

# Science of Sound

## Sound is vibrations

Sound is vibrations that go in your ear and move your eardrums, moving amniotic fluid inside your ear and ganglia in the ear canal register the vibrations and send signals to the brain that computes what it is and where it is in relation to you.

### *Sound has: Amplitude, Quality and Pitch*

- **Amplitude** or volume or loudness or intensity, measured in decibels (Alexander Graham Bell 1847-1922).
- **Quality** is parameters such as percussiveness, tambre (“oo” or “ee”), harmonic fullness (pure operatic voice or growl of Flamenco or Blues), repetitions.
- **Pitch** which has highness or lowness, **making the sound a tone.**

Highness or lowness depends on frequency, literally how often is the vibration.



Make 1 vibration per second on something, like clapping. Try 4 times per second, and be accurate. That is 4 Hz (Henrich Hertz 1857-1894). Play 4 Hz in one hand and the offbeats in the other. Now you are playing 8 Hz. Could you imagine someone playing 16 Hz? Some percussionists play this and even faster!

### **Audible Tones**

Tones most of us hear are between 20 Hz and 20,000 Hz. Dogs hear above this elephants below. Lower sounds have a long wave. The bass tones you turn up with the tone knob on your stereo you can't hear right at the speaker but your neighbor does!!!

### *Scale and Key*

A song can be in any key. From any note you sing or make, you call it the Do or beginning of a scale. Sing ANY note. Now sing the same note and start the song: “Doe, a deer, a female deer..” You can sing the Do-re-mi scale on any note or pitch.

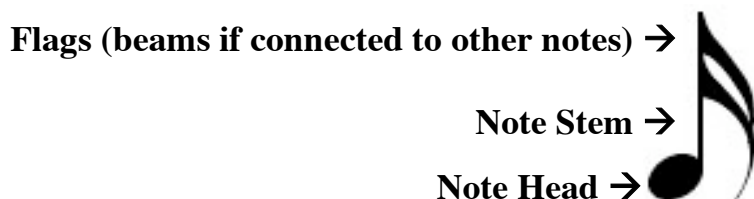


Have students find any pitch (key) they like. Have them sing “Do re me fa so la ti do.” Tell them do to do is an octave, as is re to re, etc.. Octave means 8 notes. After they are done, tell them what key they were in, have them remember it – maybe it's “their key!”



