# DEVELOPING MATHEMATICAL INQUIRY COMMUNITIES

## Measurement: Mass, volume, and capacity

## Level 3 (Year 5/ Year 6)

## Teacher Booklet

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| **Task 1** | Ta'ase is sending a parcel to her family overseas. She needs a box with a volume of 10 000 $cm^3$.<br><br>Find the volume of the boxes to see if they are big enough. |
| **Big ideas** | There are a range of attributes that we can measure including length, mass, time, area, angle, and volume. When we measure, we use comparison, specifically, we compare like properties to see which is greater. We can make comparisons using standard or non-standard units of measure and we use mathematical language to describe these.<br>Conceptual understanding of measurement requires understanding of conservation and transitivity. Conservation requires understanding that when moved or subdivided, an object will retain its size. Transitivity involves understanding that the measures of two objects can be compared to a third object. For example, if object A weighs more than object B, and object B weighs more than object C, then object A will weigh more than object C.<br>There are key principles related to measurement including that the size of the measurement unit remains the same (including identical units or subdivisions), units are repeated with no gaps or overlaps (iteration), the unit is part of a whole and the measurement is expressed as the total number of units used. |
| **Curriculum links** | GM2-2: Partition and/or combine like measures and communicate them, using numbers and units.<br>GM3-2: Find areas of rectangles and volumes of cuboids by applying multiplication.<br>NA3-1: Use a range of additive and simple multiplicative strategies with whole numbers, fractions, decimals, and percentages.<br>NA4-1: Use a range of multiplicative strategies when operating on whole numbers. |
| **Learning Outcomes: Students will be able to:** | • Explain volume as the space inside an object/container.<br>• Use standard units to measure volume.<br>• Use multiplication or grouping to find the volume. |
| **Mathematical language** | Volume, cubic centimetres, cubes, cuboids, units of measure, measurement count. |
| **Sharing back/Connect** | Select students to share who measure the volume of the boxes by finding the dimensions and using multiplication. Alternatively select students to share who have layered the bottom first and then multiplied the bottom layer to find the volume.<br><br>**Connect:**<br><br>Describe how you can find the volume of any box. |

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| **Teacher Notes** | • To launch the task, facilitate students to explore the volume of variety of boxes using informal units of measure (e.g., blocks, lego pieces). Revisit the concept that the volume of an object is the amount of space it takes up.<br>• For the task, have a variety of different sized and shaped small boxes. Provide students with centi-cubes (1 $cm^3$) and 1000 $cm^3$ cubes to measure the volume.<br>• Facilitate the students to notice that an object is measured by the number of unit volumes that fit into it. Additionally, for accuracy of measurement, there should be no gaps or spaces between the 1 $cm^3$.<br>• Students should begin to construct the formula naturally without it being taught or reinforced. For the connect, there are multiple possibilities that could be given.<br>• For the independent task, have a variety of boxes and centi-cubes available. |
| **Independent Tasks** | Measure the volume of each box.<br><br>Represent how you found the volume for each box. |
| **Anticipations** | |

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| **Task 2** | Use the cubes to build as many different box-shaped (cuboid) buildings as possible.<br>Draw each building as a 3-D representation and label this to show how you find the volume. |
| **Big ideas** | There are a range of attributes that we can measure including length, mass, time, area, angle, and volume. When we measure, we use comparison, specifically, we compare like properties to see which is greater. We can make comparisons using standard or non-standard units of measure and we use mathematical language to describe these.<br>Conceptual understanding of measurement requires understanding of conservation and transitivity. Conservation requires understanding that when moved or subdivided, an object will retain its size. Transitivity involves understanding that the measures of two objects can be compared to a third object. For example, if object A weighs more than object B, and object B weighs more than object C, then object A will weigh more than object C.<br>There are key principles related to measurement including that the size of the measurement unit remains the same (including identical units or subdivisions), units are repeated with no gaps or overlaps (iteration), the unit is part of a whole and the measurement is expressed as the total number of units used. |
| **Curriculum links** | GM2-2: Partition and/or combine like measures and communicate them, using numbers and units.<br>GM3-2: Find areas of rectangles and volumes of cuboids by applying multiplication.<br>NA3-1: Use a range of additive and simple multiplicative strategies with whole numbers, fractions, decimals, and percentages. |
| **Learning Outcomes: Students will be able to:** | • Identify the attributes of a cuboid.<br>• Demonstrate how to find the volume of a cuboid.<br>• Recognise that the volume of an object stays the same when rearranged. |
| **Mathematical language** | Cube, cuboid, face, vertex, vertices, length, breadth, height, surface, centimetre, cubic centimetres, 3-dimensional, 2-dimensional. |
| **Sharing back/Connect** | Select students to share who have found multiple possible solution strategies and represent how to find the volume using multiplication. If no student uses multiplication, then model this for the students and record (1 x 24 x 1).<br><br>**Connect:**<br><br>If the volume of your cuboid is 12 $cm^3$ what are the possible dimensions? |

