

1 Millimetre = 1 Cubic Centimetre, Convert between Liquid Units.

Table of Contents

Teaching Plan Overview and Summary.....	page 2
Relationship between cubic and liquid units of measurement of volume and capacity – 1 millilitre = 1 cubic centimetre	page3
Convert between liquid units of measurement of volume and capacity - millilitres and litres, litres and kilolitres, kilolitres and megalitres	page15

Differentiate and Assess

Not every student will be ready to investigate this concept at this Level and so we will need to differentiate to ensure every student is learning at their leading edge. Select the Differentiate button on this screen.

Integrate

Every mathematical concept is integrally related to other mathematical concepts. Teaching and learning related concepts simultaneously develops deep relational understanding. Select the Integrate button on this screen.

Intervene

Some students may not yet be ready to investigate this concept at any Level, and so we will need to provide some intervention. Select the Intervention button on this screen.

1 MILLIMETRE = 1 CUBIC CENTIMETRE, CONVERT BETWEEN LIQUID UNITS.

EXPLICIT TEACHING PLAN OVERVIEW PAGE

THIS PAGE IS A SUMMARY OF THE EXPLICIT TEACHING PLAN, INCLUDING STRATEGIC QUESTIONS, AND DESCRIBING THE SEQUENCE WHICH WILL OCCUR OVER MULTIPLE LESSONS.

RESOURCES: CONNECTING CUBIC CENTIMETRES, MEDICINE CUP WITH SCALE MARKED IN MILLILITRES, MEASURING JUG WITH SCALE MARKED IN MILLILITRES, WATER, MOISTURISER JAR AND PACKAGING, MULTIPLICATIVE PLACE VALUE CHART, MEASURING JUG, PENCIL, PAPER

WHAT COULD WE DO?

Children:

- investigate the relationship between cubic and liquid units of measurement, for example,
 - measure the volume and capacity of the box in cubic centimetres
 - measure the volume of the jar using displacement in millilitres
 - realise we can't compare the volumes because we are using different units of measurement
- investigate the relationship between cubic centimetres and millilitres, 1 millilitres has a volume of 1 cubic centimetre
- convert the volume and capacity of the box into millilitres
- convert the volume of the jar into cubic centimetres
- measure the capacity of the jar in millilitres and convert to cubic centimetres
- fill the jar with a volume of water corresponding to the volume of moisturiser stated on the box
- identify the relationships between the volumes and capacities

- convert between millilitres, litres, kilolitres, megalitres using multiplicative place value and fractions.

WHAT LANGUAGE COULD WE USE TO EXPLAIN AND ASK QUESTIONS?

Children

- ask one another questions about the relationship between cubic and liquid units, converting between millilitres and cubic centimetres, millilitres, litres, kilolitres and megalitres, for example:
 - ▶ how could we measure the volume and capacity of this moisturiser box in cubic centimetres?
 - ▶ how could we use displacement to measure the volume of this moisturiser jar in millilitres?
 - ▶ how could we compare the volume of the box and the volume of the jar?
 - ▶ could we use the relationship between cubic centimetres and millilitres?
 - ▶ how could we measure the capacity of the jar?
 - ▶ how could we convert between cubic centimetres and millilitres?
 - ▶ what are the relationships between the volume and capacity of the box and the jar?

 - ▶ how could we use multiplicative place value and fractions to convert between millilitres, litres, kilolitres, megalitres?

1 MILLIMETRE = 1 CUBIC CENTIMETRE, CONVERT BETWEEN LIQUID UNITS.

EXPLICIT TEACHING PLAN

FULL EXPLICIT TEACHING PLAN, EMBEDDING DEEP RELATIONAL UNDERSTANDING, METALANGUAGE, AND QUESTIONS THAT MAY BE USED OVER MULTIPLE LESSONS.

WHAT COULD WE DO?

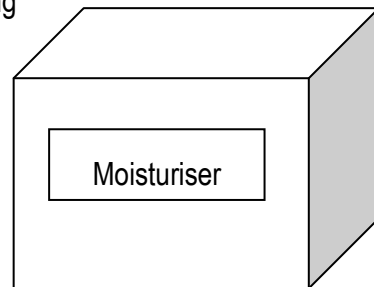
Children think about, talk and listen to a friend about, then have the opportunity to share what they already know.

