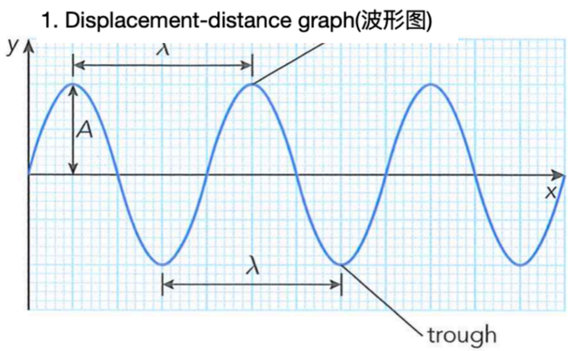
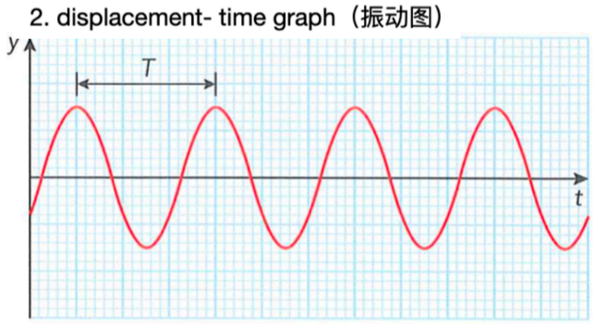
Sound

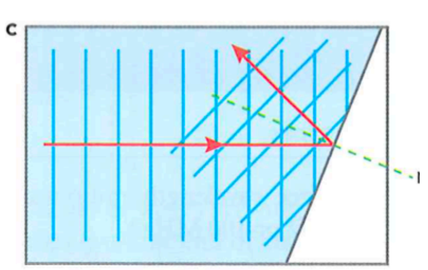
Recap of Ch14

1. What are Waves
2. Describe waves
3. Wave Characteristics

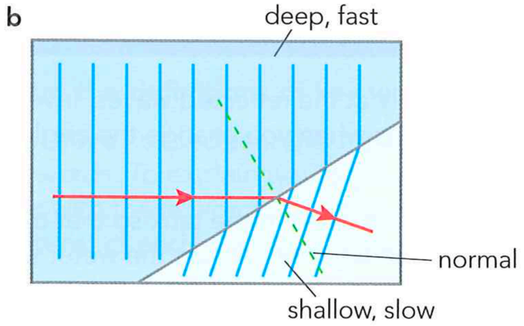




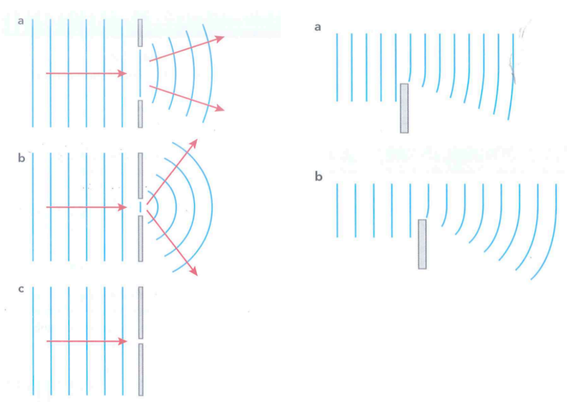
reflection



refraction



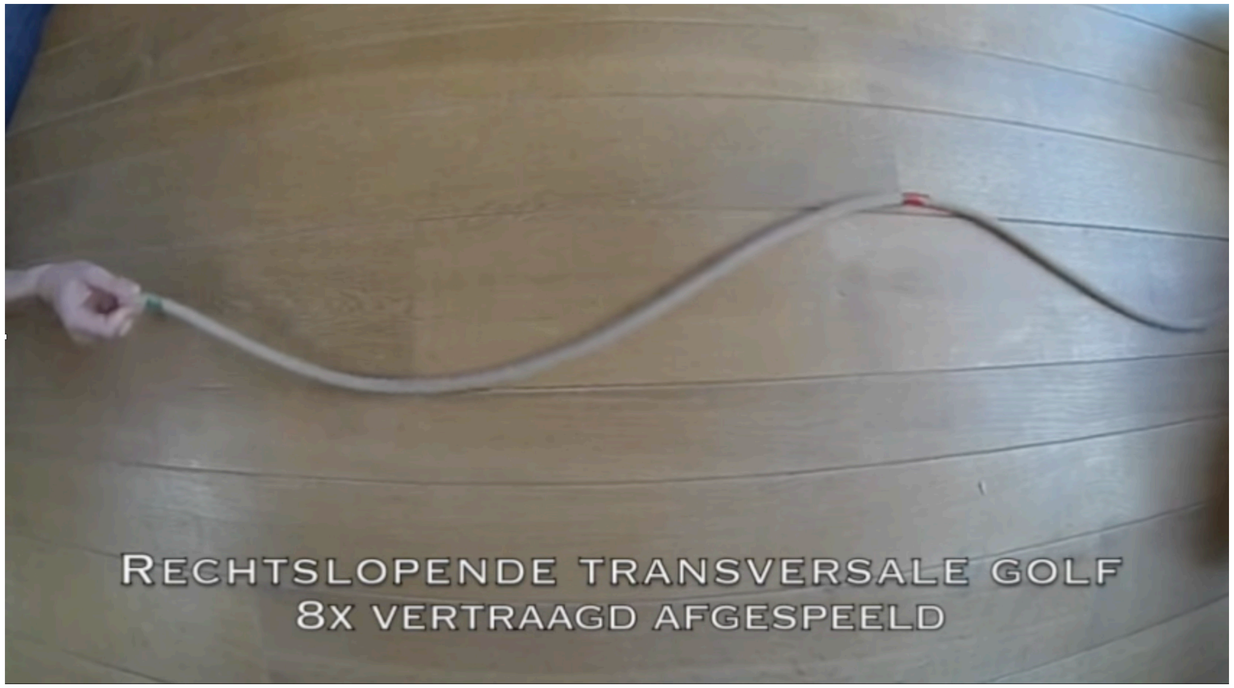
diffraction



New Words

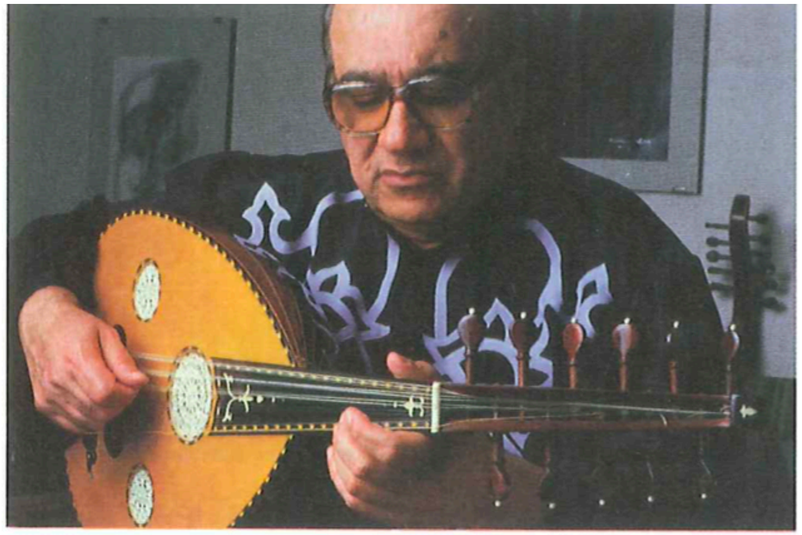
instruments echo
eardrum pulse oscilloscope drum gong flute turning fork vocal ford

Recap



Wave is a way of transferring energy **without transferring matter**.

