Year 9 – Representations: going audiovisual

Unit introduction

In this unit, learners will focus on digital media such as images and sounds, and discover the binary digits that lie beneath these types of media.

Just like in the previous unit, where learners examined characters and numbers, the ideas that learners need to understand are not really new to them. You will draw on familiar examples of composing images out of individual elements, mixing elementary colours to produce new ones, and taking samples of analogue signals, to illustrate these ideas and bring them together in a coherent narrative.

This unit also has a significant practical aspect. Learners will use relevant software (GIMP and Audacity, in this case) to manipulate images and sounds and get an idea of how the underlying principles of digital representations are applied in real settings.

This unit builds on the material from the Year 8 unit, 'Representations: from clay to silicon'.

Overview of lessons

Lesson	Brief overview	Learning objectives
1 Binary mosaic	Digital pictures are formed out of individual pixels (picture elements), just like the Greek and Roman mosaics are formed out of individual pieces of glass or stone. However, unlike their ancient counterparts, the elements in digital mosaics are aligned in rows and columns, with the colour of each element represented as a sequence of binary digits. In this lesson, learners will create digital mosaics pixel by pixel, and experience how an image composed of individual coloured elements can correspond to a sequence of binary digits. This will help them form an initial understanding of	• Describe how digital images are composed of individual elements • Recall that the colour of each picture element is represented using a sequence of binary digits • Define key terms such as 'pixels', 'resolution', and 'colour depth' • Describe how an image can be represented as a sequence of bits

	how the images that they encounter daily in their digital devices translate to nothing more than long strings of bits.	
2 A splash of colour	In the early days of personal computers, graphics were displayed in a range of different resolutions and colour depths, depending on the hardware available. Nowadays, while resolution is still being increased, there is no mention of colour depth or the number of possible colours available. We have used 24 or 32 bits for years, as this has been sufficient. In the previous lesson, learners were introduced to the idea that the colour of each pixel can be represented as a sequence of binary digits. In this lesson, they will explore the most common representation of colour as a mixture of red, green, and blue: the level of each of these colours in the mixture is represented using an 8-bit sequence, producing a total of 24 bits to represent the colour of any single pixel. Learners will also build on their existing knowledge to calculate the representation size of digital images.	• Describe how colour can be represented as a mixture of red, green, and blue, with a sequence of bits representing each colour's intensity • Compute the representation size of a digital image, by multiplying resolution (number of pixels) with colour depth (number of bits used to represent the colour of individual pixels) • Describe the trade-off between representation size and perceived quality for digital images
3 Collage	After introducing learners to the ideas behind digital image representation, it's now time for a hands-on approach. In this lesson, learners will use appropriate software to perform a range of image manipulation functions and complete specific tasks and challenges. Learners will already have varying levels of experience and proficiency in using image editing software, so this is a flexible lesson, with a range of activities provided to suit different needs and tastes. Please note that this lesson is not intended to be a comprehensive introduction to image editing.	• Perform basic image editing tasks using appropriate software and combine them in order to solve more complex problems requiring image manipulation • Explain how the manipulation of digital images amounts to arithmetic operations on their digital representation

	The instructions in the worksheets are tailored to GIMP (GNU Image Manipulation Program, available at gimp.org), which is open-source and cross-platform. However, the tasks can be performed with most image editing software.	• Describe and assess the creative benefits and ethical drawbacks of digital manipulation (Education for a Connected World)
4 Good vibrations	Tracing the steps of a hiker through the altitude data that she transmits, learners will familiarise themselves with the basic concepts necessary for understanding any analogue to digital conversion: samples, sampling rate, and sample size. The main goal is for learners to understand the 'big picture' of how sound is captured, digitised, manipulated, and reproduced in digital devices.	• Recall that sound is a wave • Explain the function of microphones and speakers as components that capture and generate sound • Define key terms such as 'sample', 'sampling frequency/rate', 'sample size' • Describe how sounds are represented as sequences of bits
5 Sonic playground	First, learners will revisit the digitisation process, in order to understand how the sampling rate and the sample size affect the size and quality of the representation. Next, they will use a sound editing program that will allow them to experiment with sound to complete specific tasks and challenges. Learners will have varying levels of experience and proficiency in using sound editing software, so this is a flexible lesson, with a range of activities provided to suit different needs and tastes. The instructions in the worksheets are tailored to Audacity (audacityteam.org), which is open-source and cross-platform. However, the tasks can be performed with most sound editing software.	• Calculate representation size for a given digital sound, given its attributes • Explain how attributes such as sampling frequency and sample size affect characteristics such as representation size and perceived quality, and the trade-offs involved • Perform basic sound editing tasks using appropriate software and combine them in order to solve

		more complex problems requiring sound manipulation
6 Always another way	To conclude the unit, learners will spend half the lesson completing a summative assessment. In the time remaining, learners will be introduced to alternative (symbolic) representations for images and sound, such as vector graphics and MIDI music. They will also be introduced to what compression is and why it is necessary.	• Recall that bitmap images and pulse code sound are not the only binary representations of images and sound available • Define 'compression', and describe why it is necessary

Progression

The fundamental concepts around binary representations and the way in which they have been approached in this unit are visualised in these concept maps:

- Bitmap images concept map (part of Lesson 1: Binary mosaic)
- PCM sound concept map (part of Lesson 4: Good vibrations.

The structures of the nodes in these two concept maps are identical. This illustrates the direct correspondence between the concepts that pertain to image and sound digital representations.

Curriculum links

National curriculum links (Computing programmes of study: Key Stage 3)

- Understand how data of various types (including text, sounds and pictures) can be represented and manipulated digitally, in the form of binary digits.