

Volume, Capacity – Liquid Units, Displacement.

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Measure capacities of containers using scale. recording as litres and millilitres, as millilitres, and as halves or quarters of litres	page 3
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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.

VOLUME, CAPACITY – LIQUID UNITS, DISPLACEMENT.

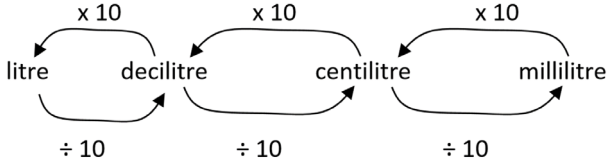
EXPLICIT TEACHING PLAN OVERVIEW PAGE

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

RESOURCES: COMPASS, GRID MAPS, THREAD, RULER, STRAW AND CHENILLE STICK ANGLE TESTERS, PAPER ANGLE TESTERS, PENCIL, PAPER

WHAT COULD WE DO?

Children:

- explain metric liquid measurement, for example,


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graph LR; litre -- "x 10" --> decilitre; decilitre -- "x 10" --> centilitre; centilitre -- "x 10" --> millilitre; decilitre -- "÷ 10" --> litre; centilitre -- "÷ 10" --> decilitre; millilitre -- "÷ 10" --> centilitre;
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- identify the relationship between millilitres and litres, including fractions, for example, $1000 \text{ mL} = 1\text{L}$, $500 \text{ mL} = \frac{1}{2} \text{L}$, $250 \text{ mL} = \frac{1}{4} \text{L}$
- measure capacities and volumes of water in millilitres, and record in litres and millilitres, and in millilitres, for example, 1 litre and 280 millilitres, 1 L 280 mL, 1280 millilitres, 1280 mL
- measure volumes of objects using displacement
- explain the volume of water displaced is the volume of the object

WHAT LANGUAGE COULD WE USE TO EXPLAIN AND ASK QUESTIONS?

Children

- ask one another questions about measuring capacities and volumes in millilitres, including using displacement, recording as litres and millilitres, and as millilitres, for example:
 - ▶ how is metric liquid measurement related to multiplicative place value?
 - ▶ how could we measure the capacity of a container?
 - ▶ how could we record the capacity in litres and millilitres?
 - ▶ how could we record the capacity in millilitres?
 - ▶ how could we record our measurement in a fraction of a litre?
 - ▶ how could we measure the volume of this object using displacement?
 - ▶ is the volume of water displaced, the volume of the object?

VOLUME, CAPACITY – LIQUID UNITS, DISPLACEMENT.

EXPLICIT TEACHING PLAN

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

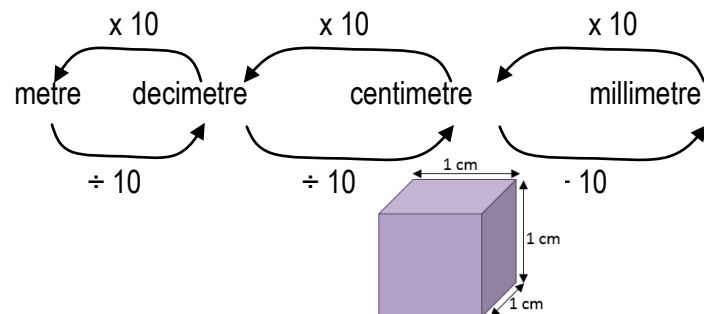
WHAT COULD WE DO?

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

Record, for example, volume is the amount of space an object takes up in 3 dimensions.

Record, for example, capacity is the volume a container can hold when it is filled to capacity.

Display the metric measurement system, for example,

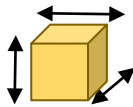


WHAT LANGUAGE COULD WE USE TO EXPLAIN AND ASK QUESTIONS?

- ▶ 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?

