YuMi Deadly Maths

Year 4 Teacher Resource:

MG – Symmetry hunt

Prepared by the YuMi Deadly Centre
Faculty of Education, QUT

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QUT

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ACKNOWLEDGEMENT

We acknowledge the traditional owners and custodians of the lands
in which the mathematics ideas for this resource were developed,
refined and presented in professional development sessions.

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Year 4 Measurement and Geometry

Symmetry hunt

Learning goal

Students will:

- investigate flip, slide, turn and symmetry
- identify symmetry in the environment
- understand some objects have more than one line of symmetry.

Content description

Measurement and Geometry – Location and transformation

- Create symmetrical patterns, pictures and shapes with and without digital technologies (ACMMG091)

Big idea

Geometry – line and rotational symmetry

Resources

Chalk, red circle (to indicate centre point), swivel chairs on wheels, wheelbarrow, Maths Mat, brightly coloured elastics of different colours, tracing paper, pencils, symmetry cards, Mira mirrors, geoboards, rubber bands, paper templates of regular shapes, e.g. equilateral triangle, square, pentagon, hexagon, octagon

Reality

Local knowledge

Discuss shapes/objects that students see in their local environment that they think are symmetrical, e.g. sunflower, bee, coins. *What makes them symmetrical? How can you prove that a shape is symmetrical?*

Prior experience

What are the features of a triangle/rectangle/circle/hexagon/kite/octagon so that the shape is given that particular name? What do we call it when we slide the same shape into different places? [translation] *What process is used when we flip a shape over a line to make a symmetrical shape on the other side of the line?* [reflection] *What are we doing when we turn the shape to a different position – a quarter, half or full turn?* [rotating it]

Kinaesthetic

Make a fist. Now slide that fist to any other place. What process is that? Show me your fist. Now show me a reflection of your fist. Hold up two fingers. Show me a translation, then the transformation that will fold to be symmetrical to those two fingers. How is that described?

Have students lie on the ground. Move their bodies so that **translation** has taken place. *What happened?* [Students moved to any other place.] *Show a **reflection** of your body over your right side/left side, across the line above your head/the line below your feet. **Rotate** your body a quarter of a turn in a clockwise direction, a half turn in an anti-clockwise direction.*

How can you tell if an object is symmetrical? [One part is exactly the same as the other part.] *What can you do to show an object is symmetrical?* [Fold it in halves so that one half fits exactly over the other half.]

Symmetry hunt: Identify objects in the classroom that are symmetrical. Walk outside, observe and note objects that are symmetrical. Conduct a class forum on return to share findings.

Abstraction

Body

Undercover area: Students work in pairs – one student lies flat on the ground with arms and legs extended and separated a little. The partner draws around the body outline with chalk. The first student stands up and "cuts" the chalk body in half lengthwise from the top of the head to the bottom of the shoes by drawing a line in a differently coloured chalk. This is **line symmetry**. Repeat the process by changing roles.

Have students stand up and adopt a pose that is symmetrical (arms and legs must look the same, so arms at sides and legs together or arms and legs the same distance apart). *Now*

take a pose that is not symmetrical. What needs to happen? [One leg or arm or both must be at different angles.]

Rotational symmetry: This occurs as objects are turned around a point. (Use a swivel chair or wheelchair or wheelbarrow with a student taking a pose sitting on the vehicle.) Mark out four quadrants (a rope circle could be placed around the perimeter) and place a red circle at the centre. One student swivels or wheels the student taking and keeping the pose around the centre point so that all students can see that the same pose is kept at every point in the full-turn rotation.

Have each student adopt a stance resembling a plane with one arm stretched out in front and the other arm stretched behind the back. Turn around on the spot as a toy plane would fly revolving on a stick.

