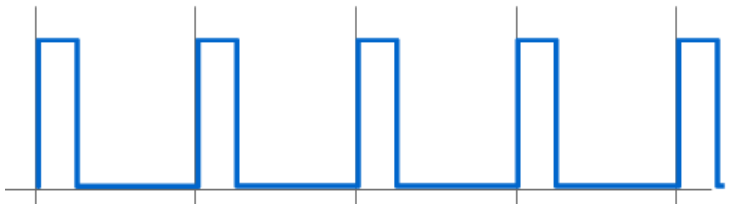
Storing Audio and Sampling Sound

- Computers don’t do waves!!

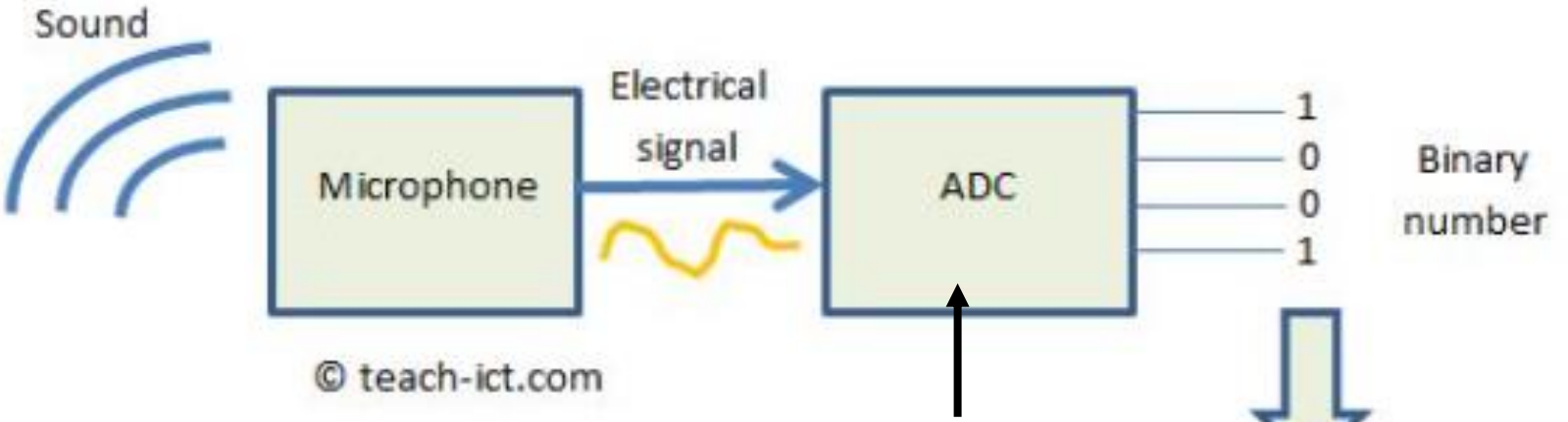
- They do On or Off. There is no middle ground!



Natural sound is in **analogue** form.

To develop knowledge by understanding the difference between analogue and digital sound

