Barefoot Computing at School

In collaboration with BT

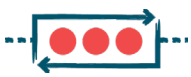
Recommended for **ages 7-11**

Shapes and Crystal Flowers

An introduction to repetition using Scratch

Duration: **1 hour**

Concepts and approaches covered



Repetition

Programming

Overview

In this activity, pupils design algorithms to draw patterns made of simple shapes before writing a Scratch program to draw their shapes. In doing so, they learn about repetition.

Pupil objectives

- I can write a program that uses a repeat command
- I can explain what the repeats in my program do

Resources

- MIT's Scratch 3.0 (see this guide)
- Shapes and crystal flowers teachers' presentation - you can access these resources from the downloads folder
- Word file for editing the house algorithm using track changes, or for printing for use under a visualiser
- Some pupils may benefit from using a preloaded Scratch project. This contains the code to draw a square using sequence rather than repeat and a repeat block ready to use in the scripting area (You can also access the Scratch resource using this link: http://Scratch.mit.edu/projects/26526384/)

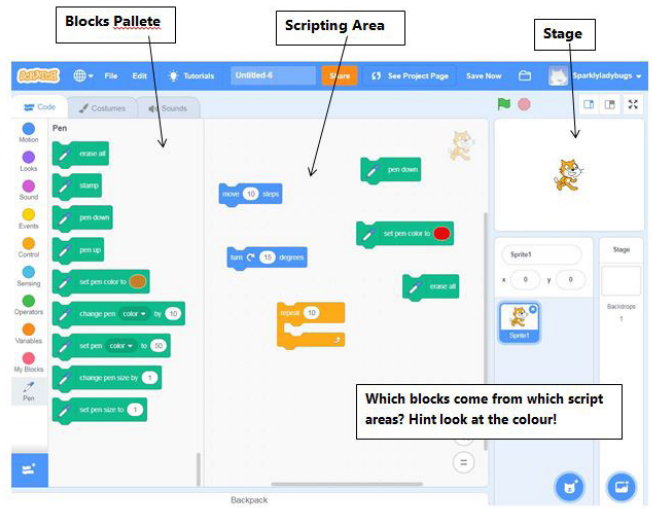
Introduction 15 minutes

Challenge: draw a square (10 mins)

Explain that you would like pupils to complete a programming challenge: draw a square using Scratch.

Ask pairs to work out the algorithm that they think they will need and discuss as a class.

Open Scratch and if necessary, review the main areas of Scratch (**slide 2**, shown below).



This page could be printed off as a help sheet as it has the basic blocks that pupils will need to create their shapes, as well as the block categories as shown circled.

Ask pupils to open Scratch and create a new project with an appropriate file name saved to the school network, or the Scratch website if they have their own accounts.

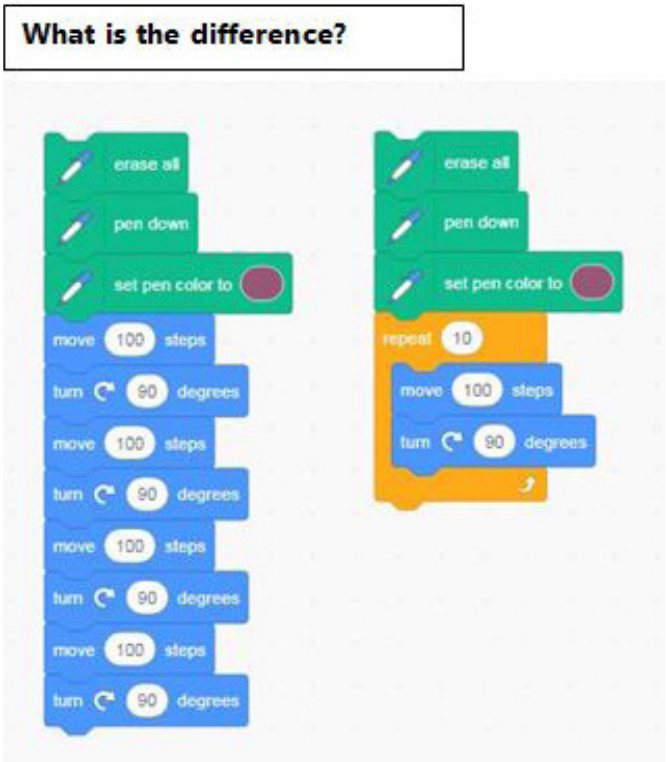
Give pupils five minutes or so to use their algorithm to write their code that might have been better. Ensure pupils swap roles during this time.

