

Combined Transformations part 1

Whether you are a parent, teacher or home school educator, we've compiled examples of activities, games and puzzles which can be used to support the learning of shape and space.

These examples are taken from the 'Combined Transformations' packs found in our SMILE resource collection. The mathematical demand increases as you work through the packs. There are lots more ideas in the complete packs, which can be downloaded at <https://www.stem.org.uk/rxzf8>

Answers to cards can be found at <https://www.stem.org.uk/rxxo5>

Smile Worksheet 2306

Patterns on a line

- Continue these patterns.

- Make up your own patterns.

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Board Order

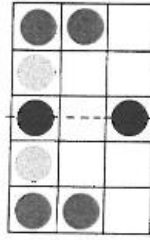
Smile 1675

– a game for 2 to 4 players
You will need counters and a board for each player.

1. Get someone to choose 15 counters for you.
2. Each player must use at least 8 counters to make a pattern with symmetry.

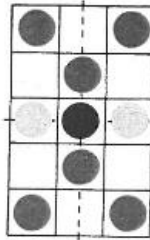
3. Scoring

One line of symmetry –
score 3 points



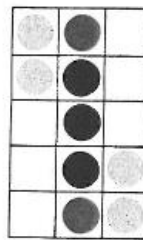
Example: One line of symmetry

Two lines of symmetry –
score 5 points



Example: Two lines of symmetry

Point symmetry – no lines of
symmetry but the
board looks the same
when turned half-way round –
score 10 points



Example: Point symmetry

Bonus Points! If you use more than 8
counters, each extra counter scores 1
bonus point.

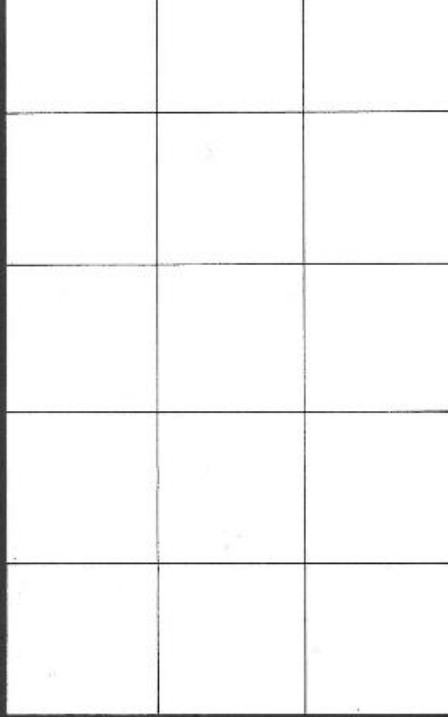
4. Calculate the score for your own pattern.

