

Perfect Pitches

with a Rubber Band Guitar

Student worksheet

Name: _____

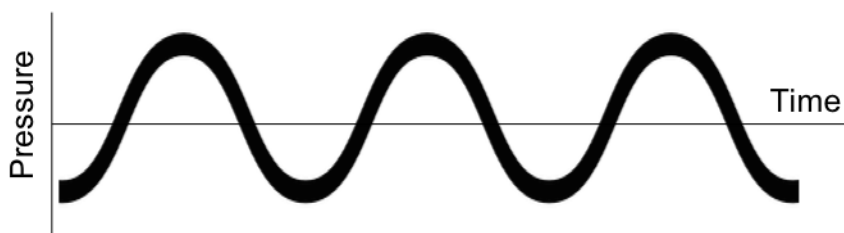
Date: _____

Word Bank (when appropriate, use these words in your short answers):

Amplitude	Longitudinal wave	Sound volume	Vibrations
Frequency	Pitch	Sound wave	
Hertz	Sound intensity	Transverse wave	

1. Before the Experiment

Briefly explain the meaning of *wave frequency*, *wave amplitude*, and *wave period* with the help of the sample wave below. You can also label the amplitude and period in the wave diagram.



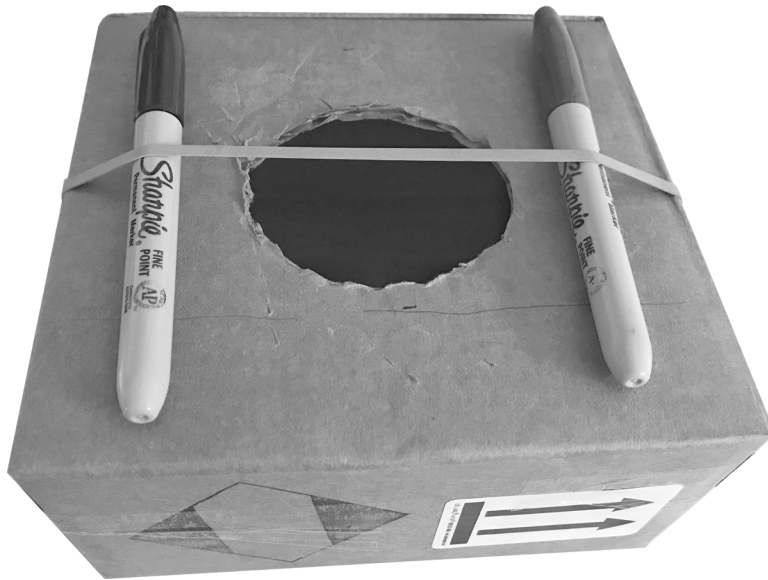
Wave Property	Explanation
Wave frequency	
Wave amplitude	
Wave period	

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2. Experiment: Follow these steps to do your investigations.

- a. Build your rubber band guitar as shown in the figure below:
 - i. Stretch the rubber band around the tissue box (or cardboard box), so it goes across the opening at the top.
 - ii. Place one pencil/crayon/marker under the rubber band on each side of the hole.



- b. Make sure there is enough space between your group and the next one, so your phone does not pick up as much noise from the other group's guitar.
- c. In the phyphox app, open the audio amplitude function before you start making any sounds. You will have to calibrate your sensor before taking any measurements. Follow your teacher's directions to do that. If you need help with the app, ask your teacher.
- d. Play with your rubber band guitar and press the play button to record the sounds that you make. You have to be very quiet while recording your sounds, as any other sound that you make will affect your data! Make sure you save your data before moving to the next step. If you take several measurements, make sure your sensor is calibrated before recording any new data.

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- e. Open the frequency history function in the phyphox app and play with your rubber band guitar again. Press the play button to record the sounds you make. You might need to pluck the rubber band multiple times to collect enough frequency data points for each test condition. Don't forget to save your data when you are done!
- f. During your investigation, try to answer following questions and write your observations below. Make sure to record data that demonstrates your observations.
 - i. How can you change the amplitude of the vibrations in the rubber band?
 - ii. Once you have figured out how to change the amplitude of the rubber band vibrations, do experiments (with at least three trials for each) that give you data to fill the table below. When you change the amplitude of the rubber band vibrations, try to keep the pitch constant, so you can investigate the effects of the amplitude change only.

Rubber band vibration	Trial number	Measured sound intensity [dB]	Measured pitch of sound [Hz]	What does it sound like?
High amplitude	1			
	2			
	3			
	Average			
Low amplitude	1			
	2			
	3			
	Average			

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iii. How can you change the pitch (frequency) of the sound you measure?

iv. Once you have figured out how to change the frequency of the rubber band vibrations, do experiments (with at least three trials for each) that give you data to fill the table below. When you change the frequency of the rubber band vibrations, try to keep the amplitude constant, so you can investigate the effects of the frequency change only.

