White Rose Maths

Properties of Shape

Overview

Small Steps

Recognise 2-D and 3-D shapes

Count sides on 2-D shapes

Count vertices on 2-D shapes

Draw 2-D shapes

Lines of symmetry

Sort 2-D shapes

Make patterns with 2-D shapes

Count faces on 3-D shapes

Count edges on 3-D shapes

Count vertices on 3-D shapes

Sort 3-D shapes

Make patterns with 3-D shapes

NC Objectives

Identify and describe the properties of 2-D shapes, including the number of sides and line symmetry in a vertical line.

Identify and describe the properties of 3-D shapes, including the number of edges, vertices and faces.

Identify 2-D shapes on the surface of 3-D shapes, [for example, a circle on a cylinder and a triangle on a pyramid.]

Compare and sort common 2-D and 3-D shapes and everyday objects.

Recognise 2-D and 3-D Shapes

Notes and Guidance

Before learning about their properties, children need to recognise and name both 2-D and 3-D shapes and to be able to differentiate between them. They begin to understand that 2-D shapes are actually flat and the manipulatives they handle in class are representations of the shapes. Children also need to be able to recognise 2-D shapes in different orientations and proportions.

Mathematical Talk

What is the difference between a 2-D and 3-D shapes?

What shape is this? If I turn it around, what shape is it now?

Can you draw around any of the faces on your 3-D shapes? Which 2-D shapes can you make?
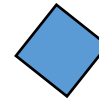
Varied Fluency

Match the names of the shapes to the pictures.

Square   Triangle   Rectangle   Circle

Put a combination of 3-D shapes in a feely bag. Can you find the cube, the cone, the cylinder? What do you notice about each shape?
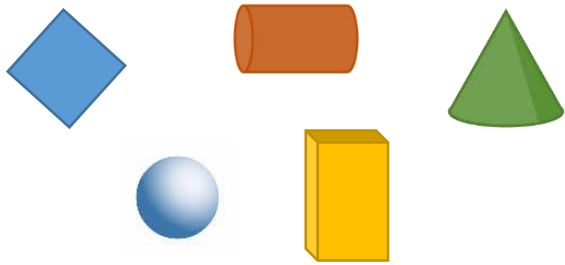
How did you know that was the right shape?

What were you feeling for?

Go on a shape hunt around school.
Create a tally of the shapes you see.
Can you see any pentagons?
Can you see any octagons?
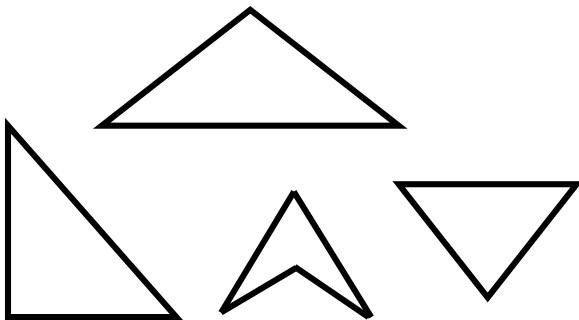Can you see any hexagons?
What was the most common shape?

Reasoning and Problem Solving

Which shape is the odd one out? Explain why.

The square is the odd one because it is the only 2-D shape or flat shape.

Which shape is the odd one out? Explain your reasoning.

Three of the shapes are triangles, one is not. Three of them have three sides, one has four.

Other answers can be accepted with a clear explanation.

I'm thinking of a 2-D shape with more than 3 sides.

What shape could Whitney be thinking of?
Are there any other shapes it could be?
What shape is Whitney definitely not thinking about? How do you know?

Use true or false to say which shapes are triangles.

Possible examples:
square
rectangle
pentagon
hexagon
octagon
Whitney is not thinking of a triangle because it only has 3 sides.
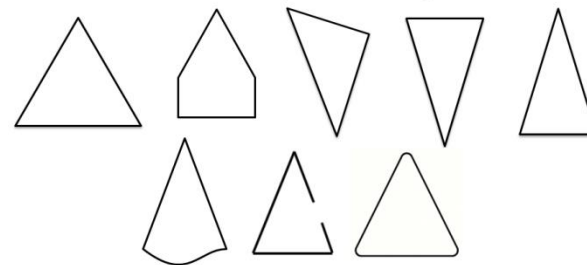
True, false, true, true, true, false, false, false

Count Sides on 2-D Shapes

Notes and Guidance

Children should be encouraged to develop strategies for accurate counting of sides, such as marking each side as it has been counted.