Making sounds



How does musical instruments make sounds?

Making sounds

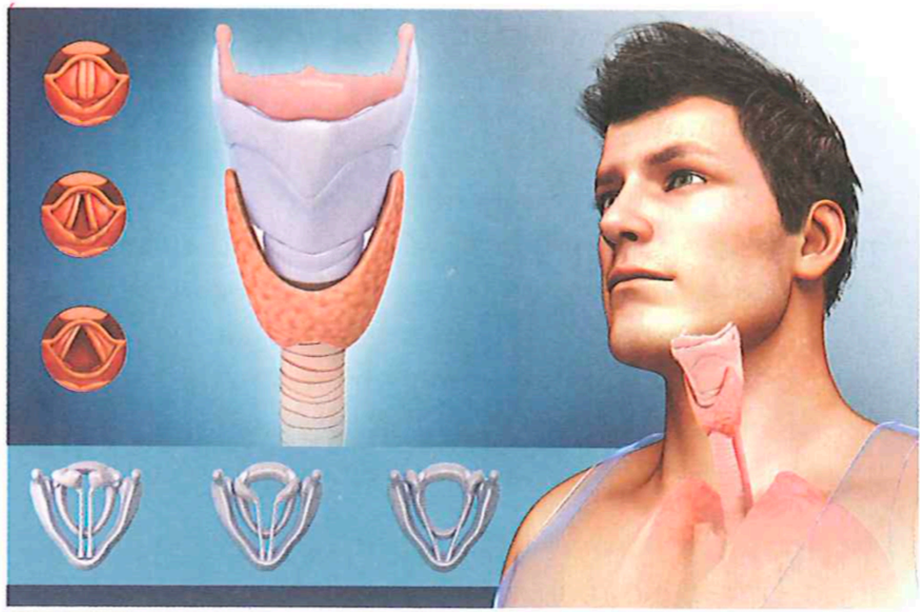


Figure 12.7: Vocal folds in the human throat vibrate to create speech.

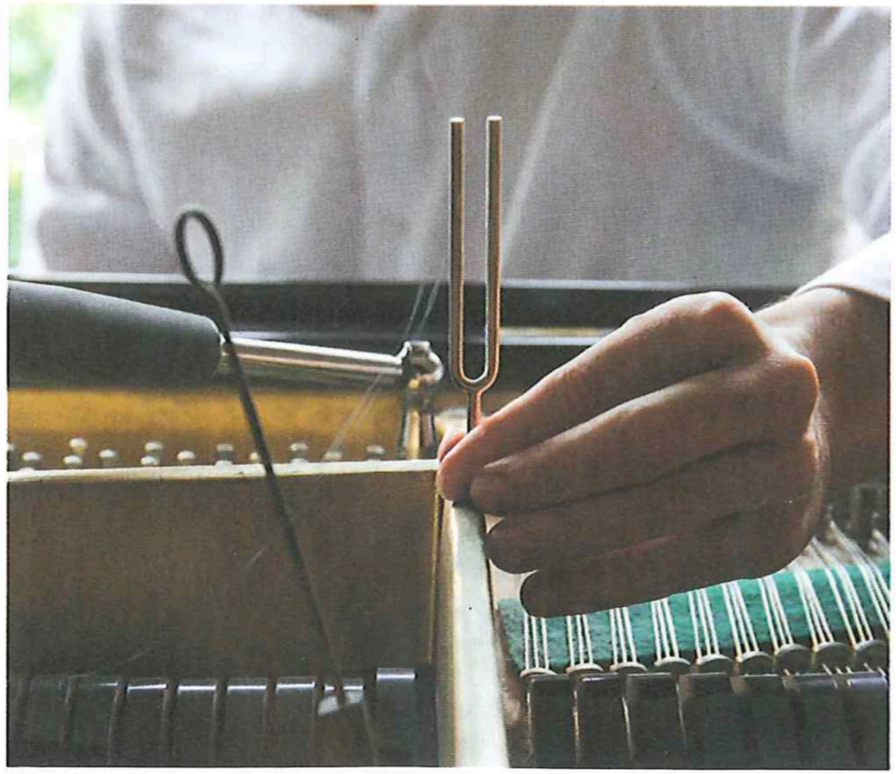
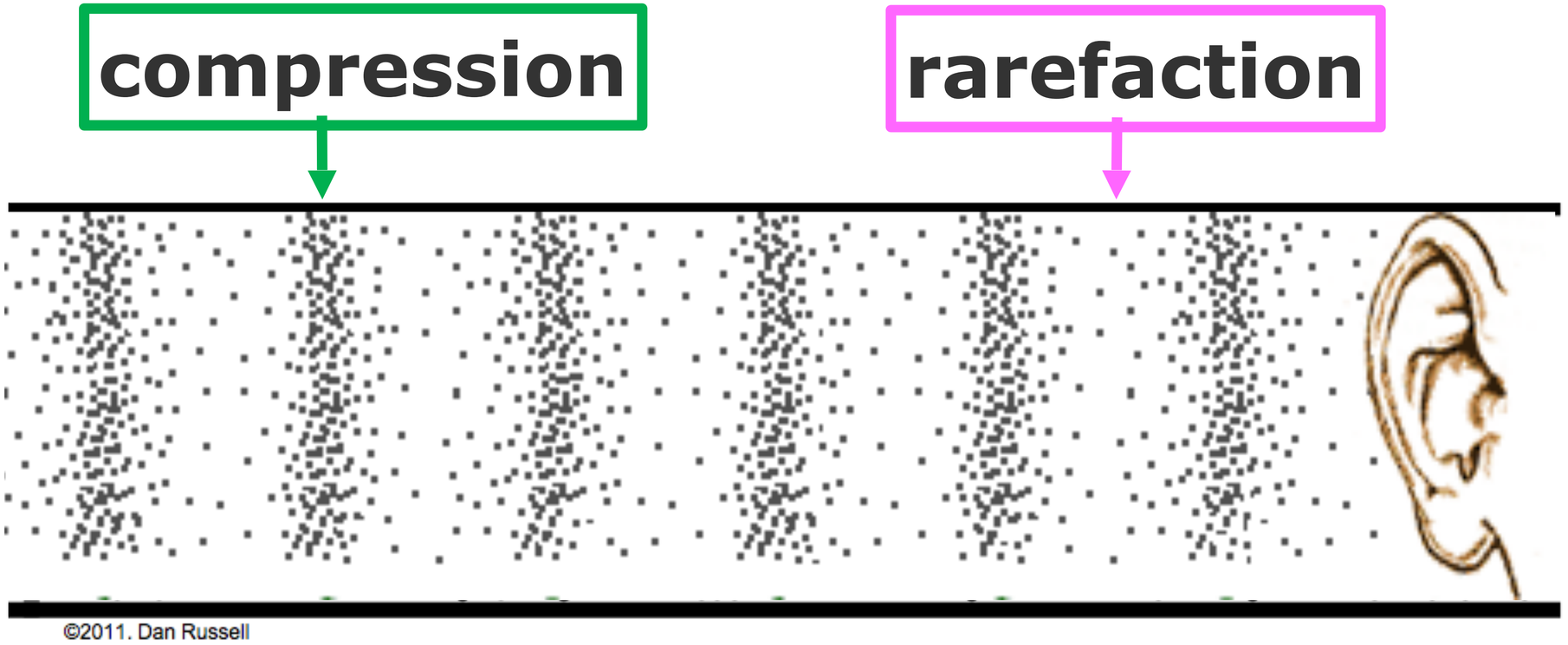


