RED PIN
PODCAST

EP. 3: **EQ and Frequency Phenomena**

Discover how equalization shapes the tone, clarity, and balance of every great mix. In this episode, Aleyna Neivandt-Brown explores the science of frequency—from overtones to beats and combination tones—and applies it to practical audio examples including flute improvisations, sine tones, and noise samples. Learn how to use EQ as both a corrective and creative tool while developing a deeper understanding of the physics behind sound. Whether you're mixing your first session or refining your engineering technique, this episode provides proven strategies for creating cleaner, more transparent mixes.

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Hey everyone, welcome back to the Red Pin Podcast. I'm your host, Aleyna Neivandt-Brown—audio engineer, composer, performer, and professor, and Founder of Red Pin Productions. The Red Pin Podcast is a platform to share with you my complete toolbox of audio engineering skills, based on my original curriculum designed for my college students and expanded to reach audiences from hobbyist to professional. Today's skill is **equalization**, which is a processing tool that can be used in both corrective and creative ways. In this episode, I'll cover what EQ is, the terminology and scientific phenomena behind it—including some really interesting physics of overtones and combination tones—types of EQ plug-ins, common EQ techniques, and some of my own tips for getting the most out of your mix using an EQ. Let's get started.

[Red Pin Podcast Intro Music]

[1:38] The term **EQ** can refer to equalization—the concept—or an equalizer, as in the plugin or channel strip module itself. Or you can use it as a verb—like to say, "Hey, EQ that incoming vocal track." I'll use it in all of those ways in this discussion, so you can get the hang of using this term in the context of different audio engineering settings. For a brief overview of the **concept** behind equalization, I'll begin with this: Using an EQ—similar to other dynamics processing or filtering—is just turning things up and turning things down. The "things" in question are frequencies. **Frequency**—referring to cycles per second, measured in Hertz—is commonly known as pitch. Not to be confused with actual pitchshifting, an EQ changes the frequency balance or tonal characteristics of a sound, but it doesn't actually change the pitch. This can be done correctively and creatively, and you'll need to have some engineering background knowledge to utilize it most effectively.

[2:58] First I'll talk about some **corrective** ways to use an EQ using my primary instrument, flute, as an example, and exploring the science behind **frequency ranges**. An EQ module on your analog console, or your EQ plugin in your DAW, will typically allow you to control different frequency bands between **20 Hz and 20 kHz**. That's the typical range of human hearing, so that's the range in which we focus our attention as mixing engineers. Not every instrument can produce sound across that entire range, so knowing where common instruments land across that spectrum is very helpful for an audio engineer to know, especially when dialing in an EQ. For example, the flute's lowest note is a B3, which is 247 Hz. [Audio Example: Flute playing a B3.] Any incoming signal below 247 Hz that has been picked up by my microphone is obviously not flute. It may be bleed from a lower instrument in the same room, or the hum of an A/C unit, or the rumble of traffic outside. If any of those are a noticeable problem, I can address it with an EQ wherein I attenuate—turn down—any frequencies below 247 Hz. My flute signal

