



Product Code: ELO0531



Scratch LED Rainbow Matrix

Teacher Guide

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Scratch LED Rainbow Matrix

Establish connections between the digital and physical world

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Previous Experiences

Prior to using the TTS Rainbow Matrix, children should have some experience of using Scratch.

Progression

The activities outlined below are in a suggested order of progression. There is no specific amount of time to be spent on each as this will vary from one situation to another. It may also be necessary to break some of the activities down further to suit children's needs.

National Curriculum

The National Curriculum for Computing references listed below are indicative of some aspects of the curriculum the activities cover. They are not an exhaustive list nor do they indicate that one activity fully covers that curriculum area. The activities support children in learning computing skills and applying computational thinking.

Attainment Targets

Key Stage 2

- Design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts
- Use sequence, selection, and repetition in programs; work with variables and various forms of input and output
- Use logical reasoning to explain how some simple algorithms work and to detect and correct errors in algorithms and programs

Key Focus 1 - Getting to know the TTS Rainbow Matrix

Explore what can be done with the Rainbow Matrix by trying out different blocks. Use the 'Set All' block to light all the pixels in a single colour.

Note: Without the 'wait' blocks the program will run very quickly!



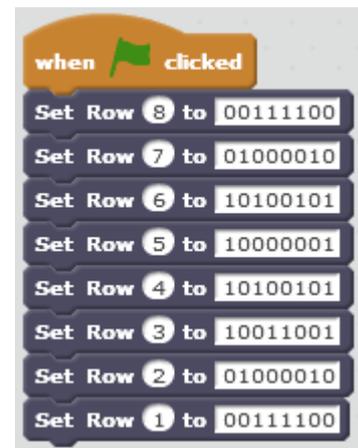
Use the 'Set Pixel' blocks to light different LEDs with different colours. The two numbers are the x and y coordinates of the pixel.

The program shown will light pixels diagonally across the matrix in different colours, wait 2 seconds, then switch them all off.



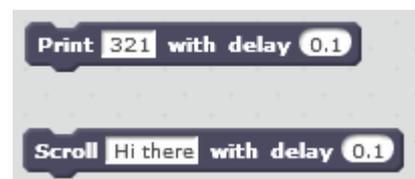
Try using 'Set Row' blocks to draw a simple picture, icon or letter.

The program shown will draw a smiley face. Try out the 'Print' and 'Scroll' blocks. For testing purposes simply drag the block to the programming area, enter some text, and then click on the block to try it out.



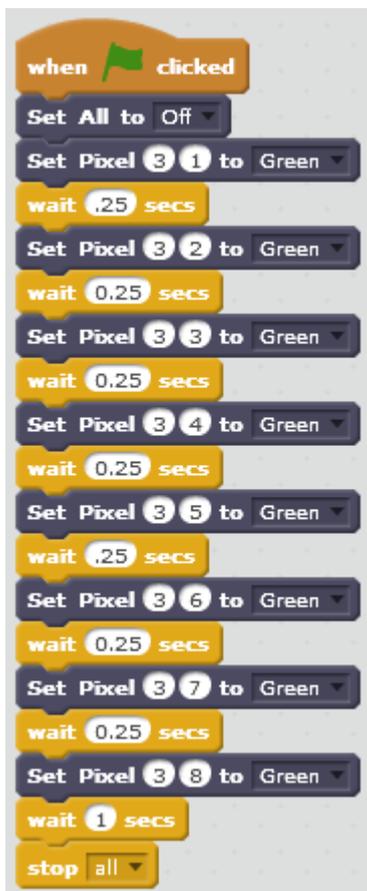
Extension

Try making changes to different parameters, e.g. change colours, change which pixels are lit or change the length of 'wait' statements.



