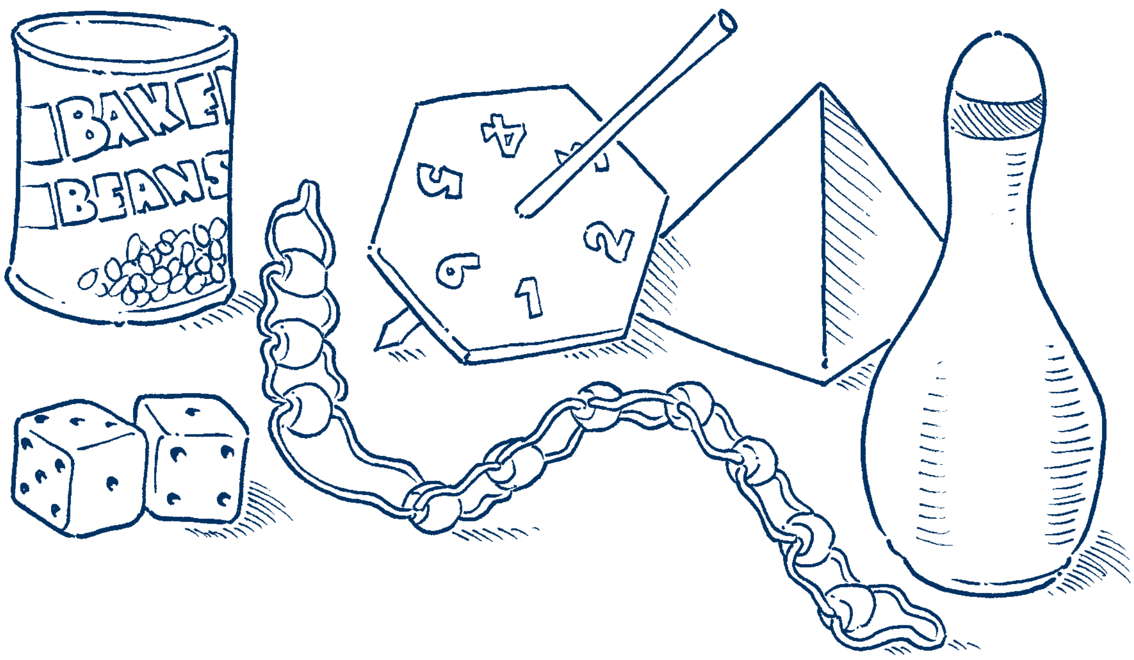
The National **Numeracy** *Strategy*

Shape and space activities



The activities in this booklet should help children to visualise and describe shapes and their properties. The purpose of the activities is to encourage children to picture things in their mind's eye.

The activities can often be presented in a variety of ways. You could take the lead, then ask each member of the group to respond. With older children, one child can take the lead, then the whole group can join in the subsequent discussion. When you are presenting an activity to the class, you may need to alter the vocabulary or context to suit your local area and the children's interests.

You will probably need to decide in advance how you want the children to respond – either orally, or by jotting something down. You will also need to think about how much discussion you want to have.

The activities may be copied freely by schools in England taking part in the National Numeracy Strategy.

Some ideas for Reception and Year 1

Position and direction

- On the magnetic board, put the red aeroplane above the boat, put the van below the green aeroplane, put the car beside the van ...
- Jessica, can you sit (or stand or lie down) in front of Ali? Who is sitting behind Manuel, next to Jane, beside Sam? Stand next to someone about the same height as you.
- Stand in a line holding a flag you have made. Wave your flag if you are ... between Julie and Patrick ... next to Tom ... last in the line ... on Susan's right ...
- Push the bean bag ... towards me ... away from you. Pass the bean bag to your left.
- Name something in the classroom that is higher than, lower than, above, below, between, beside, next to, in the middle of, at the edge of, in the corner of ...
- We can't see the hall, but what is next to the piano? What is below the big window?
- Michelle and Solomon are going to take the register to the school office. Give them instructions to tell them how to get there.