would not be compromised, and any pesky lower frequencies would be gone. This is called a **high-pass filter**, H-P-F, meaning anything below a threshold that you set—in this case, 247 Hz—would be attenuated, and anything higher can pass through. High pass filter. But let's talk about the other end. I can play notes up to a D7 reliably, E on a good day but that's what the piccolo is for… So now we're up around 2,350 Hz. But I would not want to roll-off or attenuate everything above 2.3 or 2.4 kHz, even though technically that's the highest fundamental note I can play. Why? Science. **Fundamental** is a key word here. Because beyond whatever fundamental note is being played, an instrument resonates with many more on top. These are known as **overtones**. These overtones are what help us sonically define the **timbre** of different instruments. Timbre, spelled t-i-m-b-r-e, is what allows us to discern the violin from the clarinet even at the same pitch. The construction of the instrument, the way it resonates and emanates sound, is unique in how it emphasizes or suppresses different overtones. These overtones on top of a fundamental pitch follow a specific sequence known as the **harmonic series**. You didn't really think we'd get through an episode without some physics? So here it is. The harmonic series is a naturally-occurring phenomenon—a pattern in nature—as seen in anything that vibrates, like a string. Stretch out a string and pluck it, and you get vibrations not only of the fundamental note, but also from the string vibrating in fractional divisions—halves, thirds, quarters, and so on—producing pitches that correspond to those shorter vibrating wavelengths too. The resulting series sounds like this. Take a listen to a sine tone at 250 Hz. [Audio Example: 250 Hz sine tone.] The next harmonic that occurs is an octave higher, meaning the wavelength is half and the frequency is double. So here's our fundamental 250 Hz plus 500 Hz. [Audio Example: 250 Hz sine tone by itself, short pause, 250 Hz and 500 Hz sine tones play together.] The next harmonic is an octave and a perfect 5th up from the fundamental, and after that two octaves. Let's add those. [Audio Example: 250 Hz + 500 Hz sine tones play together, short pause, add 750 Hz, short pause, add 1 kHz]. Then we get into some cool harmonics including thirds, because the divisions of the wavelengths are getting smaller, so the intervals between harmonics get smaller as well. Here's a full run up the harmonic series up to seven overtones. [Audio Example: Starting with a 250 Hz sine tone, harmonics are added with short pauses in between each addition. The full stack includes 250 Hz, 500 Hz, 750 Hz, 1 kHz, 1.25 kHz, 1.5 kHz, 1.75 kHz, and 2 kHz. Overtones fade out leaving just the fundamental 250 Hz.] Amazingly, we still hear this as one vibrantly resonating pitch. But now you hear how important all those overtones are as well, and how it changes the timbre.

[8:49] So I will now record myself playing a G on the flute. Roughly 196 Hz. [Audio Example: Flute playing a G4.] Now I will use an EQ to isolate only that frequency, attenuating everything on either side using a high pass filter and a low pass filter narrowly placed right around 196 Hz, so that frequencies

above and below those thresholds are turned down—isolating just the fundamental pitch. [Audio Example: Previous flute example of a G4 with EQ filters on either side of 196 Hz.] Hear how dull and nondescript that tone has become? Can you even tell it was played by the flute? Does it have any of the distinguishing characteristics of the flute's resonance? Listen side by side. I will play the note and toggle the EQ bypass on and off. [Audio Example: Flute playing a G—first with no EQ, then with the EQ filters, then toggling the EQ bypass on and off.] Now I'll play a short passage of notes across more of the range of the flute, and do the same thing with the EQ— placing high and low pass filters and toggling the EQ on and off for you to listen. [Audio Example: Flute improvisation—first with no EQ, then toggling the EQ bypass on and off.] What a difference the overtones make, right? Those upper frequencies, beyond the normal range of the instrument or voice, actually play a huge factor in discernment, clarity, timbre, and tone. And now, knowing how powerful the filtering of different frequency ranges can be, let's dive further into the EQ **parameters** that allow us to harness that power.

[*brief musical transition*]

[11:26] An EQ allows you to shape a signal by boosting or cutting certain frequency bands. On a multi-band EQ plug-in, you'll have a variety of controls. The first you'll want to tackle is which **bands** are active. You can engage and disengage different frequency bands to have more or fewer points of control. These bands are often divided into the categories low, low-mids, mids, high-mids, and highs. Let me use a pink noise sample and isolate each one of those typical ranges, so you can practice delineating those in your ear. [Audio Example: Noise samples separately filtered into low, low-mid, mid, high-mid, and high ranges, with brief pauses in between.] On each of these bands, you'll typically have the ability to adjust their position along the frequency spectrum; the type of curve you want to apply—like high pass, low pass, shelf, bell-curve, notch; by how much—in decibels, up or down; and how narrowly, known as **Q-value**. If you're using a **graphic EQ** plugin or an analog unit, say, on your console, these will be controlled with dials for frequency, volume, curve shape, etc., and you'll have to rely on your ears and your knowledge of typical frequency ranges for the instruments you're recording. If you're using a **parametric EQ** plugin, you'll actually see the frequency spectrum in real-time as your audio plays through, and may even be able to click and drag each little point around and up and down and get a visual representation of what you're changing, but this doesn't mean your ears or knowledge are any less important. To each her own. I prefer parametric and especially ones that show the spectrogram of the signal while you're working in the EQ—plugins like iZotope's Neutron or the stock EQ plug-in in Logic, so you can have some visual confirmation that you're addressing the right part of the signal and some

visual indicators of where those overtones are and maybe where some pesky noise is coming in. But again, it does not give you an excuse not to use your ears.