WHAT LANGUAGE COULD WE USE TO EXPLAIN AND ASK QUESTIONS?

- ▶ Today brings an investigation about volume and capacity.
- ▶ What do you know about volume and capacity?
- ▶ Talk about volume and capacity with a friend.
- ▶ Is anyone ready to share what they are thinking about volume and capacity?

- ▶ We've investigated volume and capacity.
- ▶ And we found that volume is the amount of space an object takes up in 3 dimensions.
- ▶ We found that the dimensions in an object are up and down and front to back and left to right.
- ▶ And we found that capacity is the volume a container holds when it is filled to capacity.
- ▶ We've investigated measuring volume and capacity of models and prisms using cubic units of measurement - cubic centimetres and cubic metres.
- ▶ We've investigated measuring volume and capacity of objects and containers with curved surfaces using liquid units of measurement - litres and millilitres.
- ▶ We investigated measuring the volume of objects using displacement.
- ▶ We found that the volume that a container holds when it is filled to capacity, is equal to its capacity.

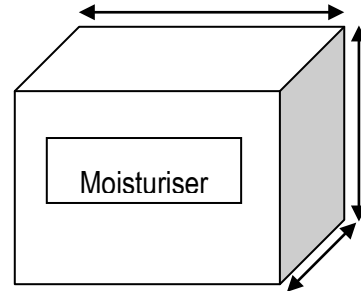
Display a rectangular prism-shaped packaging for moisturiser, for example,



Record, for example, rectangular prism

- ▶ And we found that the volume of water that an object displaces when submerged in water is equal to its volume.
- ▶ We found that when a container has thin surfaces, its volume and capacity are almost the same.
- ▶ Today we're going to investigate the relationship between liquid and cubic units of measurement.
- ▶ Here we have a box, with a jar of moisturiser inside.
- ▶ How could we compare the volume and capacity of the box with the volume and capacity of the jar?
- ▶ How could you describe this object?
- ▶ What is a face?
- ▶ Is a face a flat surface with straight lines?
- ▶ How many faces?
- ▶ Does it have 6 faces?
- ▶ What shape are the faces?
- ▶ Are the faces rectangles?
- ▶ How many bases?
- ▶ Are there 2 bases?
- ▶ What shape are the bases?
- ▶ Are the bases rectangles?
- ▶ If there are two rectangular bases, and the faces that are not bases are rectangles, is this a rectangular prism?

Indicate the 3 dimensions, for example,



Record, for example, length = 1 dimension

Record, for example, area = 2 dimensions

Record, for example, volume and capacity = 3 dimensions

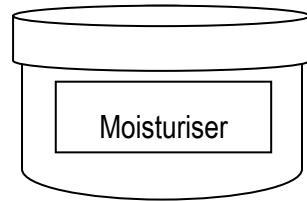
Give children time to measure and calculate the volume and capacity of the box.

- ▶ How many dimensions does this rectangular prism have?
- ▶ What are the dimensions?
- ▶ Does it go left to right, up and down and front to back?
- ▶ Does the rectangular prism have three dimensions?

- ▶ If we measure 1 dimension of the rectangular prism, will we be measuring length?
- ▶ If we measure 2 dimensions of the rectangular prism, will we be measuring area?
- ▶ If we measure all 3 dimensions of the rectangular prism, will we be measuring volume and capacity?
- ▶ Is this rectangular prism hollow?

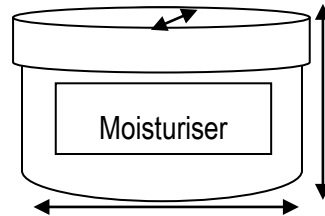
- ▶ Could we measure the capacity of the rectangular prism?
- ▶ Because the surface of this rectangular prism is thin, will the volume and capacity be just about the same?
- ▶ Could we use cubic units of measurement to measure the volume and capacity?

