

A large red square with a white border, centered on a white background. Inside the square, the text "Decibels and Acoustical Engineering" is written in white, serif font, centered vertically and horizontally.

Decibels and Acoustical Engineering

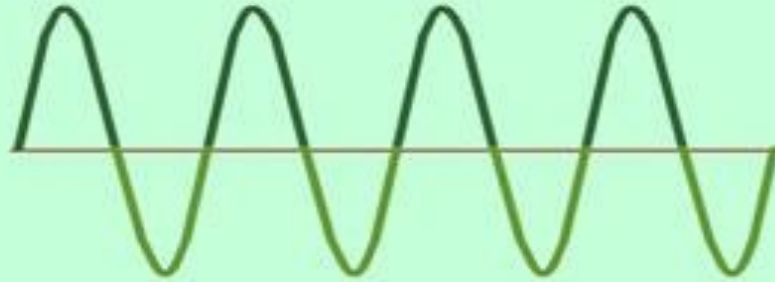
What is Sound?

Sound is the movement of **energy** through substances in longitudinal (compression/rarefaction) waves.

Sound is produced when a force causes an object or substance to vibrate — the **energy** is transferred through the substance in a wave.

The diagram below shows how a sound wave is represented:

High Volume
(more air pressure)



Low Volume
(less air pressure)



Sound is created by a vibration

A vibration is a slight shaking movement that goes back and forth.

Example: When a person hits a cymbal with a drumstick, it causes the cymbal to vibrate, which makes the sound!

<https://www.youtube.com/watch?v=kpoanOlb3> -w

Sound travels in waves

- Sound (energy) leaves an object and travels through air as a wave until it hits your ear.
- As sound waves move forward they push the air together (compressions) and pull the air apart (rarefaction).

<https://youtu.be/ACeUO4ufx2I>

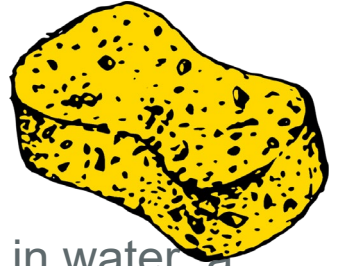
Sound needs a medium

Medium: the material or substance that carries a sound wave from one place to another.

Examples:

1. **Solids:** When you connect two cups with string, you can actually hear each other! How?
2. **Liquids:** When you yell underwater at the pool, you can hear your friend! Sound can travel through different liquids.
3. **Gases** This is hard for us to see with our eyes but with a special tool you can see it. Check this out! <https://www.youtube.com/watch?v=aPswnDcteS4>

Sound can be absorbed



Absorb: To take in or suck up like a sponge. Just like a sponge takes in water, a material can take in sound.

“If you didn’t hear your brother calling you because you are playing a videogame, you could say you were absorbed in the game.”

The sound then becomes quieter! SHHHHH.

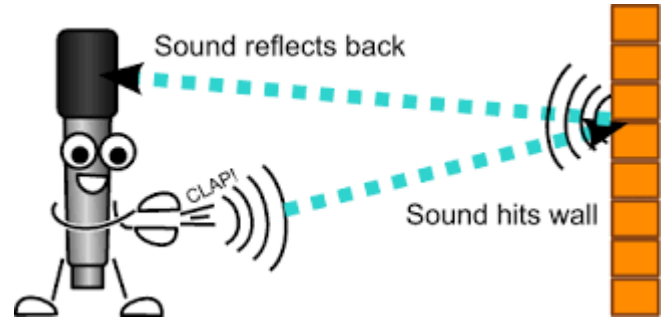
<https://www.youtube.com/watch?v=zNsGfXqxf4s>

Sound can be reflected

Reflection: when a sound wave bounces back off of a material and back to the person or object creating the sound. This causes something called an [echo](#).

