A Beginner's Guide to:

Pitch & Intonation

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When someone talks about pitch we usually think about baseball. There’s the pitcher who throws the ball to the batter and the different pitches that he throws. You’ve got the curveball, the knuckle ball, and of course the slider. But none of this actually has anything to do with music. In band when we refer to pitch we are talking about something completely different.
**What is Pitch?**

**Definition**

Pitch is defined in the Merriam-Webster dictionary as:
“b (1) : the property of a sound and especially a musical tone that is determined by the frequency of the waves producing it : highness or lowness of sound (2) : a standard frequency for tuning instruments.”

**What does this mean?**

Pitch is all around us in our everyday lives. Whether you are listening to Bach, Beatboxing, or Bieber, each individual sound that is created has a specific pitch.

When an instrument or voice creates a sound, it moves the surrounding air molecules. These moving molecules cause vibrations which travel through the air in waves. The sound waves travel in all directions, eventually ending up in your ear. What we hear as sound is really moving air.

The phrase “a musical tone that is determined by the frequency of the waves producing it” tells us that the number of times the air waves vibrate per second determines which note we hear.

In music we use the letters A, B, C, D, E, F, and G to label distinct pitches. We can also alter notes using a sharp (#) or a flat (b).

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**What does Pitch look like?**

**Sound Waves**

Unlike the waves of an ocean that move up and down, sound waves travel forward and backward. The molecules moving in the air gather and spread apart at various points.

**Waveform**

Sound can also be viewed as a waveform. This type of graph is a visual description of the sound created. **Wavelength** is the distance between two peaks or valleys. **Frequency** is the number of waves that pass a point each second. In the example below there are 6. This would be called 6 hertz. Wavelength and frequency show pitch. **Amplitude**, which is half of the distance from the peak to the valley, shows the intensity (dynamic) of a pitch.
Changing Pitch

**Frequency**

As the frequency of a pitch increases, the sounding pitch will rise. In the graph below, the frequency has doubled in the same time frame, so this would be 12 hertz.

Assigning notes

Based on the frequency, or hertz, each pitch is assigned a letter name. In music we use the letters: A, B, C, D, E, F, and G, along with sharp (#) and flat (b) signs to identify each pitch. Each combination of letter and #/b are reused many times to describe the many notes that are in our hearing spectrum.

In the chart on the right, notice that each pitch has a determined frequency. What do you notice about pitches that share the same pitch letter? Hint: look closely at both A’s.

When looking at the frequency, in hertz, for the first A, we see that it measures 220.00. This means that there are 220 waves per second. Scanning down the list as the frequency increases, the letters change, going up the alphabet. When we reach A for the second time we notice that the frequency is 440.00 hertz. It is exactly double that of the lower A.

### Common Music Pitches

<table>
<thead>
<tr>
<th>Pitch</th>
<th>Musical designation</th>
<th>Frequency (in hertz)</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>A, A&lt;sub&gt;1&lt;/sub&gt;</td>
<td>220.00</td>
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<tr>
<td>A sharp (or B flat)</td>
<td>A&lt;sup&gt;♯&lt;/sup&gt; or B&lt;sub&gt;b&lt;/sub&gt;</td>
<td>233.06</td>
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<tr>
<td>B</td>
<td>B, B&lt;sub&gt;1&lt;/sub&gt;</td>
<td>246.94</td>
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<tr>
<td>C (middle)</td>
<td>C</td>
<td>261.63</td>
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<tr>
<td>C sharp (or D flat)</td>
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<tr>
<td>D</td>
<td>D</td>
<td>293.66</td>
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<tr>
<td>D sharp (or E flat)</td>
<td>D&lt;sup&gt;♯&lt;/sup&gt; or E&lt;sub&gt;b&lt;/sub&gt;</td>
<td>311.13</td>
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<td>E</td>
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<td>329.63</td>
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<td>F</td>
<td>F</td>
<td>349.23</td>
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<td>F sharp (or G flat)</td>
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<td>A</td>
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<td>B</td>
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<td>493.88</td>
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<tr>
<td>C</td>
<td>C, C&lt;sub&gt;1&lt;/sub&gt;</td>
<td>523.25</td>
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This pattern happens for all pitches in music: sharp, flat, or natural. Pitches that are an octave (12 notes in the table above) apart will have exactly double the frequency of each other. The pitch with the larger frequency will have the higher sounding pitch.