[14:11] Now that we've discussed the parameters, let's talk about **EQ techniques**. Staying on the corrective side for now, EQ is, as we've discussed, a great way to attenuate any **unwanted noise** or bleed in your signal, so long as it doesn't materially affect the tone of the instrument or voice you're recording. The reason I could put a high pass filter on my flute signal and get rid of any low frequency noise is because the flute wasn't participating in that range anyway, so I didn't have to compromise my flute tone. But noise isn't always in a conveniently separate range, so you may have to pursue a de-noise plugin if you're not recording in a controlled environment. But what about the noises I might make, as a human performer doing the physical act of playing an instrument? There are some noisy things like my keys or my breaths, or maybe even some places where I articulated a bit too harshly, and my flute signal is riddled with noisy artifacts. I can use an EQ to first listen, look at the spectrum analysis, and identify the frequency range of those artifacts. Then, I can move one of my parametric EQ points to that range, narrow the band into a bell or even a notch shape by adjusting my Q-value, and then turning it down. This wouldn't be a dramatic change, but by honing in on exactly where those noises were happening—not in the timeline, not as a matter of amplitude, but where in the frequency spectrum—I am able to isolate and attenuate something unwanted, resulting in ideally a more polished and clean performance. So that's just one of the corrective techniques using an EQ, addressing unwanted noises or frequencies for an overall more polished and clean signal. But how often are you mixing one signal and one signal only for your whole project? Rarely, right, except for solo repertoire. We usually have more than one track to deal with. And when you start **adding multiple signals** together, a few things come up.

[*brief musical transition*]

[16:52] If I play two nearly identical frequencies—say, 440 Hz and 442 Hz—you won't hear two separate notes. Instead, you'll hear one tone whose loudness pulses twice per second. These pulsations are called **beats**. As the frequencies move farther apart, the beats become faster until we begin perceiving two distinct pitches instead of a pulsating duet that's just badly out of tune. Check this out. [Audio Example: Three sine tone pairs, each using 440 Hz as the base note, plus 442 Hz, then 445 Hz, then 450 Hz, with brief pauses in between, each pair demonstrating faster *beats* as the pitches grow farther apart.] Now how about one you've certainly heard before? [Audio Example: Sine tone pair, 440 Hz plus 480 Hz.] Yep! The sound you hear when you call someone is 440 Hz plus 480 Hz. The more you know.

