# YuMi Deadly Maths

## Year 4 Teacher Resource:

## MG – How long is a foot?

Prepared by the YuMi Deadly Centre
Faculty of Education, QUT

YuMiDeadly
Growing community through education

YuMi Deadly Maths Year 4 Teacher Resource: **MG – How long is a foot?**



**ACKNOWLEDGEMENT**

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## Year 4 Measurement and Geometry

# How long is a foot?

**Learning goal**

Students will:

- measure and compare objects using an informal measurement instrument for length
- measure lengths and distance using scaled instruments.

**Content description**

Measurement and Geometry – Using units of measurement

- Use scaled instruments to measure and compare lengths, masses, capacities and temperatures (ACMMG084)

**Big idea**

Measurement – length – continuous vs discrete; three principles: common units, inverse relationship, accuracy vs exactness

**Resources**

Body referents, strips of paper (two different colours) and/or straws and cord, template of each student's footprint, various items as non-standard units

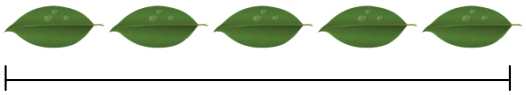
## Reality

**Local knowledge**

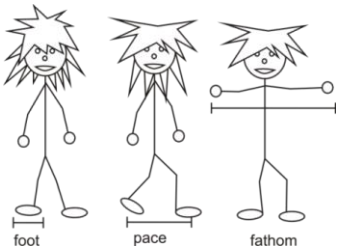
Discuss the various tools that are used in the local environment for measuring objects and differences between informal and formal/standard units of length measurement, including the differences between measurement systems used in the world, e.g. local environment, metric and imperial.

**Prior experience**

Revisit that moving to uniform non-standard units allows students to focus on the unit and the count of units as representing the length of objects.



Reflect on the body parts students could use as informal measurement tools, e.g. width of finger, palm, hand span, length elbow to fingertip, length of foot, length of a stride.


**Kinaesthetic**

Students estimate, measure and record the length/width of their desks using width of their finger, palm, hand span. Identify other objects in the room that would be the same as one desk long. Check by using body referents.

Make informal scaled measuring tapes extending to 10 units using paper strips of two different colours or straws of two different colours passed through with thick cord. Make some tapes with smaller sized strips/straws and some with larger sized strips/straws. Students then measure various objects in the room using their measuring tapes and record number of strips or straws for each object. Discuss the results comparing the number and size of the paper strips/straws that were used [smaller sized strips give greater number of strips; larger sized strips give fewer number of strips].

## Abstraction

**Body**

Have all students estimate the number of steps they will take to measure the width of the room, then measure the width of the room stepping it out heel to toe and counting the number of steps taken. Record the results on a whiteboard always giving the answer as a

number and unit. *What do you notice?* Compare the number of steps taken and discuss why there are variances. *Why has student A taken more steps than student B? Does using units that are of different sizes help us to know the real width of the room? What do we need so that we can understand exactly how wide the room is? Why do people use the same unit to measure length?*

Always get students to estimate before measuring and to give answers as numbers and units. Make students aware of the correct use of paces in measuring. Then, act out various "incorrect" ways to do the pacing, as follows. (*Note:* When we get different numbers for the same wall, ask the students what is unfair about these examples. This method is called "torpedoing".)

1. Not starting at the beginning of the wall. Start two or three paces along the wall and ask why the number is less. Start well before the wall and ask why the number is larger.
2. Not ending at the end of the wall. Try this and ask why the number is larger or smaller depending on when the walking finishes.
3. Not walking in a straight line. Try a really wobbly walk and ask why the number of paces is larger.
4. Not keeping paces the same. Walk the wall with a variety of different length paces. Ask why the number is larger or smaller depending on whether paces are mostly short or long. (This leads to the first aspect of the *common units* big idea – units in a measure must be the same.)

Again use "torpedoing" to get across correct measurement processes: (a) start and end units in line with the start and end of the object being measured; (b) place units beside each other in a straight line; (c) use the same units throughout the measuring; and (d) do not have gaps between the units.

