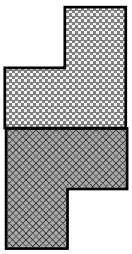
get into shape

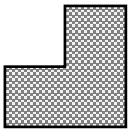
intro

This investigation is about putting simple shapes together to produce new shapes. Although the actual investigtion is relatively straightforward, it does give pupils an opportunity to think about shape and to use concepts such as symmetry, reflection and rotation – and it teaches them a useful lesson about the need to be systematic and thorough in work of this sort.



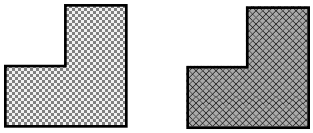
first steps

Let's start off with this simple shape :

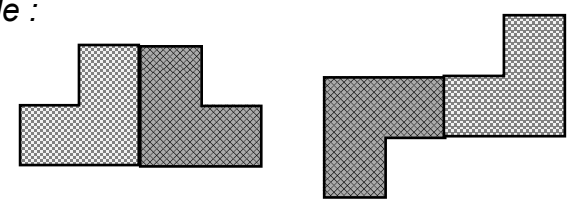


How would you describe this shape? Imagine you're speaking on the telephone to someone who can't see it . . . *it's like three squares put together to make an L-shape (or . . . if you think of four small squares put together to make a larger square and then you take away one of the small squares, you're left with a kind of L-shape, and that's it!)*

Suppose we have two of these shapes :



By putting two of these shapes together, we can make new shapes, like these, for example :

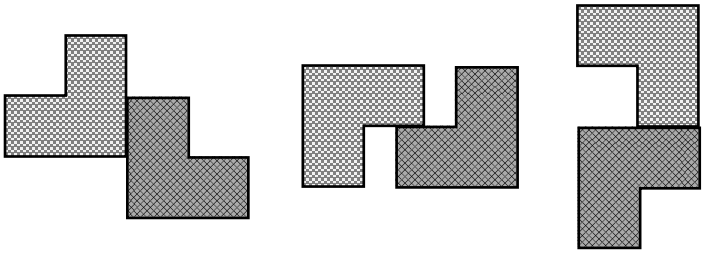


the investigation

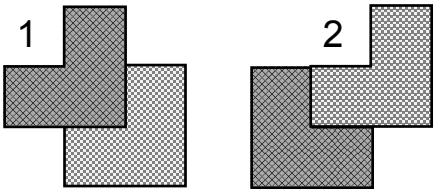
Ask the children to find as many different shapes as they can using these two simple pieces – but tell them that, for this investigation, they must follow this rule :

Each piece must have at least one whole side attached to one whole side of the other piece.

– which means that shapes like the two just above are fine, but shapes like these are definitely not :



There might need to be some discussion, either before children get started or after they've begun to produce results, about whether (or why) these two shapes are or are not allowed :



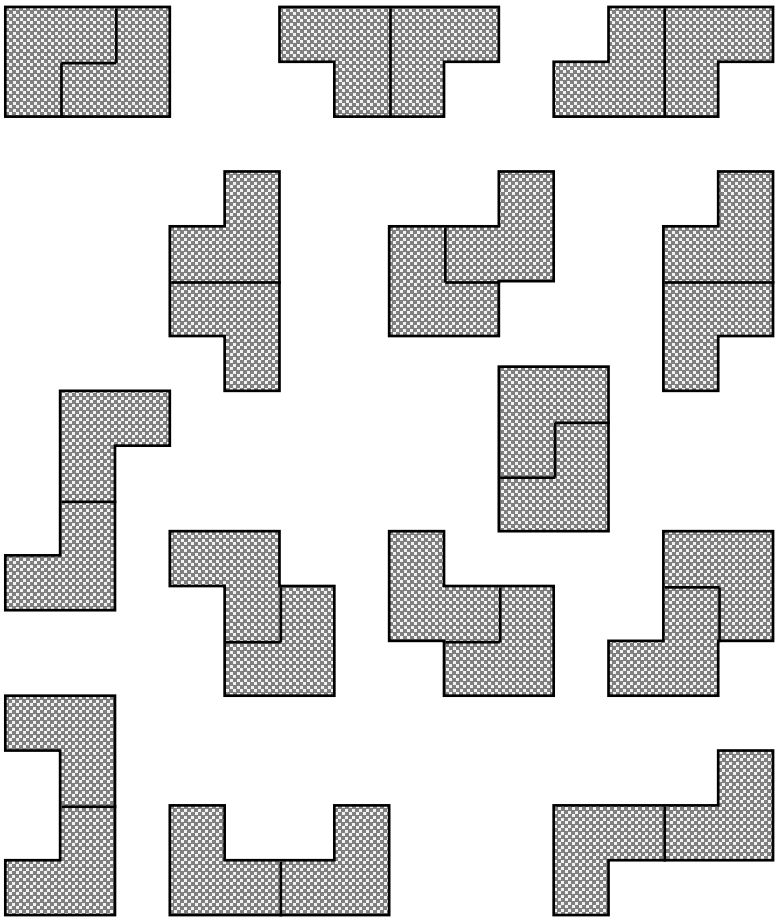
** Answer : Shape 1 is not allowed, because one of the L-shapes doesn't have a single whole edge next to the other L-shape. But shape 2 is allowed, because both L-shapes have at least one edge attached.*

