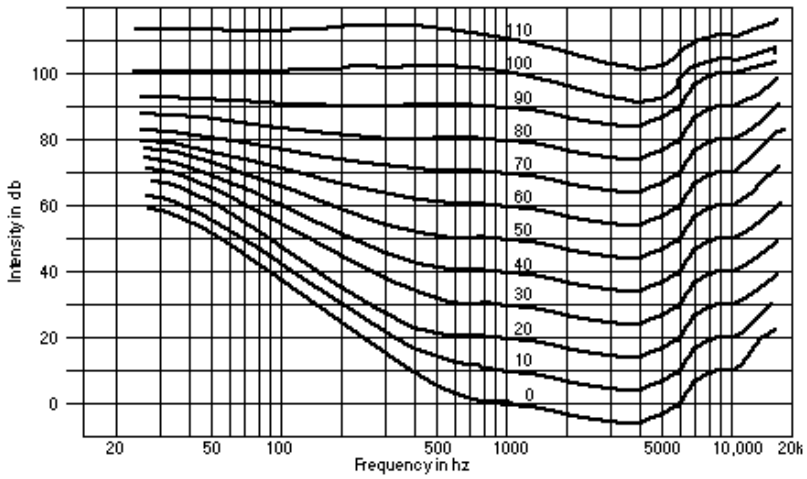
Equal Loudness and Pitch

Equal Loudness



The Fletcher-Munson Curve

Does your stereo have a 'loudness' switch or a bass boost button? The loudness button can help to make the music seem louder without turning it up. This is the principle of ***Equal Loudness***. Another name is the ***Fletcher-Munson curve.***

We've already learned that loudness is subjective. How 'loud' something is depends on the environment in which it's heard. But, Equal Loudness is not subjective; it's measurable. It says that how loud a sound seems depends on its frequency and amplitude content. Equal Loudness and the Fletcher Munson curve are based on the physiology of our ears, the way our ears are designed.

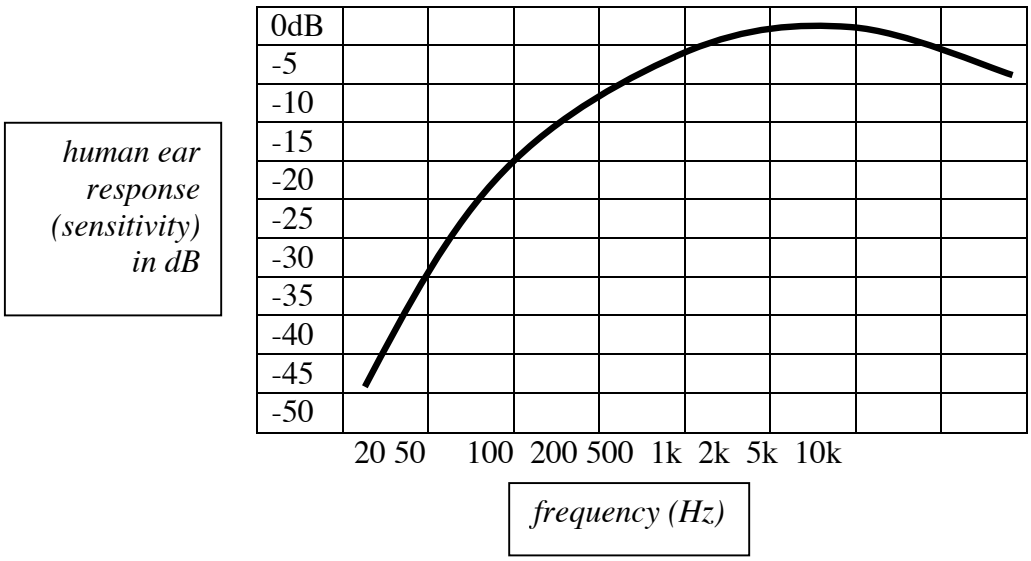
The Fletcher-Munson Curve shows that our ears are more sensitive in the 500 Hz – 5kHz range, so less energy is needed for those frequencies to be heard. More energy, on the other hand, IS needed to make lower frequencies SEEM just as loud. By boosting the lower frequencies (and to a certain extent, higher frequencies) with your Loudness control, you can make lower volume settings still seem full.

One example of this is the difference between a guitar amplifier and a bass amplifier. A typical guitar amp might be 60 watts, but a typical bass amp might be 100 watts. Bass frequencies need more watts than midrange frequencies.

The Fletcher-Munson Curve also shows that the response of the ear changes depending on how loud the music is. At lower volume levels, we hear less bass compared to the midrange. If you turn music way down, you'll probably only be able to hear the midrange. The bass and the highs will seem to disappear.

The 'optimum' listening level is about 85dB. But it's a good idea to vary the volume you're listening to during a mix, because it reduces ear fatigue, and because it helps to know how a mix will sound at lower levels (or at higher levels).

Here's an inverted way to look at what is happening:



You may notice that bass amps tend to have higher watts RMS settings than guitar amps. You need much more power to drive a bass signal so that it seems just as loud as a midrange guitar signal.

