Sound

Teacher's Notes

Lesson Plan

Length	60 mins	Specification Link	2.1.4/no	Sound
Learning objective		(a) Explain how sound can be sampled and stored in digital form (b) Explain how sampling intervals and other considerations affect the size of a sound file and quality of playback		

Time (min)	Activity	Further Notes
10	Using a projector show the following flipbook animation (http://www.cambridgegcsecomputing.org/weblink20) or similar – there are lots on YouTube. Explain that flicking through the pages, each with a slightly different 'snapshot', makes us feel as though we are looking at a moving image. Mention stop-go animation. Also that there are iPad apps such as iMotion to create similar effects by taking **'snapshots'** and then playing them back quickly. Explain that digital sound storage and playback works in a similar way – lots of **'soundshots'** are taken and then played back at the correct speed. Show students the link to the specification. Explain the purpose and objectives of the lesson.	Other examples are available on YouTube.
15	Watch the set of videos.	
5	Ask some questions about the videos to assess learning. e.g. • What is meant by the sampling rate? • Why does a greater bit depth produce more accurate recordings? • Why are digital audio files compressed?	The number of samples taken per second. More information about the sound can be stored. Raw files can be very large e.g. 50MB for a standard song. They are compressed for efficient storage and easier transmission.
5	Play the following BBC Learning Zone video about a digital recording studio. (http://www.cambridgegcsecomputing.org/weblink18)	
15	**Worksheet 1** Students to complete Worksheet 1 either on paper or on computer. Ask individual students for their answers and discuss with the class so that all students will have the correct answers entered on their worksheets.	Answers provided.
5	**Activity 1** Students to complete Activity 1.	

Time (min)	Activity	Further Notes
	Extension Challenge/Homework • The students should complete and submit Worksheet 2 if not already completed.	
5	**Plenary** Using a projector, display **Activity 2** to see if the class can differentiate between music recorded at different sample rates and bit depths.	

WORKSHEET 1 ANSWERS

1 Explain how an analogue recording is made.

A device such as a microphone converts the changes in air pressure caused by a sound wave into changing electrical voltages. The microphone is a transducer – changes one form of energy into another.

These voltage changes cause a stylus to cut a groove on a disk or an electromagnet to rearrange the ferric oxide molecules on a tape.

During playback, as the stylus moves through the grooves of the spinning record, its movement is converted back into electricity which causes the diaphragm in a speaker to vibrate.

As the tape passes under the playback head it magnetises the head and the changes in the magnetic field induce a voltage in a coil of wire.

2 Why doesn't a digital recording of a piece of music contain all of the sound available?

A digital recording contains samples of the sound.

The sound is sampled at fixed time intervals e.g. for CD quality recordings at 44,100 times per second.

3 (a) Explain what is meant by the 'sample rate'.

The number of times per second that the sound is sampled.

It is measured in kHz or kilohertz.

(b)What sample rate is standard for audio CDs?

44.1 kHz or 44,100 times per second.

4 (a)What is meant by the 'bit depth' and how does it affect the quality of the digital recording?

Bit depth is the number of bits of information in each sample.

By increasing the number of bits ("units of information") contained in the file, the amount of detail contained in each sample is increased.

WORKSHEET 1 ANSWERS

5 **(a) What is meant by the 'bit rate'**

The amount of information that is stored in each second of the digital recording.

It is measured in Kbps or kilobits per second.

(b) What is the standard bit rate for:

(i) CD quality? 128 kbps

(ii) Internet radio? 56 or 64 kbps

(c) (i) Complete the following equation which can be used to calculate the bit rate of a recording.

Bit rate = Sampling rate x Bit rate x Number of channels

(ii) Calculate the bit rate of a 24 bit file sampled at 44.1Khz in stereo (2 channels). Show your answer in bits per second kilobits per second. Show your working.

24 x 44100 x 2 = 216800 bits/sec or 2168 kbits/sec

6 **Audio files can be very large and for more efficient storage and transmission, they are often compressed.**

(a) List two uncompressed file formats.

WAV. AIFF. AU

(b) What is meant by 'lossless' compression and give an example file format.

Lossless compression formats enable the original uncompressed data to be recreated exactly.

They reduce file size by reducing redundancy e.g. if there is a period of silence they can represent this without having to store thousands of 0s.

They usually have a compression ratio of 2:1.

FLAC. m4a. MPEG 4 SLS.

WORKSHEET 1 ANSWERS

6 **(c) What is meant by 'lossy' compression and give an example file format.**

The file is compressed by reducing the amount of data stored. There is therefore a loss of information and sound quality.

None or less audible components are removed.

MP3. AAC.

7 **List *five* advantages of a digital sound recording over an analogue one**

It can be edited and manipulated easily by computer equipment.

It is more portable – can be carried on a memory stick or SD card while a vinyl record or tape are not as portable.

It can be played over and over again without deterioration. LPs and tapes deteriorate.

It can be easily copied on a computer. Expensive equipment is needed to copy a vinyl records.

Digital audio files can be easily emailed, downloaded and streamed by users.

Equipment to record and process digital sound is relatively cheap. It has allowed people to produce their own commercial music at home.

WORKSHEET 2 ANSWERS

1 **When a digital recording is being made the 'bit depth' used can have an effect on the quality of the sound when the recording is played.**

(a) Explain what is meant by the 'bit depth'. (2)

Bit depth is the number of bits used to store the information of each sample of the sound being recorded.

(b) Explain how the bit depth can affect the quality of sound when the recording is played. (2)

By increasing the number of *bits* ("units of information") contained in the file, the amount of detail contained in each sample is increased.

2 **Some audio file formats use compression.**

(a) Explain the importance of compressing files when transmitting them via the internet. (2)

It reduces the size of the file which needs to be transmitted.

Shortens download time.

Reduces internet traffic (and hence probability of lost packets).

Allows multimedia files to be streamed.

(b) Describe the difference between lossy and lossless compression. (2)

In lossy compression when a file is uncompressed it is not exactly the same as the original.

In lossless compression, when the data is uncompressed it is restored completely to the original file