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| **Teacher Notes** | • To launch the task, facilitate students to describe a 3-D cube and its attributes. Make links to the differences between cubes and cuboids (length, breadth, height). Emphasise that a cube is a special case of a square prism, and a square prism is a special case of a rectangular prism and that they are all cuboids.<br>• Have 24 x 1cm³ cubes to build the cuboids.<br>• Facilitate the students to notice that the volume of an object stays the same (does not change) when cut up and rearranged.<br>• Expect students to represent using 3-D drawings and label these.<br>• For the independent task, have centi-cubes available. |
| **Independent Tasks** | Use 36 x 1cm³ cubes to build different cuboid.<br><br>Draw each building as a 3-D representation and label this to show how you find the volume. |
| **Anticipations** | |

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| **Task 3** |  <br>Here are two towers of starburst lollies. You can choose to keep one of them. Which one would you choose to keep?<br>Represent your solution in a variety of ways and be prepared to justify your reasoning. |
| **Big ideas** | There are a range of attributes that we can measure including length, mass, time, area, angle, and volume. When we measure, we use comparison, specifically, we compare like properties to see which is greater. We can make comparisons using standard or non-standard units of measure and we use mathematical language to describe these.<br>Conceptual understanding of measurement requires understanding of conservation and transitivity. Conservation requires understanding that when moved or subdivided, an object will retain its size. Transitivity involves understanding that the measures of two objects can be compared to a third object. For example, if object A weighs more than object B, and object B weighs more than object C, then object A will weigh more than object C. |
| **Curriculum links** | GM2-2: Partition and/or combine like measures and communicate them, using numbers and units.<br>GM3-2: Find areas of rectangles and volumes of cuboids by applying multiplication.<br>GM4-3: Use side or edge lengths to find the perimeters and areas of rectangles, parallelograms, and triangles and the volumes of cuboids.<br>NA3-1: Use a range of additive and simple multiplicative strategies with whole numbers, fractions, decimals, and percentages.<br>NA4-1: Use a range of multiplicative strategies when operating on whole numbers. |
| **Learning Outcomes: Students will be able to:** | • Compare volume of objects using whole number units.<br>• Use appropriate units/whole numbers to measure volume.<br>• Use multiplicative reasoning to find volume of cuboids. |

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| | • Use side or edge lengths to find volume of cuboids.<br>• Develop a generalised for finding the volume of a cuboid. |
| **Mathematical language** | Rectangular prism, cuboid |
| **Sharing back/Connect** | Select students to share who have developed different explanations to find the total number of starbursts.<br><br>**Connect:**<br><br>Discuss, explore, and refine the explanations until a generalised rule emerges. |
| **Teacher Notes** | • During the launch, establish that there is four starbursts towards the back.<br>• Note, that the measurement for the first tower is 4 x 4 x 14 and the second tower is 4 x 8 x 7.<br>• The aim of the connect is for the students to be able to see each explanation and work at refining all explanations to an agreed on-one explanation that would be generalisable to all tasks.<br>• For the independent task, have multilink cubes available if needed. |
| **Independent Tasks** | What cuboids can you build with these dimensions?<br>What would be the volume for the cuboid?<br><br>1. Length is 6 cubes; width is 3 cubes; height is 2 cubes?<br>2. Length is 5 cubes; width is 4 cubes; height is 3 cubes?<br>3. Length is 4 cubes; width is 3 cubes; height is 3 cubes?<br>4. Length is 8 cubes; width is 4 cubes; height is 2 cubes?<br>5. Length is 3 cubes; width is 2 cubes; height is 1 cube?<br>6. Length is 7 cubes; width is 3 cubes; height is 3 cubes? |
| **Anticipations** | |