5. Play 5 rounds. The player with the highest total wins.

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Board Order

– a game for 2 to 4 players



One line of symmetry – score 3 points

Two lines of symmetry – score 5 points

Point symmetry – score 10 points

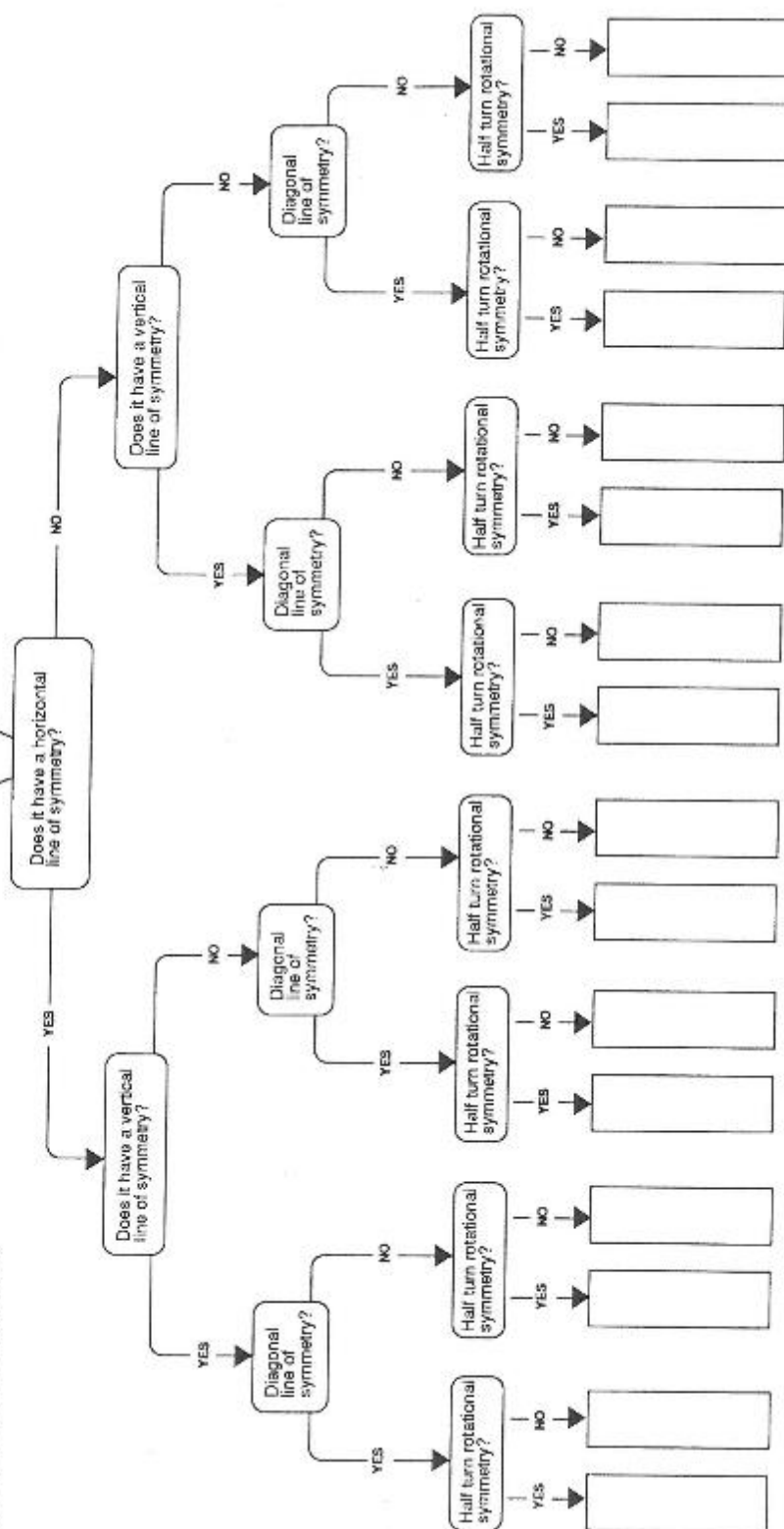
Bonus Points

If you use more than 8 counters, each
extra counter scores 1 bonus point.

Alphabet Symmetry

Put each letter into a box.

H I J K L M O P Q R S T
G F E D C B A N U V W
X Y Z



Why are most boxes empty?

You may like to design a similar sorting diagram for the numbers 0 - 9.

Rotational and line symmetry review

An activity for two. You will both need a copy of this worksheet.

