ARBOR SCIENTIFIC

TOOLS THAT TEACH.

Instructional Guide

Longitudinal Wave Spring

Part# P7-1500-01

Contents:

1 ea. Metal spring with holder
1 ea. banana plug connector
1 ea. Allen Key

Required but not included:
Sine Wave Generator
Mechanical Wave Driver

Teacher's Background Knowledge

Longitudinal standing waves are common in many different mediums; gases liquids and solids. When a wavetrain moves through a medium and encounters an end or boundary, some portion of the wave energy will be reflected backward. If the original source of the waves continues, the medium will quickly fill with waves traveling back and forth over each other. At specific frequencies the displacements of these waves will combine to produce a steady-state interference called a standing wave. If the disturbance is produced in a long spring by a back and forth displacement in the same direction of the spring, the coils will be compressed and stretched producing a longitudinal standing wave.

Introduction to the Apparatus

Arbor's Scientific's Longitudinal Wave Spring easily demonstrates the formation of nodes and antinodes in a standing wave pattern when the spring is driven by the Mechanical Wave Driver. As shown in the photo below, the spring is vertically attached to the wave driver at the bottom and above to a fixed clamp. If the fixed clamp is mounted on a ring stand, the clamp can be raised to stretch the spring. This will change the tension in the spring and the speed of the longitudinal waves that travel up and down the spring. The change in wave speed changes the wavelength of the standing waves.

First, set up the experiment as shown above, following the steps outlined.

1. Attach the banana plug to the spring by hooking one end of the spring through the hole in the plug.
2. Insert the banana plug into the shaft of the Mechanical Wave Driver.
3. Attach the other end of the spring to a ring stand clamp. Rise the camp, stretching the spring upward 40-50 cm.
4. Connect the Mechanical Wave Driver to a Sine Wave Generator.

Getting Familiar/Experimenting

With the amplitude of the function generator turned low, turn on the generator, starting with a low frequency of about 5 Hz output to Mechanical Wave Driver. Increase the amplitude and gradually increase the frequency until nodes and antinodes form along the spring.

The nodes will appear where sections of the spring appear motionless while the antinodes appear as a blurred agitation. Measuring the spacing from node to node or antinode to antinode will give a value equal to half the wavelength of the standing wave. Doubling this value and multiplying it by the frequency of the wave will give you the speed of the waves.

Try increasing the frequency of the generator until the next standing wave pattern forms on the spring and notice how the spacing pattern changes. With this new spacing and frequency, again calculate the wave speed as above and compare it to your first calculation.