

Target Ball

Lesson 2: Devise Phase

Australian Curriculum: Mathematics (Year One)

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

Lesson abstract

Students work in groups to gather evidence on how far the chosen type of ball rolls. They measure with an informal unit of their own choice. Groups use sharing opportunities to reduce error when measuring, to improve their recording methods and to address the need to record lengths involving part of the informal unit.

Mathematical purpose (for students)

Measuring and recording the distance of each ball roll will help us answer the Inquiry question.

Mathematical purpose (for teachers)

The measure of a distance is the number of chosen informal units required to make that distance; the size of the unit determines the number of units required. In order to gather accurate evidence, it is important to measure carefully and record all measurements. There are measurement conventions and strategies that can be employed to ensure measurements are as accurate as possible.

At the end of the Devise phase, groups will be able to:

- Share strategies used to reduce measurement errors.
- Describe the conventions required for accurate measurement.
- Record measurements as a quantity plus a unit name.

Lesson Length 60 minutes

Vocabulary Encountered

- evidence
- record
- unit
- distance

Lesson Materials

- access to grassed outdoor area
- selection of objects suitable to use as informal measuring units (e.g. a skipping rope, a cricket bat, other school sport equipment) (1 object per group)
- clipboard, paper, pencils (1 set per group)
- balls of the type chosen as the best in Discover phase (1 per group)
- identification markers (from Discover phase)
- 'Maths Investigator' poster from Discover phase

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



Key Measurement Ideas

About measuring with informal units

1. Revisit the displayed inquiry question (*How far does a ball roll?*) and the purpose for investigating the question (finding the best ball to use for the game Target Ball and deciding where to put the target). Review with students that in the last lesson, as maths investigators, they discovered the need to measure to tell someone how far a ball rolls (refer to Maths Investigator poster).
2. Discuss (or review) with students some informal units that could be used to measure the distance a ball rolls (*paces, skipping rope, cricket bat*). Seek further suggestions for other informal units they might use (cricket stumps, bodies, footsteps), linking units to equipment readily available to a sports teacher.
3. Provide a pair of students with a cricket stump (or other object) to measure a specified distance (from a given starting point to the door). Allow time for the pair to discuss how they will work together to measure accurately. Class observes their actions and students report the measure. e.g. it was about 6 cricket stump lengths. Repeat with another object as an informal unit, or something like paces.
4. Highlight with students:
 - the measure of a distance is the number of the chosen informal unit required to make that distance from the starting point to the finishing point,
 - the distance doesn't change when using different sized units to measure, just the number of units,
 - the smaller the unit, the more it takes to measure the distance; the larger the unit, the fewer it takes to measure the distance,
 - how an informal unit (e.g. pace, cricket stump) is used repeatedly to measure the given distance
 - that you can measure using a lot of objects of the same size (e.g. many wooden blocks) or use one object (e.g. cricket bat) repeatedly.

Eliciting the need to keep track of the distance rolled

5. Return to the Maths investigator poster and inform students they will be working in groups today to “do the maths” where they will **measure** and **gather evidence** on how far a ball rolls. Ask students to explain what ‘gather evidence on how far a ball rolls’ might mean. **Guide** the discussion until the importance of **recording measurements** is established.

Student: *We could see how far the ball rolls and tell the sports teacher.*

Teacher: *That's good to see how far the ball rolls. What will we tell the sports teacher? Do we need evidence? What do we mean by evidence?*

Student: *Evidence is clues used to solve a problem. We could measure how far everyone's ball rolls and tell the sports teacher.*

Teacher: *That would be helpful information to provide to the sports teacher. However, we may not see him/her for a few days so how will we remember what our measurements are?*

Student: *We could write them down and keep them safe until we see him/her again.*

Teacher: *That would be a useful way to keep track of the information. Also giving the measurements to him/her written on a piece of paper means he/she not have to rely on remembering it.*

Measuring How Far the Ball Rolls

6. Prior to going outside, explain to students that they will be working in a group, and share the task instructions with the class:
 - Every group will be rolling the same type of ball (chosen in the Discover Phase).
 - Everyone in the group rolls the **same ball**
 - Every group will be **rolling** the ball, not throwing or bouncing it. (Model for students)
 - Measuring needs to be done **carefully**. (Feet are behind a marked starting line when balls are rolled and measurements taken from the starting line to the finishing position.)
 - Distances rolled need to be **recorded**. (At this stage allow groups to determine their own method for recording measurements.)
 - Everyone in the group is **involved** with the ball rolling, measuring and recording. Tasks are shared. **Model** what **working collaboratively** on the task might ‘**look**’ and ‘**sound**’ like.
 - Allocate students to groups of 3 or 4. Have each group choose an informal unit for measuring the distances and collect the object (e.g. one cricket stump) and their ball.
7. Go to the grassed area. Provide sufficient time for groups to roll balls and gather evidence. It is not necessary to stipulate how many rolls each child has as this will be addressed in the Develop Phase. Observe groups as they work, prompting rather than telling groups how to reduce measurement error. Recommend to groups that they double check some measurements and try to explain any differences.
8. Take the opportunity to note groups who:
 - Work collaboratively and productively on the task
 - Observe **conventions of measuring** (measuring without gaps or overlaps, measuring in a direct line and maintaining consistency with the unit of measure particularly if using paces)
 - Require prompts to assist them to reduce measurement error (*Can you show me where you started measuring that roll? How do you know that was where the ball was actually rolled from? Can you think of a way that would help you know exactly where to start measuring from? Are you measuring the shortest, most direct pathway from where the ball started to where it finished?*)
 - Record measures of all rolls using both quantity and measurement unit (e.g., 14 paces)
 - Encounter a challenge

