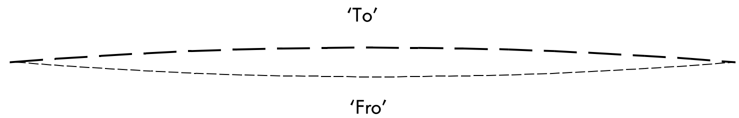
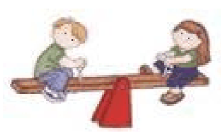
The Tone Says It All

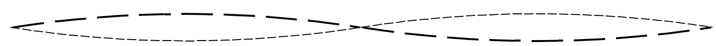
The vibrations of a musical string create sound waves that travel though the air. The **pitch**, or frequency, is created by the speed of these '**to**' and '**fro**' motions (**vps** = vibrations per second). The length of the string can be shortened by holding it against a fret. The shorter the string, the faster the vibrations... and the higher the pitch. As the string vibrates it creates the **principal tone**.

String Vibrations:



A musical string also creates **overtones**. The 1st overtone is produced as the string vibrates in two parts. When one half vibrates 'to', the other half vibrates 'fro'. As the weight of each half naturally counter-balances the other, the point where they meet should be the exact center of the string. Think of this as a kind of 'teeter-totter' effect.

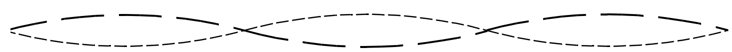




The first overtone has twice the frequency of the principal tone, but it is also allot quieter. To hear the 1st overtone more clearly, pick any open string while lightly touching it directly over the 12th fret (center of string). The notes created by picking any string while lightly touching it at various 'node points' are called **natural harmonics (N.H.)**. Try finding other natural harmonics along each string.

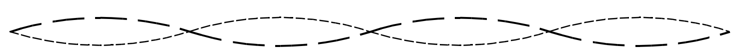
The **second overtone** is similar to the first, but in this case the string vibrates in three equal parts. It has three times the frequency of the principal tone, but is even quieter than the first overtone. This can be heard by playing the 7th fret N.H. Natural harmonics are often taught as a just fancy trick that sounds cool. So don't be afraid to add some flash and showmanship when playing these notes.

2nd overtone:



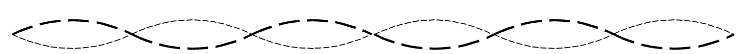
But wait! It gets even better. A musical string also vibrates in fourths, fifths, sixths, etc. As the divisions get smaller, the pitch increases by the same ratio. But the tones created also get quieter. All of this happens at the same time to form the **overtone series**. Although many guitar teachers would disagree with teaching the overtone series too soon, violinists and other fretless musicians learn about this physical phenomenon right from the start in order to help find different positions up and down the fingerboard.

3rd overtone:



4th overtone:

5th overtone:



6th overtone:

Here it is in mathematical terms. Say the principal tone vibrates at 110 vps. The frequency of the first overtone would be 220 vps. The second overtone would vibrate at 330 vps. And the third overtone would have 440 vps. Since the fourth overtone divides the string into five equal parts, it will have a frequency of 550 vps (5 x 110 = 550). And so on...

The overall **timbre** of any stringed instrument is further influenced by things like the wood it is built from and the gage of the strings. Softer woods and thicker strings tend to *absorb* the higher overtones. Harder woods, lighter strings and picking closer to the bridge all tend to *project* more of the higher overtones. All this is found within a single note created by a musical string. Wind instruments create this same overtone series. Of course, the nature of how and why wind instruments create these overtones is a little different.