practical

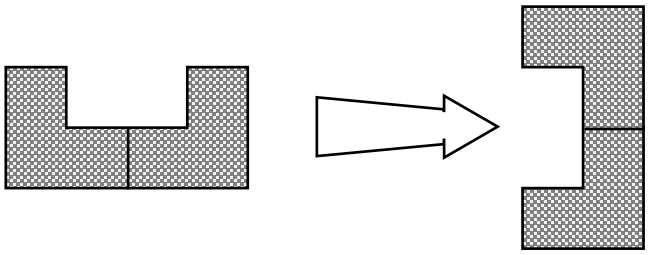
Children can work on their own or in pairs. The investigation can be done as a pencil-and-paper exercise but L-shapes made from coloured card are more cheerful – and they make it easier for the children to try out different arrangements. They can use squared paper to record their results – and at the end the original pieces can be taken in and used for a poster to display findings.

results

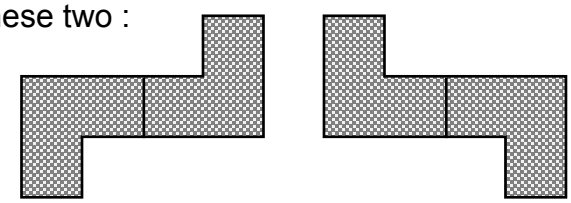
All these results are possible :



But clearly, they're not all different. We need to be sure what counts as different and what counts as the same. Pupils will have their own ideas and there's no 'right' answer – although generally investigations like this we call two shapes 'the same' if one can be rotated to get the other, for example :

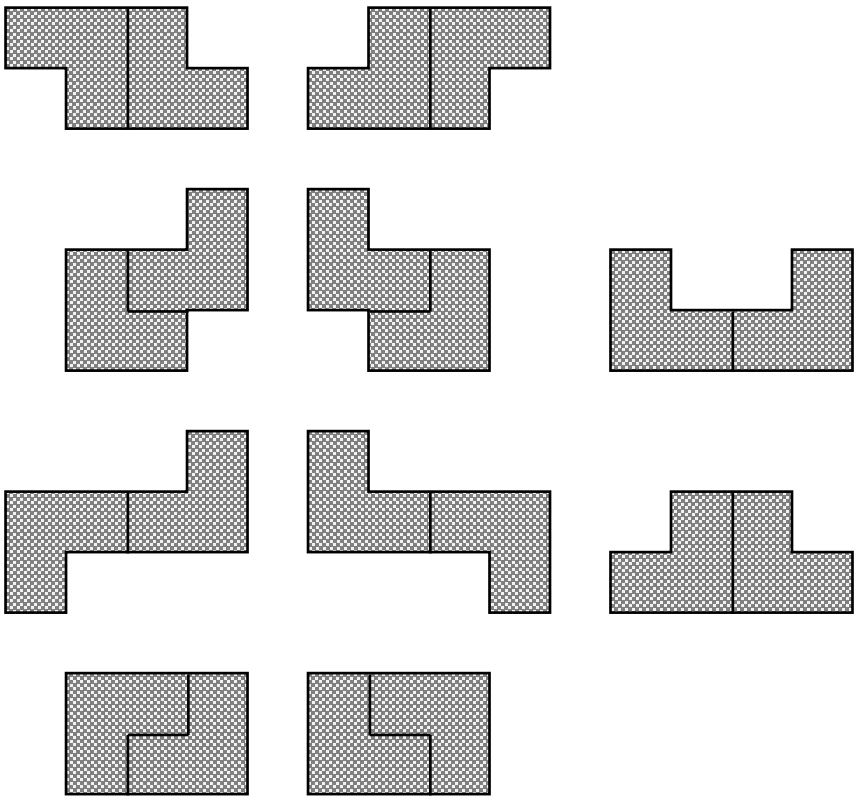


But not these two :



– which are certainly 'alike', since each one is a reflection or mirror-image of the other, but neither of which can be rotated to give the other.