Take out the cylindrical moisturiser jar that came in the packaging displayed earlier, for example,



Record, for example, cylinder

Indicate the 3 dimensions, for example,



Record, for example, length = 1 dimension

Record, for example, area = 2 dimensions

Record, for example, volume and capacity = 3 dimensions

Indicate to the thick walls on the jar.

- ▶ How could you describe this object?
- ▶ What is a face?
- ▶ Is a face a flat surface with straight lines?
- ▶ Does this object have any faces?
- ▶ Does this object have a curved surface and 2 flat surfaces?
- ▶ How many bases?
- ▶ Are there 2 bases?
- ▶ What shape are the bases?
- ▶ Are the bases circles?
- ▶ If there is 1 curved surface, 2 flat surfaces, and 2 circular bases, is this a cylinder?

- ▶ How many dimensions does this cylinder have?
- ▶ What are the dimensions?
- ▶ Does it go left to right, up and down and front to back?
- ▶ Does the cylinder have three dimensions?
- ▶ If we measure 1 dimension of the cylinder, will we be measuring length?
- ▶ If we measure 2 dimensions of the cylinder, will we be measuring area?
- ▶ If we measure all 3 dimensions of the cylinder, will we be measuring volume and capacity?

- ▶ Because the surface of this cylinder is thick, will the volume and capacity be different?
- ▶ How could we measure the capacity of the cylinder?
- ▶ Could we measure the capacity by filling it with water then measuring the

Display 5 connecting cubic centimetres, for example,



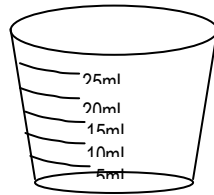
Record, for example, 5 cubic centimetres

volume of water?

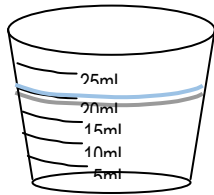
- ▶ How could we measure the volume of the cylinder?
- ▶ Could we measure the volume by submerging it in water then measuring the volume of water it displaces?
- ▶ Could we use liquid units of measurement to measure the volume and capacity of this cylinder?
- ▶ So we will use a cubic unit of measurement to measure the volume and capacity of the rectangular box.
- ▶ And we will use a liquid unit of measurement to measure the volume and capacity of the jar.
- ▶ That will make it difficult to compare their volumes and capacities.
- ▶ Do you think the European mathematicians who invented the metric system thought of this?
- ▶ Do you think they created a relationship between the cubic units of measurement and the liquid units of measurement?
- ▶ Let's investigate by starting with cubic units.

- ▶ What do you know about these cubes?
- ▶ What is the volume of each cube?
- ▶ Is each cube, a cubic centimetre?
- ▶ If we join 5 of them together, what will the model's volume be?
- ▶ Will the model's volume be 5 cubic centimetres?
- ▶ Imagine we wanted to find the volume of the 5 cubic centimetres in millilitres.
- ▶ Could we fill them with water?
- ▶ No, we couldn't fill them with water because they are not hollow.
- ▶ Could we submerge them in water, and measure the volume of water that they

Distribute a medicine measuring cup and 5 connecting cubic centimetres to children in small groups or pairs, for example,



Children fill their medicine cup to 20 millilitres with water, for example,



Observe and question children as they use displacement to find the volume of the 5 cubic centimetres in millilitres

Record, for example, 5 cubic centimetres = 5 millilitres

displace?

- ▶ What do you know about this medicine measuring cup?
- ▶ What units of measurement can you see on the scale?
- ▶ Can you see millilitres?
- ▶ Could we fill the medicine cup to a level that will cover the model of cubes?

- ▶ Let's fill the medicine measuring cup to 20 millilitres.
- ▶ What volume of water is in the medicine measuring cup?
- ▶ Is there 20 millilitres of water in the medicine measuring cup?
- ▶ If we submerge the model of 5 cubic centimetres in the water, what will happen to the level of the water?
- ▶ Will the level of the water rise?
- ▶ Why?
- ▶ Will the model displace some of the water?

