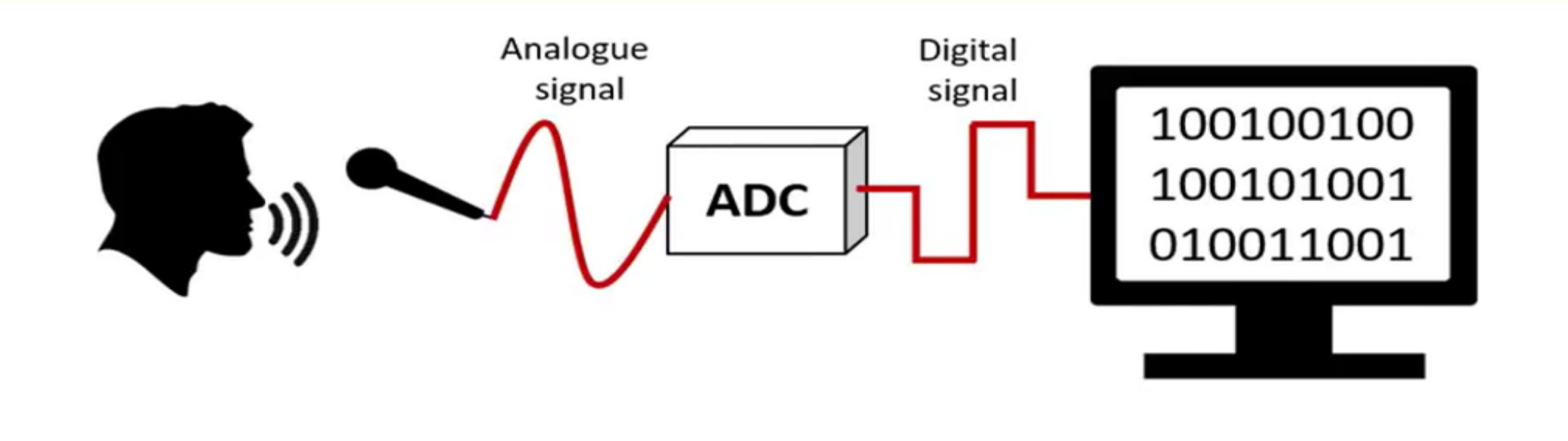
Learning Aims

- Understand how sound is stored into binary values
- Understand the factors that affect how sound is stored and how this affects the memory needed for storage.
- Understand and be able to explain why the factors affect memory storage and how this can be overcome through file compression.

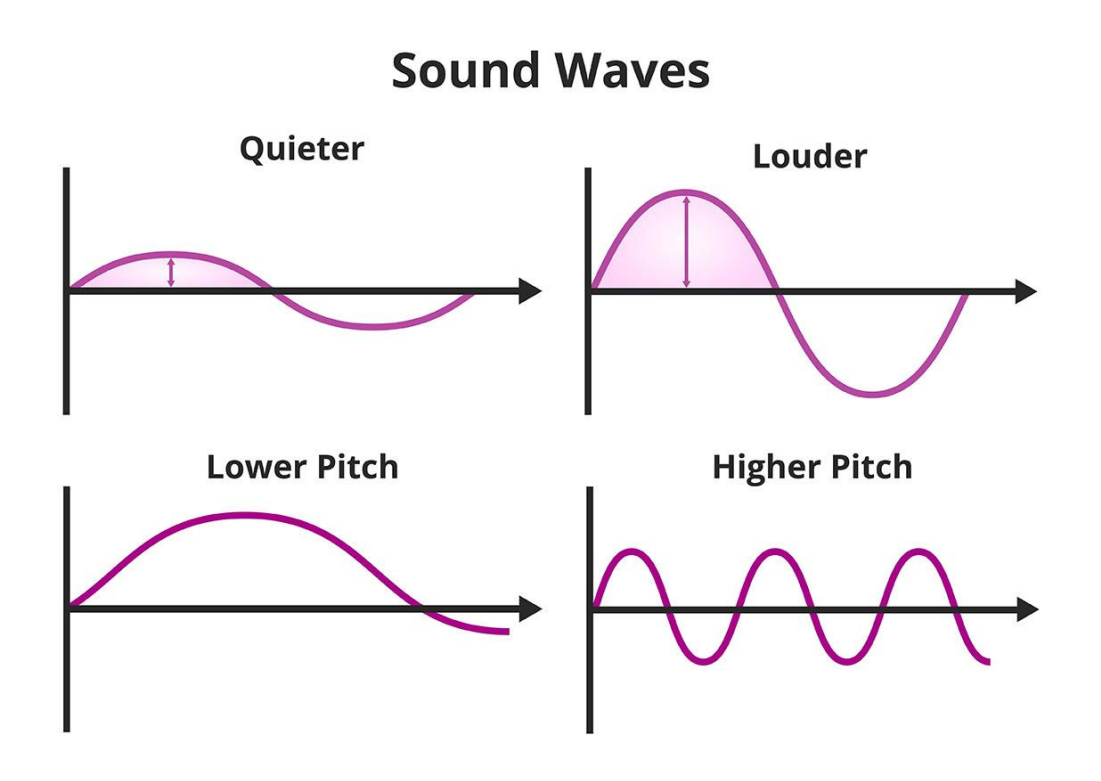
How sound is sampled and stored in digital form