Key Focus 2 - Loops and Variables

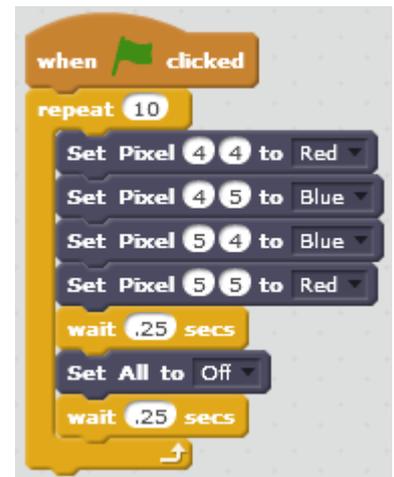
Spend time working with one type of block and explore what can be done with it. The example (opposite) uses the 'Set Pixel X Y to Colour' block. Create a loop that switches some pixels on and off.



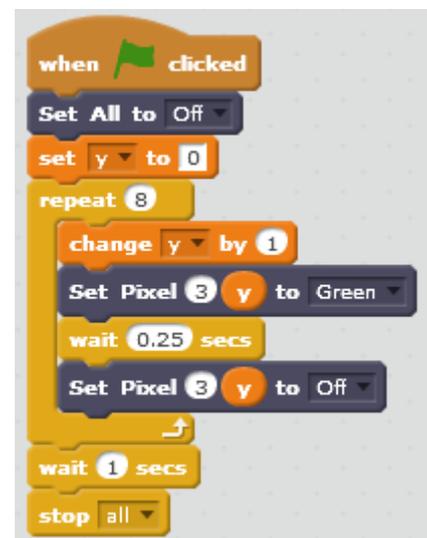
```
when clicked
  Set All to Off
  Set Pixel 3 1 to Green
  wait .25 secs
  Set Pixel 3 2 to Green
  wait 0.25 secs
  Set Pixel 3 3 to Green
  wait 0.25 secs
  Set Pixel 3 4 to Green
  wait 0.25 secs
  Set Pixel 3 5 to Green
  wait .25 secs
  Set Pixel 3 6 to Green
  wait 0.25 secs
  Set Pixel 3 7 to Green
  wait 0.25 secs
  Set Pixel 3 8 to Green
  wait 1 secs
  stop all
```

Create a simple animation by lighting pixels in sequence. Light one pixel, switch it off again and light the next pixel etc.

This can then be developed by using a loop and a variable, as shown below.



```
when clicked
  repeat 10
    Set Pixel 4 4 to Red
    Set Pixel 4 5 to Blue
    Set Pixel 5 4 to Blue
    Set Pixel 5 5 to Red
    wait .25 secs
  Set All to Off
  wait .25 secs
```



```
when clicked
  Set All to Off
  set y to 0
  repeat 8
    change y by 1
    Set Pixel 3 y to Green
    wait 0.25 secs
    Set Pixel 3 y to Off
  wait 1 secs
  stop all
```



Switching the pixel off after each step makes it appear to move.

Key Focus 3 - RGB Values

```

when clicked
  Set All to Red
  wait 1 secs
  Set All to Green
  wait 1 secs
  Set All to Blue
  wait 1 secs
  Set All to Off
  
```

To make the Rainbow Matrix easy to use there are several blocks with predefined colours. However any one of 16 million colours can be selected using the R,G,B (Red, Green, Blue) settings. The example shown, from Key Focus 1, can be created

```

when clicked
  Set All to RGB 255 0 0
  wait 1 secs
  Set All to RGB 0 255 0
  wait 1 secs
  Set All to RGB 0 0 255
  wait 1 secs
  Set All to Off
  
```

with the 'Set All to RGB' block (left image). This can be replicated with the 'Set All to RGB' block (right image).