- ▶ Let's submerge the model of 5 cubic centimetres in the 20 millilitres of water.
- ▶ What volume of water did the model of 5 cubic centimetres displace?
- ▶ Did the model of 5 cubic centimetres displace 5 millilitres of water?
- ▶ If the model of 5 cubic centimetres displace 5 millilitres of water, what is the volume of 5 cubic centimetres in millilitres?

- ▶ Is the volume of 5 cubic centimetres, 5 millilitres

Record, for example, 1 cubic centimetre = 1 millilitre

Have students investigate the relationship between millilitres and cubic centimetres and then convert between these two units of measurement, using the cubic centimetres and measuring jugs to check

Distribute an empty jar of moisturiser and the box it came in to children in small groups or pairs. A variety of brands and sizes will deepen understanding.

Allow children to measure the volume and capacity of the box by:

- packing with cubic centimetres in layers or
- working out the number of cubic centimetres in 1 layer and multiplying by the number of layers or
- measuring the lengths of each dimension, and multiplying

Allow children to record the volume and capacity of the box in cubic centimetres, for example, 200 cubic centimetres. (This will vary between brands.)

Allow children to record the volume and capacity of the box in millilitres, for example, 200 millilitres. (This will vary between brands.)

- ▶ If 5 cubic centimetres have a volume of 5 millilitres, what will the volume of 1 cubic centimetre be in millilitres?
- ▶ So what relationship did the European mathematicians make between the cubic unit of measurement and the liquid unit of measurement?
- ▶ If we could turn one millilitre of water into a cube, would it take up the space of 1 cubic centimetre?
- ▶ Do you think that understanding this relationship could make us better consumers? Let's investigate!

- ▶ Here we have a box with a container of moisturiser in it.
- ▶ We're going to measure the volume and capacity of the box and the jar, and then compare them to volume of moisturiser that came in the jar.

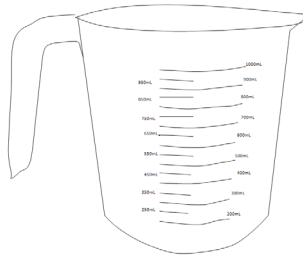
- ▶ Let's measure the volume and capacity of the box.
- ▶ Because it is a prism, could we measure its volume and capacity in cubic units?
- ▶ Because the walls of the box are thin, will its volume and capacity be almost the same?

- ▶ Let's record the volume and capacity of the box in cubic centimetres.
- ▶ How could we convert the volume and capacity in cubic centimetres to millilitres?
- ▶ What is the relationship between cubic centimetres and millilitres?
- ▶ Is 1 cubic centimetre and 1 millilitre the same volume?
- ▶ Let's record the volume and capacity of the box in millilitres.

- ▶ Let's measure the volume and capacity of the jar.

Distribute 1 litre measuring jug to children in small groups

Allow children to measure the volume of the jar by filling a litre measuring jug to about 600 millilitres, then submerging the jar in the water, then measuring the volume of water displaced.



Allow children to record the volume of the jar in millilitres, for example, 140 millilitres. (This will vary between brands.)

Allow children to record the volume of the jar in cubic centimetres, for example, 140 cubic centimetres. (This will vary between brands.)

Allow children to find what fraction or percentage of the volume of the box is the volume of the jar, for example, $\frac{140}{200} = \frac{70}{100} = \frac{7}{10} = 70\%$ (This will vary between brands.)

- ▶ Because the surface of the jar is thick, will the volume and capacity be different?
- ▶ How could we find the volume of the jar?
- ▶ Because it has curved surfaces, will we use millilitres?
- ▶ Could we use displacement to find the volume?
- ▶ Could we submerge the jar in water and measure the volume of water it displaces?
- ▶ Will the volume of water it displaces tell us the jar's volume?

- ▶ Let's record the volume of the jar in millilitres.
- ▶ How could we convert the volume in millilitres to cubic centimetres?
- ▶ What is the relationship between millilitres and cubic centimetres?
- ▶ Is 1 millilitre and 1 cubic centimetre the same volume?
- ▶ Let's record the volume of the jar in cubic centimetres.

