Released November 2017

Years 5/6

Small Steps Guidance and Examples

Block 5: Perimeter & Area

White Rose Maths

Overview

Small Steps

Year 5	Year 6
	Shapes - same area
Measure perimeter	Area and perimeter
Calculate perimeter	
Find unknown lengths	
Area of rectangles	Area of a triangle (1)
Area of compound shapes	Area of a triangle (2)
Estimate and approximate area	Area of a triangle (3)
	Area of a parallelogram
What is volume?	Volume - counting cubes
	Volume of a cuboid

Shapes – Same Area

Notes and Guidance

Children will find and draw rectilinear shapes that have the same area.

Children will use their knowledge of factors to draw rectangles with different areas. They will use their knowledge of factors to then predict the length of sides.

Mathematical Talk

What do we need to know in order to work out the area of a shape?

Why is it useful to know your times tables when calculating area?

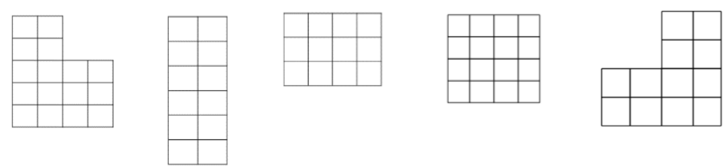
Can you have a square with an area of 48 cm²? Why?

How can factors help us draw rectangles with a specific area?

Varied Fluency

1. Sort the shapes into the Carroll diagram.

	Quadrilateral	Not a quadrilateral
Area of 12 cm²		
Area of 16 cm²		



Can you draw an extra shape in each section of the diagram?

2. How many rectangles can you draw with an area of 24 cm²?

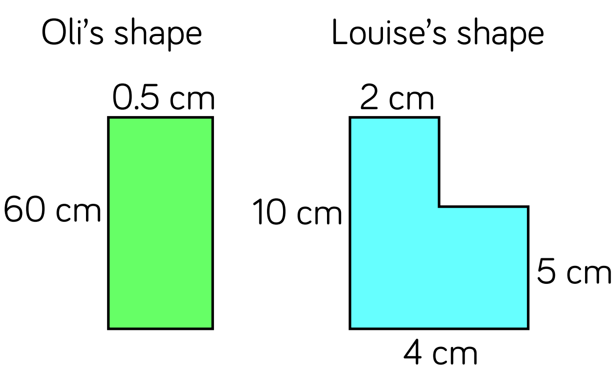
What do you notice about the lengths of their sides?

Can you use this information to calculate the lengths of sides for rectangles with an area of 96 cm²?

Shapes – Same Area

Reasoning and Problem Solving

Louise and Oli have are drawing shapes with an area of 30cm^2



Who is correct?

Explain your reasoning.

Both are correct.

Oli's shape

60 cm × 0.5 cm = 30 cm²

Louise's shape

2 cm × 10 cm

= 20 cm²

5 cm × 2 cm

= 10 cm²

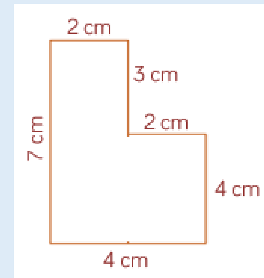
20 cm² + 10 cm² = 30 cm²

Three children are given the same shape to draw.

Kate says, "The smallest length is 2 cm."
Lucy says, "The area is less than 30 cm²"
Ash says, "The perimeter is 22 cm."

What could the shape be?

Possible answer:



Measure Perimeter

Notes and Guidance

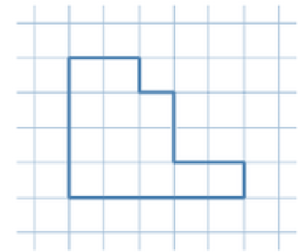
Children measure the perimeter of rectilinear shapes on a grid or by measuring with a ruler.
It is important that children measure all the sides of the shape and label them as they work round the shape to ensure they measure accurately.

Mathematical Talk

What rules do I need to remember to ensure I am measuring accurately with a ruler?
How can I make sure I don't miss any sides when measuring the perimeter?
Can I use facts about opposite sides of a rectangle to check if I am accurate with my measuments?

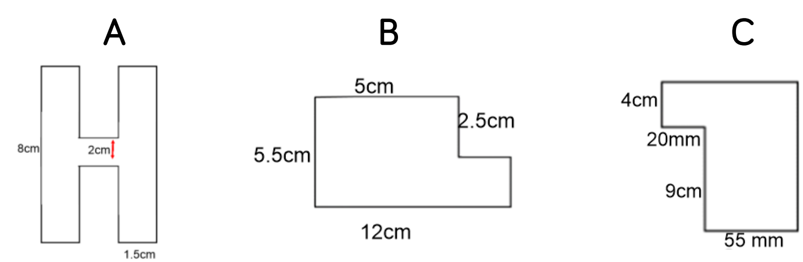
Varied Fluency

1. Here is a shape drawn on a cm^2 grid. Draw the shape to scale and find the perimeter.



2. Use a ruler to measure the perimeter of the shape.

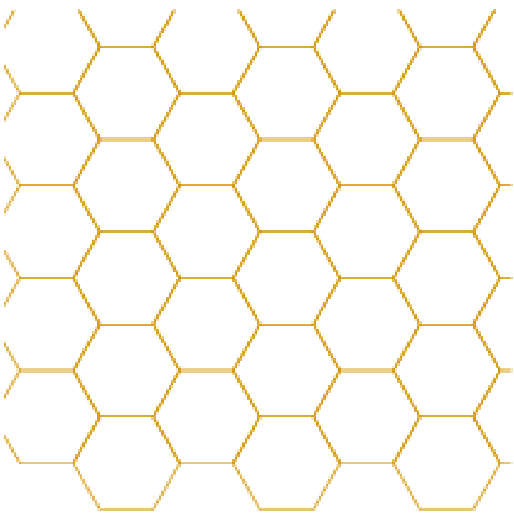
3. Draw the following shapes to scale and find the perimeter of each shape.
Order them from smallest to greatest



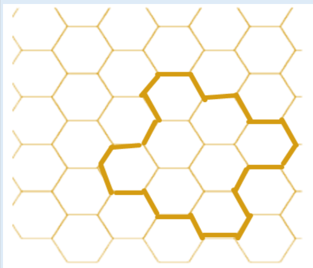
Measure Perimeter

Reasoning and Problem Solving

Each regular hexagon has sides measuring 2cm.
Can you construct a shape with a perimeter of 44cm?