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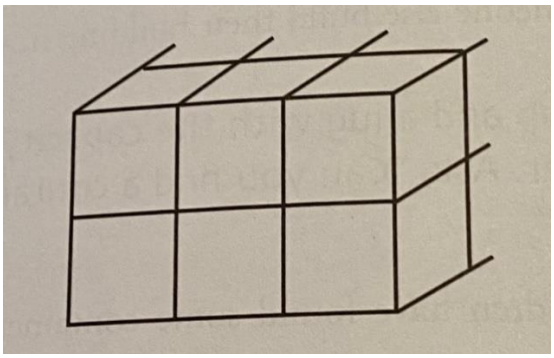
| **Task 4** | Melania has this picture of the front end of a rectangular box.<br>  <br>What might the volume of the box be?<br>Is there only one possible answer or more?<br>Explain and justify your answer. |
| **Big ideas** | There are a range of attributes that we can measure including length, mass, time, area, angle, and volume. When we measure, we use comparison, specifically, we compare like properties to see which is greater. We can make comparisons using standard or non-standard units of measure and we use mathematical language to describe these.<br>There are key principles related to measurement including that the size of the measurement unit remains the same (including identical units or subdivisions), units are repeated with no gaps or overlaps (iteration), the unit is part of a whole and the measurement is expressed as the total number of units used.<br>There are relationships between measurement units, for example, conversion between metric units involves multiplication or division by a power of ten. There are relationships between measurement attributes, for example, the area of a rectangle and the volume of a rectangular prism. |
| **Curriculum links** | GM3-2: Find areas of rectangles and volumes of cuboids by applying multiplication.<br>NA3-1: Use a range of additive and simple multiplicative strategies with whole numbers, fractions, decimals, and percentages. |
| **Learning Outcomes: Students will be able to:** | • Use multiplicative reasoning to find volume.<br>• Use multiplicative reasoning to find a variety of possible volume measurements. |
| **Mathematical language** | Multiples, cuboid, length, breadth, height, dimensions, volume, rectangular |
| **Sharing back/Connect** | Select students to share who have recognised that the volume will be calculated using multiples of six (6 = 3 x 2 x 1 and then 12 = 3 x 2 x 2). If no students recognise this relationship, then model this for the students. |

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| | **Connect:**<br><br>Draw the front end of a box to show volume to be calculated with a different multiple (e.g., 8 or 14) and ask students to find possible volumes. |
| **Teacher Notes** | • Note, some students may see the box as 3 x 1 x 2.<br>• Expect the students to use representations and equations to record their reasoning and solution.<br>• Facilitate students to use multiplicative reasoning and recognise that the volume will always be a multiple of six. |
| **Independent Tasks** | Draw the front end of a box which would have a total volume that will be a multiple of 5 and make the cuboid.<br><br>Draw the front end of a box which would have a total volume that will be a multiple of 9 and make the cuboid.<br><br>Draw the front end of a box which would have a total volume that will be a multiple of 12 and make the cuboid. |
| **Anticipations** | |

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| **Task 5** | Given global warming and Covid-19, schools need air conditioners with air filters which match the volume the classroom.<br><br>What is the volume of your classroom?<br><br>As part of your explanation, draw a representation to use to explain and justify your solution. |
| **Big ideas** | There are a range of attributes that we can measure including length, mass, time, area, angle, and volume. When we measure, we use comparison, specifically, we compare like properties to see which is greater. We can make comparisons using standard or non-standard units of measure and we use mathematical language to describe these.<br>There are key principles related to measurement including that the size of the measurement unit remains the same (including identical units or subdivisions), units are repeated with no gaps or overlaps (iteration), the unit is part of a whole and the measurement is expressed as the total number of units used.<br>There are relationships between measurement units, for example, conversion between metric units involves multiplication or division by a power of ten. There are relationships between measurement attributes, for example, the area of a rectangle and the volume of a rectangular prism. |
| **Curriculum links** | GM3-1: Use linear scales and whole numbers of metric units for length, area, volume and capacity, weight (mass), angle, temperature, and time.<br>GM3-2: Find areas of rectangles and volumes of cuboids by applying multiplication.<br>GM4-1: Use appropriate scales, devices, and metric units for length, area, volume and capacity, weight (mass), temperature, angle, and time.<br>GM4-3: Use side or edge lengths to find the perimeters and areas of rectangles, parallelograms, and triangles and the volumes of cuboids.<br>NA3-1: Use a range of additive and simple multiplicative strategies with whole numbers, fractions, decimals, and percentages. |
| **Learning Outcomes: Students will be able to:** | • Estimate the volume in cubic metres using benchmarks.<br>• Use multiplicative reasoning to find volume of space. |
| **Mathematical language** | Cubic metre, cuboids, cubes, volume, length, width, height. |
| **Sharing back/Connect** | Select student to share who has used a 3-D representation and cubic metre benchmark to justify the volume measure. |