Figure 12.4: Hitting the tuning fork causes the prongs to vibrate.

All sounds are caused by **vibrations**

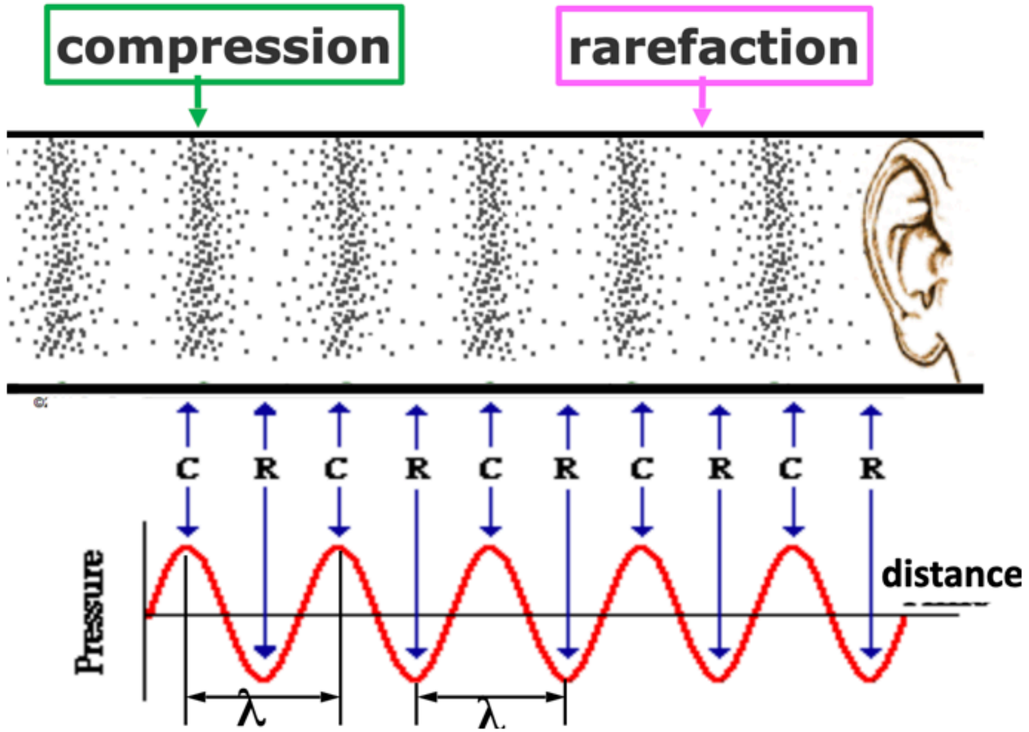
How does sound travel



Compression: regions where the vibrating particles are **closer** together

Rarefaction: regions where the vibrating particles are **further** apart

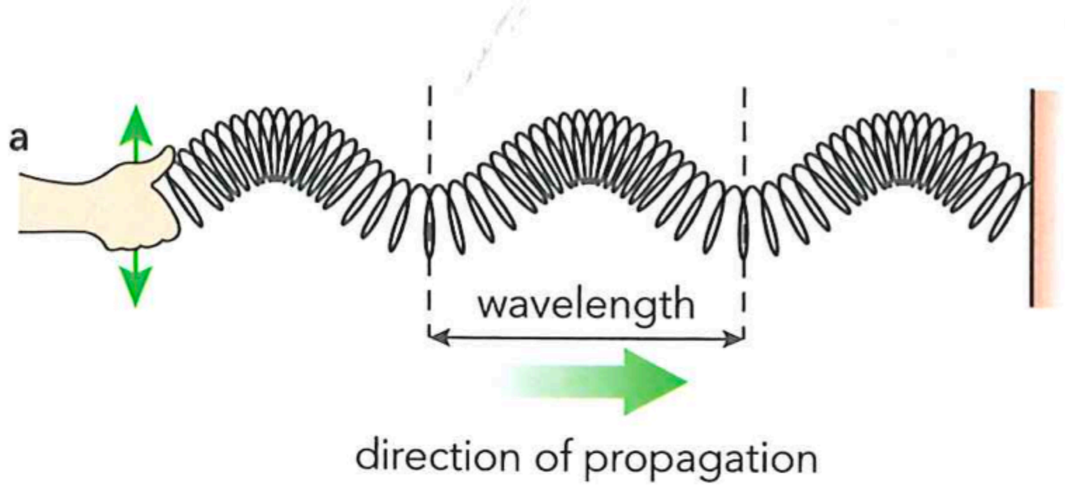
How does sound travel

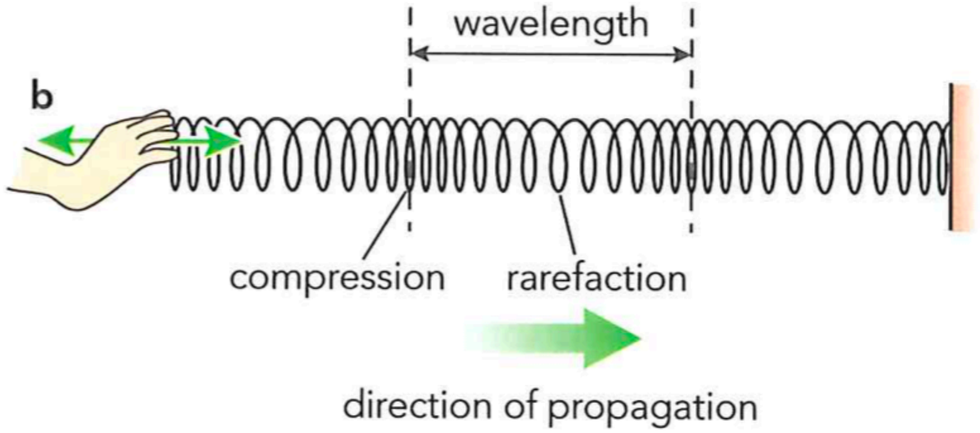


The medium particles oscillate **backwards and forwards** as the compressions and rarefactions pass through.

