Introduction
The Nature of Sound

Sound is so complex, that a concise definition is difficult to capture. A technical and scientific look at sound is not necessary to a beginner or advanced musician. So, although it might be of interest, it is not extremely practical. While Appendix A of this text takes a technical look at sound, let's start with a couple of visuals instead.

I'm pickin' up good vibrations: Every **sound** you hear is a **vibration** starting at a **source**, usually traveling through the air or some other **medium**, into your ear and then to your brain and spinal cord. Picture a disproportionately large gold man's wedding ring (the wedding ring is large and gold, not the man) spinning like a wheel through the air and hitting you square in the ear. If your ear could absorb that wedding ring and your brain could understand the size and weight of the ring and the color and texture of the gold based on the speed it was spinning, that would be kind of like what happens when a sound hits your ear. The way sound actually works is even more complex than that visual, but it is that beauty and complexity that compels some people to love all the technicalities of it. For a more concise and scientifically accurate study of the nature of sound, refer to Appendix A. You already have enough knowledge about it to keep learning the difference between tones and noises.

Sound can be perceived as **noise**, or it can be perceived as a **tone** or groups of **tones**. A noise tends to be at least slightly irritating, while tones are usually pleasant. The exception is when either one is extremely loud thereby making tones unpleasant as well. They can both actually be physically painful, if loud enough. What makes a tone a tone rather than a noise, is that more of the vibrations that your ear picks up, either resonate in time exactly together, or in some exact proportion to each other. Picture hundreds of rings of different sizes and colors spinning in front of you at different speeds. You would not possibly be able to visually track them all. That is like a noise. Now picture those hundreds of rings combining into one big ring of one blended color spinning at the same speed. That is more like a tone. This analogy is not perfect, but it gives you a good picture of how much more organized tones are than noise.

When sound hits your ear and then your brain and spinal cord, it actually creates a physical response beyond just what you are hearing. Think about watching an intense or scary scene in a movie. It usually is accompanied by some intense and, in some cases, scary sounding music. Different emotions can be evoked by different combinations of tones and noises. A composer endeavors to create a mood by the combination of tones he chooses.

A sound wave acts much like a small earthquake that creates a physical response in the listener's body. In fact, scientifically and physically, the waves caused by an earthquake are very similar to a sound wave. You do not see them, but you feel them, affecting your entire body and everything around you. Earthquake waves and sound waves are both called standing waves in physics. They are truly a combination of complex waves, acting together, having a starting point and moving on indefinitely until they decay to be too small to be perceived.

For some interesting and more technical facts on the nature of sound, look in Appendix A.

When a tone resonates at a certain velocity (speed), it will be perceived by our ear as a **pitch.** Pitch is technically defined as the **frequency** of the sound, or in our analogy, the rotation speed of the spinning ring. It gives us a sense of the tone being high or low. When the wave rotates at a **high** speed, it causes the sound to be definably **higher**. When the wave rotates at a **low** speed, it causes the sounds to be definably **lower**.

Higher speed sound waves are higher in pitch, and lower speed sound waves are lower in pitch. Higher frequency=higher pitch. Lower frequency=lower pitch.

As you work through these definitions, it helps to have a musical instrument on hand. A piano close by would be the best case scenario, but remember that the voice is also a musical instrument. Whether or not you fancy yourself a singer makes no difference. An example of higher pitched voices would be most female voices, while lower pitched voice would be like most adult male voices.

Back to vibrations. Musical instruments are mostly objects that produce tones. I say mostly, because some percussion instruments (drums) do not produce what we would call a single tone. A tone can be produced by the most simple bar of metal being struck by a percussionist, or through a complex mechanism like the keys of the piano. (If you ever get a chance, open up a piano completely and check out how it really works. It is quite amazing technology if you consider the fact that it was invented in the 1700's.) A piano has 88 different keys, connected to 88 different strings and therefore can produce 88 different tones at once if you push the keys all down at once. An instrument like a violin has 4 different strings that resonate at different high and low pitches, based on where the player places his fingers on the string.

