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Sound Level (Loudness)

Unit: Mechanical Waves

NGSS Standards/MA Curriculum Frameworks (2016): N/A

AP® Physics 2 Learning Objectives/Essential Knowledge (2024): N/A

Mastery Objective(s): (Students will be able to…)

- Explain sound levels in decibels.
- Explain the Lombard Effect.

Success Criteria:

- Descriptions & explanations account for observed behavior.

Language Objectives:

- Explain how loudness is measured.

Tier 2 Vocabulary: level

Labs, Activities & Demonstrations:

- VU meter.

Notes:

sound level: the perceived intensity of a sound. Usually called "volume".

Sound level is usually measured in decibels (dB). One decibel is one tenth of one bel.

Sound level is calculated based on the logarithm of the ratio of the power (energy per unit time) causing a sound vibration to the power that causes some reference sound level.

You will not be asked to calculate decibels from an equation, but you should understand that because the scale is logarithmic, a difference of one bel (10 dB) represents a tenfold increase or decrease in sound level.

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The following table lists the approximate sound levels of various sounds:

sound level (dB)	**Description**
0	threshold of human hearing at 1 kHz
10	a single leaf falling to the ground
20	background in TV studio
30	quiet bedroom at night
36	whispering
40	quiet library or classroom
42	quiet voice
40–55	typical dishwasher
50–55	normal voice
60	TV from 1 m away
	normal conversation from 1 m away
60–65	raised voice
60–80	passenger car from 10 m away
70	typical vacuum cleaner from 1 m away
75	crowded restaurant at lunchtime
72–78	loud voice
85	hearing damage (long-term exposure)
84–90	shouting
80–90	busy traffic from 10 m away
100–110	rock concert, 1 m from speaker
110	chainsaw from 1 m away
110–140	jet engine from 100 m away
120	threshold of discomfort
	hearing damage (single exposure)
130	threshold of pain
140	jet engine from 50 m away
194	sound waves become shock waves

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Adjusting Sound Level in Conversation

In crowds, people unconsciously adjust the sound levels of their speech in order to be heard above the ambient noise. This behavior is called the Lombard effect, named for Étienne Lombard, the French doctor who first described it.

The Lombard coëfficient is the ratio of the increase in sound level of the speaker to the increase in sound level of the background noise:

$$L = \frac{\text{increase in speech level (dB)}}{\text{increase in background noise (dB)}}$$

Researchers have observed values of the Lombard coëfficient ranging from 0.2 to 1.0, depending on the circumstances.

When you are working in groups in a classroom, as the noise level gets louder, each person has to talk louder to be heard, which in turn makes the noise level louder. The Lombard effect creates a feedback loop in which the sound gets progressively louder and louder until your teacher complains and everyone resets to a quieter volume.