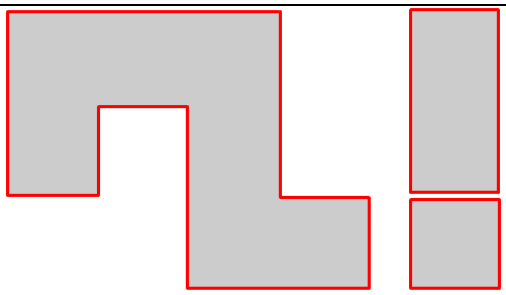
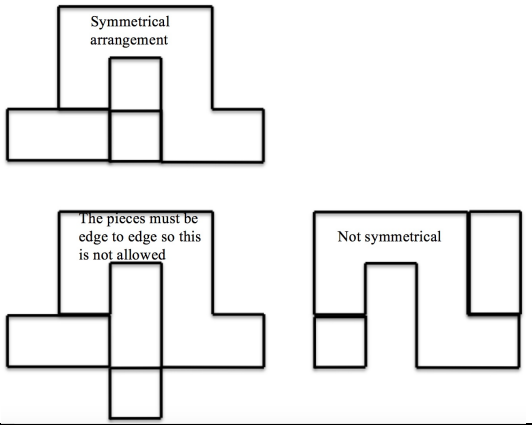


REFLECTING SQUARELY

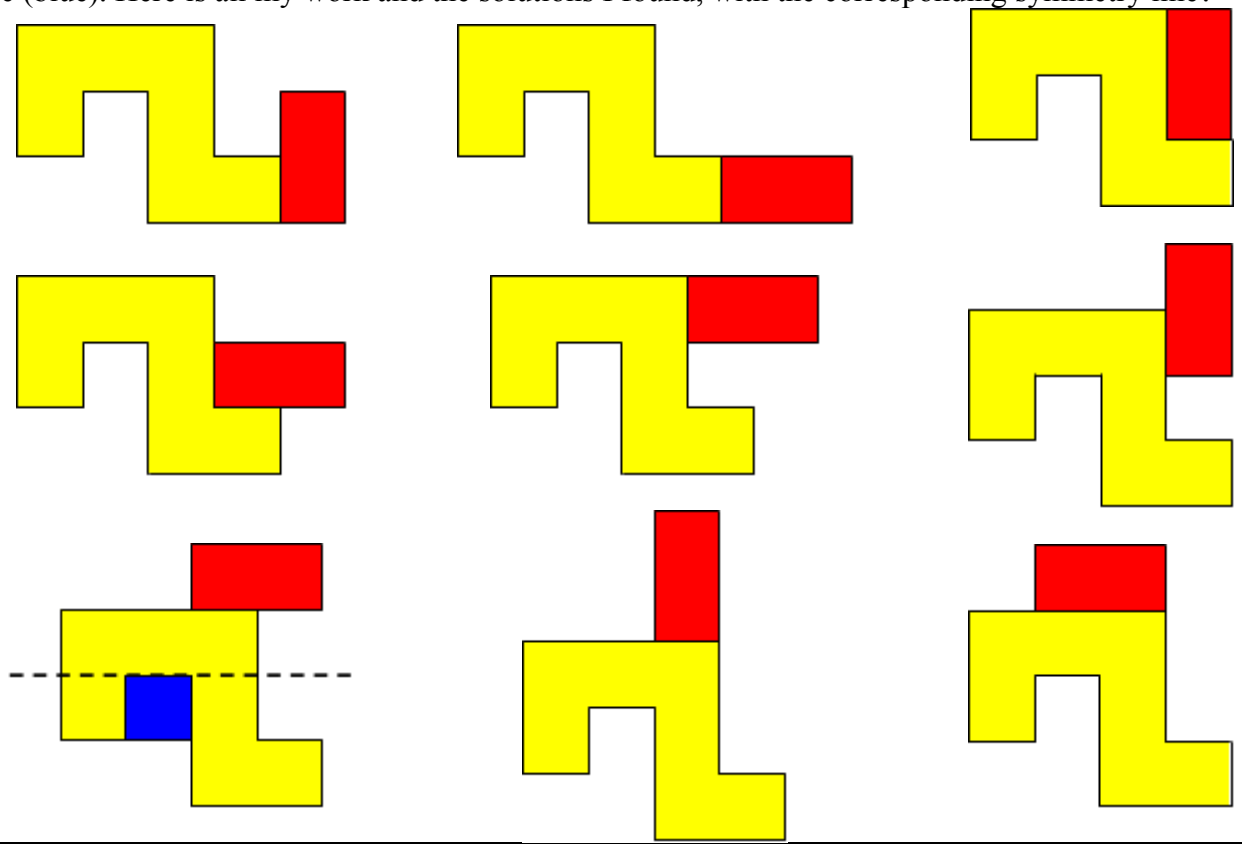
In how many ways can you fit all three pieces together, edge to edge, to make shapes with line symmetry?