Recognising shapes and some of their properties

- I spy ... something green with wheels ... that has a curved face ... that has two holes in it ... that has lots of points.
- I've hidden an object/shape/wooden numeral in this feely bag. Pass it round and tell me what you think it is. How do you know?
- Put your hands down into this big box. Can you find ... something soft?... an object with corners?... something round?... something spiky?
- Tell me where in the classroom you can see a circle, a square, a triangle. What about a cube? Can you see a cone anywhere?
- Imagine a big triangle painted on the floor. How many corners does it have? How many sides?
- Imagine holding a tin of beans, and turning it round and round in your hands. How many circles can you see?
- Shut your eyes. Listen while I describe a shape to you ... Now open your eyes. Can you pick up the shape I was describing? Now can you describe a shape for someone else to guess?
- Look at this collection of objects or shapes. Shut your eyes while I pick one up and hide it. Open your eyes. Tell me which object or shape I have hidden.
- How many of these bricks do you think will pack into this box?
- Make a simple pattern by printing five or six shapes on one half of a sheet of paper. Can you copy your pattern on the other half?
- Look at this pattern I have made. One piece is missing. Can you say which piece it is?

Size

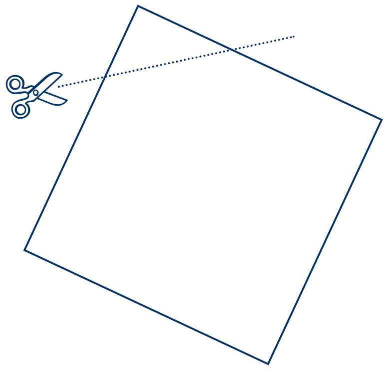
- Sort out the lids bigger than this one, the rods longer than the yellow one, the ribbons shorter than the red one, the boxes that are about the same size as this one.
- Paint a great big monster, a middle sized monster and a small monster.
- Make two snakes that are the same length. Make one fat and one thin.
- Put these stacking cups in order. I've taken one away. Which one is missing?

Short mathematical imaginings

1

Imagine a clock with hands, on the wall in front of you.
The long hand is pointing to the 3.
The short hand is pointing between 8 and 9.
What time is it?

2



Imagine you have a paper square and a pair of scissors.
Imagine cutting off a corner of the square in one straight cut.
Without saying anything, quickly draw the shape you 'cut off'.
Now draw the shape you have left.
Compare your two shapes with the rest of your group.
What are the names of your two shapes?

3

Imagine a large, yellow square on the table in front of you.
Imagine a small, blue right-angled triangle lying inside the square.
Push the right-angled triangle so that its right angle fits into a corner of the square.
Now draw the yellow shape that is left.
Compare your shape with the rest of your group.
What is the name of your shape?

4

Think about the digits 0 to 9.
Some of them can be drawn with a single stroke, like 7 or 6.
Two of them need more than one stroke. Which ones?

5

Imagine the number five hundred and thirty-two drawn in the air in front of you.
Which digit is in the middle? Which is on the left? Which is on the right?
Replace the middle digit with a four. What number can you see now?
Swap over the middle digit with the one on the left. What number can you see now?
Remove the middle digit and push the other two together so that they are next to each other.
What number can you see now?

6

Imagine a 2 by 2 grid of squares.
How many squares are there altogether in the grid?
Imagine putting a nought in the top right square.
Put a cross in the bottom left square.
Put a cross in the bottom right square. Which square is still empty?
Without saying anything, quickly sketch what you can see.

7

Imagine you have some squared paper on the table in front of you.
Imagine colouring an L-shape on the paper. It is just one square wide.
How many edges does it have?
How many corners does it have?
What sort of polygon is it?
Now imagine colouring a T-shape on your paper.
How many edges does it have?
How many corners does it have?
What sort of polygon is it?

