

Stringed Instrument Lab - Chapter 4

Many stringed instruments (such as guitars, banjos, and basses) have thin metal strips called *frets* across the neck and underneath the strings. Frets are precisely placed so that the instruments produce the 12 chromatic notes of our Western musical scale. In this lab, you will discover where the frets of a stringed instrument must be placed to produce the 12 chromatic notes. You can apply what you learn to determine where violinists and cellists must put their fingers to produce the 12 chromatic notes.

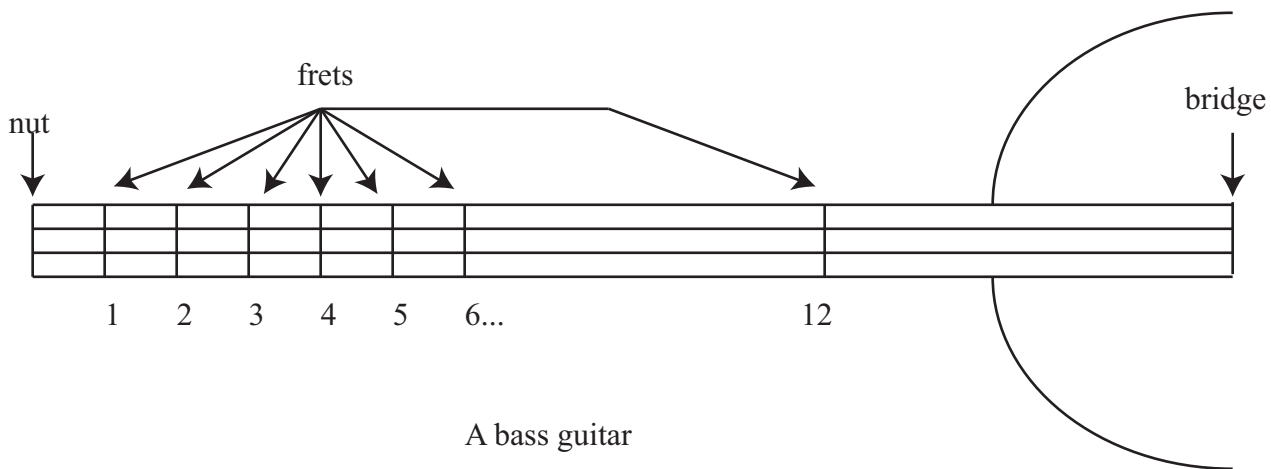
Materials

You will need the following materials:

1. a stringed instrument with frets
2. a meter stick or tape measure

Recording the Data

Measure the length (in centimeters) of one of the strings of the instrument from the *nut* to the *bridge* (see the figure). This is the length of an *open string*. Then measure the length (in centimeters) of the same string from the 12th fret to the bridge.



Analyzing the Data

1. Compare the sound produced by plucking the open string with that produced by plucking the string when it is pressed just before the 12th fret (toward the nut). The higher pitched note is called the *octave* of the lower note. How do distances between the nut and the bridge, and between the 12th fret and the bridge, compare?
2. You probably found that when you halve the length of an open string, you can produce the octave of the open string. Since the Western chromatic musical scale has 12 notes from each note to its octave, this means that the 12th fret should be placed in the middle of the nut and the bridge. Where should the 24th fret be placed to achieve the next octave?
3. Complete the following table:

Number of Frets	Length of String from Fret to Bridge (centimeters)
0	
12	
24	
36	
48	
n	

4. Let $f(n)$ be the distance (in centimeters) from the n th fret to the bridge. Based on the entries in the table, is f linear, exponential, or neither? Explain.
5. Find an equation for f .
6. Use your equation of f to find the distance between the fifth fret and the bridge.
7. Use a graphing calculator table to find the appropriate distances for all the frets of the instrument. Compare these distances with the actual distances.
8. On a 1974 Fender Jazz bass, one of the strings has an open string length of 86.5 cm. Explain how the Fender music technician knew where to put the frets.
9. In this lab, you observed that an octave is achieved by halving a string. Explain why it follows that the frets of an instrument are closer together when they are closer to the bridge.