# Earthquakes and Seismic Waves

**Focus of Lab:**

* Brief overview of Seismic Waves
* Graph seismic data and locate the epicenter of an earthquake
* Interpret aerial photograph for relative movement
* Experiment with Slinky/Spring.

**Materials:** Slinkys®, coiled spring, meter stick, stopwatches, compass, calculators, rulers

**Part #1: Lab Manual : We will complete several activities in the lab manual and turn in individual answer sheets.**

**Part #2: Experiment with Slinky/Spring for P and S Wave Velocity**

Use the following pages and **TURN IN PAGES 3 AND 4 with Part 1 Answer Sheet**.

# Earthquakes and Seismic Waves

***Wave Movement***

**S-wave** *– transverse displacement*

**P-wave** *– compression*

**Procedure**: Read the following safety instructions carefully, then complete the following exercises using both the coiled spring.

***SAFETY ALERT!!!***

The coiled spring can store an enormous amount of energy when stretched. Do ***NOT*** release either while they are under tension – especially the coiled spring. Someone could lose an eye. If you get tired while holding the coiled spring, switch off with a teammate rather than risk losing your grip.

Do ***not*** overstretch your spring or it will break. Stick to the procedures and you should have no problems.

Also be careful when doing the S-wave experiment with the coiled spring. Be sure that no one is in the line of fire, so to speak, before you start. The coiled spring is heavy enough to hurt someone simply by striking them (especially if you hit them in the head), but the spring can also snag someone’s clothing or hair and yank them out of their chair. The coils are very tight and the spring has a remarkably strong grip.

Velocities of Simulated P and S Waves

**Purpose:** To investigate the velocities of compression and transverse (shear) waves in a metal spring.

**Hypothesis:** *The P-wave (compression wave) in the spring travels faster than the S-wave (transverse wave).*

Based on this week’s lecture do you expect to ***reject*** this hypothesis?

**Yes No**

**Materials:** coiled spring, stopwatch, meter stick.

**Roles:** Each group will need two holders, one to two timekeepers, a distance measurer, and a data recorder (three to six people).

**Compression Waves:** Have the two holders each take an end of the coiled spring (hold the spring in your closed hand, not finger hold by the loop) and stretch it out (~10 meters total stretch). Use the meter stick to measure the distance between the ends of the coil to the nearest decimeter and record that data below.

**Stretched Coiled Spring Length:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ meters

One of the holders should grasp the spring about one foot ahead of the hand holding the spring and compress the spring to the other hand. This holder can then release the compressed coils, producing a compression wave (P-wave) of expansions and contractions of the coil.

The timer(s)s should use the stopwatch(es) to determine how long the wave takes to travel the distance indicated and record that time. (multiply distance by 2 to get the total 2-way travel distance and by 4 for the 4-way travel distance). Calculate and record the velocity of the wave.



**Transverse Waves.** With the same spring, practice creating a transverse wave by abruptly snapping your hand up and down (once only) about 6 inches. Measure the travel times (2- and 4-way) for the transverse wave. Calculate and record the velocity of the wave.

Compression Waves

**2-way**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Object** | **Distance (m)** | | **Time (sec)** | **Velocity (m/sec)** |
| Spring |  | |  |  |
| Spring |  | |  |  |
| Spring |  | |  |  |
| Average Velocity: | |  |  | m/s |

**4-way**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Object** | **Distance (m)** | | **Time (sec)** | **Velocity (m/sec)** |
| Spring |  | |  |  |
| Spring |  | |  |  |
| Spring |  | |  |  |
| Average Velocity: | |  |  | m/s |

Transverse Waves

**2-way**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Object** | **Distance (m)** | | **Time (sec)** | **Velocity (m/sec)** |
| Spring |  | |  |  |
| Spring |  | |  |  |
| Spring |  | |  |  |
| Average Velocity: | |  |  | m/s |

**4-way**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Object** | **Distance (m)** | | **Time (sec)** | **Velocity (m/sec)** |
| Spring |  | |  |  |
| Spring |  | |  |  |
| Spring |  | |  |  |
| Average Velocity: | |  |  | m/s |

|  |  |
| --- | --- |
|  | Spring |
| Average S-wave Velocity |  |
| Average P-wave Velocity |  |

**Hypothesis:** The P-wave (compression wave) in the spring travels faster than the S-wave (transverse wave).

Do your results support this hypothesis (circle one)? Yes No

**Explain your answer below:**