Name ______________________________________ Date __________ Period ________

Lab: Slinkies and Waves

CONCEPTUAL PHYSICS: WAVES

Introduction: Waves travel everywhere through the universe and earth. Waves are important because they transfer energy from one place to another.

Objective: You (the student) should learn…

- that there are two types of waves, ***transverse*** and ***longitudinal***.
- that waves **reflect** when they come to a ***boundary***.
- that when **waves meet** they cause ***interference***.
- that the ***medium*** affect the ***wave speed***.
- that waves can be described in terms of ***frequency***, ***wavelength***, and ***amplitude***.

Procedure: ***WARNING - WARNING - PLEASE - PLEASE***

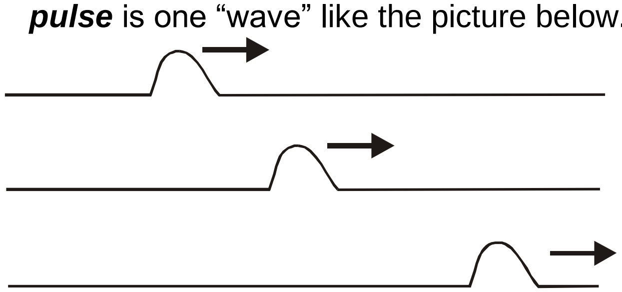
When using the slinky, don't stretch it too far and especially don't let go when you have it stretched. One or the other or a combination of the two will result in a wasted slinky or a gigantic snarl of wire. Hang on tight. Don't let the slinky get the best of you.

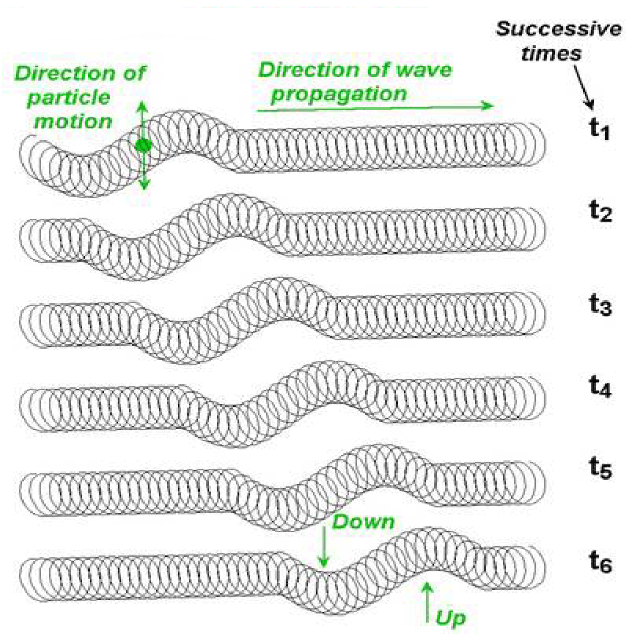
Questions

Part 1: Types of Waves

- Stretch the slinky out on the floor so that the wires in the slinky are about 1 inch apart While your partner holds one end very securely on the floor, pull the other end until the slinky's wires are about an inch apart

- Generate a ***transverse pulse*** by quickly jerking the slinky sideways on the floor. A ***pulse*** is one "wave" like the picture below.





