How to use the mixed-age SOL

In this document, you will find suggestions of how you may structure a progression in learning for a mixed-age class.

Firstly, we have created a yearly overview.

<table>
<thead>
<tr>
<th>Week 1</th>
<th>Week 2</th>
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<th>Week 6</th>
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<th>Week 11</th>
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<tbody>
<tr>
<td>Autumn</td>
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For each block of learning, we have grouped the small steps into themes that have similar content. Within these themes, we list the corresponding small steps from one or both year groups. Teachers can then use the single-age schemes to access the guidance on each small step listed within each theme.

The themes are organised into common content (above the line) and year specific content (below the line). Moving from left to right, the arrows on the line suggest the order to teach the themes.

Each term has 12 weeks of learning. We are aware that some terms are longer and shorter than others, so teachers may adapt the overview to fit their term dates.

The overview shows how the content has been matched up over the year to support teachers in teaching similar concepts to both year groups. Where this is not possible, it is clearly indicated on the overview with 2 separate blocks.
Notes and Guidance

How to use the mixed-age SOL

Here is an example of one of the themes from the Year 1/2 mixed-age guidance.

<table>
<thead>
<tr>
<th>Subtraction</th>
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</thead>
<tbody>
<tr>
<td><strong>Year 1 (Aut B2, Spr B1)</strong></td>
</tr>
<tr>
<td>• How many left? (1)</td>
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<tr>
<td>• How many left? (2)</td>
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<tr>
<td>• Counting back</td>
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<tr>
<td>• Subtraction - not crossing 10</td>
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<tr>
<td>• Subtraction - crossing 10 (1)</td>
</tr>
<tr>
<td>• Subtraction - crossing 10 (2)</td>
</tr>
<tr>
<td><strong>Year 2 (Aut B2, B3)</strong></td>
</tr>
<tr>
<td>• Subtract 1-digit from 2-digits</td>
</tr>
<tr>
<td>• Subtract with 2-digits (1)</td>
</tr>
<tr>
<td>• Subtract with 2-digits (2)</td>
</tr>
<tr>
<td>• Find change - money</td>
</tr>
</tbody>
</table>

In order to create a more coherent journey for mixed-age classes, we have re-ordered some of the single-age steps and combined some blocks of learning e.g. Money is covered within Addition and Subtraction.

The bullet points are the names of the small steps from the single-age SOL. We have referenced where the steps are from at the top of each theme e.g. Aut B2 means Autumn term, Block 2. Teachers will need to access both of the single-age SOLs from our website together with this mixed-age guidance in order to plan their learning.

**Points to consider**

- Use the mixed-age schemes to see where similar skills from both year groups can be taught together. Learning can then be differentiated through the questions on the single-age small steps so both year groups are focusing on their year group content.
- When there is year group specific content, consider teaching in split inputs to classes. This will depend on support in class and may need to be done through focus groups.
- On each of the block overview pages, we have described the key learning in each block and have given suggestions as to how the themes could be approached for each year group.
- We are fully aware that every class is different and the logistics of mixed-age classes can be tricky. We hope that our mixed-age SOL can help teachers to start to draw learning together.
<table>
<thead>
<tr>
<th></th>
<th>Week 1</th>
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<th>Week 12</th>
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</thead>
<tbody>
<tr>
<td><strong>Autumn</strong></td>
<td><strong>Number: Place Value</strong></td>
<td><strong>Number: Four Operations</strong></td>
<td><strong>Number: Fractions</strong></td>
<td><strong>Number: Fractions</strong></td>
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<tr>
<td><strong>Spring</strong></td>
<td><strong>Y5: Number: Fractions</strong></td>
<td><strong>Number: Decimals and Percentages</strong></td>
<td><strong>Y5: Number: Decimals</strong></td>
<td><strong>Y6: Number: Algebra</strong></td>
<td><strong>Measurement: Converting Units</strong></td>
<td><strong>Measurement: Perimeter, Area and Volume</strong></td>
<td><strong>Statistics</strong></td>
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<tr>
<td><strong>Y6: Number: Ratio</strong></td>
<td><strong>Number: Decimals and Percentages</strong></td>
<td><strong>Y5: Number: Decimals</strong></td>
<td><strong>Y6: Number: Algebra</strong></td>
<td><strong>Measurement: Converting Units</strong></td>
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<tr>
<td><strong>Summer</strong></td>
<td><strong>Geometry: Properties of Shape</strong></td>
<td><strong>Geometry: Position and Direction</strong></td>
<td><strong>Y5: Four Operations consolidation</strong></td>
<td><strong>Y5: FDP consolidation</strong></td>
<td><strong>Y5: Measure consolidation</strong></td>
<td><strong>Consolidation</strong></td>
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<td><strong>Y6: SATS</strong></td>
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<td><strong>Investigations</strong></td>
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</tbody>
</table>
In this section, content from single-age blocks are matched together to show teachers where there are clear links across the year groups. Teachers may decide to teach the lower year’s content to the whole class before moving the higher year on to their age-related expectations. The lower year group is not expected to cover the higher year group’s content as they should focus on their own age-related expectations.