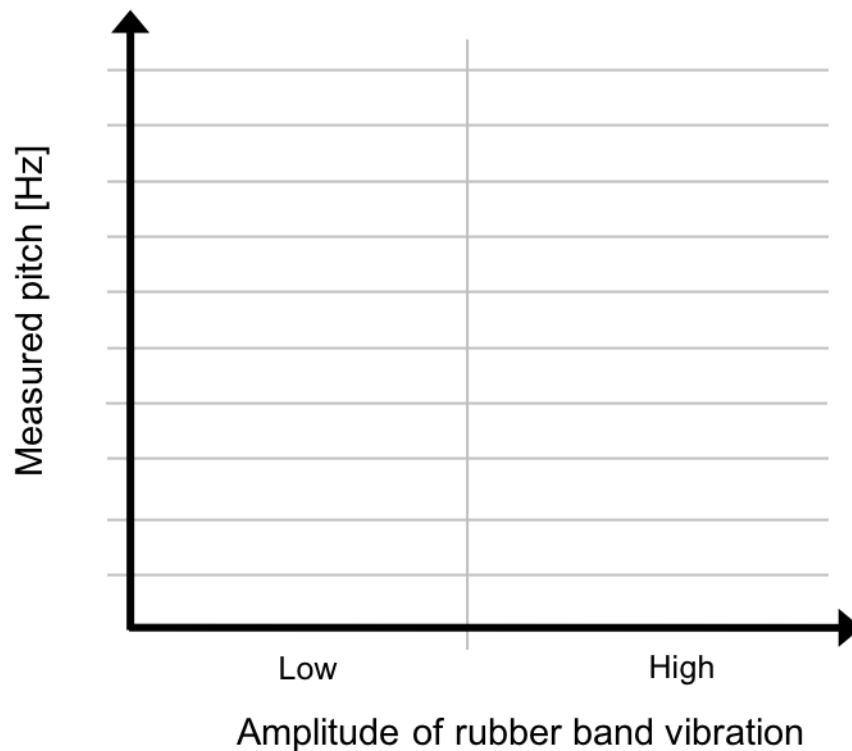
Rubber band vibration	Trial number	Measured sound intensity [dB]	Measured pitch of sound [Hz]	What does it sound like?
High Frequency (Short vibrating rubber band)	1			
	2			
	3			
	Average			
Low Frequency (Long vibrating rubber band)	1			
	2			
	3			
	Average			

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3. After the Experiment

- For each of your experiments, calculate the average sound intensity and pitch from all trials. Within the app you can pick individual data points on the graph to view their values. Use the calculated averages for the following steps.
- Complete the graph below based on your data above. Did the pitch of the sound change a lot when you changed the amplitude of the rubber band vibration? Explain in your own words why or why not, using the relevant terms from the Word Bank on the first page.

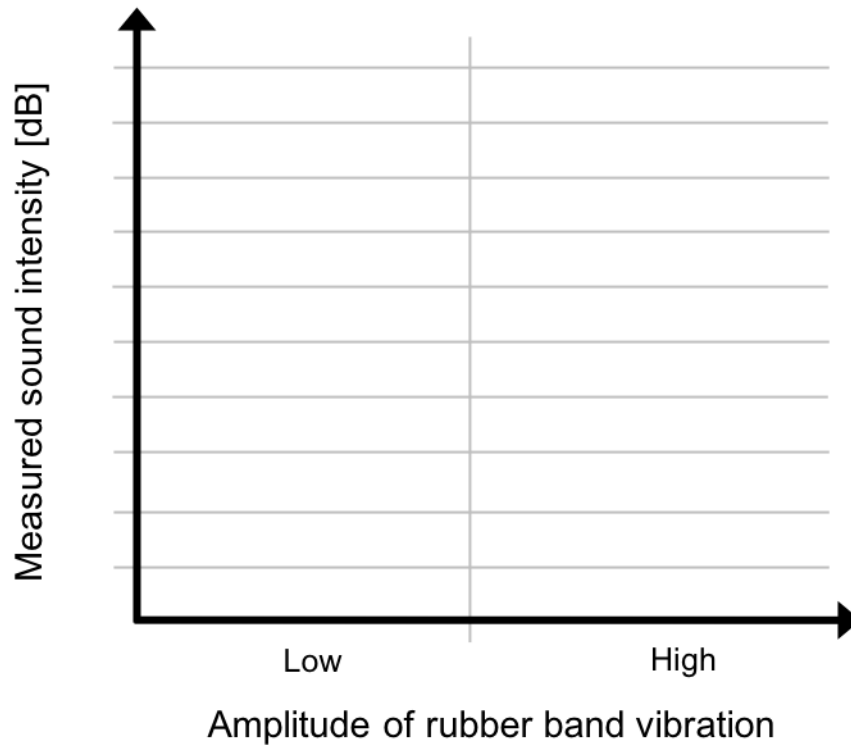


Explanation:

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- c. Complete the graph below based on your data above. Did the sound intensity change a lot when you changed the amplitude of the rubber band vibration? Explain in your own words why or why not, using the relevant terms from the Word Bank on the first page.