Whether you are dealing with pianos, vocals, violins, guitars or other instruments, there are always vibrations involved. A trumpet player begins a vibration by "buzzing" his lips. The vibration is then carried by the air stream the entire length of the trumpet. In trumpets and other "wind" instruments, the length of the air stream and the way that it vibrates inside the instrument establishes the tone and pitch of the sound produced at any given moment.

This is not only true for the wind instruments. The length of the resonating chamber of any instrument helps determine the frequency of the wave. Think of the length of a trombone compared to a trumpet. The trombone is larger and can therefore create more slowly rotating waves with lower frequencies. Violins create higher pitches in general than Cellos. Because the strings are shorter and thinner on a violin, the frequencies it creates sound higher.

Higher speed sound waves are higher in pitch, and lower speed sound waves are lower in pitch. Higher frequency=higher pitch. Lower frequency=lower pitch.

Important "note":

When we define a pitch in music, we call it a **note**. This is accomplished by designating a pitch by one of the first seven letters of the alphabet: A, B, C, D, E, F or G. Once we get to G, if we go higher, we start back at A again, and proceed with only the first seven letters. In music, there is one **whole step** between most of the letter names, but not all of them. You will see which ones soon.

A
G
F
E
D
C
B
A

Practice 1. Draw the above diagram in the blank below.

Sometimes you will see the ♯ (pronounced "**sharp**") sign or the ♭ (pronounced "**flat**") sign next to the letters of the alphabet. If the ♯ sign or ♭ sign is by the letter as in "A♯ " or "A♭ " it still signifies a single note. ♯ by the letter raises the pitch of the letter note one half step. ♭ by the letter lowers the pitch of the letter note one half step. Here is an example of what flats and sharps look like in action.

A
* A# = B♭
B
C
* C#=D♭
D
* D# = E♭
E
F
* F# = G♭
G
* G# = A♭
A

*Same note; two different names.

Practice 2. Copy the above diagram in the blank space below.

Take notice of the pattern in the above diagram. It outlines what is called the **chromatic scale**. The note just up from C is C sharp. The note just down from D is D flat. They happen to be the same note. That might make sense, but you are probably wondering why we “skip” E sharp and F flat. That will become clear once we start looking at the keys on a keyboard or piano in the next section.

Practice Time - Intro

Match these important words with their definitions:

1. Sound	a. A vibration that resonates in a way that is pleasing to the ear.
2. Pitch	b. A disturbance that courses through a medium.
3. Tone	c. A vibration that resonates in such a way as to bother the ear.
4. Note	d. High or low pitch depends on the speed of this.
5. Noise	e. A sequence of half steps.
6. Whole step	f. The object between the source and the listener.
7. Half step	g. The amount of space from a letter name note to a sharp or flat above or below that same note.
8. Chromatic	h. The amount of space between most letter names.
9. Sharp	i. Raises a pitch up one half step.
10. Flat	j. A way of writing down a sound in music.
11. Vibration	k. Any vibration that can be perceived by the ear.
12. Source	l. A sound that rotates at a certain frequency (speed) and can be perceived as high or low.
13. Medium	m. Causes the sound.
14. Frequency	n. Lowers a pitch down one half step.

Unit 1 – Notes and Fundamental Scales
Chapter 1a-Chromaticism & the Keyboard

Look at a piano. There is an example immediately below, but there is also a full scale resource in the back of the book. It is made out of paper, but if you do not have access to an actual piano, then it is a great tool to teach you about music. It is the same dimensions as a real piano, so you can visualize it accurately as we learn about music. Even though it might seem strange to play a paper piano, it is preferable that you use it as you learn, because you can actually put your fingers on it and "practice" the aspects as we go. You obviously will not hear the sound, but the physical practice aspect of it is the next best thing.