With this in mind, there are just 10 different shapes to be found :



notes

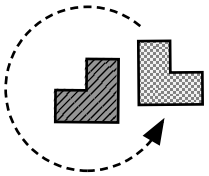
With these different shapes before them, you can ask the children :

- Obviously there are three 'pairs' here – but which individual shapes have bilateral symmetry?
- Which shape has the longest perimeter? Which has the shortest perimeter?
- Can anyone think of a method for finding all the shapes? Is there any way we could make sure that we really have got all the shapes?

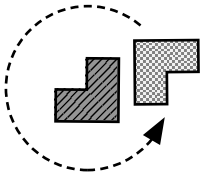
extension

If you have the appetite for it, one useful extension of this investigation is to look for ways of checking that you've got **all** the new shapes which can be made by combining two simple L-tiles. Here's one approach (called 'Walking the Dog') :

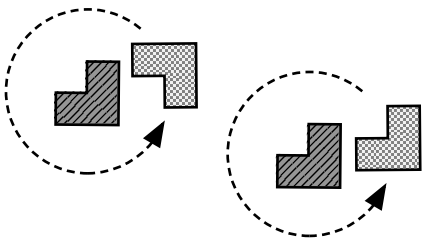
1. Select one of the L-shapes : 
2. Keep this shape in exactly the same orientation, then take a second L-shape and (always keeping it in the same orientation) 'walk' it around the first one into every position the rules allow.



3. Next, without altering the first L-shape, rotate the second L-shape clockwise by 90˚ and repeat the 'walk-around' process to find every position allowed by the rules. Now you have two sets of new shapes.

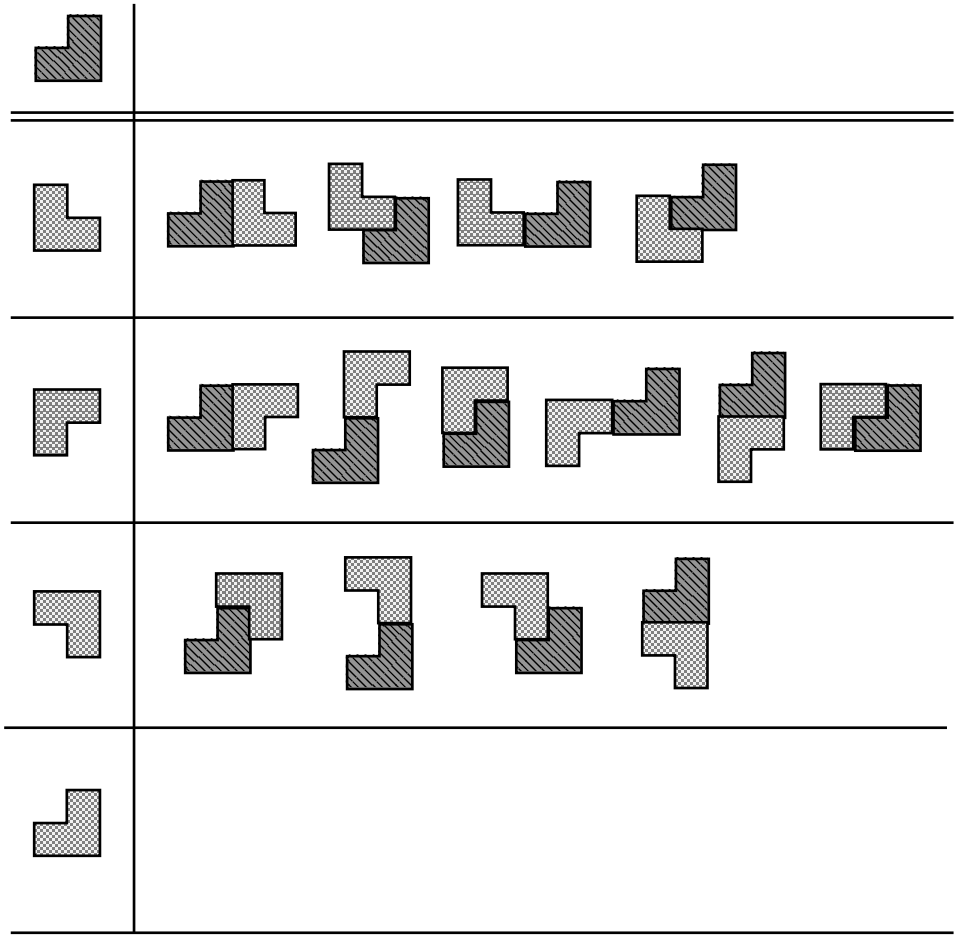


4. Rotating the second L-shape clockwise by a further two right-angles and repeating the 'walk-around' process will give you your third and fourth sets of new shapes.

