# Lesson 12: Using a Trundle Wheel to Measure Distances

## Goals

- Calculate the distance of a path using the circumference and number of rotations of a trundle wheel.
- Compare measurement calculations and express differences between measurements as a percentage.
- Critique (orally) methods for measuring a long distance.

## Lesson Narrative

This lesson is optional. In the third lesson of this sequence, students use their trundle wheels to re-measure the distance from the first lesson. After students have had experiences using their trundle wheels, they can connect their observations of how the wheel works with the distance computations and discuss the sources of errors in a more meaningful way. Students engage in important parts of mathematical modeling (MP4), they use appropriate tools (MP5), and attend to precision (MP6).

As with all lessons in this unit, all related standards have been addressed in prior units. This lesson provides an optional opportunity to go deeper and make connections between domains.

### Alignments

### Addressing

- 7.G.B.4: Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.
- 7.RP.A: Analyze proportional relationships and use them to solve real-world and mathematical problems.

### Instructional Routines

- MLR8: Discussion Supports

### Required Materials

#### Trundle wheels

### Required Preparation

Prepare to distribute the trundle wheels students built in the previous lesson. Make sure students can still get to the path (between 50 and 100 meters) that they measured the other day.

**Student Learning Goals**

Let's use our trundle wheels.

# 12.1 Measuring Distances with the Trundle Wheel

**Optional: 40 minutes (there is a digital version of this activity)**
In the previous lesson, students built trundle wheels using three different wheel sizes, and they tested the functionality of their wheels in the classroom. In this activity, they use their trundle wheels to measure a longer path of about 50–100 meters. This is the same path that they measured during a previous lesson with a different method. If several groups are sharing a trundle wheel, then they each measure the given path once and share their data with each other.

After students measure, they spend the remainder of the lesson on computations and sharing results. Students get a chance to connect the mathematical formulas and computations with the aspects of the hands-on experience they had in making and using the wheels. They attend to precision when they are deciding on how to report their results and when they are comparing results with other groups (MP6).

## Addressing

- 7.G.B.4
- 7.RP.A

## Instructional Routines

- MLR8: Discussion Supports

## Launch

Keep students in the same groups from the previous lesson. Remind students of the path they should measure. Instruct them to come back to the classroom to finish their calculations as soon as they have recorded their measurements.

Give students 10–20 minutes to take turns measuring and 10 minutes of group work time to finish their calculations, followed by whole-class discussion.

There is also a digital version of a trundle wheel available. Students can be assigned a path, numbered from 1 to 5, and collect data on different-sized trundle wheels. The applet is programmed to stop automatically at one of the five distances. The students must keep track of the number of rotations the wheel makes before it stops.

### Access for Students with Disabilities

*Action and Expression: Provide Access for Physical Action.* Support access to tools and assistive technologies. Monitor for students who may need an additional demonstration, or assistance using their trundle wheel to measure a longer path. Consider modeling a systematic way to record the number of clicks to calculate an example distance as students complete this task. *Supports accessibility for: Visual-spatial processing; Fine-motor skills*

## Anticipated Misconceptions

Students may lose count when counting the number of rotations along the path. Encourage them find a systematic way to record the number of clicks while their group member is walking along the path.

### Student Task Statement

Earlier you made trundle wheels so that you can measure long distances. Your teacher will show you a path to measure.

1. Measure the path with your trundle wheel three times and calculate the distance. Record your results in the table.

| trial number | number of clicks | computation | distance |
|---|---|---|---|
| 1 | | | |
| 2 | | | |
| 3 | | | |

2. Decide what distance you will report to the class. Be prepared to explain your reasoning.
3. Compare this distance with the distance you measured the other day for this same path.
4. Compare your results with the results of two other groups. Express the differences between the measurements in terms of percentages.

## Student Response

1. Answers vary. Sample response:
    - Diameter of wheel: 25 cm

| trial number | number of clicks | computation | distance |
|---|---|---|---|
| **1** | 63 | $25\pi \cdot 63$ | 49.5 m |
| **2** | 65 | $25\pi \cdot 65$ | 51 m |
| **3** | 63.5 | $25\pi \cdot 63.5$ | 49.9 |

2. Answers vary. Sample response: Distance to report: 50 m
3. Answers vary.
4. Answers vary. Sample response: If group A's measurement is 50 m and group B's measurement is 51 m, then group B's measurement is 2% larger than group A's since $51 \div 50 = 1.02$.

### Activity Synthesis

Ask each group to report their measurement for the length of the path and record their answers for all to see. Guide students to compare these answers by asking questions like these:

- "Do all of these answers seem reasonable? Do any of these answers seem unreasonable? Why?"
- "Why are these answers not all exactly the same? What are some sources of error?" (Not going in a straight line, the wheel wobbles, the ground is uneven, only counting number of clicks but not parts of rotations etc.)
- "What units did you use? What units would be most convenient for designing the course of a 5K walk-a-thon?" (Metric, since we are designing a 5 km course.)
- "What degree of precision is appropriate to report?" (To the closest 1 meter at most. Reporting cm or mm on such long distances with a tool like a trundle wheel would be implying a degree of precision that would not be appropriate.)

If time permits, consider asking "If you could choose your own diameter for a trundle wheel, what would it be?" (A diameter that creates a circumference of 1 m would be convenient, i.e. about 32 cm.)

Collect and store students' trundle wheels so they will have access to them again in the next lesson.

### Access for English Language Learners

*Speaking: MLR8 Discussion Supports.* To support students' discussion of their measurements comparisons, invite them to use a sentence frame such as: "Our measurement is _____% (higher/lower) than group _____'s measurement because . . . ." Call on another student or group to restate what they heard using mathematical language. Encourage students to press each other for clear explanations and precise use of language.
*Design Principle(s): Optimize output (for comparison)*