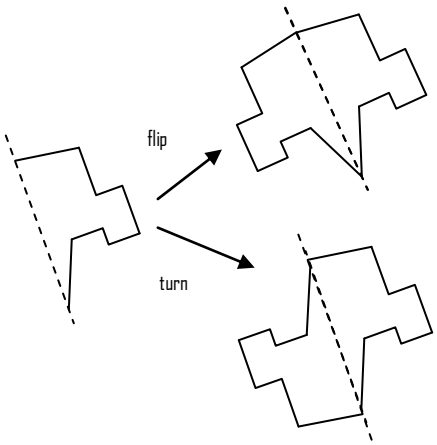
Have four students lie on the ground around a centre point marked with a red circle with their legs apart the same distance, right foot touching their neighbour's left foot and arms extended with the right arm crooked at the elbow. Each student should be a copy of the others. Have other students gather around in a circle looking down to get a bird's eye view of the four students lying on the ground. *If we could place these students on a spinner or a large Lazy Susan and turn them around, we would see how they look symmetrical at all points in the rotation.*

What could be done so that the four students would not be examples of rotational symmetry?

Use students of a similar size. Three students lie on the ground in the form of a triangle. Other students lie against the three sides to form new triangles. Extra students can then lie against the sides of the new triangles to form a "symmetrical" pattern. Other symmetrical student patterns can be formed starting with squares, pentagons and so on.

Hand

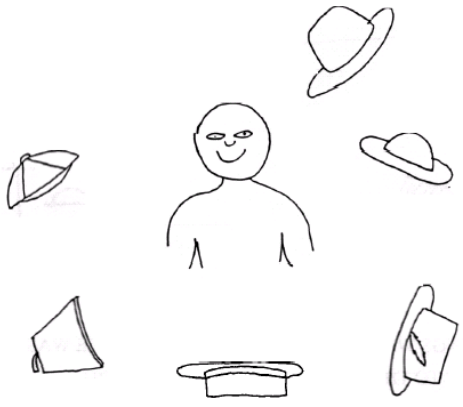
One line, two rotations: Draw a dotted line and a design on one side of the line as shown on right. For line symmetry, copy the design and the dotted line onto tracing paper, fold paper and retrace, and the result is a shape with one line of symmetry on the tracing paper. For rotational symmetry, copy the design and the line onto tracing paper as before but, this time, turn the tracing paper on top of the design and dotted line so that the dotted lines exactly match/cover each other, retrace the shape, and the result is a shape with two rotations of symmetry.



The Mira mirror will only do line symmetry but it does this well as in the following sequence.

Learning how to use a Mira: *Which hat fits best on the man?*

For each hat in turn, student places Mira between hat and man (with Mira perpendicular to an imaginary line between hat and man and bevelled edge down and facing student) and adjusts Mira until hat is on the man (or man is under the hat – depends which way student is looking into the Mira). After trying each hat, student judges which is best.



Mind Students visualise a given shape, picture, object and the reflections; pretend to look in the mirror and see the reflection. Students use Mira mirrors to see and draw symmetrical shapes from one side to the other side of the Mira mirror.

Creativity Students create half a shape, e.g. tree, and use a Mira mirror to complete the other half.