Possible answer



Investigate the different ways you can make composite rectilinear shapes with a perimeter of 54cm.

Area and Perimeter

Notes and Guidance

Children should use a formula to work out the area and perimeter of rectilinear shapes.

Children explore that shapes with the same area can have the same or different perimeters.

Mathematical Talk

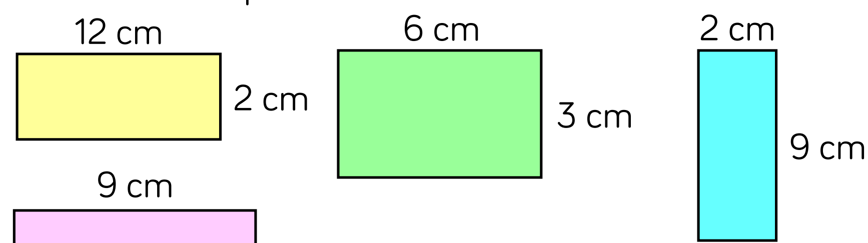
What is the difference between the area and perimeter of a shape?

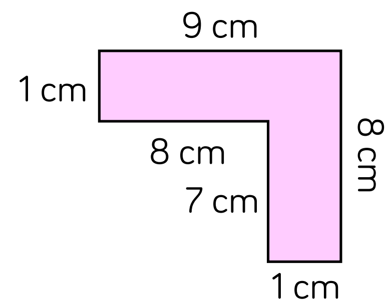
How do we work out the area and perimeter of shapes?
Can you show this as a formula?

Can you have 2 rectangles with an area of 36 cm^2 but different perimeters?

Varied Fluency

1. Look at the shapes below.

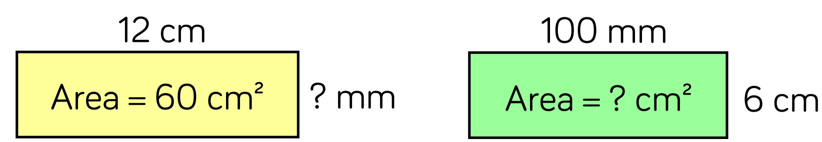




Do any of the shapes have the same area?

Do any of the shapes have the same perimeter?

2. Work out the missing values.



3. Draw two rectilinear shapes that have an area of 36 cm^2 but have a different perimeter.

State what the perimeter of each shape is.

Area and Perimeter

Reasoning and Problem Solving

True or false? Two rectangles with the same perimeter can have different areas. Explain your answer.	True e.g. 5 cm by 3 cm has an area of 15 cm^2 and a perimeter of 16 cm. 6 cm by 2 cm has an area of 12 cm^2 and a perimeter of 16 cm.

A farmer has 60 metres of perimeter fencing. For every $1m^2$ he can keep 1 chicken.  How can he arrange his fence so that the enclosed area gives him the greatest area?	The greatest area is created when the fencing is arranged into a 15 m by 15 m square, giving 225 m^2 Children may create rectangles by increasing one side by 1 unit and decreasing one side by 1 unit e.g. 16 m × 14 m = 224 m^2 17 m × 13 m = 221 m^2

Calculate Perimeter

Notes and Guidance

Children calculate the perimeter of rectilinear shapes where they are given all the lengths.
They use their addition skills to calculate the perimeter and use their number bonds to add more efficiently.
Children draw a variety of shapes with the same perimeter.

Mathematical Talk

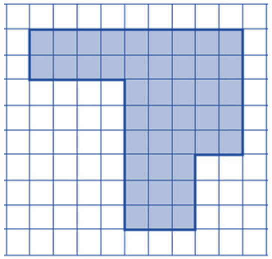
How can you ensure that you add up the length of every side?
Do you have to add them in a specific order, can you look for number bonds to add more efficiently?
Can you work systematically to draw a variety of shapes with the same perimeter?

Varied Fluency

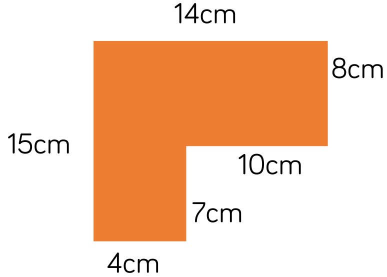
1. Here is a shape drawn on a centimetre squared grid.

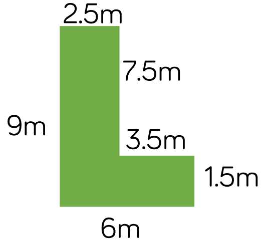
   Label the length of each side of the shape.

   Calculate the perimeter of the shape.



2. Calculate the perimeter of the rectilinear shapes.



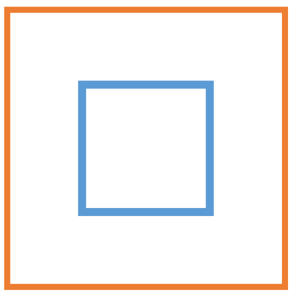


3. How many hexagons can you draw with a perimeter of 30cm?

Calculate Perimeter

Reasoning and Problem Solving

Here is a square inside another square.



The perimeter of the inner square is 16cm
The outer square's perimeter is four times the size of the inner square.

What is the length of one side of the outer square?

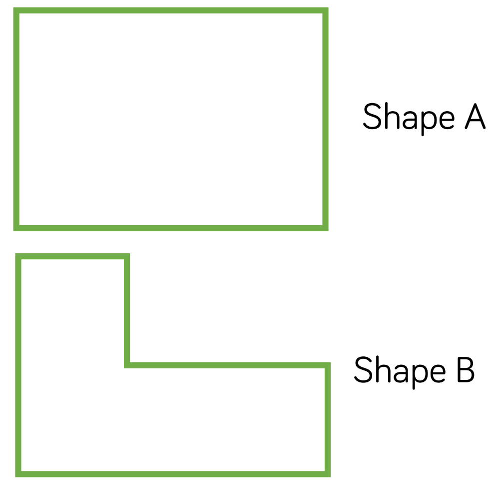
How do you Know? What do you notice?

