



The Physics of Sound



The physics of sound

i.e. what recording equipment has to capture

- Sound is made when something vibrates.
- The vibration disturbs the air around it.
- This makes changes in air pressure.
- These changes in air pressure move through the air as sound waves.
- The sound waves cause pressure changes against our ear drum sending nerve impulses to our brain.

What are the three components of sound?



Pitch (how high or low)

- The vibration patterns of some sounds are repetitive (note vs noise)
- Vibration patterns are also called waveforms.
- Each repetition of a waveform is called a cycle.
- We can hear frequencies between 20 hertz or cycles (vibrations) per second (low pitches) to 20 kilohertz, i.e. 20,000 Hz (high pitches).
- When the frequency of a sound doubles we say that the pitch goes up an octave.
- We can hear a range of pitches of about ten octaves.
- Many animals can make sounds and hear frequencies that are beyond what we can hear.

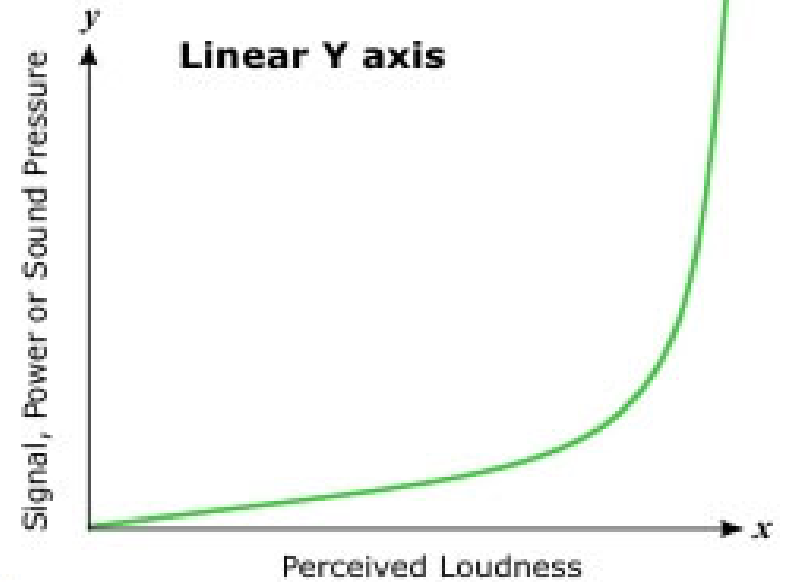
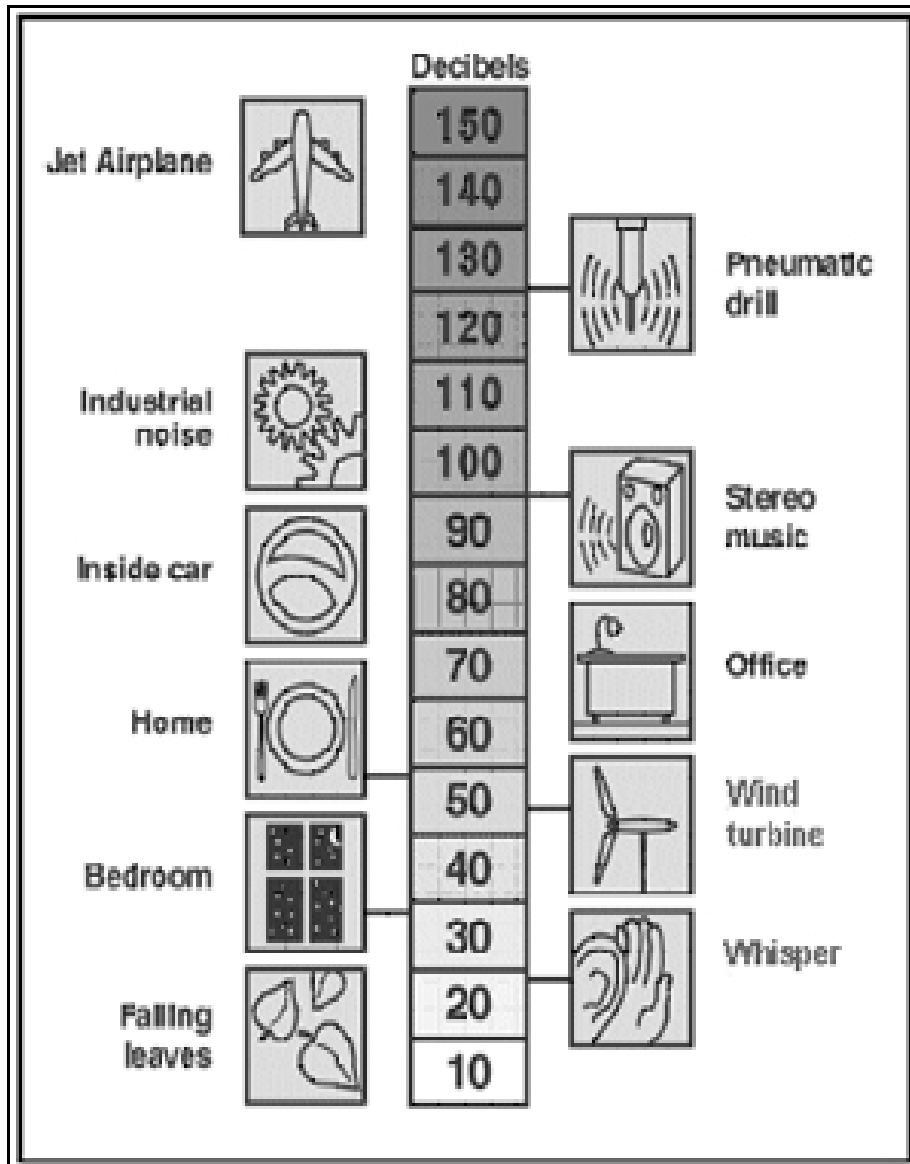
http://www.mienet.com/music/frequency_generator.html

