Build A Band Instrument Reasoning

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Intro

In this project we had to create instruments that could play eight notes. In the following document we will be explaining how our different instruments work and changes pitch. Longitudinal waves are waves that that compress and expand through a medium. This is how sound travels.

Vocals

How this works is that when you breathe through your lungs, your larynx vibrates, modulating the flow of air being expelled from the lungs during phonation, which is the production or utterance of speech sounds. Ergo creating sound, and more importantly, music. I made this by being born with them. The range is F2-B4, this would be the range of a mid bass to a mid treble. If I push more air harder through my lungs, my larynx vibrate more and amplifies the sound. My natural frequency (my normal voice) is . In order to change notes, I can stretch my larynx to make them tighter and make a higher pitch. And the more you loosen them, the lower you get. Seeing that I can't measure the length of my larynx when I sing, I don't have a diagram.

Chimes

The chimes work as follows: By hitting the copper pipe with the dowel, the copper pipe vibrates therefore it makes a sound. I suspended the pipes from low friction materials like fishing line. This allows for minimum absorption (of the sound). The rubber bands also allow the pipes have a little bounce, this lets them vibrate more and therefore, makes a louder sound. The different length of pipes vibrate at a different frequency. Since period and frequency are inversely proportional, and when the length increases so does the period, when the length increases the frequency decreases making a lower sound. A slower frequency creates a low pitched sounds. This means that the longer the pipe, the lower the sound. To calculate the length for each frequency/ note you can use the equation F=A/L^2. Where F is frequency, L is the length of the pipe, and A is a number calculated from a test pipe. To calculate A measure a piece of sample pipe and calculate the frequency using a phone app. The easiest thing to do however, is to use the approximate value for A, 67,600,000 mm^2/s, put it in the equation, and the adjust the lengths of the pipes by slowing shaving off a section. A better variation of this equation would be L= square root of A/F. Although using this equation would provide the best results because it calculates the lengths based on the specific pipe you are using, I instead decided to base my lengths off a pre calculated chart very common on the internet. I

adjusted them a little, combining information I found on other websites. The chart I based my lengths on is below:

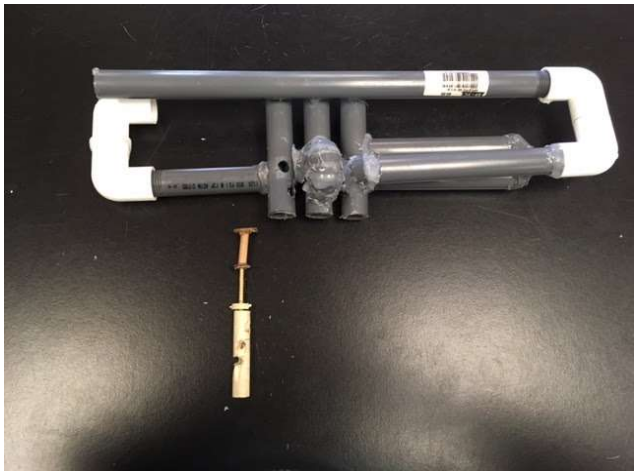
Note (Theoretically)	Length on Website	Length I used
C6	30.8 cm	29 cm
D6	27.2 cm	28 cm
E6	24.1 cm	27 cm
F6	22.8 cm	26 cm
G6	20.5 cm	24 cm
A6	17 cm	23 cm
B6	15.7 cm	22 cm

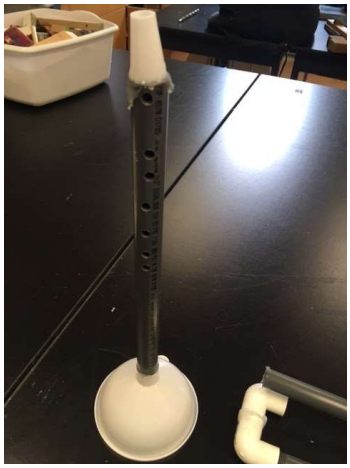
Valve Trumpet/ Valveless Trumpet

Trumpets work by “buzzing” your lips through a mouthpiece. The vibrations you make with lips travels through the the pvc piping of the trumpet. The length of the tube was determined by the wavelength of the lowest note I wanted to play which was 203 centimeters which is a F_3 I would change the rest of the notes by pressing my lips closer together making the “buzzing noise” a higher sound. This is because the wavelength of the noise would have a higher frequency to increase the pitch of the note. The purpose of keys/valves is to make the transition between notes easier because it adds more or less piping to the air flow. The keys redirect the airflow into different valve piping causing the air to travel longer making a lower frequency or a

lower note. The tuning slide changes the length of the total amount of tubing to make the overall pitch higher or lower. The bell of the trumpet helps amplify the sound

A valveless trumpet is one that only changes pitch when you tighten or loosen the corners of your mouth making the “buzzing” sound a higher or lower frequency. The length of the valveless trumpet would be determined by the lowest note you would want to play. The trumpet I made was originally going to be a valve trumpet but it broke/failed on the last day so I made a hybrid between a valve and valveless trumpet, basically it is a flute that sounds like a trumpet. I used a 30 cm so when I inserted my mouthpiece the total length would be 33cm. I drilled holes in the pvc pipe where certain notes would go. I calculated this by researching the wavelength of my desired notes and divided it by four to find where I should place the holes.