If required, support pupils by showing them the relevant blocks such as 'pen', 'move', 'turn' and 'clear'. Once all pupils have attempted this challenge, share and discuss their solutions.

Introduce repetition 5 minutes

Share a program to draw a square that uses only a sequence of instructions and one that uses the repeat command (similar to the ones below). If no pupils have used repetition, an example is shown on **slide 4**. Invite pupils to discuss the differences.

Ensure pupils understand that some steps are repeated in the sequence-based program and that these steps have been moved inside the repeat command. Ask pupils what the number next to the repeat is to ensure they understand this is the number of times the loop will run.



*Drawing a square as a linear sequence of steps and with a repeat (***slide 4***).*

Set the pupils a challenge: by the end of the lesson they should be able to tell you how repetition loops are useful!

Main activity 35 minutes

Use repetition to draw various regular polygons (10 mins)

Ask pupils to write a repeat-based version of their own 'draw a square' program. Don't model this, instead allow pupils to find out independently how to move blocks into the repeat command.

As pupils complete the task of coding a square using a repeat command, challenge them to write new programs to draw other rectangular polygons using repetition. E.g. an equilateral triangle, a regular pentagon, a regular octagon.

Show pupils how to copy their earlier code to do this (the code can be duplicated by right-clicking and selecting duplicate, or it can be copied across sprites by dragging the code from the current scripting area onto another sprite's image).

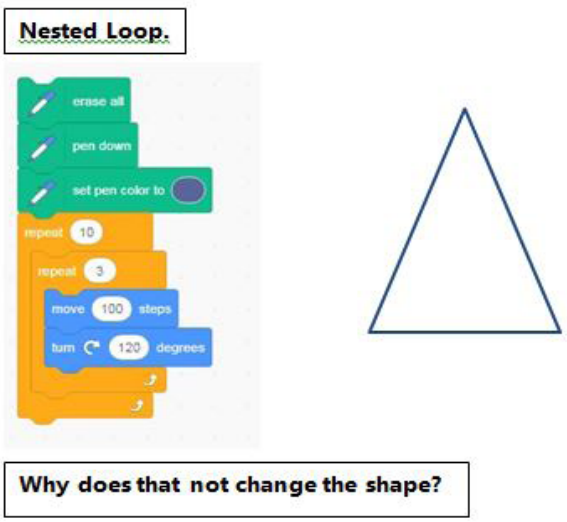
Encourage pupils to use trial and improvement (debugging) and logical reasoning to work out the angle they need for new shapes.

Ask pupils to show the shape they have drawn to their peers and ask them what it is, and what repeat has been used to create the shape.

Nested loops (10 mins)

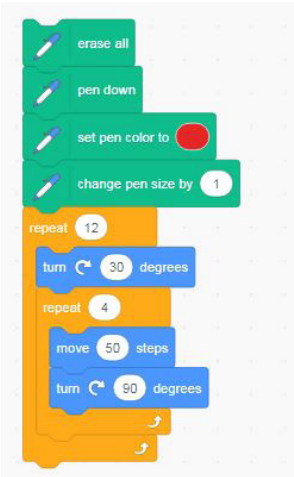
Show pupils how to create a nested repeat (a repeat within a repeat, often called a nested loop). Explain that these have sometimes been called 'crystal flowers'. You could at this point discuss the role of repeating pattern in nature or art, perhaps by looking at a small selection of flower photographs (**slides 7** and **8** have some examples).

