Two Sound Demonstrations

by

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The following two sound demonstrations have the virtue of being inexpensive; in fact the first one costs the teacher nothing. Although I have seen the first referred to somewhere, I do not recall seeing the second. Both demonstrations rely on the human ear's remarkable ability to distinguish changes in pitch.

1. Dependence of resonance frequency on column length.

Have the student roll two pieces of 8½ × 11 inch notepaper into cylindrical tubes: one the long way and the other short. Hold both tubes up to the ear and gently scratch them alternately; first one and then the other. The enhancement of the sound at the resonant frequency of the tube produces a distinct difference in pitch (higher for the shorter tube).

The resonant frequencies are 608 Hz (a very sharp D′) and 791 Hz (a slightly sharp G′). Only the rare musical student with perfect pitch will be able to come close to the absolute pitch; however, the interval is almost a perfect 4th (slightly flat) which is easy to distinguish. If a chromatic instrument is available (piano, flute, etc.), playing a 4th starting on D′ (D′ - G′ in the second octave above middle C) will match closely the interval heard in the paper tubes.

For the non-musical teacher:

A semitone frequency ratio is given by the 12th root of 2 which is 1.059463. Therefore, any frequency f multiplied by $(1.059463)^n$ is n semitones higher. A perfect 4th is an interval of 5 semitones so $608(1.0059463)^5 = 812$ Hz. As stated above, the interval from the tubes is flat from this.

2. Dependence of sound speed on medium density.

Take an 8 oz tumbler and put a heaping teaspoonful of a fine wetable powder in the bottom. I have used cement and, separately, psyllium (Metamucil, a common laxative); the latter works better. Carefully fill the tumbler with water and start stirring vigorously, including striking the glass. The sounds of the stirring action will rise in pitch as the powder is mixed. As the powder is mixed into the water, the mean density of the medium increases and so the sound speed increases. Since the resonant length is unchanged, the pitch (frequency) rises. The Metamucil can then be drunk in safety.

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Submissions describing demonstrations will be gladly received by the column editor.
