



WORKSHOP GUIDES FOR TEACHERS TO LEARN TOGETHER PRIMARY G1 INTRODUCTION TO 2D SYMMETRY

Guide for your own self-help professional development workshop
and resources for inquiry based lessons.

MANAGE YOUR OWN PROFESSIONAL DEVELOPMENT WORKSHOP

These guides are designed to support teachers in developing a deep understanding of the mathematics they are required to teach and in developing more effective ways of teaching.

You can use these guides on your own or as one of a group of teachers who meet together to talk about your mathematics lessons as part of your professional development. Maybe one of you will take the lead in organizing time, date and venue but once you are doing the activities together you will all participate on equal terms in the discussion and reflection.

EACH WORKSHOP GUIDE HAS A SIMILAR FORMAT:

- | | |
|------------------------|--|
| PAGE 1 | TITLE PAGE Teaching strategy. Curriculum content and learning outcomes. Summary of mathematical topic (FACT BOX.) |
| PAGES 2 & 3 | WORKSHOP ACTIVITIES FOR TEACHERS Two pages for you to work through with your colleagues. These are activities to be shared and discussed. For each activity there is a list of resources needed, how to organise the activity (e.g. pairs, whole group) and about how long the activity will take. |
| PAGES 4 & 5 | CLASSROOM ACTIVITIES FOR LEARNERS Two pages to help you plan your lesson. You are advised how long to allow for the activity, the resources you might need and the key questions to ask. |
| PAGES 6 TO 10 | CHANGES IN MY CLASSROOM PRACTICE Pages on implementing the teaching strategies with additional resources and activities for use during or after the workshop such as worksheets and templates. |

Introduction to 2D Symmetry

content: Recognise, draw and describe lines of symmetry in 2D shapes

Prior knowledge needed: Familiarity with the names of quadrilaterals.

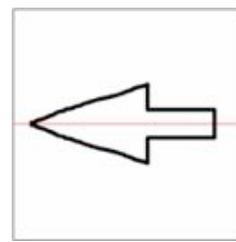
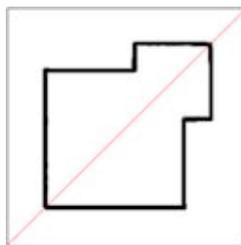
Intended Learning Outcomes At the end of this activity teachers and learners will:

- Know the line symmetries of quadrilaterals
- Understand what a line of symmetry means
- Be able to visualise lines of symmetry on other shapes
- Appreciate that symmetry is all around us
- Have experienced symmetry as folding

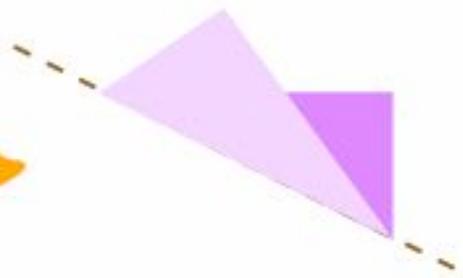
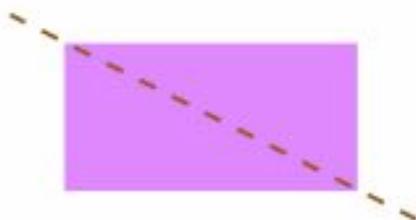
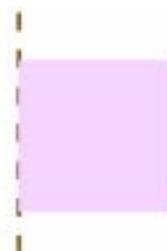
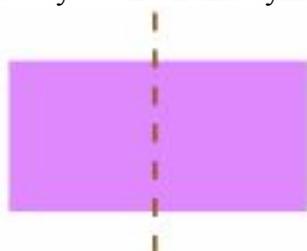
Fact box

2D shapes can have line symmetry and/or rotational symmetry.

Line symmetry is when one side of a shape is a reflection of the other. The line of reflection can be in any direction: horizontal, vertical, or diagonal.



One way to check line symmetry is by folding.



If both sides match, the fold is a line of symmetry

Resources needed for this workshop: 2 ropes about 2 m long, or some chalk if outside. Newspaper or magazine pages; two for each person, scissors, paper.

Workshop Activities for Teachers

Activity 1: I'll be your mirror

Plenty of space, 2 ropes about 2 m long, or some chalk if outside. Newspaper or magazine pages; two for each person, scissors if possible.

Whole group

30 minutes

Find a suitable space.

Put one rope down in a straight line in the middle of the space, or draw a straight line on the floor with chalk. This represents a mirror line.

One person (the object) puts their piece of paper somewhere on one side of the line. A second person (the image) who has an identical shape and size of paper puts theirs down on the opposite side of the rope to make a reflection.

Other pairs do the same.

Talk about what you notice about a) the distance from the mirror and b) the angles at which the shapes need to be arranged.