*What body referent would you use to measure the length of a pencil? Why? Would you use your foot template to measure the length of your eraser? What size of unit is required to be accurate? What body referent would you use to measure the length of the building? What does this tell us about the unit of measurement we choose?*

**Hand**

Students make a template of their foot to use as an informal measuring tool. Using their foot template they estimate and measure given classroom objects. Record the results as a number and a unit. Repeat process using their informal measuring tape, stating the number of strips/straws. *How will you measure with your foot template and measuring tape?* [You must start at one end of the object and make sure you have no overlaps or gaps between template/tape and measure right up to the end of the object.] *Why is it important to start at the beginning, have no gaps or overlaps, and finish right at the end?* Compare results of foot template and their informal scaled measuring tape.

*What is there in the classroom that is ten foot templates long? How does the measurement of your foot template compare with the measurement of your friend's foot template? Compare your measuring tape with your neighbour's. Are they the same? Why or why not?*

**Mind**

Have students visualise units that could be used to measure the length of given objects. Think of all the accurate measurement processes that need to be used to represent how length is measured accurately.

**Creativity**

Students create a variety of scaled measuring tapes using different units, e.g. heads, pegs. Make a list of items at home that they estimate would be two measuring tapes long. At home, measure the items and record the measurement. Discuss their findings at school next day.

## Mathematics

**Language/ symbols**

length, distance, width, height, metre, centimetre, kilometre, millimetre, graduated scale

**Practice**

1. Students compile a table to compare the lengths of different objects in relation to personal referents and graduated scale instruments. Always estimate first, then measure.
2. Use a variety of non-standard units to measure the lengths (e.g. how many dusters long is the whiteboard, how many pencils wide is the desk, how many sticks wide is the playground?). Objects that could be used as units to measure length could include pencils, pencil cases, sheets of paper, whiteboard dusters, Smarties, Cuisenaire rods, blocks, straws, cardboard strips, pegs, paperclips, lengths of dowel, lengths of string, and so on.
3. Provide students with a set length to find objects that are the same, longer than or shorter than.

**Connections**

Connect to informal and formal units of capacity and mass measurement. Connect non-standard measurement to number-line division. For example, the diagram on the right can be considered as the length of the rod divided by the paper-clip length. For division, the more people there are to divide the cake among means that each person gets less cake. It is the same here: increasing the length of the paperclip means fewer paperclips, and vice versa, decreasing the length of the paperclip means more paperclips. (This leads into the inverse relation big idea.)

## Reflection

**Validation**

Students check measurement with non-standard units in real-world situations; e.g. *How many hands higher is a racehorse than a pony?*

**Application/ problems**

Provide applications and problems for students to apply to different contexts independently; e.g. Estimate and measure their bedrooms and items in it using their foot template and/or informal measuring tape. Record and arrange objects in descending order of length.

**Extension**

**Flexibility**. Students are able to use a variety of personal referents to enable them to estimate the length of objects. Find non-standard units in the local community (e.g. number of cans of fuel to measure distance travelled by boats). Try to get students to think of ways non-standard units are used in the world, local and otherwise. Use history and look at other units used in the past (e.g. the mile which was 2000 paces of the Roman army).

**Reversing**. Students are able to construct meaning from any starting point: objects ↔ acting out/measuring with non-standard unit ↔ number. Given the object, students can state the unit used and how many there were. Given the unit and number, students can identify possible objects. Given the object and the unit, students can identify the number of units (how many) used to measure the object.

**Generalising**. The objective is to extend the understanding from Abstraction and Mathematics to teach continuous vs discrete and the three measurement principles as outlined in the Teacher's Notes. This is a major part of this unit.

