

Exploring Sound 7: The Harmonic Series

For any given instrument length you can make the **pitch** an **octave** higher by making the string (or air inside the instrument) vibrate twice as fast:

By touching the string or blowing faster air (overblowing) you can get other higher notes.

These notes are all part of the **harmonic series**.



Note: the B \flat is out of tune

- On string instruments this works by lightly touching the string at the half-way point
- For wind instruments you can blow faster air

N.B. This doesn't work quite the same way for the clarinet. It skips notes of the harmonic series.

It turns out that for any **pitch**, the **pitches** higher up the **harmonic series** can be heard (or detected by sensitive equipment) at quieter and quieter levels as they are higher in the series.

Here's a short video to watch about the **harmonic series**

<https://www.youtube.com/watch?v=OATjHiOuc70>

Retry this experiment from a couple of weeks ago and see if you can get other notes of the harmonic series to sound.

Experiment 1: You need 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.

Try other notes in the harmonic series to see if you can get them to sound.

Use the same steps as above, but in step 2 try:

- The G above middle C
- The C above middle C
- The E above the C above middle C

You will need to hit the low note much harder to make these notes sound. (You might not be able to make this happen on your piano.)

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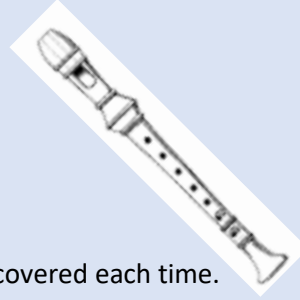
Experiment 2:

If you have a recorder at home try the following:

1. Blow very gently into the recorder
2. Blow harder to see if the note pops up an octave
3. Blow harder still to see how high you can go

Make sure you have exactly the same holes firmly covered OR uncovered each time.

See how many different notes you can get without changing the holes that are covered.



This works the same way on a trumpet.

Here's a video showing how the harmonic series works on the trumpet.

<https://www.youtube.com/watch?v=HK-m0rENx00>

The **harmonic series** he is talking about in the video is the one written on the first page. These are the **itches** the trumpet can play with no buttons pushed down. Trumpets usually have only 3 buttons. Those 3 are used to make all of the notes that are playable on the piano (within the range of how high and low the trumpet can play.)

If a trumpet player presses the 2nd valve button a tube is opened up that makes the instrument a semitone lower than it was before.

Challenge:

The notes written down are the ones a trumpet play can play with no buttons pressed.

Write the notes that a trumpet can play when the 2nd valve button is pressed

These notes are a semitone lower than the ones given

Write the new notes beside the ones given

