

Colour by Numbers

<https://csunplugged.org/en/topics/image-representation/unit-plan/colour-by-numbers/>

Objectives

Students will be able to:

1. Use digits to create images
2. Understand how the number of colours an image can include is based on the number of bits used to store it
3. Understand how images can be compressed so they take up less memory space.

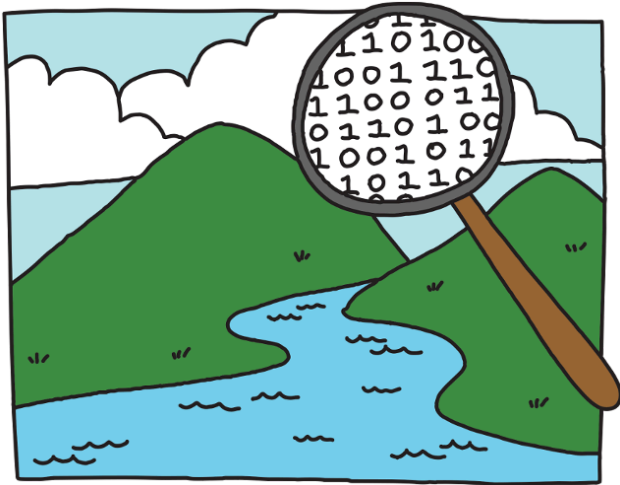
Image Representation Lesson

Introduction (10 minutes)

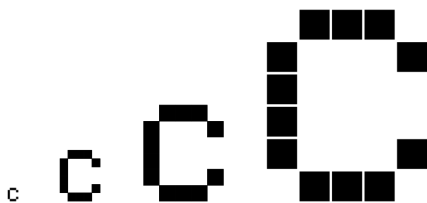
- We will discuss the vocabulary words:
 1. Pixels - Computer screens are divided into a grid of tiny squares called pixels.
 2. Bits - binary digits
 3. Display Resolution-The resolution of a screen refers to the number or density of pixels on the screen. Defined as the number of pixels per inch on the screen or the width and height of the screen measured in pixels.
- Tell students that "The colour of each pixel can be set by a computer and they are used to display images on a computer screen. The word pixel is an abbreviation of picture element."
- Display Resolution An example of this is a common screen resolution is 1920 by 1080 pixels (referred to as 1080p), which means it has 2,073,600 pixels, just over 2 million!Second, I will display the image and we will talk about what the directions tell me to do starting at the compass rose. I will say, "Something is wrong! When I follow the instructions it does not lead me to the jewel. I need to "debug" the code to find out what is wrong, and then correct the code.
- Watch the video: What are pixels? <https://www.youtube.com/watch?v=1ptJaJT8jAM> (2:28)

Activity (30 minutes)

- I will discuss, “All data on computers is represented with digits, and using these digits to represent other types of data and information is a core concept of Computer Science. At this point you have probably noticed the words represent and representation are being used a lot, so let's look at exactly what we mean by this.”



- Discuss: “Every image we see on a screen, whether it is a picture, a video, or text, is shown using pixels, and all a computer needs to store is what colour each of the pixels on the screen should be.
- Teacher to class: In a black and white image, each pixel can be either black or white, so all the computer would need to store is which dots are black and which are white. For example, if we wanted to display the letter C, we first need to divide the letter into squares. If we zoom in further and further on the letter we can see a grid of pixels similar to these:
- I will then show the following images to students on a screen or on the board.



- Then I will continue: We can represent this image using binary digits (bits). If a 1 indicates a white square and a 0 indicates a black square then we can represent our letter C, on a 5x6 pixel grid, like this:

10001, 01110, 01111, 01111, 01110, 10001

If we take these numbers and draw the image they represent we get the letter C:

					1 0 0 0 1
					0 1 1 1 0
					0 1 1 1 1
					0 1 1 1 1
					0 1 1 1 0
					1 0 0 0 1

We are using 1 to represent white and 0 to represent black, in the same way we used white and black cards to represent 'on' and 'off' in the binary numbers unit.

- Students will then work in pairs to complete the Move It, Move It Worksheet.

[https://storage.googleapis.com/cs-unplugged.appspot.com/static/resources/pixel-painter/en/Pixel%20Painter%20\(Star%20-%20Black%20and%20White%20-%20a4\).pdf](https://storage.googleapis.com/cs-unplugged.appspot.com/static/resources/pixel-painter/en/Pixel%20Painter%20(Star%20-%20Black%20and%20White%20-%20a4).pdf)

- I will have set up the Move It Maps in different areas on the floor around the room prior to class beginning.

<https://docs.google.com/document/d/1L5cczCoaANqrATxAymDwnxqzHW0Ysgvak8JsFk6nHbs/edit>

1. I will assign groups of students of 2 at each area. Students will then be given the following directions:
2. The grid on these sheets represents the pixels on a computer screen. Now you are going to be the computer and use the digits in the squares to make an image.
3. On the worksheets, have students colour in each square with a 0 in it black, and leave each square with a 1 blank so that it is white. We are using 1 to represent white and 0 to represent black, because 1 indicates that a pixel is 'on' (and therefore white) and a 0 indicates it is 'off' (and so it is black).
4. Advise students to colour the squares in lightly at first, and then when they are sure they have not made any mistakes they can colour them in fully. As they work through the worksheet they should see an image emerging.
 - Rotate coloring the squares.

Wrap-Up Activity (5-8 minutes)

- Students will journal using Padlet. They write a sentence that will answer the journal prompt:
“What is a pixel and how does it work?”