



Color By Pixel

This offline lesson plan covers the basics of computer graphics. After learning about how graphics work, students will create their own Color by Pixel programs. The lesson plan consists of four parts, each covering a specific topic. The entire five-part Color by Pixel lesson is designed to run approximately one hour.

WHAT YOU'LL NEED

- ◆ Copies of the Color by Pixel template sheets (included in the Resources section).
- ◆ Colored pencils, crayons, markers, or other supplies for coloring.



TOPIC

Computers and computer graphics go hand in hand. In this lesson, we'll learn how computers draw images using pixels.

DISCUSSION

Would you enjoy playing games on a computer that didn't have a screen with graphics? Probably not. Computer graphics and animation have become an important part of how we interact with computers today.

Computer programs are like lists of instructions that we give to a computer. Computers are not very capable on their own -- they need good instructions to tell them what to do and how to do it. Programmers can create instructions for computers by writing computer code that tells the computer exactly what to do.

But how do programs draw pictures onto the screen? Computers break each picture down into tiny blocks of color, called pixels, that are organized in a grid across the screen. Each pixel contains one single color. By combining thousands and thousands of these tiny pixels, programs can draw complicated pictures onto the screen.

VOCABULARY

- **Code:** Code is the name for the instructions you write to a computer in a program.
- **Computer:** A person or device that makes calculations, stores data, and executes instructions according to a program.
- **Computer program:** A list of code instructions a computer follows in order to perform a task.
- **Computing:** Executing instructions, calculating, or using a computer.
- **Pixel:** A single point or dot of color in a larger image. Large images are made up of thousands of small pixels.

QUESTIONS

- What is a computer program?
- What is a pixel?
- How does a computer program use pixels to display an image?

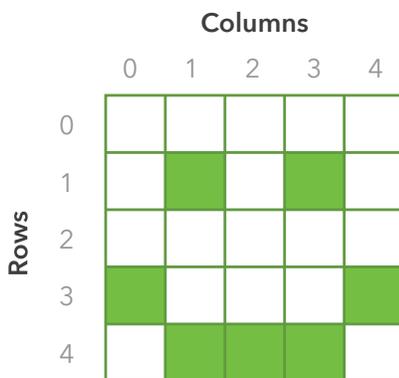


TOPIC

A demonstration of how to use pixels to make a simple image.

DISCUSSION

The image below is a very simple example of using pixels to draw a basic image. Each box in the grid is a single pixel. In this case, some of the pixels have been colored to make a smiley face. We can label the rows and columns of the image to make it easier to pick out specific pixels:



Now that we have row and column numbers, we can select individual pixels. For example, the smiley face's right eye is located in column 3, row 1 (notice that we start counting at zero). We can communicate this more quickly by writing all the pixel coordinates in this format: (column, row). We'll write the color of the pixel right after the column and row position. So to color the right eye, we can write: **(3, 1, green)**.

VOCABULARY

- **Row:** Rows run horizontally (side to side)
- **Column:** Columns run vertically (up and down)

QUESTIONS

- What format will we use to select and color a pixel for this exercise?
- It's important to not mix up rows and columns. Which direction do rows run? And which way are columns?
- What number do the rows and columns start from?

Using these coordinates, we can paint the smiley face above with the following program:

1. **(1, 1, green)**
2. **(3, 1, green)**
3. **(0, 3, green)**
4. **(4, 3, green)**
5. **(1, 4, green)**
6. **(2, 4, green)**
7. **(3, 4, green)**



TOPIC

Now that students have learned the basics of how images are drawn with pixels, it's time to practice drawing some images.

The first activity has students practice drawing out a simple message on the screen. The second activity is slightly harder, but results in a cool heart image.

SETUP

Give each student a "computer screen" grid and instructions sheet. By following the program next to the grids, students will be "human computers" who will draw out images onto the screen.

1. YOUR FIRST PIXEL PROGRAM

CODE

- | | |
|-------------------|--------------------|
| 1. (0, 0, yellow) | 9. (2, 2, yellow) |
| 2. (2, 0, yellow) | 10. (4, 2, yellow) |
| 3. (4, 0, yellow) | 11. (0, 3, yellow) |
| 4. (0, 1, yellow) | 12. (2, 3, yellow) |
| 5. (2, 1, yellow) | 13. (4, 3, yellow) |
| 6. (4, 1, yellow) | 14. (0, 4, yellow) |
| 7. (0, 2, yellow) | 15. (2, 4, yellow) |
| 8. (1, 2, yellow) | 16. (4, 4, yellow) |

