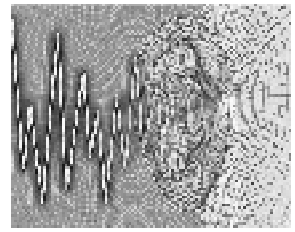
Slinky Lab
for your Slinky Badge



Activity 1: Wave Pulses and Interference

In this lab you will create different types of waves in order to discuss the differences and similarities between them. You will then type up your responses into a “fridgeworthy” document for your “Slinky Badge”.
Working with a partner and a slinky, complete the following activities.

Test 1: Stretch the slinky out on the table. Shake the slinky (up or down) sharply to the right or left one time to produce a wave pulse. Make three sketches of what the slinky looked like at three different times to show the progression of the wave.

VIDEO: ON DP VERSION

Question 1: Is this a transverse or longitudinal wave? Explain using your sketches and observations…

It is a transverse wave because the source (me) diplaced the slinky’s equilibrium in a perpendicular (left/right) pulse.

Test 2. With the slinky still stretched, sharply *push* the slinky *inward* one time. Make three sketches of what the slinky looked like at three different times to show the progression of the wave.

VIDEO: ON DP VERSION

Question 2: Is this a transverse or a longitudinal wave? Explain using your sketches and observations…

It is a longitudinal wave because the source (me) displaced the slinky’s equilibrium in a parallel (push) pulse.

Question 3: In what ways are these two waves different and in what ways are they the same?

Longitudinal waves: Compressions/rarefactions, parallel pulse displacement

Transeverse waves: Crests/troughs, perpendicular pulse displacement

Both: Types of waves (energy from a source (me) being transferred in a domino effect from each coil on one end of the slinky to the other)

Test 3. Place a light object like a crumpled piece of paper beside the slinky near one end. Create a transverse wave pulse from the other end that causes the cup to move.

VIDEO: ON DP VERSION

Question 4: The object was initially at rest, and then began to move. What type of energy did the object gain?

The source transferred kinetic energy to the slinky. The slinky used kinetic energy, displaced each coil in a domino effect, and then went back to it's equilibrium. The crumpled piece of paper was hit by the wave and moved (kinetic).

Question 5: Where did this energy come from?

The energy came from the sun (heat/light), to the food I ate (chemical), to me (kinetic), to the slinky (kinetic), to the crumpled paper.

Question 6: Would this experiment have worked with a longitudinal wave (with the object in the same position)? Explain your reasoning.

No this experiment would not have worked with a longitudinal wave because the longitudinal wave happens within the original boundaries of the slinky and would not have made contact with the paper.

Test 4) Generate a single transverse wave pulse by moving your hand quickly to either the left or right. Observe the velocity with which the wave travels through the slinky. Now change the **tension**

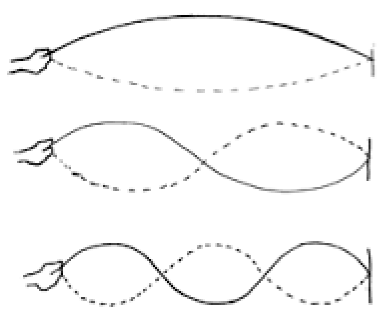
in the slinky. Gather about a quarter of the slinky in your hands making this the “end” and then stretch the remaining slinky 2 to 3 meters like before. Make a wave pulse with as close to an identical disturbance as you did above and note the time it takes to get to the other end. Repeat this again making the slinky even tighter. Describe how changing the tension affects the characteristics of the wave (wavelength and speed).

VIDEO: ON DP VERSION

With the slinky loosely extended at 1 yard, it took about one second to get from one end (start) to the other end, and back. When I increased the tension about a quarter more than the original test, keeping the same 1 yard distance, it took less than a full second to complete the same cycle.

Activity 2: Resonant Frequencies - harmonics

Instead of just producing wave pulses, you will now produce continuous waves which travel down the slinky. You will also produce continuous waves which appear to be standing still. These are called standing waves and are a special case of a continuous wave. They can be produced at only certain frequencies. It may take some practice to properly produce different numbers of standing waves. In this section you will be determining the frequency of different standing waves and coming up with a general equation that can be used for all standing waves.



Standing Waves:

Test 5: Now produce a transverse continuous standing wave and sketch how the slinky appears

VIDEO: ON DP VERSION

Question 7: Explain the difference between continuous traveling waves and continuous standing waves.

Traveling waves transfer energy in a domino effect from the source whereas standing waves appear to have a constant wave (standing). This happens because the standing wave's reflection bounces back so quickly it combines and amplifies with the first wave. Another difference is the source. In a traveling wave there is a single pulse of energy that you can watch bounce forward and back. With a standing wave the energy is being constantly supplied, making it so that you can't pinpoint one pulse, you just see one big wave constantly in place.

Question 8: You will want to determine the **frequency of various standing waves**. (Be sure to keep your slinky stretched to the **same length** for all these experiments.) What is a good method for doing this? (Be sure to think of ways to minimize error and list these.)

To find the frequency, I will watch the video of our experiment and see how many oscillations happen in 10 seconds, and then average that to find a more exact 1 second.

Problem 1: Using your method, determine the **frequency for a single standing wave**. Be sure to show your data and include proper units in your answer.

The frequency of a single standing wave is 1 hz (the period is also 1 second). There is not much work to show because in 10 seconds there were 10 oscillations, making it easy to see that the frequency is 1 hz.

Problem 2: What is the wavelength of this wave? (Be sure to explain where your result came from - use a diagram.) Include proper units in your answer. Hint: *Measure the nodes.*

For a single standing wave, you are only seeing half of the wavelength (you see only 2 nodes). Jaiden and I were standing 2.286 m apart, so will double that to find the full wavelength. 2.286 x 2 = 4.572 m.

Problem 3: What is the velocity of this wave? Show your work! Recall that velocity (v), v = wavelength * frequency (λ* f) and include proper units in your answer.

4.572 meters x 1 hz = 4.572 m/s

Test 6: With the slinky stretched the same amount as above, try to create a double standing wave.

VIDEO: ON DP VERSION

Problem 4: Using the same method, determine the frequency of this wave.

10 seconds/18 oscillations = rougly .6 hz

Question 9: How does the frequency compare to that of the single standing wave? What do you think the frequency of a triple standing wave would be?

The frequency of a double standing wave is almost half the speed of a single standing wave. I think that with a triple standing wave it would be around ⅓ of the original. I say around because I know a human source is not perfectly constant and there are bound to be some flaws. With a more accurate source, I think this pattern would be much more visible.

Problem 5: What is the **wavelength** of the *double standing wave*. How does it compare to that of the single standing wave? What do you think the wavelength of a triple standing wave would be?

The wavelength is 2.286 meters which is exactly half of our single standing wave. I think that a triple standing wave would be ⅓ because you would be fitting 3 waves in the original 4.572 meter wavelength.

Problem 6: As above, calculate the velocity of the double standing wave. What do you observe about the difference in velocities of the single and double waves?

2.286 meters x .6 hz = 1.3716 m/s About half of the original velocity.