When a compression passes, the **pressure** rises. When a rarefaction passes, the **pressure** falls.

Transverse and longitudinal waves

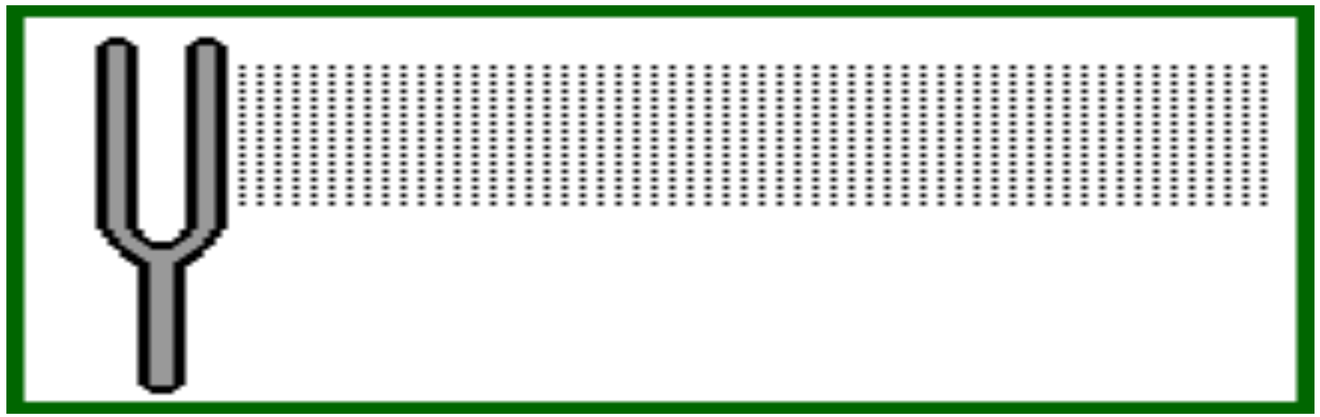




Transverse wave: the particles vibrate **perpendicular** to the direction of propagation/travel of the wave.

Longitudinal wave:the particles vibrate **parallel** to the direction of propagation/travel of the wave.

How does sound travel

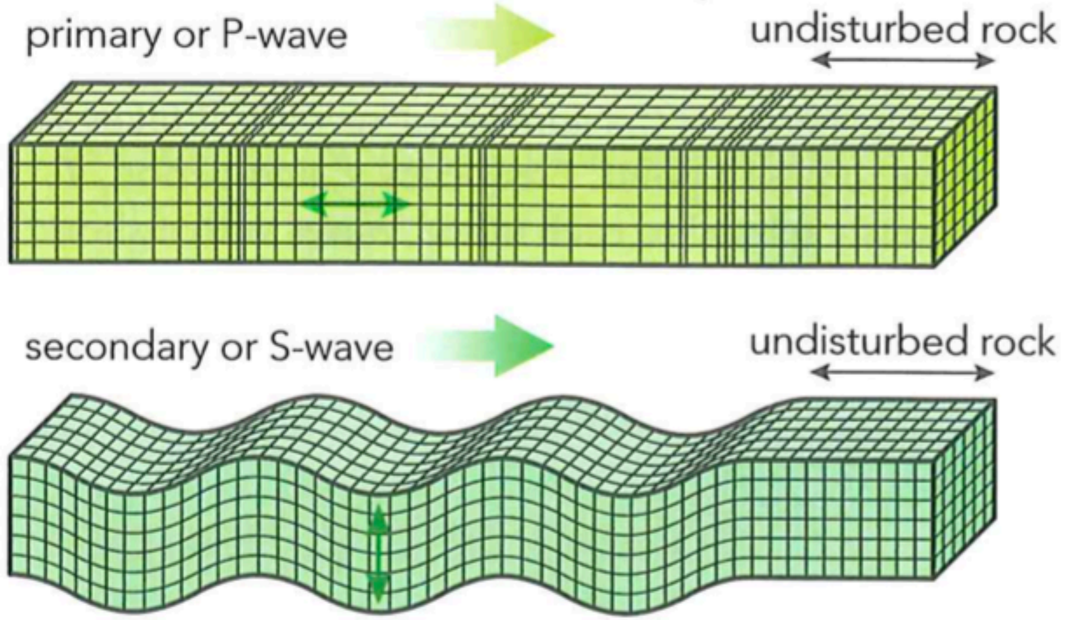


The particles vibrate parallel to the direction of propagation/travel of the wave.

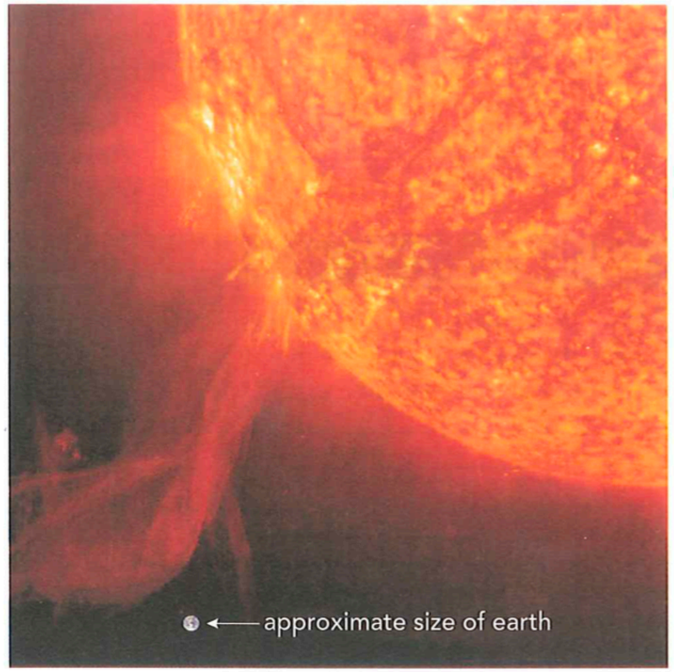
Sound waves are **longitudinal** waves.