Solution

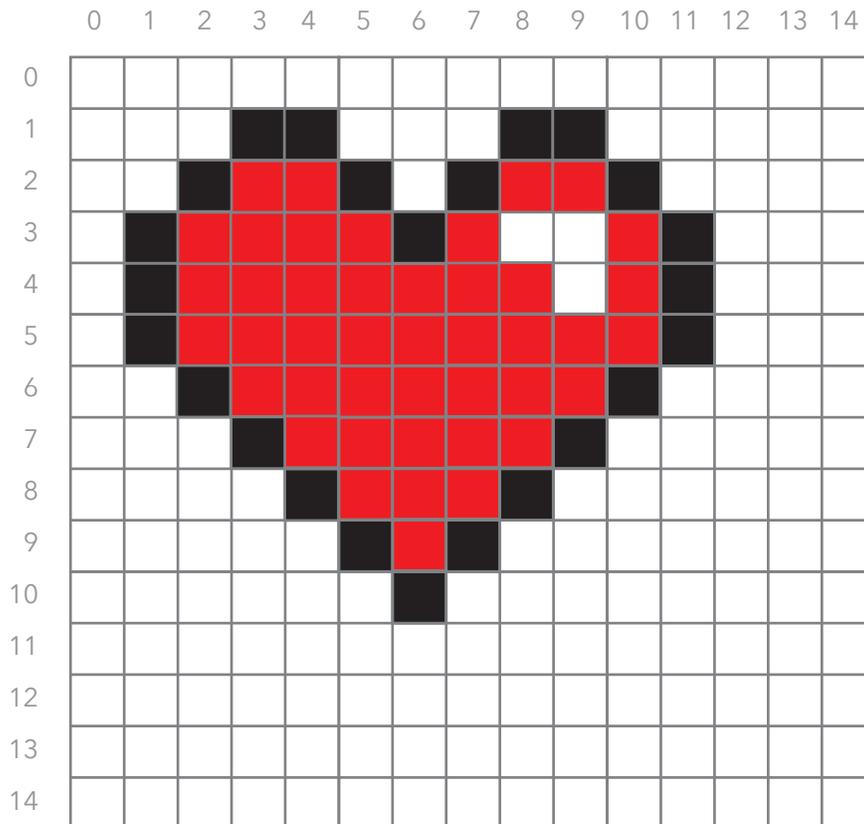
	0	1	2	3	4
0					
1					
2					
3					
4					

2. COMPUTER SCIENCE LOVE

CODE

- | | | | |
|--------------------|--------------------|--------------------|--------------------|
| 1. (3, 1, black) | 17. (5, 3, red) | 33. (2, 5, red) | 50. (9, 6, red) |
| 2. (4, 1, black) | 18. (6, 3, black) | 34. (3, 5, red) | 51. (10, 6, black) |
| 3. (8, 1, black) | 19. (7, 3, red) | 35. (4, 5, red) | 52. (3, 7, black) |
| 4. (9, 1, black) | 20. (10, 3, red) | 36. (5, 5, red) | 53. (4, 7, red) |
| 5. (2, 2, black) | 21. (11, 3, black) | 37. (6, 5, red) | 54. (5, 7, red) |
| 6. (3, 2, red) | 22. (1, 4, black) | 38. (7, 5, red) | 55. (6, 7, red) |
| 7. (4, 2, red) | 23. (2, 4, red) | 39. (8, 5, red) | 56. (7, 7, red) |
| 8. (5, 2, black) | 24. (3, 4, red) | 40. (9, 5, red) | 57. (8, 7, red) |
| 9. (7, 2, black) | 25. (4, 4, red) | 41. (10, 5, red) | 58. (9, 7, black) |
| 10. (8, 2, red) | 26. (5, 4, red) | 42. (11, 5, black) | 59. (4, 8, black) |
| 11. (9, 2, red) | 27. (6, 4, red) | 43. (2, 6, black) | 60. (5, 8, red) |
| 12. (10, 2, black) | 28. (7, 4, red) | 44. (3, 6, red) | 61. (6, 8, red) |
| 13. (1, 3, black) | 29. (8, 4, red) | 45. (4, 6, red) | 62. (7, 8, red) |
| 14. (2, 3, red) | 30. (10, 4, red) | 46. (5, 6, red) | 63. (8, 8, black) |
| 15. (3, 3, red) | 31. (11, 4, black) | 47. (6, 6, red) | 64. (5, 9, black) |
| 16. (4, 3, red) | 32. (1, 5, black) | 48. (7, 6, red) | 65. (6, 9, red) |
| | | 49. (8, 6, red) | 66. (7, 9, black) |
| | | | 67. (6, 10, black) |

SOLUTION





TOPIC

Now students can write code to make their very own pixel image!

DISCUSSION

Give each student a copy of the blank “My Pixel Image” page. Students can write their code in the area provided. Note that it might be a good idea to make a rough draft image first to help with writing the code -- having extra copies of the My Pixel Image handout would be beneficial.

