THE DEMONSTRATION CORNER

"Cheap and Easy Sound Demos with Rods and Tubes"

by
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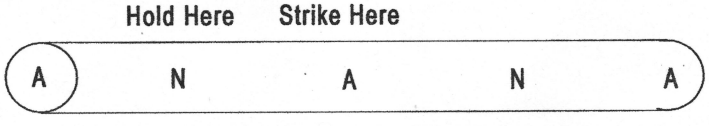
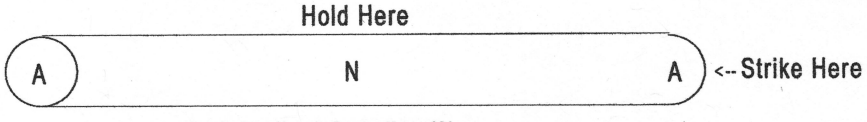
Visible standing waves with a node at each end are fairly easy to demonstrate. You can use a long spring such as a slinky (cheap way), or even order a nice transducer-based demo from one of the scientific supply companies (expensive way). However, I also wanted to demonstrate antinodes at both ends, or even one node and one antinode.

To get antinodes at both ends, I use an aluminum rod about two metres long. I was able to obtain this at no cost to the science department by a begging campaign aimed at the machine shop teacher. I learned this technique while watching PBS. It can also be done using the rod from a retort stand. You can create transverse standing waves in the rod by holding it at a point ¼ of its length from one end and hitting it in the middle. Another node appears at the ¾ point, with antinodes at the end. These are all easily visible in the two-metre rod, and can even be seen as "blurs" in the retort stand. I usually do the big rod as a demo and then let the students do it with the retort stand.



Transverse Standing Waves



Longitudinal Standing Waves

The same rod can be used for longitudinal standing waves. Hold the rod in the middle, and tap one end against the floor or other hard surface. Although the standing waves aren't visible, they are very audible. I then push one end slowly against a chalkboard to show that the vibrations are indeed longitudinal, and produce an irritating, spine-tingling noise as a bonus. You can extend this by holding the rod at the ¼ point, and generating a note one octave above the first. I am also usually able to get one more octave by holding it at the 1/8 point, although it is very sensitive to any error in the holding point.

Another bonus with the longitudinal vibrations is a Doppler Effect demo. Tap the end against the floor to excite the longitudinal standing waves. Then hold the rod horizontally over your head and start twirling it. You will get a beautiful vibrato effect from the shift in frequencies between the end moving away from the observer, and the end approaching the observer.

For a node at one end and an antinode at the other, I purchased a 12-ft length of rigid copper tubing from a hardware store. I brace one end against the floor (or a wall, if I'm in a room with low ceilings), and hold it at the closest antinode to the wall, which is 1/3 of its length from the forced node. Moving my hand back and forth at this antinode produces the desired pattern. One must be careful not to do it for too long or at too great an amplitude, since the copper will bend permanently. This demo would work better with a solid aluminum rod of similar length. I couldn't beg one using the above technique since I am now in a school without a machine shop, but I plan to buy such a rod with the greatly increased science budgets expected next September.

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Submissions describing demonstrations will be gladly received by the column editor

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