Small square = 16cm

Large square = 64cm

Length of one of the outer sides is 8cm, because 64 is a squared number.

Here are two shapes.



Stacey says 'The perimeter of shape B must be larger because it has more sides.'

Do you agree with Stacey?

Explain your answer.

Possible explanation: I do not agree with Stacey because the shapes have the same perimeter. Shape B has the same length and width overall as Shape A, the sides are just in a different direction to make it an irregular hexagon.

Finding Unknown Lengths

Notes and Guidance

Children apply their knowledge of measuring and finding perimeter to find unknown lengths.

When calculating perimeter of shapes, encourage children to mark off the sides as they add them up to prevent repetition of counting/omission of sides.

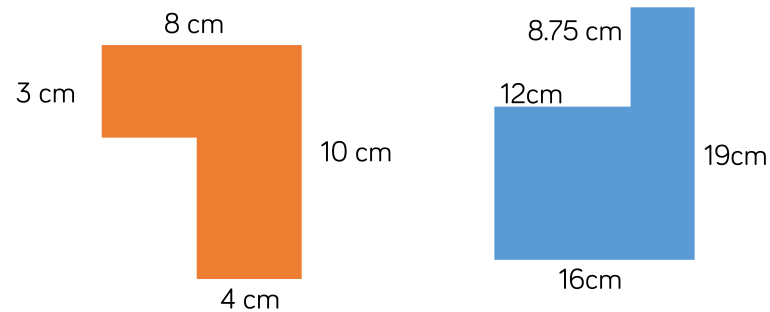
Mathematical Talk

How can you use the sides you do know to calculate the missing lengths?

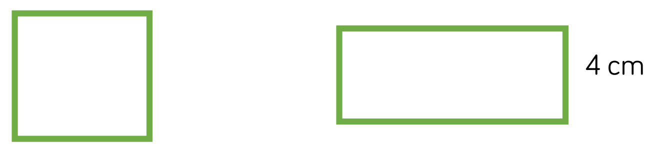
Can you draw the shape to scale on centimetre squared paper to help you find the unknown lengths?

Varied Fluency

1. Find the perimeter of the shapes.



2. A square and a rectangle both have a perimeter of $24cm^2$. Calculate the missing lengths.

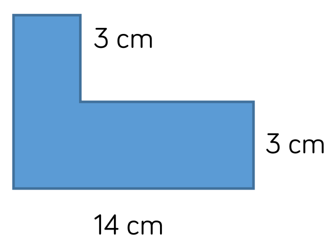


3. How many rectangles can you draw where the length and width have a difference of 5 centimetres? What is the perimeter of each rectangle?

Find Unknown Lengths

Reasoning and Problem Solving

Harry calculates the perimeter of the shape as 20 centimetres.



Is Harry correct?

Explain your answer.

Harry is incorrect as he has only added up the sides that are labelled. The perimeter of the shape is 40 centimetres.

The yellow rectangle has a perimeter of 38cm.

What is the value of a?

Total perimeter = 38cm

38 – (4.8 + 4.8) = 28.4

So 28.4 divided by 2 = 14.2cm

Area of Rectangles

Notes and Guidance

Children build on previous knowledge in Year 4 by counting squares to find the area. They then move on to using a formula to find the area.

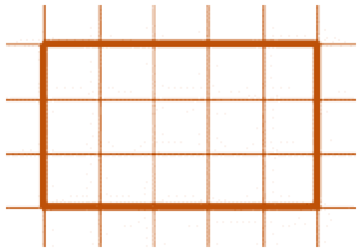
Mathematical Talk

What properties of these shapes do you need to know to help you work this out?
What can you tell me about the sides of a square/rectangle? How does this help you work out this question?
Show formula for area alongside examples:
Area = length x width

Varied Fluency

1. How many rectangles can you draw with an area of $\square$ cm^2?

2. What is the area of this shape if:
If each square is 2cm in length, what is the area of the shape?
If each square is 3.5cm in length, what is the area of the shape?



3. Simon buys a house with a small back garden, which measures $12m^2$. His house lies in a row of terraces, all identical. Simon's house lies in a row of 15 terraced houses. What is the total area of the garden space?

Area of Rectangles

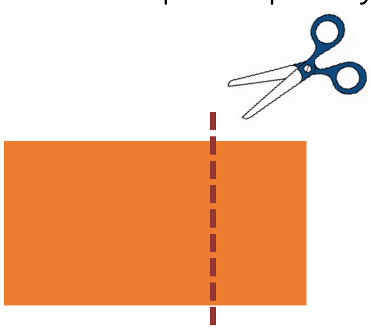
Reasoning and Problem Solving

Investigate how many ways you can make different squares and rectangles with the same area of $84cm^2$

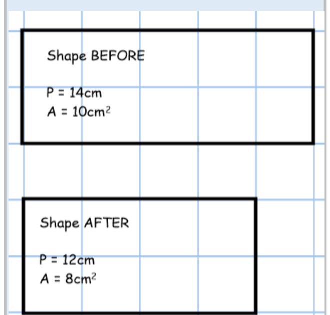
What strategy did you use?

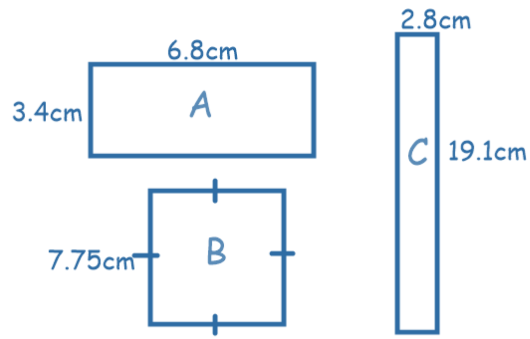
If you cut off a piece from a shape, you reduce its area and perimeter. True or False?