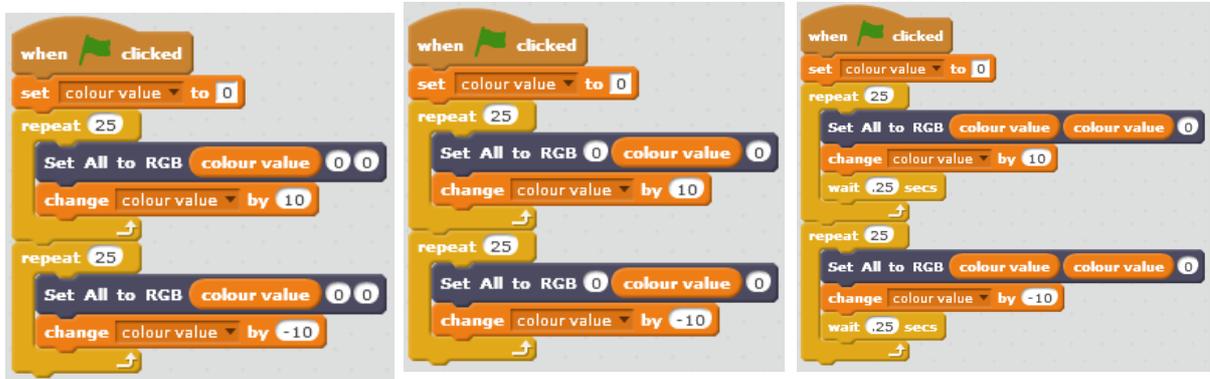
A loop can be used to change just one of the colours and make it fade in.

A variable called 'colour value' needs to be created in the Data section. The example shown makes the matrix set all the pixels to 1,0,0 then 2,0,0 etc.

```

when clicked
  set colour value to 0
  repeat 255
    Set All to RGB colour value 0 0
    change colour value by 1
  
```

all the way up to 255,0,0. This example can be modified to make the red value change in different steps – for example, 10 at a time rather than 1. The steps can also be reversed to make the red fade back out.

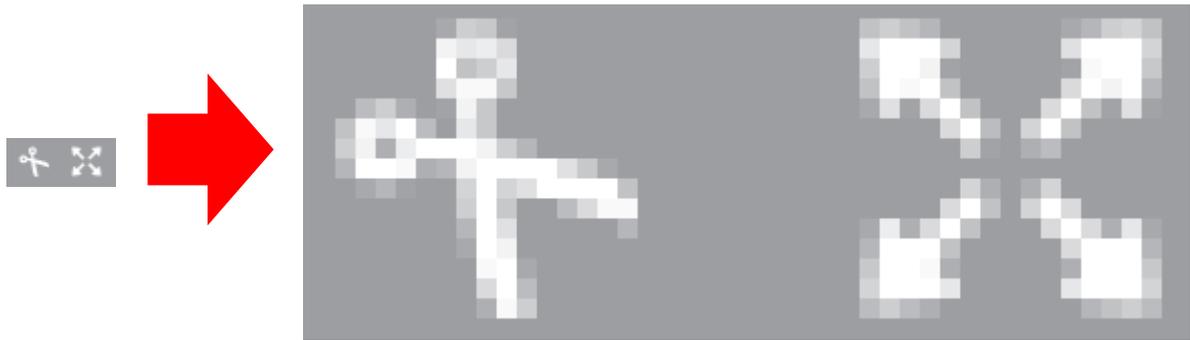


The above example runs quite quickly so 'waits' could be added to slow it down.

The idea can be further developed by changing the step size, e.g. to 5 or 20. It could also be developed by making another colour change, or even by two colours changing at the same time. (See example above)

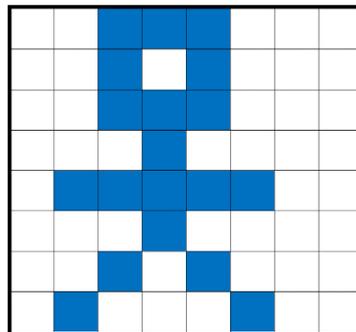
Key Focus 4 - Icons and Letters

The Rainbow Matrix is a grid of 64 RGB LEDs. These are like pixels used in a computer monitor or television. When magnified, the detail that makes up icons on a computer screen can be seen. One way to do this is to use the magnifier tool built in to Windows. Zooming in on the Scratch toolbar will show how the icons are drawn.