Checkpoint

9. Once all groups have measured and recorded at least one roll from each group member, pause students for a Checkpoint. Explain to students that this is to check their progress and get help with any challenges they are facing. This Checkpoint is for *Maths Investigators* to share three things:
 - How they measured carefully
 - Evidence gathered so far (quantity and unit name for each roll e.g. 20 cricket stump lengths)
 - Any challenges encountered (*We didn't know what to write because there was not a whole pace at the end.*)

Position students so they can clearly hear and see what is being shared or modelled. Inform students they need to listen and watch carefully as groups share their ideas and measures. Make it clear that they can ask a question that helps them understand better and/or make a comment about the ideas and measures once the group has finished sharing.

10. First invite groups you noticed **measuring accurately** to share and model how they measured:



- *Two of us were counting how many fly swats so we could check we had the right number.*
- *We measured from the start at the edge of the cricket pitch to where the identification marker was placed.*
- *Thomas made sure we measured in a straight line to the marker.*
- *We made sure there were no gaps and overlaps.*

Summarise and demonstrate the conventions for accurate measurement arising in the sharing. Add any that are not suggested.

- All units need to be equal in length; count the number of repeats of the unit.
- All units need to be placed on a direct path from the start to the finish.
- Units must be repeated with no gaps. If there are gaps, parts of the distance will not be measured.
- Units must be repeated with no overlaps. If there are overlaps, parts of the distance will be included in the measurement more than once.

11. Second, choose groups to share different ways **that measurements** have been recorded. Encourage other groups to comment on:

- The clarity of the recorded measurements (Student: *I like how you have put the measurements underneath each other because that makes them easy to see.*)
- What else could be added to make the evidence clearer (Student: *You need to tell us what unit you used not just how many.*)

12. Third, address **challenges** observed as groups worked. These are likely to involve accounting for parts of the unit of measure. Canvas multiple options.

Teacher: *Jayden's group noticed that when they used tennis bats to measure the distances, the last tennis bat sometimes went past the marker. His group had an interesting way to solve this problem. What did your group do, Jayden?*

Jayden: *My group noticed we only need half the bat at the end, so we decided the ball rolled 58 ½ tennis bats.*

Teacher: *Good. Other groups might like to say the distance is between 58 and 59 tennis bats.*

Teacher: *Ben, your group also had an interesting way to solve this problem. What did your group do?*

Ben: *Tran's roll was not quite 14 paces but it was really close, so we said it was about 14 paces. William said we should use nearest to 14 paces.*

Teacher: *Using the words 'about' and 'nearest to' are also good suggestions to describe the distance more accurately.*

Skye: *We had about half a cricket bat left, so we measured that bit with the cricket bails.*

Take this opportunity to draw out that measurements of continuous quantities are not absolutely accurate but can be made more accurate by using strategies such as: subdividing units (e.g. half a cricket stump), choosing smaller units (using cricket bails) or describing their measurements using 'between' or 'nearest to' statements (DET, 2010). Provide examples of suggested strategies, discussing how they improve the accuracy of the measurement. Introduce and discuss any strategies not suggested.

13. Finally, if working collaboratively is observed to be a challenge, address by highlighting good practice observed elsewhere. (*Juan's group worked really well together. His job was to record and watch the measuring while Darci and Emma measured with a cricket stump. Pallavi counted the number of cricket stumps needed and checked the girls were measuring in a direct line. Everyone had a job.*)
14. Before concluding the lesson, allow sufficient time for students to check the measurements they recorded and implement ideas raised in the Checkpoint to improve their accuracy and recording.

Conclusion

15. Summarise the Checkpoint discussion by reiterating the measurements conventions discussed, the clear ways to record the measurements and the use of strategies such as subdividing units, choosing smaller units, or describing their measurements using 'between' or 'nearest to' statements to improve the accuracy of the measurements.
16. Explain that in the next lesson, we will look at all the evidence that the class has collected.

Reference

A good summary of stages of learning to measure is provided by "First Steps in Mathematics".

Department of Education and Training, Government of Western Australia (DET) (2010). *First Steps in Mathematics-Measurement: Understanding Units, Direct Measure*. Port Melbourne: Rigby.

<http://det.wa.edu.au/stepsresources/detcms/navigation/first-steps-mathematics/>