

Target Ball

Lesson 3: Develop Phase

Australian Curriculum: Mathematics (Year One)

ACMMG019: Measure and compare the lengths and capacities of pairs of objects using uniform informal units.

- Understanding that in order to compare objects, the unit of measurement must be the same size.

ACMNA013: Recognise, model, write and order numbers to at least 100. Locate these numbers on a number line.

- Identifying numbers that are represented on a number line and placing numbers on a prepared number line.

Lesson abstract

Groups repeat the rolling and measuring of the previous lesson, gathering better data. This time, all groups use the same informal unit (cut-out cardboard foot). Students organise and display their own groups' measurements on a number line, then interpret their evidence and write mathematical statements to say how far the ball rolls.

Mathematical purpose (for students)

Organising measurements on a number line makes it easier to interpret them.

Mathematical purpose (for teachers)

To inform the sports teacher how far a ball will roll, a common informal unit of measurement is required to measure distances rolled. In order to share and make sense of the evidence, the differences in the distances rolled need to be displayed on a representation such as with a number line. Measurement placed on a number line can be interpreted and used as evidence to support statements made to answer the inquiry question.

At the end of the Develop Phase, groups will be able to:

- Plot on a number line, including appropriately subdivided units (e.g., $9 \frac{1}{2}$ footsteps).
- Interpret the plot to answer the inquiry question.

Lesson Length 90 minutes (2 x 45 minutes)

Vocabulary Encountered

- number line
- footstep

Lesson Materials

- cardboard [cut-out](#) of a traced adult foot - correct size (1 per group)
- printed [number line](#) (1 set per group - 2 pages each)
- scissors, sticky tape or glue to construct number lines
- balls of the type chosen in Discover phase (1 per group)
- pencils, paper, clipboard for recording (1 per group)
- number line 0-100 for display (paper, drawn, or digital)
- *Maths Investigator* poster (from Discover phase)
- identification markers from earlier lesson.

We value your feedback after these lessons via <https://www.surveymonkey.com/r/CV2TXTT>

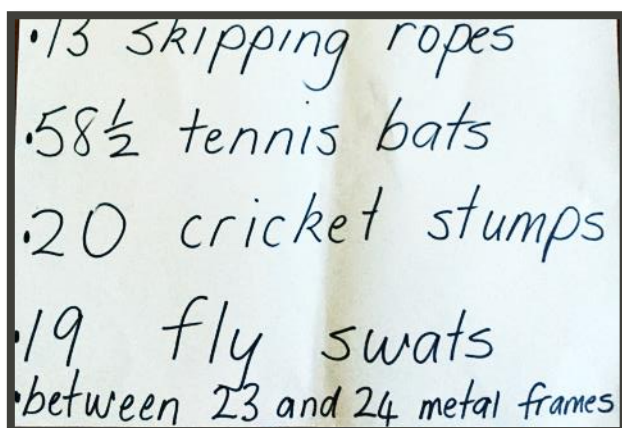


Refining Measurements

Eliciting the need for a common unit of measurement

1. Review with students that as Maths Investigators (refer to poster) in the last lesson they were measuring how far a ball rolls as accurately as possible. List some of the distances that groups recorded, aiming for a variety of informal measurement units and distances. Highlight distances that have been made more accurate by choosing smaller units, subdividing units or by descriptions using 'between', or 'nearest to' statements.
2. Engage students in a discussion about whether the evidence gathered will be helpful to the sports teacher.

Teacher: *Let's have a close look at all the measurements recorded on the board. What do you notice about the distances and how they have been recorded? Will our evidence using different units help the sports teacher make sense of the measurements? Why? Why not?*



As students explain their thinking, build on responses that focus on the need to measure with the same unit to compare distances.

Teacher: *The sports teacher needs to be able to compare the measurements we provide as evidence. What could all groups do to make the measurements easy to compare? (ANS: Use the same unit.)*

Ask students to suggest what unit they think would be the easiest for all groups to use to measure the distance. Remind students that the choice depends on what they are trying to measure, and the unit chosen should be easy to repeat without gaps or overlaps.

