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**Waves on a String: Speed of a Wave Lab**

**Part A: Method for determining speed of a wave**

**Learning Objective:** *Develop an experimental method to determine the speed of a wave on a string.*

**I. Initial Ideas:** Answer the following questions in your notebook.

1. What is a wave? Define “wave” in your own words.

2. What types of waves exist? How are these waves made? How are these waves similar and different?

3. Recall the word “speed”. What is speed? What equation(s) do we have for calculating speed? How can we measure the speed of a moving object?

4. We often talk about the *speed of sound* and the *speed of light*. Sound and light are two different types of waves. What do you think we mean when we talk about the “speed” of a wave?

**II. Explore the PhET Sim: Waves on a String**

Directions:

1. Open the sim: <http://phet.colorado.edu/sims/wave-on-a-string/wave-on-a-string_en.html>
2. Set up the sim:
   1. Select “no end”
   2. Adjust “Dampening” to zero
3. You will have 10 minutes to explore the sim. You have two challenges for your exploration:
   1. Explore the controls and determine what types of variables you can modify.
   2. Develop a basic method for determining the speed of a wave on a string. Write/sketch a brief description of your method in your notebook.

**Part** B**: Variables Affecting the Speed of a Wave**

**Learning Objective:**

1. Write a hypothesis about the relationship between a wave variable and its affect on wave speed.
2. Design an experiment to test wave speed hypothesis, and the relationships between the wave variables.
3. Make claims about the relationships (direct, inverse, none) between wave variables, using evidence to support claims, and explaining the relationship between the claim and evidence.
4. **Anatomy of a Wave & Key Vocabulary**
5. In your notebook, sketch a wave and label *amplitude* and *wavelength.*
6. Define and describe the following terms: amplitude, wavelength, frequency, period, tension.

**II. Investigation 1: How can you increase the speed of a wave?**

1. Brainstorm a list of variables that you think might change the speed of a wave.
2. Select one variable that you believe affects the speed of a wave. Write a hypothesis that makes a claim about how your variable affects speed, and explains your reasoning for this relationship using the format of *“If…then…because…”.*
3. Test your hypothesis and record your observations using the following table or a table that you create:

|  |  |  |  |
| --- | --- | --- | --- |
| **Action** | **What changed?** | **How did it change?** | **Type of Relationship** |
| *What did you do?*  *“Increased frequency”* | * Speed * Frequency * Wavelength * Tension | *What did you observe?* | * Direct * Inverse * None |

1. Make a claim about whether or not your hypothesis was correct, using evidence from your lab to support your answer and explaining your reasoning. Be prepared to share your results with the class.

**III. Investigation 2: How are other wave variables related?**

1. Investigate other relationships between variables and record your observations in the table from step
2. Make claims about the relationship between two of the variables, providing evidence from your investigations to support your claim, and reasoning to connect your claim and evidence.

**Part C: New Equation for the Speed of a Wave**

**Learning Objective:** *Develop an equation that demonstrates the relationships between wavelength, frequency and speed of a wave*

**Directions:** Answer the following questions in your notebook.

1. Identify the wave variables that we measured to indicate length and time during the lab, then substitute these values into the speed equation to develop an equation for the speed of a wave. Compare your equation with your neighbor.

|  |  |  |  |
| --- | --- | --- | --- |
| **Speed Quantity** | **Length Quantity** | **Time Quantity** | **Speed Equation** |
| Speed of a Moving Object | distance (d) | time (t) |  |
| Speed of a Wave |  |  | *s* = |
| Speed of a Wave |  |  | *s* = |

1. Frequency and wavelength are both in your equation for speed. Why is it that, when you changed the frequency, you did not change the speed of the wave?
2. The only variable we found that affects the speed of a wave on a string was the tension of the string. How does this relate to how a musician tunes a stringed instrument?