8

Imagine the number thirty-five printed in the air in front of you.
Now imagine the number forty-two printed underneath it.
Which digit is directly underneath the five?
Which digit is above the four?
What do you get when you add the top right number to the bottom left number?
Now swap over the two digits on the bottom row.
Which digit is now above the four?

9

Think about the digits 0 to 9 made out of wood.
Imagine them lying flat on the table in front of you.
Imagine turning each digit over.
Which of them still look the same?
Which of them look different?

10

Think about these capital letters – M, A, T, H, S.
Imagine them made out of wood, and lying flat on the table in front of you.
Imagine turning each letter over.
Which of them still look the same?
Which of them look different?
Now imagine your name in capital letters made of wood.
Which of the letters would look the same if you turned them all over?

11

Imagine a large, white equilateral triangle on the table in front of you.
Take a smaller, red equilateral triangle and push it into the top corner of the white triangle.
Now take a second red equilateral triangle and push it into one of the other corners of the white triangle.
Without saying anything, quickly draw the white shape that is left uncovered.
Compare it with your group's pictures.

12

This time, you will need some imaginary quick drying paint.
Imagine a cereal packet standing on the kitchen table.
Paint the front of the packet red.
Now paint the back red.
Paint the top and bottom of the packet red and the other two faces blue.
Now study the packet carefully.
How many edges has the packet altogether?
How many of these edges are where a red face meets a blue face?
How many edges are where a red face meets another red face?
How many edges are where a blue face meets another blue face?

13

Imagine you have four right-angled triangles, all the same size, flat on the table in front of you.
Slide two of the triangles together so that their shortest sides meet edge to edge and their right angles touch each other.
Do exactly the same to the other two triangles.
Now slide the two pairs of triangles together so that all four right angles touch each other.
What shape have you made? Is it the same shape as your partner imagined?

14

Think about the capital letters of the alphabet made out of wood and thick enough so that they can stand upright.
Imagine them standing on a mirror.
Imagine the capital letter H, standing on the mirror. The reflection of the letter also looks like a letter H.
Now think about the capital X standing on the mirror – think whether its reflection looks like a letter X.
What about the letter P?
Each time I mention a capital letter, I want you to think to yourself whether its reflection will look exactly like itself when it stands on the mirror.
T, A, C, K, S.
Can you think of a capital letter which looks like a different letter when it is reflected in the mirror? Are there any other letters like this?

15

Imagine a clock with hands, on the wall in front of you.
The long hand is pointing to 4. The short hand is pointing between 11 and 12.
What time is it?
Now imagine the clock is behind you and you can see it in the mirror.
The hands look as though they are saying twenty-five to three.
What time is it really?
Now imagine a digital clock behind you. In the mirror, it looks as though the time is 10:11. What time is it really?

Longer mathematical imaginings

1 Queues

Imagine standing at a bus stop in a queue of people on a cold day. Who is the first in the queue? Is it a girl or a boy, a woman or a man? How tall do you think they are?

