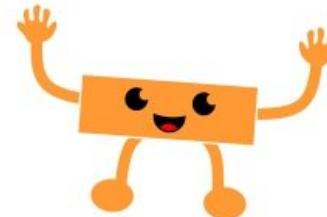
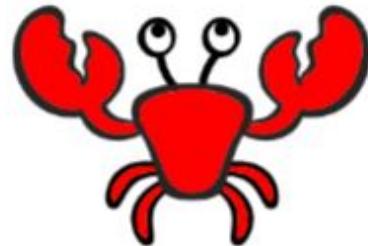
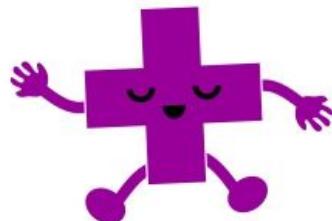


SCRATCH

Maths



SCRATCH

Maths

—

Scope & Sequence

Year 5 – Computing focus (20+ hours of teaching materials)

Module 1:
Tiling Patterns



Module 2:
Beetle Geometry



Module 3:
Animating Sprites



Year 6 – Mathematics focus (20+ hours of teaching materials)

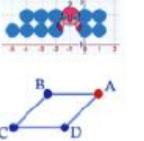
Module 4:
Building with
Numbers



Module 5:
Exploring Mathematical
Relationships



Module 6:
Coordinates and
Geometry



SCRATCH

Maths

Module 1: Tiling Patterns



Investigation 1

Moving, Turning,
and Stamping



Module 1: Tiling Patterns

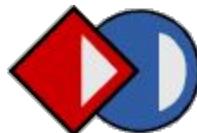
Investigation 1
Moving, Turning,
and Stamping



Investigation 3
Creating Circular
Rose Patterns



Investigation 2
Repeating and
Alternating Patterns



Investigation 4
Defining Your Own
Pattern Blocks



Links to other learning

The theme of Module 1 is repeating patterns. You may like to make links it to areas, such as art or science, where similar patterns can be observed. Some examples are below.

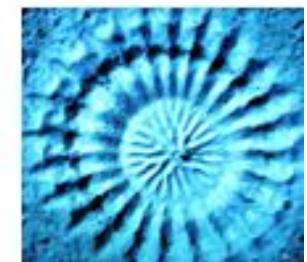
Art: Islamic or Gothic Art

Geometric patterns have been used extensively in Islamic art for many centuries and can also be found in gothic architectural features, such as stained glass windows.



Science: Patterns in Nature

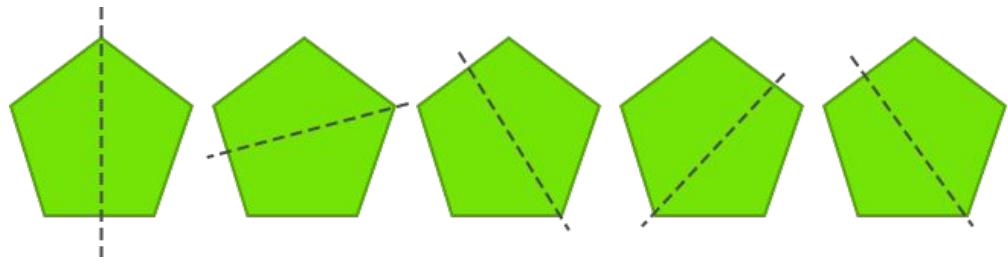
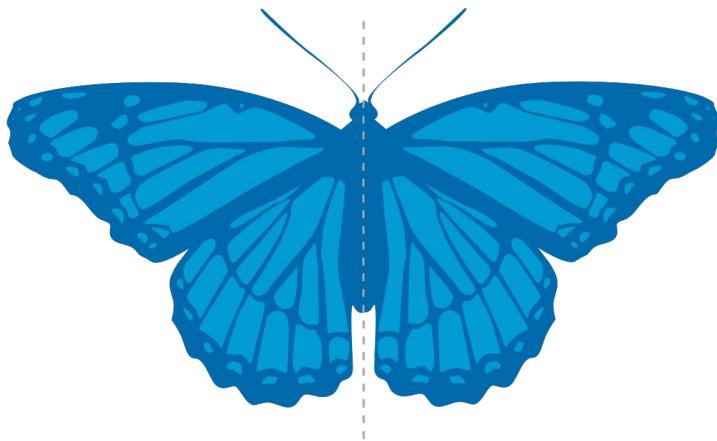
Geometric patterns are seen in nature for example in snowflakes or in the sand sculptures created by puffer fish on the ocean floor.



Links to Math concepts

Symmetry

Exploring symmetry is a 2D Space maths concept, which students can make many connections with in the world around them. This Scratch module explores reflection symmetry and rotational symmetry.

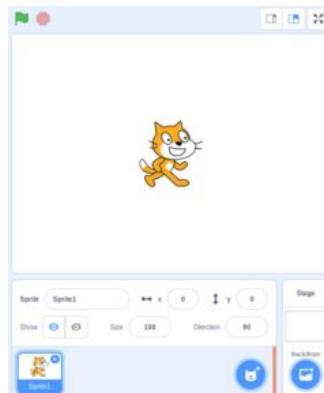
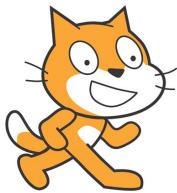


Symmetry in the real world

This module can be used to delve further into the concept of symmetry by showing students, or having them investigate and discover themselves, examples of symmetry in the real world.



SCRATCH Vocab



sprite: an object we control by our blocks and scripts e.g. a Tile, Scratch Cat.

stage: the area where you can see the sprites.

script: a sequence of blocks snapped together, a program; it can be run by clicking on any part of the script



hat block: is always placed at the top of a script



block: a command which tells the sprite what to do; it can be run by clicking on it.



a command which makes the sprite change its direction



a command which makes the sprite change its position



stamp: a block which tells the sprite to print its image on the stage

debugging: the process of fixing or improving a program or scripts

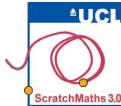
SCRATCH

Maths



Investigation 1
Moving, Turning,
and Stamping





Module 1 • Investigation 1 • Activity 1.1.1

Moving, Turning, and Stamping

Learning Intention: Explore how to drag and stamp a sprite to create symmetrical patterns.

Success Criteria:

- Drag, turn, move, and stamp a sprite;
- Build a simple script to create a pattern without using unnecessary blocks.

This investigation introduces three important Scratch commands ([move](#), [turn](#), and [stamp](#)) and gradually builds up to using these in a program or script in order to create a simple pattern.

Investigation 1

Moving, Turning, and Stamping



Drag and Stamp

Starter project:
[10-Tile Stamp](#)

Drag, Turn and Stamp

Starter project:
[11-Tile Turn](#)

Move, Turn and Stamp

Starter project:
[12-Tile move](#)

Unplugged: Simple Scripts



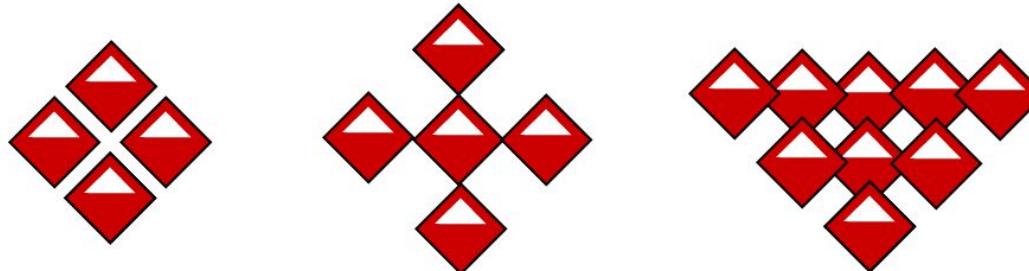
ACTIVITY INSTRUCTIONS

- 1 Open project [10-Tile Stamp](#), remix it, add your name to the title, save the project, and share it to our class studio, [Investigation 1](#).

 **Remix**

Remixing a project allows you to create a copy for you to edit, without altering the original project.

- 2 Create a symmetrical pattern by dragging the Tile sprite and clicking on the **stamp** block in the Scripts area.

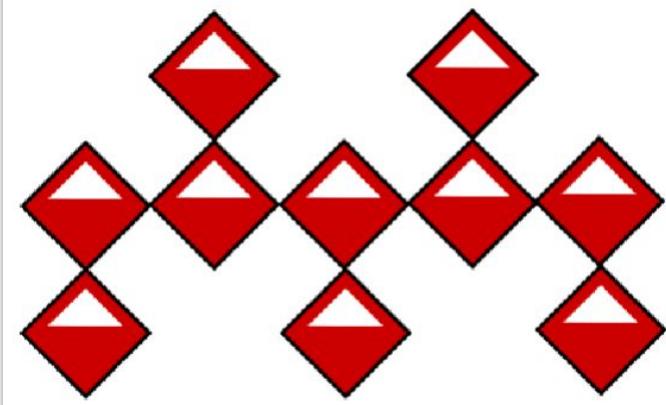
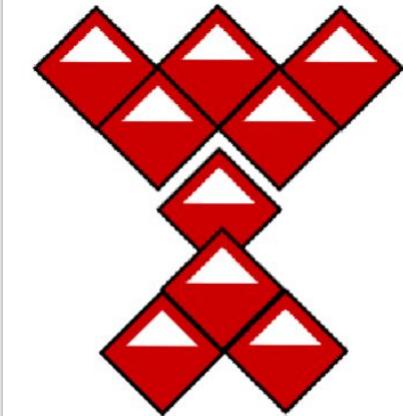
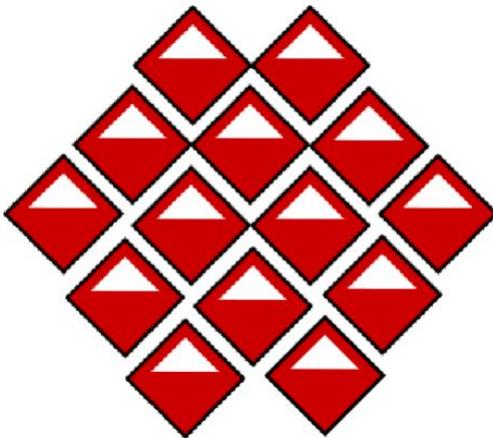


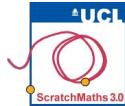
- 3 You can save your pattern by right-clicking (or Shift + click) on the stage and selecting **save picture of stage**.
- 4 Click on the green flag to run the **setup** script – this resets the stage and the sprite.

