

Lab - Wave Properties in a Spring

The wave characteristics you will observe in this lab are common to all waves (water, light, sound, etc.). Use your prior knowledge and the book to fill in the following blanks, then go in the hall and perform the lab.

A wave is a disturbance that moves through (propagates) through empty space or through a _____. There are two types of waves. A _____ wave requires matter to travel. List some examples of this type:

A _____ wave does not require a medium. Examples include:

In order to start and transmit a mechanical wave, a source of _____ and an _____ medium are required. A single disturbance is referred to as a _____, and a series of disturbances is a wave _____.

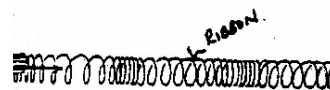
The questions in bold are those you should observe directly. Others will be answered using the book.

A. TYPES OF MECHANICAL WAVES: In the hall, stretch the slinky on the floor until it is stretched (but still loose). Practice sending single pulses down the slinky by popping your wrist from the center to the side and back to the center. Then send a continuous wave train along as your partner holds the other end still. A piece of ribbon should be tied to one coil. Watch the motion of this ribbon (representing a particle) as the wave travels through the spring.

In this type of wave, the particles move (perpendicular, parallel) to the direction the wave travels. This type of wave is called a _____ wave. Its pulses are called _____ and _____.



Now send a pulse by quickly pushing the spring forward and pulling it back, as shown. This type of wave is called _____.



In this type, the particles move _____ to the direction the wave travels. Its pulses are called _____ and _____. Label each.

Note that all waves transfer _____ without transferring _____. In mechanical waves, particles of the medium vibrate back and forth in simple harmonic motion while the disturbance (or _____) moves from one place to another.

B. WAVE SPEED

Send a large pulse, followed by a small one. **Does one pulse catch up to the other?** _____
(Hint: The person who sends these waves should watch how the waves look when they return. Make sure that both pulses are large enough initially to make it back to the sender!) The size of the pulse is called the _____ of the wave. **Did the size affect the speed?** _____
Generate a single transverse pulse in the slinky, keeping the stretch constant. Using a stopwatch, time the journey of the pulse from one end to the other and back again. Take the average of several trials. _____

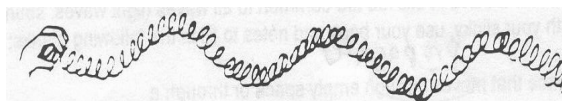
Without changing your positions on the floor (therefore keeping the _____ the pulse travels the same), pull the slinky tighter using only about 3/4 of the coils. This makes a completely different medium through which the pulse will travel. Time the journey as before. _____

Does the kind of medium affect the speed of the pulse? _____

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C. WAVELENGTH AND FREQUENCY

Shake the slinky back and forth steadily to send a transverse wave train while your partner holds the other end still. On the diagram, label wavelength (λ - Greek letter lambda). The frequency of the wave depends on how fast you shake the slinky. Shake it regularly but slowly, then regularly but rapidly.



Higher frequency waves are generated by shaking the spring (slowly, rapidly). High frequency waves have (short, long) wavelengths, and low frequency waves have _____ λ .

The speed of a wave in any medium is equal to the _____ of the wave X _____. This wave equation _____ shows that f and λ are _____ proportional. Write the units for each of the variables in this equation.

D. WAVE INTERFERENCE Both partners should practice sending single pulses toward each other at the same time. Send the pulses on the same side of the slinky. Try making one pulse large and the other small. Observe the pulses at the instant they meet and then after they pass through one another.

Pulses on the same side of the spring are said to be erect. **When pulses meet on the same side of the spring their displacements (add up, cancel out) for that instant. After they pass through each other, they continue (changed, unchanged).**

Now send identical pulses on opposite sides of the spring, observing them the instant they meet. **When crest meets trough, their displacements (add up, cancel out) for that instant.**

E. REFLECTED WAVES

Have one partner hold one end of the spring tightly against a book. The other should send a single transverse pulse of large amplitude. Watch the pulse as it hits the book and turns the other way (reflected). If it stays on the same side of the spring, it is erect, if it flips it is inverted.

A pulse reflected from a more rigid medium is reflected (erect, inverted). If these are hard to see, check the diagrams in your book for help.

Now tie a long string to the end of the slinky and hold the end of the string as your partner sends a pulse toward you. Watch the pulse as it reaches the end of the slinky and turns back to the sender.

A pulse reflected from a less rigid medium is reflected (erect, inverted). If these are hard to see, check the diagrams in your book for help.

F. WAVES GOING FROM ONE MEDIUM TO ANOTHER

Connect the slinky to the smaller, tightly coiled spring by twisting the coils together. Have one partner hold the end of the small spring while the other sends a transverse pulse. Observe the pulse at the boundary of the two media.

When a wave reaches the boundary of this new medium, it is (partially, totally) reflected and (partially, totally) transmitted. (Hint: Think of light hitting a store window.) Since the new medium, the smaller spring is (more, less) rigid than the slinky, any reflected wave will be (erect, inverted).

** In each part of the lab, what eventually happened to the amplitude of a wave as it travels? _____ This phenomena is known as damping. **