In this section, content that is discrete to one year group is outlined. Teachers may need to consider a split input with lessons or working with children in focus groups to ensure they have full coverage of their year’s curriculum. Guidance is given on each page to support the planning of each block.

The themes should be taught in order from left to right.
Perimeter, Area and Volume

Common Content

**Perimeter**
- Year 5 (Aut B5)
  - Measure perimeter
  - Calculate perimeter
- Year 6 (Spr B5)
  - Area and perimeter (focus on perimeter questions)

**Area**
- Year 5 (Aut B5)
  - Area of rectangles
  - Area of compound shapes
  - Area of irregular shapes
- Year 6 (Spr B5)
  - Shapes - same area
  - Area and perimeter (focus on area questions)

**Volume**
- Year 5 (Sum B5)
  - What is volume?
  - Compare volume
  - Estimate volume
- Year 6 (Spr B5)
  - Volume - counting cubes
  - Volume of a cuboid

**Triangles**
- Year 6 (Spr B5)
  - Area of a triangle (1)
  - Area of a triangle (2)
  - Area of a triangle (3)

**Parallelograms**
- Year 6 (Spr B5)
  - Area of a parallelogram

**Capacity**
- Year 5 (Sum B5)
  - Estimate Capacity

Both year groups find the perimeter and area of rectilinear shapes. Year 6 then move on to finding the area of triangles and parallelograms, applying their understanding of the link with rectangles. Both year groups then calculate the volume of cuboids.
Theme 1 - Perimeter
Measure Perimeter

Notes and Guidance

Children measure the perimeter of rectilinear shapes from diagrams without grids. They will recap measurement skills and recognise that they need to use their ruler accurately in order to get the correct answer. They could consider alternative methods when dealing with rectangles e.g. $l + w + l + w$ or $(l \times w) \times 2$.

What is perimeter of a shape?

What’s the same/different about these shapes?

Do we need to measure every side?

Once we have measured each side, how do we calculate the perimeter?

Varied Fluency

- Measure the perimeter of the rectangles.

- Measure the perimeter of the shapes.

- Make this shape double the size using dot paper.

- Measure the perimeter of both shapes.

What do you notice about the perimeter of the larger one? Why?
Each regular hexagon has a side length of 2 cm.

Can you construct a shape with a perimeter of 44 cm?

Possible answer:

Discuss how many sides the shape must have with the children. Encourage their reasoning that there must be 22 2 cm sides to make a total perimeter of 44 cm.

Activity

Investigate different ways you can make composite rectilinear shapes with a perimeter of 54 cm.
Children apply their knowledge of measuring and finding perimeter to find the unknown side lengths. They find the perimeter of shapes with and without grids.

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**

What can you tell me about the sides of a square/rectangle? How does this help you work out this question?

How can you use the labelled sides to find the length of the unknown sides?

What strategies can you use to calculate the total perimeter?

What does regular mean? Why are rectangles irregular?
Here is a square inside another square.

Small square = 16 cm
Large square = 64 cm
Length of one of the outer sides is 8 cm, because 64 is a square number.

The perimeter of the inner square is 16 cm
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?

The value of c is 14 m.
What is the total perimeter of the shape?

4c + 4c + c + c = 10c
10 × 14 = 140 m

Total perimeter = 38 cm
38 − (4.8 + 4.8) = 28.4
So 28.4 divided by 2 = 14.2 cm
Look at the shapes below.