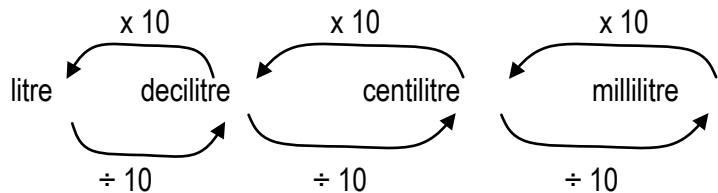
- ▶ We've investigated volume.
- ▶ And we found volume is the amount of space an object takes up in 3 dimensions.
- ▶ We've investigated capacity.
- ▶ And we found capacity is the volume a container can hold when it is filled to capacity.
- ▶ We've investigated measuring the volume and capacity of objects and containers.
- ▶ We found that we could measure the volume and capacity of objects with flat surfaces and straight lines, using cubic centimetres.
- ▶ We found that the cubic centimetre was constructed by adding another dimension to a square centimetre to make a cube.
- ▶ We found that a cubic centimetre is a cube with each dimension 1 centimetre long.

Indicate dimensions up and down, right to left, and front to back, for example,

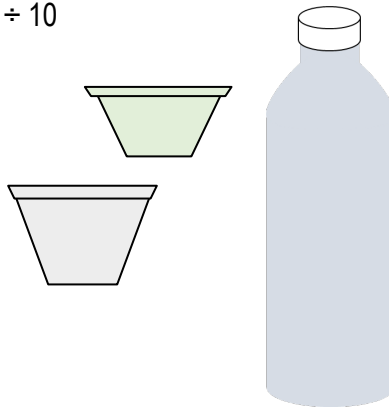


Display some containers with curved surfaces and curved lines.

Display the metric measurement system, for example,

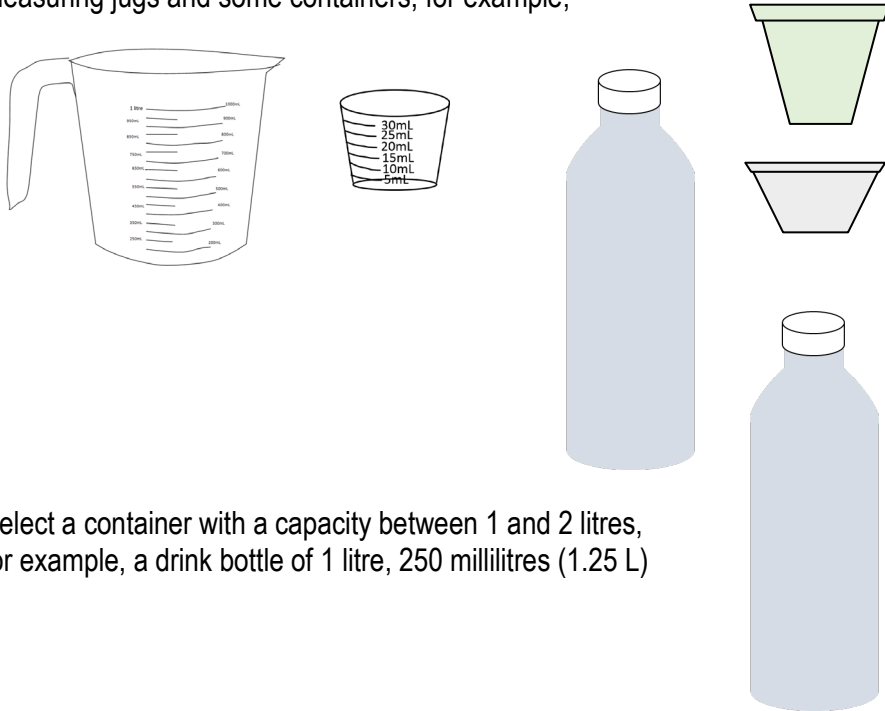


Display a container with curved surfaces with thin surfaces, for example,



- ▶ We found that a cubic centimetre has three dimensions because it goes up and down, left to right, and front to back.
- ▶ So we found that cubic centimetres are great to measure the volume and capacity of objects and models with flat surfaces and straight lines - prisms.
- ▶ We found that if an object's or container's surfaces are thin, the volume they can hold – their capacity, and the amount of space they take up – their volume, is almost the same.
- ▶ We found that cubic centimetres are not so great to measure the volume and capacity of objects with curved surfaces and curved lines because we cannot make the object out of cubes, nor pack it with cubes.
- ▶ We found that we could measure the volume and capacity of objects with curved surfaces and curved lines using water measured in millilitres and litres.
- ▶ We found that millilitres and litres are created based on multiplicative place value, by multiplying and dividing by 10.
- ▶ We found that 1 litre is 1000 millilitres.
- ▶ We measured the volume of water needed to fill a container to capacity in millilitres and litres.
- ▶ We found that if the container's surfaces are thin, the amount of water it can hold – their capacity, and the amount of space it take up – their volume, is almost the same.
- ▶ Today we're going to investigate measuring volume and capacity, in litres and

Display some medicine measuring cups, and some litre measuring jugs and some containers, for example,



Select a container with a capacity between 1 and 2 litres, for example, a drink bottle of 1 litre, 250 millilitres (1.25 L)

Allow children to suggest which measuring device they will use to measure the capacity of the bottle, for example, the litre jug.

millilitres, and in millilitres.