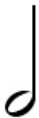







*Joke: The middle sea is the Atlantic – or the Pacific for Asians.*

## **Notation – What are all those little dots, lines and squiggles?**

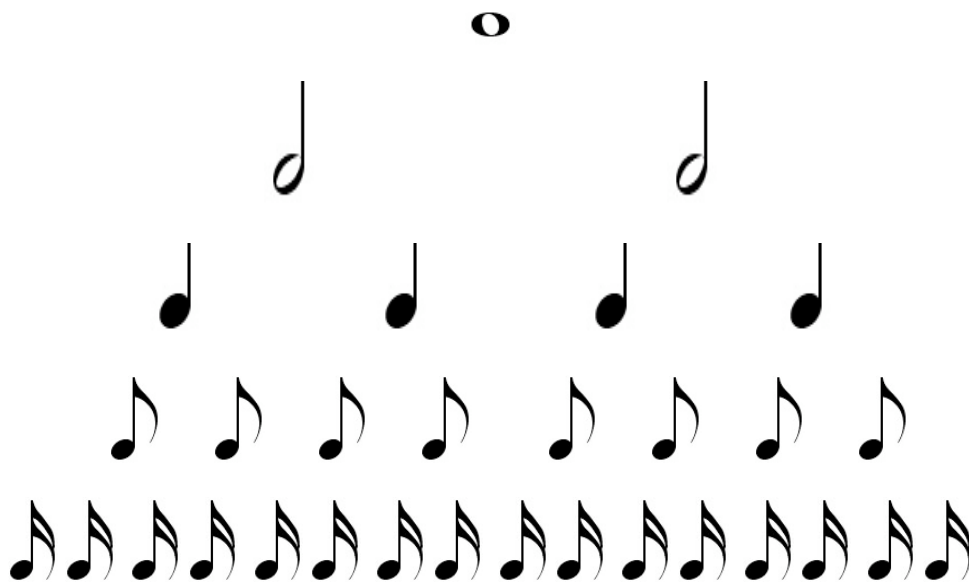
### Diagram of parts of a musical note



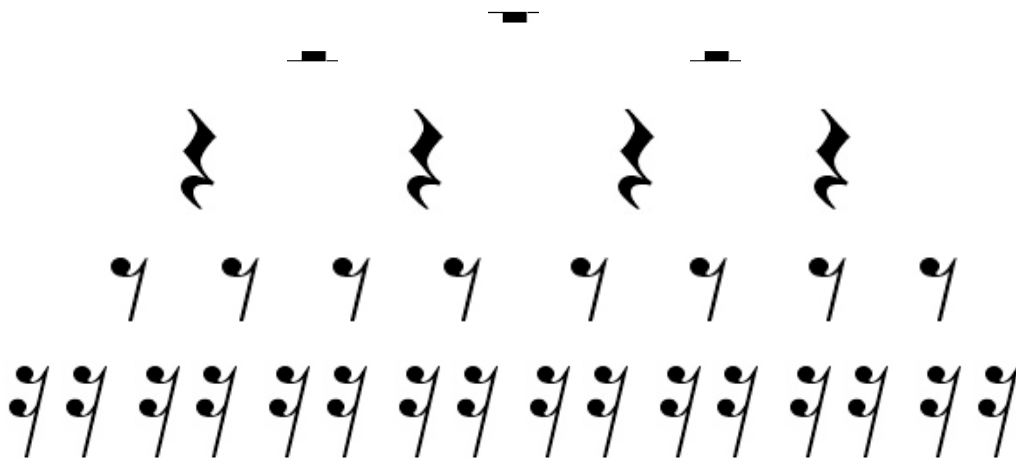
Notes on a musical staff have lengths, how long the note is held. Also the rests between notes have lengths or TIME VALUES. Here are the main ones to know:

LENGTH	NOTE SYMBOL	REST SYMBOL
WHOLE NOTE		
HALF NOTE		
QUARTER NOTE		
EIGHTH NOTE		
SIXTEENTH NOTE		

As you can see from the following, **One whole note equals two half notes**. Two quarter notes equals a half note. Two 16<sup>th</sup> notes equals one quarter note. It goes on and on.



The same is true of rests. You will see notes and rests mixed up in musical scores, but it all has to add up!



## Time is Horizontal, Harmony is Vertical



Tempo → Time goes from left to right

### TEMPO – Horizontal

Practice how your ear hears TIME. Try playing along with a recording and singing or listening along, then turn the player off for a few seconds and see if when you turn it back up you are in the right part of the song. This is testing and tuning / timing up your internal clock, your internal rhythm (of course your subconscious knows all these things, human brains manage the rhythms of hundreds of functions constantly). It's just a tuning in to your internal clocks, and learning how to give them wonderful tools to make yourself more accurate in your timing.

A great tool for this is the good old metronome, or what most SEQUENCER programs have set as the CLICK TRACK. Use a metronome or record a rhythm / click track and play along. Many professional artists can't play along with a click track. Hopefully you can hear the click or pulse in your head, hear where others might be dragging or rushing the time, hear where you want to be on the time, and in "real-time" help the other musicians get right into the time AND feel while still being impeccably in time yourself. *Solo performance is more flexible.*

You can usually change the instruments of these click tracks, the main thing is to play them loudly while you play loudly - and record and listen back to make sure and critically check where your rhythmic and timing weaknesses might be. Time and tune yourself up and be the tightest musician in your area rhythmically and the universe will hear your "tightness" and you will be dialing up your desires in the etherial universe, and probably in your real life!