[17:58] The frequency phenomena of combining multiple signals don't stop there. Bear with me for a bit more physics. When combining two or more tones, the resulting sound contains not only those two tones but also a psychoacoustic phenomenon of sum and difference tones, also known as **combination tones**. Literally, our brain perceives the resulting frequencies of adding those two tones together and subtracting those two tones from one another. This can muddy your mix in ways your meters won't even show, but your auditory system still perceives. On the other hand, being aware of this phenomenon can also be an incredible tool to understand how to get the most out of your bass range even on headphones or phone speakers that physically cannot reproduce those bass waves. News flash, that's how some earbuds work! The ones you're probably listening on right now. Phantom bass tones. How? Well, if you play a 400 Hz tone and a 500 Hz tone, your brain will also hear a faint 900 Hz summation tone and a 100 Hz difference tone. Here's 400. [Audio Example: 400 Hz sine tone.] And here's 500. [Audio Example: 500 Hz sine tone.] And now I'll play them together, and a bit louder just as a warning, because loudness does have an effect on perceiving these combination tones. [Audio Example: Sine tones at 400 Hz and 500 Hz play together.] Okay, now here's that 900 Hz summation tone by itself. [Audio Example: 900 Hz sine tone.] Here's that 100 Hz difference tone. [Audio Example: 100 Hz sine tone]. Now I'll play them all together, with the 900 and 100 manually added, and then I'll take those away, but to your brain, I bet they'll still be there. [Audio Example: Sine tone chord including 400 Hz, 500 Hz, 900 Hz (summation tone), and 100 Hz (difference tone). Sum and difference tones fade out, providing an opportunity to hear the phantom tones.] [Editor's Note: It's tricky to hear these unless your audio is pretty loud. Try listening on speakers. Also, try this experiment on your own with other combinations to practice listening for sum and difference tones!] How cool is that? Anyway, back to how this might affect your mix… By understanding how combination tones can generate phantom low frequency content, you need to be careful in how you mix your low end. You might think that your kick and your bass are different enough frequency-wise that they shouldn't be muddying the mix or masking each other, but the difference tone between them might be doing just that. You can use a sidechain compressor—by the way, I talk all about compression in an upcoming episode—or you can use an EQ to attenuate the difference tone area to preserve the separation between the kick frequencies and the bass frequencies, getting rid of any resulting frequencies of their combination. These tones aren't always bad by the way. You can harness them. They were in the early days of electronic music in the 1900s with the advent of vacuum tube oscillators, the birth of synthesis. **Heterodyning** is a signal processing technique of mixing two signals to create their sum and difference tones on purpose. You may have heard of ring modulation. It's a very cool synthesis technique. It's based entirely on sum and difference tones while

suppressing the original input signals, which creates a pretty weird, metallic sound that we often associate with robots or other Sci-Fi sound design. So unless you want some metallic dissonance in your mix, sum and difference tones are to be mindful of.

[21:59] It's not only combination tones that can muddy your mix. I used the term masking before, so let's unpack that one a bit more. **Frequency masking** occurs when two or more instruments are competing for the same space in your mix. Again, not talking about space on the timeline, but rather space on our frequency spectrum. Our mix can sound muddy if two or more instruments are vying for the same frequency range. This is common between kick and bass like we've already talked about in the low end, but also in the high end with all those overtones we talked about too. Understanding how different instruments resonate and produce harmonics can help you identify which instruments need priority in those high-mids and highs. When it comes to clarity, especially in rock and pop music, there are a lot of important signals competing for the mid-range. The vocals typically sit in the mids, with fundamental ranges roughly 100 Hz to 500 Hz, and overtones and other harmonic qualities of the voice—like resonance, articulation, and consonants—extending that upwards. Well you know what else sits in the mids? Guitars, keyboards, synths, you know, the main melodic instrumentation for the vast majority of popular music. This poses a bit of a frequency conundrum, known as masking. Competing for the same space, turning things up and up and up and wondering, *where is the intelligibility of the lyrics? Why isn't it getting clearer?* That's because you're not going to fix masking with your faders alone. You have to address the frequency conflicts. That's where EQ comes in. Using a technique called **Complementary EQ**—complementary with an "e"—you can make windows for different instruments to peek through in different places than one another. These windows mean you accentuate the frequencies that deserve to shine, and attenuate the frequencies where they don't need more light in order to still be a positive contributor to the mix. Guitar might really shine at 400, 800, and 1.2 kHz, so I'll boost those with a bell curve, and I'll go ahead and dip everything in between, and remove some low end. Now, on its own, maybe this isn't going to result in the best sounding guitar track, but you've created windows for the vocals to shine through without having to compete. Because maybe the vocals are great at 300, 600, and some presence at 2k, so those get boosted, and the other zones get turned down, letting the guitar shine through. These windows have created clarity where there used to be competition. If you want to see a real example of the complementary EQ technique in action, check out the Red Pin Review Vol 2 Issue 1 "Production Deconstruction" segment, in which I walk you through each of the unique acoustic guitar loops that make up my album *nearing* and how I used complementary EQs to create windows for each loop to shine and not compete, preserving clarity for each part in the mix.

