

## Vibrations

- The closer the frequency of the driving force is to the natural frequency of the object, the easier it is for the driving force to get that object to vibrate.



## Tubes



Images: The Physics Classroom, www.physicsclassroom.com

## Tubes



Plastic Straw Instrument



The natural frequency of a trombone can be modified by changing the length of the air column inside the metal tube.

Images: The Physics Classroom, www.physicsclassroom.com

## Tube and its resonance

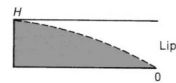


Figure 4.9. A uniform tube open at one end, showing a pressure waveform at the first formant frequency.

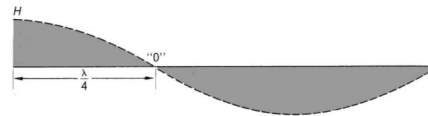


Figure 4.10. The relation of the quarter-wavelength "inside" the tube to the air pressure waveform outside the tube.

## Tube resonances

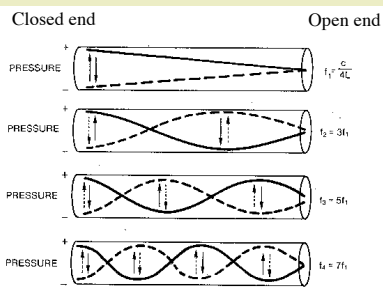
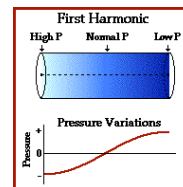


Image from <http://www.unm.edu/~faculties/arts/linguistics/russell/138/sec4/resonanc.htm>

## Closed tubes



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## Flutes vs. Clarinets



Taken from <http://www.phys.unsw.edu.au/jw/flutes.v.clarinets.html>