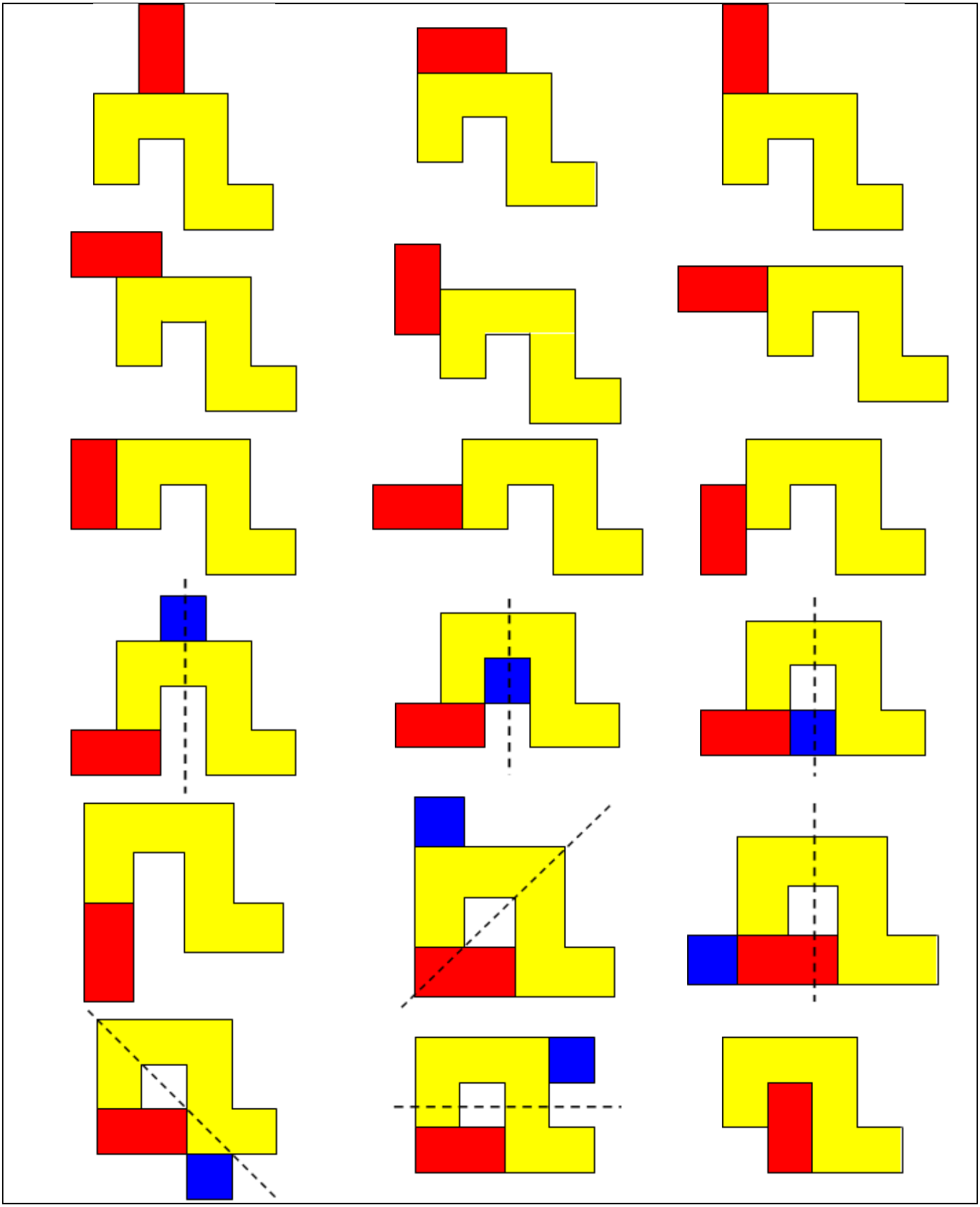


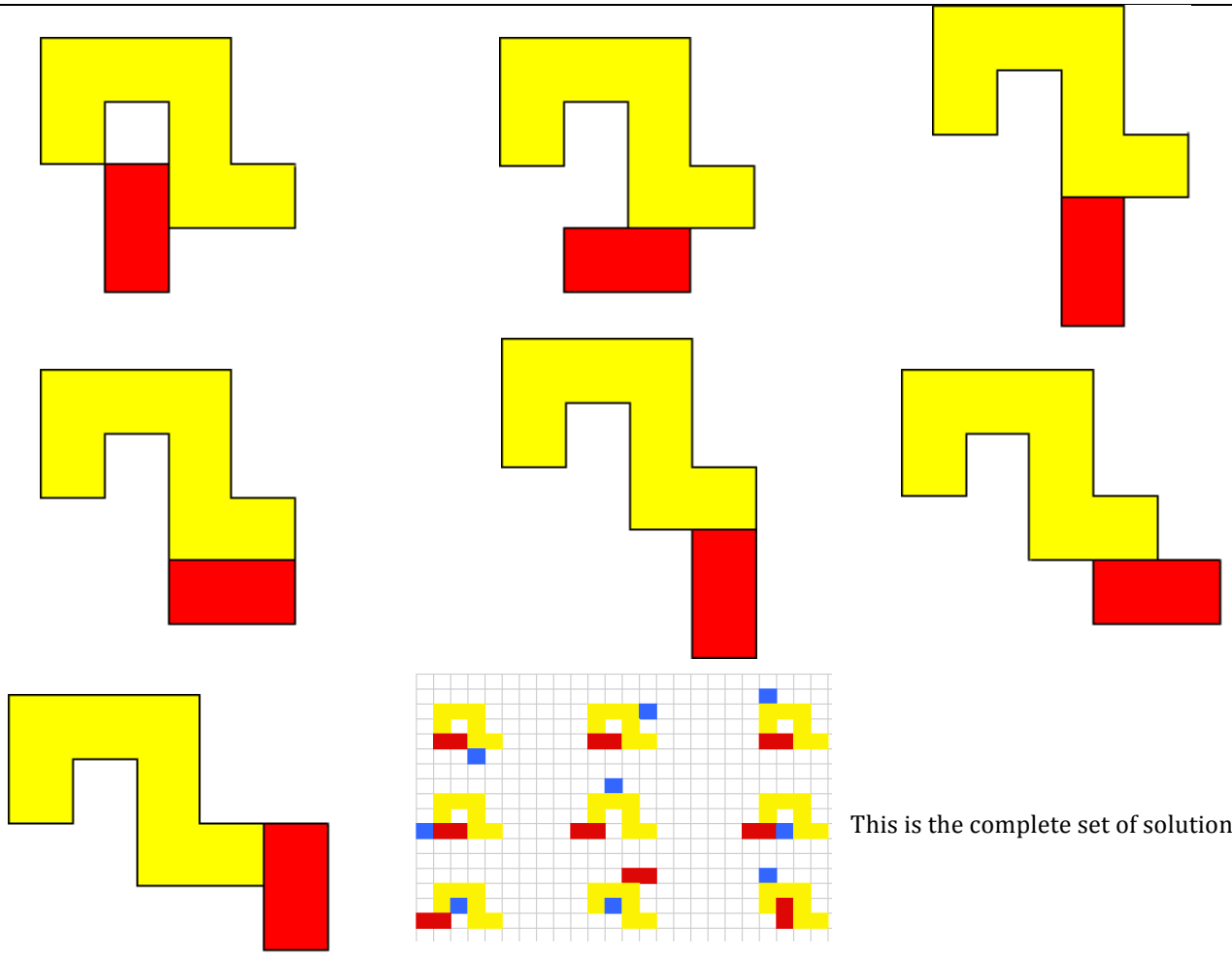
The first of these examples shows a symmetrical arrangement, the second is not allowed because the pieces are not placed edge to edge and the third is not symmetrical.

SOLUTION

This is the solution from a learner, Andrei, but he missed one of the 9 solutions. Can you find which one he missed? “I took the big (yellow) piece and I placed the rectangle in all the possible locations around it. Then I looked if the figure admitted a symmetry line (vertical, horizontal, or 45° angle – oblique) adding a small square (blue). Here is all my work and the solutions I found, with the corresponding symmetry line?”