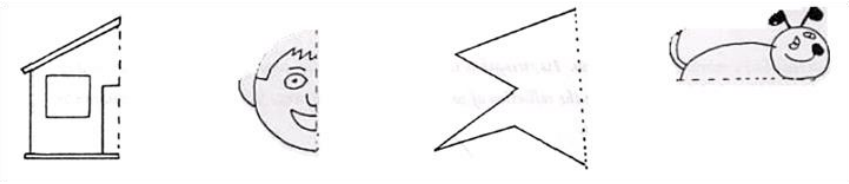
Mathematics

Language/ symbols symmetry, symmetrical, flip, slide, turn, line of symmetry

Practice

1. Maths Mat: *Divide the mat into halves with one elastic. This is one line of symmetry. Are there any other lines of symmetry for the mat?* [horizontal and vertical lines of symmetry]. Have a group of three or four students construct a shape on one half of the mat using an elastic. Another group of the same number of students flips that shape over the line of symmetry to construct a shape that is symmetrical to the first shape in the second half of the mat (part to whole). Check that the lines are congruent in length and direction is opposite. *Note that symmetrical shapes will look the same after reflection. For regular shapes, what transformation other than reflection will produce a symmetrical shape over the line of symmetry?* Repeat using different students/shapes, both regular and irregular shapes.
2. Still using the Maths Mat, make regular shapes, one at a time, with 3, 4, 5, 6, 8 sides. Using different colours of velour strips, identify the lines of symmetry in each. Record the number of sides and the number of lines of symmetry in a table. *What is the generalisation?*
3. Copy the shapes from Cards 1 and 2 (Appendix A) onto tracing paper and test for line and rotational symmetry.
4. Students use Mira mirrors to see and draw different symmetrical shapes, for example:

   Place Mira along the lines, and then draw the other half of the figures. If the result makes sense, the resulting figure is line symmetric. Does the result always make sense? Why or why not?



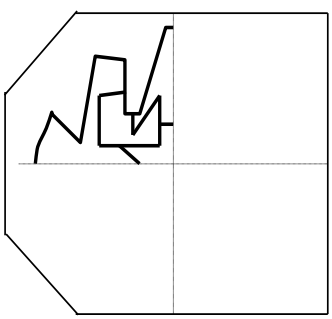
5. Students design a pattern using coloured symmetrical shapes. Make a class mural of the designs.

Connections Forming tessellations from symmetrical shapes.

Reflection

Validation Students find symmetrical shapes in the environment, draw and name these.

Application/ problems Provide applications and problems for students to apply to different contexts independently; for example: Construct the "shield" on right – students are given a shield shape and two dotted lines crossing. They put a design in one of the quadrants (as shown) and use the Mira to flip it three times into the other quadrants. The resulting design has two lines of symmetry and if the artistry is good the image will look effective as a shield.



(*Note:* Can use tracing paper to redo shield as rotations which may look better. Try both from the same starting picture and see which looks better.)

Extension

Flexibility. Provide students with many examples of line/rotational symmetry using a variety of resources. Students are able to recognise and demonstrate more than one line/rotation of symmetry where applicable. They are able to use reflection across multiple lines of symmetry.

Reversing. Students are able to show lines of symmetry in a variety of shapes across different angles and also, given one half of a shape, construct the other. Reversing the shape → symmetries teaching process, and including symmetries → shape activities, is important and enhances learning.

