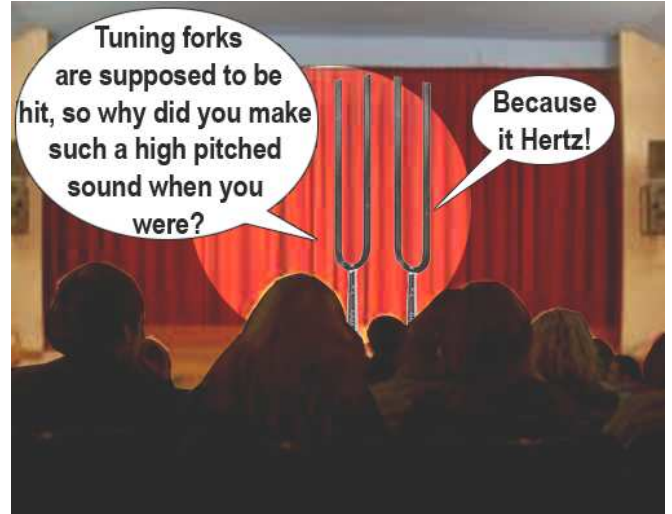


Vibrations and Sound

A vibrating object causes molecules in the surrounding medium to move back and forth. Those molecules collide with nearby molecules in the medium and cause them to move back and forth. The molecules move back and forth parallel to the direction the energy is moving. As the vibrating object moves towards the medium, it squeezes molecules together forming a region of higher density or a **compression**. As the vibrating object moves away from the medium, a region of lower density forms as the particles of the medium spread. This region of lower density is called a **rarefaction**. The vibrating object creates a series of compressions and rarefactions that move through the medium away from the source of the vibration. This is a longitudinal wave called a sound wave. It transfers energy through the medium parallel to the direction of molecular motion. The frequency of the sound wave is the number of compressions or rarefactions that pass a given point per second. The further apart the compressions and rarefactions are, the higher the wavelength is and the lower the frequency is. An object that vibrates faster forms a sound wave with a shorter wavelength and a higher frequency. The higher the frequency of a sound wave is, the higher the pitch is. **Pitch** is how high or low a tone sounds. Humans can detect sounds with frequencies between 20 Hz and 20,000 Hz. The speech of a typical adult male will have a fundamental frequency from 85 to 180 Hz, and that of a typical adult female from 165 to 255 Hz. There are also higher frequency overtones that are important to speech. Human sound is formed when air passing the vocal cords causes them to vibrate. The length and thickness of the vocal cords determine the pitch. Shorter, thinner vocal cords vibrate at higher frequencies producing a higher pitch. Muscles in the throat can stretch the vocal cords, enabling people to vary their pitch within a limited range.

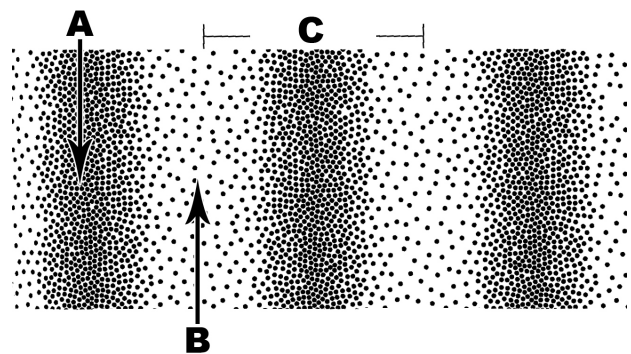


Tuning fork comedians

Answer the questions below based on the reading above, and on your knowledge of physics.

- Label the parts of the sound wave pictured to the right.
 - _____
 - _____
 - _____
- What causes sound? _____

- What causes compressions and rarefactions? _____

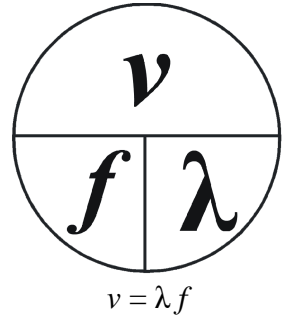


4. The speed (v) of sound is 343 m/s . What is the wavelength (λ) if the frequency (f) is:

a. 440 Hz ? _____

b. 261.6 Hz ? _____

c. What happens to the wavelength as frequency increases? _____



5. Middle C has a frequency of 261.6 Hz . Middle A has a frequency of 440 Hz . Which has a higher pitch? _____

6. How does the pitch of fast vibrating object compare to that of a slower vibrating object? _____

7. As a general rule, who has shorter, thinner vocal chords, men or women? How do you know? _____

8. When somebody sings, how does the pitch of the voice change? _____

9. How is energy transferred by a sound wave? _____