**Changing parameters**. *What if the units were the standard ones, would they act the same with regard to measurement processes and principles as non-standard units? What if the units were not length – say they were mass or area? Would they need similar study of measurement processes and principles? Would this study have common points? E.g. How many buckets of water will fill a wheelbarrow?*

## Teacher's notes

- **Continuous vs discrete**. Discuss how the act of measurement is the same as counting on a number track, ladder or line. Look at the line without regular marks or divided into units. Look at the line with these things. Elicit that the line is continuous and cannot be naturally counted. Discuss how the unit breaks it into parts that can be counted. Relate to ruler and measuring with rulers. This leads to the *continuous vs discrete* big idea – that there are two ways that number is applied: (a) to discrete objects, and (b) to continuous things such as lines by the use of units to discretify the continuous line.
- **Measurement principle 1**: **Common units**. Use torpedoing to show that we cannot know how long something is if we do not know the unit or have the **same unit**. For example, come into the class and say you caught a 24-unit long fish and draw on board. Then say also that a friend caught a 36-unit long fish and ask students to mark beside the drawing of the 24-unit fish where the 36-unit fish would end. Then put up a smaller fish for the 36-unit fish and ask: *How can this be?* (Most students will say that you are using smaller units.)

  Another example is to set a tall student and a short student to pace a wall and write their answers up in number of paces. The numbers should be different and you can ask why this is so. (Once again most students will say because pace length is different – the bigger number is caused by the smaller pace.) Repeat activities like this as much as needed. (This leads to the second aspect of the *common units* big idea – that **units must be the same length when comparing objects**.)

  Then set a common class unit – let the students choose it – with which all can measure the lengths of objects. Discuss what a bigger number will mean in this case when all are using the same length unit. (This leads to the third aspect of the *common units* big idea – that **when units are the same, the larger number specifies the longer object**.)

  Move discussion on to situations where something, say an item for building a house, is being made in one town or country and wanted in another town or country. *What is needed to ensure that the thing being made is the right length?* Discuss buying long and selling short – using a tall person to buy fabric by the fathom and a small person to sell fabric by the fathom – discuss how this would lead to anger and difficulty in buying the right amount of fabric. (This leads to the fourth aspect of the *common units* big idea – that **there is a need for a standard**.)
- **Measurement principle 2: Inverse relation**. Measure things with large and small units, with units that are half and one third the length of other units. Record the results as follows:

| UNIT | OBJECT | NUMBER |
|---|---|---|
| Small stick | Desk | 13 |
| Medium stick | Desk | 9 |
| Large stick | Desk | 6 |

  The pattern is easy to follow – the larger the unit the smaller the number and this is in inverse relation to the unit length. It is like division; to decrease or halve the divisor is to increase or double the quotient and vice versa. (Activities like this lead to the *inverse relation* big idea – **the larger the unit, the smaller the number and vice versa**.)
- **Measurement principle 3: Accuracy vs exactness**. Get students to cut ribbons into 12 small units (e.g. 12 fingers). Get them to compare ribbons and they will find slight differences in length. Ask them why? (Most students realise that in measurement you cannot be exact, you can only be as accurate as you want or are able.) Get students to measure a length in complete larger units and smaller units and then cut ribbon to the length shown with both units. Compare the ribbons with the object. Students should see that the smaller units are more accurate. (This leads to the first consequence of the *accuracy vs exactness* big idea – that **smaller units give greater accuracy**.)

  Discuss what smaller units being more accurate means. Discuss whether this means that we should always measure in small units. Argue about whether there are times when such accuracy is not needed. Provide students with measurement tasks for contexts (e.g. *Measure the window for a replacement window sill; measure the side of the classroom so we can work out if it is longer than*

*other classrooms*, and so on). Discuss what would be the best units for each task. Continue this line of thought by giving students a variety of objects of differing length and a variety of measurement instruments. Have them select and record the appropriate instrument to measure the length of each object. Practise these concepts with more tasks where students devise their own measurement plans, involving them selecting the unit of measurement and estimating and checking: Students must reflect on the quality of their measurement instrument and accuracy of estimation. (This leads to the second consequence of the *accuracy vs exactness* big idea – students require **skill in being able to choose appropriate units**.) Discuss whether estimation is ever good enough. Find situations in which it is. (This leads to the third consequence of the *accuracy vs exactness* big idea – students require **skill in estimating**.) *Length is measured using formal graduated scales to describe an exact measurement that is commonly accepted in society*.

- Clarify that measurement always starts from zero; zero is the starting point for all measurement.
- 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.