AFRICAN INSTITUTE FOR MATHEMATICAL SCIENCES
SCHOOLS ENRICHMENT CENTRE (AIMSSEC)
AIMING HIGH

PAPER DOLLS


Fold a piece of paper in two and tear out half a person. An old newspaper is good for this. Now open out your little person and flatten it. You have made a paper doll that is **symmetrical** about the fold line. The two halves of the doll on each side of the fold line are **reflections** of each other.

We call the fold line **a mirror line.**

Other names for are is **line of symmetry, axis of symmetry** and **axis of reflection.**


Make some more paper people and other objects in the same way. You might like to experiment with making a line of people holding hands.

Now make 2 folds, tear out a star shape and flatten it out. The picture shows a shape made in this way with 2 axes of symmetry along the fold lines. Create your own pattern with 2 mirror lines.

The next shape was made by making 3 folds in the piece of paper and then cutting some holes along the edges of the fold lines to make a symmetrical pattern with 4 mirror lines along the folds.

What do you think happens if you turn this pattern through a right angle? What about turning it through 2 right angles? Or 3 right angles? Make a pattern like this for yourself and see what happens when you turn it round. We say this pattern has **4-fold rotational symmetry**. Create more patterns with 4-fold rotational symmetry

The basket that this lady is making has **8-fold rotational symmetry**. Can you explain how we know that? You cannot fold this basket but can you find the mirror lines?

Can you find some flowers or other objects that have rotational symmetry.

Perhaps you would like to make a poster about symmetry or a display for your classroom.

HELP

You can make the dolls and other shapes by tearing the paper, as you see with some of the shapes above, or you can use scissors if you have them. Everywhere you go you will see symmetry around you.

NEXT

Shapes repeat themselves in patterns by 4 transformations:

Translation 

Rotation 

Reflection 

Glide reflection 

Describe how these transformations appear in the line of paper dolls and in the other paper cuts that you make.

GUIDE FOR PARENTS

Why do this activity?

This activity enables learners to experiment with creating their own shapes and patterns with line symmetry and rotational symmetry. It offers plenty of opportunity for class discussion of symmetry properties of different shapes and for learning the mathematical language. The activity will help learners to remember these concepts. It does not need any resources except scrap paper and old newspaper is good for this. Scissors can be used but they are not essential so you need not be deterred from doing the activity if scissors are not available.

Learning objectives

In doing this activity students will have an opportunity to:

- get to know and understand the meaning of line symmetry and rotational symmetry and be able to recognise and describe symmetry in shapes and to identify mirror lines (axes of symmetry);
- gain an understanding of orders of rotational symmetry;
- investigate reflections, rotations and translations.

Generic competences

In doing this activity students will have an opportunity to **visualize** and develop the skill of creating and interpreting visual images;

Suggestions for homelearning

Start by folding newspaper and tearing out a large paper doll**.** Open out the paper doll and ask:
"What do you notice about the right side and the left side of the doll?"

"How do you know"

Explain that we call the doll **symmetrical** because it is the same on one side of the fold line as it is on the other side. Ask if they are symmetrical themselves, or nearly symmetrical. Ask if they know other creatures and objects that are symmetrical.

Get everyone to hold up their hands and look at them. Ask

"What is the same and what is different about your hands?"

You may like to make hand prints and discuss how one hand is the mirror image or reflection of the other. Introduce the idea of a mirror line.

Everyone should have some sheets of newspaper or other paper. Demonstrate how to fold the paper and then how to tear out a small paper doll. Let the learners try this. If they are not happy with the first one that they make they can throw it away and keep making the paper dolls until they are happy with the results.

The paper dolls can be pasted into their workbooks with the mirror lines marked. A poster can be made, perhaps drawing features on the dolls and colouring them. Talk about how adding features changes the symmetry, for example a shirt pocket on one side but not the other.

Then the learners should make patterns with 2 folds and with 3 as described in the question.

Show different patterns and ask "How many lines mirror lines?"

Talk about turning the patterns round – rotating the patterns.

"What happens when you turn through a quarter turn (right angle)?"

"What happens when do this twice, or three times, or four times?"

Learners should find flowers and other objects that have symmetry and have a discussion about them.

Perhaps you would like to make a big poster about symmetry of different sorts showing translations, reflections and rotational symmetry.

Finish by using the Diagnostic Quiz to assess whether your learners can recognise reflection symmetry.

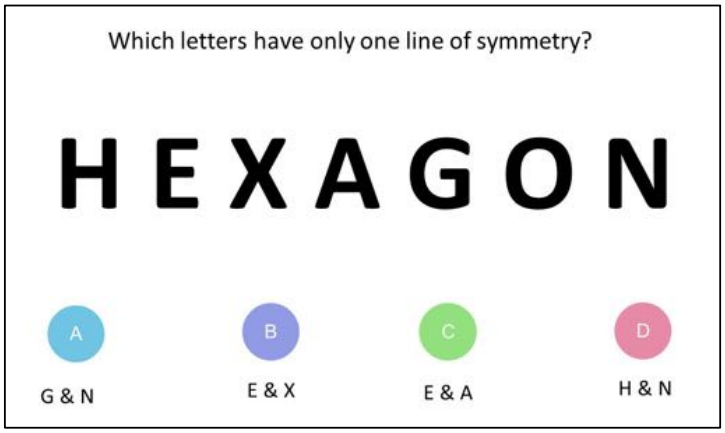
Key questions

What do you notice?
Describe the pattern you see?
Can you find a small part of the pattern that is repeated in different ways to make the whole pattern?
How is that small part of the pattern repeated?
What happens when you look at yourself in a mirror?
Can you turn that shape around a bit so it ends up looking exactly the same?
What angle did it turn through?
How many turns did you make before the shape got back to its starting position?

Diagnostic Assessment

This should take about 5–10 minutes.

Show this question to the child or children you are helping and say
"Put up 1 finger if you think the answer is A, 2 fingers for B, 3 fingers for C and 4 fingers for D".



1. Notice how they respond. Ask them to explain why they gave their answers. DO NOT say whether the answers are right or wrong but simply thank them for giving their answers.
2. Try to make sure that learners listen to each other's reasons and try to decide if their own answer was right or wrong.
3. **Ask them to vote again 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.

The correct answer is C
A. G and N have no lines of symmetry
B. E has one line of symmetry and X has two.
D. H has two lines of symmetry and N hase none.
https://diagnosticquestions.com

Follow up

Tangram Pattern https://aiminghigh.aimssec.ac.za/years-4-7-tangram-pattern/
Command the Robot https://aiminghigh.aimssec.ac.za/years-4-9-command-the-robot-1/
Symmetry Challenge https://aiminghigh.aimssec.ac.za/years-4-7-symmetry-challenge/
Mirror Mirror https://aiminghigh.aimssec.ac.za/years-8-12-mirror-mirror/
Transformation Art https://aiminghigh.aimssec.ac.za/years-7-12-transformation-art/

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. New material will be added for Secondary 6. For resources for teaching A level mathematics see https://nrich.maths.org/12339 Note: The mathematics taught in Year 13 (UK) and Secondary 6 (East Africa) is beyond 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