SCRATCH Maths

applications for learning

This activity can be used as an open-ended approach to learning about symmetry. Students can share their examples of symmetrical patterns. Ask students how many lines of symmetry each pattern has? Why do they only have 1? How could we create patterns with more lines of symmetry?





Module 1 • Investigation 1 • Activity 1.1.2

Drag, Turn, and Stamp

Learning Intention: Explore how to rotate a sprite both clockwise and anti-clockwise and change its direction to create a symmetrical pattern.

Success Criteria:

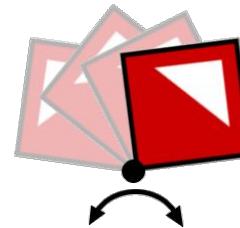
- Explain what the setup script does and how to set the direction of a sprite.

Investigation 1
Moving, Turning,
and Stamping



ACTIVITY INSTRUCTIONS

- ① Open project [11-Tile Turn](#), save as a copy and add your name to the title, save the project, and share it to our class studio, [Investigation 1](#).
- ② Explore how the Tile sprite reacts to clicking the turn blocks.



- ③ Look at the setup script and explain what has changed.

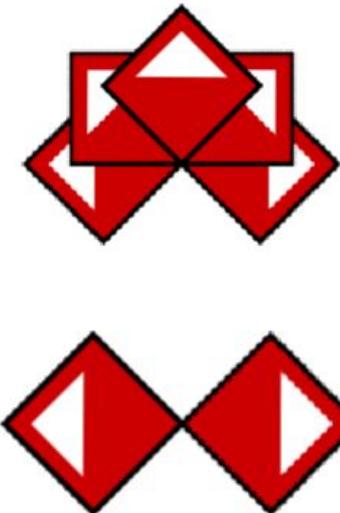
There is a new block in the setup script point in direction 0 which sets the Tile sprite to point upwards (north). This allows the pattern to be stamped from the initial starting position with initial direction after the setup script has been run.



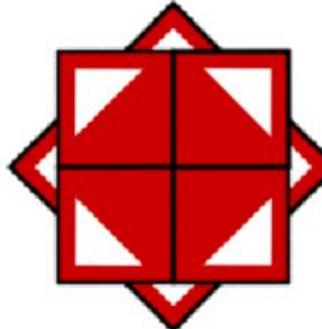
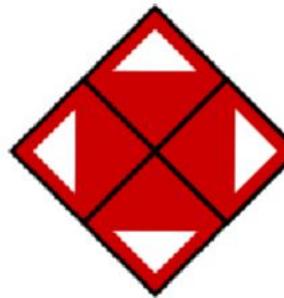
- ④ You will see blocks in the script area that will turn your Tile sprite 15° and 45° clockwise and anticlockwise.
- ⑤ Experiment with moving, turning, and stamping the Tile sprite. Try changing the angle of the turn and stamping to see how the pattern changes.

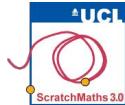
SCRATCH Maths

applications for learning



Here you can extend students by seeing if they can use the rotate block to create patterns that have more than one line of symmetry or rotational symmetry.





Module 1 • Investigation 1 • Activity 1.1.3

Move, Turn and Stamp

Learning Intention: Explore how to rotate a sprite both clockwise and anti-clockwise and change its direction to create a symmetrical pattern.

Success Criteria:

- Move the sprite without dragging it;
- Snap blocks together to create a script.

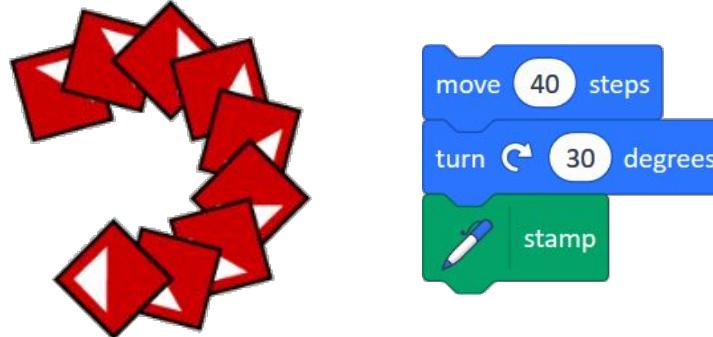
Investigation 1

Moving, Turning,
and Stamping



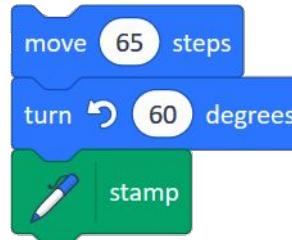
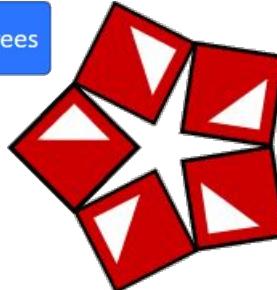
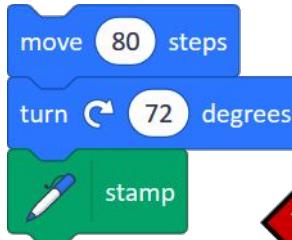
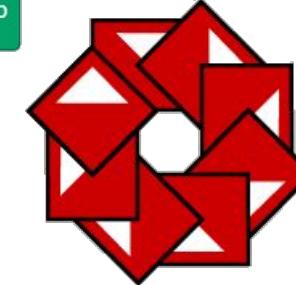
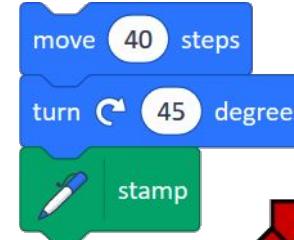
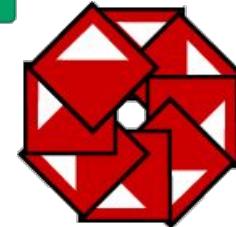
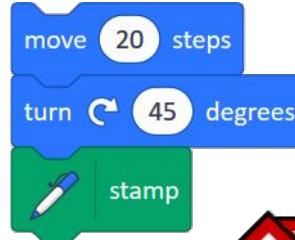
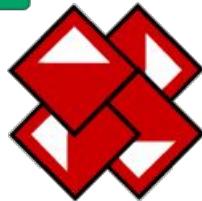
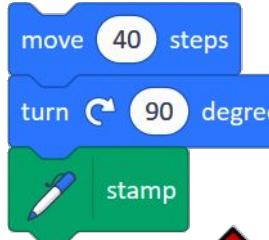
ACTIVITY INSTRUCTIONS

- ① Open project [12-Tile Move](#), save as a copy and add your name to the title, save the project, and share it to our class studio, [Investigation 1](#).
- ② Move the Tile along the stage by clicking on the **move 80 steps** or **move 40 steps** blocks in the scripts area – the Tile should now be moved only using the blocks, no dragging allowed.
- ③ Snap together one of the **move** blocks, one of the **turn** blocks and the **stamp** block and then click to run them as a whole script.



- ④ Try the same with the other blocks in the Scripts area.
- ⑤ Save your pattern by right-clicking (or Shift + click) on the stage and selecting **save picture of stage**.
- ⑥ Try using a different number of steps by changing the number in the **move** block.
- ⑦ Try turning the Tile sprite a different angle by changing the number in the **turn** block.

Explore different values of inputs and clicking the **move – turn – stamp** script several times. Note that some scripts below have different **move** and the same **turn**:



My **Investigation 1** check list:

- I created a symmetrical pattern by stamping the Tile sprite .
- In my patterns, I turned the sprite by using the **turn** block.
- In my patterns, I moved the sprite by using the **move** block.
- I changed the values in my blocks.
- I snapped the blocks together and ran my script repeatedly.
- I saved the picture of my pattern in a file.
- I can simplify a script to make it easier to read, explain and debug.

SCRATCH Maths

applications for learning

Once students have mastered this investigation, they can get creative and experiment with creating a design, such as an ANZAC or Remembrance Day wreath:

How to: students create a new costume and then code it to repeat.

The image shows the Scratch programming environment. At the top, there's a toolbar with various tools and controls. On the left, there's a palette with drawing tools like a pencil, eraser, brush, and selection tool, along with letters T, O, and a square. In the center, there's a stage area with a red poppy flower costume. Below the stage is a button labeled "Convert to Bitmap". At the bottom right, there are search and equalization icons.