Children could use a simple 8x8 grid to create icons or letters on paper. Once they've sketched a few, they can try creating them in Scratch so they display on the matrix. It is best to begin by using a single colour as shown.

The top row of the matrix is row 8, so to create the image shown begin from this row and work down. At this point it may be useful to consider whether the order of the commands matter. (The order doesn't actually make a difference, however it is easier to think about them in an ordered way.)



Try looking at the matrix across a room. This is like zooming out from a computer screen. Also try placing a sheet of paper across the pixels. This will blur the edges making some patterns stand out more.

Pupils should try creating a number of patterns. These can be explored by using rows or columns. Once

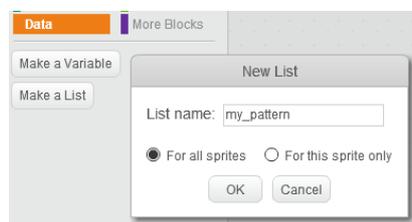


they've created several patterns they should spend some time experimenting with how they can bring up different patterns when they want. This could be using 'when [###] key pressed' hats.

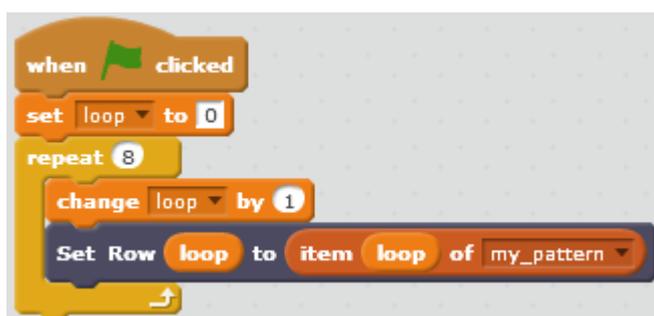
Another method that could be tried is using 'Data Lists'.

Create a list in the 'Data' section of Scratch.

Add the data for each row as an item in the list. The data is each row of the pattern listed from 1 to 8, as shown.



Create a variable called 'loop'. Add blocks which will read each line of the list and set each row on the matrix to match each item on the list, for example:



Several lists could be created, allowing different patterns to be called up when needed.

Further Ideas

The Rainbow Matrix is an open ended resource allowing children to explore and experiment.

Here are some possible projects:

- Make an electronic dice
- Create a simple game like 'Pong' or 'Snake'
- Make a sound to light display
- Create a simple animation
- Connect several Rainbow Matrix devices and explore what can be accomplished by using them together
- Use the Rainbow Matrix alongside the TTS Scratch Controller



Notes

RGB - Red Green Blue

LED - Light Emitting Diode

Getting started with the TTS Rainbow Matrix Controller

The TTS Rainbow Matrix is an ideal tool to help children develop their understanding of computer output and computer display technology.

