



SENSORY SYSTEM VI

SOUND & HEARING



What is sound?

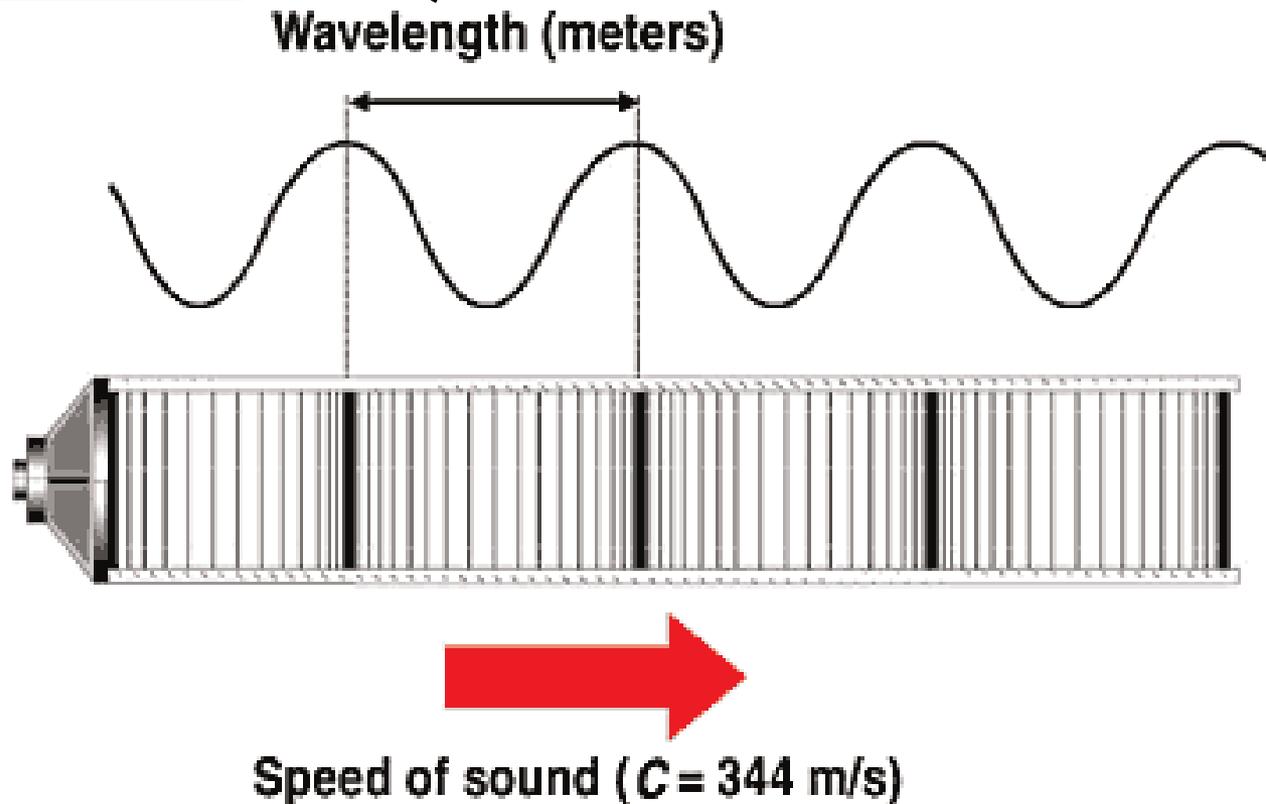
Why can we hear things?