Draw 2 examples to prove your thinking.



Possible example:

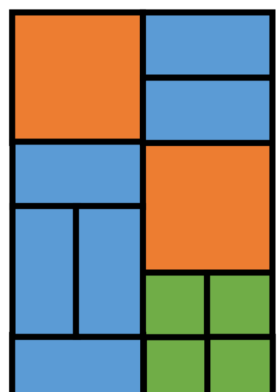




Approximate the area of each shape an then order from largest to smallest.

Answer: A = 3cm × 7cm = $21cm^2$
B = 8cm × 8cm = 64cm
C = 3cm × 19cm = $57cm^2$

Order: B, C, A



Each orange square has an area of $24cm^2$.
Calculate the total orange area.
Calculate the blue area.
Calculate the green area.
What is the total area of the whole shape?

Answer: Orange = $48cm^2$

Blue = $72cm^2$

Green = $24cm^2$

Total = $144cm^2$

Area of a Triangle (1)

Notes and Guidance

Children will use their previous knowledge of approximating and estimating to work out the area of different triangles by counting.
Children will need to physically annotate to avoid repetition when counting the squares.
Children will begin to see the link between the area of a triangle and the area of a rectangle or square.

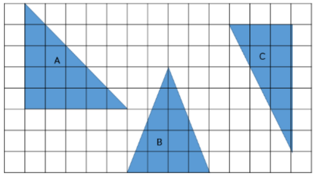
Mathematical Talk

How many whole squares can you see?
How many part squares can you see?
What will we do with the parts?

What does approximate mean?
Why will this be useful when working out the area of a triangle?

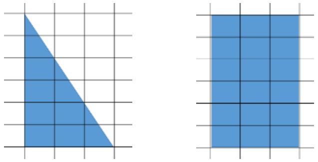
Varied Fluency

1. How could you calculate the area of each triangle?



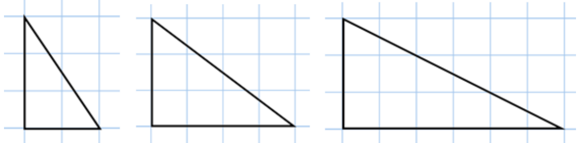
Which triangle has the largest area?

2. Calculate the area of the shapes by counting the squares.



What do you notice about the area of the triangle and the area of the rectangle?

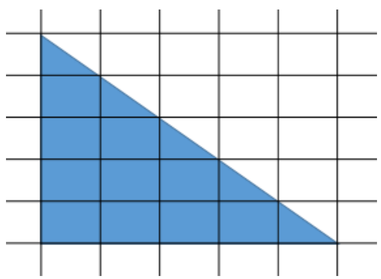
3. Find the area of each triangle.



Can you draw and calculate the area of the next triangle in the sequence?

Area of a Triangle (1)

Reasoning and Problem Solving



Simon says the area of this triangle is $13cm^2$

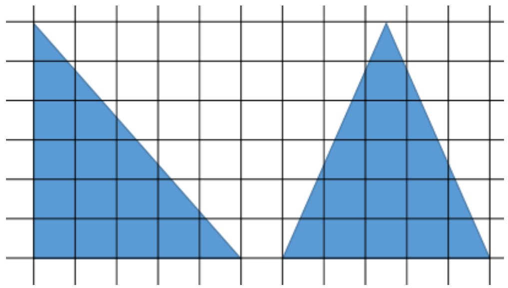
Is Simon correct?

If not, work out the correct answer and explain his mistake.

There are 10 whole squares and 5 half squares, therefore the correct answer is $12.5\ cm^2$

Simon has gone wrong because he has worked out that the 5 half squares make 3 whole squares instead of 2 and a half.

What is the same about these two triangles?
What is different?



Can you create a different right angled triangle with the same area?

Both triangles have an area of $15\ cm^2$

The triangle on the left is a right angled triangle and the triangle on the right is an isosceles triangle.

Children could draw a triangle with a height of 10 cm and a base of 3 cm, or a height of 15 cm and a base of 2 cm.

Area of Compound Shapes

Notes and Guidance

Children learn to calculate area of compound shapes. They need to apply their previous knowledge of area and the formula used. Children need to have experience of drawing their own shapes in this step.

Mathematical Talk

What formula do we use to find the area?

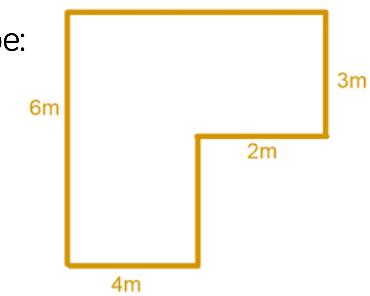
How can we split the compound shape?

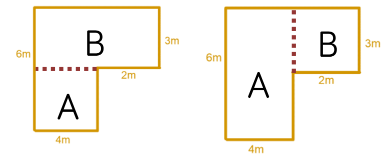
Is there more than one way?

Do we get a different answer if we split the shape differently?

Varied Fluency

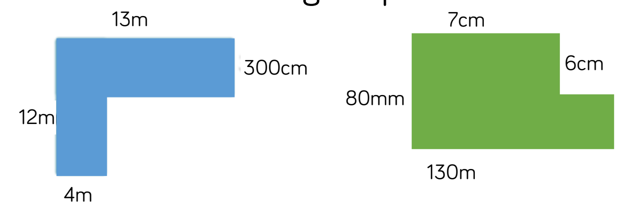
1. Find the area of the compound shape:
How many ways can we split the compound shape?
Is there more than one way?



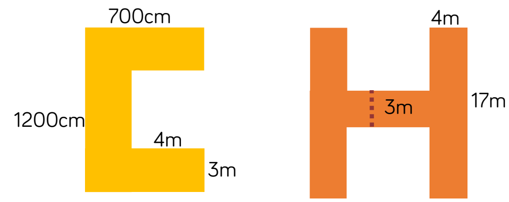


Could we multiply 6m × 6m and then subtract 2m × 3m?