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| | **Connect:**<br><br>Ask students to make a prediction about the volume of another school space using cubic metres and draw a 3-D representation to use to explain and justify their reasoning. |
| **Teacher Notes** | • To launch the task, show students pictures of large spaces (shipping container, refrigerated truck) and facilitate discussion with the students of the need to have larger measures of volume than the use of centimetres cubed ($cm^3$).<br>• Have a cubic metre prepared (use metre rulers and card and newspaper to make or use pre-prepared ones).<br>• Use the term cubic metre and record as 1 $m^3$<br>• Facilitate students to understand that volume is the space inside a unit.<br>• Expect students to use multiplicative relationships to consider the volume and justify this with a 3-D representation.<br>• For the independent task, have a variety of pictures of different sized cuboid spaces (e.g., shipping container, warehouse, classroom, lounge, aquarium). |
| **Independent Tasks** | Predict the volume in cubic metres for each space and record this as $m^3$. Draw a 3-D representation to justify your prediction.<br><br>Choose 5-10 spaces from your home or community. Predict the volume in cubic metres for each space and record this as $m^3$. Draw a 3-D representation to justify your prediction. |
| **Anticipations** | |

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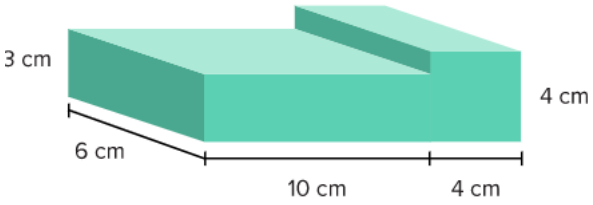
| **Task 6** | The figure below is made of 2 rectangular prisms. What is the volume of the figure?<br>  <br><br>Be ready to explain and justify your reasoning. |
| **Big ideas** | There are a range of attributes that we can measure including length, mass, time, area, angle, and volume. When we measure, we use comparison, specifically, we compare like properties to see which is greater. We can make comparisons using standard or non-standard units of measure and we use mathematical language to describe these.<br>Conceptual understanding of measurement requires understanding of conservation and transitivity. Conservation requires understanding that when moved or subdivided, an object will retain its size. Transitivity involves understanding that the measures of two objects can be compared to a third object. For example, if object A weighs more than object B, and object B weighs more than object C, then object A will weigh more than object C.<br>There are key principles related to measurement including that the size of the measurement unit remains the same (including identical units or subdivisions), units are repeated with no gaps or overlaps (iteration), the unit is part of a whole and the measurement is expressed as the total number of units used.<br>There are relationships between measurement units, for example, conversion between metric units involves multiplication or division by a power of ten. There are relationships between measurement attributes, for example, the area of a rectangle and the volume of a rectangular prism. |
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| | NA3-1: Use a range of additive and simple multiplicative strategies with whole numbers, fractions, decimals, and percentages. |
| **Learning Outcomes: Students will be able to:** | • Use multiplicative reasoning to find volume.<br>• Find the volume of a composite cuboid. |
| **Mathematical language** | Cuboid, cube, volume, rectangular prism, dimension, height, length, depth. |
| **Sharing back/Connect** | Select students to share who have split the composite cuboids into two cuboids and found the volume of each.<br><br>**Connect:**<br><br>How would you find the volume of these stairs? Use a representation and mark in the measurements you would need to find the volume.<br>  |
| **Teacher Notes** | • Facilitate students to notice that volume is the space inside a unit.<br>• Expect students to use multiplication to find the volume and use 3-D representations to explain and justify. |
| **Independent Tasks** | Here is the volume of some blocks of wood.<br>Draw the outline of the block of wood and mark the dimensions in cm which could match the volume.<br>There may be more than one solution so make sure that you have all possible solutions.<br>1. $60cm^3$<br>2. $12cm^3$<br>3. $99cm^3$<br>4. $45cm^3$<br>5. $13cm^3$<br>6. $150\ cm^3$ |
| **Anticipations** | |

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| **Task 7** | Cereal packets are packed in larger boxes and delivered in a container to shops.<br><br>Each packet of cereal has a length of 40 cm, a width of 10 cm, and a height of 15 cm.<br><br>Each **large box** holds ten packets of Weetbix.<br><br>The inside dimension of the container has a length of 6 metres, a width of 2 metres, and a height of 3 metres.<br><br>How many of the large boxes will fit in the container?<br><br>Use a representation to justify your explanation. |
| **Big ideas** | There are key principles related to measurement including that the size of the measurement unit remains the same (including identical units or subdivisions), units are repeated with no gaps or overlaps (iteration), the unit is part of a whole and the measurement is expressed as the total number of units used. There are relationships between measurement units, for example, conversion between metric units involves multiplication or division by a power of ten. There are relationships between measurement attributes, for example, the area of a rectangle and the volume of a rectangular prism. |
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| **Learning Outcomes: Students will be able to:** | • Calculate the volume of a cuboid using multiplication.<br>• Convert $cm^3$ to $m^3$.<br>• Use representations to represent how to find the volume of a cuboid. |

