

## Vector Graphics: A Circle Christmas Drawing

Take a piece of squared A4 paper, numbering the corners of the squares from top left along the top, 0,1, 2, etc and then similarly down the side.

Each step below is an instruction to draw a shape. Each specifies which shape is to be drawn, its colour, the number of squares along the top of the page to go to draw it (the x coordinate), the number of squares down the side to go (the y coordinate) and the size.

The position and size are for what is called a **'bounding box'** of the shape. First draw in lightly in pencil the bounding box square, then draw the largest given shape that fits in the bounding box. Then rub out the bounding box to leave the shape. Here all the bounding boxes are squares, though they could be rectangles if the shapes were to be squashed!

Draw each of the shapes below in the order given. Some shapes are drawn on top of others, to obscure the colour below, so the order matters.

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

## The Advantages of Vector Graphics

Vector Graphics give you lots of flexibility, if you can do a little bit of maths...not surprisingly called vector maths. The instructions that tell you how to draw a program are just a simple program, but one where you can now change the numbers in consistent ways to get different effects.

Suppose you want to position the whole shape 5cm further across the page. Just add 5 to the first number of every instruction before you start to draw as those numbers give the position across the page to draw.

Perhaps you want to move the whole picture 1cm down the page. Add 1 to the second number of each instruction, as it gives the position down the page to draw.

Finally perhaps you want a drawing twice the size. Just multiply every number in every instruction by 2 before you start to draw. Or perhaps you've changed your mind and you want it to be 3 times the size, just multiply by 3 instead. If you only have a small piece of paper, halve the numbers and you will get a picture half the size.

When you draw a picture in a vector drawing package and move the whole thing around or expand or shrink it, that is all it is doing behind the scenes.

Of course the shapes could also be represented by numbers too. Suppose 1 is used to represent a circle, 4 a square and 5 a star. An instruction like

Circle, Blue, 6, 17, 1

would really be stored then as

1, Blue, 6, 17, 1

We can also use numbers for the colours (eg 1 for red, 2 for blue, 3 for yellow, 4 for light green and 5 for dark green). Our above instruction would now be written

1, 2, 6, 17, 1

It would still mean exactly the same thing though (we just need a key to keep track of what the numbers for shapes and colours mean. Once you use numbers to represent the other parts of the instructions like this you can start to manipulate the picture in other interesting ways.

1. How would the picture change if we swapped all the shape number 1s for shape number 5s and vice versa?
2. How would the picture change if we changed all the colour numbers 1 and 2 to 3?
3. How would the picture change if we added 2 to each colour number (wrapping the numbers round so 6 becomes 1, and 7 becomes 2)?
4. Create your own Christmas tree circle picture, writing out the instructions as you draw it. Then manipulate the numbers to give instructions for a new version.