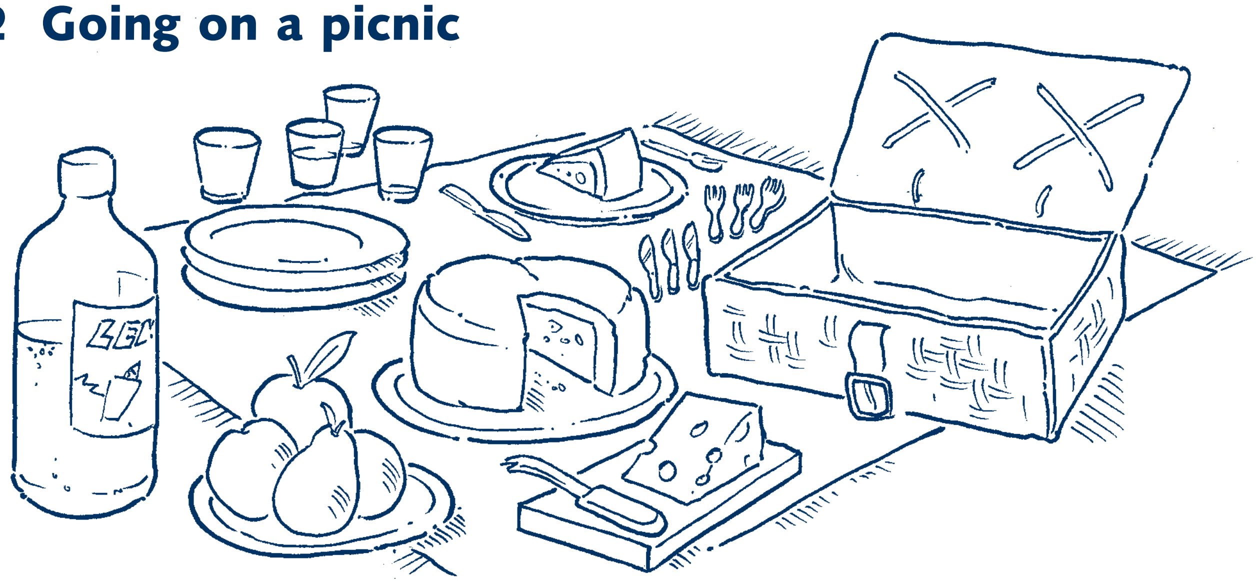
Now, there are seven people in the queue, and you are third. How many people are there in front of you? How many people behind you? Are there fewer people before you or fewer people after you? How many people apart from you are there in the queue?

The bus still hasn't come. Two more people join the queue. How many are waiting for the bus now? Remember, you are the third in the queue. How many people are behind you now?

Now, work with a partner. One of you chooses the length of the queue, and your position in it. So you could say: 'There are nine people in the queue, and you are sixth.' The other person then has to say how many people are in front of you, and how many behind.

Jot down what to do. Each time, write the length of the queue, your position, then the number of people in front of you, then the number after you.

2 Going on a picnic



Today we are going on a picnic. Where shall we go? To the park? To the canal? Or shall we go to the beach? How many people are going on the picnic? What shall we take to eat?

Now, suppose we took a big round pizza with us. What shape is that? Can you draw it in the air with a finger? Now sketch it on paper. What if you wanted to share the pizza fairly with a friend? How many pieces would you cut it into? Imagine what each piece would look like. Sketch it on your paper.

