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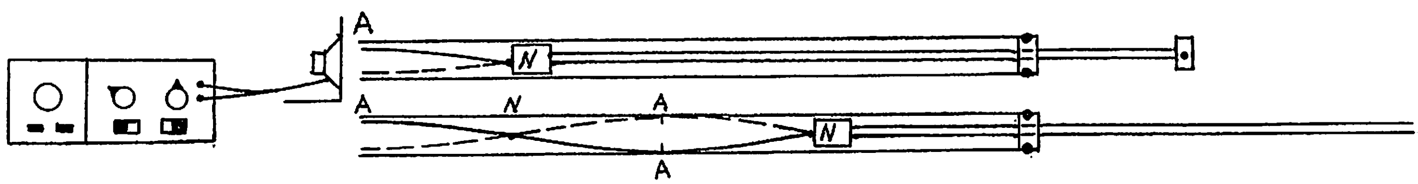
Measuring the speed of sound - Many methods have been used to measure the speed of sound, but two stand out because they are so simple to assemble and perform. One method measures the speed of sound in a gas (air), the other the speed of sound in a solid (metal rod). Thus, you are measuring two very different speeds. Both methods are safe for students to perform and can easily be seen and heard in a typical classroom.

1. The speed of sound in air using $v = \lambda f$. λ is wavelength.

Note: Your ear is very sensitive to changes in intensity at lower levels, so keep the volume very low when using the audio oscillator in this experiment.

Make up a piston and cylinder. The clear cylinder is a 3 ft. long acrylic tube with a 1.25" I.D. and a 1/8" wall. Make an easy sliding piston out of wood with a ¼" dia. dowel rod as a handle. Attach a wooden "donut" disc to one end of the tube and a small wooden handle on the end of the rod. Fasten both with small screws. Add two rubberbands to the outside of the tube as future "node markers".
Set the oscillator's speaker and the piston close to the end of the tube. Set the oscillator on very low volume at 500 Hz. Slowly pull the piston out and listen for a volume change from soft to loud to soft. At its loudest (nodal) point, place a rubberband. Continue to pull the piston out to find the next nodal point; mark with the second rubberband. You have just located two strong resonance points where the length of the air columns are odd multiples of a quarter wavelength, the first being $\lambda/4$, the second $3\lambda/4$ or $\lambda/2$ longer than the first. Of course, in each case you are setting up a standing wave pattern where the open end of the tube is an antinode and the piston face is a node, always more easily explained via an analogy using sinusoidal transverse waves instead of true longitudinal waves. Make the necessary measurements for λ and calculate. Repeat the experiment using 1000 Hz (an octave higher and $\lambda/2$) or try other frequencies you prefer. Always keep in mind the room's temperature and its effect on v .

I wish to thank Peter Lindenfeld of Rutgers U. for originally showing me this experiment.



2. The speed of sound in a metal rod using $v = \lambda f$.

Secure a 6 ft. (1.83m) long, ½" dia. aluminum rod from a local hardware store. Mark off the center and quarter ends of the rod which will become nodal points during the experiments. Set up an audio oscillator nearby. Start by holding the rod firmly at the center (node) between your index finger and thumb. With sticky rosin dust on your other index finger and thumb, begin to stroke ("stretch") the rod from the center node until a loud sound is heard; this may require some practice to do it well. (I've found that applying "Cramer's Firm Grip", a rosin spray, to the rod and letting it dry to slightly tacky worked best for me, but it's not readily available.) Once the loud sound is reached, tune the oscillator to the sound until no beats are heard. Read the frequency (1300 Hz ?) from the dial.
With the node in the center and the ends of the rod as antinodes in a standing wave pattern in the rod, the length of the rod is $\lambda/2$ or λ is double the length of the rod. Knowing f and λ , calculate v . Sound is traveling about 14 times faster through the rod than through air. Amazing! Repeat the experiment by holding the rod at the quarter mark. Notice that the pitch jumps an octave (twice the frequency) because you have reduced λ by half. Clean off any rosin buildup on the rod with alcohol.