- ▶ Here we have some measuring devices – a measuring jug and a medicine cup.
- ▶ What units of measurement can you see on the scale of these measuring devices?
- ▶ Can you see millilitres?
- ▶ Can you see 1 litre?

- ▶ Here we also have some containers.

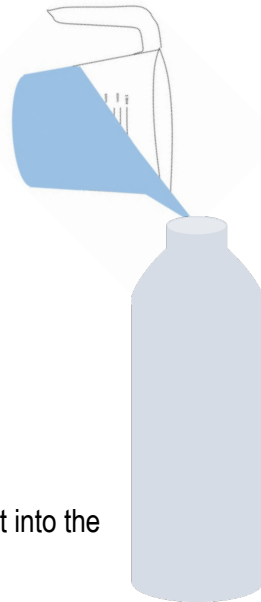
- ▶ What do you estimate is the capacity of this bottle?
- ▶ Do you estimate the capacity is more or less than a litre?
- ▶ Are the surfaces thin?
- ▶ Will the amount this bottle can hold when it is filled to capacity, be about the same as the amount of space the bottle takes up?
- ▶ Will the capacity of the bottle be about the same as its volume?

- ▶ Which measuring device will we use to measure the capacity of this bottle – the litre jug or the medicine cup?
- ▶ Will we use the litre jug? Why?
- ▶ Will we use the litre jug because the capacity of the bottle is much larger than the capacity of the medicine cup?

- ▶ How could we measure the capacity of the bottle using the litre jug?

Allow children to suggest how they would use the litre jug to measure the capacity of the bottle.

Fill the litre jug with water to 1 litre and pour it into the bottle, for example,



Fill the litre jug with water to 1 litre again and begin to pour it into the bottle again.

Children identify that the bottle is now filled to capacity.

Children identify there is 720 millilitres remaining in the litre jug.

(NB: The volume of drink sold in the bottle is 1 L and 250 mL, but it is not filled to capacity with the drink, so the capacity of the bottle will be more than 1 L and 250 mL.)

Record, for example, 1 litre = 1000 millilitres

- ▶ Could we fill the litre jug to one litre with water, and pour it into the bottle?
- ▶ Could we fill the bottle and pour 1 litre of the water into the litre jug?
- ▶ Do we have 2 ways that we could measure the capacity of the bottle?

- ▶ Let's fill the litre jug with 1 litre of water and pour it into the bottle.

- ▶ Is the bottle filled to capacity?
- ▶ Is there still space in the bottle for more water?

- ▶ Let's fill the litre jug with 1 litre of water again.
- ▶ Let's begin to pour it into the bottle, stopping when the bottle is filled to capacity.

- ▶ Is the bottle filled to capacity?

- ▶ Is there water left in the jug?
- ▶ What volume of water is left in the jug?
- ▶ Is there 720 millilitres left in the jug?
- ▶ If there is 720 millilitres of water left in the litre jug, what volume of water did we pour into the bottle?
- ▶ How many millilitres in 1 litre?
- ▶ Did we start with 1000 millilitres in the litre jug?
- ▶ Do we have 720 millilitres left in the litre jug?
- ▶ What does 1000 minus 720 equal?
- ▶ Does 1000 minus 720 equal 280?

Record, for example, $1000 - 720 = 280$

Record, for example, capacity = 1 litre and 280 millilitres

(If students notice the capacity of the bottle is not the same as the volume of drink noted on the bottle - it will be recorded as 1.25 L on the bottle – allow them to realise that the drink did not fill the bottle to capacity.)

