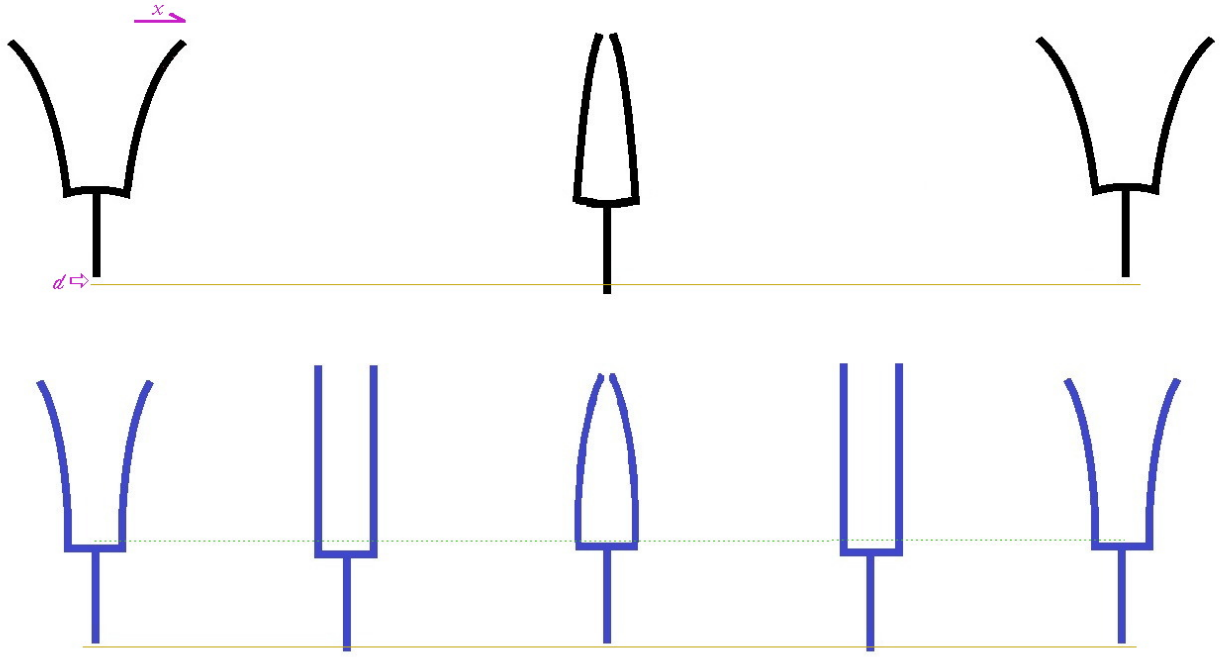
How Does a Tuning Fork Move?

Seems obvious, right? The tines move back and forth. But to hear the tuning fork, we place the stem in contact with a surface. So what we really care about is the motion of the stem.

There are two ways to think about how the stem moves. If we consider the tuning fork to be a bar that simply has two right-angle bends in it, we would expect the middle of the bar to go up when the ends go down… with bent bars, we expect the middle of the bar to go up when the ends go out.

If that is what happens, then the tuning fork stem will move up and down once when the tines move out and in once, as shown by the black fork below.



On the other hand, bending the tines lowers (very slightly) their center of mass. For all vibrational modes, we wish to fix the center of mass of the object as a whole. So if the center of mass of the *fork* remains stationary, then the stem must move up very slightly when the tines are bent… *either bent in or bent out!* If this is how the stem moves, then it will move up and down *twice* while the tines move in and out. This will create a tone an octave higher.

So which is it? The answer is: both!* There's a short video demonstrating two pitches from the same fork.

Note that this is *not* the same thing as vibrating in two different modes at once. The tuning fork is in its lowest mode, but, at reasonably large amplitudes, its motion is non-sinusoidal.

*If you were to make the tuning fork vibrate at very low amplitude, the 2nd harmonic would, in fact, vanish. However, in actual use, the fork has considerable 2nd harmonic.