Some shapes have line symmetry

Some shapes have rotational symmetry

Some shapes have both

Some shapes have neither

1. On your own:

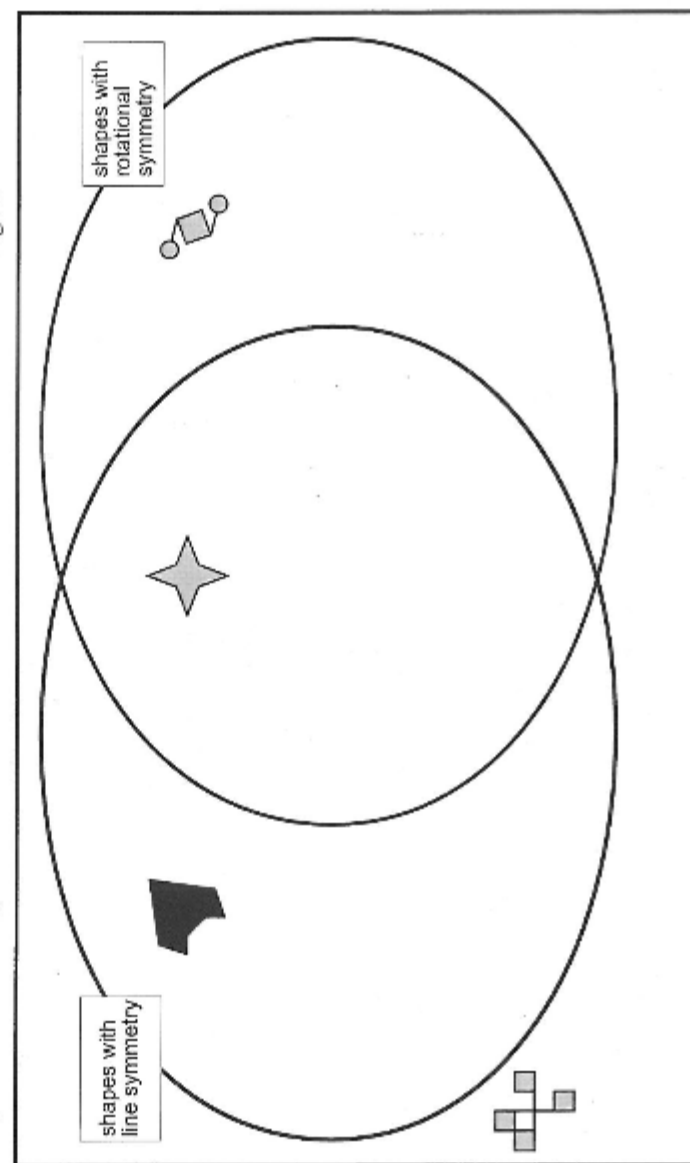
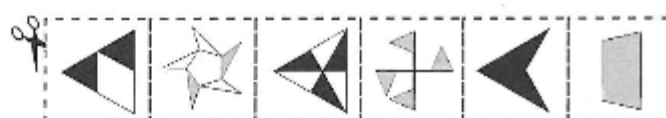
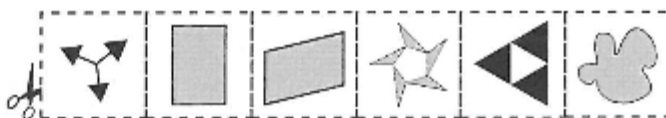
- Cut out the shapes below.
- Arrange them in the correct regions on the Venn diagram.

2. Together:

- Compare your answers.
- When you have agreed, stick them down.

3. Challenge:

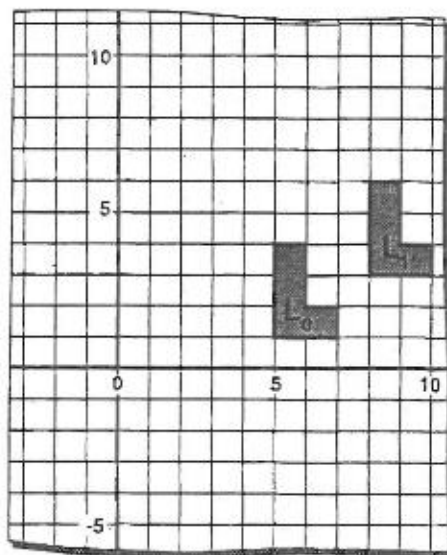
- Draw 4 shapes of your own, one to go in each region.