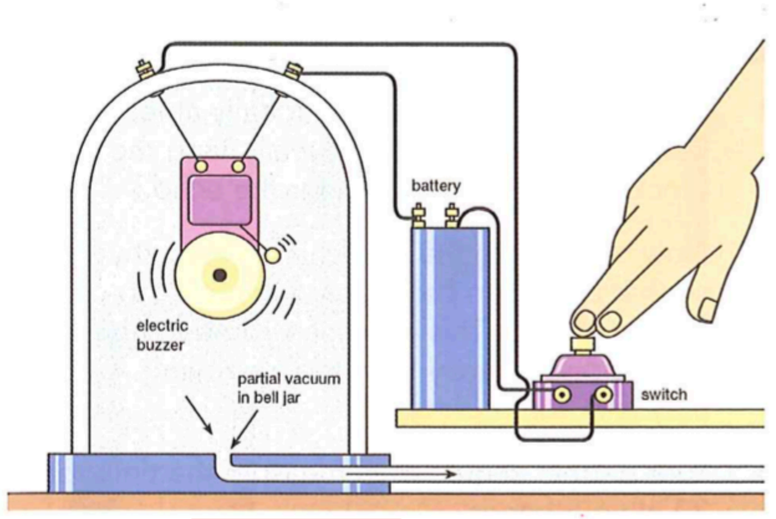
Transverse and longitudinal waves

Transverse waves	Longitudinal waves
ripples on water	sound
light and all other electromagnetic waves	primary seismic waves (P-waves)
secondary seismic waves (S-waves)	



Sound vs light





WHY?

Sound can travel in solid, liquid, gas; **cannot travel in vacuum**. Light can travel in vacuum.

In vacuum, speed of light $v = 3.0 \times 10^8 m/s$

In air, speed of sound $v = 330 - 350 m/s$

Sound speed

Medium	Speed of sound(m/s)
Rubber	60
Air at 0 °C	332
Air at 20 °C	343
Air at 40 °C	355
Lead	1210
Gold	3240
Glass	4540
Copper	4600
Aluminum	6320

In general, speed of sound

in solid > in liquid > in gas.

Typical speed: 3000m/s 1500m/s 340m/s

Particles are closer together =>

vibrations can be passed on more easily

Exercise

A boy sees lightning and hears the thunderclap 9 seconds later.

Calculate how far away the storm is.

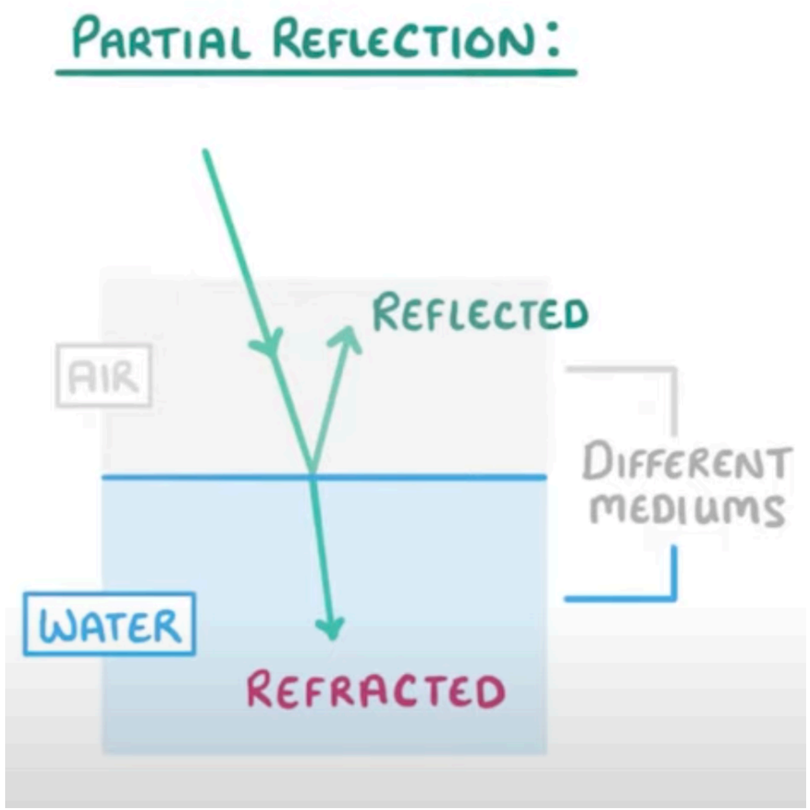
Exercise

Sound travels at 1500m/s in fresh water and at 1530m/s in salt water.

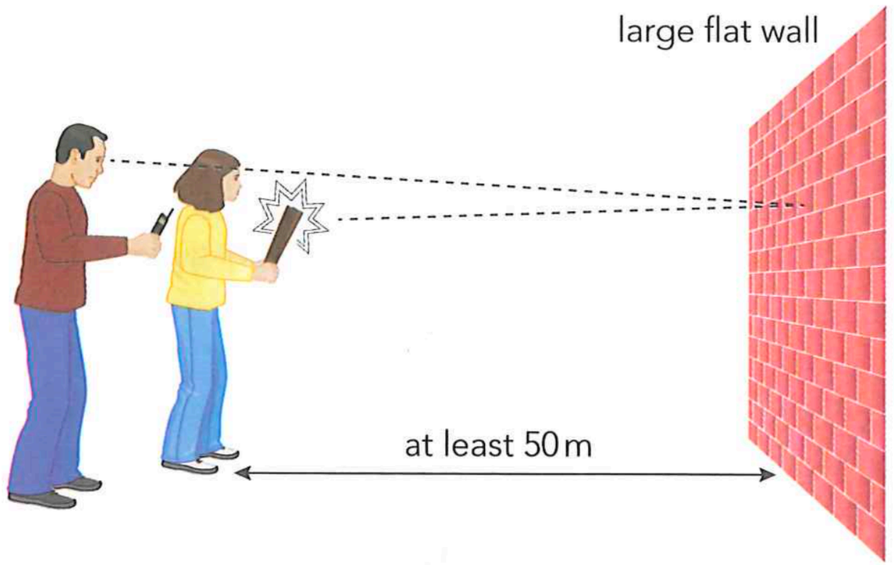
Explain the difference in speeds.