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| **Mathematical language** | Cuboid, cube, volume, rectangular prism, dimensions, length, width, height. |
| **Sharing back/Connect** | Select students to share who explain and justify their solution using a range of measurement language and representations.<br><br>Connect:<br><br>Ask students to identify volume measurement which would use $cm^3$ or $m^3$ with a focus on home and community contexts. |
| **Teacher Notes** | • To launch the task, revisit the need to have larger measures of mass than the use of centimetres cubed ($cm^3$).<br>• Facilitate students to visualise the space taken by a cubic metre and use gesture to represent the volume.<br>• Expect students to use the term cubic metre and record as $m^3$ and to use 3-D representations to justify what would fit inside the container. |
| **Independent Tasks** | Draw a 3-D representation of each of the boxes and mark their dimensions and then solve the problem:<br>1. How many smaller boxes with the dimensions of: length 1cm, width 1cm, height 1cm will fit inside a larger box with the dimensions of: length 4cm, width 2cm, height 2cm?<br>2. How many smaller boxes with the dimensions of: length 4cm, width 1cm, height 1cm will fit inside a larger box with the dimensions of: length 4cm, width 2cm, height 2cm?<br>3. How many smaller boxes with the dimensions of: length 5cm, width 2cm, height 2cm will fit inside a larger box with the dimensions of: length 4cm, width 10cm, height 25cm?<br>4. How many smaller boxes with the dimensions of: length 7cm, width 3cm, height 7cm will fit inside a larger box with the dimensions of: length 30cm, width 10cm, height 2cm? |
| **Anticipations** | |

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| **Task 8** | Find two containers that have the same capacity, will hold more than a litre but are a different shape.<br><br>Prove that they have the same or almost the same capacity. Record the capacity of each container using mL and l.<br><br>Make sure that you explain and justify your reasoning using a range of representations including a number-line. |
| **Big ideas** | There are a range of attributes that we can measure including length, mass, time, area, angle, and volume. When we measure, we use comparison, specifically, we compare like properties to see which is greater. We can make comparisons using standard or non-standard units of measure and we use mathematical language to describe these.<br>Conceptual understanding of measurement requires understanding of conservation and transitivity. Conservation requires understanding that when moved or subdivided, an object will retain its size. Transitivity involves understanding that the measures of two objects can be compared to a third object. For example, if object A weighs more than object B, and object B weighs more than object C, then object A will weigh more than object C.<br>There are key principles related to measurement including that the size of the measurement unit remains the same (including identical units or subdivisions), units are repeated with no gaps or overlaps (iteration), the unit is part of a whole and the measurement is expressed as the total number of units used.<br>There are relationships between measurement units, for example, conversion between metric units involves multiplication or division by a power of ten. There are relationships between measurement attributes, for example, the area of a rectangle and the volume of a rectangular prism. |
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| **Learning Outcomes: Students will be able to:** | • Use standard units (millilitres and litres) to describe and measure capacity.<br>• Calculate the numbers of units to describe the measurement.<br>• Convert metric units of millilitres (ml) to litres (l) |
| **Mathematical language** | Capacity, millilitres, litres, measurement markings, scale. |

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| **Sharing back/Connect** | Select students to share who have used a variety of representations including a number line with equally spaced marks to represent equal volume between measurements. Encourage and model the use of standard unit measurement language (e.g., millilitres, litres, 500mL is halfway to 1L).<br><br>**Connect:**<br><br>Have a number line which is marked from 50 mL to 1000mL with a scale but no other numbers. Ask students to identify how many millilitres would be represented at certain points.<br><br>Have a number line which is marked from 50 mL to 2 litres with a scale but no other numbers. Ask students to identify how many litres and millilitres would be represented at certain points. |
| **Teacher Notes** | • To launch the task, show students a jug with milli-litre markings and ask them to stretch a number-line to match the scale. Facilitate the students to notice that the marks on the number line should be equally spaced because the spaces between them represent slices of equal capacity/volume.<br>• Have a range of measuring tools (jugs, cups, measuring spoons) with different marked measures and closely watch for students who choose inappropriate measures.<br>• Facilitate the students to recognise that one litre is 1000mL. Press them to go above 1 litre including using fractional language. Make links to the terms, millilitre, and millimetre, and that the term milli represents one thousand. |
| **Independent Tasks** | Kilogram (kg), gram (g), milligram (mg), kilometre (km), metre (m), centimetre (cm), millimetre (mm), litre (l), millilitre (mL)<br><br>Write the unit that would be used to measure:<br>1. Quantity of water used in a bath<br>2. The mass of a bee<br>3. The length of the classroom<br>4. Coffee in a jar<br>5. Your pencil<br>6. Coffee in a cup<br>7. The water in your drink bottle<br>8. The mass of a large bag of apples<br>9. A spoonful of medicine<br>10. The mass of a feather<br><br>Write ten more things and the unit you would use to measure them. |

