Name:________________________ Period:__________

Good Vibrations - The Slinky Lab

Purpose:

Perform a series of controlled experiments to explore the characteristics and properties of transverse and longitudinal waves using Slinkys.

Materials:

Slinky
Masking Tape
Meter Stick
Stop watch

Slinky History:

In 1943, Richard James invented one of the greatest toys ever. James, a naval engineer, was conducting an experiment with tension springs. During the experiment, one of the springs fell to the floor and began to "walk." James took the spring home to his wife, Betty, and asked her if she thought it was something they could pursue. Betty had a vision for a toy and scoured the dictionary, looking for an appropriate name. She came across the word "slinky," a Swedish word meaning stealthy, sleek and sinuous. Toy history was made.

The Slinky® debuted at Gimbel's Department Store in Philadelphia, Pennsylvania in 1945. Both Betty and Richard were skeptical about how the Slinky® would sell. All their doubts were put to rest when all 400 Slinkys® for sale were purchased in 90 minutes. Since then, over three hundred million Slinkys® have been sold worldwide.

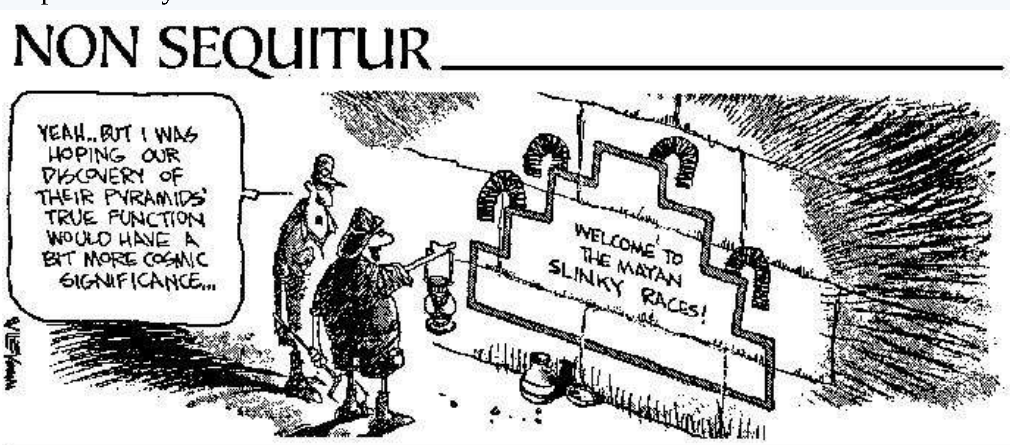
The Slinky® is still made in Hollidaysburg, Pennsylvania with the original equipment Richard James created. The Slinky® has changed little in over 60 years. A crimp was added to the ends of the wire to ensure safe play. At $2.99, the Slinky® remains a value-priced toy for children of all ages.

Though it was developed to be a toy, other applications for the Slinky® have been discovered. The Slinky® has been used as an antenna by soldiers in Vietnam, as a therapy tool and for coordination development. The possibilities are endless.

The Slinky® has even made it to the silver screen. Slinky's® appearances include: Ace Ventura When Nature Calls; Demolition Man; Other People's Money; and Hairspray. In Disney's digitally-animated feature Toy Story, the Slinky® Dog played an important role.

The Slinky® (under House Bill No.1893 - Session 2001, of the General Assembly of Pennsylvania) has been named the Official State Toy of Pennsylvania as of November 4, 2001.

Website: www.poof-slinky.com



Procedure and Analysis:

Reflections

1. Find an open area in the science hallway.
2. Measure five meters on the floor marking each meter with a small piece of masking tape.
3. With the help of your partner, stretch the slinky to a length of the 5 meters on the floor. (Do not tangle!!!)
4. One person needs to hold one end of the slinky in a rigid fixed position throughout the entire investigation.
5. The other person needs to create a pulse at his/her end of the slinky by moving one's hand quickly from the rest position to one side and back to the rest position, at right angles to the length of the spring. Practice a few times.
6. How does the direction of the motion of the slinky coils compare to the motion of the pulse?____

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7. Does the amplitude of the pulse change as the pulse moves from one end of the slinky to the other? Why?

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8. Generate a transverse pulse and observe the orientation of the reflected pulse from the fixed end.
9. Draw sketch of the pulse before and after it is reflected on the fixed end.

Before Reflection **After Reflection**

10. Suspend the spring vertically from a high point in the room so that it stretches close to, but does not touch, the floor. You may need a stool from the classroom. Avoid obstructions, since the spring must move freely along its whole length. (it may be necessary to bunch some of the coils at the top)
11. Generate a transverse pulse at the top of the spring and observe the orientation of the reflected pulse from the free end.
12. Draw sketch of the pulse before and after it is reflected on the free end.