Reflection: echo

Sound is a wave, waves can be reflected => echo



Experiment: measuring the speed of sound in air

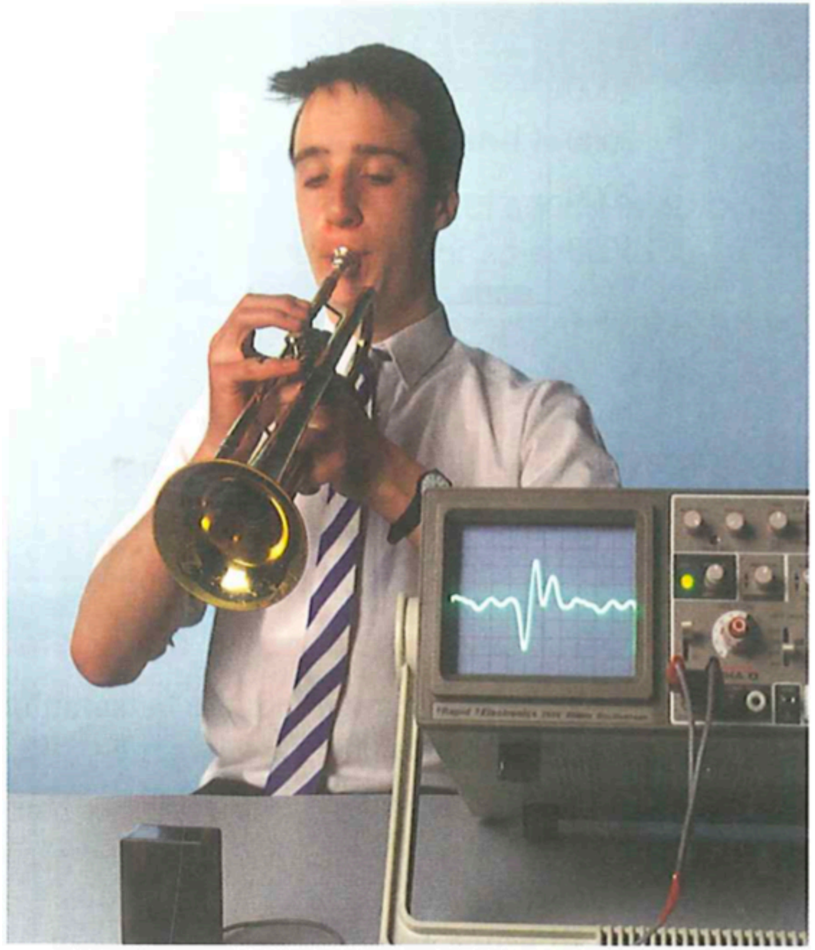


$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

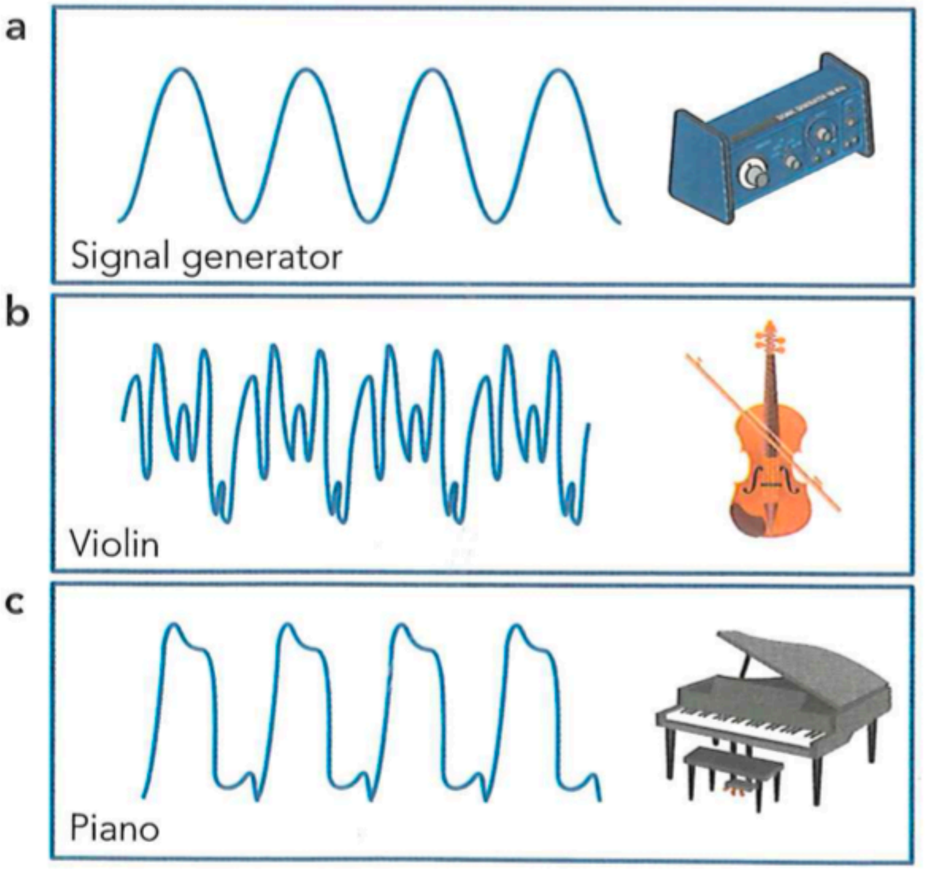
=50*2*19/time

How to increase the accuracy?

