YuMi Deadly Maths

Year 3 Teacher Resource:

MG – Fill it up

Prepared by the YuMi Deadly Centre
Faculty of Education, QUT

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QUT

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Growing community through education

ACKNOWLEDGEMENT

We acknowledge the traditional owners and custodians of the lands
in which the mathematics ideas for this resource were developed,
refined and presented in professional development sessions.

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Year 3 Measurement and Geometry

Fill it up

Learning goal Students will establish a mental image of one litre and measure the capacity of everyday containers using litres.

Content description Measurement and Geometry – Using units of measurement

- Measure, order and compare objects using familiar metric units of length, mass and capacity (ACMMG061)

Big idea Measurement – capacity: one litre

Resources Litre containers (different shapes), containers more/less than one litre, water bottles, cups, glasses, spoons, ice-cream containers, tubs, buckets, cans, metric measuring jug, rice, sand, water, pasta

Reality

Local knowledge *Where do you find containers that hold water or milk in the local environment? How much water, milk, juice, ice-cream, yoghurt does your family buy when you go to the shop? Is it important to know how much milk to use when you are making a cake? What are some different containers that are used to hold objects like sand, rice, pasta, water, petrol, etc.?*

Prior experience Check that students have heard the term "litre" and can record data. Have containers of different sizes/shapes, e.g. tall thin plastic containers, short squat containers, and ask students to identify the attributes of the selected containers: *What container is the tallest/ shortest, widest/thinnest, holds more/less, is the largest/smallest?*

Kinaesthetic Groups of four to six students with a collection of containers of different sizes and different shapes. Use one container as a "test" container.

Explore: *Can you find a container that holds more water than this one? Why do you think your container will hold more water than the test container?* [Students may say their container is bigger/taller/wider, etc.] *Are these containers full or empty?* [empty]. *How can we find out which container holds the most?* Fill the test container to the brim. *Is there any space left for some more water?*

Act it out: Tip the water from the test container into another container. *What does it mean if there is space left so that the water does not come up to the brim of the second container? What does it mean if water comes right up to the brim but there's still some water left in the test container?* Talk about the test container being filled "to capacity". *What do you think the word "capacity" means?* [The amount a container can hold when it's full.]

Compare a short squat bowl with a long thin bottle. *Which do you think will hold more? Which has the greater capacity? Why?* Perform the experiment to find out.

Have four clear water bottles of the same size filled to different capacities/levels. Ask students to put the bottles in order going from least to greatest capacity.

Distribute small plastic tubs the same size to students in each group but give measuring cups of different sizes to each group. Tell the students the tubs all have the same capacity. *What does that mean?* [The tubs all hold the same amount.] Student task: *Find out how many cups of sand the tubs hold.* Record the data from each group. Discuss reasons for differing results. [The measuring cups were not the same.] *What do we need to give a better measurement of the tubs' capacities?* [The same measuring tool.]

After the need for a standard has been developed through the use of non-standard units time can be spent measuring capacity with a class-chosen unit – e.g. a common object like a glass or cup. This can be used by students to show that with a common unit, a higher number really means a greater capacity. *What is the common measurement used when we* *buy milk, juice, soft drink, water?* [litre]. Have students select from a box of common litre containers so that students establish a mental image of a litre.

Abstraction

Body

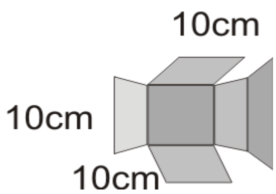
Distribute empty one-litre cartons and bags of pasta to students. *Look at the space inside the carton and predict how many handfuls of pasta it will take to fill the litre carton. Fill the carton and compare the result with your estimate. Is pasta a good material to use for measuring capacity? Why? Why not?* [too many gaps].

Groups of four to six students with different containers: cups, water bottles, vases, bowls, 1 litre, 2 litre, 1½ litre bottles, buckets and litre measuring jug. Students look at the litre measuring jug and compare it with the other containers. Predict containers that hold more than a litre, less than a litre, a full litre. Test estimates by measuring the containers with a litre measuring jug. If the estimate is wrong, move containers to the correct group.

Students pour contents (rice, liquids) of litre containers into cups/water bottles; predict and describe capacity. *One litre fills how many cups/water bottles?* Reverse: use cups/water bottles to fill litre containers; predict and describe outcomes, e.g. *Two water bottles fill one litre; five cups fill one litre.*

Hand

Students use cardboard to make a net for a cube of side 10 cm. Tape and fold this cardboard to make the cube. *This cube is 1 L. Check this by pouring 1 L of water or sand into it. Check that this cube holds the same as a 1 L soft-drink bottle. This is the same size as a MAB thousand block.*



Students calibrate a container into 100 mL levels using either of the following methods:

> **Method 1** – *take a glass jar and pour 100 mL amounts into it, marking the levels with tape as you go.*
>
> **Method 2** – *take a 1 L milk carton, cut off the top and use a ruler to divide the height into 10 equal intervals.*

Mind

Students visualise the containers that held one litre. *How many water bottles/cups could be filled from a litre jug? In your mind see the kitchen sink. How many litres would it hold? Think of how many litre cartons of milk you could store there.*

Creativity

Students draw a litre – e.g. tub of ice-cream, carton of custard, bottle of milk – and show how much of the litre they would have at a meal. Draw a litre carton of milk and make it look more than and less than a litre of milk. (Focus on long/thin and short/wide representations.)