2. Find the area of the following shapes:



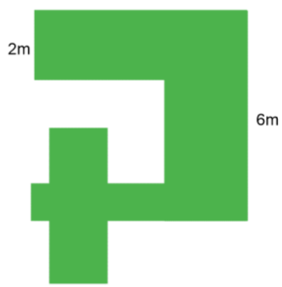
3. Find the area of the following shapes:



Area of Compound Shapes

Reasoning and Problem Solving

How many different ways can you split this shape to find the area?



Add more values and work out the area.

Possible solution:

A= 2m × 5m = $10m^2$

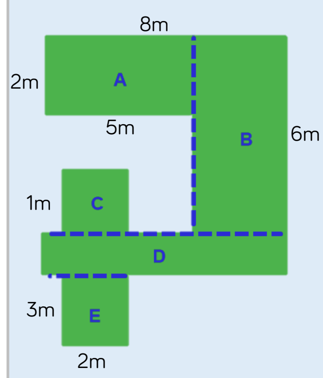
B= 6m × 3m = $18m^2$

C= 1m × 2m = $2m^2$

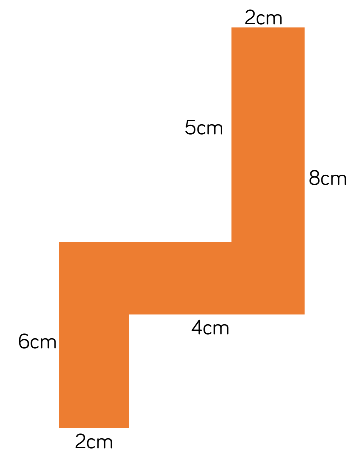
D=1m × 8m = $8m^2$

E= 3m × 2m = $6m^2$

Total area = $36m^2$

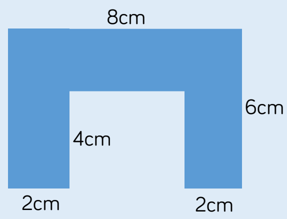


Jack has a shape with an area of $36cm^2$.



Find 3 possible compound shapes that have an area of $36cm^2$.

Possible solution:



Area of a Triangle (2)

Notes and Guidance

Children use their knowledge of finding the area of a rectangle to find the area of a right-angled triangle. They see that a right-angled triangle with the same length and perpendicular height as a rectangle will have an area half the size.
Using the link between the area of a rectangle and a triangle, children will learn and use the formula to calculate the area of a triangle.

Mathematical Talk

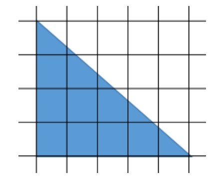
What is the relationship between the area of a rectangle and the area of a right-angled triangle?

What is the formula for working out the area of a rectangle or square?

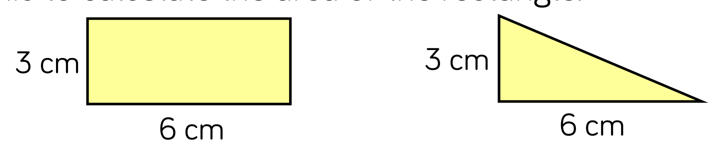
How can you use this formula to work out the area of a right-angled triangle?

Varied Fluency

1. Calculate the area of the triangle by counting the squares. Make the triangle into a rectangle with the same height and width, and calculate the area of the rectangle.
Complete: The area of the triangle is ________ the area of the rectangle.

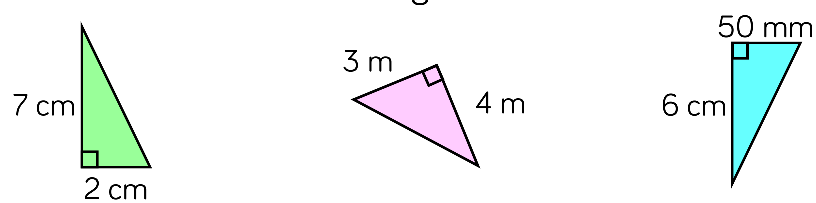


2. If l represents length and h represents height:
Area of a rectangle $= l \times h$
Use this to calculate the area of the rectangle.



What do you need to do to your answer to work out the area of the triangle?
Therefore, what is the formula for the area of a triangle?

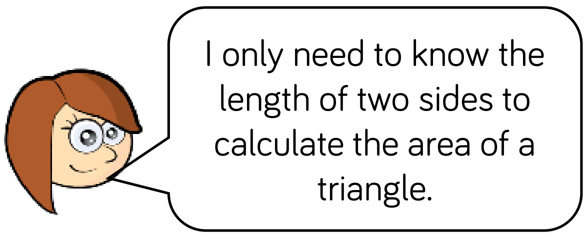
3. Calculate the area of the triangles.



Area of a Triangle (2)

Reasoning and Problem Solving

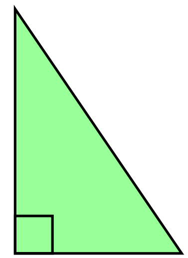
Jade is calculating the area of a right-angled triangle.



Do you agree with Jade? Explain your answer.

Jade is correct as long as the two sides you have been given are the base and the height of the triangle.

Children should give an example to show when they do need two sides, and when they need more information.



Area = 54 cm^2

What could the length and the height of the triangle be?

Is this the only possibility?

Try to think of at least three ways.

Possible answers:

Height: 18 cm
Base: 6 cm

Height: 27 cm
Base: 4 cm

Height: 12 cm
Base: 9 cm

Area of Irregular Shapes

Notes and Guidance

Children use their knowledge of counting squares to estimate the areas of irregular shapes. They use their knowledge of fractions to estimate how much of a square is covered and combine different part covered squares to give an overall approximate area.

Children need to physically annotate to avoid repetition when counting the squares.

Mathematical Talk

How many whole squares can you see?

How many part squares can you see?

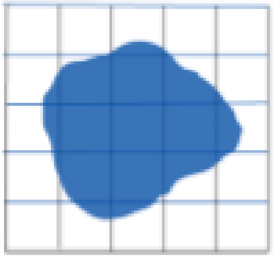
What will we do with the parts?

What does approximate mean?

