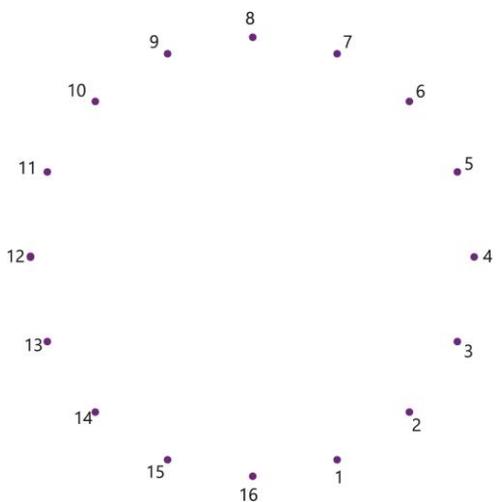




Stitching a number star

This activity is all about playing with number patterns and circles. We are going to stitch chords using number sequences as our guides. A **chord** of a **circle** is simply a straight line segment whose endpoints both lie on the circle. You will find that all sorts of interesting and beautiful patterns emerge. And you will also be able to do lots of experiments by changing the size of the circles and the number sequences you use. These experiments are stitched on card but you can readily transfer the identical technique to fabric.

You will need a piece of heavy card (this could have a picture or design on it that will sit behind your stitching), a blank piece of tracing paper, a sharp needle, a length of thread and some sticky tape. Start by drawing a perfect circle on the tracing paper. Now mark evenly spaced points around the circumference. This example uses 16 points, which you can generate by marking off the 8 compass points (North, South, East, West, NW, NE, SW, SE) and then placing marks halfway between each pair of adjacent points. Label the points 1 through 16.



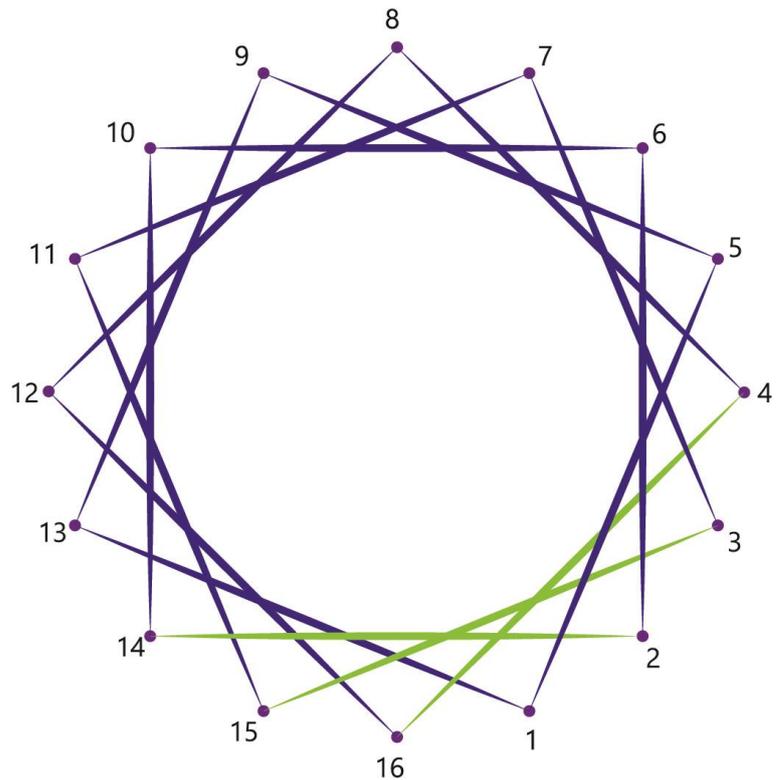
Lay the tracing paper over the card and use the sharp needle to pierce a hole through the paper and the card at each of the evenly spaced points. When you are finished, your card should have a ring of evenly spaced holes in it. If you wish, you can label these holes on the **back** of the card.

Thread your needle with a fairly long piece of thread (you want to be able to stitch the whole motif with one length of thread if possible). Use a small piece of sticky tape to attach the tail to the back of the card. Now, you are ready to start stitching. Our first pattern uses **addition**: we add 4 to our current number to tell us where to stitch.

- Bring your needle up at point '1'; then $1 + 4 = 5$, so the needle goes down at point '5'.
- Bring your needle up at point '2'; then $2 + 4 = 6$, so the needle goes down at point '6'.
- Bring your needle up at point '3'; then $3 + 4 = 7$, so the needle goes down at point '7'.
- Continue in the same way all around the circle following the table overleaf.
- When doing the final three stitches, tuck them under the previously worked stitches (shown in green on the diagram overleaf) to get a smoother final motif.

You will find that at point '13' there is a problem because $13 + 4 = 17$ but there is no point '17'! We deal with this using the mathematical idea of **modular arithmetic** (also known in computing as the MOD function). When we work 'modulo 16' we reset back to 1 after each multiple of 16, like on a clock with 16 numbers. To work out a number modulo 16, subtract multiples of 16 until you get down to a value between 1 and 16. So 17 (modulo 16) is $17 - 16 = 1$. (You can also divide the number by 16 and calculate the remainder – the answer will be the same.)

Needle Up = n	Needle Down = n+4 (modulo 16)
1	5
2	6
3	7
4	8
5	9
6	10
7	11
8	12
9	13
10	14
11	15
12	16
13	1
14	2
15	3
16	4



To finish off your stitching, tape the end of the thread to the back of the card and snip off any excess thread.

We can make a different pattern using **multiplication**: in this example we will multiply by 2. Bring your needle up at '1'. Then $1 \times 2 = 2$, so bring the needle down at '2'. Bring the needle up at '2'; then $2 \times 2 = 4$, so bring the needle down at '4'. In the same way as above, when the needle goes down goes beyond '16' use modular arithmetic to get an answer between 1 and 16.

Needle Up = n	Needle Down = 2n (modulo 16)
1	2
2	4
3	6
4	8
5	10
6	12
7	14
8	16
9	2
10	4
11	6
12	8
13	10
14	12
15	14
16	16