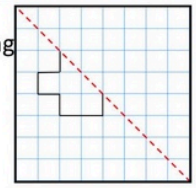
This is the complete set of solutions.

NOTES FOR TEACHERS

Diagnostic Assessment This should take about 5–10 minutes.

1. Write the question on the board, say to the class:
   "Put up 1 finger if you think the answer is A, 2 fingers for B, 3 fingers for C and 4 fingers for D".
2. Notice how the learners responded. Ask a learner who gave answer A to explain why he or she gave that answer and DO NOT say whether it is right or wrong but simply thank the learner for giving the answer.
3. Then do the same for answers B, C and D. Try to make sure that learners listen to these reasons and try to decide if their own answer was right or wrong.
4. **Ask the class again to vote for the right answer by putting up 1, 2, 3 or 4 fingers. Notice if there is a change and who gave right and wrong answers.** It is important for learners to explain the reason for their answer otherwise many learners will just make a guess.
5. If the concept is needed for the lesson to follow, explain the right answer or give a remedial task.

Which image completes the symmetric figure using the red line of symmetry?

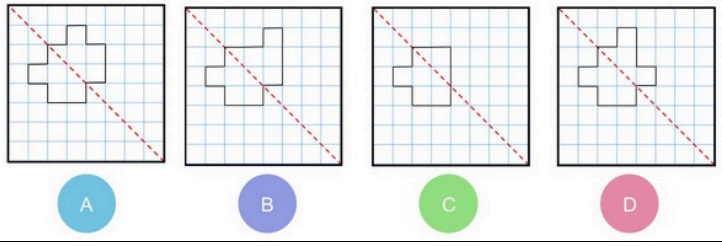


A. is the correct answer.

Common Misconceptions

B. , **C.** and **D**. have little or no understanding of symmetry.

https://diagnosticquestions.com



Why do this activity?

This activity makes learners think about the symmetries of many different shapes. There will be opportunities for instant feedback, and a challenge to engage the whole class in an activity that offers choice and room for creativity. The learners should take responsibility for checking each other's work.

Intended learning outcomes

A deeper understanding of line symmetry
Development of visualisation and creative skills and the ability to work systematically.

Possible approach

FORMATIVE ASSESSMENT.
First do the diagnostic question as formative assessment. If learners do not get it right then take some scrap paper, fold a piece, tear a shape and ask learners to draw on their show boards what the 'double' shape will look like when you open out the folded paper. Pass it around the class after they have answered so learners who got the answer wrong can look at it closely and fold and unfold it for themselves. Repeat this several times with different shapes until the learners are more confident about deciding on the final symmetric shape.

This activity could easily be used as it stands, as one of many activities on reflection symmetry. It can also be expanded, leading into a richer task.

INTRODUCING THE ACTIVITY
Either write the question on the board or give out worksheets photocopied from the top half of page 1. Have copies of the three pieces very large pieces available and blu-tacked to the board. Give out smaller card shapes. Ask the class to find a few arrangements that are symmetrical. Keep a record of correct solutions as they are suggested. Give learners time to work individually or in pairs trying to find all possible solutions.

FEEDBACK
After a while learners could be invited to draw new solutions on the board or draw them to a given size on squared paper to put on a poster. Suppose learners have found only five or six symmetric arrangements, then tell them that there are more solutions to be foun,d and make a poster with the solutions that have been found leaving room for the other solutions. Put the poster on the classroom wall and tell the learners that you will put new solutions on the poster when they discover them. Remind the learners if necessary and celebrate discoveries when they are made putting the name of the discoverer on the poster.

Key questions
Where can the mirror lines be?
Is there a systematic way of checking that you've found all the arrangements?

Possible extension
Students might like to look at Andrei's solution (page 5) and try to understand the logic behind his approach.

"Now it is time to 'beat the problem'. You can design your own three shapes, like the original, all made from squares on a square grid, with a total area of 10. Do you think we can find 3 shapes that can be put together symmetrically in more ways than the original problem? i.e. we're looking for a 7-ways-set, an 8-ways-set... (If anyone finds more symmetrical combinations for the original problem, then this task becomes even more challenging!)

"Between us, can we find a complete collection: a 0-ways-set, a 1-ways-set, a 2-ways-set... ?"