12 cm  
9 cm  
8 cm  
7 cm  
2 cm  
6 cm  
3 cm  
2 cm

Do any of the shapes have the same area?
Do any of the shapes have the same perimeter?

Work out the missing values.

12 cm 
Area = 60 cm²
? mm

100 mm  
6 cm
Area = ? cm²

Draw two rectilinear shapes that have an area of 36 cm² but have different perimeters.

What is the perimeter of each shape?
True or false?

Two rectangles with the same perimeter can have different areas.

Explain your answer.

A farmer has 60 metres of perimeter fencing.

For every $1 \text{ m}^2$ he can keep 1 chicken.

How can he arrange his fence so that the enclosed area gives him the greatest area?

True. Children explore this by drawing rectangles and comparing both area and perimeter.

The greatest area is a $15 \text{ m} \times 15 \text{ m}$ square, giving $225 \text{ m}^2$

Children may create rectangles by increasing one side by 1 unit and decreasing one side by 1 unit e.g. $16 \times 14 = 224 \text{ m}^2$ $17 \times 13 = 221 \text{ m}^2$

Tommy has a $8 \text{ cm} \times 2 \text{ cm}$ rectangle. He increases the length and width by 1 cm.

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He repeats with a $4 \text{ cm} \times 6 \text{ cm}$ rectangle.

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What do you notice happens to the areas?

Can you find any other examples that follow this pattern?

Are there any examples that do not follow the pattern?

If the sum of the length and width is 10, then the area will always increase by 11

Children may use arrays to explore this:

The red and green will always total 10 and the yellow will increase that by 1 to 11
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 of rectangles.

Is a square a rectangle? This would be a good discussion point when the children are finding different rectangles with a given area. For example, a rectangle with an area of 36 cm² could have four equal sides of 6 cm.

Mo buys a house with a small back garden, which has an area of 12 m². His house lies in a row of terraces, all identical. If there are 15 terraced houses altogether, what is the total area of the garden space?

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?

Will the formula ‘Area = length × width’ work for any shape, or only squares and rectangles?
Investigate how many ways you can make different squares and rectangles with the same area of 84 cm².

What strategy did you use?

True or False?

If you cut off a piece from a shape, you reduce its area and perimeter.

Draw 2 examples to prove your thinking.

Each orange square has an area of 24 cm².

Calculate the total orange area.

Calculate the blue area.

Calculate the green area.

What is the total area of the whole shape?

Answer: A = 3 cm × 7 cm = 21 cm²

B = 8 cm × 8 cm = 64 cm²

C = 3 cm × 19 cm = 57 cm²

Order: B, C, A

Answer:

Orange = 48 cm²

Blue = 72 cm²

Green = 24 cm²

Total = 144 cm²
Area of Compound Shapes

Notes and Guidance

Children learn to calculate area of compound shapes. They need to be careful when splitting shapes up to make sure they know which lengths correspond to the whole shape, and which to the smaller shapes they have created. They will discover that the area remains the same no matter how you split up the shapes.

Children need to have experience of drawing their own shapes in this step.

Mathematical Talk

What formula do we use to find the area of a rectangle?

Can you see any rectangles within the compound shapes?

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?

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 6 m × 6 m and then subtract 2 m × 3 m?

Calculate the area.
Area of Compound Shapes

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

Possible solution:
A = 2 m × 5 m = 10 m²
B = 6 m × 3 m = 18 m²
C = 1 m × 2 m = 2 m²
D = 1 m × 8 m = 8 m²
E = 3 m × 2 m = 6 m²
Total area = 36 m²

Jack says this shape has an area of 34 cm².

Possible solution:

Show that Jack is correct.

Find three more possible compound shapes that have an area of 34 cm².
Children use their knowledge of counting squares to estimate the areas of shapes that are not rectilinear. 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?

Can you find any part squares that you could be put together to make a full square?

What will we do with the parts?

What does approximate mean?

**Area of Irregular Shapes**

**Notes and Guidance**

- Estimate the area of the pond. Each square = 1 m²
- Ron’s answer is 4 whole squares and 11 parts. Is this an acceptable answer? What can we do with the parts to find an approximate answer?
- If all of the squares are 1 cm in length, which shape has the greatest area?
- Is the red shape the greatest because it fills more squares? Why or why not?
- What is the same about each image? What is different about the images?
- Each square is ____ m² Work out the approximate area of the shape.