The piano can be considered a **percussion** instrument because inside the piano, a hammer strikes a string. It is also a **string** instrument because strings are what are causing the actual musical vibrations. It is also a **keyboard** instrument because the keys are the devices that you use to strike the hammer, which strikes the string, which causes the musical vibration.

Notice how the **white keys** and **black keys** are laid out above. Notice the set of *two* black keys with two white notes immediately to the right of them. (These white notes are called E & F). You will also notice the set of *three* black keys with the two white notes immediately to their right (These white notes are called B & C). C is a land mark note. The note to the immediate left of the "*two* black key" combination will always be C. You can find all of the other notes if you locate the C (or C's) and memorize where it is.

To the right on the keyboard is forward in the seven letter musical alphabet. The notes also move forward in the alphabet as they go up. Up = to the right on a piano, or higher in pitch. Down = to the left on a piano, or lower in pitch. This is because the strings get thinner and shorter as you go to the right and thicker and longer as you go to the left. The white notes coincide with the letter names.

Longer, thicker strings = Lower notes and pitches. Shorter, thinner strings = Higher notes and pitches.

On a piano, "toward the right" = higher. "Toward the left"= lower.

Now let's practice. Take your right hand thumb and place it on the C closest to the middle of the piano. This is always going to be called middle C. (Profound isn't it?) This is a very important note, as we shall C.

If you start on C and go up (to the right), playing only white notes on the keyboard, you will play C, D, E, F, G, A, B, & C in that order. As mentioned earlier, notice that after you get to G, it starts back over at A. Notice there is another C exactly 8 notes up from the original middle C (make sure you count both C's in that 8). This is defined as an **octave**, and is an important term in music.

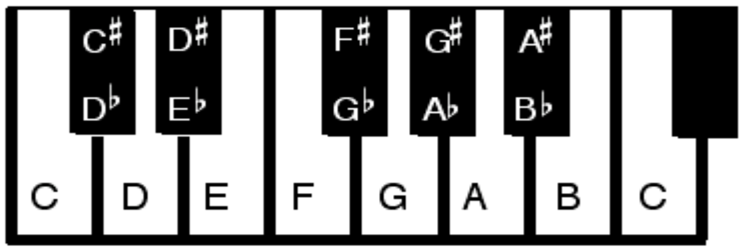
[Side note] *Oct* is a Greek prefix that means 8. An *Oct*opus has 8 tentacles. An *Oct*agon has 8 sides. *Oct*ober used to be the 8^{th} month on the Roman calendar, until Julius Caeser got egocentric and inserted July in honor of himself. Augustus Caeser had to follow suit of course, and inserted August, making October the 10^{th} month, instead of the 8th. How confusing! Regardless, *Oct* means 8.

This "C to C" pattern is repeated 8 times on the piano. There is one more octave on top and 3 extra notes at the bottom of the keyboard on a real piano, than what you see below.

Practice 1: On the keyboard below, draw in the names of all of the white notes.

That is pretty much all you have to know about the white notes. Knowing the C as the landmark and then the process of naming all of the others alphabetically will get you the most mileage. I do want you to notice that there is no black note between E & F, and B & C. That will come back to haunt us later, as we talk about half steps and whole steps.

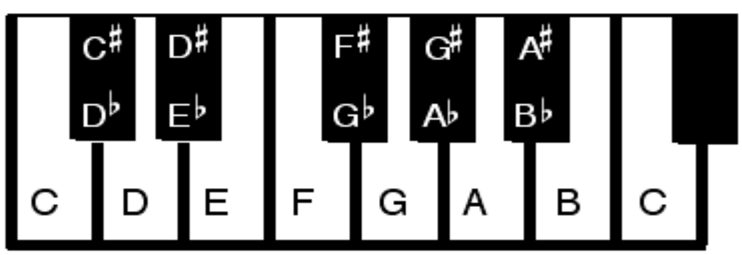
The black notes of the keyboard are where the sharps ♯ and flats ♭ come in to play.



