Demonstrating Waves

Introduction

Waves are all around us! You may not be aware of it, but we encounter waves on a daily basis. Use these demonstrations to help your students visualize the properties of waves and wave propagation.

Concepts

- Longitudinal wave
- Standing wave
- Transverse wave

Background

Think for a moment about the various types of waves that you may have encountered in your lifetime—sound waves, light waves, radio waves, microwaves, water waves, earthquake waves and so on. It is almost hard to believe that waves are travelling all around us. The majority of information we receive on a daily basis reaches us in the form of waves. Sometimes we can visibly see a wave and sometimes we cannot. But what is a wave? What are some common characteristics and properties shared by all of these different waves?

A *wave* is commonly defined as a disturbance that travels through a medium or space. As a wave propagates (travels), energy is transferred through the medium or space. Waves are often categorized based on how they travel. A *transverse wave* has vibrations that are perpendicular to the direction of wave travel. Transverse waves display the common characteristic properties of wavelength, amplitude, and frequency (see Figures 1 and 3). A *longitudinal wave*, such as sound, has vibrations parallel to the direction of wave travel. Longitudinal waves display the characteristic properties of compressions and rarefactions (see Figure 5). A *standing wave* is a wave pattern created by the interference of two identical waves travelling in opposite directions. Standing waves are often set up in musical instruments and display the characteristic properties of nodes and antinodes (see Figure 4).

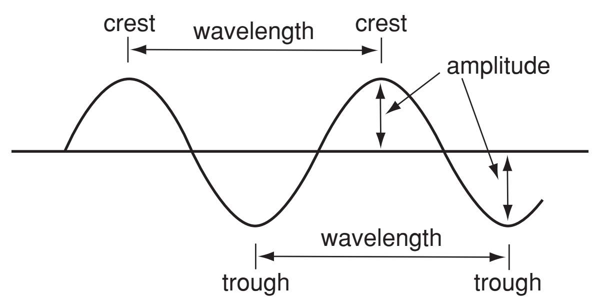

Figure 1. Transverse wave

Materials

Slinky®
String
Wave demonstrator spring

Safety Precautions

The wave demonstrator spring is safe if used in a normal manner for wave demonstrations. Only misuse of the spring is likely to result in potential injury. Protective eyewear should be worn when using the spring.

Procedure

1. **Transverse Waves:** Fasten one end of the wave demonstrator spring to a wall or stationary object using a piece of string. Shake the free end of the spring up and down once. Observe the pulse move down the spring (see Figure 2). Notice that the amplitude of the wave decreases as it moves the length of the spring. Now generate a train of transverse waves by shaking the spring up and down, respectively, while keeping the amplitude the same. Transverse waves displace particles perpendicular to the direction of wave propagation (see Figure 3). Next, increase the frequency by shaking the spring more rapidly while keeping the amplitude the same. Finally, shake the spring at various amplitudes but keeping the frequency the same in each case. Repeat until all the desired principles have been observed.

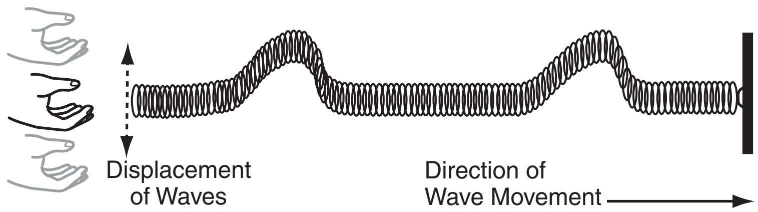

Figure 2. Pulse

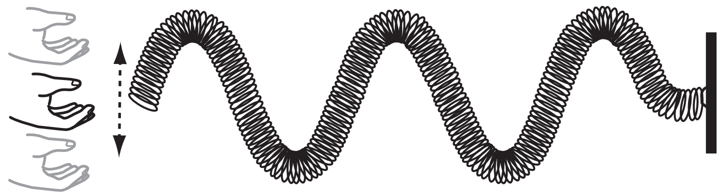

Figure 3. Transverse wave

2. **Standing Waves:** Use the Transverse Wave Procedure to create a standing wave. A standing wave is a wave pattern that results when two waves of the same frequency, wavelength and amplitude travel in opposite directions and interfere with each other. When a standing wave is created, you will see nodes and antinodes. A *node* is a point in a standing wave that appears to be stationary. This is due to complete destructive interference. An *antinode* is a point in a standing wave, halfway between two nodes, at which the largest amplitude occurs (see Figure 4).

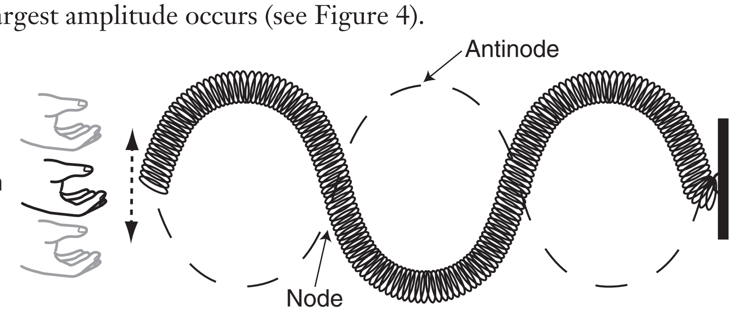

Figure 4. Standing wave

3. **Longitudinal Waves:** Using a piece of string, fasten one end of the Slinky to the bottom of the leg of a chair. Hold the free end of the Slinky in one hand and stretch it across the ground. Push the Slinky in and out as shown in Figure 5. Observe the compressions and rarefactions that are created as the energy travels. Compressions are areas of high pressure where the Slinky is compressed. Rarefactions are areas of low pressure where the Slinky is stretched out.

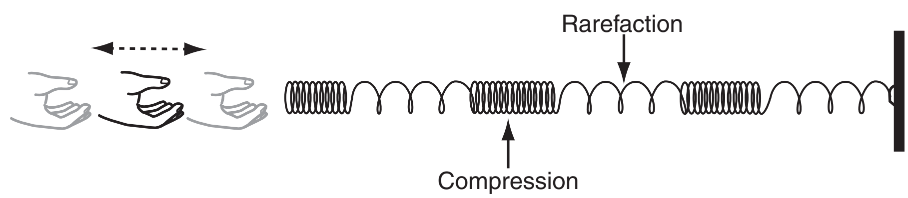

Figure 5. Longitudinal wave

Tip

- Supplemental wave kits are also available from Flinn Scientific: *Standing Wave Generator* (Catalogue No. AP6161), *Transverse Wave Demonstration* (Catalogue No. AP6252), *Simulated Double-Slit Interference* Demonstration Kit (Catalogue No. AP6626) and the *Singing Tube Demonstration Kit* (Catalogue No. AP6312).

Materials for *Demonstrating Waves* are available from Flinn Scientific Canada Inc.

Catalogue No.	Description
AP1957	Slinky®
AP9023	Wave Demonstrator

Consult www.flinnsci.ca or your *Flinn Scientific Canada Catalogue/Reference Manual* for current prices.