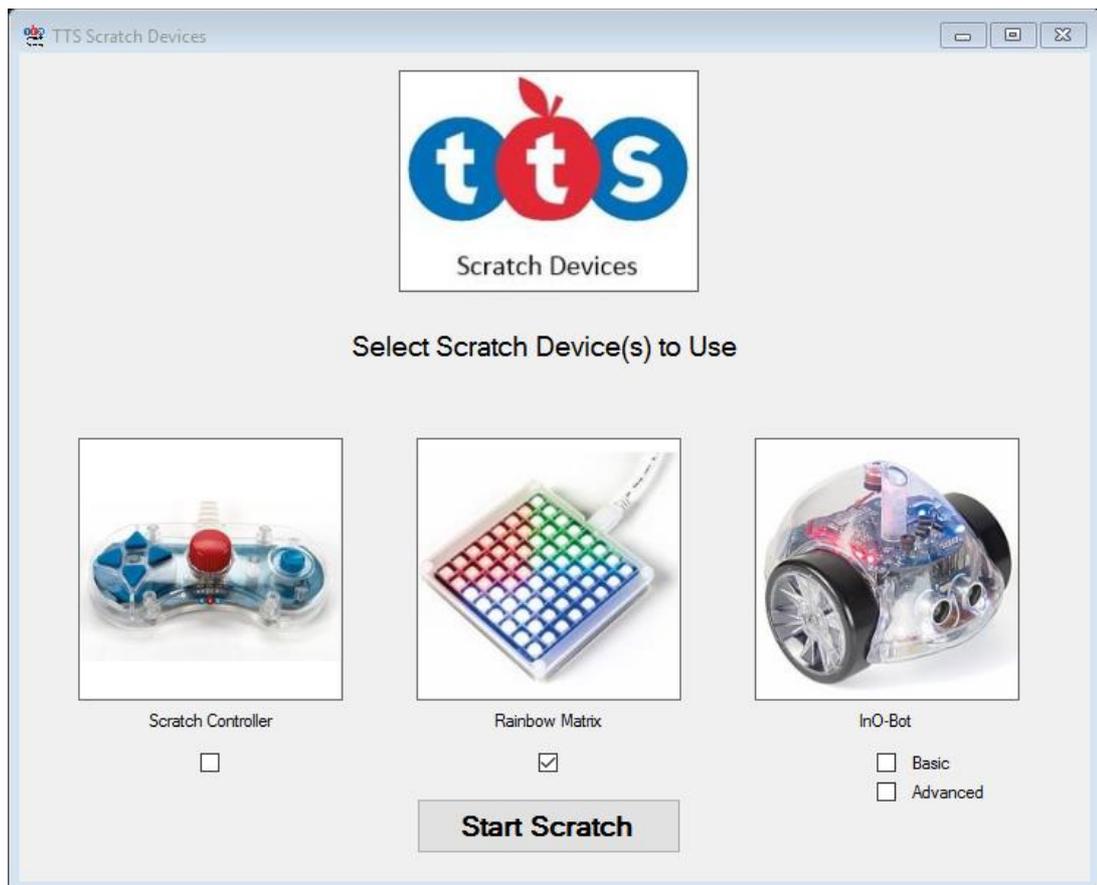
Getting Started

Please see the User Guide supplied with the product for information on connecting the TTS Rainbow Matrix to a PC and installing the software. Note a driver may be required. This driver can be downloaded from here:

<https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers>

Once installation is complete double click on the TTS Scratch Devices icon to open the Launcher.

