Wave Properties CWA

The Wave Properties CWA is a unit assessment. The overarching question is: How are the wave properties on a vibrating string related to each other? The following handouts are included:

- Prompt
- Sample student response
- Actual student response

Students should be provided the prompt, which includes the question as well as data necessary to answer the question. A sample student response is included as well as actual student work. Either the CWA Common Scoring Rubric or the Old Science CWA Rubric can be used to score the responses.

Wave Properties on Vibrating Strings

Claim-Evidence-Reasoning (CER) Writing Assignment

Scientific Question: How are the wave properties on a vibrating string related to each other?

Wave Properties on Vibrating Strings: Sample Student Response

Claim:

While tension, speed, frequency, and wavelength are related to one another, amplitude is not related to any of these wave properties.

Evidence:

In experiment 1, increasing the wave amplitude resulted in no changes to frequency or speed.

In experiment 2, increasing the string tension resulted in wave speed increasing and frequency increasing.

In experiment 3, increasing the wavelength resulted in frequency decreasing, and no change in speed.

Reasoning:

First, wave amplitude is not related to the other wave properties. This explains the results in experiment 1. Second, wave speed is determined by the characteristics of the string, including string tension. This explains the results in experiments 2 and 3: increasing tension in experiment 2 caused speed to increase, and holding tension constant in experiment 3 caused speed to remain constant. Moreover, wave speed, frequency, and wavelength are related by the formula: $v = f\lambda$. Consequently, it can also be said that $f = \frac{v}{\lambda}$. This relationship explains why, in experiment 2, the frequency increased when the speed increased while holding the wavelength constant. Likewise, it also explains why, in experiment 3, the frequency decreased when the wavelength increased while holding wave speed (tension) constant.

Wave Properties on Vibrating Strings – Sample Student Response

Name _____ Date 11/18/13

ACTIVE PHYSICS

Communications Chapter 1

Claim-Evidence-Reasoning (CER) Writing Assignment – Final Draft

"Quiz" – Due Monday, 11/18/13

Directions: Read the following Prompt. Then construct a scientific argument, using the Claim-Evidence-Reasoning (CER) framework, that answers the Scientific Question below. Use what you learned in class about waves and vibrating strings, particularly in Activities 1 and 2. Use your notebook notes, including attached sheets, for background on the relevant physics concepts. To help in preparing your response, refer to the "CER Argument Preparation" handout you received during the last class. Use the feedback on your Draft 1 response, and the information in the handout, to help in writing this Final Draft.

Prompt: A group of students performed a series of experiments to investigate various properties of a vibrating string, including: string tension, wave speed, wave amplitude, wave frequency, and wavelength. They used a special vibrating string machine that enabled them to make changes in properties, while keeping some properties constant, and take accurate measurements.

In experiment 1, the students changed the amplitude of the vibrating string, while keeping the wavelength and the string's tension constant, and measured the resulting wave speed and frequency. The results are shown in the table below.

Allowed Allowed

Amplitude (mm)	Tension (N)	Speed (m/s)	Frequency (Hz)	Wavelength (m)
1	5	300	200	1.5
2	5	300	200	1.5
3	5	300	200	1.5

increase No change No change

In experiment 2, the students changed the string tension, while keeping the amplitude and wavelength constant, and measured the resulting wave speed and frequency. The results are shown in the table below.

Amplitude (mm)	Tension (N)	Speed (m/s)	Frequency (Hz)	Wavelength (m)
1	5	300	200	1.5
1	10	450	300	1.5
1	15	600	400	1.5

increase increase of 150 increase

In experiment 3, the students changed the wavelength of the vibrating string, while keeping the amplitude and tension constant, and measured the resulting wave speed and frequency. The results are shown in the table below.

Amplitude (mm)	Tension (N)	Speed (m/s)	Frequency (Hz)	Wavelength (m)
1	5	300	600	.5
1	5	300	300	1.0
1	5	300	200	1.5

No change decrease increas

Scientific Question: How are the properties of a vibrating string related to each other?

(Remember, "related" means that a change in one property results in a change in another property.)

SCORE: Claim: 3 Evidence: 3 Reasoning: 3 Writing: 3 TOTAL: 12

(Note: Rubric scores are: 4-Exemplary, 3-Proficient, 2-Needs Improvement, 1-Critical Area. Grade is based on a total of 12 points, or overall "Proficient.")

COMMENTS: Nice job! See comments.

Be sure to write your FINAL argument response on the form on the back of this sheet.

Claim: *Write a statement (based on your evidence and reasoning) that directly answers the scientific question.*

The properties of a vibrating string are related as follows:

- wave speed does not depend on amplitude. (Depends on medium)
- frequency times wavelength equals wave speed.
- the greater tension there is, the greater wave speed.

Evidence: *Provide specific scientific observations/data that support your claim.*

In experiment 1, when wave amplitude was made to increase, speed did not change and frequency did not change. In experiment 2, when tension was made to increase, wave speed increased and frequency increased. In experiment 3, when wave length was made to increase, speed did not change and frequency decreased.

Reasoning: *Explain, using relevant science concepts you learned, why your evidence backs up your claim.*

We learned in physics class that speed does not depend on amplitude; there is a physics principle that states, wave speed cannot affect amplitude. Also speed is determined by its medium and found when you multiply wavelength and frequency. Also, with greater tension there is greater wavespeed. Since speed does not depend on amplitude, it ~~will~~ explain, how speed did not change in experiment 1. If the greater tension creates greater speed it will explain how in experiment 2 speed (and frequency) changed. Lastly, in experiment 3, when wave length increased frequency decreased. ~~so~~ When you multiplyed frequency and wave length you would get 300 m/s each time for speed.

~~It~~ explained by $f = \frac{v}{\lambda}$