Can You See the Music?

Sound, Waves, and Good Vibrations

Overview

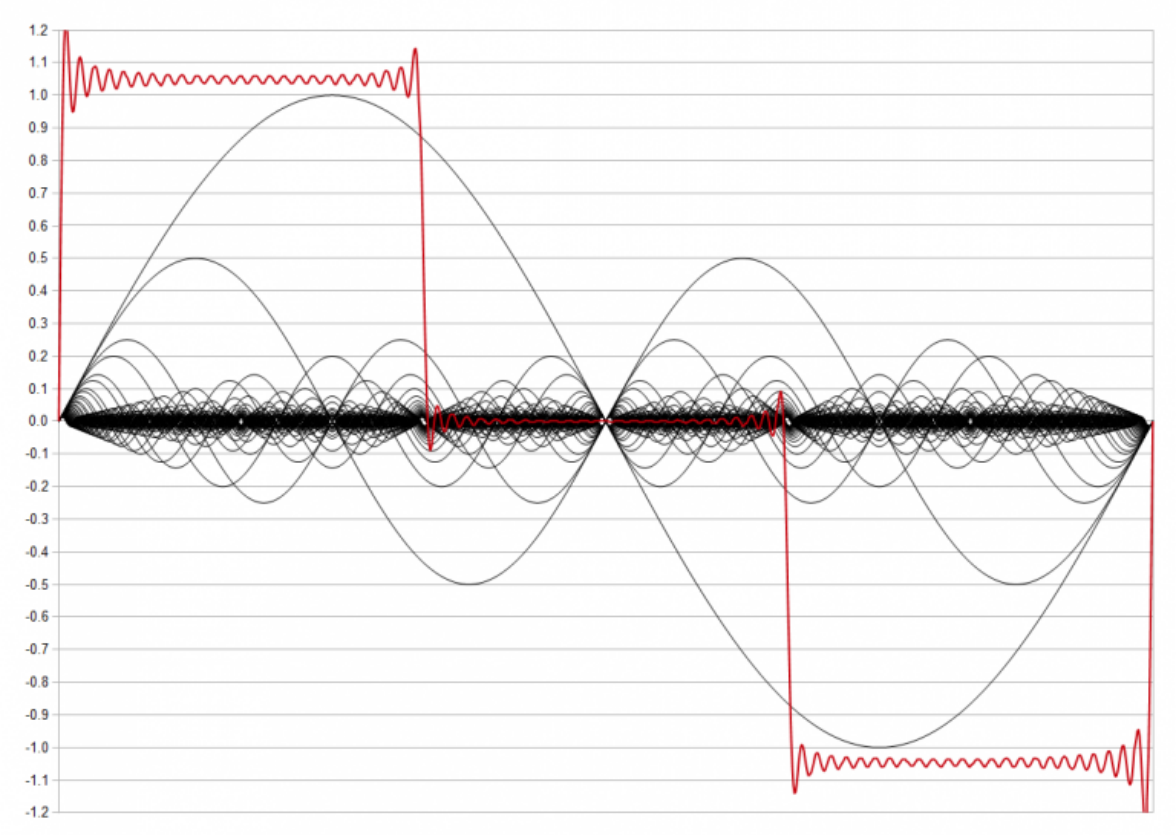
Grades: 5-8
Time: 100 minutes
Subject: Physics

What happens when we can “see” sound?! This module explores sound waves with activities in frequency, amplitude, and wavelength. Activity times in this module are: PDQs and Experiment, 50 minutes, and Coding Challenge and Collaboration, 50 minutes.

Background

Sound is a huge part of our life as we listen to music, communicate, and experience various levels of noise around the clock. Sound is actually a physical “thing” that you can measure, see, and even control. databot™ has a built-in sound sensor, a ***microphone,*** that enables you to capture sound data, visualize it, and better understand it.

Sound is transmitted through a ***medium*** such as air, in the form of waves. Imagine tossing a pebble into a pond and watching the waves spread out from the point of impact. This is how sound behaves. It spreads out from its point of origin and has some very specific characteristics that enable us to identify each exact sound. The ability to record sound and play it back is based on capturing and replicating those unique characteristics exactly! The image below is a visualization of sound. What do you think it sounds like? Ready to check it out for yourself? Let’s explore further with databot™!



Objectives

Understand:

- 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 wavelength, frequency, and amplitude.
- A sound wave needs a medium through which it can travel.
- Sound travels at different speeds through different mediums.
- How wavelength can be determined mathematically by frequency.

What You'll Need

- Windows or Mac computer + Arduino IDE for uploading databot™ programs.
- Android smart device or Chromebook with Bluetooth Low Energy (BLE) to connect to databot™.
- databot™ + Google Science Journal App installed on your Android or Chromebook device.
- Cereal bowl or open mouth container to stretch plastic wrap over.
- Plastic cellophane wrap.
- Rice Grains (about a tablespoon).
- A metal pot and spoon for making noise.

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.), a disturbance which travels through some ***medium***.

Sound Pressure: We are constantly surrounded by pressure from the atmosphere – it's invisible, but it's there. ***Sound waves*** are measured using the same units and will record as a deviation from the standard air pressure around us. Sound and air pressure are both measured in Pascals (Pa).

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

Pitch: ***Pitch*** is the highness or lowness of sound. Pitch is how humans hear different ***frequencies.***

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. When you look at the sound intensity output from databot, it is reading in decibels.

Wavelength: ***Sound waves***, like any wave, repeat in a predictable fashion. You see repetition when you toss a pebble in the pond. The distance between the repeating shapes is called ***wavelength***. If you were to measure from the crest of one puddle ripple to the next, that is its ***wavelength***. Measure fast!

Medium: In physics, a transmission ***medium*** is the substance that transmits the energy from a wave. The standard transmission ***medium*** for sound that we know well is air. Water, wood, clay – which of these have you heard sounds penetrate? If sound can be transmitted, it's a ***medium.***

Prep

Read the background information, study the terms, and explore the additional resource links.

Educator Info

Prep: (30 minutes)

- Read the background information, study the terms, and explore the additional resource links.
- Do the PDQs and Experiment and review the accompanying educator information.
- Review the Coding and Collaboration extensions if of interest.

Objectives:

Understand:

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NGSS

- NGSS PS4.A Wave Properties

Misconceptions:

- Sound moves faster in the air than in other mediums such as through a wall or underwater.
- Sound intensity, or loudness, is often confused with sound pitch, or tone.
- Sound can be heard in space (those dramatic science fiction explosions are silent – there is no medium to transmit the sound)
- Sound is not dangerous.

Guiding questions:

- If a tree falls in the forest and there is no one around to hear it, does it make a sound?
- If two asteroids collide in space, how close do you need to be to hear it?
- Will sound travel faster underwater or through the air if you need to cry “shark” to your friends?
- What does “sound pressure” mean?
- What is the difference between frequency and wavelength?
- What is the difference between frequency and intensity?
- Is a sound with a longer wavelength louder when compared to a sound with a shorter wavelength?

Additional resources:

- Acoustics Society of America
- https://exploresound.org
- 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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