Children also need to understand that not all same-sided shapes look the same, such as irregular 2-D shapes.

Mathematical Talk

What is a side?

How can you check that you have counted all the sides?

Do all four-sided shapes look the same?
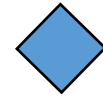
Why do you think the shapes have the names that they do?

Varied Fluency

Match the shapes to the number of sides.
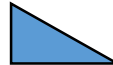
Six   Four   Three

Colour the four-sided shapes.
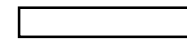
Complete the table.

Name	Shape	Number of sides
Pentagon		
Rectangle		
Square		
Triangle		
Hexagon		

Count Sides on 2-D Shapes
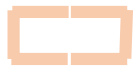
Reasoning and Problem Solving

Here are 18 lollipop sticks.
How many hexagons can you make?

How many octagons can you make?

What other shapes can you make with 18 lollipop sticks?

Using one stick per side:
3 hexagons, 2 octagons with 2 lollipop sticks spare, 6 triangles, 4 squares or 3 pentagons.
May also create shapes with more than one stick on each side.

Mo makes a rectangle using the sticks.

How many identical rectangles could he make with 18 sticks?
Make your own rectangle. How many sticks did you use? Is your rectangle the same as your friend's?

Mo could make 3 rectangles using 6 sticks.
Talk about how rectangles can look differently.

If I put these shapes into order from the smallest number of sides to the largest, which shape would come third?
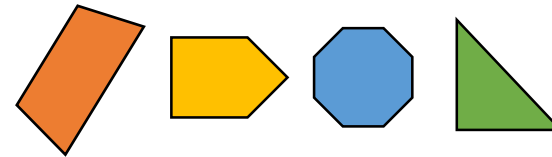
Where would a hexagon come in the list? Why?

triangle, quadrilateral, pentagon, octagon

The pentagon would be third.

A hexagon would come after the pentagon and before the octagon because it has 6 sides which is more than 5 and less than 8.

Count Vertices on 2-D Shapes

Notes and Guidance

Children are introduced to the terms vertex and vertices. They understand that a vertex is where two lines meet at a point. They recognise that corners are vertices and will be able to identify and count them on shapes.

Ensure from this point forwards the word vertex is used in place of corner throughout all content.

Mathematical Talk

Show me a vertex.

Can you identify the vertices in this shape?

Would this be a vertex? Explain why.

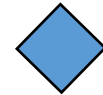If my shape has ____ vertices, what could my shape be?

What couldn't it be?

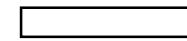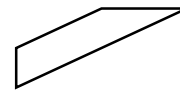## Varied Fluency

Match the shapes to the number of vertices.
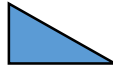
Six   Four   Three

Colour the shapes with 4 vertices.

Complete the table.

Name	Shape	Number of vertices
Pentagon		
Rectangle		
Square		
Triangle		
Hexagon		

Count Vertices on 2-D Shapes
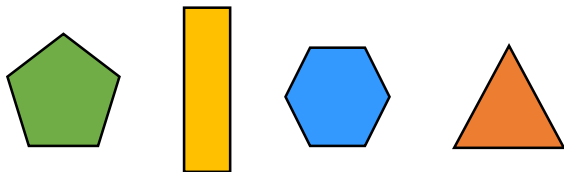
Reasoning and Problem Solving

Amir says:

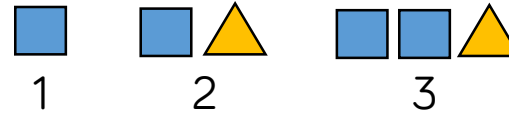My shape has half the number of vertices as an octagon.

What shape could he have?

Square
Rectangle

Put these shapes in order based upon the number of vertices they have.

Triangle, rectangle, pentagon, hexagon

Jack has created a pattern using shapes.

1   2   3

How many vertices does each step in the pattern have?

What do you notice?

Can you predict how many vertices the next step in the pattern will have?

Is there more than one way to continue the pattern?

Can you create your own pattern and explore how the vertices change?

Possible answer: 4, 7, 11

The next step could have another square (15 vertices) or another triangle (14 vertices).

Draw 2-D Shapes

Notes and Guidance

Children use their knowledge of properties of shape to accurately create 2-D shapes. Children could use geo-boards to make shapes with elastic bands and look carefully at the number of sides and vertices.