A 440.00 is the pitch used most often for tuning. We will talk more about that in the next section, **Intonation**.
Intonation is a part of performing music that every musician continually works to improve. Even the most skilled musician is concerned about their intonation and how it will sound with others in their band or ensemble. Some of the most common musical jokes are about intonation as it so challenging to achieve and yet so rewarding when it happens.
**What is Intonation?**

**Definition**

Merriam-Webster’s dictionary defines *intonation* as: “3 : the ability to play or sing notes in tune.” Wikipedia expands on that definition as states, “intonation, in music, is a musician’s realization of pitch accuracy, or the pitch accuracy of a musical instrument.”

**What does this mean?**

The first definition from Merriam-Webster uses the words “in tune” to describe intonation. This in of itself needs to be defined so we can clearly discuss intonation. To be “in tune” means to match the pitches being played to one specific pitch. This creates a pleasing sound to the ear. We can refer to it as “in tune” or having “good intonation”.

Notes that are not “in tune” with each other will create variations in the sound that will be less appealing. These are usually referred to as “beats”. The beats, or pulsations in sound, will be fastest when they are most out of tune. The beats become further apart and slow as the two pitches get closer together. To the right is a demonstration of what this might look like. Pitches can be classified as flat (below the pitch), sharp (above the pitch) or in tune (matching the pitch). Being either flat or sharp will cause the beats to occur.

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**What does Intonation look like?**

**Intonation in a Waveform**

The diagram below shows two pitches with a difference of one hertz (small difference in frequency). This represents two instruments playing the same pitch, but one slightly out of tune. As they play together, the sound waves move together for a brief moment, before they begin to move further and further out of phase with each other. The time when they are most out of phase, when the peak of one lines up with the valley of the other, creates what we hear as a “beat”.

![Two sound waves, offset in frequency by 1 hertz.](image)

Notes that are farther out of tune with each other, will move in and out of phase faster. This causes us to hear faster beats. As two musicians are tuning they are listening for these beats and aiming to rid them from their sound.
WORKING AS A TEAM

There is no “I” in band. Just like any team sport all members of the band must work together to produce a beautiful sound. Other than playing the right music, at the right time, band members must also consider their intonation and whether the sound they are producing matches those around them.
How do we use Intonation in Band?

The magic of A-440

The key to getting the band to sound its best is through proper intonation. Universally, bands and orchestras use the pitch A-440 as a standard tuning pitch. Before performing a concert together, all members of an ensemble will tune to A-440. Usually an oboe, clarinet, or tuba will play this pitch while others in the band use it as a reference pitch.

In an orchestra the pitch can also be given by the Concertmaster.

Does it stop?

Intonation is something that we are continually monitoring during rehearsals and performances; it never ends. Because we use imperfect instruments and an imperfect scale, performers are always needing to make adjustments. As a piece is being performed members of the ensemble are listening to themselves and to those that play lower sounding instruments.

We will discuss in later sections how adjustments can be made on the instruments or through embouchures. Either way, it is a constant battle for most musicians. With practice, like many things, it does improve.

Why do we use Intonation in Band?

The Perfect Sound

Bands are always striving to have perfect intonation. To the trained ear even one note out of tune can ruin a performance and remain in the listener’s mind for hours if not days after a performance has ended. By tuning to a constant A-440, performers from all over have the ability to come together and play under the same expectations.

