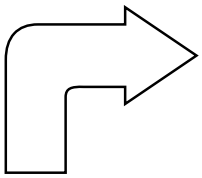
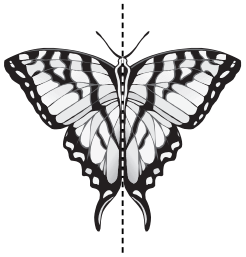
# Transformation, tessellation and symmetry – symmetry

Reflective or line symmetry describes mirror image, when one half of a shape or picture matches the other exactly. The middle line that divides the two halves is called the line of symmetry.
Shapes may have:

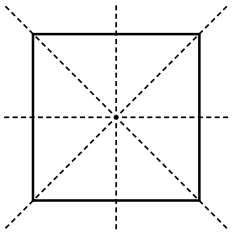
no line of symmetry



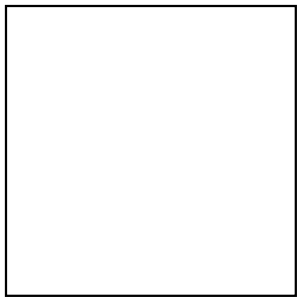
one line of symmetry



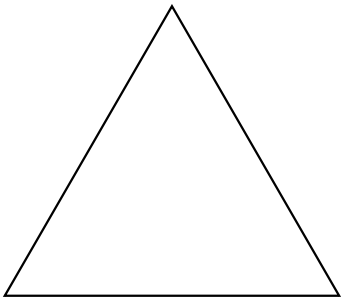
more than one line of symmetry



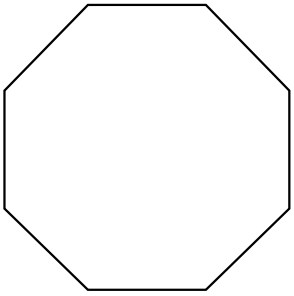
**1** **Find and mark any lines of symmetry on these regular polygons. These can be vertical, horizontal or diagonal. If it's easier, cut out copies of the shapes and fold them to test them.**



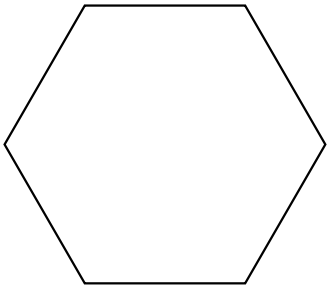
**a** A square has _____ lines of symmetry.



**b** An equilateral triangle has _____ lines of symmetry.



**c** An octagon has _____ lines of symmetry.



**d** A hexagon has _____ lines of symmetry.

**2** **What do you notice about lines of symmetry in regular polygons?**

**3** **Look at these letters of the alphabet. Work with a partner to decide which ones have lines of symmetry when written in this font. Which ones have more than one? Which ones have none? Record them in the table below:**