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| **Task 9** | Find three things which would have a total mass of 1.5 kilograms.<br><br>Draw a number line to represent the mass measure of each item and show how altogether their estimated mass is 1.5 kilograms.<br><br>Now use the scales to check the mass of each object against your estimation.<br><br>Draw another number line to represent the mass measure of each item from the scale and show the individual and combined mass.<br><br>How close to 1.5 kilograms was your estimation? |
| **Big ideas** | There are a range of attributes that we can measure including length, mass, time, area, angle, and volume. When we measure, we use comparison, specifically, we compare like properties to see which is greater. We can make comparisons using standard or non-standard units of measure and we use mathematical language to describe these.<br>There are key principles related to measurement including that the size of the measurement unit remains the same (including identical units or subdivisions), units are repeated with no gaps or overlaps (iteration), the unit is part of a whole and the measurement is expressed as the total number of units used.<br>There are relationships between measurement units, for example, conversion between metric units involves multiplication or division by a power of ten. There are relationships between measurement attributes, for example, the area of a rectangle and the volume of a rectangular prism. |
| **Curriculum links** | GM3-1: Use linear scales and whole numbers of metric units for length, area, volume and capacity, weight (mass), angle, temperature, and time.<br>GM4-1: Use appropriate scales, devices, and metric units for length, area, volume and capacity, weight (mass), temperature, angle, and time.<br>GM4-2: Convert between metric units, using whole numbers and commonly used decimals.<br>GM4-4: Interpret and use scales, timetables, and charts. |
| **Learning Outcomes: Students will be able to:** | • Estimate the mass of objects in grams and kilograms.<br>• Find the mass of objects in grams and kilograms using a scale.<br>• Convert grams to kilograms.<br>• Use measurement language to describe the measurement of mass.<br>• Use linear scales to represent mass |
| **Mathematical language** | Mass, massive, massive, equal, kilogram, gram, scale. |

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| **Sharing back/Connect** | Select students to share who have closely approximated a total mass of 1.5 kg (including slightly below and above).<br><br>**Connect:**<br><br>Ask students to explain and justify which measure is closest to 1.5 kilograms.<br><br>1kg and 49g or 1490g<br>1.511kg or 1490g<br>1500g or 1½kg |
| **Teacher Notes** | • To launch the task, ask students if they have heard the word 'gram' and 'kilogram' and what they think it means. Have centi-cube (1gm) and bags of objects which have a mass equivalent to 500grams and 1 kg. Let the students lift and hold them. Discuss the use of g for grams and kg for kilograms to record the measures of mass.<br>• Have analogue/digital scales and a selection of objects.<br>• Use the term finding the mass and not weighing. Facilitate the students to use the terms more massive or less massive rather than heavier or lighter. or so on. Discuss the use of mg, g and kg, and decimals and fractions to describe and record measures of mass.<br>• Note, the mass of an object is the amount of matter in it. The mass of the object is measured by the number of unit masses that balance it. A kilogram is a national and international agreed unit (metric standard) for measuring mass and is recorded as kg and gram is recorded as g. Scales find the weight of an object. This is the force of gravity by which it is attracted to the Earth (gravitational pull). However, because gravity is almost the same everywhere on Earth an object's weight provides a good estimate of its mass. |
| **Independent Tasks** | Solve the first multiple choice questions and then write 10 more of your own.<br><br>A marble will have a mass of about<br>1g 50mg 5g<br><br>A man could have a mass of about<br>80kg 8kg 8g<br><br>A truck could have a mass of about<br>500kg 5t 500g<br><br>A large whale will have a mass of about<br>20g 50kg 50t |

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| | A teaspoon will have a capacity of about<br>300ml 5ml 5l<br><br>A cup of water will have a capacity of about<br>350ml 5ml 1l |
| **Anticipations** | |