3. Value all suggestions but guide students towards using footsteps and demonstrate placing heel to toe. Discuss the advantages and disadvantages of using footsteps. (*Sports teacher would not need any equipment. Footsteps will give a more accurate measure than paces or skipping ropes because they are smaller. Our footsteps are a different size from the sports teacher's footsteps.*)

Seek suggestions on ways to overcome the challenge of the sports teacher having a different sized foot. (*We could ask the sports teacher to trace around his/her foot for us*). Show students a [cut-out trace of a foot](#), informing students it belongs to the sports teacher, and ask them how it could be used to improve the evidence given to the sports teacher. (*We could all use that foot to measure our distances.*)

Acknowledging the need for more than one roll

4. Return to the Maths Investigator poster and inform students they will be working in groups today to “do the maths”. All groups will **measure** and record the distances rolled with the same cut out foot (**evidence**). Ask how much evidence is required to convince the sports teacher how far most Year One students can roll a ball.

Teacher: *I noticed last lesson some groups measured one roll for each group member, so you had four measurements for the group. I wonder if these groups rolled the ball again whether each person would roll the same distance. What do you think?*

Share some responses before summarising for students that the distances rolled will vary, and if we collect more measurements we will get a more reliable idea of how far a ball usually rolls.

Tell your partner how many rolls you think each group member should have and explain why.

Invite students to share their thinking and comment on others' ideas.

Rea: It would need to be about 5 because each time I rolled the ball it landed in a different spot. The first time it only went a short distance. Then I rolled it faster and it went further. It will probably be different today.

Thanh: I think 5 rolls is too many. It would take a long time to measure 5 rolls. It should be more than one so what about 2 rolls? That would give us better evidence about how far a ball will roll.

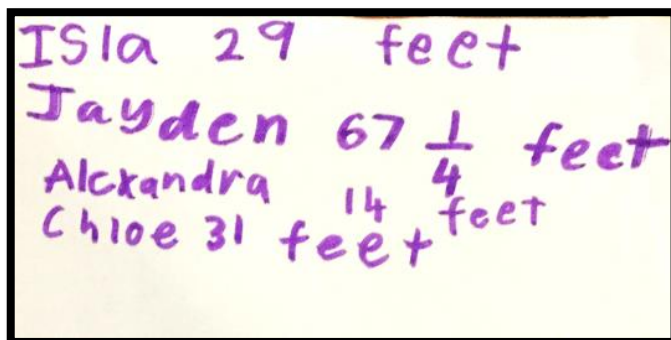
Reach consensus as a class on the number of rolls (2 or 3) each person will complete.

Gathering better evidence

5. Provide each group with a [cardboard cut-out foot](#) for measuring.
6. Review the task instructions:
 - Everyone in the group contributes. The jobs need to be shared. (For example, take turns so everyone measures at least one roll.)
 - Everyone in the group rolls the same ball the agreed number of times.
 - Measure carefully - all use cardboard foot, same starting point for group, markers on finishing points, no gaps or overlaps, measure in a straight line.
 - Distances rolled need to be accurately recorded using whole units and part of a unit if required, or by describing the measurements using 'between' or 'nearest to' statements.
7. Return to the grassed area. Allow sufficient time for groups to complete rolls and record measurements on their clipboard. As groups work, check to see if they are observing measurement conventions and recording both quantity and measurement units. Prompt groups, where required, to ensure their evidence is as accurate as possible, and possibly re-measure, explaining discrepancies. *(How confident are you that your measurement is accurate? How did you know where to start measuring from? What else could you add to the measurements to make them clearer? How are you keeping track of the number of rolls everyone in your group has?).*



Students measuring with foot cut-out.



Recorded numbers of footsteps (students wrote "feet").

Organising and Interpreting the Evidence

8. Once all groups have completed their measurements, return to the classroom.

Ask students from each group to share two or three of the distances their ball rolled, recording these results on the board unsystematically. Ensure some measurements have been made more accurate by subdividing units or with 'between' or 'nearest to' statements.

Discuss what students notice about the measurements and whether it is easy to get a clear picture of how different these measurements are when they are written on the board in this way. *What could we do with these measurements that would make it easier for us to talk about how far Year One students roll a ball?*

Guide students towards the understanding that it is easier to **share** and **make sense of the evidence** if the measured distances are organised. Seek suggestions on ways to display the different distances. If students do not suggest **ordering** from shortest to longest or **placing on a number line**, suggest these ideas.