If we look at our waveforms again, we see that when there are multiple instruments that are out of tune the beats will increase. When the instruments all align in tune, the sound intensifies, clears up and becomes pleasant for the audience to listen to.

Above: Waveform with the same note played out of tune by many instruments.
Below: When all of the notes of the same pitch are played in tune the amplitude is intensified. This results in the note sounding louder and as if one person is playing instead of a group of people.
What does good Intonation sound like for a band?

Jack Stamp and Why Music Matters

A YouTube video that surfaced in December of 2008 illustrates the importance of intonation in band performance. In this video, world renowned composer/conductor/clinician Jack Stamp addresses a crowd of parents about “Why Music Matters.” After reminding the audience that in most cases getting 95% on a test is acceptable; it’s an “A” that we would be thrilled to have, Mr. Stamp reminds them that in music 95% is unacceptable.

To prove his point he has the band before him perform a section of Frank Ticheli’s “Shenandoah” at 100%. It sounds beautiful. The students play all of the correct notes, at the right time, and with proper intonation. Then he has the band play the same section, with each of the 160 students making one mistake. Individually this would mean that each student earned 95%, if it were a test. This time the performance is horrendous; notes were played at the wrong time, accidentals were missed, and intonation was a problem throughout the ensemble.

The difference between 95% and 100% is dramatic. Music matters because we always strive to be better, in all aspects of our playing including intonation.

How does Intonation between different notes look and sound different?

Tuning Harmonies

So far we have only addressed the idea of tuning one note with another of the same pitch. However, in band we are often just as concerned with playing in tune with those playing in harmony with us, as we are with people playing in unison.

In the example above from Simple Song by Ralph Hultgren, the first flutes are playing the melody (the top notes) while the second flutes are creating harmony by playing in thirds (the lower notes). This type of combination of notes is equally as important to play with good intonation and equally as difficult to create.

The waveform above represents one pitch and a major 3rd away are played in tune.
Now that we have a greater understanding of pitch and intonation we can begin to apply it to our instrument. Each instrument has its own set of intonation or pitch tendencies. In this section we will explore what those tendencies are and various ways to adjust to make them better.
**What are my instrument issues?**

**Why should we know them?**

Since each instrument has different intonation tendencies, it is important we know what they are for our specific instrument. By knowing what our instrument and embouchure naturally do, we are able to anticipate these changes and make adjustments as we are playing. Also, at times when we do not make the adjustments right away but hear poor intonation, we can then make adjustments in the correct directions without having to guess at what we are hearing.

**General Tendencies**

- High register notes will be flat at first, sharp once the embouchure is strong
- F side of a double horn must be in tune with the Bb side of the horn
- Low range is flat and flabby
- Easy misplaced notes on wrong partials

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Remember that the French horn is a **transposing instrument**. This means when you play F it sounds a Bb. Some tuners will be able to transpose for you. If your tuner cannot transpose, make sure you think to do it when you read the tuner.

For French horn you will need to bring the note on the tuner up a Perfect 4th to know what note you are playing.
How do I fix it?

**Physical Techniques of Adjustment**
- There are two main tuning slides on the French horn; one for the F side, and one for the Bb side.
- To figure out which slide is F or Bb, follow the tubing from the mouthpiece to the first slide, this will tune the F side. As you continue around from the trigger, you will find the Bb main tuning slide.

- To LOWER the pitch PULL out the tuning slide.
- To RAISE the pitch PUSH in the tuning slide.
- Make small adjustments so you don’t go past in tune.
- It’s a great idea to use a pencil to mark on the slides where you are most likely to be in tune.

**Lower = Longer**

How do I fix it?

**More Physical Adjustments**
- There are six more slides on the front of the French horn.
- The three on top are for the F side of the horn, the bottom three are for the Bb side.

**Other Adjustments**
- Always play with good air support and speed.
- Listen to other players to match pitch.
- Be sure that the right hand placement, in the bell of the horn, is correct. Too closed off, or open, will affect the intonation of various pitches.

