Pop Bottle Music

You may work with a team during this activity.

note frequency for this activity: $f_n = 440\ Hz\ x \left(\sqrt[12]{2}\right)^n$

for a bottle with one closed end: $L = \frac{v}{4 f_n}$

air column length L = bottle height H – water height h

1. The frequencies 440Hz and 880Hz both correspond to the musical note A, but one octave apart. The next higher A in the musical scale would have the frequency 1760 Hz, twice 880 Hz. In the western musical scale, there are 12 notes in every octave. These notes are evenly distributed geometrically, so the next note above A, which is B flat, has frequency $440\ Hz\ x \left(\sqrt[12]{2}\right)^1$. The value of $\sqrt[12]{2}$ is approximately 1.0595. The next note above B flat, which is B, has frequency $440\ Hz\ x \left(\sqrt[12]{2}\right)^2$, and C has a frequency of $440\ Hz\ x \left(\sqrt[12]{2}\right)^3$, etc.

2. Complete the table below. Assume that the speed of sound is 343 m/s.

3. Using the equations in the example noted above, perform the calculations necessary to tune each of your team's bottles.

Sound and Bottle Data

A	B	C	D	E = D/4C	F	G = F - E
Scale note	n	Frequency f_n in Hz	Sound velocity v in m/s	Air column height L in m	Bottle height H in m	Water height h in m
A	0					
B flat	1					
B	2					
C	3					
C sharp	4					
D	5					
D sharp	6					
E	7					
F	8					
F sharp	9					
G	10					
A flat	11					

4. You can determine if your bottles are tuned using the website http://ptolemy.eecs.berkeley.edu/eecs20/week8/scale.html or the tuning forks.

5. If you brought music to class or you know the notes to a song, try playing it on your bottles.