Chapter 3 Sound Basics

Sound Basics

Learning Outcomes:

A basic understanding of how sound works is the building block for music, mixing and most concepts in this course.

Introduction to Sound

Sound, as humans perceive it, is the detection and interpretation of vibrating acoustical energy. Waveforms are created by minute periodic changes in pressure.

An increase in pressure is called compression (speaker pushes out, positive numbers in digital editing). This compression is not to be confused with dynamic compression.

A decrease in pressure is rarefaction (speaker pulls in, negative numbers in digital editing).

Psychoacoustics play a factor in how our brains interpret sound. Psychoacoustics, for example, is the way in which our brain localizes sound based on both the time delay between sound arriving at our left and right ears and the frequency difference between the sound arriving at both ears.

Sound is periodic in nature: **CYCLE** (it arises and subsides like all things in life and in the universe)

Sound can be measured and/or described by:

- Amplitude – volume – the distance away from zero pressure: **dB**
- Frequency – pitch – the time it takes to complete a cycle: **Hz**
- Velocity – the speed at which sound travels through objects
- Wavelength – the distance sound travels to complete one cycle
- Phase – a measure of where a sound is in it's cycle
- Harmonic Content – timbre or sound colour
- Envelope – how the sound develops over time (attack, decay, sustain, release)

For our purposes, we are mainly concerned with: **Amplitude, Frequency, Timbre, and Envelope.**

Amplitude: volume measured in decibels – dB

The dB scale is logarithmic meaning that every 6 dB doubles the perceived intensity of the sound as heard while 3 dB doubles the electrical power of a sound.

0 dB	- Threshold of Hearing
60 dB	- Conversation
120 dB	- Band Practice
140 dB	- Threshold of Pain
150 dB	- Jet taking off

Frequency

Frequency is pitch or cycles per second measured in Hertz – Hz. Frequency, in the most basic sense, is how often something happens. Our ears can hear anything that happens between 20 and 20,000 times per second. If you hear the hum of fluorescent lights, you are hearing electrical voltage cycle 60 times per second within the light. The same is true of any motion; if you move your hand up and down 20 or more times per second, as impossible as that may sound, you will actually hear the motion.

Theoretical hearing range of humans: 20 Hz – 20 kHz
Average hearing range: 30 Hz – 18 kHz
Females typically have a broader hearing range than males.

Timbre

Timbre or tone is the harmonic content or overtones of a sound. The theory of sound is that all sounds at their most basic level are comprised of sine waves of different pitch (frequency) and volume (amplitude). This theory is the basis of **Additive Synthesis**. Timbre allows the ear to distinguish between sounds of equal pitch and amplitude. For example, timbre allows us to hear the difference between a piano and a guitar playing the same note.

Timbre is closely related to the Natural Harmonic Series described below:

Natural Harmonic Series

The Natural Harmonic Series is the naturally occurring overtones determined by physics.