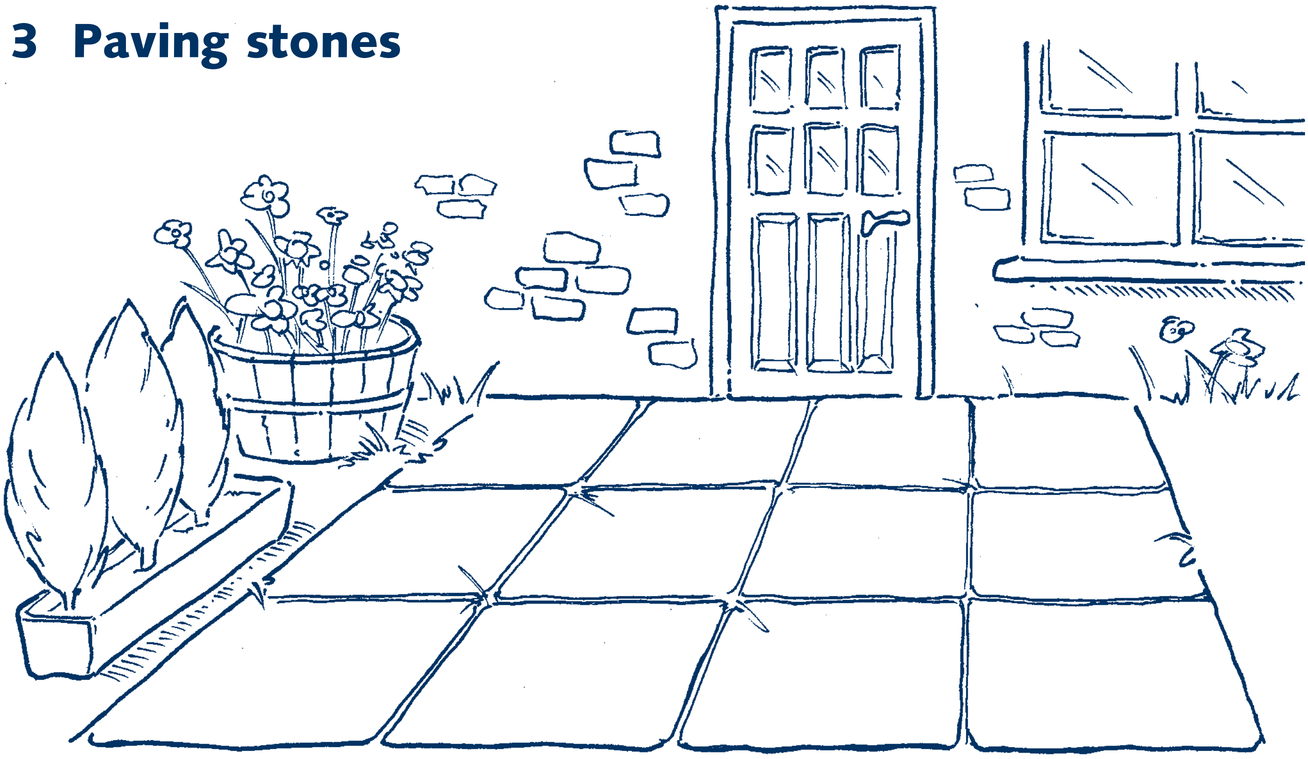
Suppose we had a sandwich. What shape is it? Let's call the sandwich a square. If you cut the sandwich in half, what would each half look like? Sketch it on paper. What did your half sandwich look like? Was it a triangle, or was it something else?

What if we took some samosas? What do they look like? Can you draw an outline in the air with a finger? If we cut a triangular samosa in half, how many people could have a piece? Imagine the shape you would get if you cut the samosa into two equal pieces. What shape would one half be? Sketch it on paper.

Suppose you had six chocolate muffins on your picnic, and you gave half of them to me. How many would I get? What if you had twelve muffins? What if you had three? Or seven?

Now work with a partner. One of you choose how many apples there are for a picnic for two people. The other one must say how many apples each of you would get. Make a note on your paper of what you decide each time.

3 Paving stones



Can you imagine one single paving stone or slab, the sort which are used to make pavements? What colour is your paving stone? Could you lift it, or would it be too big or too heavy? Imagine laying 8 paving stones, one after another, to make a long, thin path ...1, 2, 3 ... and so on.

Next, think of a path 2 paving stones wide and perhaps 12 long. How many paving stones would you need to make a path like that in the shape of a long rectangle, 2 wide and 12 long?

If you had 15 paving stones to lay each time, what square or rectangular pavements could you make? How many wide by how many long, using exactly 15 paving stones?

What rectangular or square pavements could you make with exactly 25 paving stones?

Now imagine, then write down or draw, all the different squares and rectangles you could make if you used exactly 12 slabs each time. Include long, thin rectangles that are only one slab wide, as well as the squares and rectangles which could be used for playing and sitting areas.

Try these three problems using imaginary paving stones.

Problem 1

Describe a rectangular or square pavement to your partner. You might say: ‘It’s 7 long and 3 wide.’ Then ask how many paving stones were used. Take turns to answer and explain how you work it out. Write down your questions as a record.

Problem 2

Work in pairs for this activity. The first person should choose a number between 30 and 80 and tell your partner what it is. The second person will think carefully and say the sizes of all the different squares and rectangles she can make with that number of paving stones. The first person writes them down or draws them quickly as they are being said. Swap over, and choose another number.