Record, for example, capacity = 1 litre and 280 millilitres

Record, for example, capacity = 1280 millilitres

Fill the bottle to capacity with water, for example,



- ▶ Did we pour 280 extra millilitres into the bottle?
- ▶ So what is the capacity of the bottle?
- ▶ Is the capacity of the bottle, 1 litre and 280 millilitres?

- ▶ Did you expect the capacity to be 1 litre and 250 millilitres because of what it says on the bottle?
- ▶ When you buy drink, is the bottle filled to capacity, or is there a gap in top?

- ▶ So is 1 litre and 250 millilitres the volume of drink that you get in the bottle, and 1 litre and 280 millilitres the capacity of the bottle?

- ▶ So we've recorded the capacity in litres and millilitres.
- ▶ How could we record this capacity just in millilitres?
- ▶ How many millilitres in 1 litre?
- ▶ Are there 1000 millilitres in 1 litre?
- ▶ So do we have 1000 millilitres plus 280 millilitres?
- ▶ Is the capacity 1280 millilitres?

- ▶ How else could we measure the capacity of the bottle?
- ▶ Could we start by filling the bottle to capacity with water?

- ▶ Could we measure the volume of water by pouring the water into the litre jug?

Pour some water from the bottle into the litre jug, up to the 1 litre mark on the scale.

Record the litre, then pour out the water from the litre jug, for example, 1 litre.

Pour the remaining water from the bottle into the litre jug.

Record the capacity, for example, capacity = 1 litre 280 millilitres

Record, for example, 1 litre = 1000 millilitres

Record, for example, capacity = 1 litre and 280 millilitres

Record, for example, capacity = 1 280 millilitres

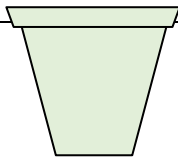
- ▶ Let's start pouring the water into the litre jug, up to the 1 litre mark on the scale.
- ▶ Do we have some water left in the bottle?
- ▶ Is the capacity of the bottle greater than a litre?

- ▶ Could we record the litre, then pour out the first litre of water.
- ▶ Could we now pour in the remaining water from the bottle?

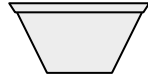
- ▶ How many millilitres?
- ▶ Are there 280 millilitres?

- ▶ What is the capacity of the bottle?
- ▶ Is the capacity 1 litre and 280 millilitres?
- ▶ How many millilitres is this?
- ▶ If there are 1000 millilitres in a litre, and we have 1 whole litre, how many millilitres is that?
- ▶ Is the volume of water 1000 millilitres plus another 280 millilitres?
- ▶ Is the capacity of the bottle, 1280 millilitres?

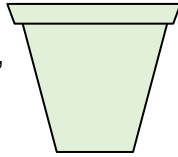
- ▶ What do you estimate is the capacity of these containers?



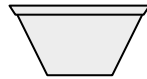
Select a container with a capacity of 500 millilitres and container with a capacity of 250 millilitres, for example,



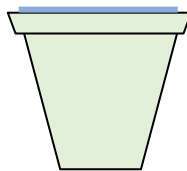
Display the container with a capacity of 500 millilitres, for example,



Display the container with a capacity of 250 millilitres, for example,



Fill the first container to capacity with water, for example,
Pour the water from the container into the litre jug.



- ▶ Are the surfaces thin?
- ▶ Will the amount these containers can hold when they are filled to capacity be about the same as the amount of space the containers take up?
- ▶ Will the capacity of the containers be about the same as their volumes?

- ▶ What do you estimate the capacity of this container to be?
- ▶ Will it be less than a litre?
- ▶ What fraction of a litre do you estimate?
- ▶ Do you estimate it will be more than, less than, or about half a litre?

- ▶ What do you estimate the capacity of this container to be?
- ▶ Will it be less than a litre?
- ▶ What fraction of a litre do you estimate?
- ▶ Do you estimate it will be more than, less than, or about quarter of a litre?

- ▶ Let's measure the capacity of the first container by filling it to capacity with water.
- ▶ Let's pour the water into the litre jug.
- ▶ How many millilitres?
- ▶ Is the volume of water 500 millilitres?
- ▶ What is the capacity of the first container?
- ▶ Is the capacity of the first container 500 millilitres?

- ▶ Let's measure the capacity of the second container by filling it to capacity with water.

Fill the second container to capacity with water, for example,



Pour the water from the container into the litre jug.

