



A piano keyboard gives us easy access to every (western) tone. As we go from left to right, the pitches get higher. Pressing the middle A, for example, would give us a tone of 440 Hertz. Pressing the next A up (to the right) gives us 880 Hz, while the next one down (left) produces 220 Hz. These A tones each sound very similar to us - just higher and lower. Each A is an “octave” apart from the next. Going key by key, we count 12 “half tone” steps between one A and the next - 12 steps in an octave.

As you may have guessed, elf (and human) ears perceive pitches logarithmically. That is, the frequency jump between octaves doubles as we go up the keyboard, and that sounds normal to us. Consequently, the precise frequency of each note other than A can only be cleanly expressed with a log base 12 expression. Ugh! For our purposes though, we can think of note separation in terms of whole and half steps.

Have you noticed the black keys on the keyboard? They represent half steps between the white keys. For example, the black key between C and D is called C# (c-sharp) or Db (d-flat). Going from C to D is a whole step, but either is a half step from C#/Db. Some white keys don't have black ones between them. B & C and E & F are each only a half step apart. Why? Well, it turns out that our ears like it that way. Try this: press C D E F G A B C on a piano. It sounds natural, right? The “C major” scale you just played matches every other major scale:

- whole step from C to D
- whole step from D to E
- half step from E to F
- whole step from F to G
- Whole step from G to A
- Whole step from A to B, and finally
- Half step from B to C

If you follow that same pattern (whole whole half whole whole whole half), you can start from any note on the keyboard and play a major scale. So a Bb major scale would be Bb C D Eb F G A Bb. You can get this by counting whole and half steps up from Bb or by taking each note in the C major scale and going down a whole step.

This uniform shifting of tones is called transposition. This is done all the time in music because of differences in how instruments are designed, the sound an arranger wants to achieve, or the

comfortable vocal range of a singer. Some elves can do this on the fly without really thinking, but it can always be done manually, looking at a piano keyboard.

To look at it another way, consider a song “written in the key of Bb.” If the musicians don’t *like* that key, it can be transposed to A with a little thought. First, how far apart are Bb and A? Looking at our piano, we see they are a half step apart. OK, so for each note, we’ll move down one half step. Here’s an original in Bb:

D C Bb C D D D C C C D F F D C Bb C D D D D C C D C Bb

And take everything down one half step for A:

C# B A B C# C# C# B B B C# E E C# B A B C# C# C# C# B B C# B A

We’ve just taken Mary Had a Little Lamb from Bb to A!