Using geo-boards is a practical step to take before children draw their own shapes on dotted or squared paper.

Mathematical Talk

Compare your shape with a friend's shape. Is it in the same position? Is it the same size?
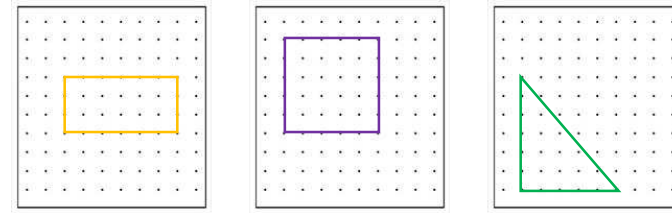
Where are you going to start drawing the shape?
In the middle of a side? At a vertex?
Which is the most efficient way?

Why is it important to use a ruler?

Is your shape an exact copy? How do you know?

Varied Fluency

Use a geoboard to make different 2-D shapes. Can you make a rectangle? Can you make a square? Can you make a triangle?

Can you draw a rectangle on dotted paper? Start at a vertex and use a ruler to draw your first straight side. How many straight sides will you need? Rotate the paper to help you draw the shape more accurately.
Try drawing other shapes in the same way.
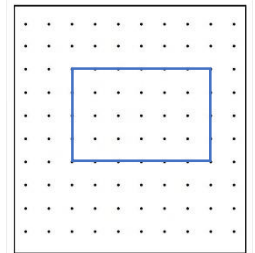
Choose a 2-D shape.
Build it on a geo-board.
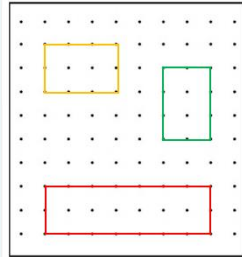Can you copy the shape onto dotted paper and squared paper?

Draw 2-D Shapes

Reasoning and Problem Solving

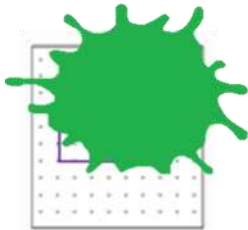Using geoboards, how many different rectangles can you make?

What's the same about the rectangles? What's different?

Has your friend made any different rectangles?

Possible answer:

What shape could be hiding under the spilt paint?

Prove your answer by drawing it.

Could be any 2-D shape.

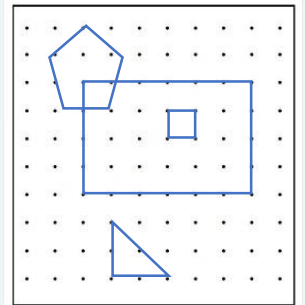Encourage children to think about irregular pentagons, hexagon, etc.

Draw a large rectangle on squared paper or dotted paper.

Draw a square inside the rectangle.

Draw a triangle below the rectangle.

Draw a pentagon that is bigger than the square.

Can you give instructions to your partner to help them draw different shapes?

Children may end up with a different picture from above however they should have four shapes drawn.

Lines of Symmetry

Notes and Guidance

Children are introduced to the concept of vertical lines of symmetry. They should be exposed to examples that are symmetrical and also examples that are not.

Children use a range of practical resources (mirrors, geoboards, paper folding) to explore shapes being halved along their vertical line of symmetry.

Mathematical Talk

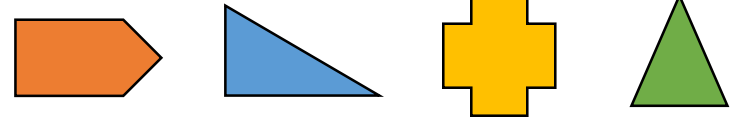Where is the vertical line of symmetry?

What does vertical mean?
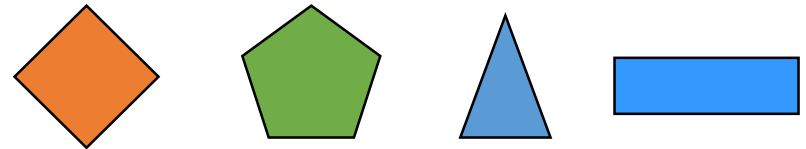
Which is the odd shape out? How do you know?