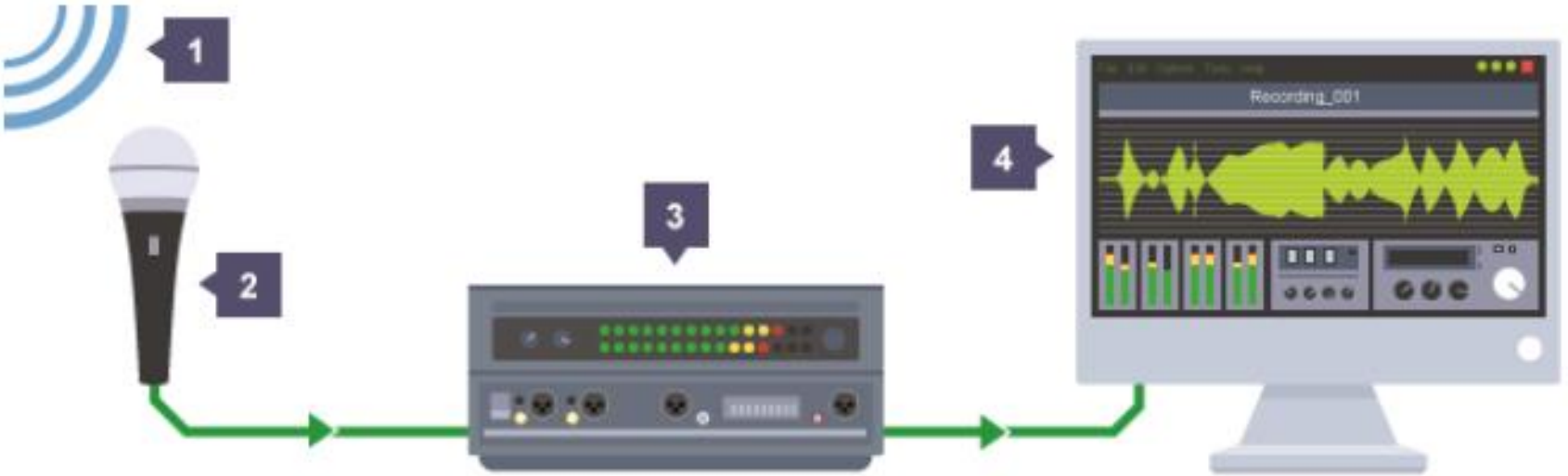
It has to be converted to digital form to be used in a computer



1. Microphone measures change in air pressure
2. Microphone translates air pressure into electrical voltage
3. Analogue to Digital Converter digitises the electrical voltage to bytes of information

http://www.teach-ict.com/2016/GCSE_Computing/OCR_J276/2_6_data_representation/sound/miniweb/index.php

https://www.bbc.com/bitesize/guides/z7vc7ty/revision/1



1. Microphone measures change in air pressure
2. Microphone translates air pressure into electrical voltage
3. Analogue to Digital Converter digitises the electrical voltage to bytes of information
4. Computer displays the digitised sound for manipulation

To develop knowledge by understanding the difference between analogue and digital sound

Sampling

- An analogue signal, such as sound, is sent to a computer system, it has to be converted into a digital signal before it can be processed.

- Sound is stored as a digital representation.

In other words…Sound is stored in a computer as BINARY DIGITS

- Sound is converted into a digital signal by a process called **sampling**.

- Sampling is where hardware, such as a microphone, **measures the level of sound many times per second** and records this as binary digits.

To secure understanding

Explain the digital storage and sampling of sound.

Sampling frequency

- The number of times that the sound level is sampled per second is called the *sampling frequency (or sample rate)*.

- A typical sampling frequency is 44,000 times per second, also known as 44 kHz. This is the sampling frequency used on most audio CDs.

The higher the sampling frequency:

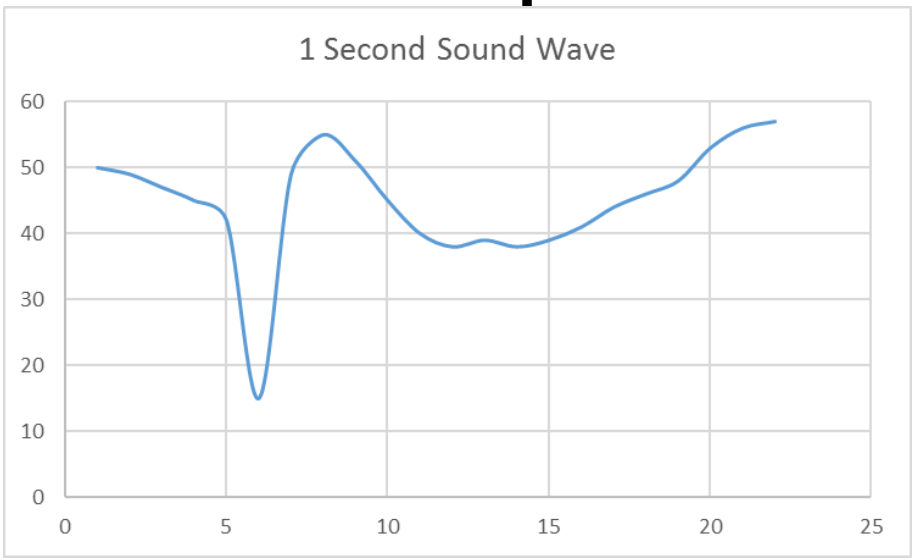
- **The better the quality of the sound recorded.**
- **The larger the file size**