Repeat the activity using 2 ropes which cross each other at right angles. This time one person (the object) puts down a piece of paper and three others act as images.

Talk about what you notice about a) the distances from the mirrors and b) the angles at which the shapes need to be arranged. **T**

Notes

Topic: Multiples

This is an introductory activity to help educators to be clear about what a line of symmetry is. Creating a big picture that everyone can see is good for discussion.

Talk about how the group knew where to place their paper and in which orientation. Check that if you imagined a line joining the corresponding corners of the papers, they would cross the rope at right angles.

Activity 2: Paper symmetry

Scissors, lots of paper. A4 paper used on one side works well.
 Pairs, whole group

40 minutes

1. Folding and cutting to make shapes

a. **One fold.** Each person folds their sheet of paper in half.

Either cut with scissors, or rip carefully so that when you open out the paper, you have made a rectangle. Repeat with other sheets of paper to make a square, then a rhombus and then a kite.

Talk about how you knew where to cut. **T**

b. **Two folds** Each person folds a new sheet of paper in half and half again. Check that the fold lines cross at right angles when you open it out.

Fold the paper back and either cut with scissors, or rip to make a rectangle. Use other sheets of paper folded twice to make a square and then a rhombus. **T**

2. Drawing the lines of symmetry on the shapes.

Look at your collection of shapes. You should have: square, rhombus, kite and a rectangle. Now decide where to draw **a second** line of symmetry on each shape. Is it always possible? Is this easier using the shapes made by cutting the paper with **two** folds?

As a group experiment with folding and cutting to make other quadrilaterals.

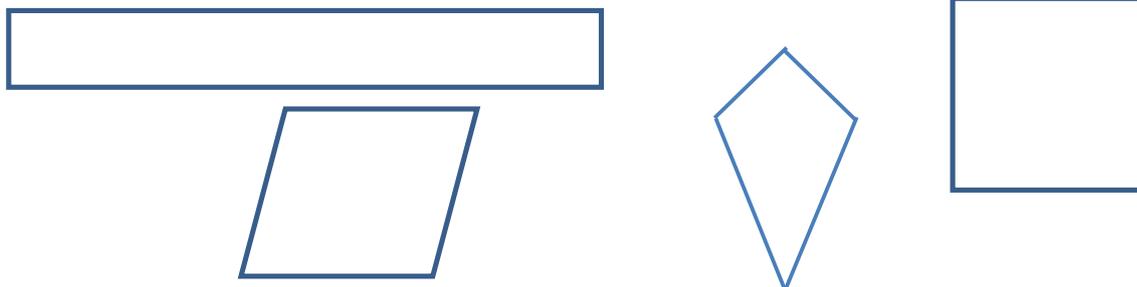
Which can only be made with one fold? Which with two? Are there some that it is not possible to cut at all from a folded piece of paper? Is there more than one way to do it? Is it possible to fold the paper to make a shape which is not a quadrilateral. How?

Discuss where symmetry is found in everyday life. How could educators help learners to appreciate this?

Notes

1. This activity follows the previous one by making connections with the mirror lines or symmetries of quadrilaterals and other 2D shapes.

You may want to be clear about what all these quadrilaterals look like before the group starts cutting. Draw a rectangle, square, rhombus and kite on the board and together decide where to draw **one** line of symmetry on each. Does this help with knowing how to make these shapes by cutting the paper with **one** fold?



Classroom Activities for Learners

Activity 1: I'll be your mirror

Plenty of space, 2 ropes about 2 m long, or some chalk if outside.

Whole class or large group

50 minutes

| What the teacher is doing | What the learners are doing |
|---|--|
| <p>Put the rope on the floor so that it makes a straight line. This marks the place of a pretend mirror and whatever happens on one side of it has to also happen on the other.</p> <p>Choose two learners to stand on each side of the rope.</p> <p>One (the object) does an action and the other (the image) has to move as though they were the reflection.</p> <p>Ask the group what they notice.</p> <p>When the object waves their right hand, what happens to the image?</p> <p>What happens when the object moves towards the mirror?</p> <p>Invite the rest of the group, working with a partner, to stand on either side of the rope, and performs lots of different actions.</p> <p>You could do this to music if you wish!!</p> <p>After you have discussed what you notice place the two ropes at right angles to each other. Repeat with one learner as the object and one as an image. How many other images will be needed?</p> | <p>Watching the teacher and wondering what is going to happen</p> <p>Watching the pair of learners to see what they notice</p> <p>Offering suggestions</p> <p>Being object and image</p> |

Ideas for Teaching

The object and image should be the same distance away from the mirror. In other words, the mirror should be exactly half way between them.

If the object waves with the right hand, the image will wave with the left.

What happens if the object turns round in an anticlockwise direction?

