

Sound Waves & Audition Cheat Sheet

LECTURE 11: Sound Waves & Audition

I. Sound Waves

Definition: Vibrations created by moving air.

- **Formation:**

- When an object vibrates, the surrounding air molecules:
 - **Condense:** Become compressed.
 - **Rarefy:** Pull apart.
- These fluctuations give rise to a sound wave that travels away from the object.

- **Characteristics:**

- Consist of alternating areas of compressed air and rarefied air.
- Travel at approximately 700 mph.

II. Audition (Hearing)

- **Function of Human Ear:** Transduces fluctuations in air pressure.
- **Perceivable Range:** Human ears can detect sound waves generated by vibrations between 20-20,000 Hertz (Hz, or cycles per second).
- **Pressure Range:** The ear transduces fluctuations in air pressure corresponding to wavelengths from 17mm to 17m.
- **Wavelength Relationship:**
 - Faster vibrations lead to smaller wavelengths.
 - Slower vibrations lead to longer wavelengths.

III. Three Physical Dimensions of Sound

1. Loudness (Amplitude / Intensity)

Definition: The relative difference in the density of air molecules between compressed and rarefied air. It corresponds to the amplitude or intensity of molecular vibrations.

- **Perception:**

- **LOUD** sounds have high amplitude (a large difference in air density).
- **SOFT** sounds have low amplitude (a small difference in air density).

- **Impact:** Determines how far the sound travels.

2. Pitch (Tone / Frequency)

Definition: The frequency of molecular vibrations.

- **Measurement:** Measured in Hertz (Hz – cycles per second).
- **Characteristics:**
 - Represents the distance between peaks of the sound wave.
 - Every frequency has a corresponding wavelength.
- **Perception:**
 - **HIGH** pitch corresponds to high frequency (many cycles per second).
 - **LOW** pitch corresponds to low frequency (few cycles per second).

3. Timbre (Complexity)

Definition: The complexity of the sound wave, influenced by its waveform.

- **Purpose:** Humans listen to complexity to determine the source of a sound.
- **Perception:**
 - **Simple** waveforms result in a simpler timbre.
 - **Complex** waveforms result in a richer or more complex timbre.
- **Property:** A distinguishing characteristic of how a sound wave is uniquely distorted or composed of multiple frequencies.

Example: Differentiating between various musical instruments playing the same note.