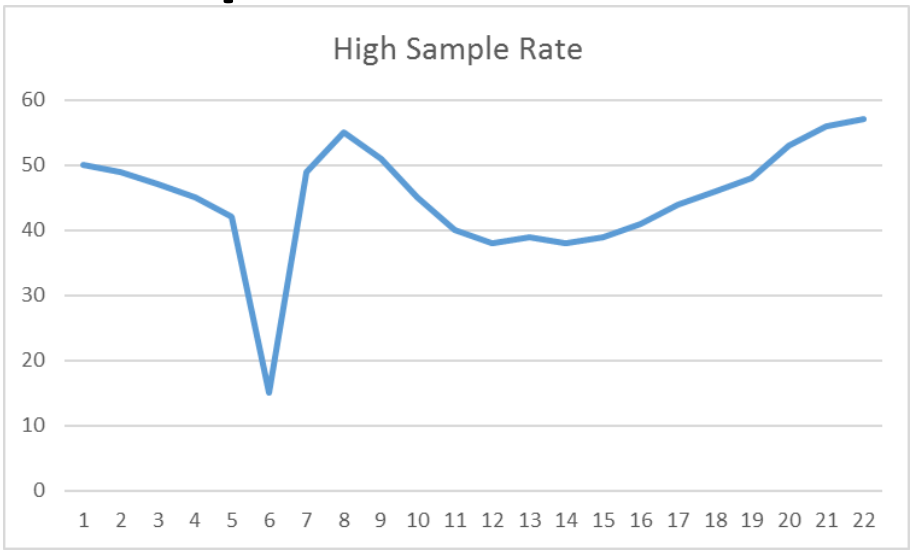
(*The more samples taken per second – the better the sound quality)*

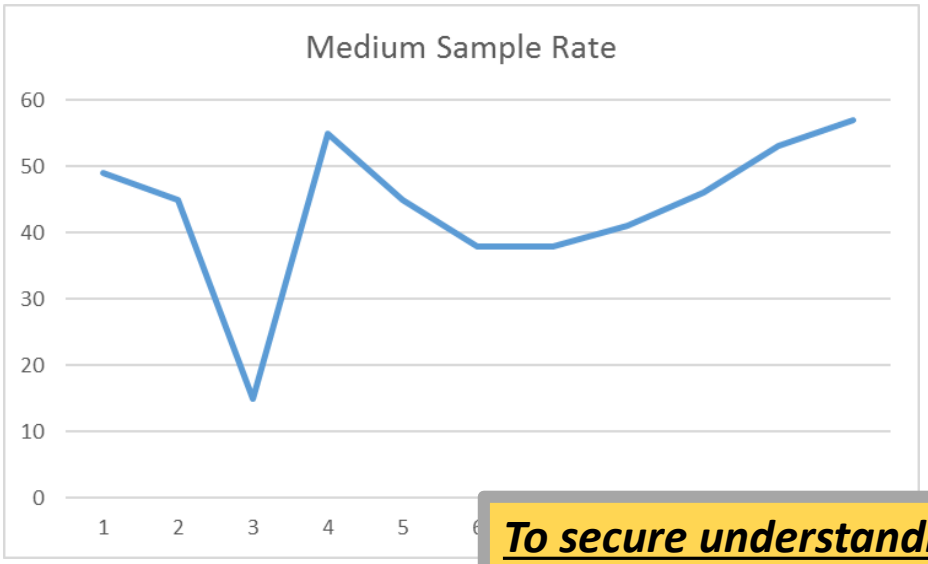
To secure understanding
Explain the digital storage and sampling of sound.