Costume poppy

Fill Outline 4

Group Ungroup

Forward Backward

Front Back

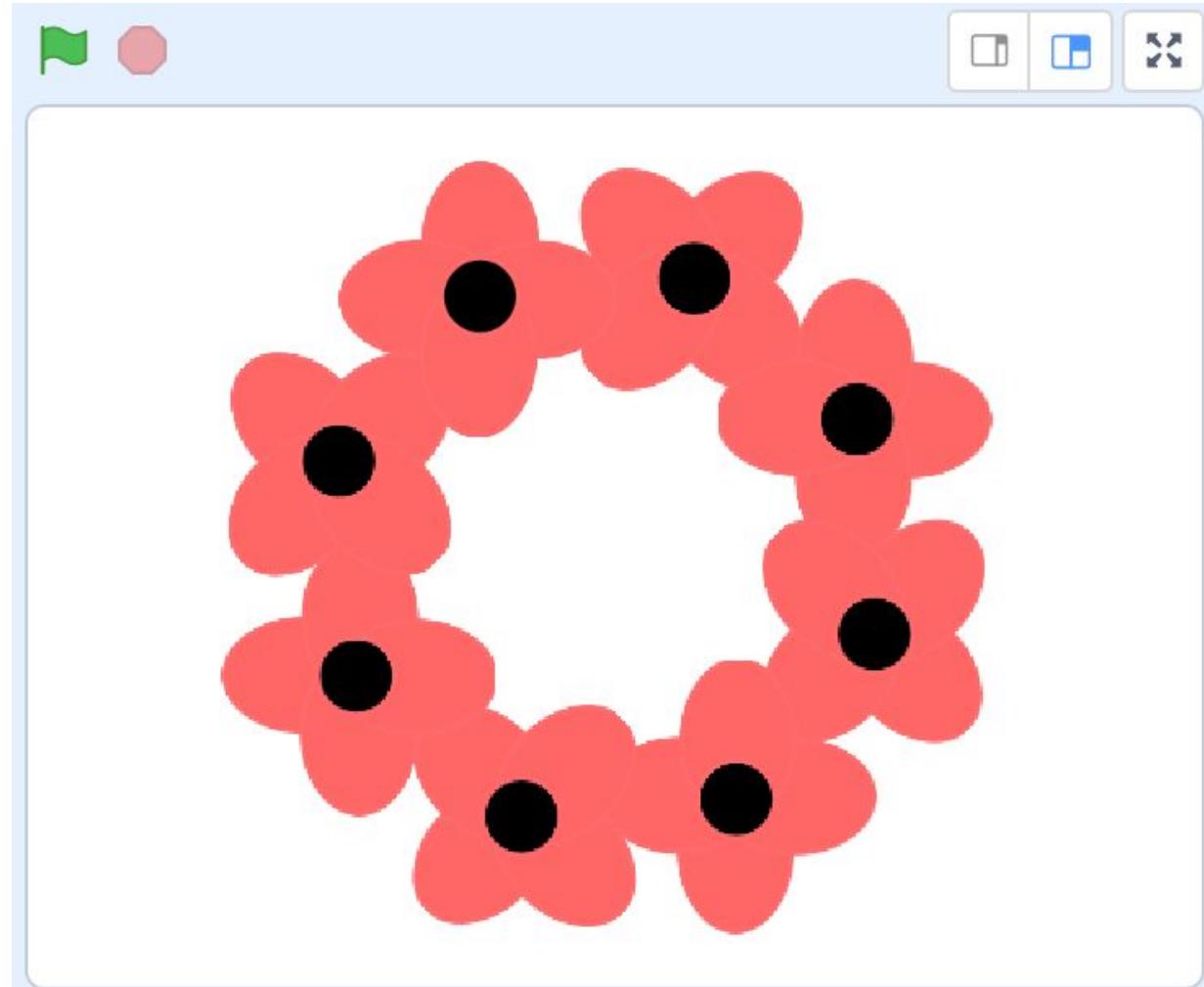
Copy Paste

Delete

Flip Horizontal Flip Vertical

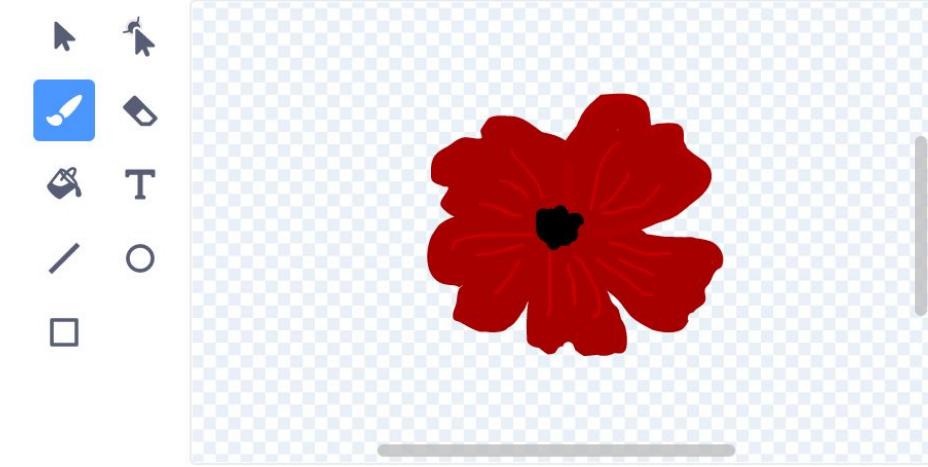
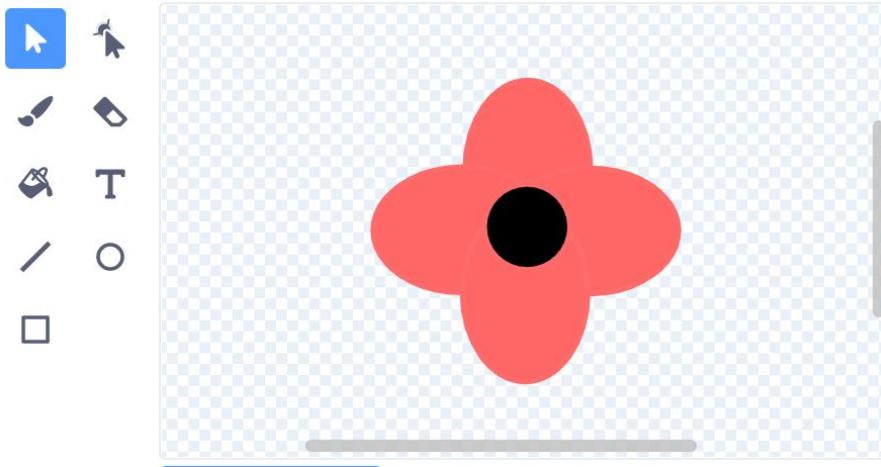
Convert to Bitmap

```
when green flag clicked
  [erase all
    go to x: -100 y: -40
    point in direction 0
    repeat (10)
      [move (80) steps
        turn (45) degrees
        stamp]
    end]
```



Be creative!

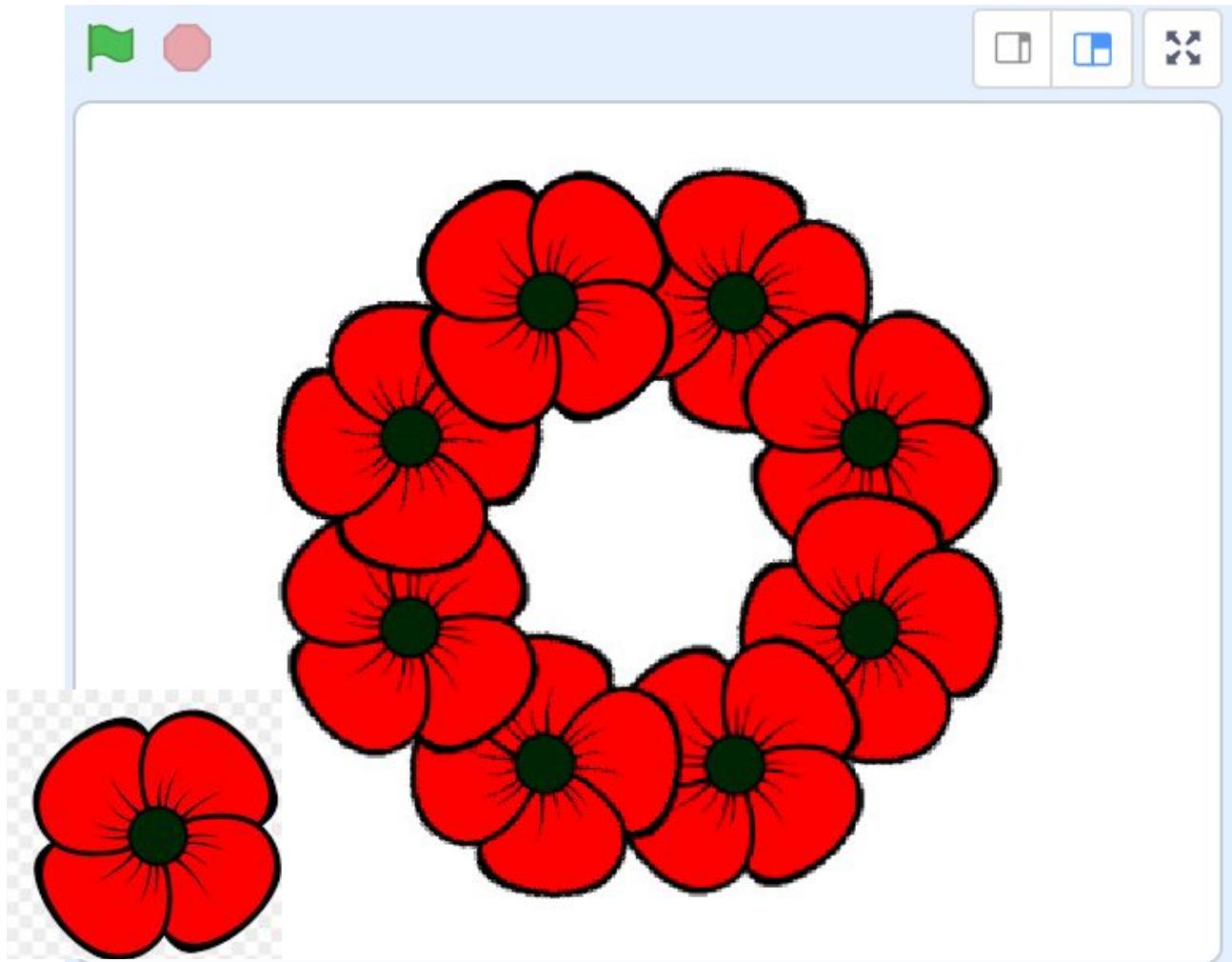
Encourage students to be creative with their Sprite design. It can be as simple or complex as they like.





