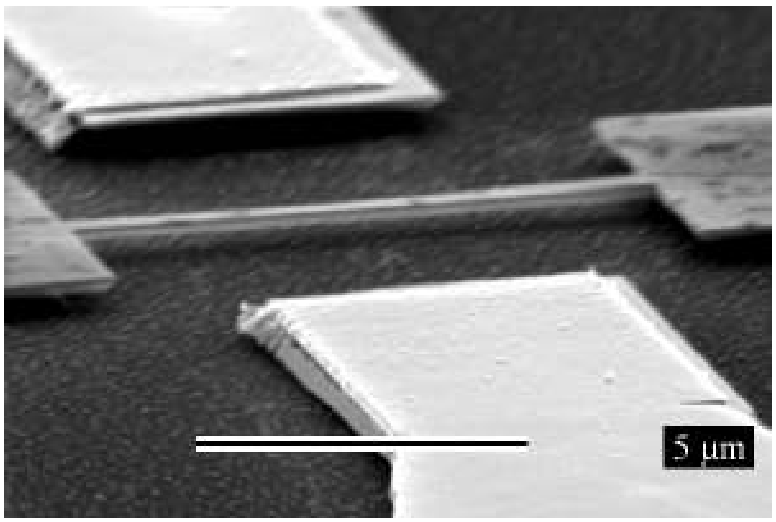
Although a mass on a spring may be the most common example of a harmonic oscillator, it's certainly not the only one. Picture yourself relaxing by the pool. Your friend strolls over to the diving board and tiptoes out to the edge, placing his/her weight at the end. What happens? First the board bends downward, but after a certain point, the board responds and thrusts him/her back upward.

Much like the spring, a diving board has an elastic property that makes it always try to return to equilibrium. When it is pushed away from equilibrium, it oscillates (think of the loud vibration of the board after your friend jumps off). The same can be said for a beam which is clamped at both ends, like the one shown below. When displaced, the center of the beam will oscillate up and down.

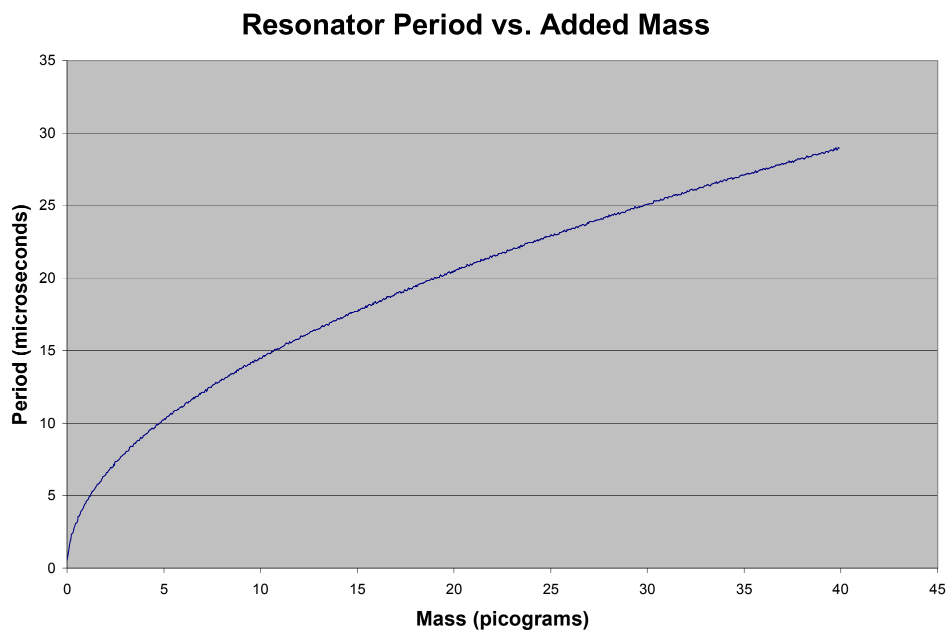


As you just proved, a relationship exists between the mass of an oscillator (or as scientists often call it, a *resonator*) and its period of oscillation. Suppose some extra molecules were to land on the beam shown above. How would its period of oscillation change?

As you can probably guess, measuring the mass of something very small, like a bacterium, a virus, or even an individual cell is not quite as simple as just placing it on a scale. Much more sensitive measurement techniques must be used. Can you explain a way in which a resonator could be used to measure masses of very small particles?

Scientists are, in fact, working on using simple harmonic motion to measure and detect the masses of biological particles. If you look at the size scale on the picture above, you'll notice that the resonator shown is extremely small. A human hair has a diameter of approximately 50 µm (50×10^{-6} m). The beam pictured has a width of 0.5 µm, small enough that it could be laid roughly 100 times across the surface of a single strand of hair! It is so small, in fact, that many biological molecules of interest (viruses, disease markers, etc.) are of a similar size, meaning that if one of these molecules wound up on the beam, the period of oscillation of the resonator would change a measurable amount.

Here's an example of what the data for such a resonator might look like. Notice that the period is very small. Even those of you with outstanding reaction times would not be able to measure 20 microseconds (20×10^{-6} seconds) on a stopwatch. It takes sophisticated techniques to measure a beam oscillating with this high of a frequency.



Suppose you were to measure this resonator oscillating with a period of approximately 18×10^{-6} seconds. Which type of bacteria would you deduce was present on your sample?

Bacteria	Mass (picograms or 10^{-12} g)
Bacteria A	10
Bacteria B	25
Bacteria C	17
Bacteria D	3
Bacteria E	2
Bacteria F	4
Bacteria G	8