

Mechanical Snake Lab

Purpose: the purpose of this activity is to measure the velocity of transverse and longitudinal pulses (waves) in a spring, to determine the factors which affect the velocity and to observe the properties of waves when they interact with each other.

Materials: Slinky, chalk, stop watch, meter stick

Procedure:

Part A: Comparing the velocity of pulses

In this part of the lab you will test what variables effect the speed of wave pulses.

Pulses can be generated in a slinky stretched out on a floor by one person holding one end firm and another person giving their end a single quick jerk sideways and back. This is called a transverse pulse. A longitudinal pulse can be created by plucking the coils parallel to the length of the slinky or spring. Be careful not to stretch the slinky past the point where it will not return to its original shape and don't let go of one end when the slinky is stretched which will result in an unreparable tangle.

Measure the velocity of pulses with changed variables such as type of pulse, stretch of the coil, etcetera. Organize a data table showing the variables that were tested and all measured data used to determine the velocity of the pulses.

B. Reflection and superposition of wave forms

1. With your partner holding the far end of the slinky firmly against the floor, create a sharp single pulse disturbance in your stretched slinky and note carefully the direction of displacement of the original incident and reflected pulses.
2. You and your partner can generate a disturbance from both ends of the slinky at the same time. Move your hands in opposite directions from each other; note whether the pulses pass through each other or reflect back from the collision.
3. Now generate equal sized pulses from each end on the same side and compare the maximum displacement when they meet with the original pulses. Use a piece of chalk to measure these displacements.

C. Standing waves

With your partner holding the opposite end of the slinky, generate a standing wave by moving the end steadily back and forth at an appropriate frequency. If you have difficulty establishing it your partner can try moving forward or backward. Note that at a proper frequency the spring will vibrate in one, two, three or more segments.

Indicate and sketch all the different standing wave patters you were able to generate.

Questions (to be answered in your data analysis section)

1. What effect, if any, did a greater stretch have on wave speed in the slinky?
2. How does the speed of the longitudinal wave compare with that of the transverse for the same stretch?
3. How does a reflected pulse compare to the original incident pulse?
4. Do the pulse appear to pass through each other or do they “bounce back” from collision with another pulse? How can you verify your answer?
5. How does the maximum displacement where the pulses meet compare with the displacement of each individual pulse?
6. What happens to the wavelength as the frequency increases?

Extra Credit (NEEDS TO BE DONE IN LAB): A region of the standing wave where there is no motion is called a node. The distance between two nodes is $1/2$ a wavelength. Conduct an experiment to find a relationship between the wavelength and frequency of various standing waves. Show all your measurements in a well organized data table. What can you conclude from your experiment?