- Relevance to recording equipment?



Loudness (volume)

- To create vibrations energy is used.
- The greater amount of energy used the louder the sound.
- The strength of the changes in air pressure made by the vibrating object determines loudness.
- As the sound spreads out from its source, the concentration of power becomes less. As the distance from the source increases the amount of power is spread over a greater area:
 - Twice the distance = a quarter of the volume (inverse square law)
- Human ears have built in compensation mechanism.
- Relevance to microphone placement?
- The amount of power per square meter is called the intensity of the sound.
- Humans do not perceive sound intensity linearly.
- For us to perceive a sound as twice as loud its intensity must be ten times greater.
- The perceived intensity level of sound is measured in a logarithmic scale using a unit called the decibel (dB):

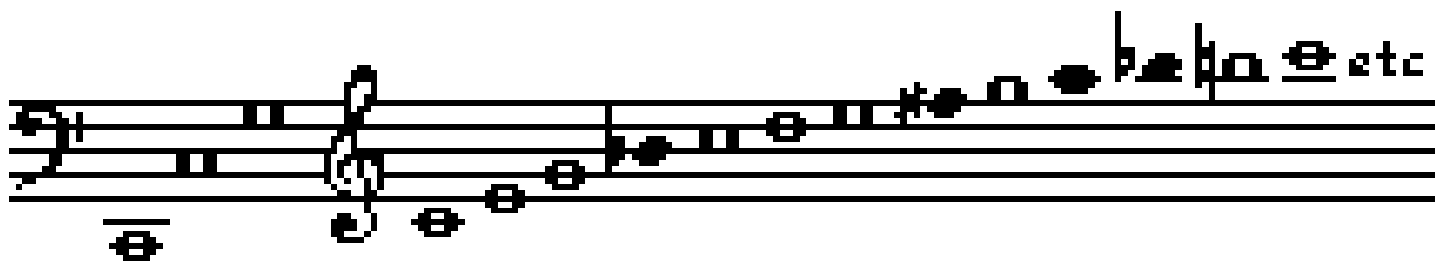


– Relevance to recording equipment?



Timbre (tone 'colour')

- specific property/quality of sound that enables us to determine the difference, say, between a piano and a harp
- An extremely broad variety of tone colors exist because most sounds that we perceive as pitch actually contain many frequencies.
- The predominant pitch is called the fundamental frequency.
- The other frequencies in the sound are called harmonics.
- For example, when C1 is the fundamental the following pitches represent the next fifteen harmonics:



- The relative strength of the different harmonics change the quality of the sound
- Relevance to recording equipment?
- Demonstration (MidiCode)



Travelling Sound

- Low frequencies spread out from their source more than high frequencies.
- Relevance to microphone placement?

Distortion - unwanted change of shape

Absorption and reflection

Sound travels at different speeds in different media (depending on their density)