A B C D E F G H I

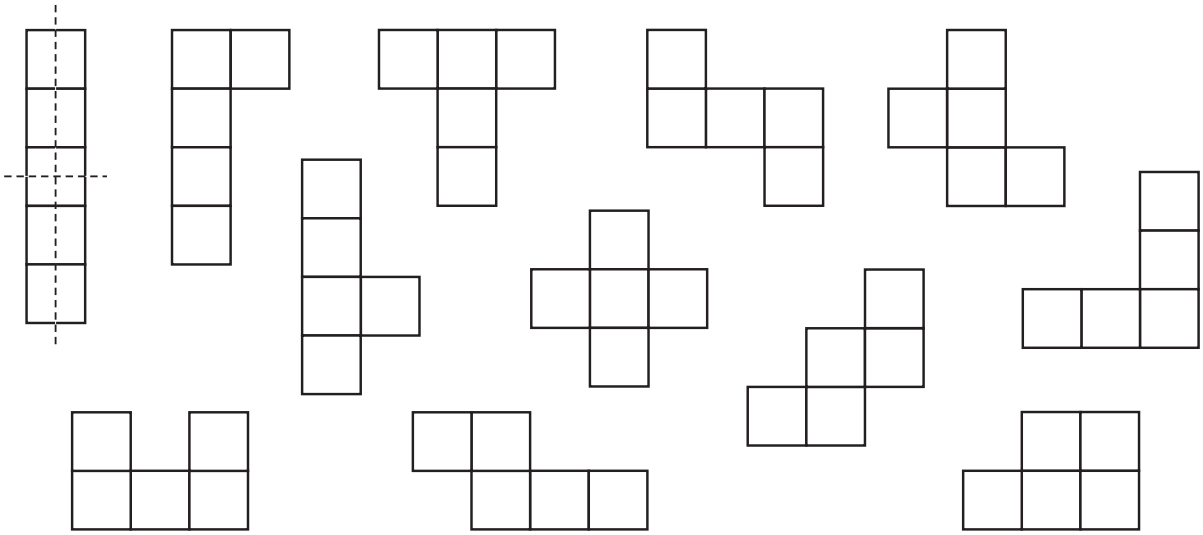
J K L M N O P Q R

S T U V W X Y Z

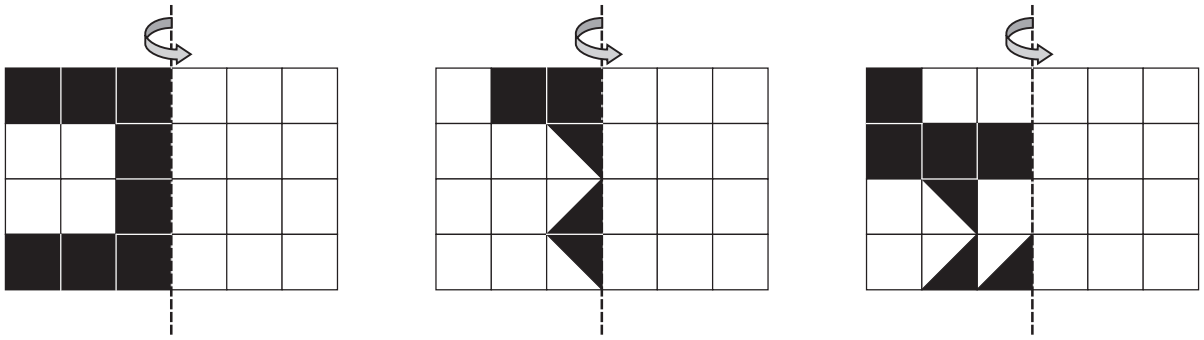
| Vertical line of symmetry | Horizontal line of symmetry | More than one line of symmetry | No lines of symmetry |
|---|---|---|---|
| | | | |

**4** **Compare your list with that of another group. Do they agree? If there are any letters you disagree on, present your cases to each other and see if you can reach a consensus.**

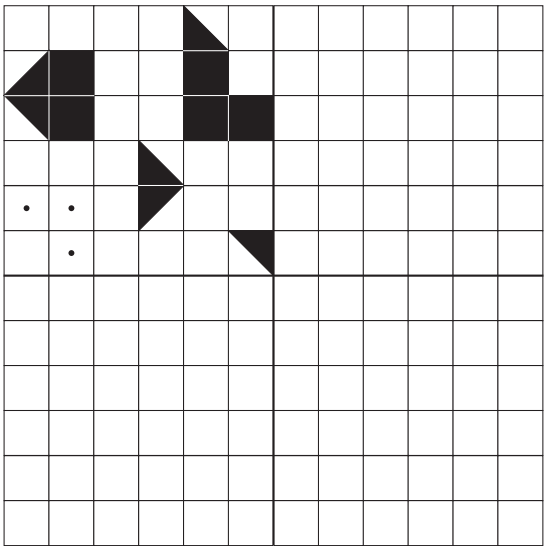
**5** **These shapes are called pentominoes. Some have lines of symmetry. Draw them in. The first one has been done for you.**



**6** **Colour the other half of these pictures so that they're symmetrical:**



**7** **Using the vertical line as the line of symmetry, draw the mirror image in the top right square. Now reflect the picture on the other side of the horizontal line of symmetry.**