What resources could you use to check if a shape has a vertical line of symmetry?
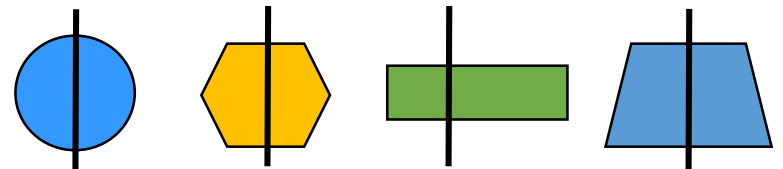
Varied Fluency

Can you fold these shapes to find a vertical line of symmetry?

Draw the vertical lines of symmetry on these shapes.

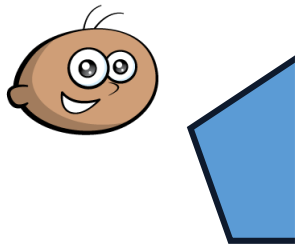Circle the shape with an incorrect line of symmetry. Can folding help you prove your answers.

Lines of Symmetry

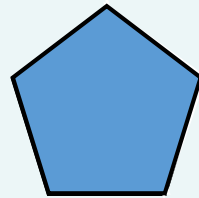# Reasoning and Problem Solving

Can you draw more than one four-sided shape that has a vertical line of symmetry?

Possible answers: square, rectangle, kite.

Tommy has placed a mirror on the vertical line of symmetry. This is what he sees:
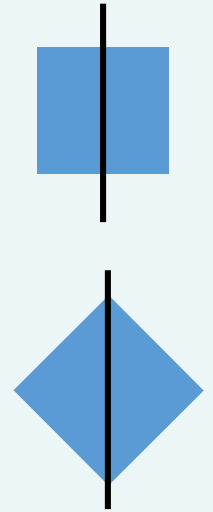

Can you complete the other half of the shape?

Which 2-D shapes can be made when a vertical line of symmetry is drawn on a square?

Rectangle and triangle.

Sort 2-D Shapes

Notes and Guidance

Children recognise and sort 2-D shapes including circle, square, triangle, rectangle, pentagon, hexagon and octagon using a range of different orientations.

Children should be encouraged to sort the shapes in more than one way. They can then describe how they have sorted them using key language including side, vertex and symmetrical.

Mathematical Talk

How have you sorted your shapes?

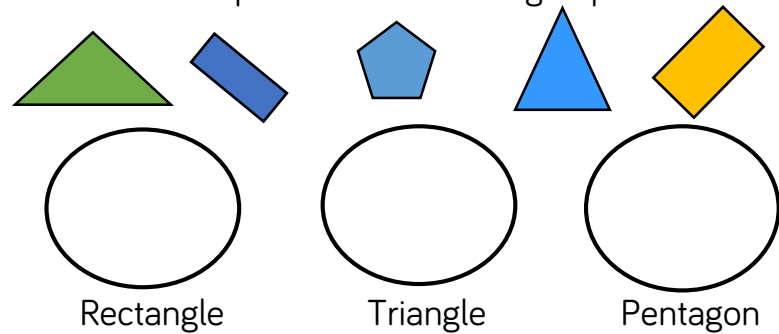How do you know you have sorted your shapes correctly?

Can you sort the shapes in a different way?
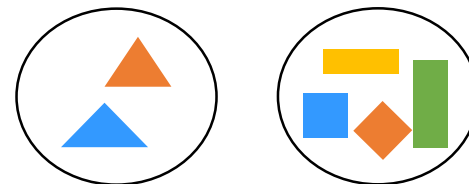
Can you find a shape which is in the wrong place?

Can you see how these shapes have been sorted?

Varied Fluency

Sort the 2-D shapes into the correct group:

Rectangle   Triangle   Pentagon

How have the shapes been sorted?

Whitney sorted her shapes by the number of sides.
What shapes could belong to each group?

4 sides	Not 4 sides

Sort 2-D Shapes

Reasoning and Problem Solving

Ron sorted the shapes in order of the number of sides. Has he ordered them correctly?
Explain why.