TIP

If students are not confident with drawing their own Sprite, they can find an image from Google and upload it as their Sprite, then code to create a wreath design.



Spot the difference

Students can experiment with changing the number of movements their Sprite will take when stamped. Depending on the size and shape of their Sprite, this can create a loosened or tightly coiled wreath design.

The image shows a Scratch script editor with two scripts side-by-side, each creating a wreath of red poppies.

Script 1 (Left):

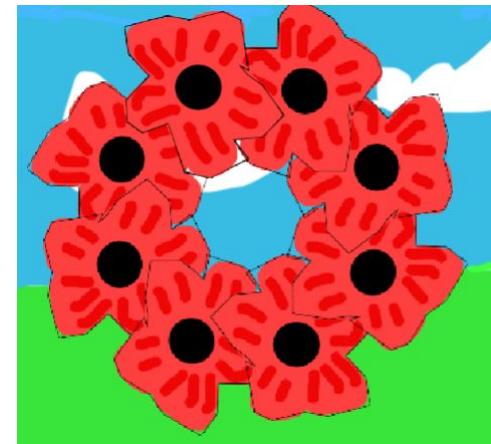
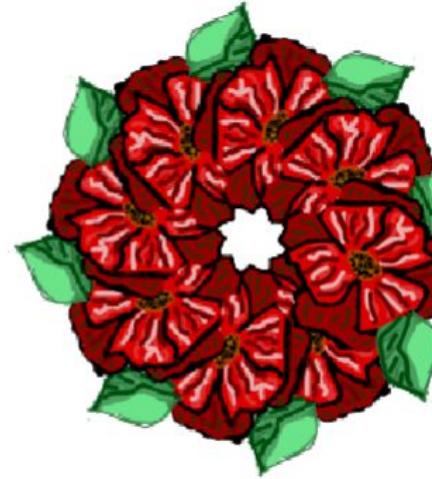
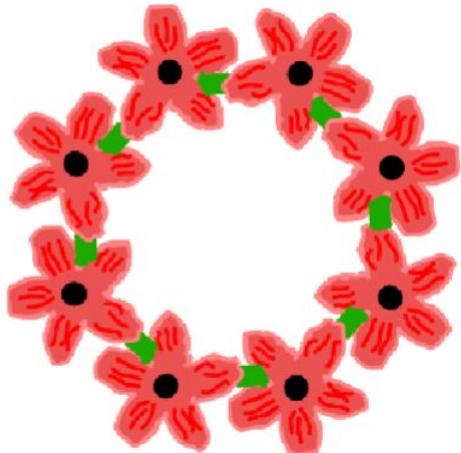
- when green flag clicked
- erase all
- go to x: -100 y: -40
- point in direction 0
- repeat (10)
 - move (80) steps
 - turn (45) degrees
 - stamp

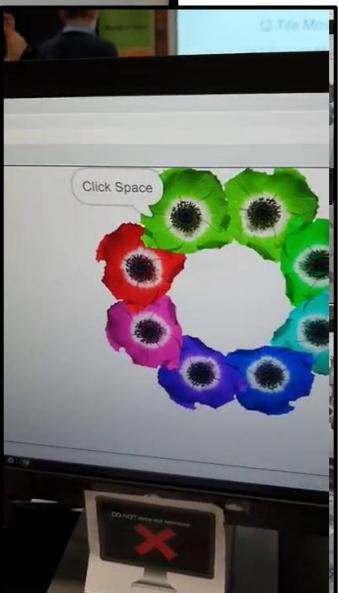
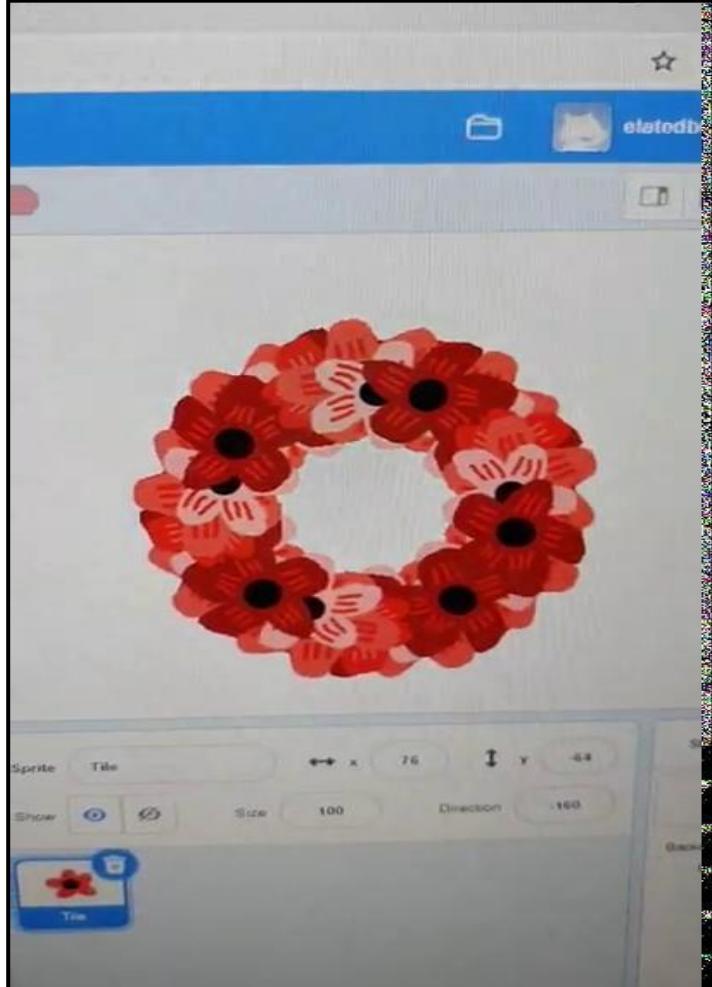
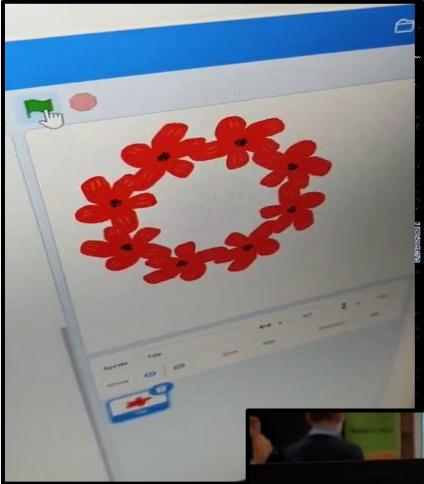
Script 2 (Right):

- when green flag clicked
- erase all
- go to x: -100 y: -40
- point in direction 0
- repeat (10)
 - move (70) steps
 - turn (45) degrees
 - stamp

The wreath on the left is more loosely coiled than the one on the right, due to the larger step size in the repeat loop of Script 1.

