Lesson 10

Building a Trundle Wheel

Goals

- Create a trundle wheel and use it to calculate the length of the classroom.
- Explain (orally and in writing) how a trundle wheel is used to measure long distances.

Lesson Narrative

In this optional lesson, students build a trundle wheel, a device used to measure walking distances. First, they learn about a trundle wheel and discuss how such a device works and when it is the appropriate measuring tool. Then students use paper plates to make a usable trundle wheel and practice using it to measure distances in the classroom.

Students can either use the same-sized paper plates, or different groups can use different-sized paper plates. The use of different-sized plates allows for more mathematical discussion about how diameter and circumference of the plates affect how the precision of the distance being measured is reported.

Student Learning Goal

Let's build a trundle wheel.

Lesson Timeline

10 min	30 min
Activity 1	Activity 2

Access for Students with Diverse Abilities

- Representation (Activity 2)

Access for Multilingual Learners

- MLR2: Collect and Display (Activity 1)

Instructional Routines

- MLR2: Collect and Display

Required Materials

Materials to Gather

- Index cards: Activity 2
- Measuring tools: Activity 2
- Metal paper fasteners: Activity 2
- Paper plates: Activity 2
- Tape: Activity 2

Activity 2:
To build the trundle wheel, each group of 3–4 students will need 1 paper plate, a metal paper fastener, something long object to use as the handle, an index card, and tape.

Ideally, have three different sizes of paper plates for different groups to work with (typical sizes are 6–12 inches) to help reinforce the point that the size of the plate affects how many "clicks" (rotations) it takes to measure the same distance.

There are many options for how to make the handles. A yardstick or meter stick with a hole on one end is most convenient. Alternatively, you can tape two rulers together or cut pieces of sturdy cardboard or foam core that are about 1.5 inches wide by 30 inches long, and poke a hole centered at one end.

Activity 1
What Is a Trundle Wheel?

10 min

Activity Narrative

In this activity, students learn that a trundle wheel is a tool used in real-world situations to measure long distances. From an image and a description of what a trundle wheel looks like, students think about how the tool works and how they could build one. Students think about the tasks for which a trundle wheel is an appropriate measuring tool. This builds on work students did in an earlier unit, when they learned about the relationship between the circumference of a wheel and the distance it travels.

Launch

Keep students in the same groups of 3–4 from the previous lesson. Explain to students that a trundle wheel is a measuring device composed of a handle, a wheel, and a device that clicks each time the wheel completes one rotation. Give students 5 minutes of group work time followed by whole-class discussion.

Use *Collect and Display* to create a shared reference that captures students' developing mathematical language. Collect the language students use to discuss measurement. Display words and phrases such as "measure," "trundle wheel," "measuring tape," "circumference," and "standard."

Student Task Statement

A tool that surveyors use to measure distances is called a trundle wheel.

1. How does a trundle wheel measure distance?

   Sample response: The wheel is pushed, and as it turns it keeps track of the number of rotations. If the circumference of the wheel is known, this can be multiplied by the number of rotations to find the distance walked.

2. Why is this method of measuring distances better than the methods we used earlier?

   Sample response: The circumference is constant, meaning it does not change, and each rotation follows the next without any gaps. Strides can be slightly different from step to step, and if a measuring tape is used, there might be a gap between iterations.

3. How could we construct a simple trundle wheel? What materials would we need?

   Sample response: A wheel, a handle, and a way to keep track of and count rotations are needed.

Inspire Math

Cable Cars video

Go Online
Before the lesson, show this video to reinforce the real-world connection.

ilclass.com/l/614223

Please log in to the site before using the QR code or URL.

Instructional Routines

MLR2: Collect and Display

ilclass.com/r/10690754
Please log in to the site before using the QR code or URL.

Access for Multilingual Learners (Activity 1, Narrative)

MLR2: Collect and Display
This activity uses the *Collect and Display* math language routine to advance conversing and reading as students clarify, build on, or make connections to mathematical language.

Building on Student Thinking

If students do not recognize the relationship between the circumference of a wheel and the distance traveled by the wheel, consider asking:

"What measurement of a circle tells us how far a wheel travels each rotation?"
"How do we calculate circumference?"