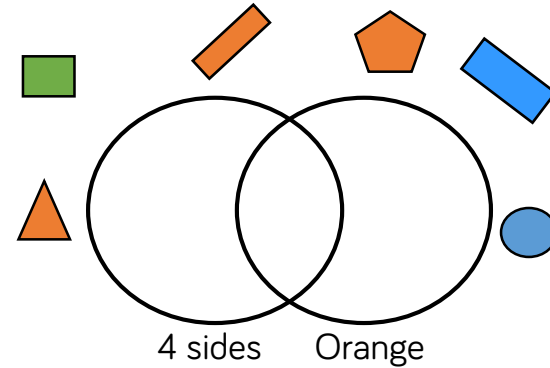No because the square should be before the pentagon.
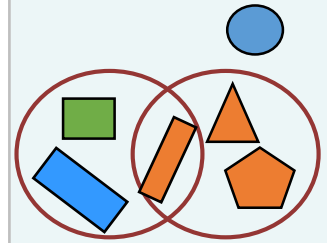
Which shape is in the wrong set?
Explain why.

Vertical line of symmetry	No vertical line of symmetry

The circle is in the wrong set because it does have a vertical line of symmetry.

Where should these shapes go in the Venn diagram?

4 sides   Orange

Create your own labels and sort the shapes in a different way.

Possible labels:
Blue
Less than 4 vertices.

Make Patterns with 2-D Shapes

Notes and Guidance

Children use their knowledge of the properties of 2-D shapes to create patterns.

They are encouraged to place the shapes in different orientations when making patterns and recognise that it is still the same shape. In particular, squares do not become diamonds when turned sideways.

Mathematical Talk

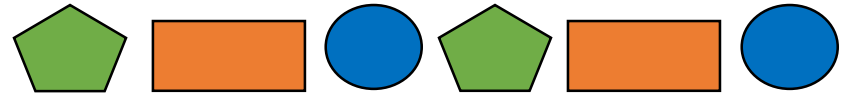Can you explain the pattern? How does circling the set of shapes that repeat help you see the pattern?

Continue the pattern. Which shape will be next?

How are these patterns similar? How are these patterns different?

How can you work out which shape will come __th ?
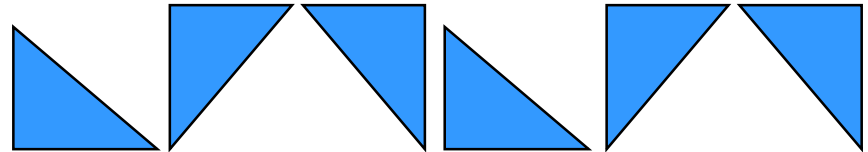
Varied Fluency

Continue this pattern:

Can you circle the set of shapes that repeat?

What is the next shape in the pattern? What is the 9th shape in the pattern?

Draw pictures to represent this pattern:

Square, circle, triangle, triangle, square, circle, triangle, triangle.

How many times does the pattern repeat?
Which shape would be 10th?

Can you make your own repeating patterns using only one shape?

# Make Patterns with 2-D Shapes

Reasoning and Problem Solving

Dora says that the 12th shape in this pattern will be a triangle.

Is she correct?
How do you know?

The 12th shape will be a triangle. Children may physically continue the pattern to find the answer or recognise that the triangle is the 3rd and count in 3s.

How many different ways can you arrange these shapes to make a repeating pattern?

Can you translate this pattern using shapes?

Clap, clap, snap, clap, clap, snap, clap, clap ……
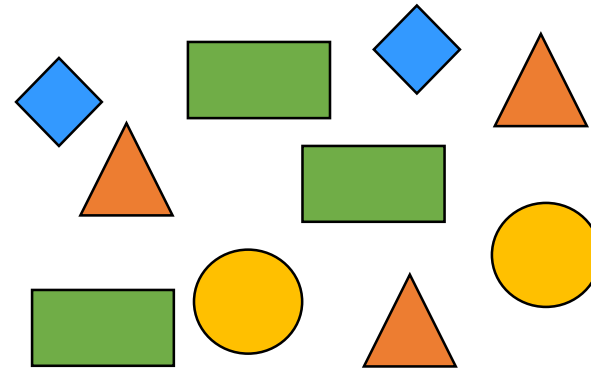
There are many ways to make different repeating patterns. Encourage children to orally describe the pattern they have created.

Possible answer:

Square, square, triangle or pentagon, pentagon, circle.

Count Faces on 3-D Shapes

Notes and Guidance

Children use their knowledge of 2-D shapes to identify the shapes of faces on 3-D shapes. To avoid miscounting the faces children need to mark each face in some way. Children identify and visualise 3-D shapes from 2-D representations. Cones should be described as having 1 face and 1 curved surface; cylinders as having 2 faces and 1 curved surface and spheres having 1 curved surface.

Mathematical Talk

What do we mean by the 'face' of a shape?