[25:49] Now, remember in the beginning of this episode when I said EQ is like many other dynamics processors—turning things up and turning things down? It is important to remember that an EQ is changing the volume of your track. If you only ever boost frequencies you like, that's an **additive** approach, and what comes out of your EQ will be louder than what went in. Now, there's a psychoacoustic tendency for us to prefer something that's louder—not necessarily because it sounds better—it's just human nature. There have been really interesting experiments on people's music preferences where they almost always pick whatever is louder. Biologically speaking, studies show louder music stimulates a part of the inner ear that triggers endorphins. So you can set yourself a bit of a trap if you're just using your EQ to boost volume—1. Because you may be making decisions based on loudness preference not tonal precision, and 2. You might lose track of your track volume if you're not careful. If EQ is buried within a signal chain including compression and then sending to a reverb, well, how much signal is being sent? You can actually clip inside your EQ and end up with some digital distortion but your main track meter never shows it, because it goes into the compressor next which levels it out again and you're none the wiser. So those are two reasons to be mindful of the additive EQ approach. I personally believe in addition by subtraction. To make certain frequencies pop, turn down the others. You can remember this: Make room, not make louder. A **subtractive** approach will create those windows we talked about earlier, and it can create clarity, upon which you can turn up your track fader if you want more of it in the mix. But I believe in the EQ serving a tonal purpose, and leaving the volume to the fader.

[*brief musical transition*]

[28:17] Now, we've spent a lot of time on corrective ways to use an EQ—for polishing and clarifying a signal or mix—but what about some creative ways? Next, I'll demonstrate how you can use EQ as an **effect** and how you can **automate** an EQ for a **sweep**. By now you've certainly gotten used to how my voice sounds. But what if I was talking to you on an old phone? [Filtered with a telephone EQ: "This is a telephone EQ effect, created with a bandpass around 300 Hz to 3 kHz, which was the frequency band that best traveled across telephone wires in the early telecommunication days that allowed for intelligibility without too much rumble or static hiss on the lines." Filter removed.] And now I'm back to normal. But what if I wasn't speaking to you from my mic into your headphones, but rather—[Filtered with a LPF "—outside the door or in another room, where suddenly my consonants aren't as crisp and maybe my overall intelligibility is less, because I've used an EQ to remove all the high frequencies." Filter removed.] And now back to normal. Now let's take another listen to the Red Pin Podcast intro music. In the beginning you'll hear an effect known as an EQ sweep, that I automated. I used my pencil tool to

move a low pass filter threshold across the spectrum, initially only allowing the very low tones to pass through and gradually allowing higher and higher tones through as the threshold follows the automation across the spectrum. [Audio Example: The beginning of the Red Pin Podcast Theme Music.] Now let me make it a little more dramatic for you. I'll automate an EQ sweep that boosts a narrow band across the spectrum in an effect that feels a lot like a riser before the beat drops… [Audio Example: automated EQ sweeps up and down using the Red Pin Podcast Theme Music.] Now you know what those DJs are doing onstage to set up their drop—performing EQ sweeps, live.

[Red Pin Podcast Outro Music begins in the background]

[30:44] And that brings us to the end of this episode on EQ and Frequency Phenomena. I hope the lesson and audio examples helped you better understand the power of your EQ as both a corrective and creative tool. For more information, resources, or to submit a topic, visit redpinproductions.com. I'm Aleyna Neivandt-Brown. Thanks for listening.

References and Further Reading

Cullari, Salvatore, and Olga Semanchick. “Music Preferences and Perception of Loudness.” *Perceptual and Motor Skills* 68, no. 1 (1989): 186. https://doi.org/10.2466/pms.1989.68.1.186

Mas-Herrero, Ernest, et al. “The Role of Opioid Transmission in Music-Induced Pleasure.” *Annals of the New York Academy of Sciences* (2023). https://doi.org/10.1111/nyas.14946

Neivandt-Brown, Aleyna. "Production Deconstruction: An Inside Look at the Complementary EQ Techniques Used in the Album *nearing*." *Red Pin Review* 2, no. 1 (February 16, 2026): 20–25. https://www.redpinproductions.com/_files/ugd/6a3d60_b2a6dda0a52845e28a87b57fa60ada17.pdf?index=true

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