**Wave Properties Lab**

**Objective:**

Identify the properties of waves and relate them to the energy they carry

**Materials:**

* 1 piece of string (2-3 meters long)
* 1 piece of tape
* 1 spring toy (Slinky)
* 1 short piece of yarn or ribbon
* 1 calculator
* 1 Meter stick
* Stop watch
* Photo/video device

**Demonstration:**

As your teacher and the student volunteers demonstrate two types of waves, analyze the different waves by answering the following questions.

Rope Waves

1. In which direction does the wave move?
2. In what direction does the disturbance (your hand) move?
3. What type of wave was created?
4. How does the movement of the rope compare with the movement of the wave?
5. Where does the energy of the wave come from?

Spring Toy Waves

1. In which direction does the wave move?
2. In what direction does the disturbance (your hand) move?
3. What type of wave was created?
4. How does the movement of the toy compare with the movement of the wave?
5. Where does the energy of the wave come from?

**Part A: Wave Properties**

1. Make sure that the movement of the yarn is horizontal (side to side) not up and down.
2. Use the yarn given to you by your teacher to demonstrate a transverse wave. (Leave some extra yarn (slack) at the end of the wave to be used later.) Make sure to record the motion using a phone or laptop.
3. Stop moving the yarn and leave it on the table in the wave position so it can be drawn and measure using the ruler.
4. Draw your string (in the space below) and identify the crest, trough, wavelength, and amplitude of the wave that you created.
5. Use the data table below to record the wavelength and amplitude of the wave.

|  |  |
| --- | --- |
| Wavelength in cm | Amplitude in cm |
|  |  |

1. Increase the amplitude of the wave while keeping the frequency constant. (Use the excess yarn for this step.)
2. Explain what increasing the amplitude represents.
3. Change the frequency (make it higher and lower).
4. What happened to the wavelength when you changed the frequency?

**Part B: Relationship between Energy and Amplitude & Frequency and Wavelength**

1. Obtain a spring toy (Slinky) from your teacher.
2. Sit on the floor facing another student (sit far enough apart so that the spring toy is stretched out and straight).
3. Use a computer or phone to record the slinky as it moves back and forth. Make sure the recording device is above the slinky looking down.
4. Keeping the slinky on the floor move one end forward and back, while at a constant rate so that you create a transverse wave.
5. Look back at the video and in the data table below count the squares in the recording to measure the wavelength and amplitude of the wave

|  |  |
| --- | --- |
| Wavelength in squares | Amplitude in squares |
|  |  |

1. Increase the amplitude of the waves. Note you want to keep frequency (the amount waves moving down) the same.
2. Describe what you had to do to increase the amplitude without changing the frequency.
3. Keeping the slinky on the floor move one end forward and back at twice the speed as before. Make sure that your arm moves the same distance back and forth as before.
4. How does moving your hand back and forth more quickly changed the wave?

**Part C: Measuring Frequency**

1. Tie a piece of yarn to one of the center coils of the spring toy.

2. Move one end of the toy side to side at a constant rate to make a series of transverse waves.

3. Using a stop watch, count how many waves pass through the coil in 10 seconds. You will know when a wave passes through the coil because the piece of yarn will move up and down. Place a meter stick above the wave so you can see the wavelength. **Have one student capture a photo or video of the spring motion.**

4. Since frequency is the number of waves that pass a given point in one second, divide the number of waves by 10 since you timed the waves for 10 seconds. Now you can determine the number of waves that passed through the coil in 1 second. That is the frequency of the wave.

5. Record your results in the chart below.

6. **Remember** that scientists must use units of measure when recording lab data. Frequency in measured in hertz (Hz).

7. Repeat this portion of the experiment three times.

|  |  |  |
| --- | --- | --- |
| **Trials** | **Number of waves that pass through the toy in 10 seconds** | **Frequency (Hz)** |
|  |  |  |
|  |  |  |
|  |  |  |

1. Describe IN DETAIL how amplitude, wavelength, and frequency relate to the amount of energy carried by a wave. Pay close attention to particle motion and wave direction in your answer.