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| **Task 10** | For Maia's birthday party her family ordered small bottles of mixed soft drinks. Each bottle contained 635ml of drink.<br><br>They bought 60 bottles but only 47 bottles were used.<br><br>How much in litres and millilitres was used?<br>How much in litres and millilitres was left? |
| **Big ideas** | There are relationships between measurement units, for example, conversion between metric units involves multiplication or division by a power of ten. There are relationships between measurement attributes, for example, the area of a rectangle and the volume of a rectangular prism.<br>Equations show relationships of equality between parts on either side of the equal sign. The properties of equality are: If the same real number is added or subtracted to both sides of an equation, equality is maintained; If both sides of an equation are multiplied or divided by the same real number (not dividing by 0), equality is maintained; Two quantities equal to the same third quantity are equal to each other. A solution to an equation is a value of the unknown or unknowns that makes the equation true. Properties of equality and the inverse property can be used to generate equivalent equations and find solutions.<br>There are arithmetic properties that characterise addition and multiplication as operations. These are the commutative, associative, distributive, and identity properties. Addition and subtraction and multiplication and division have an inverse relationship. Relationships can be described and generalisations made for mathematical situations that have numbers or objects that repeat or grow in predictable ways. |
| **Curriculum links** | GM3-1: Use linear scales and whole numbers of metric units for length, area, volume and capacity, weight (mass), angle, temperature, and time.<br>GM4-2: Convert between metric units, using whole numbers and commonly used decimals.<br>NA3-1: Use a range of additive and simple multiplicative strategies with whole numbers, fractions, decimals, and percentages.<br>NA4-1: Use a range of multiplicative strategies when operating on whole numbers. |
| **Learning Outcomes: Students will be able to:** | • Solve multiplication problems that involve capacity including millilitres and litres.<br>• Convert between millilitres and litres. |
| **Mathematical language** | Capacity, litres, millilitres, difference, multiplication, subtraction. |
| **Sharing back/Connect** | Select students to share who use the distributive property or equivalence and compensation and have recognised that 1000mL equals a litre and converted between the two units of measure. |

<table>
<tr><td></td><td>Connect:<br><br>Discuss and explore the use of decimals to record in litres and millilitres. Model how you would record 1400 millilitres as 1.4 litres. Ask students to convert the following:<br><br>1800 millilitres to litres<br>2.5 litres to millilitres<br>900 millilitres to litres<br>1.25 litres to millilitres<br>75 millilitres to litres.</td></tr>
<tr><td>Teacher Notes</td><td>• To launch the task, explore different shaped containers (drink bottles) that hold millilitres and litres.<br>• Expect students to represent using equations.<br>• Facilitate students to make connections in relation to converting between millilitres and litres.</td></tr>
<tr><td>Independent Tasks</td><td>These measurements have got all in a jumble. Sort them so they match correctly.<br><br>
<table>
<tr><td>Area of a football field</td><td>26</td><td>Metres</td></tr>
<tr><td>Capacity of a bath</td><td>50000</td><td>Seconds</td></tr>
<tr><td>Height of a 3-year-old</td><td>5</td><td>$m^2$</td></tr>
<tr><td>Length of a finger</td><td>60</td><td>Kg</td></tr>
<tr><td>Mass of a ship</td><td>7000</td><td>kilometres</td></tr>
<tr><td>Time for a sprinter to run 100m</td><td>1</td><td>Litres</td></tr>
<tr><td>Your walking speed</td><td>300</td><td>Mm</td></tr>
<tr><td>Temperature of a glacier</td><td>80</td><td>℃</td></tr>
<tr><td>Snail’s speed</td><td>37</td><td>$m^3$</td></tr>
<tr><td>Temperature of the human body</td><td>2600000</td><td>Tonnes</td></tr>
<tr><td>Area of a stamp</td><td>3.5</td><td>mm/second</td></tr>
<tr><td>Volume of Egypt’s Great Pyramid</td><td>10</td><td>℃</td></tr>
<tr><td>Mass of a baby</td><td>1</td><td>$mm^2$</td></tr>
<tr><td>Length of a marathon</td><td>-20</td><td>km/h</td></tr>
</table></td></tr>
<tr><td>Anticipations</td><td></td></tr>
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| **Task 11** |  <br><br>This weekend our church had a special children's celebration for White Sunday. TJ and his friends had to mix the orange juice for lunch. He had two recipes for mixing the orange juice. They were told to make the one with the most orange taste because most children preferred that.<br><br>Recipe 1: Mix 2l orange to 3l water<br>Recipe 2: Mix 3l orange to 5l water<br><br>Which recipe did they use? |
| **Big ideas** | There are relationships between measurement units, for example, conversion between metric units involves multiplication or division by a power of ten. There are relationships between measurement attributes, for example, the area of a rectangle and the volume of a rectangular prism.<br>Ratio is a relationship between two numbers of the same kind and a way of comparing two things of the same kind. |
| **Curriculum links** | GM3-1: Use linear scales and whole numbers of metric units for length, area, volume and capacity, weight (mass), angle, temperature, and time.<br>GM4-2: Convert between metric units, using whole numbers and commonly used decimals.<br>NA3-1: Use a range of additive and simple multiplicative strategies with whole numbers, fractions, decimals, and percentages.<br>NA4-4: Apply simple linear proportions, including ordering fractions. |
| **Learning Outcomes: Students will be able to:** | • Solve ratio problems involving litres and millilitres by using equivalent relationships.<br>• Solve ratio problems involving litres and millilitres by using a representation.<br>• Convert between litres and millilitres. |
| **Mathematical language** | Capacity, ratio, litre, millilitre, equivalent. |
| **Sharing back/Connect** | Select students to share who use a representation to solve the problem or equivalent relationships. If no students use an equivalent relationship, then model this for them. |

