**Natural Frequency & Resonance**

Name:

**(aka Wiggler Lab)**

**STUDENT LAB SHEET**

**Harmonics are the bumps**

*In this investigation you will:*

1. *Create standing waves*
2. *Learn about resonance*
3. *Learn how musical instruments create only the frequencies we want*
4. *Explore the connection between frequency of a wave and its wavelength*

*When you pluck a stretched string, it vibrates. If you pluck the same string 10 times in a row, it will vibrate at the same frequency every time.*

*The frequency at which objects tend to vibrate is called the natural frequency.*

*We use natural frequency to create all kinds of waves, from microwaves to the musical sounds from a guitar.*

**Part 1. *What is resonance? What is the relationship between frequency & wavelength? [Each of the patterns occurs at a resonance of the string. The resonances are called harmonics.]***

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| --- | --- | --- | --- |
| **Harmonic #** | **Frequency (hz)** | **Wavelength (m)** | **Wave Speed (m/s)** |
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Q1. In one sentence or two sentences, describe how the frequencies of the different harmonic patterns are related to each other. Do you see a pattern?

Q2. Describe how the product of frequency times wavelength (wave speed) changes compared to the changes in frequency. (What happens to the wave speed when frequency increases?)

Q3. Describe how the product of frequency times wavelength (wave velocity) changes compared to the changes in wavelength. (What happens to the wave speed when wavelength increases?)

Q3. If the frequency increases, what happens to the wavelength? Your answer should say if the wavelength changes and by how much it changes compared to the change in frequency.

**Part 2. *What is the relationship between amplitude & frequency?***

Measure at least 5 different harmonics, including the 6th or higher.

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| --- | --- | --- |
| **Harmonic #** | **Frequency hz)** | **Amplitude (cm)** |
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Q4. Make a graph showing how the amplitude changes with frequency.

Q5. Write one sentence explaining what your graph shows.

Q6. Imagine you had 3 sets of waves that all have the same amplitude but different frequencies. If the amplitude is the same, which wave has more energy, the higher frequency wave or the lower frequency wave? Use your results to explain your answer.

**Part 3. *How can you change the natural frequency of a system?***

|  |  |  |
| --- | --- | --- |
| Harmonic # | Tension (N) | Frequency (hz) |
| 3 |  |  |
| 3 |  |  |
| 3 |  |  |
| 3 |  |  |
| 3 |  |  |
| 3 |  |  |

Q7. What happens to the natural frequency as you increase the tension of a string?

Q8. As the tension is increased, making the string stiffer, what happens to the amplitude of the wave? An earthquake is like the wiggler in that it makes the ground shake back and forth with a certain frequency. How do your results relate to making tall buildings sway less in an earthquake? You should consider what happened to the amplitude of the wave when you increased the tension in the string to answer the question.