**Sharper = Shorter**
As any musician will tell you, the electronic tuner is both a great invention and the worst thing ever created. This finicky machine will tell you, within a fraction of a hertz, how close you are to being in tune. The lights flicker and needle moves as it works to gauge the pitch being played. In this section we’ll discuss what it all means.
Steps to using a Tuner

Let’s make the Tuner your friend

When using a tuner it is important to be set up correctly. You should always be sitting or standing with proper posture, with the tuner on the music stand. Make sure you are in a quiet place where the microphone in the tuner will be able to pick up your sound. If the room is noisy, you may have to have someone hold the tuner in front of your instrument so it picks up your sound.

How do I read it?

When you play a pitch the note name will show up on the screen. The number next to it indicates the octave it is in. The red needle in the middle shows how in tune the pitch is. When the needle is steady straight up and down (as shown above) the pitch is perfectly in tune, the lights on both sides of the needle should be solid. On some tuners a light at the top will turn green to show that the note is in tune.

If the tip of the needle is leaning towards the right the note is sharp, the light next to the sharp should also flash. If the tip of the needle is leaning toward the left the note is flat. The light next to the flat should flash at this time too.

Types of Tuners

More to choose from

There are many different types of tuners to choose from. It is up to the musician to decide what works best for their situation.

- This clip on tuner can attach to any part of an instrument closer to where the sound is produced.
- This is a standard tuner with a digital needle.
- This tuner has multiple options available for the musician to use. Different from other tuners this has a physical needle.
- This is both a tuner and a metronome. These are great for musicians who don’t want to carry around two different electronics.
As you heard before, practice is the only way to improve your sound on your instrument. The same goes for improving your intonation; with practice it gets easier to play in tune. In this section we’ll discuss various ways to work on your own to improve.
**On Your Own**

**Warm-up With a Tuner**

When practicing at home, it’s important to do your warm-up with a tuner. Using whole notes on the Concert Bb Major Scale, play each note starting with your eyes closed, then open them to see what the tuner reads as the intonation. Try to tell, before opening your eyes, if the note is in tune, sharp or flat.

Once you get comfortable with the Concert Bb Major Scale in whole notes, try to extend it to 6 or 8 beats on each note. Your goal should be to hold the note steadily in tune for the entire duration of the note.

**Lip, Octave or Register Slurs**

More advanced players can try to tune notes through lip, octave or register slurs.

Brass instruments can do lip slurs or changing notes without tonguing or changing fingerings. For Bb instruments and this would mean moving from C to G up to C and back down again. For C instruments it would be Bb to F up to Bb and French Horns move between C, E, G, and up to C before coming back down.

Woodwind instruments like the flute, saxophones, oboe and bassoon can do octave slurs; which means switching from low to high notes (of the same pitch) without tonguing, using their air and embouchure to change pitches. Clarinets jump pitches in 12ths using the register key (above the left thumb hole). For example, playing the low A with the register key sounds a high E.

Use the same strategy as the Concert Bb Major Scale for tuning these notes. See if your tendencies change with this different approach.

**A YouTube Exercise Just For You**

**Pitch Workout**

A series of YouTube videos, called PitchTuning, has been created to help musicians, like yourself, improve their knowledge of pitch tendencies. There is a series of videos for each instrument that covers the notes of the Concert Bb Major Scale. The next few pages will describe how to use the videos to make the most out of your time practicing with PitchTuning.

**The Set-Up**

The first page you’ll see when you go to www.youtube.com/pitchtuning is an introduction video. If you can watch this video, it will walk you through all of the steps on how to use it. You can also visit www.pitchtuning.weebly.com to download your own copy of this book and get links to the videos.

Be sure to have ear buds, a tuner, and your instrument set up before you start the videos. Also, have access to a the Pitch Assessment Worksheet and a writing utensil.
Pitch Tuning Videos

Getting Started
Let’s get acquainted with the video layout and how to use each one. Below is the third exercise for trumpet. In the center, is the note to play, which in this case an E natural. When the video begins, you will hear the E natural played (make sure you have your ear bud in).