- ▶ Let's pause to compare the volume of the box and the volume of the jar.
- ▶ What fraction or percentage of the volume of the box is the volume of the jar?
- ▶ Why do you think the manufacturer made the box rectangular and the jar cylindrical?
- ▶ Does this make comparing their volumes trickier?

- ▶ Let's continue our investigation by working out the capacity of the jar

Allow children to measure the capacity of the jar by filling the jar to capacity with water, then measuring the volume of water in millilitres.

Allow children to record the capacity of the jar in millilitres, for example, 70 millilitres. (This will vary between brands.)

Allow children to record the capacity of the jar in cubic centimetres, for example, 70 cubic centimetres. (This will vary between brands.)

Allow children to find what fraction or percentage of the volume of the jar is the capacity of the jar, for example, $\frac{70}{140} = \frac{7}{14} = \frac{1}{2} = 50\%$. (This will vary between brands.)

Allow children to read on the label the original volume of moisturiser.

Allow children to record the volume of moisturiser in millilitres, for example, 50 millilitres. (This will vary between brands.)

Allow children to record the volume of moisturiser in cubic centimetres, for example,

- ▶ How could we work out the capacity of the jar?
- ▶ Could we fill the jar to capacity with water, then measure the volume of water in millilitres?

- ▶ Let's record the capacity of the jar in millilitres.
- ▶ How could we convert the capacity in millilitres to cubic centimetres?
- ▶ What is the relationship between millilitres and cubic centimetres?
- ▶ Is 1 millilitre and 1 cubic centimetre the same capacity?
- ▶ Let's record the capacity of the jar in cubic centimetres.

- ▶ Let's pause to compare the capacity of the jar and the volume of the jar.
- ▶ What fraction or percentage of the volume of the jar is the capacity of the jar?

- ▶ Why do you think the manufacturers made the sides of the jar so thick?

- ▶ Let's now identify the volume of moisturiser that the jar actually held when it was sold.
- ▶ Find on the label what the volume of moisturiser was.
- ▶ Let's record the volume of moisturiser in millilitres.
- ▶ How could we convert the volume of moisturiser in millilitres to cubic centimetres?
- ▶ What is the relationship between millilitres and cubic centimetres?
- ▶ Is 1 millilitre and 1 cubic centimetre the same volume?
- ▶ Let's record the volume of moisturiser in cubic centimetres.

50 cubic centimetres. (This will vary between brands.)

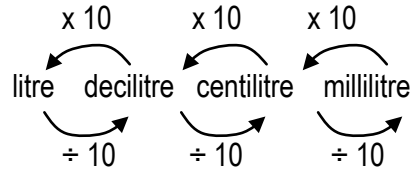
Allow children to find what fraction or percentage of the capacity of the jar was the volume of moisturiser, for example, $\frac{50}{70} = \frac{5}{7}$. (This will vary between brands.)

Allow children to measure the same volume of water and to pour it into the jar, identifying where the actual space the moisturiser took up.

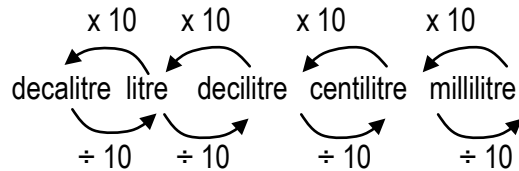
- ▶ Let's pause to compare the capacity of the jar and the volume of moisturiser.
- ▶ What fraction or percentage of the capacity of the jar was the volume of moisturiser?
- ▶ What was the volume of moisturiser?
- ▶ Let's make the same volume in water.
- ▶ Let's pour the same volume of water into the jar to see how much space the moisturiser took up.

▶ Today we're going to investigate converting between liquid units of

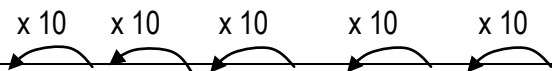
Record a metric system chart for liquid units of measurement, for example,



Record, for example,



Record, for example,

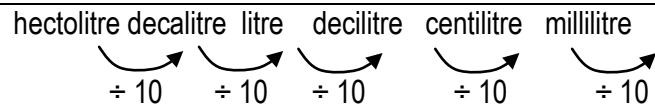


measurement.