Digital sound is broken down into thousands of samples per second – each of these samples is then stored as binary data.

Sound Wave Amplitude

Amplitude = How loud or soft a sound is (depends on wave height).



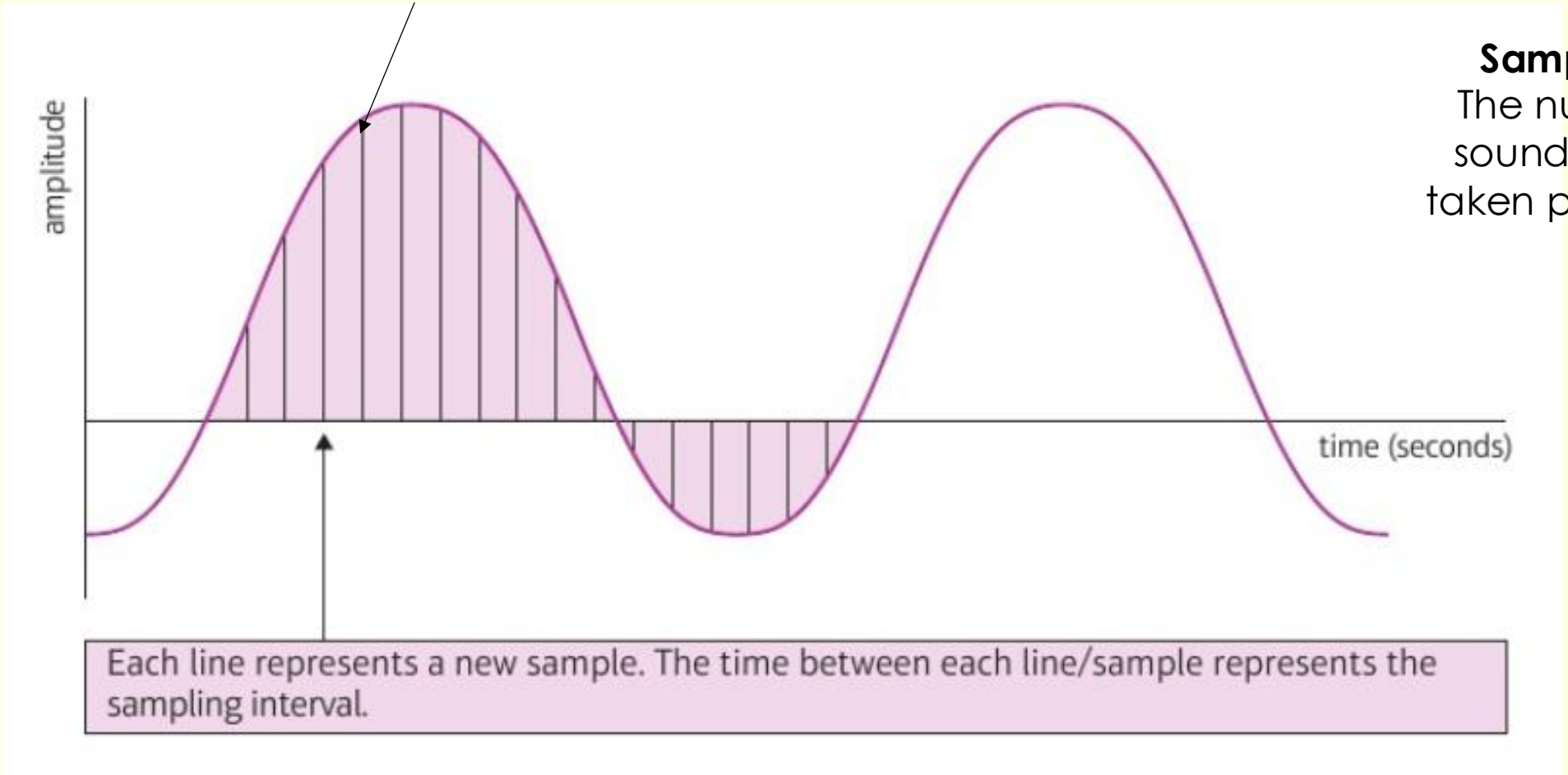
Pitch = How high or low a sound is (depends on frequency).