On top of the note you see an ‘s’ followed by a sharp sign. This lets you know that, in general, when a trumpet plays this E natural it is usually slightly sharp. This does not mean, however, that when you play E natural it will definitely be slightly sharp.

As you listen to the note with your ear bud, you should play the note on your instrument first with your eyes closed. After a few seconds, open your eyes and read the tuner. Take a mental note of where the needle starts so you can record it later.

The Process
While continuing to looking at a tuner sustain the note while trying to make some adjustments to get the note to sound more in tune. Remember you want the needle to be straight up and down. When you run out of air, or the video has stopped, record your results on the Pitch Assessment Worksheet. Record how you started the note and how you ended the note.

Different Symbols
It’s important to know that not all pitches will be slightly sharp. You may see ‘s’ for slightly, ‘m’ for moderately and ‘v’ for very in combination with sharp or flat. If the pitch has a tendency to be in tune, there will be no symbol above the note.

Moving Forward
To move on to the next exercise you can click where it says “Next Note”. You can also replay the current note at any time by clicking “Replay”. As you move through the exercises, the arrow at the top will move to let you know where you are within the Concert B flat Major Scale. If you would like to jump between notes, you can click on them at the top to go to that exercise.

If at anytime you need help with making pitch adjustments on your instrument, refer back to the Beginner’s Guide to Pitch and Intonation. If you do not have a copy at home, go to www.pitchtuning.weebly.com to download your own copy.
Pitch Assessment Worksheets

Concert B-Flat Major Scale

The next few pages are the Pitch Assessment Worksheets. You will notice that there are a few different versions of the worksheet. Remember that some instruments are transposing instruments and therefore will use different notes. Make sure you use the worksheet specific for your instrument.

Entire Range

Also available on the website www.pitchtuning.weebly.com is a larger version of the Pitch Assessment Worksheet that covers the entire range of each instrument. Once you have successfully mastered tuning the Concert Bb Major Scale challenge yourself to move on to other notes that you play often.

Remember only practice will help you to continue to see improvements.

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| Flute, Oboe, Bassoon, Trombone, Baritone B.C., Tuba |

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<tr>
<th>Concert Bb Major Scale</th>
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<tbody>
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<td>Begin</td>
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<td>Bb</td>
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## Pitch Assessment

### Alto Saxophone and Baritone Saxophone

**Concert Bb Major Scale**

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IN TONATION PAIN SCALE
ON A SCALE OF 1 TO 10 PLEASE RATE YOUR ENSEMBLE’S INTONATION PROBLEMS

1  BEAUTIFUL INTONATION
   Angels and unicorns are dancing in mid-air. Gas prices drop to 75 cents a gallon.

2  MILD INTONATION PROBLEMS
   Great for the most part, but it’s like finding the word "ain’t" in a Shakespeare play.

3  IRRITATING INTONATION
   Uncomfortable enough for a facial twitch to permanently develop.

4  NAGGING INTONATION
   It’s like Holst’s First Suite in Eb with a canker sore.

5  TROUBLESOME INTONATION
   Your band boosters are starting to lose confidence in your teaching. But what else is new?

6  MISERABLE INTONATION
   It’s like having to watch Keanu Reeves act, but for your ears.

7  DISTRESSING INTONATION
   Your ears are praying to hear the sweet, sweet sounds of the school fire alarm.

8  DREADFUL INTONATION
   Your colleagues refuse to come in and help your band. No friendship is worth this.

9  HORRIFIC INTONATION
   The intonation is so outstandingly awful that kittens are murdering themselves.

10 WORST INTONATION POSSIBLE
    Never in the history of band has a band ever performed with such unbearable intonation. Somewhere, Sousa is crying like a little baby.

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Notes