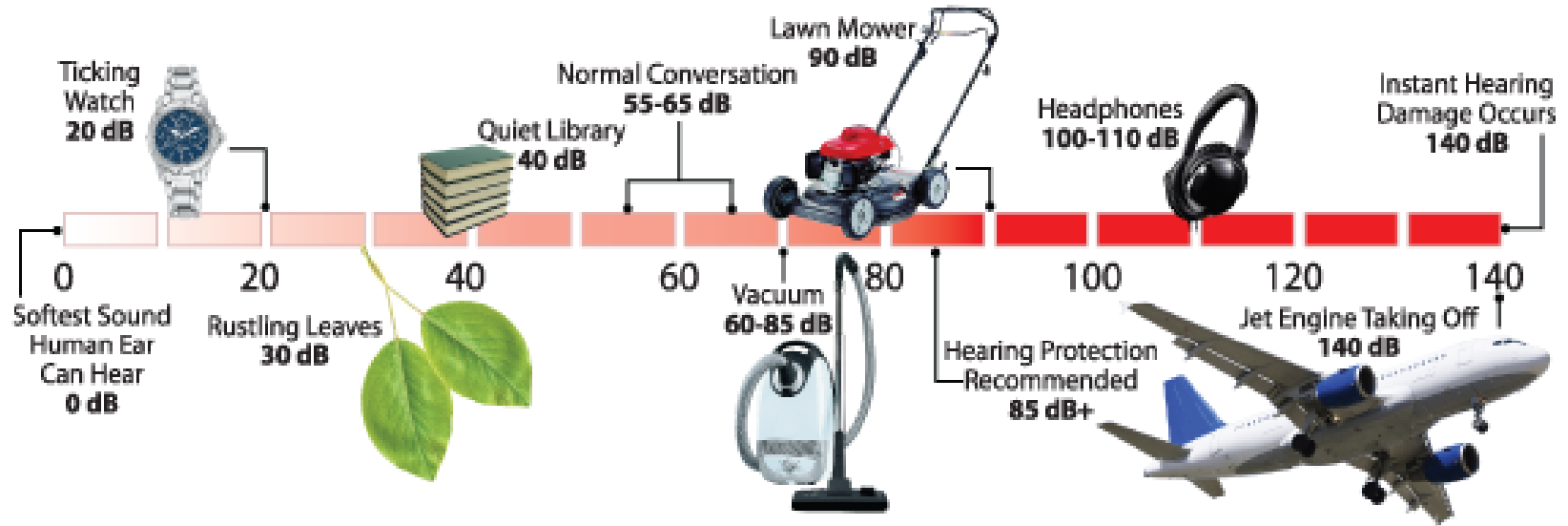
Think about when you are in the gym or a long hallway and you make a noise. It repeats after you multiple times when the sound waves are [reflected](#) off of the material.

<https://www.youtube.com/watch?v=TAliq8lXCZE>



Decibel

A unit to measure sound



Vocabulary

Word	Definition
absorption	The process by which a material, structure, or object takes in sound energy when sound waves are encountered, as opposed to reflecting the energy.
acoustic	The branch of physics that deals with the study of all mechanical waves in gases, liquids, and solids including vibration, sound, ultrasound, and infrasound.
decibel	A unit of measurement used to express the intensity of a sound, or the power level of an electrical signal by comparing it with a given level on a logarithmic scale.
medium	A material substance that can help move energy waves (such as sound) along. Also known as a transmission medium.
oscillation	The repetitive variation, typically in time, of some measure about a central value (often a point of equilibrium) or between two or more different states. The term vibration is precisely used to describe mechanical oscillation.
reflection	The change in direction of a wave at the fact of a medium so that the wave returns to where it originated.
sound	A vibration that manifests itself as a wave of pressure and can be perceived by humans (depending on the frequency) via the ear. Humans can hear soundwaves when the frequency lies between 20Hz and 20 kHz.
transmit	In acoustics, sound passing from one area to another, normally through air or through a material constructed by some other medium.
soundproof	The means of preventing sound by constructing material that prevents its passage and reflection.
vibration	In mechanics, an oscillation of the parts of a fluid or an elastic solid whose equilibrium has been disturbed, or of an electromagnetic wave.
wave	A wave of compression by which sound is propagated in an elastic medium such as air.

What Soundproofing Material Works Best?

Each group will be testing a box filled with a different material to see if the decibel reading becomes lower (is absorbed) or if the decibel reading increases/does not absorb (is reflected).

- a. Group 1: Felt
- b. Group 2: Popsicle sticks
- c. Group 3: Styrofoam
- d. Group 4: Paper
- e. Group 5: Foil
- f. Group 6: Plastic plates

We will test the box first without any materials to get your initial reading, then we will test the box again when you have your material inside the box.

Creating your box

Tips and tricks:

- Place your materials down so that they are one layer surrounding the box
 - Don't just stuff the materials in the box and then test!
- If you need to cut materials to make them flat against the surface you can
- You may use tape or glue to secure the materials to the box

Motivational activity

Students, today you will have QUIZ!

Each table group will be given one reading and only one student will read in each group. You will need to make sure you hear all of the information they are reading because you will be quizzed right after. Make sure you are listening!

Article : “World’s largest Marsupial”

Whole class discussion

- How would you feel if you had to listen to these loud noises each time you were trying to read a book or article?
- Would this affect your concentration?
- How would your grades be affected from the constant noise?

Designing a Soundproof Room

- Your new school is under construction and the architect *accidentally* put the music room next to the library.
- You need to design a room that will absorb the most amount of sound, so that the music room's sound does not disturb the library.
- You will be given a box and will need to create a design for the inside of the box that will decrease the sound decibel's that are being measured from the outside of the box.
- To measure this challenge, there will be a speaker within the box and an app to measure the sound decibels from the outside.

The “store”

- Each material you can buy for your soundproof room is within our classroom store
- Each item has a price and there is a limit on how many items you can buy per group
- You also have a budget that you MUST stay within **\$15**
- Choose your materials wisely!