**Varied Fluency**

- If all of the squares are 1 cm in length, which shape has the greatest area?
- Is the red shape the greatest because it fills more squares? Why or why not?
- What is the same about each image? What is different about the images?
- Each square is ____ m² Work out the approximate area of the shape.
Area of Irregular Shapes

Reasoning and Problem Solving

Draw a circle on 1 cm² paper. What is the estimated area?
Can you draw a circle that has area approximately 20 cm²?

If each square represents 3 m², 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 4 m².

The island must include the following features and be of the given approximate measure:
- Circular Island 180 m²
- Oval Lake 58 m²
- Forests with a total area of 63 m² (can be split over more than one space)
- Beaches with a total area of 92 m² (can be split over more than one space)
- Mountains with a total area of 57 m²
- Rocky coastline with total area of 25 m²

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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 make connections between side lengths and factors.

**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?

**Shapes – Same Area**

**Notes and Guidance**

Sort the shapes into the Carroll diagram.

<table>
<thead>
<tr>
<th>Quadrilateral</th>
<th>Not a quadrilateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of 12 cm²</td>
<td></td>
</tr>
<tr>
<td>Area of 16 cm²</td>
<td></td>
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</tbody>
</table>

Now draw another shape in each section of the diagram.

**Varied Fluency**

How many rectangles can you draw with an area of 24 cm² where the side lengths are integers?

What do you notice about the side lengths?

Using integer side lengths, draw as many rectangles as possible that give the following areas:

- 17 cm²
- 25 cm²
- 32 cm²
Rosie and Dexter are drawing shapes with an area of 30cm²

Both are correct.

Dexter’s shape:
60 cm × 0.5 cm
= 30 cm²

Rosie’s shape:
2 cm × 10 cm
= 20 cm²
5 cm × 2 cm
= 10 cm²
20 cm² + 10 cm²
= 30 cm²
Could be split differently.

Three children are given the same rectilinear shape to draw.

Amir says, “The smallest length is 2 cm.”
Alex says, “The area is less than 30 cm².”
Annie says, “The perimeter is 22 cm.”

What could the shape be?
How many possibilities can you find?

Always, Sometimes, Never?

If the area of a rectangle is odd then all of the lengths are odd.
Area and Perimeter

Notes and Guidance

Children should calculate area and perimeter of rectilinear shapes. They must have the conceptual understanding of the formula for area by linking this to counting squares. Writing and using the formulae for area and perimeter is a good opportunity to link back to the algebra block. 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 24 cm² but different perimeters?

Varied Fluency

Look at the shapes below.

Do any of the shapes have the same area?
Do any of the shapes have the same perimeter?

Work out the missing values.

Draw two rectilinear shapes that have an area of 36 cm² but have different perimeters.
What is the perimeter of each shape?
Area and Perimeter

Reasoning and Problem Solving

**True or false?**

Two rectangles with the same perimeter can have different areas.

Explain your answer.

A farmer has 60 metres of perimeter fencing.

For every 1 m² he can keep 1 chicken.

How can he arrange his fence so that the enclosed area gives him the greatest area?

True. Children explore this by drawing rectangles and comparing both area and perimeter.

The greatest area is a 15 m × 15 m square, giving 225 m²

Children may create rectangles by increasing one side by 1 unit and decreasing one side by 1 unit e.g. 16 × 14 = 224 m² 17 × 13 = 221 m²

Tommy has a 8 cm × 2 cm rectangle. He increases the length and width by 1 cm.

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He repeats with a 4 cm × 6 cm rectangle.

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What do you notice happens to the areas?

Can you find any other examples that follow this pattern?

Are there any examples that do not follow the pattern?

If the sum of the length and width is 10, then the area will always increase by 11

Children may use arrays to explore this:

The red and green will always total 10 and the yellow will increase that by 1 to 11
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 could we do with the parts?
What does estimate mean?
Why is your answer to this question an estimate of the area?
Revisit the idea that a square is a rectangle when generalising how to calculate the area of a triangle.

Varied Fluency

Count squares to calculate the area of each triangle.

