

## Unit Overview: Target Ball

### Summary of learning goals

This inquiry is based around the question: “How far does a ball roll?”. The authentic problem is to recommend how the sports teacher should set up a game of ‘Target Ball’ for young students. Students investigate the best type of ball to roll, and where to position the target. The inquiry integrates content in measurement and statistics to deepen students’ understanding of and confidence in working with informal units to measure distances and make inferences for setting up the game. In groups, students develop and implement ways to reduce measurement error and devise strategies to more accurately record their measurements. They make sense of the differences in their measurements by organising and displaying them on a number line. The class then uses a table (categorised data) to display all measurements collected to predict a fair placement for a target ball and to justify whether this placement would be fair for other young students.

#### Australian Curriculum: Mathematics (Year 1)

**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.

**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.

**ACMSP262:** Choose simple questions and gather responses and make simple inferences.

**ACMSP263:** Represent data with objects and drawings where one object or drawing represents one data value. Describe the displays.

- Describing displays by identifying categories with the greatest or least number of objects.

### Summary of lessons

#### Who Is This Unit For?

This unit is for Year 1 students who are developing fluency when comparing distances and measuring using informal units of measure. Students will have had experience describing and comparing short lengths using direct and indirect comparisons and will have ‘measured’ with informal units such as matching with a string of paperclips. Students will be developing counting with 2-digit numbers, and have a qualitative familiarity with a half and possibly other fractions. They will be familiar with placing 2-digit whole numbers on a number line and will have made simple tables of categorical data (such as hair colour of students in class).

#### Lesson 1: Discover Phase

Students are presented with the real-life context of having to advise the sports teacher on setting up a game of ‘Target Ball’. They need to investigate how far a ball rolls and the best type of ball to use in the game. They each choose a ball, roll it and mark where it stops. They use direct comparison of distances rolled to propose factors that may influence the distances rolled, including the type of ball. Students review the class results to decide on the best ball for Target Ball, and come to appreciate that they will need to measure the distances rolled.

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



## Lesson 2: Devise Phase

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.

## Lessons 3: Develop Phase

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.

## Lessons 4: Defend Phase

Students investigate where to position the target in Target Ball to make the game fair. The previously collected measurements from the whole class are categorised into intervals and displayed in a table. Students then make simple inferences to recommend the position of the target. To convince themselves and others that this position is fair, students play the game and use the results in their justification. They reflect on the whole inquiry.

## Reflection on this sequence

### Rationale

Students are introduced to using uniform informal units of measurement to quantify the lengths of objects and distances. This unit provides a meaningful context for students to develop the understanding that measuring a distance involves selecting an appropriate unit and counting the number of repeats required to cover the distance. The expectation that distances are measured precisely requires students to reason about and develop strategies that account for measures that lie between two whole numbers of units (e.g. twelve and a half). In the early years of schooling, students require many experiences measuring using a non-standard unit before they make the link between the process of iterating individual units and using the standard units on a ruler. These stages are described in *First Steps* (DET 2010). The inquiry requires groups to gather, organise and interpret evidence to answer the inquiry question. Students use their answers to make justified inferences about the fair placement of the target ball.

The lessons use the 4D Guided Discovery model, progressing through stages of Discover, Devise, Develop, Defend, featuring regular Checkpoints to support students in their inquiry, and emphasising the importance of gathering mathematical evidence to justify a solution. Further information is given in the “Mathematical Inquiry into Authentic Problems” Teachers’ Guide.

### reSolve Mathematics is Purposeful

This unit provides a real world context and a clear purpose for students to apply mathematical ideas and the Mathematical Proficiencies of the Australian Curriculum: Mathematics in an authentic way. This creates connections to deepen students’ understanding.

**Understanding:** Students determine the relationship between an informal unit of measure and what is being measured. When comparing measurements of the same distance, they acknowledge the distance does not change but the number of different sized units required does, depending on the size of the unit. In the inquiry students begin with multiple informal units of measure, but the real-world context motivates a need for a common unit.

**Fluency:** The iterations of ball rolling in this inquiry provide rich opportunities for students to repeatedly apply the conventions of measurement and to develop strategies to improve the accuracy of their measuring, recording and comparing distances.

**Reasoning:** Students make an evidence-based judgement by referring to class data displayed in an interval table. They interpret and use the class data to justify simple inferences and with a variety of evidence convince themselves that the recommendations for target ball are fair.

## reSolve Tasks are Challenging Yet Accessible

Working and collaborating in small group allows students at multiple levels of performance to develop their measurement skills as they gather evidence to support their conclusion to the inquiry question. For example, while students may be familiar with measurement conventions, it is challenging for them to maintain precision when measuring larger distances, particularly avoiding gaps or overlaps. Having groups share how they measured carefully, provides ideas and support for groups who are finding the task challenging.

Students can also work satisfactorily in this inquiry at different levels. For example, some groups will confidently describe and record the distance using whole and fractional units (9 and  $\frac{1}{2}$  footsteps) while others will describe and record their measurements using 'between' or 'nearest to' statements. As these recorded distances are also challenging for some students to locate on a number line, placement is modelled to the class.

The expectation that all students contribute ideas and explain their thinking during partner sharing and class discussions provides each student with an opportunity to demonstrate their ability to reason and justify and to develop conceptual understanding. In the Defend Phase students are required to make an evidence-based prediction on the best placement for the target ball and predictions tend to be very general (near the middle). Class interpretation of distances rolled makes it clearer for students to express their predictions more precisely (e.g., between 30 and 40 footsteps) and justify their thinking using specific evidence.

## reSolve Classrooms Have a Knowledge Building Culture

The inquiry provides opportunities for all students to create shared knowledge. The expectation that students work collaboratively and productively to answer the inquiry question ensures all students engage actively with the inquiry task, supporting and guiding peers where required. Regular opportunities to share effective processes and practices and challenges encountered, help everyone advance and develop their mathematical understanding. Sharing work allows others to build on incomplete ideas and/or provide suggestions to refine or improve ideas and evidence. Iterative sharing encourages students to consider the diversity of ideas raised by others and to compare, reconceptualise and extend concepts. Students see value in organising and displaying their evidence to support class sense-making.

## Reference

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

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