Activity Synthesis

The goal of this discussion is for students to remember the connection between the circumference of a wheel and the distance the wheel travels during one rotation so that they are prepared to use a trundle wheel to measure distances in the next activity.

Direct students' attention to the reference created using *Collect and Display*. Ask students to share how a trundle wheel is used to measure distance. Invite students to borrow language from the display as needed and update the reference to include additional phrases as they respond.

Invite students to share their ideas about how to build a trundle wheel and ask them how their design will allow them to measure distances.

Consider asking the following questions:

- *"What information about the wheel is needed? What quantities should be measured?"*
- *"Trundle wheels often have a clicking device that signals each time the wheel completes one rotation. How is this helpful?"*
- *"If there is a wheel that has a diameter of 25 cm and 11 clicks are counted to go across the classroom, what is the length of the room?"*

  $25\pi \cdot 11$ cm, or between 8 and 9 m.

Distance can be measured by counting the rotations of the wheel and multiplying by the circumference of the wheel. The construction of the trundle wheel allows one to easily count the rotations as they walk.

Activity 2

Building a Trundle Wheel

30 min

Activity Narrative

In this activity, students build a trundle wheel and use it to measure distances in the classroom. The trundle wheels need to be stored in the classroom for use in the next lesson. If it is not feasible to store a trundle wheel from every group of 3–4 students, combine them to form larger groups before building the wheels. Each student should still get a chance to practice measuring with the trundle wheel.

It is suggested that students build their trundle wheels using a paper plate as the wheel, two rulers taped together end to end as the handle, a metal paper fastener, and an index card taped to the wheel to produce an audible "click" when it hits the handle. There are many other ways to build a trundle wheel. If this fits into the culture of the class, students can use other designs and materials, for example, students could use a bike with a playing card in the spokes to count rotations.

Launch

Keep students in the same groups, or if necessary, combine them to form larger groups. Discuss how to build the trundle wheel and distribute the supplies. Give students 15 minutes of group work time to build and try out their trundle wheels, followed by whole-class discussion.

Student Task Statement

Your teacher will give you some supplies. Construct a trundle wheel and use it to measure the length of the classroom.

Record:

1. The diameter and circumference of your trundle wheel.

   Sample response: Plate diameter is 26 cm. Circumference is 26π cm or about 81.7 cm.

2. The number of clicks across the classroom.

   Sample response: 12 clicks

3. The length of the classroom.

   Sample response: About 9.8m because: $12 \cdot 81.7 = 980.4$ cm

Be prepared to explain your reasoning.

Activity Synthesis

The goal of this discussion is for students to double-check that their trundle wheels work correctly and their results are reasonable. Invite one group that used each size of paper plate to demonstrate how their wheel works by walking across the classroom and counting the "clicks." Record the data for all to see and discuss how these groups' calculations for the length of the classroom compare, which may include the following points:

- The group with the smaller plate had a larger number of clicks, and vice versa.
- Each group needs to multiply their number of clicks by the circumference of their wheel.
- The circumference of the wheel can be found by multiplying the diameter times π or the radius times 2π.

If these ideas do not come up during the discussion, consider asking:

💬 *"Should the answer be reported in terms of π or should an approximation be used?"*

"Is it possible to count half rotations of the wheel?"

"What is the same and what is different about how groups used their trundle wheels?"

Access for Students with Diverse Abilities (Activity 2, Student Task)

Representation: Develop Language and Symbols.
Create a display of important terms and vocabulary. Invite students to suggest language or diagrams to include that will support their understanding of the relationship between the circumference of a wheel and the distance traveled. Terms may include "radius," "diameter," "circumference," "rotation," and "number of clicks."
Supports accessibility for: Conceptual Processing, Language

Student Workbook


2 Building a Trundle Wheel

Your teacher will give you some supplies. Construct a trundle wheel and use it to measure the length of the classroom. Record:

1. The diameter and circumference of your trundle wheel.
2. The number of clicks across the classroom.
3. The length of the classroom.

Be prepared to explain your reasoning.

GRADE 7 • UNIT 9 • SECTION C | LESSON 10 221