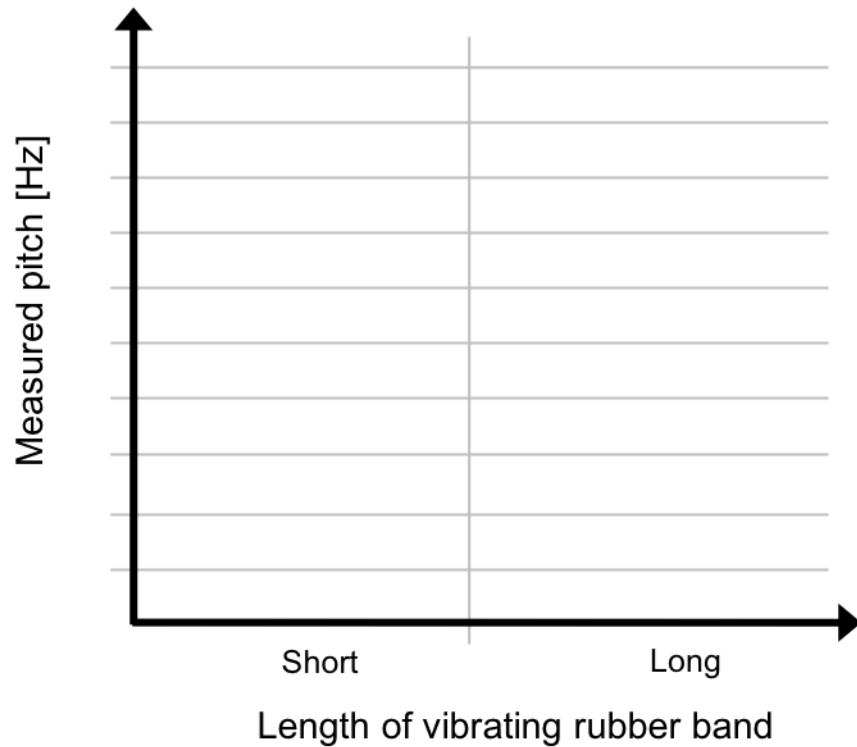
Explanation:

- d. Looking at your graphs, what effect does the amplitude of the sound wave have on the sound we hear?

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- e. Complete the graph below based on your data above. Did the pitch of the sound change a lot when you changed the frequency of the rubber band vibration by varying the length of the vibrating part? Explain in your own words why or why not, using the relevant terms from the Word Bank on the first page.

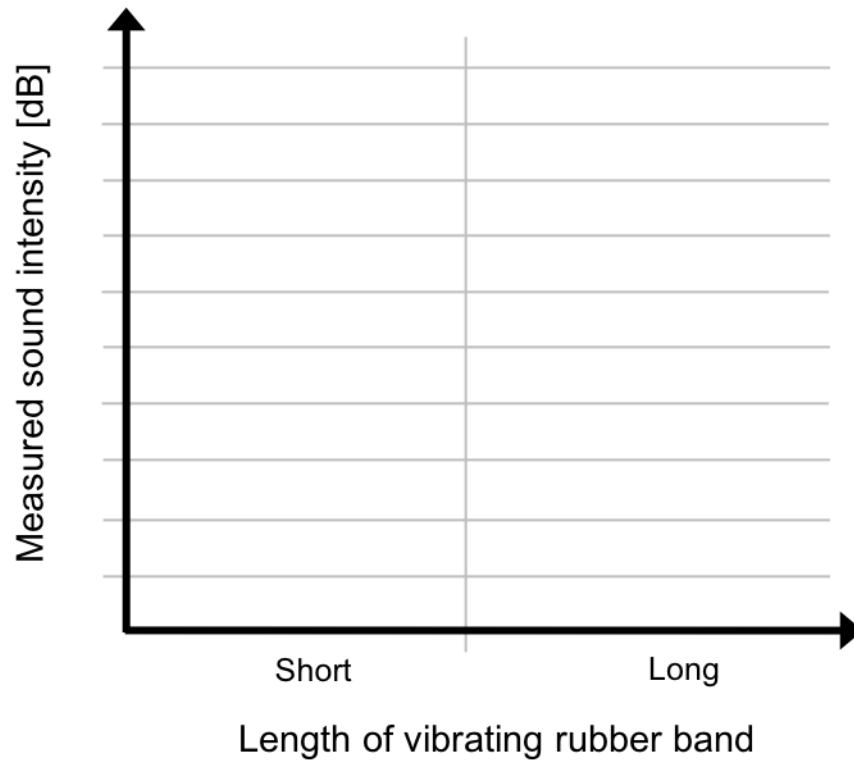


Explanation:

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- f. Complete the graph below based on your data above. Did the sound intensity change a lot when you changed the frequency of the rubber band vibration by varying the length of the vibrating part? Explain in your own words why or why not, using the relevant terms from the Word Bank on the first page.



Explanation:

- g. Looking at your graphs, what effect does the amplitude of the sound wave have on the sound we hear?