**HINT: A small mirror on the line of symmetry will help.**

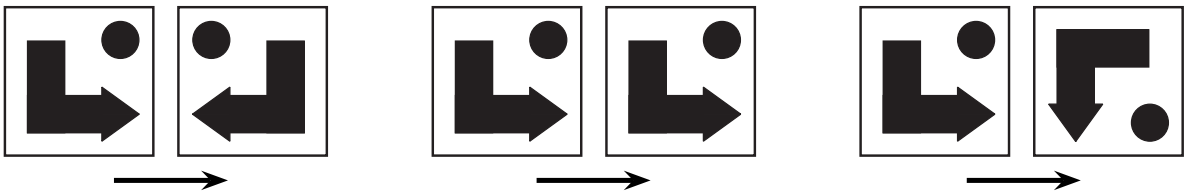
**We humans like symmetry. People considered to be beautiful usually have symmetrical faces.**

**Top racehorses are very symmetrical too – this helps them run smoothly and fast!**

REMEMBER

# Transformation, tessellation and symmetry – transformation

When we move a shape, we **transform** it. This tile shows three ways we can do this:



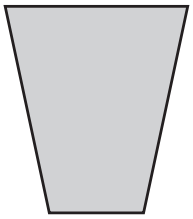
**reflect** (flip)

**translate** (slide)

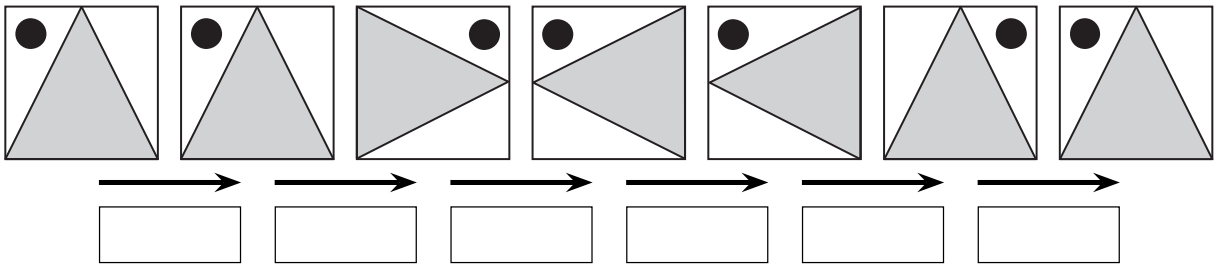
**rotate** (turn)

When we're asked to flip, slide or turn, it helps to visualise the move in our heads.

**1** **Look at this trapezoid. Flip it in your head and then record what it looks like. Then turn it 180˚ clockwise (a half turn) in your head and record what it looks like now. Turn it another 90˚ clockwise (a quarter turn) and record.**



**2** **What has been done to this tile? Describe each transformation as either a flip, slide or turn:**



**3** **Transform these letters:**

**a** T → turn 90° clockwise

**b** H → flip

**c** J → slide

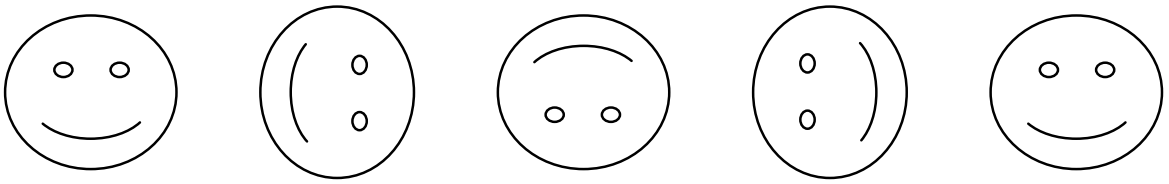
**d** N → flip

**e** Q → flip

**f** W → turn 180°

**4** **Think of the name of a capital city somewhere in the world. Disguise its name by choosing to either flip, slide or turn each capital letter. Ask a partner to decode it. For example, PARIS could be disguised as ꟼƆЯIS.**

These are common rotations:

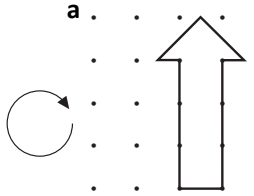


original position | quarter turn 90˚ | half turn 180˚ | three quarter turn 270˚ | full turn 360˚

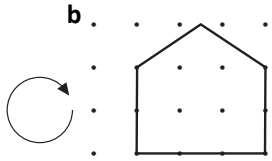
What do you notice about a full turn?

