Can You See the Music?

PDQ 2 - Faster Higher Taller Louder

Grades: 5-8
Time: 5 -15 minutes
Subject: Physics
Topics: Sound, Wave Properties

Overview

Sound waves "look" like they sound, check this out and see if you can guess your favorite sound simply by looking at it!

Background

We all enjoy listening to different types of music, and love it! Regardless of the type of music you love, rock, classic, blues, or reggae, all music, all sound for that matter, have things in common.

One is "intensity", which we think of as loud or soft. Intensity is measured in decibels and the higher the decibel number, the louder the sound. The other attribute is "*frequency*" which we call *pitch*. It's how high or low the sound is on the music scale. We measure *frequency* in Hertz, a unit that describes how many cycles something happens in a second. 1 hertz (Hz) = 1 cycle per second. When you see "kHz" the kilo prefix means thousands, so 1 kHz = 1,000 Hz. The higher the Hertz, the higher the pitch! The normal range for human hearing is 20 to 20 kHz. Imagine a high pitched whistle in the 20kHz range. Fun fact, dogs have a hearing range nearly twice that of humans and can hear tones as high as 45kHz! When you look at the representation of a sound wave using databot™, you can tell how loud and how high a sound is by the size and shape of the sound wave. Check it out in this quick and easy PDQ!

Objectives

Understand & Recognize:

- That sound is transmitted in waves.
- A *microphone* (sound sensor) vibrates from sound waves and converts this *vibration* to electrical energy.
- Sound intensity is measured in *decibels* - a unit of measurement.
- Wave properties of *frequency*, and *amplitude*.

What You'll Need

- databot™ + Google Science Journal + Arduino IDE

Important Terms

Microphone: A microphone, sometimes referred to as a mike or mic,converts sound into an electrical signal.

Sound Wave: Sound is a vibration that travels in waves through a medium, such as air (or water, wood, etc.) These invisible waves have specific attributes such as frequency and amplitude. When a sound wave interacts with your eardrum, the vibrations of the wave are converted into a sound that you "hear" thanks to that amazing brain of y

Vibration: Vibration is an oscillating (back and forth) movement, like a vibrating reed in a clarinet. This vibration results in a soundwave that then travels through a medium, like the air.

Pitch: Pitch is how we perceive sound, or music, as being a higher or lower tone. When you are singing a song, your pitch is the note you are trying to hit. Pitch corresponds to frequency when looking at sound waves.

Frequency: Frequency is determined by the number of vibrations per second. The highest key on a piano, for instance, vibrates 4,000 times per second

Amplitude: The amplitude or peak amplitude of a wave is a measure of how big its oscillation is.

decibel (db):Sound intensity is measured in units called decibels. The decibel scale is logarithmic, which means doubling the decibel units does not double the output, it can increase as much as 100 times! Normal conversation is about 60 dB, a soft whisper around 30 dB, and a lawn mower about 85 dB.

Prep (5 mins)

Arduino IDE:

- Upload the IDE Frequency & Amplitude sketch to databot™.
- Open the Serial Plotter to display the sound data and test by humming into the microphone. You should see two data streams displayed.

Google Science Journal

- Upload the GSJ Frequency and Amplitude sketch to databot™.
- Connect GSJ to your databot™ and open the Frequency and Intensity cards displaying databot™ data.

PDQ 2 (10 mins)

- Hum into databot™'s microphone and watch the data display. You should have two data displays, one is displaying frequency (pitch) and the other is intensity (volume).
- Now, hum the C scale into the microphone, you should see the frequency increasing in Hz as you go up the scale. *Do you see it?*
- Next, try to hum the same note louder and softer. *Can you get the frequency to stay the same while the intensity* increases?
- Now try the other way around, try to increase the frequency as you hum while holding intensity exactly the same.
- Challenge yourself or others to hum a perfect C scale while holding the intensity perfectly level. *Can you do it?*

Pick a note on the C scale to be your favorite. Can you identify it simply by looking at the sound display? What is the absolute lowest frequency you can hum or sing? What is the absolute highest frequency you can hum or sing?

Wow, you came off the blocks like a rocket!

Since you came off the blocks like a rocket in PDQ 1 and 2, are you ready for a bigger bite? Next stop, the Experiment!

Next Step, Time to Experiment!

Educator Resources

Prep

- Read through PDQ 2, load the sound program and conduct the activity yourself viewing the sound wave display and identifying frequency and pitch in the display

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NGSS

- NGSS PS4.A Wave Properties

Misconceptions

- Sound is not dangerous. (Highlight the decibel levels at which damage to hearing can occur in your discussion).
- Sound intensity, or loudness, is often confused with sound pitch, or tone.

Guiding Questions

- What is the difference between frequency and amplitude?
- What is amplitude compared to intensity?
- What is the wave attribute related to volume?
- What is the wave attribute related to tone or pitch?
- What level of intensity do you think could cause hearing damage?

Additional Resources:

CDC: What Noises Cause Hearing Loss?
https://www.cdc.gov/nceh/hearing_loss/what_noises_cause_hearing_loss.html
NASA - The Sounds of Space
https://www.nasa.gov/vision/universe/features/halloween_sounds.html

Misconceptions about sound
http://amasci.com/miscon/opphys.html
Explain that Stuff - Sound
https://www.explainthatstuff.com/sound.html

References:

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