To extend this activity, have each student pair up with another student after they have finished writing their code. Using Student A’s code instructions, Student B can be the human computer and draw out the image. The students can then switch roles and Student A can draw out Student B’s program.



TOPIC

Computer graphics are all around us, from the phones in our pockets to the movies we watch. In order to display images, computers follow basic lists of instructions called programs. Each image is made up of individual pixels. Each pixel only displays one color, so computers combine thousands of pixels in a grid in order to display complex images. Displaying an image is like giving the computer a list of instructions of which pixels need to be colored in a certain color.

To continue learning, visit www.CodeHS.com

DISCUSSION QUESTIONS

Part 1

- What is a computer program?
- What is a pixel?
- How does a computer program use pixels to display an image?

Part 2

- What format will we use to select and color a pixel for this exercise?
- It's important to not mix up rows and columns. Which direction do rows run? And which way are columns?
- What number do the rows and columns start from?

VOCABULARY

Part 1

- **Code:** Code is the name for the instructions you write to a computer in a program.
- **Computer:** A person or device that makes calculations, stores data, and executes instructions according to a program.
- **Computer Program:** A list of code instructions a computer follows in order to perform a task.
- **Computing:** Executing instructions, calculating, or using a computer.
- **Pixel:** A single point or dot of color in a larger image. Large images are made up of thousands of small pixels.

Part 2

- **Row:** Rows run horizontally (side to side)
- **Columns:** Columns run vertically (up and down)

RESOURCES



-Blank “code editor” and “computer screen” sheet for the *Your First Pixel Program* and *Computer Science Love* exercises.

-Blank “My Pixel Image” page for the Create Your Own activity



	0	1	2	3	4
0					
1					
2					
3					
4					

Program Instructions

- | | |
|-------------------|--------------------|
| 1. (0, 0, yellow) | 9. (2, 2, yellow) |
| 2. (2, 0, yellow) | 10. (4, 2, yellow) |
| 3. (4, 0, yellow) | 11. (0, 3, yellow) |
| 4. (0, 1, yellow) | 12. (2, 3, yellow) |
| 5. (2, 1, yellow) | 13. (4, 3, yellow) |
| 6. (4, 1, yellow) | 14. (0, 4, yellow) |
| 7. (0, 2, yellow) | 15. (2, 4, yellow) |
| 8. (1, 2, yellow) | 16. (4, 4, yellow) |



	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
0															
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															

PROGRAM INSTRUCTIONS

- | | | | |
|--------------------|--------------------|--------------------|--------------------|
| 1. (3, 1, black) | 17. (5, 3, red) | 33. (2, 5, red) | 50. (9, 6, red) |
| 2. (4, 1, black) | 18. (6, 3, black) | 34. (3, 5, red) | 51. (10, 6, black) |
| 3. (8, 1, black) | 19. (7, 3, red) | 35. (4, 5, red) | 52. (3, 7, black) |
| 4. (9, 1, black) | 20. (10, 3, red) | 36. (5, 5, red) | 53. (4, 7, red) |
| 5. (2, 2, black) | 21. (11, 3, black) | 37. (6, 5, red) | 54. (5, 7, red) |
| 6. (3, 2, red) | 22. (1, 4, black) | 38. (7, 5, red) | 55. (6, 7, red) |
| 7. (4, 2, red) | 23. (2, 4, red) | 39. (8, 5, red) | 56. (7, 7, red) |
| 8. (5, 2, black) | 24. (3, 4, red) | 40. (9, 5, red) | 57. (8, 7, red) |
| 9. (7, 2, black) | 25. (4, 4, red) | 41. (10, 5, red) | 58. (9, 7, black) |
| 10. (8, 2, red) | 26. (5, 4, red) | 42. (11, 5, black) | 59. (4, 8, black) |
| 11. (9, 2, red) | 27. (6, 4, red) | 43. (2, 6, black) | 60. (5, 8, red) |
| 12. (10, 2, black) | 28. (7, 4, red) | 44. (3, 6, red) | 61. (6, 8, red) |
| 13. (1, 3, black) | 29. (8, 4, red) | 45. (4, 6, red) | 62. (7, 8, red) |
| 14. (2, 3, red) | 30. (10, 4, red) | 46. (5, 6, red) | 63. (8, 8, black) |
| 15. (3, 3, red) | 31. (11, 4, black) | 47. (6, 6, red) | 64. (5, 9, black) |
| 16. (4, 3, red) | 32. (1, 5, black) | 48. (7, 6, red) | 65. (6, 9, red) |
| | | 49. (8, 6, red) | 66. (7, 9, black) |
| | | | 67. (6, 10, black) |

MY PIXEL IMAGE



	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
0															
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															

PROGRAM INSTRUCTIONS

--	--	--	--