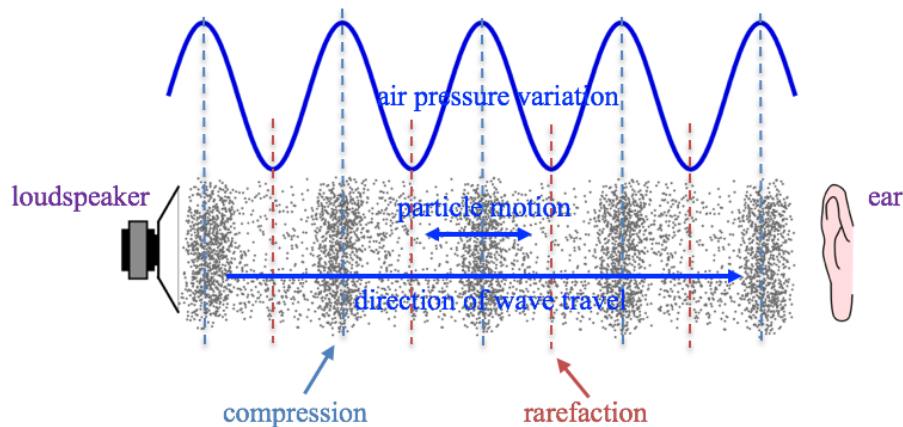


### 6.3.1 Sound and ultrasound

Sound waves are longitudinal waves in which vibrations are parallel to the direction the wave propagates (travels). Sound waves require a medium (such as air) in which to travel, and it is the vibrations of the material particles that transfer the wave energy.



videos



(1) ✎ What are areas called where there is high pressure (i.e. where the particles are close together)?

(2) ✎ What are areas called where there is low pressure (i.e. where the particles are far apart)?

(3) ✎ "Sound waves cannot travel between astronauts standing on the Moon." Explain why this statement is only partly true.

Sound travels around  $330\text{m/s}$  through the air. Compare this with the speed of light ( $3 \times 10^8\text{m/s}$ ).

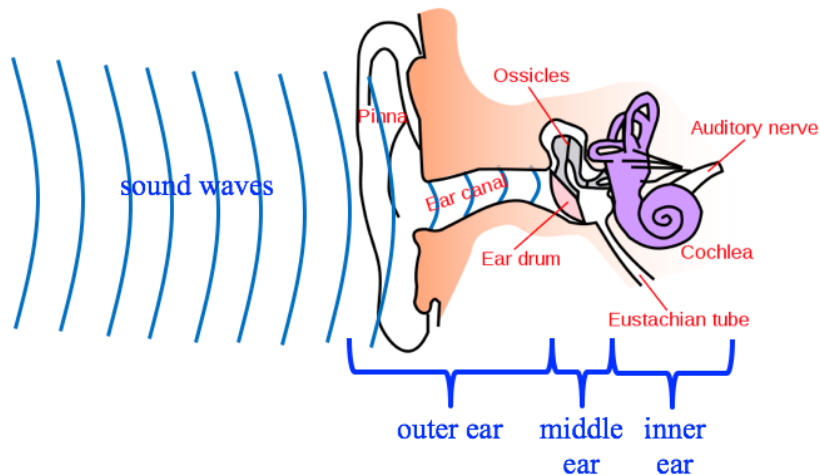
(4) ✎ Why do we always see the flash of lightning before hearing the thunder?

(5) ✎ A flash of lightning is seen and 6 seconds later thunder is heard. Approximately how far away did the lightning strike?

Sound travels more quickly through solids than gases (e.g. the air).

(6) *Give a reason why native Americans might have listened for buffalo approaching by putting their ears to the ground.*

### The human ear



In the diagram, above, the cone of a loudspeaker oscillates backwards and forwards. This repeatedly compresses and stretches the air producing sound waves. The opposite happens at the ear. Here, compressions and rarefactions arriving at the ear cause the ear drum to vibrate backwards and forwards. These oscillations are passed on and amplified by small bones in the middle ear, called 'ossicles'. In the inner ear (in the cochlea), the oscillations are picked up by sensitive hairs, which send electrical signals to the brain about the frequency and loudness of the sounds detected.

(7) *Why is it difficult to hear if there is a build-up of wax in the ear canal?*

(8) *Why is it still possible to hear some sound in this situation?*

### Range of human hearing

Humans can only detect sound with frequencies in the range from 20 to 20000Hz. Above 20000Hz, the sound is referred to as 'ultrasound'.

(9) *What is 'frequency' and how is it related to the 'pitch' of a sound?*

The ability to hear certain frequencies diminishes with age, with the highest frequencies being affected the most.

Repeated exposure to loud sounds can also lead to hearing impairment.

(10) ✎ *Give an example of a job that may expose workers to loud sounds.*

(11) ✎ *How can workers protect their hearing in these circumstances?*