Sound

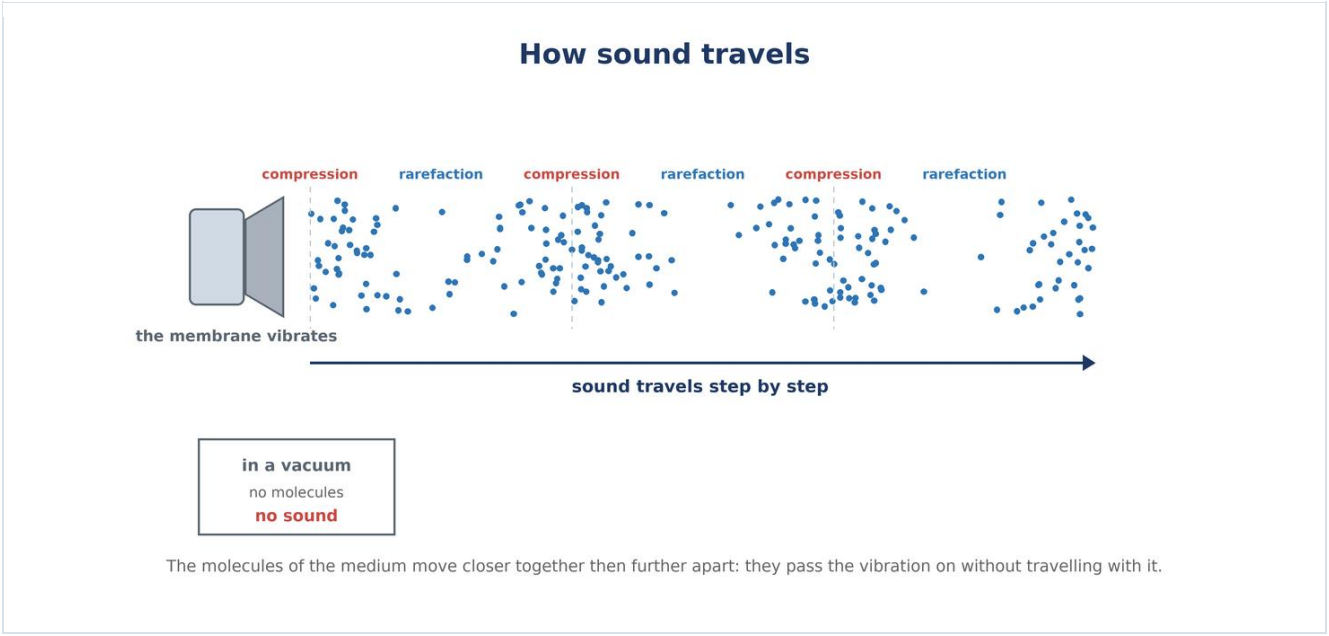
Printable revision sheet — Galaxscia

LEVEL 1

What is sound?

Sound is a **mechanical wave**: a vibration that travels through a material medium such as air, water or a solid. The molecules of this medium move closer together and further apart, passing on the energy of the vibration like a ripple on the surface of water.

Examples : - The human voice: the vocal cords vibrate in the air. - A drum: the drum skin vibrates to produce the sound. - Guitar strings: they vibrate to create musical notes.



The molecules of the medium move closer together then further apart: they pass the vibration on without travelling with it.

How sound travels

Sound needs a medium in order to travel. In a vacuum there are no molecules to pass the vibration on, so nothing is heard. The speed of sound depends on the medium:

Air: 340 m/s

Water: 1500 m/s

Steel: 5000 m/s

The denser and stiffer the medium, the faster sound travels through it.

Example : If you put your ear on a table, you hear a noise coming from the other side sooner than through the air.

Key points — revision questions

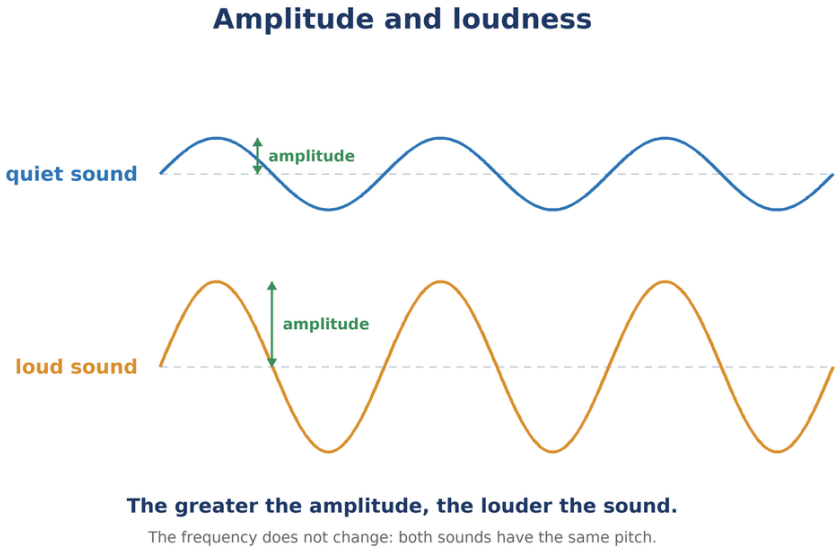
What is a mechanical wave?

Which media allow sound to travel?

How does the speed of sound change with the medium?

