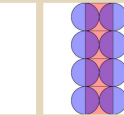
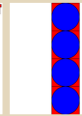
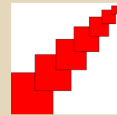


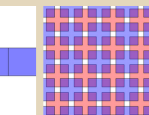
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There are three main patterns of repeated elements:

- A *single loop*, with one or more loop variables, applies when the answers to "what is repeated?", "what changes?", and "how do things change?" are the same for all repetitions.

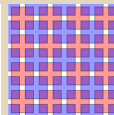
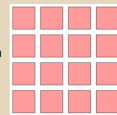


- *Multiple loops one after another* applies when elements can be grouped into two or more groups where the answers for the loop questions ("what is repeated?", "what changes?", "how do things change?", "how do things start?", and/or "when do you keep going?") are the same for all repetitions within one group but different for different groups.



Note: the rightmost example includes both multiple loops and nested loops — the red squares and the blue squares are drawn with separate loops, one after another, with nested loops being used to draw each grid of squares.

- *Nested loops* applies when the answer to "what changes?" and/or "how do things change?" involves "sometimes" — elements can be grouped so that "what changes?" and "how do things change?" is the same for the elements within each group and also between groups (though with different answers between groups than within groups).

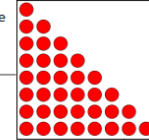


With a grid, a common application of nested loops, elements can be grouped into rows and/or columns which are then repeated.

Note: the rightmost example includes both multiple loops and nested loops — the red squares and the blue squares are drawn with separate loops, one after another, with nested loops being used to draw each grid of squares.

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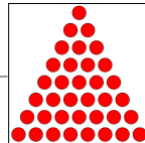
1. A sketch which draws the picture shown. The pattern should fill the window (without going outside) no matter what size the window is. Make the circles a fixed size rather than always ensuring exactly 8.



what pattern? (single loop, multiple loops one after another, nested loops)	nested loops (decompose into repeating rows or repeating columns of circles, where each row or column itself involves repeating ellipses)	
what is repeated?	rows of circles	(for each row) an ellipse
what changes from one repetition to the next?	y coordinate number of circles in the row	x coordinate
how do things start?	from the top – y = 25, number of circles = 1 (CENTER mode)	from the left – x = 25 (CENTER mode)
how do things change?	y = y+50 number of circles increases by 1	x = x+50
when do you keep going?	the bottom of the window hasn't been reached – y <= height-25	repeat number of circles times

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2. A sketch which draws the picture shown. The pattern should fill the window (without going outside) no matter what size the window is. Make the circles a fixed size rather than always ensuring exactly 8..



what pattern? (single loop, multiple loops one after another, nested loops)	nested loops (decompose into repeating rows, where each row involves repeating ellipses)	
what is repeated?	rows of circles	(for each row) an ellipse
what changes from one repetition to the next?	y coordinate number of circles in the row where the row starts (x coordinate)	x coordinate
how do things start?	from the top – y = 25, number of circles = 1, rowx = width/2 (CENTER mode)	where the row starts – x = rowx
how do things change?	y = y+50 number of circles increases by 1 rowx = rowx-20 (each row starts half a circle to the left of the previous)	x = x+50
when do you keep going?	the bottom of the window hasn't been reached – y <= height-25	repeat number of circles times

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3. A sketch which draws the picture shown. The pattern should fill the window (without going outside) no matter what size the window is. Make the ring width a fixed size rather than always ensuring exactly the number shown.



what pattern? (single loop, multiple loops one after another, nested loops)	single loop	
what is repeated?	gray circle + black circle	
what changes from one repetition to the next?	size of the circles (CENTER mode)	
how do things start?	from the outside – size = width (larger circles must be drawn first because smaller ones need to be drawn on top of larger ones)	
how do things change?	decrease by the combined width of one set of gray and black circles size = size-40	
when do you keep going?	as long as there is room for the next set of circles – size >= 40	