Record the capacity, for example, capacity = 250 millilitres

Display the litre jug, indicating the 500 mL and 1L marks

Record, for example, capacity = 500 millilitres
capacity = $\frac{1}{2}$ litre

Display the litre jug, indicating the 250 mL and 1L marks

Record, for example, capacity = 250 millilitres
capacity = $\frac{1}{4}$ litre

- ▶ Let's pour the water into the litre jug.
- ▶ How many millilitres?
- ▶ Is the volume of water 250 millilitres?
- ▶ What is the capacity of the second container?
- ▶ Is the capacity of the second container 250 millilitres?

- ▶ How could we record the millilitres as a fraction of a litre?
- ▶
- ▶ What fraction of litre is 500 millilitres?
- ▶ Let's look at the litre jug
- ▶ Is 500 millilitres half of a litre?
- ▶ If there are 1000 millilitres in a litre, and we have 500 millilitres, do we have half a litre?
- ▶ Is 500 millilitres, half a litre?
- ▶ Does it make sense that 500 millilitres equals half a litre?

- ▶ What fraction of litre is 250 millilitres?
- ▶ Let's look at the litre jug
- ▶ Is 250 millilitres quarter of a litre?
- ▶ If there are 1000 millilitres in a litre, and we have 250 millilitres, do we have quarter of a litre?
- ▶ Is 250 millilitres, quarter of a litre?
- ▶ Does it make sense that 250 millilitres equals quarter of a litre?
- ▶ If 250 millilitres is 1 quarter of a litre, what fraction of a litre would 750 millilitres of water be?

- ▶ Is 750, 3 times 250?
- ▶ If 250 millilitres is 1 quarter of a litre, would 750 millilitres be 3 quarters of a litre?

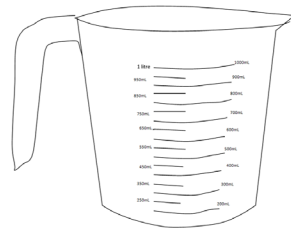
- ▶ We've investigated finding the volume and capacity of objects with flat surfaces and straight lines using cubic centimetres as our unit of measurement.
- ▶ We've investigated finding the volumes and capacities of containers with curved

Display some objects with curved surfaces, for example, marbles, stones, rocks, modelling clay.

Select one, for example, a rock



Display a litre jug with scale marked in millilitres, for example,



surfaces using millilitres and litres by filling the container with water.

- ▶ And we've investigated comparing and ordering volumes by displacement.
- ▶ We found that when we place an object into water, the water rises because the object displaces some of the water.
- ▶ **Today we're going to investigate measuring the volume of water displaced when an object is submerged.**

- ▶ How could we measure how much space this rock takes up?
- ▶ How could we measure the volume of this rock?
- ▶ We can't fill it to capacity with water.
- ▶ We can't pack it with cubes.
- ▶ And we can't make this object out of cubes.
- ▶ Could we submerge it in water and measure the volume of water it displaces? Let's investigate!
- ▶ Here we have a litre measuring jug with scales marked in millilitres and litres.
- ▶ What do you think would happen if we poured some water into the litre jug, then placed the rock in the water?
- ▶ Do you think the water would rise?
- ▶ Could we measure the amount that the water rises?
- ▶ Will that tell us the volume of the rock?

- ▶ Let's pour some water into the litre jug.
- ▶ Do you think we have enough water in the litre jug to cover the rock?

Pour some water into the litre jug to a level that will cover the rock, for example, 500 millilitres

Record, for example, 500 millilitres
 $\frac{1}{2}$ litre

Carefully place the rock into the water ensuring no water splashes out, for example,

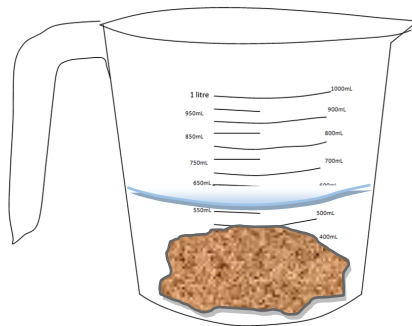
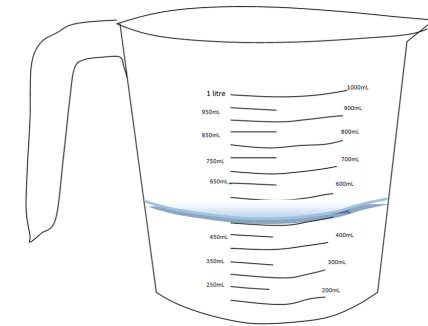
Record, for example, 550 millilitres