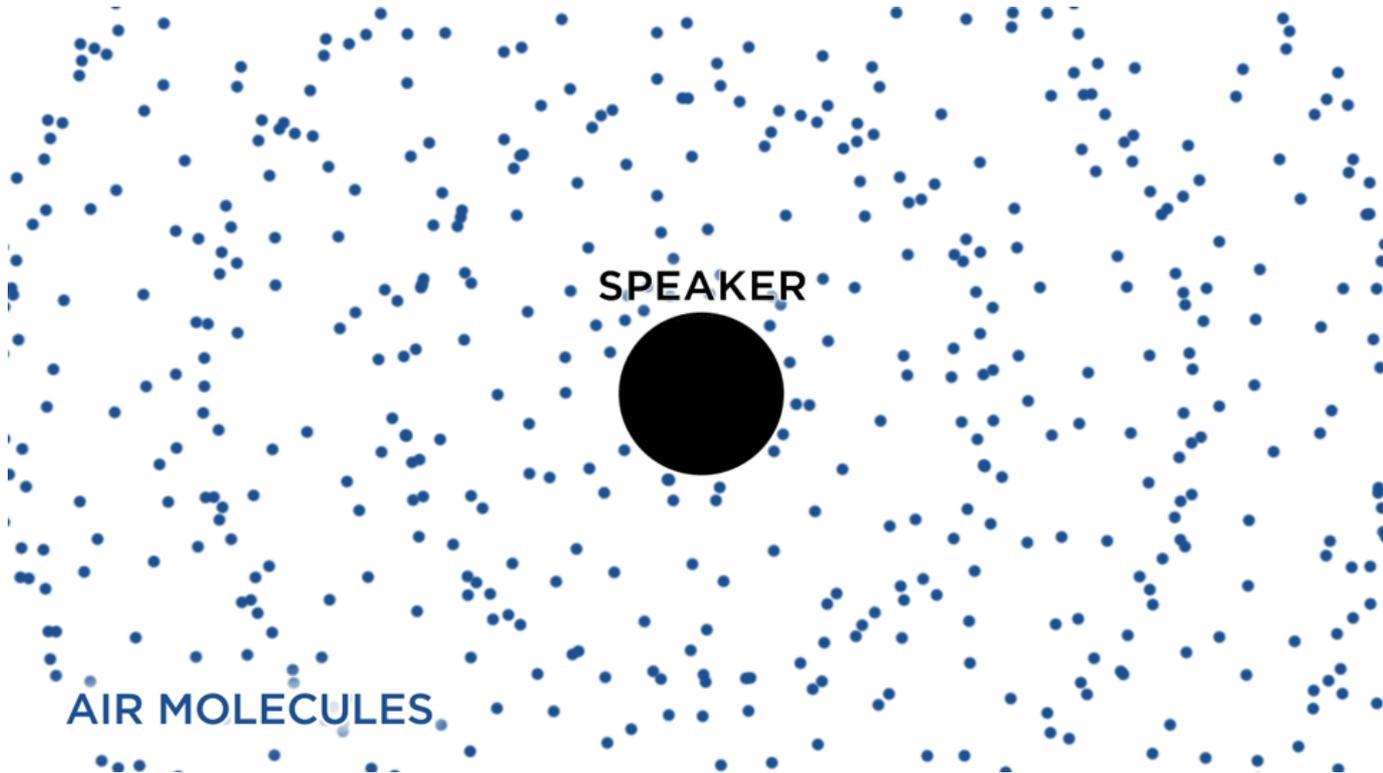
Notes on Sound

Waves

- Sound is a **compression** wave (a type of **mechanical** wave)



(Courtesy of Jack Heeg, 1999)



Sound

- Sound is a longitudinal mechanical wave produced by the vibration of an object and transmitted to the object's environment
- How does vibration create sound?

Sound

- As an object vibrates (like the membrane on a drum) it moves up and down pushing the air molecules next to it
 - ▣ These continue to bump each other like dominoes



How does a guitar make sound?



Guitars and Vocal cords

- By plucking or strumming the strings on a guitar we cause them to vibrate
 - ▣ The soundboard on an acoustic guitar is hollow and helps amplify the sound
- Just like the strings on a guitar our vocal cords produce sound by vibrating

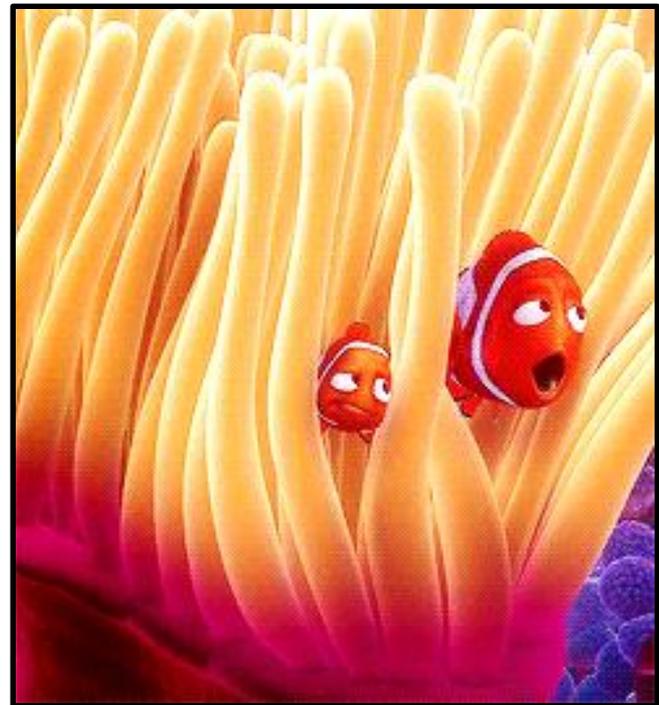
How do we hear?

- We are able to hear sounds once the sound wave reaches our eardrum
- Just like when you tap a drum, the air molecules being pushed by the sound wave hit the eardrum and cause it to vibrate



How do we hear?

- The cochlea is not only filled with fluid but also lined with hair-like receptor cells
- As the eardrum vibrates, it causes the fluid to “slosh” around which moves the receptor cells
 - ▣ Like seaweed
(or an anemone) in the ocean



Amplitude and Frequency

- Just like light waves, sound waves have both amplitude and frequency
- For sound:
 - Its amplitude determines how loud the sound is
 - Its frequency determines the pitch of the sound

Amplitude

- The volume of sound depends on its intensity, meaning how much energy it transmits
- We measure the intensity (amplitude) of sound using the decibel (dB) scale
 - An increase in 10 dB means that a sound becomes 10 times louder
 - E.g. 65 dB is 10 times louder than 55dB
 - 75 dB is 10 times louder than 65dB
 - 75 dB is 100 times louder than 55dB

Loud music and hearing loss

- Prolonged exposure to sounds louder than 100 dB can cause long-term hearing loss
- **60-60 rule**
 - ▣ You shouldn't listen to music for more than 60 minutes at 60% of the maximum volume

FYI: a concert is usually around
100-120 dB

- **Threshold of hearing:**
 - ▣ The minimum sound level that a healthy person can hear

Frequency

- Frequency is the number of waves per second
- The frequency of the sound changes its tone or pitch
 - low frequency = low sound
 - High frequency = high-pitch sound
- Just like with light, frequency and wavelength are related
 - Low frequency = longer wavelength
 - Higher frequency = shorter wavelength

Frequency

- The human ear can generally hear between 20-20 000 Hz
- As you age you lose the ability to hear the higher end of the spectrum

The “Mosquito” or “teen buzz”

- A high frequency sound that can only be heard by people under 25 (between 14400-17000Hz)