Estimate the area of each triangle by counting squares.

Calculate the area of each shape by counting squares.

What do you notice about the area of the triangle compared to the area of the square?
Does this always happen?

Explore this using different rectangles.
Mo says the area of this triangle is 15cm². Is Mo correct? If not, explain his mistake.

Mo is incorrect because he has counted the half squares as whole squares.

Part of a triangle has been covered. Estimate the area of the whole triangle.

9 cm²

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 cm². 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 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 same/different about the rectangle and triangle?

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

Estimate the area of the triangle by counting the squares.

Make the triangle into a rectangle with the same height and width. Calculate the area.

The area of the triangle is _______ the area of the rectangle.

If \( l \) represents length and \( h \) represents height:

\[
\text{Area of a rectangle} = l \times h
\]

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?

Calculate the area of these triangles.
**Area of a Triangle (2)**

### Reasoning and Problem Solving

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

**Do you agree with Annie? Explain your answer.**

- **Annie is incorrect as it is not sufficient to know any two sides, she needs the base and perpendicular height. Children could draw examples and non-examples.**

<table>
<thead>
<tr>
<th>Area = 54 cm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>What could the length and the height of the triangle be?</td>
</tr>
<tr>
<td>How many different integer possibilities can you find?</td>
</tr>
</tbody>
</table>

- **Possible answers:**
  - Height: 18 cm, Base: 6 cm
  - Height: 27 cm, Base: 4 cm
  - Height: 12 cm, Base: 9 cm

---

**Calculate the area of the shaded triangle.**

- **Mo says,**
  - I got an answer of 72 cm²

**Mo is incorrect as he has just multiplied the two numbers given and divided by 2, he hasn't identified the correct base of the triangle.**

<table>
<thead>
<tr>
<th>The area of the shaded triangle is 24 cm²</th>
</tr>
</thead>
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</table>

*Year 6 | Spring Term | Week 9 to 10 – Measurement: Perimeter, Area & Volume*
Area of a Triangle (3)

Notes and Guidance

Children will extend 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 × perpendicular 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 does the word perpendicular mean?

What do we mean by perpendicular height?

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 perpendicular height of the triangle?

Varied Fluency

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

Estimate the area of the triangle by counting squares.

Now calculate the area of the triangle. Compare your answers.

Calculate the area of each shape.
Area of a Triangle (3)

Reasoning and Problem Solving

Class 6 are calculating the area of this triangle.

Here are some of their methods.

The correct methods are:
- $16 \times 2 \div 2$
- $4 \times 8 \div 2$

All mistakes are due to not choosing a pair of lengths that are perpendicular.

Children could explore other methods to get to the correct answer e.g. halving the base first and calculating $8 \times 2$ etc.

The shape is made of three identical triangles.

What is the area of the shape?

Each triangle is 6 cm by 11 cm so area of one triangle is 33 cm$^2$

Total area = 99 cm$^2$
Area of a Parallelogram

Notes and Guidance

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

Children investigate the link between the area of a rectangle and parallelogram by cutting a parallelogram so that it can be rearranged into a rectangle. This will help them understand why the formula to find the area of parallelograms works.

Mathematical Talk

Describe a parallelogram.

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

Approximate the area of the parallelogram by counting squares.

Now cut along the dotted line.

Can you move the triangle to make a rectangle?

Calculate the area of the rectangle.

Here are two quadrilaterals.

• What is the same about the quadrilaterals?
• What’s different?
• What is the area of each quadrilateral?

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

Children investigate the link between the area of a rectangle and parallelogram by cutting a parallelogram so that it can be rearranged into a rectangle. This will help them understand why the formula to find the area of parallelograms works.
Teddy has drawn a parallelogram.
The area is greater than 44 m² but less than 48 m².
What could the base length and the perpendicular height of Teddy's parallelogram be?

Possible answers:

- 9 m by 5 m = 45 m²
- 6.5 m by 7 m = 45.5 m²
- 11 m by 4.2 m = 46.2 m²

Dexter thinks the area of the parallelogram is 84 cm².
What mistake has Dexter made?
What is the correct area?

Dexter has multiplied 14 by 6 when he should have multiplied by 4 because 4 is the perpendicular height of the parallelogram.
The correct area is 56 cm².