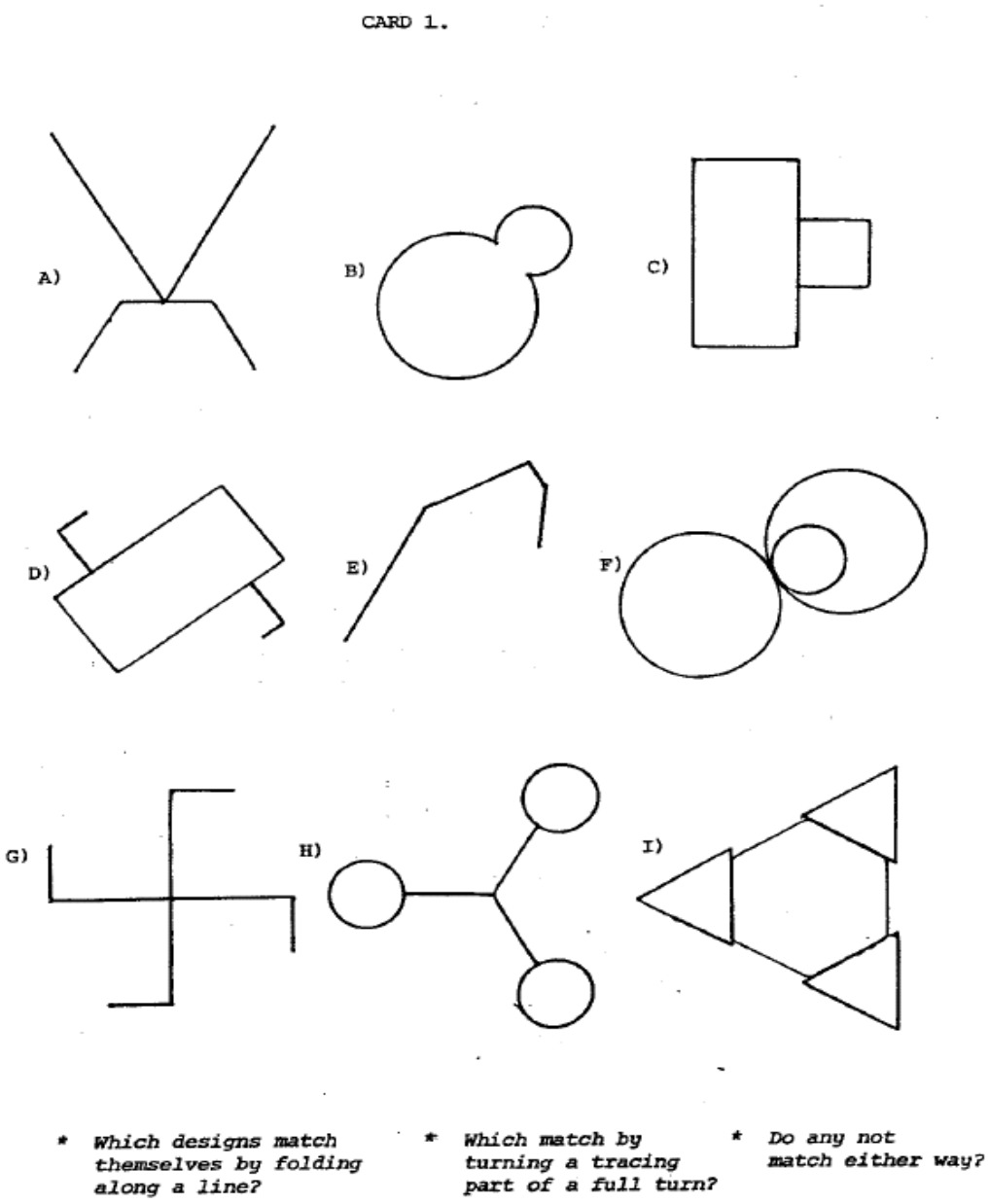
Generalising. *Figures/shapes are symmetrical when one part, folded in half over the other, covers it completely with no gaps or overlaps.*

Changing parameters. Students explore creating tessellations using symmetrical shapes. Use the *YDM Geometry* book (pp. 75–78).

