Curiosity Guide #609
Waves

Accompanies Curious Crew, Season 6, Episode 9 (#609)

String Machine

Investigation #6

Description

Play with waves of light!

Materials

- Stringin' It Light Show toy

Procedure

1) String the motors.
2) Turn on the machine.
3) Adjust the speed and turn on the LED lights.
4) Separate the arms to different angles to experiment with different string tensions.
5) What do you notice?
6) How does the light behave at different speeds?

My Results

Explanation

If the string length is short enough and the arms are spread far apart, the light movement can look like a jump rope rotating very fast. The ends, or the nodes, appear to have little movement, while the center, or the antinode, has a high peak and low trough. Nodes result from two opposite waves canceling each other out. This is called destructive interference. Antinodes result from two opposing waves combining to the maximum oscillation. This is called constructive interference. Adjusting the tone frequency and string tension can create a center node as well, so that the wave looks like three loops, or three nodes and two antinodes.

If the string makes a stable shape, it is called a standing wave. A single standing wave, like a jump rope, is a fundamental wave, or first harmonic, and has half a wavelength. Each successive harmonic is a multiple of the frequency. The wave with three nodes or 2 loops is a second harmonic and shows one complete wavelength. Having a standing wave with four nodes is the third harmonic and shows 1 $\frac{1}{2}$ wavelengths. Changing the speed and string tension will result in new wave patterns, some of which are in different frequencies, resulting in complex interactions. All of the patterns are easier to see with the LED lights, and using a strobe feature can make the string appear stationary.

Visualize this. We have seen how transverse waves move up and down as they travel away from a disturbance. We call the peak the top part of the wave, the bottom is a trough or valley, and one complete wave is a wavelength. Imagine if we had a string attached to the wall and we flicked the other end. The wave would move toward the wall coming in low but would leave coming out high and inverted. Now pretend the fixed end could move up and down. This time, the return wave reflects how the wave looked when the wave came in. And when opposing waves hit, they combine for a moment and move on. Amazing!

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