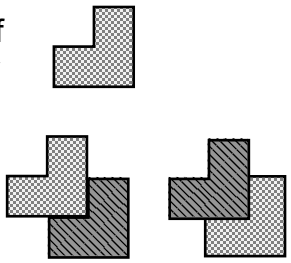


Now you've covered every possibility! See the next page for our table of results. Of course, the 13 shapes we you see there really amount to only 10 different ones (the same 10 shapes we've already met).

Walking the Dog : table of results



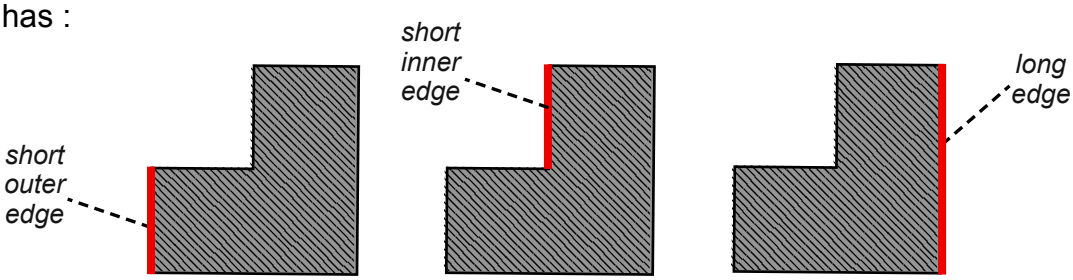
As you can see, the space for our fourth set of results is empty. Why haven't we included any results for 'walking' this orientation of shape 2 around shape 1?
The answer is that the only new shapes this will give you are these two . . .



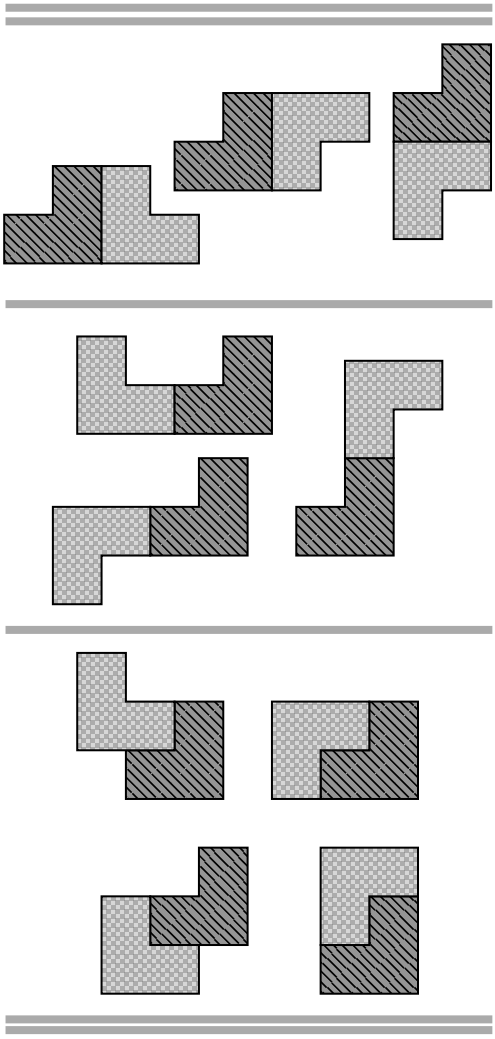
. . . and these two don't qualify. Why not? Because although the dark L-shape has two complete edges involved, the lighter L-shape doesn't have any complete edges involved.

Another way of making sure we've got **all** possible results is based on what you can do starting with different edges. See the next page for an account of this approach . . .

Walking the Dog is not the only way of checking for completeness. Another way is to take a first L-shape and identify the three types of edge which it has :



Then select one type of edge eg the long edge – and see how many ways you can find of attaching L-shape 2 to this edge. Repeat this process for the other two types of edge. You're left with three sets of new shapes, making 10 new shapes in all (same result as before!) :



If an investigation you're doing involves finding a set of shapes, numbers or whatever, checking for completeness is always a good follow-up, as long as you can find a fairly straightforward way of doing it. The completeness tests above perhaps stray a little beyond the normal year 3 limits of understanding (but they are optional).

How else could you extend this investigation? Here are two suggestions :

- Investigate how many shapes can be found using three of the L-shapes instead of two.
- Investigate how many shapes can be found using two (simple) shapes of a different kind as 'building blocks'.

No doubt you can think of your own variation on the theme. But – for each investigation you'll need to make sure that the children understand exactly what the rules are.