**5** **Rotate each shape and record the new position. Starting from the original position each time, rotate each shape by a quarter turn, half turn, three quarter and full turn and record each new position.**

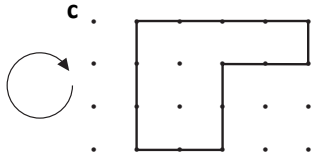
**a**



**b**



**c**



# Transformation, tessellation and symmetry – tessellation

Tessellation comes from the Greek word, *tessere*, which means square tablet. It means covering a surface with a pattern of 2D shapes with no gaps or spaces. When we tessellate a shape, we often flip or turn the shapes so that they fit together.

Some shapes will tessellate on their own. We call this regular tessellation.

Some shapes tessellate when you use 2 shapes in the pattern. We call this semi-regular tessellation.

Tessellation is closely linked with art. Mosaics, patchwork and paving use tessellation. Can you think of others?

**1** **We bet you've been tessellating with pattern blocks since you were a little kid. Now we want you to work out which shapes tessellate and which don't.**

**a** Work with a partner and use pattern blocks to find 3 regular polygons that tessellate on their own. Remember, a regular polygon has sides of equal length. Record your proof below:



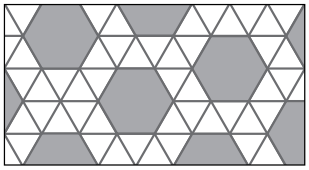



**b** Which of the 3 regular polygons tessellated without flipping or turning? _____

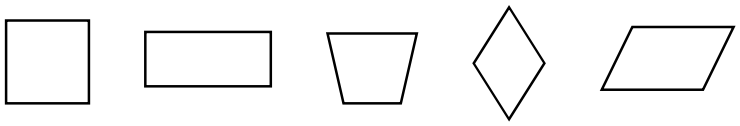
**c** Which regular polygons do you need to flip or turn to get them to tessellate?

_____

**2** **Use pattern blocks to find shape pairs that tessellate. Record them here. How many can you find? Here's one to get you started:**



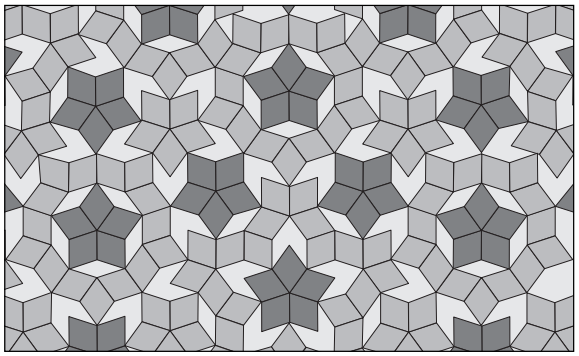
**3** **It's said that all quadrilaterals tessellate. Is this true? Work with a partner to test this theory out. Use blocks or tessellation shapes such as those below. Record your findings below then tick the ones that tessellate once you know:**

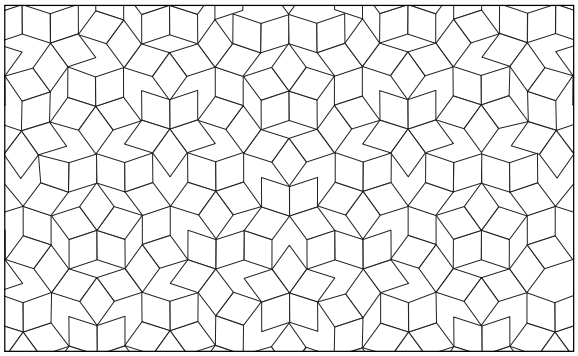


**4** **Do you agree with the statement that all quadrilaterals tessellate? Why or why not?**

**5** **Tessellations usually involve creating a pattern and repeating it over and over. A famous mathematician named Roger Penrose was obsessed with finding a tessellation that was created without repeating any large patterns. It took him a while but he got there. It's often called "Kites and Darts" as the two parallelograms in the pattern resemble these.**

**Colour the pattern in colours of your choice on the right to recreate his discovery. While you're doing that, check – can you see any large repeated patterns?**