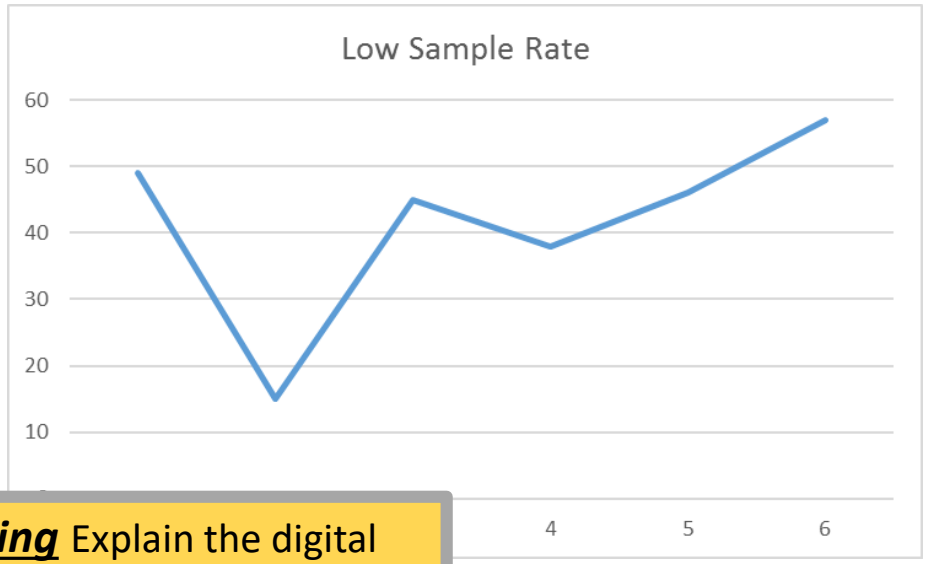
To achieve excellence
Evaluate the affect sampling rate, bit depth and bit rate have on the quality of sound.

Sample Rate Comparisons









To secure understanding Explain the digital storage and sampling of sound.

Examples

- https://www.youtube.com/watch?v=96jFvdteqWI

To secure understanding
Explain the digital storage and sampling of sound.

To achieve excellence
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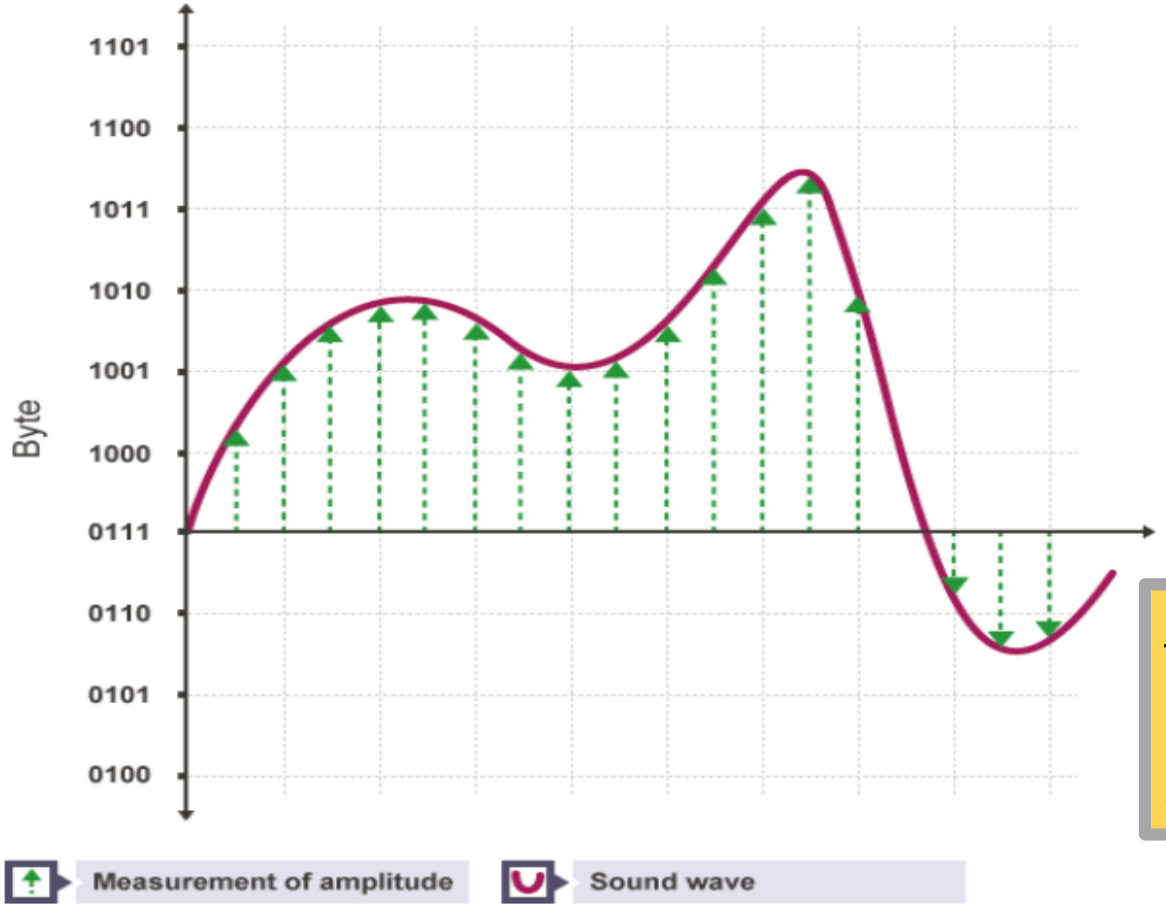
Bit depth / sample resolution