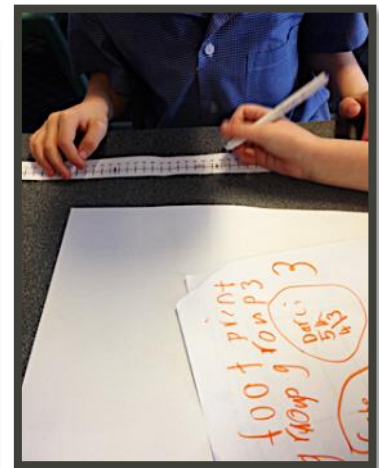
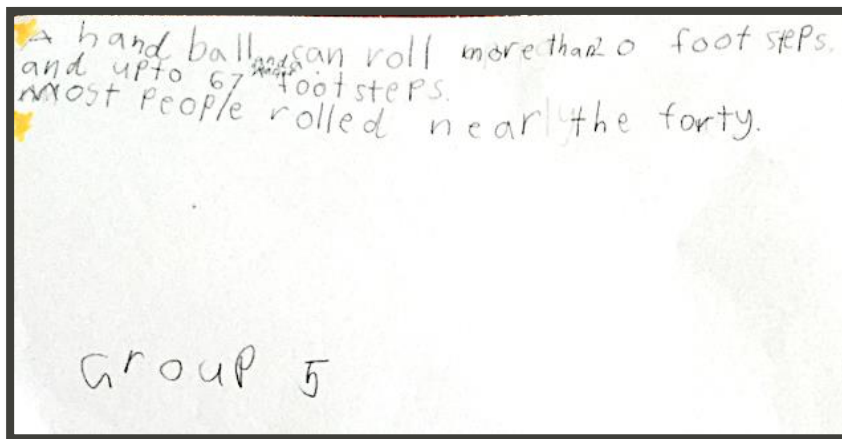
- Introduce the idea of a number line, drawn or displayed on the whiteboard, to organise the data. Discuss the importance of starting this number line with zero and determine whether the largest distance recorded on the board will fit on the displayed number line. Select students to mark the shared measurements (about a dozen) on a number line with a hand drawn dot or X or initial. Use this opportunity to model where to place unfamiliar distances.

Students will be familiar with placing whole numbers on a number line but may be unsure where to place measures such as “9½ footsteps” and “nearly 23 footsteps”. Help all students make sense of these measurements by either inviting the student who has correctly positioned the number to explain the placement or prompting the student who is unsure (9½ is more than ____ whole footsteps but not as big as ____ whole footsteps. Can you find the position on the number line that is halfway between 9 and 10 footsteps?)

- Once measurements have been placed on the number line, seek suggestions for what else needs to be added to the number line to help others make sense of the information (title, unit of measure used). Jointly construct a suitable title for the number line display.
- Have students refer to the number line to **interpret the evidence** shared so far and practise making **mathematical statements** that **answer the inquiry question**, *how far does a ball roll?* Record the statements on the board or a poster.

Possible statements include:

- The **shortest distance** a ball rolled was ____ footsteps and the **longest distance** was ____ footsteps.
 - Most balls rolled **between** ____ and ____ footsteps.
 - Only one person rolled **further than** ____ footsteps.
 - ____ balls rolled **about** ____ footsteps.
- Provide groups with a [number line](#) to organise and display the measurements made by their group. Direct them to interpret their display by making mathematical statements about how far their ball rolled. Circulate between groups as they complete their displays and statements, prompting them to add titles and referring them to statements on the board, when a model is needed.



Checkpoint

- Once most groups have completed their displays and started their statements, bring the class together for a Checkpoint. **This Checkpoint is for Maths Investigators to share** their evidence displays and answers to the inquiry question, **so they** need to listen and watch carefully. Invite some groups to share their displays and statements and encourage the audience to make comments and ask questions about the displays or statements made once a group has shared. Highlight good examples of statements supported by evidence that answer the inquiry question.
- Allow students the remainder of the lesson to complete and/or revise their number lines and statements based on the presentations in the Checkpoint. Once completed, display this work for the next lesson when the class data will be collected so that a recommendation can be made to the sports teacher.

Cut strips and paste or tape together to make one long number line.