Activity 2: Quadrilateral symmetry

Scissors. Large cut out shapes from newspaper, one set for each group, of: square, rectangle, parallelogram, rhombus, kite, trapezium

Whole class then groups of 4

50 minutes

| What the teacher is doing | What the learners are doing |
|--|---|
| <p>Model what you want the learners to do. Take one of the cut out shapes (the kite is a good one to start with) and ask the learners how you could fold it so that both sides match exactly. Demonstrate. Draw a picture of the kite on the board and mark in the fold line, explaining that this is called a line of symmetry, or mirror line.</p> | <p>Offering suggestions</p> <p>Watching</p> |
| <p>In groups of 4, the learners try each shape in turn to find all the lines of symmetry. They each make a record of what they have found out.</p> | <p>Folding and drawing</p> |

Ideas for teaching

Line symmetry is about halves of a shape being perfect matches for each other. The usual way of teaching learners this is to ask them to draw lines on worksheet shapes to represent the mirror line, but being given the opportunity to fold and check that the shapes *fit exactly on top of each other* helps learners to be able to visualise in a different way.

Shapes that are particularly tricky are the rectangle and parallelogram. Learners are often sure that the rectangle has a line of symmetry from corner to corner – it is only by folding that they realise this is not so. It's true that the line cuts the shape in half, but the halves don't match when you fold them, which means that it's not a line of symmetry.

A parallelogram which is not a rectangle or a rhombus is another interesting problem. Again learners are often sure that there are lines of symmetry but folding helps them to see that halving is not the same as finding a line of symmetry.

Later learners will be introduced to the idea of rotational symmetry and you can refer back to the discussions you had here.

Changes in my classroom

Implementing the Teaching Strategy

Symmetry is often taught by drawing lines on shapes and many learners copy what they have seen without really experiencing or understanding what symmetry means. Here learners explore the idea firstly that a line of symmetry is a mirror line, and secondly that both sides have to match. This is consolidated by the folding and cutting where they experiment and then check their results, getting better by using trial and improvement.

If you have access to lots of safety mirrors, you could give that to the learners to check their results by placing the mirror on the mirror line and checking that the shape looks the same with or without the mirror in place.

For those who have worked through the quadrilaterals, challenge them to explore what other familiar shapes can be made. Make large versions of the shapes and draw along the folds. Hang the shapes somewhere to remind learners what they found out.

Key Questions to develop understanding

Is that a line of symmetry?

If you fold along that line will it fit exactly?

How far is this point from the mirror line? How far is the image of the point from the mirror line?

Further questions

Can you give explanations for all your answers?

Which quadrilaterals can only be made with one fold?

Which with two?

Are there any with three? Explain your answer

Are there any with four? Explain your answer

Are there some quadrilaterals that it is not possible to cut at all from a folded piece of paper? Which?

Is it possible to fold the paper to make a shape which is not a quadrilateral. How?

Use what you know about the symmetry of a rectangle to describe the sides and angles.

Do the same for the other quadrilaterals.

Errors and Misconceptions

The line marked on this shape is NOT a line of symmetry.

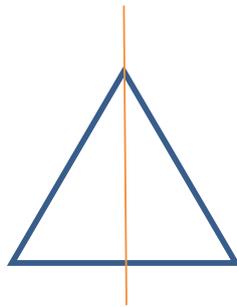


It is true that the red line cuts the rectangle into two equal pieces. This is probably why so many people think it is a mirror line. Try actually placing a mirror along the line. You won't see a rectangle in the mirror. Now try cutting out the shape and folding along the line. Does it fit?



Is this a line of symmetry? Check by folding.

The line on this parallelogram is NOT a mirror line. Again check with a mirror and by folding. This error is an example of over generalizing. A learner may correctly notice that the diagonals of a square are mirror lines and so think that the diagonals of ALL shapes are lines of symmetry. In some ways it is an intelligent mistake! We want learners to look for patterns but they must always THINK and CHECK for what shapes the patterns work.



This is an equilateral triangle and the line of symmetry marked is correct BUT there are two more lines of symmetry. The vertical line of symmetry is the obvious one. Try turning the page to see if that makes it easier to spot the other two lines of symmetry.

Making a display

There are many everyday objects and beautiful objects which have lines of symmetry. Some objects are nearly symmetrical but if you look closely the symmetry is not perfect.



You could ask learners to bring in photographs or objects which show symmetry and set up a display. Give the learners squared paper and ask them to colour in squares to create a pattern which has two lines of symmetry.

Follow up Activities:

There are lots of symmetrical pictures on the internet.
There are two useful activities on the NRICH website:
Reflecting squarely <http://nrich.maths.org/1840>
Shady patterns: <http://nrich.maths.org/1868>