How a sound wave is sampled digitally

Amplitude is stored as binary at each sampling point

Sampling interval
time between sampling points

Sampling points



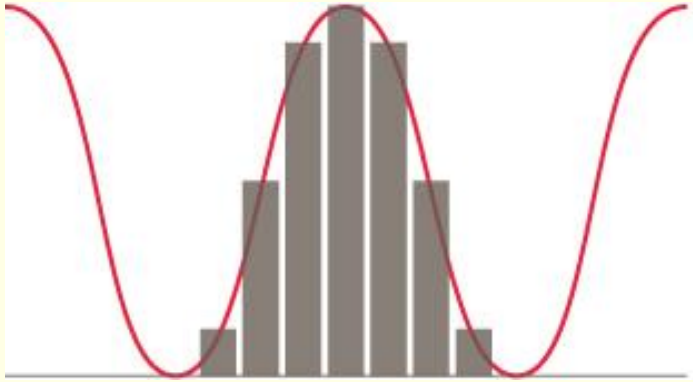
Sample rate
The number of sound samples taken per second

Digital Audio Key Words

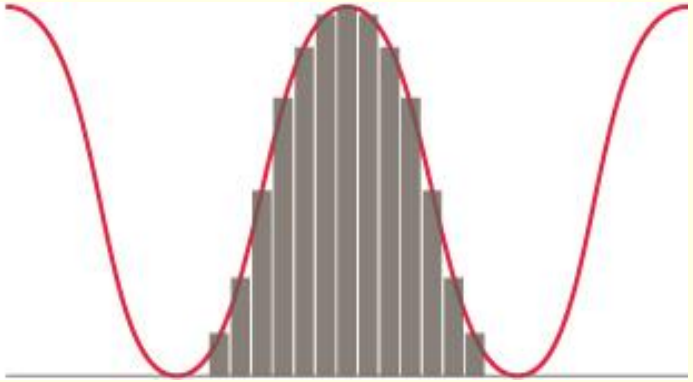
Sample Rate	**Bit Depth**	**Sample Size**	**Bit Rate**
Sample rate The number of sound samples taken per second Measured in hertz	Number of bits used to encode each sample	The number of bits in a sound file	The number of bits processed per second of audio

Sample Rate

Sample rate is measured in hertz.



Low Sample Rate



High Sample Rate

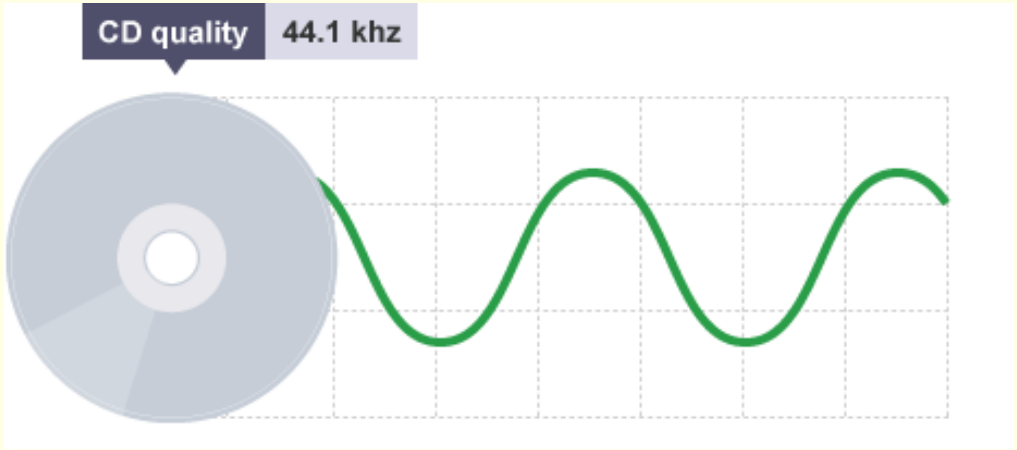
This refers to the number of samples taken per second

The higher the sample frequency the **more accurate** it represents the true sound wave