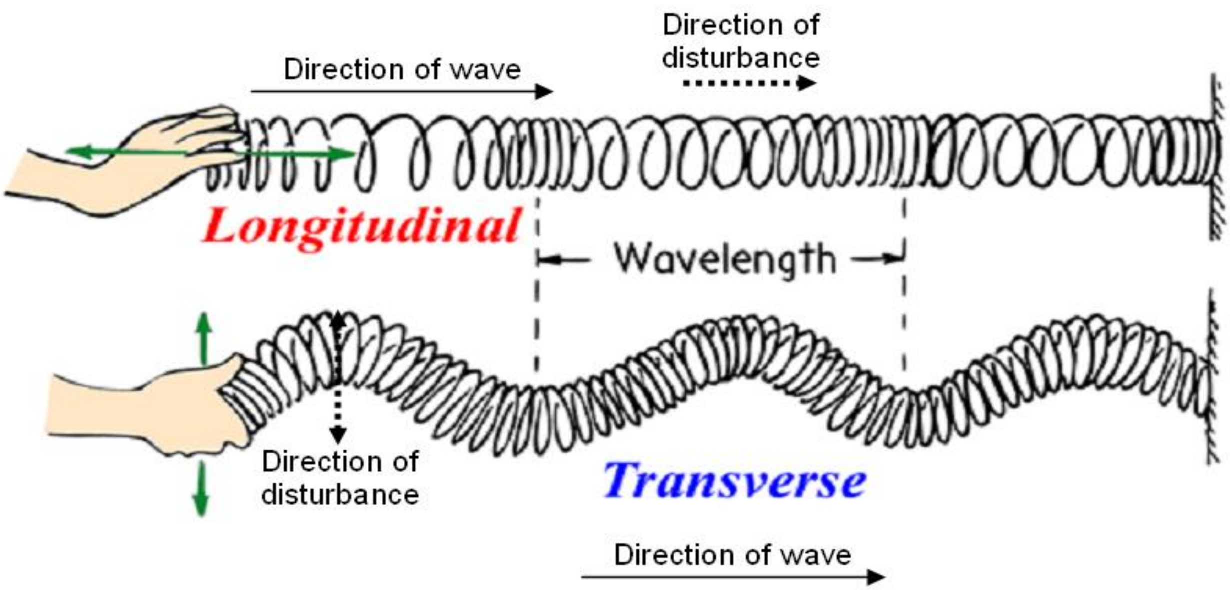
Question 1 - Try making larger and <u>smaller</u> **transverse pulses**. Does the size of the pulse change how long it takes to reach your partner?

- Generate a ***longitudinal pulse*** by quickly pushing the slinky towards the other side

In a ***transverse*** wave the individual parts of the wave (the disturbance direction) move **perpendicular** to the direction the wave is moving.

In a ***longitudinal*** the individual parts of the wave (the disturbance direction) move in the **same direction** as the wave is moving.

The drawing below shows the difference between a transverse wave and a longitudinal wave.



Part 2: Reflection and Interference

- While one partner holds their end of the slinky in place, send a transverse pulse to them.

Question 2 - What happens when the pulse gets to the other side of the slinky?

What happened at the far side of the slinky is called ***reflection.*** Reflection occurs when a wave comes to a boundary (like the end of the slinky). Some of the wave energy still travels straight ahead (and you feel it in your arm) but most of the wave energy reflects.

Question 3 - What are some other examples of reflection that you already know about? Describe for each case the boundary that the wave reaches.

- Send a transverse wave on one side of the slinky as your partner sends a wave to you on the <u>same side.</u>

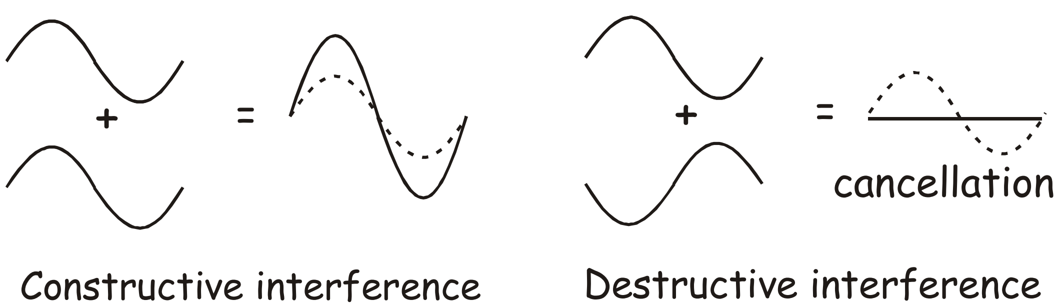
Question 4 - What happens to the two wave pulses when the waves meet in the middle?

Question 5 - Do you think the pulses reflect off each other or go through each other? Explain your reasoning.

Question 6 - What do you think would happen if the two pulses were on **opposite** sides of the slinky?

- Try out your prediction by sending a pulse from each end of the slinky but on **opposite** sides.

What you have just observed is called ***interference***. There are two types of interference, constructive and destructive. In ***constructive interference***, when two pulses meet the resulting pulse is bigger (you add the pulses together). In ***destructive interference***, when two pulses meet, the resulting pulse is smaller (you subtract one pulse from the other).