LEVEL 2

Loudness (intensity)



The loudness of a sound depends on the **amplitude** of the wave: the greater the amplitude, the louder the sound. Intensity is measured in **decibels (dB)**.

Examples : - Whisper: 30 dB - Normal conversation: 60 dB - Rock concert: 120 dB

Pitch (frequency)

The frequency of a sound decides whether it is low or high and is measured in **hertz (Hz)**.

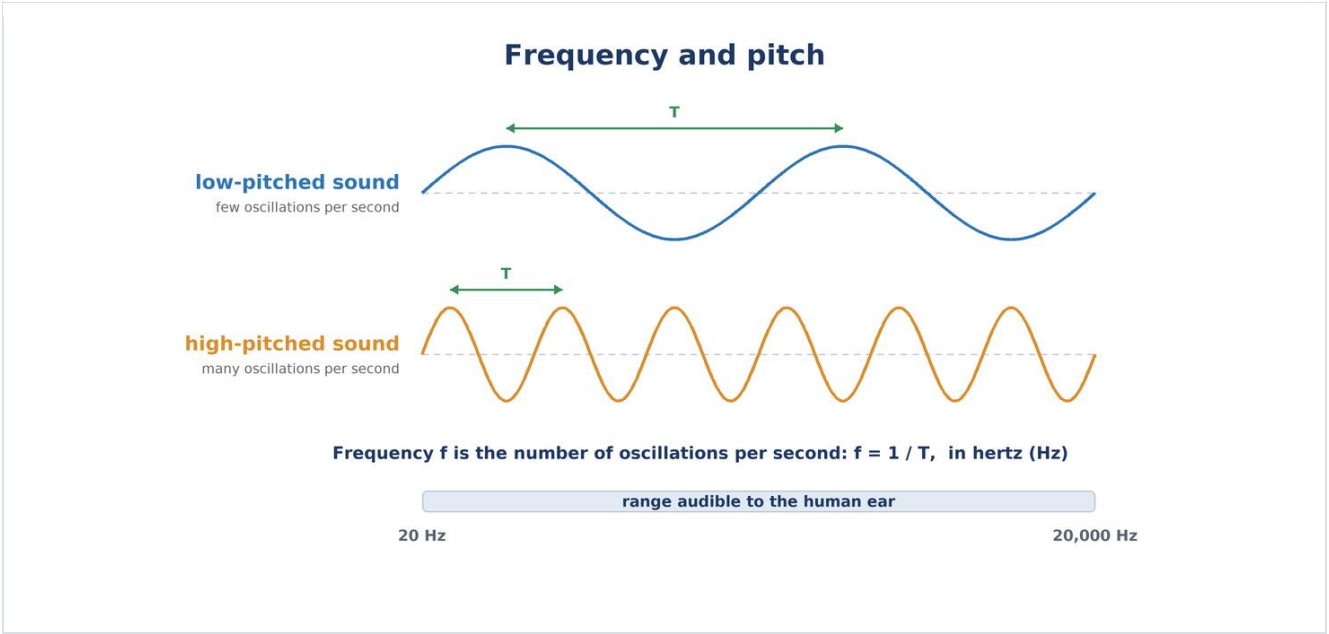
Low frequencies (20-200 Hz) → low-pitched sounds

Middle frequencies (200-2000 Hz) → mid-range sounds

High frequencies (2000-20000 Hz) → high-pitched sounds

Examples : - A bass guitar: 50 Hz (low) - A flute: 2000 Hz (high)

This measurement defines the frequency range over which the human ear hears sound: from **20 Hz** to **20,000 Hz**



Key points — revision questions

What is the amplitude of a wave?

How is the intensity of a sound measured?

What is the frequency of a sound and what does it let us tell apart?

What are the 3 ranges of sound?

LEVEL 3

Echo and the reflection of sound

When a sound meets a surface, it can be **reflected**. If the distance is great enough, the wave comes back towards the source as an **echo**. Echoes are used in many technologies such as sonar and animal echolocation.

Examples : - Shouting in a valley or in a large empty hall: you hear the same sound come back a few seconds later. - Bats use echoes to detect obstacles and to hunt.

The Doppler effect

The Doppler effect happens when a source of sound moves relative to an observer. The sound seems **higher-pitched** when the source comes closer and **lower-pitched** when it moves away.

Examples : - An ambulance siren coming closer then moving away. - A train going past: the pitch of the whistle changes.

Key points — revision questions

What is an echo and how is it formed?

What is echolocation used for in some animals?

What happens to the way sound is heard in the Doppler effect?

LEVEL 4

Timbre and musical instruments

Timbre is what lets us tell apart two sounds of the same pitch and the same loudness. It depends on the **mix of frequencies** in a sound, called harmonics.

Examples : - The note C played on a piano and on a guitar does not sound the same: the timbre is different. - The voices of two people singing the same note can be told apart thanks to timbre.

Technologies that use sound

Sound is used in many scientific and medical applications:

Ultrasound: for medical scans, for cleaning or for industrial testing.

Audio systems: microphones, loudspeakers, recordings.

Sonar: to detect objects under water.

Examples : - An ultrasound scan to see a foetus. - Sonar to locate a submarine or a shoal of fish.

Key points — revision questions

What is the timbre of a sound and what is it used for?

Which phenomena make it possible to create ultrasound?

Give examples of sound being used in technology and in medicine.