Combining Transformations

- Draw a grid with x -axis from -7 to 14 and y -axis from -7 to 10.
Plot the points (5, 1), (7, 1), (7, 2), (6, 2), (6, 4), (5, 4), (5, 1) and join them in order.
Shade the 'L' shape and label it L_0 .
- Draw the resulting 'L' shapes for the transformations in the table below.
The first transformed 'L' shape L_1 has been completed for you.

Starting Shape	Transformation	Label of new shape
L_0	translate $\begin{pmatrix} 3 \\ 2 \end{pmatrix}$	L_1
L_1	translate $\begin{pmatrix} 4 \\ 3 \end{pmatrix}$	L_2
L_0	reflect in x -axis	L_3
L_3	reflect in y -axis	L_4
L_0	reflect in $y = x$	L_5
L_5	rotate 180° about (0,0) anticlockwise	L_6
L_0	rotate 90° about (0, 0) anticlockwise	L_7
L_7	rotate 180° about (0, 0)	L_8
L_0	reflect in $x = 3$	L_9
L_9	reflect in $x = -2$	L_{10}

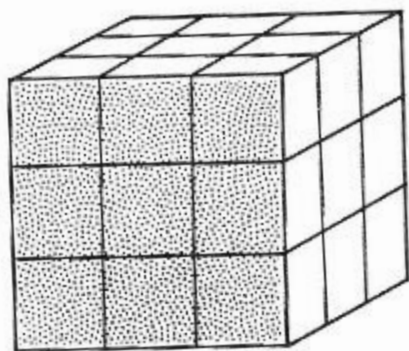


- Describe the single transformation to map:

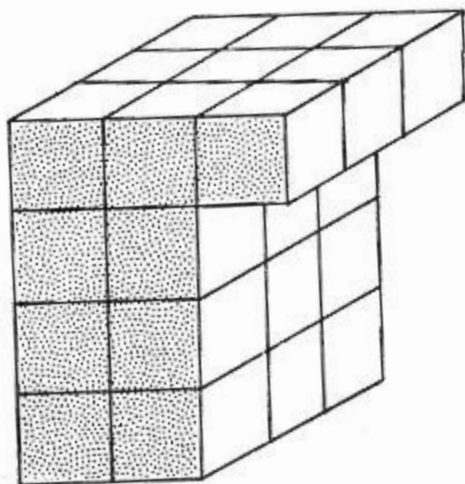
- L_2 on to L_0
- L_4 on to L_0
- L_6 on to L_0
- L_8 on to L_0
- L_{10} on to L_0

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You will need: Cubes

Cube Cuts

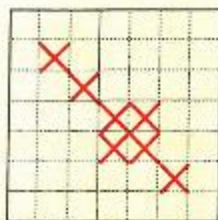
Problem: Cut the cube with a saw into
centimetre cubes.
How many cuts are needed?



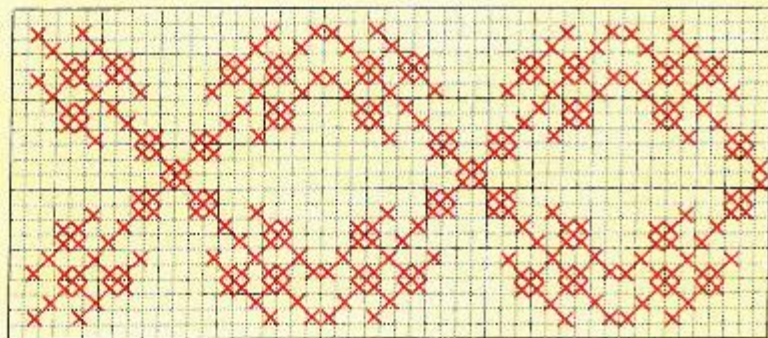
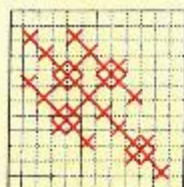
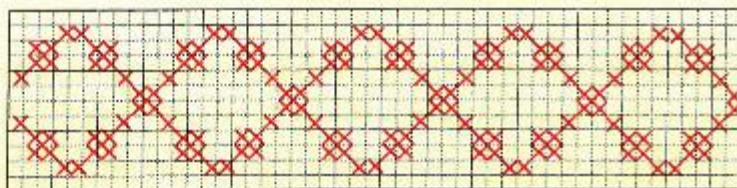
If you may re-arrange
the pieces after each
cut, can you do it
with fewer cuts?

