PROGRESS OUTCOME 5

24-bit colour calculations

Annotation

Grace is able to use a spreadsheet to convert between 24-bit binary and decimal values. She can use logical reasoning to work out that a colour displayed by a computer is stored as a 24-bit digital value that can be calculated, and that this is what enables computers to display colours. She can calculate how many different colours can be displayed by a computer using 4, 8, 16, and 24 bits. She is able to describe how a computer uses bits (binary digits) and pixels to represent a digital image, and how colour is converted into digital data.

Background

The students in Grace's learning space have been using their knowledge of binary representation to look at how pixels and colours are represented.

Task

The students are asked to read and complete the tasks outlined in the following worksheets.

The task provides an opportunity to explore the mathematical relationships between bits, binary, and powers of 2.

Student response

Grace

Creating Colours from Bits

We have learned that each pixel on the screen is made up of three tiny red, green and blue lights. By changing the amount of light each red, green and blue light emits, we can mix millions of different colours, in fact more than the human eye can perceive.

The following activities will help you work out how a particular colour is represented in both decimal (for humans to understand) and binary (for the computer to understand).

Use an online RGB colour picker to find the red, green and blue values for a colour of your choice. Add a screen shot of the colour you have selected and write in the values below:

Red 250 **Green** 15 **Blue** 150

Open the **RGB Colour Calculator** spreadsheet and use the **Binary Calculator** to work out the binary representation for the red, green and blue values and write in the binary below:

Red 11111010 **Green** 00001111 **Blue** 10010110

Now use the **Colour Code Calculator** on the spreadsheet to work out the calculated number for the colour as well as the final binary number for the colour:

Red 250 **X 655536 =** 16384000

Green 15 **X 256 =** 3840

Blue 150 **X 1 =** 150

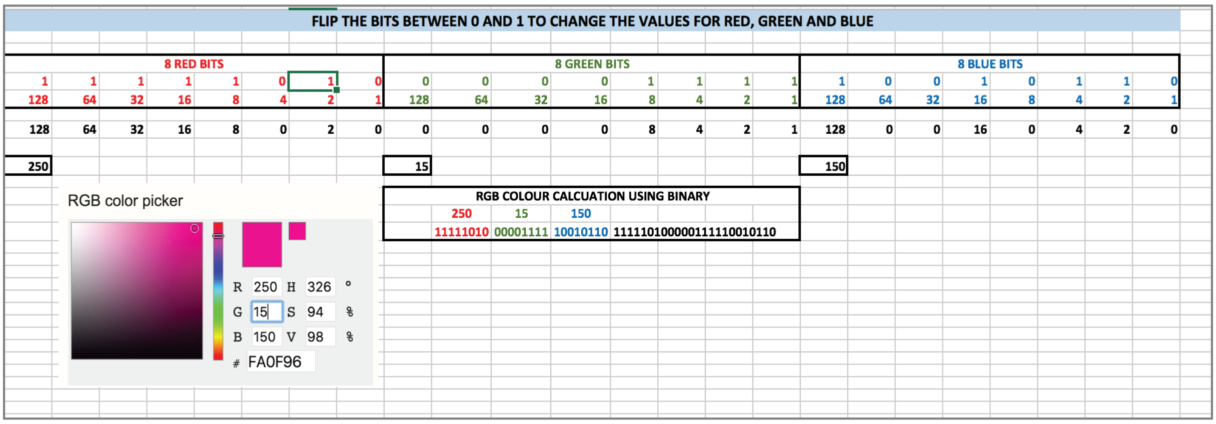
Total Colour Value 16,387,990

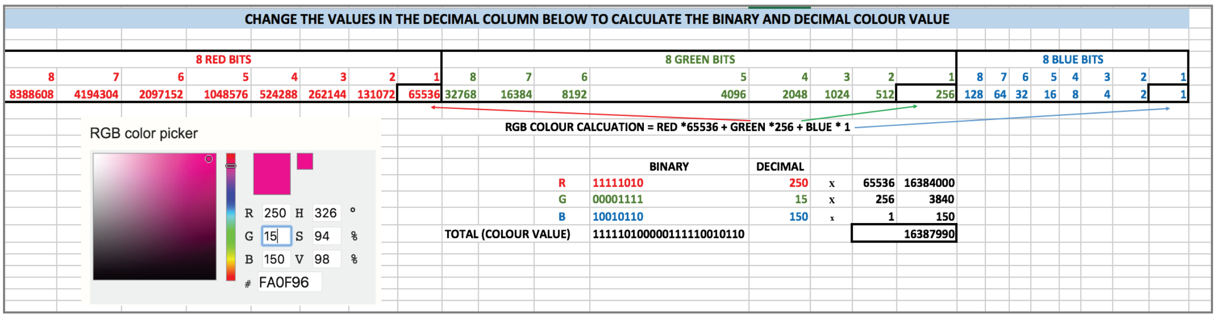
Colour Value in Binary 111110100000111110010110

The total colour value in binary for 16,387,990 is the same as the RGB in order.

Ms Williams: *How did you use the spreadsheet to help you with your calculations in this part of the activity?*

Grace: *First I picked a shade of pink with the RGB colour code of 250, 15, 150. I changed the bits between 0 and 1 to calculate the binary values for the red, green, and blue colours. Next, I used the spreadsheet to help me calculate the total decimal and binary number that represents the colour.*





How many different colours can be displayed with 24-bits (**8 red bits**, **8 green bits** and **8 blue bits**)? Show your calculation below:

8 bits is one byte. 1 byte has 256 numbers that it can represent (0-255). So you have 256 of each colour.
256 x 256 x 256 = 16,777,216 can be displayed.

How many different colours can be displayed with 16-bits (**5 red bits**, **6 green bits** and **5 blue bits**)? Show your calculation below:

5 bits can represent 32 different numbers.
6 bits can represent 64 different numbers.
32 x 64 x 32 = 65,536 different colours

How many different colours can you make from 8-bits (**3 red bits**, **3 green bits** and **2 blue bits**)? Show your calculation below:

3 bits can represent 8 different numbers
2 bits can represent 4 different numbers
8 x 8 x 4 = 256 different colours

How many different colours can you make from 4-bits (**1 red bit**, **2 green bits** and **1 blue bit**)? Show your calculation below:

1 bit can represent 2 different numbers
2 bits can represent 4 different numbers
2 x 4 x 2 = 16 different colours

Now that you have completed this investigation, describe in your own words how a computer would represent all the colours that make up a digital image and what happens when you have fewer bits to represent colours.

Digital images are made up of millions of pixels that can each have a colour value. So the computer represents an image by storing the red, green and blue values for each pixel in the image. Each tiny pixel shows a different amount of red, green and blue light to mix different colours, like a colour mixer of light. When you have fewer bits there aren't as many different colours to display so the image quality isn't as good. It becomes blotchy.

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