Let's check out the black notes. You may have already noticed that the black notes have more information on them than the white notes. This is because the same black note can have two different names based on where your starting point is. Let me explain. Black notes do not have their own separate letter names like A, B, & C. They are derivative names of the white note that is nearest to them. The sharp symbol takes a note to the next closest note to the right, which is a **half step higher** sounding than the original letter note. The flat symbol takes a note to the next closest note to the left, which is a **half step lower** sounding than the original letter note. Most of the time, flats and sharps refer to the black notes. There are exceptions that we will see shortly.

What does a half (1/2) step sound like? **Listen to CD Track 1**

♭ makes the note lower; ♯ makes the note higher

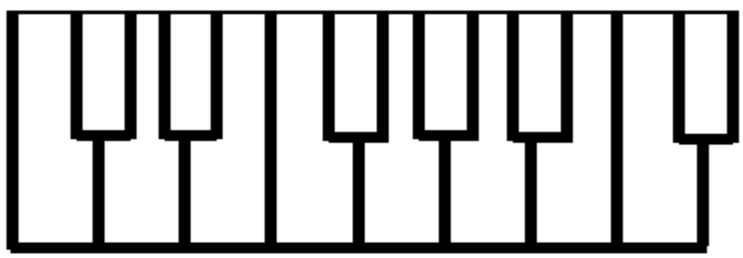


Notice that the black note that is up to the right of C is called C sharp. But, the black note that is down to the left of the D is called D flat. That is why the black note between C & D can be called C sharp or D flat. When two note names indicate the same exact note, they are called **enharmonically equivalent**. This is a big word that means these notes have different names but sound the same. I'll bet you are wondering if there is a reason why you would call it one or the other. Is it just random? No. There are reasons that will come out when we start learning the major scale. The other rule will become apparent as we learn about the chromatic scale.

Important Information: ♯ is pronounced "**sharp**" in music and ♭ is pronounced "**flat**". Every time you see these symbols you should say sharp and flat accordingly. A note without the sharp or flat by it (like C, for instance) can be called the letter name only as in "C" or "**natural**" as in "C natural". The symbol for "natural" is ♮ . Naturals cancel out a ♭ or a ♯ in both terminology and practice. They revert the note to the original white key of the keyboard.

When written on the musical staff directly in front of a note, sharps, flats, and naturals are called "**accidentals**". We'll see examples of this in Chapter 2b.

Practice 2. For the keyboard below, draw in all of the names on each of the white and black notes. Don't forget that the black notes have two names.

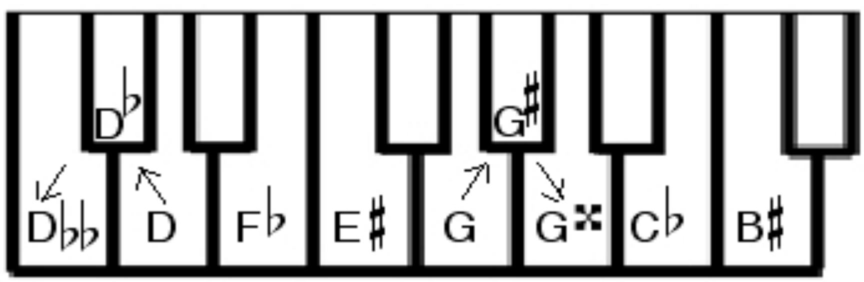


Practice 3. Draw 3 of your own keyboards below and draw in the note names.

