Comparing and Contrasting Waves

OBJECTIVE: Students investigate and demonstrate wave types and their characteristics. (TEKS 5A)

PROBLEM: How does the energy of a wave affect the characteristics of a wave?

HYPOTHESIS: Record in your journal.

MATERIALS:
- Large, metal slinky

PROCEDURES:

NOTE: ***DO NOT OVERSTRETCH THE SLINKY! ONCE YOU HAVE THE SLINKY STRECHED OUT, DO NOT LET GO! THIS WILL DAMAGE THE SLINKY.***

TRANSVERSE WAVES

A transverse wave is easy to see. To make one, practice moving your hand very quickly back and forth at right angles to the stretched spring until you can produce a pulse that travels down only one side of the spring. This pulse is called "transverse " because the individual coils of wire move at right angles to (transverse to) the length of the spring.

1. Look at the wave generated by the slinky and draw what the wave looks like in your journal. Label the parts of the wave accordingly (amplitude, wavelength, crest, trough).

2. Stretch the spring out a few meters more. Does a change in the tension of the spring have any effect on the speed of the pulses? (When you stretch the spring farther, you are changing the nature of the medium through which the pulses move.)

ANALYSIS/CONCLUSIONS:

1. Does the pulse reflected from the far end return to you on the same side of the spring as the original, or on the opposite side? Why?
2. What kinds of waves travel as transverse waves?

LONGITUDINAL WAVES

With a partner to help you, pull the spring out on a smooth floor to a length of about 6 to 10 meters. With your free hand, grasp the stretched spring about a meter from one end. Pull the meter of spring together toward yourself and then release it being careful not to let go of the fixed end with your other hand! Notice the single wave, called a pulse, travel along the spring. In such a longitudinal pulse, the spring coils move back and forth along the same direction as the wave travels. The wave carries energy, but the spring remains stationary after the pulse has passed

through it and reflected from the other end. **Note: You can see a longitudinal wave more easily if you tie pieces of string or put a paper clip on several of the loops of the spring and watch their motion when the spring is pulsed.**

ANALYSIS/CONCLUSIONS:

1. Look at the second wave generated and draw what it looks like in your journal.
2. What kinds of waves travel as longitudinal pulses?
3. How are the transverse waves similar to the longitudinal?
4. How are the transverse waves different from the longitudinal?

CONSTRUCTIVE AND DESTRUCTIVE INTERFERENCE

*Have your partner send a pulse on the **same side** at the same instant you do, so that the two pulses meet the middle of the spring. The interaction of the two pulses is called interference.*

1. What happens when the two pulses reach the center of the spring? Describe the size, shape, speed and direction of each pulse during and after the interaction. It will be easier to see what happens in the interaction if one pulse is larger than the other.

2. What happens when two pulses on opposite sides of the spring meet? That is, send one down the right side and have your partner send another down the left side at the same time. Describe the size, shape, speed and direction of each pulse during and after the interaction. It will be easier to see what happens in the interaction if one pulse is larger than the other.

STANDING WAVES

By vibrating your hand steadily back and forth, you can produce a train of pulses, or a periodic wave. The distance between any two neighboring crests on such a periodic wave is the wavelength. The rate at which you vibrate the spring will determine the frequency of the periodic wave. Produce various short bursts of periodic waves so that you can answer the following question.

1. How does the wavelength depend on the frequency?

ANALYSIS/CONCLUSIONS:

By vibrating your hand steadily back and forth, you can produce a train of pulses, or a periodic wave. Try to create and draw the following waves with the characteristics described:

- High Amplitude-short Wavelength
- Low Amplitude-short Wavelength
- High Amplitude-long Wavelength
- Low Amplitude- long Wavelength

1. Label the parts of your waves in each drawing.
    - Crest
    - Trough
    - Wavelength
    - amplitude

2. Look back at the waves that you created above. Which waves have a high frequency?
3. Which waves have a low frequency?