This small project comprised:

- two weeks of maths lessons at a Pupil Referral Unit in Buckinghamshire
- two Y10 pupils who had been permanently excluded from mainstream school
- one hopeful, excited and eventually relieved maths teacher
- MSWLOGO, a wonderful and totally free resource

Motivation is often increased in mathematics by the use of ICT and/or Art. Curve stitching never ceases to impress pupils who have not seen the effect before – how do you get curves from straight lines? Hence the idea to get KS4 pupils to program the computer to curve stitch. By embedding this program in more complex programs they were able to produce beautiful and colourful patterns.

First I got them to draw the $10 \times 10, 90^\circ$ curve stitch pattern by hand. The pupils were already familiar with the basic LOGO commands and knew how to write a simple program. I introduced Pythagoras’ Theorem as a means of calculating the lengths and trigonometry, the tangent function, as a means of calculating the angles.

The pupils could calculate the lengths and angles and, referring to their curve stitch drawing, check their answers were in the right ‘ball-park’ by measuring. Once the values were checked they began to create their program ‘stitch’ (figure 1).

These were then used to make patterns at which to marvel (figures 2, 3 & 4).

One of the pupils was desperate to recreate the equilateral triangle and subsequent patterns he had seen in John Millington’s book Curve stitching. [1] Warily I told him that the maths would be very hard but he still wanted to give it a go. Cosine rule and

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sine rule were needed and he valiantly fed numbers into formulae but the ensuing program did not work for the first three values. I realised, a little belatedly, that I needed to refer to the sine wave to explain to him how to calculate the equivalent obtuse angle from the acute ones he had obtained from the formula. My concern that the complexity of the maths would leave his head reeling were allayed by his: “so you just take the angle off 180 to get the one we want” and a couple of edits later he had the first vertex “stitched” (figure 5).

With the introduction of setpc[ ] he decided not to use repeats so as to create a three-coloured equilateral triangle (figure 6).

Once he had the 90° and 60° curve stitch programs and knew how to alter colours the patterns were endless …

I think we’ll pause there for breath and do the epicycloids by hand, with a pencil and then embroidery thread!

Your homework is to match the pictures to the programs – ENJOY!

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The LOGO code is available as a text file from the ATM web site. Paste it into the LOGO editor.

to stitch
  fd 100*3 rt (180-5.7) fd 100.5*3 rt (90 + 5.7) fd 10*3 rt 90
  fd 90*3 rt (180-12.5) fd 92.1*3 rt (90 + 12.5) fd 20*3 rt 90
  fd 80*3 rt (180-20.5) fd 85.4*3 rt (90 + 20.5) fd 30*3 rt 90
  fd 70*3 rt (180-29.7) fd 80.6*3 rt (90 + 29.7) fd 40*3 rt 90
  fd 60*3 rt (180-39.8) fd 78.1*3 rt (90 + 39.8) fd 50*3 rt 90
  fd 50*3 rt (180-50.2) fd 78.1*3 rt (90 + 50.2) fd 60*3 rt 90
  fd 40*3 rt (180-60.3) fd 80.6*3 rt (90 + 60.3) fd 70*3 rt 90
  fd 30*3 rt (180-69.5) fd 85.4*3 rt (90 + 69.5) fd 80*3 rt 90
  fd 20*3 rt (180-77.5) fd 92.1*3 rt (90 + 77.5) fd 90*3 rt 90
  fd 10*3 rt (180-84.3) fd 100.5*3 rt (90 + 84.3) fd 100*3 rt 90
  END

to circle
  repeat 4 [stitch fd 300 rt 90]
end

to shape
  repeat 4 [stitch rt 90 circle rt 90]
end

to start
  repeat 4 [stitch rt 90]
end

to diamond
  star fd 300 rt 90 repeat 4 [fd 300 rt 90 stitch fd 300]
end

to stitch
  FD 1000/2 RT (180 - 5.7) FD 1005/2 RT (90 + 5.7) FD 100/2 RT 90
  FD 900/2 RT (180 - 12.5) FD 921/2 RT (90 + 12.5) FD 200/2 RT 90
  FD 800/2 RT (180 - 20.5) FD 854/2 RT (90 + 20.5) FD 300/2 RT 90
  FD 700/2 RT (180 - 29.7) FD 806/2 RT (90 + 29.7) FD 400/2 RT 90
  FD 600/2 RT (180 - 39.8) FD 781/2 RT (90 + 39.8) FD 500/2 RT 90
  FD 500/2 RT (180 - 50.2) FD 781/2 RT (90 + 50.2) FD 600/2 RT 90
  FD 400/2 RT (180 - 60.3) FD 557/2 RT (90 + 60.3) FD 700/2 RT 90
  FD 300/2 RT (180 - 77.5) FD 608/2 RT (90 + 77.5) FD 800/2 RT 90
  FD 200/2 RT (180 - 84.3) FD 1005/2 RT (90 + 84.3) FD 1000/2 RT 90
  END

to marvel
  repeat 4 [stitch rt 90]
  repeat 4 [stitch rt 90]
  rt 45
  repeat 4 [stitch rt 90]
  repeat 4 [stitch rt 90]
end

to triangle
  FD 1000/4 LT 120 FD 100/4 LT (180 - 114.8) FD 954/4 LT (60 + 114.8)
  FD 1000/4 LT 120 FD 200/4 LT (180 - 107.88) FD 819/4 LT (60 + 107.88)
  FD 900/4 LT 120 FD 300/4 LT (180 - 98.21) FD 700/4 LT (60 + 98.21)
  FD 800/4 LT 120 FD 400/4 LT (180 - 85.61) FD 608/4 LT (60 + 85.61)
  FD 700/4 LT 120 FD 500/4 LT (180 - 68.89) FD 557/4 LT (60 + 68.89)
  FD 600/4 LT 120 FD 600/4 LT (180 - 49.44) FD 557/4 LT (60 + 49.44)
  FD 500/4 LT 120 FD 700/4 LT (180 - 34.73) FD 608/4 LT (60 + 34.73)
  FD 400/4 LT 120 FD 800/4 LT (180 - 21.79) FD 700/4 LT (60 + 21.79)
  FD 300/4 LT 120 FD 900/4 LT (180 - 12.79) FD 819/4 LT (60 + 12.79)
  FD 200/4 LT 120 FD 1000/4 LT (180 - 5.21) FD 954/4 LT (60 + 5.21)
end

to tri
  setpc [255 000 200] triangle fd 100/4 lt 120
  setpc [000 255 100] triangle fd 100/4 lt 120
  setpc [000 000 100] triangle fd 100/4 lt 120
end

to try
  repeat 6 [tri fd 100 lt 60]
end
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