
Ph 212 – Make up lab – Straw Oboe Lab

Goal: To use the concept of standing waves to make a musical instrument out of a straw

Key ideas: Wind instruments all create sound by producing a vibration of air within a column. Length of this column determines the pitch, or frequency, or the sound. For this lab, we will make a reed at one end of straw and cut notches further down to allow us to play multiple notes.

Reeds are made of springy cane and can vibrate on their own. Attached to the instrument, they are forced to vibrate at the natural frequency of the air in the tube. When the pressure falls, the reed tends to close and to let less air in, when the pressure goes up the reed opens a little and lets more air in. The power in the air stream from the player's lungs is used to sustain the vibration in the air in the instrument.

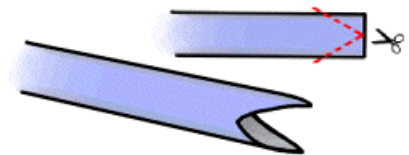
You can make a double reed out of a plastic drinking straw. Cut a V shaped point on the end of the straw as shown in the diagram at right.

Materials:

Straw
Scissors
Ruler
Marker
A smart phone with an FFT ap downloaded

Procedure:

1. Make a reed from one end of your straw
 - Flatten about 1.5 cm of one of the straw with your teeth
 - Using scissors, create a V shaped point by diagonally cutting off the corners of the flattened end (see figure to right)



2. Determine lowest frequency of straw
 - Draw the first 3 standing waves for the full length of the tube below. Consider whether each end of the tube is opened or closed.
 - Next to each standing wave, identify how many wavelengths there are

___ λ

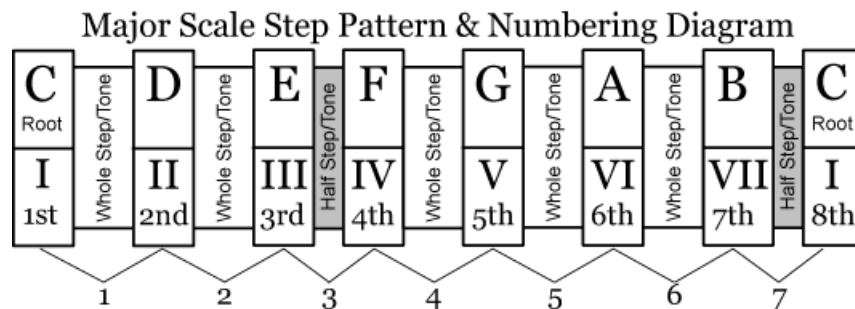
___ λ

___ λ

- Find an equation that relates the length of the straw to the frequency of the sound
- Predict what the lowest frequency for the straw should be by measuring it's length and assuming that the only frequency you hear for each note is the fundamental frequency.
- Compare this frequency to that found using the FFT ap you have downloaded on your phone. (If you get an prediction that's wildly off from your actual frequency, you might have chosen the wrong formula!)

3. Add holes to allow for more notes!

Western musical scales are composed of a series of 8 notes in the units of half tones, or half steps. A major scale can be broken down into units of half steps according to the following diagram



For any major scale, the number of steps between each note will follow the pattern above. If the frequency of lowest note is known (I), then the frequencies (fundamental only) of the other notes can be found using the following equation:

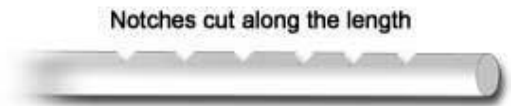
$$f_n = f_o a^n$$

where f_o = frequency of the lowest note
 $a = 2^{1/12}$
 n = the number of half steps from the lowest note

Using the formula above, fill in the table below to find all the frequencies that would make your instrument play a major scale

Note	n	f (Hz)	L (m)	f (from FFT)
I	-----			
II	2			
III	4			
IV	5			
V	7			
VI	9			
VII	11			
VIII	12			-----

For each note, find the length the air column must be. Measure each point from the end of the reed (notes 1 – 7) and mark your straw. Carefully cut a small notch out to create a hole. Be sure to keep all holes aligned on the top.



Now try your instrument out! Here are the notes for ‘Mary had a little lamb’

3 2 1 2 3 3 3, 2 2 2, 3 5 5

3 2 1 2 3 3 3, 3 2 2 3 2 1