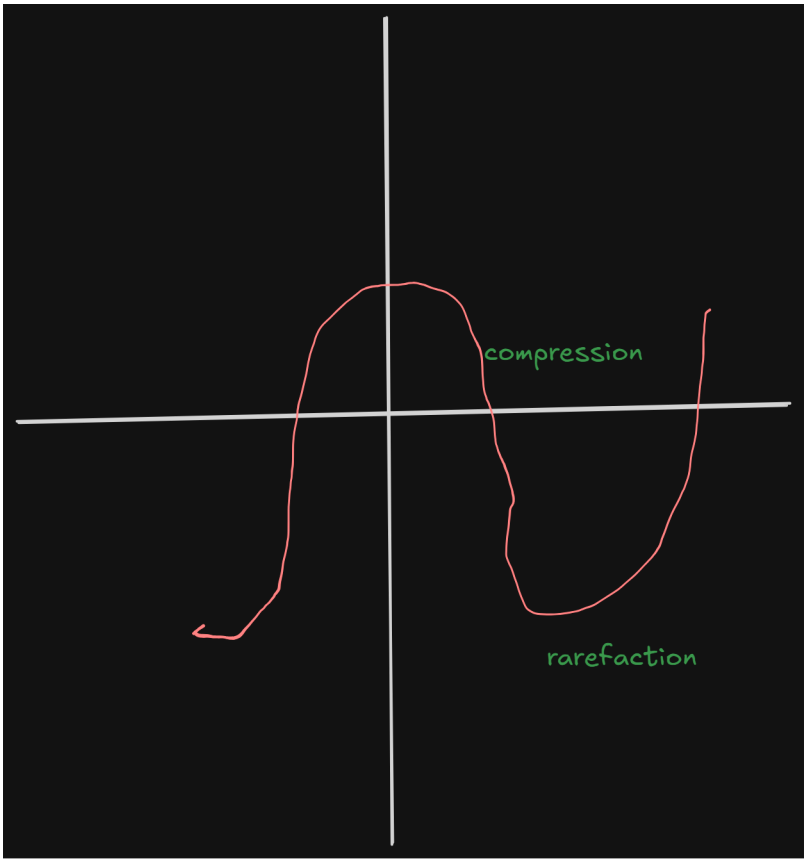
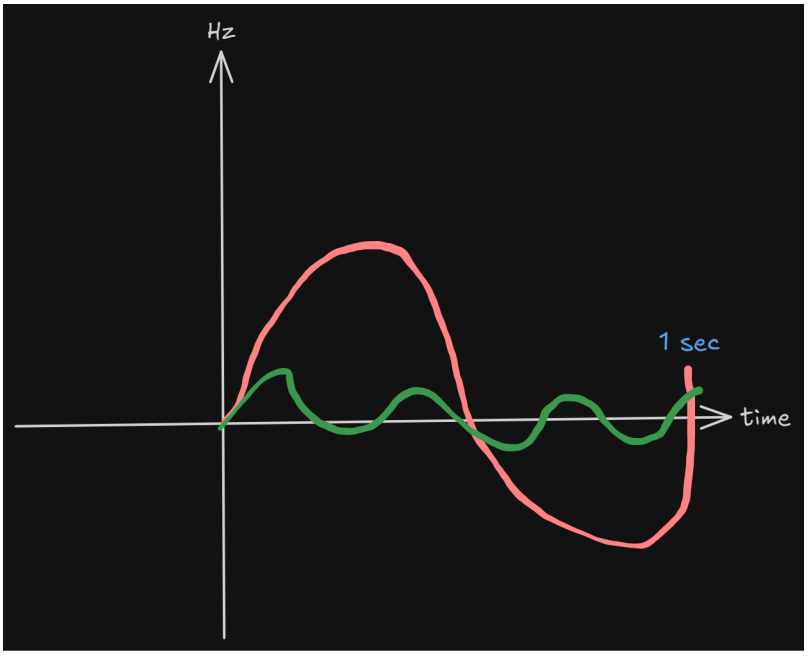
Physics of Sound

Pressure Waves

- Molecules in the air are compressed and a rarefaction is created
- In its simplest form, sound can be represented as a sine wave
    - Sound is not actually a sine wave because the sound goes in all directions, but waveforms can be a helpful way to visualize sound waves





Properties

Perceptual Properties	Physical Properties
Pitch	Frequency
Volume	Amplitude
Timber	Waveform & Spectrum
Articulation	Amplitude Envelope
Rhythm	Transient Patterns

Amplitude (volume)

- Decibels are logarithmic
  - $20dB$ is NOT twice as loud as $10dB$

Transient Patterns

- The onset of the specific noise
- Usually the tall part marks the transient

Safe Limits

decibels (dB)	Example	Exposure Limit
10-50	Quiet room	None
60	Normal conversation	18 hrs
70	Chamber orchestra	4.5 hrs
80	Telephone dial tone	1.2 hrs
90	Train whistle from $30m$ away	18 minutes
100	Jackhammer from $1m$ away	5 minutes
120+	Auditory pain	0 minutes

Frequency

- The human hearing range at best is $20Hz - 20kHz$

Amplitude Envelope

- How the amplitude changes over time
- See ADSR

Movement

Transmission

- The sound traveling through a medium
- Needs to be adjusted appropriately depending on the medium to preserve sound quality
- Different mediums change sound waves
- The type of audio cable used affects signal transmission of sound
- Transducers convert sound waves between energy forms