Patterns in Simple Waves

**Purpose**: What patterns exist in waves?

**Background Information:**

Compressing – Part of a wave where the particles of the medium are close together

**Procedures:**

1. Copy the data table below
2. Two of the group members will each take one end of the spring toy, stretch it to about 1 meter in length, and rest the stretched spring toy on a smooth table or floor. It does not have to be exactly 1 meter, just approximately.
3. While one partner holds one end still, another partner will “send” waves by repeatedly compressing the other end of the spring toy back and forth.
4. The third group member will be the timer. That person should set the stopwatch for 10 seconds each trial and tell the other partners when to start and stop.
5. Using a moderately slow tempo, send waves from one end of the spring toy to the other. Do not start out too fast. You will be completing five trials, increasing your tempo each time. Count the number of waves you send during the 10 seconds and record it in the first row of Table 1.
6. Repeat four more times, increasing your tempo each time and recording the number of waves sent in each trial in Table 1.

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| --- |
| Table 1 |
| Trials | Number of waves sent in 10 seconds |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| Average |  |

1. By increasing the number of waves that were sent during the 10 second time period, you were increasing the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the wave.
2. You modeled a simple wave in this activity. Write your own definition of simple wave.

**Frequency and Energy**

As you were sending waves through the spring toy, you were transferring energy from one end to

the other. Each wave that you sent carried with it a certain amount of energy. You can think of it as

if each wave “delivered” some energy to the other end of the spring toy. To make things simple,

let’s assume that each wave carried five units of energy with it. If you sent nine waves during the

10 seconds, you would have sent a total of 45 units of energy (9 waves x 5 units each = 45 units).

If, during trial 2, you sent 12 waves during the 10 seconds, you would have sent 60 units of energy

(12 waves X 5 units each = 60 units).

1. Copy down the data table below (Table 2)
2. Complete Table 2, and then answer questions 9-11. You will copy the number of waves sent with each trial from Table 1 into the second column of Table 2, and then complete the third column.

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| Table 2 |
| Trials | Number of Waves sent (frequency) | Total Amount of Energy Sent (assuming 5 units sent with each wave) |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |
| 5 |  |  |
| Average |  |  |

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| --- |
| Table 3 |
| Amplitude (units) | Energy (units) |
| 1 | 2 |
| 2 | 8 |
| 3 | 18 |
| 4 | 32 |
| 5 | 50 |

1. What do you notice about the relationship between the number of waves sent during a period of time and the total amount of energy sent during that time?
2. Write a one-sentence description of the relationship between the frequency of a wave and the amount of energy transferred by the wave.

**Amplitude and Energy -** A repetitive pattern also exists between amplitude and energy.

1. Is the relationship between frequency and energy proportional or inverse? Explain your thinking.
2. Look at Table 3 below. What mathematical relationship do you see between amplitude and energy? Hint: You must first look at the increase in amplitude (increase from 1 unit to 2 units is a “double,” the increase from 1 unit to 3 units is a “triple,” etc). Then you must do something with that increase in amplitude to calculate the increase in energy.
3. Now try it on your own. Complete Table 4. The first 2 rows have been completed for you.

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| Table 4 |
| Amplitude (units) | Energy (units) |
| 1 | 3 |
| 2 | 12 |
| 3 |  |
| 4 |  |
| 5 |  |

1. If there are 2 waves that are the same except for their amplitude, which wave will carry the most energy?
2. If the height of a water wave is doubled, how much will the energy increase?