Sensor Starters

Grades: 4 & Up
Time: 15 Minutes -PDQ 1 & 2

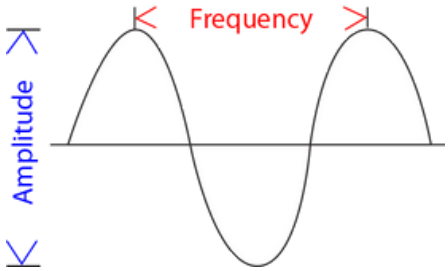
Subject: Physics, Technology, STEM
Topics: Sound, Sound Intensity, Decibels, Amplitude

Meet the Sound Sensor!

databot's sound sensor is an omnidirectional MEMS (Micro Electrical Mechanical System) microphone that sips low amounts of power while converting sound waves to digital data. As a multipurpose microphone it is used in a number of consumer and business-type applications including smartphones, teleconferencing systems, video cameras, and more.

Background

The sound sensor measures sound intensity. Sound intensity is what we typically think of as "loudness." If you look at an illustration of a sound wave "amplitude" corresponds to intensity. The higher the amplitude, the louder the sound!



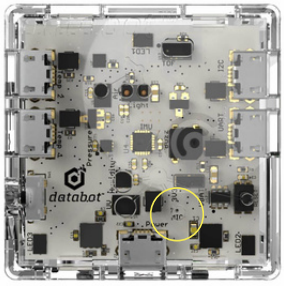
A MEMS microphone works on the principle of a pressure-sensitive membrane that is mounted to a silicon wafer. The pressure of the sound waves is transmitted by the membrane to the chip and converted to electrical signals.

The sound sensor is a bottom-mounted sensor so it is on the back side of the PCB. However, it needs a hole for sound to enter. Look for the label Mic on your databot!

What You Will Need/Prep

- databot™ & Vizeey™
- IOS/Android Smart Device
- Use Vizeey to scan the QR Code for Sound Intensity
- Measuring Tape - cloth

Sound Intensity
databot is listening! Use th...



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Important Terms

Amplitude: The strength or level of sound pressure.

Decibels: A unit used to measure sound level.

Sound: Continuous vibrations that travel from one medium such as air or water to another.

Sound Intensity: Intensity is determined by two factors: 1) the amplitude of the sound waves; and 2) how far they have traveled from the source of the sound.

How do we measure Sound?

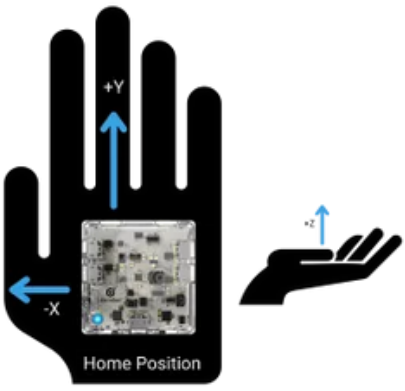
Sound intensity is measured in units called decibels. The decibel scale is logarithmic, which means doubling the decibel units does not double the output, it can increase as much as 100 times!

Decibels (dB)	Common Sounds
60 dB	Normal Conversation
85 dB	Lawn Mower
30 dB	Soft Wisper

Exploration Preparation!

In the coming activities you will be exploring your local environment and identifying illuminance levels using databot. databot is loaded with sensors and capabilities and it helps to have a common orientation for holding it and conducting experiments. That way if you are communicating with a partner you can communicate clearly - moving left, moving right, etc.

"Home position," shown here, is holding databot flat in the palm of your hand with the power and programming port oriented to the back of your palm. In this position sensors are facing up and you can move freely in any direction.



databot in "home position"

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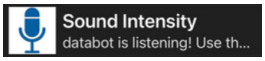
PDQ1 : Etch A Sketch with Sound!

Prepare to experiment with your sound levels and watch the image that is generated by the graphic display. Can you draw shapes with the sound of your own voice? Let's explore with databot and find out!

- Open the Vizeey App on your smart device
- Turn on databot.
- Tap on "**Sound Intensity** " *i*n Vizeey™ to load the experiment. 

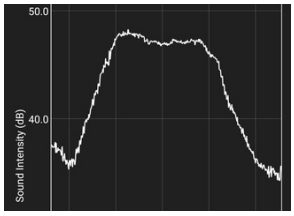
- Start your and pause your experiments using . 
- Begin the experiment and do some free-form **sound** trials to see how **sound intensity** affects the display.
  - Try different orientations with your smart device and try expanding the display until you have a display you are comfortable with.

Increase your voice to increase the amplitude.

Decrease your voice to reduce the amplitude

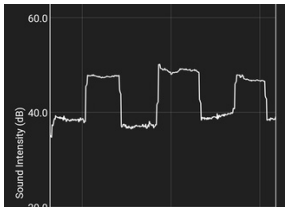
Experiment 1:

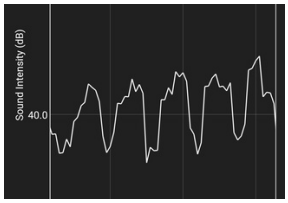
- Control your voice and sound such that your data draws a round mound.



