AGE RANGE
7-10

LESSON TYPE
Unplugged

REQUIREMENTS
Per team (two to three students)
- Squared paper
- Six coloured pens or pencils
- One or two dice

THOMAS'S TANGLES

Algorithmic thinking doesn't just happen when coding. **Scott Turner** and his son **Thomas** have developed a game that uses an algorithm to produce drawings

The aim of this game is to use an algorithm to generate an image and see the main algorithmic constructs in action.

> A FEW MINUTES MAY BE NEEDED TO GO THROUGH THE ALGORITHM AND SHOW AN EXAMPLE

Students may need some guidance on interpreting the 'check for blocks' part of the algorithm/subroutine: essentially it is just either if the move is off the page or the blocks have already been filled in, then find a new starting point

LEARNING OBJECTIVES

- ✔ Explore abstract patterns using randomness within an algorithm.

After this activity, students should be able to:

- ✔ Use an algorithm that uses randomness
- ✔ Produce a picture by using an algorithm

ACTIVITY 1: PRODUCE YOUR TANGLES 30 minutes

Get your students into pairs, each with a copy of the algorithm, a sheet of squared paper, pens, and dice. A few minutes may be needed to go through the algorithm and show an example. Working in pairs, ask the children to take turns with the two roles.

- Person A: Rolls the dice and reads out the instructions – using the algorithm.
- Person B: Is the 'robot' carrying out the instructions.
- When the starting or central square is blocked and a new central square is needed, the roles of A and B swap (so A is the 'robot', and B rolls the dice and reads out the instruction).
- The roles keep swapping.
- Pedagogically, the approach is inspired by pair programming and this activity has elements of the Run and Investigation parts of PRIMM.

Algorithm

Start from a random square – call it the centre square
Repeat until end of game

If die roll = 1
Roll die for number of moves
Check for blocks
If not blocked then
move die roll number of steps up the page

If die roll = 2
Roll die for number of moves
Check for blocks
If not blocked then
move die roll number of steps down the page

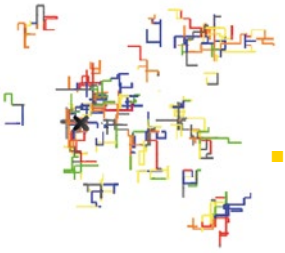
If die roll = 3
Roll die for number of moves
Check for blocks
If not blocked then
move die roll number of steps to the left

If die roll = 4
Roll die for number of moves
Check for blocks
If not blocked then
move die roll number of steps to the right

If die roll = 5
Roll die
If die = 1 change colour to Red
If die = 2 change colour to Blue
If die = 3 change colour to Black
If die = 4 change colour to Red
If die = 5 change colour to Orange
If die = 6 change colour to Yellow

If die roll = 6
Return to current centre square

Check for blocks:
If number of free blocks in the direction < number of moves, choose a new centre square.



As an extension activity, your students could write a program to create the 'tangles' in Scratch

ACTIVITY 2: REVIEW, MODIFY AND MAKE 30 minutes

- Share examples of the children's work around the class.
- What changes would you make to the algorithm?
- Make the changes to the algorithm (and, if there is time, repeat on a new piece of paper using the modified algorithm).

THOMAS TURNER AND SCOTT TURNER

Thomas Turner has an interest in both playing and creating games. He is 14 years old. Scott Turner (@scottturneruon) is Principal Lecturer in Computing at the University of Northampton. He is also a Code Club leader and volunteer.

ASSESSMENT

Some suggestions for questions:

- What part of this algorithm uses selection?
- How do we know what will be repeated?
- How would you modify to improve the algorithm?
- How could we alter the algorithm to use 12 colours instead of 6?

DIFFERENTIATION

For a follow-on activity, can you build part of this in Scratch? As a suggestion, build it so that only a single 'spiral' of one colour is used.

FURTHER READING

- A simple Scratch version of the game: helloworld.cc/tangles
- Scott Turner and Katharine Childs have written a chapter on artists in the book *Teaching Computing Unplugged in Primary Schools*: helloworld.cc/primaryup