What is the difference between a face and a curved surface?

What real life objects have 6 faces like a cube?

Does a cuboid always have 2 square faces and 4 rectangular faces?

Which 2-D shapes can you see on different 3-D shapes?

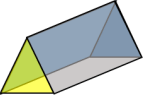How can you make sure that you don't count the faces more than once?

Varied Fluency

Look at these 3-D shapes:
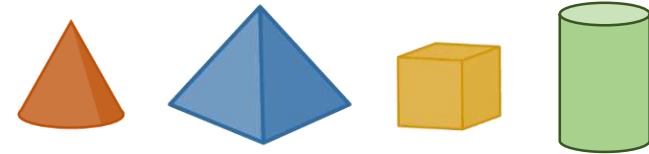
Which 2-D shapes can you see on the surface of each one?

Complete the table:

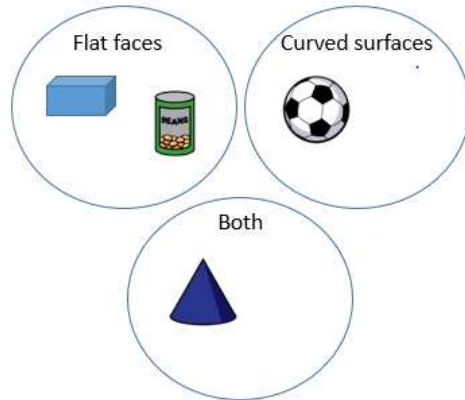| Shape	Name of shape	Number of flat faces	Draw the faces

Reasoning and Problem Solving

Teddy says my 3-D shape has 6 faces.

Mo says he must have a cube.

Is Mo correct?

Explain your answer.

No because Teddy could have a cube or a cuboid.

Annie has sorted these 3-D shapes.

Can you spot her mistake?

Can you add another shape to each set?

The can should be in the 'both' set because it has flat faces and a curved surface.

Flat faces

Curved surfaces

Both

Whitney says,

I have a 3-D shape with 2 square faces and 4 rectangular faces.

What shape does Whitney have?

Play this game with a friend. Describe the faces of a 3-D shape and they need to guess what it is.

Whitney has a cuboid.

Count Edges on 3-D Shapes

Notes and Guidance

Children use their knowledge of faces and curved surfaces to help them to identify edges on 3-D shapes. They learn that an edge is where 2 faces meet or where a face and a curved surface meet. To avoid over counting the edges children need to mark each edge in some way. Children identify and visualise the 3-D shape from a 2-D representation.
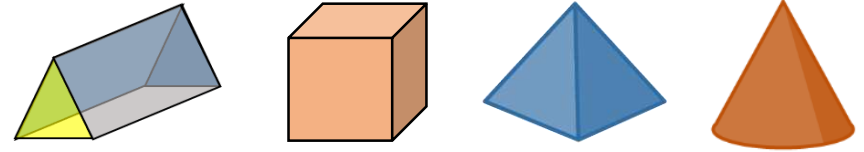
Mathematical Talk

What do we mean by the 'edge' of a shape?

How can you make sure that you don't count the edges more than once?
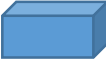
What do you notice about the shapes with ____ edges?

Varied Fluency

Look at these 3-D shapes:

How many edges does each shape have?

Complete the table:

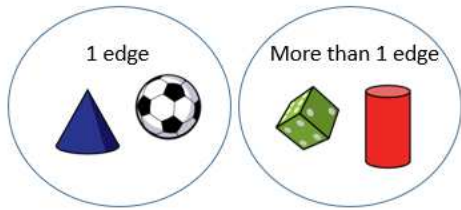| Shape	Name	Edges	Faces

How many edges does this shape have?

Count Edges on 3-D Shapes

Reasoning and Problem Solving

Ron has sorted these shapes according to the number of edges.
Which shape is in the wrong place?
Explain why.

The sphere (football) is in the wrong place because it doesn't have any edges, it has one curved surface.

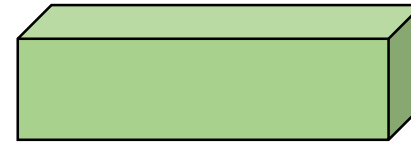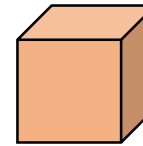Eva says her 3-D shape has 12 edges.

Dora says she could have a cube, cuboid or square-based pyramid.