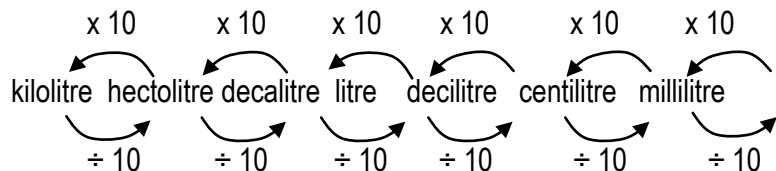
- ▶ We've investigated metric measurement.
- ▶ And we found that the European mathematicians who invented it based it on multiplicative place value because they multiplied and divided by 10.
- ▶ We found that if we divide a litre by 10, we have a decilitre, if we divide a decilitre by 10, we have a centilitre, and if we divide a centilitre by 10, we have a millilitre
- ▶ Could we continue dividing by 10 forever?
- ▶ If we divide a millilitre by 10 we have a tenth of a millilitre. If we divide a tenth of a millilitre by 10, we have a hundredth of a millilitre. And if we divide a hundredth of a millilitre by 10, we have a microlitre.
- ▶ A microlitre is a millionth of a litre.
- ▶ A nanolitre is a billionth of a litre
- ▶ And a picolitre is a trillionth of a litre!
- ▶ If we continue dividing by 10, will we get smaller and smaller units? Will each unit be 10 TIMES smaller than the unit before it?

- ▶ Could we also multiply by 10 forever?
- ▶ If the litre is too small, could we multiply it by 10?
- ▶ What unit of measurement would we have?
- ▶ Would we have a decalitre?
- ▶ Does the prefix 'deca' mean 10?

- ▶ If the decalitre is too small, could we multiply it by 10?



Record, for example,



- ▶ What unit of measurement would we have?
- ▶ Would we have a hectolitre?
- ▶ Does the prefix 'hecto' mean 100?

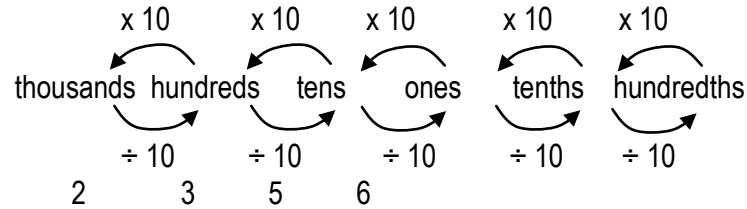
- ▶ If the hectolitre is too small, could we multiply it by 10?
- ▶ What unit of measurement would we have?
- ▶ Would we have a kilolitre?

- ▶ Could we continue multiplying by 10?
- ▶ If we multiply a kilolitre by 10 we have 10 kilolitres. If we multiply 10 kilolitres by 10, we have 100 kilolitres. And if we multiply 100 kilolitres by 10, we have a megalitre.
- ▶ A megalitre is a million litres.
- ▶ A gegalitre is a billion litres.
- ▶ And a teralitre is a trillion litres!
- ▶ If we continue multiplying by 10, will get larger and larger units? Will each unit be 10 TIMES larger than the unit before it?
- ▶ Which units of measurement do we use?
- ▶ Do we use millilitres, litres and kilolitres?
- ▶ In Europe and Arabic countries, they use centilitres.
- ▶ Drink bottles from Europe and Arabic countries have the abbreviation cL, meaning centilitres.

- ▶ We've investigated converting between length units of measurement using place value.