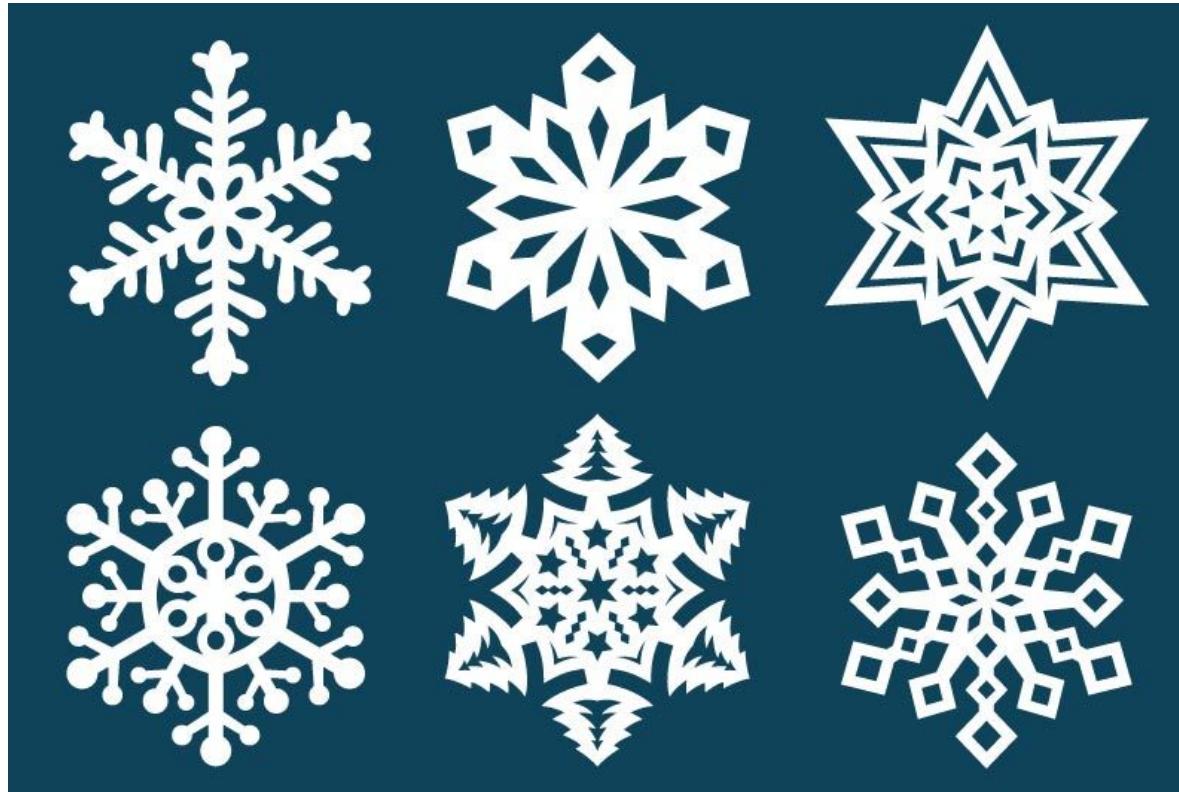
REMEMBERANCE





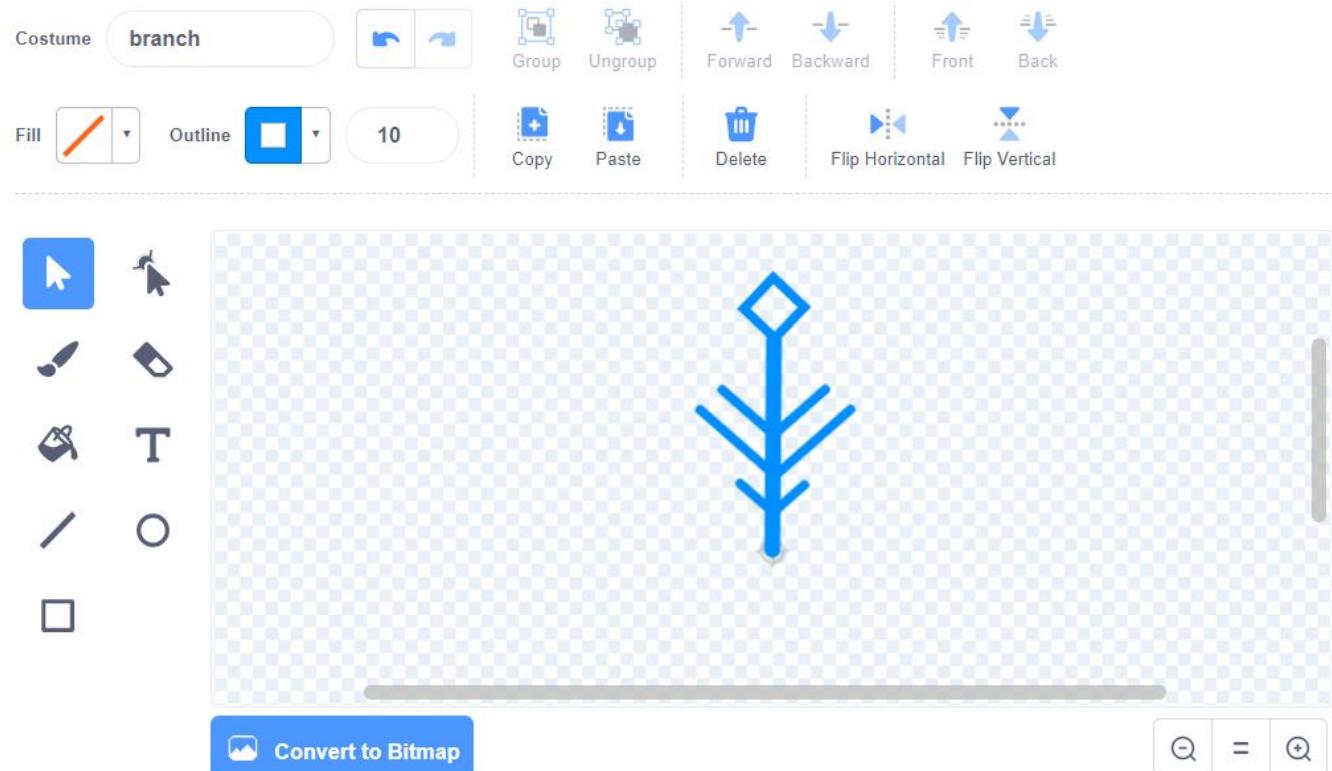
Snowflake Design

Students can research different snowflake patterns in nature to use as inspiration to create their own design. I have used the snowflake image in the top left as my inspiration for the following Scratch project.

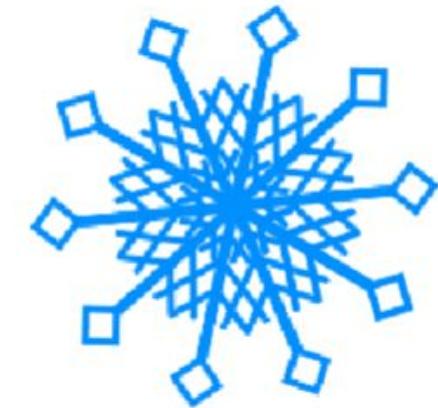
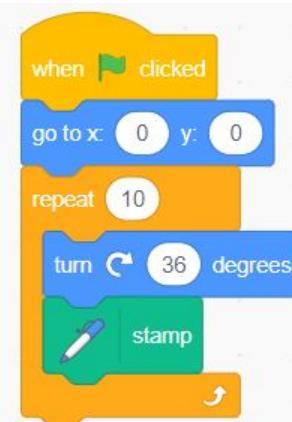
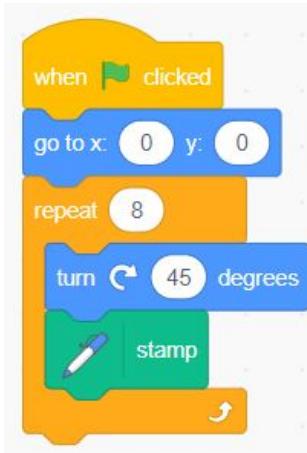


Activity Modifications

You can modify this activity to focus just on angles and symmetry by instructing students to design a branch that they will code to create a snowflake design. I created this design using the line and square tool.



Students can experiment with the repeat block and angle block to create a design. They can change the numbers to be factors of 360 and compare the different results.





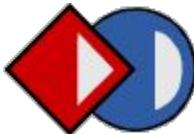
End of Investigation 1

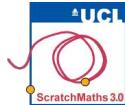
SCRATCH

Maths

Module 1: Tiling Patterns

Investigation 2
Repeating and
Alternating Patterns





Module 1 • Investigation 2 • Activity 1.2.1

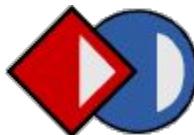
Repeating Flowers

Learning Intention: Use a script to make a circular pattern.

Success Criteria:

- Use the repeat block as an alternative to repeatedly clicking a script to create a circular pattern.

Investigation 2
Repeating and
Alternating Patterns



SCRATCH Vocab

repetition: running a sequence of commands a certain number of times



is a control block which runs the blocks inside a specified number of times



is a command which waits a specified number of seconds, e.g. 1, 2, or 0.2, then continues with the next blocks

total turn: total number of degrees the sprite turns when running a script

costumes: are alternative ways that a sprite can look on the stage

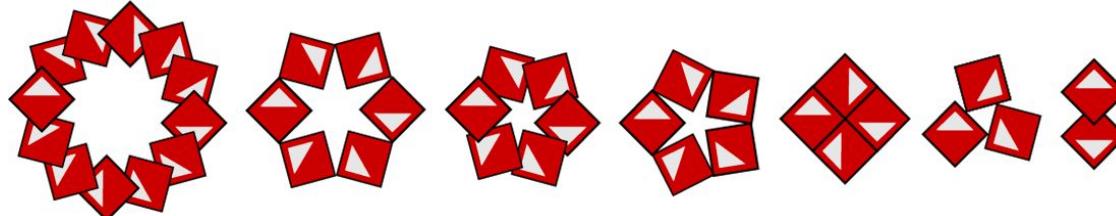


is the block which, when clicked, switches the sprite's costume to the next one in the list.

unplugged: activity away from the computer

ACTIVITY INSTRUCTIONS

- 1 Open project [13-Tile Repeat](#), remix, add your name to the title, save the project, and share it to our class studio, [Investigation 2](#).
- 2 Click on the **move-turn-stamp** script repeatedly until they create a complete circular pattern i.e. one whole turn.
- 3 Discuss the *minimum number of clicks* we needed to complete the pattern.
- 4 Click the green flag to clear the stage.
- 5 Find the **repeat** block in the **Control** group and put it around the script.
- 6 In the **repeat** block, type the *minimum number of clicks* that you previously calculated to create the same pattern and run the script.
- 7 Duplicate your script by right-clicking (or Shift + click) on it and selecting **duplicate**.
- 8 Place this script in the scripts area and change the numbers in the **repeat** and **turn** blocks to create different flower patterns.



- 9 You can add the **wait** block to your script to see how the pattern is created.



Module 1 • Investigation 2 • Activity 1.2.3

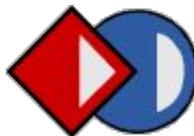
Alternating Flowers

Learning Intention: Use a script with 2 costumes to make a circular pattern.

