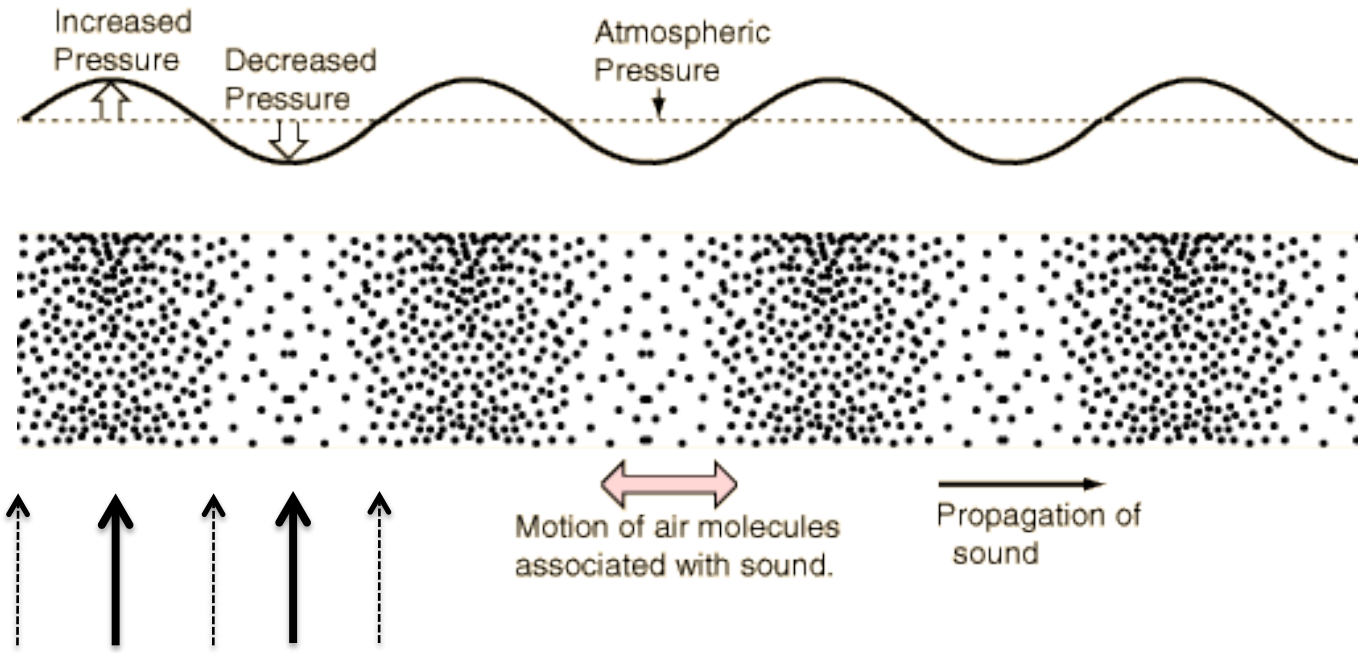
Pressure Wave representation of Sound



anti-node

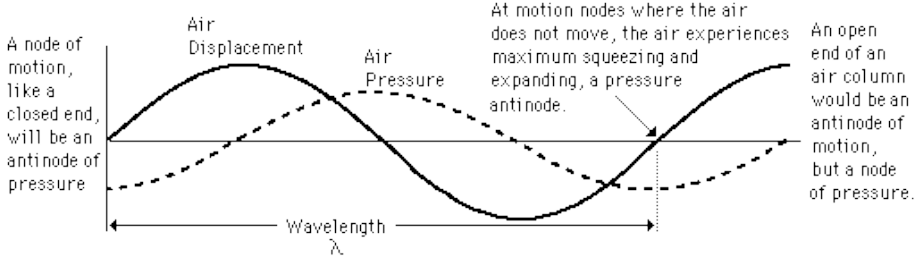
node

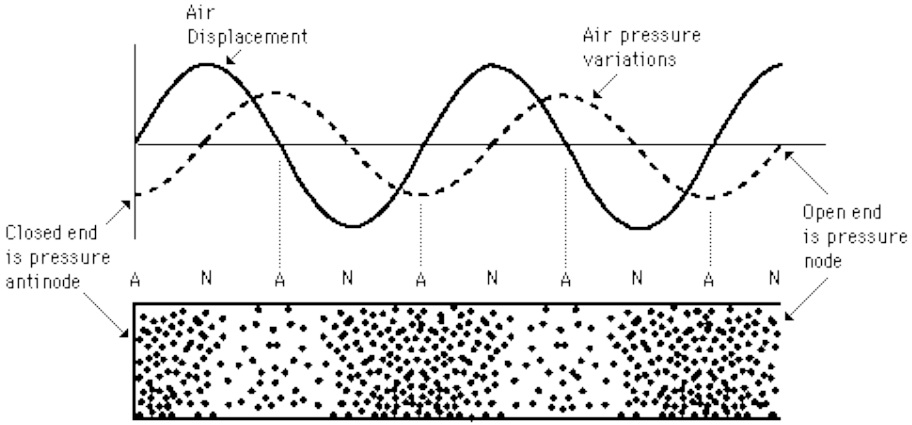
Sound travels best in ELASTIC media, that is, media with a restoring force. In air, the restoring force that makes it have elastic properties is the atmospheric pressure. Sound waves create a pressure differential higher and lower than the prevailing atmospheric pressure and the sound propagates as the wave pressure is restored to atmospheric pressure.

Air Columns

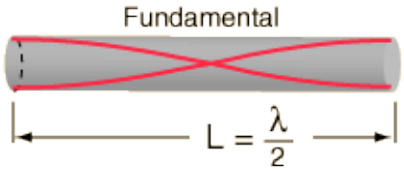
images from Ga St. HYPERPHYSICS

Sounds waves in a “pipe”, such as a musical instrument can be treated as a standing wave. The air displacement is 90^o out of phase with the pressure variation. An air pressure node is aligned with an air displacement anti-node. I’m NOT saying there are two different waves. You can visualize these standing wave in terms of pressure variations or matter displacement variations.





Open column of air (flute, organ pipe)

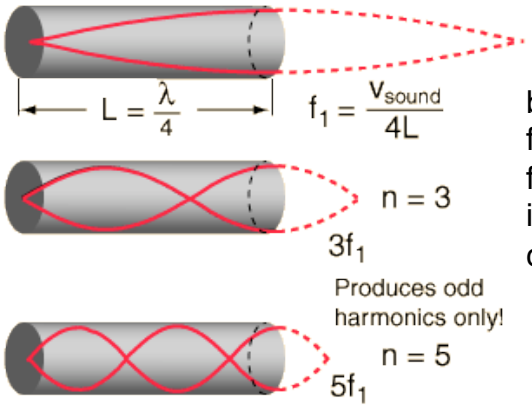


$$f_1 = \frac{v_{sound}}{2L}$$

open columns can produce ALL harmonics

Each end of the column must be an anti-node for the sound wave. The wavelength must be 2x the length of the column

Closed (one end) column of air (clarinet)



$$f_1 = \frac{v_{sound}}{4L}$$

because the closed end forces a node, the fundamental wavelength is 4x the length of the column