Using one of your pupil's programs that draws a regular polygon, add an outer loop. Ask pupils to predict what will happen. Model testing it. (The pattern does not change we just drew over the top as many times as the outer loop, see example below).

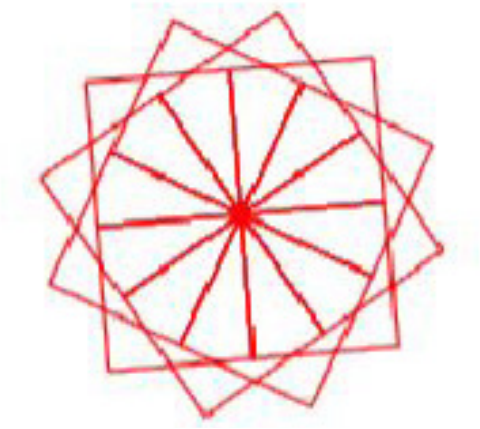


*Drawing a square as a linear sequence of steps and with a repeat (**slide 4**).*

Add a turn within that outer repeat (loop). Ask pupils to predict what will happen. Model testing it

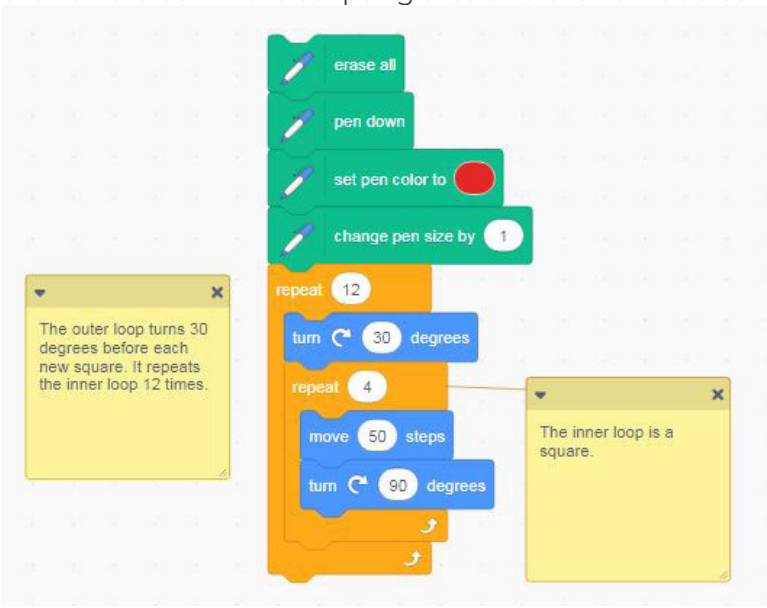


A nested loop. The extra repeat has been snapped around the repeat code that draws a square and a turn command added within the outer loop.



The output from the nested loop code.

Model how to add comments, describing what shape the inner loop is and how the repeat works (right-click on a block in the scripting area and click on 'add comment')



The output from the nested loop code.

Challenge pupils to use nested loops to create new patterns, copying existing code to create new programs and adding comments to their work. Encourage pupils to change the angle and number of repetitions in the outer loop to explore the emerging patterns and to predict what the effect their changes to their code will have on their patterns.