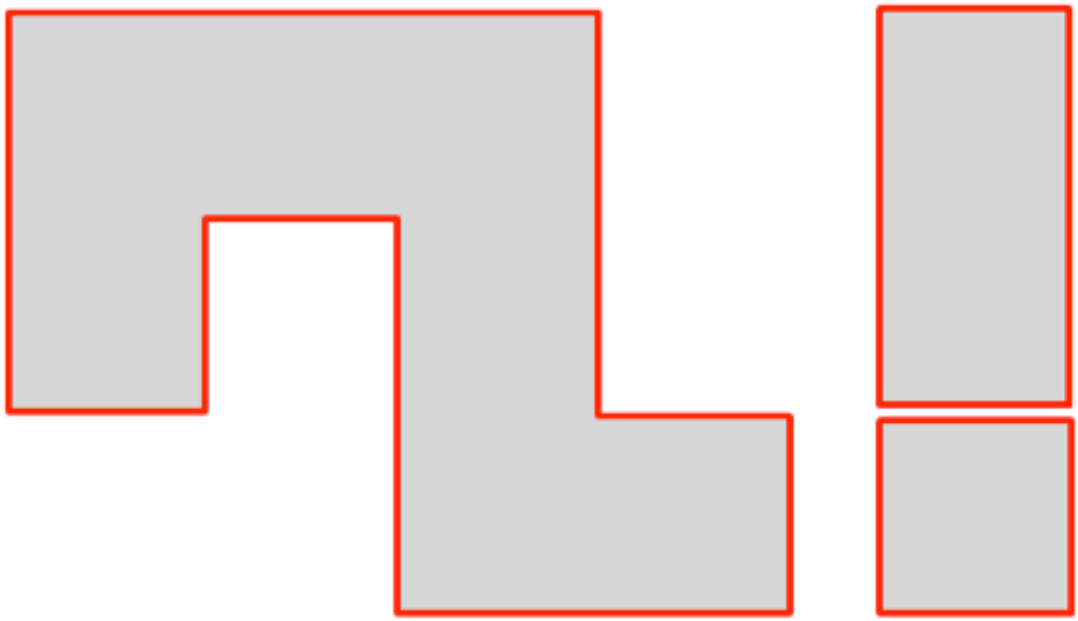
"When you have designed a set, and think you have found all the symmetrical arrangements, draw them clearly and stick your work to the board, for others to check." The board could be prepared with headings: 0-ways-sets, 1-ways-sets, 2-ways-sets... Ask all students to take responsibility for checking at least one displayed solution and confirm that it is in the right category.

Keep the work on display at the end of the lesson, so that students (from this class or another) can add to it over the next couple of weeks.

Encourage students to find three shapes that have very few possible arrangements (or none), and/or more than anything found so far.

Possible support

Provide mirrors, and/or scissors so students can cut out their arrangement of shapes and fold them to check potential mirror lines. Print the pieces below for the learners to cut out.



Note: The Grades or School Years specified on the AIMING HIGH Website correspond to Grades 4 to 12 in South Africa and the USA, to Years 4 to 12 in the UK and up to Secondary 5 in East Africa. **Note:** The mathematics taught in Year 13 (UK) and Secondary 6 (East Africa) is **not** included in the school curriculum for Grade 12 SA.				
	Lower Primary or Foundation Phase Age 5 to 9	**Upper Primary Age 9 to 11**	**Lower Secondary Age 11 to 14**	**Upper Secondary Age 15+**
South Africa	**Grades R and 1 to 3**	**Grades 4 to 6**	**Grades 7 to 9**	**Grades 10 to 12**
USA	**Kindergarten and G1 to 3**	**Grades 4 to 6**	**Grades 7 to 9**	**Grades 10 to 12**
UK	**Reception and Years 1 to 3**	**Years 4 to 6**	**Years 7 to 9**	**Years 10 to 13**
East Africa	**Nursery and Primary 1 to 3**	**Primary 4 to 6**	**Secondary 1 to 3**	**Secondary 4 to 6**

Reflecting Squarely

Problem 2107, content level grades 8 to ~~10~~ http://nrich.maths.org/2107

One learner, Andrei, gave the following solution but he missed one of the 9 solutions. Can you find which one he missed? "I took the big (yellow) piece and I placed the rectangle in all the possible locations around it. Then I looked if the figure admitted a symmetry line (vertical, horizontal, or 45° angle – oblique) adding a small square (blue). Here is all my work and the solutions I found, with the corresponding symmetry line?