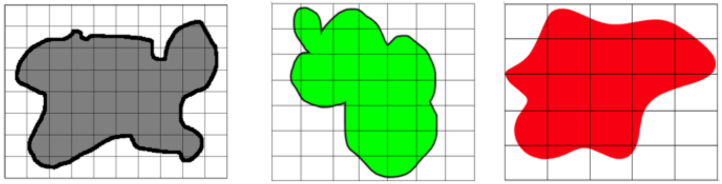
Varied Fluency

1. Estimate the area of the pond.
Each square = $1m^2$

The answer is 6 whole and 4 parts is this an acceptable answer? What can we do with the parts?

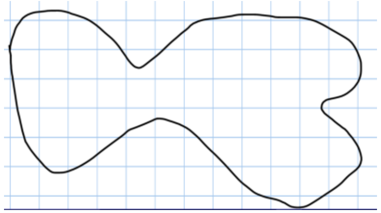


2. If all of the squares are 1cm in length, which shape has the greatest area?



Is the red shape the greatest because it fills more squares? Why? Why not?
What is the same about each image? What is different about each image?

3. Each square is $\boxed{}$ m^2
what is the approximate area?

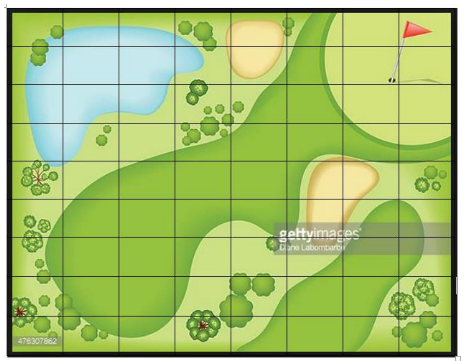


Area of Irregular Shapes

Reasoning and Problem Solving

Draw a circle on $1cm^2$ paper. What is the estimated area?

Can you draw a circle that is approximately $20cm^2$?



If each square represents $3m^2$, what is the approximate area of:

- The lake
- The bunkers
- The fairway
- The rough
- Tree/forest area

Can you construct a 'Pirate Island' to be used as part of a treasure map for a new game? Each square represents $4m^2$.

The island must include the following features and be of the given approximate measure:

Circular Island $180m^2$

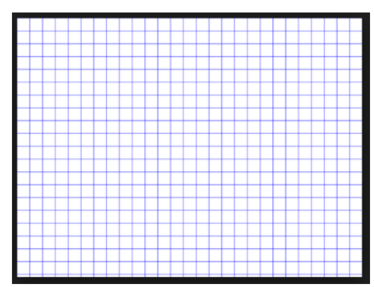
Oval Lake $58m^2$

Forests with a total area of $63m^2$ (can be split over more than one space)

Beaches with a total area of $92m^2$ (can be split over more than one space)

Mountains with a total area of $57m^2$

Rocky coastline with total area of $25m^2$



Area of a Triangle (3)

Notes and Guidance

Children will use their knowledge of working out the area of a right-angled triangle to work out the area of any triangle.

They use the formula, base × height ÷ 2 to calculate the area of a variety of triangles where different side lengths are given and where more than one triangle make up a shape.

Mathematical Talk

What formula can you use to calculate the area of a triangle?

If there is more than one triangle making up a shape, how can we use the formula to find the area of the whole shape?

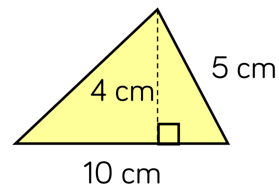
How do we know which length tells us the height of the triangle?

Varied Fluency

1. To calculate the height of a triangle, you can use the formula:

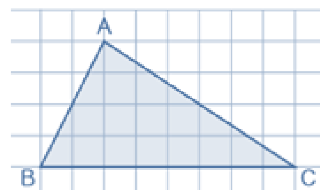
base × height ÷ 2

Choose the correct calculation to find the area of the triangle.



- 10 × 5 ÷ 2
- 10 × 4 ÷ 2
- 5 × 4 ÷ 2

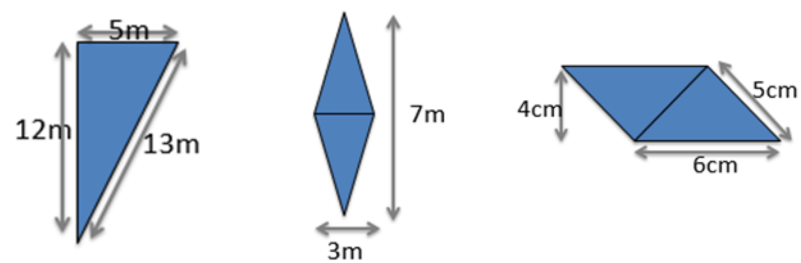
2. Calculate the area of the triangle.



How did you calculate the area?

Could you do it another way?

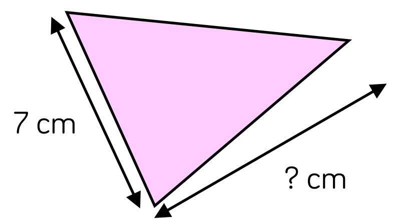
3. Calculate the area of each shape.



Area of a Triangle (3)

Reasoning and Problem Solving

The area of this triangle is $42cm^2$



Two children worked out the height. Here are their answers:

Simon: $42 \div 7 = 6$ cm

Jade: $42 \times 2 = 84$

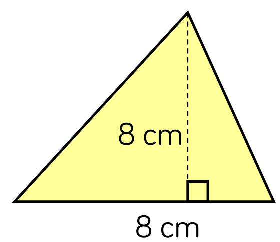
$84 \div 7 = 12$ cm

Who is correct?

Explain how you know.

Jade is correct. She has understood that to work out the missing value she will need to change the triangle into a rectangle by doubling the area. She has then divided the total area by the value she has (7cm) to work out the missing value.

Macey and Lainey are working out the area of this triangle:



Macey says, "To work out the area, you multiply 8 by 8, then you divide your answer by 2"

Lainey says, "To work out the area you only need a half of the base, so you multiply 8 by 4, then divide it by 2"

Who do you agree with?