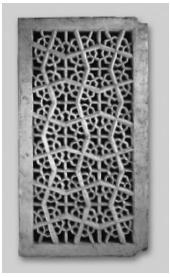


# Tessellate and create

create

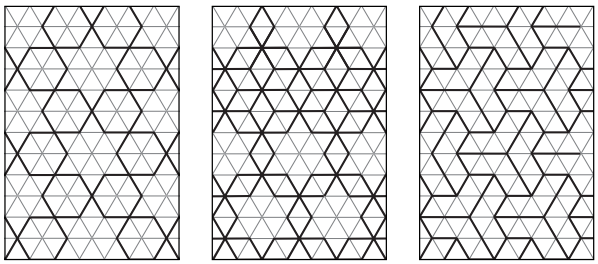
**Getting ready**

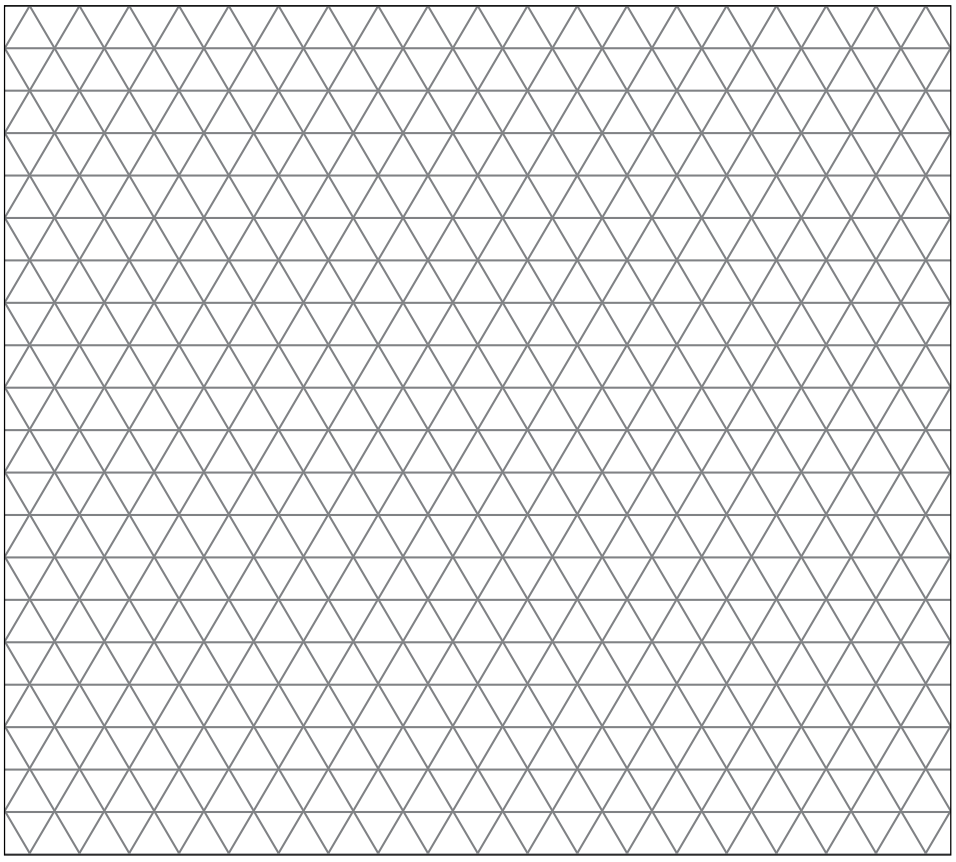
Many cultures and art styles use tessellations as a basis for creating intricate and beautiful patterns. Islamic art is one such art form. Look at the examples below.



**What to do**

Recreate one of the designs below by ruling over certain lines. Pick a colour scheme and complete your design.





# Dig it, Dr Jones

create

**Getting ready**

While working on an archaeological dig with the famous Dr Jones, you come across a portion of a beautiful old plate.

Dr Jones thinks it may be $\frac{1}{4}$ of the Lost Plate of Icarus, a priceless find. He asks you to recreate what you think the entire plate may have looked like.

**What to do**

You have $\frac{1}{4}$ of the plate. You need to find a way to recreate the rest of it. How will you do this? Would a compass help? How will you find the right centre point?

Then, use your knowledge of symmetry and tessellation to complete the design.