Record, for example,

Volume of water with no rock submerged = 500 millilitres

Volume of water with rock submerged = 550 millilitres

$550 - 500 = 50$ millilitres



- ▶ What is the volume of water in the litre jug?
- ▶ Is there 500 millilitres of water?
- ▶ Is 500 millilitres, half a litre?

- ▶ Let's place the rock into the water and observe what happens to the level of the water.
- ▶ What happened to the level of the water?
- ▶ Did the level of the water rise?

- ▶ What is the level of the water with the rock submerged?
- ▶ Is the level of the water with the rock submerged, 550 millilitres?

- ▶ Could we measure how much the level of the water rose?
- ▶ The water level was 500 millilitres without the rock submerged, and now the water level is 550 millilitres with the rock submerged.

- ▶ How much did the water rise?
- ▶ Did the water rise 50 millilitres?
- ▶ What made the water rise?
- ▶ Did the rock take up some of the space that the water was taking up?
- ▶ Could we say that the rock displaced some of the water?
- ▶ Does displace mean 'take the space of'?
- ▶ What volume of water did the rock displace?

Volume of water displaced = 50 millilitres

Volume of the rock = 50 millilitres

Display 2 objects, for example,



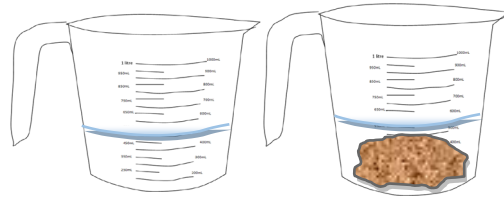
Pour 500 mL of water in the measuring jug.

- ▶ Did the rock displace 50 millilitres of water?
- ▶ So does the rock take the space of 50 millilitres of water?
- ▶ If the rock takes the place of 50 millilitres of water, is the volume of the rock, 50 millilitres?
- ▶ If the volume of water the rock displaced is 50 millilitres, is the volume of the rock, 50 millilitres?

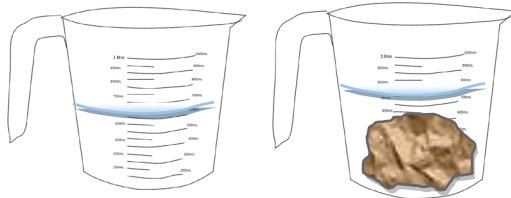
- ▶ When we place the rock in water, is the volume of water it displaces the volume of water it would hold if we could fill it to capacity?
- ▶ If we could fill the rock with water, what volume of water would it hold?
- ▶ Would the rock hold a volume of 50 millilitres of water if it was filled to capacity?

- ▶ Let's compare and order volumes by displacement.
- ▶ Here we have 2 rocks.
- ▶ Let's measure their volumes by submerging them in water, then measure the volume of water they displace.
- ▶ What volume of water could we place in the measuring jug to make sure we cover the rock?
- ▶ Could we pour in 500 millilitres of water?
- ▶ Could we pour in half a litre of water?
- ▶ Let's submerge the first rock.
- ▶ Is the level of water now 550 millilitres?
- ▶ Did the first rock displace 50 millilitres of water?

Measure the volumes of the objects by submerging them in water, then measuring the volume of water that the object displaced, for example,



volume of rock 1 = 50 mL



volume of rock 2 = 150 mL

- ▶ What is the volume of the first rock?
- ▶ Is the volume of the first rock, 50 millilitres?
- ▶ Let's fill the jug to 500 millilitres again.
- ▶ Let's submerge the second rock.
- ▶ Is the level of water now 650 millilitres?
- ▶ Did the second rock displace 150 millilitres of water?
- ▶ What is the volume of the second rock?
- ▶ Is the volume of the second rock, 150 millilitres?
- ▶ Which rock has the larger volume?
- ▶ Does the larger rock have the larger volume?
- ▶ Which rock has the smaller volume?
- ▶ Does the smaller rock have the smaller volume?