Problem 3

Imagine placing one square paving stone in the corner of a square playground. It would be 1 long and 1 wide. Add some more paving stones to this one to make a square 2 long and 2 wide. How many more stones did you need? Now, add some more to make a bigger square, 3 by 3. How many more did you lay this time? Go as high as you can in your head. Jot down or draw what you find as a record of what you have been doing.

4 In the playground

Think of the playground at your school. How many people will it hold?

That’s a difficult question, so you need to break it down into manageable bits. It’s also a question which only has an approximate or rough answer, so no one number will be right.

Some people may decide before they start that their problem is how many children will the playground hold at playtime. This means the children have to have room to play. Others may decide to count how many people will fit standing crammed together like people in a lift.

Work as a class in pairs or in small groups. Discuss first what question you are trying to answer, then make a plan of how you could do it. Jot down your plan so you don’t forget.

Now, work out your estimate of how many people the playground will hold. Draw a diagram to show where all the people go. Remember to point out which parts of the playground you are including and which parts you are not counting. Make your drawing as clear as you can for other people to understand.

Group problem solving

In this type of activity, each group is given a set of cards. Each card contains either the statement of a problem or a clue to solving the problem. The cards are dealt round the group, face down. Some children may get more than one card. The group has to solve the problem together but no one may show their card(s) to anyone else. They therefore have to read the problem and the clues aloud or explain them to the rest of the group.

1

The problem:

There are 3 shapes in a row.

What are they and what colour?

The cube is in the middle.

The pink shape is not the pyramid.

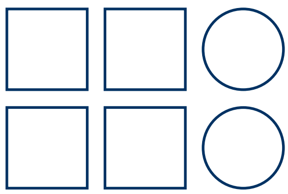
The red shape is next to the pyramid.

The cone is not blue.

2

The problem:

What colour is each shape?



Red is not next to grey.

Blue is between white and grey.

Green is not a square.

Blue is above pink.

3

The problem:

You need 2 each of red, green, blue, yellow and brown cubes.

Build a tower of 6 cubes.

The blue cube is directly below a yellow cube.

One red cube has only one other cube touching it.

Both red cubes are below the brown cube.

The green cube is above the yellow cube.

The green cube is between the two red cubes.

4

The problem:

Joy, Ram, Pat and Eva each have a different shape. Who has which shape and what is its colour?

One of the shapes is a cube.

One of the shapes is red.

Eve's shape is a cone. The cone is not blue.

Joy's shape is yellow. It is not the sphere.

Pat's shape is not the green cylinder.

Shape and space activities to promote discussion

Greetings: Year 1

Objectives

- Use everyday language to describe features of 2-D shapes, positions, directions and movements
- Make and describe patterns and pictures using everyday materials

You will need

For each pair of children, an old greetings card cut into interesting shapes (not too many)
For the follow up, more old cards and some scissors

Organisation

Within a larger group, children should work in pairs, sitting side by side.

What to do

Take the picture from an old greetings card, one for each pair of children. Cut the picture into not too many pieces, using wavy or zig-zag lines to make interesting shapes. Give the shuffled pieces to a pair of children. One child, who must not touch the pieces, gives instructions so that the other child can complete the 'jig-saw'.

As a follow-up activity, give each pair of children another old card, a pencil and some scissors, to make another jigsaw. They can then shuffle the pieces and give them to another pair to put together again. Higher attainers can be given two cards cut up and shuffled together. Lower attainers can assemble cards made from fewer pieces.

Vocabulary

shape, flat, curved, straight, square, round, pointed, side, edge, middle, corner,
top, bottom, under, over, above, beside, next to, below, up, down, right, left,
move, turn, slide, fit

Questions to ask

- What might the picture or pattern be? Tell me about it.
- How many pieces are there? How many pieces have square corners?
- How could you sort the pieces?
- What other ways of sorting the pieces are there?
- What pieces would fit in the corner ... or go round this point?
- What sort of edge would fit here?
- What shape is your whole jigsaw?