Bit depth: the number of bits available for each clip

- The samples below are stored using a 4 bit-depth



To secure understanding

Explain the digital storage and sampling of sound.

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Evaluate the affect sampling rate, bit depth and bit rate have on the quality of sound.

Bit depth / sample resolution example

Bit depth	Each sample contains	Quality
2 bit resolution	00 01 10 11	4 possible values of sound
16 bit resolution	0000000000000000 to 1111111111111111	65,535 possible sound values

The higher the bit depth:
- **The better the quality of sound**
- **The larger the file size**

Bit depth is usually 16 bits on a CD and 24 bits on a DVD.

To secure understanding Explain the digital storage and sampling of sound.

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Evaluate the affect sampling rate, bit depth and bit rate have on the quality of sound.

Bit rate

Bit rate: – the number of bits used per second of audio

The bit rate is calculated using the formula:

Sample frequency × bit depth (sample resolution)

Example: 1 sample is taken per second and stored with a bit depth of 8 (8 bits per sample)

Bit rate = 1 (sample frequency) x 8 (bit depth) = 8

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Calculating file size

The size of the storage requirement will depend on:

- the sample rate (*how many samples per second*)
- the sample resolution and (*how many bits per sample*)
- the length of the sound.

File size = sample rate x sample resolution x length of sound

(or File size = bit rate x length of sound)

Sample rate = 8KHz (8000 samples per second)

Sample resolution = 16 bit (16 bits in each sample)

Length of sound = 30 seconds

=> 8000 x 16 x 30 = 3840000 bits

3840000 bits

(384000 ÷ 8)

=> 480000 bytes

(480000 ÷ 1024)

=> 468.75KB

Keyword recap

Sampling frequency / sample rate = amount of samples taken per second

Bit depth / sound resolution = the number of **bits** available for each **sample**.

Bit rate = the number of bits used per second of audio

Amplitude = The maximum height of a wave from the middle of the wave to its peak or trough.

Higher bit depth = higher quality of audio.

Higher sampling frequency = better quality of sound recorded.
(***The more samples taken per second – the better the sound quality)***

More bits = larger file size

Tasks

GRASP IT TASK
Write questions in book and answer

1.How does sample rate affect the quality of the playback for an MP3 sound track? **(2 marks)**

2.What factors affect the file size for a sampled MP3 soundtrack? **(4 marks)**

THINK IT Tasks

To achieve excellence

Evaluate the affect sampling rate, bit depth and bit rate have on the quality of sound and file size.

Task 1

A 20 second sound has been sampled using a sample rate of 8KHz with a bit depth of 8 bits. Calculate the amount of storage required to store the sample. Give answer in bytes and kilobytes

Task 2

Sample file 1

Sample rate = 5KHz

Sample resolution = 8 bit

Length of sound = 30 seconds

Sample file 2

Sample rate = 5KHz

Sample resolution = 4 bit

Length of sound = 30 seconds

1.State which sample file will have the biggest file size. You must justify your answer:

2. Calculate the file size for each file (show working out)

Were you correct?