Explain your reasoning.

Macey is correct as she has found the area of the square and then divided by 2

Lainey has divided by 2 twice, once on the sides and once on the area of the square.

The area should be $32 cm^2$

Area of a Parallelogram

Notes and Guidance

Children apply their knowledge of finding the area of a rectangle to find the area of a parallelogram.

Children investigate how they can make a rectangle and a parallelogram using a rectangle and two identical triangles. This will help them understand why the formula to find the area of parallelograms works.

Mathematical Talk

Can you describe a parallelogram?

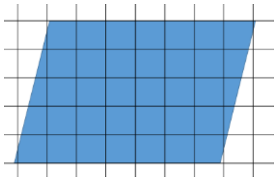
Can you make a parallelogram in to a rectangle?

What do you notice about the area of a rectangle and a parallelogram?

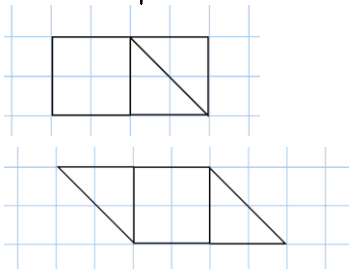
What formula can you use to work out the area of a parallelogram?

Varied Fluency

1. Work out the approximate area of the parallelogram by counting squares.

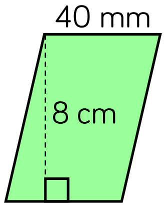


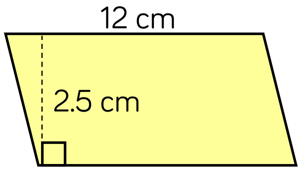
2. Here are two quadrilaterals made up of two identical triangles and a square.



- What is the same about the quadrilaterals?
- What's different?
- What is the area of each quadrilateral?

3. Use the formula base × perpendicular height to calculate the area of the parallelograms.

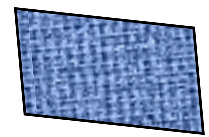




Area of a Parallelogram

Reasoning and Problem Solving

The base of a flower planter is a parallelogram. The area is greater than $44m^2$ but less than $48m^2$ What could the dimensions of the base of the flower planter be?	The total area needs to be between 44 m^2 and 48 m^2 therefore the dimensions could be, e.g. 9 m by 5 m = 45 m^2 6.5 m by 7 m = 45.5 m^2 11 m by 4.2 m = 46.2 m^2

Lucy has a piece of fabric in the shape of a parallelogram.  The height of the fabric is 12 m and the base is 18 m. She cuts the fabric into four equal parallelograms by cutting the base and the height in half. What is the area of each new parallelogram?	Children could work out the answer in two ways: 12 m × 18 m = 216 m^2 216 m^2 ÷ 4 = 54 m^2 OR They could divide 18 and 12 by 2 first, then do 9 m × 6 m = 54 m^2

What is Volume?

Notes and Guidance

Children will build on their knowledge of finding the area of two-dimensional shapes to estimate and measure volume by using 1 cm^3 blocks to build solid shapes.

Children will become aware of the conservation of volume by building different solids using the same amount of cm^3 blocks.

Mathematical Talk

What does the word 'volume' mean?

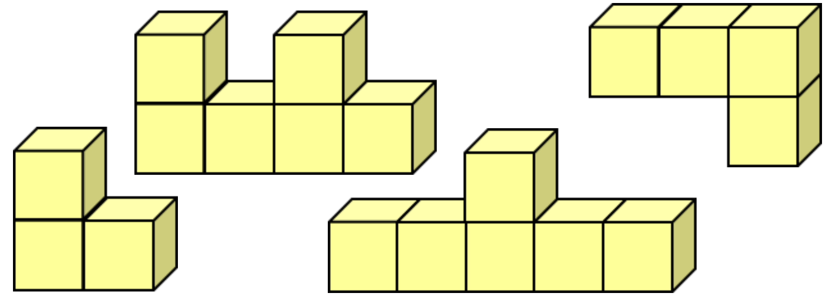
How do we measure and record volume?

Do we always have to count the cubes to work out the volume?

Can you come up with a more efficient method?

Varied Fluency

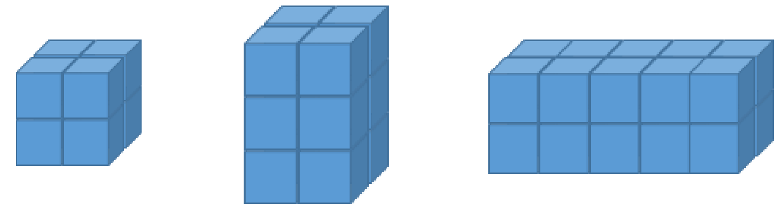
1. Look at the four solids below. Put the shapes in order based on the number of cubes they are made up of.



If each cube has a volume of 1 cm^3, find the volume of each solid.

Do any shapes have the same volume?

2. How would you work out the volume of these shapes?



What is Volume?

Reasoning and Problem Solving

Sam has built a shape that has a volume of 12 cm^3

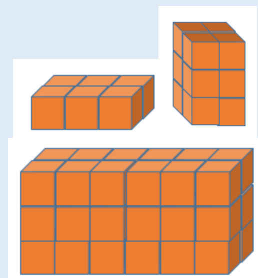
Using 1 cm^3 blocks, build a shape that is:

a) Half the volume of Sam's.

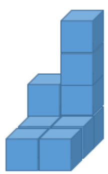
b) Double the volume of Sam's.

c) Three times the volume of Sam's.

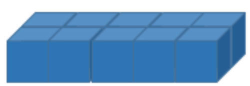
Possible solution:



Lucy has built this solid:



Tom has built this solid:



Lucy thinks her shape must have the greatest volume because it's taller.

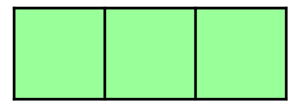
Do you agree?

Explain your answer.

Lucy is incorrect, both solids have a volume of 10 cm^3

If children struggle to see this, encourage them to build both shapes.

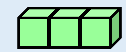
Here is one side of a cuboid.