Teacher's notes

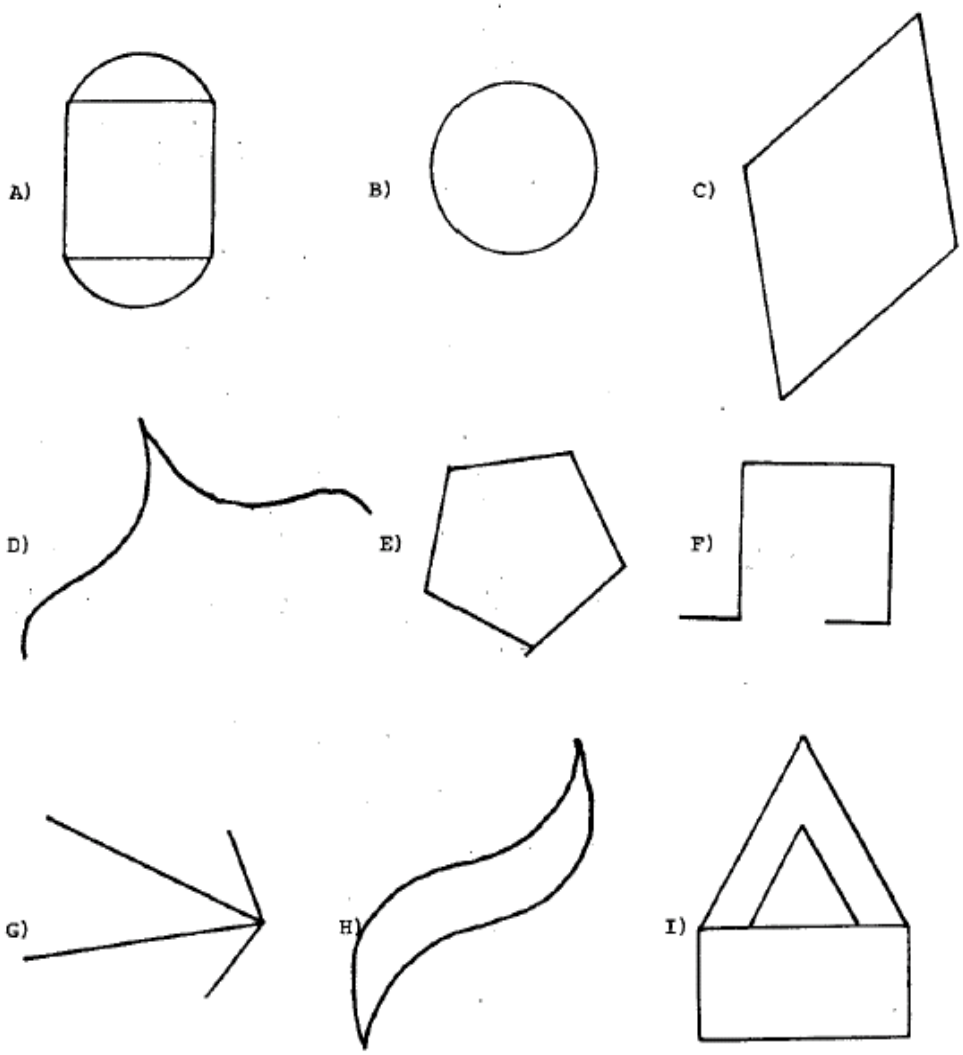
- Check that students are able to differentiate the reflection from the translation and understand that three-dimensional as well as two-dimensional shapes may be symmetrical.
- The Mira is very effective in constructing line symmetric figures and in checking if changes proposed to figures will achieve the desired line symmetric changes. It cannot help with regard to rotational symmetry.
- Students need to be taught the skill of visualising: closing their eyes and seeing pictures in their minds, making mental images; e.g. show a picture of a kookaburra, students look at it, remove the picture, students then close their eyes and see the picture in their mind; then make a mental picture of a different bird.
- Suggestions in Local Knowledge are only a guide. It is very important that examples in Reality are taken from the local environment that have significance to the local culture and come from the students' experience of their local environment.
- Useful websites for resources: www.rrr.edu.au; https://www.qcaa.qld.edu.au/3035.html
- Explicit teaching that **aligns with students' understanding** is part of every section of the RAMR cycle and has particular emphasis in the Mathematics section. The RAMR cycle is not always linear but may necessitate revisiting the previous stage/s at any given point.
- Reflection on the concept may happen at any stage of the RAMR cycle to reinforce the concept being taught. Validation, Application, and the last two parts of Extension should not be undertaken until students have mastered the mathematical concept as students need the foundation in order to be able to validate, apply, generalise and change parameters.

Appendix A: Symmetry



Note: The language is important here and needs to be developed – particularly the words "match", "not match", "folding along a line", "part turn", "full turn" and "either way".

CARD 2.



* *Which designs have line symmetry?*
* *Which designs have rotational symmetry?*
* *How many lines of symmetry do they have?*
* *How many rotations of symmetry do they have?*

Note: The number of lines of symmetry is the number of different ways a shape can be folded in half. The number of rotations is the number of different part-turn matches plus the 360° turn. The 360° turn is counted if there is a match on a part turn but not counted when there is no part-turn match – so the number of rotations goes from 0 to 2 – there is never one rotation of symmetry.