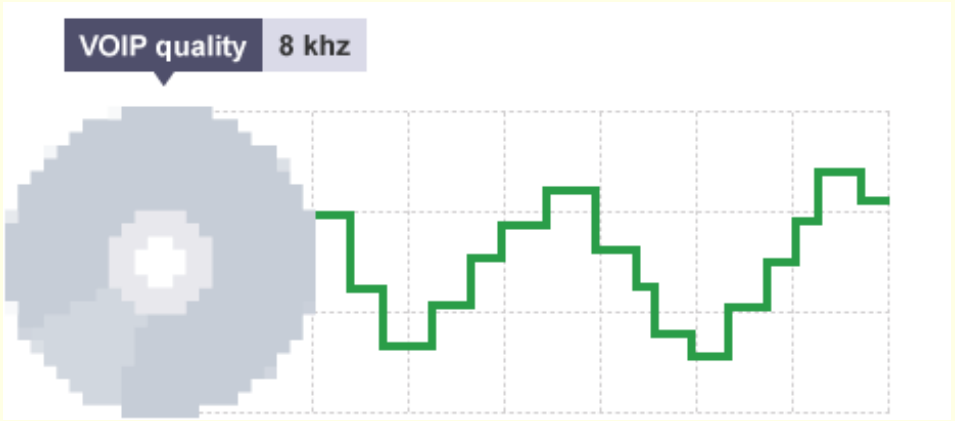
ALTHOUGH it increases the size of the file!

Sample Rate Example

Common audio sample rate for music is 44,100 samples **per second (CDs) – the unit this is measured in is hertz –** This is 44,100 hertz or 44.1 kilohertz (kHz)



Telephone networks and VOIP services use a sample rate as low as 8 kHz



Bit Depth

- Bit depth is the number of bits used to encode each sound sample.
- Using a higher bit depth allows much smaller changes in the volume difference to be recorded.
- If the bit depth is too low, the re3cording is not accurate and a lot of differences in the sound are lost.
- Using a bit depth of 8 bits (256) changes of sound can be measured compared with 24bits 16.7 million measured volume levels.

Balancing quality and sound file size

- Sample rate and bit depth determine how accurately a digital representation matches the original analogue sound

- But the higher the sample rate and bit depth, the larger the file size

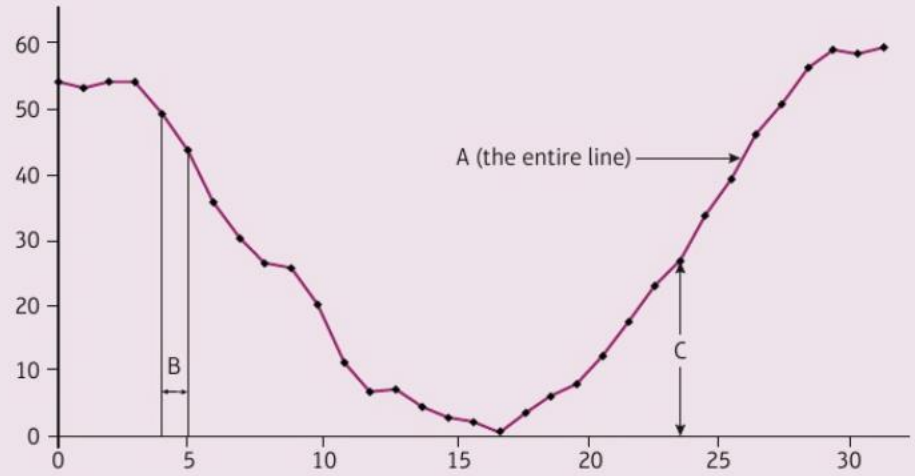
Task

Activity

This diagram shows the process of converting sound from analogue to digital.

a) Label the x and y axes.

b) Give the names of the items labelled A, B and C.



Activity

2 An analogue sound signal needs to be digitised.

a) State the aspect of the analogue signal that will be sampled and stored as binary data during the analogue to digital conversion. (1 mark)

b) State how reducing the bit depth affects the digital representation of the original audio. (1 mark)

c) Explain how increasing the sampling interval affects the digital representation of the original audio. (2 marks)

3 An analogue sound is never fully reproducible in digital format. Explain why this is the case. (2 marks)

Sample Size

BIT DEPTH X SAMPLE RATE X NUMBER OF SECONDS

Bit rate

- Bit rate is simply a measure of how much data is processed for each second of sound. Bit rate is calculated by:

bit rate = Frequency/sample rate × bit depth × channels

- As with sample rate, the higher the bit rate, the better quality of the recorded sound.