Experiment 2:

- Holding the same sound intensity will display a flat line. Draw square waves by varying your sound intensity.





- Challenge: Create triangular spikes in your display by varying your sound intensity.

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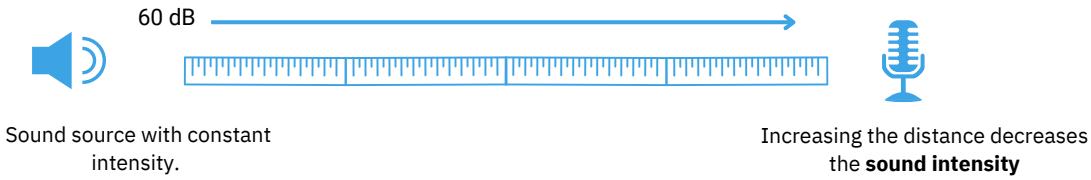
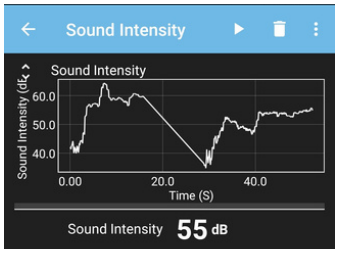
PDQ2 : Sound Intensity vs Distance

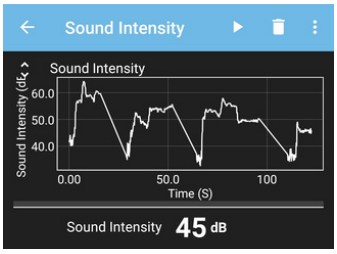
In PDQ 2, use the Sound Intensity experiment to visualize how sound intensity varies as you get closer or move farther away from the source. Record the distance required to achieve a dB level of 60, 55, 50, and 45. Can you predict the sound level at a particular distance based on your experimentation? Test your hypothesis and record your findings.



- Open the Vizeey™ App on your smart device.
- Turn on databot.
- Tap on "**Sound Intensity**" *i*n Vizeey™ to load the experiment.
- Start and pause your experiments using :
- Devise a constant sound source like a tone generator app on a phone and lay out a tape measure.
  - Set databot on the tape and measure at a distance that records an intensity of 60 dB.
- Move databot away from the sound source to reduce the sound intensity to 55 dB.
  - *Note the distance.*
- Move databot again until the sound intensity reads 50 dB. Note the distance on your tape.
- Predict the distance required to achieve 45 dB. Now move databot to that point - were you successful in your prediction?



At what distance do you achieve 55 dB?



At what distance do you achieve 45 dB?

Check for Understanding

1. In your own words, explain **sound intensity.**
2. What are the units used for expressing levels of **sound intensity**?
3. What happens to **sound intensity** levels as you move further from a light source?

Standards & Alignment

NGSS Standards

- Waves and Their Applications in Technologies for Information Transfer (MS-PS4-1) (MS-PS4-2/) (HS-PS4-1) (HS-PS4-3)
- MS-ETS1-3: Analyzing Data
- HS-ETS1-3: Analyzing Data

Science and Engineering Practices

- 1st Practice: Asking Questions and Defining Problems
- 2nd Practice: Developing and Using Models
- 3rd Practice: Planning and Carrying Out Investigations
- 4th Practice: Analyzing and Interpreting Data
- 6th Practice: Constructing Explanations and Designing Solutions
- 7th Practice: Engaging in Argument from Evidence
- 8th Practice: Obtaining, Evaluating, and Communicating Information

Crosscutting Concepts

- Patterns
- Cause and Effect
- Scale, Proportion, and Quantity
- Systems and System Models
- Energy and Matter
- Structure and Function
- Stability and Change

Disciplinary Core Ideas

- Wave Properties (PS4.A)
- Engineering, Technology, and Applications of Science (ETS1.B)
- Earth and Space Sciences (ESS3.B)

ISTE Standards

- 1.1 Empowered Learner (1.1.d)
- 1.3 Knowledge Constructor (1.3.a) (1.3.b)(1.3.d)
- 1.4 Innovative Designer (1.4.a) (1.4.b)
- 1.5 Computational Thinker (1.5.a) (1.5.b)
- 1.6 Creative Communicator (1.6.a) (1.6.b)

Standards & Alignment

TEKS -Texas Essential Knowledge and Skills

Elementary Process TEKS

5.2C Scientific investigation and Reasoning: Collect and record information

5.2D Scientific investigation and Reasoning: Analyze and interpret information to construct reasonable explanations.

Elementary Level Content TEKS

5.6A Force, Motion and Energy: Explore the uses of sound energy

High School Level Process TEKS

P.2F: Scientific Investigation and Reasoning: Collect and organize qualitative and quantitative data and make measurements with accuracy and precision, using tools such as data collecting probes.

High School Level Content TEKS

P.7C Physics: Compare characteristics and behaviors of waves, including sound waves.

P.7D Physics: Investigate behaviors of waves