Try a 4 by 4 by 4 cube
Try other cuboids.

Here is another motif.



✕ Analyse and describe the patterns created.



- ✕ Using 5mm square paper to represent the cloth, design a motif of your own and create patterns, describing them in terms of reflections, rotations and translations.
- ✕ Take one of your patterns and make it into a rectangular border keeping the design continuous and making right-angled bends in the appropriate places. You may find a mirror helpful to plan the corners.

You might like to choose one of your patterns and using cross stitch embroider it.

Cross Stitch

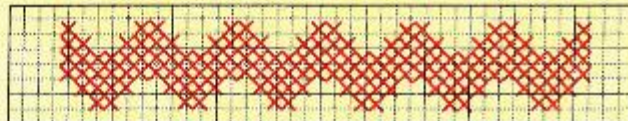
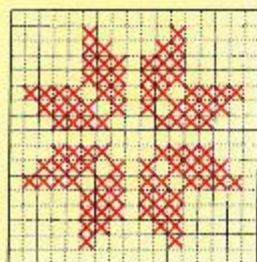
You will need 5mm square paper.

Simple motifs, using cross stitch, can be used to create elaborate patterns by using transformations including reflections, rotations and translations.

The patterns below have been created by transforming this motif.



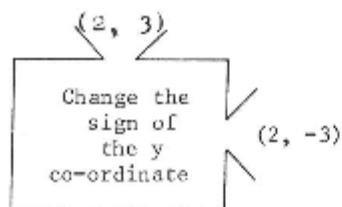
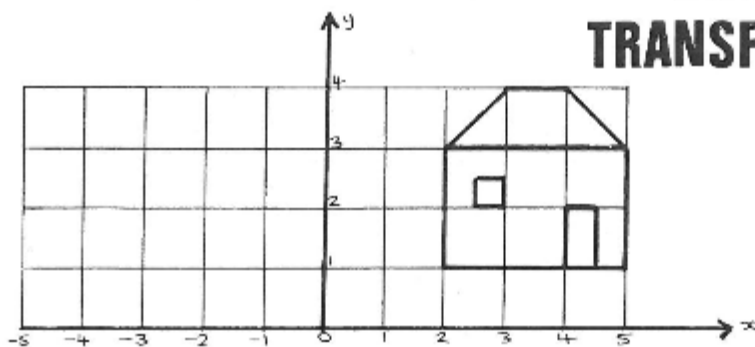
- ✕ Analyse and describe each pattern in terms of transformations used.



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SMILE

MATRICES AND TRANSFORMATIONS



This machine changes the point $(2, 3)$ to $(2, -3)$

- (1) Copy and complete, for the corners of the house:

$(2, 3) \longrightarrow$	$(2, -3)$	$(5, 3) \longrightarrow$	$(\blacksquare, \blacksquare)$
$(3, 4) \longrightarrow$	$(\blacksquare, \blacksquare)$	$(5, 1) \longrightarrow$	$(\blacksquare, \blacksquare)$
$(4, 4) \longrightarrow$	$(\blacksquare, \blacksquare)$	$(2, 1) \longrightarrow$	$(\blacksquare, \blacksquare)$

- (2) On squared paper draw both the original house, and the house after it has been through the machine.

Describe what has happened to the house?

- (3) Repeat (1) and (2) for each of the following machines, drawing just the new house in each case.