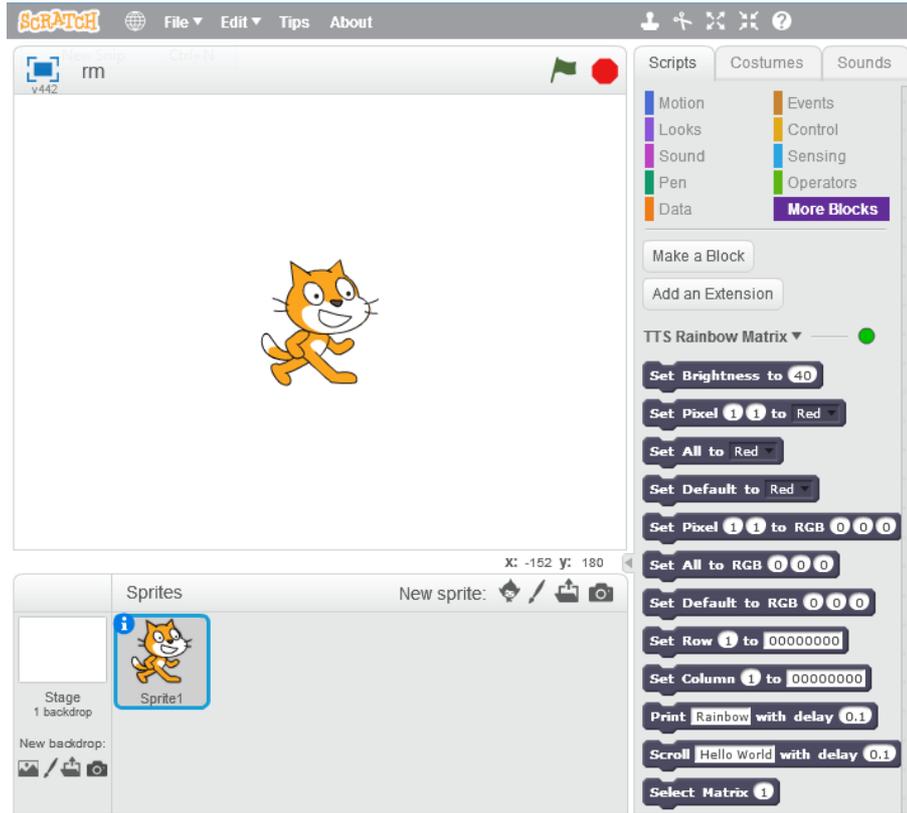
The Launcher should automatically detect that a Rainbow Matrix is connected and tick the box underneath. If a Matrix isn't detected the box can be manually ticked. This will make the additional block appear in Scratch. NB This will not make an undetected Matrix work. Click on 'Start Scratch' to begin programming.



Scratch

When Scratch opens there will be twelve additional blocks available.

There is an indicator to show if the Rainbow Matrix is detected and available.



Scratch Blocks

Twelve special blocks can be found in the 'more blocks' section of Scratch.

Pixel 1, 1 is in the bottom left corner and 8, 8 is in the top right. X and Y values set any pixel between those two points.



1. Set Brightness to [0 - 100]

Set Brightness to 40

This block sets the brightness used across the whole panel. Brightness values can be between 0 and 100.

2. Set Pixel [x] [y] to [colour]

Set Pixel 1 1 to Red

This block will set a single pixel to one of seven predefined colours (red, orange, yellow, green, blue, purple or white).

3. Set All to [Colour]

Set All to Red

This block will set all pixels to one of seven predefined colours (as listed above).

4. Set Default to [Colour]

Set Default to Red

This block sets the default colour to one of seven predefined colours (as listed above). When a default is set, the colour selected will be used by a block which doesn't contain a colour value i.e. Set row, column and text blocks.

5. Set Pixel [x] [y] to RGB [0-255][0-255][0-255]



This block will set a single pixel to the colour defined by the red, green and blue values given.

E.g. Set Pixel [4] [4] to RGB [255][0][0] will set pixel 4 in and 4 up to red.

6. Set All to RGB [0-255][0-255][0-255]



This block sets all pixels to the colour defined by the red, green and blue values entered.

E.g. Set All to RGB [0][180][60] will light the entire panel in a light green / blue.

7. Set Default to RGB [0-255][0-255][0-255]



This block works in the same way as 'Set Default to [Colour]', but allows red, green and blue values to be used to set the colour.

8. Set Row [1-8] to [#####]



This block lights specific pixels in a given row.

E.g. Set Row [3] to 11110000 will light the first four pixels on row three in the default colour.

9. Set Column [1-8] to [#####]



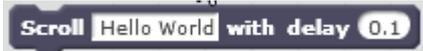
This block works in a similar manner to the row block but addresses columns instead.

10. Print [Text] with delay [seconds]



This block displays text on the panel. It displays a letter at a time from the word entered in the box. The delay sets the duration each letter is lit.

11. Scroll [Text] with delay [seconds]



This block displays text on the panel. It scrolls the word entered in the box across the panel. The delay sets the duration each letter is lit.

12. Select Matrix [1-3]



This block allows you to state which particular panel the commands are being sent to when multiple matrixes are connected to one computer.