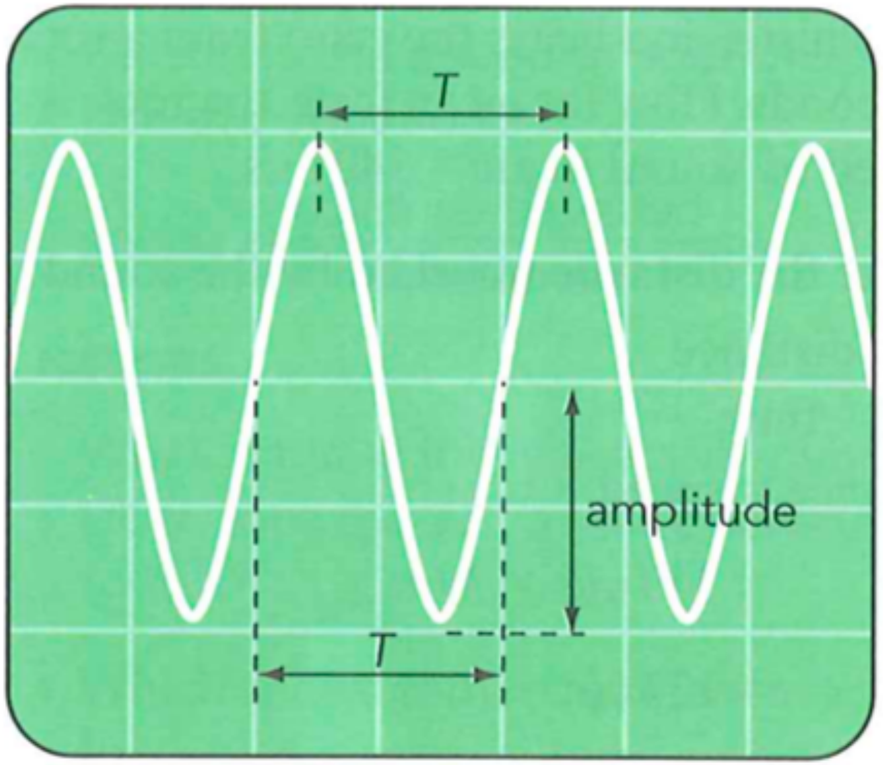
Seeing sound



Oscilloscope



Seeing sound



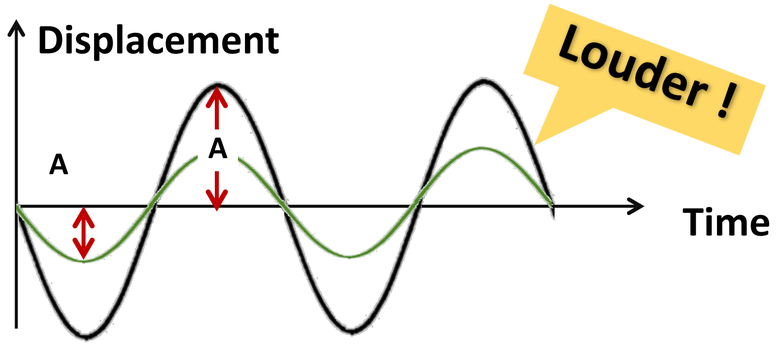
Amplitude: A

Period: T

Frequency: $f = \frac{1}{T}$

Hertz: Hz

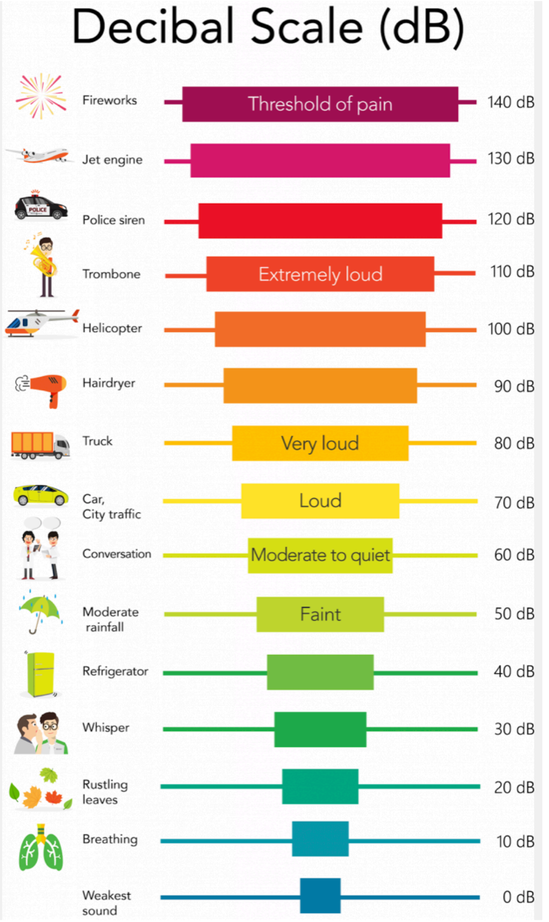
Loudness



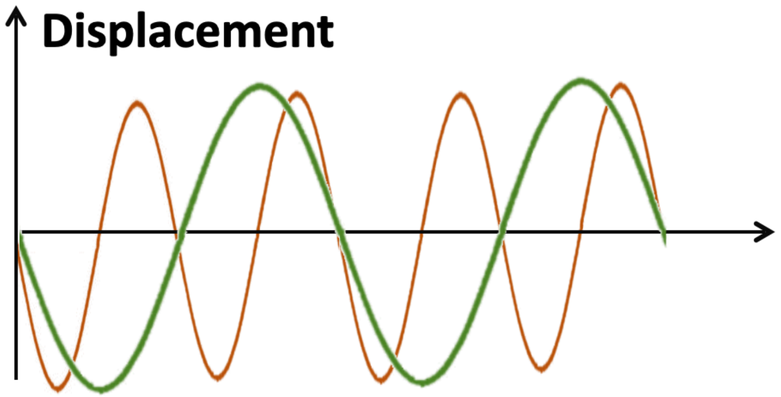
loudness of the sound

How quiet a sound is depends on the amplitude of the sound wave.

The greater the amplitude of the wave the louder the sound.



Pitch



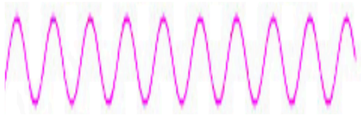
pitch of the sound

The pitch of a note depends on the frequency of the wave.

The higher the frequency of the wave the higher the note.