Is Dora correct?
Explain your answer.

Dora is not correct, because a square-based pyramid has 8 edges.

Compare these 3-D shapes.

What is the same and what is different?

Same – both have square faces, 6 faces, 12 edges, don't roll, can stack, no curved edges.

Different – name, colour, size, one only has square faces the other has squares and rectangles….

Count Vertices on 3-D Shapes

Notes and Guidance

Children use their knowledge of edges to help them to identify vertices on 3-D shapes. They understand that a vertex is where 2 or more edges meet. To avoid over-counting the vertices children need to mark each vertex in some way.

The point at the top of a cone can be referred to as an apex or a vertex.

Mathematical Talk
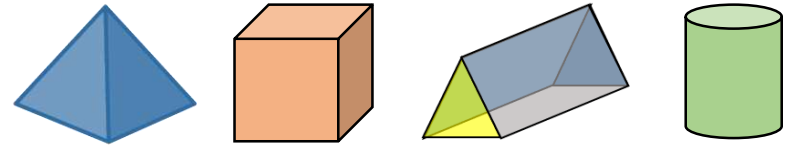
What is the difference between vertex and vertices?

How can you make sure that you don't count the vertices more than once?

How many edges meet to make a vertex on a 3-D shape?

How many sides meet to make a vertex on a 2-D shape?

Varied Fluency

Look at these 3-D shapes:

How many vertices does each shape have?

Complete the table:

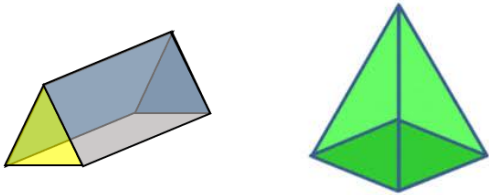| Shape	Name	Faces	Edges	Vertices

Place 3-D shapes in order starting with the shape with the fewest vertices.

Count Vertices on 3-D Shapes

Reasoning and Problem Solving

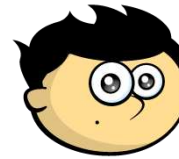What is the same about these 2 shapes?

What is different about them?
Talk about faces, edges and vertices in your answer.

Example answer:

Same – both have a triangular face, both have 5 faces.

Different – name, colour, size, one has 6 vertices the other has 5 vertices, one has a rectangular face, one has a square face….

Jack says:

All 3-D shapes have at least one vertex.

Is this true or false?
Explain why

False.

A sphere has no vertices.

Could also be an opportunity to talk about the words apex and vertex.

Alex has a shape with 8 vertices.

What 3-D shape could it be?

Cube or cuboid.

Sort 3-D Shapes

Notes and Guidance

Children use their knowledge of shape properties to sort 3-D shapes in different ways e.g. faces, shapes of faces, edges, vertices, if they roll, if they stack…

They should have access to a range of real life objects to sort and compare. Before sorting it may be useful to give children the opportunity to match the object e.g. a can of pop to a cylinder etc.

Mathematical Talk

How have you sorted your shapes?

How do you know you have sorted your shapes correctly?

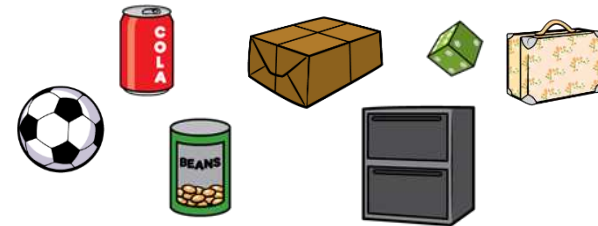Which method have you used to sort your shapes?

Can you sort your shapes in a different way?

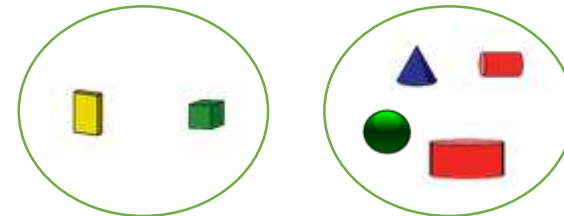Can your friend guess how you have sorted them?

Can you group your solids by shape, type of faces and size?

Varied Fluency

How could you sort these objects?
Can you find some other classroom objects to add to each set?

How are these shapes grouped?
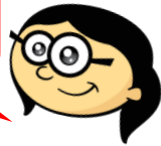

Could you group them in a different way?

