

The Trumpet Harmonic Series

-Chromatic capability is enabled through use of valve combinations; each of which produces a progressively lower-pitched harmonic series-

Producing tones throughout the range of the trumpet is based on the ability to play different pitches using the same valve combinations. The first trumpets didn't have any valves, and could only play notes of the fixed harmonic series on their instrument. It was like playing only the open notes on a modern trumpet.

"Open" notes: Harmonic series from C4 to E6, excluding "missing" fundamental

C4 G4 C5 E5 G5 Bb5 C6 D6 E6

Valves allow us to add lengths of tubing to the trumpet that lower the pitch by definite half-step intervals. As you can see on the harmonic series notated above, the interval size between successive harmonics becomes smaller as the pitch ascends. The largest of these intervals is at the low end: the six half-step interval between C4 and G4. Three valves are needed in combination to produce the six definite lengths of tubing that can play each of these chromatic half-steps. Each of these valve combinations also produces its own harmonic series:

Harmonic series for each valve combination

open 2 1 2 3 1 2 3

(one half-step) (two half-steps) (three half-steps) (four half-steps) (five half-steps) (six half-steps)

Using these valve combinations in sequence starting on each "open" pitch, you can demonstrate how they function chromatically:

Depressing valves in sequence: O, 2, 1, 2, 3, 1, 2, 3

Note: measure 2 shows the 6 half-steps needed to bridge C4 to G4

Note: increased overlapping (alternate fingerings) as harmonics get closer together

Notice that in the upper register, the decreasing interval between successive harmonics results in the ability to play certain pitches with more than one valve combination. These are known as alternate fingerings. The chart on the next page summarizes which valve combinations can be used to produce each pitch.