Success Criteria:

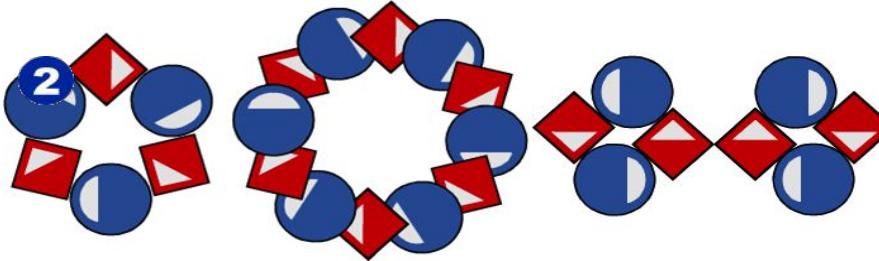
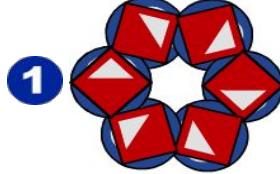
- Create a circular pattern that alternates between 2 different costumes.

Investigation 2
Repeating and
Alternating Patterns



ACTIVITY INSTRUCTIONS

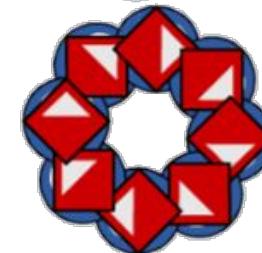
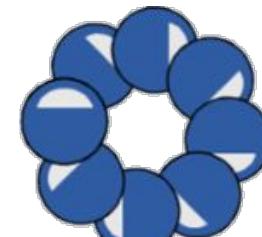
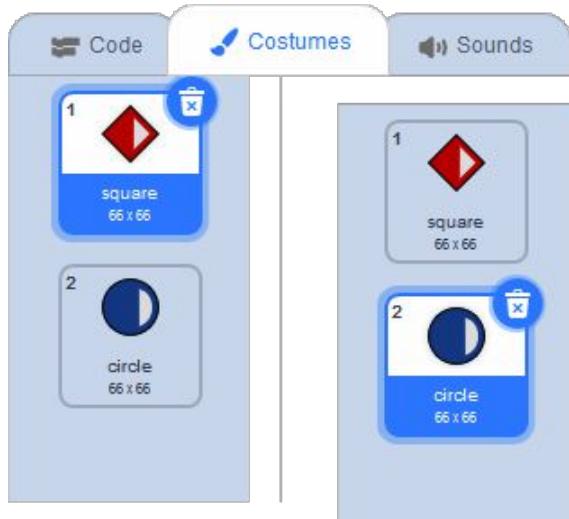
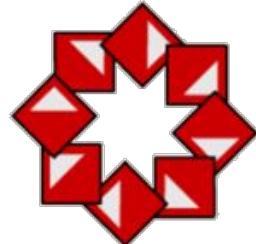
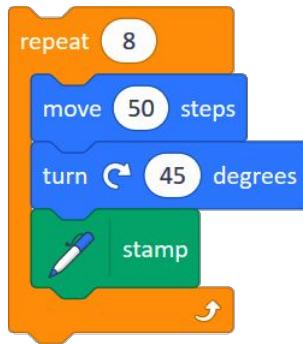
- 1 Continue in your copy of the [13-Tile Repeat](#) project.
- 2 Clear the stage and choose one of your previous flower scripts to use.
- 3 Click on the **Costumes** tab between the stage and the scripting area. You will find the Tile sprite has two different shapes or 'costumes'.
- 4 Click on the second costume – the circle. Go back to the **Scripts** tab and run their script.
- 5 Go to the **Costumes** tab again and select the first costume – the square. Run your script again.
- 6 Drag the **next costume** block from the **Looks** blocks to the **Scripts** area.
- 7 Try to create example pattern 1 below, then experiment with other patterns (e.g. 2).



- 8 As before to save their pattern, students can right-click on the stage (or Shift + click) and select **save picture of stage**.

EXTRA SUPPORT

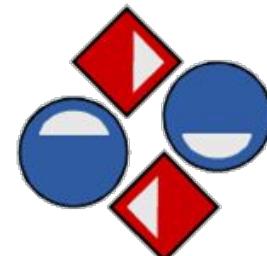
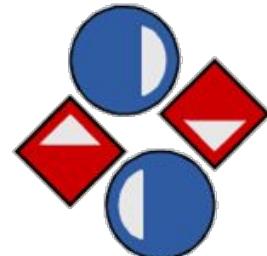
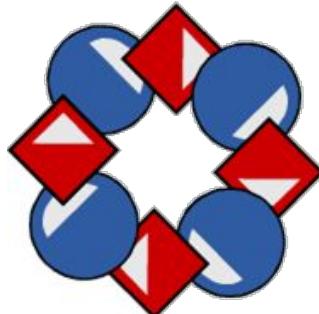
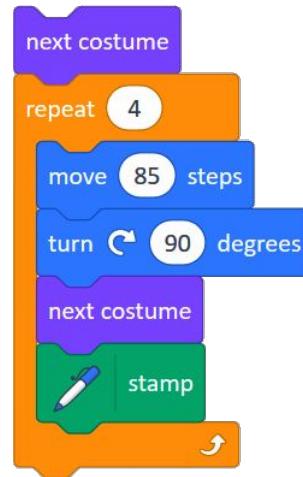
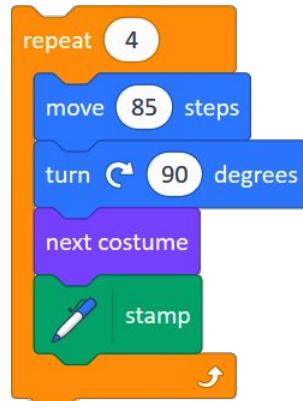
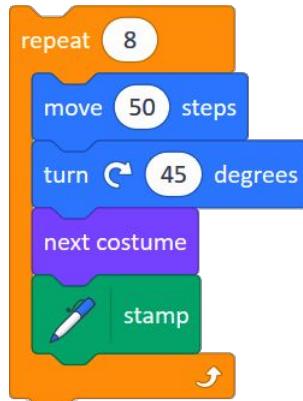
The screenshot below shows how to create patterns using multiple costumes.



next costume

EXTRA SUPPORT

Below are the scripts for some alternating costume patterns.

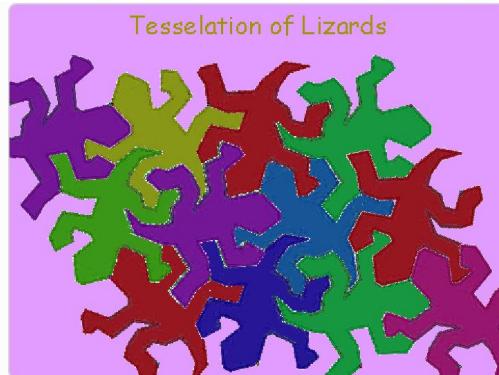


Links to other learning

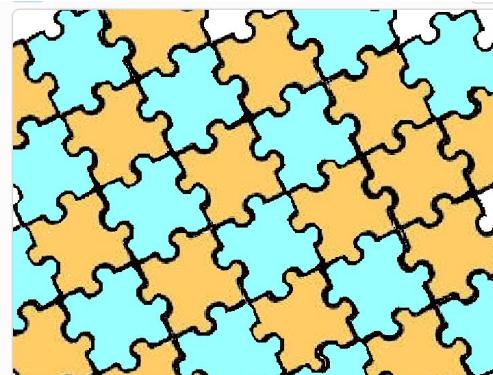
The theme of Module 1 is repeating patterns. You may like to make links it to areas, such as art or science, where similar patterns can be observed. Some examples are below.

Tessellations

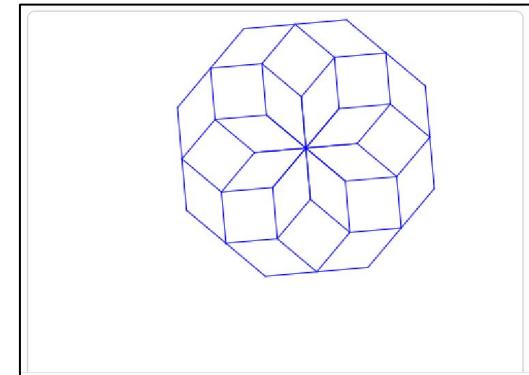
Exploring tessellations is an excellent 2D Space maths activity, which also links to art and creativity. This Scratch module is perfect for this!



<https://scratch.mit.edu/projects/872507/>



<https://scratch.mit.edu/projects/2537749/>



<https://scratch.mit.edu/projects/305345814/>



Module 1 • Investigation 2 • Activity 1.2.4

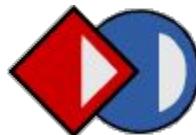
[Extension] Repeating & Alternating

Learning Intention: Use a script to create a repeating and alternating pattern.

Success Criteria:

- Create a circular pattern that alternates between different costumes and repeats.

Investigation 2
Repeating and
Alternating Patterns

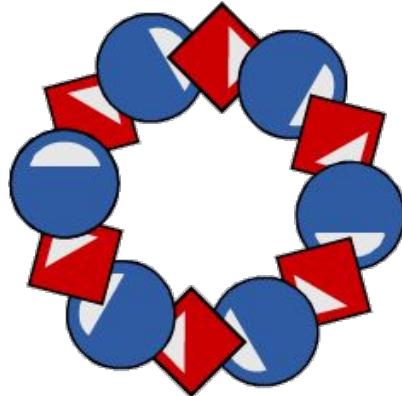
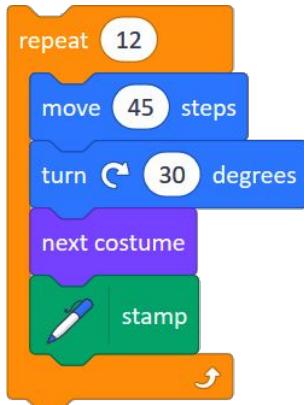


ACTIVITY INSTRUCTIONS

- 1 Continue in your copy of the [13-Tile Repeat](#) project.
- 2 Rearrange the blocks inside the **repeat** block of your flower scripts so that you create patterns similar to those below.