### HARMONY – Vertical

Sometimes it's great to go "out-of-time" and just tell musicians to play a certain chord until cued to the next chord, this is truly seeing HARMONY AS VERTICAL. It's similar to how an enlightened Buddhist would say there is ONLY THE NOW. Rhythm goes along horizontally just as time does, but Harmony is in the immediate this second, totally vertical, unlimited height; that's a revelatory technique and it definitely ties in to this area of study. Of course **all pitches are frequency** just like rhythms and timing.

For some people the way to describe notes is the do-re-mi-fa-so-la-ti system. Fa = the 4<sup>th</sup>, so the 5<sup>th</sup>, la the 6<sup>th</sup>, etc..

# Letter Names Of Notes On Instruments

## *Piano and Keyboards*

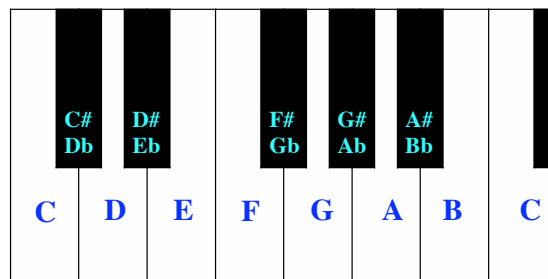
All keyboards have the same general layout. The middle C on the piano is C3. You should always know how to find the letter notes quickly on keyboards.

Some people put the letter names on every key of their keyboard.



Cut out little As, Bs, Cs and so on. Let students lick the back and put them on keyboards.

There are little sheets you can slide carefully behind the black notes of your keyboard that show all the letter names of the notes. Whatever helps you know the letters is good.



Once you remember them, it's easy. All keyboards will have sets of 2 black notes, then three black notes. Just below the 2 black notes is the note "C." The note between the 2 black notes is "D." The next note is "E," and you can see how the system works, going up to "G" and then starting with "A" again.

Here's a trick you can use. Since you need to "See sharp!" what note is what, quickly spot the 2 black notes. The lowest one is C#! There is no C flat, you want to see sharp!

## Note Letter Names on **String** Instruments



### *Guitar*



The bottom and top strings of a guitar are the note E. The notes of guitars are a fourth apart – E to A is a fourth, A to D a fourth, etc. The only different one is G to B which is a 3<sup>rd</sup>. See that on the keyboard. Notice how many half steps it is between E and A. The notes of the guitar are E2 A3 D3 G3. Bass guitar is all fourths E0 A1 D1 G1.

On most guitars you can easily see where to put your finger to be a fourth above, notice that violins don't have those lines (called **frets**) to help! These musicians know instinctually where to put their fingers to get a fourth above.

You can put your finger down on the 7<sup>th</sup> fret of a guitar and get the fifth above. Another technique, that doesn't even require the frets **but is maybe even more exact** is this:



**Just where the 7<sup>th</sup> fret is, hold your finger on the string to get the harmonic – notice it is exactly an octave and a fifth above! This is called an overtone.**

### *String Instrument Family*

While guitars are said to be in fourths, violins are in fifths: Violin is G2 D3 A4 E4, viola C2 G2 D3 A4. cello is C1 G1 D2 A3.



**Whatever instruments are in the classroom, play a C on them**

**Whatever instruments are in the classroom, play a D on them**



**Have students when they go home write down what notes are on the instruments at home**



double bass

cello

viola

violin

## **How to Find the Notes for a Song**

Whether or not it is a song or just music in your head, it is a great thing to find it on your instrument, and then write it down for the future.

Keep it in your head, and go to your instrument and find the first note. Write the letter name of the note down. Continue finding the notes of the song and writing down the letters. This is a great start at scoring!

Notes that are shorter you can write closer to each other, so that Beethoven's Fifth would look like:

Eb Eb Eb C--- D D D B--- Eb Eb Eb C G G G Eb C C C G

And so on. Make whatever other notes help you remember what you are hearing, they always help!