Record, for example, 2356 millilitres

Record 2356 in a place value chart, for example,



Record, for example, 1000 millilitres = 1 litre

Record, for example, 2000 millilitres = 2 litres

Record, for example, 3000 millilitres = 3 litres

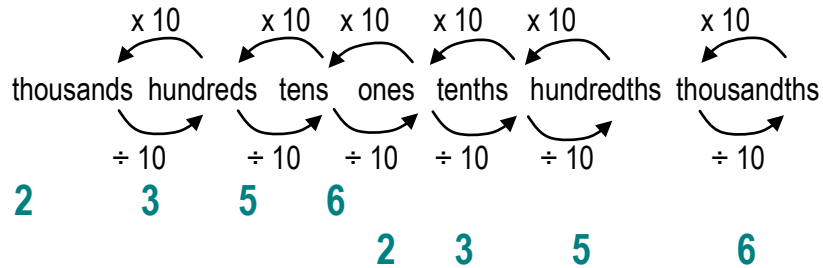
Record, for example, $2356 \div 1000 =$

► **Let's investigate how we can use place value to convert between liquid units of measurement.**

- Let's record a volume in millilitres.
- Let's record 2356 in a place value chart.

- If we have 1000 millilitres – how many litres do we have?
- Do we have 1 litre?
- What did we do to the number of millilitres to get litres – did we divide by 1000?
- If we have 2000 millilitres – how many litres do we have?
- Do we have 2 litres?
- What did we do to the number of millilitres to get litres – did we divide by 1000?
- If we have 3000 millilitres – how many litres do we have?
- Do we have 3 litres?
- What did we do to the number of millilitres to get litres – did we divide by 1000?
- Are we dividing the number of millilitres by 1000 to get the number of litres? Why?
- Are there 1000 millilitres in every litre?
- If there are 1000 millilitres in every litre, will there 1000 times fewer litres than millilitres to measure the same volume?
- If there are 1000 times fewer litres than millilitres, will we divide the number of millilitres by 1000 to get the number of litres?
- How could we divide the number of millilitres by 1000?

Move the digits 3 places to the right to divide by 1000, for example,



Record, for example, 2356 millilitres = 2.356 litres

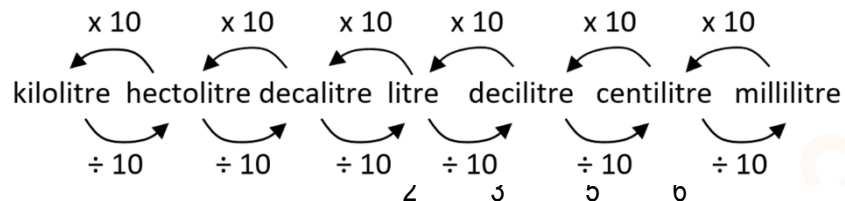
Record, for example, 2356 millilitres = 2.356 litres = $2 \frac{356}{1000}$ litres

Record, for example,

- ▶ Will the digits move 3 places to the right?
- ▶ Let's move the digits 3 places to the right to divide by 1000.

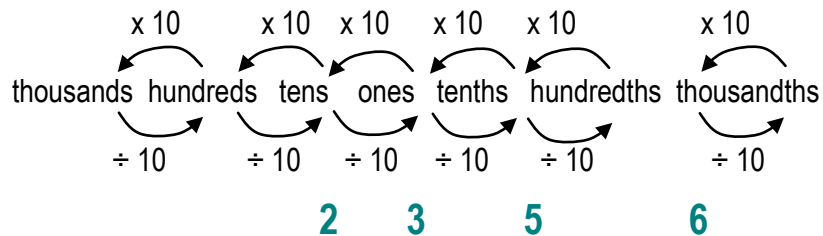
- ▶ How many litres do we have?
- ▶ Do we have 2 point 356 litres?
- ▶ How can we describe the value of 2.356 using non-standard place value?
- ▶ Is the value of the 2.356, 2 and 356 thousandths?
- ▶ Is 2356 millilitres, 2 and 356 thousandths of a litre?
- ▶ Is 1 millilitre, 1 thousandth of a litre?
- ▶ If 1 millilitre is 1 thousandth of a litre, does it make sense that 356 millilitres would be 356 thousandths of a litre?
- ▶ Does it make sense that 2 thousand, 356 millilitres would be 2 litres, plus 356 thousandths of a litre?
- ▶ Does it make sense that 2 thousand, 356 millilitres would be 2.356 litres?