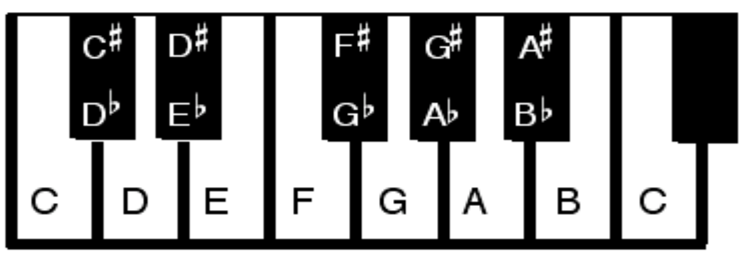
When rules are set in theory, they are set for good. The rule is that a sharp adjusts the original letter note to the next adjacent note up (or to the right on the keyboard). So what about E and B. Can you go to the next adjacent note up to the right and call it E sharp and B sharp, respectively? Absolutely. F can also be called E sharp even though it is a white note. C can also be called B sharp. The flats adjust any note down a half step as well, so E can also be called F flat. B can also be called C flat.

In fact, if you go a ½ step up from C you get C sharp. Go up one more ½ step and you can call that note C **double sharp.** So, D could also be called C double sharp. Of course, the opposite is true as well. C natural could also be called D **double flat**. These terminologies rarely happen, but there are some reasons for them when you get into more advanced concepts like minor scales.

This diagram looks wacky, but is technically correct. The arrows demonstrate some reasons why you can say D double flat instead of C, or G double sharp instead of A.



Most of the time E, F, B, & C are called E, F, B, & C, not the sharp or flat name. The better name is the letter name. (That is a sick rhyme!) So stick to memorizing this diagram,

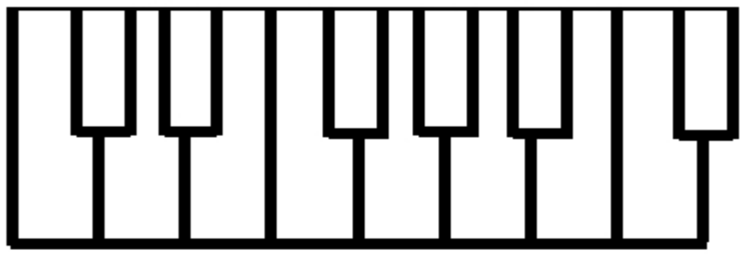


but, there are some occasions that they will be called differently if they violate other theoretical rules. We will see a couple of examples of this in chapter 3, when we get to the major scale.

Practice Time 1a

Draw in all of the common names of the black and white notes on all 3 of the pianos below. Use the letter name on the white notes, not the enharmonic flat or sharp name:

1.



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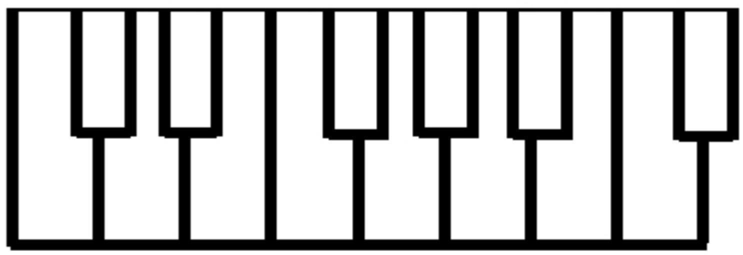

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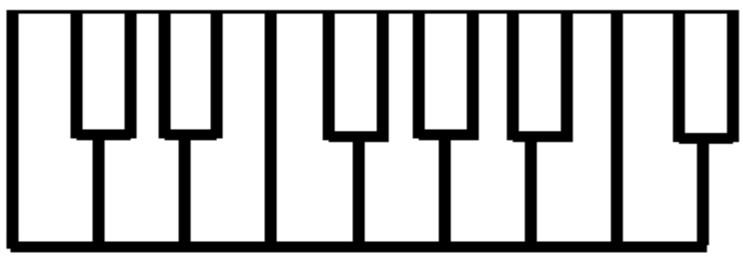

Define:

Percussion instrument ____

String Instrument____

Keyboard Instrument____

White keys____

Black keys____

Chromatic____

Octave____

Half step higher____

Half step lower____

Sharp____

Flat____

Natural____

Enharmonically Equivalent______________________________________

Double sharp____

Double flat____

Accidental____