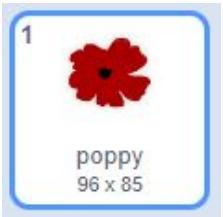
Hint: You might need to remove some of the blocks or use them more than once.

Below are the scripts for some patterns that you might like to try:



SCRATCH Maths

applications for learning



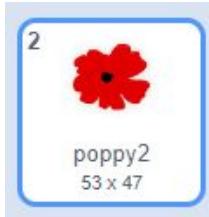
Students can duplicate or create a second Sprite to alternate between. Then they can experiment with their repeat, movement, and turning numbers to create a wreath design.

To create this design, I duplicated my original poppy Sprite, made the size smaller, and changed the colour.

The Scratch script consists of the following blocks:

- when green flag clicked
- erase all
- go to x: -100 y: -40
- point in direction 0
- repeat (12)
 - move (50) steps
 - turn (30) degrees
 - next costume
 - stamp

The resulting image is a circular wreath composed of 12 red poppy flowers, each with a black center, arranged in a circle.

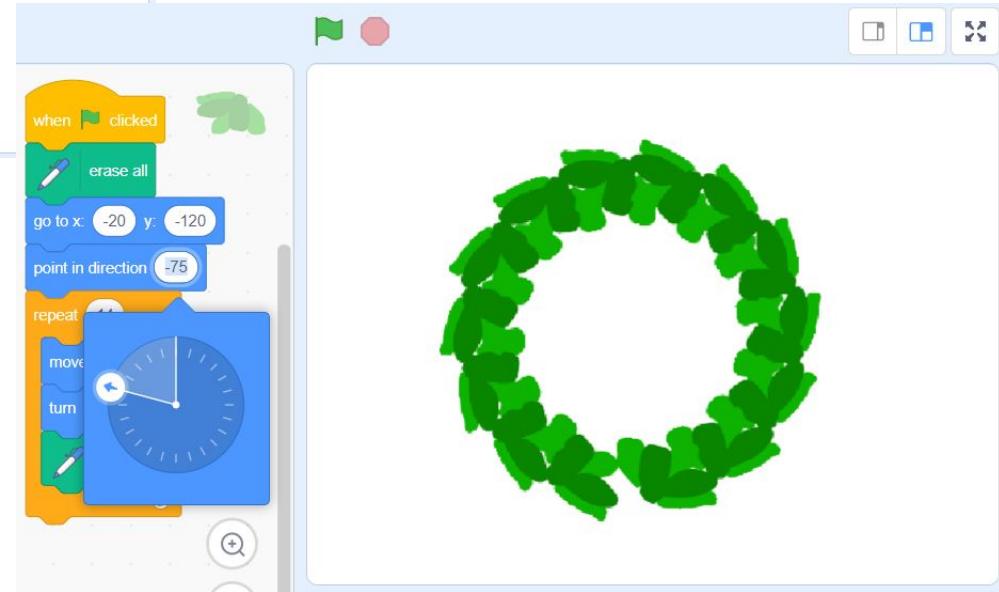


SCRATCH Maths

applications for learning

Students can design multiple Sprites to alternate between. Then they can experiment with their repeat, movement, and turning numbers to create a Christmas wreath design.

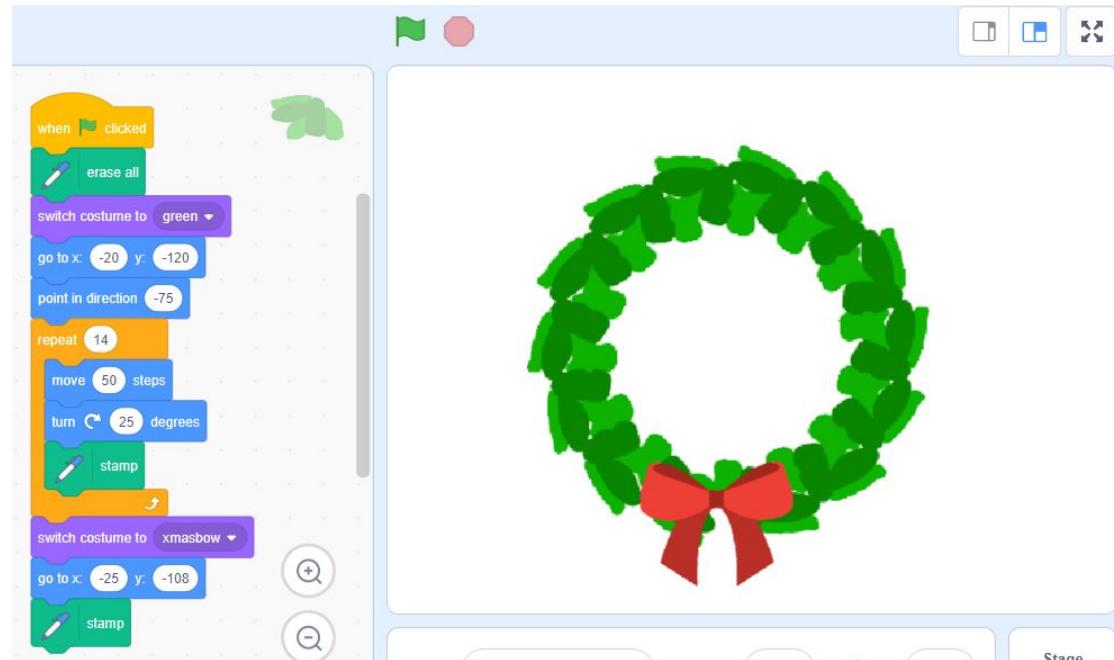
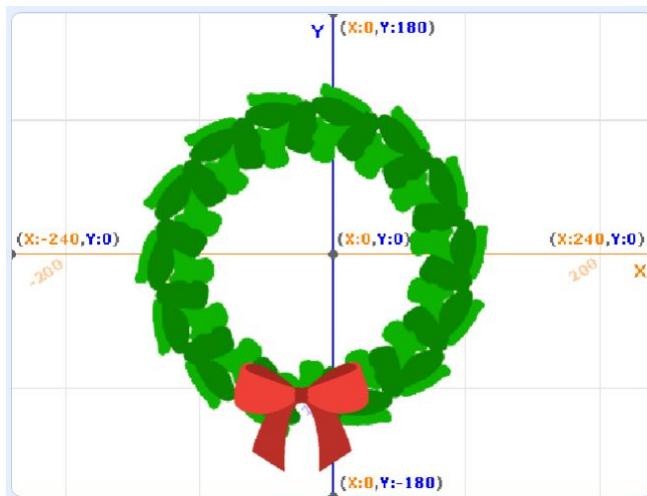




Add more detail

Students can learn more about the x and y axis by uploading a Christmas bow as a Sprite, then positioning it at the base of the wreath.

Tip: in backgrounds, you can select the xy grid, which will help your students visualise the x and y axis.





To extend students who are looking for something more complex:

Instruct them to use the ball Sprite and code baubles to appear on the wreath as well.



End of Investigation 2

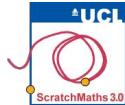
SCRATCH

Maths

Module 1: Tiling Patterns

Investigation 3
Creating Circular
Rose Patterns





Module 1 • Investigation 3 • Activity 1.3.1

Moving Forwards and Backwards

Learning Intention: Use a script to make a circular pattern using a different algorithm.

Success Criteria:

- Create a circular pattern;
- Explain how I have moved the sprite backwards.

Investigation 3

Creating Circular Rose Patterns



ACTIVITY INSTRUCTIONS

- ① In the previous investigation, you used the algorithm **move-turn-stamp** to create patterns. You will now use a different algorithm to create a rose pattern – **move-stamp-move back-turn**.
- ② How do you think you could program your sprite to move backwards? Physically step through the algorithms.
- ③ Open the [14-Rose Patterns](#) project, remix, add your name to the title, save the project, and share it to our class studio, [Investigation 3](#).
- ④ Build a script to create the circular rose pattern below using the **repeat** block. Include a **wait** block to slowly demonstrate how the pattern is created.



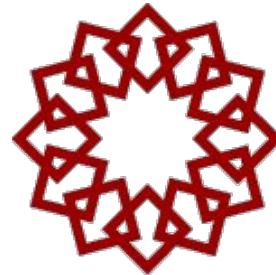
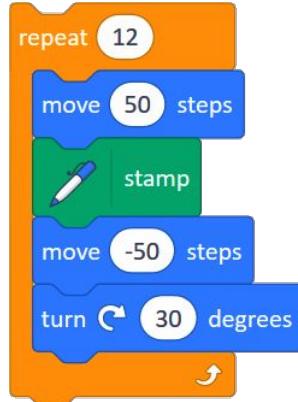
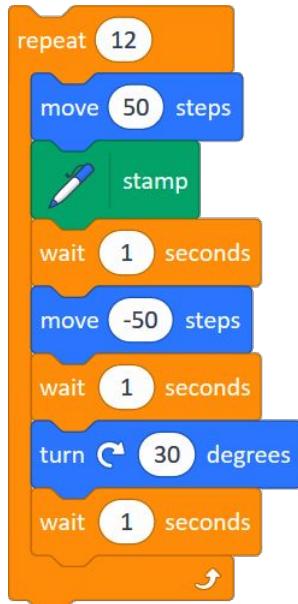
- ⑤ Experiment with changing the number of steps in the **move** block, the number of degrees in the **turn** block and the number in the **repeat** block.
- ⑥ Try changing the numbers in your scripts to create some of the patterns below.



