- 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 Slinky[®], 1 meterstick, 1 stopwatch
- **Safety:** Keep Slinky[®] away from face, do not use in a moving vehicle, do not throw out a window...as a matter of fact don't throw it or any part of it ever.



Part 1: Standing Waves

- 1. Measure and record the length of your lab table.
- Hold a few coils at each end of the Slinky[®]. Stretch the Slinky[®] the entire length of your lab table as in Figure 1. Please try not to over-stretch the Slinky[®] as per your teacher's instructions.
- 3. 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.
- 4. 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.
- 5. 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.
- 6. Complete three trials of the time for 10 waves. Have data approved at this point
- 7. Repeat steps 1 -5 for Figure A and Figure C. Have data approved at this point
- 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.
- 9. Write the results of your calculations in the second table



| Wave | Time (s) for 10 waves | | | Average Time (s) |
|------|-----------------------|--|--|------------------|
| Α | | | | |
| В | | | | |
| С | | | | |

| Wave | Period | Frequency | Wavelength | Wave Speed |
|------|--------|-----------|------------|------------|
| Α | | | | |
| В | | | | |
| С | | | | |

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

Have K-U-E-S approved

Part 2: Wave Speed in different media

- 10. Hold a few 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[®].
- 11.Complete three trials.
- 12. Stretch the Slinky[®] to 3m in length and repeat steps 9 and 10
- 13. 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:

| Slinky [®] Lab useful terms |
|---|
| wave pulse - a single disturbance through a medium. |
| wave - a series of wave pulses at regular intervals of time. |
| 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. |
| 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 <i>wavelength of the</i> <i>standing waves you observe</i> 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: (will be discussed as a class)

1. Draw the three standing waves in Figures A, B, and C. Label the nodes and anti-nodes.

- 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?