Shapes from cubes: Year 2

Objectives

- Make and describe 3-D shapes
- Use mathematical vocabulary to describe position and visualise objects in given positions

You will need

Interlocking cubes
Large thin books to act as screens
Pictures or diagrams of simple 3-D shapes made from coloured cubes

Organisation

This activity works well with a group of up to 8 to 10 children.

What to do

You need some interlocking cubes, such as Multilink, and a large thin book to make a screen between you and your children. Place a few cubes on your own side of the screen and put the rest where the children can reach them. Make a shape from three or four cubes. Keep it hidden on your side of the screen. Explain how you made your shape, cube by cube, so that the children can make one exactly the same as yours. For example: *Take a green cube. Put a second green cube on top of it. Put a yellow cube to the right of the top green cube. Put a red cube behind the yellow cube.* When they have finished, the children can compare their shapes with yours.

To follow up, children can continue by working in pairs, one making an interesting hidden shape for the other to replicate. Alternatively, draw a picture or diagram of a 3-D shape for children to assemble.

Vocabulary

one, two, three ... first, second, third ...
position, top, bottom, side, middle, corner, over, under, underneath, above, beside, next to, below, right, left, in front, behind, opposite, between
cube

Questions to ask

- Are our shapes the same? If not, how are they different?
- On my shape, which cube is in front of the red cube?
- If I turn the shape like this, where is the yellow cube now?
- How many faces does my shape have?
- Can you count the edges with me?

Peek-a-boo: Year 3

Objectives

- Identify lines of symmetry in simple shapes, and recognise shapes with no line of symmetry
- Identify right angles

You will need

Assorted 2-D shapes, including semicircles, stars
Large thin books to act as screens
For the follow up, pencil and paper

Organisation

This activity works best with a group of about 6 children, so that they do not have to wait too long between turns.

What to do

You need a box of assorted flat shapes and a large book to make a screen between you and the children. Choose a shape without letting the children see it, and show a tiny part of it above the screen, perhaps a corner or an edge. Ask the children to take turns to guess what the shape might be. Each time anyone makes a guess, they must say why they think it might be that shape before being told yes or no. After each guess, take the shape down behind the screen and turn it round so that a different part is showing.

To follow up, children can carry on, working in pairs. Or one child might draw a picture of a hidden shape from an oral description given by the other. A simplified task would be to draw and label all the shapes used.

Vocabulary

names of shapes
angle, right angle, right-angled
vertex, vertices
curved, straight, side, edge, top, bottom
symmetrical, line of symmetry

Questions to ask

- What might the shape be? Why do you think that?
- What other shape could it be? Why?
- Is there a right angle showing?
- Is that angle greater or less than a right angle?
- Is the part of the shape that you can see symmetrical?
- Is the whole shape symmetrical? How many lines of symmetry does it have?

Picture gallery: Year 4

Objectives

- Describe and visualise 2-D shapes
- Recognise equilateral and isosceles triangles
- Recognise positions and directions
- Make clockwise and anti-clockwise turns

You will need

For each pair, a card with a simple picture or pattern made from some 2-D shapes such as these, all in the same colour.
At least two of each shape for each pair.

Organisation

Children should work in pairs, sitting side by side at a table.

What to do

One child should take a card, hiding it from his or her partner. Without touching any of the pieces, this child should give instructions to enable the other to assemble the picture. Once complete, the arrangement can be compared with the picture on the card. Higher attainers might be asked to give instructions to make the mirror image of the picture. Lower attainers can be given pictures with fewer shapes.

To follow up, individual children can create a simple picture, then write a set of instructions for a partner to assemble without seeing the picture.