Dora and Eva are creating a mosaic.
They are filling a sheet of paper this size.

Dora is using tiles that are rectangular.
Eva’s tiles are parallelograms.

Dora thinks that she will use fewer tiles than Eva to fill the page because her tiles are bigger.
Do you agree? Explain your answer.

Dora is wrong because both hers and Eva’s tiles have the same area and so the same number of tiles will be needed to complete the mosaic.
The area of the paper is 285 cm² and the area of each tile is 15 cm² so 19 tiles are needed to complete the pattern.
What is Volume?

Children understand that volume is the amount of solid space something takes up. They look at how volume is different to capacity, as capacity is related to the amount a container can hold.

Children could use centimetre cubes to make solid shapes. Through this, they recognise the conservation of volume by building different solids using the same amount of centimetre cubes.

Notes and Guidance

Mathematical Talk

Does your shape always have 4 centimetre cubes? Do they take up the same amount of space?

How can this help us understand what volume is?

If the solid shapes are made up of 1 cm cubes, can you complete the table?

Look at shape A, B and C. What’s the same and what’s different?

How is capacity different to volume?

Varied Fluency

Take 4 cubes of length 1 cm. How many different solids can you make? What’s the same? What’s different?

Make these shapes.

Complete the table to describe your shapes.

<table>
<thead>
<tr>
<th>Shape</th>
<th>Width (cm)</th>
<th>Height (cm)</th>
<th>Length (cm)</th>
<th>Volume (cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
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</tr>
</tbody>
</table>

Compare the capacity and the volume. Use the sentence stems to help you.

Container ___ has a capacity of ____ ml
The volume of water in container ___ is ___ cm³
What is Volume?

Reasoning and Problem Solving

How many possible ways can you make a cuboid that has a volume of 12cm³?

Possible solutions:

- My shape is made up of 10 centimetre cubes.
- The height and length are the same size.
- What could my shape look like?

Create your own shape and write some clues for a partner.

Possible solutions include:
Children use their understanding of volume (the amount of solid space taken up by an object) to compare and order different solids that are made of cubes.

They develop their understanding of volume by building shapes made from centimetre cubes and directly comparing two or more shapes.

**What does volume mean?**

**What does cm³ mean?**

How can we find the volume of this shape?

Which shape has the greatest volume?

Which shape has the smallest volume?

Do we always have to count the cubes to find the volume?
Shape A has a height of 12 cm. Shape B has a height of 4 cm. Dora says Shape A must have a greater volume. Is she correct? Explain your answer.

Dora is incorrect e.g.
Shape A
12 cm × 1 cm × 2 cm = 24 cm³
Shape B
4 cm × 9 cm × 2 cm = 72 cm³

Amir, Whitney and Mo all build a shape using cubes. Mo has lost his shape, but knows that it’s volume was greater than Whitney’s, but less than Amir’s.

Amir’s

Whitney’s

What could the volume of Mo’s shape be?

The volume of Amir’s shape is 56 cm³
The volume of Whitney’s shape is 36 cm³
The volume of Mo’s shape can be anywhere between.

Eva has built this solid:

Tommy has built this solid:

Eva thinks that her shape must have the greatest volume because it is taller. Do you agree? Explain your answer.

Eva is incorrect, both solids have an equal volume of 10 cm³. Children might want to build this to see it.
Estimate Volume

Notes and Guidance

Children estimate volume and capacity of different solids and objects. They build cubes and cuboids to aid their estimates. Children need to choose the most suitable unit of measure for different objects e.g. using m$^3$ for the volume of a room. Children should understand that volume is the amount of solid space taken up by an object, whereas capacity is the amount a container can hold.

Mathematical Talk

What is the difference between volume and capacity?

Do you need to fill the whole box with cubes to estimate its volume?

Would unit to measure would you use to estimate the volume of the classroom?

Varied Fluency

- Estimate and match the object to the correct capacity.

- Use a box or drawer from your classroom. Use cubes to estimate the volume of the box or drawer when it is full.

- Estimate then work out the capacity of your classroom.
Each of the cubes have a volume of 1 m³
The volume of the whole shape is between 64 m³ and 96 m³
What could the shape look like?

