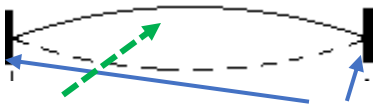
Explaining Music 5: An Introduction to String Lengths and the Harmonic Series

We've looked at how **string length** affects **pitch** and **perfect intervals** (**fourths**, **fifths** and **octaves**). Now we're going to put those together.

A diagram of a string vibrating can look like this:



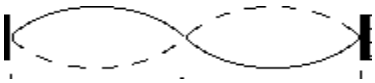
https://newt.phys.unsw.edu.au/jw/strings.html

The string is free to vibrate between the 2 end points

The **length** of the string (and the thickness/weight and tension) make a specific musical pitch

We're going to assume for the rest of this lesson that we're using the same type of string (thickness and weight) and the same tension of string so that we can see exactly how the length changes pitch

If you cut the string in half (or put your finger on it half way to stop it), the string will make the note an **octave** higher than before.



https://newt.phys.unsw.edu.au/jw/strings.html

The new string will naturally vibrate twice as fast (which means the **pitch** will be an **octave** higher)

Experiment: If you have an acoustic piano (sorry an electric piano won't work for this)

1. Push down the damper (sustain) pedal and hold it down
2. Without making it sound, press down middle C and keep holding it down
3. Are you still holding down middle C?
4. Play the C below middle C really loud – *fortissimo!*
5. Are you still holding down middle C?
6. Let go of the low C and the damper pedal – *but keep holding down middle C*

You should be able to hear middle C start to ring quietly.

Have a look at the first graphic at https://en.wikipedia.org/wiki/String_vibration

The graphic shows how a string vibrates when it is allowed to make 1 wobble per length, 2 wobbles per length, and so on up to 6 wobbles per length.

Compare how fast the strings move. You should see that the one with 2 arcs across moves twice as fast as the string with only 1 arc across. See if you can count and compare the others with the first one.

If you play a violin, viola or cello you can force this to happen by lightly touching the string at one of the "horizon" points (which are called **nodes**). It will be easier to hear if you're bowing. You need to be extremely accurate or it won't work.

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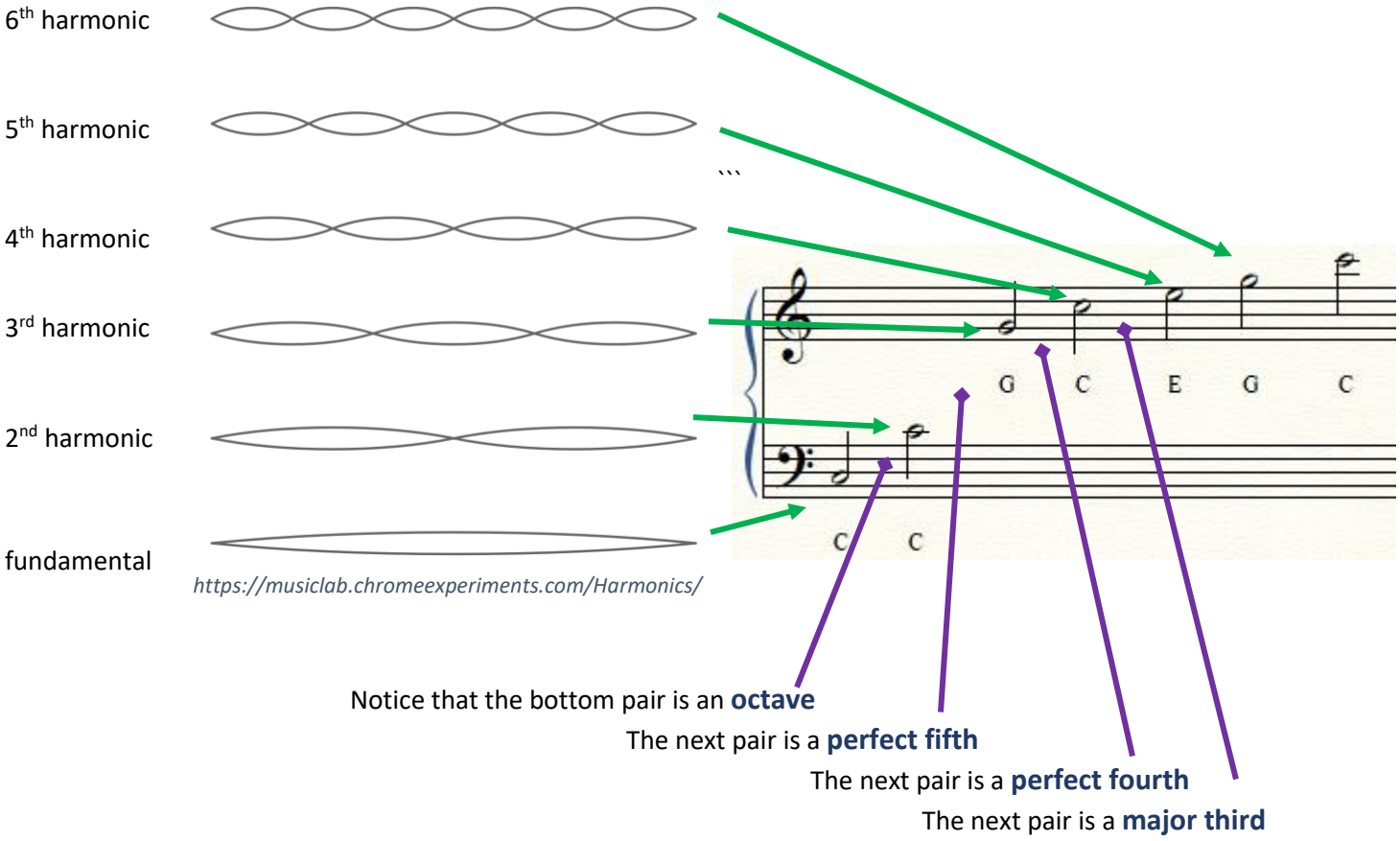
Harmonics

For any string length there is the possibility of sounding other higher **pitches** on that string if you can accurately stop the string at exactly the point where the arcs in the diagrams hit the horizon line. These points are called **nodes**.

In fact, all of those higher **pitches** are always sounding a little bit. We call this group of pitches the **harmonic series**. The lowest **pitch** is called the **fundamental**.

This also works for the length of tube on a wind instrument, but it is slightly more complicated. On some instruments every other harmonic is skipped.



https://musiclab.chromeexperiments.com/Harmonics/

Notice that the bottom pair is an **octave**

The next pair is a **perfect fifth**

The next pair is a **perfect fourth**

The next pair is a **major third**

Playing With Harmonics

Go to https://musiclab.chromeexperiments.com/Harmonics/

Click on the images to make them sound. Play around with this and try to notice the relationship between the images and the sounds created.

You will need the volume turned up to be able to hear the lowest note.