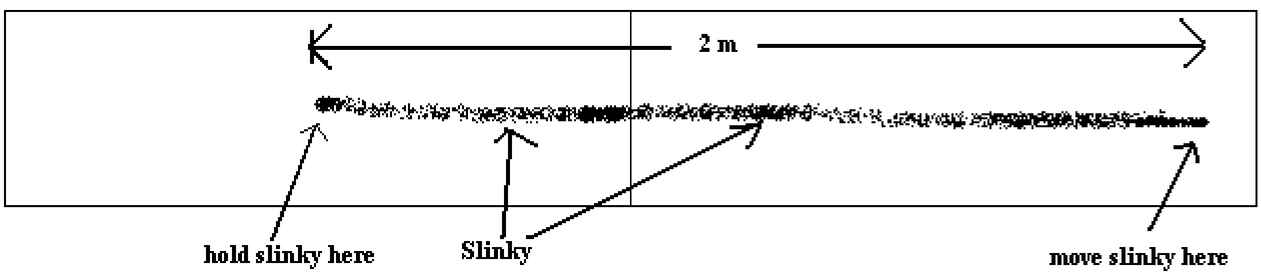
Slinky® Waves

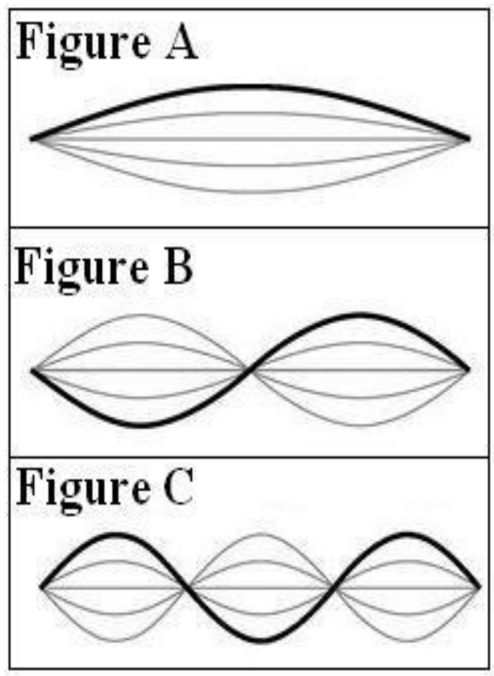
Purpose: to measure wave properties using a Slinky®
to determine the relationships among the wave properties
to discover the causes of changes in the wave properties

Materials: 1 double Slinky® Jr, 1 meterstick, 1 stopwatch

Figure 1



Part 1: Standing Waves



1. Hold 8 coils at each end of the Slinky®. Stretch the Slinky® to a length of 2 meters along the tables as in Figure 1.

2. Create a standing wave that looks like Figure B. To make the wave, move one end of the Slinky® back and forth across the table. Be careful not to move it so far that it goes past the edge of the table.

3. Once you have the "perfect" standing wave you will be able to feel it…the Slinky® has a natural frequency that it "wants" to match. You may notice the amplitude increase when you find the correct wave.

4. Measure and record the time for ten waves. Wait until you have the correct wave as described in step 3 and then start the timing. Count the waves based on the movement of the hand generating the waves.

5. Complete three trials of the time for 10 waves.
   Have data approved at this point

6. Repeat steps 1 -5 for Figure A and Figure C.
   Have data approved at this point

7. Use your data to calculate the period, frequency, wavelength, and wave speed of each standing wave. Each student should show **K-U-E-S** for one wave below the data table. Be sure that the **K-U-E-S** are shown for each wave within the whole group…you can't all show **K-U-E-S** for wave A.

8. Write the results of your calculations in the second table

Wave	Time (s) for 10 waves			Average Time (s)
A				
B				
C				

Wave	Period	Frequency	Wavelength	Wave Speed
A				
B				
C				

Show K-U-E-S for one wave below:

Have K-U-E-S approved

Part 2: Wave Speed in different media

9. Hold 8 coils at each end and stretch the Slinky® to 1m in length. Make a single compression pass through the Slinky®. To do this, simply pull back and release some coils at one end of the Slinky® and let them go. Measure the time it takes for this compression to reach the other end of the Slinky®.

10. Complete three trials.

11. Stretch the Slinky® to 3m in length and repeat steps 9 and 10

12. Determine the average speed **(K-U-E-S for one)** for the compression to travel through each length of Slinky®.

Slinky® Length	**Time (s)**			**Average Time (s)**	**Wave Speed**
3 m					
1 m					

Show K-U-E-S for one length below:

Have K-U-E-S approved

Mechanical wave motion terms

medium - the substance through which a mechanical wave travels.

rest position - the natural orientation of the medium without the effects of a wave disturbance. For example, a pond may be perfectly flat and still. This is its rest position and it will return to this position after a wave completes its disturbance.

wave pulse - a single disturbance through a medium.

wave - a series of wave pulses at regular intervals of time.

transverse wave - a wave in which the medium is displaced perpendicular to the direction of travel of the wave itself. A surface water wave would be an example. This type of wave is described in appearance by its crests (high points) and troughs (low points). High and low are simply relative to the rest position.

longitudinal (compressional) wave - a wave in which the medium is displaced parallel to the direction of travel of the wave itself. An accordion being played would be an example. This type of wave is described in appearance by its compressions (high density of medium) and rarefactions (low density of medium).

wavelength (λ) - the distance between two consecutive crests or troughs, or any other similar points on a wave.

frequency (f) - the number of waves passing a fixed point in a given time. Usually written as waves per second or Hertz (Hz). The inverse of the period.

period (T) - the time required for one complete wave (crest to crest) to pass a fixed point. The inverse of the frequency.

wave speed (v) - (a) Distance traveled by a wave in a given time. (b) Wavelength divided by the period. (c) Wavelength multiplied by the frequency.

amplitude (A) - how much the medium is displaced by a wave. The distance from the rest position to the crest or the trough. Proportional to the energy of a wave.

standing wave - wave pattern that occurs due to the reflection of waves in a medium with distinct and "fixed" ends. Composed of nodes, no displacement from the rest position, and anti-nodes, maximum displacement from the rest position.

To determine the ***wavelength of the standing waves you observe*** in a Slinky® you will need the equation for the wavelength of a standing wave:

$$\lambda = 2L/n$$

Where **L** is the stretched length of the Slinky® and **n** is the number of anti-nodes observed in Slinky®

Slinky® Lab Questions for discussion

1. **Draw the three standing waves in Figures A, B, and C.**
2. **What happens to the period of the waves from Wave A to C?**
3. **What happens to the frequency of the waves from Wave A to C?**
4. **About how many times larger is the frequency of Wave B than Wave A? f of Wave C than Wave A?**
5. **What happened to the wavelength of the waves as the frequency increased?**
6. **Was the wave speed dramatically different for each wave in Part 1?**
7. **Was the wave speed dramatically different for the compressions through the different lengths in Part 2?**
8. **What causes a change in wave speed?**