27.5 Hz

4186.01 Hz

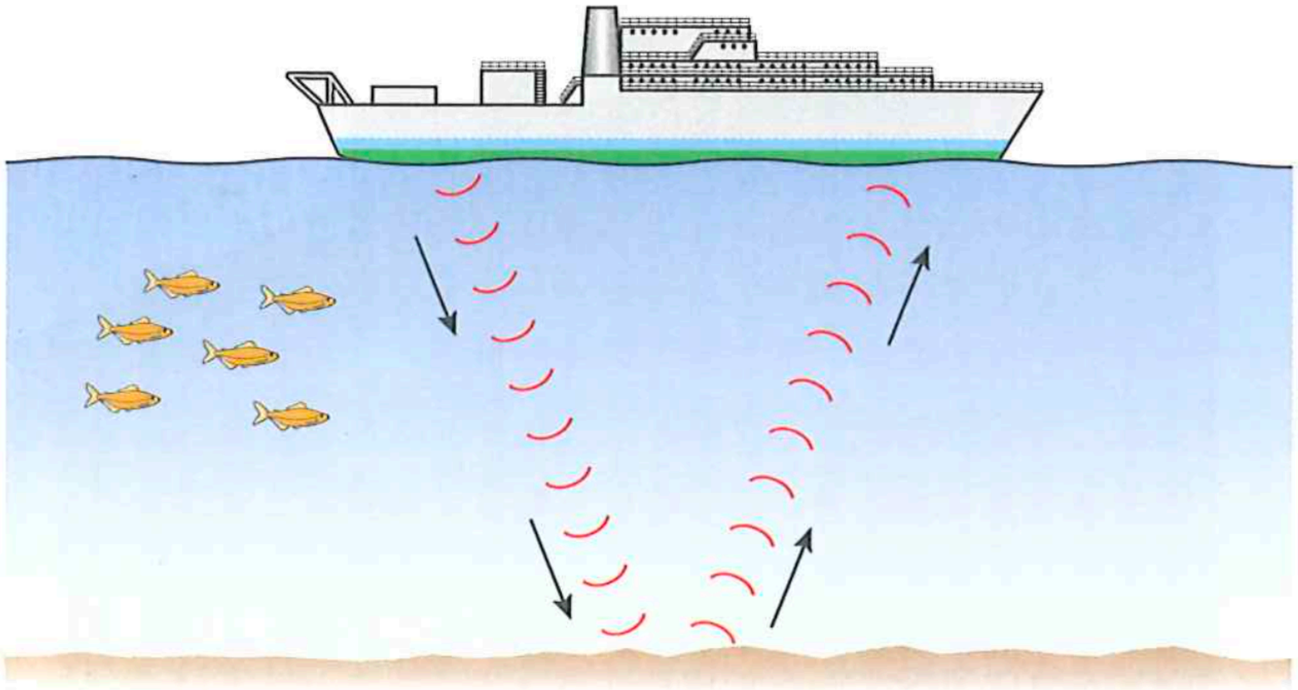


Human hearing

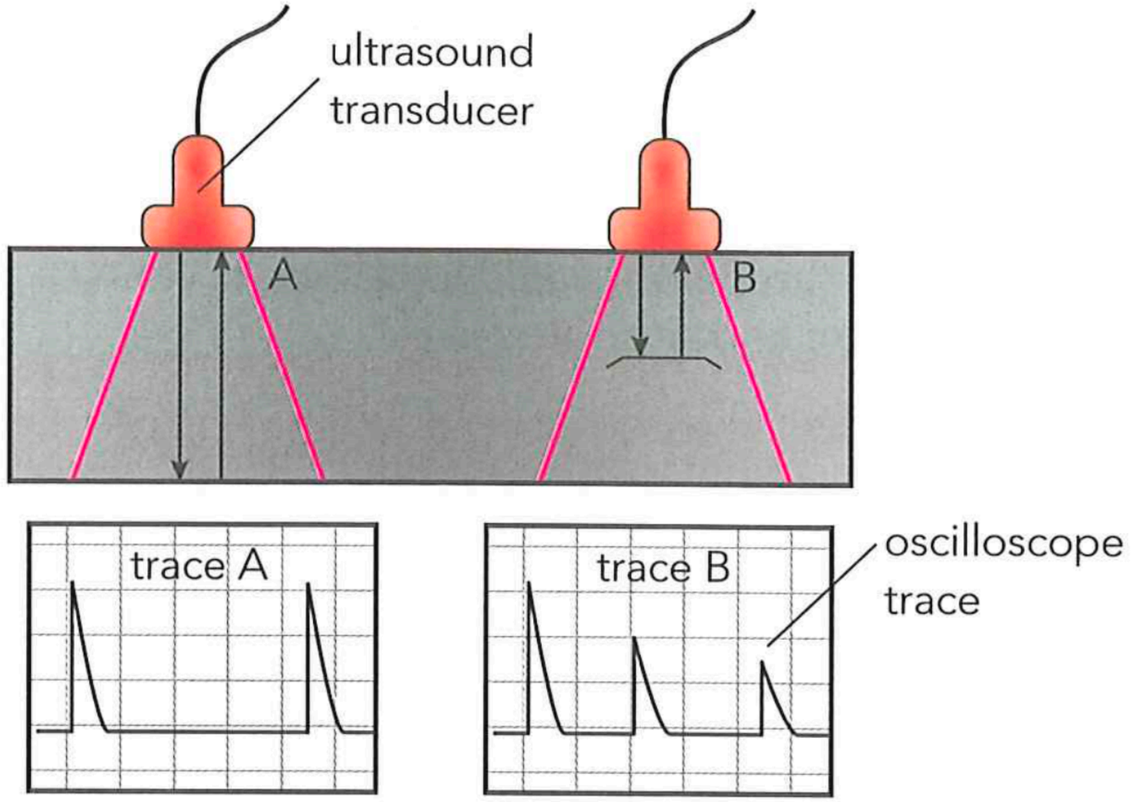
Infrasonic	Audio/Sonic	Ultrasonic
<20Hz	20Hz – 20 kHz	>20 kHz

Human ear is capable of hearing

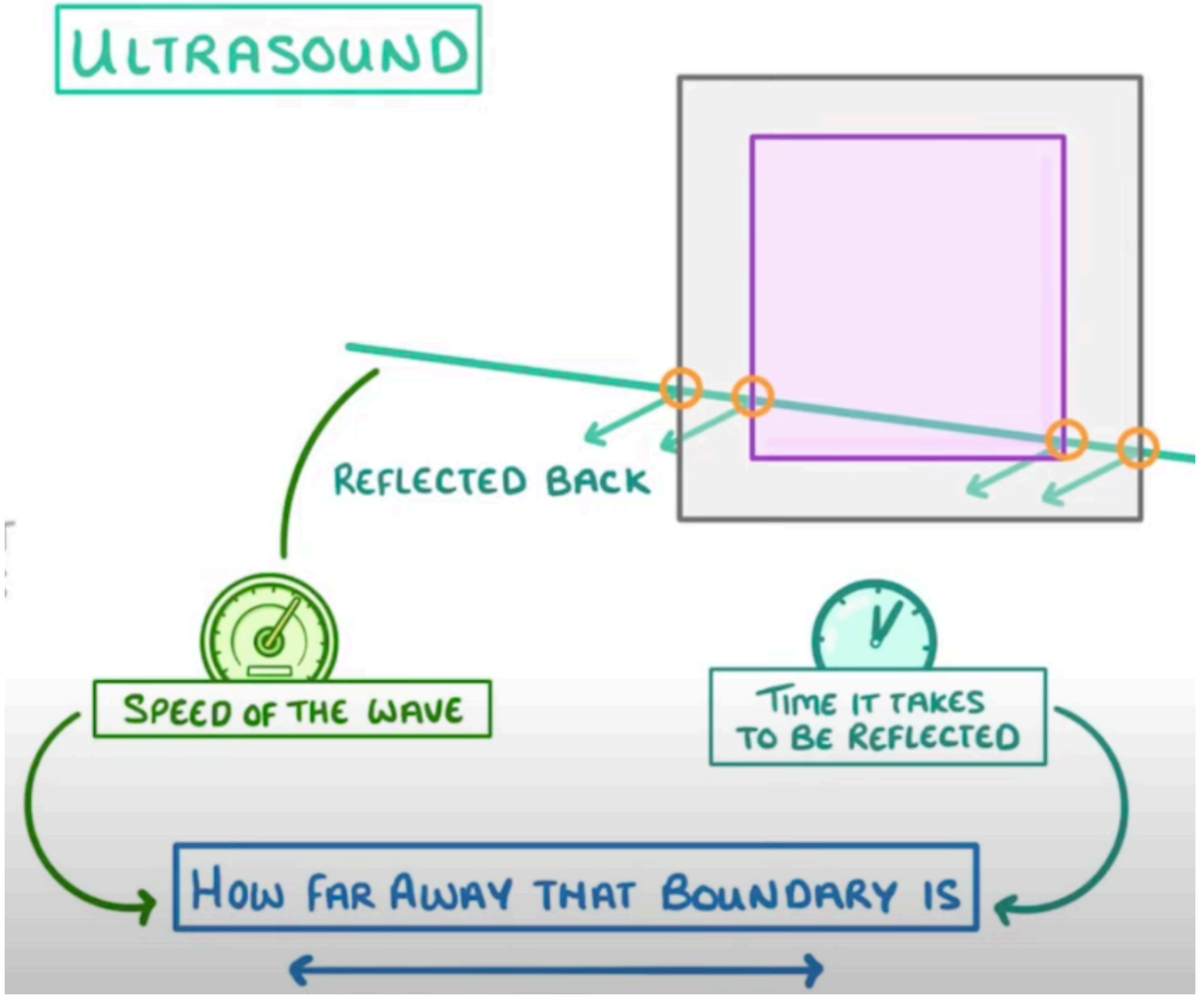
Application of ultrasound



Application of ultrasound



Application of ultrasound



Application of ultrasound