EXTRA SUPPORT

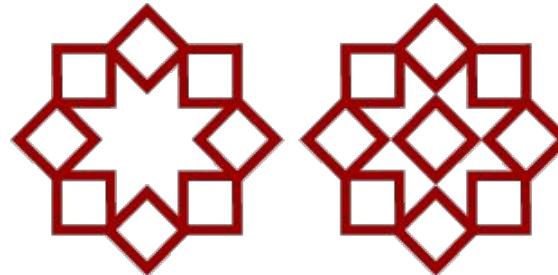
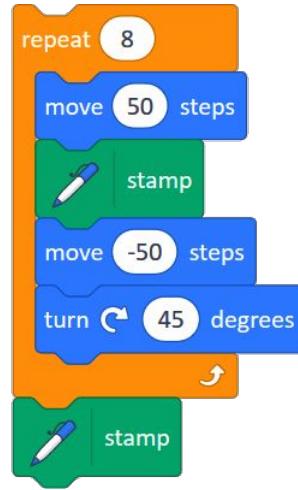
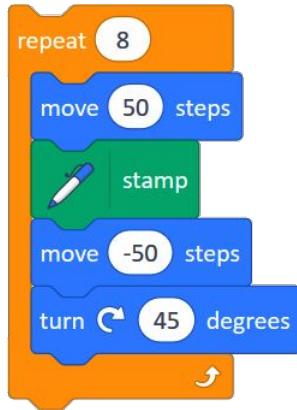
You might like to physically demonstrate for yourself how the rose pattern is stamped – e.g. take 1 step forward, stamp your foot, take 1 step backward, rotate slightly to the right and repeat...

You can use the script below to create the rose pattern on the right. Use the script that includes the **wait** blocks to slowly demonstrate how the pattern is stamped.



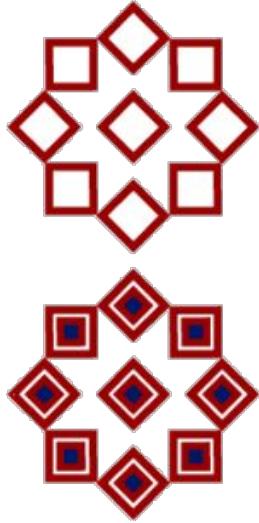
EXTRA SUPPORT

The scripts below create rose patterns without and with a **stamp** in the centre.



EXTRA SUPPORT

You can use the script below to create the first rose pattern on the left.



The Scratch script consists of two parallel `repeat (8)` loops. Each loop contains the following steps:

- `switch costume to [square v]`
- `move (60) steps`
- `stamp`
- `move (-60) steps`
- `turn (45) degrees`
- `stamp`



Module 1 • Investigation 3 • Activity 1.3.3

Combining Different Costumes

Learning Intention: Use a script to make a rose pattern.

Success Criteria:

- Create a rose pattern;
- Switch between specific costumes.

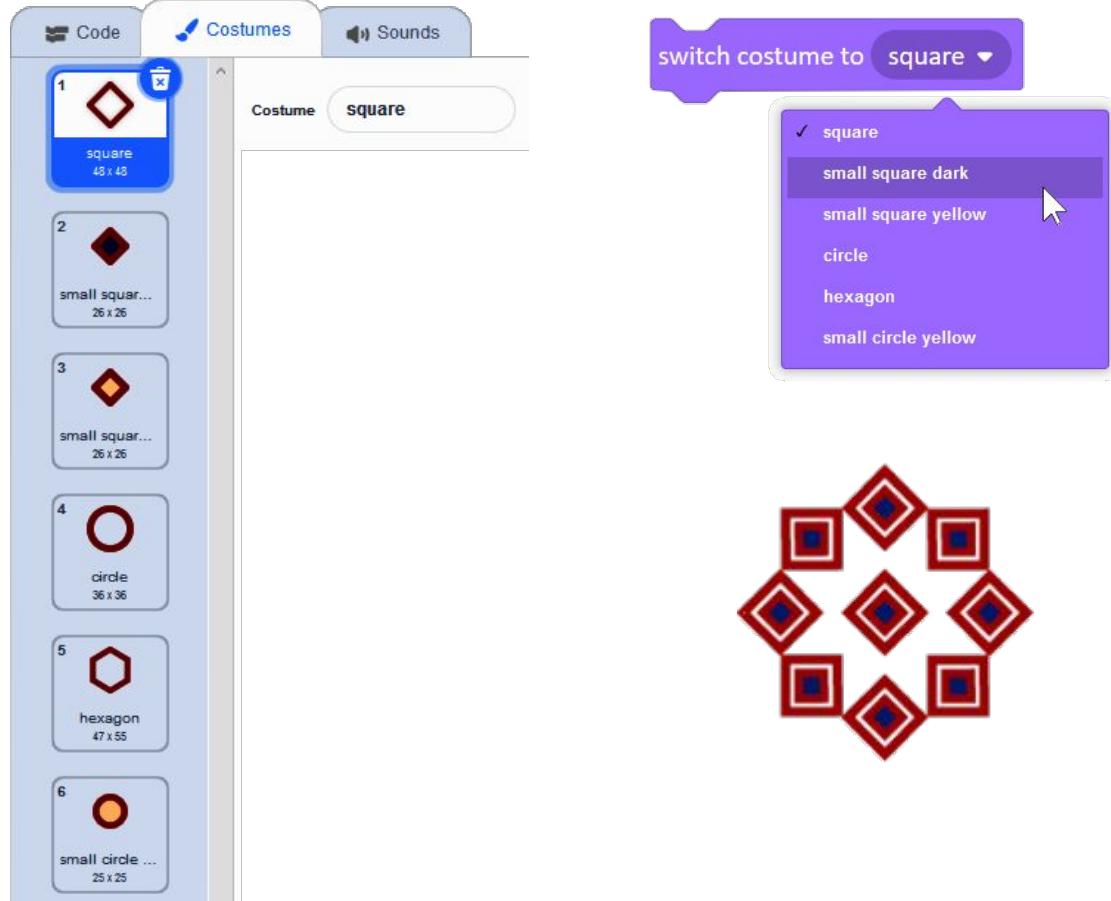
Investigation 3

Creating Circular Rose Patterns



ACTIVITY INSTRUCTIONS

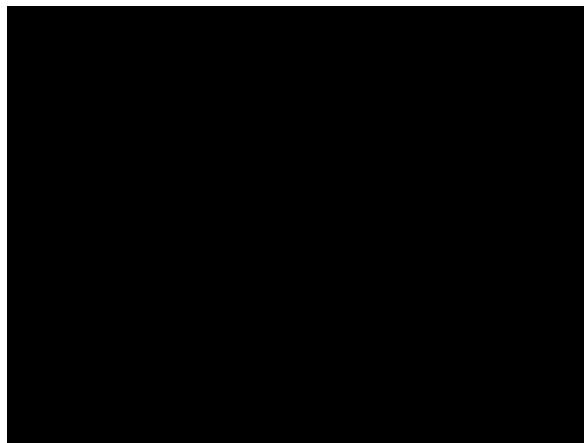
- 1 Continue in your copy of the 14-Rose Patterns project.
- 2 Go to the Costumes tab and explore how many costumes the Tile sprite has. Look at each of the different costumes and notice each costume has its own name.
- 3 Find the **switch costume to ...** block and click on its drop down menu: this has the same list of costume names.
- 4 Use this block in your scripts to create your own rose patterns.



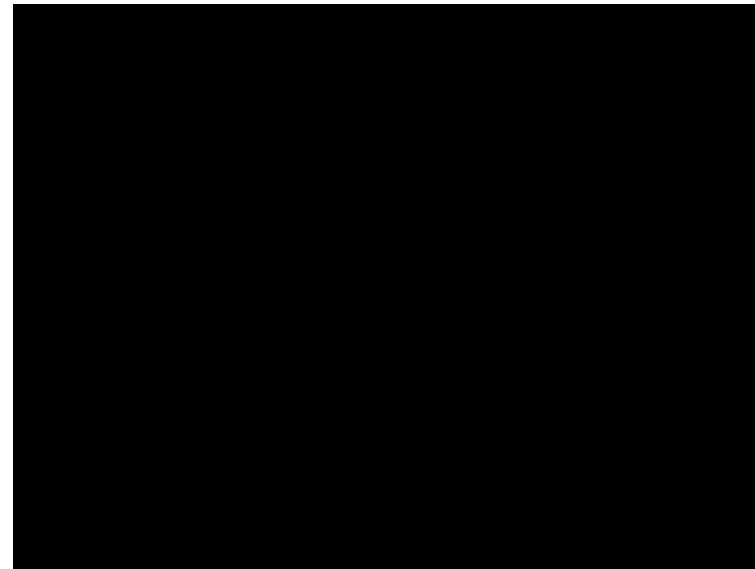
Links to other learning

Art: The Mandala

Using the idea of a circular repeated pattern makes the mandala an obvious choice for exploration. Check out these examples on Scratch - or make your own!



<https://scratch.mit.edu/projects/349957316/>



<https://scratch.mit.edu/projects/208138925/>



End of Investigation 3



A

```
repeat (6)
  move (60) steps
  stamp
  move (-40) steps
  turn (60) degrees
```

B

```
repeat (6)
  move (40) steps
  stamp
  move (-40) steps
  turn (60) degrees
```

C

```
repeat (6)
  move (40) steps
  stamp
  move (-40) steps
  turn (45) degrees
```

Explain why **Script A** would or would not create the pattern above.

Explain why **Script B** would or would not create the pattern above.

Explain why **Script C** would or would not create the pattern above.