Mathematics

Language/ symbols

capacity, volume, full, empty, half-full, compare, order, measure, pour, informal units, estimate, holds more, holds less, holds the most, litre

Practice

1. Have an array of containers for students firstly to estimate (< = > 1 L) and then to measure the capacity of objects. Estimate and measure each object before moving on to the next. **Estimate the capacity – do not estimate length, breadth, height**. Use measuring cylinders for checking.

OBJECT	< = > 1 L	Estimate	Measure
Capacity			
8 cups			
6 glasses			
2 bottles			
1 plastic container			

2. In pairs, students investigate how many litres a bucket would hold by marking the bucket after each litre is poured in. Compare the capacity of a kitchen bucket with a sand toy bucket.
3. Activity – *Guess what holds more?*
   (a) Take two pieces of A4 paper.
   (b) Make the round part of a cylinder longwise from one A4 sheet and the round part of a cylinder shortwise from the other.
   (c) Use more tape and paper to give each cylinder a base.
   (d) Pour rice from one cylinder to the other. Which is larger? Why?

Connections Compare with measuring flour in kilograms and length of room in metres.

Reflection

Validation Students find examples in their world where measuring capacity occurs: filling their drink bottle or a glass/mug; cooking – different liquid measurements for cakes/soups.

Application/ problems Provide applications and problems for students to apply to different real-world contexts independently, e.g. predict and measure how many litre bottles of water are needed to fill the class fish tank; predict and measure the capacity of a household bucket and mark it after each litre to find the actual capacity of the bucket; predict and measure how many buckets of water will fill a wheelbarrow and calculate the capacity of the wheelbarrow.

Extension **Flexibility**. Students are able to identify and predict containers of various shapes that would hold a litre capacity.

Reversing. Students can reverse the process of describing capacity, e.g. one litre fills x number of cups/bottles ↔ it will take x number of cups/bottles to fill one litre or a given container ↔ acting it out ↔ telling the story.

The components of a non-standard and standard measure are object, non-standard/standard unit and number. These form a classical triad and result in three problem types:

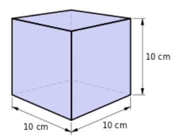
(a) Number unknown – *How many jugs to fill the bucket?*
(b) Object unknown – *Find an object which is 5 jugs in capacity*.
(c) Unit unknown – *The container has a capacity of 7, what is the unit?*

Make sure all three directions are taught. (This leads to understanding the **triadic relationship** big idea.)

Generalising. *Standard units of measurement describe an exact capacity that is universally recognised within the same country*. The **three measurement principles** for non-standard and standard measurement are:

- Measurement principle 1: **common units** – units must be the same size when measuring and comparing containers. When units are the same, the larger number specifies the larger object.
- Measurement principle 2: **inverse relation** – the larger the unit, the smaller the number and vice versa. Relate this understanding to division – measuring in units is like dividing.
- Measurement principle 3: **accuracy vs exactness** – (a) smaller units give greater accuracy, (b) students require skill in being able to choose appropriate units, and (c) students require skill in estimating.

Changing parameters. Given that one litre is the volume of a cube with 10 cm sides, explore containers holding a kilolitre (cm^3), e.g. a tank (not necessarily cubes). Also conduct experiments with mass.



Teacher’s notes

- Identify the various containers by number or name or colour.
- Students need to be taught the skill of visualising: closing their eyes and seeing pictures in their minds, making mental images; e.g. show a picture of a kookaburra, students look at it, remove the picture, students then close their eyes and see the picture in their mind; then make a mental picture of a different bird.
- Suggestions in Local Knowledge are only a guide. It is very important that examples in Reality are taken from the local environment that have significance to the local culture and come from the students’ experience of their local environment.
- Useful websites for resources: www.rrr.edu.au; https://www.qcaa.qld.edu.au/3035.html
- Explicit teaching that **aligns with students’ understanding** is part of every section of the RAMR cycle and has particular emphasis in the Mathematics section. The RAMR cycle is not always linear but may necessitate revisiting the previous stage/s at any given point.
- Reflection on the concept may happen at any stage of the RAMR cycle to reinforce the concept being taught. Validation, Application, and the last two parts of Extension should not be undertaken until students have mastered the mathematical concept as students need the foundation in order to be able to validate, apply, generalise and change parameters.