Sort the 3-D shapes on your table.
Label the groups.
Can you find more than one way?
Remove the labels. Can someone guess how you sorted?

Sort 3-D Shapes

Reasoning and Problem Solving

Annie is sorting 3-D shapes.
She puts a cube in the cuboid pile.

A cube is a type of cuboid.
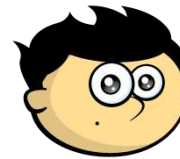
Do you agree? Why?

Annie is right.

They both have 6 faces.
They both have 12 edges.

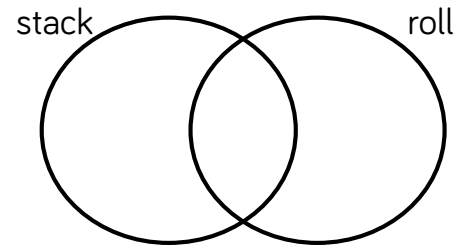A cube is a special kind of cuboid where all faces are squares.

Jack is investigating which shapes stack and which shapes roll.

He says:

Some shapes will stack **and** roll.

Is he correct?

stack   roll

Sort your shapes using the Venn diagram.
Explain what you notice about each set.
Do all shapes with flat surfaces stack?

Some shapes with flat faces will stack – they will need to have flat faces on opposite sides. (cubes, cylinders, cuboids)

Shapes with a curved surface will roll. (cone, sphere, cylinder)

Some shapes with a flat face cannot be stacked (square based pyramid, cone)

Make Patterns with 3-D Shapes

Notes and Guidance

Children use their knowledge of the properties of 3-D shapes to create patterns. They are encouraged to place the shapes in different orientations.

A wide range of examples of shapes should be used, including, construction shapes, cereal boxes, different sized balls etc.

Mathematical Talk

Where can you see real life patterns with 3-D shapes?

Can you explain your pattern to a partner?

Does the shape always have to be a certain way up?

Can you work out what shape would be the ___th?

Varied Fluency

Use some different coloured cubes to make a repeating pattern. Can you describe the pattern to your partner?

Using colours? Using letters? Using sounds?

Make a sequence of 3-D shapes.

Can you build a similar pattern with real life objects?

You could use food cans, boxes, balls, or other things in your classroom. Describe the pattern.

How many times does the pattern repeat?
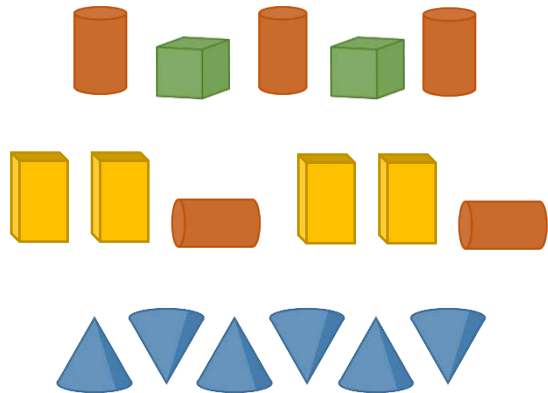What will the 10th cylinder look like?
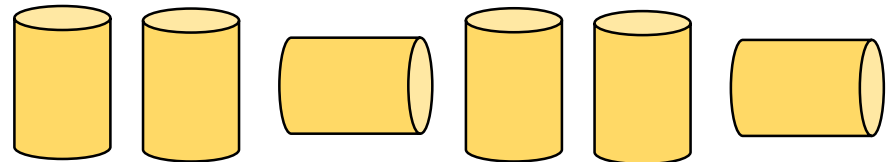
Can you make your own repeating patterns using only one 3-D shape?

Make Patterns with 3-D Shapes

Reasoning and Problem Solving

What is the same about these patterns?
What is different about these patterns?

The first and second patterns use two shapes. Colour is a difference to note. In the 3rd pattern, one shape is used in different orientations. In the 2nd pattern, the shape is used twice each time.

Choose two 3-D shapes.
What different repeating patterns could be made?

Possible answer:
Cube, cylinder, cube….

Cube, cube, cylinder…

Using the 3-D shapes:
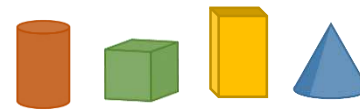
- Make a repeating pattern where there are more cones than cuboids.
- Make a repeating pattern where the third shape is always a cylinder.

Answer will depend on the shapes used.

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