples of mechanical waves. Electromagnetic waves, such as light, can be transmitted through matter as well as empty spaces.

The high part or hill of a transverse wave is the crest. The low part or valley of a transverse wave is the trough. The amplitude of a mechanical wave is the distance the material through which the wave is passing rises or falls below its usual rest position. Mechanical waves of large amplitude transmit more energy than mechanical waves of small amplitude.



The wavelength is the distance between two similar points on successive waves. The number of wavelengths that pass a fixed point in one second is the frequency of the wave. Frequency is measured in a unit called hertz (Hz). A frequency of 1 Hz indicates that one wavelength is passing a point each second. The frequency can be found using the following equation:

frequency = number of wavelengths/1 second

The velocity of a wave depends upon the material through which the wave passes. The velocity of a wave is equal to its wavelength times its frequency. A wave's velocity is expressed in the same units as any measurement of velocity—meters per second (m/s).

velocity = wavelength × frequency

Strategy

You will identify the crest, trough, and amplitude of a wave.
You will determine the wavelength and frequency of a wave.
You will calculate the velocity of a wave.

Materials

instant developing camera
meterstick
20 pieces of colored yarn
rope, about 5 m long
or
coiled spring toy

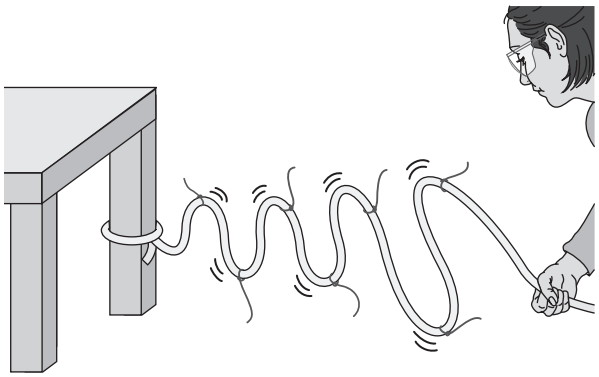
Procedure

Part A—Frequency of a Wave

1. Safety goggles should be worn throughout the experiment. Tie the pieces of yarn to the rope at 0.5 m intervals. Use the meterstick to measure the distances.
2. Tie one end of the rope to an immovable object, such as a table leg. Pull the rope so it does not sag.
3. Make waves in the rope by moving the free end up and down. Continue to move the rope at a steady rate. Observe the crests, troughs, and amplitude of the waves.

Laboratory Activity 1 (continued)

4. Continue making waves by moving the rope at a constant rate. Observe a particular piece of yarn. Count the number of wavelengths that you produce during a period of 30 seconds. Record this value in Table 1 as wave motion A.
5. Slow the rate at which you are moving the rope. Predict what will happen to the frequency. Count the number of wavelengths produced in 30 seconds while maintaining this constant slower rate. Record this value in Table 1 as wave motion B.
6. Repeat the procedure in step 4 moving the rope at a faster rate. Maintain this constant rate for 30 seconds. Record this value in Table 1 as wave motion C.



have a classmate move the rope with a constant motion. Record the number of wavelengths produced in 30 seconds in Table 2 as wave motion A. Photograph the entire length of the moving rope using the instant developing camera. Rest the camera on a table to keep it still.

2. Have your classmate increase the motion of the rope and take another photograph. Predict what will happen to the wavelength. Again count the number of wavelengths produced in 30 seconds, and record these values in Table 2 as wave motion B.
3. Observe the developed photographs. For each photograph, use the yarn markers to determine the length of one wavelength. Record these values in Table 2. You may tape the photographs to the last page of this Laboratory Activity.

4. Calculate the frequency of each of the three

Part B—Velocity of a Wave

1. Using the same rope setup as in Part A,

waves produced in Part A. Use the equation for the frequency found in the introduction. Record the values of the frequencies in Table 1.

5. Calculate the frequencies of the two waves produced in Part B. Record these values in Table 2.
6. Calculate the velocities of the two waves using the values of the wavelengths and frequencies in Table 2. Use the equation for velocity of a wave found in the introduction. Record the values of the velocities in Table 2.

Laboratory Activity 1 (continued)

Data and Observations

Part A—Frequency of a Wave

Wave motion	Number of waves in 30 s	Frequency (Hz)
A		
B		
C		

Part B—Velocity of a Wave

Wave motion	Number of waves in 30 s	Frequency (Hz)	Wavelength (*m*)	Velocity (*m*/s)
A				
B				

Questions and Conclusions

1. As you increased the motion of the rope, what happened to the frequency of the waves?

2. As the frequency of the waves increased, what happened to the wavelength?

3. As the frequency of the waves increased, what happened to the velocity of the waves?

4. Does your data indicate that the velocity of a wave is dependent or independent of its frequency? Explain.

Strategy Check

_____ Can you identify the crest, trough, and amplitude of a wave?

_____ Can you determine the wavelength and frequency of a wave?

_____ Can you calculate the velocity of a wave?

Laboratory Activity 1 (continued)

Attach photographs here.