Music Notation 2

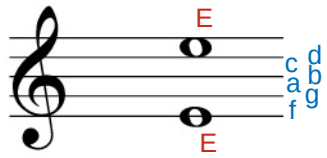
Music Fundamentals **14-119-T**

In the last lecture, we discovered the musical alphabet, and how a clef defines where a note is positioned in the staff.

More on the Octave:

At this point, you are probably asking what the numbers after the note names indicate. These simply identify the octave of the note. Do you remember what an octave is? To review, an octave is the *interval*, or distance between two notes, where of seven letter names [see figure1]. We can also explain this using basic acoustics, but this requires a little further explanation.

figure 1

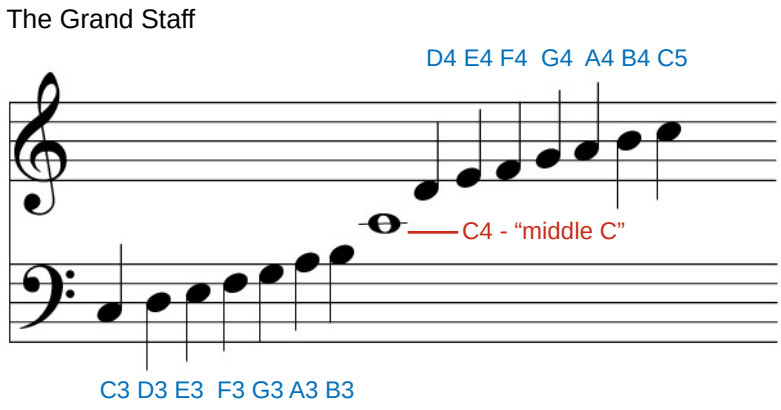


You probably remember from your high school physics course that sound is simply oscillations in a sound medium. Sound can generally be described as waves of compression and rarefaction in the air. The more compressions and rarefactions, or cycles, that occur within a time period determine the pitch of the sound. For example, if a sound source, such as a vibrating string changing the air pressure, oscillates, or completes a cycle, at 440 times per second, the frequency is said to be 440 herz (Hz). 440Hz, in our musical system, happens to be the **A** above **middle C** (or **A4**), and is the pitch orchestras in the United States use to tune – it is also known as "concert A". In Europe, their concert A is 441Hz. The difference between 440Hz and 441Hz is not recognizable to the normal ear unless you listen to the two simultaneously. I'm not sure why the Europeans use a different tuning scale, but it's an interesting trivia fact you can use to impress people at your next cocktail party.

If we have labeled A4 as 440Hz, then the next octave up, or A5, cycles 880 times per second (880 Hz). In other words, the ratio of two audio signals an octave apart is 2:1. With this knowledge, you can figure out what the frequency is for a pitch an octave lower than 261.6Hz (**middle C**). Ok, don't get out your calculators. The answer is 130.8Hz (261.6 divided by 2).

In the most common system, **middle C** is **C4**. What is middle C? It is the **C** that is located in the middle of the keyboard. It is also the *ledger line* **C** that lies between the grand staff [see figure 2]. The grand staff is actually two staves (staves is plural of staff). The top staff uses the treble clef and the bottom staff uses the bass clef. It is

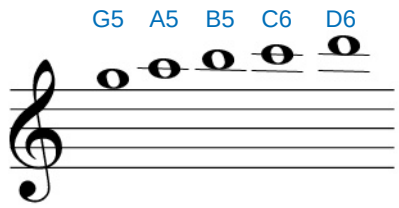
figure 2



the common setup for music on keyboard instruments (piano, harpsichord, organ, etc.).

Ledger Lines:
Music would be rather boring if we had to limit ourselves to the notes within the staff. Using our four clefs, the total number of notes would only span a little over 3 octaves. The piano has a range of over 8 octaves! For notes that are not in the staff, ledger lines are used to continue the staff. This allows the staff to become infinite. However, just like notes in the staff, you can still identify the notes by simply counting up or down in the musical alphabet [see figure 3].

figure 3



Accidentals:
Music would also be boring if the octave were only divided seven ways. In fact, our musical system divides the octave into 12 equal intervals called half-steps. Some cultures divide their octave differently, and many composers who use the computer to write music have divided the octave in numerous ways. You may notice that if you have a frequency of 440Hz, you cannot find the 1/2 step above 440Hz simply by adding .8333333 (or 12 divided by 1) to 440. Unfortunately it's not that easy. We can't simply add a constant to a frequency to find another. Instead, pitches share relationships. For our tuning system (equal temperament), the ratio for our 1/2 steps are 1:1.0594 (actually it's 12th root of 2, but we can get 'close' with 1.0594). The following table proves this equation:

1)	**440.000** X 1.0594	=	466.136
2)	466.139 X 1.0594	=	493.824
3)	493.824 X 1.0594	=	523.157
4)	523.157 X 1.0594	=	554.233
5)	554.233 X 1.0594	=	587.154
6)	587.154 X 1.0594	=	622.031
7)	622.031 X 1.0594	=	658.980
8)	658.980 X 1.0594	=	698.123
9)	698.123 X 1.0594	=	739.592
10)	739.592 X 1.0594	=	783.524
11)	783.524 X 1.0594	=	830.065
12)	830.065 X 1.0594	=	**879.371**

Notice that the 12th step is approximately twice the beginning frequency! Obviously, you can now see that simply adding .833333 will not even come close (in fact you would be much closer to 440 than 880).

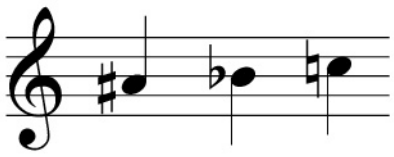
As I mentioned in the last lecture, music notation is very efficient. Luckily, musicians don't have to memorize frequency numbers. Could you imagine a score that looked like this: 440, 554.23, 493.824? Of course not. It's too confusing and very inefficient. Instead, we have names for the twelve steps in the octave. You already know seven which makes up our musical

figure 4

♯ = sharp

♭ = flat

♮ = natural



alphabet. To get the other five pitches, we use two accidentals [see figure 4]. The sharp raises the pitch 1/2 step. In figure 4, we would call the first note “A-sharp.” The flat lowers the pitch 1/2 step, and in figure 4, the second note is called “B-flat.” The last note is simply “C-natural”, or just **C**. If there is not an accidental, the note is simply natural. Please note that all accidentals are placed immediately to the left of the notehead.

Before you start wondering why there aren’t 21 steps in our system (7 notes with a flat, a sharp, and a natural), let’s introduce a new term: *enharmonic*. Notes that are enharmonic share the same frequency (or pitch), but are have different note names. Enharmonic notes are very important, but the reason is beyond the scope of this course. Below is a table of enharmonics.

C-sharp	=	D-flat
D-sharp	=	E-flat
F-sharp	=	G-flat
G-sharp	=	A-flat
A-sharp	=	B-flat

You may notice that C-flat, B-sharp, E-sharp, and F-flat are not mentioned; however, they also exist.

C-flat	=	B-natural
B-sharp	=	C-natural
E-sharp	=	F-natural
F-flat	=	E-natural

In other words, the 1/2 step above **B** is **C**, and the 1/2 step above **E** is **F**. This will become clearer when we apply these letters to the keyboard. Although it’s not really accurate, many times we say that, “there is no 1/2 step between **B** and **C**, or **E** and **F**.” We will continue this discussion in the next lesson.