Before Reflection **After Reflection**

Amplitudes

13. Again with the help of your partner, stretch the slinky to a length of the 5 meters on the floor. (Do not tangle!!!)

14. Move your hand in such a way as to generate a single pulse with larger amplitude.

15. Now move your hand in such a way as to generate a single pulse with smaller amplitude.

16. Practice making pulses over varying amplitudes

17. Generate 2 pulses right after the other of the same amplitude.

18. Now generate 2 pulses right after the other with the first one having a smaller amplitude followed by a pulse of larger amplitude.

19. Now generate 2 pulses right after the other with the first one having a larger amplitude followed by a pulse of smaller amplitude.

20. When the pulses had the same amplitude, did the second pulse catch up to the first pulse? ____________

21. When the first amplitude was smaller, did the second larger pulse catch up to the first pulse? ____________

22. When the first amplitude was larger, did the second smaller pulse catch up to the first pulse? ____________

23. From your answers in questions 20 and 21 and 22, what can you conclude about the effect of amplitude on wave speed?

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Frequencies

24. Generate 3 pulses very fast of the same amplitude.

25. Now generate 3 pulses very slow with the same amplitude as in step 24.

26. Which set of pulses has a higher frequency, the 3 fast pulses or the 3 slow pulses?

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27. Which set of pulses has a lower frequency, the 3 fast pulses or the 3 slow pulses?

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28. Generate 3 pulses very fast of the same amplitude.

29. Time with the stopwatch how long it takes the *first pulse* of the three pulses to travel to your partner and back.

30. Time for the 3 fast pulses: ______________

31. Now generate 3 pulses very slow with the same amplitude as in step 23.

32. Time with the stopwatch how long it takes the *first pulse* of the three pulses to travel to your partner and back.

33. Time for the 3 slow pulses: ______________

34. From your answers in questions 30 and 33, what can you conclude about the effect of frequency on wave speed?

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35. From your answer in question 34, what can you conclude about the effect of period on wave speed?

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Velocities

36. With the help of your partner, stretch the slinky to a length of the 3 meters on the floor. (Do not tangle!!!)

37. Generate a pulse and time with the stopwatch how long it takes the pulse to travel to your partner and back. Repeat three times and record in Data Table 1.Repeat step 30 and 31 for distance of 4, and 5 meters. Keep the amplitudes of each trial the same. Record all results in Data Table 1.

DATA TABLE 1

Distance between Partners (meters)	Time Trials of Pulses (sec)			Ave. Time (sec)	Distance traveled by the Pulse (meters)	Speed of the Pulse * (m/s)
3						
4						
5						

* Remember speed equals distance traveled divided by time

38. When you increased the distance between you and your partner, what happened to the tension in the slinky?

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39. From your results in Data Table 1, what can you conclude about the effect of tension on wave speed?

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Longitudinal Waves

40. With the help of your partner, stretch the slinky to a length of the 5 meters on the floor. (Do not tangle!!!)

41. Attach masking tape tabs at six equally spaced points along the slinky. (The tabs may already be on your slinky.)

42. At one end of the slinky, compress approximately 10 coils between your fingers.

43. Release the compressed coils and observe the motion of the masking tape tabs as the pulse travels along the slinky. (Repeat until motion is easily observed)

44. Draw a sketch of the pulse as it travels down the slinky.

45. How does the direction of the motion of the slinky coils compare to the motion of the pulse?

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46. Place your hand in the coils at one end of the slinky and move your hand forward quickly and then stop. Note the motion of the tabs.

47. Now move your hand back quickly and stop, and again note the motion of the tabs.

48. What happened to the spaces between the coils when your hand moved forward? (This is called a compression)

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49. Move your hand back and forth quickly at a uniform frequency. Watch the series of pulses as it travels down the coil. Note the motion of the tabs.

50. How many complete vibrations of your hand were required to produce one compression and one rarefaction?

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51. When you moved your hand back and forth at a uniform frequency were the spaces between successive compressions equal or unequal in length? Why?

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Wave Interference

52. With the help of your partner, stretch the slinky to a length of the 5 meter on the floor. (Do not tangle!!!)

53. Simultaneously, generate positive pulses from both ends of the slinky. (Repeat until motion is easily observed)

54. Simultaneously, generate positive pulses from both ends of the slinky. Make sure one pulse has a larger amplitude than the other (Repeat until motion is easily observed)

55. Draw sketch of the two pulses as they travel down the slinky. Label each pulse.

Before Interference

During Interference

After Interference

56. Is a pulse affected when it passes through another pulse in the same medium? From your observations explain your answer.

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57. Simultaneously generate a positive pulse from one end and a negative pulse from the other with the same amplitude. (Repeat until motion is easily observed)

58. Simultaneously generate a positive pulse from one end and a negative pulse from the other with the different amplitudes. (Repeat until motion is easily observed)

59. When a positive and a negative pulse act simultaneously on a particle in a medium, is the resultant displacement greater or smaller than it would be in the case of either of the pulses acting alone? From your observations explain your answer.

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