

## Physical Science Lab: Wave Motion

### Waves on a Spring

Equipment: 1 Spring      1 Meter Stick or utilize 1' x 1' Floor Tiles      1 Stopwatch

#### A. Wave Pulses

1. Stretch out the slinky (*do not overstretch !*), on the floor, between you and your lab partner.
2. Stretch it out far enough that you can send transverse pulses down it (*do not overstretch !*).
3. Send a transverse **pulse** down the slinky. The other person should hold their end stationary.
4. Does the pulse “reflect” off your lab partner’s hand and come back? \_\_\_\_\_
5. When the pulse reflects, it \_\_\_\_\_ a) *stays right side up*    b) *turns upside down*

Since the end is fixed (*held stationary*), this is called “fixed-end reflection.”

6. Send a longitudinal pulse down the slinky. The easiest way is to PUSH the slinky quickly or, if you have a “thin” slinky, pull back a few coils and release.
7. Does a longitudinal pulse reflect? \_\_\_\_\_

#### B. Wave Speed

1. Stretch out the spring between you and your lab partner (*do not overstretch !*).
2. Measure the spring length. Note it here: \_\_\_\_\_
3. Time how long it takes a pulse to travel the length of the wave and back (*or even down & back two or three times*).
4. Figure out the **total distance** that the pulse travels and divide by the time to get the speed. Repeat twice more. Put your results in this table:

	Total Distance	Time	Speed
Trial #1			
Trial #2			
Trial #3			

5. Average speed = \_\_\_\_\_
6. Now make the spring **tenser**.
7. Repeat the above. Be careful, the **distance may be different**.
8. Put the results in this table:

	Total Distance	Time	Speed
Trial #4			
Trial #5			
Trial #6			

9. Average speed = \_\_\_\_\_

10. When the spring is tenser, the waves travel \_\_\_\_\_  
a) *Slower*    b) *the same speed*    c) *faster*

### C. Standing Waves

1. **SKETCH** standing waves here (*use your notes*):

1<sup>st</sup> harmonic

2<sup>nd</sup> harmonic

3<sup>rd</sup> harmonic

4<sup>th</sup> harmonic

2. For this part you may need to use only part of the slinky.

3. Play with the slinky, holding it at different places and different lengths, until you can create standing waves – at least the first 4 harmonics.

4. Do all the rest of this part holding the spring **exactly** the same way – the same distance, etc.

5. Get a 1<sup>st</sup> harmonic going. Figure out the frequency by counting cycles while you time. Record your measurements here in the table:

Harmonic	Number of Cycles	Time	Frequency
1 <sup>st</sup>			
2 <sup>nd</sup>			
3 <sup>rd</sup>			
4 <sup>th</sup>			

6. Now do the exact same thing for the other harmonics, up to the 4<sup>th</sup>.

7. If you want, you can try to measure the 5<sup>th</sup> and/or 6<sup>th</sup> harmonics, too.

### D. Show Me

When I come to your group, be able to show me:

- Both transverse and longitudinal waves.
- Waves with small, medium, and large amplitudes.
- Waves with a low frequency and waves with a high frequency.
- Waves with large wavelengths and waves with small wavelengths.
- Reflection of a wave pulse.
- Standing waves – 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> harmonics.
- How frequency and wavelength are related – does a higher frequency produce a longer wavelength, a shorter one, or have no effect?