Many natural and instrumental sounds have most of their acoustic energy in the lower range of their harmonic spectrum—this complements the frequency response of our ears. Some synthesis techniques, such as FM synthesis (the famous Yamaha DX7!) tend to create energy equally distributed across the harmonic spectrum, and so we say they're 'weighted' towards the upper frequencies. They tend to sound brighter!

Pitch

When we say music, we usually mean an organized collection of many notes played on different instruments. The notes change, blend and flow to work together and create music. The notes are called pitches. A series of different pitches would be an important part of a melody.

The perceived pitch of a sound is the ear's response to frequency (and the physiological and psychological impact on the listener). Usually, pitch and frequency are thought of as the same thing. But 'frequency' is a number (440Hz) and 'pitch' is a musical letter (A above middle C).

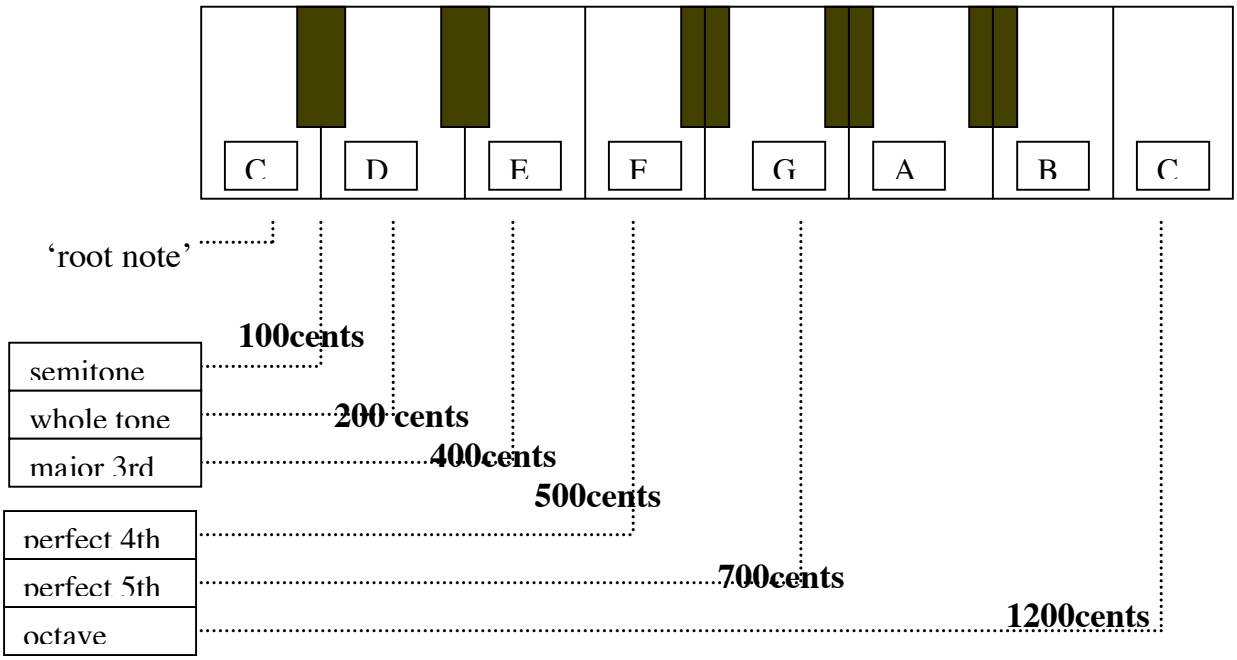
We usually talk about pitch as being **high** or **low**, higher or lower. This means the frequency is higher or lower. A flute has a *higher* pitch than a tuba. A male voice *usually* has a lower pitch than a female voice. A music box has *high* pitches. An electric bass guitar has *low* pitches.

Examples of pitch:	Tuning note of an oboe in concert	-	440 Hz
	Middle C on a piano	-	261.6 Hz
	A string on a guitar	-	110 Hz
	Lowest note on a piano	-	27.5 Hz

Cents

Cents are tiny changes in pitch, much smaller than semitones on a piano. There are 100 cents in a semitone, such as from C to C#. There are 200 cents between C and D, because there are two semitones. There are 500 cents between middle C and F, because there are 5 semitones.

Since an octave on the piano is made of 12 semitones, an octave is 1200 cents.



Humans can hear pitch changes of about 5 cents. This is the 'just noticeable difference' in pitch for human hearing. 5 cents is about how much flatter or sharper a note has to get before we can hear the change.

Musical Intervals

A musical ***interval*** is a step up or down in pitch. Intervals are based on a normal 8-note scale found in Western music. For example, the interval that's 2 notes apart in the scale is called a 2nd. The interval made by two notes that are 5 notes apart is called a 5th. And so on. Because we have a limited number of notes in the scale, we have a limited number of intervals to explore. Some intervals are ***major*** or ***minor***, like 2nds, 3rds, 6ths and 7ths. Others are ***perfect***, like 4ths, 5ths and octaves.