If you can, use the information below and put the notes on musical staves, or ask a friend to do it for you.

## How to Teach Yourself to Read Short Music Scores

Using the picture of the piano keyboard with the lines of the musical staffs and middle C that is on page 13 and looking at a short score you want to learn, just start finding the notes on the staff one note at a time.

It is especially good if the song is “in your ear,” and you remember it well enough that you will know when you play a wrong note.

Take your time and find the first few notes from the score on the piano, and play them while reassuring yourself that they are the right notes to the song.

You may want to play as much as you can play on the instrument, and then sing the rest. A big part of playing on instruments is visualizing the music in your head. In one sense the instrument is just an extension of you – like a car or screwdriver or spoon.

Be patient and once you have part of the song in your head, keep repeating it so that you won't forget it.

Nowadays with everyone having so many gadgets, you can probably find a phone, laptop, walkman tape recorder or something to let you record yourself playing what you have learned. This is good 1) to hear it and get ideas to improve it, and 2) so that if you can't practice for a little while you can listen and remember exactly what you have achieved!

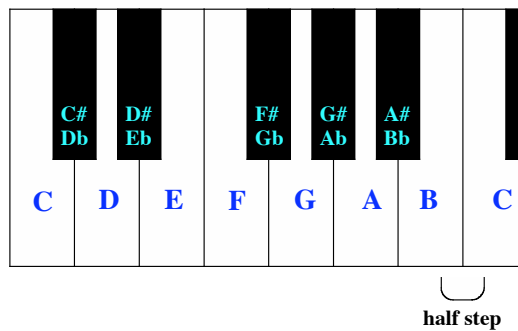
### *Twinkle Twinkle Little Star / Baa Baa Black Sheep / ABCs*



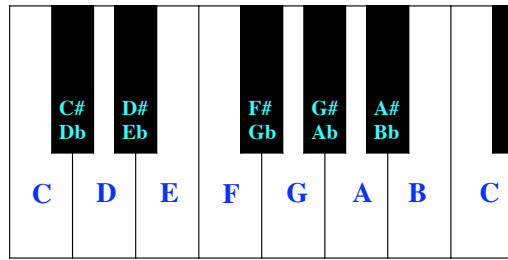
Make up inspirational songs like: *Twinkle twinkle shining star, when you practice you go far. As you practice every night, you are happy, playing right...* Practice scoring by writing out the songs Baa Baa Black Sheep & the ABCs.

## Intervals Between Notes

Between any two notes is call an interval. Between B and C is a semitone or half step.

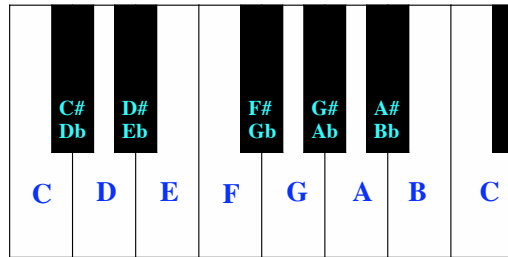


Between C and D is a whole step, whole tone or whole note.



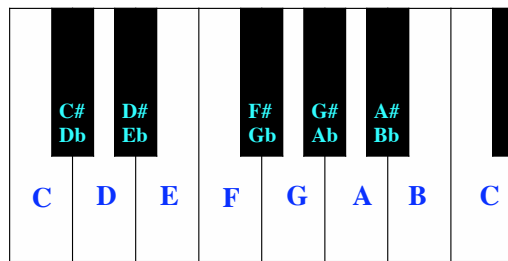
whole step

A half step is called a “Diminished 2<sup>nd</sup>.” A whole step is called a “Perfect 2<sup>nd</sup>.”