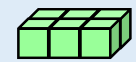


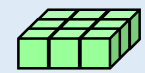
What could the volume of the cuboid be?

Investigate with a partner.

Possible solution:


3 cm^3


6 cm^3


9 cm^3

etc.

Volume – Counting Cubes

Notes and Guidance

Children should understand that volume is the 3D space an object takes up.

Children will start by counting cubic units (1 cm^3) to find the volume of 3D shapes. They will then use cubes to build their own models and describe the volume of the models they make.

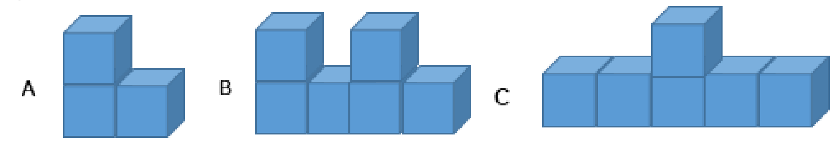
Mathematical Talk

What's the same and what's different between area and volume?

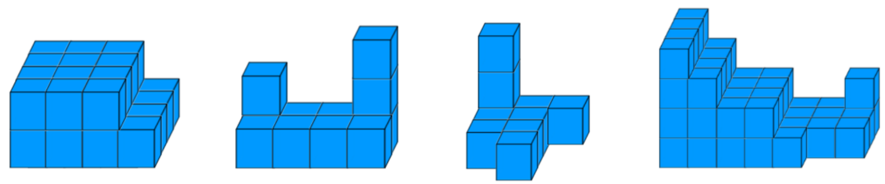
Can you explain how you worked out the volume?
What did you visualise?

Varied Fluency

1. If each cube has a volume of 1 cm^3, find the volume of each solid.



2. Calculate the number of cubic units in each shape.



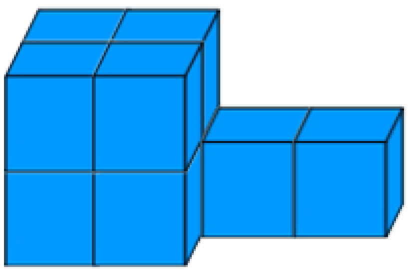
3. If one multilink cube = one cubic unit, make as many models as you can with 12 cubic units.

Volume – Counting Cubes

Reasoning and Problem Solving

Ibrahim says he will need 8 cm^3 to build this shape.

Aleena says she will need 10 cm^3



Who do you agree with?

Explain why.

Aleena is correct because there are 8 cm^3 making the shape, then there are an additional 2 cm^3

Reuben is making cubes using multilink.

He has 64 multilink cubes altogether.

How many cubes could he make?

Reuben could make:

- $1 \times 1 \times 1$
- $2 \times 2 \times 2$
- $3 \times 3 \times 3$
- $4 \times 4 \times 4$

Or a combination of these such as two $3 \times 3 \times 3$ cubes, one $2 \times 2 \times 2$ cube and two $1 \times 1 \times 1$ cubes.

Volume of a Cuboid

Notes and Guidance

Children make links with counting cubic units to understand how to use the formula (l × w × h) for calculating the volume of cuboids.
Children understand that when using the formula l × w will tell you the area of the base then to calculate the volume of the whole shape, you then need to multiply this by the height.

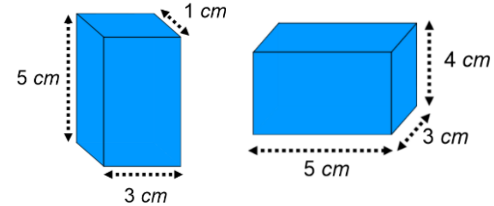
Mathematical Talk

Can you identify the length, width and height of the cuboid?

If the length of a cuboid is 5 cm and the volume is 100 cm³, what could the width and height of the cuboid be?
What knowledge can I use to help me calculate the missing lengths?

Varied Fluency

1. Complete the sentences for each cuboid.



The length is: ___________
The width is: ___________
The height is: ___________

The area of the base is: _____ × _____ = _____

Volume = The area of the base × _____ = _____

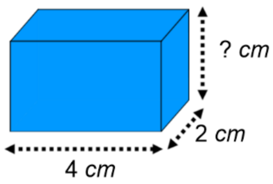
2. What is the volume of a cube with:

- 2 metre edges?
- 160 mm edges?

Give your answers in cm³

3. The volume of the cuboid is 32 cm³

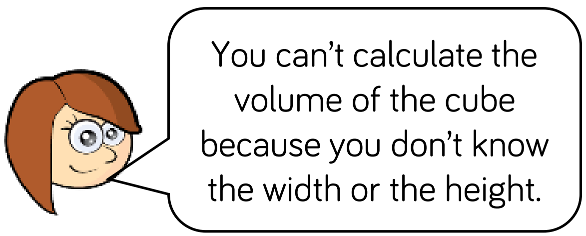
What is the missing height?

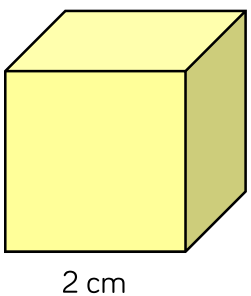


Volume of a Cuboid

Reasoning and Problem Solving

Clare says,





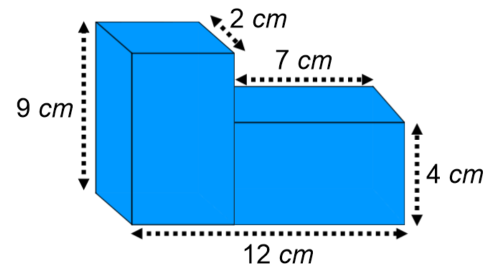
Do you agree?

Explain why.

You don't need the rest of the measurements because it's a cube and all the edges of a cube are equal.
Therefore, the width would be 2 cm and the height would be 2 cm.

The volume of the cube is 8 cm³

Calculate the volume of the shape:



146 cm³

How many different ways can you make a cuboid with a volume of 48 cm³?

Possible answers:

$24 \times 2 \times 1$

$2 \times 6 \times 4$

$6 \times 8 \times 1$

etc.