Ukulele

The ukulele works in a similar way of any string instrument. The body is normally made out of a rigid wood with a sound hole in it so so the sound vibrates more making the sound louder. Our

ukuleles body is made out of a thick cardboard so it wouldn't break as easily. To amplify the sound more we added a sound hole and lined the inside of the body with tin foil so the sound can bounce off the tin foil and not be absorbed by the cardboard. We chose to get actual ukulele strings which are different thicknesses. The thicker the string the lower the pitch because it takes longer for the string to vibrate, therefore creating a lower pitch and frequency. The thinner strings can vibrate faster, creating a higher frequency and pitch. We made sure the strings did not touch the body or neck because that would stop the vibrations, stopping the sound. The frets are each one half step up from the the previous one in relation to the sting they are on. (A half step is every note in a chromatic scale. That is a scale comprised of every natural note with the flat/ sharp note in between.) To find this we used the equation x/2^1/12. "X" is the distance between the bridge and

the nut. Theoretically, this would work, but since our frets were made out of toothpicks it started to absorb the sound after reaching a certain fret.

Notes (theoretically)	**Distance From Bridge (cm)**	**Frequencies (Hz)**
Bb 4, F 4, C# 4, Ab 4	36	466.16, 349.23, 277.18, 415.30
B 4, F# 4, D 4, A 4	33.5	493.88, 369.99, 293.66, 440.00
C 5, G 4, Eb 4, Bb 4	31.75	523.25, 392.00, 311.13, 466.16
C# 5, Ab 4, E 4, B 4	30	554.37, 415.30, 329.63, 493.88
D 5, A 4, F 4, C 5	28	587.33 , 440.00, 349.23, 523.25
Eb 5, F# 4, E 4, C# 5	26.6	622.25, 466.16, 369.99, 554.37
E 5, B 4, G 4, D 5	25	659.25, 493.88, 392.00, 587.33
F 5, C 5, Ab 4, Eb 5	23.6	698.46, 523.25, 415.30, 622.25
F# 5, C# 5, A 4, E 5	22.3	739.99, 554.37, 440.00, 659.25
G 5, D 5, Bb 4, F 5	21	783.99, 587.33, 466.16, 698.46
Ab 5, Eb 5, B 4, F# 5	19.8	830.61, 622.25, 493.88, 739.99
A 5, E 5, C 5, G 5	18.8	880.00, 659.25, 523.25, 783.99
Bb 5, F 5, C# 5, Ab 5	17.75	932.33, 698.46, 554.37, 830.61

Flute

Wind instruments can use many ways to create a vibration like using a reed, vibrating your lips like a trumpet, or splitting the air like a flute when you blow into the flute. The holes are placed at a certain location to create a note. The holes are placed by taking ¼ of a note's wavelength

because at the mouth piece, where you are blowing air into the flute, there is the most pressure and at the end of the tube is where the least pressure is and the equilibrium point is at ¼ of the wavelength. To create the notes you plug all the holes with your fingers leading up to the hole that makes the note you want to play. The more holes you plug the longer the tube is becoming which is creating a lower note/frequency. The less holes that are plugged the higher the note/frequency. To also make a higher or lower pitch you can blow more into the blowhole than across to create a faster vibration that results in a higher pitch. When you blow more across the blowhole the vibration is slower, resulting in a lower pitch. This is how a flute works and is played.

Works Cited

Flute

http://astro.pas.rochester.edu/~aquillen/phy103/Labs/FluteLab.pdf

http://www.phy.mtu.edu/~suits/notefreqs.html

Chimes

http://www.instructables.com/id/Copper-pipe-glockenspiel/step5/Cutting-a-pipe-for-the-glockenspiel/

http://www.gdiy.com/projects/copper-pipe-glockenspiel/index.php?lang=en

http://ask.metafilter.com/181158/What-length-to-cut-pipes-for-a-xylophone

https://sites.google.com/site/graciaphysics/how-does-the-length-of-a-pipe-affect-sound-pitch

Ukulele

http://www.phy.mtu.edu/~suits/notefreqs.html

http://www.ugrad.cs.jhu.edu/~ihsahn/FretScale.html

Valveless Trumpet

http://hyperphysics.phy-astr.gsu.edu/hbase/Music/trumpet.html#c**2**

Vocals

It's me

https://en.wikipedia.org/wiki/Vocal_folds