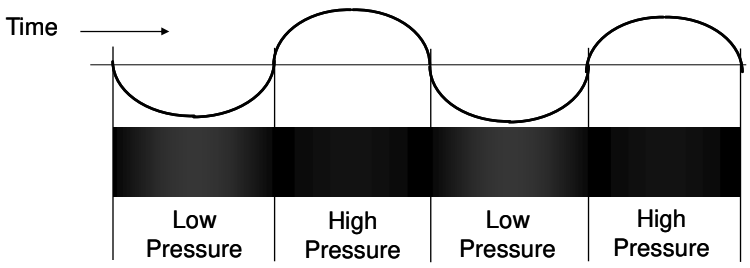
Sound Waves

The Physics of Music

1

Sources of Sound

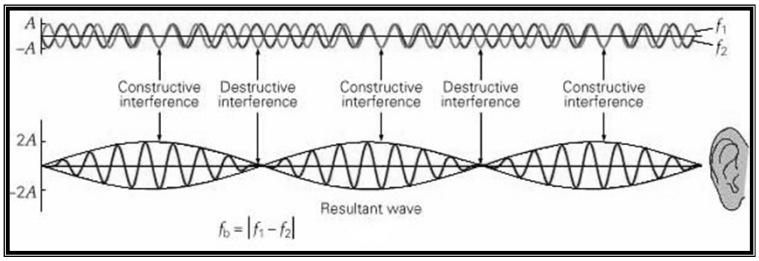
- Any _____ object can produce a sound
- The vibrations move molecules in the air creating pressure differences creating sound.



2

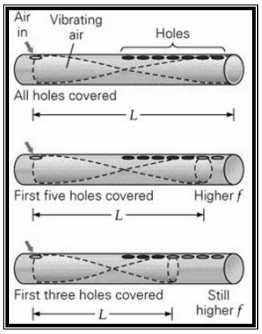
Beats

- _____ variation of loudness
- The number of beats per second = the difference between source frequencies
- Humans can detect beat frequencies up to approximately 7Hz
- Over 7Hz we hear a complex wave



Resonance

- How it works
  - Certain frequencies will produce _____ waves in a given length of pipe or string
  - These standing waves produce the sound we hear in musical instruments.
  - By changing the _____ of the string or pipe, we can change the frequency that resonates



Resonance

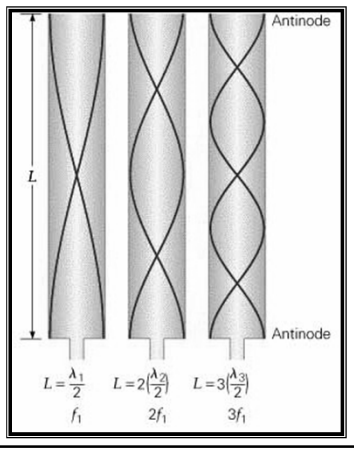
- Fundamental Frequency
  - the _____ frequency of vibration of a standing wave
- Harmonics
  - whole number multiples of the fundamental frequency

Note on musical vocabulary:
- The fundamental is also the first harmonic

Open-pipe resonator

- Resonating tube open at both ends
- Produces a standing wave with antinodes on both ends
- Minimum length is 1/2 λ
  or _____

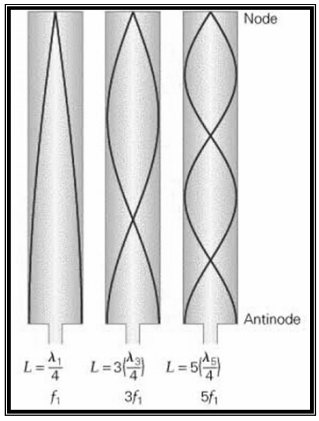
Notice <u>all</u> harmonics resonate in a open tube



Closed pipe resonator

- Resonating tube with one end closed
- Produces a standing wave with a node on one end and an antinode on the other
- Minimum length is 1/4 λ
  or _____

Notice only <u>odd</u> harmonics resonate in a closed tube



Harmonics Sample Problem

- A tuning fork produces resonance when held above a 2.45 m long pipe that is open at both ends. Assuming the speed of sound is 345 m/s, what is the frequency of the tuning fork? What are the next two frequencies that would resonate in the same tube?

Harmonics Sample Problem

- A 392 Hz tuning fork is used with a closed pipe resonator. The length is 0.32 m when the loudest sound is produced. What is the speed of sound? What is the temperature of the air during the experiment?