Any variation of cubes drawn between the following:

Jack is using cubes to estimate the volume of his money box.

He says the volume will be 20 cm³

Do you agree with Jack?
Explain your answer.

What would the approximate volume of the money box be?

Jack is incorrect because he has not taken into account the depth of the money box.
The approximate volume would be 80 cm³
Volume – Counting Cubes

Notes and Guidance

Children should understand that volume is the space occupied by a 3-D object.

Children will start by counting cubic units (1 cm³) 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?

What units of measure could we use for volume? (Explore cm³, m³, mm³ etc.)

If each cube has a volume of 1 cm³, find the volume of each solid.

Make each shape using multilink cubes.

If each cube has a volume of 1 cm³, what is the volume of each shape?
Place the shapes in ascending order based on their volume. What about if each cube represented 1 mm³, how would this affect your answer? What about if they were 1 m³?

If one multilink cube represents 1 cubic unit, how many different models can you make with a volume of 12 cubic units?
Amir says he will need 8 cm³ to build this shape.

Dora says she will need 10 cm³.

Who do you agree with?

Explain why.

Amir is incorrect because he has missed the 2 cubes that cannot be seen.

Dora is correct because there are 8 cm³ making the visible shape, then there are an additional 2 cm³ behind.

Tommy is making cubes using multilink. He has 64 multilink cubes altogether.

How many different sized cubes could he make?

He says,

If I use all of my multilink to make 8 larger cubes, then each of these will be 2 by 2 by 2.

How many other combinations can Tommy make where he uses all the cubes?

Possible answers:

64 cubes that are 1 × 1 × 1
2 cubes that are 3 × 3 × 3; 1 cube that is 2 × 2 × 2;
2 cubes that are 1 × 1 × 1

Tommy could make:

• 1 × 1 × 1
• 2 × 2 × 2
• 3 × 3 × 3
• 4 × 4 × 4
### Volume of a Cuboid

**Notes and Guidance**

Children make the link between counting cubes and the formula \(l \times w \times h\) for calculating the volume of cuboids.

They realise that the formula is the same as calculating the area of the base and multiplying 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

Complete the sentences for each cuboid.

- The length is: __________
- The width is: __________
- The height is: __________

The area of the base is: _____ \times _____ = _____

Volume = The area of the base \times _____ = _____

Calculate the volume of a cube with side length:

- 4 cm
- 2 m
- 160 mm

Use appropriate units for your answers.

The volume of the cuboid is 32 cm³.

Calculate the height.

You might want to use multilink cubes to help you.
Rosie says,

You can't calculate the volume of the cube because you don't know the width or the height.

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.

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

146 cm³
Estimate Capacity

Notes and Guidance

Children estimate capacity using practical equipment such as water and rice.

Children explore how containers can be different shapes but still hold the same capacity.

Children will understand that we often use the word capacity when referring to liquid, rather than volume.

Mathematical Talk

Can I fill the tumbler so it is ___ full?
Compare two tumblers, which tumbler has more/less volume? Do they have the same capacity?

Can we order the containers?
If I had ___ ml or litres, which container would I need and why?
How much rice/water is in this container? How do you know?

Varied Fluency

Use five identical tumblers and some rice.
• Fill a tumbler half full.
• Fill a tumbler one quarter full.
• Fill a tumbler three quarters full.
• Fill a tumbler, leaving one third empty.
• Fill a tumbler that has more than the first but less than the third, what fraction could be filled?

Show children 5 different containers. Which containers has the largest/smallest capacity? Can we order the containers? If I had ___ ml/l, which container would I need and why? Fill each container with rice/water and estimate then measure how much each holds.

Match the containers to their estimated capacity.

Use this to help you compare other containers. Use ‘more’ and ‘less’ to help you.
Give children a container. Using rice, water and cotton wool balls, can children estimate how much of each they will need to fill it?

Discuss what is the same and what is different.
Will everyone have the same amount of cotton wool?
Will everyone have the same amount of rice?
Will everyone have the same amount of water?

Possible response: Explore how cotton wool can be squashed and does not fill the space, whereas water and rice fill the container more.

Give children a container. Using rice/water and a different container e.g. cups, discuss how many cups of rice/water we will need to fill the containers.
Link this to the capacity of the containers.

Various different answers.