- ▶ If we record 2.356 litres in a metric volume chart, can we also see it as 2356 millilitres?



Record, for example, 2.356 litres

Record 2356 in a place value chart, for example,



Record, for example, 1 litre = 1000 millilitres

Record, for example, 2 litres = 2000 millilitres

► If we record 2356 millilitres in a metric volume chart, can we also see it as 2.356 litres?

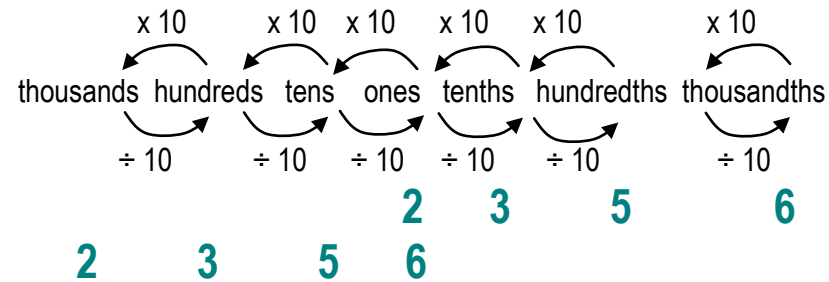
- Let's investigate how we can use place value to convert from litres to millilitres.
- Let's record a volume in litres.
- Let's record 2.356 in a place value chart.

- If we have 1 litre – how many millilitres do we have?
- Do we have 1000 millilitres?
- What did we do to the number of litres to get millilitres – did we multiply by 1000?
- If we have 2 litres – how many millilitres do we have?
- Do we have 2000 millilitres?
- What did we do to the number of litres to get millilitres – did we multiply by 1000?
- If we have 3 litres – how many millilitres do we have?
- Do we have 3000 millilitres?

Record, for example, 3 litres = 3000 millilitres

Record, for example, $2.356 \times 1000 =$

Move the digits 3 places to the right to divide by 1000, for example,



Record, for example, 2.356 litres = 2356 millilitres

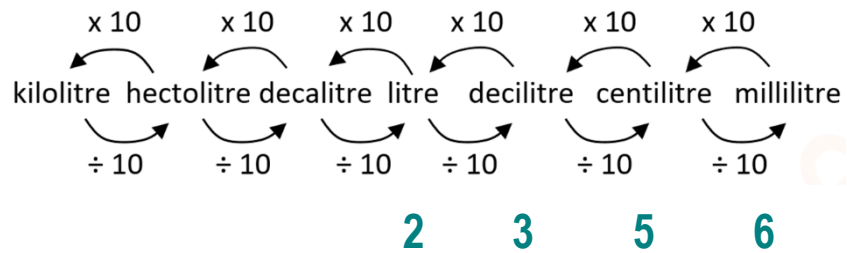
Record, for example,

- ▶ What did we do to the number of litres to get millilitres – did we multiply by 1000?
- ▶ Are we multiplying the number of litres by 1000 to get the number of millilitres? Why?
- ▶ Is there 1 litre for every 1000 millilitres?
- ▶ If there is 1 litre for every 1000 millilitres, will there be 1000 times more millilitres than litres to measure the same volume?
- ▶ If there are 1000 times more millilitres than litres, will we multiply the number of litres by 1000 to get the number of millilitres?

- ▶ How could we multiply the number of litres by 1000?
- ▶ Will the digits move 3 places to the left?
- ▶ Let's move the digits 3 places to the left to multiply by 1000.

- ▶ How many millilitres do we have?
- ▶ Do we have 2356 millilitres?

- ▶ Is 1 litre, 1000 millilitres?
- ▶ If 1 litre is 1000 millilitres, does it make sense that 2.356 litres would be 2356



millilitres?

- ▶ If we record 2356 millilitres in a metric volume chart, can we also see it as 2.356 litres?
- ▶ If we record 2.356 litres in a metric volume chart, can we also see it as 2356 millilitres?
- ▶ Could we convert between litres and kilolitres by multiplying and dividing by 1000?
- ▶ Could we convert between kilolitres and megalitres by multiplying and dividing by 1000?