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| | **Connect:**<br><br>Ask the students to provide different recipes that would make the drink have a stronger or weaker orange taste. |
| **Teacher Notes** | • Expect students to use representations to represent the ratio and relationship.<br>• Facilitate students to notice that the numbers can be adjusted using equivalent relationships.<br>• Monitor for students using measurement language and conversions between litres and millilitres. |
| **Independent Tasks** | Identify the attribute being measured: Volume, capacity, mass<br><br>The amount of matter that makes up a sheep.<br>The amount of liquid medicine given to a human<br>The amount of space inside a shipping container<br>The space inside a tent<br>The water inside a pool<br>The amount of matter that makes up a milk tanker<br>The amount of matter that makes up a packet of rice |
| **Anticipations** | |

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| **Task 12** | You and your cousin are making recipes for lemon drink.<br><br>Recipe 1: 200ml of lemon juice and 300ml of water.<br><br>Recipe 2: 100ml of lemon juice and 200ml of water.<br><br>You want to make the one with the least lemon taste. Your cousin wants to make the one with the strongest lemon taste.<br><br>Which one do you each make? |
| **Big ideas** | There are relationships between measurement units, for example, conversion between metric units involves multiplication or division by a power of ten. There are relationships between measurement attributes, for example, the area of a rectangle and the volume of a rectangular prism.<br>Ratio is a relationship between two numbers of the same kind and a way of comparing two things of the same kind. |
| **Curriculum links** | GM3-1: Use linear scales and whole numbers of metric units for length, area, volume and capacity, weight (mass), angle, temperature, and time.<br>GM4-2: Convert between metric units, using whole numbers and commonly used decimals.<br>NA3-1: Use a range of additive and simple multiplicative strategies with whole numbers, fractions, decimals, and percentages.<br>NA4-4: Apply simple linear proportions, including ordering fractions. |
| **Learning Outcomes: Students will be able to:** | • Solve ratio problems involving litres and millilitres by using equivalent relationships.<br>• Solve ratio problems involving litres and millilitres by using a representation.<br>• Convert between litres and millilitres. |
| **Mathematical language** | Capacity, litre, millilitres, unit measure, ratio, equivalent. |
| **Sharing back/Connect** | Select students to share who use a representation to solve the problem or equivalent relationships. If no students use an equivalent relationship, then model this for them.<br><br>**Connect:**<br><br>Ask the students to provide different recipes that would make the drink have a stronger or weaker orange taste. |
| **Teacher Notes** | • Expect students to use representations to represent the ratio and relationship.<br>• Facilitate students to notice that the numbers can be adjusted using equivalent relationships. |

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| | Monitor for students using measurement language and conversions between litres and millilitres. |
| **Independent Tasks** | Select one or more of the following assessment tasks (attached at the end of the document) as the independent activity:<br><br>M45: Volume of Rubik cube<br><br>M13: Volume: Design a chocolate box<br><br>M3D: Mass: Find a collection of objects with a mass of 2.5kg |
| **Anticipations** | |

# DMIC

## DEVELOPING MATHEMATICAL INQUIRY COMMUNITIES
## ASSESSMENT TASK

MEASUREMENT - MASS, VOLUME, CAPACITY: LEVEL 3 Task M45

Rubik's cubes were invented by a Hungarian professor. What would the volume be for the traditional Rubik cube? Explain and justify how you found the volume (NB: each cube is $1cm^3$).

Companies have designed more challenging puzzles. Can you find the volume for each of these and explain and justify your solution? (NB: each cube is $1cm^3$).

DMIC
DEVELOPING MATHEMATICAL INQUIRY COMMUNITIES
ASSESSMENT TASK

MEASUREMENT – MASS, VOLUME, CAPACITY: LEVEL 3-4 Task M13

Cadbury wants to make a new box for their chocolates. Each chocolate is a cube that measures 2 $cm^3$

They would like to fit 24 chocolates in the box. Can you design some different options for them to choose from and include the measurements and volume of the boxes?

# DMIC
## DEVELOPING MATHEMATICAL INQUIRY COMMUNITIES
## ASSESSMENT TASK

MEASUREMENT – MASS, VOLUME, CAPACITY: LEVEL 3 Task M3D

Find a collection of objects that have a total mass of 2.5 kilograms. Record the mass measure of each object and use representations such as a number-line to show how altogether the mass is 2.5kg.

(Teacher notes: Provide students with an analogue or digital scale and a collection of objects to measure).