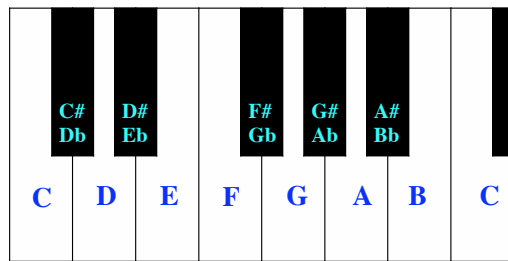


major third

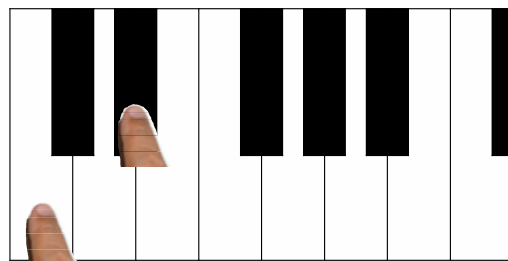
Thirds, from A to C or from C to E are called differently. They are called Major and Minor.



minor third



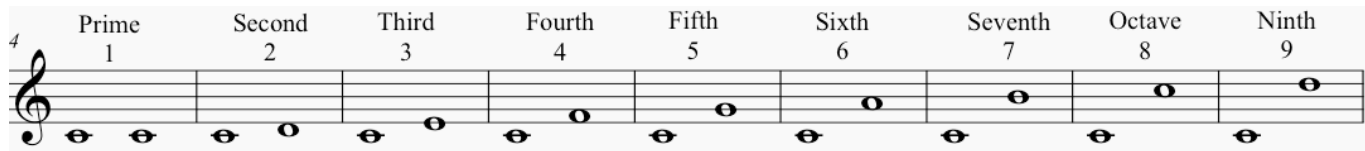
minor third



minor third

Each interval has specific terms to describe if it is slightly less or slightly more.

## Basic Intervals on the Treble Clef



***Table of Intervals & numbers of Semitones & Whole Tones***

Interval	Semitones	Whole Tones
Diminished 2 <sup>nd</sup>	1	0
Perfect 2 <sup>nd</sup>	2	1
Augmented 2 <sup>nd</sup> & Minor 3 <sup>rd</sup>	3	1 ½
Major 3 <sup>rd</sup>	4	2
Perfect 4 <sup>th</sup>	5	2 ½
Augmented 4 <sup>th</sup> & Diminished 5 <sup>th</sup>	6	3
Perfect 5 <sup>th</sup>	7	3 ½
Augmented 5 <sup>th</sup> & Minor 6 <sup>th</sup>	8	4
Major 6 <sup>th</sup>	9	4 ½
Minor 7 <sup>th</sup>	10	5
Major 7 <sup>th</sup>	11	5 ½
Perfect Octave	12	6

A 9<sup>th</sup>, though useful, is simply reduced to being a 2<sup>nd</sup>. The 10<sup>th</sup> is simply the 3<sup>rd</sup>, the 11<sup>th</sup> the fourth, and so on. For the sake of Harmony, the intervals don't really matter what octave they are in. For example: Any octave of C and any octave of E and any octave of G is always considered the 1-3-5 of a C Major chord, completely regardless of octaves.

For any note you need to know how to find the note above or below it, using ALL of the intervals in the table above. Example: from G, find the note a perfect 5<sup>th</sup> above, then a perfect 5<sup>th</sup> below.

It can not be overstressed how useful it is for those who wish to know music to be able to find any interval from any note, and also the reverse, determine what interval any note is from any other.

*The common practice is: if someone asks for an interval, and doesn't specify diminished, perfect, augmented, major or minor, then it will be the most common one – perfect and major. In other words “give me a 6<sup>th</sup>” means give me a major 6<sup>th</sup>.*



Someone play a random note. Someone else find a third above it. Someone else, a fifth above it.

Some intervals are associated with certain things. The Operator tone on the phone is the diminished 5<sup>th</sup> of E and Bb. Ambulances usually have this interval. Door chimes are usually a major chord, similar to the three notes mentioned above though often in another order. Show Sol-Mi-Do.