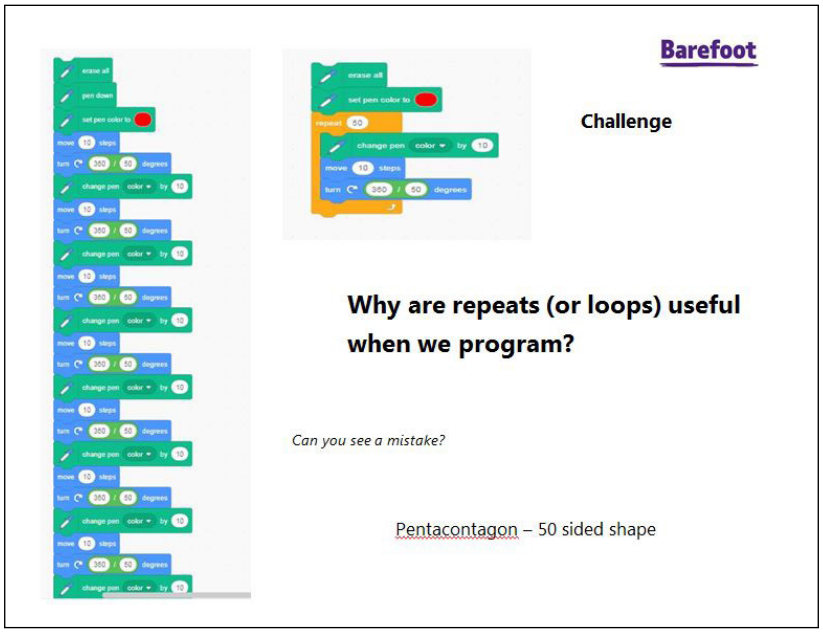
Further challenges could include:

- use different pen colours or pen sizes for parts of the shape (e.g. by using the pen block 'change pen colour by')
- change the inner repeat to draw a triangle, pentagon or other regular shape
- add a 'move' block within the outer repeat

Plenary 5 minutes

Ask pupils to show another pair one of their shapes and ask them to work out what the loops are that have been used. Then they should share the program and see if they can make any suggestions to improve the code.

Look at one or two interesting examples as a class. Ask pupils to discuss why repetition is useful when we program. Guide the discussion to the idea that you reduce the number of lines of code, and so it is quicker to code and easier to fix. An ideal example to help this thinking is ask if you created a pentacontagon (50 sided shape) or chiliagon (1000 sides). How long would it take to write the program with just a sequence?



The output from the nested loop code.

Differentiation

Support

Pupils who find the maths difficult could be given the angles of the shapes they are using and the values to use for the outer nested loops, although all pupils can experiment with changing these values in the Scratch programs.

When programming, pupils who find it difficult to remember which blocks to use can be given sample code that does not give the answer, but is for a different shape.

A template Scratch file has been provided for those pupils who need it, this file has the sequence based square program already coded and a repeat block already on the scripting area.

Stretch and Challenge

Pupils could use rectangles, rhombuses, parallelograms or other quadrilaterals as the base shape for their repeating patterns.

Pupils could be asked to add a 'move' block to the outer loop as well as a turn, and encouraged to explain the effect.

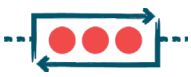
Pupils should be asked to explain how their loops work, perhaps using comments in Scratch. Pupils can be asked to add commands to change the colour or thickness of lines, at different points in their shape design, explaining their reasoning of what they changed and what the impact was.

Assessment opportunities

- Informal teacher assessment of progress during the lesson. Key pupil knowledge and skills to identify include:
  Do pupils understand the concept of repetition?
  Do pupils see the benefit of using repetition commands?
  Can pupils use repetition commands to draw shapes?
  Can pupils nest repetition commands to create crystal flowers?
  Can pupils debug their programs when required?
- Formal, summative assessment of Scratch projects (pairs)
- Peer assessment and feedback of crystal flower programs during the plenary

Teaching notes

Concepts and approaches



Repetition
Pupils use repetition commands to write efficient code to draw regular polygons. They then use nested repetition commands to create patterns.

Programming
Pupils create their crystal flower programs in Scratch.
If required pupils debug their code to remove errors.
Pupils write out the algorithm for drawing regular polygons and use these to help write the code for their programs.

Curriculum links

Please refer to the resource overview page on the website, to understand how the learning objectives covered in this lesson relate to the curriculum in your country.

Taking this further

Scratch workbook exploring shape:

http://scratch.ie/sites/all/themes/scratch_theme/resources/newworkbook/Module2.pdf

Creating snowflakes in Scratch

Related activities

Lower KS2 Fossil formation sequencing activity
Upper KS2 Viking raid animation sequence activity
KS2 Maths Quiz - selection activity
KS2 Maths Quiz - variables activity

Barefoot

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