Part 3: Changing Medium

- Obtain a timer for this part of the lab. Time how long it takes one pulse to go from one end of the slinky to the other.

- While remaining at the same distance from your partner, make the slinky more stretched out. To do this, gather more of the slinky in your hand, so that the distance between the coils of the slinky is greater.

Time for regular stretch slinky:

Question 7 - With a stretched out slinky, do you think the time it takes for a pulse to go from one end of the slinky to the other will change?

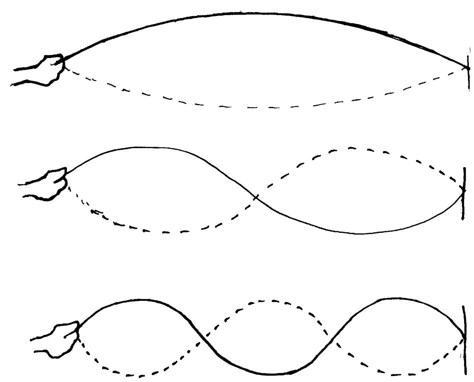
- Time how long it takes for the pulse to travel from one end of the slinky to the other when it is stretched out more

Time for stretched out slinky:

You have just observed one of the fundamentals of wave travel. The speed of a wave is dependent on what medium it is in (the speed is dependent on the “stuff” that the waves goes through). By changing the tension of the slinky or how spread out slinky was, you changed the medium that the wave travels through. Other examples of medium are air, water, metal etc (pretty much everything!).

Part 4 Standing Waves

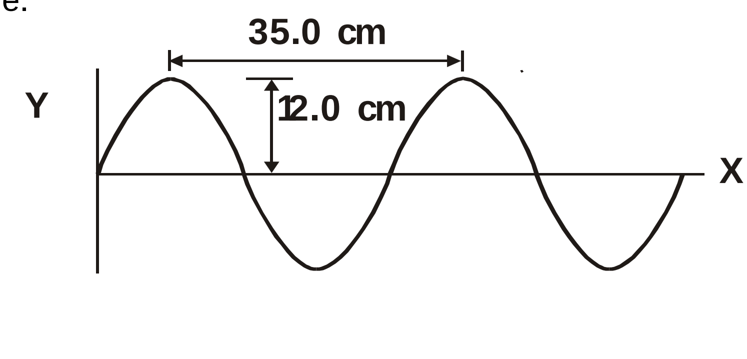
- With one student holding their end of the slinky in place, create a standing wave by moving your hand back and forth repeatedly. You should see a waveform that looks like this:



Note the places on your standing wave that do not move. These are called ***nodes***. The places where the wave is moving the most are called ***antinodes***.

Question 8 - Make a standing wave by moving your hand faster than you did before. What happens to the number of nodes and antinodes that you see?

Another way to look the shape of a standing wave is to describe the wavelength, frequency and amplitude. The ***wavelength*** is the distance between two ***crests*** (or antinodes) on the same side. The ***frequency*** is the number of crests you see (usually in an amount of time). The ***amplitude*** is just how big the crest (or antinode) is. The diagram on the next page shows the wavelength and the amplitude of a wave.



Let's say that we saw this wave go by in 1 second. Remember the wavelength is the distance between crests on the same side. So the wavelength is 35.0 cm. The amplitude is the size of the crest, which is 12.0 cm. Since I see two complete waves, that means that there have been 2 waves per second, so the frequency is 2 waves per second.

Question 9 - Try changing how fast you move your hand back and forth as you create a standing wave (don't move it any further on the floor), but just faster What happens to the wavelength, frequency and amplitude when you make changes in how fast your hand moves back and forth?

When I move my hand faster….

the frequency (number of crests I see)

increases decreases stays the same

the wavelength (distance between crests)

increases decreases stays the same

the amplitude (height of crest)

increases decreases stays the same

When I move my hand slower….

the frequency (number of crests I see)

increases decreases stays the same

the wavelength (distance between crests)

increases decreases stays the same

the amplitude (height of crest)

increases decreases stays the same

Question 10- From the data you collected about frequency, wavelength and amplitude, do you think there is a relationship between any of wave these factors (like when one of the wave factors changes, another has to change)? Explain your reasoning.