Vocabulary

names of shapes
position, top, bottom, side, middle, corner, over, under, underneath, above, beside, next to, below, right, left, in front, behind, opposite, between
right angle, 45°, 30°, turn, rotate, flip, reflect, slide, translate

Questions to ask

- Where should that piece go in relation to the ...?
- How can that piece be moved into the right position? Should it be... rotated or reflected? ... rotated through 90º?... or through 45º?... clockwise?... or anti-clockwise?
- About how many centimetres should you slide that piece? In what direction?
- How are instructions best worded to be really helpful?

Symmetrical shapes: Year 5

Objectives

- Recognise reflective symmetry
- Recognise parallel and perpendicular lines
- Identify different nets for an open cube

You will need

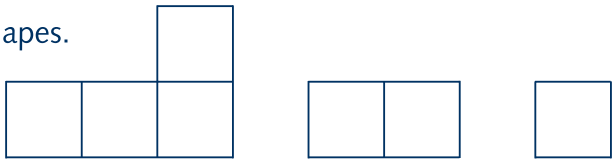
Pencil and squared paper for each pupil

Organisation

Introduce the activity to the whole group. Continue by working in pairs.

What to do

Show the children a picture of these three shapes.



Ask them to imagine the pieces arranged in a symmetrical shape. The children should then sketch their symmetrical shapes on squared paper, and then share what they have done with a partner. Using the questions below discuss the shapes they have made.

To follow up, perhaps in the next lesson, find out how many different shapes you can make from five squares that touch edge to edge. (12) How many of these shapes have at least one line of symmetry? (6) How many could be folded to make an open cube? (8) Find ways to sort the shapes you have made.

Vocabulary

axis of symmetry
parallel, perpendicular
net

Questions to ask

- Can you describe your shape to your partner? How many axes of symmetry has it?
- What other symmetrical shapes can you make from the shapes?
- Which have line symmetry?
- Can you identify a pair of parallel sides in your shape? A pair of perpendicular sides? Are there any others?
- What can you do to check whether each shape is new or a repeat of a previous one?

Overlaps: Year 6

Objectives

- Describe and visualise properties of 2-D shapes
- Recognise quadrilaterals

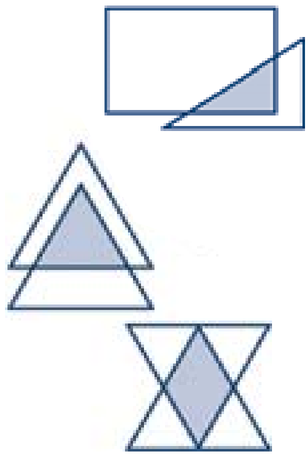
You will need

Shapes to demonstrate with, preferably made from transparent film to use with an overhead projector. Alternatively, sketch the shapes on the board. For the follow up each pair of pupils will need two card squares, tracing paper, scissors, plain paper and pencil.

Organisation

Do this activity with a group of 8 to 10 children.

What to do



Take a rectangle and a triangle. Using the OHP, show one shape placed over the other. Tell the children that when two shapes overlap each other, a third shape is made. Discuss the 'overlap' shape you have made, and its properties. Now ask the children to imagine two equilateral triangles overlapping to make a triangle. Are there different ways of doing it? What about making a rhombus? A hexagon? Invite different children to demonstrate their ideas on the OHP.

To follow up, ask the group to investigate what overlap shapes they can make with two squares. What quadrilaterals can be made? Are there any special quadrilaterals that cannot be made?

Vocabulary

names of shapes, particularly different quadrilaterals and triangles
parallel, perpendicular, acute, obtuse

Questions to ask

- How could two equilateral triangles overlap to make another equilateral triangle? Are there other ways of doing it?
- What other types of triangle could you make?
- Can you make a triangle with an obtuse angle? With three acute angles?
- What if you rotate, reflect or slide the top triangle?
- Can you make an overlap shape with four sides? A different shape with four sides? A shape with five sides? Six sides?
- What if the two triangles were right-angled?
- What if you used a rectangle and a triangle?

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